Transportation Master Plan
Infrastructure Requirement Study

Development of a Downtown Transit Solution and Network Implications

April 2008

Ottawa

MRC McCORMICK RANKIN CORPORATION

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PREFACE

The recommendations and findings presented in this report are one component of a larger study to develop the transit and road infrastructure requirements of the 2008 update to the City of Ottawa's Transportation Master Plan (TMP). This study is being conducted in such a manner as to satisfy Phases 1 and 2 of the Municipal Class Environmental Assessment (October 2000, as amended in 2007) as follows:

Phase 1 – Problem or Opportunity: *The development of a long-term Transportation Vision and associated planning principles, identifying problems and opportunities;*

Phase 2 – Alternative Solutions: *A review of transit and road networks. This includes a capacity review of the City's downtown rapid transit network (this report).*

Further documentation will be prepared which describes all of the work undertaken to fulfill Phases 1 and 2, as well as the public and stakeholder consultation carried out.

The Municipal Class Environmental Assessment (EA) recognizes the benefits of long-range infrastructure planning under the Master Planning process and outlines various approaches for Master Plans to fulfill the requirements of the Class EA. The 2008 TMP update is being carried out as part of the City of Ottawa's mandatory 5-year Official Plan Review, and will therefore be planned in accordance with Approach #4 – Integration with the Planning Act.

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1. Introduction

1.1. Background

Ottawa's award-winning Transitway is regarded as one of the world's most successful implementations of a Bus Rapid Transit (BRT) system. Forming the backbone of OC Transpo's rapid transit network, it has been a key factor in Ottawa attaining enviable transit ridership levels. This success, however, has led to an emerging congestion problem in the downtown. Ridership growth on the four Transitway corridors converging in the downtown has seen the system reach its capacity. With the projected increase in population and employment over the next 20 to 30 years, combined with the introduction of the developing "Rapibus" service delivering a high percentage of the Gatineau ridership into Ottawa's central core, there is no room for future growth on the current rapid transit system in the downtown.

A two-stage approach is being undertaken to develop the long-range rapid transit network component of this update to the City's Transportation Master Plan (TMP). Since a solution for the downtown transit problem will have major ramifications for the rest of the City's rapid transit network, it is being developed first. Founded on the most recent City-wide travel demand data derived from the 2005 Origin-Destination survey and Council's recently approved population and employment projections for the 2031 planning horizon, the recommended downtown transit solution, with associated modifications to the existing network, will form the basis of a primary rapid transit network. It will be refined based on feedback from public and stakeholder consultations and will be presented to the City's Transportation and Transit Committees and Council for approval in May 2008.

Upon Council approval of the primary rapid transit network, the second stage will consider other possible corridors for inclusion in the overall network. These 'secondary' corridors will address and identify those rapid transit services outside of the downtown that are necessary to attain the City's overall 30% transit modal split goal for the 2031 planning horizon, and will be the subject of a follow-on report. The primary network and recommended secondary corridors will be combined and presented to City Council as the City's TMP rapid transit network for approval in early 2009.

1.2. History

Transit capacity in downtown Ottawa has been a topic of discussion for many years. In the mid-1970's, the former Regional Municipality of Ottawa-Carleton first suggested the eventual need for a grade separated rapid transit facility through the downtown, such as a tunnel. In June 1986, Regional Council directed that a study be undertaken to examine the feasibility of grade separating the Transitway through the Central Area linking the existing East/Southeast and West/Southwest Transitways. The study examined both above and below-ground alternatives, as well as alternative alignments and station configurations in the Central Area. It was completed in 1988 and determined that a tunnel was the most appropriate grade separated alternative. Regional Council decided to continue with further extensions of the bus Transitway outside of the Central Area as the first priority, leaving the expensive grade separation of the downtown section until it was required. This "outside-in" approach to Transitway development helped with the early establishment of Ottawa's high transit ridership.

In October 2001, the City began operating a pilot light rail service, to compliment the existing Transitway, using diesel-powered Bombardier 'Talent' vehicles. Known as the O-Train, the service runs within the

former CPR Ellwood North-South railway corridor between the Greenboro and Bayview Transitway Stations. Having exceeded its ridership objectives, in 2005 the service became a permanent, fully integrated component of the OC Transpo system.

In May 2003, the City of Ottawa adopted a new **Official Plan (OP)** that set out a growth management strategy emphasizing urban intensification and increased mixed-use development centered on rapid transit lines as a means to address travel demand and to discourage single occupancy vehicle use as the preferred mode of peak period travel. To support this strategy, the City approved a **TMP** that set a 30% transit modal split target for the year 2021. The TMP identifies an expanded rapid transit network as a key component to achieving this target.

This rapid transit network was developed through the City's **Rapid Transit Expansion Study (RTES)** that was approved by Council on 26 February 2003. The expansion of light rail transit (LRT) service into the downtown (Rideau Centre) and to Riverside South (Limebank Station) was identified as the top priority project for implementation. RTES reviewed the concept of a downtown transit tunnel and concluded that a proposed new on-street LRT corridor (such as Sparks or Queen Streets), combined with operational improvements along the Albert and Slater Street Transitway, would provide the required transit capacity within the 2021 planning period.

Furthermore, staff developed an implementation strategy - entitled the **Ottawa Rapid Transit Expansion Program (ORTEP)** Implementation Strategy – for the long-term plan for the overall rapid transit network that included timelines, funding and partnership options, and financial implications. On 24 September 2003 City Council received the ORTEP Implementation Strategy report and authorized staff to initiate the Environmental Assessment (EA) for the **North-South Corridor LRT Project**. On 15 July 2005, City Council received the study findings and approved the EA recommended plan, which included operating LRT and BRT service through the downtown using Albert and Slater Streets, subject to a series of conditions.

Although the EA findings showed that there is sufficient capacity on the Albert/Slater Corridor to accommodate a new LRT service with 5-minute headways, one of the conditions of approval was that a reduction in the number of buses operating on Albert and Slater Streets by 30% be in place when the LRT operation began in 2009. The resultant plan, which was approved by Council in November 2005, was to have consolidated and reduced the number of direct-to-downtown express routes – thereby increasing the number of bus to bus transfers required by riders.

EA approval was received from the Province and Federal Government in May and July 2006, respectively. In July 2006, City Council took steps to initiate the procurement of the design-build and a 15-year maintenance agreement of the North-South Corridor LRT Project.

In December 2006, due to non-fulfillment of conditions, the Project Agreement for the LRT Project was terminated in accordance with its terms. One of the principle reasons leading to the decision not to proceed with the contract award for the North-South Corridor LRT project was concern over the proposed mixed operation of the LRT with buses and general traffic on Albert and Slater Streets. On 11 January 2007, Mayor O'Brien announced his intent to form a Task Force to study the City's transportation priorities with final recommendations due by June 2007. The Mayor's Task Force recommended that the City move forward with the construction of a downtown transit tunnel as a priority.

In accordance with the Ontario Planning Act, the OP must be reviewed every 5 years. Accordingly, the City is updating the 2003 Official Plan based on a revised population and employment forecast for the 2031

horizon year. In support of the Official Plan update, the TMP is also being updated with forecast regional travel patterns for the year 2031. With the termination of the Project Agreement for the North-South Corridor LRT Project, and the subsequent identification of long-term transit capacity issues in the downtown, the current update of the TMP and the related Transportation Infrastructure Requirements Study provides the opportunity to review the previous recommendations formulated in both RTES and the 2003 TMP.

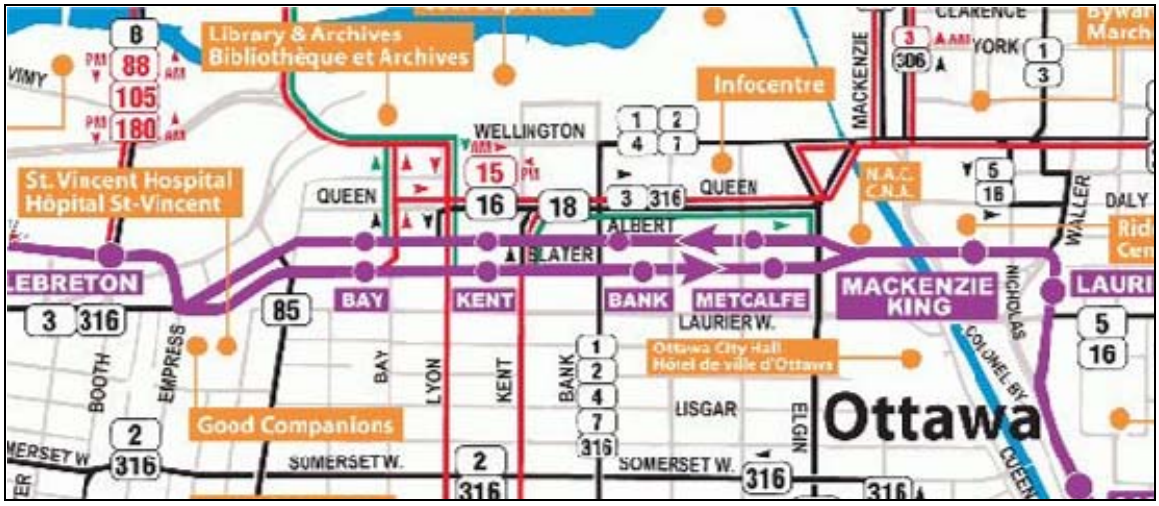
This report identifies the appropriate transit network and technologies (e.g. bus, rail) for the downtown and the implications for the other rapid transit corridors identified in the TMP.

1.3. Existing Downtown Transit Services

1.3.1. OC Transpo

OC Transpo operates public transit services on most of the primary streets in downtown Ottawa. These services include Rapid Transit services on the Central Area Transitway (Albert and Slater Streets and the Mackenzie King Bridge); and local transit services that come together on Rideau Street east of the Rideau Canal. Figure 1.1 illustrates all of these services.

Figure 1.1: Existing Central Area OC Transpo Bus Routes



The local services use Lyon, Kent, Bank, Elgin, Wellington and Queen Streets to travel through downtown west of the Canal and then converge at Confederation Square before proceeding onto Rideau Street. From Rideau Street these services disperse onto Sussex, Dalhousie, and Nicholas Streets, or continue east on Rideau Street. Between 40 and 50 buses cross the Canal on Rideau Street during the peak hour, depending on the time of day and the direction. The number of buses operating on each of the individual streets approaching Rideau Street ranges from as low as 5 to as high as 30 in the peak direction during the peak hour.

The Central Area Transitway carries the majority of the transit riders in downtown Ottawa in terms of the number of passengers and the number of buses using the corridor, as well as the number of routes. The primary rapid transit services (Routes 95, 96 and 97) use this corridor, as do numerous other all day cross-town transit routes and virtually all of the peak period and express services connecting suburban

communities directly with the downtown. A mixture of standard and articulated buses provides this service. During the afternoon peak hour, approximately 180 buses travel eastbound along Slater Street.[1] Currently the peak hour, peak direction passenger volume reaches 10,000 customers in the afternoon on the approaches to the Central Area Transitway.

The Central Area Transitway consists of reserved bus lanes on Albert Street (westbound), Slater Street (eastbound), and on the Mackenzie King Bridge. Albert and Slater Streets are currently comprised of three through traffic lanes: one reserved bus-only lane (in effect from 6:00 a.m. to 6:00 p.m. Monday-Friday) and two lanes for general purpose travel. One of the general purpose lanes is used for parking during off-peak periods. The right-side curb lane on both Albert and Slater is used for transit platforms, on-street parking, loading bays, and at some intersections, right-turn lanes. The dedicated on-street portion of the Central Area Transitway begins/terminates at Empress Avenue (in the west) and Waller Street (in the east). Traffic signals located on the bus-only portion of the Transitway at Booth Street in the west and Laurier Avenue East in the east dictates bus capacity along the Central Area Transitway to some extent.

The critical time of day for bus operating capacity on the Central Area Transitway is the afternoon peak period, and the critical direction is eastbound on Slater Street and the Mackenzie King Bridge where bus volumes are the highest. The most congested point on Slater Street is the stop east of Metcalfe Street. Delays on this portion of the downtown Transitway affect not only customers heading east at that time, but also customers across the entire transit system as buses delayed on their eastbound trips from the downtown result in delays on subsequent trips on other parts of the system. This has been recognized for a number of years, and since 2004, ridership growth east from the downtown has been managed by the judicious assignment of high-capacity articulated buses and scheduling of trips at this critical time. Based on experience the scheduled level of service has been kept at or below 180 bus trips per hour in order to maintain service reliability.

The morning is less of a restriction because most passengers are stepping off buses by all doors and walking directly away from the bus towards their destination. Very few passengers board buses on the Central Transitway during the morning. In the afternoon, most passengers are arriving at station platforms, joining the group of customers already there, waiting for a bus on a particular route, moving along the platform to the point where their bus stops, and largely boarding by the front[2] door and paying their fare or showing their pass. More buses can therefore be accommodated through the downtown in the a.m. than in the p.m.

The majority of passengers boarding at the stops on the Central Area Transitway during peak periods pay their fares using monthly passes. While this makes for an efficient boarding time for most buses, those remaining cash-paying passengers often offset the speed of boarding created by the pass holders. Planned initiatives such as the introduction of the Smartcard electronic fare system and the future introduction of real-time bus arrival signs will reduce passenger boarding times.

These measures were among those outlined in a report delivered to the City's Transit Committee in May 2007 (*Downtown Transit Operating Strategies 2007 - 2010*). The report indicated that the current level of service on Slater Street in the afternoon is near its practical capacity and that in its current configuration, the street is capable of accommodating no more than 195 bus trips per hour per direction.[3] The report

[1] This is the equivalent of 220 standard buses/hr.
[2] Boarding by the rear door is permitted for pass holders on articulated buses only.
[3] This number is derived as follows: Each bus platform along Albert and Slater Streets is approximately 55 metres long, and has room for either three 60-foot (18-metre) articulated buses or four standard 40-foot (12-metre) buses. As many articulated buses are required to carry the volume of customers on the busiest routes, there are rarely four 40-foot buses in a row, and the service is planned to have

identified strategies which would allow current bus volumes on Slater Street to be maintained during the weekday afternoon peak hour until such time as a rapid transit solution for downtown Ottawa is chosen and implemented.

The following specific measures were identified to improve transit operations for the period 2008-2010:

- Improving the Metcalfe platform on Slater Street;
- Using high-capacity buses (i.e. articulated or double deck);
- Attracting more through-passengers away from the Central Area by improving by-pass routes;
- Moving some service onto other streets; and
- Speeding up boarding times through the use of real-time passenger information and a smartcard fare system.

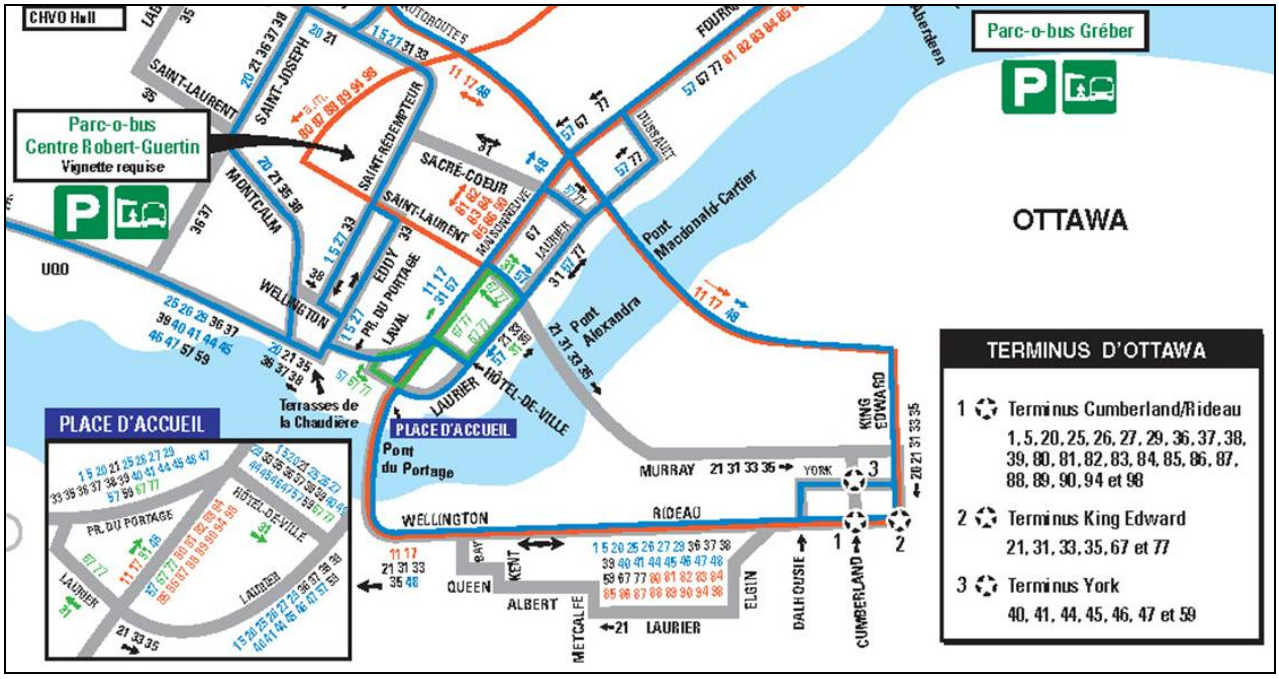
Some of these measures have already been put into place, while others have had initial steps taken towards their implementation.

1.3.2. Société de transport de l'Outaouais

Transit services provided by the Société de transport de l'Outaouais (STO) also use the road network within Ottawa's downtown core. The majority of the STO buses serving Ottawa mix with general purpose traffic on Wellington Street and use the dedicated bus lanes on Rideau Street between King Edward Avenue and Sussex Drive mixed with OC Transpo services. In-service STO buses cross the Ottawa River on either the Alexandra or the Portage Bridges. Those services crossing on the Alexandra Bridge generally follow a one-way route using St. Patrick/Murray, King Edward, Rideau and Wellington Streets to the Portage Bridge. Services crossing on the Portage Bridge use Wellington and Rideau Streets before turning around on Cumberland Street, George Street and King Edward Avenue to return back to the Portage Bridge via Rideau and Wellington Streets. Some of the buses on peak period STO services dead-head to the start of their route or return back to Gatineau via the Macdonald-Cartier Bridge and King Edward Avenue. STO service in the Wellington/Rideau corridor currently amounts to approximately 120 buses in the peak direction during the weekday afternoon peak hour and carry as many as 4,400 passengers. As a large number of STO buses are required to lay-up in Ottawa east of the downtown prior to the commencement of afternoon service, the City of Ottawa has recently constructed a small lay-by area for buses on King Edward Avenue as part of its King Edward Avenue reconstruction project.

no more than three buses move through each green light, which are set to change on a 55-second cycle. At three buses every 55 seconds and with 55-metre platforms, the maximum number of buses that can move through downtown in an hour is 195.

Figure 1.2: Existing Central Area STO Bus Routes



1.4. Approach

This report details the development of the downtown transit solution and identifies alternatives, including costs, for the recommended primary rapid transit network. The approach taken begins with a discussion on the City's approved population and employment growth projections and related land use planning principles used to forecast City-wide travel demands for the 2031 planning horizon. Using the City's TRANS regional travel demand model, expected ridership levels in the downtown are established. This data is matched against the design carrying capacity of a variety of transit vehicles (bus and rail) to determine the number of vehicles required to accommodate the forecasted passenger demand. From this, the headways between the transit vehicles is calculated to determine the transit service levels that may be provided by each transit vehicle alternative at specific points in the downtown.

These transit service levels are then considered for all existing and possible future transit services in the downtown and compared against the practical capacity for rapid transit on the existing downtown street network. Should it be determined that the surface system cannot accommodate the forecasted transit vehicle volumes through the downtown, then grade separated alternatives would be considered for the downtown transit solution. The configuration and technology chosen for the downtown will have implications on the balance of the rapid transit network outside of the downtown – specifically with regards to possible conversion of portions of the existing Transitway system to rail. The final portion of this work considers the extent to which conversion of the Transitway would be necessary to attract new riders, while minimizing bus to rail transfer requirements. The result will be a recommended primary transit network.

2. Population and Employment Growth: 2031

Projections of Ottawa's long-term growth are fundamental to the City's planning of land use and infrastructure needs. With the OP review well underway, the City's current 2021growth projections were comprehensively re-examined for the new 2031 planning horizon to establish a planning framework for the assessment of future infrastructure requirements.

The development of these new growth projections considered the Greater Ottawa-Gatineau Area (the metropolitan area including adjacent municipalities) to ensure that the magnitude of the metropolitan economy and the extent of the commuter shed were included in the overall assessment of growth for the City of Ottawa. Looking beyond Ottawa's borders at the growing adjacent communities indicates that Ottawa will maintain its historical share of the growth attracted to the region. Overall, the City of Ottawa's report on "New Growth Projections for 2006-2031" predicts ***a 2031 population of 1,136,000****, about five per cent lower than the previous 2021 projection*." Employment levels are projected to increase to 703,000 jobs.

In addition, the report highlighted several key changes for our communities by 2031 that include:

- The aging of the baby-boom, the leading edge of which first turns 65 in 2011, continues to be the most significant demographic force. In the Reference Projection, the population aged 65 and over will account for almost 50 per cent of our population growth to 2031. The share of population 65 and over will increase from about 12 per cent in 2006 to over 20 per cent by 2031.
- The very elderly population, those over 80, will more than double in number, from 29,000 to 59,000, placing high demands on health and long term care facilities in particular, and on many other services.
- The demographic dependency ratio, the number of children (14 and under) and seniors (65 and over) per 100 working age people (15 to 64) will increase significantly, from 42 per 100 in 2006 to 54 by 2031. Statistics Canada projects that nationally the ratio will increase from 44 in 2006 to 61 in 2031, pointing to Ottawa's relatively younger projected population. It should be noted that both locally and nationally, the major increases in the dependency ratio do not occur until after 2021.

An assessment of the infrastructure requirements to accommodate future growth is largely influenced by the magnitude and distribution of the projected growth over the planning period. Specifically, the requirements for transportation systems is fundamentally linked to where people live and work, with the most significant demands occurring during peak commuter travel times.

The 2031 population and employment levels for major growth areas, and the percentage increase over current population and employment levels, is summarized in Figure 2.1: Major Growth Areas - 2031 Planning Horizon and in the accompanying Table 2.1: Growth in Population and Employment for Major Growth Areas. Table 2.1 indicates that the City of Ottawa is projected to grow by approximately 30% in terms of population (an additional 265,000 persons in Ottawa) and 35% in employment (an additional 181,300 jobs). This growth in employment is based on the City's economic role in serving the greater Ottawa-Gatineau region and outlying areas. A more detailed summary indicating the growth of population and employment to 2031 projected by planning districts is provided in Appendix A. Overall, the geographic distribution of the growth in both population and employment levels across the planning regions is summarized as follows:

- The population growth projected for areas inside the Greenbelt (52,700 persons) will be relatively evenly split between the inner area (see Figure 3.7: Inner Area Screenlines) and the remaining urban areas inside the Greenbelt. This suggests increasing intensification within the Inner Area and reflects the aging of the resident population and lower average number of persons per household.
- Employment growth across the City will be split between areas inside the Greenbelt (42%) and urban centres outside the Greenbelt (50%). Both the Ottawa and Gatineau core areas will continue to accommodate, on a proportional basis, equal percentages of the total employment located in each of the cities (26% of the projected 2031 employment for Ottawa within the Inner Area and 30% of employment for Ile de Hull when compared with all employment across the Outaouais in 2031).

Figure 2.1: Major Growth Areas - 2031 Planning Horizon

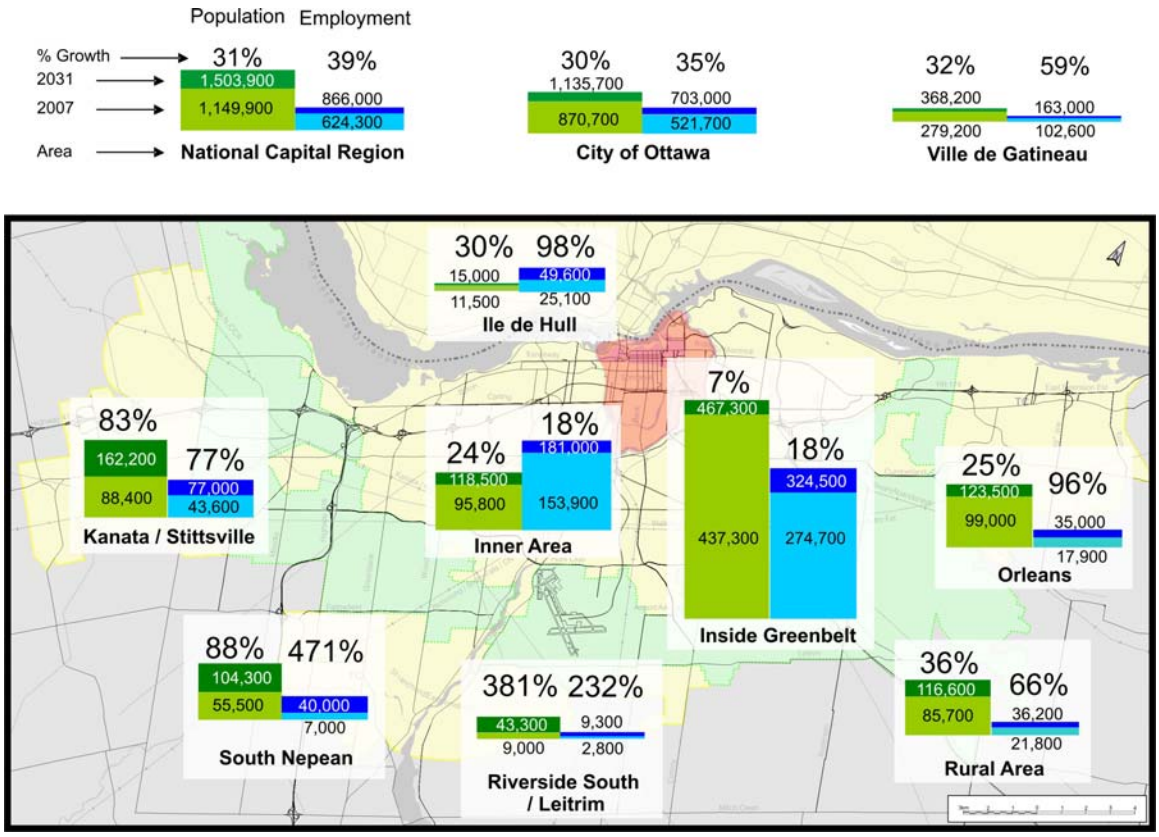


Table 2.1: Growth in Population and Employment for Major Growth Areas

	Population							Employment						
	Base Year	% of Total	2031	% of Total	Growth	% of Total	% of Base Year	Base Year	% of Total	2031	% of Total	Growth	% of Total	% of Base Year
Ottawa Inner Area	95,800	11%	118,500	10%	22,700	9%	24%	153,900	29%	181,000	26%	27,100	15%	18%
Inside Greenbelt*	437,300	50%	467,300	41%	30,000	11%	7%	274,700	53%	324,500	46%	49,800	27%	18%
Inside Greenbelt (Urban) Subtotal	**533,100**	**61%**	**585,800**	**52%**	**52,700**	**20%**	**10%**	**428,600**	**82%**	**505,500**	**72%**	**76,900**	**42%**	**18%**
Orleans	99,000	11%	123,500	11%	24,500	9%	25%	17,900	3%	35,000	5%	17,100	9%	96%
South Nepean	55,500	6%	104,300	9%	48,800	18%	88%	7,000	1%	40,000	6%	33,000	18%	471%
Riverside South / Leitrim	9,000	1%	43,300	4%	34,300	13%	381%	2,800	0.5%	9,300	1%	6,500	4%	232%
Kanata / Stittsville	88,400	10%	162,200	14%	73,800	28%	83%	43,600	8%	77,000	11%	33,400	18%	77%
Outside Greenbelt (Urban) Subtotal	**251,900**	**29%**	**433,300**	**38%**	**181,400**	**68%**	**72%**	**71,300**	**14%**	**161,300**	**23%**	**90,000**	**50%**	**126%**
Ottawa Urban Areas	**785,000**	**90%**	**1,019,100**	**90%**	**234,100**	**88%**	**30%**	**499,900**	**96%**	**666,800**	**95%**	**166,900**	**92%**	**33%**
Rural Areas	**85,700**	**10%**	**116,600**	**10%**	**30,900**	**12%**	**36%**	**21,800**	**4%**	**36,200**	**5%**	**14,400**	**8%**	**66%**
City of Ottawa Total	**870,700**	**100%**	**1,135,700**	**100%**	**265,000**	**100%**	**30%**	**521,700**	**100%**	**703,000**	**100%**	**181,300**	**100%**	**35%**
Ile de Hull	11,500	4%	15,000	4%	3,500	4%	30%	25,100	24%	49,600	30%	24,500	41%	98%
Remainder of Gatineau & MRC[4]	267,700	96%	353,200	96%	85,500	96%	32%	77,500	76%	113,400	70%	35,900	59%	46%
Gatineau & MRC Total	**279,200**	**100%**	**368,200**	**100%**	**89,000**	**100%**	**32%**	**102,600**	**100%**	**163,000**	**100%**	**60,400**	**100%**	**59%**
National Capital Region	**1,149,900**		**1,503,900**		**354,000**		**31%**	**624,300**		**866,000**		**241,700**		**39%**

**Does not include Ottawa Inner Area*

- Approximately 52% of the population and 72% of employment will be located in areas inside the Greenbelt. The population will reach 585,800 persons (an increase of 52,700) and the employment will increase to 505,500 jobs (an increase of 76,900) by the 2031 planning horizon.
- Collectively, the population in the urban communities located outside the Greenbelt will increase by approximately 72 % (an 181,400 increase) to approximately 433,300 persons. Employment levels are projected to reach 161,300 jobs (a 90,000 increase), or more than a doubling of current levels.
- The 2031 population projections for the urban communities located outside the Greenbelt are 162,200 persons for Kanata, 104,300 persons for South Nepean, 43,300 persons for Riverside South/Leitrim, and 123,500 persons for the Orleans. The employment projections follow a similar pattern with the highest levels of employment at 2031 to be located in Kanata (77,000 jobs), followed by South Nepean (40,000), Orleans (35,000 jobs), and Riverside South/Leitrim (9,300 jobs).
- The Rural districts are projected to maintain their historic growth rates reaching population and employment levels of approximately 116,600 persons and 36,200 jobs over the planning horizon –36% and 66% respectively above current levels.
- For the National Capital Area (i.e. including Gatineau), the historical proportion of population and employment locating on either side of the Ottawa River will remain relatively static (slightly more than 75% of the population and about 80% of the employment levels being located in Ottawa). Despite these historical splits, the employment projection for the region suggests slightly higher growth, on a

[4] Municipalité Régionale des Collines de l'Outaouais – rural areas in Outaouais

proportional basis, for the Outaouais and in particular, indicates that employment within the core area (Ile de Hull) will double from approximately 25,000 to 50,000 jobs.

The above-noted population and employment projections are allocated to a traffic zone system that reflects the density/intensity of development across the City. The scale and intensity of development nodes within a region are an influencing factor in the ability of transit to penetrate key market segments. As the intensity of development nodes increase, the transit servicing options increase and transit services are generally more effective in attracting ridership. The population and employment density maps, for the base year and the future 2031 planning horizon (Figure 2.2 and Figure 2.3), provide an opportunity to identify existing and emerging development nodes and their relative development intensity.

Existing and Future Population Densities:

A comparison of the existing and future distribution of population density (Figure 2.2) indicates that residential areas inside the Greenbelt are not projected to experience significant changes in terms of the population density despite possible increased residential development. However, based on the geographic size of Ottawa's Inner Area, and the projected increase in the residential development within the core, increased residential densities are noted for the areas adjacent to Ottawa's downtown, including the Lowertown/Market Area.

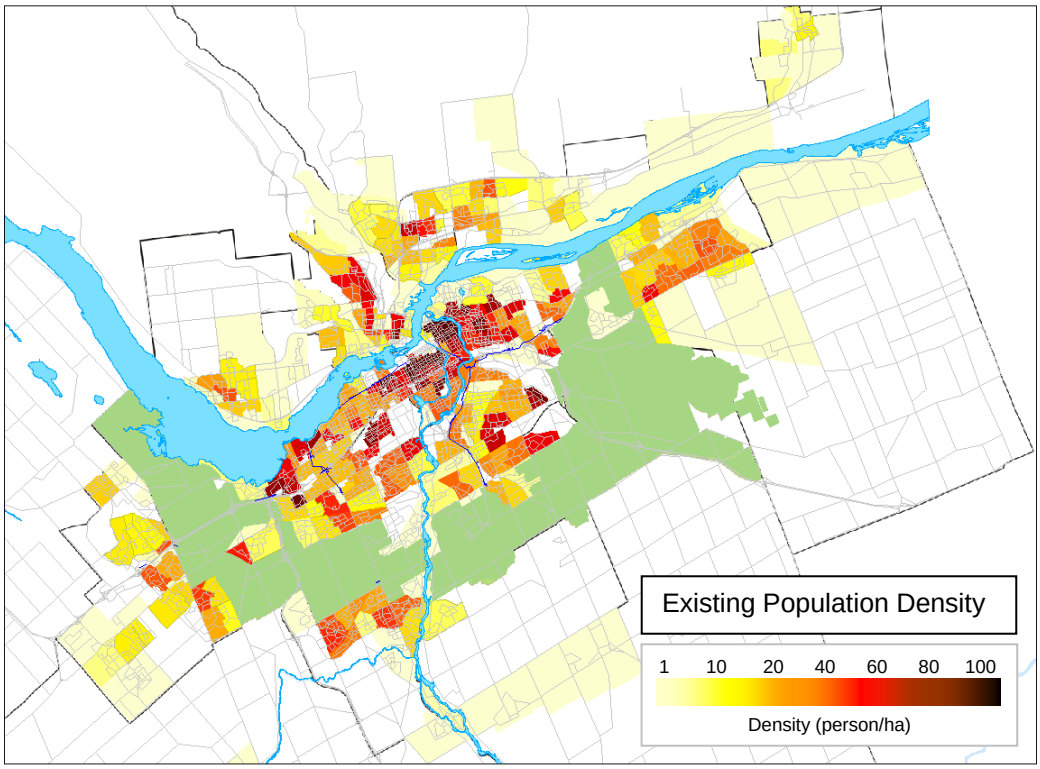
Each of the urban communities located outside the Greenbelt are projected to have increased residential densities, primarily as vacant urban lands are more fully developed to their potential. However, it is noted that in some areas, a decline in population occurs despite growth in residential units over the planning period, with this being attributed to the aging population which reduces the number of persons per household.

Existing and Future Employment Densities:

A comparison of the existing and future distribution of employment density (Figure 2.3) highlights areas inside the Greenbelt where higher employment densities occur. In a large number of cases, the future growth in employment is concentrated within existing employment nodes. Specific areas where density increases are significant include: the Core Area where densities increase westward to the Tunney's Pasture area; the employment node bounded by Highway 417, Industrial Avenue and St Laurent Boulevard; and the employment node centered on Merivale Road, Clyde Avenue and Baseline Road. A number of other employment nodes within the Greenbelt experience higher densities, however, the changes are less dramatic.

As the urban communities located outside the Greenbelt grow in population, they are also projected to increase in employment levels. Increased employment in Kanata West and the distribution of employment growth in Kanata Town Centre and the Kanata North Business and the Terry Fox/Palladium Business Parks indicate significant changes in employment densities by 2031. Increased employment densities for the east and south urban communities are less noticeable. However it is also noted that in some cases, based on the larger tracts of land (and area used in determining employment densities for these districts) available for development, there are lower reported densities at an aggregate level.

Figure 2.2: Existing and Future Population Densities



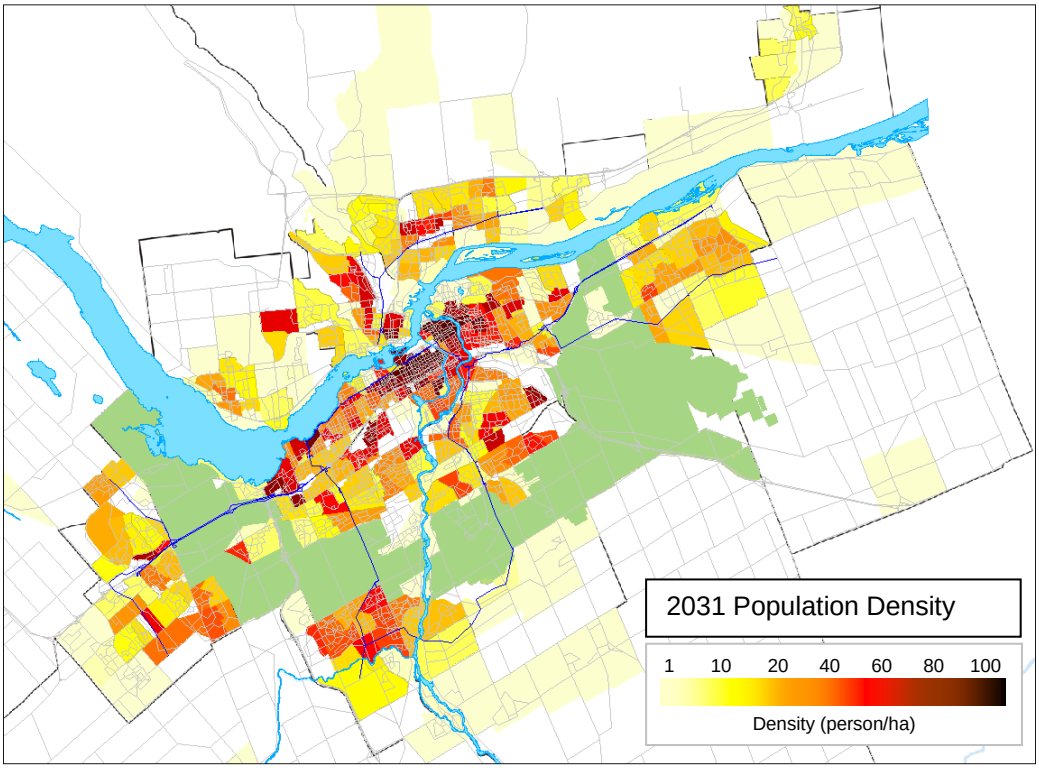
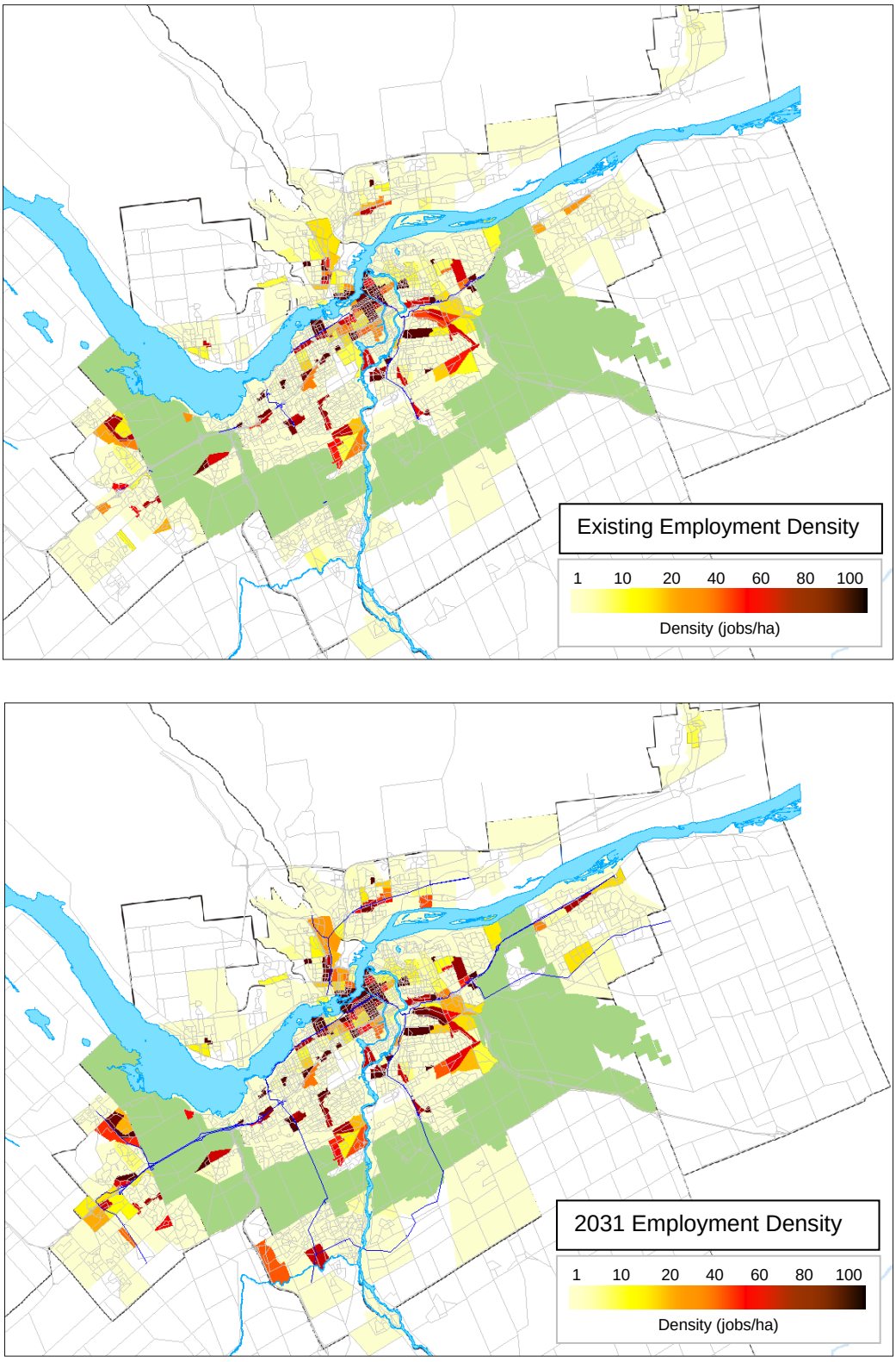


Figure 2.3: Existing and Future Employment Densities



3. Travel Demand Forecast: 2031

3.1. Background

In Fall 2005, the City of Ottawa, in partnership with other regional planning agencies, completed a comprehensive area-wide Origin-Destination (O-D) Survey. This survey included a number of related data collection activities including screenline traffic counts, detailed auto travel time surveys and traffic counts for roadways linking areas outside the National Capital Region. These activities are coordinated by TRANS (a joint transportation planning committee comprised of municipal, provincial and federal agencies) which oversees the development and maintenance of the comprehensive TRANS regional travel demand forecasting model. This model was recently redeveloped to incorporate a number of new technical features associated with the new generation of activity-based models. Calibrated against the 2005 OD Survey, it is a significant improvement over previous area planning models.

The major new features of the TRANS Model are the addition of trip chaining procedures, daily tour generation and distribution, and more detailed mode choice models to consider a variety of transit modes (bus, Transitway, rail/LRT) and access options (walk, park & ride, kiss & ride). The TRANS model continues to serve area transportation planners in understanding the impact of long-term development patterns and growth within Ottawa and Gatineau on future growth in regional travel demands across the region.

The future travel demands identified within this study have, therefore, been undertaken through the application of the most up-to-date regional transportation planning data as well as advanced modeling practices as implemented in the updated TRANS Model. While it is noted that the tour based modeling framework explicitly considers daily tours (travel to work, school and return, etc) with both morning and evening commuter travel modeled, the focus of the travel demand analysis which follows is on the a.m. peak hour as it represents a period of the day when road networks experience increased levels of congestion and is the busiest hour for transit.

3.2. Planning Assumptions

An assessment of the growth in future travel demand for any urban area is fundamentally linked to a number of assumptions regarding future conditions within the planning area. In addition to understanding where people will live and work, it is also necessary to include a number of preliminary assumptions regarding future transit and road networks in the travel demand model. A balanced supply of transit and road facilities to service future growth ensures that travel patterns and demands emerging from the analysis reflect current and future expectations with respect to growth in motorized and non-motorized travel and live/work relationships within various planning districts. This is particularly important in new growth areas (with significant population and/or employment growth) where, in many cases, the existing road and transit services are largely undeveloped today. In these situations, preliminary assumptions were made to ensure strong connections between emerging and future communities. These assumptions are comprised of extensions or expansions to existing and planned transit and road facilities to reflect the location of growth in demographics across the planning region as defined in the previous chapter of this report.

3.3. Growth in Travel Demands

The growth in forecast travel demand over the 2031 planning period was identified with the assistance of the long-range planning model (TRANS Model). The planning model relies on the local travel behaviour as identified in the 2005 O-D Travel Survey as a means to capture and model key variables in forecasting future trip patterns and travel choices based on estimates of future travel times for competing travel modes between O-D pairs. Trips using the NCR road and transit networks can either be:

- originating from Ottawa and destined to Ottawa;
- originating from Ottawa and destined to Gatineau/MRC;
- originating from Gatineau/MRC and destined to Ottawa; or
- originating from Gatineau/MRC and destined to Gatineau/MRC.

For the purpose of our analysis, references to Ottawa city-wide trips will include the above mentioned trips, excluding trips made from Gatineau/MRC to Gatineau/MRC.

Table 3.1: Projected Travel Demand: All Modes – City Wide

Ottawa Travel* AM Peak Hour	Base Year			2031			Percentage Growth
	Person Trips	Mode Share	Mode Split	Person Trips	Mode Share	Mode Split	
Walking/Cycling (Non-Motorized)	23,700	11%	-	35,400	12%	-	49%
Transit Riders	44,500	21%	23%	78,300	26%	30%	76%
Private Auto Trips	146,600	68%	77%	182,300	62%	70%	24%
Total - All Trips	214,800	100%	100%	296,000	100%	100%	38%

** Includes all travel originating or destine to Ottawa (i.e. excludes travel originating and destine to Gatineau/MRC)*

Table 3.1 above, summarizes both the existing and forecast 2031 city-wide travel by various modes for the a.m. peak hour. While city-wide travel is forecast to increase by approximately 38% over the planning period, the portion of travel accommodated by transit is forecast to increase by 76% with overall travel by auto to increase by 24 %. The resulting mode split for motorised travel indicates the 30% mode split target for transit would be achieved within the planning period.

3.3.1. Non-Motorized Travel

Non-motorized travel refers to both cycling and walking (more frequently walking) trips and is accounted for in the TRANS model. A number of factors impact on the proportion of travel that is allocated to non-motorized travel including land use densities, car ownership levels and household income. Table 3.2 summarizes, at a district level, both the current and 2031 percentage of non-motorized travel during the a.m. peak.

While the City-wide non-motorized share of travel is forecast to grow by about one percent by 2031, it is noteworthy that a significantly larger portion of the trips originating in the Inner Area, where congested transit and road networks are under significant pressure, will be attracted to non-motorized modes by 2031. It is also noted that trip destinations to the Inner Area are significantly higher in magnitude than the trip origins. This is due to commuters being attracted to the employment base located in district areas spread across the region. The non-motorized travel is therefore lower at 12% for the planning horizon of 2031.

Furthermore, within the Greenbelt the non-motorized share of travel (for all trips originating during the a.m. peak) is forecast to increase from 13% to 17% reducing the proportion of motorized travel to be accommodated by transit and road systems.

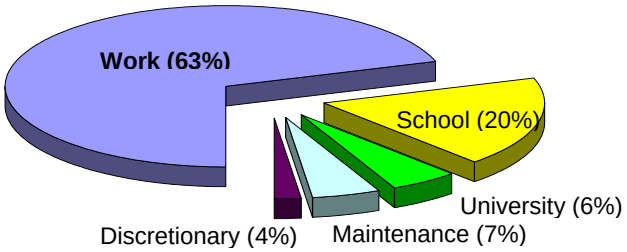
Table 3.2: Existing and Forecast Non Motorized Travel Shares by District

	District Trip Origins				District Trip Destinations			
	Base Year*		2031		Base Year*		2031	
	Total Person Trips	% non - motorized	Total Person Trips	% non - motorized	Total Person Trips	% non - motorized	Total Person Trips	% non - motorized
Ottawa Inner Area	22,600	35%	27,400	43%	47,400	10%	53,700	13%
Ottawa East	11,100	11%	11,700	13%	9,100	12%	8,900	13%
Beacon Hill	7,000	7%	9,600	8%	7,900	8%	9,700	10%
Alta Vista	16,500	8%	19,100	9%	23,400	8%	28,400	9%
Hunt Club	11,000	3%	11,600	3%	6,200	8%	8,500	9%
Merivale	17,500	7%	18,600	7%	21,100	9%	22,600	10%
Ottawa West	9,200	10%	10,900	13%	9,900	11%	11,600	12%
Bayshore/Cedarview	16,900	5%	17,200	6%	14,800	9%	16,600	9%
Inside Greenbelt Subtotal	**111,800**	**15%**	**126,100**	**19%**	**139,800**	**10%**	**160,000**	**12%**
Orleans	21,800	3%	27,000	4%	10,700	8%	16,900	8%
Riverside South/Leitrim	1,800	1%	9,500	2%	1,500	6%	6,100	7%
South Nepean	11,200	4%	23,000	4%	5,000	7%	16,600	10%
Kanata/Stittsville	17,800	5%	34,300	6%	15,300	6%	29,800	8%
Outside Greenbelt Subtotal	**52,600**	**4%**	**93,800**	**5%**	**32,500**	**8%**	**69,400**	**9%**
City of Ottawa (Urban Area)	**164,400**	**11%**	**219,900**	**12%**	**172,300**	**10%**	**229,400**	**11%**

* *Base Year is used consistently throughout this report to reference the common set of OD Survey data, employment and population data, and ground traffic counts used in the model calibration and validation to base year conditions (2005-2006).*

3.3.2. Motorized Travel

Figure 3.1: Travel Purposes – a.m. Peak



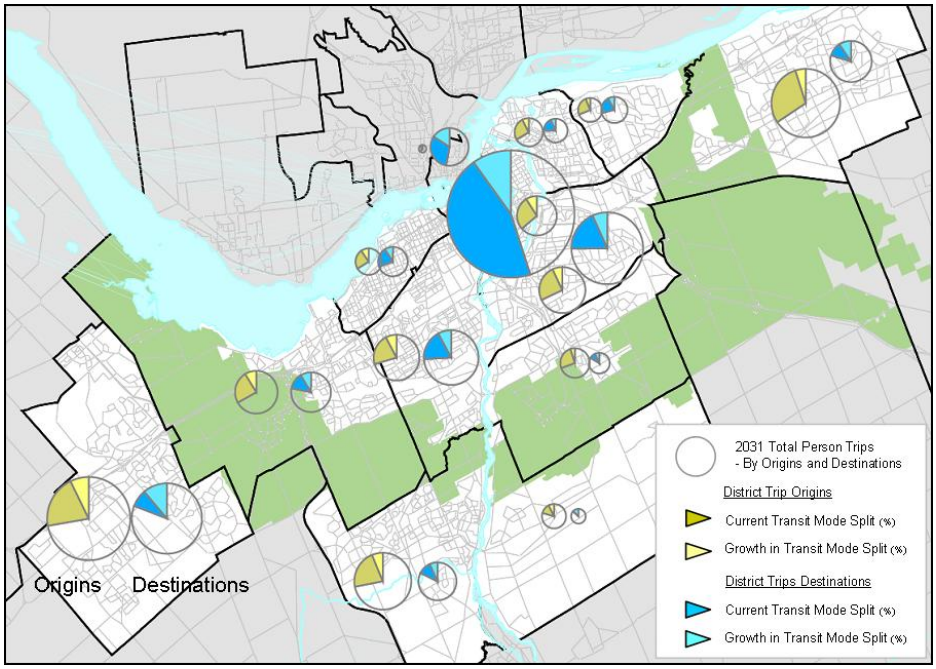
A focus on a.m. peak travel reduces the impact of diverse travel purposes, as during this time of day commuter-related trips predominate. Trips to work represent approximately 63% of all travel followed by trips to school at 20% and trips to University at approximately 6% of the total travel. The remaining travel purposes collectively represent 11% of all travel. Of these, "Maintenance" travel involves those trips that are essential to maintaining the household, including weekly shopping, medical, most types of personal business (e.g., banking), and other trips that more or less have to be performed on a regular basis. "Discretionary" travel includes those trips that are more optional in nature, such as dining out,

entertainment, visiting friends, recreation, etc. Figure 3.1 highlights the various motorized trip purposes and associated shares during the a.m. peak.

A review of the forecast motorized travel demand for the City of Ottawa indicates that a significant portion of the growth will be accommodated by public transit. City-wide growth in auto vehicle travel is forecast to increase by approximately 24%, less than the rate of population growth, while public transit ridership is forecast to increase by 76% for Ottawa city-wide and 85% percent for the National Capital Region which includes the Quebec side of the Ottawa River. This is particularly relevant for peak hour travel destined to areas inside the Greenbelt as presented in Table 3.3. Transit mode splits are projected to increase to 36% for trips with origins in the Inner Area and 55% for trips with destinations in the Inner Area, and about 35% for all motorized travel with origins or destinations inside the Greenbelt. For Greenbelt origins or destinations, this approximate 10% increase (from 25% to 33% and 28 to 36% in 2031) represents a ridership increase of one third over existing levels (i.e. about 50% increase over existing levels).

Key changes in transit mode split for each of the planning districts are highlighted in Figure 3.2: Current and Future Mode Splits by Trip Origin and Destinations. The size of the circle represents the number of trips either destined to or originating from the district. For example, the largest circle in the figure indicates the importance of the Inner Area as a trip destination during the a.m. peak hour. The mode split of all travel destined to the Inner Area is forecast to increase from 46% to 55%. Individual area transit mode split values are summarized in Appendix C (Tables C-7 and C-8). In addition to the growth in transit mode split for each of the planning areas, the figure also indicates the balance between trip origins and destinations for each of the districts. For example, the Orleans district is a net exporter of trips during the a.m. peak hour (more trip origins compared to trip destinations). The differences in transit mode splits between trip origins versus destination are also shown for each of the districts.

Figure 3.2: Current and Future Mode Splits by Trip Origin and Destinations



Growth in private vehicle use is largely to destinations outside the Greenbelt. Within each of the urban growth communities (Orleans, South Nepean, Riverside South/Leitrim and Kanata) increased employment and typically lower employment densities – with the resulting shorter trip lengths – make travel by public transit less attractive when compared with destinations inside the Greenbelt. While travel by private cars is forecast to double (~94% over current levels), it is noteworthy that the public transit share of motorized travel in the urban communities outside the Greenbelt is projected to increase from an aggregate mode split of approximately 9% to approximately 19% by 2031 (quadrupling the number of transit riders). This represents an increase of almost 10,000 public transit trips during the a.m. peak hour.

Table 3.3: Growth in Travel by Private Vehicle and Transit – Trip Origins & Destinations by Sub-Area

Sub Area			Auto Vehicle Trips			Public Transit Trips			Transit Mode Split	
			Base Year	2031 Forecast	% Growth	Base Year	2031 Forecast	% Growth	Base Year	2031 Forecast
Trips Origins	Ottawa	Ottawa Inner Area	9,500	9,410	-1%	4,500	6,710	49%	28%	36%
		Greenbelt Subtotal*	63,000	64,500	2%	26,000	38,600	48%	25%	33%
		Outside Greenbelt Subtotal	32,700	55,900	71%	12,800	27,400	114%	24%	29%
	City of Ottawa - Total**		107,700	137,000	27%	39,800	68,200	71%	23%	29%
	Gatineau & MRC	Ile de Hull	1,330	1,580	19%	630	1,200	90%	28%	38%
		All Districts	34,400	43,900	28%	9,700	21,000	116%	19%	28%
	National Capital Area		142,000	181,000	27%	49,000	89,000	82%	22%	29%
Trips Destinations	Ottawa	Ottawa Inner Area	22,700	21,360	-6%	23,900	32,350	35%	46%	55%
		Greenbelt Subtotal*	85,800	89,300	4%	40,000	60,100	50%	28%	36%
		Outside Greenbelt Subtotal	22,800	44,260	94%	2,900	12,440	329%	9%	19%
	City of Ottawa - Total**		114,100	142,220	25%	43,000	72,650	69%	24%	30%
	Gatineau & MRC	Ile de Hull	4,660	6,820	46%	2,560	7,240	183%	31%	47%
		All Districts	28,000	38,700	38%	6,500	16,500	154%	16%	26%
	National Capital Area		142,000	181,000	27%	49,000	89,000	82%	22%	29%

Note: All numbers have been rounded and consequently the totals when summed individually may differ slightly as a result of rounding.

As noted, public transit levels are projected to increase across all geographic areas within the City of Ottawa and across the region. City-wide transit mode splits during the morning peak hour are forecast to increase from approximately 24% to 30% by 2031. Transit mode splits destined to Gatineau's core area (Ile de Hull) are also expected to increase significantly in response to increased levels of employment planned for the district.

Existing and forecast 2031 district level travel flows are summarized in Appendix C for transit trips (which are assigned to the rail and bus networks) and automobile (trips which are assigned to area road networks). These trip matrices have been organized to highlight both the scale of trip interchanges between districts

for public transit and private automobile travel, as well as identifying the growth in trip interchanges and resulting transit modal splits.

3.4. Regional Travel Desire Lines

An important step in understanding future regional travel and trends in trip making is the development of major travel desire lines (a graphical representation of travel demand) based on the future demographic patterns, including projected increases in employment and population. To facilitate the analysis of major urban travel flows, the planning districts used include seven districts for areas largely located within the Greenbelt, and four districts to track travel demands associated with each of the urban centres of Orleans, South Gloucester/Leitrim, South Nepean and Kanata. A similar aggregation of rural areas as well as areas located on the Gatineau side of the Ottawa River ensures these travel flows are also considered in the analysis of travel demands.

The identification and establishment of desire lines was undertaken and trip flows were categorised based on their magnitude as follows;

- Primary Travel Desire Lines were established with a threshold of 1,700 district to district trips per hour (a.m. peak hour person travel).
- Secondary Travel Desire Lines were established to capture between 1,100 and 1,700 district to district trips per hour.
- Tertiary Travel Desire Lines were established to capture between 500 and 1,100 district to district trips per hour.
- The remaining travel demands not captured by the 500 district to district trips per hour threshold represent more diverse travel. While not insignificant at an aggregate level, they do not lend themselves easily to establishing discernable desire lines, often representing travel from areas with significantly lower population levels. While 500 may seem like a large number of trips, it is important to note that each of the districts are comprised of 30 to 40 traffic zones and consequently the number of trips between individual traffic zone pairs is, in this respect, very low.
- Inter-district trip flows, those which start and end within the same planning district, can represent a significant proportion of district travel demands. Since these trips stay within the district they originated, desire lines are not an effective way to present these flows. It is noted that some districts with balanced employment/population levels achieve relatively high levels of trip internalization (origins and destinations remain within the same district) – Kanata for example. Overall inter-district travel demand grows from 58,000 and 86,000 person trips by 2031. To a large extent this reflects the maturing of the urban areas located outside the Greenbelt as more development occurs within their community; and the need for travel beyond their immediate community particularly for school, discretionary travel and to a lesser extent work is significantly reduced.

Figures 3.3, 3.4 and 3.5 illustrate the major travel desire lines, highlighting both the number of trips between districts as well as the transit mode split. The width of arrow indicates the magnitude of travel (number of a.m. peak hour person trips) and the colour of the arrow indicates the transit mode split (higher mode splits represented by increased colour tones and shading). Each of the categories of travel is briefly discussed as follows:

Primary Desire Lines: Overall, the combined primary travel demands depict an increase in the aggregate number of person trips from approximately 57,000 to 82,000 person trips. Points of note include:

- The focus of these major travel demands for the a.m. peak hour remains Ottawa's Inner Area where more than one-quarter of Ottawa's 2031 employment base is located. The mode split to Ottawa's Inner Area, as depicted by the strength of the red colour, indicates that the role of public transit in serving Ottawa's core area will continue to increase. Urban areas located outside the Greenbelt will continue to be attracted to transit to reach Ottawa's Inner Area with average mode splits for the three urban centres reaching 70% compared with the current average of approximately 60%.
- A number of new district pairs emerge as a result of the significant planned growth in both the South Nepean and Kanata districts. Commuting from the Kanata to the Merivale district is noted, as is the South Nepean commuting to both the Kanata and Bayshore districts. Transit mode splits are also noted in the mid 20% range for the South Nepean desire lines, while the Kanata commuting indicates a mode split in the mid 30% range.

Secondary Desire Lines: In general, the growth in this set of travel desire lines is lower than above, with the aggregate number of person trips increasing from approximately 27,000 to 34,000 person trips. The growth in regional travel results in some desire lines being promoted to the primary desire line category discussed above by 2031 (i.e. the South Nepean to Bayshore and Kanata to Merivale desire lines). This movement between categories also impacts on the overall growth for this category (between 1,100 and 1,700 person trips) across the planning period. Points of note include:

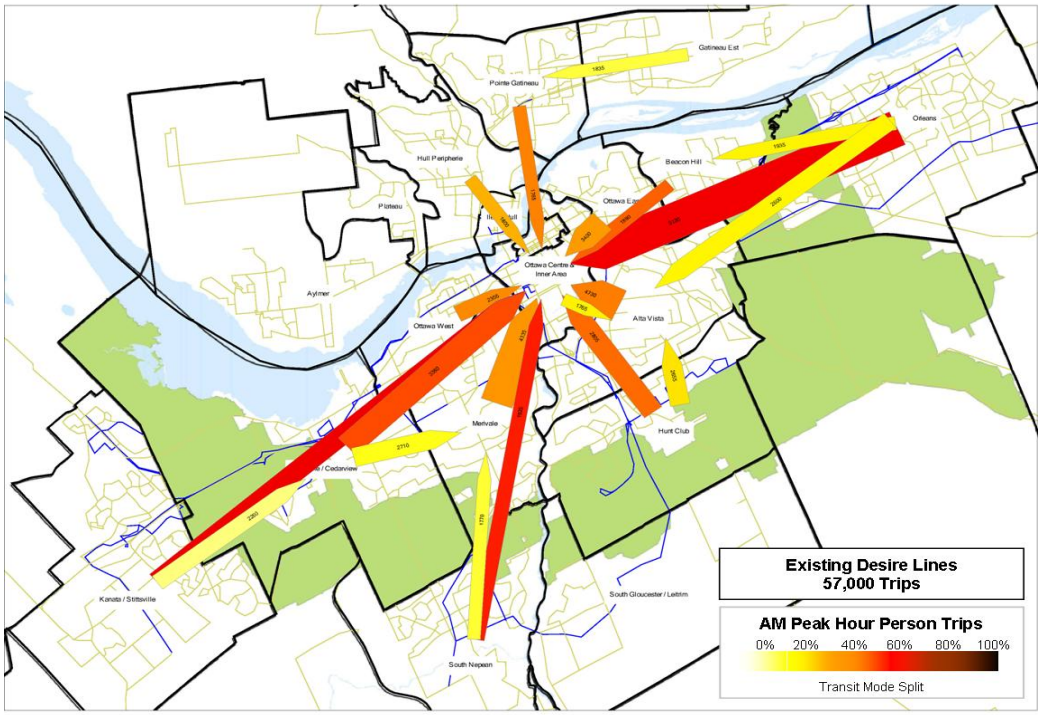
- The South Nepean to Ottawa Inner Area increases are included in this group and the transit mode split for this desire line has increased from the mid 50% to the mid 60%.
- Increased travel between South Nepean and South Gloucester emerges in this group by 2031, which confirms the need to provide strong transportation linkages between these two growth centres.
- The growth in employment in the Alta Vista District, combined with increase population growth in both Kanata and South Nepean, results in the promotion of these desire lines into this category of travel desire lines.
- The large population growth within the Kanata district and the planned employment growth in South Nepean results in a desire line between these two centres.

Tertiary Desire Lines: The aggregate number of person trips in this category grows from approximately 29,000 to 47,000 person trips. Points of note include:

- The trip desire line patterns are much more diverse for this group; however, the pattern which emerges is an increasing number of links between the urban areas outside the Greenbelt to areas inside the Greenbelt.
- In general, the trips associated with this group of desire lines tend to be longer in overall trip length, resulting in significant mode split increases for areas well served by transit.

