Ottawa Light Rail Transit (OLRT)
Updated Business Case –
Project Benefits Analysis

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1 Background

The Ottawa Light Rail Transit (OLRT) project is the centrepiece of a new investment strategy for public transit in the City of Ottawa. It is the core element of a transportation strategy that can support a more compact form of growth, reduce greenhouse gas emissions, increase mobility for residents and visitors, and dramatically improve the urban environment. A Business Case document for the Ottawa Light Rail Transit (OLRT) was prepared in March 2010.

The Business Case document submitted for the OLRT in March 2010 had incorporated time saving benefits accruing to existing transit riders. Vehicle operating cost savings, accident avoidance benefits and environment benefits were estimated for induced riders to the transit system. However, in that analysis, benefits to auto users due to reduced congestion faced by auto users such as user benefits and environmental resulting from the project could not be estimated since the traffic modelling data availaible at the time did not include estimates of the savings of time travelled and vehicle kilometre travelled (VKT) by auto users due to less congestion forecast to accrue as a result of the OLRT project. Subsequent to the business case submission, these estimates were updated by the City's Transportation Planning Branch.

This supplementary report presents the updated results to our previous work undertaken for the business case for the OLRT project in Ottawa based on the revised traffic modelling data provided by the Transportation Planning Branch of the City of Ottawa. This report presents the analysis updated to 2011 Constant $ and provides an overview of the project benefits and the calculation of economic benefits.

2 Project Benefits

The City of Ottawa's OLRT project will provide many of the objective outcomes identified by the Government of Canada in the Building Canada Fund template, including:

- Improve mobility, reduce travel times and increase safety and efficiency,
- Expand public access and ridership,
- Reduce the growth of GHG and other emissions, and
- Contribute to sustainable municipal development and land-use planning.

Building and widening roads alone, especially in downtown Ottawa, is not a practical or affordable solution to meet the anticipated demands and to support the projected growth on the City's transportation system. By providing greater transportation choice, attracting more riders and adding more capacity to the overall transportation network, the OLRT project will help address existing congestion and aid in preventing even higher levels of congestion in the future. The growth of downtown employment will continue through the ability to increase capacity on transit service in the downtown, primarily on the OLRT line. Riders will see:

2.1 Reduced transit travel times.

The average speed of the LRT system will be higher than the current BRT system primarily because of the downtown tunnel, which will remove the mixed operation through 14 traffic signals along Albert and Slater, reducing conflicts with surface traffic, service vehicles, and pedestrian crossings. Geometric improvements will also contribute.

2.2 Reduced congestion downtown.

The majority of Transitway buses will be removed from the downtown streets allowing for a reallocation of street space through the core to improve the pedestrian and cycling environment. Local bus routes will be adjusted to provide good local coverage.

2.3 More efficient transit operations.

Customers will use off-board fare payment, allowing for more efficient train boarding (as all doors to all trains can be used). Singular routing through the downtown will eliminate current confusion and also reduce wait times as every train is my train.

2.4 Improved levels of comfort and convenience.

Customers will have a weather-protected environment, with access to more amenities than exist at current Transitway stations. Real-time train information, improved lighting, public address and dynamic information displays will help transit riders navigate the system more easily.

The OLRT project will also allow for redevelopment and transit-integrated development along its route. This will help the City achieve its targets for increased intensification and the protection of agricultural and sensitive environmental areas against urban expansion pressure.

