The Big Move: Transforming Transportation in the Greater Toronto and Hamilton Area
Modelling and measuring against the triple bottom line

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Paper prepared for Best Practices in Urban Transportation Planning: Measuring Change Session

2009 Annual Conference of the Transportation Association of Canada
Vancouver, British Columbia
October 2009

Acknowledgements: *Metrolinx wishes to acknowledge the invaluable contribution of IBI Group in the preparation of the modelling work in support of the Big Move and of in the drafting of the modelling sections of this paper.*

Abstract:

In November 2008, Metrolinx - the transportation authority for the Greater Toronto and Hamilton Area - released its 25-year regional transportation plan: The Big Move. The Big Move adopts the “triple bottom line” of a high quality of life, a protected environment and a prosperous economy as its foundational basis. The triple bottom line is used to inform the development and measurement of a comprehensive vision, goals and objectives for the regional transportation system, and to model and analyse system performance and implementation options.

This paper describes the process followed by Metrolinx to develop the goals and objectives for the regional transportation plan and the metrics that will be used to measure its implementation. The paper provides an in depth overview of the technical modelling and system performance analysis undertaken to support the development of the plan. The paper describes the way in which an iterative process of stakeholder input and technical analysis were used together to select a recommended regional rapid transit network. Finally, the paper provides an overview of the Benefits Case Analysis that Metrolinx is using to select and prioritize project implementation options based on the triple bottom line.

1.0 Introduction

Metrolinx is the regional transportation authority for the Greater Toronto and Hamilton Area (GTHA). Metrolinx was established in 2006 as an agency of the Ministry of Transportation of Ontario. It is governed by a board of directors appointed by the provincial government.

This technical paper discusses the development process for the regional transportation plan (RTP) for the GTHA and the way in which transportation modeling and transportation system performance measures based on a "triple bottom line" were used in the development of the plan and in further planning work to implement the plan. This paper outlines how system performance measures for quality of life, the environment and the economy were developed based on the vision, goals and objectives of the plan, and how they were used to select the rapid transit network and policies and programs in the plan. The paper also describes the subsequent Benefits Case Analysis (BCA) that will determine project implementation and prioritization. Finally, this paper presents current early work by Metrolinx to develop metrics for the future evaluation of the impact of implementing the RTP, to serve as a baseline for comparison in the years to come.

2.0 Context

The GTHA, located in southern Ontario, is Canada's largest urban region. It is also one of Canada's fastest growing urban regions. It has an approximate area of 8,242 km^2 and a current population of over six million people. The region comprises two single-tier municipalities (Hamilton and Toronto) and four regional municipalities (Durham, Halton, Peel and York), along with their 24 lower-tier municipalities (see Figure 1).

The cities of Toronto and, to a lesser extent, of Hamilton are urban, built-up areas with high degrees of residential and employment density. The regional municipalities of Durham, Halton, Peel and York have suburban municipalities in the areas surrounding Toronto and rural municipalities towards the edges of their political boundaries.

The GTHA is currently served by a network of regional corridors that was mostly developed several decades ago. Regional rapid transit – transit service that connects component parts of the GTHA – is comprised of the GO commuter rail network and the Toronto subway system, with a historical emphasis on serving Downtown Toronto. (See Figure 2).

The GTHA's region-wide mode shares are as follows:

- auto 75%
- transit 16%
- walk and cycle 9%.

2.1 GTHA Challenges

The GTHA will continue to be one of Canada's fastest growing areas in the coming decades. By 2031, the population of the GTHA is estimated to grow from 6 to 8.6 million people and from 2.95 to 4.33 million jobs[i]. Clearly, this growth will require a massive increase in transportation infrastructure; the issue is what form this infrastructure should take.

Outside the City of Toronto proper, the GTHA has become increasingly dependent on private automobiles for mobility. The number of car trips on the GTHA's roads is increasing at a faster rate than that of the population: between 1986 and 2006 the number of trips made by automobile in the GTHA grew 56 per cent compared to a population increase of 45 per cent.

According to a study commissioned by Metrolinx on the economic costs of congestion in the GTHA, in 2006 the annual cost of congestion to commuters was $3.3 billion and the annual cost to the economy was $2.7 billion. It is estimated that if no further large investments are made to the transportation infrastructure, the cost of congestion would increase to approximately $15 billion per year by 2031.

Dependence on cars is in part a result of how new communities have been built in the GTHA over the past few decades. Lower density, dispersed development – both residential and employment – has resulted in a pattern of travel that is less and less focused on downtowns and other core urban areas, and hence more difficult to serve by transit. The province's new Growth Plan for the Greater Golden Horseshoe (Growth Plan), adopted in 2006, begins to address this challenge by setting a policy framework and intensification targets that effectively mandate the development of mixed-use, transit-supportive, cycling- and pedestrian-friendly communities. The Growth Plan works hand in hand with the province's Greenbelt Plan which protects a 1.8 million acre Greenbelt of agricultural and rural areas around the GTHA.