Figure 3.3: Growth in Primary Desire Lines

(District to District OD pairs greater than 1,700 a.m. peak hour person trips)



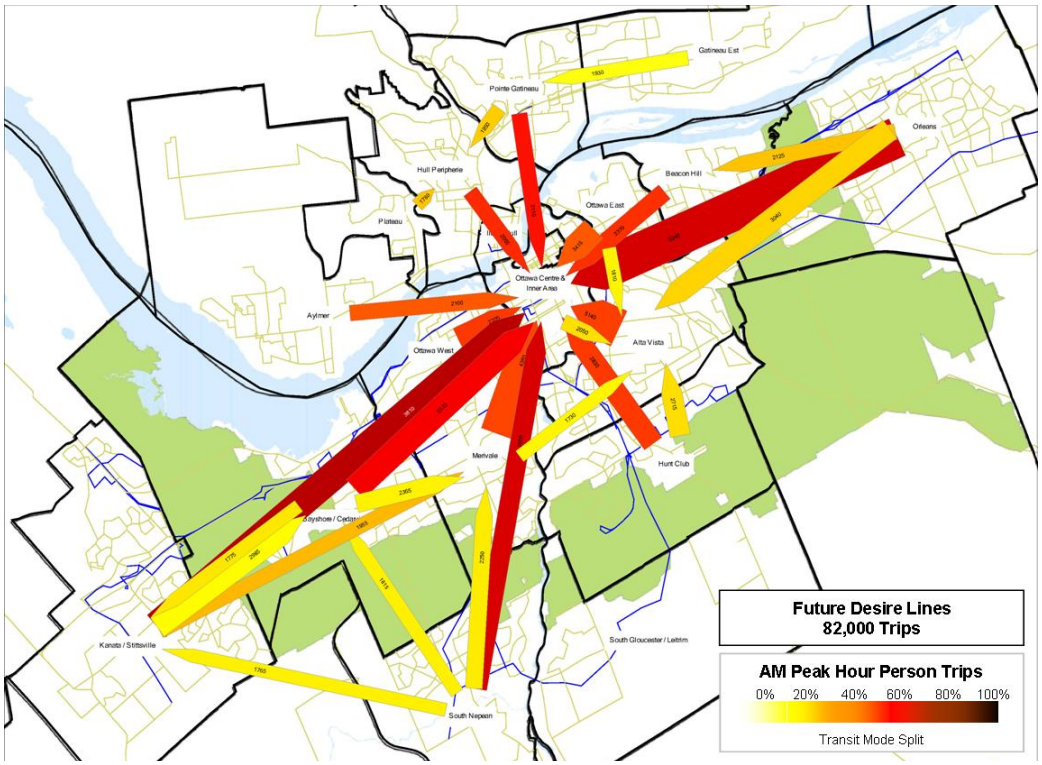


Figure 3.4: Growth in Secondary Desire Lines

(District to District OD pairs between 1,100 and 1,700 a.m. peak hour person trips)

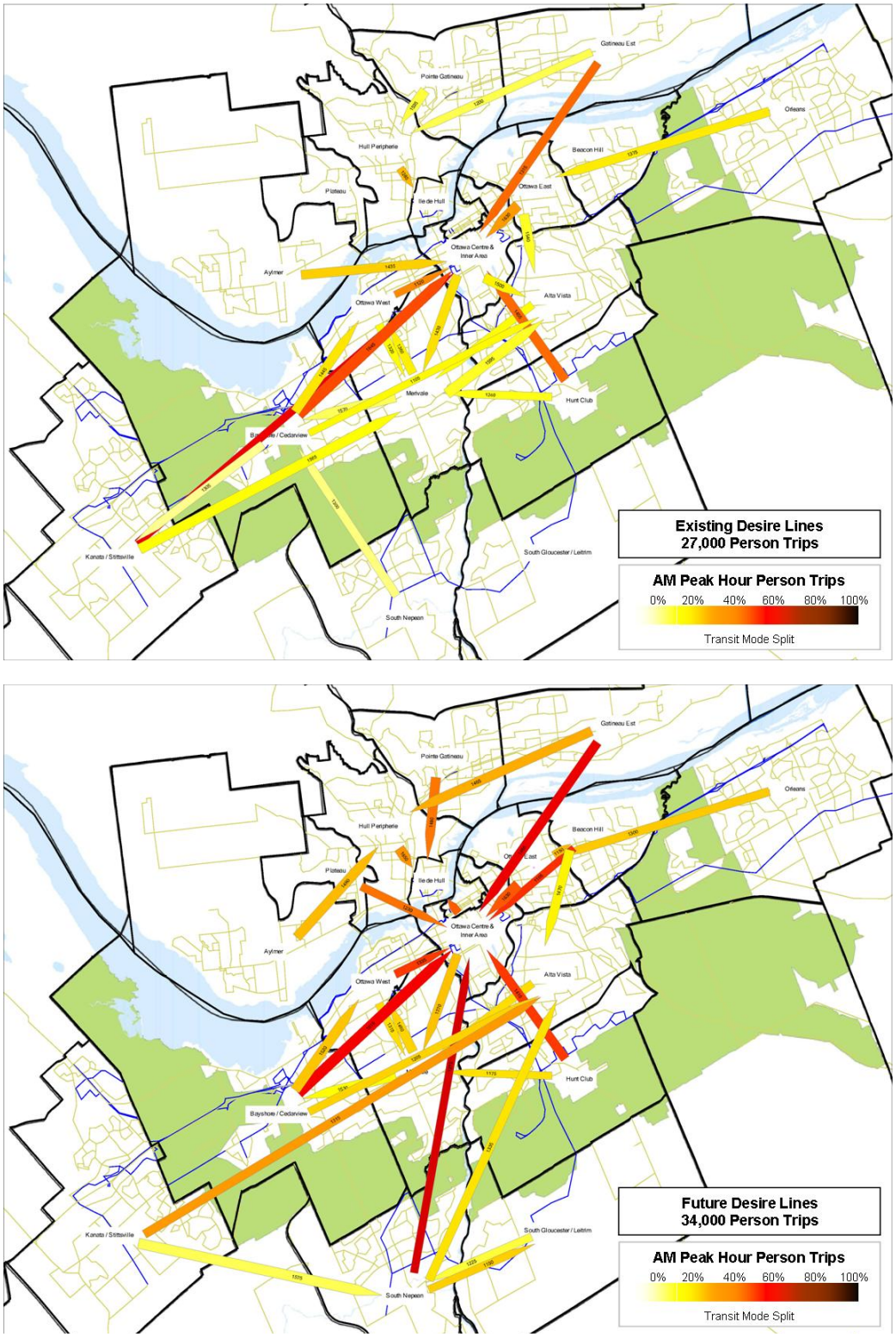
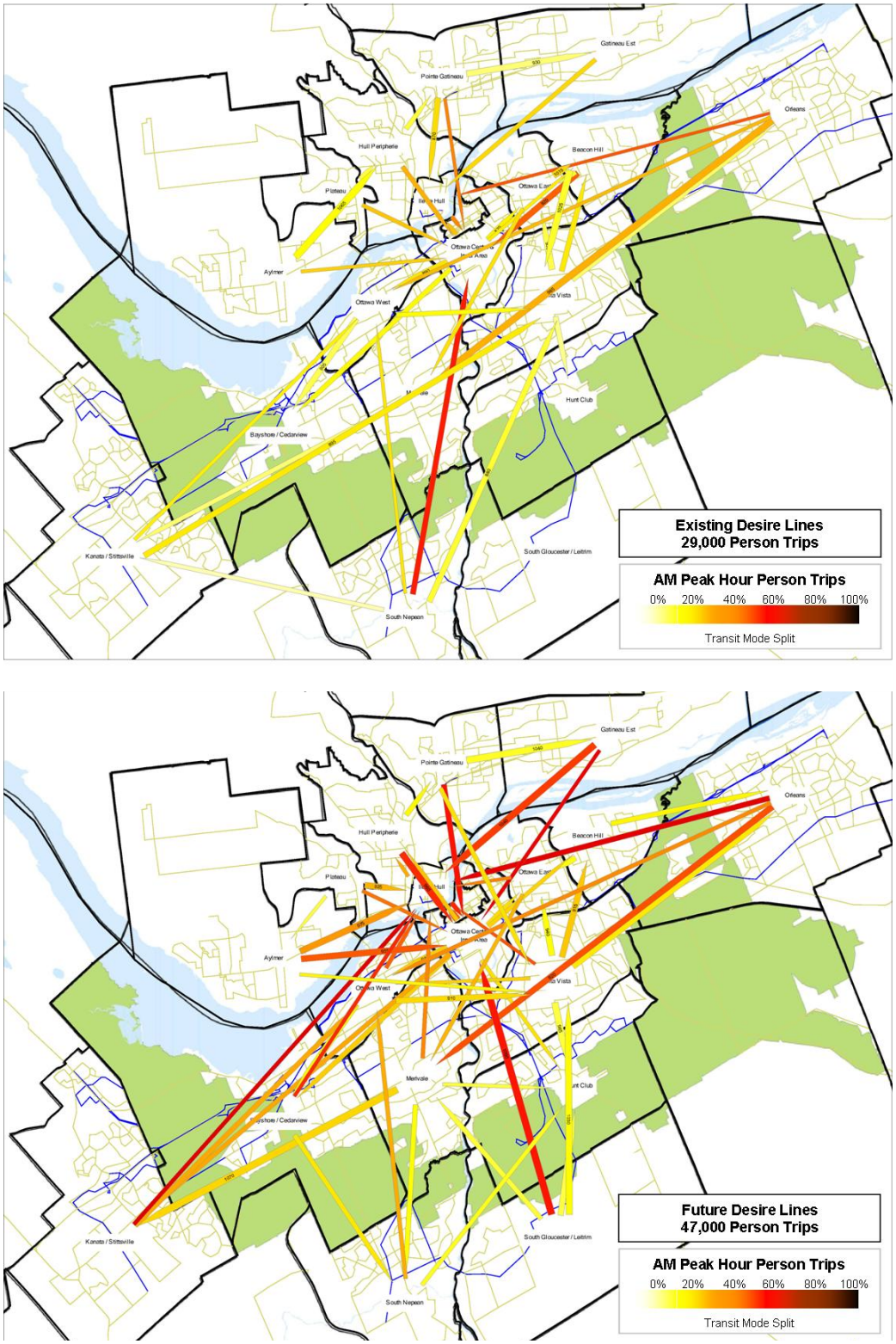


Figure 3.5: Growth in Tertiary Desire Lines

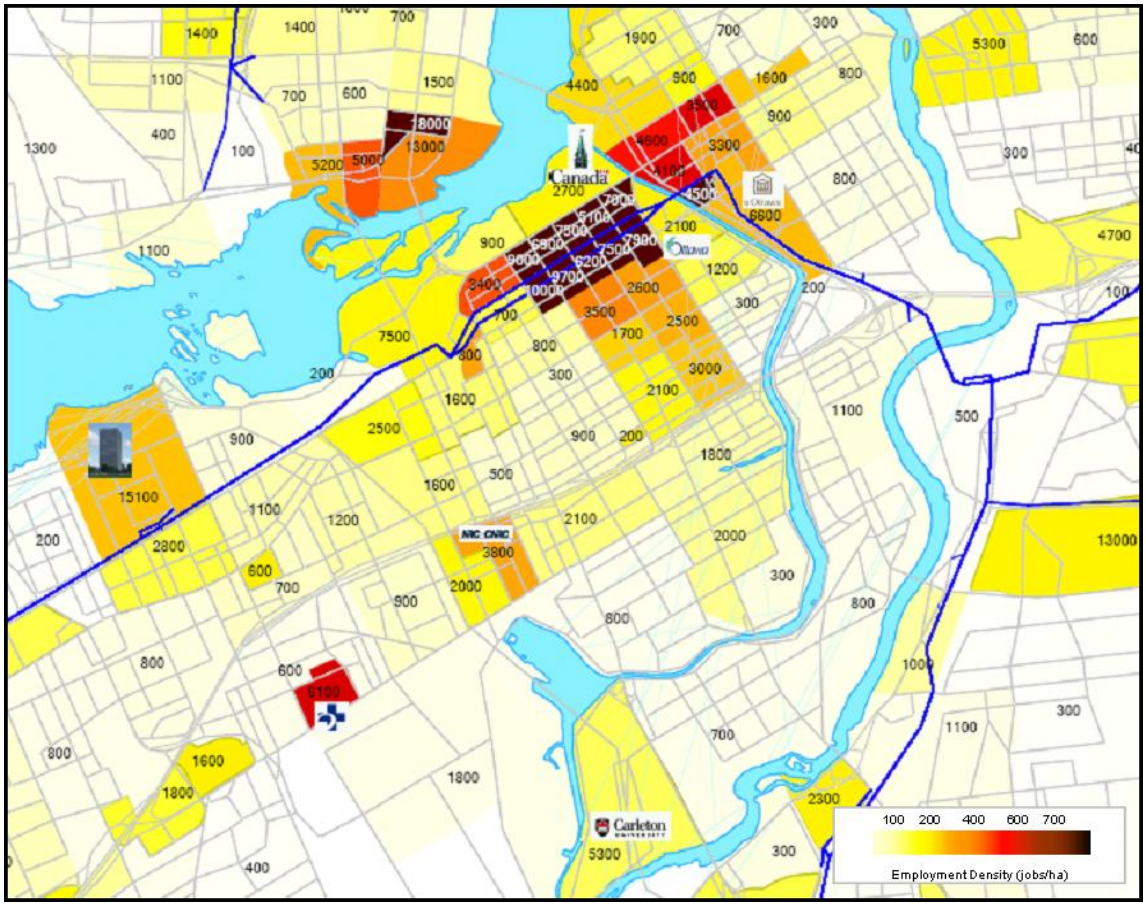
(District to District OD pairs between 500 and 1,100 a.m. peak hour person trips)



3.5. Focussing on Travel in Ottawa's Inner Area

The afore-mentioned assessment of travel desire lines demonstrates that Ottawa's Inner Area is the most significant destination for travel during the a.m. peak. Major employment nodes located within Ottawa's Inner Area are highlighted in Figure 3.6. Traffic zone employment densities identify the high concentration of employment in Ottawa's central business district (CBD), as well as other major nodes such as Carleton University and the University of Ottawa which have enrolments of approximately 25,000 and 30,000 student respectively. Located just west of the Inner Area, Tunney's Pasture and the Ottawa Hospital Civic Campus have an impact on Inner Area travel demands. Figure 3.6 also indicates the employment levels projected for 2031 for various traffic zones.

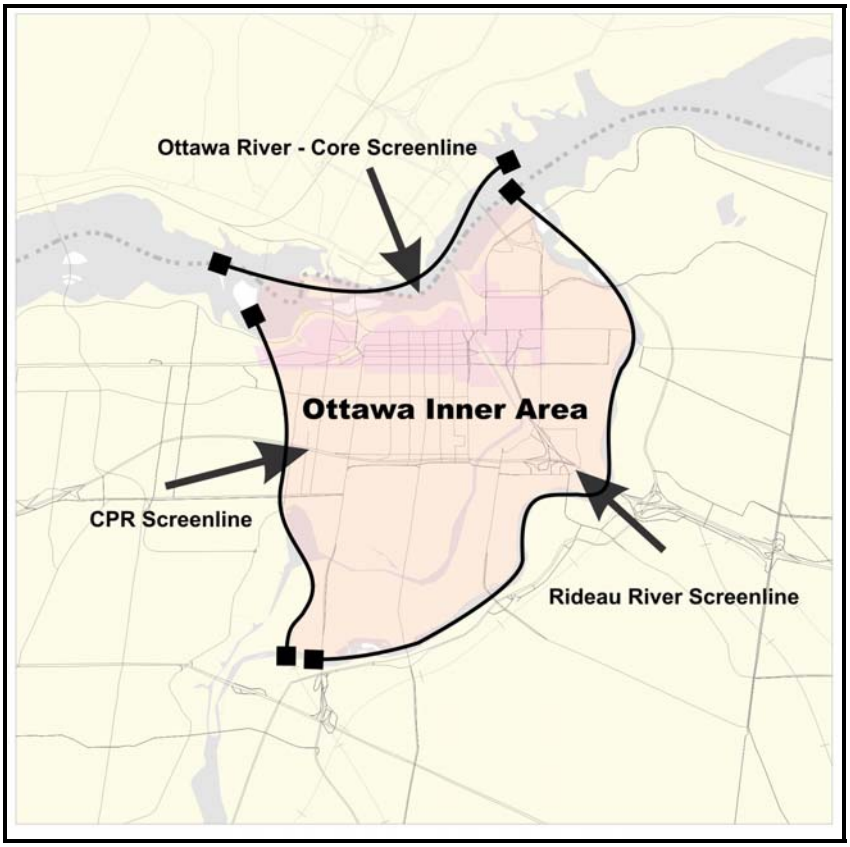
Figure 3.6: Major Employment Nodes and Density: 2031 – Ottawa Inner Area



Travel demands to and through Ottawa's Inner Area were measured across strategic screenlines. Screenlines typically are established across barriers to transportation, such as rivers, railways and other geographic features which tend to limit the number of crossing points and consequently offer key opportunities to compare transportation demands against various supply options. Often within transportation networks, screenlines provide a means to identify choke points in the system where the imbalance between supply and demand can manifest itself in significant increases in the level of congestion.

Ottawa's Inner Area, with its geographic features including rivers to the north, east and south together with the rail line corridor to the west, has historically been used to record existing and forecast future growth in transportation demands. The locations of the various screenlines which encompass the Inner Area are highlighted in Figure 3.7: Inner Area Screenlines. The boundary formed by these three screenlines defines the Inner Area Cordon.

Figure 3.7: Inner Area Screenlines



A review of the a.m. peak travel demands to and from and through the Inner Area is summarized in Table 3.4. Future trends are noted as follows:

- The low growth in private automobile demand reflects congestion currently experienced on existing roadways that serve the Inner Area, as well as a potential shifting of through travel demand outside the Inner Area. Both auto vehicle and auto passenger demands increase by approximately 3% by 2031 for the peak travel direction (inbound). It is also noted that Base Year non-peak direction travel (outbound) is about 62% of the peak direction travel, and that this will increase by 8% over the planning period.
- Transit growth is substantial across all three screenlines, with a commensurate increase in transit modal split to the Inner Area. In the peak travel direction the transit modal split increases from 37% to 45% by 2031. This represents a 48% increase (from 27,100 to 40,000) in transit ridership into the Inner Area.
- Base Year transit travel in the non-peak direction, unlike the auto component of travel, represents a substantially lower portion (30%) of the peak direction transit demands. Nonetheless, the transit

mode split for the non-peak direction of travel from Ottawa's Inner Area increases from 22% to 33%, or an almost doubling of the number of riders.

Table 3.4: Growth in Travel by Mode – Inner Area Cordon (a.m. Peak Hour)

		Base Year				2031 Forecast				Percentage Growth			
		Auto		Transit Riders	Mode Split	Auto		Transit Riders	Mode Split	Auto		Transit Riders	Mode Split
		Veh	Per			Veh	Per			Veh	Per		
Inbound (peak dir)	Rideau River	15,700	19,100	13,000	40%	16,800	20,100	17,200	46%	7%	5%	32%	6%
	CPR	13,300	16,000	9,200	37%	14,000	16,500	14,300	46%	5%	3%	55%	10%
	Ottawa River – Core	9,900	11,800	4,900	29%	9,300	11,600	8,500	42%	-6%	-2%	73%	13%
Inbound Total		38,900	46,900	27,100	37%	40,100	48,200	40,000	45%	3%	3%	48%	9%
Outbound (non-peak dir)	Rideau River	10,400	12,200	3,200	21%	10,600	12,600	5,500	30%	2%	3%	72%	10%
	CPR	8,800	10,400	2,900	22%	9,100	10,800	3,900	27%	3%	4%	34%	5%
	Ottawa River – Core	4,900	6,000	1,900	24%	6,400	7,500	5,500	42%	31%	25%	189%	18%
Outbound Total		24,100	28,600	8,000	22%	26,100	30,900	14,900	33%	8%	8%	86%	11%

Note: Ottawa River – Core includes only travel on the four core area river crossings; Macdonald Cartier west to Chaudière Bridges and consequently does not reflect the growth in overall Interprovincial travel and/or associated mode splits. This definition of Ottawa River – Core Screenline was established to focus attention on core area travel demand only.

Figure 3.8: 2031 Transit Trip Assignments

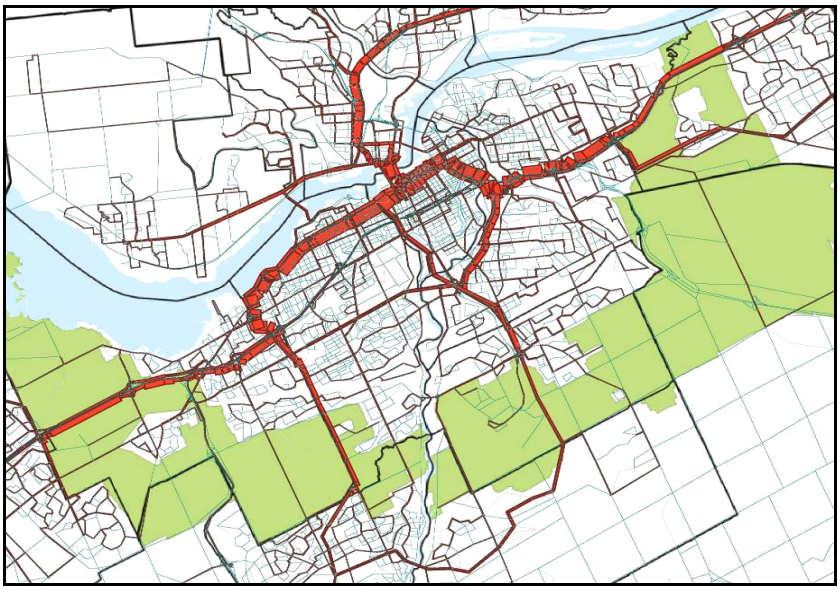


Figure 3.8 above is a graphical representation of the a.m. peak transit travel demand generated by the TRANS model. It illustrates that by 2031 the majority of transit trips converge in the downtown, being fed by the east and west Transitways, and from Gatineau.

4. Transit Ridership: Implications for the Downtown

4.1. Ridership and Service Levels in the Downtown

For the purposes of this discussion, downtown Ottawa is generally defined by the limits of the CBD, bounded to the north by the Ottawa River; to the west by the escarpment adjacent to Bronson Avenue; to the east by the University; and to the south by Laurier Avenue.

Rapid transit ridership into downtown Ottawa flows from four directions: east, west, south, and north. Riders from the east, west, and south currently travel on OC Transpo services entering via the East and West Transitways. Riders from the north (Gatineau) travel primarily on STO services entering from the west via the Portage and from the east via the Alexandra bridges. The downtown transit solution must provide sufficient capacity to accommodate the projected 2031 ridership entering the downtown during the morning peak hour via the East and West Transitways, and consider the implications of accommodating some or all of the STO customers as well.

The level of service on all transit services into downtown Ottawa, both now and in the future, is set to meet the customer demand on the busiest point on each service as it approaches downtown. For example, bus services from the east must be frequent enough to accommodate the customers who are travelling to Ottawa's downtown as well as those traveling to the University of Ottawa or beyond into downtown. From the west, the busiest point is at Tunney's Pasture west of Ottawa's downtown.

4.2. Ridership Levels in 2031

The primary factors affecting the number of customers who will be travelling on rapid transit into downtown Ottawa by 2031 will be the population and employment levels of the City, the demographic characteristics of the population, and the overall quality of the transit service provided. The configuration of the City-wide rapid transit network will also have an effect on the number of customers travelling into downtown, as it will dictate the paths and travel times they take to get to downtown and the directions through which they enter downtown. The effects of the configuration of the City-wide rapid transit network on downtown transit services are as follows:

- *From the east* – The primary rapid transit corridor into downtown from the east is and will continue to be the East Transitway through the St. Laurent, Hurdman, and Campus Stations. No alternatives to this corridor are being evaluated. A subsequent chapter will discuss technology alternatives (bus or rail) to provide service within this corridor.
- *From the west* – The primary rapid transit corridor into downtown from the west is and will continue to be the West Transitway through the Westboro, Tunney's Pasture and Bayview Stations. No alternatives to this corridor are being evaluated. A subsequent chapter will discuss technology alternatives (bus or rail) to provide service within this corridor.
- *From the south* – Two existing options are possible for the primary rapid transit corridor connecting Riverside South/Leitrim and South Nepean to the downtown. Customers could be carried north on the current O-Train corridor through Carleton University and Bayview Stations, and then enter downtown from the west; or customers could be carried north on the current Southeast Transitway corridor through Billings Bridge and Hurdman Stations, and then enter downtown from the east. Both corridors are important and will remain important in the long term.

This report will consider the ridership implications of each option on the capacity requirements and level of service for downtown transit. A subsequent chapter will discuss which of the two should be designated as the primary corridor for extending rapid transit service further south and the technology implications of that choice.

- *From the north* – Options for a possible primary rapid transit corridor from the north will be developed in a forthcoming Interprovincial Rapid Transit Integration – Core Area Strategic Planning Study. For the purposes of this analysis it is assumed that future Gatineau transit riders, as they do now, cross the bridges at the west end of downtown Ottawa. The passenger volumes represent approximately 75% of Gatineau's peak hour ridership destined for the combined core areas of Ottawa and Gatineau. Future interprovincial rapid transit options may provide opportunities for more than one point of access into Ottawa's downtown, helping to balance passenger flows.

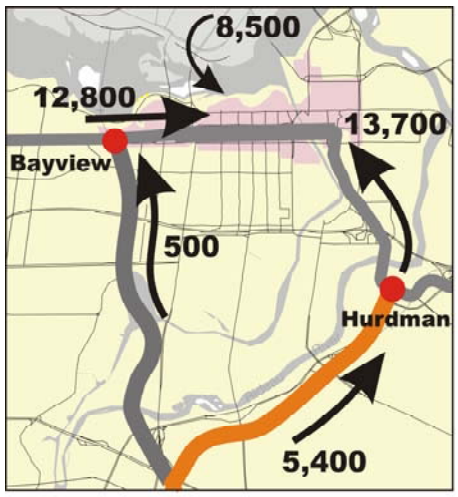
Using the travel demand data discussed in the previous chapter, the two network options to serve the southern growth areas were analyzed separately. The results are outlined in Table 4.1, which identifies that the extension of the O-Train corridor to serve Riverside South shifts the peak passenger load point from east of Ottawa's downtown to the west side (just west of the downtown).

Table 4.1: Network Impacts on Downtown Peak Passenger Load Point Forecasts

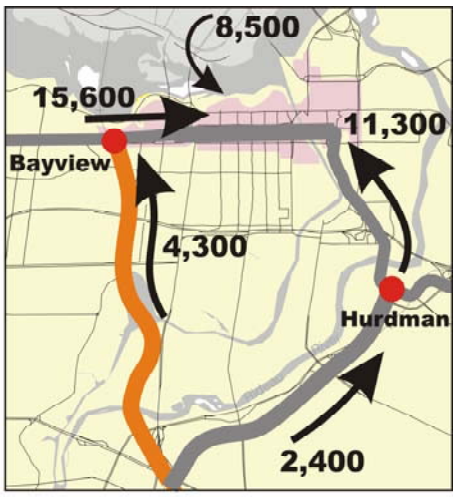
Services the South Through	West of CBD (Le Breton)	East of CBD (Hurdman)	From Gatineau
Southeast Transitway Corridor extension	**12,800**	**13,700**	**8,500**
O-Train Corridor extension	**15,600**	**11,300**	**8,500**

Figure 4.1 illustrates these rapid transit volumes, highlighting the difference brought about by which corridor is chosen to carry the majority of customers from the southern growth communities.

Figure 4.1: Ottawa's Core Area Transit Demands- 2031



Serving growth area in the South by Southeast Transitway extension



Serving growth area in the South by O-Train Corridor extension

Depending on the network option, the forecast peak passenger load points would range between 13,700 to 15,600 passengers per hour for transit flows into Ottawa's downtown from the east and/or the west. Options to fully integrate interprovincial transit services from the north into a single corridor could potentially add up to 8,500 passengers per hour depending on the form and routing of transit ridership from Gatineau.

The detailed analysis of downtown passenger volumes is provided in Appendix D.

4.3. Future Transit Service Levels in the Downtown

In order to determine the future transit service levels in the downtown, it is first necessary to identify the peak passenger load points on those segments of the rapid transit network that lead into the downtown. These peak load points identify the maximum passenger volumes that must be carried during the a.m. peak hour. The level of service is defined by the number of transit vehicles that must cross this point within a given time period to carry this passenger volume. The number of vehicles required is directly proportional to its design capacity – which for each specific type of transit vehicle is the assumed number of passengers carried for service design purposes.

4.3.1. 2031 OC Transpo Service Levels

OC Transpo develops their service operating plans on a vehicle design capacity which accommodates 50% of the maximum standing capacity. Table 4.2 summaries this information for a range of transit vehicles.

Table 4.2: Design Passenger Capacity for Transit Vehicles

Passenger Capacity	Standard 40-ft Bus	Articulated Bus	Double-Deck/Double-Articulated Bus	Light Rail Vehicle (1 car)
Seated Capacity	**39**	**54**	**70**	**70**
Standing Capacity	**12**	**32**	**40**	**130**
Proportion of Standing Capacity for Design	**50%**	**50%**	**50%**	**50%**
Design Capacity	**45**	**70**	**90**	**135**

Note: Appendix D includes additional information regarding other high capacity vehicles.

These design standards have been applied to the various forecasted numbers of passengers at the peak load points for the 2031 planning horizon and outlined previously in Table 4.1. The resulting numbers of transit vehicles necessary to accommodate the forecast peak load points are summarized in Table 4.3. The shaded areas are indicative of the higher peak point.

Table 4.3: Theoretical Number of Transit Vehicles per Hour at Peak Passenger Load Point

Services the South Through	Vehicle Type	West of CBD (Le Breton)	East of CBD (Hurdman)
Southeast Transitway extension	Standard 40-ft Bus	285	305
	Articulated Bus	183	196
	Dbl Deck/Dbl Articulated bus	143	153
	LRT (2 car train)	48	51
	LRT (4 car train)	24	26
O-Train Corridor extension	Standard 40-ft Bus	347	252
	Articulated Bus	223	162
	Dbl Deck/Dbl Articulated bus	174	126
	LRT (2 car train)	58	42
	LRT (4 car train)	29	21

Note: STO passengers entering the downtown from Gatineau are not included in table calculations. Appendix D includes additional information regarding other high capacity vehicles.

The number of peak point transit vehicles can be converted into service headways, or time between transit vehicles. This measure of service frequency is shown in Table 4.4.

Table 4.4: Theoretical Headways (rounded) between Vehicles at Peak Passenger Load Point

Services the South Through	Vehicle Type	West of CBD (Le Breton)	East of CBD (Hurdman)
Southeast Transitway extension	Standard 40-ft Bus	12 sec	11 sec
	Articulated Bus	19 sec	18 sec
	Dbl Deck/Dbl Articulated bus	25 sec	23 sec
	LRT (2 car train)	1 min 15 sec	1 min 10 sec
	LRT (4 car train)	2 min 30 sec	2 min 18 sec
O-Train Corridor extension	Standard 40-ft Bus	10 secs	14 secs
	Articulated Bus	16 secs	22 secs
	Dbl Deck/Dbl Articulated bus	20 secs	28 secs
	LRT (2 car train)	1 min 2 sec	1 min 25 sec
	LRT (4 car train)	2 min 4 sec	2 min 51 sec

Note: STO passengers entering the downtown from Gatineau are not included in table calculations. Appendix D includes additional information regarding other high capacity vehicles.

For example, to carry the required 15,600 passengers per hour entering downtown via the west when the South is served by extending the O-Train corridor the tables above identify that the City will need up to 347

standard 40-foot buses at 10 seconds apart; or 223 articulated buses at 16 seconds apart; or 29 four car LRT trains every 2 min and 4 seconds.

These numbers of transit vehicles presented only cater to the OC Transpo long-range demand on the main east-west corridor through the downtown on the Albert/Slater corridor. They do not include passengers served on local OC Transpo routes or STO passengers entering the downtown from Gatineau.

4.3.2. 2031 STO Service Levels

The total population and employment in the National Capital Region is split across the Ottawa River with approximately 75% of the population and 80 % of the employment located in Ottawa. The close proximity of the central areas of the two cities, and the distribution of federal government employment as well as general employment services, requires large volumes of people moving into and out of the combined central areas during peak hours. Based on the distribution of employment across the region, larger portions of the Gatineau population base travel to Ottawa than the reverse. However, jurisdictional arrangements, with Ottawa and Gatineau being in different provinces, have limited the options to fully integrate transit services. Consequently, OC Transpo and the STO have historically organized their services to ensure their customers are not unduly inconvenienced as they travel to locations on either side of the Ottawa River. As a result, the majority (~75%) of STO passengers arriving at Place du Portage in Hull continue through into Ottawa's downtown along Wellington Street via the Portage Bridge. STO transit services are currently provided with approximately 120 standard 40-foot buses during the peak hour, typically serving more than 4,400 passengers. OC Transpo conversely provides service into Hull's CBD across the Chaudière and Portage Bridges.

As the STO's 'Rapibus' system develops more fully in the future, the requirement to operate additional buses connecting the Gatineau sector with downtown Ottawa along Wellington Street is expected. Assuming the current operating strategy of 75% of STO passengers continuing their journey into Ottawa's central core remains in place, future interprovincial travel demands of 8,500 a.m. peak hour passengers will require the equivalent of 252 standard 40-foot buses (one every 16 seconds); or 162 articulated buses (one every 22 seconds); or 95 double-deck or double-articulated buses (one every 38 seconds) to provide the service level necessary to accommodate this ridership.

Further detail about the vehicle numbers and frequency required to accommodate the detailed volumes can be found in Appendix D.

5. Alternatives for Serving the Downtown

The previous chapter identifies the a.m. peak hour number of transit vehicles required (bus and rail) and their associated service frequencies to accommodate the forecast long-term rapid transit ridership demands in downtown Ottawa. The next step in developing a downtown transit solution is to assess a range of alternatives to provide the necessary capacity to meet these service levels. The range of alternatives includes:

- Maintaining all rapid transit service on the surface streets;
- Fully grade-separating all rapid transit services; or
- Combinations of surface and grade-separated rapid transit services.

A discussion of each of these families of alternatives follows. For the purposes of developing the downtown transit solution, only OC Transpo services are considered. The implications of accommodating STO ridership are considered later in this report.

5.1. Technologies Considered

This report has considered a certain range of rapid transit bus and rail technologies able to accommodate the 2031 and longer demands on the primary rapid transit network feeding in to and out of the downtown. The range of technologies considered for this TMP is intended to be functional rather than related to any specific vehicle design or manufacturer. However, certain generic vehicle types based on specific characteristics have been assumed in developing both capital and operating costs. The determination of the exact vehicle specifications and manufacturer will be left to the more detailed project design and procurement stages.

This report uses the generic term “BRT” to describe the bus vehicle and “LRT” to describe the rail vehicle. The functional characteristics assumed for both vehicle types are outlined below.

5.1.1. Characteristics of the Generic BRT Vehicle

For the purposes of supporting the primary rapid transit network options, the generic BRT vehicle should be capable of:

- Carrying a large number of passengers, indicating that it will be classified as a high capacity vehicle and could be articulated, double-articulated, or double-decked; and,
- Operating in an underground environment, implying dual-mode operation or substantial ventilation of the tunnel.

The use of 18m articulated hybrid diesel-electric buses for has been assumed for this report for bus alternatives with the buses operating in the electric mode in any tunnel scenario.

5.1.2. Characteristics of the Generic LRT Vehicle

There are various definitions of Light Rail Transit (LRT) and many LRT systems around the world having a multitude of design parameters. Examples range from the earlier Calgary and Edmonton systems to the newer Houston and Minnesota systems, and from the Toronto Transit Commission’s (TTC) Scarborough Rapid Transit to Vancouver’s Skytrain – which some might label as LRT but others might call mini metros.

The Transportation Research Board (TRB) in the USA defines LRT as:

> *"A metropolitan electric railway system characterized by its ability to operate single cars or short trains along exclusive rights-of-way at ground level, on aerial structures, in subways or, occasionally, in streets, and to board and discharge passengers at track or car-floor level"*

The American Public Transit Association's (APTA) Glossary of Transit Terminology defines LRT as:

> *"An electric railway with a "light volume" traffic capacity compared to heavy rail. Light rail may use shared or exclusive rights-of-way, high or low platform loading and multi-car trains or single cars."*

For the purposes of supporting the primary rapid transit network options in Ottawa, the generic LRT vehicle should be capable of:

- Single unit operation;
- Multiple unit operation;
- Operating on tracks designed to the Transitway geometry; namely:
  - Minimum curve radius of 150 metres
  - Maximum grade of 6%
- Operating in an underground environment; requiring:
  - Electric traction power
- Providing accessibility for the disabled.

In addition, for flexibility for the future and the ability to minimize costs, the LRT should be capable of:

- Median operation along suburban or secondary corridors; and
- Operating over level crossings.

For the purposes of capital and operating costs in this report, LRT Vehicles:

- Can be coupled for multiple unit operation when required; and
- Operate with overhead electrical power pick-up for electrified territory to allow for median operation and level crossings.

The use of 28m electric articulated LRT has been assumed for the purposes of costing in this report. The assumed vehicle would be capable of operating as a single unit or in trains, has low floor for accessibility and has overhead power pick up.

5.1.3. Metro (or Subway)

Metros are the highest form of urban public transport. The International Association for Public Transport (UITP) defines Metros as follows:

> *"Metropolitan railways are urban, electric transport systems with high capacity and a high frequency of service. Metros are totally independent from other traffic, road or pedestrians. They are consequently designed in tunnel, viaducts or on surface level but with physical separation. Metropolitan railways are the optimal public transport mode for a high capacity line or network service. Some systems run on rubber-tyres but are based on the same control-command principles as steel-wheel systems. In different parts of the world metro systems are also known as the underground, subway or tube."*

A traditional heavy rail metro (or subway) can carry up to 30,000 passengers per hour which is considerably more than any future scenario would suggest is required for the city of Ottawa. In addition Metros generally utilize ground level high voltage power pick-up (third-rail) and for that reason their corridors have to be physically protected from any encroachment by pedestrians or other vehicles. The larger vehicles tend to have more restrictions than LRT with respect to grade, turning radius and the flexibility to operate as individual vehicles.

For the above reasons, a heavy rail metro system has not been considered for the Ottawa base rapid transit network.

5.2. Options for Providing All Rapid Transit Service on the Surface

The following surface options are under consideration for the downtown transit solution:

- Bus-only;
- LRT-only; and
- Combination of bus and LRT.

This section provides an overview of the likely implications of using the existing surface streets for each of these options.

Despite the fact that six major arterial roads cross downtown Ottawa, the range of on-street options to provide high-quality rapid transit service is constrained by local geographic conditions. The escarpment to the west of downtown presents a physical barrier limiting direct connections from the West Transitway into the downtown. Similarly, to the east there are a limited number of crossings of the Rideau Canal that directly connect to the East Transitway. Also, street widths and block lengths dictate the physical space available for transit lanes and station platforms.

All surface options must consider the influences of downtown traffic operations, pedestrian and cycling needs and the requirement to provide parking, loading and access to the businesses adjacent to the corridors under consideration. It is assumed that a sufficient number of bypass routes to carry customers who are travelling between points that are not within the downtown are in operation, and that the Smartcard fare payment and real-time passenger information systems are in place to optimize passenger boarding operations.

5.2.1. Bus-Only Surface Option

In their present configuration, Albert & Slater Streets are theoretically capable of accommodating no more than 195 buses per hour. Since 2004 OC Transpo has operated a maximum of 180 trips per hour in the afternoon using a mixture of standard and high capacity articulated buses to maintain service reliability. The proportion of the buses that are articulated ranges from 20% to 33% depending on the direction and time of day. The photo below illustrates the typical nature of current operations on Albert and Slater Streets. While theoretically the 180 bus per hour limit does not apply in the a.m. when passenger service time at the platforms is shorter, it is being used for this analysis as the practical maximum capacity for a single dedicated bus-only rapid transit lane on the surface. It is also assumed that 30% of the current bus fleet is articulated.

The City has investigated ways and means to optimize bus operations on the Central Transitway several times in the last 5 years. In September 2004, responding to severe delays to service that developed during 2003/04, OC Transpo modified their services in the afternoon to reduce the number of eastbound buses from over 200 to fewer than 180. More recently, as a condition of approval of the North-South Corridor LRT project recommended plan, City Council directed staff to ensure that a minimum of 30% of bus traffic be removed from Albert and Slater Streets by 2009. In November 2005 Council approved a service design concept that met this objective. With the cancellation of the LRT project, this operating plan was not put into effect. However, with transit ridership continuing to grow by approximately three percent per year, and recognizing that it would take several years to implement any major rapid transit project in the downtown, it was necessary to develop a strategy to accommodate the continuing ridership growth without exceeding the physical capacity of the Central Transitway. Accordingly in May 2007 City Council received the staff report "*Downtown Transit Operating Strategies 2007 – 2010*" which identified some projects and actions to be implemented in the near-term and discussed long-term measures to maintain current bus volumes beyond 2010.

The development of the 2009 service design and the 2007-2010 operating strategy considered a common set of measures which included:

- Consolidating direct to downtown express routes to reduce the total number of routes operating in the downtown;
- Further use of other downtown streets;
- Increasing use of high-capacity buses; and

- Implementing other possible rapid transit projects to improve the balance of eastbound and westbound flows.

Each of these measures has opportunities and constraints that affect their feasibility.

Capacity of the Corridor

It is important to determine the theoretical ultimate design capacity of the Albert/Slater Street corridor before assessing the need for, and viability to implement any one or combination of the above-noted measures to meet the forecast 2031 downtown transit demand. Due to the mixed operation of standard and articulated buses, the current capacity of the Albert/Slater corridor must be expressed in terms of an equivalent number of standard 40-foot buses. Assuming a 30% mix of articulated buses, this number is calculated as follows:

- 30% of 180 buses are articulated = 54 articulated buses
- At a design capacity of 70 passengers per articulated bus, the 54 buses have a capacity of 3,780 people.
- The remaining 126 standard buses have a design capacity of 45 passengers each and can carry a total of 5,670 people.
- Thus, the total of 9,450 people can be carried on the equivalent of 210 standard buses (45 passengers per bus).

Thus, the theoretical design capacity of the Albert/Slater corridors is 210 standard buses per direction. Clearly, this number falls significantly short of the 347 standard buses required for the future (refer to Table 4.3). However, assuming that the total number of 180 buses can be maintained, increasing the percentage of bus trips operated with articulated buses will result in the following potential capacities:

Percentage of Articulated Buses	Number of Articulated	Number of Standard	Passenger Capacity	Total Equivalent Standard Buses
50%	90	90	10,350	230
75%	135	45	11,475	255
100%	180	0	12,600	280

Therefore it is shown that even using 100% articulated buses, the Albert/Slater corridor does not have sufficient capacity to carry the forecast 2031 downtown rapid transit demand. Therefore any bus-only surface option must consider the following additional measures to provide the remaining required capacity.

Consolidating Express Routes

The provision of direct to downtown rapid transit service has contributed significantly to the high ridership on the OC Transpo system. However, as ridership continues to grow, a reduction in the total number of individual routes serving the downtown will be required to optimize the use of the existing capacity of the Central Area Transitway. Accordingly, this measure would see the number of express routes serving the downtown reduced. New higher frequency express routes serving a larger area and likely using articulated buses would replace a small group of express routes that currently serve several neighbourhoods. The impacts of this measure include:

- The higher frequency routes result in less waiting time for passengers at the central area stops in the afternoon. This means there is less accumulation of passengers and, as a result, less congestion on the platforms;

- The more routes there are in a corridor, the more difficult it can be to balance the number of customers with the optimum frequencies for each route. With fewer routes, there will be better balance and a more productive use of service. This could result in fewer buses being required; and
- To access the consolidated routes in the suburban neighbourhoods, many customers will have a longer walk. In addition, some customers may have to transfer from a local service to reach the new route. Both of these will result in an increased travel time for these customers compared with their current service.

Use of Other Downtown Streets

This measure considers the potential for other downtown streets such as Wellington Street, Queen Street, and Laurier Avenue to accommodate rapid transit bus services. Sparks Street is not considered because of its current configuration as a pedestrian mall and the unlikelihood of changing its configuration in the future. Also, streets to the south of Laurier Avenue are not considered for additional bus operations because they are too far south of the primary downtown transit demand and the streets are generally narrower and more residential in character.

During the development of the 2009 service design concept, the analysis of alternatives for diverting buses from Albert and Slater Streets to Wellington, Queen, or Laurier resulted in the following conclusions:

- Wellington Street can not accommodate any additional buses in the westbound direction, and only a small number of buses in the eastbound direction;
- Queen Street could accommodate at most 20 buses per hour in the westbound direction and 30 buses per hour in the eastbound direction;
- Laurier Avenue could accommodate at most 20 buses per hour in the westbound direction and 15 to 20 buses in the eastbound direction;
- Intersection and turning movement issues must be addressed at each end of each of the streets for any of the alternatives.

Subsequent work associated with the development of the 2007 – 2010 operating strategy identified that a maximum total of 25 bus trips in the afternoon peak hour could be diverted to the combination of Wellington and Queen Streets. In light of this, it is estimated that diverting bus routes to other streets would result in a net capacity increase of the Central Area Transitway of about 45 buses per hour (25 on Wellington/Queen plus 20 on Laurier).

The 45 buses identified could offer between 45 standard equivalents, if all the buses were standard length,, and 70 standard equivalents if all of the buses were articulated. If 100% of the buses on Albert/Slater were articulated and all of the buses using neighbouring streets were also articulated, the resulting 350 standard bus equivalents could, theoretically, just accommodate the required future passenger demand calculated in Chapter 4. However, it is not reasonable to suggest that all of the buses operating could be articulated for the following reasons:

- While the current bus operation can reliably accommodate passenger boarding and alighting of three buses during each 55 to 60 second cycle, it is unclear if three articulated buses could do this. This is because the third articulated bus at the platform would be the same distance back from the bus stop as a fourth standard length bus is in today's operation. It is usually the case today that the fourth bus has to stop a second time at the platform, most often at the bus stop. Even with advanced information systems to inform customers about where buses would be stopping, it is unclear that every bus that is third in line would be able to clear the platform with only one stop.

Operating rules that only allowed one stop would address this, but could not be considered as customer friendly.

- On the neighbouring streets, most of the buses will have to move around corners such as Queen and Elgin or Lyon and Albert to get to or from the primary rapid transit corridor. These movements will require additional time for articulated buses compared with standard buses, and it is not certain that this additional time can be accommodated within the available capacity of the intersections and street network.

Based on these points, it is reasonable to suggest that perhaps no more than 50% to 75% of the Albert/Slater buses and approximately 50% of the neighbouring street buses could be articulated. This would result in between 287 and 312 standard bus equivalents being able to be accommodated, which does not meet the forecast 2031 demand of 347 equivalent standard buses.

Caution should be exercised in considering adjustments to these calculations to demonstrate that the future passenger demand can be met by some combination of these vehicles and routings. This is because the analysis is looking at the upper end of the operating capacity of the streets. Everything on the streets must work smoothly for this level of bus operation to be successful. For example, schedules must be smoothly balanced to prevent peak within the peak bus volumes, technology must be present to indicate where on the platforms buses will stop, off-board fare collection would need to be operational, traffic signals would need to provide smooth progression designed around bus operations, no buses can stop more than once at a platform, and there can be no interference from general traffic. In reality, it will be nearly impossible to achieve all of these elements consistently.

Also, the introduction of rapid transit operations onto new streets would result in major impacts to existing street operations, including: effects on pedestrian facilities due to the loss of sidewalk space to bus platforms; the loss of parking and loading zones; and additional congestion brought about by the lack of intersection capacity to accommodate the volume of buses turning to or from the streets. Additional considerations associated with the use of other streets include:

- Diverted buses would have increased travel time compared with those buses operating on Albert and Slater Streets ;
- Bus turning movements would bring some key intersections closer to their operational capacity resulting in potential bottlenecks;
- With rapid transit routes operating on a variety of downtown streets, there would be less connectivity with the rest of the Transitway; and
- Some or all of the buses routed to other streets must re-converge onto the Mackenzie King bridge to cross the Rideau Canal. This situation would not address the current congestion on the Mackenzie King bridge and at Laurier Station, which could develop into bottlenecks in the transitway system.

As many intersections in downtown Ottawa are currently operating at their practical capacity in peak hours due to the combination of high traffic volumes, large numbers of turning vehicles and large pedestrian movements, it can take more than one “green” phase to advance through an intersection, which affects the reliability of rapid transit operations. Therefore, even with the use of additional downtown streets, it would not be possible to reliably operate a sufficient volume of additional transit vehicles to accommodate the forecast 2031transit demand.

Increasing use of High Capacity Buses

To address the deficiencies noted above, consideration could be given to reduce or possibly eliminate articulated buses for rapid transit use in the Central Area and replace them with high capacity double-deck or double-articulated buses. These vehicles have a practical design capacity of 90 customers compared with 70 for articulated buses. Double articulated vehicles will not likely solve this deficiency because they do not add any capacity relative to their length – their primary advantage is a lower operating cost per passenger because one operator can serve more people.

Double-deck buses do offer higher capacity relative to length because of the large number of seats on the upper floor of the vehicle. However, with only two doors to accommodate boarding and alighting and a question whether or not buses will be allowed to be in motion with customers on the stairs, it is likely that the boarding times may be slightly higher. This in turn raises questions about the feasibility of operating three double-deck buses successfully and reliably through every signal cycle. This suggests that it may not be feasible to operate 180 double-deck buses successfully. If it is assumed that 75% of this amount could be successfully operated, then the resulting 135 vehicles would represent 270 standard bus equivalents. Combined with the standard bus equivalents from the neighbouring streets if all 45 were double-deck vehicles, then 340 standard equivalents could be accommodated. While it comes close, this number of standard bus equivalents would not meet the 2031 planning horizon year requirements. Other considerations include:

- The current strategy of using high capacity buses to accommodate future ridership growth can limit bus volume increases in the short-term;
- Restricting the use of the Central Area Transitway to high capacity buses would be most effective in increasing passenger capacity if the number of routes were reduced by significantly increasing line-haul feeder service and consolidating express routes. This service design, however, would increase the requirement for transfers, increase walking distances and increase operating costs; and
- If high capacity buses were used without changes to the service design, route frequencies would be reduced resulting in less attractive service for customers;
- Operating 100% high capacity buses would increase the “wall” effect on Albert and Slater that is already of concern to neighbouring businesses and property owners. All articulated buses would create a longer wall than today’s operations while double-deck buses would be taller and create more of a canyon effect. Neither of these results are expected to be acceptable to the neighbouring businesses and property owners;
- Continuing to operate this volume of buses will not allow for any significant change to the on street environment. Sidewalk and platform space would not see any significant improvement and would, in fact, become more congested as passenger volumes grow; and
- The other aspect of the on-street environment relates to noise and air quality. While transitioning the vehicle fleet to diesel hybrid technology and eventually fuel cells or other technology will certainly improve air quality, the current hybrid vehicles are not significantly quieter. It is not certain that the vehicles will get quieter in the future.

It is clear from the above points that trying to accommodate all of the demand on the surface using high capacity buses is not a practically achievable solution.

Other Possible Projects

This heading groups together a number of measures to increase the potential capacity of the Albert/Slater Street corridor. These include designating an additional bus-only lane on each street in order to increase potential capacity, adding stops on those blocks that don't currently have them, and dedicating the Mackenzie King Bridge for transit only. Additional stops and additional lane capacity for rapid transit service would be the result.

While the provision of an additional bus-only lane on each of Albert and Slater Streets would suggest a theoretical doubling of bus volume capacity, weaving requirements and operational considerations with all of the buses having to get to the curb in station areas would almost eliminate any benefit of having two lanes of buses. Other considerations include:

- Increased bus volumes would not be acceptable to adjacent landowners and businesses;
- The requirement for platform space in the blocks not currently used could be physically difficult and has been unacceptable to adjacent landowners[5];
- The closure of the Mackenzie King Bridge to general traffic is unpopular with downtown businesses and would constrain vehicle access to one less crossing of the Rideau Canal,
- The remaining single lane for regular traffic would be insufficient to provide for existing truck delivery requirements and general traffic volume (e.g. 1,000 vehicles per hour on Slater); and
- Traffic diversion to other streets might result in operational bottlenecks at other locations.

While it would not be expected that any one single measure could provide the required capacity to accommodate 2031 ridership demand, the analysis shows that even combining all of the above-noted measures (without taking into account the added negative impacts to on-street function) does not offer sufficient long-term capacity.

The suggestion to increase capacity on Albert and Slater Streets and on the Mackenzie King Bridge by dedicating a second bus-only lane for transit and increasing the number of stops would have unfavourable traffic impacts and would create an on-street environment that would be unattractive for pedestrians and unacceptable to the adjacent businesses and property owners. Clearly the bus-only surface option would only exacerbate the present negative impacts of transit operation on downtown streets and is not an acceptable downtown transit solution.

5.2.2. LRT-Only Surface Option

To accommodate all of the Central Area rapid transit requirements in 2031, it is estimated that a single LRT vehicle operating every 0.6 minutes will be required. This frequency is too high for practical rail operation and can be addressed by linking LRT vehicles together. An operating frequency of approximately every 2-2.5 minutes is the minimum for practical rail operation, which would necessitate trains comprised of four vehicles linked together to carry the projected 2031 ridership. This results in a train length of 120 metres. The platforms necessary to accommodate these train lengths would have significant negative impacts on adjacent properties by blocking lanes and garage entrances. The findings of the North-South Corridor LRT project EA study showed that a two-vehicle train with a required platform length of 60 metres was the practical maximum that could be accommodated without having to consider the closure of adjacent property accesses. This was sufficient to accommodate the forecast North-South Corridor LRT ridership but will not accommodate the total required 2031 ridership (4 car trains required).

[5] It should be noted, however, that there were stops on every block along Albert and Slater Streets during the 1970s and 1980s.

Thus, accommodating all of the 2031 transit demand on the surface with LRT in a single corridor is not possible. The blocks on Albert and Slater Streets have enough property access requirements that they can not accommodate the length of trains necessary at the minimum practical operating frequency. Consequently, an additional LRT-only surface corridor would be required to accommodate the long-term transit demand, which would disrupt operations on that street and due to the expense not be a cost-effective solution.

Therefore the LRT-only surface option is not an acceptable downtown transit solution.

5.2.3. Combined Bus and LRT Surface Option

The concept of a combined bus and LRT operation was examined in detail during the North-South Corridor LRT project EA study. Two families of alignments for LRT service within the Albert/Slater Corridor were developed:

1. Operating two directions of LRT service on one of the streets and two directions of BRT service on the other street.
2. Operating one direction of LRT and BRT on each of the streets.

The resulting assessment concluded that the operation of one direction of LRT and BRT service on each of Albert and Slater Streets was the only safe and feasible option. Based on this analysis a preliminary preferred plan was developed. It maintained the existing right-side parking/loading, Transitway, and general traffic lanes as is, and dedicated the left-side lane being as an LRT-only lane. This concept was rejected based on the feedback received through public and stakeholder consultation, as it would have resulted in significant impacts to the businesses along each street due to the loss of the left-hand curb lane for parking, loading, delivery and taxi zones on both streets. As a result, a revised plan was developed that incorporated both LRT and BRT operations in the existing transitway lane. The LRT platforms would extend out to this lane for the boarding of passengers, while buses would move into the curb lane to pick up passengers and allow Light Rail vehicles to pass. Under this plan, all building accesses were maintained and over 92% of the existing total length of parking, loading, taxi, and hotel drop-off areas were to be retained, as well as all existing turning movements. This concept was approved by City Council on 15 July 2005 as the EA recommended plan.

It was determined during the EA that operating 20 two vehicle LRT trains and up to 180 buses on Albert or Slater Streets during the peak hour was feasible. Despite this, due to concerns related to the reliability of the combined LRT/BRT operation, Council directed staff to reduce by 30% the number of buses operating on these streets. When the two-vehicle train limitation is taken into consideration, it is clear that this amount of service would not accommodate the transit demand being forecast for the 2031 planning horizon.

To address this level of future demand on the surface with a mixed LRT and bus option, it would be necessary to either consider some form of a two transit lane option on each of Albert and Slater Streets and the Mackenzie King Bridge, or use additional streets for rapid transit operations. The first scenario would be similar to the two-lane bus-only arrangements discussed previously in this section. As that scenario is considered to create an unattractive urban environment and be unacceptable to the adjacent businesses and property owners, it is reasonable to assume that operating both modes in a similar fashion would also be unattractive and unacceptable. The second scenario would not provide sufficient additional capacity to accommodate the long term demand using buses only, and would not be cost effective if implemented as LRT-only or as a mixed mode operation.

Thus a combined bus and LRT surface option is not an acceptable downtown transit solution.

5.2.4. Conclusions

It has been shown that it is not possible to develop an acceptable bus-only surface operation as the options considered to meet the 2031 transit ridership demand, would be no more reliable than their current operation and would result in increased downtown transit congestion, noise and harmful emissions over and above that which is experienced today. An LRT-only surface operation would require an additional corridor with dedicated rail transit, which would be disruptive to operations on that street and not be cost effective to implement. Combined bus and LRT options would similarly require more than one corridor to accommodate the 2031 transit demand. Implementing any surface-only solution would result in lost opportunities to significantly improve the street-level pedestrian and urban environment, and not meet the expectations of local business and property owners or the general public.

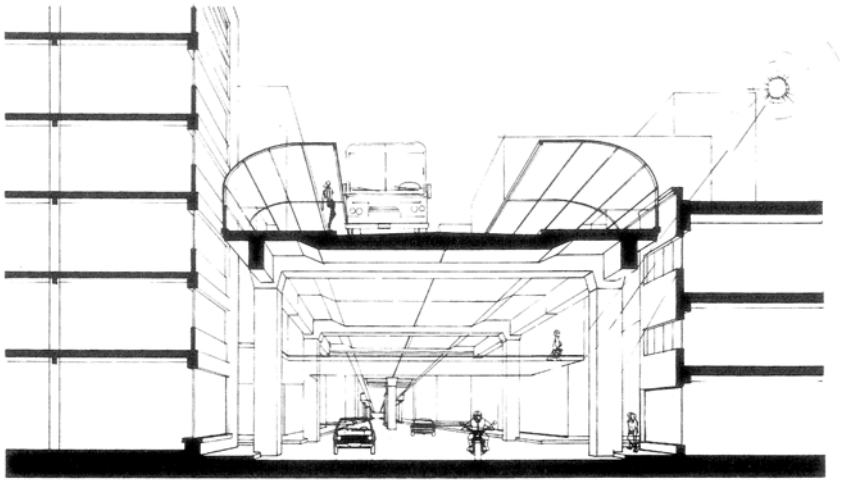
Based on the foregoing assessment, there is no acceptable surface-only downtown transit solution to accommodate the projected level of transit passenger demand on the Central Area Transitway in 2031. If STO ridership demand is considered in this analysis, then it is even clearer that surface-only options are impractical for the future. Therefore some, or all, of this service has to be accommodated either above ground or in one or more tunnels underground.

5.3. Elevated Options

Elevated rapid transit options, similar to the Skytrain in Vancouver, the Scarborough LRT line in Toronto, or the Docklands Light Railway in the UK could be considered as a potential solution in downtown Ottawa. Elevated systems are similar in cost to underground installations but can be considered where underground conditions are poor, where the appropriate corridors have enough room so that the elevated guideway does not overpower the ambiance of the corridor and when the climate is amenable.

An elevated option for downtown was considered in the 1988 “Central Area Transitway Grade Separation Feasibility Study”. A preferred option was developed and compared with a tunnel solution. The Transitway would have been elevated approximately 10 m above Slater Street, supported by a two-column pier bent structure (See Figure 5.1). This structural configuration is necessary in station areas due to the width of the cross section, and was used for the full length of the street to avoid underground utility conflicts. At the stations, pedestrian underpasses would be provided at 6m level for passengers crossing from the south to north of the street. Slater Street would have been reduced from four to three traffic lanes to accommodate the structural columns.

Figure 5.1: Proposed Elevated Transitway



The elevated option was not recommended due to the major aesthetic and physical impacts it would introduce into the downtown urban environment. Any currently contemplated elevated option would result in similar impacts. An elevated facility would:

- Create a formidable visual barrier through the heart of the downtown;
- Require significant and costly modifications to integrate into adjacent buildings;
- Result in the reduction of direct sunlight to street level and the lower floors of adjacent buildings;
- Require significant utility relocations to accommodate structural foundations;
- Constrain access by emergency vehicles along the corridor;
- Negatively impact open spaces it crosses along the corridor;
- Negatively impact heritage buildings adjacent to corridor;
- Require expensive snow-removal operations, or a covered system;
- Restrict the use of heavy construction equipment/cranes within the corridor; and,
- Have higher long-term life-cycle costs due to exposure of the system to the elements.

For these reasons an elevated facility is not an acceptable downtown transit solution, and therefore only underground tunnel options are being considered for further study.

5.4. Tunnel Options

Having determined that a tunnel-based option is required to provide the necessary transit service levels to accommodate the long-term downtown ridership demands, the next step is to consider the range of transit technologies that may be incorporated underground. Similar to the surface-only options, these include:

- Bus-only;
- LRT-only; and,
- Combination of bus and LRT.

Regardless of the technology chosen, a downtown transit tunnel would resolve many of the current surface operating problems encountered today, as it would:

- Allow unconstrained flow through the downtown as signalized intersection conflicts no longer exist;
- Allow for a fare paid zone to be created in the station eliminating the need for front door entry and on-board fare payment;
- Provide a weather-protected environment for passengers;
- Provide adequate space for passenger queuing at station platforms to assist with boarding;
- Allow for arriving vehicles to be announced in advance to allow passengers to position themselves appropriately[6];
- Allow for future growth on the system beyond the 2031 planning horizon by constructing station platforms sized to accommodate six-car trains; and,
- Improve transit accessibility by directly integrating into adjacent buildings and businesses.

Furthermore, implementing transit services within a downtown transit tunnel would permit the urban renewal of Albert and Slater Streets; provide a spur to the redevelopment of property parcels adjacent to the corridor; and, introduce other economic development opportunities such as underground shops and businesses. Some specific benefits include:

- An enhanced pedestrian environment with widened sidewalks, more trees and enhanced streetscaping features;
- An opportunity to introduce outdoor shops and café's as well as public art to enhance the street side ambiance;
- An opportunity to incorporate dedicated bicycle lanes in the corridor;
- More parking, loading, delivery and access opportunities to support adjacent business operations;
- Improved pedestrian, cycle and vehicular traffic operations at signalized intersections;
- Less congestion and noise; and,
- Reallocation of the transit-only lane to general vehicular traffic on the Mackenzie King bridge.

The 1988 "Central Area Transitway Grade-Separation Feasibility Study" concluded that twin deep bus tunnels under the downtown would eventually be required to respond to the growing transit service requirements of the City. The western tunnel entrance (portal) would be in the vicinity of the Escarpment immediately west of downtown, with the eastern portal located on the existing Transitway alignment south of Laurier Avenue in the vicinity of Campus Station. The final study report identified key station locations (Rideau Centre, Metcalfe, Bank and Lyon) to service the downtown. (These same locations were confirmed in the 2005 North-South Corridor LRT Project EA and reflect approximately current surface transit stop locations on Albert and Slater Streets.) The station and tunnel configurations were planned where feasible within the road right of way. Albert and Slater Streets were identified as an appropriate tunnel corridor location because station and tunnel configurations are feasible within the road right of way and the adjacent developments generate transit riders. The twin tunnels would be drilled through the bedrock using tunnel-

[6] This is done on Market Street in San Francisco. Dynamic signs are used to indicate the composition of the arriving train so that passengers can queue for the car or cars that are going to their ultimate destination. This speeds boarding and reduces the number of passengers scrambling on the platform when vehicles arrive.

boring machines, and a combination of open-cut and/or standard mining techniques would be used to construct the stations.

Similar basic design concepts were used to develop the different tunnel options for this study. To address air quality concerns it is assumed that minimal emission buses, such as hybrid-electric, will be used for bus operations in a tunnel. Conceptual alignments, profiles and cross-sections are included in Appendix E. The exact location and design details will be developed through an environmental assessment. The following sections describe each option in more detail.

5.4.1. Bus-Only Tunnel

Each of the twin tunnels would incorporate a two-lane cross-section comprised of through and passing lanes within and outside the station areas. This provides an opportunity for buses to pass any disabled vehicle in the tunnel. Without the passing lane, the tunnel would be blocked until a service vehicle could remove the bus. This is considered an unacceptable risk, as it would cause a major disruption to rapid transit operations downtown, and potentially throughout the entire system[7]. A 10m diameter tunnel bore will accommodate the two lanes per tunnel, with open-cut techniques used at the tunnel portal locations. The tunnels would be located sufficiently deep under the street right-of-way to minimize impacts on existing utilities and avoid disruptions to surface operations during construction.

A centre-island configuration would be used for the station platforms. Advantages of this configuration include the centralization of passenger amenities, interconnectivity of platforms and shared access facilities to the surface. For bus technology to take advantage of a centre island platform, a contra flow network is required. This is accommodated by crossing each tunnel over before reaching the tunnel portal locations.

5.4.2. LRT-Only Tunnel

The LRT tunnel would incorporate a single track per direction throughout its length, including through the station areas. The rationale for a single-track tunnel is that if a train breaks down in the tunnel area the next train can physically push it through the tunnel to a siding beyond the tunnel portal. A 6.0m diameter tunnel bore will accommodate a single rail and required safety/maintenance walk. The tunnels would be located sufficiently deep under the street right-of-way to minimize impacts on existing utilities and avoid disruptions to surface operations during construction.

Since LRT vehicles have doors on both sides, a centre island platform configuration would again be used at the LRT stations. The advantages of this configuration include; the centralization of passenger amenities, interconnectivity of platforms and shared access facilities to the surface. Since trains have access from both sides, a cross-over of the tunnels to produce contra flow is not required as it would be for the BRT Tunnel Option discussed above.

5.4.3. Combined Bus/LRT Tunnel

Similar to the bus-only option, a combined bus/LRT tunnel would incorporate a two-lane cross-section to provide a bus passing lane inside and outside of the station area. This is required so that a bus can pass any broken down bus in the bus lane. If a train breaks down, the next train can push it through the station on its lane to a siding outside the tunnel. A 10m diameter tunnel would accommodate the two lanes. The tunnels would be located sufficiently deep under the street right-of-way to minimize impacts on existing utilities and avoid disruptions to surface operations during construction.

[7] The typical operation to remove a disabled bus in a one-lane tunnel would require the tow vehicle to wait until the in-service vehicles in front of the disabled vehicle have exited the tunnel before the tow-vehicle backs into the tunnel to remove the bus from its front end.

A centre island platform configuration would be used for the LRT, and a side platform used for the buses in the stations. This configuration takes advantage of the LRT's versatility and eliminates the cross over and contra flow bus requirement. To accommodate bus passing requirements in the stations, the LRT and bus platforms will be staggered by about 20m. This will provide 20m of clear lane between the platforms so that a bus can manoeuvre past a bus or train stopped at the end of their platform.

5.5. Combined Surface/Tunnel Options

The following options are a combination of the surface and tunnel options, and arise from the practical reality that a single solution may not address all needs. In these options, one technology would be located on street and the other in a tunnel. The approach in this section is to look at the ultimate configuration and work back to practical options that can be developed to address intermediate stages.

There are two main options:

- LRT is installed on-street and a bus-only tunnel is constructed; or,
- Buses operate on-street and the tunnel is dedicated to LRT.

The stated goal of the ultimate network is to provide a high quality, urban rapid transit system which will support the downtown and the predicted future transit volumes.

5.5.1. LRT on Street and Buses in a Tunnel

In this option, a new bus-only tunnel would be built across downtown to carry buses, and Albert and Slater Streets would be reconfigured to accommodate an on-street LRT. This would require the construction of the tunnel and modifications on each street to install the tracks, overhead catenary systems to operate LRT and modification of the existing stop locations.

The two systems would likely have to operate in parallel for some distance beyond the downtown, and at the ends of the dual system segment there would need to be some form of interconnection. In the west, the segment through LeBreton Flats would need to accommodate both as far as one of the following points:

- LRT diverges from the Transitway and turns south towards Barrhaven, or diverges both north and south from the Transitway with branches that serve the southern area to Barrhaven and the northern area in Gatineau; or,
- The LRT reaches a temporary terminal west of Bayview Station; or,
- The LRT reaches a western terminal which balances the service.

At some point in the future, the LRT will extend far enough west that the majority of passengers can be transferred onto the train and the parallel BRT service can be eliminated.

5.5.2. BRT on Street and LRT in a Tunnel

In this option, a tunnel would be built to accommodate LRT, and the current Transitway infrastructure on Albert and Slater would remain in use, but for a smaller number of buses. This option could:

- Relieve pressure from on street operations;
- Not require modifications to the on street facilities;

- Allow a flexible response to STO services and some OC Transpo services by allowing them to operate through downtown on-street;
- Allow a combination of bus and LRT corridors to be developed outside the downtown core, which would both have direct access to the core; and
- Requires a smaller set of twin tunnels to accommodate two single tracks.

5.5.3. Conclusion

Both of the options that combine tunnel and surface operations require an extensive financial investment in the implementation of the tunnel component. As such, maximizing the use of the tunnel will improve the return on that investment. Since the analysis has shown that a tunnel alternative can provide the necessary capacity to fully accommodate the City's 2031 transit demand, a combined surface/tunnel option is not recommended as the downtown rapid transit solution.

Since any conversion of the Transitway to rail associated with the construction of an LRT-only tunnel is a major undertaking, the operation of LRT in tunnel with reduced on-street bus service may be considered as a possible primary rapid transit network staging option for the downtown.

5.6. Recommendations

The single-use and combined tunnel options described herein have the potential to provide the service required to support the transit network and, therefore, may be considered as acceptable downtown transit solutions. Each will be carried forward to be considered in the primary rapid transit network options.

6. Primary Rapid Transit Network Options

With both single-use and combined-use tunnel options identified as possible downtown transit solutions, a number of primary rapid transit network options, each incorporating a tunnel, have been developed. These options will be evaluated to determine the most appropriate long-range rapid transit network and technology to serve Ottawa.

Using the 2003 TMP Rapid Transit Network plan (Appendix B) as a starting point, the corridors identified for consideration in the primary network are shown in Figure 6.1. This plan illustrates the key future rapid transit corridor network made up of existing corridors (solid) and possible future extensions (dashed). Depending on the network options being tested, these corridors could either be LRT, BRT, or both LRT and BRT.

The broad grey arrows in the background represent other possible rapid transit corridors for the future which will be further tested later in the development of the Transportation Master Plan once the appropriate primary transit network is determined.

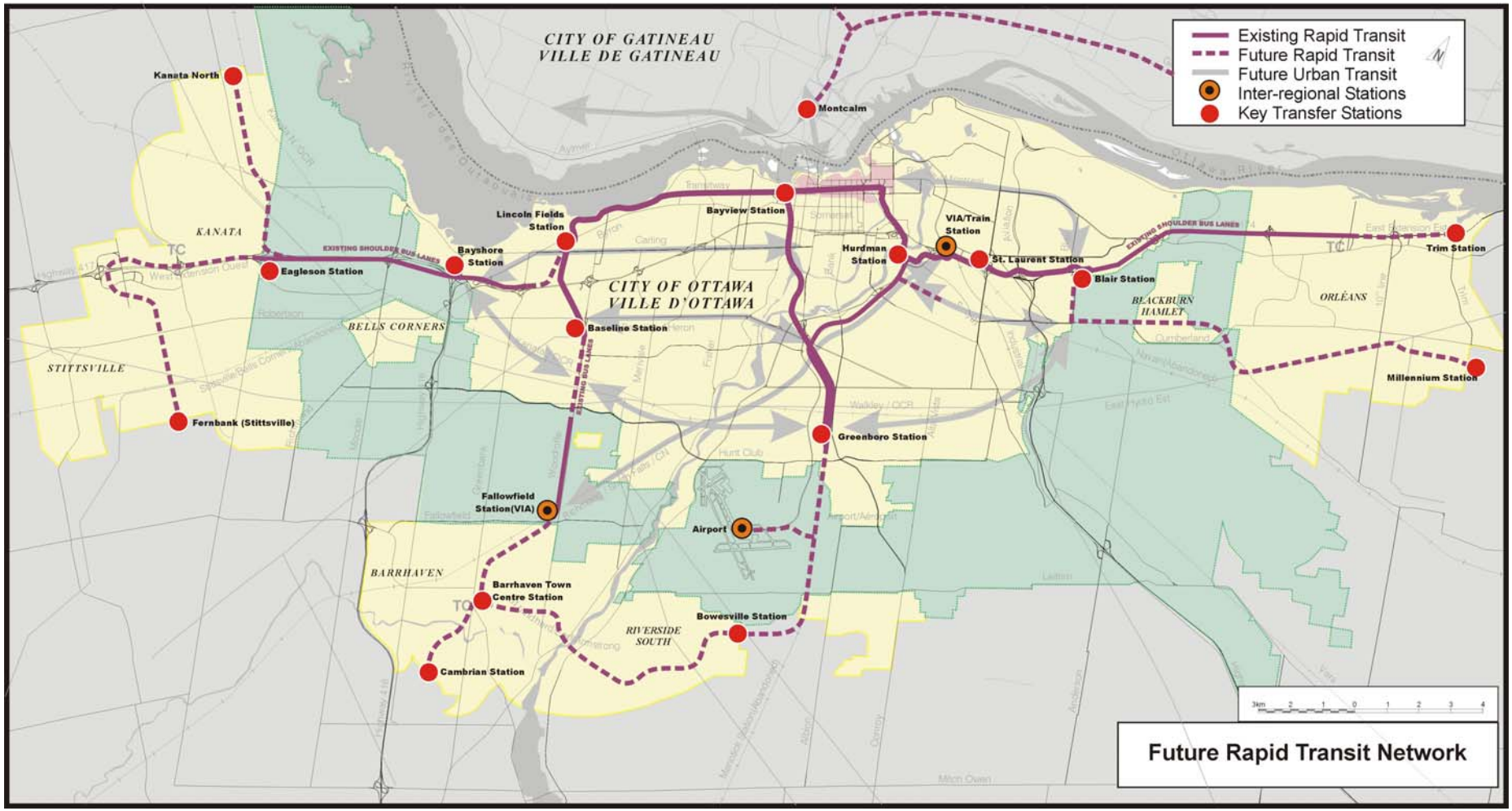
The Primary Rapid Transit Network options considered include:

- Network Option 1: BRT Tunnel - Bus based
- Network Option 2: BRT/LRT Tunnel – Bus based with North-South LRT
- Network Option 3: LRT Tunnel - East & West downtown LRT
- Network Option 4: LRT Tunnel - East & West downtown LRT plus North-South LRT

The basic difference between each of the above-noted network options is the extent to which LRT is incorporated. Note that Options 3 and 4 require the conversion of segments of the existing bus Transitway extending east and west of the downtown to LRT.

A description of each of the four networks options follows:

Figure 6.1: Future Rapid Transit Corridor Network Considerations



6.1. Network Option 1: BRT Tunnel-Bus Based

6.1.1. Description

This option is illustrated in Figure 6.2. It is essentially a bus-only alternative to which the other three options will be compared. It comprises the existing bus Transitway, with extensions, operating in twin bus-only tunnels through the downtown as noted in Section 5.4.1. A service level of one articulated bus running every 18 seconds through the downtown tunnel is required to accommodate the projected 2031 peak hour transit ridership demand.