2.5 Increased transit ridership.

By 2018 with projected growth, the capacity of current Transitway system will reach its limit in the westbound direction towards downtown in the morning peak period. The OLRT project will provide a substantial increase in carrying capacity through the core and is expected to contribute to significant ridership increases. Ridership estimates indicate that the total system ridership will increase from 93 million in 2005 to 164 million trips per annum by 2031:

- Current ridership on the Tunney's Pasture to Blair portion of the Transitway totals 39 million. This ridership on the OLRT corridor is expected to grow in the future to 51 million trips in 2021 and 76 million trips in 2031;
- Estimates from the OC Transpo Rapid Transit Network Operation Review indicate that the current network, including the existing Transitways can carry a maximum of 132 million annual trips. The growth in system ridership beyond 132 million annual trips is the result of the infrastructure investment in the OLRT project. This translates into 34 million new trips per year in 2031 (as a result of the additional capacity to be provided by the OLRT as well as due to the attractiveness of LRT over BRT);
- Cumulative 156 million new trips between an opening in 2018 and 2031;
- More than 40% of all transit trips taken in the City will use the OLRT project for all or part of their journey; and
- The downtown stations currently handle the largest number of annual trips, and represent the most congested section of the existing Transitway. Annual ridership through the four downtown stations is expected to increase from 25 million to 50 million annual trips by 2031, representing 65% of the ridership on the line. These riders will see the largest benefits from the OLRT project due to travel time saving and improvements in reliability, comfort and convenience.

2.6 Reduced Emissions of Air Pollutants and Greenhouse Gases

Greenhouse gas emissions are reduced by transit projects in several ways. First, by replacing diesel fuelled bus trips with electrified LRT, emissions from transit vehicles themselves are reduced. Secondly and more significantly in terms of the total amount of emissions reduced, trips made by private cars are replaced by transit trips, resulting in a substantial reduction in greenhouse gas emissions per kilometer.

Preliminary forecasts indicate that the OLRT project will generate considerable greenhouse gas emission savings compared to the base case scenario, where ridership growth will be constrained by capacity. The project is forecast to reduce carbon dioxide emissions by approximately 94,000 tonnes in 2031. It will also reduce criteria air contaminant emissions by approximately 4,600 tonnes in the same year.

2.7 Improved Mobility

The OLRT project will be complemented by a number of other projects that are part of the TMP. New sections of Transitway and transit priority measures will allow service to operate at reduced travel times as compared to operations on city streets.

The OLRT project will allow for improved travel from many parts of the City, speeding journey times into and out of the core. The number of stations in the core will provide a similar level of service as the existing transitway, with improved connections to the Byward Market, north Elgin Street, LeBreton Flats and services to Gatineau. The reductions in bus service through the core will also allow for local routes to better accommodate demand and connect to all points in the core. Pressure along Wellington can also be relieved providing improved operational opportunities for STO services.

Planned improvements in accessibility and the potential to link station accesses directly to adjacent buildings will provide increased mobility in poor weather conditions. These types of connections have proven to be beneficial in other cities.

2.8 Travel Time Savings

2.8.1 Travel Time Saving for Transit Riders

The current Transitway provides a high quality of service, except in the downtown core where on-street operations reduce both speed and reliability. Today buses travel along Albert and Slater and pass through 14 signalized intersections. The removal of this operational constraint is the major improvement in speed, and results in substantial time savings for the transit traveller.

The majority of the 51 million trips in 2021 and 76 million trips in 2031 will experience time savings; a total time savings of 2.3 million hours as a result of the operational improvements is projected for 2031. Customers who travel across the core will experience the largest time savings.

As important as travel time savings is the improvement in reliability. Service is currently scheduled at 17 minutes to cross the downtown (between LeBreton and Hurdman), but regularly exceeds that by 5-10 minutes. More regular service will allow riders to plan for shorter journeys without the need to allocate time for potential delays.

In addition to actual in-vehicle time there are other potential time savings from off-board fare collection, accessing trains from all doors and taking the first train for their trip (rather than waiting for specific bus routes).

It is estimated that the the total travel time saving for transit riders to be 2.3 million hours in 2031.

2.8.2 Travel Time Saving for Auto Users

The City's Transportation Planning Branch undertook an additional modelling analysis which calculated that the OLRT project would result in 13,750 fewer vehicles on the road as compared to without OLRT scenario leading to a saving of 9,600 person hours in the am peak and converted to over 15 million hours in 2031.

As a result of OLRT project the total time saving for both auto users (drivers and passengers) and transit riders is estimated to be over 17 million hours in 2031.