The GTHA's public transit system is currently comprised of nine separately-governed local transit agencies and one regional transit provider – GO Transit which operates the commuter rail system. This patchwork of systems is poorly integrated, making travel across boundaries by public transit an inconvenient, frustrating, unattractive and costly option for many travellers. Given that one out of every four trips in the GTHA crosses a regional boundary, these arrangements need to change if transit is to attract a larger share of trips.

Like other city-regions around the world, the GTHA must also prepare to deal with a number of global challenges such as climate change, increased energy costs and peak oil, fast-paced urbanization, the shifting global economy, and an aging population.

Transforming how we travel around the GTHA is crucial to addressing climate change, achieving the greenhouse gas emission (GHG) reductions, reducing reliance on oil, and shaping a more sustainable urban structure that protects natural and agricultural lands.

3.0 Developing the Regional Transportation Plan

The RTP development process was original in its combination of wide-ranging technical analysis and extensive public and stakeholder consultation. As shown in Figure 3, several milestones preceding the release of the final plan.

Seven Green Papers - i.e. discussion papers - were developed on a wide range of transportation topics related to:

- Passenger transportation (Active Transportation, Transportation Demand Management, Highways and Roads, and Transit);
- Goods movement (Moving Goods and Delivering Services); and
- Land use-transportation connections (Mobility Hubs).

Each discussion paper outlined the importance of the topic to transportation, presented an environmental scan of key related issues in the GTHA, reviewed international best practices, identified key needs and opportunities, and proposed a wide range of potential initiatives that could form part of the RTP.

Based on the comments received on the Green Papers, Metrolinx developed 2 White Papers. The first provided preliminary policy and program directions for the RTP, and test concepts for the regional rapid transit and highway network. The second paper outlined proposed vision, goals and objectives of the RTP, as well as 120 potential indicators to measure progress towards the goals and objectives.

Metrolinx adopted an innovative approach to consultation, using a specialized software package which allowed members of the public and stakeholders to comment on specific aspects of each report through an interactive website. This approach facilitated more meaningful and detailed feedback. Feedback was also solicited at each step from a number of specially created advisory bodies including a Technical Advisory Group (TAG), comprised of municipal and provincial stakeholders, the Advisory Committee (AC), comprised of a diverse group of community leaders, and the Multi-Disciplinary Expert Review Panel (MERP), composed of independent experts in the fields of transportation, planning, engineering, and finance.

3.1 The Big Move

The consultation and analysis processes for the RTP culminated in the adoption of the Big Move by the Metrolinx Board of Directors in November 2008.

The Big Move includes:

1. A vision for the future in numbers
2. Goals and objectives

3. 10 strategic directions, comprised of priority actions and supporting policies to achieve the vision, goals and objectives:
    - Strategy #1 Build a Comprehensive Regional Rapid Transit Network
    - Strategy #2 Enhance and Expand Active Transportation
    - Strategy #3 Improve the Efficiency of the Road and Highway Network
    - Strategy #4 Create an Ambitious Transportation Demand Management Program
    - Strategy #5 Create a Customer-First Transportation System
    - Strategy #6 Implement an Integrated Transit Fare System
    - Strategy #7 Build Communities that are Pedestrian, Cycling and Transit-Supportive
    - Strategy #8 Plan For Universal Access
    - Strategy #9 Improve Goods Movement Within the GTHA and With Adjacent Regions
    - Strategy #10 Commit to Continuous Improvement

4. Identification of transformational initiatives (9 Big Moves) that are key priorities for implementation:
    - A fast, frequent and expanded regional rapid transit network, including a 25 year plan, a 15 year plan and the identification of 15 top priority regional rapid transit projects
    - High-order transit connectivity to the Pearson Airport District from all directions
    - An expanded Union Station - the heart of the GTHA's transportation system
    - A complete walking and cycling network with bike-sharing programs
    - An information system for travelers, where and when they need it
    - A region-wide integrated transit fare system
    - A system of connected mobility hubs
    - A comprehensive strategy for goods movement
    - An Investment Strategy to provide stable and predictable funding

5. An implementation strategy, including recommended legislative and regulatory amendments
6. An investment strategy

The following sections of the paper describe the ways in which performance measures have been used in the development of the RTP and the way in which they are beginning to play a role in the implementation of the Big Move.

4.0 Establishing and measuring RTP goals and objectives

The Big Move's vision, goals and objectives are based on a triple bottom line that recognises the significance of planning a transportation system to achieve social, environmental and economic outcomes.

The vision outlined in White Paper #1, and subsequently adopted in the Big Move, was one that proposed that in the next generation, the nearly 9 million residents of the GTHA would enjoy a well integrated transportation system that supports:

- **A high quality of life**. Our communities will support healthy and active lifestyles, with many options for getting around quickly, reliably, conveniently, comfortably and safely
- **A thriving, sustainable, and protected environment**. Our transportation system will have low carbon footprint, conserve resources, and contribute to a legacy of a healthy and clean environment for future generations.
- **A strong, prosperous, and competitive economy**. Our region will be competitive with the world's strongest regions. Businesses will be supported by a transportation system that moves goods and delivers services quickly and efficiently.