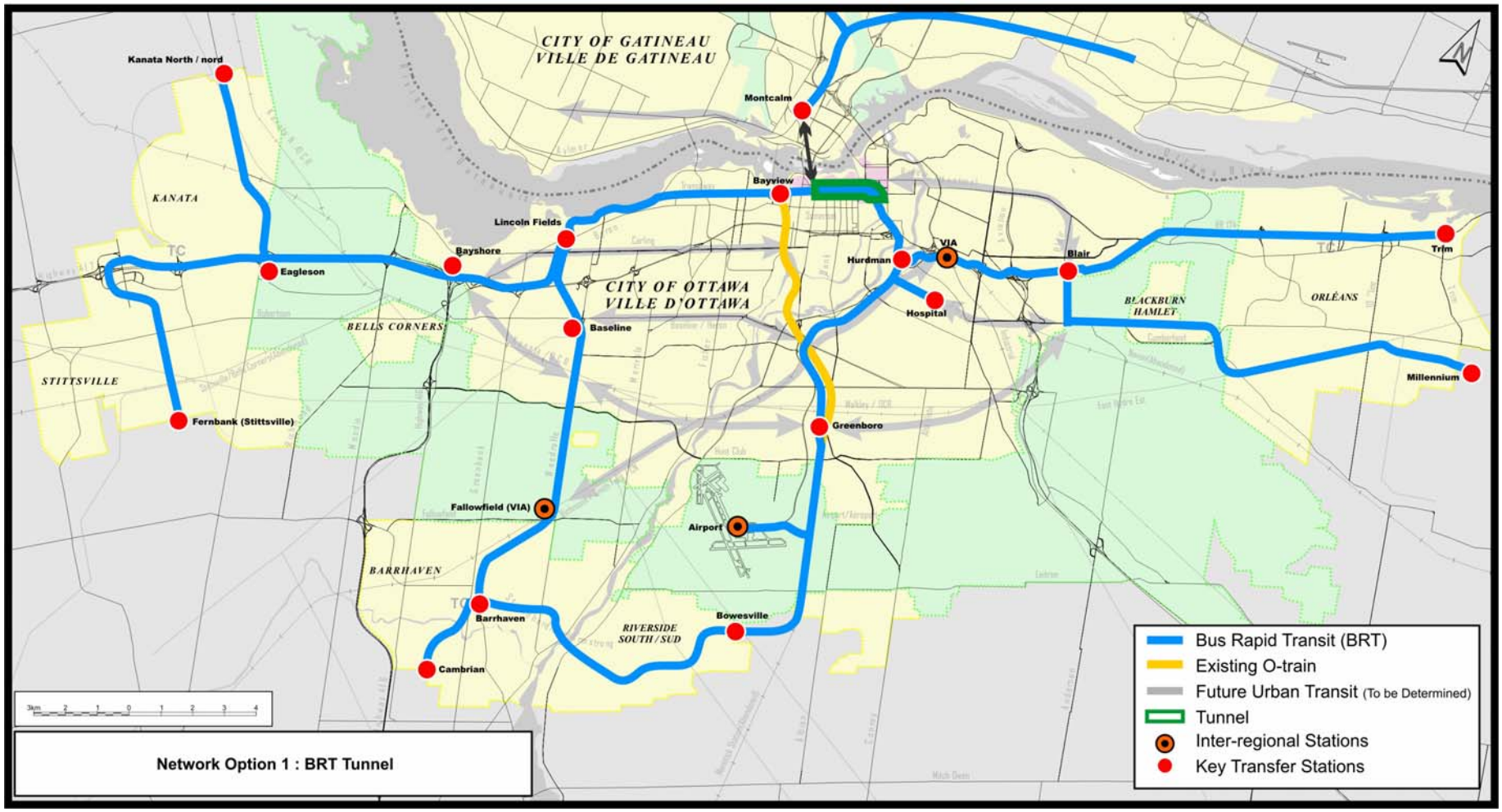
The existing Transitway would be extended as follows:

- West Transitway – branches to Kanata West and North
- East Transitway – from Place d'Orleans to Trim Road
- Cumberland Transitway – from Blair Station to Millennium Station
- Southeast Transitway – from South Keys to Riverside South, Barrhaven and the Airport
- Southwest Transitway –from Baseline Station to Nepean Sportsplex and Fallowfield Station to Cambrian Road

The buses would continue to operate on the Ottawa River Parkway as well as on the existing exclusive shoulder lanes on Highway 417 between Moodie Drive and Eagleson Road, and on City Freeway 174 between Blair Road and Place d'Orleans Station.

In this scenario the existing diesel-powered O-Train would continue to provide 15-minute service between Bayview and Greenboro station.

Figure 6.2: Network Option 1: BRT Tunnel



6.2. Network Option 2: BRT/LRT Tunnel – Bus based with North-South LRT

6.2.1. Description

This option is illustrated in Figure 6.3. It is a joint bus and LRT scenario comprised of the existing bus transitway, with extensions, combined with twin track LRT running in the North-South corridor from Bowesville Station in the south and through the downtown to Ottawa University. The North-South line continues as a bus transitway corridor from Bowesville Station west to Barrhaven Town Centre. To accommodate both the east-west buses and the north-south LRT trains, both types of vehicles would run jointly in twin dual lane tunnels through the downtown as described in Section 5.4.3. Within the tunnel stations, separate boarding areas would be provided for bus and LRT passengers. A combination of 2-car LRT trains running every 3 minutes and 45 seconds, and articulated buses running every 22 seconds through the downtown tunnel is required to accommodate the projected 2031 ridership demand.

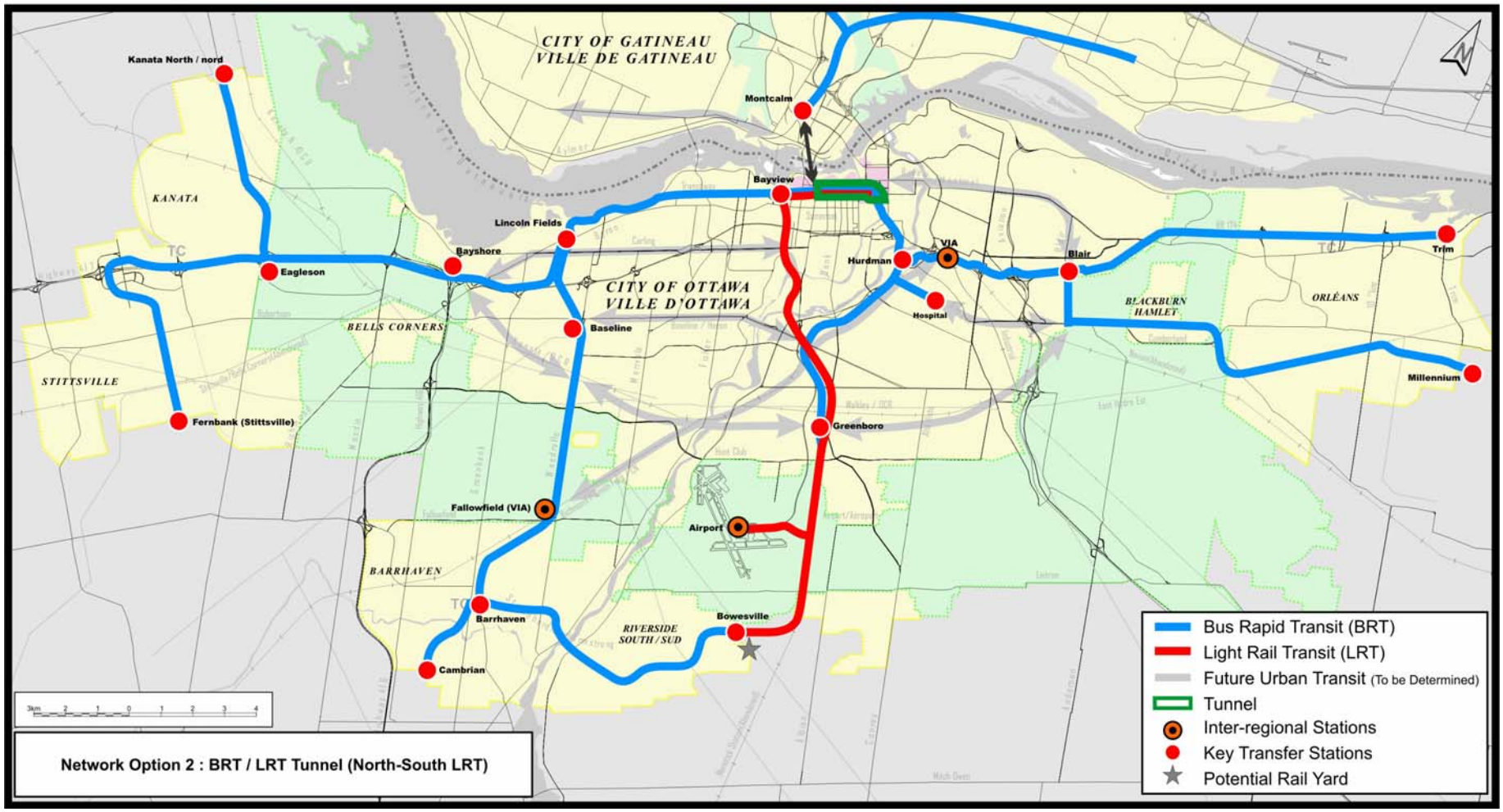
Within the North-South corridor, the existing single-track O-Train would be replaced by twin-track LRT, and extended south to Bowesville Station and with a spur into the Ottawa International Airport. A rail maintenance and storage facility would be located adjacent to Bowesville Station.

The bus Transitway would be extended as follows:

- West Transitway – branches to Kanata West and North
- East Transitway – from Place d'Orleans to Trim Road
- Cumberland Transitway – from Blair Station to Millennium Station
- South Transitway – from Bowesville to Barrhaven Town Centre
- Southwest Transitway – from Baseline Station to Nepean Sportsplex and Fallowfield Station to Cambrian Road

The buses would continue to operate on the Ottawa River Parkway as well as on the existing exclusive shoulder lanes on Highway 417 between Moodie Drive and Eagleson Road, and on City Freeway 174 between Blair Road and Place d'Orleans Station.

Figure 6.3: Network Option 2: BRT / LRT Tunnel



6.3. Minimum Transitway Segments for LRT Conversion

Primary rapid transit network options 3 and 4 that follow are based on the implementation of new east-west LRT lines crossing through the downtown in a rail-only tunnel. By necessity, this requires converting some of the connecting portions of the existing East and West Transitways to rail technology. A number of factors were considered to determine the minimum LRT segments that are required, and select the eastern and western limits of initial conversion. These factors include:

- Minimum operable segment – or the shortest section of rail that can reasonably be operated, which generally ranges from 5-10 km;
- Downtown must be served – segment has to connect to the proposed downtown tunnel;
- Passenger transfers – length of the line needs be located far enough from major destinations to warrant the passengers' time penalty for the transfer and be far enough out of the core to make the transferring volumes as reasonable as possible. Terminal stations must also have adequate space for efficient transfers;
- Terminal station is an anchor – the existing or proposed land use at the terminal ends of the segment are sufficiently dense and developed to attract riders, making more effective use of the infrastructure; and,
- Maintenance facility access – the initial segment has to connect to a maintenance and storage facility.

In options 3 and 4, the combination of the downtown tunnel and any one or more of the east, west or south legs would be ample as an operable segment. Access to a maintenance and storage facility will be a more significant determinant to the sequence of implementation.

Passenger transfer facilities at the terminal stations must be carefully considered. Ideally, transfer locations should be at key nodes, sufficiently removed from the downtown to reduce total transfer total volumes and provide sufficient benefit to riders to warrant the change in mode. Transfer hubs are frequently located where opportunities for transit supportive development exist, thereby maximizing accessibility to transit and providing a destination for trips, thereby increasing the effective use of the rail segment as trains have passengers on them in the off-peak direction. Experience has shown that the most efficient transfer facilities utilize vertical passenger movements, incorporate a range of passenger amenities, and have sufficient land area to optimize transit vehicle movements. This often requires a multi-storey facility, frequently incorporated into local buildings in higher density areas.

Applying these criteria to each of the east, west and south segments leads to the recommendation to use:

- **Hurdman and Blair Stations in the east**. These two locations balance connections to Transitways further east and southeast and allow for two smaller stations to be constructed. Both locations are in areas with existing or potential transit-supportive development. Blair Station is at the convergence point of the East and Cumberland Transitways, and is surrounded by recent employment and retail developments. Hurdman Station is already a major transfer facility, located at the connection of the East and Southeast Transitways.
- **Lincoln Fields and Baseline Stations in the west**. These two locations allow for two smaller stations to be constructed to serve the Transitways further to the west and southwest. Baseline Station in the west directly serves Algonquin College and is a focal point for the development of the Nepean Centrepointe lands. Lincoln Fields Station, while less of a future development node

provides a direct connection to the west, as well as to local routes operating on Carling Avenue. It also allows development along Carling to have good access to rail service into the downtown.

- **Bowesville Station in the south**. Bowesville Station was selected to take the line at least as far as the maintenance facility site and will provide service to Riverside South.

Further LRT extensions east, west and south-west are possible and can be considered but the locations above have been selected as the minimal segments required for a successful operation.

6.4. Network Option 3: LRT Tunnel - East & West Downtown LRT

6.4.1. Description

This option is illustrated in Figure 6.4. It is the first of 2 scenarios that carry the majority of passengers through the downtown on LRT. It is based on the conversion of the Transitway between Baseline Station and Blair Station from bus to LRT, passing through the downtown in an LRT-only tunnel. A service level of 4-car LRT trains running every 2 minutes and 18 seconds through the downtown tunnel is required to accommodate the projected 2031 transit ridership demand.

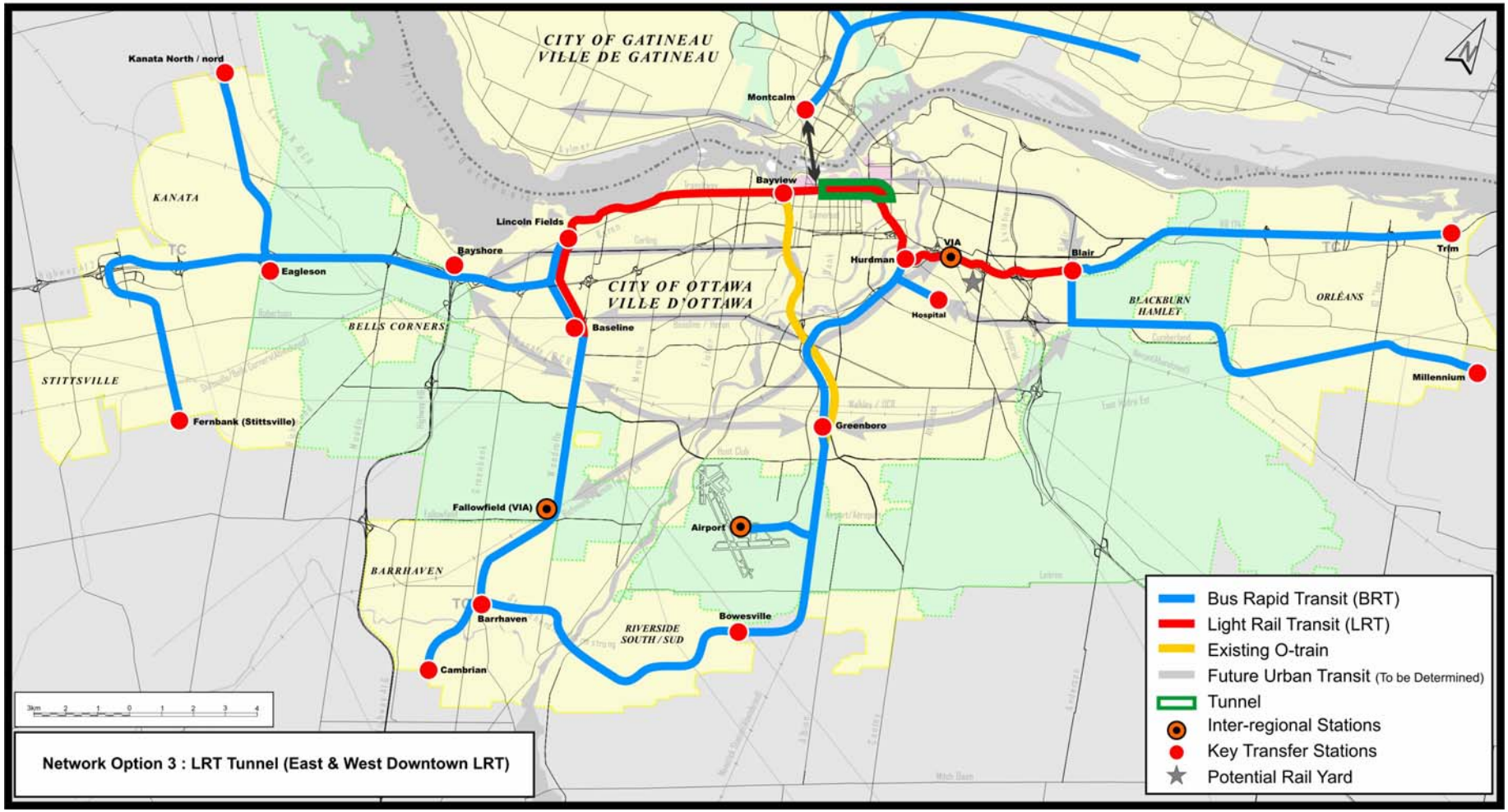
Bus to rail transfers will occur at Baseline, Lincoln Fields, Hurdman and Blair Stations. The existing diesel-powered O-Train would continue to provide 15-minute service between Bayview and Greenboro station, with passengers transferring to the east-west LRT to access the downtown at Bayview Station. The location of the required LRT maintenance and storage facility would be dependent on which portion of the network would be converted first. A possible location for the east-west line is the industrial sector in the vicinity of Belfast Road/St. Laurent Boulevard, but this will have to be investigated in more detail.

The remainder of the network would continue to operate as the bus Transitway, with extensions as follows:

- West Transitway – branches to Kanata West and North
- East Transitway – from Place d'Orleans to Trim Road
- Cumberland Transitway – from Blair Station to Millennium Station
- Southeast Transitway – from South Keys to Riverside South, Barrhaven Town Centre and to the Airport
- Southwest Transitway – from Baseline Station to Nepean Sportsplex and Fallowfield Station to Cambrian Road

The buses would continue to operate on the existing exclusive shoulder lanes on Highway 417 between Moodie Drive and Eagleson Road, and on City Freeway 174 between Blair Road and Place d'Orleans Station.

Figure 6.4: Network Option 3: East & West Downtown LRT



6.5. Network Option 4: LRT Tunnel - East & West Downtown LRT plus North-South LRT

6.5.1. Description

This option is illustrated on Figure 6.5. It is similar to Option 3, but with the addition of twin track LRT replacing the O-Train and running in the North-South corridor between Bowesville Station and the Downtown. All services would pass through the downtown in an LRT-only tunnel. A service level of 4-car LRT trains running every 2 minutes and 4 seconds through the downtown tunnel is required to accommodate the projected 2031 transit ridership demand. Bus to rail transfers will occur at Baseline, Lincoln Fields, Bowesville, Hurdman and Blair Stations.

Within the North-South corridor, the existing single-track O-Train would be replaced by twin-track LRT, and extended south to Bowesville Station and with a spur into the Ottawa International Airport. At Bayview station the north-south trains would connect with the east-west line and operate on the same tracks into and through the downtown.

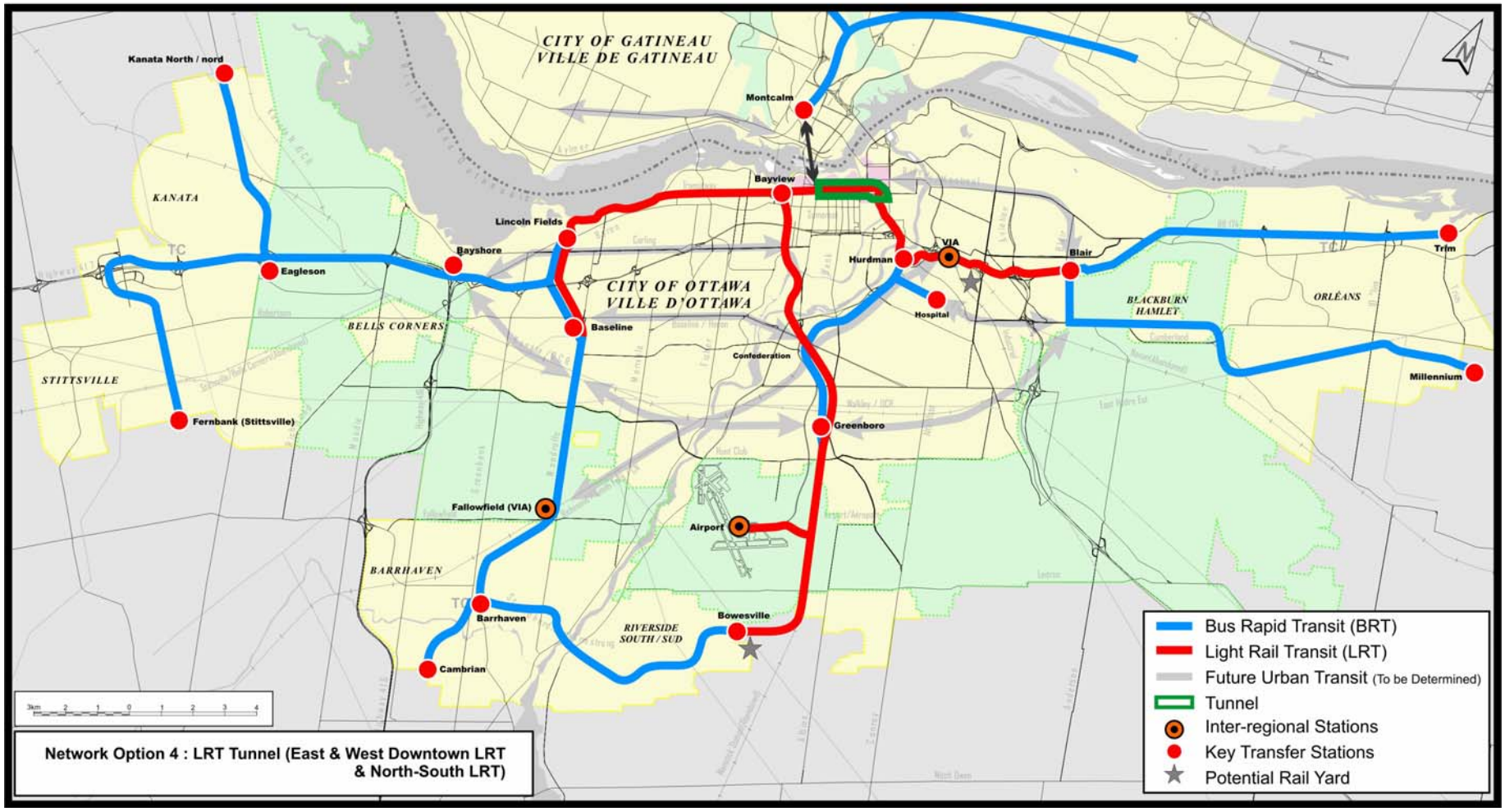
Possible locations for a rail maintenance and storage facility include adjacent to Bowesville Station, or in the industrial sector in the vicinity of Belfast Road/St. Laurent Boulevard.

The remainder of the network would continue to operate as the bus Transitway, with extensions as follows:

- West Transitway – branches to Kanata West and North
- East Transitway – from Place d'Orleans to Trim Road
- Cumberland Transitway – from Blair Station to Millennium Station
- South Transitway – from Bowesville to Barrhaven Towne Centre
- Southwest Transitway –from Baseline Station to Nepean Sportsplex and Fallowfield Station to Cambrian Road

The buses would continue to operate on the existing exclusive shoulder lanes on Highway 417 between Moodie Drive and Eagleson Road, and on City Freeway 174 between Blair Road and Place d'Orleans Station.

Figure 6.5: Network Option 4: LRT Tunnel – East & West Downtown LRT plus North-South LRT



7. Preliminary Integration Opportunities for STO Services

Bus operations on the Albert and Slater Street Central Transitway is only one component of the overall transit congestion being experienced on Ottawa's downtown streets. There are many buses that service interprovincial commuters during peak hours on the Rideau/Wellington Street corridor. As outlined in section 1.3.2, the Société de transport de l'Outaouais (STO) currently operate approximately 120 buses serving 4,400 peak hour transit passengers through Ottawa's central core. This interprovincial ridership demand is expected to increase to 8,500 peak hour passengers by 2031, which translates to approximately 250 standard buses. Operational experience on Albert and Slater indicates that they can theoretically accommodate a maximum of 195 buses per hour, but to maintain service reliability no more than 180 buses are scheduled during peak hours. The combined operation of STO interprovincial and OC Transpo local transit on the Rideau/Wellington corridor is currently nearing capacity, and as such there is no room for any capacity growth within this corridor by the 2031 planning horizon. It is therefore important to consider the implications of STO transit operations when developing future rapid transit options for Ottawa's downtown.

7.1. Alternatives Considered:

The four primary rapid transit network options developed in Chapter 6 all include a tunnel under the downtown to address current transit congestion and future downtown transit demand. These options were developed to identify the implications of a downtown transit solution on the balance of the rapid transit network. Options 1 & 2 allow for bus operations through the tunnel while options 3 & 4 include rail-only tunnels. STO currently uses mostly standard buses to service their interprovincial passengers. Their operating strategy provides a direct to downtown bus service that utilizes transit priority measures on existing arterial streets with plans for a future BRT operation in a freight rail corridor. Given the success of the service and the ability for growth and service flexibility, they do not anticipate any need to convert to rail transit service within the planning horizon.

A number of very preliminary alternatives were developed to show how interprovincial STO service might be integrated in downtown Ottawa with the primary rapid transit network options described above.

Alternative 1: Surface Transit
Alternative 2: Shared Transit Tunnel
Alternative 3: Separate Transit Tunnel
Alternative 4: Transfer between STO and OC Transpo

7.2. Description of Alternatives

The following sections describe the four main alternatives for interprovincial transit service as well as their implications for each one of the primary rapid transit network options. These alternatives were developed to show how service can be provided as well as to show a comparison of costs. A more detailed analysis and the selection of a preferred alternative for interprovincial rapid transit service will be undertaken in the up-coming joint NCC/Ottawa/Gatineau-STO Interprovincial Rapid Transit Strategic Integration Study.

7.2.1. Alternative 1: Surface Transit

Regardless of which of the proposed network options developed in Chapter 6 is chosen for Ottawa's rapid transit system, STO might choose to continue to operate on the surface in downtown Ottawa. However, with a projected 250 buses per hour in the peak direction, a single corridor will not provide enough capacity. STO buses would therefore require using more streets in Ottawa's downtown to service the future interprovincial transit demand.

In addition, even the present day operation is causing serious concerns on Rideau Street and in the By-ward Market area and its surroundings calling out for a more acceptable solution to the growing congestion and degradation of the street ambiance in the Market and around Parliament Hill. While continuing operation on Ottawa city streets is an option it is not an acceptable option and solutions have to be developed.

7.2.2. Alternative 2: STO Buses in a Shared Transit Tunnel

Ottawa's proposed primary rapid transit network options 1 & 2 include twin tunnels for buses under downtown Ottawa. These tunnels cannot effectively accommodate all of the future OC Transpo bus service required so there is certainly no room for sharing with an additional 250 STO buses. Option 2 has slightly fewer buses than option 1, but this reduction in buses due to passengers being accommodated on the North-South LRT would not provide the additional capacity required to allow STO buses to operate with OC Transpo buses. STO buses can therefore not be accommodated in the OC Transpo bus tunnels as shown in options 1 & 2.

Ottawa's proposed primary rapid transit network options 3 & 4 include twin tunnels for LRT under downtown Ottawa. As proposed, these tunnels are smaller than the bus tunnels proposed above and cannot accommodate STO buses. It is possible to widen the tunnels so that it could also accommodate STO buses. As one alternative for accommodating STO buses in the tunnel, it might be possible to widen only the westbound LRT tunnel (Albert Street) to accommodate joint STO BRT and Ottawa LRT westbound. This would mean that STO buses would run in a loop entering Ottawa at the east end of the tunnel and exiting at the west end. The widened tunnel would be 2 lanes wide accommodating LRT in the left lane and the STO buses the right lane. The buses would be able to cross into the LRT lane should a problem arise in the bus lane. At the station, an additional lane would allow for buses to pass each other without impacting the LRT operations. Platforms for the LRT and the buses would be separate with bus passengers alighting on a north platform and the LRT passengers alighting on a south platform.

The widened tunnel would include a 10m diameter bore instead of the 6m diameter (LRT only) bore to accommodate the 2 transit lanes. Stations would be further widened to accommodate an additional passing lane for the STO buses. Buses would enter downtown Ottawa from the east on the Macdonald-Cartier or Alexandria bridges and would travel south on King Edward. A tunnel portal would be located in the vicinity of King Edward and St. Patrick with a 10m diameter tunnel connecting to Ottawa's westbound tunnel at the Rideau Centre. STO buses would exit the tunnel west of Ottawa's CBD and would cross back into Gatineau via the Portage Bridge. STO buses can therefore be accommodated in an OC Transpo LRT tunnel as shown in options 3 & 4 with an estimated construction cost of $475M.

7.2.3. Alternative 3: STO Buses in a Separate Tunnel

Regardless of the technology choice for Ottawa's downtown transit tunnel, a separate tunnel facility might be considered for STO transit operations. Since STO plans to operate buses throughout the planning horizon, this would be a bus tunnel with portals on either end of downtown. For costing purposes, one portal is assumed to be located west of downtown for buses crossing the Portage Bridge. The portal would be located south of the Ottawa River Parkway intersection with the tunnel being potentially aligned under Wellington, Sparks, or

Queen Street. The other portal will allow buses to access the tunnel from the east in the vicinity of the King Edward and St. Patrick intersection. The 10m diameter tunnel would be approximately 3km long and would include 2 bus lanes, 1 for each direction. Stations would be widened to include an additional 2 lanes allowing buses to pass each other. The HOV lanes on the Portage Bridge would be converted to exclusive bus-only transit lanes with special signals at the Ottawa River Parkway intersection to allow buses to access the tunnel portal. Additional exclusive bus-only lanes would be required on King Edward Avenue and across the Macdonald-Cartier Bridge. Construction costs for this option are estimated at $610M.

7.2.4. Alternative 4: Transfer from STO buses to LRT

The proposed primary rapid transit network options 2, 3 & 4 include a tunnel that accommodates LRT through downtown Ottawa. There is capacity in all the options to accommodate some of the additional STO passengers if they transferred to the LRT system. This would mean adding additional trains to the system to accommodate this extra demand. This transfer point could be located on either side of the river (i.e. in Ottawa or Gatineau) and the objective would be to eliminate most or all of the interprovincial buses operating through the downtown.

A) Transfer in Ottawa

This alternative would require the STO buses to travel into Ottawa to a location where all interprovincial passengers can transfer to/from Ottawa's LRT facility. The transfer station would likely be located on the west side of downtown near Bayview/LeBreton and the buses would use the existing bridges (Portage, Chaudière) to cross the Ottawa River. The transfer station would require significant space and would need to accommodate the large number of STO buses. The estimated construction cost for the transfer station is $25M or more.

A rail crossover and 120m long double tail track is included just east of the Rideau Centre station. This allows for some LRT vehicles to service only the downtown and avoid travelling further east to Hurdman. These modification to the LRT tunnel are estimated to cost an additional $10M.

B) Transfer in Gatineau (spur)

This concept suggests a transfer station be located on the Quebec side of the river where passengers can access an LRT that travels into downtown Ottawa via the proposed LRT transit tunnel. On the west side of downtown the LRT could travel over the Portage Bridge and across the Ottawa River Parkway intersection to access the Ottawa LRT tunnel. This STO LRT would use the same stations as the OC Transpo LRT. A tail track located just east of the Rideau Centre allows LRT vehicles to short-turn and return back to Gatineau. Estimated costs for tracks over the Portage Bridge connecting to Ottawa's LRT, the tail track, and intersection modifications are in the range of $60M. The $25M transfer station is still required and can be located in Gatineau at Place du Portage.

C) Transfer in Gatineau (loop)

A variation to the above alternative would include an additional tunnel portal on King Edward allowing the LRT to operate as a loop (2 directions) through both downtown Ottawa and Gatineau instead of short-turning east of the Rideau centre. This option requires additional 2.5km long 3m radius tunnel to be bored as well as LRT tracks on King Edward, over the Macdonald-Cartier bridge and through downtown Gatineau for an estimated cost of $165M. The $25M transfer station would still be required resulting in a total construction cost of $190M.

7.3. Vehicles

Vehicle costs for Alternative 1 would only be considered if the surface transit would be a rail based system. If buses are going to continue to be the selected vehicle, then existing bus purchasing and replacement programs would cover the increased number of buses to accommodate the transit demand.

Alternatives 2 and 3 would require additional costs for vehicles as new hybrid–electric buses would be required if they are to operate in a tunnel. At an estimated cost of $630,000 per standard hybrid-electric bus, 250 buses would cost approximately $160M. Including 15% spare vehicles and assuming that half of the buses would be replaced within the planning horizon, an additional $115M is added to the vehicle costs for a total vehicle cost of $275M.

In Alternative 4A, the interprovincial transit passengers are being loaded on Ottawa's LRT, therefore an additional 12 LRT vehicles (including spares) would be required to provide the increased capacity. At $5M a vehicle, this option requires $60M for LRT vehicles. Similarly, in Alternative 4B, an additional 16 LRT vehicles would be required (including spares) with a cost of $80M and option 4C requires 18 LRT vehicles for $90M. The differences in these vehicle costs are due to the variations in travel time for the LRT to perform a complete trip.

7.4. Summary

The following table summarizes these very preliminary options to accommodate STO transit service in downtown Ottawa. No attempt has been made to develop detailed options as these and other options would be undertaken in the upcoming interprovincial transit study.

STO Alternative	Accommodates Network Options	Construction Costs	Vehicle Costs
1) Surface Transit	1, 2, 3, 4		
2) Shared OC Tunnel	3, 4	$ 475 M	$ 275 M
3) Separate STO Tunnel	1, 2, 3, 4	$ 610 M	$ 275 M
4a) Transfer (Ottawa)	2, 3, 4	$ 35 M	$ 60 M
4b) Transfer (Gatineau spur)	2, 3, 4	$ 85 M	$ 80 M
4c) Transfer (Gatineau loop)	2, 3, 4	$ 190 M	$ 90 M

8. Summary of Consultation To Date

8.1. Objective

The mandate of the Transportation Master Plan (TMP) Infrastructure Requirements Study Consultation Program is to engage, in a meaningful way, a broad range of citizens and stakeholders in a dialogue around Ottawa's long-term transportation planning. This chapter summarizes the findings of the Phase II component of the Consultation Program, which was to inform the public and obtain feedback on the four Primary Rapid Transit Network options.

8.2. Methodology

Consultation began March 3rd, and concluded March 31st, 2008. A number of activities were designed and executed to provide flexible and convenient opportunities for the public to provide comment to the City. These included:

- Open Houses and Discussion Groups
- Stakeholder Focus Group Sessions
- City Advisory Committee Briefings
- Online Materials and Consultations
- Internal and External Agency Group Meetings
- A Mayor's Streeter Survey

The following sections describe the logistics and provide summaries of the outcomes of the various methods of consultation. For more detailed information, refer to Appendix G: Consultation, which includes the following report: *Transportation Master Plan Infrastructure Requirement Study Summary Report: Phase II Consultations – A Review of the Downtown Rapid Transit Network Options* (PACE 2008).

8.3. Public Open Houses and Discussion Groups

8.3.1. Logistics

Four Public Open House events took place, in various regions of the city. Thirty bilingual project boards on the TMP Update and the network options were displayed. Members of the Study Team were available to answer any technical questions. The project boards were arranged around the perimeter of the event rooms to allow for facilitated Registered Discussion Group sessions to take place inside the same venue as the Open House. The open houses occurred as follows:

Table 8-1: Public Open House and Discussion Group Logistics

Dates	Location	# of Open House Participants	# of Discussion Group Participants
East Monday, March 3	Bob MacQuarrie Recreation Complex 1490 Youville Drive, Orleans	70	25
Central Tuesday, March 4	City Hall 100 Laurier Avenue West	200	80
West Wednesday, March 5	Earl March High School 4 The Parkway, Kanata	65	35
South Thursday, March 6	John McCrae High School 103 Malvern Drive, Nepean	60	24

Promotion and Recruitment: Promotion for the Open Houses and recruitment for the discussion groups was through various media. Newspaper advertisements were inserted in *The Citizen* and *Le Droit* on Friday, February 21st and 28th. Promotional postcards were distributed on all OC Transpo buses, and made available at public libraries, City kiosks and recreation facilities. Citizens that had participated in Phase I of the TMP consultations, as well as those registered in the City's Ottawa 20/20 mailing list were also emailed an invitation to register for the Discussion Groups. Members of the public were also invited to call 3-1-1, and register online on the City's website.

8.3.2. Comment Summary-Open House

In total, 156 comment sheets were submitted at the Public Open Houses. Members of the public were asked to provide responses to three questions. Seventy-three per cent (68%) of the submissions indicated Option #4 as the preferred option, followed by twenty-seven per cent (25%) for Option #3.

Table 8-2: Public Open Houses ~ Question 1

Which downtown rapid transit option do you prefer?"						
Location	**Options**					**Total Choices Made**
	1	**2**	**3**	**4**	**N/A**	
West	0	0	17	17	1	35
East	2	1	7	17	3	30
South	0	0	3	25	0	28
Central	0	1	15	55	5	72
Total	**2**	**2**	**42**	**114**	**9**	**169***
What you like about your chosen option - Key Trends(Comments refer to Option 4)						
•Operating costs are cheaper •Environmentally friendly •Goes direct from downtown to airport •Services all communities of Ottawa with use of Hub and Spoke •Ability to expand network						•Converts Transitway to LRT (use of existing assets) •High capacity service where it is needed most •Underground tunnel removes congestion •Underground tunnel promotes business development – offsetting costs Is a world transit system for Nation's Capital

**Please note that some comment sheets included two selected options*

Table 8-3: Public Open Houses ~ Key Trends Question 2

"Are there other features you would like to see included into Ottawa's rapid transit network?"	
Key Trends	
•N/S rail to connect to Gatineau •Extension of LRT to Kanata and Orleans •Use existing rail lines •Encourage intensification inside greenbelt •One transit pass for all transit systems •Bike routes, paths and parking at transit stations is necessary	•Comfortable transit stations •Security for underground tunnel •Accessibility for underground tunnel and all LRT stations •Free downtown LRT use to promote ridership and tourism •Option of running LRT on waterway as a tourist attraction

Table 8-4: Public Open Houses ~ Key Trends Question 3

Other Comments	
•Consider the environment in any option •STO/Gatineau sharing of costs and integration •The proposed options are too narrow and should extend even further •Personal safety needs to be considered	•Ensure Walking and Cycling is integrated and maintained •Make transit attractive and affordable •Ensure that the correct corridors are chosen •Money is not the deciding point - it is what is best for Ottawa

8.3.3. Comment Summary – Discussion Groups

Over 150 people registered for the Discussion Groups held at the Public Open House events. Discussions focused largely around Option numbers 3 and 4. While discussions at each table were designed to reflect the questions listed in the Comment Sheets, some led to other relevant topics. Facilitators were encouraged to carry the conversation wherever participants felt it needed to go. With this in mind, the following table provides a summary of key trends captured at each of the Discussion Group tables.

Table 8-5: Discussion Groups ~ Key Comments on the Four Options

Network	***Key Comments***
Option 1	•Buses do not help us overcome the congestion issue in the downtown core •Buses are less reliable •There is no clear benefit for choosing this option •Operating costs are very high •This is not a sustainable option •There is no room for growth •It is the least efficient use of time, money and the environment •Buses in the tunnel would cause serious health concerns
Option 2	•There is no clear benefit for choosing this option •This option is too expensive •There is no consideration for growth •This option is the most expensive •It is not a sustainable choice •Buses in the tunnel would cause serious health concerns
Option 3	•Option 3 is a good interim starting point to get to Option 4 •The link to the airport is important •Future growth is possible with this option

	•If this option is selected, an increase in O-Train service is needed
Option 4	•It is the best option for the environment •It offers best long-term solution •It supports urban growth realities •Option 4 is the best use of money •It is adaptable •It is convenient

The following table reflects what participants indicated was most important for the City to consider when implementing a new transit plan.

Table 8-6: Registered Discussion Groups ~ Key Areas of Consideration

Area of Dialogue	*Key Areas of Consideration*
Location of Corridors, Stops, etc.	•Explore the feasibility of existing corridors •Ensure the appropriate corridor choices (e.g. Baseline vs. Barrhaven, East-West vs. North-South)
Environment	•Technology choice is important to investigate – hybrid vs. electric vs. diesel •Choose the best alternative for the environment •Consider future fuel costs •Choose a system that considers Ottawa's environment and winter temperatures
Considering STO	•A solution for the Gatineau buses must be considered •Create a transfer point on the Gatineau side •STO link is imperative •Ensure systems are compatible •STO system must not be detrimental to Ottawa (e.g. contribute to the congestion issues in the downtown core)
Construction and Disruption of Service	•Concern about construction at transfer stations •Concern about construction disruption in residential areas •Concern that disruption to service will result in losses to ridership and increases in car use
Transfer Stations with Hub and Spoke System	•Must encourage acceptance of transferring •Determine elements that make transferring attractive (e.g. shopping, etc.) •Accommodate multi-modal use (e.g. bike paths, bike stations, walkways and more Park and Rides) •Personal safety at transit station and tunnel •One transfer limit
Urban Planning	•Increase development density •Land use planning is critical for transit planning
Encouraging Transit Ridership	•Choose the system that will encourage the highest ridership •Aim for high modal splits •Convenience, reliability and speed will appeal to citizens •Incentives for transit use •Internet access on trains •Affordability (e.g. car ownership and parking costs vs. transit pass)
Financing	•Focus on decreasing maintenance costs •Secure funding from other levels of government

8.4. Stakeholder Focus Groups

8.4.1. Logistics

Three Focus Group sessions were held at City Hall on March 4th and 5th providing key stakeholders in the process an opportunity to supply their input on the four network options. Participants at the Stakeholder Focus Group sessions were grouped according to their various interests and areas of expertise, and represented the City's Industry, Economic, and Downtown sectors.

8.4.2. Comment Summary-Stakeholder Groups

The feedback generated at each of the Stakeholder Focus Group sessions was collected by the facilitator on flip-charts and in notes taken by a scribe. The following table provides a summary of the key trends captured at each of the three Stakeholder sessions.

Table 8-7: Stakeholder Focus Group Sessions ~ Key Trends

Stakeholder Focus Group	*Comments*
Industry Voices	•Option #4 best option •Future growth with rail is a benefit •LRT moves people quickly and is cheaper •Inter-provincial support is needed for STO problem •Public buy-in is important – market the options well
Downtown Voices	•Option #4 makes sense •Intensification is needed as it relieves congestion •Flexibility with being able to add more rail cars, extending rail lines and seeing multi-modalities integrated •Inter-provincial support is needed for STO problem •Local service will need improvements •Public buy-in is crucial – market the options well
Economic Voices	•Downtown emphasis is good •Tunnel is needed •Build economic nodes within the transfer areas •Inter-provincial support is needed for STO problem •Public buy-in is important – market the options well •Intensification is necessary

8.5. City Advisory Committee Briefings

A number of the City of Ottawa's Advisory Committees, with an interest in transit and transportation, were invited to participate in a briefing session on the four network options.

- Roads and Cycling Advisory Committee
- Environmental Advisory Committee
- Rural Issues Advisory Committee
- Accessibility Advisory Committee
- Pedestrian and Transit Advisory Committee.

No direct feedback was received at this session. Those Advisory Committees whose mandates do not directly pertain to transit or transportation issues were invited to participate in the Open House sessions and Registered Discussion Groups.

8.6. Internal and External Agency Meetings

The City of Ottawa held Internal and External Agency meetings during the week of March 3rd. The primary objective of the Agency meetings was to provide the two groups with information on the four network options. Both meetings consisted of a 45 minute presentation updating participants on the TMP project, and providing an overview on the four options. This was followed by an open discussion. Meeting minutes for both the Internal and External sessions can be found in the *Phase II Consultation Report*.

The External Agency meeting took place on Tuesday, March 4th, at City Hall from 1:30 to 3:30 p.m. Participants included representatives from the following agencies:

Federal Government
- PWGSC
- Health Canada
- Transport Canada
- Infrastructure Canada
- National Capital Commission

City of Gatineau
Société de transport de l'Outaouais (STO)
Provincial Government
- Ontario Ministry of Transportation
- Ontario Ministry of Public Infrastructure Renewal

Advisory Agencies and Private Interest
- Rideau Valley Conservation Authority
- Canadian Pacific Railway

The Internal Agency meeting took place on Friday, March 7th, at City Hall from 9:30 to 11:30 a.m. Participants at the Internal Agency Meeting consisted of various departmental staff from the City of Ottawa.

8.7. Online Consultation

8.7.1. Logistics

The Beyond Ottawa 20/20 web site (www.ottawa.ca/beyondottawa2020) was used to promote the public consultation activities and to provide browsers with information on the four network options. The Open House display boards were uploaded to the website, along with supporting materials, in both official languages for review and comment

8.7.2. Comment Summary-Online Consultation

Comments were submitted to the City by email, mail and fax. Over 600 comments were received and are summarized in Tables 12, 13 & 14 of Appendix G and below:

Table 8-8: On-line Comments

Which downtown rapid transit option do you prefer?"					
Location	**Options**				**Total Choices Made**
	1 or 2	**3**	**4**	**None**	
Total*	27	111	413	88	**631**
Key Comments					
• Access to all citizens regardless of region EW/NS/etc. • Tunnel is a good idea and eliminates congestion • LRT is the best for the environment • Option 4 is the best long term choice with the ability to expand rail to outlying areas in the future • Option 4 has the cheapest Operating and Maintenance costs • Phase out reliance on fossil-fuel-burning buses • LRT will reduce the congestion going into and out of downtown • Greater reliability • Streamlining of inner-greenbelt transit helps improve liveability • •LRT connection to other areas (e.g. Barrhaven, Gatineau, Fallowfield Via Station) • Accessibility is important • Convenience and reliability of transfers is important • Tunnel pathway and connections to shops, residences, buildings is important • Bike paths and walkways along the Transitway is essential • Larger park and rides • Ongoing consideration for late night routes to service downtown core and entertainment destinations • All buses should be removed off Albert, Slater, Queen and Laurier downtown and should connect to bus station hubs					• The LRT should be faster than the bus, which will entice more transit riders • Tunnel should only be accessible to LRT • Technology choice is important to investigate – hybrid vs. electric vs. diesel • Eventual conversion/extension of LRT promotes further environmental benefits • Increase development density • Land use planning is critical for transit planning • A solution for the Gatineau buses must be considered • Concern about construction at transfer stations • Concern about construction disruption in residential areas • Concern that disruption to service will result in losses to ridership and increases in car use • Must encourage acceptance of transferring • Determine elements that make transferring attractive (e.g. shopping, etc.) • Accommodate multi-modal use (e.g. bike paths, bike stations, walkways and more Park and Rides) • Choose the system that will encourage the highest ridership • One pass/smart card system for all types of transit • Aim for high modal splits • Focus on decreasing maintenance costs • Secure funding from other levels of government • Make the planning process open and transparent to citizens • Implement the plan now; not in 30 years

8.8. Mayor's Streeter Survey

8.8.1. Logistics

A Mayor's Streeter Survey was conducted during the week of March 17th to provide a brief snapshot of the public's awareness and opinion of the City's long-term transit plans.

The Streeter Survey locations were selected to capture a diverse set of opinions, mostly from transit users. Locations included downtown at the McKenzie King Bridge; the Eagleson Park and Ride Lot in Kanata; the Place d'Orléans Station transit shelter in Orléans; and the Fallowfield Park and Ride Lot in Barrhaven. The survey team approached various people at transit stations, bus stops, city parking lots and sidewalks, and asked them to participate in the brief questionnaire.

8.8.2. Comment Summary – Mayor's Streeter Survey

The Mayor's Streeter Survey generated over 400 completed questionnaires. The following is an overview of the key findings:

- The majority of participants had heard about the downtown tunnel proposal and/or the four Downtown Rapid Transit Network Options
- Ottawa needs a light rail system to service its growing population
- A connection to the airport is necessary
- Light rail should be extended to service suburban communities such as Kanata, Orleans and Barrhaven
- It is more fiscally prudent to spend an increased amount upfront in capital costs to develop a transit system, and spend less on operating and maintenance costs over the lifetime of the project
- There is support for the tunnel and decongestion of the core
- The light rail system should be phased so that it serves the demand

Key comments in reference to financing a transit system were as follows:

- A good system is needed now - spend the money to do it well
- Do not increase taxes
- Do not increase transit fees
- More information is needed on the options and what the overall costs will be

8.9. Conclusions

In total, approximately 1,200 written comments were received through the Public Open Houses, Online Consultations and the Mayor's Streeter Survey consultation activities. Overall, a strong majority of the public and stakeholders indicated Option 4 as their preferred long-term transit solution for the City of Ottawa (approximately 70% of all comments received supported Option 4). Many people commented that Option 4 provides the highest quality of transit service; the best approach for urban intensification; the lowest operating costs; optimum long-term transit growth capacity; the most positive environmental, social and economic impacts; and the most favourable perceptions of Ottawa as the Nation's Capital City.

While there was also support for Option 3 (approximately 22% of all comments received). Many suggested that this alternative could serve as a 'staged' implementation for ultimately developing Network Option 4.

There was little to no support for Option 1 and Option 2 (approximately 3% of all comments received). People found these options to be the least sustainable and economically viable networks for the future.

Few people were either undecided or did not prefer any of the four options (approximately 5% of all comments received).

9. Assessment of Network Options

This section of the report sets out the criteria that have been used to assess the network options, provides a detailed assessment of each option against each criteria, summarizes the evaluation of the four options and provides conclusions and a recommended network option.

The groupings of criteria are developed along with a description of each one. The criteria have been applied to the various features, aspects and considerations of each the four network options to develop a comprehensive assessment, using a common set of evaluation criteria.

After each network has been evaluated, the evaluations are compared to provide a summary assessment, which leads to the development of a recommended option.

9.1. Criteria for Consideration

The evaluation of the network options requires a common set of criteria and a common understanding of how they are measured. In many cases, the criteria are relative; that is, they measure the effectiveness of options relative to each other. Where possible, criteria that can provide objective measurements are calculated, and the absolute values are compared to provide the analysis. At the level of detail available at the TMP stage criteria have been established that will allow for a comprehensive comparative evaluation. However more work will be required during the environmental assessment and design stages to determine the details of alignment, station locations and localized impacts and mitigation. The criteria that are used in this evaluation can be broken down into the following general headings:

- Transportation;
- Natural environment;
- Social/cultural environment, and
- Capital and operating costs.

Each of these general headings contains a number of sub-criteria that will allow for a thorough assessment.

9.1.1. Transportation

Factors considered under the transportation criteria are principally related to transit ridership potential, and include discussion of the ability of the network to meet transit mode split targets, accommodate growth beyond the planning horizon and attract the highest possible levels of ridership. Operating issues relate to the physical arrangement of the infrastructure elements and their effects on service reliability. The forecast 2031 ridership is outlined in chapter 4 of the report and the physical layout of the network is described in chapters 5 and 6.

More specifically the criteria include:

- Accommodating forecast ridership
- Accommodating growth beyond the planning period
    - Additional capacity left after accommodating the forecast ridership
- Ridership attraction
    - Ability to attract additional peak hour ridership
    - Ability to attract additional midday, evening, weekend and special event ridership
    - Perception of quality of service and its effect on attracting new riders
- Operating issues
    - Reliability and ability to maintain required service levels
    - Physical constraints that limit potential operational expansion
    - Qualitative analysis of level of service provided to service the forecast demand to 2031

Each of the four options being considered has varying potential for attracting ridership.

9.1.2. Natural Environment

This group of criteria include impacts on air quality and groundwater. Air quality factors are the principal comparators under the natural environment criteria. Air quality was assessed based on the vehicle emissions produced and the air pollutants that are created including smog and greenhouse gases. At this stage an estimate of the amount of pollutants created in operating the full transit system are used to compare the options. Reductions in automobile vehicle-kilometres of travel (VKT) will offset the pollutants created by operating rapid transit however estimating these additional benefits is difficult given the diverse range of vehicles on the road and the range of emissions they create.

Air quality calculations used the projected 2031 transit service hours for the various vehicle types and the emission rates listed in Table 9.1, below. Pollutants evaluated include;

- Carbon monoxide (CO),
- Hydrocarbons (HC),
- Nitrogen oxides (NOx), and
- Suspended particulates, including both PM 2.5 and PM 10
- Carbon Dioxide (CO_2)

The approach to estimate the GHG produced by each option was to estimate the annual VKT for each type of transit vehicle and apply the emission rates to determine the total annual emissions for each of the options. Controlled vehicle testing[8], confirmed by operation of Hybrid-Electric Buses, indicate that they produce significantly less emissions than diesel buses, which in the individual vehicle testing can range up to a 90% reduction in CO, HC, PM 2.5 and PM 10 levels, and up to a 30% reduction in NOx. The major benefit to hybrid buses is on routes with short distances between stops where the bus is required to start and stop very frequently. For the operation on the Transitway, it is unlikely that reductions in emissions will be as substantial as the controlled vehicle testing indicates, however there will be measurable benefits.

[8] Federal Transit Authority report entitled "Transit Bus Life Cycle Cost and Year 2007 Emissions Estimation, July 2007

Table 9.1: Vehicle Emission Rates
(Source: HLB Decision Economics Inc.)

Emission Rate (g/vkt)	Bus		Light Rail	
	Diesel	Hybrid	Diesel[9]	Electric
CO	11.101	5.770	6.66	0
HC/VOC	1.030	0.539	0.62	0
NOx	8.398	4.365	5.04	0
SOx	0.348	0.281	0.21	0
PM	0.190	0.098	0.11	0
CO_2	1348.94	751.37	791.36	0

The vehicle emissions rates are for the emissions produced at the vehicle. For that reason the electric options have rates equal to zero, however they may produce emissions at the power plant where the electricity is produced depending on the electricity generator. Total emissions are still substantially lower than for diesel or gasoline vehicles as approximately 75% of Ontario's electricity is produced without using fossil fuels.

Smog is produced when fossil fuels are burned. It is composed of many pollutants with the main components being ground-level-ozone and particulate matter (PM). Ground-level ozone can be especially harmful for people with heart and lung conditions such as emphysema, bronchitis, and asthma. It can also cause eye and nose irritation and dries out the protective membranes of the nose and throat and interferes with the body's ability to fight infection, increasing susceptibility to illness. PM10 is a standard measure of air pollution and elevated concentrations are associated with a variety of health risks and in particular, cardio-respiratory illnesses.

The material that is excavated to construct the tunnel and underground stations is also considered. The volumes of material that will be produced have been estimated for comparative purposes. All excavated material will be tested for contaminants before it is transported off site.

The majority of the material will consist of ground limestone from the tunnel and station excavation. Some material that is excavated at the tunnel portals and the station sites will be more varied and will include concrete and asphalt from roads and sidewalks on the sites and fill and overburden over the limestone bedrock. While none of these areas are thought to contain contamination, a soils testing program will be implemented to verify that materials are disposed of properly. At this stage haul routes and disposal locations have not been considered.

The use of salt to control ice and snow in the winter is another major impact on the natural environment. As the snow and ice melt, the salt is carried into the local sewers, streams and groundwater. While less salt is used now than has been used in the past, there are still significant quantities of salt in use. Salt will continued to be used at stations under all scenarios, to maintain safe winter operations.

[9] O-Train is assumed to use 40% less fuel than a transit bus, based on information from Transport Canada's pilot project evaluation.

9.1.3. Social/Cultural Environment

The social and cultural features that distinguish each of the four primary network options relate primarily to the ability of each option to interact with existing and future communities as well as to influence the form of urban development. It should be noted for this criteria group assessment that each of the primary rapid transit network options are comprised of the same corridors, with the only distinguishing feature being the extent of LRT used.

The presence of higher-order transit, such as LRT supports development in a direct way, by providing additional transportation capacity to a constrained urban environment, allowing higher densities. It also supports development in an indirect way, in that the presence of LRT can help create urban environments that are more attractive for development, due to the perceived "permanence" of the rail infrastructure, the convenience of access and the lifestyle benefits associated with access to transit. Generally, the higher order the transit technology, the greater the development impact. Revitalization of corridors and downtown centres with LRT projects include St. Louis, Kansas City and San José where thriving suburbs with a dynamic urban core have developed.

Higher density development has a variety of social, environmental, physical, and fiscal benefits. It makes better use of existing municipal services, it can assist in revitalizing struggling urban areas, and reduces the need for travel. Consequently, if LRT has the potential to attract higher levels of development adjacent to the corridor, then by reason it would have better potential to limit urban sprawl by contributing to a more compact, high-density city – resulting in more liveable and sustainable communities.

BRT can create some of the same influences if the stations are properly developed and the service provides rapid, frequent and fast service to a large market area. There is less evidence that BRT is as successful in fostering the same level of intensification of development.

The City of Ottawa Transit-Oriented Development (TOD) guideline describes TOD as a mix of moderate to high-density transit-supportive land uses located within an easy walk of a rapid transit stop or station that is oriented and designed to facilitate transit use. LRT enhances opportunities for high-quality transit-oriented development encourages vibrant community centres. The proposed development of large multi-modal stations at Lincoln Fields, Baseline, Blair and Hurdman as part of options 3 provides opportunities for TOD. Option 4 also includes TOD opportunities at Bowesville Station.

LRT enhances property values and areas in the vicinity of light rail stations normally see an increase in land value (People for Modern Transit, Seattle (Adapted by Light Rail Progress) – March 2001). Generally, the options with the greater level of LRT service have the greater potential impact.

9.1.4. Capital and Operating Costs

Capital and operating cost estimates for the full build-out of each option are presented in 2008 dollars. They are broken down and presented in more detail in Sections 9.5 and 9.6.

The capital cost estimates were developed on an elemental basis, that is, the cost per metre of track or per station was developed and multiplied by the number of metres of track and the number of stations. Costs for bridges, grade separations and other structures were developed on a per square metre cost multiplied by the size of the structure. This approach is industry standard at this level of conceptual design. Allowances for engineering and design as well as contingencies were added to the costs by section to arrive at the totals indicated. For buses and rail vehicles, an initial capital costs as well as a mid-life allowance for replacement vehicles required over the planning period was included.

Operating costs were estimated for the entire OC Transpo system modelled to be in place for the planning period year, 2031. These were based on per kilometre and per hour costs for OC Transpo and comparable systems in North America.

9.2. Assessment of Transportation Criteria

9.2.1. Accommodating Forecast Ridership

Chapter 3 outlined the development of the travel demand forecasts, and chapter 4 outlined the development of the future ridership forecasts for the year 2031. To accommodate the forecast ridership the network option must carry:

- 12,800 to 15,600 west of the downtown (at LeBreton)
- 11,300 to 13,700 east of the downtown (at Hurdman)
- 8,500 from Gatineau.

The range for west of downtown and east of downtown ridership depends on whether the Southeast Transitway or O-Train corridor is used to carry the majority of passengers from the southern areas into the downtown.

Table 4.3 indicates that based on the current OC Transpo loading standard, the number of vehicles required to carry this peak hour passenger volume is:

- 305-347 standard 40-foot buses, or
- 196-223 articulated buses, or
- 153-174 double-deck or double-articulated buses, or
- 51-58 LRTs (2-car train), or
- 26-29 LRTs (4-car train).

Before the options can be analyzed, the maximum number of vehicles that can be carried in the various tunnel configurations needs to be assessed. There are very few BRT tunnels or, in fact, BRT systems that operate at the volumes currently operating on the Albert/Slater corridor in downtown Ottawa.

Research into the vehicle throughputs of various BRT configurations indicate that the Seattle tunnel, which operated as a bus-only facility and has now been converted to rail-based operation, is the only North American example of a BRT tunnel. A report done for King County indicates that the theoretical capacity of that tunnel is 145 buses per hour or 33 trains per hour. The train throughput was limited by the geometry of a curve in the tunnel, which is instructive for a future tunnel design. As a comparison, a Transport and Road Research Laboratory Research Report[10] has looked at BRT throughput in a number of systems in developing cities outside North America. In that paper the range of bus volumes spans from 140 to 195 for systems in Turkey and Brazil. The Research Report suggests that for a fully segregated, high volume station, with 4 bus bays and fare pre-payment the maximum number of buses per hour is 217. A likely maximum theoretical value for Ottawa is about 220 buses per hour or a bus every 16 seconds. The number of articulated buses required in the planning period is at the high end of the likely range

[10] G. Gardner, PR Cornwell and JA Cracknell, "The Performance of Busway Transit in Developing Cities", Transport and Road Research Laboratory, research Report 329, 1991.

As a comparison, the existing surface operation in the Downtown is at capacity with a limit of approximately 180 vehicles per hour (eastbound in the afternoon with a mix of 37% articulated buses and the remainder standard buses). Transferring this operation to a tunnel with pre-paid fares will provide an improvement. However, bus services will also have to be considerably restructured from the existing operation providing fewer bus routes directly into the downtown with more bus to bus transfers required.

While this type of high capacity bus operation can be scheduled it will be very difficult to sustain the required headways on a regular basis. This type of operation would require significant route supervision to attempt to ensure that the buses entered the downtown stations in 4-bus platoons on a regular basis and leave the platforms at the same time. Any lag in any in this very tight operation will have a repercussion effect and delay service from entering the downtown. Automated information systems to assist passengers in positioning themselves on the platforms to facilitate boarding would also be required. Reducing the total number of routes through the tunnel would also improve conditions, but would increase the number of passenger transfers required elsewhere in the system.

For rail systems the capacity will be determined by the tunnel geometry and the signal system that is used. Industry standard signal planning is based on a 90-second minimum headway, or 45 trains per hour. This level of throughput will be more than sufficient to carry the required passenger volumes.

	Option 1 Bus Based	Option 2 Bus with NS LRT	Option 3 EW LRT	Option 4 EW & NS LRT
Transportation – Accommodating Forecast Ridership				
	Requires stations with; • 4 bus bays • Fare pre-payment • Bus platoons Theoretically could operate at capacity	NS LRT vehicles can easily be accommodated Buses may be accommodated but will operate close to theoretical capacity Mix of bus and LRT traffic is unbalanced	LRT vehicles can be accommodated	LRT vehicles can be accommodated
Summary	●	●	●	●

9.2.2. Accommodating Growth beyond the Planning Period

The evaluation in the previous section is informative for evaluating the ability to accommodate growth beyond the planning period. Both options 1 and 2 are at or near the theoretical capacity for bus volumes operating in the tunnel. Options 3 and 4 have extra capacity, and with the addition of additional cars or service frequency can further increase passenger throughput.

As the investment in a downtown tunnel is a "100-year solution" or at the very least a generational solution, the ability to handle increased ridership is important. Unforeseen changes in travel behaviour including substantial increases in the cost of owning or operating a private vehicle are just one possibility. The increase in riders who make a conscious decision to reduce their energy consumption, or who choose to let someone else do the driving for their commute can also increase ridership.

	Option 1 Bus Based	Option 2 Bus with NS LRT	Option 3 EW LRT	Option 4 EW & NS LRT
Transportation – Accommodating Growth beyond the Planning Period				
	No flexibility to accommodate growth beyond the planning period	Minimal room for additional buses LRT component has additional capacity but it is not required for this option	Longer trains and more frequent service can be provided	Longer trains and more frequent service can be provided
Summary				

9.2.3. Ridership Attraction

The attractiveness of each of the options to new riders is being discussed extensively in the transit planning community. Research to support the popular belief that rail-based transit is more attractive to riders, does more to increase land values around stations and is more likely to attract development is now starting to emerge. Another small influence that is also being recognized is that rail-based transit encourages lower rates of car ownership and can reduce the total vehicle-kilometres of travel in a community.

Research conducted for the World Bank, completed in March 2003[11] used the U.S. 1990 Nationwide Personal transportation Survey to address two questions:

- How do measures of urban form, including city shape, road density, the spatial distribution of population, and jobs-housing balance affect annual miles driven and commute mode choice of U.S. households? and,
- How does the supply of public transportation (annual route miles supplied and availability of transit stops) affect miles driven and commute mode choice?

The authors of the report found that jobs-housing balance, population centrality and rail miles supplied significantly reduce the probability of driving to work in cities with some rail transit. The influences are individually quite small, but when put together can have a substantial influence on vehicle miles of travel.

Research conducted by the Victoria Transport Policy Institute[12], in 1994, evaluated the benefits of rail transit in American cities and found, among other things, that:

- People living close to rail stations were many times more likely to use public transit, use it more often, and were more likely to use rail transit to substitute for car travel
- Cities with rail transit had higher transit mode splits and a higher number of trips per capita
- Vehicle ownership rates are lower in cities with rail transit

Various research studies[13] have been done to quantify the impact of urban transit systems on adjacent land values. A number of studies have shown a positive correlation, that is, proximity to a station increases the value of property. However other studies have contradicting conclusions. Research is currently focussed on finding ways to undertake meta-studies[14], or studies that use the information in many other studies and standardize the analysis to determine an overall impact. The meta-studies are finding that there is a positive correlation, but that a number of factors, including highway access make the results uncertain.

The model used to estimate ridership has found a similar correlation. While each of the network options was designed to accommodate the peak hour ridership in 2031, the actual forecast ridership varies by option. As noted in the evaluation table below, Option 4 is estimated to generate 9% more riders than Option 1. The analysis of the model results also indicate that the increased riders are moving from auto travel to transit travel.

LRT service is also more likely to attract additional midday, evening and special event ridership for the same reasons identified in the Victoria Transport Policy Institute report. As the ridership model used in this evaluation specifically addresses the AM Peak Hour, this additional ridership is not included in the analysis.

[11] Antonio M. Bento, Maureen L. Cropper, Ahmed Mushfiq Mobarak and Katja Vinha, "The Impact of Urban Spatial Structure on Travel Demand in the United States", prepared for the World Bank Development Research Group, Infrastructure and Environment, March 2003.
[12] Todd Litman, "Rail Transit in America, A Comprehensive Evaluation of Benefits", published by the Victoria Transport Policy Institute with support from the American Public Transit Association, October 2004.
[13] Parsons Brinkerhoff, "The Effect of Rail Transit on Property Values: A Summary of Studies", Draft Report, February, 2001. Results are derived from a number of other quoted reports.
[14] G. Debrezion, E. Pels and P. Rietveld, "The Impact of Railway Stations on Residential and Commercial Property Value", 2004.

The evaluation of the four options is outlined in Table 9.2.

Table 9.2: AM Peak Hour Ridership – City-wide

AM Peak Hour Ridership (City-Wide)	Existing 2007 BRT with O-Train	Forecast Planning Horizon (2031)			
		Option 1 BRT with Existing O-Train	Option 2 BRT with N-S LRT Extension	Option 3 E-W LRT with Existing O-Train	Option 4 E-W LRT and N-S LRT Extension
City-Wide Transit Ridership *(% growth over 2007 levels)*	44,500	76,400 *(72%)*	76,900 *(73%)*	78,700 *(77%)*	79,200 *(78%)*
City-Wide Mode Split	23%	29.3%	29.5%	30.2%	30.4%
Growth in Ridership *(% growth over Option 1)*		31,900	32,400 *(2%)*	34,200 *(7%)*	34,700 *(9%)*

The assessment of ridership attraction is summarized as follows:

	Option 1 Bus Based	Option 2 Bus with NS LRT	Option 3 EW LRT	Option 4 EW & NS LRT
Transportation – Ridership Attraction				
	Base ridership of 76,400 trips (Growth of 31,900 trips) Limited potential	Ridership of 76,900 trips (Growth of 32,400, 2% more than Option 1) Some potential	Ridership of 78,700 (Growth of 34,200, 7% more than Option 1) Greater potential	Ridership of 79,200 trips (Growth of 34,700, 9% more than Option 1) Greatest potential
Summary				

9.2.4. Operating Issues

This criterion focuses on how the options will function on a day-to-day basis. Emphasis is placed on how the vehicles and passengers interact, and whether the service that can be provided will be reliable and robust. OC Transpo customers, like all transit users, place a premium on fast and reliable service.

The Albert Slater section of the Transitway currently experiences reliability problems. The number of buses has been reduced to manage congestion, yet delays still happen. There are several reasons why bus the current service is less reliable than the proposed rapid transit tunnel, including:

- Fare payment and transfer checking is done on-board the vehicle, increasing the average boarding time per passenger and the variability of average boarding time;

- Boarding does not effectively use all vehicle doors, resulting in uneven dwell times;
- Buses arrive in random patterns and passengers have to walk along the platform (often in conflicting direction to other passengers) to access the bus route they want; and,
- Buses have to move in a coordinated fashion with the other buses operating around them, leading to reduced productivity as reaction time, vehicle manoeuvrability, and acceleration and deceleration rates vary.

In Option 1, there is a bus passing lane at each station location, which will help address some of the bus issues; however in Option 2 the LRT is in the other lane meaning that buses will have to queue to enter the tunnel and follow in platoon from one end to the other. There may be some potential for buses to use the LRT lane, but this will be limited as the number of trains increases. In Seattle, where joint operation of buses and trains was proposed in the same lane, the safety concerns required that all vehicles slow down, reducing throughput and affecting the capacity of the tunnel.

In Options 3 and 4, LRT movements in the tunnel will be controlled by a signal system. This system will maintain safe operating distances between trains and allow for better performance than can be achieved in a mixed operation or under unsignalized operation.

In Option 4 trains serving both the west and south LRT lines will use the same platform. The introduction of multiple branch lines into the tunnel will not impact operations if the rail junctions are designed to accommodate the required movements. Passenger information systems, including clear signage and announcements will reduce or eliminate any impacts. Many systems worldwide operate multiple lines from a single platform.