2.9 Reduced Vehicle Kilometres Travelled (VKT) by Auto Users

The City's updated modelling analysis calculated that the OLRT project would result in 13,750 fewer vehicles on the road leading to a saving of 232,700 VKT in 2031 during the morning peak hours. In order to arrive at the annual VKT values from the 2031 figures provided by the City, VKT is assumed to escalate on a linear basis starting at zero in 2022 and will reach at 232,700 VKT in 2031; and the annual VKT is assumed to continue to grow at the same linear rate through the analysis period to 2039.

2.10 Economic Development

The OLRT project will contribute to the regeneration of the economy of the Central Area and the creation of new jobs or increased employment in the following ways:

- Jobs associated with constructing, operating and maintaining the LRT system;
- Jobs arising as a result of the improved travel conditions in the downtown and at stations along the line; and
- Increased employment in the downtown core, where offices can be more effectively serviced.

Using standard economic impact modelling (input-output modelling), the multiple account evaluation estimated the employment that will be generated by the construction of the project. The total amount of direct, indirect, and imputed employment generated associated with the investment is just over 20,000 person-years.

From an employer's perspective, what matters is the accessibility of a given location, and how the OLRT project makes that location more or less attractive for the expansion of an existing business or the establishment of a new one. These factors include:

- Access to a suitable workforce living within acceptable travel times and costs;
- Access to or by customers;
- Access to or by suppliers.

For these reasons, the improved access to station areas will promote intensification and the clustering of higher density employment uses. Consistent with the City's growth management objectives, the increased access to employment should also result in more of the City's residents choosing to travel to work by transit.

3 Calculation of Economic Benefits

The assessment of the economic benefits of the project has been undertaken using a Multiple Account Evaluation (MAE) approach. MAE provides decision-makers with a broader representation of the project's benefits by allowing the consideration of factors that could not be considered in a traditional cost-benefit analysis. The structuring of metrics into a series of separate accounts allows for a relative assessment of the project's impacts on different aspects of the economy and society.

The MAE is prepared by comparing a project case against a base case over an analysis period, on a present value basis. In the project case, the OLRT is assumed to be constructed with the light rail service assumed to be in operation in 2019 for first full year. The base case assumes the existing Transitway service continues, and capacity limitations begin to restrict ridership growth within the forecast period. The analysis period for the MAE is thirty years (2010 to 2040). All costs and benefits are expressed in 2011 constant dollars. The discount rate is 5% (for constant dollar analysis and consistent with the discount being used by MTO to evaluate transit projects). The detailed MAE report is attached as Appendix A.

The conduct of the economic analysis is based on assembling existing data as inputs. The inputs and assumptions used are drawn from various sources, and have not been independently audited or verified prior to their use in the MAE.

The estimated travel time savings is derived from transit risers having a faster average trip than the current system provides. Further, we note that all findings are based on ridership data provided by the City's TRANS model.

3.1 Transportation User Benefits

This account summarizes economic benefits accruing to users of the transportation system in terms of travel time savings, vehicle operating cost savings and accident avoidance savings.

Ridership forecasts for the LRT indicate 51 million riders in 2021, rising to 76 million riders by 2031. The new riders, i.e., riders that will be induced from auto to transit, was derived as a residual of the projected riders on the OC Transpo system with the project in place and the total capacity of the OC Transpo system without the project in place, which would reach a fixed capacity of 132 million riders within the next approximately 10 years.

3.1.1 Travel Time Savings

Transit projects typically produce travel time savings in two ways; first, by increasing the speed of travel for transit passengers; secondly, by shifting some travel from cars to transit, which in turn relieves road congestion in the transit corridor. The travel time for transit was estimated from the average trip length of 5.2 km. Travel time savings for existing riders accrue due to the improved speed with the project in place, allowing average transit speeds in the corridor to increase from existing 27 kph to 35 kph.