White Paper #1 was a starting point to propel a conversation with stakeholders and the public about the transportation goals and objectives for the region. White Paper #1 proposed 19 goals and 41 corresponding objectives. In addition a set of indicators (total 120 indicators) was proposed for each objective to spur discussion about the ways in which the goals and objectives could be measured.

Goals proposed in the White Paper include:

Goals for a high quality of life:
- Comfort and Convenience
- Travel Time Reliability
- Transportation Choices
- Active Places
- Balanced
- Fit and Healthy Lifestyles
- Safe and Secure Mobility
- Fairness and transparency

Goals for a thriving, sustainable, and protected environment
- A smaller carbon footprint and reduced dependence on non-renewable resources
- Adopt the precautionary principle and an ecosystem approach
- Reduced land consumption for urban development

Goals for a strong, prosperous, and competitive economy
- Prosperity and competitiveness
- Foundation of a well-functioning region
- Multi-modal integration
- Interconnectedness
- Resilience
- Efficiency and fiscal responsibility
- Fiscal sustainability

- Safety and security

A complete list of the objectives and indicators proposed to support these goals can be found in White Paper #1 at http://www.metrolinx.com/Docs/WhitePapers/WhitePaper1.pdf

An intense round of consultation followed the publication of the White Papers, including six stakeholder workshops and an online consultation for stakeholders and the general public. Commentary received supported for the stated goals and objectives, and helped Metrolinx shape and focus the development of the Draft Regional Transportation Plan (Draft RTP). Stakeholders urged Metrolinx to take a bold approach in its plans, integrate land-use and transportation planning and shift to more sustainable modes of transportation in order to ensure the social, economic and environmental sustainability of the GTHA.

Drawing on this feedback, input from the Metrolinx citizen Advisory Committee and the results of the modelling work (to be described in next section), a set of key indicators against which to benchmark the implementation of the RTP in a publicly accessible manner was identified.

5.0 Regional Transportation Plan Modelling

5.1 Simulating Transportation Demand and System Performance

The model used in developing the RTP was initially developed for the Ministry of Transportation of Ontario (MTO) for transportation planning in the Greater Golden Horseshoe (GGH) region and is referred to as the GGH Model. MTO provided the model as a prototype to Metrolinx to assist with the development of the RTP.

Metrolinx has adapted some of the parameters of the model, as described in this paper, for the purpose of developing the RTP. MTO continues to refine the model and the inputs so that it can also be used for other planning studies in the Greater Golden Horseshoe.

The GGH Model is a computer simulation of transportation demand and supply interactions which represents the transportation network by links and nodes, all with specified capacities, speeds, costs and access times. Land use throughout the GTHA is represented by more than 3,000 traffic zones with current and projected population, jobs, population and employment densities, land use, socio-economic factors, and demographics specified for each. The model estimates users' travel decisions including trip purposes, start and end times, origins and destinations, travel routes and travel modes, which leads to estimated volumes of travellers and vehicles on each link by mode (e.g. walking, cycling, transit, automobile). For the RTP, the model was used to simulate the morning three hour peak period (6:00 a.m. – 9:00 am) of a typical workday in 2020 and 2031. These are the hours of maximum demand in the transportation system, when work and school trips are most concentrated. Some model results,

such as transit ridership levels and greenhouse gas (GHG) emissions, were also extended to daily and/or annual levels based on observed and projected "peaking factors" relating peak period travel volumes to daily and annual volumes.

The model simulates the behaviour of travellers taking into account the different costs (e.g. transit fares, auto operating costs, road tolls, parking charges,) and travel times (e.g. walking, waiting, in-vehicle) via the available modes (e.g. auto, transit, walking, cycling) for that individual's trip. Different types of people behave differently and thus key socio-economic characteristics that affect travel and travel choices such as age, employment status, occupation type, household structure (e.g. single, married, married with children, etc.) are reflected when determining propensities to make trips or use a given mode. The computer model covers the entire GTHA as well as surrounding areas that comprise the Greater Golden Horseshoe.

5.2 Limitations of the Model

As with any model that simulates reality, the GGH Model has limitations which should be borne in mind in interpreting its results. Specifically, the model has been calibrated based on a range of actual behavioural responses and current preferences as travellers choose among the travel modes and routes available to them in the existing system. It contains equations that represent observed behavioural responses to those choices as represented by alternative travel times, costs, and convenience ranges provided by the system and measured by travel surveys. In the GTHA, the Transportation Tomorrow Survey[1] (TTS) has been carried out at five-year intervals from 1986 through 2006, providing a rich source of travel behaviour data with which to calibrate and test the model.

Model limitations include the following:

The model used for this study was calibrated based on 2001 TTS data since the 2006 TTS and Census data were not yet fully available. If a future transportation network to be tested presents a significantly broader range of times, costs and/or convenience levels than those that existed at the time when the model was calibrated, as is the case with the RTP network, the reliability of model results becomes more uncertain. Experience over the past 40 years suggests that the model may tend to under-estimate demand levels on new or greatly improved transportation facilities under such circumstances.