	Option 1 Bus Based	Option 2 Bus with NS LRT	Option 3 EW LRT	Option 4 EW & NS LRT
Transportation – Operating Issues				
	Operating at capacity will mean that the service reliability is substantially reduced Small delays will cascade through the system causing larger delays well after the first delay is cleared	Buses will be operating close to capacity, which may alleviate some of the reliability issues however the loss of the passing lane will affect service Allowing buses to use the LRT lane will require reduced operating speed, affecting capacity	Signalized system will operate well	Signalized system will operate well
Summary				

9.2.5. Summary

	Option 1 Bus Based	Option 2 Bus with NS LRT	Option 3 EW LRT	Option 4 EW & NS LRT
Transportation				
Accommodating Forecast Transit Ridership				
Accommodating Growth Beyond the Planning Period				
Ridership Attraction				
Operating Issues				
Transportation Summary				

9.3. Assessment of Natural Environment Criteria

9.3.1. Air Quality

The estimated vehicle kilometres for all OC Transpo services in each of the four options were used to calculate the total emissions generated. These values do not consider the reductions in emissions that result from the different ridership levels that each option will achieve. In the next phase of the study, when the secondary transit facilities are defined, the vehicle kilometres of travel by automobile will be estimated by the model and used to estimate the reduction in vehicle emissions attributed to increase transit travel.

	Option 1 Bus Based	Option 2 Bus with NS LRT	Option 3 EW LRT	Option 4 EW & NS LRT
Natural Environment – Air Quality				
	682,800 kg CO 63,900 kg HC 516,500 kg NOx 33,300 kg SOx 11,800 kg PM 88,880 t CO_2	646,900 kg CO 60,400 kg HC 489,400 kg NOx 31,600 kg SOx 11,100 kg PM 84,230 t CO_2	557,300 kg CO 52,200 kg HC 421,700 kg NOx 27,200 kg SOx 9,600 kg PM 72,560 t CO_2	512,000 kg CO 47,800 kg HC 387,300 kg NOx 25,000 SOx 8,800 kg PM 66,665 t CO_2
Summary				

9.3.2. Excavated Material

The material that will be excavated for the tunnels, the portals and the stations will have to be removed from the downtown area. Assumptions used to create the conceptual cost estimates can be used to determine the approximate amount of material to be excavated.

For the LRT options, a 6 metre diameter tunnel was assumed to accommodate a single LRT track. This will fit the majority of LRT vehicles commercially available. The LRT options also assume three stations.

The BRT and combined BRT/LRT tunnel is assumed to be a 10 metre diameter to accommodate the bus passing lane in Option 1 or the bus lane and LRT lane in Option 2. This added tunnel size has a substantial impact on the quantity of material that will be excavated. The LRT tunnels will generate approximately 140,000 cubic metres of material, whereas the larger BRT and combined BRT/LRT tunnels will generate approximately 390,000 cubic metres based on two 2.5 km tunnels.

The size of the stations will vary depending on the construction technique and the depth of the stations. For this evaluation the size is assumed to be similar for Options 1, 3 and 4. The combined BRT/LRT operation in Option 2 requires larger stations to accommodate the added platform requirements.

	Option 1 Bus Based	Option 2 Bus with NS LRT	Option 3 EW LRT	Option 4 EW & NS LRT
Natural Environment – Excavated Materials				
	Tunnels: 390,000 cu. m. Stations: 3 standard stations	Tunnels: 390,000 cu. m. Stations: 3 larger stations (to accommodate extra platforms)	Tunnels: 140,000 cu. m. Stations: 3 standard stations	Tunnels: 140,000 cu. m. Stations: 3 standard stations
Summary				

9.3.3. Use of Salt

The use of salt has been estimated based on the technology selected. Salt will be used in each scenario to melt snow and ice at stations, and on the Transitway portions of the network. No salt is required for the LRT tracks except in areas where the track bed is surfaced to allow emergency vehicle access. If all of the track bed is hard surfaced there will still be a small but significant reduction in salt use as the standard for snow clearing will be less for infrequent emergency use than for full BRT use.

	Option 1 Bus Based	Option 2 Bus with NS LRT	Option 3 EW LRT	Option 4 EW & NS LRT
Natural Environment – Use of Salt				
	Highest use	Second highest use	Second lowest use	Lowest use
Summary				

9.3.4. Summary

	Option 1 Bus Based	Option 2 Bus with NS LRT	Option 3 EW LRT	Option 4 EW & NS LRT
Natural Environment				
Air Quality				
Excavated Materials				
Salt Use				
Natural Environment Summary				

9.4. Assessment of Social/Cultural Environment Criteria

9.4.1. Property and Development Criteria

One of the most important impacts a rapid transit system will have is related to its impact on adjacent properties. Improved rapid transit improves accessibility to the station areas and the downtown. In addition the station sites can serve as potential TOD sites, further enhancing the positive impacts on property.

In the same way that utility servicing, roads and highways improve neighbourhoods and increase their value, rapid transit service can have a similar effect. The quantification of this impact is difficult to measure, however there are some conclusions that can be drawn:

- In Options 1 and 2, the BRT services using the downtown tunnel will be operating close to their theoretical capacity by 2031. As demand for travel increases and the reliability of the BRT system is reduced due to high demand there will additional pressure to add service back to the surface. This will impact the potential redevelopment opportunities in the Downtown, particularly along Albert and Slater Streets.
- Access to Downtown is improved through convenient access to rapid transit. Congestion and reliability problems associated with near-capacity operation of BRT will make that access less convenient.

	Option 1 Bus Based	Option 2 Bus with NS LRT	Option 3 EW LRT	Option 4 EW & NS LRT
Social/Cultural Environment – Property and Development Criteria				
	Continuation with the current technology will encourage similar property and development patterns	Introduction of some LRT will encourage more development in those areas	Substantial LRT network will encourage a substantial amount of property and development interest	Largest LRT network with the greatest potential to encourage property and development interest
Summary				

9.4.2. Culture and National Capital Image Criteria

In general LRT is perceived to have more prestige than buses and so tends to receive more public support as was evident by the public support of Option 4 and the suggestions that the LRT be extended beyond the Greenbelt and to the outlying communities. This attraction is attributed to the perceived higher quality ride provided by LRT, being faster, quieter and more comfortable than buses. In addition, the presence of a modern LRT system aids Ottawa's vital tourism sector, projecting a strong national capital image of Ottawa as a world class G-8 Capital and international tourist destination.

Direct rail service to the Airport from the Downtown is also a major transportation objective for many cities in the world. The benefits include a stronger tourist and business travel link to important central destinations and good rapid transit connection to other major destinations within the City. Options 2 and 4 have direct LRT service to the Airport.

	Option 1 Bus Based	Option 2 Bus with NS LRT	Option 3 EW LRT	Option 4 EW & NS LRT
Social/Cultural – Cultural and National Capital Image				
Capital Image				
Public Support				
Direct Airport Service				
Summary				

9.4.3. Noise and Vibration

Noise pollution can be described as an undesirable sound that annoys people, interferes with communication, disturbs sleep or rest or causes loss of hearing. It can come from a number of sources, including road, rail and air traffic and construction and industrial activities

> *"Almost 37% of Canadians said they were slightly to extremely bothered by noise from road traffic. When asked to rate how bothered they were with road traffic noise on a scale from zero to ten, the mean rating was 2.14 and the median rating was 1.00, suggesting that 50% of Canadians are bothered at least very slightly by road noise. The extent to which respondents were bothered by noise varied by sex, age category, income, education, work status, community size and region."*
>
> Traffic Noise Outside the Home: HealthInsider No. 8, December 2002

Noise can affect the quality of life of existing and future residents with respect to the enjoyment of the indoor living space and the outdoor amenity environment. Noise levels of the various options have been assessed on a qualitative basis for the purposes of comparison and in general, buses produce more noise than LRT. A detailed analysis of the actual levels adjacent to sensitive receptors (i.e., households) will need to be done during future assessments.

The pass-by noise levels for rail and bus transit technologies are very similar, with electric LRT being slightly quieter (typically in the range of 72 dB versus 74 dB). With respect to acceleration/deceleration, LRT vehicles will be noticeably quieter than existing buses on the street (typically 60-65 dB for LRT versus 70-75 dB for buses). For diesel engines, this increase in ambient noise is quite intrusive whereas electric LRT vehicles have no noticeable start-up/acceleration sound increase.

Vibration levels for the buses, being lighter vehicles, will be less than those of the heavier LRT vehicles. While higher than that of buses (except where buses cross a structural expansion joint, drainage catch basin or utility access cover and create a vibration from the impact), the typical LRT vibration is not intrusive and can be mitigated where sensitive receptors are an issue.

	Option 1 Bus Based	Option 2 Bus with NS LRT	Option 3 EW LRT	Option 4 EW & NS LRT
Social/Cultural Environment – Noise and Vibration				
	Largest proportion of the network is bus-based	Less bus-based activity than Option 1, however busiest routes remain bus-based	Similar to Option 4, but with more bus-based service in the south	Smallest proportion of the network is bus-based
Summary				

9.4.4. Summary

	Option 1 Bus Based	Option 2 Bus with NS LRT	Option 3 EW LRT	Option 4 EW & NS LRT
Social/Cultural Environment				
Property and Development				
Culture and National Capital Image				
Noise and Vibration				
Social/Cultural Summary				

9.5. Capital Costs

Very preliminary capital cost estimates for each of the four options are provided in Table 6.1 for comparative purposes only. These estimates include engineering and contingency costs, but make no allowance for property costs. Details are included in Appendix F.

Table 9.3: Capital Cost Estimate for OC Transpo (in Millions of $)

Section	Description	Option 1 BRT Tunnel	Option 2 BRT / LRT Tunnel (NS LRT)	Option 3 LRT Tunnel (E&W Downtown LRT)	Option 4 (E&W Downtown + NS LRT)
Central Downtown	Bayview to Hurdman (excluding Tunnel)	$49	$68	$112	$112
	Downtown Tunnel	$780	$1032	$555	$555
West Downtown	Baseline to Bayview	$22	$22	$237	$237
East Downtown	Blair to Hurdman	0	0	$97	$97
South Downtown	Bayview to Bowesville Including Airport Link	$100	$435	$100	$435
South Transitway	Barrhaven Town Centre to Bowesville	$100	$100	$100	$100
West Transitway	From Southwest Transitway to Kanata	$338	$338	$338	$338
Southwest Transitway	Cambrian to Baseline	$180	$180	$180	$180
Southeast Transitway	Greenboro to Hurdman Includes Hospital Link	$44	$44	$44	$44
East Transitways	Blair to Trim & Blair to Millennium	$239	$239	$239	$239
LRT Maintenance Facilities			$100	$100	$200
Bus Maintenance Facilities		$300	$240	$120	$120
Infrastructure Sub-Total		**$ 2,152**	**$ 2,798**	**$ 2,222**	**$ 2,657**
LRT Vehicles		**0**	**$140**	**$750**	**$890**
BRT Vehicles*	**Initial Fleet**	**$800**	**$720**	**$400**	**$320**
	Replacement Vehicles	**$600**	**$540**	**$200**	**$160**
Vehicles Sub-Total		**$1,400**	**$1,400**	**$1,350**	**$1,370**
TOTAL		**$3,552**	**$4,198**	**$3,572**	**$4,027**

* *Note*: that the capital cost estimates presented above include an allowance for vehicle replacement costs. Typically LRT vehicles last longer than buses. Therefore, in order to compare the vehicle costs between the options, replacement buses would also need to be considered. A 30 year period was assumed in determining the replacement fleet. For options 1 & 2, where all or most of the existing express buses continue to run downtown, it is assumed that ¾ of the buses would need to be replaced over the 30 years. For options 3 & 4, only ½ of the buses would need to be replaced within the 30 year time frame.

9.6. Operating Costs

The bus and LRT vehicle requirements for the four options used to develop 2031 vehicle costs (Appendix D) were used to estimate the operating cost of each scenario. These peak hour vehicle requirements also represent peak hour vehicle-hours. The hours were proportionally expanded to represent daily and annual vehicle hours for each of the vehicle types being considered.

Hourly operating costs for standard buses, high capacity buses and LRT vehicles were applied to the annual vehicle hours for each vehicle. The costs used for this analysis are $105 per hour for standard buses, $115 per hour for high capacity buses and $172 per car-hour for LRT vehicles. All numbers represent 2008 dollars. The bus costs are representative of what OC Transpo currently uses in service planning and analysis. The LRT cost comes from the City of Calgary and is the 2008 operating cost per car-hour and includes maintenance costs. This means that if a four car train of LRT vehicles is used, the actual operating cost of that train-set would be $688 per hour[15].

The following table summarizes the results of this analysis.

Table 9.4: Operating Cost of Rapid Transit Options for the Year 2031

	Option 1	Option 2	Option 3	Option 4
	BRT Tunnel	BRT / LRT Tunnel (NS LRT)	LRT Tunnel (E&W Downtown LRT)	(E&W Downtown + NS LRT)
Operating Costs	**$ 485 M**	**$ 472 M**	**$ 453 M**	**$ 434 M**

A more detailed determination of operational costs is included in Appendix F.

[15] Hourly costs for LRT operation include a component for the operator. The hourly cost assumes a mix of single and multi-unit trains and accounts for the fact that there will not be an operator required for each vehicle hour but each average train hour.

9.7. Evaluation Summary

Based on the assessment summary presented above, a relative comparison of each of the 4 primary rapid transit network options was undertaken based on the previously discussed evaluation criteria. The results of this evaluation are presented in the following table:

	Option 1 Bus Based	Option 2 Bus with NS LRT	Option 3 EW LRT	Option 4 EW & NS LRT
Evaluation Summary				
Transportation				
Natural Environment				
Social/Cultural Environment				
Capital Costs	**$3,552 M**	**$4,198 M**	**$3,572 M**	**$4,027 M**
Operating Costs	**$ 485 M**	**$ 472 M**	**$ 453 M**	**$ 434 M**
Results				

9.8. Conclusions and Recommendations

9.8.1. Conclusions

Based on the analysis of the long-range issues in the downtown and the assessment of the options the following conclusions can be drawn:

- Projected long-range transit ridership volumes into downtown Ottawa cannot be accommodated on the surface streets, consequently a grade separated solution is required;
- Elevated options were previously reviewed and rejected. This previous rationale has been reviewed and remains valid, thereby, leaving underground options as the only possibility;
- A transit tunnel is required through the Downtown;
- Any “west of Downtown” LRT should be extended at least to Lincoln Fields and Baseline Stations to minimize bus to rail transfer volumes; and,
- Any “east of Downtown” LRT should be extended at least to Blair Station in order to minimize bus to rail transfer volumes.

- Any “south of Downtown” LRT should be extended to Bowesville in order to provide a connection to the Airport, serve Riverside South and connect to the preferred maintenance yard site selected at Bowesville Rd.
- Network Option 4 is the preferred long-term primary rapid transit network option, offering the greatest benefit and value to the city. While the long-term capital cost of this option is the most expensive, it provides a number of major benefits to the City. This system results in the:
    - lowest future annual operating costs;
    - highest annual ridership;
    - lowest negative impact on the environment as a result of the lowest greenhouse gas emissions and the least amount of winter salt contamination;
    - best overall quality of rapid transit service over the entire City;
    - best overall image of the City as a world capital including a direct and attractive rail connection from the airport to downtown and the parliament precinct for visiting tourists and world delegations; and,
    - most direct rail connections between key City destinations.

9.8.2. Recommendations

Based on the assessment work included in this report, which developed ridership forecasts for the 2031 planning period, assessed passenger flows in the downtown, and developed four network and technology options to meet the downtown needs, it is recommended that:

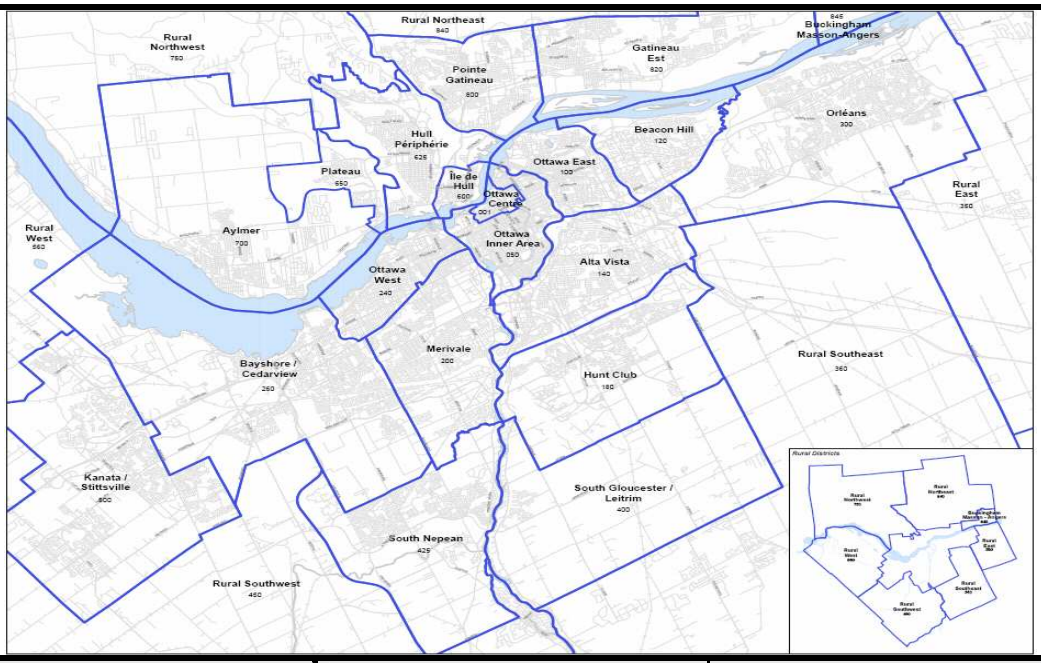
1. Council adopt an “inside-to-out” approach to rail implementation. That is, the focus of rail implementation should start in the Downtown and radiate out across the urban area.
2. Option 4, which includes constructing an LRT Tunnel in the Downtown, and East and West downtown LRT plus North-South LRT, be selected as the primary rapid transit network (to year 2031) upon which to build the remaining transportation components of the Transportation Master Plan.
3. Option 4 be recognized as a minimum network and that through the direction of Council, and the availability of funding, additional segments of Transitway be converted to LRT if growth and ridership forecasts support such conversion.

3.1.1. Next Steps

There are still several stages to completing the TMP update. With the adoption of the recommendations outlined below work will proceed to define the roles that the secondary corridors will play, and which of those corridors will be recommended for implementation over the planning period. Work will also proceed on developing a framework to assess the merits of each corridor segment to assist in developing an implementation and phasing plan.

Appendix A: Existing & Future Population & Employment

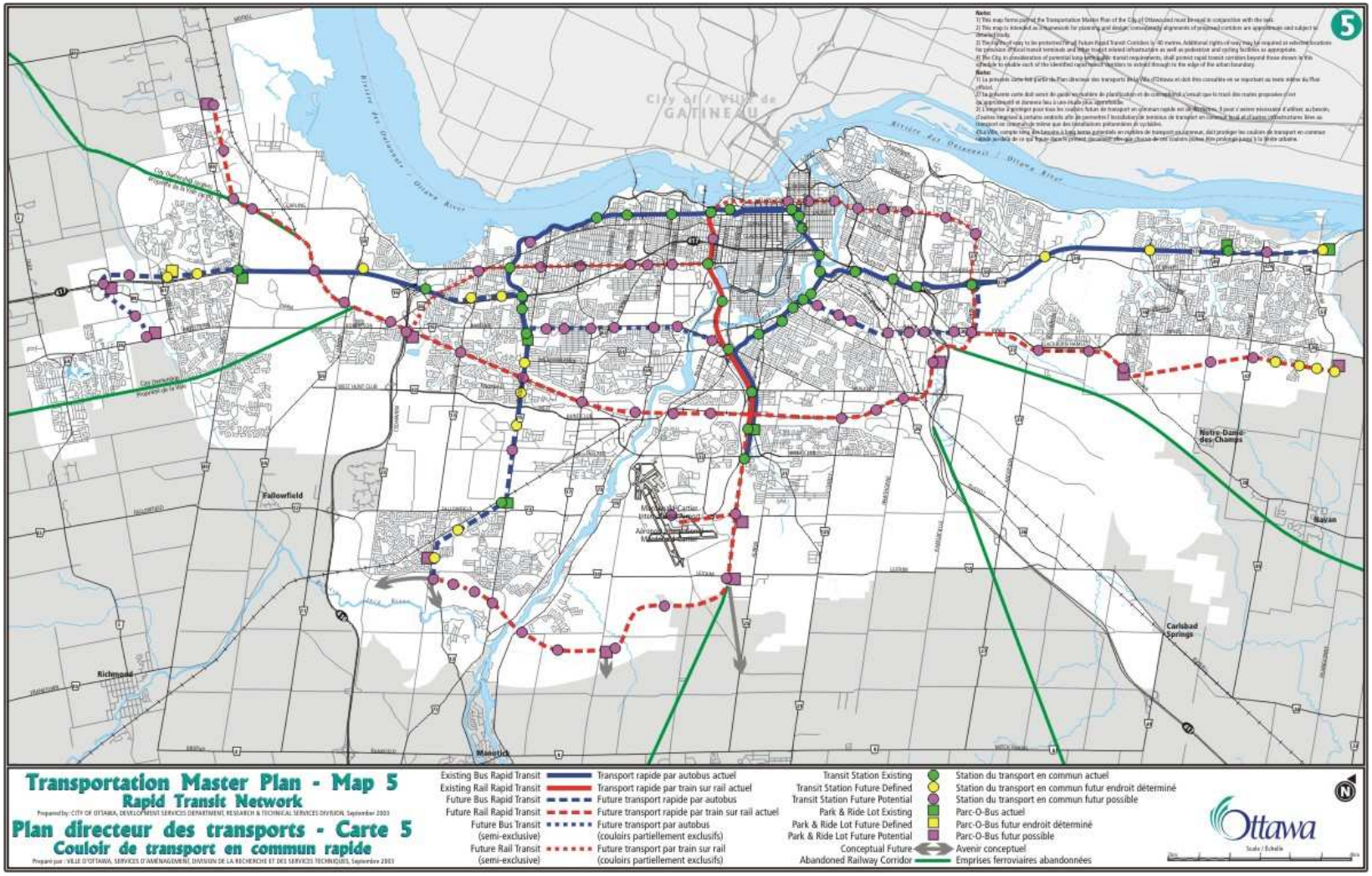
Distribution of Existing and Future 2031 Population and Employment by Planning District



District	Location	Population			Employment		
		Base Year	2031	% Growth	Base Year	2031	% Growth
Urban	Ottawa Centre	8,300	15,600	88%	94,200	109,000	16%
	Ottawa Inner Area	87,500	102,900	18%	59,700	72,000	21%
	Ottawa East	54,900	55,500	1%	25,400	27,800	9%
	Beacon Hill	32,900	46,000	40%	21,800	28,800	32%
	Alta Vista	80,900	85,900	6%	75,500	91,100	21%
	Hunt Club	56,100	59,200	6%	19,900	28,400	43%
	Merivale	78,200	81,000	4%	56,100	61,000	9%
	Ottawa West	50,000	57,200	14%	36,700	41,900	14%
	Bayshore/Cedarview	84,300	82,500	-2%	39,300	45,500	16%
	Greenbelt Subtotal	*533,100*	*585,800*	*10%*	428,600	*505,500*	18%
	Orleans	99,000	123,500	25%	17,900	35,000	96%
	South Gloucester/ Leitrim	9,500	44,600	369%	4,400	12,900	193%
	South Nepean	55,100	103,000	87%	5,400	36,400	574%
	Kanata/Stittsville	88,400	162,200	83%	43,600	77,000	77%
	Outside Greenbelt Subtotal	*252,000*	*433,300*	*72%*	*71,300*	*161,300*	126%
Rural	Rural East	12,100	13,700	13%	3,000	4,800	60%
	Rural Southeast	25,000	36,200	45%	5,600	10,000	79%
	Rural Southwest	25,000	34,800	39%	7,700	12,500	62%
	Rural West	23,600	31,900	35%	5,500	8,900	62%
	Subtotal	*85,700*	*116,600*	*36%*	*21,800*	*36,200*	66%
City of Ottawa - Total		870,800	1,135,700	30%	521,600	703,000	35%
QC	Ile de Hull	11,500	15,000	30%	25,100	49,600	98%
	Gatineau & MRC - Total	279,200	368,200	32%	102,600	163,000	59%
National Capital Area (ON & QC)		1,150,000	1,503,900	31%	624,300	866,000	39%

Base Year is used consistently throughout this report to reference the common set of OD Survey data, employment and population data, and ground traffic/transit ridership counts used in both the model calibration and validation to base year conditions (2005-2006). Note also that the geography used in presenting information by planning district within the long range planning model differs slightly from the aggregations used in the Official Plan. Rounding may also introduce slight differences when compared with other city data sources.

Appendix B: 2003 Transportation Master Plan - Rapid Transit Network



Appendix C: Existing and Future Trip Tables

C1 – Base Year - Motorized Person Trips
C2 – Forecast 2031 Planning Horizon – Motorized Person Trips
C3 – Forecast Percentage Growth 2031 Planning Horizon – Motorized Person Trips

C4 – Base Year – Transit Trips
C5 – Forecast 2031 Planning Horizon – Transit Trips
C6 – Forecast Percentage Growth 2031 Planning Horizon – Transit Trips

C7 – Base Year – Transit Trip Mode Split
C8 – Forecast 2031 Planning Horizon – Transit Trip Mode Split

C9 – Base Year – Auto Vehicle Trips
C10 – Forecast 2031 Planning Horizon – Auto Vehicle Trips
C11 – Forecast Percentage Growth 2031 Planning Horizon – Auto Vehicle Trips

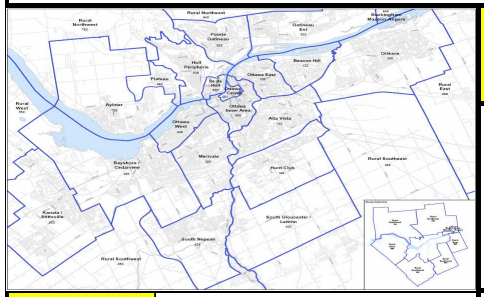
C12 – Base Year – Auto Person Trips
C13 – Forecast 2031 Planning Horizon – Auto Person Trips
C14 – Forecast Percentage Growth 2031 Planning Horizon – Auto Person Trips

(All tables are a.m. Peak Hour)

Existing and Future 2031 Person Trip Tables by Planning District

C-1 BASE YEAR Motorized Person Trips (a.m. Peak Hour)

Total Person Trips - Base Year



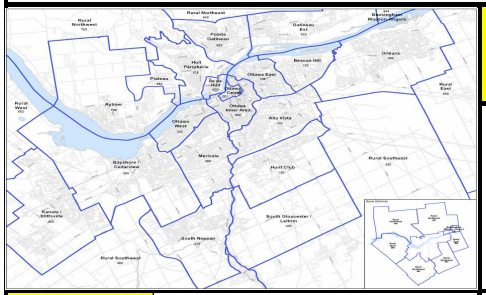
		Urban Area (Greenbelt)									Urban Area Outside Greenbelt					City of Ottawa - Total	Gatineau & MRC		National Capital Area
		Ottawa Inner Area	Ottawa East	Beacon Hill	Alta Vista	Hunt Club	Merivale	Ottawa West	Bayshore/Cedarview	Greenbelt Subtotal	Orleans	South Gloucester/ Leitrim	South Nepean	Kanata/Stittsville	Outside Greenbelt		Ile de Hull	All Districts	
Urban Area (Greenbelt)	Ottawa Inner Area	6,890	870	510	1,820	470	1,440	910	700	13,600	290	50	70	510	930	14,700	50	2,050	16,700
	Ottawa East	3,470	1,750	1,010	1,610	180	610	330	250	9,200	340	70	20	180	610	9,900	270	840	10,800
	Beacon Hill	1,920	700	1,400	1,070	90	320	210	140	5,800	450	20	20	110	590	6,500	150	360	6,900
	Alta Vista	4,830	960	790	4,460	810	1,240	460	450	14,000	550	70	120	300	1,030	15,200	260	800	16,000
	Hunt Club	2,830	330	310	2,720	1,590	1,250	360	360	9,800	180	160	70	220	630	10,700	290	470	11,100
	Merivale	4,410	440	250	1,640	500	4,460	1,370	1,550	14,600	160	120	360	770	1,410	16,300	330	780	17,100
	Ottawa West	2,440	250	160	750	130	1,330	1,630	900	7,600	120	30	90	370	610	8,300	280	690	9,000
	Bayshore/Cedarview	3,410	310	220	1,130	330	2,700	1,460	4,020	13,600	140	80	420	1,470	2,120	16,000	350	760	16,800
	Greenbelt Subtotal	30,200	5,600	4,600	15,200	4,100	13,400	6,700	8,400	88,200	2,200	600	1,200	3,900	7,900	97,600	2,000	6,800	104,300
Urban Area Outside Greenbelt	Orleans	5,180	1,360	1,900	2,710	320	1,000	560	470	13,500	6,660	130	120	270	7,180	21,100	490	1,070	22,200
	South Gloucester/ Leitrim	370	40	30	290	180	240	60	80	1,300	20	230	40	50	340	1,800	50	90	1,900
	South Nepean	1,950	200	120	910	340	1,780	530	1,280	7,100	100	80	2,530	720	3,430	10,800	150	370	11,200
	Kanata/Stittsville	2,710	300	150	900	250	1,550	530	2,220	8,600	120	50	250	7,340	7,760	17,000	210	470	17,500
	Outside Greenbelt Subtotal	10,200	1,900	2,200	4,800	1,100	4,600	1,700	4,000	30,500	6,900	500	2,900	8,400	18,700	50,700	900	2,000	52,700
City of Ottawa - Total		42,600	8,000	7,200	21,400	5,700	19,300	8,800	13,500	126,600	9,800	1,400	4,600	14,300	30,100	163,400	3,000	9,200	172,600
Gatineau & MRC	Ile de Hull	660	80	50	120	20	130	130	70	1,300	30	0	10	40	90	1,400	230	930	2,300
	All Districts	9,340	1,220	840	2,180	420	1,490	1,450	750	17,700	460	160	90	540	1,230	19,200	4,580	33,000	52,100
National Capital Area		52,000	9,200	8,000	23,600	6,200	20,800	10,300	14,200	144,300	10,300	1,500	4,600	14,900	31,300	182,600	7,610	42,200	225,000

Existing and Future 2031 Person Trip Tables by Planning District

C-2 FORECAST 2031 PLANNING HORIZON

Motorized Person Trips (a.m. Peak Hour)

Total Person Trips - 2031



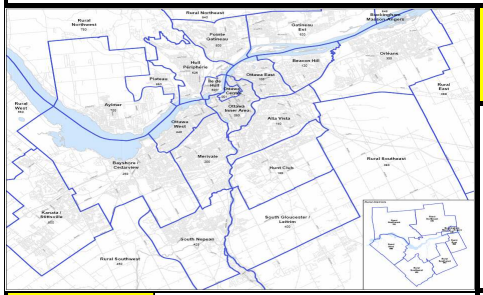
		Urban Area (Greenbelt)									Urban Area Outside Greenbelt					City of Ottawa - Total	Gatineau & MRC		National Capital Area
		Ottawa Inner Area	Ottawa East	Beacon Hill	Alta Vista	Hunt Club	Merivale	Ottawa West	Bayshore/Cedarview	Greenbelt Subtotal	Orleans	South Gloucester/ Leitrim	South Nepean	Kanata/Stittsville	Outside Greenbelt		Ile de Hull	All Districts	
Urban Area (Greenbelt)	Ottawa Inner Area	6,950	740	600	2,050	560	1,370	940	700	13,900	480	100	210	710	1,500	15,610	50	870	16,480
	Ottawa East	3,410	1,420	1,150	1,810	210	580	340	230	9,200	460	90	40	260	850	10,180	520	1,240	11,420
	Beacon Hill	2,370	810	2,050	1,470	160	380	270	180	7,700	770	30	60	190	1,050	8,860	360	920	9,780
	Alta Vista	5,150	940	910	5,250	980	1,250	530	470	15,500	770	170	310	430	1,670	17,430	500	1,260	18,690
	Hunt Club	2,830	290	320	2,750	1,780	1,180	380	360	9,900	230	280	190	280	970	11,220	490	740	11,960
	Merivale	4,380	400	270	1,730	580	4,340	1,460	1,530	14,700	230	260	750	1,070	2,300	17,330	610	1,190	18,520
	Ottawa West	2,700	250	200	910	160	1,320	1,940	960	8,400	190	50	170	500	910	9,480	610	1,200	10,670
	Bayshore/Cedarview	3,360	280	230	1,210	340	2,360	1,520	3,830	13,100	170	110	690	1,770	2,740	16,220	560	1,010	17,230
	Greenbelt Subtotal	31,200	5,100	5,700	17,200	4,800	12,800	7,400	8,300	92,400	3,300	1,100	2,400	5,200	12,000	106,300	3,700	8,400	114,800
Urban Area Outside Greenbelt	Orleans	5,340	1,300	2,120	3,050	380	920	630	470	14,200	10,470	180	220	360	11,240	26,030	850	1,730	27,770
	South Gloucester/ Leitrim	1,090	80	140	1,030	880	740	210	280	4,500	170	2,480	1,230	270	4,140	9,340	320	540	9,880
	South Nepean	2,600	300	150	1,340	590	2,250	670	1,810	9,700	250	1,150	8,620	1,760	11,780	22,040	380	970	23,010
	Kanata/Stittsville	3,810	390	250	1,320	440	1,960	750	2,990	11,900	290	230	1,580	16,990	19,080	32,200	600	1,500	33,690
	Outside Greenbelt Subtotal	12,800	2,100	2,700	6,700	2,300	5,900	2,300	5,600	40,300	11,200	4,000	11,600	19,400	46,200	89,600	2,100	4,700	94,400
City of Ottawa - Total		47,000	7,800	8,800	25,800	7,800	20,300	10,200	15,100	142,900	15,500	5,700	15,000	27,500	63,800	217,200	6,200	13,900	231,100
Gatineau & MRC	Ile de Hull	730	90	70	150	30	140	140	80	1,400	60	10	20	70	150	1,580	500	1,550	3,130
	All Districts	11,770	1,840	1,740	3,370	610	1,820	1,880	1,010	24,000	1,300	220	380	980	2,870	27,320	7,920	47,400	74,700
National Capital Area		58,740	9,630	10,590	29,170	8,450	22,140	12,060	16,140	166,900	16,780	5,970	15,410	28,470	66,630	244,550	14,110	61,300	306,000

Existing and Future 2031 Person Trip Tables by Planning District

C-3 FORECAST PERCENTAGE GROWTH 2031 PLANNING HORIZON

Motorized Person Trips (a.m. Peak Hour)

Percentage Growth in Total Person Trips - Base Year to 2031

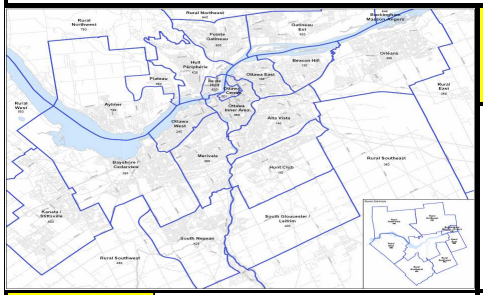


		Urban Area (Greenbelt)								Urban Area Outside Greenbelt					City of Ottawa - Total	Gatineau & MRC		National Capital Area
		Ottawa Inner Area	Ottawa East	Beacon Hill	Alta Vista	Hunt Club	Merivale	Ottawa West	Bayshore/Cedarview	Greenbelt Subtotal	Orleans	South Gloucester/ Leitrim	South Nepean	Kanata/Stittsville	Outside Greenbelt		Ile de Hull	All Districts	
Urban Area (Greenbelt)	Ottawa Inner Area	1%	-15%	18%	13%	19%	-5%	3%	0%	2%	66%	100%	200%	39%	61%	6%	0%	-58%	-1%
	Ottawa East	-2%	-19%	14%	12%	17%	-5%	3%	-8%	0%	35%	29%	100%	44%	39%	3%	93%	48%	6%
	Beacon Hill	23%	16%	46%	37%	78%	19%	29%	29%	33%	71%	50%	200%	73%	78%	36%	140%	156%	42%
	Alta Vista	7%	-2%	15%	18%	21%	1%	15%	4%	11%	40%	143%	158%	43%	62%	15%	92%	58%	17%
	Hunt Club	0%	-12%	3%	1%	12%	-6%	6%	0%	1%	28%	75%	171%	27%	54%	5%	69%	57%	8%
	Merivale	-1%	-9%	8%	5%	16%	-3%	7%	-1%	1%	44%	117%	108%	39%	63%	6%	85%	53%	8%
	Ottawa West	11%	0%	25%	21%	23%	-1%	19%	7%	11%	58%	67%	89%	35%	49%	14%	118%	74%	19%
	Bayshore/Cedarview	-1%	-10%	5%	7%	3%	-13%	4%	-5%	-4%	21%	38%	64%	20%	29%	1%	60%	33%	3%
	Greenbelt Subtotal	3%	-9%	24%	13%	17%	-4%	10%	-1%	5%	50%	83%	100%	33%	52%	9%	85%	24%	10%
Urban Area Outside Greenbelt	Orleans	3%	-4%	12%	13%	19%	-8%	13%	0%	5%	57%	38%	83%	33%	57%	23%	73%	62%	25%
	South Gloucester/ Leitrim	195%	100%	367%	255%	389%	208%	250%	250%	246%	750%	978%	2975%	440%	1118%	419%	540%	500%	420%
	South Nepean	33%	50%	25%	47%	74%	26%	26%	41%	37%	150%	1338%	241%	144%	243%	104%	153%	162%	105%
	Kanata/Stittsville	41%	30%	67%	47%	76%	26%	42%	35%	38%	142%	360%	532%	131%	146%	89%	186%	219%	93%
	Outside Greenbelt Subtotal	25%	11%	23%	40%	109%	28%	35%	40%	32%	62%	700%	300%	131%	147%	77%	133%	135%	79%
City of Ottawa - Total		10%	-3%	22%	21%	37%	5%	16%	12%	13%	58%	307%	226%	92%	112%	33%	107%	51%	34%
Gatineau & MRC	Ile de Hull	11%	13%	40%	25%	50%	8%	8%	14%	8%	100%	>1000%	100%	75%	67%	13%	117%	67%	36%
	All Districts	26%	51%	107%	55%	45%	22%	30%	35%	36%	183%	38%	322%	81%	133%	42%	73%	44%	43%
National Capital Area		13%	5%	32%	24%	36%	6%	17%	14%	16%	63%	298%	235%	91%	113%	34%	85%	45%	36%

Existing and Future 2031 Transit Trip Tables by Planning District

C-4 BASE YEAR Transit Trips (a.m. Peak Hour)

Transit Ridership - Base Year



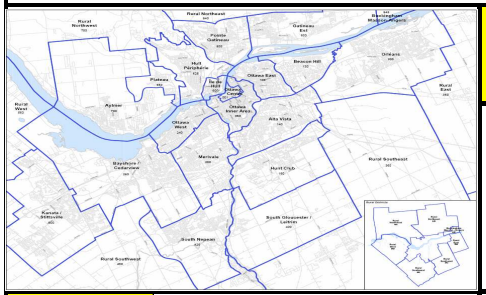
		Urban Area (Greenbelt)								Urban Area Outside Greenbelt					City of Ottawa - Total	Gatineau & MRC		National Capital Area
		Ottawa Inner Area	Ottawa East	Beacon Hill	Alta Vista	Hunt Club	Merivale	Ottawa West	Bayshore/Cedarview	Greenbelt Subtotal	Orleans	South Gloucester/ Leitrim	South Nepean	Kanata/Stittsville	Outside Greenbelt		Ile de Hull	All Districts	
Urban Area (Greenbelt)	Ottawa Inner Area	2,340	200	120	420	80	390	240	150	4,000	60	0	10	110	170	4,100	210	370	4,500
	Ottawa East	1,480	190	300	270	20	160	80	40	2,500	50	0	0	40	90	2,600	80	180	2,800
	Beacon Hill	950	120	180	170	10	90	60	20	1,600	50	0	0	20	70	1,700	50	70	1,700
	Alta Vista	2,210	140	190	760	70	250	100	60	3,800	70	0	10	30	110	3,900	90	160	4,100
	Hunt Club	1,360	60	70	700	150	230	70	40	2,700	20	0	0	10	40	2,700	90	120	2,800
	Merivale	1,880	80	50	280	40	640	320	200	3,500	20	0	30	90	140	3,600	90	130	3,800
	Ottawa West	1,070	50	40	160	20	280	230	130	2,000	20	0	10	40	80	2,100	80	140	2,200
	Bayshore/Cedarview	1,770	80	60	240	30	490	380	650	3,700	30	0	40	140	210	3,900	120	190	4,100
	Greenbelt Subtotal	13,100	900	1,000	3,000	400	2,500	1,500	1,300	23,700	300	0	100	500	900	24,600	800	1,400	26,000
Urban Area Outside Greenbelt	Orleans	3,300	340	430	610	50	390	210	130	5,500	670	0	20	60	760	6,200	240	340	6,600
	South Gloucester/ Leitrim	150	10	0	30	10	20	10	0	200	0	0	0	0	10	200	10	10	200
	South Nepean	1,110	50	30	150	20	280	140	130	1,900	20	0	380	50	440	2,400	60	90	2,400
	Kanata/Stittsville	1,720	90	40	210	20	300	130	220	2,700	20	0	10	610	640	3,400	80	120	3,500
	Outside Greenbelt Subtotal	6,300	500	500	1,000	100	1,000	500	500	10,300	700	0	400	700	1,900	12,200	400	600	12,800
City of Ottawa - Total		20,100	1,400	1,500	4,100	500	3,600	2,000	1,800	35,000	1,000	0	500	1,200	2,800	37,900	1,200	2,000	39,800
Gatineau & MRC	Ile de Hull	300	20	10	30	0	40	40	20	500	10	0	0	10	20	500	40	150	630
	All Districts	3,810	210	140	290	40	210	260	80	5,000	60	0	10	50	120	5,200	1,350	4,500	9,700
National Capital Area		23,900	1,700	1,700	4,300	600	3,800	2,300	1,900	40,000	1,100	0	500	1,300	2,900	43,000	2,560	6,500	49,000

Existing and Future 2031 Transit Trip Tables by Planning District

C-5 FORECAST 2031 PLANNING HORIZON

Transit Trips (a.m. Peak Hour)

Transit Ridership - 2031



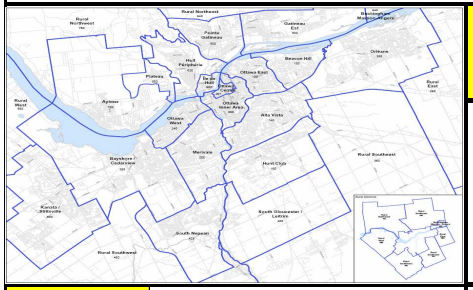
		Urban Area (Greenbelt)									Urban Area Outside Greenbelt					City of Ottawa - Total	Gatineau & MRC		National Capital Area
		Ottawa Inner Area	Ottawa East	Beacon Hill	Alta Vista	Hunt Club	Merivale	Ottawa West	Bayshore/Cedarview	Greenbelt Subtotal	Orleans	South Gloucester/ Leitrim	South Nepean	Kanata/Stittsville	Outside Greenbelt		Ile de Hull	All Districts	
Urban Area (Greenbelt)	Ottawa Inner Area	2,990	200	180	590	150	470	300	220	5,100	160	20	70	290	530	5,640	640	1,070	6,710
	Ottawa East	1,690	210	420	430	50	220	100	70	3,200	130	10	10	100	240	3,410	230	410	3,820
	Beacon Hill	1,280	150	380	350	30	150	90	50	2,500	170	0	20	80	270	2,760	180	290	3,050
	Alta Vista	2,830	190	310	1,460	160	360	170	110	5,600	210	20	80	150	450	6,040	260	400	6,450
	Hunt Club	1,540	70	90	840	250	320	110	80	3,300	50	30	20	80	190	3,500	260	310	3,810
	Merivale	2,260	110	80	400	80	880	440	310	4,600	80	20	140	310	560	5,120	270	360	5,490
	Ottawa West	1,440	70	60	280	40	370	440	210	2,900	70	10	40	150	270	3,180	300	430	3,610
	Bayshore/Cedarview	2,060	100	80	390	60	540	500	870	4,600	70	10	170	450	700	5,300	310	400	5,700
	Greenbelt Subtotal	16,100	1,100	1,600	4,700	800	3,300	2,100	1,900	31,700	900	100	600	1,600	3,200	35,000	2,400	3,700	38,600
Urban Area Outside Greenbelt	Orleans	3,710	420	720	970	100	470	280	180	6,800	1,720	10	80	160	1,970	8,820	560	760	9,580
	South Gloucester/ Leitrim	620	20	30	210	130	120	50	30	1,200	40	290	190	30	550	1,770	190	260	2,030
	South Nepean	1,780	110	50	380	110	540	260	420	3,700	90	360	1,500	420	2,360	6,030	270	460	6,490
	Kanata/Stittsville	2,870	190	120	570	110	700	300	630	5,500	140	20	210	2,860	3,220	8,720	400	610	9,330
	Outside Greenbelt Subtotal	9,000	700	900	2,100	400	1,800	900	1,300	17,200	2,000	700	2,000	3,500	8,100	25,300	1,400	2,100	27,400
City of Ottawa - Total		26,200	1,900	2,600	7,000	1,300	5,300	3,100	3,300	50,700	3,000	800	2,600	5,200	11,600	62,300	3,900	5,800	68,200
Gatineau & MRC	Ile de Hull	400	30	20	50	10	60	50	30	700	20	0	10	30	70	720	150	480	1,200
	All Districts	6,110	470	490	910	140	470	570	260	9,400	380	20	170	290	860	10,300	3,310	10,700	21,000
National Capital Area		32,350	2,400	3,060	7,950	1,420	5,750	3,690	3,530	60,100	3,420	820	2,740	5,460	12,440	72,650	7,240	16,500	89,000

Existing and Future 2031 Transit Trip Tables by Planning District

C-6 FORECAST PERCENTAGE GROWTH 2031 PLANNING HORIZON

Transit Trips (a.m. Peak Hour)

Percentage Growth in Transit Trips - Base Year to 2031

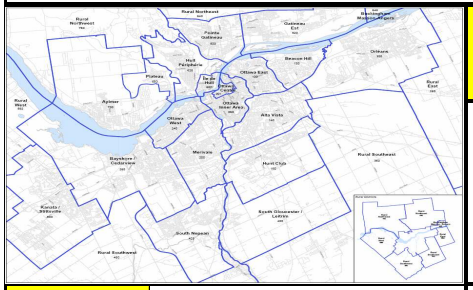


		Urban Area (Greenbelt)									Urban Area Outside Greenbelt					City of Ottawa - Total	Gatineau & MRC		National Capital Area
		Ottawa Inner Area	Ottawa East	Beacon Hill	Alta Vista	Hunt Club	Merivale	Ottawa West	Bayshore/Cedarview	Greenbelt Subtotal	Orleans	South Gloucester/ Leitrim	South Nepean	Kanata/Stittsville	Outside Greenbelt		Ile de Hull	All Districts	
Urban Area (Greenbelt)	Ottawa Inner Area	28%	0%	50%	40%	88%	21%	25%	47%	28%	167%	>1000%	600%	164%	212%	38%	205%	189%	49%
	Ottawa East	14%	11%	40%	59%	150%	38%	25%	75%	28%	160%	>1000%	>1000%	150%	167%	31%	188%	128%	36%
	Beacon Hill	35%	25%	111%	106%	200%	67%	50%	150%	56%	240%	>1000%	>1000%	300%	286%	62%	260%	314%	79%
	Alta Vista	28%	36%	63%	92%	129%	44%	70%	83%	47%	200%	>1000%	700%	400%	309%	55%	189%	150%	57%
	Hunt Club	13%	17%	29%	20%	67%	39%	57%	100%	22%	150%	>1000%	>1000%	700%	375%	30%	189%	158%	36%
	Merivale	20%	38%	60%	43%	100%	38%	38%	55%	31%	300%	>1000%	367%	244%	300%	42%	200%	177%	44%
	Ottawa West	35%	40%	50%	75%	100%	32%	91%	62%	45%	250%	>1000%	300%	275%	238%	51%	275%	207%	64%
	Bayshore/Cedarview	16%	25%	33%	63%	100%	10%	32%	34%	24%	133%	>1000%	325%	221%	233%	36%	158%	111%	39%
	Greenbelt Subtotal	23%	22%	60%	57%	100%	32%	40%	46%	34%	200%	>1000%	500%	220%	256%	42%	200%	164%	48%
Urban Area Outside Greenbelt	Orleans	12%	24%	67%	59%	100%	21%	33%	38%	24%	157%	>1000%	300%	167%	159%	42%	133%	124%	45%
	South Gloucester/ Leitrim	313%	100%	>1000%	600%	1200%	500%	400%	>1000%	500%	>1000%	>1000%	>1000%	>1000%	5400%	785%	>1000%	>1000%	915%
	South Nepean	60%	120%	67%	153%	450%	93%	86%	223%	95%	350%	>1000%	295%	740%	436%	151%	350%	411%	170%
	Kanata/Stittsville	67%	111%	200%	171%	450%	133%	131%	186%	104%	600%	>1000%	2000%	369%	403%	156%	400%	408%	167%
	Outside Greenbelt Subtotal	43%	40%	80%	110%	300%	80%	80%	160%	67%	186%	>1000%	400%	400%	326%	107%	250%	250%	114%
City of Ottawa - Total		30%	36%	73%	71%	160%	47%	55%	83%	45%	200%	>1000%	420%	333%	314%	64%	225%	190%	71%
Gatineau & MRC	Ile de Hull	33%	50%	100%	67%	>1000%	50%	25%	50%	40%	100%	>1000%	>1000%	200%	250%	44%	275%	220%	90%
	All Districts	60%	124%	250%	214%	250%	124%	119%	225%	88%	533%	>1000%	1600%	480%	617%	98%	145%	138%	116%
National Capital Area		35%	41%	80%	85%	137%	51%	60%	86%	50%	211%	>1000%	448%	320%	329%	69%	183%	154%	82%

Existing and Future 2031 Transit Mode Split Tables by Planning District

C-7 BASE YEAR Transit Trip Mode Split Percentage (a.m. Peak Hour)

Transit Mode Split - Base Year



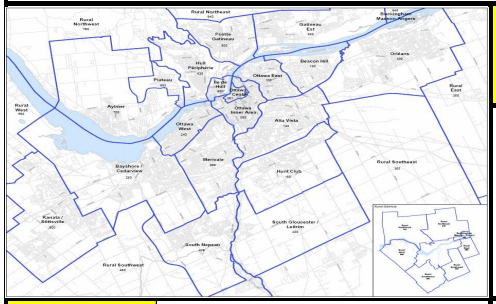
		Urban Area (Greenbelt)									Urban Area Outside Greenbelt					City of Ottawa - Total	Gatineau & MRC		Natiiona Capital Area
		Ottawa Inner Area	Ottawa East	Beacon Hill	Alta Vista	Hunt Club	Merivale	Ottawa West	Bayshore/Cedarview	Greenbelt Subtotal	Orleans	South Gloucester/ Leitrim	South Nepean	Kanata/Stittsville	Outside Greenbelt		Ile de Hull	All Districts	
Urban Area (Greenbelt)	Ottawa Inner Area	34%	24%	24%	23%	17%	27%	27%	22%	29%	19%	6%	11%	21%	19%	28%	34%	23%	28%
	Ottawa East	43%	11%	30%	17%	12%	27%	23%	17%	28%	15%	3%	9%	21%	15%	27%	28%	22%	26%
	Beacon Hill	49%	16%	13%	16%	12%	29%	27%	17%	27%	11%	1%	10%	21%	12%	26%	32%	20%	25%
	Alta Vista	46%	14%	25%	17%	9%	20%	22%	13%	27%	12%	3%	9%	12%	11%	26%	33%	20%	25%
	Hunt Club	48%	19%	22%	26%	9%	18%	19%	11%	27%	11%	3%	3%	7%	6%	26%	32%	25%	25%
	Merivale	43%	18%	21%	17%	8%	14%	23%	13%	24%	15%	2%	8%	11%	10%	22%	28%	17%	22%
	Ottawa West	44%	22%	24%	21%	16%	21%	14%	14%	26%	18%	4%	11%	12%	12%	25%	30%	20%	24%
	Bayshore/Cedarview	52%	24%	27%	21%	9%	18%	26%	16%	27%	20%	2%	9%	10%	10%	24%	34%	25%	24%
	Greenbelt Subtotal	43%	16%	22%	20%	10%	19%	22%	15%	27%	14%	3%	9%	12%	12%	25%	32%	21%	25%
Urban Area Outside Greenbelt	Orleans	64%	25%	23%	23%	16%	39%	37%	28%	40%	10%	3%	21%	24%	11%	30%	49%	32%	30%
	South Gloucester/ Leitrim	40%	14%	7%	10%	7%	10%	13%	5%	18%	4%	1%	2%	3%	2%	13%	19%	14%	13%
	South Nepean	57%	25%	27%	16%	6%	16%	26%	10%	27%	18%	1%	15%	6%	13%	22%	44%	24%	22%
	Kanata/Stittsville	63%	30%	30%	23%	10%	19%	24%	10%	32%	20%	1%	4%	8%	8%	20%	41%	26%	20%
	Outside Greenbelt Subtotal	61%	26%	23%	21%	10%	22%	29%	12%	34%	10%	2%	14%	9%	10%	24%	45%	28%	24%
City of Ottawa - Total		47%	18%	21%	19%	9%	19%	23%	13%	28%	11%	2%	11%	9%	9%	23%	34%	22%	23%
Gatineau & MRC	Ile de Hull	46%	26%	25%	23%	16%	30%	29%	22%	36%	22%	2%	12%	18%	19%	35%	15%	17%	28%
	All Districts	41%	18%	17%	13%	9%	14%	18%	10%	28%	14%	1%	7%	9%	10%	27%	29%	14%	19%
Natiiona Capital Area		46%	18%	21%	18%	9%	18%	22%	13%	28%	11%	2%	11%	9%	9%	24%	31%	16%	22%

Existing and Future 2031 Transit Mode Split Tables by Planning District

C-8 FORECAST 2031 PLANNING HORIZON

Transit Trip Mode Split Percentage (a.m. Peak Hour)

Transit Mode Share - 2031

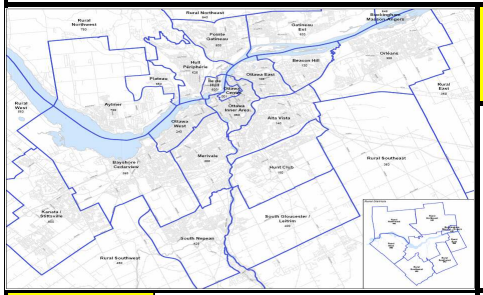


		Urban Area (Greenbelt)									Urban Area Outside Greenbelt					City of Ottawa - Total	Gatineau & MRC		Natiiona Capital Area
		Ottawa Inner Area	Ottawa East	Beacon Hill	Alta Vista	Hunt Club	Merivale	Ottawa West	Bayshore/Cedarview	Greenbelt Subtotal	Orleans	South Gloucester/ Leitrim	South Nepean	Kanata/Stittsville	Outside Greenbelt		Ile de Hull	All Districts	
Urban Area (Greenbelt)	Ottawa Inner Area	43%	28%	30%	29%	27%	34%	32%	31%	37%	34%	20%	31%	41%	36%	36%	49%	38%	36%
	Ottawa East	50%	14%	37%	24%	22%	37%	29%	28%	35%	27%	7%	23%	37%	28%	34%	45%	33%	33%
	Beacon Hill	54%	18%	18%	24%	22%	40%	34%	29%	32%	22%	9%	32%	44%	26%	31%	50%	32%	31%
	Alta Vista	55%	20%	34%	28%	16%	29%	32%	23%	36%	27%	13%	25%	34%	27%	35%	52%	32%	34%
	Hunt Club	55%	26%	27%	31%	14%	27%	29%	23%	33%	23%	10%	13%	30%	20%	31%	53%	42%	32%
	Merivale	52%	27%	29%	23%	14%	20%	30%	20%	31%	34%	8%	19%	29%	24%	30%	44%	30%	30%
	Ottawa West	53%	30%	32%	30%	26%	28%	23%	22%	35%	34%	14%	26%	30%	29%	34%	48%	36%	34%
	Bayshore/Cedarview	61%	34%	34%	32%	18%	23%	33%	23%	35%	40%	9%	25%	25%	26%	33%	55%	39%	33%
	Greenbelt Subtotal	52%	21%	28%	28%	17%	26%	29%	23%	34%	28%	11%	23%	31%	27%	33%	49%	35%	33%
Urban Area Outside Greenbelt	Orleans	69%	32%	34%	32%	26%	51%	44%	39%	48%	16%	5%	34%	45%	18%	34%	66%	44%	34%
	South Gloucester/ Leitrim	57%	28%	23%	21%	15%	16%	23%	10%	27%	24%	12%	15%	13%	13%	19%	61%	48%	21%
	South Nepean	68%	38%	33%	28%	18%	24%	39%	23%	38%	37%	31%	17%	24%	20%	27%	70%	47%	28%
	Kanata/Stittsville	75%	49%	48%	43%	24%	36%	40%	21%	46%	47%	8%	13%	17%	17%	27%	67%	40%	28%
	Outside Greenbelt Subtotal	70%	36%	35%	32%	19%	31%	39%	23%	43%	18%	17%	17%	18%	18%	28%	66%	44%	29%
City of Ottawa - Total		56%	25%	29%	27%	16%	26%	31%	22%	35%	20%	14%	17%	19%	18%	29%	53%	37%	29%
Gatineau & MRC	Ile de Hull	55%	33%	35%	34%	31%	43%	37%	41%	46%	43%	23%	39%	48%	44%	46%	31%	31%	38%
	All Districts	52%	26%	28%	27%	22%	26%	30%	26%	39%	30%	8%	44%	30%	30%	38%	42%	23%	28%
Natiiona Capital Area		55%	25%	29%	27%	17%	26%	31%	22%	36%	20%	14%	18%	19%	19%	30%	47%	26%	29%

Existing and Future 2031 Auto Vehicle Trip Tables by Planning District

C-9 BASE YEAR Auto Vehicle Trips (a.m. Peak Hour)

Auto Vehicle - Base Year

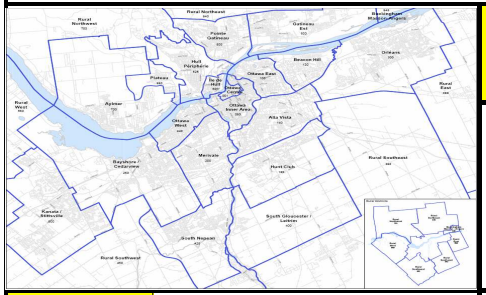


		Urban Area (Greenbelt)									Urban Area Outside Greenbelt					City of Ottawa - Total	Gatineau & MRC		National Capital Area
		Ottawa Inner Area	Ottawa East	Beacon Hill	Alta Vista	Hunt Club	Merivale	Ottawa West	Bayshore/Cedarview	Greenbelt Subtotal	Orleans	South Gloucester/ Leitrim	South Nepean	Kanata/Stittsville	Outside Greenbelt		Ile de Hull	All Districts	
Urban Area (Greenbelt)	Ottawa Inner Area	3,440	520	330	1,180	340	870	540	460	7,700	200	40	50	350	640	8,400	330	1,020	9,500
	Ottawa East	1,530	1,140	490	1,130	130	360	220	170	5,200	240	50	20	100	410	5,700	160	520	6,200
	Beacon Hill	790	470	920	770	70	200	130	100	3,400	330	10	10	70	430	3,900	90	240	4,200
	Alta Vista	2,090	710	450	2,880	650	840	310	350	8,300	400	60	90	230	780	9,200	150	480	9,700
	Hunt Club	1,220	220	200	1,620	1,190	840	260	280	5,800	140	130	60	180	510	6,600	170	310	6,900
	Merivale	2,040	300	170	1,190	410	2,980	800	1,140	9,000	110	110	280	580	1,080	10,300	200	480	10,800
	Ottawa West	1,110	170	100	510	90	820	1,020	650	4,500	80	30	70	280	460	5,000	170	440	5,400
	Bayshore/Cedarview	1,370	210	140	770	260	1,870	860	2,580	8,100	100	70	320	1,150	1,630	10,000	200	460	10,400
	Greenbelt Subtotal	13,600	3,700	2,800	10,000	3,100	8,800	4,100	5,700	52,000	1,600	500	900	2,900	5,900	59,100	1,500	3,900	63,000
Urban Area Outside Greenbelt	Orleans	1,580	860	1,110	1,840	240	520	310	300	6,800	4,530	110	80	180	4,900	12,000	220	630	12,600
	South Gloucester/ Leitrim	190	30	20	230	150	180	50	70	900	20	180	40	50	280	1,300	30	60	1,300
	South Nepean	700	140	80	670	280	1,290	330	980	4,500	70	70	1,530	590	2,260	6,900	70	240	7,200
	Kanata/Stittsville	830	180	90	600	200	1,090	360	1,720	5,100	80	40	200	5,350	5,670	11,300	110	300	11,600
	Outside Greenbelt Subtotal	3,300	1,200	1,300	3,300	900	3,100	1,100	3,100	17,200	4,700	400	1,800	6,200	13,100	31,500	400	1,200	32,700
City of Ottawa - Total		18,100	5,300	4,400	14,600	4,500	13,000	5,500	9,700	75,100	6,800	1,200	3,100	10,700	21,800	102,200	2,000	5,500	107,700
Gatineau & MRC	Ile de Hull	290	50	30	80	10	70	80	40	700	20	0	0	30	60	700	150	600	1,330
	All Districts	4,530	870	590	1,650	340	1,090	1,040	570	10,700	340	130	70	420	960	11,800	2,630	22,500	34,400
National Capital Area		22,700	6,200	5,000	16,200	4,800	14,100	6,600	10,300	85,800	7,100	1,300	3,200	11,200	22,800	114,100	4,660	28,000	142,000

Existing and Future 2031 Auto Vehicle Trip Tables by Planning District

C-10 FORECAST 2031 PLANNING HORIZON — Auto Vehicle Trips (a.m. Peak Hour)

Auto Vehicle - 2031



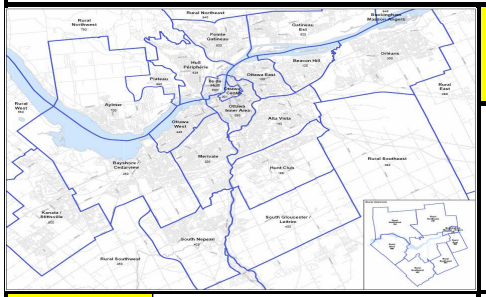
		Urban Area (Greenbelt)									Urban Area Outside Greenbelt					City of Ottawa - Total	Gatineau & MRC		National Capital Area
		Ottawa Inner Area	Ottawa East	Beacon Hill	Alta Vista	Hunt Club	Merivale	Ottawa West	Bayshore/Cedarview	Greenbelt Subtotal	Orleans	South Gloucester/ Leitrim	South Nepean	Kanata/Stittsville	Outside Greenbelt		Ile de Hull	All Districts	
Urban Area (Greenbelt)	Ottawa Inner Area	2,970	440	360	1,230	350	750	520	410	7,000	270	70	130	360	820	7,990	550	1,420	9,410
	Ottawa East	1,330	990	520	1,200	150	300	210	150	4,800	280	60	30	110	480	5,410	240	700	6,120
	Beacon Hill	900	570	1,270	990	110	200	150	110	4,300	500	30	40	80	640	5,050	150	530	5,580
	Alta Vista	1,890	660	480	3,060	740	760	310	320	8,200	480	120	200	250	1,050	9,490	210	740	10,230
	Hunt Club	1,080	190	210	1,600	1,260	730	240	250	5,600	160	210	140	170	670	6,510	200	370	6,880
	Merivale	1,740	250	170	1,180	440	2,780	790	1,030	8,400	130	190	520	610	1,450	10,120	290	700	10,820
	Ottawa West	1,040	150	120	550	100	770	1,120	640	4,500	110	40	110	300	550	5,140	270	630	5,770
	Bayshore/Cedarview	1,100	160	130	730	250	1,590	830	2,320	7,100	90	90	440	1,150	1,760	9,170	220	540	9,710
	Greenbelt Subtotal	12,100	3,400	3,300	10,500	3,400	7,900	4,200	5,200	49,900	2,000	800	1,600	3,000	7,400	58,900	2,100	5,600	64,500
Urban Area Outside Greenbelt	Orleans	1,390	780	1,140	1,860	250	400	320	260	6,400	7,040	150	130	180	7,500	14,370	250	850	15,220
	South Gloucester/ Leitrim	400	50	100	730	670	550	140	230	2,900	110	1,680	910	210	2,910	6,380	110	240	6,620
	South Nepean	700	170	90	850	430	1,490	350	1,200	5,300	140	640	5,680	1,120	7,590	13,320	90	430	13,750
	Kanata/Stittsville	800	180	120	670	300	1,120	410	2,080	5,700	130	190	1,210	11,370	12,900	19,530	170	750	20,280
	Outside Greenbelt Subtotal	3,300	1,200	1,400	4,100	1,700	3,500	1,200	3,800	20,200	7,400	2,700	7,900	12,900	30,900	53,600	600	2,300	55,900
City of Ottawa - Total		16,800	5,000	5,100	16,100	5,700	12,800	5,800	10,100	77,400	10,100	4,000	10,400	18,200	42,800	128,600	3,000	8,400	137,000
Gatineau & MRC	Ile de Hull	260	50	40	80	10	70	70	40	600	30	10	10	30	70	710	260	860	1,580
	All Districts	4,520	1,090	940	2,020	410	1,140	1,100	620	11,800	620	160	160	550	1,500	13,660	3,860	30,200	43,900
National Capital Area		21,360	6,130	6,000	18,160	6,140	13,910	6,900	10,680	89,300	10,760	4,180	10,530	18,800	44,260	142,220	6,820	38,700	181,000

Existing and Future 2031 Auto Vehicle Trip Tables by Planning District

C-11 FORECAST PERCENTAGE GROWTH 2031 PLANNING HORIZON

Auto Vehicle Trips (a.m. Peak Hour)

Percentage Growth 2031 Planning Horizon

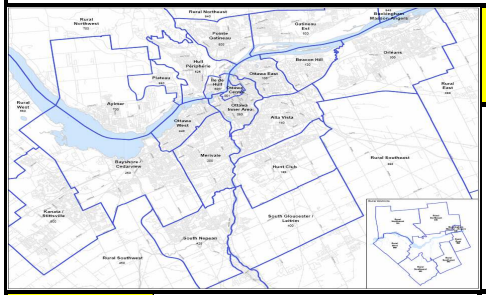


		Urban Area (Greenbelt)									Urban Area Outside Greenbelt					City of Ottawa - Total	Gatineau & MRC		National Capital Area
		Ottawa Inner Area	Ottawa East	Beacon Hill	Alta Vista	Hunt Club	Merivale	Ottawa West	Bayshore/Cedarview	Greenbelt Subtotal	Orleans	South Gloucester/ Leitrim	South Nepean	Kanata/Stittsville	Outside Greenbelt		Ile de Hull	All Districts	
Urban Area (Greenbelt)	Ottawa Inner Area	-14%	-15%	9%	4%	3%	-14%	-4%	-11%	-9%	35%	75%	160%	3%	28%	-5%	67%	39%	-1%
	Ottawa East	-13%	-13%	6%	6%	15%	-17%	-5%	-12%	-8%	17%	20%	50%	10%	17%	-5%	50%	35%	-1%
	Beacon Hill	14%	21%	38%	29%	57%	0%	15%	10%	26%	52%	200%	300%	14%	49%	29%	67%	121%	33%
	Alta Vista	-10%	-7%	7%	6%	14%	-10%	0%	-9%	-1%	20%	100%	122%	9%	35%	3%	40%	54%	5%
	Hunt Club	-11%	-14%	5%	-1%	6%	-13%	-8%	-11%	-3%	14%	62%	133%	-6%	31%	-1%	18%	19%	0%
	Merivale	-15%	-17%	0%	-1%	7%	-7%	-1%	-10%	-7%	18%	73%	86%	5%	34%	-2%	45%	46%	0%
	Ottawa West	-6%	-12%	20%	8%	11%	-6%	10%	-2%	0%	38%	33%	57%	7%	20%	3%	59%	43%	7%
	Bayshore/Cedarview	-20%	-24%	-7%	-5%	-4%	-15%	-3%	-10%	-12%	-10%	29%	38%	0%	8%	-8%	10%	17%	-7%
	Greenbelt Subtotal	-11%	-8%	18%	5%	10%	-10%	2%	-9%	-4%	25%	60%	78%	3%	25%	0%	40%	44%	2%
Urban Area Outside Greenbelt	Orleans	-12%	-9%	3%	1%	4%	-23%	3%	-13%	-6%	55%	36%	63%	0%	53%	20%	14%	35%	21%
	South Gloucester/ Leitrim	111%	67%	400%	217%	347%	206%	180%	229%	222%	450%	833%	2175%	320%	939%	391%	267%	300%	409%
	South Nepean	0%	21%	13%	27%	54%	16%	6%	22%	18%	100%	814%	271%	90%	236%	93%	29%	79%	91%
	Kanata/Stittsville	-4%	0%	33%	12%	50%	3%	14%	21%	12%	63%	375%	505%	113%	128%	73%	55%	150%	75%
	Outside Greenbelt Subtotal	0%	0%	8%	24%	89%	13%	9%	23%	17%	57%	575%	339%	108%	136%	70%	50%	92%	71%
City of Ottawa - Total		-7%	-6%	16%	10%	27%	-2%	5%	4%	3%	49%	233%	235%	70%	96%	26%	50%	53%	27%
Gatineau & MRC	Ile de Hull	-10%	0%	33%	0%	0%	0%	-13%	0%	-14%	50%	>1000%	>1000%	0%	17%	1%	73%	43%	19%
	All Districts	0%	25%	59%	22%	21%	5%	6%	9%	10%	82%	23%	129%	31%	56%	16%	47%	34%	28%
National Capital Area		-6%	-1%	20%	12%	28%	-1%	5%	4%	4%	52%	222%	229%	68%	94%	25%	46%	38%	27%