The City of Ottawa's Transportation Planning Branch undertook an estimate of travel time savings accruing as a result of reduced congestion on the road network as OLRT project. Increased ridership on to transit results in reduced number of buses and cars from the road network resulting in reduced congestion faced by auto users.

The total saving in hours for the study period was converted to monetary terms by multiplying the total savings with the average value of travel time for Ottawa. The metric is reported as the monetary value of these savings.

3.1.2 Vehicle Operating Cost Savings

This metric is a calculation of the operating costs avoided for car owners who travel by transit instead. The calculation is the product of vehicle kilometres travelled (VKT), and the costs per kilometre of operating a standard four-door sedan. The metric is reported as the monetary value of these savings.

3.1.3 Accident Avoidance Savings

This metric represents the savings to society resulting from the road accidents avoided through modal shift to transit. The calculation is performed using incident factors for accidents per vehicle kilometre, typical costs of fatal, injury, and property accidents, and the number of vehicle kilometres avoided. The metric is reported as the net present value of the monetary value of these savings for the full 30-year analysis period.

3.1.4 Analysis of Transportation User Benefits

Travel time savings have been reported in two ways: annual minutes saved, and the monetary value of these savings. Travel time savings for the OLRT project indicates that a total of over 2.3 billion hours are saved by the transit users in comparison to the time they may have taken when travelling by the existing transit service. Due to decreased congestion, auto users save 15 million hours in 2031. Once monetized over 30 years, these savings are equivalent to an estimated benefit of over $1.5 billion in present value for the Ottawa and area economy.

Vehicle Operating Cost savings are a function of the number of riders on transit, which in turn affects the number of vehicle kilometres travelled (VKT) on the network. The vehicle operating cost savings are estimated to be over $1.1 billion over 30 years. Accident avoidance savings are also a result of reduced vehicle kilometres travelled (VKT) due to trips being taken by transit instead, this accounts for an additional savings of nearly $400 million. The results are a total user benefit of over $3.0 billion in present value over the 30-year analysis period.

Transportation User Benefits Account		
Travel Time Savings	Hours, 2031	17,370,048
Travel Time Savings	$(NPV)	$1,509,706,658
Vehicle Operating Cost Savings	$(NPV)	$1,107,014,855
Accident Avoidance Savings	Fatal/Injury/Property, $(NPV)	$399,826,047
Summary Metric: NPV of Annual Benefits		**$3,016,547,560**

3.2 Environmental Benefits

3.2.1 Greenhouse Gas Reductions

Studies have shown that the transportation sector is a significant contributor of GHG emissions. Within this sector, automobiles are a significant source of emissions. GHG emissions are reduced by the OLRT project by shifting travel from cars to rapid transit. In this analysis, the reduction in vehicle kilometres travelled formed the basis for the reduction in emissions. Greenhouse gas emissions were estimated from the Urban Transport Emissions Calculator (UTEC). The volume of GHG emission savings is reported in tonnes per year for a typical year (2031).

3.2.2 Criteria Air Contaminants

Criteria Air Contaminants (CAC's) are pollutants with a variety of impacts on the natural environmental and human health. These are associated with vehicle emissions and as such, are also a function of vehicle kilometres travelled, as forecast by the transportation model. The CAC emissions calculated by the UTEC model are volatile organic compounds (VOC), nitrous oxides (NOx), sulphur oxides (SOx), and particulate matter (PM).

Results

The greenhouse gas emission reductions and their monetary value (NPV), and the CAC reductions and their monetary values in (NPV), are reported in the table below.

Environmental Account		
GhG Emissions Savings	Tonnes/Year, 2031	93,908
Value of GhG Emissions Savings	$ (NPV)	$24,532,689
Critical Air Contaminants (CAC) Emissions Savings	Tonnes/Year,2031	4,592
Critical Air Contaminants (CAC) Emissions Savings	$ (NPV)	$11,867,918
Summary Metric: NPV of Annual Benefits	**$ NPV**	**$36,400,607**

3.3 Economic Development Account

Investment in downtown Ottawa Light Rail Transit Project and its ancillary projects can create spinoff impacts for Ottawa's economy. The effect of spending money on public transportation creates immediate jobs and income by supporting manufacturing, construction and public transportation operation activities.