The model is less sensitive to differences among alternatives that are not readily quantifiable such as amenities for pedestrians, maintenance levels of transit stations and vehicles, on-time performance, and the possible diversity of fare products. As a result, the model will tend to have a built-in bias reflecting existing amenity and reliability levels in various parts of the region. In some cases, such qualitative variables can be reflected by categorizing traffic zones, for example, in terms of their level of amenity and convenience for pedestrian travel. This feature is included in the GGH Model in that a neighbourhood or area

[1] Carried out by the Data Management Group (DMG) at the University of Toronto with funding from the following GTHA agencies: Cities of Hamilton and Toronto, the Regional Municipalities of Durham, Halton, Peel and York, the Toronto Transit Commission, GO Transit and the Ontario Ministry of Transportation.

typology category is defined for each traffic zone and may be changed to represent future conditions; for example, as a zone's levels of population/job densities and mixed uses increase in future, its pedestrian amenity category will change for the better and model results will show higher walking percentages for relevant trips.

The model is limited by the information that is traditionally collected by, and available to, transportation planners and engineers. For example, regional economic trends, social values and environmental concerns are reflected in the model as they manifested themselves in the travel behaviour of various socio-economic groups at the time(s) for which the model was calibrated. More detailed travel market information, such as the method of fare payment (e.g. pass, multi-ride, single) or parking costs, are not available from the TTS for each individuals' trip and thus averages by area or type of trip are made to depict these costs and other such factors. The TTS data is also subject to sampling bias and measurement errors as is true of any survey. For example, the TTS may under-report non home-based travel and trips by younger people. Model estimation of behavioural responses to major changes in those trends and attitudes (beyond the range of variation in the calibration data) would be subject to more uncertainty and simulated changes in behaviour may tend to be under-estimated in such cases.

The model's usefulness as a planning tool would be enhanced if it were calibrated and applied for other time periods as well as the a.m. peak period, such as the p.m. peak period, the mid-day period and/or the evening/night period of a typical weekday, and similar periods for a typical weekend day. More detailed simulations such as these would pick up differences in the time-of-day variations of transportation service levels and resulting travel behaviour in various parts of the GTHA which would, in turn, provide more accurate estimates of off-peak, daily, and annual demand levels and emissions as well as peak period levels.

5.3 Model Input Assumptions

5.3.1 Population, Employment and Land Use

The 2031 projections are consistent with the population and employment forecasts of the Growth Plan for the Greater Golden Horseshoe (Growth Plan) for municipalities at the single- and upper-tier level. Demographic analysis was undertaken to derive population by age, occupation status, dwelling type, household structure (number of adults and children per household) and employment by type (i.e. professional/technical, general office, retail/services and manufacturing/construction). Allocation of the population and employment forecasts to the traffic zone level for the purpose of the model was based on an analysis of local planning documents as they existed at the time of the model's development, and the achievement of the Growth Plan's minimum requirements for intensification and density:

- Urban Growth Centres (UGCs) – the model assumes that the 17 urban growth centres in the GTHA will achieve, by 2031, the Growth Plan's minimum density requirement of 400 residents and jobs combined per (gross) hectare for the centres located in Toronto and 200 residents and jobs combined per (gross) hectare in other GTHA centres. Urban growth centre boundaries were based on the Spring 2008 Technical Paper produced by the Ontario Growth Secretariat, Ministry of Energy and

Infrastructure entitled “Proposed Size and Location of Urban Growth Centres in the Greater Golden Horseshoe”.

- Intensification Areas – the model assumes that at least 40% of the population growth for single- or upper-tier municipalities occurs in existing built-up areas, which is the minimum requirement of the Growth Plan. For the model, 40% of the municipality’s growth was allocated to traffic zones within the built-up areas, with the exception of Toronto, where 100% intensification was assumed.
- Designated Greenfield Areas – for the purpose of the model, 60% of the growth projected for each municipality was allocated to traffic zones within designated greenfield areas.

5.3.2 Local bus, streetcar and paratransit networks

Local bus, streetcar and paratransit networks were broadly assumed to be expanded into new urbanized areas (e.g. designated greenfield areas) and improved service levels (frequencies) were assumed for existing urbanized areas and to/from higher order transit stations, consistent with population growth, projected transit mode share increases, and typical bus loading standards.

5.3.3 Transit Fares

Transit fares for the model were kept at the same current level, in real terms, with fare integration between local transit operators assumed, such that double fares for short cross-boundary trips would be eliminated. As discussed earlier in this paper, model limitations preclude the ability to predict the beneficial impact on ridership of more widespread use of transit passes in the future. Discretionary use of transit would be expected to increase as the number of pass-holders increases, particularly in non-peak periods. As a result, the model may under-estimate future ridership.