Existing and Future 2031 Auto Person Trip Tables by Planning District

C-12 BASE YEAR Auto Person Trips (a.m. Peak Hour)

Auto Person Trips - Base Year



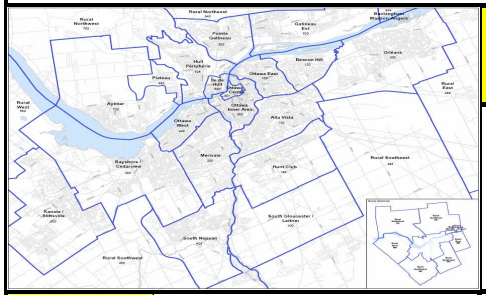
		Urban Area (Greenbelt)									Urban Area Outside Greenbelt					City of Ottawa - Total	Gatineau & MRC		National Capital Area
		Ottawa Inner Area	Ottawa East	Beacon Hill	Alta Vista	Hunt Club	Merivale	Ottawa West	Bayshore/Cedarview	Greenbelt Subtotal	Orleans	South Gloucester/ Leitrim	South Nepean	Kanata/Stittsville	Outside Greenbelt		Ile de Hull	All Districts	
Urban Area (Greenbelt)	Ottawa Inner Area	4,550	670	390	1,400	390	1,050	670	550	9,600	230	50	60	400	760	10,600	-160	1,680	12,200
	Ottawa East	1,990	1,560	710	1,340	160	450	250	210	6,700	290	70	20	140	520	7,300	190	660	8,000
	Beacon Hill	970	580	1,220	900	80	230	150	120	4,200	400	20	20	90	520	4,800	100	290	5,200
	Alta Vista	2,620	820	600	3,700	740	990	360	390	10,200	480	70	110	270	920	11,300	170	640	11,900
	Hunt Club	1,470	270	240	2,020	1,440	1,020	290	320	7,100	160	160	70	210	590	8,000	200	350	8,300
	Merivale	2,530	360	200	1,360	460	3,820	1,050	1,350	11,100	140	120	330	680	1,270	12,700	240	650	13,300
	Ottawa West	1,370	200	120	590	110	1,050	1,400	770	5,600	100	30	80	330	530	6,200	200	550	6,800
	Bayshore/Cedarview	1,640	230	160	890	300	2,210	1,080	3,370	9,900	110	80	380	1,330	1,910	12,100	230	570	12,700
	Greenbelt Subtotal	17,100	4,700	3,600	12,200	3,700	10,900	5,200	7,100	64,500	1,900	600	1,100	3,400	7,000	73,000	1,200	5,400	78,300
Urban Area Outside Greenbelt	Orleans	1,880	1,020	1,470	2,100	270	610	350	340	8,000	5,990	130	100	210	6,420	14,900	250	730	15,600
	South Gloucester/ Leitrim	220	30	30	260	170	220	50	80	1,100	20	230	40	50	330	1,600	40	80	1,700
	South Nepean	840	150	90	760	320	1,500	390	1,150	5,200	80	80	2,150	670	2,990	8,400	90	280	8,800
	Kanata/Stittsville	990	210	110	690	230	1,250	400	2,000	5,900	100	50	240	6,730	7,120	13,600	130	350	14,000
	Outside Greenbelt Subtotal	3,900	1,400	1,700	3,800	1,000	3,600	1,200	3,500	20,200	6,200	500	2,500	7,700	16,800	38,500	500	1,400	39,900
City of Ottawa - Total		22,500	6,600	5,700	17,300	5,200	15,700	6,800	11,700	91,600	8,800	1,400	4,100	13,100	27,300	125,500	1,800	7,200	132,800
Gatineau & MRC	Ile de Hull	360	60	40	90	20	90	90	50	800	20	0	10	30	70	900	190	780	1,670
	All Districts	5,530	1,010	700	1,890	380	1,280	1,190	670	12,700	400	160	80	490	1,110	14,000	3,230	28,500	42,400
National Capital Area		28,100	7,500	6,300	19,300	5,600	17,000	8,000	12,300	104,300	9,200	1,500	4,100	13,600	28,400	139,600	5,050	35,700	176,000

Existing and Future 2031 Auto Person Trip Tables by Planning District

C-13 FORECAST 2031 PLANNING HORIZON

Auto Person Trips (a.m. Peak Hour)

Auto Person Trips - 2031



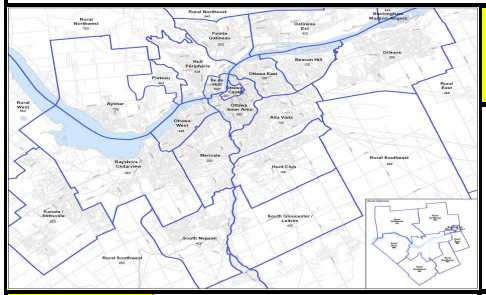
		Urban Area (Greenbelt)									Urban Area Outside Greenbelt					City of Ottawa - Total	Gatineau & MRC		National Capital Area
		Ottawa Inner Area	Ottawa East	Beacon Hill	Alta Vista	Hunt Club	Merivale	Ottawa West	Bayshore/Cedarview	Greenbelt Subtotal	Orleans	South Gloucester/ Leitrim	South Nepean	Kanata/Stittsville	Outside Greenbelt		Ile de Hull	All Districts	
Urban Area (Greenbelt)	Ottawa Inner Area	3,960	540	420	1,460	410	900	640	480	8,800	320	80	140	420	970	9,970	-590	-200	9,770
	Ottawa East	1,720	1,210	730	1,380	160	360	240	160	6,000	330	80	30	160	610	6,770	290	830	7,600
	Beacon Hill	1,090	660	1,670	1,120	130	230	180	130	5,200	600	30	40	110	780	6,100	180	630	6,730
	Alta Vista	2,320	750	600	3,790	820	890	360	360	9,900	560	150	230	280	1,220	11,390	240	860	12,240
	Hunt Club	1,290	220	230	1,910	1,530	860	270	280	6,600	180	250	170	200	780	7,720	230	430	8,150
	Merivale	2,120	290	190	1,330	500	3,460	1,020	1,220	10,100	150	240	610	760	1,740	12,210	340	830	13,030
	Ottawa West	1,260	180	140	630	120	950	1,500	750	5,500	120	40	130	350	640	6,300	310	770	7,060
	Bayshore/Cedarview	1,300	180	150	820	280	1,820	1,020	2,960	8,500	100	100	520	1,320	2,040	10,920	250	610	11,530
	Greenbelt Subtotal	15,100	4,000	4,100	12,500	4,000	9,500	5,300	6,400	60,700	2,400	1,000	1,800	3,600	8,800	71,300	1,300	4,700	76,200
Urban Area Outside Greenbelt	Orleans	1,630	880	1,400	2,080	280	450	350	290	7,400	8,750	170	140	200	9,270	17,210	290	970	18,190
	South Gloucester/ Leitrim	470	60	110	820	750	620	160	250	3,300	130	2,190	1,040	240	3,590	7,570	130	280	7,850
	South Nepean	820	190	100	960	480	1,710	410	1,390	6,000	160	790	7,120	1,340	9,420	16,010	110	510	16,520
	Kanata/Stittsville	940	200	130	750	330	1,260	450	2,360	6,400	150	210	1,370	14,130	15,860	23,480	200	890	24,360
	Outside Greenbelt Subtotal	3,800	1,400	1,800	4,600	1,900	4,100	1,400	4,300	23,100	9,200	3,300	9,600	15,900	38,100	64,300	700	2,600	67,000
City of Ottawa - Total		20,800	5,900	6,200	18,800	6,500	15,000	7,100	11,800	92,200	12,500	4,900	12,400	22,300	52,200	154,900	2,300	8,100	162,900
Gatineau & MRC	Ile de Hull	330	60	50	100	20	80	90	50	700	40	10	10	40	80	860	350	1,070	1,930
	All Districts	5,660	1,370	1,250	2,460	470	1,350	1,310	750	14,600	920	200	210	690	2,010	17,020	4,610	36,700	53,700
National Capital Area		26,390	7,230	7,530	21,220	7,030	16,390	8,370	12,610	106,800	13,360	5,150	12,670	23,010	54,190	171,900	6,870	44,800	217,000

Existing and Future 2031 Auto Person Trip Tables by Planning District

C-14 FORECAST PERCENTAGE GROWTH 2031 PLANNING HORIZON

Auto Person Trips (a.m. Peak Hour)

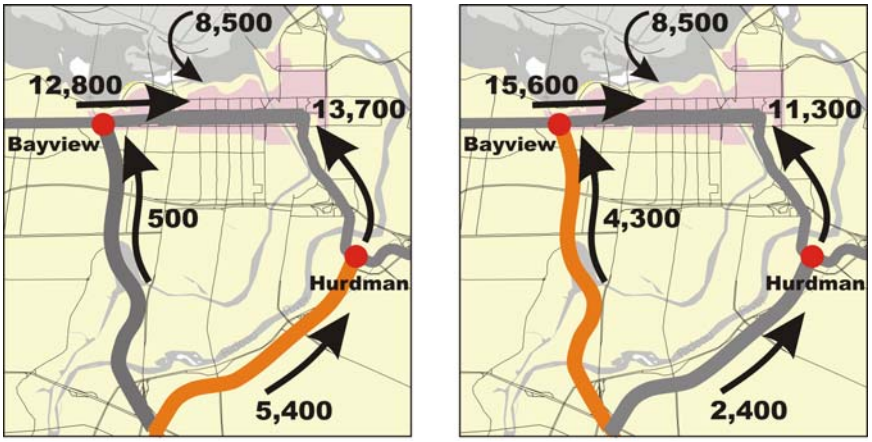
Percentage Growth in Auto Person Trips - Base Year to 2031



		Urban Area (Greenbelt)									Urban Area Outside Greenbelt					City of Ottawa - Total	Gatineau & MRC		National Capital Area
		Ottawa Inner Area	Ottawa East	Beacon Hill	Alta Vista	Hunt Club	Merivale	Ottawa West	Bayshore/Cedarview	Greenbelt Subtotal	Orleans	South Gloucester/ Leitrim	South Nepean	Kanata/Stittsville	Outside Greenbelt		Ile de Hull	All Districts	
Urban Area (Greenbelt)	Ottawa Inner Area	-13%	-19%	8%	4%	5%	-14%	-4%	-13%	-8%	39%	60%	133%	5%	28%	-6%	269%	-112%	-20%
	Ottawa East	-14%	-22%	3%	3%	0%	-20%	-4%	-24%	-10%	14%	14%	50%	14%	17%	-7%	53%	26%	-5%
	Beacon Hill	12%	14%	37%	24%	63%	0%	20%	8%	24%	50%	50%	100%	22%	50%	27%	80%	117%	29%
	Alta Vista	-11%	-9%	0%	2%	11%	-10%	0%	-8%	-3%	17%	114%	109%	4%	33%	1%	41%	34%	3%
	Hunt Club	-12%	-19%	-4%	-5%	6%	-16%	-7%	-13%	-7%	13%	56%	143%	-5%	32%	-4%	15%	23%	-2%
	Merivale	-16%	-19%	-5%	-2%	9%	-9%	-3%	-10%	-9%	7%	100%	85%	12%	37%	-4%	42%	28%	-2%
	Ottawa West	-8%	-10%	17%	7%	9%	-10%	7%	-3%	-2%	20%	33%	63%	6%	21%	2%	55%	40%	4%
	Bayshore/Cedarview	-21%	-22%	-6%	-8%	-7%	-18%	-6%	-12%	-14%	-9%	25%	37%	-1%	7%	-10%	9%	7%	-9%
	Greenbelt Subtotal	-12%	-15%	14%	2%	8%	-13%	2%	-10%	-6%	26%	67%	64%	6%	26%	-2%	8%	-13%	-3%
Urban Area Outside Greenbelt	Orleans	-13%	-14%	-5%	-1%	4%	-26%	0%	-15%	-8%	46%	31%	40%	-5%	44%	16%	16%	33%	17%
	South Gloucester/ Leitrim	114%	100%	267%	215%	341%	182%	220%	213%	200%	550%	852%	2500%	380%	988%	373%	225%	250%	362%
	South Nepean	-2%	27%	11%	26%	50%	14%	5%	21%	15%	100%	888%	231%	100%	215%	91%	22%	82%	88%
	Kanata/Stittsville	-5%	-5%	18%	9%	43%	1%	13%	18%	8%	50%	320%	471%	110%	123%	73%	54%	154%	74%
	Outside Greenbelt Subtotal	-3%	0%	6%	21%	90%	14%	17%	23%	14%	48%	560%	284%	106%	127%	67%	40%	86%	68%
City of Ottawa - Total		-8%	-11%	9%	9%	25%	-4%	4%	1%	1%	42%	250%	202%	70%	91%	23%	28%	13%	23%
Gatineau & MRC	Ile de Hull	-8%	0%	25%	11%	0%	-11%	0%	0%	-13%	100%	1000%	0%	33%	14%	-4%	84%	37%	16%
	All Districts	2%	36%	79%	30%	24%	5%	10%	12%	15%	130%	25%	163%	41%	81%	22%	43%	29%	27%
National Capital Area		-6%	-4%	20%	10%	26%	-4%	5%	3%	2%	45%	243%	209%	69%	91%	23%	36%	25%	23%

Appendix D: Detailed Downtown Ridership and Vehicle Requirements

Design of Downtown Transit Service - Required Service Frequencies (not including STO)



Alternative 1 Serves south Via SW Transitway

Peak Point between Hurdman and Campus
13,700 passengers / hour

305	buses @ 45 per standard Bus	=	11	sec headway
196	**buses @ 70 per articulated Bus**	**=**	**18**	**sec headway**

Alternative 2 Serves south Via NS-LRT

LRT designed for Peak at Carleton
4,300 passengers / hour on LRT

32	LRT unit @ 135 per unit	=	112	sec headway	=	1 min	52 sec
16	**2-car LRT trains @ 135 per car**	**=**	**225**	**sec headway**	**=**	**3 min**	**45 sec**

BRT designed for Peak entering downtown
11,300 passengers / hour

252	buses @ 45 per standard Bus	=	14	sec headway
162	**buses @ 70 per articulated Bus**	**=**	**22**	**sec headway**

Alternative 3 Serves South Via SW Transitway

Peak Point between Hurdman and Campus
13,700 passengers / hour

102	LRT unit @ 135 per unit	=	35	sec headway	=	0 min	35 sec
51	2-car LRT trains @ 135 per car	=	70	sec headway	=	1 min	10 sec
26	**4-car LRT trains @ 135 per car**	**=**	**138**	**sec headway**	**=**	**2 min**	**18 sec**

Alternative 4 Serves south Via NS-LRT

Peak point West of Downtown
15,600 passengers / hour

116	LRT unit @ 135 per unit	=	31	sec headway	=	0 min	31 sec
58	2-car LRT trains @ 135 per car	=	62	sec headway	=	1 min	2 sec
29	**4-car LRT trains @ 135 per car**	**=**	**124**	**sec headway**	**=**	**2 min**	**4 sec**

Network configurations (Considering STO Passengers)

The numbers of customers that need to be accommodated are tabulated in this section to find the numbers that govern the design of the possible downtown transit facility. The greater the number of customers travelling through a single point in a single direction, the greater must be the level of service provided and the greater must be the capacity of the possible transit facility.

The numbers of customers are tabulated on six possible network configurations. As described above, two possible paths are included to carry customers from the south, either via Hurdman Station and entering downtown from the east (options marked with an "A") or via Carleton Station and entering downtown from the west (options marked with a "B"). Also as described above, three possible paths are included to carry customers from the north, either in a separate corridor from the possible downtown transit facility (options marked with a "1"), or on a facility entering downtown from the west (options marked with a "2"), or on a facility carrying customers into downtown equally from the west and from the east (options marked with a "3").

The options are:

- A1 – From the south via Hurdman, from the north on a separate corridor
- A2 – From the south via Hurdman, from the north entering downtown from the west
- A3 – From the south via Hurdman, from the north entering downtown equally from the west and from the east
- B1 – From the south via Carleton, from the north on a separate corridor
- B2 – From the south via Carleton, from the north entering downtown from the west
- B3 – From the south via Carleton, from the north entering downtown equally from the west and from the east

Each of these network configurations carries different groups of customers into downtown over different paths, and thus has different requirements for the level of service and the capacity of the possible downtown transit facility.

All of these network configurations are compatible, in different ways, with options for transit facilities throughout the rest of the City. The evaluation of those options is the subject of subsequent parts of this report and subsequent parts of the preparation of the Transportation Master Plan later in 2008.

The following table summarizes the projected ridership levels into downtown Ottawa for each of the network configuration options.

Projected ridership levels into Downtown Ottawa
In 2031, Morning peak hour

Network configuration		Entering Downtown from the west	Entering Downtown from the east	Entering Downtown from the north (if via separate corridor)
A1	From south via Hurdman From north via separate corridor	12,800	13,700	8,500
A2	From south via Hurdman From north via west	21,300	13,700	–
A3	From south via Hurdman From north via east and west	17,050	17,950	–
B1	From south via Carleton From north via separate corridor	15,600	11,300	8,500
B2	From south via Carleton From north via west	24,100	11,300	–
B3	From south via Carleton From north via east and west	19,850	15,550	–

The higher of the two directions through downtown governs the level of service required through downtown and the capacity required of the possible downtown transit facility. The following table shows the number of customers that the facility would be required to handle in 2031 under each of the six network configuration options.

Principal ridership flows governing required facility capacity

Basic network configuration		Customers per hour	Direction
A1	From south via Hurdman From north via separate corridor	13,700	Entering downtown from the east
A2	From south via Hurdman From north via west	21,300	Entering downtown from the west
A3	From south via Hurdman From north via east and west	17,950	Entering downtown from the east
B1	From south via Carleton From north via separate corridor	15,600	Entering downtown from the west
B2	From south via Carleton From north via west	24,100	Entering downtown from the west
B3	From south via Carleton From north via east and west	19,850	Entering downtown from the west

All of the network configurations accommodate approximately the same total level of transit ridership into downtown each morning. The table shows that, even though the number of customers is the same, the possible transit facility must be designed to have different capacities, ranging from 13,700 to 24,100 customers per hour, depending on the network configuration that is selected.

The conclusions of this analysis are:

- Most customers travelling from the east will enter downtown through Hurdman Station;
- Most customers travelling from the west will enter downtown through Tunney's Pasture Station;
- Customers travelling from the south can be accommodated either through Carleton and Bayview Stations, entering downtown from the west, or through Billings Bridge and Hurdman Stations, entering downtown from the east;
- Customers travelling from the north can be accommodate either on a separate corridor, on a facility entering downtown from the west, or on a facility bringing customers into downtown from both the west and the east;
- The level of service required through downtown and the capacity required of the possible downtown transit facility are greatly affected by the configuration of the rapid transit flows approaching downtown from the south and the north; and
- If customers from the north are to be accommodated in the possible downtown transit facility, the level of service required through downtown and the capacity required of the facility is least if Option A3 is selected, carrying customers from the south into downtown via Hurdman Station and carrying customers from the north into downtown equally from the west and from the east.

The following table provides a detailed breakdown of vehicle requirements and service frequencies for all of the network options and a variety of vehicle types and configurations.

Service levels required in Downtown facility
Considering different vehicle types and different basic network configurations
Shown in vehicles or trains per hour

		A1	A2	A3	B1	B2	B3
	Passenger Design Capacity	From south via Hurdman From north via separate corridor	From south via Hurdman From north via west	From south via Hurdman From north via east and west	From south via Carleton From north via separate corridor	From south via Carleton From north via west	From south via Carleton From north via east and west
		13,700	21,300	17,950	15,600	24,100	19,850
40-foot standard bus	45	305	474	399	347	536	442
60-foot articulated bus	70	196	305	257	223	345	284
75-80-foot double-articulated bus	90	153	237	200	174	268	221
40-foot double-decker bus	90	153	237	200	174	268	221
Single light rail car	135	102	158	133	116	179	147
2-car light rail train	270	51	79	67	58	90	74
3-car light rail train	405	34	53	45	39	60	49
4-car light rail train	540	26	40	34	29	45	37

Service levels required in Downtown facility
Considering different vehicle types and different basic network configurations
Shown in vehicles or trains per hour

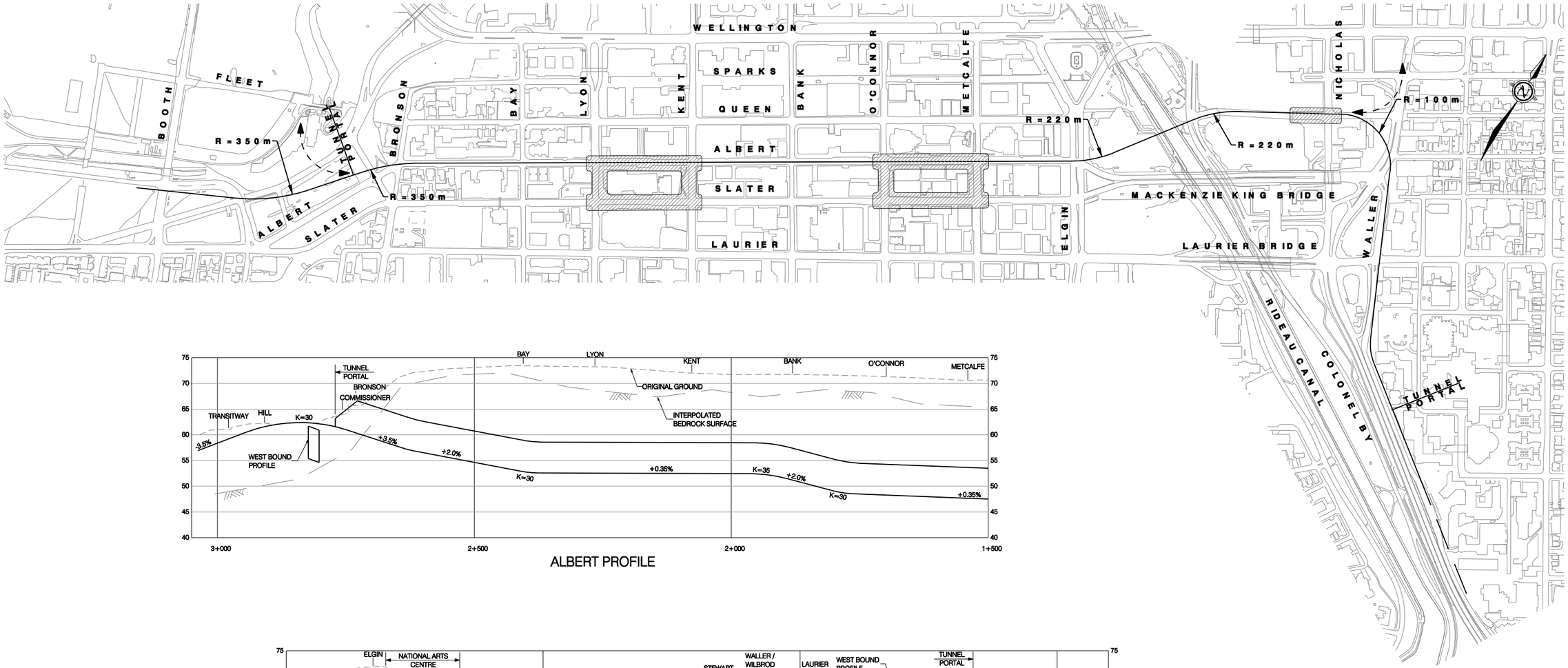
		A1	A2	A3	B1	B2	B3
	Passenger Design Capacity	From south via Hurdman From north via separate corridor	From south via Hurdman From north via west	From south via Hurdman From north via east and west	From south via Carleton From north via separate corridor	From south via Carleton From north via west	From south via Carleton From north via east and west
		13,700	21,300	17,950	15,600	24,100	19,850
40-foot standard bus	45	0 min 11 s	0 min 7 s	0 min 9 s	0 min 10 s	0 min 6 s	0 min 8 s
60-foot articulated bus	70	0 min 18 s	0 min 11 s	0 min 14 s	0 min 16 s	0 min 10 s	0 min 12 s
75-80-foot double-articulated bus	90	0 min 23 s	0 min 15 s	0 min 18 s	0 min 20 s	0 min 13 s	0 min 16 s
40-foot double-decker bus	90	0 min 23 s	0 min 15 s	0 min 18 s	0 min 20 s	0 min 13 s	0 min 16 s
Single light rail car	135	0 min 35 s	0 min 22 s	0 min 27 s	0 min 31 s	0 min 20 s	0 min 24 s
2-car light rail train	270	1 min 11 s	0 min 45 s	0 min 53 s	1 min 2 s	0 min 40 s	0 min 48 s
3-car light rail train	405	1 min 45 s	1 min 7 s	1 min 20 s	1 min 32 s	1 min 0 s	1 min 13 s
4-car light rail train	540	2 min 18 s	1 min 30 s	1 min 45 s	2 min 4 s	1 min 20 s	1 min 37 s

These tables show the dramatically different numbers of vehicles or trains required with different vehicle types and with different network configurations. To carry the same number of customers into downtown each morning, the possible downtown transit facility could be designed to accommodate 305 articulated buses per hour, at an average interval of 11 seconds, or to accommodate 26 four-car light rail trains per hour, at an average interval of 2 minutes and 18 seconds.

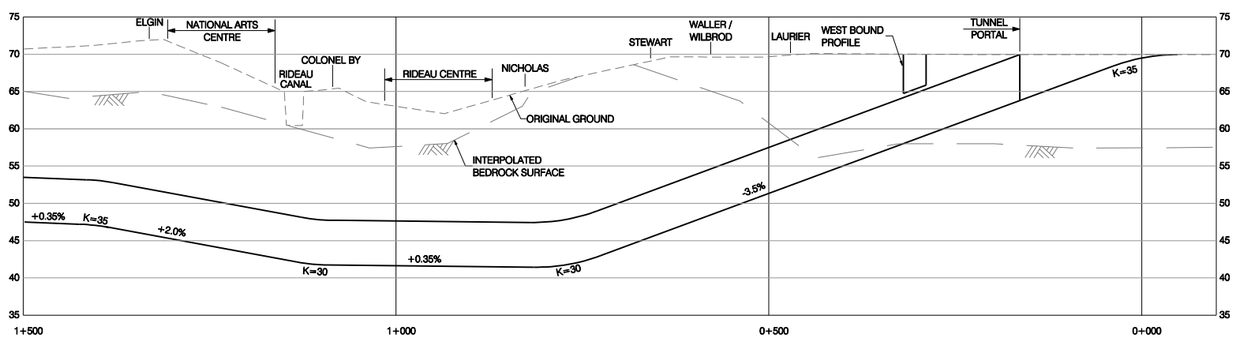
The choice of vehicle type for the possible downtown transit facility will have ramifications for the network configuration and for the design of the transit facilities outside downtown.

Appendix E: Tunnel Alignments / Profiles / Cross sections

Exhibit No. 1A	Downtown Transit Tunnel – Westbound BRT Tunnel
Exhibit No. 1B	Downtown Transit Tunnel – Eastbound BRT Tunnel
Exhibit No. 2A	Downtown Transit Tunnel – Westbound LRT Tunnel
Exhibit No. 2B	Downtown Transit Tunnel – Eastbound LRT Tunnel
Exhibit No. 3A	Downtown Transit Tunnel – Westbound BRT/LRT Tunnel
Exhibit No. 3B	Downtown Transit Tunnel – Eastbound BRT/LRT Tunnel
Exhibit No. 4	Downtown Transit Tunnel – Typical Sections



ALBERT PROFILE



ALBERT PROFILE

LEGEND

STATION PLATFORM

POTENTIAL EXPANSION LINKS

DOWNTOWN TRANSIT TUNNEL
WEST BOUND BRT TUNNEL

McCORMICK RANKIN CORPORATION

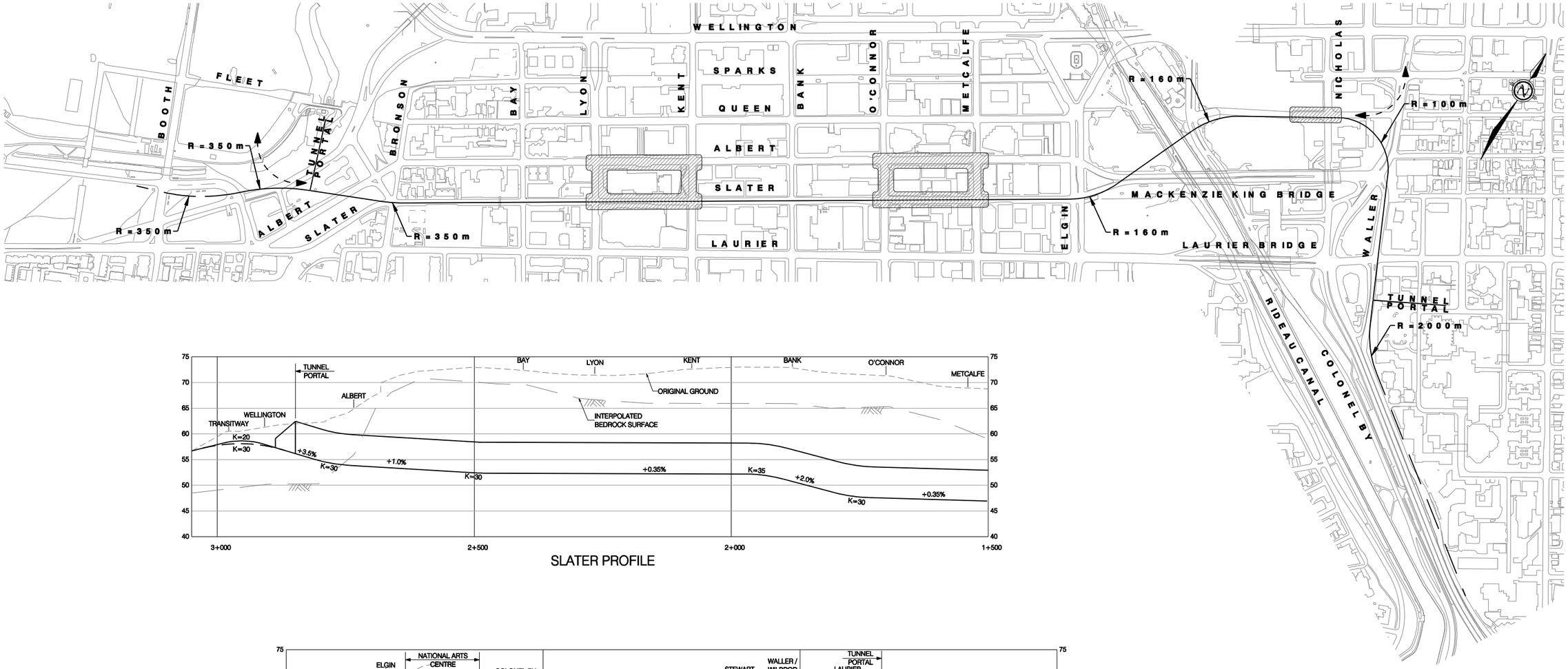
Delcan

EXHIBIT NO. 1A

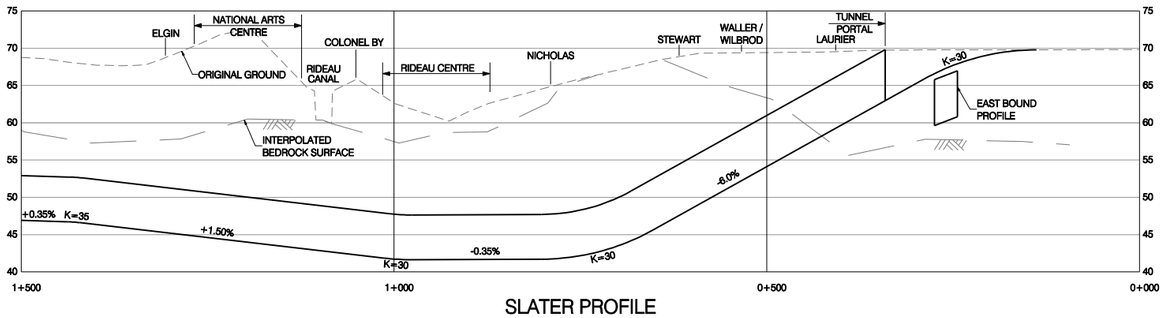
Date: JANUARY 2008

Scale: H 1:8000 V 1:800

Ottawa



SLATER PROFILE



SLATER PROFILE

LEGEND

STATION PLATFORM

POTENTIAL EXPANSION LINKS

DOWNTOWN TRANSIT TUNNEL
EAST BOUND BRT TUNNEL

McCORMICK RANKIN CORPORATION

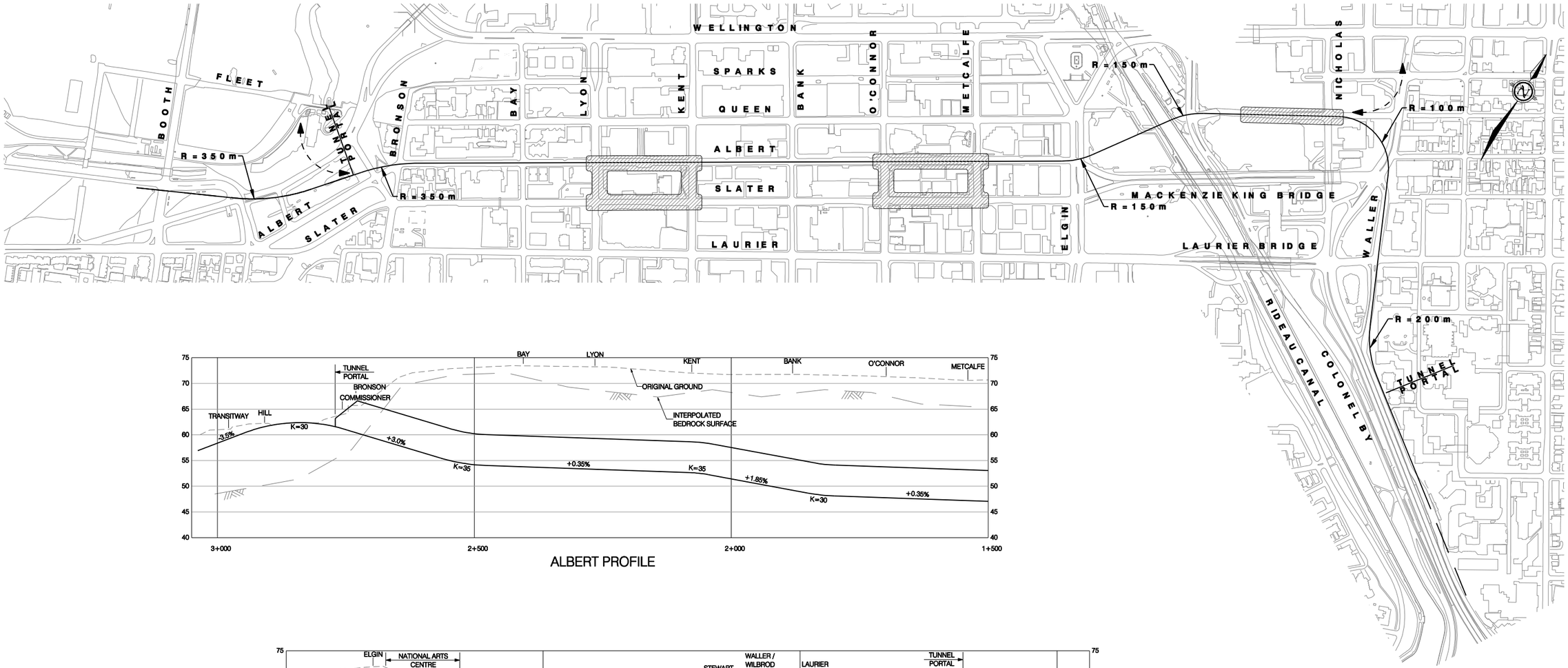
Delcan

EXHIBIT NO. 1B

Date: JANUARY 2008

Scale: H 1:8000 V 1:800

Ottawa



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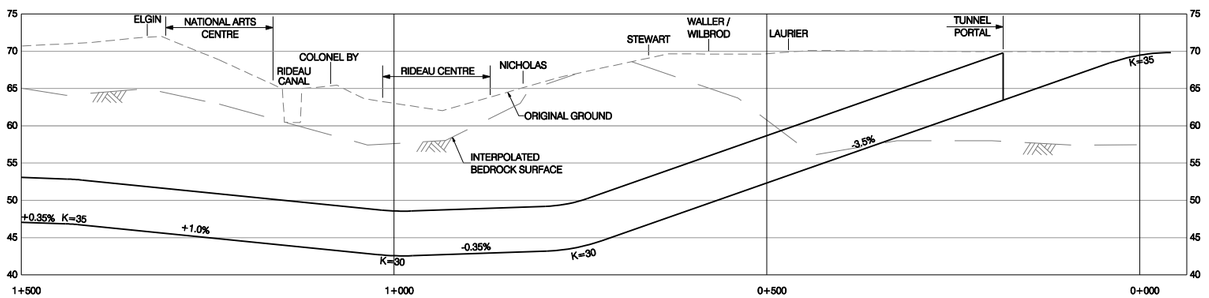


ALBERT PROFILE

LEGEND

STATION PLATFORM

POTENTIAL EXPANSION LINKS

DOWNTOWN TRANSIT TUNNEL
WEST BOUND LRT TUNNEL

McCORMICK RANKIN CORPORATION

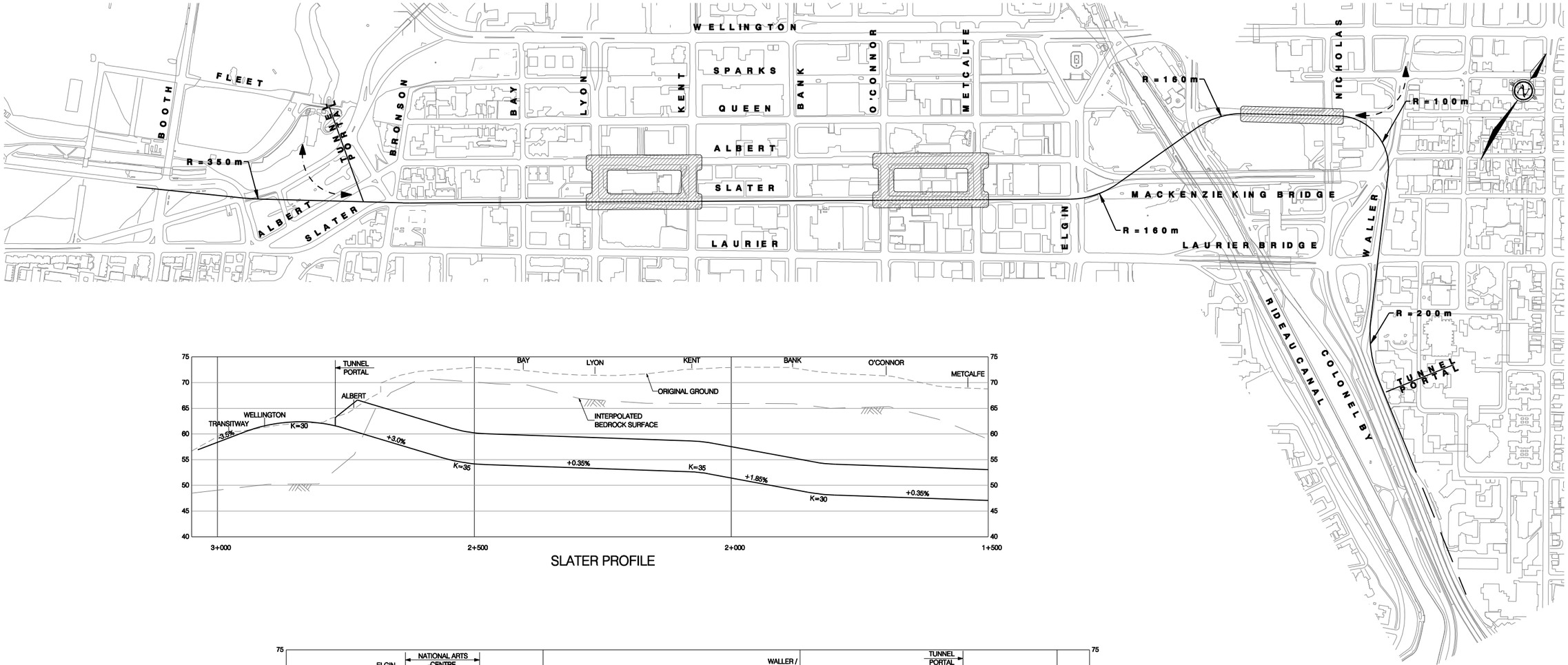
Delcan

EXHIBIT NO. 2A

Date: JANUARY 2008

Scale: H 1:8000 V 1:800

Ottawa



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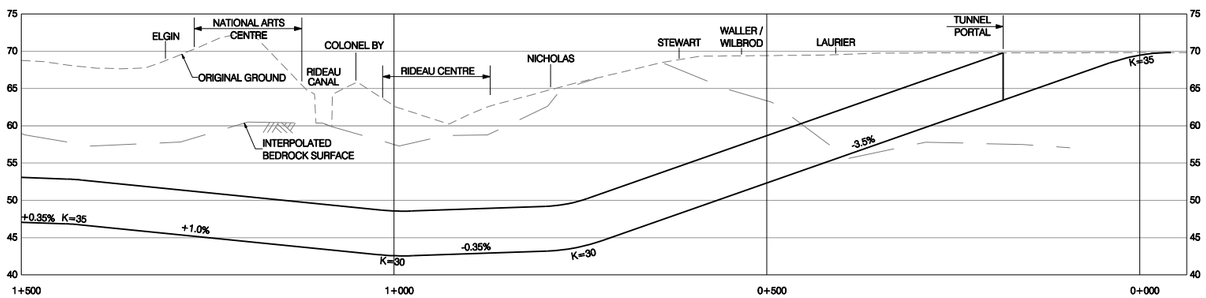


SLATER PROFILE

LEGEND

STATION PLATFORM

POTENTIAL EXPANSION LINKS

DOWNTOWN TRANSIT TUNNEL
EAST BOUND LRT TUNNEL

McCORMICK RANKIN CORPORATION

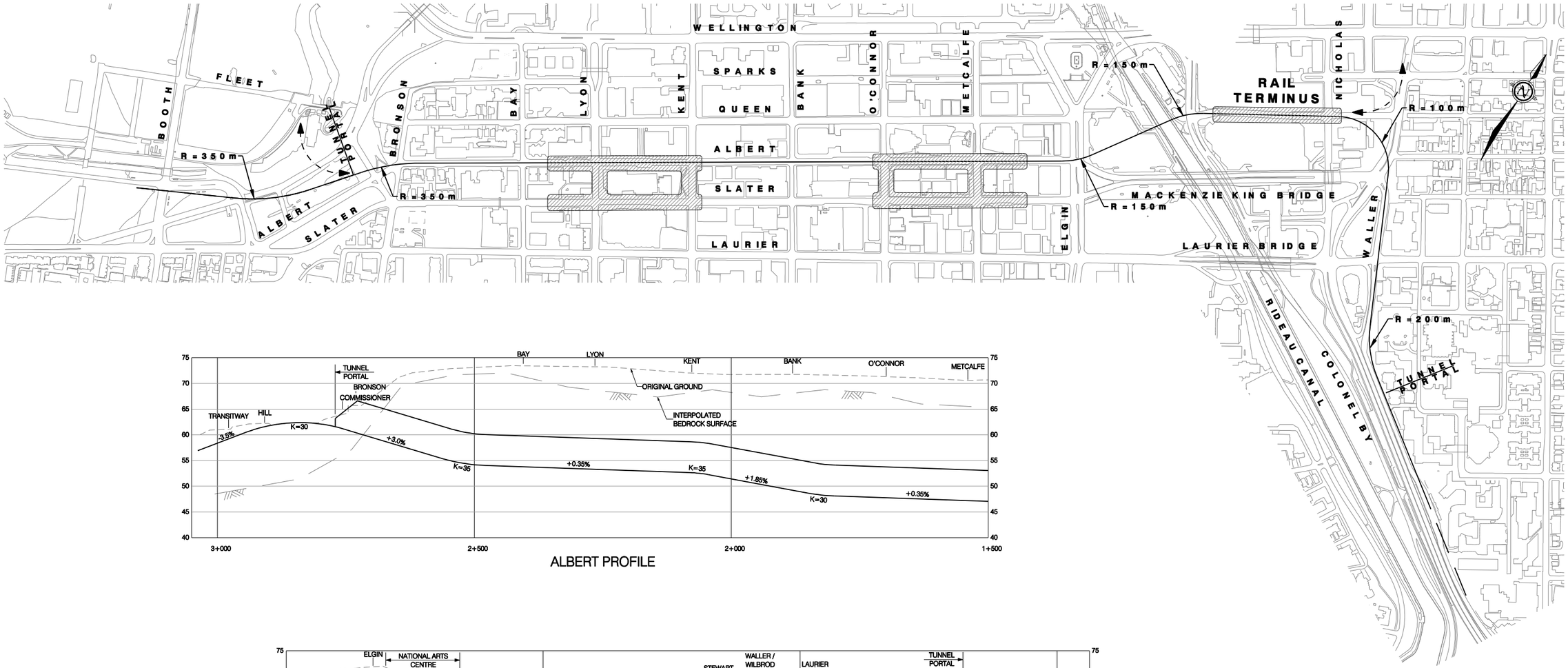
Delcan

EXHIBIT NO. 2B

Date: JANUARY 2008

Scale: H 1:8000 V 1:800

Ottawa



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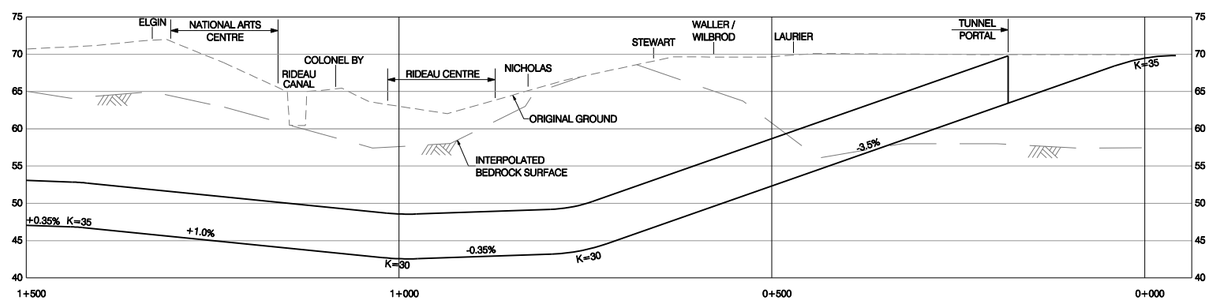


ALBERT PROFILE

LEGEND

STATION PLATFORM

POTENTIAL EXPANSION LINKS

DOWNTOWN TRANSIT TUNNEL
WEST BOUND BRT / LRT TUNNEL

McCORMICK RANKIN CORPORATION

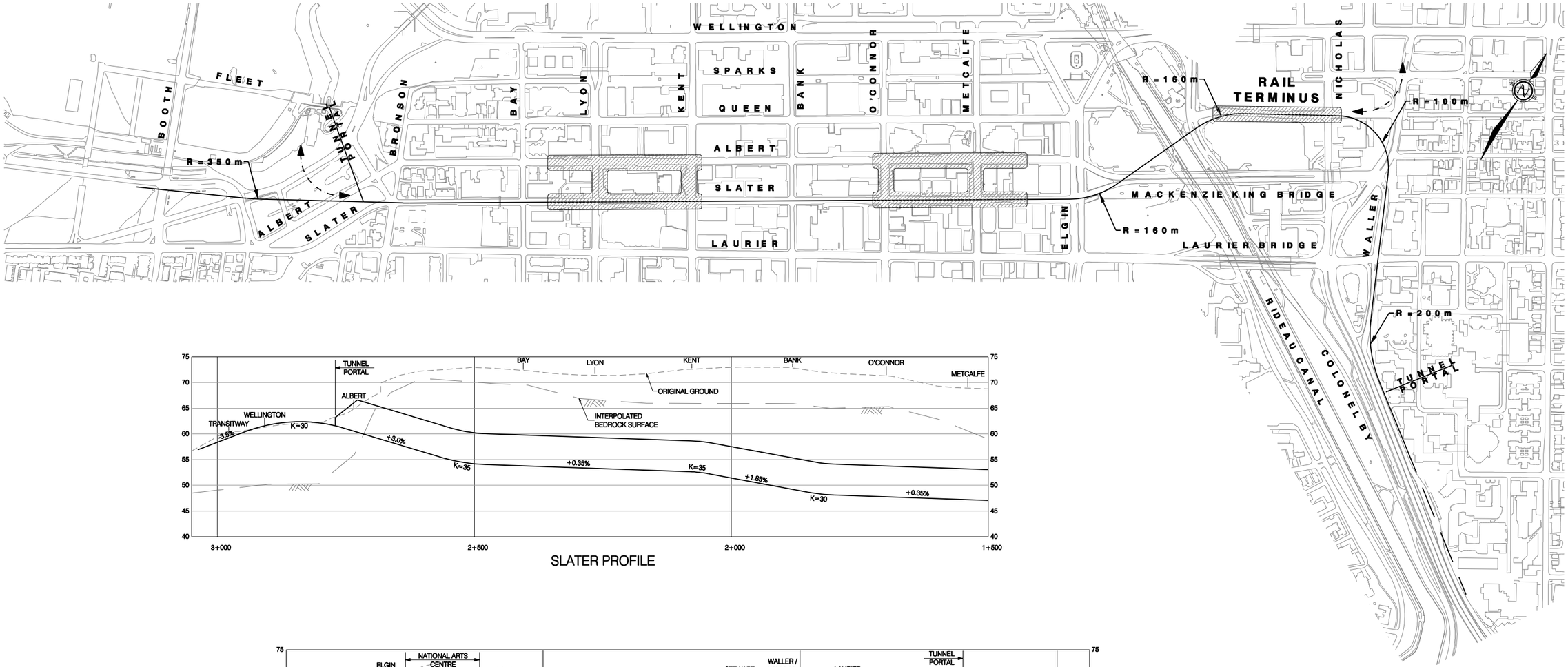
Delcan

Date: JANUARY 2008

EXHIBIT NO. 3A

Scale: H 1:8000 V 1:800

Ottawa



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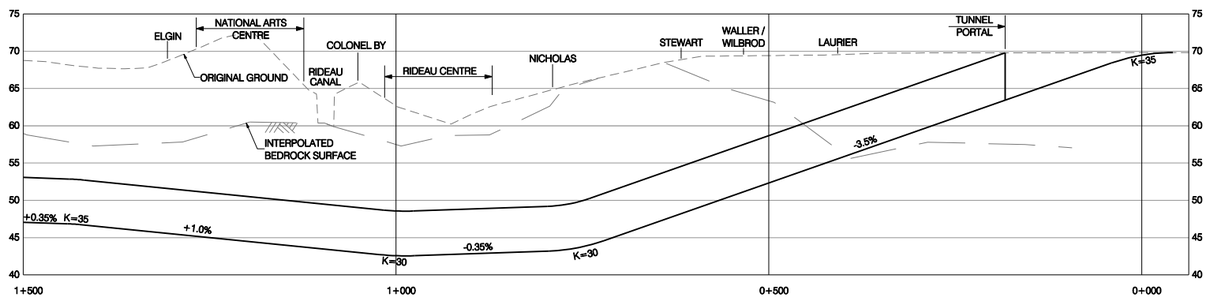


SLATER PROFILE

LEGEND

STATION PLATFORM

POTENTIAL EXPANSION LINKS

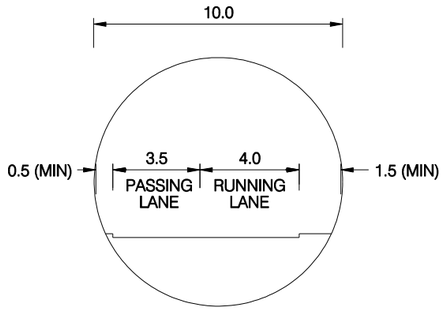
DOWNTOWN TRANSIT TUNNEL
EAST BOUND BRT / LRT TUNNEL

McCORMICK RANKIN CORPORATION

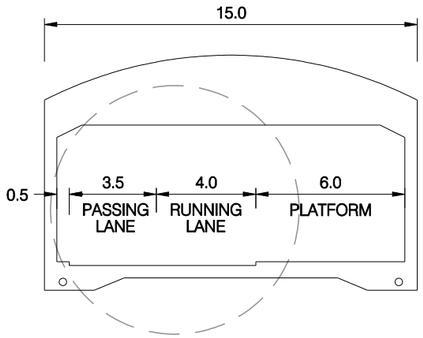
Date: JANUARY 2008

EXHIBIT NO. 3B

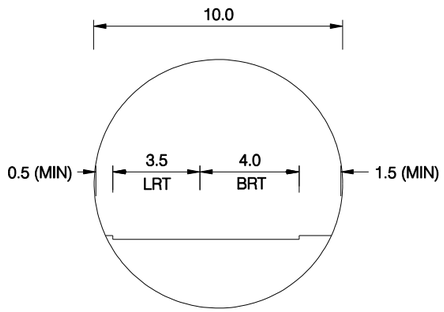
Scale: H 1:8000 V 1:800



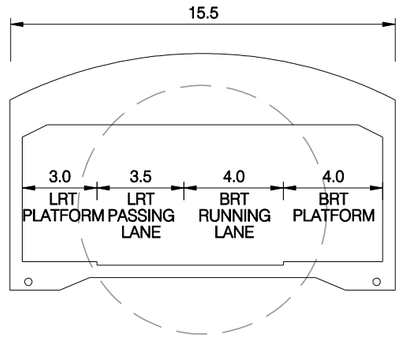
10.0m BRT TUNNEL



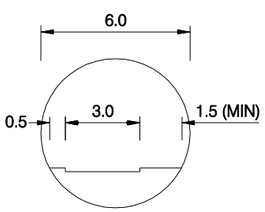
BRT SECTION ALONG PLATFORM



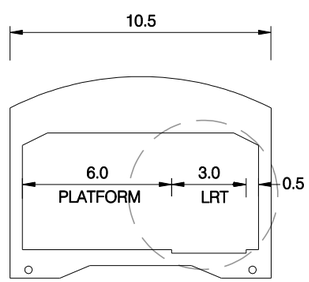
10.0m BRT / LRT TUNNEL



LRT / BRT SECTION ALONG PLATFORM



6.0m LRT TUNNEL



LRT SECTION ALONG PLATFORM

DOWNTOWN TRANSIT TUNNEL
TYPICAL SECTIONS

McCORMICK RANKIN CORPORATION

Delcan

EXHIBIT NO. 4

Date: JANUARY 2008

Scale: N.T.S.

Ottawa

Appendix F: Cost Estimates

Summary of Capital Infrastructure Costs

Cost estimates were prepared for various segments of the proposed primary rapid transit network. As the technology has not been determined for a number of the corridors, estimates were done for both a BRT facility and an LRT facility. In some sections a shared facility for both BRT and LRT was considered. The following lists the rapid transit corridors as well as the technologies considered for developing cost estimates.

Rapid Transit Corridor Section	LRT	BRT	BRT/LRT
Bayview to Bronson	X	X	X
Downtown Tunnel (Bronson to Campus)	X	X	X
Campus to Hurdman	X		
Hurdman to Blair	X		
Bayview to Lincoln Fields	X	X	
Lincoln Fields to Baseline	X		
Lincoln Fields to Bayshore		X	
Hurdman to South Keys		X	
Hospital Link		X	
Bayview to Greenboro	X		
Greenboro to Bowesville	X	X	
Airport Link	X	X	
Baseline to Barrhaven Town Centre (BTC)		X	
BTC to Cambrian		X	
BTC to Bowesville		X	
Blair to Trim		X	
Blair to Innes		X	
Innes to Millenium		X	
Bayshore to Terry Fox		X	
Terry Fox to Arena		X	
Arena to Kanata West		X	
Eagelson to Kanata North		X	

An additional 15% is added to the cost of each section for engineering and project management.

A contingency allowance to account for the project uncertainty is applied to the cost estimates for each section. The contingency accounts for uncertainty in project limits, number of station, park and ride lot and locations, soil foundation conditions, pavement design, drainage outlet capacity and SWM measures required. A 30% contingency is used for all sections except for the downtown tunnel where a 50% contingency is used since fewer details are known. More detailed tunnel costs would be developed as part of an Environmental Assessment (EA) process. The EA would identify a recommended preliminary design for a tunnel including its associated cost estimates.

The following table includes descriptions of what was included in the cost estimates.

Description	Scope
Property and Right of way	**Property is not included as part of the cost estimate.**
Clearing & Removals	The costs associated with the removal of natural vegetation within the right-of-way, Also includes removal of curbs, asphalt, sidewalks, medians, boulevards, barriers signs, and drainage structures. A unit cost per meter of new alignment is applied.
Grading	The cost estimate for the removal of earth and rock including stripping and reuse of excavated materials for earth fill required to construct embankments to the design subgrade elevation.
Drainage & Erosion Control	Cost associated with; ditching, supply and installation of the storm sewer pipe manholes, catchbasins, and subdrains to accommodate the surface runoff. Unit costs were used depending on weather it is an urban or rural cross section.
SWM Facility	SWM facilities required to facilitate the quantity and quality control of the outlet waters. If it was decided that a SWM facility is required, a Lump sum cost was included for each facility.
Running Surface	For LRT, the cost includes the construction of the granular bedding, ties, rails, switches, crossover tracks and turnouts. Costs were also included for asphalt during construction as buses will still need to use the Transitway while the LRT facility is being constructed. The running surface for a Bus Transitway includes granular materials (A, B, O), asphalt, curbs sidewalks, and boulevards. If the Transitway is located in rural areas then sidewalks and boulevards may not be needed. At grade intersections would require new signals and may need to be reconstructed. Regardless of weather the alignment is for a BRT or LRT facility, fencing and lighting will be required.
Utilities	The cost of engineering, design and the relocation of utilities (Enbridge Gas, Ottawa Hydro, Hydro One, Bell, Rogers, Watermains, Telcom, Telus, Videotron, Allstream, other City Services) in conflict with the construction limits.
Structures	The cost estimate associated with the construction of structural elements including; wing walls, retaining walls, abutments, foundations, bridge decks, retaining walls, culverts and structures to accommodate pedestrian and vehicular grade separation along the right-of-way.
Landscaping	Supply and placement of topsoil, sodding (staked/unstaked), seeding, mulching and/or aesthetic landscaping (coniferous and deciduous trees, shrubs and street hardware)
Stations	The cost estimate associated with the construction of transit station at key locations along the right-of-way. May include station elements such as the station structure, elevator and stair wells, platform, shelters, links, pedestrian access, passenger waiting areas, platform and station lighting, wayfinding signage, HVAC, and furnishings.

Description	Scope
Associated Works	Includes additional cost estimates such as relocation of existing freight rail tracks and impacts to the airport operations during construction.
Park and Ride Lots	The cost associated with the development of new park and ride facilities to service the expanded network. Cost includes earth works, pavement structure, pavement markings, illumination, transformer installation, access roads, fencing, barriers, signage, curbs and drainage. Cost does not include the development of a rail or bus station.
Traction Power	The cost associated with delivery of electric power to the train includes; connections to a Hydro supply, overhead DC system, substations, and support structures.
Train Control System	The cost estimate associated with the installation of vehicle location and control equipment, connecting duct and wiring, passenger information system, and security telephones and surveillance equipment.

Summaries of the cost estimates are included on the following tables for each portion of the Rapid Transit Network. The tables list the stations, park and ride lots, and structures that have been included in the cost estimate. Additional costs for property, vehicles, and maintenance facilities are not included.

Central Downtown

C2 Bayview to Campus
C3 Campus to Hurdman
Downtown Tunnel

Option 1 BRT Based	Option 2 NS LRT	Option 3 EW LRT	Option 4 NS & EW LRT
New Alignment outside Tunnel	New Alignment outside Tunnel	New Alignment outside Tunnel	New Alignment outside Tunnel
10m diameter tunnel bore Ventilation	10m diameter tunnel bore Ventilation	6m diameter tunnel bore	6m diameter tunnel bore
Stations			
Lebreton 3 Underground	Lebreton 3 underground Campus Lees Hurdman	Lebreton 3 Underground Campus Lees Hurdman	Lebreton 3 underground Campus Lees Hurdman
Structures			
Preston Street Booth Street Cliff Street Access	Preston Street Booth Street Cliff Street Access	Preston Street Booth Street Cliff Street Access Rideau River Rehab	Preston Street Booth Street Cliff Street Access Rideau River Rehab
Cost			
$829M	$1100M	$667M	$667M

Central East

C4 Hurdman to Blair

Option 1 BRT Based	Option 2 NS LRT	Option 3 EW LRT	Option 4 NS & EW LRT
Existing Transitway	Existing Transitway	Conversion of Transitway	Conversion of Transitway
Stations			
		Train St. Laurent Cyrville Blair	Train St. Laurent Cyrville Blair
Structures			
Cost			
0	0	$97M	$97M

Central South

C1 Bayview to Greenboro
S1 Greenboro to Bowesville
S5 Airport Link

Option 1 BRT Based	Option 2 NS LRT	Option 3 EW LRT	Option 4 NS & EW LRT
New Transitway: South Keys to Bowesville	Conversion of O-Train: Bayview to Greenboro New LRT: Greenboro to Bowesville	New Transitway: South Keys to Bowesville	Conversion of O-Train: Bayview to Greenboro New LRT: Greenboro to Bowesville
Stations			
Bowesville Leitrim Lester Alert Airport	Bowesville Leitrim Lester Alert Airport South Keys Greenboro Walkley Confederation Carleton Carling Gladstone Somerset Bayview	Bowesville Leitrim Lester Alert Airport	Bowesville Leitrim Lester Alert Airport South Keys Greenboro Walkley Confederation Carleton Carling Gladstone Somerset Bayview
Park and Ride			
Bowesville Leitrim	Bowesville Leitrim	Bowesville Leitrim	Bowesville Leitrim
Structures			
Delta Taxiway/Alert rd	Walkley Diamond Walkley Road Sawmill Creek Southeast Transitway Ellwood Diamond Heron Road Rideau River Carleton Pedestrian Carleton Station Dows Lake Tunnel Hwy 417 East Transitway Hunt Club Delta Taxiway/Alert rd	Delta Taxiway/Alert rd	Walkley Diamond Walkley Road Sawmill Creek Southeast Transitway Ellwood Diamond Heron Road Rideau River Carleton Pedestrian Carleton Station Dows Lake Tunnel Hwy 417 East Transitway Hunt Club Delta Taxiway/Alert rd
Cost			
$100M	$435M	$100M	$435M

Central West

C5 Bayview to Lincoln Fields
C6 Lincoln Fields to Baseline

Option 1 BRT Based	Option 2 NS LRT	Option 3 EW LRT	Option 4 NS & EW LRT
New Transitway: Dominion to Lincoln Fields	New Transitway: Dominion to Lincoln Fields	Conversion of Transitway: Bayview to Dominion New LRT: Dominion to Lincoln Fields	Conversion of Transitway: Bayview to Dominion New LRT: Dominion to Lincoln Fields
Stations			
		Tunney's Pasture Westboro Dominion Lincoln Fields Queensway Baseline	Tunney's Pasture Westboro Dominion Lincoln Fields Queensway Baseline
Structures			
Woodroffe Ave Richmond Road	Woodroffe Ave Richmond Road	Carling Highway 417 Creek Baseline Woodroffe Ave Richmond Road	Carling Highway 417 Creek Baseline Woodroffe Ave Richmond Road
Cost			
$22M	$22M	$237M	$237M

Central Area Summary

in millions $	Option 1 BRT Based	Option 2 NS LRT	Option 3 EW LRT	Option 4 NS & EW LRT
Central Downtown	**$829**	**$1100**	**$667**	**$667**
Central East	**0**	**0**	**$97**	**$97**
Central South	**$100**	**$435**	**$100**	**$435**
Central West	**$22**	**$22**	**$237**	**$237**
TOTAL	**$951**	**$1,557**	**$1,101**	**$1,436**

East Transitway

E1 Blair to Trim
E2 Blair to Innes
E3 Innes to Millennium

Option 1 BRT Based	Option 2 NS LRT	Option 3 EW LRT	Option 4 NS & EW LRT
New Transitway: Place d'Orleans to Trim New Transitway: Blair to Millennium			
Stations			
Innes @ Blair Blackburn Hamlet E 2 on line stations Blackburn Hamlet W Page mere Bleue 10th Line / Bypass Navan (P&R) Millennium Station (P&R) OTC 10th Line / 174 Taylor Creek Trim			
Park and Ride			
Navan Millennium			
Structures			
Montreal Road & Hwy ramps over creek . Rockliffe Boulevard Jean Darc Boulevard & Hwy Ramps Orleans Boulevard Champlain Place D'orleans Drive & Hwy Ramp 10th line hwy ramps Trim Road & Ramps Blair hwy ramp HWY 174 east of Blair Innes Road Mere Bleue 10th line / Bypass Esprit Portobello			
Cost			
$239M			

West Transitway

C7 Lincoln Fields to Bayshore
W1 Bayshore to Terry Fox
W2 Terry Fox to Arena
W3 Arena to Fernbank (Stittsville)
W4 Kanata North

Option 1 BRT Based	Option 2 NS LRT	Option 3 EW LRT	Option 4 NS & EW LRT
New Transitway: Lincoln Fields to Pinecrest Shoulder lanes HWY 417 Arterial Bus Lanes in Kanata			
Stations			
Dumaurier Pinecrest Moodie Eagelson Pedestrian Bridge Campeau Scotiabank Place Huntmar N. of Maple Grove S. of River Hazeldean Eagelson Klondike 4 On Line Stations			
Park and Ride			
Hazeldean Campeau Klondike			
Structures			
pedestrian bridge over 417 at Bayshore Pinecrest Creek Cut and Cover Tunnel Pinecrest Road & hwy Ramps March Road & hwy ramps modification of existing pedestrian bridge Terry Fox Drive Carp River x2 Over 417 to Arena			
Cost			
$338M			

Southeast Transitway

C8 Hurdman to Greenboro
C9 Hospital Link

Option 1 BRT Based	Option 2 NS LRT	Option 3 EW LRT	Option 4 NS & EW LRT
New Transitway: Hospital Link			
Stations			
Hospital			
Structures			
Riverside Drive access Via Rail Alta Vista			
Cost			
$44M			

Southwest Transitway

S2 Baseline to Barrhaven Town Centre (BTC)
S3 BTC to Cambrian

Option 1 BRT Based	Option 2 NS LRT	Option 3 EW LRT	Option 4 NS & EW LRT
New Transitway: Baseline to Hunt Club & Strandherd to Cambrian Conversion of Transitway: Hunt Club to Strandherd			
Stations			
Tallwood Knoxdale Hunt Club Longfields Strandherd Marketplace Chapman Mills 3 online stations			
Structures			
Tallwood CP Rail Line Cut and Cover Tunnel Highburry Strandherd North Drive Isle Jock River			
Cost			
$180M			

South Transitway

S4 Bowesville to Barrhaven Town Centre (BTC)

Option 1 BRT Based	Option 2 NS LRT	Option 3 EW LRT	Option 4 NS & EW LRT
New Tway Bowesville to BTC			
Stations			
Woodroffe River Road 12 online stations			
Park and Ride			
Woodroffe River Road			
Structures			
Cresthaven Rideau River Mosquito Creek			
Cost			
$100 M			

Transitway Summary

in millions $	Option 1 BRT Based	Option 2 NS LRT	Option 3 EW LRT	Option 4 NS & EW LRT
East Transitway			$ 239	
West Transitway			$ 338	
Southeast Transitway			$ 44	
Southwest Transitway			$ 180	
South Transitway			$ 100	
TOTAL			$ 901	

TOTAL INFRASTRUCTURE SUMMARY

in millions $	Option 1 BRT Based	Option 2 NS LRT	Option 3 EW LRT	Option 4 NS & EW LRT
Core Area	$ 951	$ 1,557	$ 1,101	$ 1,436
Transitways	$ 901	$ 901	$ 901	$ 901
TOTAL	$ 1,852	$ 2,458	$ 2,002	$ 2,337

Note: The costs shown above exclude the maintenance facility costs of $300, $340, $220 and $320 million respectively for the Options 1 to 4.