For this analysis, input – output multipliers obtained from Statistics Canada were used to obtain the direct and indirect job impacts of the OLRT investment. The output produced by the investment has also been estimated with the use of these multipliers.

The economic impact of the investment is outlined on the table below. The analysis indicates that this investment results in creation of over 20,000 person-years of employment, and total output of some $3.3 billion.

Economic Development Account		
Output Generated	$	$3,341,424,516
Employment Generated (Incremental)	Direct, Indirect, Induced jobs	20,724
Taxes Generated (Incremental)	$	$148,804,418

Appendix A – Multiple Account Evaluation

This appendix outlines a summary of data sources and assumptions used to generate values for the inputs required for each account for the purpose of MAE modelling. The inputs include general inputs, which include assumptions about broader economic indicators and relevant rates and indicators, as well as ridership and traffic inputs that are used in calculations in many accounts. Account-related inputs are specific to individual metrics in the MAE modelling.

The inputs can be grouped under the following categories:

- General Assumptions
- Ridership and Traffic Projections
- Direct Project and Transportation Account
- Direct Transportation User Benefits Account
- Environmental Account
- Land Use/Economic Development Account

A discussion of the sources of data and associated assumptions in each category follows below.

3.4 General Assumptions

The general assumptions include several variables that impact all calculations in the analysis. A 30 year analysis period was used for the analysis, in conformity with typical infrastructure investment analyses. Based on the current core inflation rates, an inflation rate of 1.5% was used for projecting the various inputs into 2011$. This was held constant across all inputs.

The investment start year is 2011. The first full year of operation is 2019, following the anticipated completion of construction by that year.

A discounted cash flow model was developed to provide comparisons of the base case to the project case on a net present value basis. The base case and project case were evaluated at a 5% real discount rate (for constant dollar analysis) over a 30-year period (2011-2040). This analysis assumed that the residual values calculated at the end of the evaluation period were zero and salvage value has not been estimated.

3.5 Ridership and Traffic Projections

3.5.1 Ridership Projections

The City's Transportation Planning Branch modelling analysis also estimated that the transit ridership from the east would be capped at the 2018 level and from the west at the 2027 level (without OLRT). For the purpose of this analysis, city-wide congestion relief is assumed to start in 2022.

3.5.2 Traffic Projections

Traffic data is used to determine the impact of transit on the environment as a result of the shift of some trips to transit. For the purposes of MAE analysis, figures for annual traffic estimates were derived from the estimates of total new ridership generated assuming an average auto occupancy of 1.2, and the average trip length on the LRT system of 5.2 kilometers. However, as traffic modelling was not available for the post-transit and pre-transit condition, travel time benefits that may result from the reduction in congestion resulting from

the OLRT project were not calculated. This could represent an understatement of the overall travel time benefits.

3.6 Direct Project and Transportation Account:

Direct project cost refers to the cost to the infrastructure provider of the project being evaluated. The cost estimates included capital costs and annual operating/maintenance costs.

3.6.1 Capital Costs

Capital cost estimates were provided for the project scenario by Delcan Consultants, at current 2009 prices, as part of the analysis completed for the City in 2010. These were updated to 2011 prices. To obtain present value estimates these cost streams were discounted at 5% to the current year.

3.6.2 Operating and Maintenance Costs.

Based on OC Transpo estimates, the project will result in annual operating costs savings of 9.6 million, at current 2009. These were updated to 2011 prices. The present values of these estimates were also estimated by discounting the cost stream at 5%.

3.7 Direct Transportation User Benefits Account

3.7.1 Travel Time

For this project, the travel time savings that will accrue to transit riders due to improved service speeds have been estimated. It is assumed that the operating speed would increase from 27 km per hour currently to 35 km per hour in the project case for the average trip length of 5.2 km. This benefit was quantified in monetary terms, based on the value of travel time for Ottawa at $12.75 per hour in 2006 from a recent Transport Canada study, Value of Time and Reliability for Local Trips in Canada, March 2008. These values were escalated to the 2011 level by applying the rate of inflation and estimated at $13.74 per hour.