5.3.4 Vehicle Fuel Efficiencies, Emission Rates and Fleet Replacement Rates

Vehicle fuel efficiencies, emission rates and fleet replacement rates were assumed to improve at rates projected by Transport Canada’s Urban Transportation Emissions Calculator (UTEC).

5.4 Model Output Adjustments

As noted earlier, the model in its presently calibrated form is likely to underestimate transit ridership. This is because the future network envisioned in the RTP will include very substantial improvements well beyond the range of existing service levels, as well as supporting policies and programs and facility amenities, such that the calibrated range of equations in the model may not fully reflect how travellers will respond to these unprecedented improvements. To compensate for this, a number of post-run adjustments were made to the model results for the RTP. Specifically, the following types of adjustments were made:

- Average auto occupancy was increased to reflect results of preferential treatment for high occupancy vehicles in carpool lots, parking lots and on HOV lanes, as well as employer education and incentive programs, as recommended in the RTP. The increased auto occupancy, in turn, reduces the volume of autos required to move a given number of people, with resulting reductions in rates of increase in congestion levels and in auto emissions.

- The percentage of people anticipated to work at home was increased, reflecting information programs and corporate policies to encourage home-based work. This, in turn, reduces the number of peak period work trips, with positive impacts on congestion, emissions, etc. as above.

- The transit mode split was increased to reflect the introduction of various measures in the RTP such as integrated fare systems, employer-provided transit passes and better integration with other modes, which cannot be captured explicitly by the model as currently calibrated. This, in turn, reduces auto volumes and increases the ridership and viability of transit services.

- The active transportation mode split was increased for trips of 10 kilometres or less in length, to reflect the enhanced pedestrian environment and more extensive networks of bicycle lanes and bicycle/pedestrian paths which are part of the RTP. This, in turn, reduces auto and other motorized trips, with positive impacts as noted above.

5.5 Comparing Initial Network Test Concepts

As outlined above, prior to developing the Big Move, Metrolinx published two White Papers in May 2008. White Paper 2: Preliminary Directions and Concepts included a description of several network test concepts. Each concept took an alternative approach to addressing the present and future transportation needs of the GTHA (looking forward 25 years). The concepts were tested to provide analysis to inform the development of a recommended regional rapid transit network. The various concepts were not intended to be mutually exclusive and it was anticipated that elements from each could form part of the recommended regional rapid transit network in the final RTP.

Primary characteristics of the White Paper test concepts were as follows:

- **Test Concept A: Linear** – Existing or planned transit improvement projects with some additions and enhancements to improve inter-regional connectivity.

- **Test Concept B: Radial** – Includes elements of the “Linear” concept, plus strengthens several major radial corridors from downtown Toronto with lines providing very high levels of rail service.

- **Test Concept C: Web** – Includes “Linear” and “Radial” routes strengthened by additional east-west connectivity.

The test concepts were modelled to determine their relative performance. Preliminary findings from the test concept model runs include the following:

- Significant increases in transit use are achievable in the GTHA through bold transit investment, coordinated rapid transit/land use planning, and supporting policies and programs.

- Significant progress towards achieving the economic, social and environmental goals and objectives of the RTP can be achieved only through bold transit investment and supporting policies. Achieving these goals will also require the cooperation of all levels of government.

- Greenhouse gas emissions are not estimated to drop enough to meet provincial targets solely as a result of network and service improvements as simulated in the model. Criteria air contaminant (CAC) emissions, which contribute to smog, are not estimated to go down from 2006 levels, even in the boldest test concept.

- Transit benefits are most significant when combined with aggressive land use intensification in transit corridors and mobility hubs. Intensification at hubs above and beyond minimum Growth Plan density targets allows for further leverage of the transit investment and greater shift from driving to transit.

- Large mobility hubs (e.g. employment > 60,000 jobs) provide critical anchors to support any new rapid transit investment considered. The extent to which the development potential at mobility hubs may be achieved will affect the timing and viability of major new cross-regional rail facilities. The benefits in terms of transit use and efficiency of concentrating development in a relatively small number of anchor hubs, particularly those with high employment targets, greatly exceeds that which can be achieved by distributing similar levels of development growth over a more dispersed urban area with significantly greater transit ridership and resulting moderation of auto traffic growth pressures.

- A web Express Rail network is viable, at least in part, and strongly supports the vision for transportation in the GTHA. It could have a major transformative impact on the GTHA with greatly enhanced cross-regional mobility and associated transportation, quality-of-life, environmental, and economic benefits.

- Subway or grade-separated LRT improvements should be considered in existing higher-density areas if the higher range of transit market shares are to be achieved.

- Strong feeder bus and paratransit services are critical to support the regional rapid transit network under any future scenario, with fleet sizes doubling to quadrupling in suburban areas.

5.6 Developing and Measuring the RTP Regional Rapid Transit Network

The process of developing the Big Move's regional rapid transit network did not rely on any one input or information source, and it was not distilled down to a simple mathematical scoring exercise. It involved a consideration and balancing of many different factors that are described below.