Rapid Transit Network

14-Apr-08

	Section	30 % Contingency + 50% on Tunnel			
		Option 1 BRT Tunnel	Option 2 BRT / LRT Tunnel (NS LRT)	Option 3 LRT Tunnel (E&W Downtown LRT)	Option 4 LRT Tunnel (E&W Downtown + NS LRT)
Central Downtown	Bayview to Campus (Excluding Tunnel)	$ 48,093,200.68	$ 67,992,771.93	$ 62,249,729.43	$ 62,249,729.43
	Tunnel portion	$ 780,000,000.00	$ 1,032,000,000.00	$ 555,000,000.00	$ 555,000,000.00
	Campus to Hurdman	Existing Transitway	Existing Transitway	$ 49,215,400.00	$ 49,215,400.00
		$ 829,000,000.00	$ 1,100,000,000.00	$ 667,000,000.00	$ 667,000,000.00
Central East	Hurdman to Blair	Existing Transitway	Existing Transitway	$ 96,360,972.50	$ 96,360,972.50
		$ -	$ -	$ 97,000,000.00	$ 97,000,000.00
Central West	Bayview to Lincoln Fields	$ 21,916,700.00	$ 21,916,700.00	$ 125,574,020.00	$ 125,574,020.00
	Lincoln Fields to Baseline	Existing Transitway	Existing Transitway	$ 110,525,350.00	$ 110,525,350.00
		$ 22,000,000.00	$ 22,000,000.00	$ 237,000,000.00	$ 237,000,000.00
Central South	Bayview to Greenboro	Existing O-Train	$ 226,976,693.13	Existing O-Train	$ 226,976,693.13
	Greenboro to Bowesville	$ 59,087,632.50	$ 133,423,415.95	$ 59,087,632.50	$ 133,423,415.95
	Airport Link	$ 40,391,910.00	$ 74,141,535.00	$ 40,391,910.00	$ 74,141,535.00
		$ 100,000,000.00	$ 435,000,000.00	$ 100,000,000.00	$ 435,000,000.00
East Transitway	Blair to Trim	$ 110,857,987.50	$ 110,857,987.50	$ 110,857,987.50	$ 110,857,987.50
	Blair to Innes	$ 24,397,652.50	$ 24,397,652.50	$ 24,397,652.50	$ 24,397,652.50
	Innes to Millenium	$ 103,588,550.00	$ 103,588,550.00	$ 103,588,550.00	$ 103,588,550.00
		$ 239,000,000.00	$ 239,000,000.00	$ 239,000,000.00	$ 239,000,000.00
SE Transitway	Smyth to Hospital	$ 43,792,287.50	$ 43,792,287.50	$ 43,792,287.50	$ 43,792,287.50
	Hurdman to Greenboro	Existing Transitway	Existing Transitway	Existing Transitway	Existing Transitway
		$ 44,000,000.00	$ 44,000,000.00	$ 44,000,000.00	$ 44,000,000.00
South Transitway	Bowesville to Barrhaven Town Centre	$ 97,129,781.11	$ 97,129,781.11	$ 97,129,781.11	$ 97,129,781.11
		$ 100,000,000.00	$ 100,000,000.00	$ 100,000,000.00	$ 100,000,000.00
SW Transitway	Baseline to Barrhaven Town Centre	$ 154,572,535.00	$ 154,572,535.00	$ 154,572,535.00	$ 154,572,535.00
	Barrhaven Town Centre to Cambrian	$ 24,636,852.50	$ 24,636,852.50	$ 24,636,852.50	$ 24,636,852.50
		$ 180,000,000.00	$ 180,000,000.00	$ 180,000,000.00	$ 180,000,000.00
West Transitway	Lincoln Fields to Bayshore	$ 171,885,756.25	$ 171,885,756.25	$ 171,885,756.25	$ 171,885,756.25
	Bayshore to Arena	$ 80,833,902.50	$ 80,833,902.50	$ 80,833,902.50	$ 80,833,902.50
	Arena to Fernbank (Stittsville)	$ 31,871,905.00	$ 31,871,905.00	$ 31,871,905.00	$ 31,871,905.00
	Kanata North	$ 52,952,152.50	$ 52,952,152.50	$ 52,952,152.50	$ 52,952,152.50
		$ 338,000,000.00	$ 338,000,000.00	$ 338,000,000.00	$ 338,000,000.00
INFRASTRUCTURE		$ 1,852,000,000.00	$ 2,458,000,000.00	$ 2,002,000,000.00	$ 2,337,000,000.00
Vehicles	LRT Vehicles	$ -	$ 140,000,000.00	$ 750,000,000.00	$ 890,000,000.00
	BRT Vehicles	$ 800,000,000.00	$ 720,000,000.00	$ 400,000,000.00	$ 320,000,000.00
	replacement Buses	$ 600,000,000.00	$ 540,000,000.00	$ 200,000,000.00	$ 160,000,000.00
VEHICLES		$ 1,400,000,000.00	$ 1,400,000,000.00	$ 1,350,000,000.00	$ 1,370,000,000.00
	LRT Maintenance Yard	$ -	$ 100,000,000.00	$ 100,000,000.00	$ 200,000,000.00
	BRT Maintenance Yard	$ 300,000,000.00	$ 240,000,000.00	$ 120,000,000.00	$ 120,000,000.00
MAINTENANCE FACILITIES		$ 300,000,000.00	$ 340,000,000.00	$ 220,000,000.00	$ 320,000,000.00
		$ 3,552,000,000	**$ 4,198,000,000**	**$ 3,572,000,000**	**$ 4,027,000,000**

note: includes engineering & Project Managemen
note: does not include vehicles or propert
note: cost estimates are preliminary and are subject to change through EA Studie

Ottawa TMP Update
Rapid Transit Network Study
14-Apr-08

Section #		Description	Length	Estimate	30%	50%
Tunnel	LRT	Downtown Tunnel	2500	$ 370,000,000.00	481,000,000.00	555,000,000.00
Tunnel	BRT	Downtown Tunnel		$ 520,000,000.00	676,000,000.00	780,000,000.00
Tunnel	BRT / LRT	Downtown Tunnel		$ 688,000,000.00	894,400,000.00	1,032,000,000.00
C1	LRT	Greenboro to Bayview	7800	$ 174,597,456.25	226,976,693.13	
C2	LRT	Bayview to Bronson	1275	$ 47,884,407.25	62,249,729.43	
C2	BRT	Bayview to Bronson		$ 36,994,769.75	48,093,200.68	
C2	BRT / LRT	Bayview to Bronson		$ 52,302,132.25	67,992,771.93	
C3	LRT	Campus to Hurdman	2000	$ 37,858,000.00	49,215,400.00	
C3	BRT	Campus to Hurdman		$ -	-	
C4	LRT	Hurdman to Blair	5300	$ 74,123,825.00	96,360,972.50	
C4	BRT	Hurdman to Blair		$ -	-	
C5	LRT	Bayview to Lincoln Fields	7600	$ 96,595,400.00	125,574,020.00	
C5	BRT	Bayview to Lincoln Fields		$ 16,859,000.00	21,916,700.00	
C6	LRT	Lincoln Fields to Baseline	3000	$ 85,019,500.00	110,525,350.00	
C6	BRT	Lincoln Fields to Baseline		$ -	-	
C7	BRT	Lincoln Fields to Bayshore		$ 132,219,812.50	171,885,756.25	
C8	BRT	Hurdman to South Keys		$ -	-	
C9	BRT	Hospital Link		$ 33,686,375.00	43,792,287.50	
S1	BRT	Bowesville to Greenboro		$ 45,452,025.00	59,087,632.50	
S1	LRT	Bowesville to Greenboro	7000	$ 102,633,396.89	133,423,415.95	
S2	BRT	Baseline to BTC		$ 118,901,950.00	154,572,535.00	
S3	BRT	BTC to Cambrian		$ 18,951,425.00	24,636,852.50	
S4	BRT	Barrhaven to Bowesville		$ 74,715,216.24	97,129,781.11	
S5	LRT	Airport Link	2500	$ 57,031,950.00	74,141,535.00	
S5	BRT	Airport Link		$ 31,070,700.00	40,391,910.00	
E1	BRT	Blair to Trim		$ 85,275,375.00	110,857,987.50	
E2	BRT	Blair to Innes		$ 18,767,425.00	24,397,652.50	
E3	BRT	Innes to Millenium		$ 79,683,500.00	103,588,550.00	
W1	BRT	Bayshore to Terry Fox		$ 30,119,535.00	39,155,395.50	
W2	BRT	Terry Fox to Arena		$ 32,060,390.00	41,678,507.00	
W3	BRT	Arena to Fernbank (Stittsville)		$ 24,516,850.00	31,871,905.00	
W4	BRT	Eagelson Kanata North		$ 40,732,425.00	52,952,152.50	

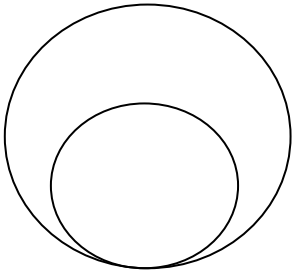
note: includes engineering & Project Management
note: does not include vehicles or property
note: cost estimates are preliminary and are subject to change through EA Studies

Downtown Tunnel

	T1 LRT	T2 BRT	T3 BRT/LRT
Length (Km)	2.5	2.5	2.5
twin bore per KM	$ 45,000,000.00	$ 125,000,000.00	$ 125,000,000.00
Tracks/ electrical	$ 55,000,000.00		$ 55,000,000.00
Asphalt/ ventilation		$ 35,000,000.00	$ 35,000,000.00
Tunnel Bore	**$ 250,000,000.00**	**$ 400,000,000.00**	**$ 538,000,000.00**
Stations (each)	$ 40,000,000.00	$ 40,000,000.00	$ 50,000,000.00
# of Stations	3	3	3
Station Cost	**$ 120,000,000.00**	**$ 120,000,000.00**	**$ 150,000,000.00**
Sub-total	$ 370,000,000.00	$ 520,000,000.00	$ 688,000,000.00

includes engineering and project management

50% contingency	$ 555,000,000.00	$ 780,000,000.00	$ 1,032,000,000.00
cost per KM - single bore	$ 111,000,000.00	$ 156,000,000.00	$ 206,400,000.00



combined =	5	m radius =	78.53982 m2
LRT =	3	m radius =	28.27433 m2
		larger =	178%

C1 LRT GREENBORO TO BAYVIEW 7800

WBS #	Item	Quantity	Units	Unit Cost	Total
10	**Property and Right of Way**				
10.1	**Property Acquisition**				
10.2	**ROW Preparation**				
10.3	**Property Maintenance**				
10.4	**Recovery**				
10.99	**Contingency**				
	WBS 10	**Subtotal**			$ -
20.6.01	**Clearing & Removals**				
	New corridor	7800	m	$ 375.00	$ 2,925,000.00
20.6.02	**Grading**				
	Fill	200000	m3	$ 20.00	$ 4,000,000.00
	Ex	300000	m3	$ 22.50	$ 6,750,000.00
	Rock Ex	60000	m3	$ 85.00	$ 5,100,000.00
20.6.03	**Drainage & Erosion Control**				
	ditching	65	m	$ 175.00	$ 11,375.00
20.6.04	**SWM Facility**				
20.6.05	**Running Surface**				
	Tracks	7,800	m	$ 1,215.00	$ 9,477,000.00
	Crossings	1	each	$ 50,000.00	$ 50,000.00
	Turnout	2	each	$ 500,000.00	$ 1,000,000.00
	fencing	15,600	m	$ 80.00	$ 1,248,000.00
	roadwork	1	LS	$ 700,000.00	$ 700,000.00
20.6.06	**Utilities**				
	relocation	1	LS	$ 5,615,000.00	$ 5,615,000.00
20.6.07	**Structures**				
	Walkley Diamond	500	m2	$ 3,500.00	$ 1,750,000.00
	Walkley Road	1	LS	$ 75,000.00	$ 75,000.00
	Sawmill Creek	2,500	m2	$ 3,500.00	$ 8,750,000.00
	Southeast Transitway	400	m2	$ 3,500.00	$ 1,400,000.00
	Ellwood Diamond	500	m2	$ 3,500.00	$ 1,750,000.00
	Heron Road	825	m2	$ 2,500.00	$ 2,062,500.00
	Rideau River	600	m2	$ 4,000.00	$ 2,400,000.00
	Pedestrian Underpass - Carleton Uni	100	m2	$ 2,500.00	$ 250,000.00
	Pedestrian Underpass - Carleton Station	100	m2	$ 2,500.00	$ 250,000.00
	Dow's Lake Tunnel	580	m	$ 26,500.00	$ 15,370,000.00
	Hwy 417 Modifications	1	LS	$ 200,000.00	$ 200,000.00
	Grade Separate Transitway	860	m2	$ 3,500.00	$ 3,010,000.00
	WBS 20	**Subtotal**			**$ 74,143,875.00**
	FACILITIES				
30.1	**Storage Yards, Maintenance**				
30.2	**Stations**				
	Greenboro	1	each	$ 3,300,000.00	$ 3,300,000.00
	Walkley	1	each	$ 3,300,000.00	$ 3,300,000.00
	Confederation	1	each	$ 3,300,000.00	$ 3,300,000.00
	Carleton	1	each	$ 3,300,000.00	$ 3,300,000.00
	Carling	1	each	$ 3,300,000.00	$ 3,300,000.00
	Gladstone	1	each	$ 3,300,000.00	$ 3,300,000.00
	Somerset	1	each	$ 3,300,000.00	$ 3,300,000.00
	Bayview transfer (7M LRT-LRT, 5M Otrain-LRT, 3M LRT-Tway)	1	each	$ 7,000,000.00	$ 7,000,000.00
30.3	**Associated Works**				
	relocate existing track	7800	m	$ 300.00	$ 2,340,000.00
30.4	**Park and Ride Lots**				
	WBS 30	**Subtotal**			**$ 32,440,000.00**
40	**Traction Power System**				
45.3.01	Traction Power	7800	m	$ 1,350.00	$ 10,530,000.00
45.3.02	Power Supply	7800	m	$ 1,000.00	$ 7,800,000.00
45.3.03	Sub-stations	7800	m	$ 1,200.00	$ 9,360,000.00
	WBS 40	**Subtotal**			**$ 27,690,000.00**
50	**Train Control System**				
50.3.01	Control / Signals	7800	m	$ 1,500.00	$ 11,700,000.00
50.3.02	Communication System	7800	m	$ 750.00	$ 5,850,000.00
	WBS 50	**Subtotal**			**$ 17,550,000.00**
	SECTION TOTAL				**$ 151,823,875.00**
	Engineering & Project Management	15%			$ 22,773,581.25
	TOTAL				**$ 174,597,456.25**
		30%			52,379,236.88
	TOTAL				**$ 226,976,693.13**

C2 LRT BAYVIEW TO CAMPUS excluding tunnel 1275

WBS #	Item		Quantity	Units	Unit Cost	Total
10	**Property and Right of Way**					
10.1	**Property Acquisition**					
10.2	**ROW Preparation**					
10.3	**Property Maintenance**					
10.4	**Recovery**					
10.99	**Contingency**					
		WBS 10	**Subtotal**			$ -
20.5.01	**Clearing & Removals**					
20.5.02	**Grading**					
	Fill		80000	m3	$ 20.00	$ 1,600,000.00
	Ex		20000	m3	$ 22.50	$ 450,000.00
						$ -
20.5.03	**Drainage & Erosion Control**					$ -
	bayview to west portal		1275	m	$ 475.00	$ 605,625.00
						$ -
20.5.04	**SWM Facility**					$ -
						$ -
20.5.05	**Running Surface**					$ -
	Tracks		2,550	m	$ 1,215.00	$ 3,098,250.00
	Crossings		4	each	$ 50,000.00	$ 200,000.00
	At Grade Crossings		0	each	$ 400,000.00	$ -
	fencing		2,550	m	$ 80.00	$ 204,000.00
						$ -
20.5.06	**Utilities**					$ -
						$ -
20.5.07	**Structures**					$ -
	Preston Street		300	m^2	$ 2,500.00	$ 750,000.00
	Booth Street - heritage style		900	m^2	$ 4,000.00	$ 3,600,000.00
	Cliff Street Access		300	m^2	$ 2,500.00	$ 750,000.00
	retaining walls		1200	m^2	$ 1,000.00	$ 1,200,000.00
20.5.08	**Landscaping**					
	downtown beutification (Albert & Slater Streets)		3000	m	$ 4,000.00	$ 12,000,000.00
	Albert / Slater Asphalt Removals (12 m width)		36000	m^2	$ 10.00	$ 360,000.00
	Albert / Slater Material Removals (12 m width x 0.3m depth)		10800	m3	$ 25.00	$ 270,000.00
	Albert / Slater Resurface (12m width)		36000	m2	$ 61.97	$ 2,230,740.00
	Mackenzie King Bridge		550	m	$ 3,500.00	$ 1,925,000.00
		WBS 20	**Subtotal**			**$ 29,243,615.00**
	FACILITIES					
30.1	**Storage Yards, Maintenance**					
30.2	**Stations**					
	Lebreton	new LRT station	1	each	$ 5,000,000.00	$ 5,000,000.00
30.3	**Associated Works**					
		WBS 30	**Subtotal**			**$ 5,000,000.00**
	Traction Power System					
45	Traction Power		1275	m	$ 1,350.00	$ 1,721,250.00
45.3.01	Power Supply		1275	m	$ 1,000.00	$ 1,275,000.00
45.3.02	Sub-stations		1275	m	$ 1,200.00	$ 1,530,000.00
		WBS 40	**Subtotal**			**$ 4,526,250.00**
50	**Train Control System**					
50.3.01	Control / Signals		1275	m	$ 1,500.00	$ 1,912,500.00
50.3.02	Communication System		1275	m	$ 750.00	$ 956,250.00
		WBS 50	**Subtotal**			**$ 2,868,750.00**
		SECTION TOTAL				**$ 41,638,615.00**
	Engineering & Project Management		15%			$ 6,245,792.25
		TOTAL				**$ 47,884,407.25**
			30%			14,365,322.18
		TOTAL				**$ 62,249,729.43**

C2 BRT BAYVIEW TO CAMPUS excluding tunnel 1275

WBS #	Item		Quantity	Units	Unit Cost	Total
10	**Property and Right of Way**					
10.1	**Property Acquisition**					
10.2	**ROW Preparation**					
10.3	**Property Maintenance**					
10.4	**Recovery**					
10.99	**Contingency**					
		WBS 10	**Subtotal**			**$ -**
20.5.01	**Clearing & Removals**					
20.5.02	**Grading**					
	Fill		80000	m3	$ 20.00	$ 1,600,000.00
	Ex		20000	m3	$ 22.50	$ 450,000.00
20.5.03	**Drainage & Erosion Control**					
	bayview to west portal		1275	m	$ 475.00	$ 605,625.00
20.5.04	**SWM Facility**					
20.5.05	**Running Surface**					
	fencing		2,550	m	$ 80.00	$ 204,000.00
	Transitway Surface		1,275	m	$ 660.00	$ 841,500.00
20.5.06	**Utilities**					
20.5.07	**Structures**					
	Preston Street		300	m^2	$ 2,500.00	$ 750,000.00
	Booth Street - heritage style		900	m^2	$ 4,000.00	$ 3,600,000.00
	Cliff Street Access		300	m^2	$ 2,500.00	$ 750,000.00
	retaining walls		1200	m^2	$ 1,000.00	$ 1,200,000.00
20.5.08	**Landscaping**					
	downtown beutification (Albert & Slater Streets)		3000	m	$ 4,000.00	$ 12,000,000.00
	Albert / Slater Asphalt Removals (12 m width)		36000	m^2	$ 10.00	$ 360,000.00
	Albert / Slater Material Removals (12 m width x 0.3m depth)		10800	m3	$ 25.00	$ 270,000.00
	Albert / Slater Resurface (12m width)		36000	m2	$ 61.97	$ 2,230,740.00
	Mackenzie King Bridge		550	m	$ 3,500.00	$ 1,925,000.00
		WBS 20	**Subtotal**			**$ 26,786,865.00**
	FACILITIES					
30.1	**Storage Yards, Maintenance**					
30.2	**Stations**					
	Lebreton	new BRT station	1	each	$ 5,000,000.00	$ 5,000,000.00
30.3	**Associated Works**					
		WBS 30	**Subtotal**			**$ 5,000,000.00**
50.3.02	Communication System		1275	m	$ 300.00	$ 382,500.00
		WBS 50	**Subtotal**			**$ 382,500.00**
		SECTION TOTAL				**$ 32,169,365.00**
	Engineering & Project Management		15%			$ 4,825,404.75
		TOTAL				**$ 36,994,769.75**
			30%			11,098,430.93
		TOTAL				**$ 48,093,200.68**

C2 BRT LRT BAYVIEW TO CAMPUS 1275

WBS #	Item		Quantity	Units	Unit Cost	Total
10	**Property and Right of Way**					
10.1	**Property Acquisition**					
10.2	**ROW Preparation**					
10.3	**Property Maintenance**					
10.4	**Recovery**					
10.99	**Contingency**					
		WBS 10	**Subtotal**			**$ -**
20.5.01	**Clearing & Removals**					
20.5.02	**Grading**					
	Fill		80000	m3	$ 20.00	$ 1,600,000.00
	Ex		20000	m3	$ 22.50	$ 450,000.00
20.5.03	**Drainage & Erosion Control**					
			1275	m	$ 475.00	$ 605,625.00
20.5.04	**SWM Facility**					
20.5.05	**Running Surface**					
	Tracks		2,550	m	$ 1,215.00	$ 3,098,250.00
	Crossing		4	each	$ 50,000.00	$ 200,000.00
	fencing		2,550	m	$ 80.00	$ 204,000.00
	Transitway Surface		1,275	m	$ 660.00	$ 841,500.00
20.5.06	**Utilities**					
20.5.07	**Structures**					
	Preston Street		300	m^2	$ 2,500.00	$ 750,000.00
	Booth Street - heritage style		900	m^2	$ 4,000.00	$ 3,600,000.00
	Cliff Street Access		300	m^2	$ 2,500.00	$ 750,000.00
	retaining walls		1200	m2	$ 1,000.00	$ 1,200,000.00
20.5.08	**Landscaping**					
	downtown beutification (Albert & Slater Streets)		3000	m	$ 4,000.00	$ 12,000,000.00
	Albert / Slater Asphalt Removals (12 m width)		36000	m^2	$ 10.00	$ 360,000.00
	Albert / Slater Material Removals (12 m width x 0.3m depth)		10800	m3	$ 25.00	$ 270,000.00
	Albert / Slater Resurface (12m width)		36000	m2	$ 61.97	$ 2,230,740.00
	Mackenzie King Bridge		550	m	$ 3,500.00	$ 1,925,000.00
		WBS 20	**Subtotal**			**$ 30,085,115.00**
	FACILITIES					
30.1	**Storage Yards, Maintenance**					
30.2	**Stations**					
	Lebreton	Bus and Rail Station	1	each	$ 8,000,000.00	$ 8,000,000.00
30.3	**Associated Works**					
		WBS 30	**Subtotal**			**$ 8,000,000.00**
	Traction Power System					
45	Traction Power		1275	m	$ 1,350.00	$ 1,721,250.00
45.3.01	Power Supply		1275	m	$ 1,000.00	$ 1,275,000.00
45.3.02	Sub-stations		1275	m	$ 1,200.00	$ 1,530,000.00
		WBS 40	**Subtotal**			**$ 4,526,250.00**
50	**Train Control System**					
50.3.01	Control / Signals		1275	m	$ 1,500.00	$ 1,912,500.00
50.3.02	Communication System		1275	m	$ 750.00	$ 956,250.00
		WBS 50	**Subtotal**			**$ 2,868,750.00**
		SECTION TOTAL				**$ 45,480,115.00**
	Engineering & Project Management		15%			$ 6,822,017.25
		TOTAL				**$ 52,302,132.25**
			30%			15,690,639.68
		TOTAL				**$ 67,992,771.93**

C3 LRT CAMPUS TO HURDMAN 2000

WBS #	Item	Quantity	Units	Unit Cost	Total
10	**Property and Right of Way**				
10.1	**Property Acquisition**				
10.2	**ROW Preparation**				
10.3	**Property Maintenance**				
10.4	**Recovery**				
10.99	**Contingency**				
	WBS 10	**Subtotal**			$ -
20.4.01	**Clearing & Removals**				
		2000		$ 375.00	$ 750,000.00
20.4.02	**Grading**				
	Fill	0	m3	$ 20.00	$ -
	Ex	0	m3	$ 22.50	$ -
20.4.03	**Drainage & Erosion Control**				
20.4.04	**SWM Facility**				
20.4.05	**Running Surface**				
	Tracks	4,000	m	$ 1,215.00	$ 4,860,000.00
	Crossings	1	each	$ 50,000.00	$ 50,000.00
	Turnout	1	each	$ 500,000.00	$ 500,000.00
	fencing	0	m	$ 80.00	$ -
	asphalt during construction	2,000	m	$ 330.00	$ 660,000.00
20.4.06	**Utilities**				
20.4.07	**Structures**				
	Modifications to Rideau River	1	LS	$ 1,500,000.00	$ 1,500,000.00
20.4.08	**Landscaping**				
	WBS 20	**Subtotal**			**$ 8,320,000.00**
	FACILITIES				
30.1	**Storage Yards, Maintenance**				
30.2	**Stations**				
30.2.1	Lees	1	each	$ 4,000,000.00	$ 4,000,000.00
30.2.2	Hurdman	1	each	$ 8,000,000.00	$ 8,000,000.00
30.2.3	Campus	1	each	$ 1,000,000.00	$ 1,000,000.00
30.3	**Associated Works**				
	WBS 30	**Subtotal**			**$ 13,000,000.00**
	Traction Power System				
	Traction Power	2000	m	$ 1,350.00	$ 2,700,000.00
45.3.01	Power Supply	2000	m	$ 1,000.00	$ 2,000,000.00
45.3.02	Sub-stations	2000	m	$ 1,200.00	$ 2,400,000.00
	WBS 40	**Subtotal**			**$ 7,100,000.00**
50	**Train Control System**				
50.3.01	Control / Signals	2000	m	$ 1,500.00	$ 3,000,000.00
50.3.02	Communication System	2000	m	$ 750.00	$ 1,500,000.00
	WBS 50	**Subtotal**			**$ 4,500,000.00**
	SECTION TOTAL				**$ 32,920,000.00**
	Engineering & Project Management	15%			$ 4,938,000.00
	TOTAL				**$ 37,858,000.00**
		30%			11,357,400.00
	TOTAL				**$ 49,215,400.00**

C4 LRT HURDMAN TO BLAIR — 5300

WBS #	Item	Quantity	Units	Unit Cost	Total
10	**Property and Right of Way**				
10.1	**Property Acquisition**				
10.2	**ROW Preparation**				
10.3	**Property Maintenance**				
10.4	**Recovery**				
10.99	**Contingency**				
	WBS 10	**Subtotal**			$ -
20.1.01	**Clearing & Removals**				
		5,300	m	$ 375.00	$ 1,987,500.00
20.1.02	**Grading**				
	Fill				
	Ex				
20.1.03	**Drainage & Erosion Control**				
20.1.04	**SWM Facility**				
20.1.05	**Running Surface**				
	Tracks	10,600	m	$ 1,215.00	$ 12,879,000.00
	Crossings	2	each	$ 50,000.00	$ 100,000.00
	Turnout	2	each	$ 500,000.00	$ 1,000,000.00
	fencing	0	m	$ 80.00	$ -
	asphalt during construction	5,300	m	$ 330.00	$ 1,749,000.00
20.1.06	**Utilities**				
20.1.07	**Structures**				
20.1.80	**Landscaping**				
	WBS 20	**Subtotal**			**$ 17,715,500.00**
	FACILITIES				
30.1	**Storage Yards, Maintenance**				
30.2	**Stations**				
	Train	1	each	$ 3,000,000.00	$ 3,000,000.00
	St. Laurent	1	each	$ 2,000,000.00	$ 2,000,000.00
	Cyrville	1	each	$ 1,000,000.00	$ 1,000,000.00
	Blair	1	each	$ 10,000,000.00	$ 10,000,000.00
					$ 16,000,000.00
30.3	**Associated Works**				
	WBS 30	**Subtotal**			**$ 16,000,000.00**
45	**Traction Power System**				
45.3.01	Traction Power	5300	m	$ 1,350.00	$ 7,155,000.00
45.3.02	Power Supply	5300	m	$ 1,000.00	$ 5,300,000.00
45.3.99	Sub-stations	5300	m	$ 1,200.00	$ 6,360,000.00
	WBS 40	**Subtotal**			**$ 18,815,000.00**
50.3.02	**Train Control System**				
50.3.03	Control / Signals	5300	m	$ 1,500.00	$ 7,950,000.00
50.3.04	Communication System	5300	m	$ 750.00	$ 3,975,000.00
	WBS 50	**Subtotal**			**$ 11,925,000.00**
	SECTION TOTAL				$ 64,455,500.00
	Engineering & Project Management	15%			$ 9,668,325.00
	TOTAL				**$ 74,123,825.00**
		30%			22,237,147.50
	TOTAL				**$ 96,360,972.50**

C5 LRT BAYVIEW TO LINCOLN 7600

WBS #	Item		Quantity	Units	Unit Cost	Total
10	**Property and Right of Way**					
10.1	**Property Acquisition**					
10.2	**ROW Preparation**					
10.3	**Property Maintenance**					
10.4	**Recovery**					
10.99	**Contingency**					
	WBS 10	**Subtotal**				**$ -**
20.3.01	**Clearing & Removals**					
	strip Tway surface / New alignment adjacent parkway		7600	m	$ 375.00	$ 2,850,000.00
20.3.02	**Grading**					
	Fill		5000	m3	$ 20.00	$ 100,000.00
	Ex					
20.3.03	**Drainage & Erosion Control**					
	ditch along LRT adjacnt Parkway	4000 from dominion to lincoln	4000	m	$ 125.00	$ 500,000.00
20.3.04	**SWM Facility**					
	new facility for new alignment		1	LS	$ 3,000,000.00	$ 3,000,000.00
20.3.05	**Running Surface**					
	Tracks		15,200	m	$ 1,215.00	$ 18,468,000.00
	Crossings		5	each	$ 50,000.00	$ 250,000.00
	Turnout		3	each	$ 500,000.00	$ 1,500,000.00
	fencing		8,000	m	$ 80.00	$ 640,000.00
	Asphalt during construction		7,600	m	$ 330.00	$ 2,508,000.00
20.3.06	**Utilities**		1	LS	$ 100,000.00	$ 100,000.00
20.3.07	**Structures**					
	Woodroffe Ave		400	m^2	$ 2,500.00	$ 1,000,000.00
	Richmond Road		600	m^2	$ 2,500.00	$ 1,500,000.00
20.3.08	**Landscaping**					
	adjacent new alignment		1	LS	$ 1,500,000.00	$ 1,500,000.00
	WBS 20	**Subtotal**				**$ 33,916,000.00**
	FACILITIES					
30.1	**Storage Yards, Maintenance**					
30.2	**Stations**					
	Tunney's Pasture		1	each	$ 1,000,000.00	$ 1,000,000.00
	Westboro		1	each	$ 1,000,000.00	$ 1,000,000.00
	Dominion		1	each	$ 1,000,000.00	$ 1,000,000.00
	Lincoln Fields		1	each	$ 3,000,000.00	$ 3,000,000.00
						$ 6,000,000.00
30.3	**Associated Works**					
	WBS 30	**Subtotal**				**$ 6,000,000.00**
45	**Traction Power System**					
45.3.01	Traction Power		7600	m	$ 1,350.00	$ 10,260,000.00
45.3.02	Power Supply		7600	m	$ 1,000.00	$ 7,600,000.00
45.3.99	Sub-stations		7600	m	$ 1,200.00	$ 9,120,000.00
50	**WBS 40**	**Subtotal**				**$ 26,980,000.00**
50.3.01	**Train Control System**					
50.3.02	Control / Signals		7600	m	$ 1,500.00	$ 11,400,000.00
50.3.03	Communication System		7600	m	$ 750.00	$ 5,700,000.00
	WBS 50	**Subtotal**				**$ 17,100,000.00**
	SECTION TOTAL					**$ 83,996,000.00**
	Engineering & Project Management		15%			$ 12,599,400.00
	TOTAL					**$ 96,595,400.00**
			30%			28,978,620.00
	TOTAL					**$ 125,574,020.00**

C5 BRT BAYVIEW TO LINCOLN — 7600

WBS #	Item		Quantity	Units	Unit Cost	Total
10	**Property and Right of Way**					
10.1	**Property Acquisition**					
10.2	**ROW Preparation**					
10.3	**Property Maintenance**					
10.4	**Recovery**					
10.99	**Contingency**					
		WBS 10 Subtotal				**$ -**
20.3.01	**Clearing & Removals**					
	New alignment adjacent parkway	4000 from dominion to lincoln	4000	m	$ 375.00	$ 1,500,000.00
20.3.02	**Grading**					
	Fill		5000	m3	$ 20.00	$ 100,000.00
20.3.03	**Drainage & Erosion Control**					
	rural ditching		4000	m	$ 125.00	$ 500,000.00
20.3.04	**SWM Facility**					
	new facility for new alignment		1	LS	$ 3,000,000.00	$ 3,000,000.00
20.3.05	**Running Surface**					
	2 new lanes for transit		4,000	m	$ 660	$ 2,640,000.00
	fencing		8,000	m	$ 80.00	$ 640,000.00
20.3.06	**Utilities**					$ -
20.3.07	**Structures**					
	Woodroffe Ave		400	m^2	$ 2,500.00	$ 1,000,000.00
	Richmond Road		600	m^2	$ 2,500.00	$ 1,500,000.00
20.3.08	**Landscaping**					
	adjacent new alignment		1	LS	$ 1,500,000.00	$ 1,500,000.00
		WBS 20 Subtotal				**$ 12,380,000.00**
	FACILITIES					
30.1	**Storage Yards, Maintenance**					
30.2	**Stations**					
	Tunney's Pasture			each		$ -
	Westboro			each		$ -
	Dominion			each		$ -
	Lincoln Fields			each		$ -
						$ -
30.3	**Associated Works**					
		WBS 30 Subtotal				**$ -**
45	**Traction Power System**					
45.3.01	Traction Power			m		$ -
45.3.02	Power Supply			m		$ -
45.3.99	Sub-stations			m		$ -
50		**WBS 40 Subtotal**				**$ -**
50.3.01	**Train Control System**					
50.3.02	Control / Signals			m		$ -
50.3.03	Communication System		7600	m	$ 300.00	$ 2,280,000.00
		WBS 50 Subtotal				**$ 2,280,000.00**
		SECTION TOTAL				**$ 14,660,000.00**
	Engineering & Project Management		15%			$ 2,199,000.00
		TOTAL				**$ 16,859,000.00**
			30%			5,057,700.00
		TOTAL				**$ 21,916,700.00**

C6 LRT LINCOLN TO BASELINE						3000
WBS #	**Item**	**Quantity**	**Units**	**Unit Cost**	**Total**	
10	**Property and Right of Way**					
10.1	**Property Acquisition**					
10.2	**ROW Preparation**					
10.3	**Property Maintenance**					
10.4	**Recovery**					
10.99	**Contingency**					
	WBS 10	**Subtotal**				
20.1.01	**Clearing & Removals**					
	Strip Transitway surface	3,000	m	$ 375.00	$ 1,125,000.00	
20.1.02	**Grading**					
	Fill				$ -	
	Cut				$ -	
20.1.03	**Drainage & Erosion Control**					
	ditch along LRT	3000	m	$ 125.00	$ 375,000.00	
20.1.04	**SWM Facility**					
20.1.05	**Running Surface**					
	Tracks	6,000	m	$ 1,215.00	$ 7,290,000.00	
	Crossings	1	each	$ 400,000.00	$ 400,000.00	
	Turnout	1	each	$ 600,000.00	$ 600,000.00	
	fencing		m	$ 80.00	$ -	
	Aspalt during construction	3,000	m	$ 330.00	$ 990,000.00	
20.1.06	**Utilities**					
20.1.07	**Structures**					
	Carling Ave	600	m^2	$ 2,500.00	$ 1,500,000.00	
	Queensway	3500	m^2	$ 5,500.00	$ 19,250,000.00	
	creek	400	m^2	$ 2,500.00	$ 1,000,000.00	
	Baseline	800	m^2	$ 2,500.00	$ 2,000,000.00	
20.1.80	**Landscaping**					
	WBS 20	**Subtotal**			**$ 34,530,000.00**	
	FACILITIES					
30.1	**Storage Yards, Maintenance**					
30.2	**Stations**					
	Queensway	1	each	$ 1,000,000.00	$ 1,000,000.00	
	Iris	1	each	$ 1,000,000.00	$ 1,000,000.00	
	Baseline (below grade station all in including approaches)	1	each	$ 20,000,000.00	$ 20,000,000.00	
					$ 22,000,000.00	
30.3	**Associated Works**					
	WBS 30	**Subtotal**			**$ 22,000,000.00**	
45	**Traction Power System**					
45.3.01	Traction Power	3000	m	$ 1,350.00	$ 4,050,000.00	
45.3.02	Power Supply	3000	m	$ 1,000.00	$ 3,000,000.00	
45.3.99	Sub-stations	3000	m	$ 1,200.00	$ 3,600,000.00	
50	**WBS 40**	**Subtotal**			**$ 10,650,000.00**	
50.3.01	**Train Control System**					
50.3.02	Control / Signals	3000	m	$ 1,500.00	$ 4,500,000.00	
50.3.03	Communication System	3000	m	$ 750.00	$ 2,250,000.00	
	WBS 50	**Subtotal**			**$ 6,750,000.00**	
	SECTION TOTAL				$ 73,930,000.00	
	Engineering & Project Management	15%			$ 11,089,500.00	
	TOTAL				**$ 85,019,500.00**	
		30%			25,505,850.00	
	TOTAL				**$ 110,525,350.00**	

existing from Pinecrest to Bayshore	1500	m
new Tway from Pinecrest to Split	1700	m
widen SW Tway for turning lanes	400	m

C7 BRT LINCOLN TO BAYSHORE — 1700

WBS #	Item		Quantity	Units	Unit Cost	Total
10	**Property and Right of Way**					
10.1	**Property Acquisition**					
10.2	**ROW Preparation**					
10.3	**Property Maintenance**					
10.4	**Recovery**					
10.99	**Contingency**					
		WBS 10 Subtotal				$ -
20.2.01	**Clearing & Removals**					
	Earth Ex		2100	m	$ 375.00	$ 787,500.00
20.2.02	**Grading**					
	fill / grading					
	Cut / excavation		289000	m3	$ 85.00	$ 24,565,000.00
20.2.03	**Drainage & Erosion Control**					
	600 storm sewer		1,700	m	$ 600.00	$ 1,020,000.00
	CB	2 @ 40m spacing	85	each	$ 2,000.00	$ 170,000.00
	CB leads	ROW @ 40m spacing	425	m	$ 250.00	$ 106,250.00
20.2.04	**SWM Facility**					
20.2.05	**Running Surface**					
	Transitway Roadway (rural and urban)		2,100	m	$ 660	$ 1,386,000.00
	Sidewalks, boulevards (Urban)		2,100	m	$ 330	$ 693,000.00
	fencing		4,200	m	$ 80	$ 336,000.00
20.2.06	**Utilities**					
20.2.07	**Structures**					
	ped bridge over 417		320	m2	$ 10,000.00	$ 3,200,000.00
	Pinecrest Creek		400	m^2	$2,500	$ 1,000,000.00
	Tunnel	includes cut	6200	m^2	$6,500	$ 40,300,000.00
	Pinecrest W-NS Ramp		1100	m^2	$2,500	$ 2,750,000.00
	Pinecrest SW Ramp		200	m^2	$2,500	$ 500,000.00
	Pinecrest		700	m^2	$2,500	$ 1,750,000.00
	retaining walls		28900	m^2	$1,000	$ 28,900,000.00
20.2.08	**Landscaping**					
		WBS 20 Subtotal				**$ 107,463,750.00**
	FACILITIES					
30.1	**Storage Yards, Maintenance**					
30.2	**Stations**					
	Dumaurier		1	each	$ 3,500,000	$ 3,500,000.00
	Pinecrest		1	each	$ 3,500,000	$ 3,500,000.00
					.	**$ 7,000,000.00**
30.3	**Associated Works**					
30.4	**Park and Ride Lots**					
		WBS 30 Subtotal				**$ 7,000,000.00**
50.3.04	Communication System		1700	m	$ 300.00	$ 510,000.00
		WBS 50 Subtotal				**$ 510,000.00**
		SECTION TOTAL				$ 114,973,750.00
	Engineering & Project Management		15%			$ 17,246,062.50
		TOTAL				**$ 132,219,812.50**
			30%			39,665,943.75
		TOTAL				**$ 171,885,756.25**

C8 BRT HURDMAN TO SOUTH KEYS

WBS #	Item	Quantity	Units	Unit Cost	Total
10	**Property and Right of Way**				
10.1	**Property Acquisition**				
10.2	**ROW Preparation**				
10.3	**Property Maintenance**				
10.4	**Recovery**				
10.99	**Contingency**				
20.6.01	**Clearing & Removals**				
20.6.02	**Grading**				
20.6.03	**Drainage & Erosion Cont**				
20.6.04	**SWM Facility**				
20.6.05	**Roadway**				
20.6.06	**Utilities**				
20.6.07	**Structures**				
20.6.08	**Landscaping**				
	FACILITIES				
30.1	**Storage Yards, Maintenance**				
30.2	**Stations**				
30.3	**Associated Works**				
40	**Vehicles and Equipment**				
45	**Traction Power System**				
50	**Train Control System**				
	SECTION 6 TOTAL				
	Engineering & Project Management	15%			$ -
	TOTAL				**$ -**

Existing BRT

C9 BRT HOSPITAL 1500

WBS #	Item		Quantity	Units	Unit Cost	Total
10	**Property and Right of Way**					
10.1	**Property Acquisition**					
10.2	**ROW Preparation**					
10.3	**Property Maintenance**					
10.4	**Recovery**					
10.99	**Contingency**					
		WBS 10 Subtotal				
20.6.01	**Clearing & Removals**					
	earth EX for new alignment		1,500	m	$ 375.00	$ 562,500.00
20.6.02	**Grading**					
	fill / grading					
	Cut / excavation	l=325, w= 25avg, h=7	57000	m3	$ 85.00	$ 4,845,000.00
	For Structure					
20.6.03	**Drainage & Erosion Control**					
	Transitway urban		1500	m	$ 475.00	$ 712,500.00
	Culverts and Outlets		3200	m	$ 1,000.00	$ 3,200,000.00
20.6.04	**SWM Facility**					
	Stormwater Management Facilities		1	LS	$ 3,310,000.00	$ 3,310,000.00
20.6.05	**Surface Roadway**					
	Granulars & Asphalt		1,500	m	$ 660.00	$ 990,000.00
	Curbs & Sidewalks (Urban)		1,500	m	$ 330.00	$ 495,000.00
	At Grade Intersection (at transitway)		1	each	$ 500,000.00	$ 500,000.00
	fencing		3,000	m	$ 80.00	$ 240,000.00
20.6.06	**Utilities**					
	Utilities (Bell, Hydro, Gas, Fibreoptic) + Tower Relocations		1	LS	$ 1,250,000.00	$ 1,250,000.00
	Municipal Services Relocations (Water, Sanitary and Storm)		1	LS	$ 3,500,000.00	$ 3,500,000.00
20.6.07	**Structures**					
	Under Riverside Drive Access	15	15	m^2	$ 2,500.00	$ 562,500.00
	Under Via	10	15	m^2	$ 2,500.00	$ 375,000.00
	Under Alta Vista	20	15	m^2	$ 2,500.00	$ 750,000.00
	retaining walls	650	7	m^2	$ 1,000.00	$ 4,550,000.00
20.6.08	**Landscaping**					
		WBS 20 Subtotal				**$ 25,842,500.00**
	FACILITIES					
30.1	**Storage Yards, Maintenance**					
30.2	**Stations**					
	Hospital		1	LS	$ 3,000,000	$ 3,000,000.00
		WBS 30 Subtotal				**$ 3,000,000.00**
50.3.04	Communication System		1500		300	$ 450,000.00
		WBS 50 Subtotal				**$ 450,000.00**
		SECTION 6 TOTAL				**$ 29,292,500.00**
	Engineering & Project Management		15%			$ 4,393,875.00
		TOTAL				**$ 33,686,375.00**
			30%			10,105,912.50
		TOTAL				**$ 43,792,287.50**

S1 BRT BOWESVILLE TO GREENBORO

south keys to greenboro

6000

WBS #	Item		Quantity	Units	Unit Cost	Total
10	**Property and Right of Way**					
10.1	**Property Acquisition**					
10.2	**ROW Preparation**					
10.3	**Property Maintenance**					
10.4	**Recovery**					
10.99	**Contingency**					
		WBS 10 Subtotal				
20.6.01	**Clearing & Removals**					
	earth EX for new alignment		6,000	m	$ 375	$ 2,250,000.00
20.6.02	**Grading**					
	fill / grading		100000	m3	$ 20.00	$ 2,000,000.00
	Cut / excavation		51000	m3	$ 22.50	$ 1,147,500.00
20.6.03	**Drainage & Erosion Control**					
	Transitway rural		6000	m	$ 125.00	$ 750,000.00
20.6.04	**SWM Facility**					
20.6.05	**Surface Roadway**					
	Granulars & Asphalt		6,000	m	$ 660	$ 3,960,000.00
	At Grade Intersection	Lester / Leitrim	2	each	$ 500,000	$ 1,000,000.00
	Fencing		12,000	m	$ 80	$ 960,000.00
20.6.06	**Utilities**		1	LS	$ 2,806,000.00	$ 2,806,000.00
20.6.07	**Structures**					
	culvert		150	m	$ 1,000.00	$ 150,000.00
	retaining wall		1475	m2	$ 1,000.00	$ 1,475,000.00
20.6.08	**Landscaping**					
		WBS 20 Subtotal				**$ 16,498,500.00**
	FACILITIES					
30.1	**Storage Yards, Maintenance**					
30.2	**Stations**					
	Bowesville		1	each	$ 3,000,000	$ 3,000,000.00
	Leitrim		1	each	$ 3,300,000	$ 3,300,000.00
	Lester		1	each	$ 3,200,000	$ 3,200,000.00
30.3	**Associated Works**					
	relocate existing track		4200	m	$ 300.00	$ 1,260,000.00
	Turnout for Freight Track to CN		1	each	$ 150,000.00	$ 150,000.00
	Track Removal		4,200	m	$ 75.00	$ 315,000.00
30.4	**Park and Ride Lots**					
	Bowsville		1	LS	$ 6,000,000	$ 6,000,000.00
	Leitrim		1	LS	$ 4,000,000	$ 4,000,000.00
		WBS 30 Subtotal				**$ 21,225,000.00**
50.3.04	Communication System		6000	m	300	$ 1,800,000.00
		WBS 50 Subtotal				**$ 1,800,000.00**
		SECTION 6 TOTAL				**$ 39,523,500.00**
	Engineering & Project Management		15%			$ 5,928,525.00
		TOTAL				**$ 45,452,025.00**
			30%			13,635,607.50
		TOTAL				**$ 59,087,632.50**

S1 LRT BOWESVILLE TO GREENBORO 7000

WBS #	Item	Quantity	Units	Unit Cost	Total
10	**Property and Right of Way**				
10.1	**Property Acquisition**				
10.2	**ROW Preparation**				
10.3	**Property Maintenance**				
10.4	**Recovery**				
10.99	**Contingency**				
	WBS 10 Subtotal				
20.6.01	**Clearing & Removals**				
	New alignment	7000	m	$ 375.00	$ 2,625,000.00
20.6.02	**Grading**				
	Fill	100000	m3	$ 20.00	$ 2,000,000.00
	Ex	51000	m3	$ 22.50	$ 1,147,500.00
20.6.03	**Drainage & Erosion Control**				
	ditch along LRT	7000	m	$ 125.00	$ 875,000.00
20.6.04	**SWM Facility**				
20.6.05	**Running Surface**				
	Tracks	7,000	m	$ 1,215.00	$ 8,505,000.00
	Crossings	1	LS	$ 175,848.75	$ 175,848.75
	Turnout	1	LS	$ 1,080,670.50	$ 1,080,670.50
	fencing	7,000	m	$ 80.00	$ 560,000.00
	roadwork	1	LS	$ 720,225.32	$ 720,225.32
20.6.06	**Utilities**				
	relocation	1	LS	$ 2,806,000.00	$ 2,806,000.00
20.6.07	**Structures**				
	Hunt Club	900	m2	$ 3,500.00	$ 3,150,000.00
	culvert	150	m	$ 1,000.00	$ 150,000.00
	retaining wall	1,475	m2	$ 1,000.00	$ 1,626,187.50
20.6.08	**Landscaping**				
	WBS 20 Subtotal				**$ 25,421,432.07**
	FACILITIES				
30.1	**Storage Yards, Maintenance**				
	Bowesville Yard	0	LS	$ 75,000,000.00	$ -
30.2	**Stations**				
	Bowesville	1	each	$ 3,000,000.00	$ 3,000,000.00
	Leitrim	1	each	$ 3,300,000.00	$ 3,300,000.00
	Lester	1	each	$ 3,200,000.00	$ 3,200,000.00
	South Keys	1	each	$ 2,000,000.00	$ 2,000,000.00
30.3	**Associated Works**				
	relocate existing track	4200	m	$ 300.00	$ 1,260,000.00
	Turnout for Freight Track to CN	1	each	$ 150,000.00	$ 150,000.00
	Track Removal	4,200	m	$ 75.00	$ 315,000.00
30.4	**Park and Ride Lots**				
	Bowsville	1	LS	$ 6,000,000.00	$ 6,000,000.00
	Leitrim	1	LS	$ 4,000,000.00	$ 4,000,000.00
	WBS 30 Subtotal				**$ 23,225,000.00**
	Traction Power System				
45.3.01	Traction Power	7000	m	$ 1,350.00	$ 9,450,000.00
45.3.02	Power Supply	7000	m	$ 1,000.00	$ 7,000,000.00
45.3.03	Sub-stations	7000	m	$ 1,200.00	$ 8,400,000.00
	WBS 40 Subtotal				**$ 24,850,000.00**
50	**Train Control System**				
50.3.01	Control / Signals	7000	m	$ 1,500.00	$ 10,500,000.00
50.3.02	Communication System	7000	m	$ 750.00	$ 5,250,000.00
	WBS 50 Subtotal				**$ 15,750,000.00**
	SECTION TOTAL				**$ 89,246,432.07**
	Engineering & Project Management	15%			$ 13,386,964.81
	TOTAL				**$ 102,633,396.89**
		30%			30,790,019.07
	TOTAL				**$ 133,423,415.95**

baseline to Hunt Club	2600	m
Hunt Club to Fallowfield	3600	m
Fallowfield to Strandherd	3000	m
Strandherd to Marketplace	400	m
Marketplace to Chapman Mills	400	m
TOTAL	10000	
Chapman Mills to Cambrian	2500	m

S2 BRT BASELINE TO BTC — 10000

WBS #	Item		Quantity	Units	Unit Cost	Total
10	**Property and Right of Way**					
10.1	**Property Acquisition**					
10.2	**ROW Preparation**					
10.3	**Property Maintenance**					
10.4	**Recovery**					
10.99	**Contingency**					
		WBS 10 Subtotal				**$ -**
20.5.01	**Clearing & Removals**					
	earth EX for new alignment		6,400	m	$ 375	$ 2,400,000.00
20.5.02	**Grading**					
	fill / grading		15000	m3	$ 20.00	$ 300,000.00
	Cut / excavation			m3		$ -
	For Structures (not tunnel)		59000	m3	$ 85.00	$ 5,015,000.00
20.5.03	**Drainage & Erosion Control**					
	Transitway urban		3400	m	$ 475.00	$ 1,615,000.00
	Transitway rural		3000	m	$ 125.00	$ 375,000.00
	Woodroofe Ave		500	m	$ 690.00	$ 345,000.00
20.5.04	**SWM Facility**					
20.5.05	**Roadway**					
	Granulars & Asphalt		6,400	m	$ 660	$ 4,224,000.00
	Curbs & Sidewalks (Urban)		3,400	m	$ 330	$ 1,122,000.00
	At Grade Intersection (at transitway)	Fallowfield, Berrigan, Marketplace	3	each	$ 250,000	$ 750,000.00
	reconstruct woodroffe (35m wide, asphalt,A, B, Blvd,	Sidewalk/Median, Curb, Lights)	550	m	$ 3,900	$ 2,145,000.00
	reconstruct woodroffe intersections	knoxdale, hunt club	2	each	$ 500,000	$ 1,000,000.00
20.5.06	**Utilities**					
	relocate utilities under woodroffe for tunnel		500	m	$ 3,500	$ 1,750,000.00
20.5.07	**Structures**					
	retaining wall (btwn baseline & Knoxdale)		23100	m^2	$ 1,000.00	$ 23,100,000.00
	Tallwood		500	m^2	$ 2,500	$ 1,250,000.00
	CP Rail Line		625	m^2	$ 3,000	$ 1,875,000.00
	Cut and Cover Tunnel	550	10	m^2	$ 4,000	$ 22,000,000.00
	retaining wall (s of hunt club)	200	7.5	m^2	$ 1,000	$ 1,500,000.00
	Highburry		400	m^2	$ 2,500	$ 1,000,000.00
	Strandherd		900	m^2	$ 7,500	$ 6,750,000.00
	Strandherd retaining walls		1337	m^2	$ 1,000	$ 1,337,000.00
	North Drive Isle		300	m^2	$ 3,000	$ 900,000.00
20.5.08	**Landscaping**					
		WBS 20 Subtotal				**$ 80,753,000.00**
	FACILITIES					
30.1	**Storage Yards, Maintenance**					
30.2	**Stations**					
	Tallwood		1	each	$ 4,000,000	$ 4,000,000.00
	Knoxdale		1	each	$ 4,000,000	$ 4,000,000.00
	Hunt Club Station		1	each	$ 3,000,000	$ 3,000,000.00
	Longfields		1	each	$ 3,000,000	$ 3,000,000.00
	Strandherd		1	each	$ 3,000,000	$ 3,000,000.00
	Marketplace		1	each	$ 1,500,000	$ 1,500,000.00
	Chapman Mills		1	each	$ 3,000,000	$ 3,000,000.00
30.3	**Associated Works**					
		WBS 30 Subtotal				**$ 21,500,000.00**
50.3.04	Communication System		3800	m	$ 300.00	$ 1,140,000.00
		WBS 50 Subtotal				**$ 1,140,000.00**
		SECTION 5 TOTAL				**$ 103,393,000.00**
	Engineering & Project Management		15%			$ 15,508,950.00
		TOTAL				**$ 118,901,950.00**
			30%			35,670,585.00
		TOTAL				**$ 154,572,535.00**

baseline to Hunt Club	2600	m
Hunt Club to Fallowfield	3600	m
Fallowfield to Strandherd	3000	m
Strandherd to Marketplace	400	m
Marketplace to Chapman Mills	400	m
TOTAL	10000	
Chapman Mills to Cambrian	2500	m

S3 BRT BARRHAVEN TO CAMBRIAN 2500

WBS #	Item		Quantity	Units	Unit Cost	Total
10	**Property and Right of Way**					
10.1	**Property Acquisition**					
10.2	**ROW Preparation**					
10.3	**Property Maintenance**					
10.4	**Recovery**					
10.99	**Contingency**					
		WBS 10 Subtotal				
20.6.01	**Clearing & Removals**					
	earth EX for new alignment		2,500	m	$ 375	$ 937,500.00
20.6.02	**Grading**					
	fill / grading	Marketplace to Greenbank	750	m3	$ 20.00	$ 15,000.00
	Cut / excavation	Marketplace Mills to Greenbank	5700	m3	$ 85.00	$ 484,500.00
20.6.03	**Drainage & Erosion Control**					
	Transitway urban (assumed main sewer line part of road project)		2500	m	$ 475.00	$ 1,187,500.00
20.6.04	**SWM Facility**					
20.6.05	**Running Surface**					
	Granulars & Asphalt		2,500	m	$ 660	$ 1,650,000.00
	Curbs / Sidewalks / Boulevards		2,500	m	$ 330	$ 825,000.00
	At Grade Intersection (not including stns)	btwn Greenbank & Cambrian	3	each	$ 250,000.00	$ 750,000.00
	Reconstruct Intersection	Chapman Mills, greenbank	2	each	$ 500,000	$ 1,000,000.00
20.4.06	**Utilities**					
20.4.07	**Structures**					
	2 lanes of new bridge over jock river	140	12	m2	3500	$ 5,880,000.00
20.4.08	**Landscaping**					
		WBS 20 Subtotal				**$ 12,729,500.00**
	FACILITIES					
30.1	**Storage Yards, Maintenance**					
30.2	**Stations**					
30.2.1	On Line Stations		3	each	$ 1,000,000	$ 3,000,000.00
30.3	**Associated Works**					
30.4	**Park and Ride**					
		WBS 30 Subtotal				**$ 3,000,000.00**
50.3.04	Communication System		2500	m	$ 300.00	$ 750,000.00
		WBS 50 Subtotal				**$ 750,000.00**
		SECTION 4 TOTAL				**$ 16,479,500.00**
	Engineering & Project Management		15%			$ 2,471,925.00
		TOTAL				**$ 18,951,425.00**
			30%			5,685,427.50
		TOTAL				**$ 24,636,852.50**

S4 BRT BARRHAVEN TO BOWESVILLE — 10,600

WBS #	Item		Quantity	Units	Unit Cost	Total
10	**Property and Right of Way**					
10.1	**Property Acquisition**					
10.2	**ROW Preparation**					
10.3	**Property Maintenance**					
10.4	**Recovery**					
10.99	**Contingency**					
		WBS 10 Subtotal				
20.6.01	**Clearing & Removals**					
	earth EX for new alignment		10,600	m	$ 375	$ 3,975,000.00
20.6.02	**Grading**					
	fill / grading		134600	m3	$ 20.00	$ 2,692,000.00
	Cut / excavation		113000	m3	$ 22.50	$ 2,542,500.00
20.6.03	**Drainage & Erosion Control**					
	Transitway rural		10600	m	$ 125.00	$ 1,325,000.00
20.6.04	**SWM Facility**					
20.6.05	**Running Surface**					
	Granulars & Asphalt		10,600	m	$ 660	$ 6,996,000.00
	At Grade Intersection		13	each	$ 250,000	$ 3,250,000.00
	roadwork		1	LS	$ 416,000	$ 416,000.00
	fence		10,600	m	$ 80	$ 848,000.00
20.4.06	**Utilities**					
	electrical for pedestrian walkway		1	LS	$ 374,078.25	$ 374,078.25
20.4.07	**Structures**					
	Cresthaven	50	20	m^2	$ 2,500	$ 2,500,000.00
	Rideau River (only 2 lanes of bridge)	156	8	m^2	$ 4,000	$ 4,992,000.00
	Mosquito Creek	79	20	m^2	$ 3,000	$ 4,740,000.00
	retaining wall		1	LS	$ 959,175	$ 959,175.00
20.4.08	**Landscaping**					
		WBS 20 Subtotal				**$ 35,609,753.25**
	FACILITIES					
30.1	**Storage Yards, Maintenance**					
30.2	**Stations**					
30.2.1	Barrhaven/Riverside stations		12	each	$ 1,000,000	$ 12,000,000.00
30.2.2	Woodroffe		1	each	$ 3,000,000	$ 3,000,000.00
30.2.3	River Road		1	each	$ 3,000,000	$ 3,000,000.00
30.3	**Associated Works**					
30.4	**Park and Ride**					
30.4.1	Woodroofe		1	each	$ 4,000,000	$ 4,000,000.00
30.4.2	River Road		1	each	$ 4,000,000	$ 4,000,000.00
		WBS 30 Subtotal				**$ 26,000,000.00**
50.3.04	Communication System		11200		$ 300.00	$ 3,360,000.00
		WBS 50 Subtotal				**$ 3,360,000.00**
		SECTION 4 TOTAL				**$ 64,969,753.25**
	Engineering & Project Management		15%			$ 9,745,462.99
		TOTAL				**$ 74,715,216.24**
			30%			22,414,564.87
		TOTAL				**$ 97,129,781.11**

9.16 M per KM

S5 LRT AIRPORT						2500
WBS #	Item	Quantity	Units	Unit Cost	Total	
10	**Property and Right of Way**					
10.1	**Property Acquisition**					
10.2	**ROW Preparation**					
10.3	**Property Maintenance**					
10.4	**Recovery**					
10.99	**Contingency**					
	WBS 10	**Subtotal**			$	-
20.2.01	**Clearing & Removals**				$	-
	New alignment	2,500	m	$ 375.00	$	937,500.00
20.2.02	**Grading**					
	Fill	40,000	m3	$ 20.00	$	800,000.00
	Cut	94,000	m3	$ 22.50	$	2,115,000.00
20.2.03	**Drainage & Erosion Control**					
	New ditch for alignment to Airport	2500	m	$ 125.00	$	312,500.00
20.2.04	**SWM Facility**					
	SWM Facility	1	LS	$ 100,000.00	$	100,000.00
20.2.05	**Running Surface**					
	Tracks	5,000	m	$ 1,215.00	$	6,075,000.00
	Crossings	3	each	$ 50,000.00	$	150,000.00
	Turnout	1	each	$ 500,000.00	$	500,000.00
	fencing	5,000	m	$ 80.00	$	400,000.00
	roadwork	1	LS	$ 68,000.00	$	68,000.00
20.2.06	**Utilities**					
	Utility relocations	1	LS	$ 85,000.00	$	85,000.00
20.2.07	**Structures**					
	Under delta taxi / Alert / Retaining Walls	1	LS	$ 8,000,000.00	$	8,000,000.00
20.2.08	**Landscaping**					
	WBS 20	**Subtotal**			**$**	**19,543,000.00**
	FACILITIES					
30.1	**Storage Yards, Maintenance**					
30.2	**Stations**					
	Airport	1	LS	$ 3,800,000.00	$	3,800,000.00
	Alert Rd.	1	LS	$ 3,000,000.00	$	3,000,000.00
30.3	**Associated Works**					
	impacts to Airport Operations / detours	1	LS	$ 5,000,000.00	$	5,000,000.00
	WBS 30	**Subtotal**			**$**	**11,800,000.00**
45	**Traction Power System**					
45.3.01	Traction Power	2500	m	$ 1,350.00	$	3,375,000.00
45.3.02	Power Supply	2500	m	$ 1,000.00	$	2,500,000.00
45.3.99	Sub-stations	2500	m	$ 1,200.00	$	3,000,000.00
50	**WBS 40**	**Subtotal**			**$**	**8,875,000.00**
50.3.01	**Train Control System**					
50.3.02	Control / Signals	2500	m	$ 3,000.00	$	7,500,000.00
50.3.03	Communication System	2500	m	$ 750.00	$	1,875,000.00
	WBS 50	**Subtotal**			**$**	**9,375,000.00**
	SECTION TOTAL				$	49,593,000.00
	Engineering & Project Management	15%			$	7,438,950.00
	TOTAL				**$**	**57,031,950.00**
		30%				17,109,585.00
	TOTAL				**$**	**74,141,535.00**

S5 BRT AIRPORT						2500
WBS #	Item	Quantity	Units	Unit Cost		Total
10	**Property and Right of Way**					
10.1	**Property Acquisition**					
10.2	**ROW Preparation**					
10.3	**Property Maintenance**					
10.4	**Recovery**					
10.99	**Contingency**					
	WBS 10	**Subtotal**			**$**	**-**
20.2.01	**Clearing & Removals**					
	New alignment	2,500	m	$ 375.00	$	937,500.00
20.2.02	**Grading**					
	Fill	40,000	m3	$ 20.00	$	800,000.00
	Cut	94,000	m3	$ 22.50	$	2,115,000.00
20.2.03	**Drainage & Erosion Control**					
	rural ditching	2500	m	$ 125.00	$	312,500.00
20.2.04	**SWM Facility**					
	SWM Facility	1	LS	$ 100,000.00	$	100,000.00
20.2.05	**Running Surface**					
	granulars & asphalt	2,500	m	$ 660.00	$	1,650,000.00
	fencing	5,000	m	$ 80.00	$	400,000.00
	roadwork	1	LS	$ 68,000.00	$	68,000.00
20.2.06	**Utilities**					
	Utility relocations	1	LS	$ 85,000.00	$	85,000.00
20.2.07	**Structures**					
	Under delta taxi / Alert / Retaining Walls	1	LS	$ 8,000,000.00	$	8,000,000.00
20.2.08	**Landscaping**					
	WBS 20	**Subtotal**			**$**	**14,468,000.00**
	FACILITIES					
30.1	**Storage Yards, Maintenance**					
30.2	**Stations**					
	Airport	1	LS	$ 3,800,000.00	$	3,800,000.00
	Alert Rd.	1	LS	$ 3,000,000.00	$	3,000,000.00
30.3	**Associated Works**					
	impacts to Airport Operations / detours	1	LS	$ 5,000,000.00	$	5,000,000.00
	WBS 30	**Subtotal**			**$**	**11,800,000.00**
50.3.03	Communication System	2500	m	$ 300.00	$	750,000.00
	WBS 50	**Subtotal**			**$**	**750,000.00**
	SECTION TOTAL				$	27,018,000.00
	Engineering & Project Management	15%			$	4,052,700.00
	TOTAL				**$**	**31,070,700.00**
		30%				9,321,210.00
	TOTAL				**$**	**40,391,910.00**

E1 BRT BLAIR TO TRIM	new alignment south of HWY174 btwn Place d'orleans and trim					12700
WBS #	**Item**		**Quantity**	**Units**	**Unit Cost**	**Total**
10	**Property and Right of Way**					
10.1	**Property Acquisition**					
10.2	**ROW Preparation**					
10.3	**Property Maintenance**					
10.4	**Recovery**					
10.99	**Contingency**					
		WBS 10				**$ -**
20.3.01	**Clearing & Removals**					
	New alignment		3,500	m	$ 375.00	$ 1,312,500.00
20.3.02	**Grading**					
	fill / grading		126,000	t	$ 20.00	$ 2,520,000.00
20.3.03	**Drainage & Erosion Control**					
	urban		3500	m	$ 475.00	$ 1,662,500.00
20.3.04	**SWM Facility**					
20.3.05	**Running Surface**					
	Transitway		3,500	m	$ 660.00	$ 2,310,000.00
	At Grade Intersection		0	each	$ 250,000.00	$ -
	curbs		7,000	m	$ 50.00	$ 350,000.00
	sidewalks		0	m2	$ 55.00	$ -
20.3.06	**Utilities**					
	high tension hydro pole relocation	spced at 160m	22	m	$ 250,000.00	$ 5,500,000.00
20.3.07	**Structures**					
	montreal: EB off ramp	25	15	m2	$ 2,500.00	$ 937,500.00
	montreal: EB on ramp s of mtl	10	15	m2	$ 2,500.00	$ 375,000.00
	Montreal Road	35	15	m2	$ 3,000.00	$ 1,575,000.00
	Montreal: EB on ramp n of mtl	40	15	m2	$ 2,500.00	$ 1,500,000.00
	over creek	20	15	m2	$ 2,500.00	$ 750,000.00
	Punch hole through Rockliffe		1	each	$ 1,000,000.00	$ 1,000,000.00
	Jean D'arc: EB off ramp	90	15	m2	$ 2,500.00	$ 3,375,000.00
	Jean D'arc: EB on ramp w of Jd'A	20	15	m2	$ 2,500.00	$ 750,000.00
	Jean Darc Boulevard	25	15	m2	$ 3,000.00	$ 1,125,000.00
	Jean D'arc: EB on ramp e of J'dA	50	15	m2	$ 2,500.00	$ 1,875,000.00
	Punch hole through Orleans		1	each	$ 1,000,000.00	$ 1,000,000.00
	Under Champlain	40	15	m2	$ 3,000.00	$ 1,800,000.00
	Under Place D'orleans Drive	75	15	m2	$ 3,000.00	$ 3,375,000.00
	Place D'orleans EB Hwy on ramp	50	15	m2	$ 2,500.00	$ 1,875,000.00
	10th line EB HWY off ramp	30	15	m2	$ 2,500.00	$ 1,125,000.00
	Hwy On ramp	25	15	m2	$ 2,500.00	$ 937,500.00
	under trim off ramp	45	15	m2	$ 2,500.00	$ 1,687,500.00
	under trim	25	15	m2	$ 3,000.00	$ 1,125,000.00
	culvert extensions		100	m	$ 10,000.00	$ 1,000,000.00
	retaining walls	half the length, both sides, 3m h	10500	m2	$ 1,000.00	$ 10,500,000.00
20.3.08	**Landscaping**					
		WBS 20				**$ 51,342,500.00**
	FACILITIES					
30.1	**Storage Yards, Maintenance**					
30.2	**Stations**					
	OTC		1	each	$ 5,000,000.00	$ 5,000,000.00
	10th Line		1	each	$ 5,000,000.00	$ 5,000,000.00
	Taylor Creek		1	each	$ 1,500,000.00	$ 1,500,000.00
	Trim		1	each	$ 7,500,000.00	$ 7,500,000.00
30.3	**Associated Works**					
30.4	**Park and Ride Lots**					
		WBS 30				**$ 19,000,000.00**
50	**Train Control System**					
50.3.02	Communication System		12700	m	$ 300.00	$ 3,810,000.00
		WBS 50 Subtotal				**$ 3,810,000.00**
						$ 74,152,500.00
	Engineering & Project Management		15%			$ 11,122,875.00
		TOTAL				**$ 85,275,375.00**
			30%			25,582,612.50
		TOTAL				**$ 110,857,987.50**

E2 BRT BLAIR TO INNES 2300

WBS #	Item		Quantity	Units	Unit Cost	Total
10	**Property and Right of Way**					
10.1	**Property Acquisition**					
10.2	**ROW Preparation**					
10.3	**Property Maintenance**					
10.4	**Recovery**					
10.99	**Contingency**					
	WBS 10 Subtotal					**$ -**
20.2.01	**Clearing & Removals**					
	new alignment		2,300	m	$ 375	$ 862,500.00
20.2.02	**Grading**					
	fill / grading		82,800	t	$ 20.00	$ 1,656,000.00
	Cut / excavation					
20.2.03	**Drainage & Erosion Control**					
	urban ditching		800	m	$ 475.00	$ 380,000.00
	rural		1500	m	$ 125.00	$ 187,500.00
20.2.04	**SWM Facility**					
20.2.05	**Running Surface**					
	Transitway Roadway (rural and urban)		2,300	m	$ 660	$ 1,518,000.00
	At Grade Intersection		2	each	$ 150,000	$ 300,000.00
	fencing		4,600	m	$ 80	$ 368,000.00
20.2.06	**Utilities**					
20.2.07	**Structures**					
	Over HWY 174	50	15	m2	$ 3,500.00	$ 2,625,000.00
	Over EB on ramp	**75**	15	m2	$ 2,500.00	$ 2,812,500.00
	culvert		1	each	$ 100,000.00	$ 100,000.00
20.2.08	**Landscaping**					
	WBS 20 Subtotal					**$ 10,809,500.00**
	FACILITIES					
30.2	**Stations**					
	Innes @ Blair		1	each	$ 3,000,000	$ 3,000,000.00
	on line stations		2	each	$ 1,000,000	$ 2,000,000.00
30.3	**Associated Works**					
31.4	**Park and Ride Lots**					
	WBS 30 Subtotal					**$ 5,000,000.00**
50.3.04	Communication System		1700	m	$ 300.00	$ 510,000.00
	WBS 50 Subtotal					**$ 510,000.00**
	SECTION TOTAL					$ 16,319,500.00
	Engineering & Project Management		15%			$ 2,447,925.00
	TOTAL					**$ 18,767,425.00**
			30			$ 5,630,227.50
	TOTAL					**$ 24,397,652.50**