3.7.2 Vehicle Operating Costs

Total vehicle operating costs were estimated by multiplying per kilometre costs for vehicle operating expenses, with the additional vehicle kilometres travelled by automobiles in the absence of the project (ie. without the modal shift that will result from the project).

According to Canadian Automobile Association (CAA) estimates, the average costs to operate a typical four-door sedan driven 18,000 km annually was 49.7 cents per kilometre in 2009, these were inflated to 2011 values. This cost included variable operating costs including fuel and oil as well as fixed ownership costs such as insurance, licence fees, registration fees, taxes, finance costs, and depreciation.

3.7.3 Accident Costs

Incident rate for accidents is directly related to the number of vehicle kilometres travelled. In order to estimate the average cost of accidents for each scenario, the incident rate in Ontario was multiplied by the average cost of accidents and the total automobile VKT.

For the purpose of this analysis the incident rate of accidents in Ontario was multiplied by the average cost of accidents and the total automobile vehicle kilometres travelled (VKT).

Accident incidents can be categorised into fatal accidents, injury only, and property damage incidents. The values of average cost of these accidents and average incident rate for accidents are outlined below. The cost data was available for 2004 and was inflated to 2011 values.

Average Cost of Accident by Collision Severity (2004$)

Fatal Collisions	$15,700,000
Injury only	$ 82,000
Property damage only	$ 8,000

Source: Transport Canada Accidents Analysis and Estimation of the Social Cost of Motor Vehicle Collisions in Ontario. *http://www.tc.gc.ca/roadsafety/tp/tp14800/pdf/TP14800E.pdf*.

Rate of Incidence Accidents by Collision Severity

Incidence Rates per Billion VKT:

Fatal Collisions	8.9
Injury Only	604
Property Damage Only	3670

Source: *Canadian Motor Vehicle Traffic Collision Statistics: 2006*.

3.8 Environmental Costs

Urban transportation is a major contributor of Green House Gases (GhG) and Criteria Air Contaminants (CAC). Changes in emissions affect ambient air quality and related environmental impacts.

In order to estimate the environmental impacts the underlying assumption is that reduction in GHG and CAC emissions will result primarily from the number of cars taken off the road as a result of increased transit ridership.

For this analysis, data for the emissions in the base case scenario, as well as the project scenarios, was estimated using the Urban Transportation Emission Calculator (UTEC) model from Transport Canada. For estimating the monetary impacts, the average emission costs by pollutant are detailed below.

3.8.1 Green House Gas Emissions

According to a Transport Canada study, unit cost of GhG emissions is estimated at $37.38 per tonne of CO2 equivalent. This value was updated by applying inflation to get current values for the analysis year.

3.8.2 Critical Air Contaminants

The unit costs of air pollution by pollutant emitted has been estimated by Transport Canada in a 2007 study entitled Total Cost of Air Pollution Due to Transportation in Canada, which are:

Unit Cost of Air Pollutant Emitted (Ontario)

Pollutant	Unit Cost per tonne
VOC	$877
Nox	$5,940
SO2	$6,520
PM10	$28,600

Source: *Transport Canada, Total Cost of Air Pollution Due to Transportation in Canada, 2007*.

These values were in 2000$ and were updated by applying the inflation rate of 1.5% to get the values in 2011$.

3.9 Economic Development Account

3.9.1 Employment Generated, Output Generated, Taxation Revenue

Economic impact analysis was undertaken using Ottawa-based input-output multipliers relating to the transportation sector for the investment proposed for the OLRT project. The output provided estimates of the direct and indirect employment impacts of the capital investment in Ottawa. The input-output analysis also includes economic output generated in dollar terms, and an estimate of taxation revenue generated.