The underlying basis for developing and assessing the Big Move's transit network is found in the vision, goals and objectives of the Big Move. These are based on the three pillars of a high quality of life; a thriving, sustainable and protected environment; and a strong, prosperous and competitive economy. As such, the process considered more than just traditional transportation indicators such as transit ridership, but also social, environmental and economic factors.

Regional Significance: The Big Move is fundamentally about building an integrated, regional transportation network. As such, an initial step in the process involved identifying projects that made a significant contribution to a regional network. The regional significance of individual projects was assessed by rating each based on seven general criteria.

- Does the facility operate predominantly within its own right of way, separate from other traffic?
- Does the project connect key places (e.g. urban growth centres, areas of high density and/or social need)?
- Does the project provide significant carrying capacity?
- Is the project likely to have a minimum average distance between stops of 500 m or more?
- Does the project propose service that operates at an average speed of 25 km/h or greater?
- Does the project cross municipal boundaries or represent a significant transportation corridor of 15 km or more?
- Is the project cost/effective in terms of riders and/or passenger/kms per million dollars capital investment?

Projects meeting four or more of the above criteria were considered regionally significant and were carried forward for further analysis.

Modelling and Comparing Network Test Concepts: The White Paper network test concepts provided the starting point for developing the RTP network. The modelling results for those concepts, and subsequent analysis, provided a general indication of the performance of individual projects and their contribution to the performance of the overall system.

Municipal and Stakeholder Feedback: As described above, public and stakeholder feedback on the White Papers and Draft RTP contributed significant input and insight into the development of the RTP rapid transit network. During the consultations, stakeholders were

asked what were the most important places that needed to be linked by the transportation system in their local area and throughout the GTHA, and what were the most critical linkages.

Modelling: The GGH Model was also a key input to the development of the recommended RTP network. This involved a combination of "top down" modelling approach that measured the overall performance of the rapid transit system, and a "bottom up" approach that measured the performance of individual transit projects.

5.6.1 System Performance

The performance of the overall transportation system, or "top down" modelling approach, provided information about how all components of the system would work together.

As a basis for comparison of the system performance, Metrolinx developed a current trends scenario that assumed that future travel will increase proportionately with population and employment growth and would exhibit travel patterns similar to those observed today. This stability in travel behaviour also assumed that the current policy context and the transportation improvement trends of the past two decades are continued.

The analysis looked at the current trends scenario and the RTP 15 year and 25 year plan for each of the following measures:

- Transit trips by destination region in the a.m. peak period
- Annual total transit trips
- Transit modal split by destination region
- New kilometres of rapid transit by region
- Per cent of population within 2 kilometres of rapid transit
- Per cent of commuters who can get to work within 45 minutes via transit and auto
- Average home-based work trip length (km)
- Vehicle kilometres of travel (VKT) in the a.m. peak hour
- AM peak period auto trips
- Active transportation (AT) modal split
- Total annual fuel and electricity consumption
- Greenhouse gas (GHG) emission levels
- Auto and transit criteria air contaminant total emissions (million kg/year)
- Auto and transit criteria air contaminant total emissions (grams/person-km)
- Auto ocupancy

5.6.2 Individual Project Performance

For the "bottom up" component of the analysis, potential transit projects were subjected to a project assessment based on the indicators described below. These indicators were developed to reflect the broad vision, goals and objectives of the RTP. They include both quantitative and qualitative indicators. It is important to note that the indicators were not weighted, and as a result this analysis was not used to produce a numerical "score" for individual projects.

Rather, the individual project performance was considered in balance with the other factors and inputs described above to develop the recommended RTP regional rapid transit network.

- AM Peak Hour Boardings
- AM Peak Hour Peak Point Riders
- Total AM Peak Hour Pass-km
- Annual Riders
- Average employment and residential density within 500m of the project
- Number of mobility hubs connected (anchor hubs and gateway hubs
- Diversion of person trips from 400 series highways onto transit
- Number of seniors and number of low-income persons (15+) within 500 metres of a rapid transit station
- Annual Reduction in GHG Emissions (tonne CO2 equivalent
- Estimated percentage of the route within the existing built-up area
- Approximate length of line crossing the Greenbelt
- Approximate number of rapid transit network cross-connections provided

Following the examination of the results of this modelling analysis, Metrolinx recommended a final rapid transit network in The Big Move. For each rapid transit project recommended was modelled based on a standard set of assumptions for service and alignment as described above. As implementation of the Big Move now proceeds further analysis has begun, through a benefits case analysis to more specifically identify the optimum project for each of the rapid transit lines identified in the Big Move.

6.0 Benefits Case Analysis

Benefits Case Analysis (BCA) is intended to be a standardized approach for analyzing the transportation, business and financial rationale for each project and determining the best alternative option for each project. The Big Move's vision, goals and objectives and the modelling supporting the design of the regional transportation system were developed as to address the triple bottom line and to ensure that, in the future, progress is measured in a comprehensive fashion. Similarly, Benefits Case Analysis is a more comprehensive cost-benefit analysis, allowing investment decision-making to be shaped by public policy objectives aimed at protecting the quality of our environment, strengthening economic competitiveness and prosperity, and promoting a high quality of life for a segments of communities across the GTHA. In other words, the Benefits Case attempts to quantify all benefits and costs, to more effectively assess options for each project and determine the net benefit of implementing a particular project.