Blair to Anderson	1600 m
Anderson to Bypass	1000 m
Bypass to Navan	2100 m
Navan to Hydro	1500 m
Hydro to 10th line	4200 m
10th line to Millenium	3100 m
TOTAL	13500 m

E3 BRT INNES TO MILLENIUM	via Blackburn Hamlet Bypass					**13,500**
WBS #	**Item**		**Quantity**	**Units**	**Unit Cost**	**Total**
10	**Property and Right of Way**					
10.1	**Property Acquisition**					
10.2	**ROW Preparation**					
10.3	**Property Maintenance**					
10.4	**Recovery**					
10.99	**Contingency**					
		WBS 10 Subtotal				**$ -**
20.2.01	**Clearing & Removals**					
	new alignment		13,500	m	$ 375	$ 5,062,500.00
20.2.02	**Grading**					
	fill / grading		486,000	t	$ 20.00	$ 9,720,000.00
	Cut / excavation					
20.2.03	**Drainage & Erosion Control**					
	rural ditching		13,500	m	$ 125.00	$ 1,687,500.00
20.2.04	**SWM Facility**					
20.2.05	**Running Surface**					
	Transitway Roadway (rural and urban)		13,500	m	$ 660	$ 8,910,000.00
	At Grade Intersection		7	each	$ 250,000	$ 1,750,000.00
	fencing		27,000	m	$ 80	$ 2,160,000.00
20.2.06	**Utilities**					
20.2.07	**Structures**					
	Culvert		5	each	$ 100,000.00	$ 500,000.00
	Over Innes	40	15	m2	$ 2,750.00	$ 1,650,000.00
	Mere Bleue	30	15	m2	$ 2,500.00	$ 1,125,000.00
	10th line	30	15	m2	$ 2,500.00	$ 1,125,000.00
	Esprit	30	15	m2	$ 2,500.00	$ 1,125,000.00
	Portobello	30	15	m2	$ 2,500.00	$ 1,125,000.00
20.2.08	**Landscaping**					
		WBS 20 Subtotal				**$ 35,940,000.00**
	FACILITIES					
30.2	**Stations**					
	Millenium Station (P&R)		1	each	$ 3,000,000	$ 3,000,000.00
	Navan (P&R)		1	each	$ 3,000,000	$ 3,000,000.00
	10th Line		1	each	$ 3,000,000	$ 3,000,000.00
	mere Bleue		1	each	$ 3,000,000	$ 3,000,000.00
	Page		1	each	$ 3,000,000	$ 3,000,000.00
	Blackburn Hamlet E		1	each	$ 3,000,000	$ 3,000,000.00
	Blackburn Hamlet W		1	each	$ 3,000,000	$ 3,000,000.00
30.3	**Associated Works**					
31.4	**Park and Ride Lots**					
	Millenium		1	each	$ 4,000,000.00	$ 4,000,000.00
	Navan		1	each	$ 4,000,000.00	$ 4,000,000.00
		WBS 30 Subtotal				**$ 29,000,000.00**
50.3.04	Communication System		14500	m	$ 300.00	$ 4,350,000.00
		WBS 50 Subtotal				**$ 4,350,000.00**
		SECTION TOTAL				$ 69,290,000.00
	Engineering & Project Management		15%			$ 10,393,500.00
		TOTAL				**$ 79,683,500.00**
			30%			23,905,050.00
		TOTAL				**$ 103,588,550.00**

Bayshore tp Moodie	2600 m
Moodie to March	4250 m
March to Terry Fox	2150 m
TOTAL	**9000 m**

Current cross section from Bayshore to March includes BUS lanes

New Transitway from March to Terry Fox adjacent N. Side of Highway

W1 BRT BAYSHORE TO TERRY FOX 9000

WBS #	Item			Quantity	Units	Unit Cost	Total
10	**Property and Right of Way**						
10.1	**Property Acquisition**						
10.2	**ROW Preparation**						
10.3	**Property Maintenance**						
10.4	**Recovery**						
10.99	**Contingency**						
			WBS 10	**Subtotal**			
20.1.01	**Clearing & Removals**						
				2,150	m	$ 375	$ 806,250.00
20.1.02	**Grading**						
	fill / grading			77,400	t	$ 20.00	$ 1,548,000.00
20.1.03	**Drainage & Erosion Control**						
	600 storm sewer			2,150	m	$ 600.00	$ 1,290,000.00
	CB	4 @ 40m spacing		215	each	$ 2,000.00	$ 430,000.00
	CB leads	ROW @ 40m spacing		1,075	m	$ 250.00	$ 268,750.00
20.1.04	**SWM Facility**						
20.1.05	**Running Surface**						
	asphalt			14,749	t	$ 100.00	$ 1,474,900.00
	Curbs			4,300	m	$ 330.00	$ 1,419,000.00
	At Grade Intersection			0	each	$ 250,000.00	$ -
	fencing			4,300	m	$ 80.00	$ 344,000.00
20.1.06	**Utilities**						
20.1.07	**Structures**						
	under March WB off ramp (skewed)		120	20	m2	$ 2,500	$ 6,000,000.00
	Flyover over Hwy 417		250	10	m2	$ 2,500	$ 6,250,000.00
	Under March		40	15	m2	$ 3,500	$ 2,100,000.00
	modification of existing ped bridge			1	LS	$ 515,000	$ 515,000.00
	Culvert			1	each	$ 100,000	$ 100,000.00
20.1.80	**Landscaping**						
			WBS 20	**Subtotal**			**$ 22,545,900.00**
	FACILITIES						
30.1	**Storage Yards, Maintenance**						
30.2	**Stations**						
	Moodie			1	each	$ 1,000,000	$ 1,000,000.00
	Eagelson			1	each	$ 1,000,000	$ 1,000,000.00
	Ped Bridge			1	each	$ 1,000,000	$ 1,000,000.00
30.3	**Associated Works**						
30.4	**Park and Ride Lots**						
	eagelson			0		$ 4,000,000.00	$ -
			WBS 30	**Subtotal**			**$ 3,000,000.00**
50.3.04	Communication System			2150	m	$ 300.00	$ 645,000.00
			WBS 50	**Subtotal**			**$ 645,000.00**
		SECTION TOTAL					$ 26,190,900.00
	Engineering & Project Management			15%			$ 3,928,635.00
		TOTAL					**$ 30,119,535.00**
				30%			9,035,860.50
		TOTAL					**$ 39,155,395.50**

Terry Fox to 1st Line	1000
1st line to Arean	2100
TOTAL	3100 m

W2 BRT TERRY FOX TO ARENA 3100

WBS #	Item		Quantity	Units	Unit Cost	Total
10	**Property and Right of Way**					
10.1	**Property Acquisition**					
10.2	**ROW Preparation**					
10.3	**Property Maintenance**					
10.4	**Recovery**					
10.99	**Contingency**					
		WBS 10	**Subtotal**			
20.1.01	**Clearing & Removals**					
			3,100		$ 375.00	$ 1,162,500.00
20.1.02	**Grading**					
20.1.03	**Drainage & Erosion Control**					
	600 storm sewer		3,100	m	$ 600.00	$ 1,860,000.00
	CB	4 @ 40m spacing	310	each	$ 2,000.00	$ 620,000.00
	CB leads	ROW @ 40m spacing	1,550	m	$ 250.00	$ 387,500.00
20.1.04	**SWM Facility**					
20.1.05	**Running Surface**					
	asphalt		21,266	t	$ 100.00	$ 2,126,600.00
	Curbs		6,200	m	$ 330.00	$ 2,046,000.00
	At Grade Intersection		0	each	$ 250,000.00	$ -
	fencing		6,200	m	$ 80.00	$ 496,000.00
20.1.06	**Utilities**					
20.1.07	**Structures**					
	Under Terry Fox Drive	40	20	m2	$ 2,500	$ 2,000,000.00
	Carp River	15	20	m2	$ 2,500	$ 750,000.00
	over 417 to scotiabank place	70	20	m2	$ 3,500	$ 4,900,000.00
	culverts		1	LS	$ 500,000	$ 500,000.00
	retaining walls		100	m2	$ 1,000	$ 100,000.00
20.1.80	**Landscaping**					
		WBS 20	**Subtotal**			**$ 16,948,600.00**
	FACILITIES					
30.1	**Storage Yards, Maintenance**					
30.2	**Stations**					
	Campeau		1	each	$ 1,000,000.00	$ 1,000,000.00
	Scotiabank Place		1	each	$ 5,000,000.00	$ 5,000,000.00
30.3	**Associated Works**					
30.4	**Park and Ride Lots**					
	Campeau		1		$ 4,000,000.00	$ 4,000,000.00
		WBS 30	**Subtotal**			**$ 10,000,000.00**
50.3.04	Communication System		3100	m	$ 300.00	$ 930,000.00
		WBS 50	**Subtotal**			**$ 930,000.00**
		SECTION 1 TOTAL				$ 27,878,600.00
	Engineering & Project Management		15%			$ 4,181,790.00
		TOTAL				**$ 32,060,390.00**
			30%			$ 9,618,117.00
		TOTAL				**$ 41,678,507.00**

Arena to Palladium	150	m
Palladium to Maplegrove	1200	m
Maplegrove to Hazeldean	950	m
TOTAL	2300	m

W3 BRT ARENA to FERNBANK (Stittsville) 2300

WBS #	Item		Quantity	Units	Unit Cost	Total
10	**Property and Right of Way**					
10.1	**Property Acquisition**					
10.2	**ROW Preparation**					
10.3	**Property Maintenance**					
10.4	**Recovery**					
10.99	**Contingency**					
		WBS 10	**Subtotal**			
20.1.01	**Clearing & Removals**					
			2,300		$ 375.00	$ 862,500.00
20.1.02	**Grading**					
20.1.03	**Drainage & Erosion Control**					
	600 storm sewer		2,300	m	$ 600.00	$ 1,380,000.00
	CB	4 @ 40m spacing	3,230	each	$ 2,000.00	$ 6,460,000.00
	CB leads	ROW @ 40m spacing	1,150	m	$ 250.00	$ 287,500.00
20.1.04	**SWM Facility**					
20.1.05	**Running Surface**					
	Tway		2,300	m	$ 660.00	$ 1,518,000.00
	Curbs		2,300	m	$ 110.00	$ 253,000.00
	At Grade Intersection		3	each	$ 250,000.00	$ 750,000.00
	fencing		4,600	m	$ 80.00	$ 368,000.00
20.1.06	**Utilities**					
20.1.07	**Structures**					
	Carp River	20	15	m2	$ 2,500	$ 750,000.00
20.1.80	**Landscaping**					
		WBS 20	**Subtotal**			**$ 12,629,000.00**
	FACILITIES					
30.1	**Storage Yards, Maintenance**					
30.2	**Stations**					
	Huntmar		1	each	$ 1,000,000.00	$ 1,000,000.00
	N. of Maple Grove		1	each	$ 1,000,000.00	$ 1,000,000.00
	S. of River		1	each	$ 1,000,000.00	$ 1,000,000.00
	Hazeldean		1	each	$ 1,000,000.00	$ 1,000,000.00
30.3	**Associated Works**					
30.4	**Park and Ride Lots**					
	Hazeldean		1		$ 4,000,000.00	$ 4,000,000.00
		WBS 30	**Subtotal**			**$ 8,000,000.00**
45	**Traction Power System**					
45.3.01	Power Supply					$ -
45.3.02	Power Distribution					$ -
		WBS 40	**Subtotal**			**$ -**
50	**Train Control System**					
50.3.01	Control / Signals					$ -
50.3.02	Switches					$ -
50.3.03	Control Centre					$ -
50.3.04	Communication System		2300	m	$ 300.00	$ 690,000.00
		WBS 50	**Subtotal**			**$ 690,000.00**
		SECTION 1 TOTAL				$ 21,319,000.00
	Engineering & Project Management		15%			$ 3,197,850.00
		TOTAL				**$ 24,516,850.00**
			30%			7,355,055.00
		TOTAL				**$ 31,871,905.00**

417 to Herzberg	1700	m	
Herzberg to Carling	1700	m	
Carling to Klondike	2600	m	2950 m if aligned on Legget
TOTAL	6000	m	

W4 BRT KANATA NORTH 6000

WBS #	Item		Quantity	Units	Unit Cost	Total
10	**Property and Right of Way**					
10.1	**Property Acquisition**					
10.2	**ROW Preparation**					
10.3	**Property Maintenance**					
10.4	**Recovery**					
10.99	**Contingency**					
		WBS 10	**Subtotal**			
20.1.01	**Clearing & Removals**					
	widened roadway		6,000		$ 375.00	$ 2,250,000.00
20.1.02	**Grading**					
	fill / grading		162,000	t	$ 20.00	$ 3,240,000.00
	Cut / excavation					
20.1.03	**Drainage & Erosion Control**					
	600 storm sewer		6,000	m	$ 600.00	$ 3,600,000.00
	CB	4 @ 40m spacing	600	each	$ 2,000.00	$ 1,200,000.00
	CB leads	ROW @ 40m spaci	2,250	m	$ 250.00	$ 562,500.00
20.1.04	**SWM Facility**					
20.1.05	**Running Surface**					
	At Grade Intersection		7	each	$ 250,000.00	$ 1,750,000.00
	asphalt		30,870	t	$ 100.00	$ 3,087,000.00
	curbs		24,000	m	$ 50.00	$ 1,200,000.00
	sidewalks		24,000	m2	$ 55.00	$ 1,320,000.00
	streetighting		300	each	$ 3,200.00	$ 960,000.00
20.1.06	**Utilities**					
20.1.07	**Structures**					
	3 culvert extensions		3	LS	$ 150,000.00	$ 450,000.00
20.1.80	**Landscaping**					
		WBS 20	**Subtotal**			**$ 19,619,500.00**
	FACILITIES					
30.1	**Storage Yards, Maintenance**					
30.2	**Stations**					
	Eagelson		1		$ 3,000,000.00	$ 3,000,000.00
	Klondike		1		$ 3,000,000.00	$ 3,000,000.00
	On Line Stations (including signal rebuild)		4	each	$ 1,000,000.00	$ 4,000,000.00
30.3	**Associated Works**					
30.4	**Park and Ride Lots**					
	Klondike		1		$ 4,000,000.00	$ 4,000,000.00
		WBS 30	**Subtotal**			**$ 14,000,000.00**
50.3.04	Communication System		6000		$ 300.00	$ 1,800,000.00
		WBS 50	**Subtotal**			**$ 1,800,000.00**
		SECTION TOTAL				$ 35,419,500.00
	Engineering & Project Management		15%			$ 5,312,925.00
		TOTAL				**$ 40,732,425.00**
			30			$ 12,219,727.50
		TOTAL				**$ 52,952,152.50**

Summary of Vehicle Costs

This analysis compares the vehicle costs for the bus and LRT scenarios under consideration. It looks only at the number of vehicles required to accommodate the demand at the end of the planning horizon and does not consider the overall fleet requirements to operate the entire system.

Bus Only Reference Scenario

- Analysis from the City of Ottawa network planning model suggests a total of 1,662 buses required for peak service by the end of the planning horizon. 1,195 of these buses would be standard buses while 467 would be high capacity buses (for this analysis, high capacity buses are assumed to be articulated). The analysis undertaken matched the frequencies of the routes to the projected demand on the route, resulting in a realistic reflection of the overall vehicle requirements.
- Review of the routes in the model has estimated that 627 of the standard buses and 92 of the articulated buses would be required for routes that would not likely use a downtown bus tunnel. Thus, 568 standard buses and 375 articulated buses would be assigned to routes that need to use the downtown tunnel. OC Transpo's operating strategy would see the exclusive use of high capacity buses on rapid transit within the downtown in order to keep the absolute number of vehicles to a minimum. This results in a total of 740 articulated buses would be required to provide the same level of service (based on vehicle design capacity of 45 people on a standard bus and 70 on an articulated bus). This does not include spare bus requirements.
- All of the buses required for the tunnel are desired to be very low emission vehicles. This would likely require diesel electric hybrid propulsion technology that is capable of allowing the bus to operate in full electric power mode through the length of the tunnel. Standard buses that have this ability are being purchased beginning in 2009.
- No articulated buses are planned to be ordered with hybrid technology because the business case previously completed by City of Ottawa staff did not identify this combination as cost effective.
- For a full bus tunnel operation, it will be necessary for a fleet of hybrid technology buses to be in place. Thus, high capacity vehicle requirements in the tunnel are assumed to use hybrid technology.
- For the purpose of this analysis, calculations are for the purchase of the number of vehicles required at the end of the planning horizon. Assumptions include a cost of $630,000 for a standard hybrid bus and $900,000 for an articulated hybrid bus. These costs are based on recent purchases of similar vehicles. Costs are likely to decline slightly as volume of purchases in the industry increases.
- A standard bus spare ratio of 15% and an articulated bus spare ratio of 20% is assumed
- 740 articulated hybrid buses plus 148 additional spare vehicles (a total of 888) result in total bus costs of $799,200,000.
- It should be noted that these are the costs to purchase the minimum necessary number of buses to meet the demand at the end of the planning horizon. Less cost will be necessary to meet some interim date when the tunnel would actually open.
- It should also be noted that the costs of the other buses that are not being used in the downtown are not considered in this analysis, as they are common to all scenarios.

Blair to Baseline LRT

- This scenario assumes that only LRT will operate through the tunnel in the downtown. Bus Transitway services will require customers to transfer to the LRT to travel to downtown.
- The number of trains necessary to meet the demand through the tunnel is calculated as follows:
    - 21.7 km long line length operating at a 35 kph average speed. This requires 37 minutes of travel time for one-way operation, or 74 two minutes for a round trip. Assume 3 minutes of layover at the end of each direction of travel for an overall round trip running time of 80 minutes.
    - The maximum number of passengers that must be accommodated during the peak hour is 13,500 (maximum link volume is north of Hurdman Station approaching the University of Ottawa). The design capacity of an LRT car is 135 customers (seated plus standing). Therefore, 13,500/135 or 100 trips per hour are required. This equates to a frequency of every 0.6 minutes. Note that in reality LRT cars will be linked together into a train of 4 to 6 cars in order to create a manageable frequency.
    - Dividing an 80 minute round trip running time by the 0.6 minute frequency results in an overall LRT car requirement of 133, not including spares vehicles requirements.
- A cost of $5,000,000 per LRT vehicle is assumed. Therefore, 134 vehicles will cost $670,000,000. Assuming a 12% spare ratio for LRT vehicles results in an additional 16 vehicles being required at a cost of $80,000,000. The total LRT cost, therefore, is 750,000,000
- The 627 standard and 92 articulated buses required for non downtown services would still be required. It is estimated that approximately half of 568 standard and 375 articulated downtown buses would still be required in order to provide sufficient frequency of service to access the LRT service. This estimate of 50% of buses still being required comes from the fact that at least half of the length of all of the downtown routes would be replaced by the LRT service (the actual length of each route that would be replaced varies quite a bit, but on balance approximately 50% of the routes could still be in tact). If hybrid technology is assumed for all of these vehicles, then the total bus cost including spares would be $409,410,000.

Bowesville to Rideau Centre LRT

- This scenario assumes that the north/south LRT line would be in place from Bowesville in the south, through downtown to St. Laurent in the east. No other LRT service would be in place.
- This line would be approximately 18.6 km in length, and assuming a 35 kph average operating speed would result in a 64 minute round trip running time (70 minutes including a 3 minute layover at each end).
- The service would be designed to accommodate the maximum demand on the north south line, just south of Bayview Station, of 2,800 passengers during the peak hour (based on analysis from the model).
- An LRT vehicle design capacity of 135 requires a headway of 2.9 minutes to accommodate the 2,800 passengers.
- The 70 minute round trip running time and 2.9 minute headway results in 25 LRT vehicles being required for the service. Three spare vehicles will be required.
- At $5,000,000 per LRT vehicles, $140,000,000 is required for LRT vehicles.

- It is estimated that this scenario would still require approximately 90% of the downtown buses required in the bus only scenario (all of the non-downtown buses would also still be required). This 90% estimate comes from the fact that this LRT scenario would reduce the total volume of passengers entering the downtown on rapid transit by about 10% and would still require all of the buses from the east, west and southwest to continue to serve the core. Hybrid buses would be required in order to accommodate joint bus/LRT tunnel operation. Thus, 512 standard buses at $630,000 and 338 articulated buses at $900,000 will be required for a total cost of $626,760,000. As the OC Transpo operating plan assumes that all of the buses will be articulated, then the total bus cost would be $600,300,000 for 667 articulated hybrid vehicles. 133 additional vehicles at a cost of $119,700,000 will be required as spares, resulting in a total bus cost requirement of $720,000,000.

Baseline to Blair and Bowesville to Bayview LRT (Full LRT)

- This scenario combines the two LRT corridors from the previous discussion together into a single scenario. It is assumed that both LRT routes as described above would be operated, including the Bowesville to Bayview service operating into the downtown and on to St. Laurent.
- Total LRT vehicle costs would be the some of the two scenarios – 134+25 vehicles for a total cost of $795,000,000. 19 spare vehicles add $95,000,000 for a total LRT vehicle cost of $890,000,000.
- Substantial bus service would still be required to feed the LRT service. It is estimated that about forty percent of the downtown buses required in the bus only scenario would be required (the 50% of buses identified in the Baseline to Blair scenario with additional buses removed to reflect the replacement by rail as far south as Bowesville). Thus, 228 standard buses and 150 articulated buses at will be required. Spare Buses include 34 standard and 30 high capacity for a total bus cost of $327,060,000.

Replacement Fleet

Typically LRT vehicles last longer than buses. In order to compare the vehicle costs between the options, replacement buses would also need to be considered. A 30 year period was assumed in determining the replacement fleet. For options 1 & 2, where all or most of the existing express buses continue to run downtown, it is assumed that ¾ of the buses would need to be replaced over the 30 years. For options 3 & 4, only ½ of the buses would need to be replaced within the 30 year time frame.

Summary of Vehicle Costs

Vehicle Costs		Option 1	Option 2	Option 3	Option 4
		BRT Tunnel	BRT / LRT Tunnel (NS LRT)	LRT Tunnel (E&W Downtown LRT)	(E&W Downtown + NS LRT)
LRT		$ 0	$ 140,000,000	$ 745,000,000	$ 890,000,000
Bus	Initial	$ 799,200,000	$ 719,100,000	$ 408,960,000	$ 326,430,000
	Replacement	$599,250,000	$539,325,000	$204,480,000	$163,215,000
Total Vehicle Costs		$1,398,450,000	$1,398,425,000	$1,358,440,000	$1,379,645,000

Note: The bus only scenario includes hybrid buses necessary for tunnel operation. Hybrids are also necessary in the Bowesville to St. Laurent LRT scenario where buses and LRT will share tunnel operation. Standard propulsion buses are assumed in the other LRT scenarios.

LRT Vehicles Required

		Travel Time					Service Frequency			Required Vehicles			
		length (m)	TT (min)	round trip (min)	layover (min)	Total (min)	pass / hr	veh / hr	headway (min)	# of LRT veh	12% spare	TOTAL	@ $5M each
Option 2	Bayview to Bowesville	18,575	31.84	63.69	6	**69.69**	2800	20.7	2.9	25	3	28	**$ 140,000,000**
Option 3	Baseline to Blair	21,675	37.16	74.31	6	**80.31**	13500	100.0	0.6	134	16	150	**$ 750,000,000**
	NS LRT	18,575	31.84	63.69	6.00	69.69	2,800	20.7	2.9	25	3	28	$ 140,000,000
	EW LRT	18,575	37.16	74.31	6.00	80.31	13,500	100.0	0.6	134	16	150	$ 750,000,000
Option 4	TOTAL						16,300						**$ 890,000,000**

LRT Maintenace Facilities Required

		# of Vehicles	Facilities required	@ 100 M per facility
Option 1	Bus based	0	0	$ -
Option 2	NS LRT	28	1	**$ 100,000,000**
Option 3	EW LRT	150	1	**$ 100,000,000**
Option 4	Rail based	-	2	**$ 200,000,000**

Total Buses Required

			For CBD			Not for CBD			TOTAL BUSES		
			standard	High Capacity	Total	standard	High Capacity	Total	standard	High Capacity	Total
Option 1	Bus based	100%	568	375	943	627	92	719	1195	467	1662
Option 2	NS LRT	90%	512	338	850	627	92	719	1139	430	1569
Option 3	EW LRT	50%	284	188	472	627	92	719	911	280	1191
Option 4	Rail based	40%	228	150	378	627	92	719	855	242	1097

Cost for Downtown Buses

			For CBD			Articulated Equivilant						
			standard	High Capacity	Total	standard	High Capacity	Total	Standard 15% spares	High Capacity 20% spares	Total w/ spares	Total Cost
Option 1	Bus based	100%	568	375	943	365	375	740		148	888	**$ 799,200,000.00**
Option 2	NS LRT	90%	512	338	850	329	338	667		133	800	**$ 720,128,571.43**
Option 3	EW LRT	50%	284	188	472	183	188	371	43	38	553	**$ 409,410,000.00**
Option 4	Rail based	40%	228	150	378	147	150	297	34	30	442	**$ 327,060,000.00**

Bus Maintenace Facilities Required

		standard	Standard	High Capacity		20% spares	Total	Existing	Remaining	@ 250 buses		Facilities Required
		40ft	15% spares	60ft	40 ft eq	(std eq)	40 ft eq			per facility		@ $60M per facility
Option 1	Bus based	1195	179	467	701	140	2215	1000	1215	4.86	5	$ 300,000,000.00
Option 2	NS LRT	1139	171	430	645	129	2084	1000	1084	4.34	4	$ 240,000,000.00
Option 3	EW LRT	911	137	280	420	84	1552	1000	552	2.21	2	$ 120,000,000.00
Option 4	Rail based	855	128	242	363	73	1419	1000	419	1.68	2	$ 120,000,000.00

Operating Costs

Assumptions:

2.7	peak period factor
2	for both peak periods
85%	portion of peak period trips during the rest of the day
300	average service days per day
105	$/h to operate a standard bus
115	$/h to operate a high capacity bus
27	kph assumed average operating speed (reported by OC transpo 2005)
172	$/h to operate an LRT car ($/car-hour)

Alternative 1: Bus Only	Standard Buses	High Capacity Buses	LRT vehicles	Total
2031 AM Peak Hour	627	832	2	**1,461**
2031 AM Peak Period	1,693.00	2,247	6	**3,946**
2031 AM & PM Peak Periods	3,386	4,494	12	**7,892**
2031 Off Peak Periods	2,879.000	3,820	11	**6,710**
2031 Daily Services Hours	6,265	8,314	23	**14,602**
2031 Annual Services Hours	1,879,500	2,494,200	6,900	**4,380,600**
2031 Annual Service KM	50,746,500	67,343,400	186,300	**118,276,200**
2031 Operating Cost per Vehicle Type	197,347,500	286,833,000	1,186,800	**$ 485,367,300.00**

0 LRT = **2** O-Trains + **0** LRT cars = **1** 4-cars LRT vehciles
1195 standard buses = **627** buses for non CBD service + **100%** of **568** buses for CBD services
467 high capacity buses = **92** buses for non CBD service + **100%** of **375** buses for CBD services
943

118,089,900 KM of Bus operation
186,300 KM of Diesel LRT

Alternative 2: NS LRT	Standard Buses	High Capacity Buses	LRT vehicles	Total
2031 AM Peak Hour	627	758	25	**1,410**
2031 AM Peak Period	1,693.00	2,047	68	**3,808**
2031 AM & PM Peak Periods	3,386	4,094	136	**7,616**
2031 Off Peak Periods	2,879.000	3,480	116	**6,475**
2031 Daily Services Hours	6,265	7,574	252	**14,091**
2031 Annual Services Hours	1,879,500	2,272,200	75,600	**4,227,300**
2031 Annual Service KM	50,746,500	61,349,400	2,041,200	**114,137,100**
2031 Operating Cost per Vehicle Type	197,347,500	261,303,000	13,003,200	**$ 471,653,700.00**

Notes
7 LRT = **0** O-Trains + **25** LRT cars = **7** 4-cars LRT vehciles
1138 standard buses = **627** buses for non CBD service + **90%** of **568** buses for CBD services
430 high capacity buses = **92** buses for non CBD service + **90%** of **375** buses for CBD services

112,095,900 KM of Bus operation
- KM of Diesel LRT
2,041,200 KM of electric LRT

Alternative 3: EW LRT	Standard Buses	High Capacity Buses	LRT vehicles	Total
2031 AM Peak Hour	911	280	135	**1,326**
2031 AM Peak Period	2,460.00	756	365	**3,581**
2031 AM & PM Peak Periods	4,920	1,512	730	**7,162**
2031 Off Peak Periods	4,182.000	1,286	621	**6,089**
2031 Daily Services Hours	9,102	2,798	1,351	**13,251**
2031 Annual Services Hours	2,730,600	839,400	405,300	**3,975,300**
2031 Annual Service KM	73,726,200	22,663,800	10,943,100	**107,333,100**
2031 Operating Cost per Vehicle Type	286,713,000	96,531,000	69,711,600	**$ 452,955,600.00**

Notes
36 LRT = **2** O-Trains + **133** LRT cars = **34** 4-cars LRT vehciles
911 standard buses = **627** buses for non CBD service + **50%** of **568** buses for CBD services
280 high capacity buses = **92** buses for non CBD service + **50%** of **375** buses for CBD services

96,390,000 KM of Bus operation
162,120 KM of Diesel LRT
10,943,100 KM of electric LRT

Alternative 4: EW + NS LRT	Standard Buses	High Capacity Buses	LRT vehicles	Total
2031 AM Peak Hour	854	242	158	**1,254**
2031 AM Peak Period	2,306.00	654	427	**3,387**
2031 AM & PM Peak Periods	4,612	1,308	854	**6,774**
2031 Off Peak Periods	3,921.000	1,112	726	**5,759**
2031 Daily Services Hours	8,533	2,420	1,580	**12,533**
2031 Annual Services Hours	2,559,900	726,000	474,000	**3,759,900**
2031 Annual Service KM	69,117,300	19,602,000	12,798,000	**101,517,300**
2031 Operating Cost per Vehicle Type	268,789,500	83,490,000	81,528,000	**$ 433,807,500.00**

Notes
40 LRT = **0** O-Trains + **158** LRT cars = **40** 4-cars LRT vehciles
854 standard buses = **627** buses for non CBD service + **40%** of **568** buses for CBD services
242 high capacity buses = **92** buses for non CBD service + **40%** of **375** buses for CBD services

88,719,300 KM of Bus operation
- KM of Diesel LRT
12,798,000 KM of electric LRT

Annual Emissions

		Bus		LRT	
		Diesel	diesel-hybrid	Diesel*	Electric
Emission Rate (g/vkt)	VOC	1.030	0.539	0.618	-
	CO	11.101	5.770	6.660	-
	NOx	8.398	4.365	5.039	-
	SOx	0.348	0.281	0.209	-
	PM10	0.190	0.098	0.114	-
	CO2	1,318.940	751.370	791.364	-

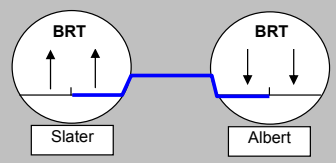
Source: HLB Decision Economics inc.

* O-Train assumed to use 40% less fuel than a transit bus. (http://www.tc.gc.ca/programs/environment/UTSP/otrainlightrailproject.htm)

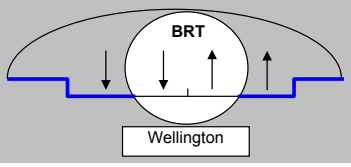
		Alternative1		Alternative2		Alternative3			Alternative4	
		Bus Only		NS LRT		EW LRT			NS + EW LRT	
		Bus	O-Train	Bus	LRT	Bus	O-Train	LRT	Bus	LRT
		Hybrid	Diesel	Hybrid	Electric	Hybrid	Diesel	electric	Hybrid	electric
Annual Vehicle-Kilometres		118,089,900	186,300	112,095,900	2,041,200	96,390,000	162,120.00	10,943,100.00	88,719,300	12,798,000
Total Emissions (g)	VOC	63,700,000	200,000	60,400,000	0	52,000,000	200,000	0	47,800,000	0
	CO	681,500,000	1,300,000	646,900,000	0	556,200,000	1,100,000	0	512,000,000	0
	NOx	515,500,000	1,000,000	489,400,000	0	420,800,000	900,000	0	387,300,000	0
	SOx	33,200,000	100,000	31,600,000	0	27,100,000	100,000	0	25,000,000	0
	PM10	11,700,000	100,000	11,100,000	0	9,500,000	100,000	0	8,800,000	0
	CO2	88,729,300,000	147,500,000	84,225,500,000	0	72,424,600,000	128,300,000	0	66,661,100,000	0
Total Emissions (Kg) Rounded	VOC	63,900		60,400		52,200			47,800	
	CO	682,800		646,900		557,300			512,000	
	NOx	516,500		489,400		421,700			387,300	
	SOx	33,300		31,600		27,200			25,000	
	PM10	11,800		11,100		9,600			8,800	
	CO2	88,876,800		84,225,500		72,552,900			66,661,100	

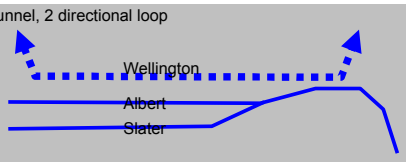
Integration of STO

New BRT Tunnel



no capacity for STO buses in OC BRT tunnel therefore separate STO tunnel, 2 directional loop





						eng& PM: 15%	contingency30%	contingency50%
single tunnel 5m radius bore - 2 lanes	2970	m	$	62,500.00	/ m	$ 185,625,000.00		278,437,500.00
station cost - widen by 2 lanes + 2 platforms	3	@	$	60,000,000.00	each	$ 180,000,000.00		270,000,000.00
roadway / ventilations	1	@	$	35,000,000.00	LS	$ 35,000,000.00		52,500,000.00
portals	2	@	$	1,000,000.00	each	$ 2,000,000.00		3,000,000.00
roadwork (outside tunnel)	2700	m	$	**660.00**	/ m	1,782,000.00	2,049,300.00	2,664,090.00
intersection reconstruction	2	@	$	1,000,000.00	each	$ 2,000,000.00	2,300,000.00	2,990,000.00
communications	2700	m	$	300.00	/ m	$ 810,000.00	931,500.00	1,210,950.00

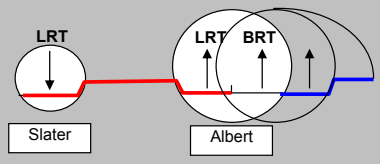
Total STO Construction Cost **$ 610,802,540.00**

	pass / hr	Ottawa = 75%	@ 45 passengers / vh		
standard vehicles required	8500	11333	252	buses	$ 158,760,000.00
spare vehicles		15%	38	buses	$ 23,940,000.00
replacement vehicles		50%	145	buses	$ 91,350,000.00
TOTAL			435	buses	$ 274,050,000.00

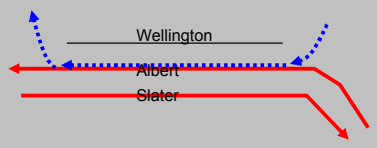
STO Vehicles Required **$ 274,050,000.00**

TOTAL STO COST **$ 884,852,540.00**

Widen tunnel for BRT



BRT connections to OC LRT Tunnel on both sides of downtown, 1 directional loop



						eng& PM: 15%	contingency30%	contingency50%
premium from 3 to 5m radius bore	2000	m	$	40,000.00	/ m	$ 80,000,000.00		$ 120,000,000.00
new single 5m radius tunnel	1210	m	$	62,500.00		$ 75,625,000.00		$ 113,437,500.00
station cost - widen by 1 lane + 1 platform	3	each	$	40,000,000.00		$ 120,000,000.00		180,000,000.00
roadway / ventilations	1	@	$	35,000,000.00	LS	$ 35,000,000.00		52,500,000.00
portals	2	@	$	1,000,000.00	each	$ 2,000,000.00		3,000,000.00
roadwork	2700	m	$	**660.00**	/ m	1,782,000.00	2,049,300.00	2,664,090.00
intersection reconstruction	2	@	$	1,000,000.00	each	$ 2,000,000.00	2,300,000.00	2,990,000.00

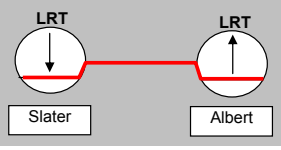
Total STO Construction Cost **$ 474,591,590.00**

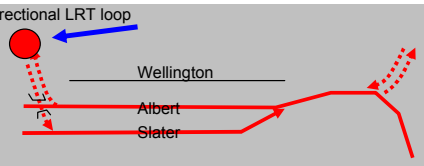
	pass / hr	Ottawa = 75%	@ 45 passengers / vh		
standard vehicles required	8500	11333	252	buses	$ 158,760,000.00
15% spare vehicles			38	buses	$ 23,940,000.00
replacement vehicles		50%	145	buses	$ 91,350,000.00

STO Vehicles Required **$ 274,050,000.00**

TOTAL STO COST **$ 748,641,590.00**

Transfer in Gatineau — connections to OC LRT tunnel on both ends of downtown, 2 directional LRT loop





					eng& PM: 15%	contingency30%	contingency50%
Single tunnel 3m radius bore - 1 lane	2490 m	$	22,500.00 / m	$ 56,025,000.00			$ 84,037,500.00
Tunnel Portals	4	$	1,000,000.00	$ 4,000,000.00			$ 6,000,000.00
tracks	11160 m	$	1,215.00 / m	$ 13,559,400.00	15,593,310.00	20,271,303.00	
crossings	4 @	$	50,000.00 each	$ 200,000.00	230,000.00	299,000.00	
Traction power (twin track)	5630 m		1350 / m	$ 7,600,500.00	8,740,575.00	11,362,747.50	
power supply (twin track)	5630 m		1000 / m	$ 5,630,000.00	6,474,500.00	8,416,850.00	
sub stations (twin track)	5630 m		1200 / m	$ 6,756,000.00	7,769,400.00	10,100,220.00	
control/signals (twin track)	5630 m		1500 / m	$ 8,445,000.00	9,711,750.00	12,625,275.00	
communications (twin track)	5630 m		750 / m	$ 4,222,500.00	4,855,875.00	6,312,637.50	
modification to portage bridge	1 @	$	1,000,000.00 each	$ 1,000,000.00	1,150,000.00	1,495,000.00	
intersection reconstruction	2 @	$	1,000,000.00 each	$ 2,000,000.00	2,300,000.00	2,990,000.00	

Total STO Construction Cost **$ 163,910,533.00**

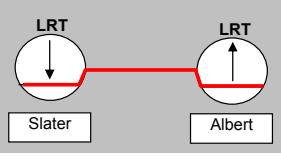
	pass / hr	pass / vh	Vehicles / hr	headway (min)	Length (m) (loop)	aveage speed (kph)	travel time (min) 1 way loop	travel time with 2 min layover (min)
STO Vehicles Required	8500	135	63	0.95	7630	35	13.08	15.08

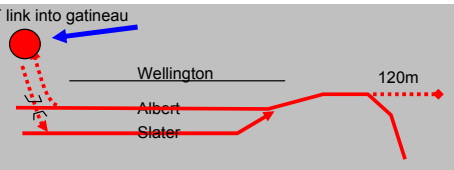
15.83 trains required
1.90 12% spare
17.73 Total trains required — 18 Trains = **$ 90,000,000.00**

STO Major Transfer Station **$ 25,000,000.00**

TOTAL STO COST **$ 278,910,533.00**

Transfer in Gatineau — connections to OC LRT tunnel on west end of downtown, LRT link into gatineau





					eng& PM: 15%	contingency30%	contingency50%
Single tunnel 3m radius bore - 1 lane	610 m	$	22,500.00 / m	$ 13,725,000.00			$ 20,587,500.00
Tunnel Portals	2	$	1,000,000.00	$ 2,000,000.00			$ 3,000,000.00
tracks	2800 m	$	1,215.00 / m	$ 3,402,000.00	3,912,300.00	5,085,990.00	
crossings	2 @	$	50,000.00 each	$ 100,000.00	115,000.00	149,500.00	
Traction power	2800 m		1350 / m	$ 3,780,000.00	4,347,000.00	5,651,100.00	
power supply	2800 m		1000 / m	$ 2,800,000.00	3,220,000.00	4,186,000.00	
sub stations	2800 m		1200 / m	$ 3,360,000.00	3,864,000.00	5,023,200.00	
control/signals	2800 m		1500 / m	$ 4,200,000.00	4,830,000.00	6,279,000.00	
communications	2800 m		750 / m	$ 2,100,000.00	2,415,000.00	3,139,500.00	
modification to portage bridge	1 @	$	1,000,000.00 each	$ 1,000,000.00	1,150,000.00	1,495,000.00	
intersection reconstruction	1 @	$	1,000,000.00 each	$ 1,000,000.00	1,150,000.00	1,495,000.00	

Total STO Construction Cost **$ 56,091,790.00**

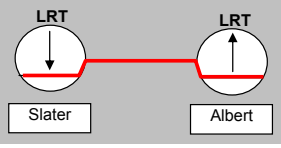
	pass / hr	pass / vh	Vehicles / hr	headway (min)	Length (m) (round trip)	aveage speed (kph)	travel time (min) 1 way loop	travel time with 2 min layover (min)
STO Vehicles Required	8500	135	63	0.95	6620	35	11.35	13.35

14.02 trains required
1.68 12% spare
15.70 Total trains required — 16 Trains = **$ 80,000,000.00**

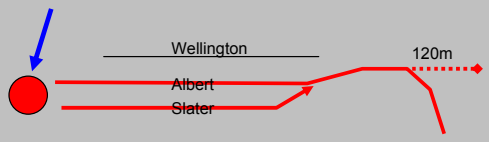
STO Major Transfer Station **$ 25,000,000.00**

TOTAL STO COST **$ 161,091,790.00**

Transfer in Ottawa



downtown LRT shuttle goes from Lebreton to Rideau Centre = 2300 m
additional bore for tail track = 120m x 2



Single tunnel 3m radius bore - 1 lane	240 m	$	22,500.00 / m	$ 5,400,000.00			$ 8,100,000.00
Tunnel Portals	0	$	1,000,000.00	$ -			$ -
tracks	240 m	$	1,215.00 / m	$ 291,600.00	335,340.00	435,942.00	
crossings	1 @	$	50,000.00 each	$ 50,000.00	57,500.00	74,750.00	
Traction power	240 m		1350 / m	$ 324,000.00	372,600.00	484,380.00	
power supply	240 m		1000 / m	$ 240,000.00	276,000.00	358,800.00	
sub stations	240 m		1200 / m	$ 288,000.00	331,200.00	430,560.00	
control/signals	240 m		1500 / m	$ 360,000.00	414,000.00	538,200.00	
communications	240 m		750 / m	$ 180,000.00	207,000.00	269,100.00	

Total STO Construction Cost **$ 10,691,732.00**

STO Major Transfer Station **$ 25,000,000.00**

	pass / hr	pass / vh	Vehicles / hr	headway (min)	Length (m) (round trip)	aveage speed (kph)	travel time (min)	travel time with 2 min layover (min)
STO Vehicles Required	8500	135	63	0.95	4600	35	7.89	9.89

10.38 trains required
1.25 12% spare
11.63 Total trains required

12 Trains = **$ 60,000,000.00**

TOTAL STO COST **$ 95,691,732.00**

Appendix G: Consultation



Transportation Master Plan
Infrastructure Requirement Study

Summary Report: Phase II Consultations – A Review of the Downtown Rapid Transit Network Options

March 3 to March 31, 2008

Pace

Public Affairs & Community Engagement

Table of Contents

Executive Summary

Introduction

The mandate of the Transportation Master Plan (TMP) Study Consultation Program is to engage, in a meaningful way, a broad range of citizens and stakeholders in a dialogue around Ottawa's long-term transportation planning. The primary objective of the Phase II consultations was to inform and gather feedback from the public regarding the following four Downtown Rapid Transit Network Options:

- Bus Tunnel
- Joint Use BRT/LRT (North-South LRT)
- LRT Tunnel (East/West Downtown LRT)
- LRT Tunnel (East/West Downtown LRT and North-South LRT).

Phase II consultations began March 3, and concluded March 31, 2008. A number of activities were designed and executed to provide flexible and convenient opportunities for the public to provide comment to the City. These included:

- Open Houses
- Registered Discussion Groups
- Stakeholder Focus Group Sessions
- City Advisory Committee Briefing
- Online Materials and Consultations
- Internal and External Agency Group Meetings
- A Mayor's Streeter Survey.

In total, approximately 1,200 written comments were received through the Public Open Houses, Online Consultations and the Mayor's Streeter Survey consultation activities. Overall, a strong majority of the public and stakeholders indicated Option 4 as their preferred long-term transit solution for the City of Ottawa (approximately 70% of all comments received supported Option 4). Many people commented that Option 4 provides the highest quality of transit service; the best approach for urban intensification; the lowest operating costs; optimum long-term transit growth capacity; the most positive environmental, social and economic impacts; and the most favourable perceptions of Ottawa as the Nation's Capital City.

While there was also support for Option 3 (approximately 22% of all comments received) many suggested that this alternative could serve as a 'staged' implementation for ultimately developing Network Option 4.

There was little to no support for Option 1 and Option 2 (approximately 3% of all comments received). People found these options to be the least sustainable and economically viable networks for the future.

Few people were either undecided or did not prefer any of the four options (approximately 5% of all comments received).

Activities and Outcomes

Open Houses:

Approximately 400 individuals attended four Public Open House sessions during the first week of March 2008. In total, 156 comment sheets were completed and submitted at the Open Houses, indicating:

- 68 per cent of respondents prefer Option 4 as their Downtown Rapid Transit Network.
- 25 per cent of respondents prefer Option 3
- One per cent prefers either Option 1 or 2
- Five per cent were undecided

Additional key comments from the Open Houses are summarized in the Outcomes section of this report.

Discussion Groups:

Over 150 people participated in Registered Discussion Groups conducted at each of the Public Open Houses. A majority of participants supported Option 4 as a sustainable and forward-thinking plan. Some of those that supported Option 4 felt that it would be fiscally prudent to implement Option 3 as "stage one," with the expectation that a future expansion would include the conversion and expansion of the O-Train to electric technology. Options 1 and 2 received little to no support.

Stakeholder Focus Group Sessions:

Three Focus Group sessions were held at City Hall during the first week of March 2008, providing key stakeholders from the City's Industry, Economic and Downtown sectors an opportunity to supply their input on the four Downtown Rapid Transit Network Options. Option 4 was the preferred option at each Focus Group session, as it was seen to be the option that best

promoted intensification and economic growth, and that was the most effective in alleviating downtown congestion and allowing for future expansion.

City Advisory Committee Briefings:

A briefing session on the Downtown Rapid Transit Network Options was held for City of Ottawa Advisory Committees with an interest in transit and transportation during the first week of March 2008. All Advisory Committees were also invited to participate in the Open House sessions and Registered Discussion Groups.

Online Consultation:

The Beyond Ottawa 20/20 website (www.ottawa.ca/beyondottawa2020) was used to provide information and solicit feedback regarding the various Downtown Rapid Transit Network Options from March 3 to March 31, 2008.

In total, 631 written submissions were received. Of these, a significant majority indicated Option 4 as their preferred option, consistent with the following multiple-choice results from the online questionnaire that was completed by nearly 500 participants:

- 70 per cent chose Option 4 as their preferred Downtown Rapid Transit Network
- 18 per cent chose Option 3
- Five per cent selected either Options 1 or 2
- Seven per cent were undecided

Additional key comments from the online consultations are summarized in the Outcomes section of this report.

Internal and External Agency Group Meetings:

The City of Ottawa hosted Agency meetings during the first week of March 2008, which included representatives from various levels of governments, crown corporations, private interest groups and departmental staff from the City of Ottawa. The primary objective was to provide information about the four Downtown Rapid Transit Network Options through a presentation followed by an open discussion. Although the majority favoured Option 4, some recommended a more detailed analysis of the costs and benefits, including impacts on ridership and environmental impacts.

Mayor's Streeter Survey:

A Mayor's Streeter Survey was conducted during the week of March 17th to provide a brief snapshot of the public's awareness and opinion of the City's long-term transit plans.

The Streeter Survey locations were selected to capture a diverse set of opinions, mostly from transit users. In total, 401 surveys were completed. Of these, 318 respondents (79%) wanted light rail in Ottawa. A strong majority (298 or 74%) thought light rail should service the suburban communities such as Kanata, Orleans and Barrhaven.

Objective

The mandate of the Transportation Master Plan (TMP) Study Consultation Program is to engage, in a meaningful way, a broad range of citizens and stakeholders in a dialogue around Ottawa's long-term transportation planning.

The primary objective of Phase II of the Consultation Program was to inform the public on four Downtown Rapid Transit Network Options and the implications these options would have on the outlying transportation systems. The four options are:

1. Bus Tunnel
2. Joint Use BRT/LRT (North-South LRT)
3. LRT Tunnel (East/West Downtown LRT)
4. LRT Tunnel (East/West Downtown LRT and North-South LRT)

Consultation began March 3, and concluded March 31, 2008. A number of activities were designed and executed to provide flexible and convenient opportunities for the public to provide comment to the City. These included:

- Open Houses
- Registered Discussion Groups
- Stakeholder Focus Group Sessions
- Advisory Committee Briefings
- Online Materials and Consultations
- Internal and External Agency Group Meetings
- A Mayor's Streeter Survey.

For each of the consultation events, members of the public and stakeholders were provided with the opportunity to consult with technical experts on each of the options and to provide feedback. Comments collected have been summarized to highlight areas of common interest and concern. These summaries are provided in the main body of this report; full comments can be found in the appendices. Databases of compiled comments sheets and completed surveys were submitted to the City of Ottawa's Planning, Transit and Environment Department.

Methodology

The Phase II consultation activities were designed to provide members of the public and stakeholders with the technical information they required to meaningfully consider each of the four Downtown Rapid Transit Network Options and to assess which one best reflected their needs, and those of the city to 2031. Citizens were encouraged to participate and submit input on each of the alternatives through a variety of mechanisms. Below is a description on the seven consultation programs that were developed and used to engage the public and obtain their feedback.

1) Public Open Houses

Four Public Open House sessions took place between Monday, March 3, and Thursday, March 6, in various regions of the city (including in the east, west, south and downtown). Approximately 400 individuals participated in the Public Open House events. Attendees received an information package that included an update by the Mayor, an informational postcard, and a comment sheet. Upon request, attendees were also provided with paper copies of the display boards and more detailed information on the four network options.

Thirty bilingual project boards on the TMP Update and the options were displayed at each event. Engineering and planning experts from the TMP Consulting Team (from McCormick Rankin, Delcan, and the City of Ottawa's Planning Department) were on hand at all Open House sessions to answer any technical questions.

The project boards were arranged around the perimeter of the event rooms to allow for facilitated Registered Discussion Group sessions to take place inside the same venue as the Open House. More information on the Registered Discussion Groups follows below.

An 'input' table with bilingual resource materials, such as the 2003 TMP, Official Plan documents, and comment sheets, was also made available for attendees to further inform themselves and to provide detailed comment on the proposed alternatives.

The Mayor attended all of the Open House sessions and was available to discuss the options with constituents and gauge their reaction first-hand. Several City Councillors also participated.

Table 1: Public Open House and Discussion Group Location and Registration

Dates and Times	Open House, Discussion Group Location	# of Open House Participants (approximate)	# of Discussion Group Participants (approximate)
Monday, March 3 6:00 p.m. – 8:30 p.m.	**East** Bob MacQuarrie Recreation Complex 1490 Youville Drive, Orleans	70	25
Tuesday, March 4 6:00 p.m. – 8:30 p.m.	**Central** City Hall 100 Laurier Avenue West	200	80
Wednesday, March 5 6:00 p.m. – 8:30 p.m.	**West** Earl March High School 4 The Parkway, Kanata	65	35
Thursday, March 6 6:00 p.m. – 8:30 p.m.	**South** John McCrae High School 103 Malvern Drive, Nepean	60	24

2) Registered Discussion Groups

The Registered Discussion Groups provided citizens with the opportunity to engage in in-depth discussions around the four Downtown Rapid Transit Network Options. It was a participatory form of public engagement that allowed those involved to explore and consider the network options in an interactive, face-to-face setting.

The Registered Discussion Groups were conducted between 7:00 and 8:00 p.m., to coincide with the Open Houses. While the majority of participants were pre-registered, spaces at the tables were left open to accommodate any of the Open House attendees that showed an interest in participating.

Participants were seated at tables and supplied with copies of the four Downtown Rapid Transit Network Options. Technical facilitators led the discussions at each table, and a scribe captured the participants' input on a flip chart. The Discussion Groups were also facilitated in French, as required. For the full notes from each of Discussion Group tables, please see Appendix I.

The technical facilitators began the discussion by introducing the TMP and summarizing developments on the update program, before proceeding to describe the four Downtown Rapid Transit Network Options. Participants were then asked which option they preferred and the reasons why. Each participant had an equal opportunity to explain their likes and dislikes, and could ask the technical facilitator for further clarification on various concerns.

The discussion tables were located in the same room as the Open House, which gave citizens, the Mayor and City Councillors the opportunity to listen in on the Discussion Groups, as well as to provide the technical experts, located at the Open House project boards, easy access to provide technical advice and answers to specific questions, as required.

Promotion and Recruitment: Promotion for the Open Houses and recruitment for the Registered Discussion Groups was conducted via media advisories, ad placements, promotional material, as well as through the City's website and email lists.

Newspaper advertisements were inserted in *The Citizen* and *Le Droit* on Friday, February 21, and Friday, February 28. Promotional postcards were distributed on all OC Transpo buses, and made available at public libraries, City kiosks and recreation facilities.

Citizens that had participated in Phase I of the TMP consultations, as well as those registered in the City's Ottawa 20/20 mailing list were also emailed an invitation to register for the Discussion Groups.

Members of the public were also invited to call 3-1-1, register online on the City's website, or contact Colin Simpson of the City's Planning Department, to obtain more information on the events or to register.

3) Stakeholder Focus Groups

Three Focus Group sessions were held at City Hall from Tuesday, March 4, to Wednesday, March 5, providing key stakeholders in the process an opportunity to supply their input on the four Downtown Rapid Transit Network Options. Participants at the Stakeholder Focus Group sessions were grouped according to their various interests and areas of expertise, and represented the City's Industry, Economic, and Downtown sectors.

The 2-hour sessions consisted of a 45 minute presentation introducing the TMP project and the four Downtown Rapid Transit Network Options. This was followed by an open discussion on the benefits and drawbacks of each of the four alternatives, and to explore which one best met the needs of Ottawa's growing population and employment demands to the year 2031.

The Focus Group sessions were facilitated by a member of PACE Public Affairs & Community Engagement, and City of Ottawa staff provided and delivered the technical content. Two technical experts from McCormick Rankin and Delcan were also present at each of the three Stakeholder sessions, to provide detailed answers to technical questions.

The feedback generated at each of the Stakeholder Focus Group sessions was collected by the facilitator on flip-charts and in notes taken by a scribe. Summaries of these notes can be found in Appendix II.

Table 2: Stakeholder Focus Group Schedule

Date	'Voices'	Representation
Tuesday, March 4 9.30 – 11.30 a.m.	Industry Voices	Stakeholders that rely on the transportation system including school transit organizations, taxi services, car-sharing organizations, and general aviation organizations.
Wednesday, March 5 9.30 – 11.30 a.m.	Downtown Voices	Business and community members representing the downtown area.
Wednesday, March 5 1.30 – 3.30 a.m.	Economic Voices	Businesses, business associations, major employers, and other representatives that are interested in transportation from an economic perspective.

Recruitment: Attendance at the Stakeholder Focus Groups was drawn from existing City stakeholder lists, supplemented by additional research to create a broad-based pool of participants. Stakeholders were sent email invitations and received follow-up calls to confirm their interest and availability to attend.

4) Advisory Committee Briefing

A number of the City of Ottawa's Advisory Committees, with an interest in transit and transportation, were invited to participate in a briefing session on the Downtown Rapid Transit Network Options. The session, which consisted of a presentation on the TMP update and the four options, was scheduled at City Hall in the evening of March 5. The Advisory Committees invited to attend included:

- Roads and Cycling Advisory Committee
- Environmental Advisory Committee
- Rural Issues Advisory Committee
- Accessibility Advisory Committee
- Pedestrian and Transit Advisory Committee.

No feedback was received at this session.

Those Advisory Committees whose mandates do not directly pertain to transit or transportation issues were invited to participate in the Open House sessions and Registered Discussion Groups. Invitations were sent to the following Advisory Committees:

- Arts, Heritage and Culture Advisory Committee
- Equity and Diversity Advisory Committee
- French Language Service Advisory Committee
- Health and Social Services Advisory Committee
- Local Architectural Conservation Advisory Committee
- Ottawa Forests and Greenspace Advisory Committee
- Parks and Recreation Advisory Committee
- Poverty Issues Advisory Committee

- Seniors Advisory Committee.

Note that representatives of the Business Advisory Committee were invited to attend the 'Economic Voices' Stakeholder Focus Group. The Taxi Advisory Committee, which had been invited to participate in Phase I consultation activities, was disbanded prior to the occurrence of Phase II events.

Recruitment: Invitations were sent to each of the Advisory Committees by members of the Planning Department at the City of Ottawa.

5) Internal and External Agency Meetings

The City of Ottawa held Internal and External Agency meetings during the week of March 3. The primary objective of the Agency meetings was to provide the two groups with information on the four options. Both meetings consisted of a 45 minute presentation updating participants on the TMP project, and providing an overview on the four alternatives. This was followed by an open discussion. Meeting minutes for both the Internal and External sessions can be found in Appendix III.

The External Agency meeting took place on Tuesday, March 4, at City Hall from 1:30 to 3:30 p.m. Participants included representatives from the following agencies:

Federal Government

- Public Works and Government Services Canada
- Health Canada
- Transport Canada
- Infrastructure Canada

Provincial Government

- Ontario Ministry of Transportation
- Ontario Ministry of Public Infrastructure Renewal

City of Gatineau

- Société de transport de l'Outaouais (STO)

Crown Corporations

- National Capital Commission

Advisory Agencies and Private Interest

- Rideau Valley Conservation Authority
- Canadian Pacific Railway

The Internal Agency meeting took place on Friday, March 7, at City Hall from 9:30 to 11:30 a.m. Participants at the Internal Agency Meeting consisted of various departmental staff from the City of Ottawa, including representatives from:

- Economic Development
- Surface Operations
- Traffic & Parking Operations Branch
- Real Property Asset Management Branch.

Feedback was not collected at either of these two Agency Meetings, as participants were asked to provide comments to Steven Boyle at the City of Ottawa, by March 31, 2008.

6) Online Consultation

The Beyond Ottawa 20/20 website (www.ottawa.ca/beyondottawa2020) was used to promote the Open Houses and the Registered Discussion Groups activities and to provide browsers with information on the various Downtown Rapid Transit Network Options.

The online consultation took place from Monday, March 3, to Monday, March 31. All thirty Open House display boards were uploaded to the website, along with supporting materials, in both official languages. Citizens were encouraged to review the information and provide comments through an online feedback form, by email, regular mail or by fax. The online feedback form included both multiple-choice and open-ended questions.

A database compiling input obtained from the comments sheets and online submissions was submitted to the City of Ottawa's Planning, Transit and Environment Department.

7) Mayor's Streeter Survey

A Mayor's Streeter Survey was conducted to provide a brief snapshot of the public's awareness and opinion of the City's long-term transit plans.

The Streeter Survey locations were selected to capture a diverse set of opinions, mostly from transit users. Locations included downtown at the McKenzie King Bridge; the Eagleson Park and Ride in Kanata; the Place d'Orleans transit shelter in Orleans; and the Fallowfield Park and Ride in Barrhaven. The survey team approached various people at transit stations, bus stops, city parking lots and sidewalks, and asked them to participate in the brief questionnaire.

The surveys were conducted during the week of March 17th at the following six locations:

Table 3: Mayor's Streeter Survey Schedule and Locations

DATE	LOCATION	TIME
Monday, March 17th	Eagleson Park and Ride	7:30 a.m. to 10:00 a.m.
	Mackenzie King Bridge	7:30 a.m. to 10:00 a.m.
Tuesday, March 18th	Place d'Orléans Park and Ride	3:00 p.m. to 6:00 p.m.
	Mackenzie King Bridge	3:00 p.m. to 6:00 p.m.
Thursday, March 20th	Fallowfield Park and Ride	7:30 a.m. to 10:00 a.m.
	Mackenzie King Bridge	7:30 a.m. to 10:00 a.m.

In order to maximize the number of completed surveys within the allotted three days, teams of 'surveyors' were assigned to each location. Each team had a 'team leader' from PACE Public Affairs & Community Engagement. Surveyors were identified by a City of Ottawa winter toque.

Team members were provided with surveys and copies of the Mayor's Newsletter which highlighted the four Downtown Rapid Transit Network Options and also directed readers to the Ottawa.ca/BeyondOttawa2020 website for further information and opportunities to provide feedback. All materials were available in both official languages.

The survey results were reviewed, collated and analyzed to identify key comments in the public's attitude towards the City's long-term transit plans. The database of completed surveys was submitted to the City of Ottawa's Planning, Transit and Environment Department.

Outcomes

Overall, at each of the consultation events, a strong majority of the public and stakeholders indicated Option 4 as the preferred long-term solution for the City of Ottawa. While there was also support for Option 3, many suggested that this alternative could serve as a 'staged' implementation for ultimately developing Network Option 4. There was little to no support for Options 1 and 2, as these were found to be the least sustainable and economically viable networks for the future.

In total, over 1,100 comments (1,188) were received through the Public Open Houses, Online Consultation and the Mayor's Streeter Survey consultation activities.

1) Public Open Houses

In total, approximately 400 individuals attended the Public Open Houses during the week of March 3, and 156 comment sheets were submitted.

Members of the public were asked to provide responses to the following three questions/prompts:

- Which downtown rapid transit option do you prefer?
- Please outline below what you like about your chosen option.
- Other Comments

Just over two thirds of the submissions indicated Downtown Rapid Transit Network Option 4 as the preferred option, while a quarter indicated Option 3. Options number 1 and 2 received next to no support.

Table 4: Public Open Houses ~ Preferred Downtown Rapid Transit Network Option, as Submitted in Response to Question 1 of the Comment Sheet

Question 1 ~ "Which downtown rapid transit option do you prefer?"

Location	Options					Total Choices Made
	1	2	3	4	N/A	
West	0	0	17	17	1	35
East	2	1	7	17	3	30
South	0	0	3	25	0	28

Central	0	1	15	55	5	72
Total	**2**	**2**	**42**	**114**	**9**	**169***

*Please note that some comment sheets included two selected options

Table 5: Public Open Houses ~ Key Comments, as Identified in Response to Question 1a of the Comment Sheet

Question #1a ~ "Please outline below what you like about your chosen option."

Key Comments
(Comments refer to Option 4) • Operating costs are cheaper • Environmentally friendly • Goes direct from downtown to airport • Services all communities of Ottawa with use of Hub and Spoke • Ability to expand network • Converts Transitway to LRT (use of existing assets) • High capacity service where it is needed most • Underground tunnel removes congestion • Underground tunnel promotes business development – offsetting costs • Is a world transit system for Nation's Capital

Table 6: Public Open Houses ~ Key Comments, as Identified in Response to Question 2 of the Comment Sheet

Question #2 ~ "Are there other features you would like to see included into Ottawa's rapid transit network?"

Key Comments
• N/S rail to connect to Gatineau • Extension of LRT to Kanata and Orleans • Use existing rail lines • Encourage intensification inside greenbelt • One transit pass for all transit systems • Bike routes, paths and parking at transit stations is necessary • Comfortable transit stations • Security for underground tunnel • Accessibility for underground tunnel and all LRT stations • Free downtown LRT use to promote ridership and tourism • Option of running LRT on waterway as a tourist attraction

Table 7: Public Open Houses ~ Key Comments, as Identified in Response to Question 3 of the Comment Sheet

Question #3 ~ "Other Comments"

Key Comments
• Consider the environment in any option • STO/Gatineau sharing of costs and integration

- The proposed options are too narrow and should extend even further
- Personal safety needs to be considered
- Ensure Walking and Cycling is integrated and maintained
- Make transit attractive and affordable
- Ensure that the correct corridors are chosen
- Money is not the deciding point - it is what is best for Ottawa

2) Registered Discussion Groups

Over 100 people registered for the various Discussion Groups held across the city. Discussions focused largely around Options number 3 and 4. There was little to no discussion or questions regarding Options 1 or 2. The majority of participants favoured Option 4 as the best long-term solution for Ottawa.

While discussions at each table were designed to reflect the questions listed in the Comment Sheets, some led to other relevant topics. Facilitators were encouraged to carry the conversation wherever participants felt it needed to go. With this in mind, the following table (Table 8) provides a summary of key Comments captured at each of the Discussion Group tables. For in-depth notes captured on flip charts at each table, please see Appendix I.

Table 8: Registered Discussion Groups ~ Key Comments on the Four Options

Network	*Key Comments*
Option 1	• Buses do not help us overcome the congestion issue in the downtown core • Buses are less reliable • There is no clear benefit for choosing this option • Operating costs are very high • This is not a sustainable option • There is no room for growth • It is the least efficient use of time, money and the environment • Buses in the tunnel would cause serious health concerns
Option 2	• There is no clear benefit for choosing this option • This option is too expensive • There is no consideration for growth • This option is the most expensive • It is not a sustainable choice • Buses in the tunnel would cause serious health concerns
Option 3	• Option 3 is a good interim starting point to get to Option 4 • The link to the airport is important • Future growth is possible with this option • If this option is selected, an increase in O-Train service is needed
Option 4	• It is the best option for the environment • It offers best long-term solution • It supports urban growth realities • Option 4 is the best use of money • It is adaptable • It is convenient

The following table (Table 9) reflects what participants indicated was most important for the City to consider when implementing a new transit plan.

Table 9: Registered Discussion Groups ~ Key Areas of Consideration

Area of Dialogue	*Key Areas of Consideration*
Location of Corridors, Stops, etc.	• Explore the feasibility of existing corridors • Ensure the appropriate corridor choices (e.g. Baseline vs. Barrhaven, East-West vs. North-South)
Environment	• Technology choice is important to investigate – hybrid vs. electric vs. diesel • Choose the best alternative for the environment • Consider future fuel costs • Choose a system that considers Ottawa's environment and winter temperatures
Considering STO	• A solution for the Gatineau buses must be considered • Create a transfer point on the Gatineau side • STO link is imperative • Ensure systems are compatible • STO system must not be detrimental to Ottawa (e.g. contribute to the congestion issues in the downtown core)
Construction and Disruption of Service	• Concern about construction at transfer stations • Concern about construction disruption in residential areas • Concern that disruption to service will result in losses to ridership and increases in car use
Transfer Stations with Hub and Spoke System	• Must encourage acceptance of transferring • Determine elements that make transferring attractive (e.g. shopping, etc.) • Accommodate multi-modal use (e.g. bike paths, bike stations, walkways and more Park and Rides) • Personal safety at transit station and tunnel • One transfer limit
Urban Planning	• Increase development density • Land use planning is critical for transit planning
Encouraging Transit Ridership	• Choose the system that will encourage the highest ridership • Aim for high modal splits • Convenience, reliability and speed will appeal to citizens • Incentives for transit use • Internet access on trains • Affordability (e.g. car ownership and parking costs vs. transit pass)
Financing	• Focus on decreasing maintenance costs • Secure funding from other levels of government

3) Stakeholder Focus Groups

Overall, attendees at the three Stakeholder Focus Group sessions provided very positive feedback on the focus group structure and were pleased with the opportunity to provide in-depth input on the four Downtown Rapid Transit Network Options.

In each of the three Focus Group sessions, common themes and elements emerged. The majority of participants felt strongly that Downtown Rapid Transit Network Option 4 was the most comprehensive and beneficial to the city, providing citizens with a sustainable, reliable transit system that allowed for future growth as population and employment opportunities increase.

The following table (Table 10) provides a summary of the key Comments captured at each of the three Stakeholder sessions. For full notes, please see Appendix II.

Table 10: Stakeholder Focus Group Sessions ~ Key Comments

Stakeholder Focus Group	*Comments*
Industry Voices	• Option 4 best option • Future growth with rail is a benefit • LRT moves people quickly and is cheaper • Inter-provincial support is needed for STO problem • Public buy-in is important – market the options well
Downtown Voices	• Option 4 makes sense • Intensification is needed as it relieves congestion • Flexibility with being able to add more rail cars, extending rail lines and seeing multi-modalities integrated • Inter-provincial support is needed for STO problem • Local service will need improvements • Public buy-in is crucial – market the options well
Economic Voices	• Downtown emphasis is good • Tunnel is needed • Build economic nodes within the transfer areas • Inter-provincial support is needed for STO problem • Public buy-in is important – market the options well • Intensification is necessary

4) Advisory Committee Meeting

No feedback was received at this meeting.

5) Internal and External Agency Meetings

Feedback was not collected at either the Internal or External Agency Meetings, as participants were asked to submit comments to Steven Boyle at the City of Ottawa, by March 31, 2008. Meeting minutes can be found in Appendix III.

6) Online Consultation

Citizens were encouraged to participate and provide feedback through a multitude of channels: by emailing the Mayor directly; emailing City staff at plan@ottawa.ca; submitting online comments on the City's website; mailing feedback to the City; or by faxing in their feedback.

Of the 631 total comment submissions received, an overwhelming majority indicated Option 4 as their preferred option. The bulk of these comments (494 of the 631) were received through the online feedback form on ottawa.ca, which indicated the following multiple-choice results:

- 70 per cent chose Option 4
- 18 per cent chose Option 3
- 5 per cent selected either Options 1 or 2
- 7 per cent were undecided

Participants that chose to email, fax or mail their feedback (126 or 20% of comments received) mostly commented openly about specific concerns they had about transit in Ottawa.