As a tool for informing investment decision making, the Benefits Case is intended to:

- Align with the evaluation tools and criteria deployed by the Big Move and a durable, long-term project prioritization network;
- Produce quality data inputs for public-private partnership evaluation, consistent from one project to the next; and

- Anticipate and meet the business case and funding submission requirements of both the provincial and federal governments, assuming that the project will be a candidate for senior government cost-sharing.

The BCA provides a standardized approach for analyzing and linking projects according with the triple bottom line, and at the same time addresses the needs of senior government due diligence and funding criteria. As noted above, each of the recommended rapid transit projects has been subjected to varying levels of analysis. Where information gaps are identified, the BCA develops new data-generation requirements in consultation with its partners.

The BCA process begins with the identification of options for each project, determined in consultation with affected transit providers and municipalities. Options may be developed for different alignments of a project, different transit technologies, and/or for different service levels. For each of the options selected, transportation, economic, environmental and social indicators are then analysed and a recommended option is brought forward.

7.0 Post-implementation performance measurement

With the adoption of the Big Move, Metrolinx is undertaking work to develop a set of indicators to measure improvements to the transportation system and related land-use patterns. The Big Move recommends the development of a "Mobility Index" that will build on the baseline data collected for modelling work and BCA, and may also incorporate best practices in indicators developed for other initiatives.

Currently, Metrolinx is involved in external efforts to develop transportation performance indictors, including the National Sustainability Indicators project led by the Canadian Urban Transit Association, and the Provincial Policy Statement (PPS) monitoring framework led by the Ontario Ministry of Municipal Affairs. These external ventures will help inform the work undertaken by Metrolinx through the experience of various jurisdictions, as well as generate data, and geographically specific transport and related indicators. The National Sustainability Indicators will develop comprehensive indicators of sustainability and sustainable development by transit agencies. Metrolinx participates on the project's Steering Committee and will work to align the mobility index with this initiative.

8.0 Conclusion

The development process of the Big Move was designed to be comprehensive in scope and inclusive of stakeholder, public and technical inputs. The approach taken by Metrolinx was to ensure that the technical inputs, such as the modelling exercise, were informed by the public consultation process in an iterative manner. By the same token, the approach adopted in the consultation process was to seek input from and to inform and educate the public of the science behind the planning for the region's transportation future.

The consultation process yielded valuable information that guided the work of Metrolinx staff, informed the modelling process and alerted the Metrolinx Board of Directors of important areas of concern raised by stakeholders, experts and GTHA residents. The approach adopted during the developmental stages of the Big Move, underlining the importance of the triple bottom line, will be followed as Metrolinx implements the projects, policies and programs in the plan. Building on the data and analysis compiled at these stages, and through the development of a complete set of indicators in the Mobility Index, Metrolinx will be able to measure progress, and the performance of the regional transportation system, not only in terms of it's efficiency to move people and goods around the region, but also in terms of its impact on the natural environment, the regional economy, and the GTHA's residents quality of life.

To download the Big Move go to www.metrolinx.com

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[i] Ministry of Public Infrastructure Renewal (Now Ministry of Energy and Infrastructure), *Places to Grow: Growth Plan for the Greater Golden Horseshoe,* Queen's Printer of Ontario: 2006.

Figures:

Figure 1. Greater Toronto and Hamilton Area Context Map

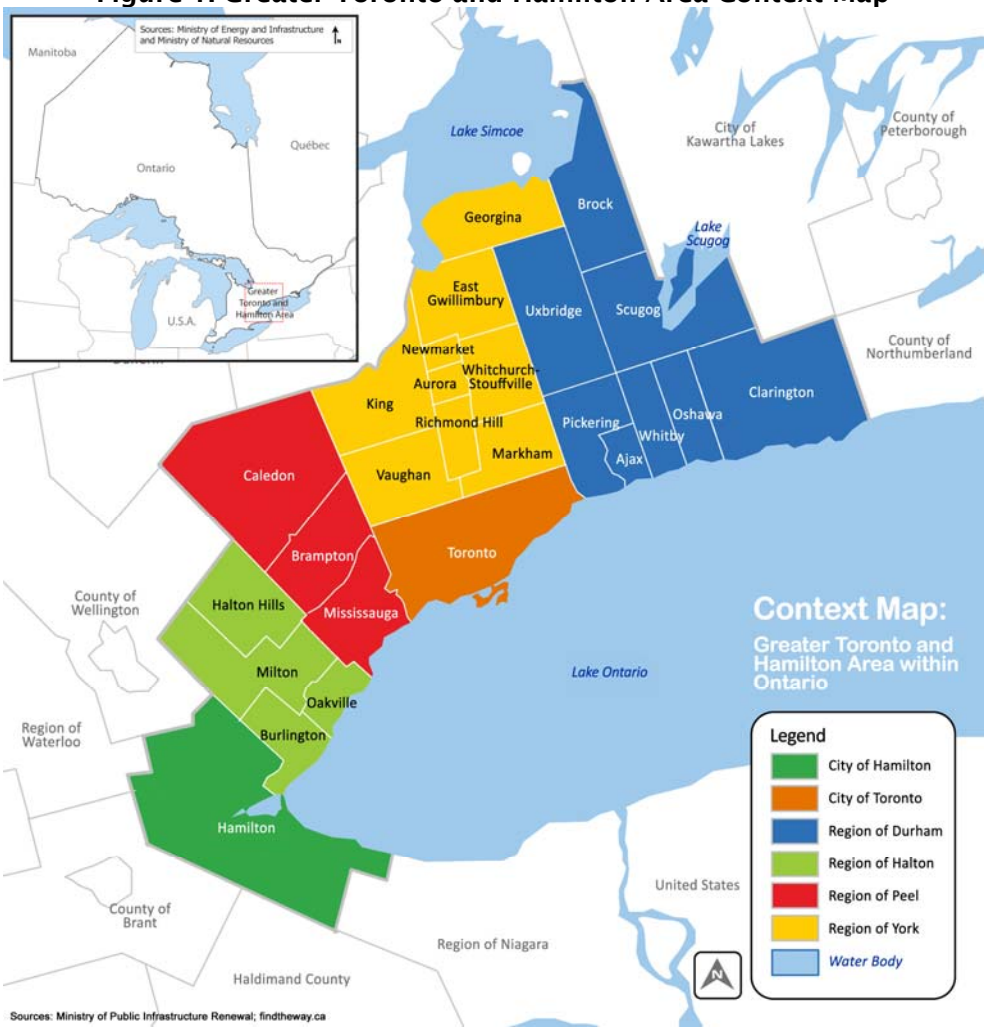

Figure 2. Existing Regional Rapid Transit and Highway Network in the GTHA.

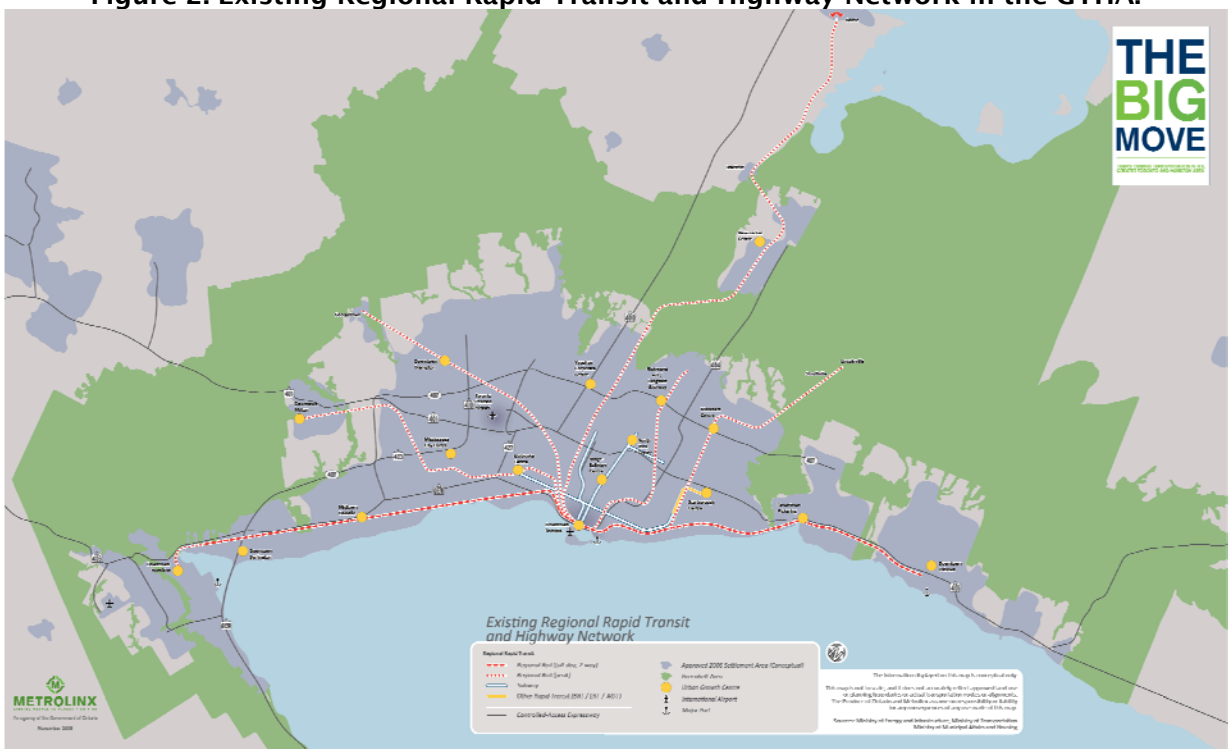

Figure 3. Development Process for the Regional Transportation Plan