Tables 11 through 14 summarize the feedback received through the online consultation process. All comments submitted are on file with City's Planning, Transit and Environment Department.

Table 11: Online Consultation ~ Preferred Downtown Rapid Transit Network Option

Question #1 ~ "Which downtown rapid transit option do you prefer?"

Method of Submission	Options					Total Choices Made
	1	2	3	4	N/A	
Fax	0	0	3	0	0	3
Mail	0	0	1	5	4	10
Email	1	1	18	67	36	123
Online Form	14	11	89	341	40	495
Total	**15**	**12**	**111**	**413**	**80**	**631**

Table 12: Online Consultation ~ Key Comments Identified with Respect to Option 4

Question #1a ~ "Please outline below what you like about your chosen option."

Key Comments
• Access to all citizens regardless of region EW/NS/etc. • Tunnel is a good idea and eliminates congestion • LRT is the best for the environment • Option 4 is the best long term choice with the ability to expand rail to outlying areas in the future • Option 4 has the cheapest Operating and Maintenance costs • Phase out reliance on fossil-fuel-burning buses • LRT will reduce the congestion going into and out of downtown • Greater reliability • Streamlining of inner-greenbelt transit helps improve liveability

Table 13: Online Consultation ~ Key Comments Identified with Respect to Features

Question #2 ~ "Are there other features you would like to see included into Ottawa's rapid transit network?"

Key Comments
• LRT connection to other areas (e.g. Barrhaven, Gatineau, Fallowfield Via Station) • Accessibility is important • Convenience and reliability of transfers is important • Tunnel pathway and connections to shops, residences, buildings is important • Bike paths and walkways along the Transitway is essential • Larger park and rides • Ongoing consideration for late night routes to service downtown core and entertainment destinations • All buses should be removed off Albert, Slater, Queen and Laurier downtown and should connect to bus station hubs • The LRT should be faster than the bus, which will entice more transit riders • Integration with STO and getting Ottawa residents access to major government workplaces in Gatineau • The city should be encouraging higher density residential, commercial, and institutional development adjacent to LRT • Incorporation of the old Union Station downtown as the main downtown stop • Train connection to Scotia Bank Place • Reduction / Freeze on fares • Better coordination with STO schedules • Phasing of Option 3 and Option 4 allows for immediate construction

Table 14: Online Consultation ~ Key Comments Identified as Other

Question #3 ~ "Other Comments"

Key Areas of Consideration	*Key Comments*
Environment	• Tunnel should only be accessible to LRT • Technology choice is important to investigate – hybrid vs. electric vs. diesel • Eventual conversion/extension of LRT promotes further environmental benefits • Explore the feasibility of existing corridors • Ensure the appropriate corridor choices (e.g. Baseline vs. Barrhaven, East-West vs.

	North-South) • Consider future fuel costs • Choose a system that considers Ottawa's environment and winter temperatures • LRT will increase transit ridership
Economic Benefits	• Increase development density • Land use planning is critical for transit planning
Ottawa/Gatineau Cooperation	• A solution for the Gatineau buses must be considered • Inter-provincial cooperation is necessary • Create a transfer point on the Gatineau side
Construction and Disruption of Service	• Concern about construction at transfer stations • Concern about construction disruption in residential areas • Concern that disruption to service will result in losses to ridership and increases in car use • Use of existing infrastructure should be considered
Transfer Stations with Hub and Spoke System	• Must encourage acceptance of transferring • Determine elements that make transferring attractive (e.g. shopping, etc.) • Accommodate multi-modal use (e.g. bike paths, bike stations, walkways and more Park and Rides) • Personal safety at transit station and tunnel • One transfer limit
Encouraging Transit Ridership	• Choose the system that will encourage the highest ridership • One pass/smart card system for all types of transit • Aim for high modal splits • Convenience, reliability and speed will appeal to citizens • Incentives for transit use • Internet access on trains • Affordability (e.g. car ownership and parking costs vs. transit pass)
Financing	• Focus on decreasing maintenance costs • Secure funding from other levels of government • Need to consider the costs and implement accordingly
Other	• Consider the location of the tunnel and ensure it is the right choice • Make the planning process open and transparent to citizens • Implement the plan now; not in 30 years • Do not cancel anymore transit contracts • Rail cars should be longer than two cars

7) Mayor's Streeter Surveys

The Mayor's Streeter Survey – conducted at various transit stations, bus stops, City Park & Rides, and sidewalks across Ottawa during the week of March 17th, generated a total of 401 completed questionnaires. The following is an overview of the key findings:

- 261 (65%) participants have heard about the downtown tunnel proposal and/or the four Downtown Rapid Transit Network Options
- 318 respondents (79%) believe that Ottawa needs a light rail system to service its growing population
- A majority (225 of 358 responses) would like to see a connection to the airport

- 298 (74%) think light rail should service suburban communities such as Kanata, Orleans and Barrhaven
- 284 (71%) respondents believe it more fiscally prudent to spend an increased amount upfront in capital costs to develop a transit system, and spend less on operating and maintenance costs over the lifetime of the project (than the opposite).

Common themes heard throughout the duration of the survey, regardless of the location, include:

- Support for the tunnel and decongestion of the core
- Phasing of the light rail system so that it serves the demand
- Extension of light rail to the suburbs.

Key comments in reference to financing a transit system were as follows:

- A good system is needed now - spend the money to do it well
- Do not increase taxes
- Do not increase transit fees
- More information is needed on the options and what the overall costs will be.

Appendix I
Registered Discussion Groups — Flip Chart Notes

Orléans Public Open House – Monday, March 3, 2008

Table 1:

Leader	Scribe
Peter Steacy, McCormick Rankin	Monica Bailey, PACE

Questions & Discussion

Buses more expensive
Health Issues
Bus expense = driver (LRT requires 1 driver / large train)

- Option #1 is no good

Buses slower

- Cause congestion and problems in downtown core
- Overtime bus very expensive

Cost: operating cost - $700 million to build

- Same environment of congestion if we use BRT in tunnel
  - limitations to this option for the future
- Rush hour – broad peak times
  - buses aren't moving
  - only standing room

Option #1 – least efficient
Between option 1 and option 4

- Time it would take from start to end – Bus vs. LRT
  - considering transfer (Blair to Baseline)
- Both same travel time - But not during peak hours
- Peak hour = buses slower

Reliability – Option 1 vs. Option 4

- LRT would be far more reliable – especially during bad weather
- **Speed and reliability = key concerns**

2 min at downtown for LRT

- Transfer from bus to LRT – seamless
- Transfer nodes must consider bus to LRT

Baseline to Blair and effects
Rail should go to River Road

- Eliminates road widening
- Helps people cross bridge

Greely – to be included in growth area
Transfer points available to those in Greely
Yellow = urban boundaries

- Development on those corridors

How do people connect to LRT from Bus?

- Stations are at intersections of Arterial roads
  - Frequent stations to be efficient

Collection of people important – 8 must be accessible at bus routes / stops

Option #1 = tunnel
Scale – tunnel to give option for the future (two level)
*Bike paths? Bike option.

Convert O-Train to LRT – must make double rail and electric

Option 3 – include widening?

- No
- Extension to Bowesville to be considered

Airport rail – is it needed?

- To be looked into but is seen as an economic benefit to the city

Wrap Up

Table Preferences*			
Option 1	**Option 2**	**Option 3**	**Option 4**
0	0	1	7

* Totals may exceed number of participants as individuals indicated more than one option as their preference

Comments

Extension to River Road (option 5)
Tunnel needed and must be rail

- Should we keep O-Train? (fiscally responsible – extra cost)

Interconnect rail
Assumption that everyone wants to go downtown
Grey line = 2003 TMP "Rapid Transit Expansion Study"

- Corridors – East-West / North-South
- To attain 30% transit modal split – look at these not just going downtown. Looked at interconnecting lines and modes

Plan doesn't adequately look at growth outside urban boundary

- West rails "too close together"
- Navan to Trim Road bus transit approved - #94

Support inter-connecting links – Grey Lines
**Rapid transit to Quebec side – STO / LRT / BRT to provide service

**2031 cheap energy? – No available energy in 2031
Start thinking about walkability / biking and land use

- This is important to the TMP

Bike routes, traffic free – roads accommodate bikes
Timelines 2009

- EA for tunnel next
- Construction
- Bayview to Hurdman = #2 for construction
- Tunnel = #1 for construction

Transit plan – 2 years planning

- City approved downtown tunnel network
- EA on tunnel
- Joint STO / City of Ottawa for transit to/from Quebec

*Station locations will drive length of approval process

- City to get landowner approval for building LRT

*Technical

- 1 ½ to 2 years for building
- Agencies
- Utilities
- Centre out – tunnel and downtown then construct outwards

Bus vs. LRT – acceleration – ex: Edmonton Streetcars faster than bus because they don't carry fuel
Suburban communities gravity – LRT considers this
Impact assessment?

- GHG part of analysis
- Focus on different technology
- Movement from place to place
- *Health impact assessment needed
  - Especially considering cycling
  - Diesel particles
  - Asthma
  - Heart attacks
  - Money from Health budget
  - Accident costs – Assess this. Are there fewer and what is the cost benefits to LRT vs. Car?

Table 2:

Leader	Scribe
Ronald Fournier, Delcan	David Forsey, City of Ottawa

Questions & Discussion

Question 1: Which alternative do you prefer? And why?

- St-Laurent shows the environment of a bus tunnel. Any option with an LRT tunnel.
- Option 4. Start with 3 aim for 4
- Option 4. It extends to airport. Could use Diesel for Option #5
- Importance of train for airport to downtown
- Interlining
- Difficulty of serving N-S demand with diesel/stock
- (Use of tracks from Barrhaven to VIA)

Question 2: Other features?

- Using the Ottawa River Parkway - Is it the right alignment for the money?
- Concerned about connections with STO

Question 3: Other comments?

- First thing to do is to get LRT running in a tunnel
- Tunnel alignment built further South to serve downtown

Wrap Up

Table Preferences*			
Option 1	**Option 2**	**Option 3**	**Option 4**
0	0	2	4

* Totals may exceed number of participants as individuals indicated more than one option as their preference

Table 3:

Leader	Scribe
Colin Simpson, City of Ottawa	Ian Borsuk, McCormick Rankin

Questions & Discussion

Option 1

- Phasing of tunnel first before building second tunnel
- Is maintenance of hybrid buses more expensive?
- Do we consider a diesel tunnel?

Option 2

- Can O-Train be extended into Gatineau – benefits both downtowns
- Why is the Cumberland Transitway shown through Blackburn Hamlet and then South of the majority of Orleans?

Option 3

- Why is Blair shown as the transfer location? Could it not go to Place d'Orleans or Trim?
- Can we use the VIA track for rail from Barrhaven?
- Can we connect Trim (10th Line) and Millennium with Rapid Transit?
- Is the East Transitway a candidate for LRT conversion?

Option 4

- Why is rail going to Bowsville when Orleans still has Transitway?

Wrap Up

Table Preferences*			
Option 1	**Option 2**	**Option 3**	**Option 4**
0	0	5	5

* Totals may exceed number of participants as individuals indicated more than one option as their preference

Comments

- Need to extend rail to Orleans to reduce transfers
- O-Train extension to Gatineau (x 3 comments)
- Link to airport is important
- The more rail the better for the environment
- If transfers are required, then we can save costs and not take it all the way to Blair
- **Transfers will lower ridership**
- #27 goes from Orleans to Gatineau and would require 3 transfers with Alternates 3 and 4
- Rail to Orleans: Build it and the density will develop

Table 4:

Leader	Scribe
Steven Boyle, City of Ottawa	Daydria Gordon, Delcan

Discussion & Questions

- Why not have a high-capacity hybrid electric train in the tunnel instead of an electric train and then a bio-diesel (purified) train for transit outside of the tunnel?
- We have a higher surface capacity (much like Montréal)

- There is no double-track hybrid option
- We should consider using rails already in existence like those belonging to VIA and CN (this would help lower costs)
- We should have an electric battery in the trains themselves, this would make trains and buses interchangeable
  - Avoid having diesel trains in the proposed downtown tunnels
- Should check out New flyer industry in Winnipeg – they have an efficient hybrid system
- Will the trains on the circuit be interchangeable or not?
- The frequency of buses seems ideal, but very realistic
- We should have trains that run both on diesel and electric battery
  - Once in the tunnel they would switch from diesel to electric
- Have we considered the gas usage?
- Have we considered safety issues (especially inside the tunnel)?
- We could implement a system that blows the diesel fumes out of the tunnel (but this may be costly)
- The O-Train should be extended from Bayview to Lincoln Fields

Downtown Public Open House – Tuesday, March 4, 2008

Table 1:

Leader	Scribe
Peter Steacy, McCormick Rankin	Anna, Delcan

Discussion and Questions

Option 3

- Could be an interim step
- O-train – can be redeployed in a different place (e.g. to the South-East Transitway) – on Option 4
- What is the economic impact of removing travelers from the surface to the tunnel?
- What is an overall vision for downtown Ottawa?
  - More pedestrian malls instead of buses
  - Opportunities for stations (economic development)
- 2, 3 and 4 have more future
- Relationship to the bridges – has to be addressed
- Has to link up with the City of Gatineau (e.g., Prince of Wales bridge) - VERY strong opinion – NCR – demands it
- Transit plan should facilitate through the link to Gatineau
- No rail line along the river (would be a barrier)
- Concerned with safety issues along the rail line in an urban context

Option 4

- People in the South (Barrhaven) get a bad deal (buses)
- Access to airport a very good idea – light rail
- Potential for more light rail in the future

Opportunities Downtown (with buses underground)

- More convenient, faster
- Businesses, some underground at stations
- Would the surface suffer (business, urban life?) with less people above?
- Streets would be returned to pedestrians
- Don't make it easier on cars (fill the space with cars – no)
- Need good service during off hours (e.g., the market)
- Service people downtown?
- Need easy/simple pay structure

Tourists

- Tourists are interested in transit/light rail – because it is easy (park and a park and ride)
- Why not use the VIA tracks – link up with the rest of the system?

Wrap Up

Table Preferences*			
Option 1	**Option 2**	**Option 3**	**Option 4**
0	0	3	5

* Totals may exceed number of participants as individuals indicated more than one option as their preference

Table 2:

Leader	Scribe
Ian Borsuk, McCormick Rankin	Caroline Beaulieu, McCormick Rankin

Discussion and Questions

Option 1: Bus Only

- Use of hybrid bus questioned
- Why switch to electric only in tunnel
- 14s headway – operating issue (downtown)
- Not as much benefit for shopping as other options

Option 2:

- Why not stop the LRT right before the tunnel or extend it more to get more benefit?
- Greenboro to south of Blair station LRT?
- In balance system
- Under-utilizing the technology as not enough demand for 4-car trains

Option 3:

- Under-utilizing O-train. Should at least be extended to airport if not Bowesville and to the beginning of the tunnel with existing technology
- Double track only stations
- Put rail on the Hospital corridor instead of East Transitway
- Think about future technology – bi-level cars
- One alternative East/West route to be considered with dedicated ROW as a by-pass to CBD
- Keep Transitway portion to connect West Transitway and South

Option 4:

- Cheaper to convert rest of Transitway E/W than the N/S LRT project
- Consider 4/7 for transit use to force transfer to transit

Wrap Up

Table Preferences*			
Option 1	**Option 2**	**Option 3**	**Option 4**
0	0	All	0

* Totals may exceed number of participants as individuals indicate more than one option as their preference

Comments

Preferred Option: 3

- With O-Train extension to airport
- To bank
- Consider connection to Gatineau
- Rail on the Hospital Transitway instead of east Transitway

Table 3:

Leader	Scribe
Mohammad Tayyaran, City of Ottawa	Gareth Wood, Delcan

Discussion and Questions

- Option 3 & 4
- Good to expand to airport
- Everything transferred to train
- Prefer option 4
- Minimize transfer less than 2 mins

- Prefer 3 & 4, more people on light rail
- More references to environment
- Option 4
- Consider Option 3 using extension of O-Train to Riverside South
- Refer fact we are using Transitway to convert to rail
- Status Quo
- Avoid tunnel
- Elevated surface option
- Option 3 – we have to build tunnel to reduce congestion. Riverside South
- Transitway Option 3 can be converted to train later on
- Can be extended to Gatineau site
- Option 4 – Do LRT, should not wait
- Can't see how buses and LRT will work
- Difficult to choose between 3 and 4. Concentrate on 3 and then convert to 4 later on
- Emphasize link with Quebec side
- Prince of Wales bridge connection
- Like to see STO buses out of the downtown surface
- Transfer point in Gatineau
- Concern with effects of construction
- With the tunnel what happens to buses?
- Consideration of integration with Centrepoint town centre
- Need to increase service on O-Train if going for Option 3. Double track or increase train size
- Advantage of tunnel to improve streetscaping
- How much more construction at transfer stations?
- More transfer stations – less congestion
- Spread out as much as possible
- Transitway to suburban areas
- Transitway extensions to be designed to be converted to rail

Wrap Up

Table Preferences*			
Option 1	**Option 2**	**Option 3**	**Option 4**
0	0	2	5

* Totals may exceed number of participants as individuals indicated more than one option as their preference

Table 4:

Leader	Scribe
Colin Simpson, City of Ottawa	Katie Peak, Delcan

Discussion & Questions

- Residents of Centretown are very interested
- Ottawa U submissions representative present (bringing the student point of view)

Option 1:
- Special conditions? Some believe it may not be possible
- Least intrusive option, but has the highest operating cost
- Theoretically impossible?
- How about including a double platform?

Option 2:
- Still needs the use of double-decker buses?
- Could we use a double platform here as well?
- Still a belief from the group that this may not be possible and is not likely the best option
- A difference of technology
- Only looking at primary routes – big picture?

Option 3:
- Major destinations are linked
- What kind of train?
- Airport not included in LRT could be a mistake
- Airport and VIA Train should be easily connected
- Transferring from LRT to bus – would this be easy?
- Enough space for train and bus? Did EA address this point?
- Transfer stations – Algonquin college

Option 4:
- LRT through core of the city
- More linked major stations
- Connection through airport and VIA rail train? – again not linked directly

To Gatineau?
- Connect to Ottawa?
- It's key to have a link to Gatineau (instead of driving). Mostly cars/bridges
- Will their system work with us?
- Quebec – Ontario linked?
- Prince of Wales bridge
- Is there a highway being extended (Gatineau?)
- Casino – readily accessible from downtown Ottawa?
- Does Ottawa bus transit suffer from transfer to get to Gatineau (LeBreton transfer station)
- Will people tolerate a delayed transfer?
- Capacity of these trains?
- Are 2 min interval between trains too much time? seems excessive for normal daily commute

- How many tracks in the tunnel?

Comments

- All options are including tunnels – important to investigate surface alternatives
  - keep car traffic away from Albert/Slater
  - no interference
- Narrow streets if it's exclusively rail
  - include green space
  - look at Calgary – transit above ground and is a similar size to our city
  - blocking access to driveways and buildings
- Can work in a staged format so that upgrades can happen still during construction periods
  - it's the future volumes we have to plan for - plan for it now while we work on surface
- Consider future growth
  - instead of widening Queensway and looking at car traffic, start working on bus/train transportation on Queensway
- We still have to look at cars since no matter what, people will still want to drive
- Increasing transferability between stations makes it convenient and easy for passengers (especially young people and students)
- Also have to make sure we are not only looking at a growing population but where it is growing
- Environment is a large issue – Alternative 4 is best for that
- Not only look at cost of these options but look at how much road maintenance costs would be in its place
- Could do better than 30% ridership – Aim higher!! Look at Europe!
- Would like to see a breakdown of the costs
- Just too expensive – will it be used enough to make it worth it?
- Reduce greenhouse gas emissions – make pedestrian friendly
- All other cities spend way more – have to keep it in perspective
- Most taxes are going to road maintenance – this will cut that down
- Community buses are woven in to the main downtown stops – important to residences
- LRT is also more quiet – better for downtown areas (offices/residence)
- Is the tunnel as important?
- Personal Automated Transit (PAT) was an option that came up. Probably better for small areas and is this really practical?

Wrap Up

Table Preferences*			
Option 1	**Option 2**	**Option 3**	**Option 4**
0	0	0	All

* Totals may exceed number of participants as individuals indicated more than one option as their preference

Table 5:

Leader	Scribe
David Hopper, Delcan	Daydria Gordon, Delcan

Discussion & Questions

- Need plans with sustainability - go beyond 2031 – it would attract more people
- Criteria Used to Judge Transit
  - Speed
  - Reliability
  - Comfort
  - Convenience
  - Cost
  - Sustainability
  - Emissions
  - Gatineau – the ease of access
  - Flexibility/adaptability
- Need to consider that all forms of fuel will rise in cost
- Need for greater frequency of non-polluting buses – shorter distance between stations
- Need to facilitate transportation to Hull – consider connections through downtown and not just to it
- Tunnel will improve reliability
- Should consider light rail for more areas
  - less expensive in long run
  - current plan leaves areas unserved
- Should criteria carry same weight when planning? public surveys used to determine weight of each criteria
- Land use issues
- Hospital route require additional consideration
- Why aren't there anymore hybrid options?
- Integration with STO issue

Option 1:
- Tunnel will not help bus congestion
- Lacks long-tern capacity
- Conclusion – Option 1 has no future

Option 2:

- Option is the most expensive

Option 3:
- Electric vehicles less polluting and less problems with emissions in tunnel
- Narrow Ottawa street foundation eliminates the possibility of a single tunnel
- Double tunnels underground linked to adjacent buildings
- Riverside South to Barrhaven route not needed – Road bridge waste of money

Option 4:
- Use "old" Railway instead of the Ottawa parkway
- Omit tunnel and extend light rail east/west
  - congestion/population growth issues
  - paradigm shift – car to public transit
- Speed of service issue – provisions for express rail line needed
- Extended electric rail unnecessary

Table 6:

Leader	Scribe
Paul Croft, Delcan	Brandon Jarvis, Delcan

Discussion & Questions

- 3 and 4 Best option, South-west separation
- 4→ "Big bang" approach – connection to airport
- Supporting urban growth
- Oversight in core of city
- Bottleneck in core of city
- Increasing housing costs within city – can't move outside city because accessibility will increase housing costs
- Plans don't address downtown population, only the suburbs
- Move focus downtown
- Needs to look forward 50-60 years
- Build within the greenbelt – discourage building outside, encourage building inside (plan lacks this)
- Increased transportation might encourage school closings
- Concerns that tunnel is not big enough – the capacity is too small
- Population projections to 2031 – how come to this projection?
- Need policies to develop downtown
- Concerns about land purchase (tax money?)
- Need simple way to get people into downtown
- Environmental impact is a high priority
- 2031 needs increased number of buses and needs to look deeper at plan

- East and downtown Montreal – use existing expressway for rail
- Consider other transportation lines
- Need expandable system for increased volume
- Encourage development but not Toronto
- Council has an interest in plan because line in suburbs
- Access onto system, encourage people with disabilities
- Reliable system – what about weather?
- Possible problems with outdoor transit system
- Bus not a viable option
- Lack of an integrated plan
- Planning has not been addressed
- There is a need for a full subway
- Why underground Tunnel?
- 4 – Scotiabank place?
- Less environmental impact; good vision
- Need to encourage inner city growth
- Tunnel will discourage pedestrian travel
- Plans designed by developer
- Environment
- Scale – look forward 60 years

Table 7:

Leader	Scribe
Ronald Fournier, Delcan	Greg Jodouin, PACE

Discussion & Questions

Question 1

- #4 – Consider fuel costs for a diesel technology and fossil fuel impact
- # 3 or 4 - would like Blair transfer station to be a little further East
- How many stops in the tunnel? 5-6 doesn't seem like enough
- Understands need for tunnel but not perfect
- One train system only – convert the O-train
- #4 needs N/S also E/W needs buses
- #4 huge investment but option 4 is the most forward looking (invest big now and have it complement city as it expands)
- Trusting that electric is the way to go
- Needs to be paired with a program to get people off roads. Can't spend billions on something people won't use
- #2 is not feasible or safe to have buses and LRT in the tunnel
- O-Train needs to be converted to 2 tracks
- Free downtown ridership is a wonderful idea

- Need incentives to get people to use transit
- You can start with #3, but need to end up at #4
- Interest in how conversion will happen on parkway after Scott Transitway
- For #4 full electric is the way to go
- Express buses are a problem
- Free zone downtown will encourage and make more vibrant (Rideau Centre to LeBreton) – "Fareless Square"
- Little value in most Southern leg of LRT (i.e., Bowesville station)
- Either 3 or 4. Prefers 4
- Takes his bike to O-train. Can he do this with the LRT?
- Need to plan for cycling as well. Need to incorporate with #4 on off peak hours
- Combine new paths as you construct system

Question 2 – Other Features

- No fares in downtown
- Connection to Gatineau (LRT access on Prince of Wales Bridge)
- Consider conversion of BRT to LRT. Build it such that it can be converted later on
- Disincentives to drive or incentives to ride (e.g., London car tax)
- Bus route #2 needs improvements
- Diesel buses are bad for scheduling. Hard to keep up
- Consideration for students
  - Carleton (esp. if we need to close O-train for 2 years of construction)
  - need schooling institute in East end (college)
- What about a watercourse option on Outaouais River or Canal such as in Vancouver or Halifax? Not a priority but has good tourism value
- Park and Ride lots with security camera and staff

Wrap up

Table Preferences*			
Option 1	**Option 2**	**Option 3**	**Option 4**
0	0	0	8

* Totals may exceed number of participants as individuals indicated more than one option as their preference

Table 8:

Leader	Scribe
Mohammad Tayyaram, City of Ottawa	David Forsey, City of Ottawa

Discussion & Questions

Question 1:

- Options 1 & 2 are not sustainable
- Option 3 lower capital $, but not significantly less than 4 billion

- Option 4 is ideal (why not cut and cover)
- Bus tunnel more expensive than LRT tunnel
- Stage surface rail first, then build tunnel
- Putting off tunnel is not wise
- St. Laurent shows the poor environment of a bus tunnel
- Option 4 is ideal
- Baseline-Blair critical
- Elevated option discounted. Why? Current station design is lacking amenities which has an effect on costing
- Time savings by bus tunnel may be offset by the time accessing stations – depth of the tunnel is an issue
- The experience, impression left with the riders
- Security
- Must think about what happens when everything goes underground
- Look at the impact on the streets and need to plan accordingly
- Will the City look into ALRT?
- Favour electronic options – Power sources much more stable and reliable
- Increasing gas prices factored into operating costs?
- Why use Baseline instead of Bayshore
- Use of Byron trainway ROW
- Factor in the benefits of the City becoming a land developer at LRT stations into costing
- Why BRT between Bowesville and Barrhaven?
- Connect airport with VIA by LRT for tourism and business purposes
- Minimize or facilitate ease of transfers
- Security is with automated system. Access/egress
- Importance of building safe/efficient infrastructure for future generations
- Building for the future
- Facilitate connection with STO
- Ottawa should not suffer the consequences of STO's bus-based system
- Loop through downtown Ottawa and downtown Gatineau
- Real time incident management

Wrap up

Table Preferences*				
Option 1	**Option 2**	**Option 3**	**Option 4**	**Other**
0	0	0	0	All prefer "light metro"

* Totals may exceed number of participants as individuals indicated more than one option as their preference

Kanata Public Open House – Wednesday, March 5, 2008

Table 1:

Leader	Scribe
Ronald Fournier, Delcan	Greg Jodouin, PACE

Discussion & Questions

Question 1

- 4: Wants remaining buses to be diesel hybrid. Second choice is number 3
  - Covers most of the area
  - Would like conversion to East and West extremities to happen sooner
  - Interested in future commuter rail to be converted to LRT
- 3&4: But concerned about cost – because of that, would suggest a version of alternative 3 that extends LRT East and West (ie. Take savings from not doing alternative 4 and apply full East/West LRT line)
- 3&4: Combine with option 4. LRT extends to nowhere in the North; build were the people are, such as in Kanata and Stittsville. Keep the airport link
- 3&4: But problems as above – remove N/S LRT and spend it on an E/W line. Just put off an N/S plan for now
  - Transfers are death
  - We are an E/W city
- 3&4 Combo
  - Keep single track diesel until you can justify electric
  - Go full E/W LRT line
  - Look at how regional buses fit in Kanata
  - Consider inter-regional buses in Kanata
  - Keep buses on roads for now until you can justify a dedicated expressway
  - Take 6-lane roads and convert 2 for bus lanes (HOV)
  - Get rid of Express buses and make local just as good
- 4: But implementation plan is crucial. Devil is in the details. Extend LRT to Kanata's Park and Ride, more buses in Kanata rather than BRT and feed LRT.

Question 2

- Bicycle options for trains and buses
- Internet service/wifi if possible
- Train connector to Airport ASAP (but not at expense of E/W)
- Some participants wonder whether ridership would justify an airport link
- Diesel/hybrid buses → need to be plug-in hybrids to maximize electronic use and decrease diesel use
- Consider Hydrogen buses such as in Iceland

- **Consider "Dial-a-Bus" system for Kanata. A shuttle-like service that you can call up for service to transfer stations**
- Consider an automated service
- SAFETY
- Build a proper transfer station in Kanata to encourage ridership, with retail
- Would be more attractive
- Extension of the O-Train
- Allow high density development around LRT lines to help fund system

Comments

Option 4

- With limitation on N/S and extension on E/W
- Service south with O-Train until population warrants
- Shows us the implementation plan
- With extension E/W, no transfers

Option 3

- Take off N/S and use for E/W LRT
- Extend O-Train (single-track diesel). Train only in tunnel
- Extend O-Train to Bowesville
- Build Kanata to Orleans LRT

Table 2:

Leader	Scribe
Colin Simpson, City of Ottawa	Ian Borsuk, McCormick Rankin

Discussion & Questions

- Downtown is Government and will not grow as much
- Is the Manotick Development being considered?
- Surface and elevated need to be considered further

Option 1:

- Will there still be surface buses?
- Why is the city considering this option if it's capacity is limited?
- How does STO get accommodated?

Option 2:

- How many riders does the airport contribute?
- Why not continue the shared operation to Hurdman?

Option 3:

- What would be the travel time from Lincoln to Blair?
- Why is the rail not extending to Kanata/Orleans?

Option 4:

- Single O-train tunnel can work since elimination of Downtown variability
- Connect O-Train to Hurdman also
- Extend rail to Gatineau

Wrap up

Table Preferences*			
Option 1	**Option 2**	**Option 3**	**Option 4**
0	0	4	3

* Totals may exceed number of participants as individuals indicated more than one option as their preference

Comments

- Alternative 3 is good but should be modified – extend diesel O-Train south (x2 comments)
- Rail tunnel should be able to accommodate emergency vehicles
- City is purchasing buses anyway – we should not be including their costs

Table 3:

Leader	Scribe
Ron Jack, Delcan	David Forsey, City of Ottawa

Discussion & Questions

- Should study elevated options in greater detail, straddled, suspended
- Interlining may reduce system reliability
- Rapid bus through Kanata may introduce bottlenecks
- Instead of LRT to Bowesville, bring LRT to Kanata
- Driverless trains save operating expenses
- Dedicated ROW is key
- Longer trains reduce operating costs
- Consider Carling Ave. as primary Rapid Transit corridor up to Tunney's Pasture
- Consensus that LRT to Kanata and Orleans should be priority instead of to Riverside south
- To achieve 30% ridership, the ride must be safe, comfortable and timely. Two objectives which should be considered are:
  1. Majority of riders traveling to the CBD should only be required to make one transfer

2. Except where buses travel in a completely protected right of way separate from other traffic, no passengers should be allowed to stand-up if speed exceeds 50kph

Barrhaven Public Open House – Thursday, March 6, 2008

Table 1:

Leader	Scribe
Mona Abouhenidy, City of Ottawa	Cori Lytle, Delcan

Discussion & Questions

Lack of vision for greater plan
Tunnel option too expensive

- Extend O-Train line to service Hull/Gatineau
- Middle lane on Alexandra Bridge - restore railway
- Restore railways to old Union Station

Alternative 1 BRT Tunnel (cheapest option) => Highest operating cost
Top employers consulted?

- Servicing + accommodating employees
    - How to be better connected
- Don't forget about reverse commuters

Option 4 is the best

- Lower operating costs
- Most efficient
- Direct link to key areas in City
- Economical
- Very adaptable
- Consider more rapid extension of rail out to Kanata/Barrhaven

**Get cars off road, cut down pollution – service outskirts
**Cheapest option not always best

- Not a strategic vision – how does it link to schools, environment, and tourism?
- Alternatives put together in order to pick Option 4
- Extended rail into Barrhaven at start
    - Line to Riverside South or N-S line

Express bus problem in Barrhaven => buses full

- All mass transit should be light rail to move people efficiently
- Accommodate for growth in outer areas
- All extensions should be rail

Option 2. Allow 2 technologies in tunnel

- Make tunnel available for both/flexibility
- Mixed traffic (bus/rail)

Option 4 but allow buses – on Blair – mixed traffic

- Leave buses as an option

New Option (Option 5)

- All rail
- Simple stations, only a few major stations
- Use existing rail corridors / infrastructure

Buses too much pollution – O-Train preferred
Downtown core served by trolley cars
Move towards "world-class" – show more than minimum requirements
Highest population (Barrhaven) should be served by rail

Table 2:

Leader	Scribe
Steven Boyle, City of Ottawa	Cathie Lytle, Delcan

Discussion and Questions

- Not using railway corridors
- Downtown growth not as big as outlying areas
  - Focus on downtown
  - Why only 2 options to get downtown?
  - Population growth on outskirts – why stay focused on downtown commute
- Better shelters
- Space on buses
- Remove buses on surface in the core area - both OC Transpo and STO
- Ventilation of tunnels / emissions – where do they go?
- Drainage in tunnels
- Longer travel time – Barrhaven to Core
- Greenspace usage
- Sparks Street
- Studies for 'peak' periods
- New routes for cost savings
  - Better route planning for existing routes
- No tunnel as an option – use existing resources + improve routes
- Nice to see phases of the project
- Assumption making now in terms of future transit
- Process works closely with economic development

Wrap up

Table Preferences*			
Option 1	**Option 2**	**Option 3**	**Option 4**
0	0	1	3

* Totals may exceed number of participants as individuals indicated more than one option as their preference

Table 3:

Leader	Scribe
Mohammad Tayyaram, City of Ottawa	Monica Bailey, PACE

Discussion and Questions

Option 1 - Bus only tunnel
- lowest capital cost
- highest operating cost

Option 2 - Bus and LRT tunnel
- electric O-Train
- highest capital cost

Option 3 - LRT-only tunnel
- Transfer from bus to LRT to downtown
- Eliminate buses downtown??
  - → Yes, but local services will run

Option 4 - O-Train replaced with LRT
- Second highest capital cost
- Lowest operating cost

Option 4
- O-Train conversion can wait
- O-Train extended to Airport. Strong Destination
- Airport destination = single train without stop
- Train and bus station should be closely integrated
- Inter-modal integration very relevant
- Land-use planning critical for transit planning
- Multi-use stations
- Do not split up modes of transports – create park-and-rides and station stops as multi-use modal areas

Option 4 – Costs
- Other level of the governments need to be approached
- Do we do this Piecemeal? Yes
- Option 3 could be done and then option 4 could be achieved with more funding

Option 4/3 – Good

- Buses do not make sense
- Staff and vehicle maintenance is costly
- Buses unreliable during winter

Option 4

- Bayshore transfer point = extension possible
- Station LRT plans
  - Fare = subway style
- Bus plans:
  - Smart card
  - New technology needed for payment

Better service to South
Will there be problems with service during construction?

- Some interruptions – shift buses to one lane

Will putting rail on same bus lane cause buses to change roads?

- Yes. LRT and bus could share same converted road

Old rail line should be used

Option 3

- O-Train could go across river
- Integration with STO
  - NCC, City of Ottawa, City of Gatineau and STO = study of integration of LRT/bus

Explain train cars:

- 4-car trains => walk-through to each car to keep people moving and comfortable

Locate route => transfers

- Increase park-and-rides
- Transfers no problem as long as quick reliable service is available at Transitway (or LRT station)
- Do local buses go to LRT HUB or is there another spoke for buses to take you to LRT HUB? => Local bus to bus spoke to LRT spoke?
  - Still needs to be worked on but possibility of local bus to LRT spoke

Difference between Express and BRT transit

- Express direct from Orleans to downtown on BRT
- BRT = exclusive right of way – fewer steps
- Express also have their own dedicated lanes

**All agreed rail based is best
Bus problems:

- Loading and unloading
- Cramped
- Bus should be fuller-system to take far to Main HUB
  - HUB should move many in great numbers in quick time

- Bus is not well integrated with buildings (i.e., St-Laurent LRT could be integrated well)

Train: How likely will train break down?

- Not likely. In emergency what would happen?

Bronson-Nicholas = free LRT in downtown core

- Is this possible?
- Would make downtown pedestrian-friendly
- Can we make pedestrian tunnels through downtown?
  - Downtown parking lots (underground) could become connected

**Whichever option is chosen we must make sure people choose transit over cars! People need to know the benefits of transit as being comfort, cost, time and speed

Construction date?

- 2014 / 2015 earliest

Mayor's Task Force:

- Congress Centre
- Old train station

Is there a corridor that is protected and able to extend/increase for LRT at Richmond road?

- City is going to make use of corridors that are available as it is a cost savings

Wrap up

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Option 1	**Option 2**	**Option 3**	**Option 4**
0	0	All	All

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Table 4:

Leader	Scribe
Ronald Fournier, Delcan	Greg Jodouin, PACE

Discussion and Questions

Question 1:

Option #3

- No longer feasible to have express buses
- Train can take more people

Option #4

- Encouraged by whole process
- Cost aside, like #4 for convenience
- Doesn't think population justifies LRT past Greenboro station (airport has no volume). Rather extend South from Baseline station
- Less interested in Supplying Gatineau with any service

- Wants LRT
- For #2, likes option of giving E-W residents only 1 bus to downtown (no transfers for them)
- Most robust solution
- Would eliminate many buses
- Should complete LRT loop in the South Cover Bridge and back up to Baseline **OR** take advantage of Richmond/Smith VIA Rail corridor to have LRT from VIA station to Fallowfield VIA station
- Likes airport spur (as with other G8 cities)
- BRT needs to be built such that it can be converted to LRT in future
- Prefer to see LRT from Baseline station to Fallowfield

No preference

- Vision for Ottawa isn't clear so it's hard to plan a transit system. Do we want to be a big city or a capital city?
- What will our destiny be?

Doesn't like any. All blue lines should be LRT (people don't like buses)

Question 2:

- Make system affordable to encourage transit (i.e., add a transit line to tax bill and make fares free. Roll into property taxes)
- Can we not use more existing rail lines in system for commuter rail (similar to Go-Train)
- Wants electric LRT
- More of the blue lines should be LRT – doesn't want to transfer, no more than once
- Encourage density – reduce urban sprawl
- Need service to Gatineau
- What about inter-provincial bridge?
- Convert existing Transitway to LRT

Appendix II
Stakeholder Focus Group Notes

Industry Voices

Date: Tuesday, March 4th
Location: City Hall, Billings Room
Time: 9:30 – 11:30 a.m.

Presenter:
Colin Simpson, City of Ottawa

Experts:
Denis Callan, McCormick Rankin
David Hopper, Delcan Corporation

Industry Voices:
Ottawa Central Railway
Citizens for Safe Cycling

Question 1: Which downtown rapid transit option do you prefer? Why?

- Option 4 is the best option as it allows for future growth and considers environmental issues
- In the future rail should go further west and east
- Rationale behind liking Option 4 is because LRT moves people quickly for less money
- Tunney's Pasture should be considered

Question 2: Are there other features you would like to see included?

- Using the existing rail bridge to Gatineau
- Train Yards - Walkley yard – it's a brownfield so you're not taking greenspace out

Comments:

- Option 4 best option
- Future growth with rail is a benefit
- LRT moves people quickly and is cheaper
- Inter-provincial support is needed for STO problem
- Public buy-in is important – market the options well
    - Public must be aware of the costs, and why there is a benefit to moving this city to LRT. Transfers should not cause concern and this issue must be properly expressed and addressed to the public

Downtown Voices

Date: Wednesday, March 5th
Location: City Hall, Billings Room
Time: 9:30 – 11:30 A.M.

Presenter:
Colin Simpson, City of Ottawa

Experts:
Denis Callan, McCormick Rankin
David Hopper, Delcan Corporation

Downtown Voices:
Action Sandy Hill
Domicile
Ottawa U
Centertown Citizens Ottawa Corporation
Ottawa Gatineau Hotel Association (Westin)

Question 1: Which downtown rapid transit option do you prefer? Why?

- Option 4 is the best option as it allows for future growth and considers environmental issues
- Hub integration is interesting
- Flexibility with being able to add more rail cars, extending rail lines and seeing multi-modalities integrated

Question 2: Are there other features you would like to see included?

- STO is a problem in the Market area. This must be addressed
- Use existing corridors
- Intensification is good. We must build with intensified land-use in mind. This relieves congestion

Comments:

- Option 4 makes sense
- Intensification is needed as it relieves congestion
- Inter-provincial support is needed for STO problem
- Local service will need improvements.
  - Do not let the local service get left aside while infrastructure is being developed for LRT
- Public buy-in is crucial – market the options well
  - Public will need to understand how the new system will decrease the bus system

- A breakdown of the costs should be given to the public with an explanation on how valuable the 10% savings is in Operating and Maintenance Costs compared to Option 1 (BRT Only). This is crucial

Economic Voices

Date: Wednesday, March 5th
Location: City Hall, Billings Room
Time: 1:30 – 1:30 p.m.

Presenter:
Colin Simpson, City of Ottawa

Experts:
Denis Callan, McCormick Rankin
David Hopper, Delcan Corporation

Economic Voices:
Morrision Hershfield (2 representatives)
City Centre Coalition
Crain Architects
H&R Property
Ottawa International Airport Authority
Hanscomb Ltd
Arnon Corp

Question 1: Which downtown rapid transit option do you prefer? Why?

- Option 4 is the best option because it connects to the airport
- The tunnel is the right thing to alleviate downtown congestion
- Reduced emissions are a real likelihood with this option
- The ability to build economic nodes at the various transit stations, and within the tunnel, allows for a great economic boon for businesses
- O-Train conversion is imperative and must be done before the ridership becomes even greater

Question 2: Are there other features you would like to see included?

- Gatineau connection is needed
- Intensification must become a reality to increase ridership

Comments

- Downtown emphasis is good
- Tunnel is needed
- Build economic nodes within the transfer areas
- Inter-provincial support is needed for STO problem

- Public buy-in is important – market the options well
- Properly express what the costs are
- People have a disconnect when thinking about buying something that appears to be so far into the future
- The business case must be sold to business owners
- Intensification is necessary

Appendix III
Internal and External Agency Meeting Minutes

Internal Agency Meeting

Minutes of Meeting

Project: Ottawa Transportation Master Plan Update
Progress: Meeting Number 2
File No.: 6939-702.3

Date: March 7, 2008
Place: Ottawa City Hall – Richmond Room

Present:	Steven Boyle	City of Ottawa
	Peter Steacy	McCormick Rankin
	Monica Bailey	PACE Public Affairs & Community Engagement
Participants:	Kerry Gavan	PWS – Fleet Services
	Douglas Bowron	TPO – Safety and Traffic Services
	Ian Scott	Economic Development
	Darrell Cox	Economic Development
	Chris Cope	Economic Development
	Glen Emond	RPAM – CAM
	Dave Donaldson	RPAM – RESD
	Gord MacNair	RPAM – RESD
	Gary O'Conner	Surface Operations
	Amira Shehata	IAD

Purpose: Agency Consultation group (Internal Agencies)
Information session about work to date, and a presentation on the four Downtown Network Options and the implications the options will have on the outlying areas.

Proceedings

The following is an overview on the presentation "Downtown Transit Development & Network Implications" presented by Steven Boyle, City of Ottawa.

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- 2007-2009: 5-year OP Review, TMP Update

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- Nov 2007: Council's 4 key priorities for transit

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- Dedicated, grade-separated corridors, protection for future conversion to rail
- "Outside → In" approach
  - 4 grade-separated corridors from suburbs to downtown
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- 34 km of Transitway (BRT), 8 km of LRT lanes
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- Transit trips per capita: 120
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Requirements

- New growth projections (1.136M by 2031) – complete review of Growth from 2001 which was overestimated. The new projections are 5% less than what was projected for 2021, and the tech boom (and bust) have certainly affected these numbers
- 2005 Origin-Destination Survey ($1M) – This survey will be done by technical staff with the City of Ottawa, City of Gatineau, both provincial governments, and the NCC
- 2006 Commercial Vehicle Survey ($80k)
- TRANS model redevelopment ($400k)
- Transportation Visioning – consultation – (an overview on the Phase I Consultation events: Streeter Survey, White Papers and Ottawa Talks)

Deliverables

- Policies, targets
- Transportation Network
- Costs, Implementation Plan

Public Comments – Vision, Issues

- 85% of public is satisfied with the existing networks. Many people said that they would be willing to transfer as long as the service was frequent, reliable and comfortable. Transfer stations also have to provide comfortable amenities
- Convenient, reliable transit system
- Transfers are acceptable provided that service is frequent and waiting area is pleasant
- More park-&-ride lots
- Variety of opinions regarding technology
- Strong interest in a downtown tunnel
- Care for the environment
- Affordable

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- 181, 300 employment growth
- 80% of population growth will occur outside Greenbelt. A high percentage of employment is inside the greenbelt and downtown

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- Downtown, 54% today must reach 67% in 2031 – this translates to: every two out of three people would be taking transit

Transit Ridership (per Capita)

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- Main Issues
  - Need to address capacity through the downtown – Cars avoid the MacKenzie King bridge because of the heavy congestion of buses
  - Need to expand current rapid transit coverage

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Different zones become a part of the picture. There is flow from suburban to suburban reaching the required Travel Desire Line of 1,700 + trips/hour

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- East 11,300/hr
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- Option based on accommodating 16,000 – 29,000 if we accommodate STO (This is per hour)
- Bus Option: We would be looking at 535 buses/hr which would not permit pedestrian crossings! The maximum number of buses has been achieved on Albert and Slater already at 180/hr.
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Alternatives for Serving the Downtown

- Surface
- Grade-separated
- Combination

Surface Options

- Based on the numbers of population expected to take transit, this would not be possible and doesn't permit for further growth on the surface

Bus
LRT
Combination Bus & LRT
Conclusion: Not recommended
High volume of vehicles
Growth capacity issues
Size of LRT vehicles cannot be accommodated
Physical limitation of the surface environment

Grade-Separated Options

- Elevated – this is not recommended because of: available right of way, would not be sufficient with station location, would be a visual distraction, weather would cause a problem and there would be emergency vehicle disruption.
- Deep Tunnel
  - BRT Tunnel
  - BRT-LRT Tunnel
  - LRT Tunnel
  - Combination (Surface & Tunnel operation)
  - Conclusion: Deep Tunnel & Combination (interim or ultimate)

Downtown Rapid Transit Network Options

- The tunnel would run from LeBreton Flats to the University of Ottawa but this will be determined during the EA process
- Bus Tunnel (O-Train) - O-Train stays the same. Least number of transfers (Express service would stay), STO Option includes a second tunnel, a wider tunnel, or STO remains on the surface
- BRT-LRT Tunnel (N-S LRT) – Same as Option 1 except North-South LRT would be built from Riverside South to downtown (with a stop at Ottawa U). A bigger tunnel would be needed to accommodate both BRT and LRT. The Bowsville Rail Yard would be needed.
- Conclusion: Bus congestion would still be an issue
- LRT Tunnel (O-Train; E, W LRT) – Convert Transitway from Blair to Baseline with LRT. One transfer needed to get from suburbs to downtown. Extension to Orleans and Kanata is feasible. O-Train stays the same
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- STO cost is not included in any of the overall costs. STO will be an additional cost within these 4 Options

Mayor's Task Force Report

Compatibility with TMP Approach:

- Address transit network "gap" in downtown
- Address multi-modal needs
- Engage public, agencies, businesses, institutions
- Encourage development that is supportive of sustainable transportation
- Make use of existing assets – Rail corridors and transitway
- Move forward in a fiscally-responsible manner

Peer Review Panel

The Peer Review Panel will report back on their findings at the April 16 Committee Meeting. To assess the reasonableness of the study's assumptions, methodologies, findings and conclusions:

- Alan Jones (Steer Davies Gleave, UK)
- Alan Danaher (Kittelson & Associates Inc. USA)
- Russell Chisholm (Transportation Mgt & Design, USA)
- Glen Leicester (Shirocca Consulting, CANADA)
- Paul Bedford (Paul Bedford & Associates, CANADA)

TMP Consultation Activities

- Mar 3-7: Agency & Public Consultation
- Open Houses:
  - Monday March 3 – East
  - Tuesday March 4 – Central
  - Wednesday March 5 – West
  - Thursday March 6 – South
- Discussion Groups during Open Houses (7 – 8 p.m.)
- Three Stakeholder Focus Groups (Industry, Economic, downtown)
- City Advisory Committees

What is Next?

- Apr 16: Tabling recommended downtown option
- May 21, 28: Committee & Council decisions
- April – Sept: City-wide transit network, Roads, cost
- Sept/Oct: Agency & Public Consultation – The "Gray Arrows" are the secondary transit corridors such as Road Networks, Cycling, and Walking and we will be consulting on these and the costs in the fall.
- Nov: Tabling of draft TMP (and OP)
- Feb 2009: Final TMP (Committee, Council)

Question Period

Q: Would North South Option change if the Greenbelt changed?
A: If Greenbelt changes there are options such as a transit network that runs the line of the Greenbelt. There is a position paper coming out on the Greenbelt and we will see what happens.

Q: Would none of the North-South LRT network go to the East-West?
A: There is operational flexibility and things can change and move.

Q: O-Train could be better used as a commuter rail to avoid cost of changing rail tracks. Option three could extend O-Train and make it a commuter rail.
A: These plans right now are looking at solving the downtown problem.

Q: What is the current service of VIA to Fallowfield?
A: There are six trains in the morning.
Q: Is there a pattern on users in the morning?

A: No. Council asked VIA to provide this service but that hasn't yet started. Sharing the VIA track will be difficult as providing reliable and frequent service cannot be guaranteed on shared tracks.
Q: Is VIA not interested in providing a city service?
A: The conversation has happened but the corridor isn't big enough to accommodate their trains and their service along with our trains and our service.

Q: Is the Peer Review done?
A: The final report will be submitted on April 16th at the Transit and Transportation Committee.

Q: Would Option 4 promote growth in the South?
A: No. In 2031 Barrhaven will not be as big as Orleans is right now. The rates of growth would also depend on where they build the LRT.

Q: If BRT is not expected to come downtown anymore, then why isn't the surface option being considered?
A: There is no room for the platforms on the surface as they would block access points for services like parking, entrances to buildings. The surface option is not being considered because of the physical limitations.

Q: Can't the Ottawa River Parkway be used as a corridor?
A: NCC will be looking into it. The other alternative would be the Richmond corridor.
Q: Would the issue be more visual than noise on the Parkway?
A: Yes, I suspect it is.

Q: Is LRT considered quieter than buses?
A: Yes, particularly during acceleration and stopping.

Q: For Option 3 and 4 would it be a twinned tunnel?
A: Yes.

Q: How many stations would be downtown?
A: This will be looked into during the EA process.

External Agency Meeting

Minutes of Meeting

Project: Ottawa Transportation Master Plan Update
Progress: Meeting Number 2
File No.: 6939-702.3

Date: March 4, 2008
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Present:	Mona Abouhenidy	City of Ottawa
	Steven Boyle	City of Ottawa
	Dennis Callan	McCormick Rankin
	David Hopper	Delcan
	Monica Bailey	PACE Public Affairs & Community Engagement
Participants:	Arto Keklikian	NCC
	Sandra Candow	NCC
	Phil Pawliuk	MTO
	Glenn Higgins	MTO
	Nadia Brescacin	MTO
	Vance Bedore	PWGSC
	Jocelyn Chandler	RVCA
	Carolyn Dunn	Health Canada
	Martin McKay	Transport Canada
	Sandy Schaffhauser	FoTenn (on behalf of CPR)
	Felix Fung	Public Infrastructure Renewal
	Erinn Cunnigham	Transport Canada
	Colin Stacey	Transport Canada
	Gillian Webster	Infrastructure Canada
	Chris Maziarski	Infrastructure Canada
	Carmel Dufour	Société Transport Outaouais

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- May 21, 28: Committee & Council decisions
- April – Sept: City-wide transit network, Roads, cost
- Sept/Oct: Agency & Public Consultation – The "Gray Arrows" are the secondary transit corridors such as Road Networks, Cycling, and Walking and we will be consulting on these and the costs in the fall.
- Nov: Tabling of draft TMP (and OP)
- Feb 2009: Final TMP (Committee, Council)

Question Period

Q: How are you going to rank and weigh all opinions from the Technical Advisory Committee, Staff Recommendations, Peer Review and Public Opinion?
A: We are looking at all comments and so far we have not seen anything blatantly contradictory. The Peer Review has submitted draft comments and their opinions are in line with public opinion.

Q: Will "Grey Areas" (Road Networks) consultation in the fall affect the decision tabled to the City in April?
A: Downtown is the ultimate solution and the spine of the whole network so no the consultations in the fall will not affect the decisions made in the spring.

Q: How long will it take to build a 3 km $600 Million tunnel for LRT and all the stations?
A: Implementation is based on how much money there is to spend to start building the rail tunnel. There is an expectation that it may take 10-15 years to roll it all out.

Q: What do you want from us?
A: We need you to provide your Agency's comments by March 31st on what you think about the four Downtown Rapid Transit Network Options.

Q: Are there any technical reports you can send us?

A: Mona will forward a draft report before the end of the month.

Q: Is there a business case framework you can share?
A: No business case has started since the network hasn't been defined yet. The tunnel is not a detailed estimate, just a unit estimate at $600 Million. It has been over-estimated and we expect to see concrete numbers emerge through the EA process.

Q: Are transfers from BRT to LRT causing people concern?
A: There are speed and added comfort and reliability benefits with the transfer. In all there will be far less congestion and less rider-confusion. So far there has been no penalty perceived from the transfer scenario. In fact there is room for growth and extension further out East, West and South in the future.

Appendix H: Conversion of Transitway To Rail

Primary rapid transit network options 3 and 4 incorporate the conversion of sections of the east and west Transitway to rail operation. This Appendix outlines a possible approach and estimated costs to undertake this conversion.

The need or desire to convert the Transitway to rail was foreseen at the time of its inception. Accordingly, the design criteria established for the Transitway were set to be compatible with rail usage. As such, the horizontal and vertical geometrics, as well as all structural clearances along the Transitway and through station areas, are compatible with LRT technologies.

Approach

The conversion of the Transitway from bus to rail technology needs to consider both station and running way sections. Two basic approaches can be taken for the conversion: relocation of all Transitway services to adjacent transportation facilities thus allowing unimpeded retrofitting of the Transitway; or, maintaining one direction of service within the corridor while staging construction activities within the right-of-way with the use of detours.

The requirements for construction staging will need to be carefully considered during the design stage to balance provision of existing services against the speed and ease of construction. In all likelihood a combination of transit operations on adjacent roads for off peak transit service and staging within the Transitway right-of-way will be required. Construction will require a number of diverse activities including:

- relocation of utilities in conflict with LRT;
- modification of Transitway pavement structure for tracks;
- installation of rail infrastructure;
- installation of the overhead catenary system, power supply and communications, including signal systems;
- modifications to drainage;
- modifications to platforms and stations; and
- testing and commissioning.

Construction duration will be affected by the number of detours and stages required, but it is expected that each segment will be under construction for 2 to 3 years.

Considerations for Transitway Conversion

In order to minimize Transitway service disruption to acceptable levels, the following will be considered.

Running Way Sections

- Where there are wide shoulders or additional lands along the running way, construction activities could be staged using the shoulders of the existing bus lanes or temporary localized widenings;
- If there is little or no extra space alongside the bus lanes, construction would be constrained, and some bus services may have to be relocated; and,
- For a few specific locations, all Transitway service may need to be relocated to allow construction to be completed more quickly and easily, but this would need to be balanced against the ability of the local roads to accommodate services.

Stations

- The long station platforms and generous approaches will allow for the temporary stops to be located outside the work zone;
- Removal of the median barrier will accommodate bus detours within the station during construction;
- Embedding the track in concrete or providing temporary planking for the end stages will accommodate bus service while the conversion is underway and will accommodate emergency services in the final configuration;
- The platform height will be a major consideration depending on whether the selected rail vehicles are low or high floor vehicles. High floor vehicles are incompatible with the current bus boarding areas as well as existing station waiting areas, stairs, escalators and elevators. .Low-floor rail vehicles will reduce but not eliminate platform height issues; and,
- The implementation of rail may also be an opportunity to upgrade stations, which could add to the duration and intensity of construction at each site.

Alternative Service Routes

- For most areas where some service needs to be relocated, a single peak direction Transitway lane may be able to be maintained and off-peak direction buses to be rerouted onto local, parallel streets; and,
- Where the Transitway needs to be completely closed, all Transitway service may need to be relocated to local streets to allow construction to be completed more quickly and easily, but this would need to be balanced against the ability of the local roads to accommodate services.

Construction Staging

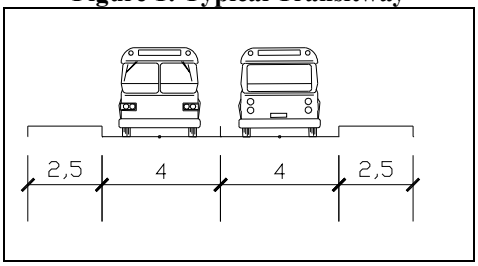
The following demonstrates one possible construction staging methodology that may be employed for running way and station areas. The actual details will have to be developed as part of the design of individual sections and contractors may suggest other alternatives when they bid on construction packages.

Main Line Running Way

Existing Transitway Configuration

- Typically the Transitway right-of-way is comprised of two 4m wide lanes with 2.5m boulevards on either side (Figure 1).

Figure 1: Typical Transitway



Step 1:

- Relocate utilities as required within the right-of-way.
- Remove and pave 2.5m boulevards to accommodate detours (Figure 2)
- Install construction barrier to separate construction zone
- Peak direction bus traffic operates in reconfigured boulevard and existing bus lane
- Off-peak direction bus traffic detoured to adjacent roadways
- Install ballast, ties and track flush with future running surface (Figure 3)
- Install hard running surface within rail area to accommodate buses and emergency vehicle traffic

Step 2:

- Peak direction bus traffic relocated onto newly constructed rail section (Figure 4)
- Off-peak direction bus traffic remains on adjacent roadways
- Install ballast, ties and track flush with future running surface
- Install hard running surface within rail area to accommodate buses and emergency vehicle traffic

Step 3:

- Bus traffic detoured onto paved shoulders during installation of overhead power supply (Figure 5)

Step 4:

- Bus service can run on the retrofitted Transitway until the stations modifications are completed and sufficient rail has been installed to operate the rail service. (Figure 6)

Figure 2: Remove Boulevards

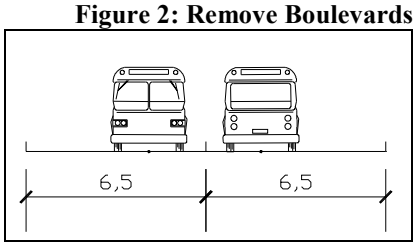


Figure 3: Rail in 1 Direction

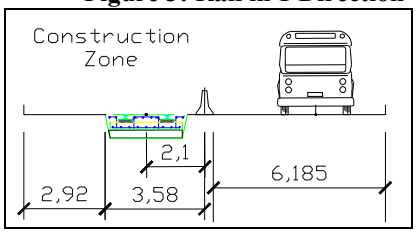


Figure 4: Rail in Other Direction

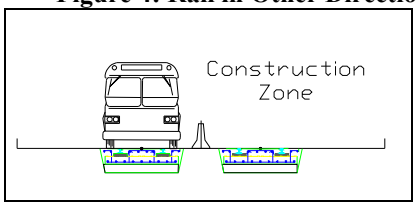


Figure 5: Install Electrical

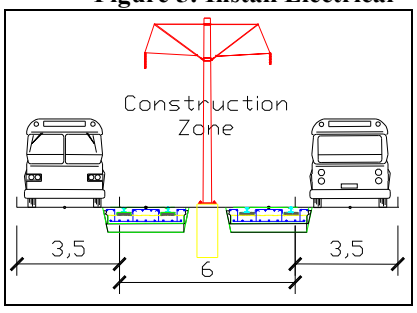
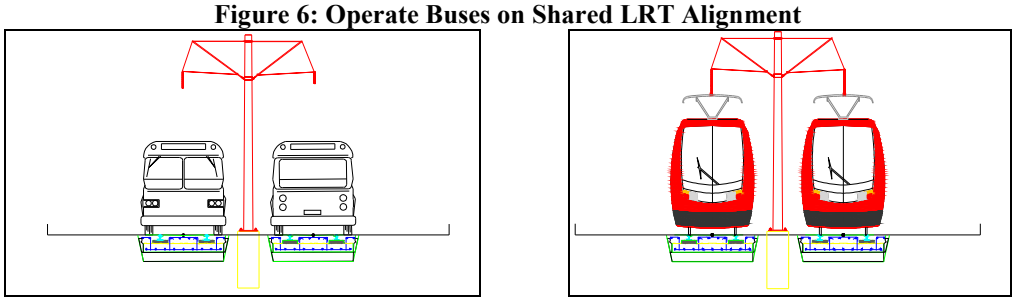


Figure 6: Operate Buses on Shared LRT Alignment

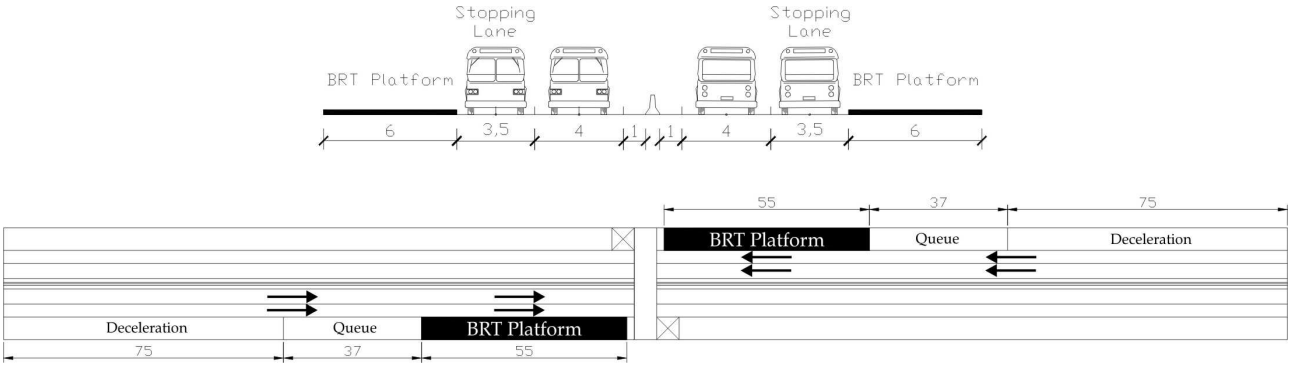


Stations

Existing Station Configuration:

- A typical Transitway station configuration includes 55m BRT Platforms, as well as queuing storage and a deceleration lane.
- Stations also provide for 2 lanes in either direction for buses to pass each other. (Figure 7)

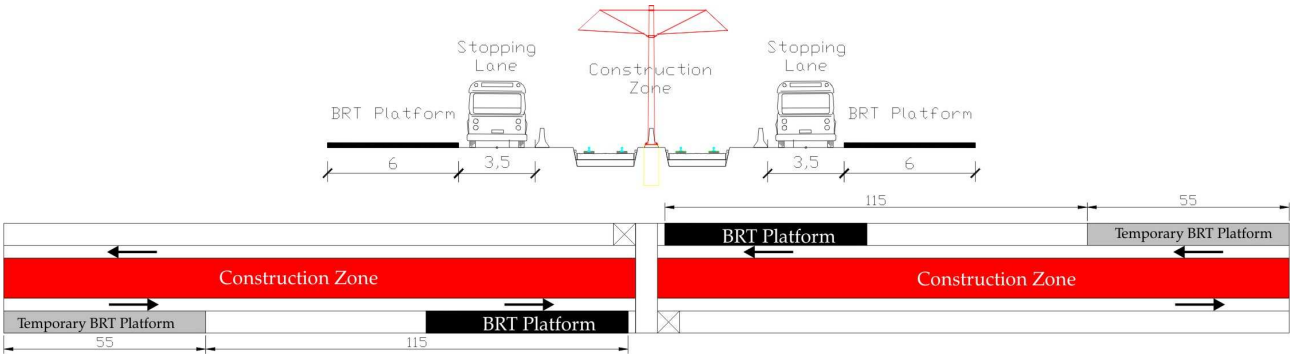
Figure 7: Typical Transitway Station Configuration



Step 1:

- Construct temporary bus platforms so service is outside the station work zone (deceleration zone) with pathway connections to elevators, stairs
- Install rail and Power Source through the platform area as part of running way conversion.

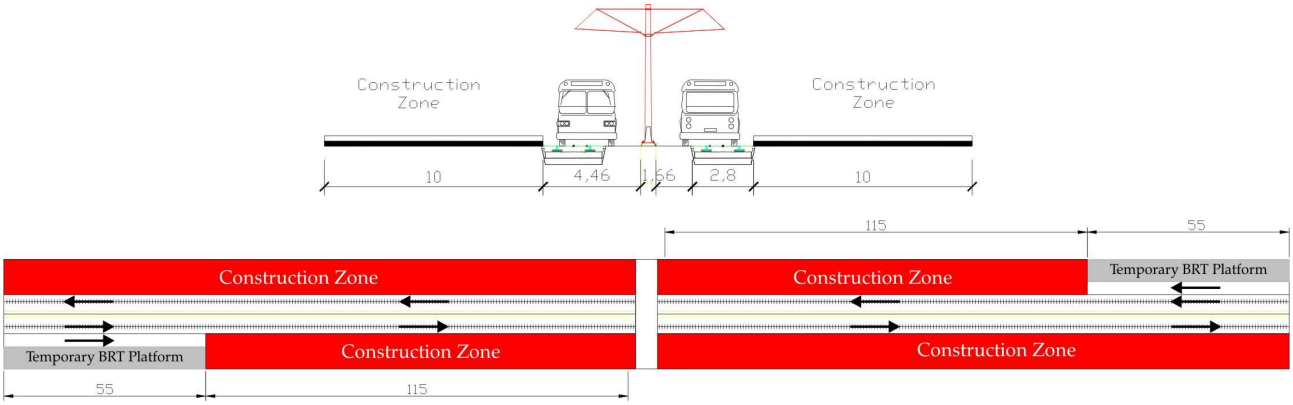
Figure 8: Step 1 – Install Rail through Platform Area



Step 2:

- Remove existing platform furniture, provide temporary passenger information signs
- Construct extended LRT platform on existing 3m bus loading lane to meet rail line

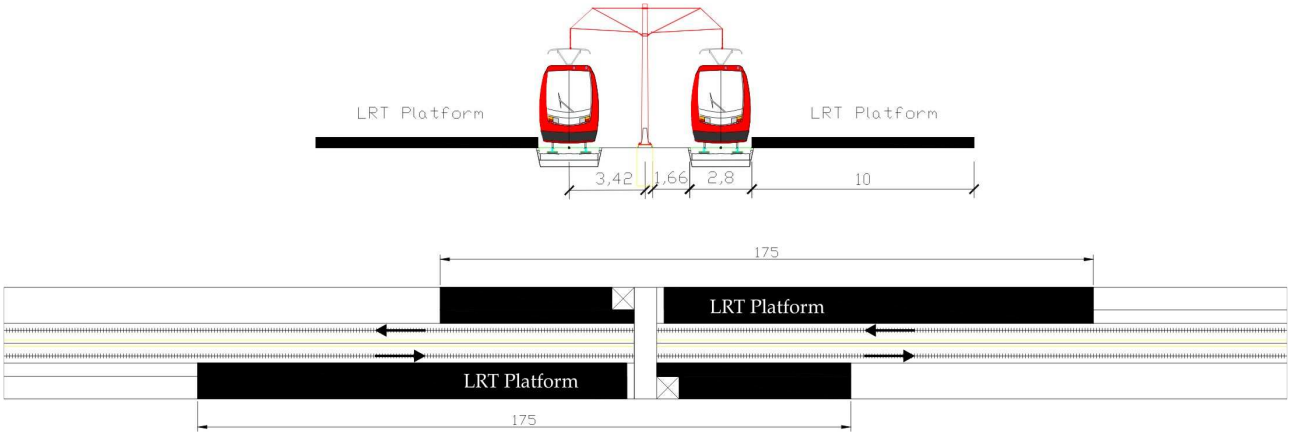
Figure 9: Step 2 – Modify Platforms for LRT



Step 3:

- Modify stairs and elevator access levels as required to match LRT platform elevation
- Reinstate platform furniture, lighting and passenger information signs on LRT platforms

Figure 10: Step 3 – Reinstate Platform Furniture



Transitway Conversion Capital Costs

The estimated costs to convert sections of the existing BRT Transitway to rail presented below include: the cost of retrofitting the road bed; installation of ties and rails; switches; communications; signals and power supply; station modifications; allowance for maintenance and storage facilities; engineering and contingencies. The cost estimates do not include the operating costs for additional buses and temporary transit priority measures required to maintain the desired service level during the retrofit process.

Section of Exclusive Transitway to be Converted to LRT

Dominion to Bayview	3.6 Km	$ 54 M
Campus to Hurdman	2 Km	$ 49 M
Hurdman to Blair	5.3 Km	$ 97 M

The existing Transitway is an exclusive corridor for most of its length with a few sections where buses operate in transit lanes or shared with mixed traffic. All primary network options assume the LRT facility operates in an exclusive corridor for its entire length. Therefore additional exclusive corridors sections will need to be constructed. The following table lists the sections where new exclusive LRT corridors would need to be created.

New Exclusive LRT to be Constructed

Baseline to Lincoln Fields	3 Km	$ 110 M
Lincoln Fields to Dominion	4 Km	$ 71 M