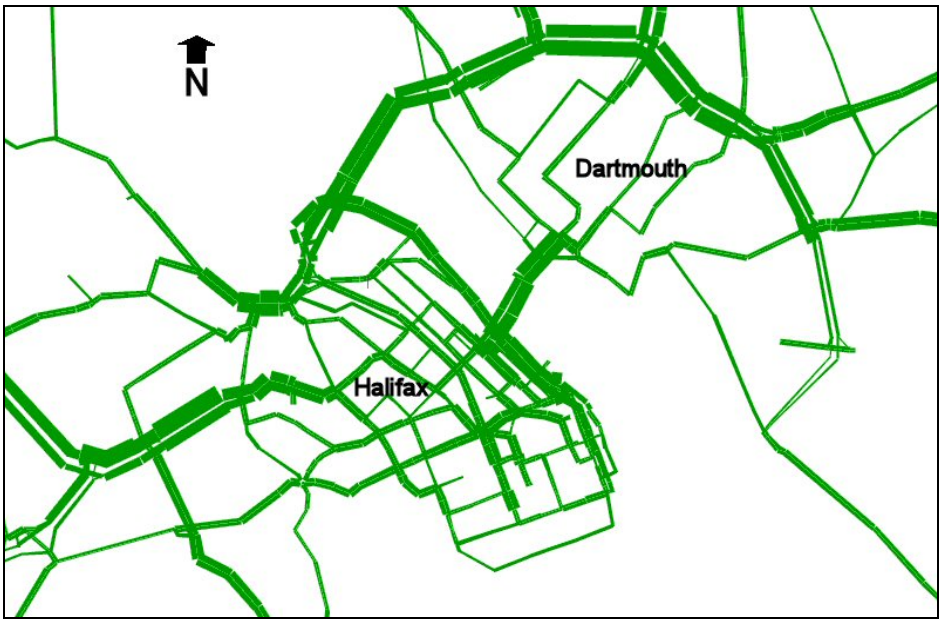
Final Report

Roadway Network Functional Plan Study:

Halifax Regional Municipality



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1 Introduction

1.1 A historical perspective

Since the founding of the twin communities of Halifax and Dartmouth in the middle of the eighteenth century, people have found it necessary to travel repeatedly between the two communities. The world's oldest salt water ferry service was established in 1752 to service this demand and it continues to operate to this day, serving 4,000 people every weekday. But it was the completion of the Angus L. Macdonald Bridge in 1955 that radically altered our vehicular mobility in the region.

One of the earliest regional planning efforts undertaken for the Halifax area was adopted by the Province of Nova Scotia in 1975. The findings of this work encouraged growth in Sackville and in the Cole Harbour/Westphal area and recommended transportation network upgrades were necessary to support this land use distribution. They included express transit routes, new ferry routes (including a route to Bedford) and new arterial roadways. Over the next two decades several of these transportation recommendations were completed including the Dartmouth Circumferential Highway (Highway 111), additional lanes on the Magazine Hill; Highway 118 (from Dartmouth to Highway 102), widening Portland Street, and new interchanges along Highway 111.

Continued growth in Halifax, Dartmouth, Bedford, and the greater surrounding area has contributed to increased travel around the Region. While various actions have been taken over the years to improve roadway infrastructure and public transit service to better accommodate the growing demand, a new Plan that encompassed all of Halifax Regional Municipality (HRM) was required to accommodate the expected growth over the next 25 years.

Thus HRM undertook the development of a new Regional Municipal Planning Strategy (MPS) in November 2001. The goal of developing a new MPS was to review the 18 MPS within HRM (for the various communities) that were currently in effect, and to lay a foundation to help shape and influence growth over the next 25 years. It was also intended to provide guidance with respect to future development, with a particular focus on compact mixed-use settlement centres[1].

Between 2001 and 2004, HRM undertook a public consultation process to gather input on an initially set of four proposed long term land use alternatives. The information gathered during this process lead HRM to develop an additional fifth alternative. Late in 2004, McCormick Rankin Corporation was engaged by HRM to undertake a transportation demand modeling effort to quantify the roadway impact of these five scenarios.

1.2 Purpose

The purpose of this report is to document the transportation modeling work that was carried out in support of the Regional Planning process and the findings that

[1] Halifax Regional Municipality Regional Plan and By-Laws. As approved by Regional Council on June 27, 2006.

flowed from these efforts. As the technical analysis discussed in this report was undertaken prior to the finalization of the Regional Planning document, we have taken a retro-spective approach to summarizing the work.

1.3 Project scope

This report provides an overview and summary of the technical aspects of the transportation demand modeling efforts that were undertaken as part of the roadway function plan study. The focus was therefore on the impacts to the roadway infrastructure associated with the five land use scenarios as contemplated for the 2026 planning horizon – the planning horizon chosen by HRM for their Regional Planning process.

McCormick Rankin Corporation was engaged in 2004 to undertake the transportation modeling work on behalf of the Halifax Regional Municipality and our approach was based on the understanding that the findings flowing from the modeling work would have to rely on both quantitative and qualitative inputs. As a result, a technical approach to the analysis of travel demand modelling was taken. This approach is discussed in more detail in Sections 3 and 4 of this report.

A significant amount of data were required to execute the model. These data were developed both by HRM staff and other consulting firms prior to the modeling efforts. These data included – for each of the five land use scenarios – population and employment data (prepared by HRM), the road network (provided by HRM), the initial QRS II software files (provided by HRM) and the modal share forecasts (prepared by Entra Consultants). The findings that flowed from the transportation demand modeling were assessed by HRM staff and became one set of inputs to the overall decision process for HRM's Regional Plan.

1.4 A multi-disciplinary approach

The roadway functional plan project was multi-disciplinary in nature and thus required the contributions of several organizations to complete. The majority of the work preceding our efforts as well as the quantitative analysis that followed was completed by staff at HRM and included contributions by other consulting firms on behalf of HRM. We have attempted to prepare this report to include all of the efforts related to the transportation aspects of the Regional Plan – with a focus on our transportation modeling efforts. To assist the reader, we have attempted to identify the report and authors relevant to the particular task being discussed.

1.5 The need for sensitivity analysis

Uncertainty is present in all planning and analysis efforts. In some cases uncertainty may arise from the quality of data available. In others, historical data may simply not be applicable to the analysis of future needs. Instances may even arise where reliable quantitative data is not available and expert opinion must provide the basis for a particular input value. Sensitivity analysis – the use of a range of values for various inputs instead of a single value – is invaluable in helping both specialist experts and decision makers to better understand the implications of various assumptions that underlie specific recommendations. Throughout our review we used sensitivity analysis to help provide this type of guidance.

1.6 Report organization

This report is presented in seven sections. Section 1, of which this is part, offers a background and context to the study. Section 2 provides an overview of the future land use scenarios contemplated by the HRM and evaluated using the transportation demand model. Section 3 offers a general understanding of transportation demand models and explains how we measure the performance of each alternative under study.

Section 4 discusses the history of the HRM transportation demand model and identifies the approach taken for the modeling process. The findings of the analysis are presented in Section 5 and the role of public transit is presented in Section 6. Section 7 completes the report with some concluding thoughts.

2 The Future Land Use Scenarios

2.1 Background

In Canada, one of the key influences on population growth is the economy. If a regional economy is buoyant, the population tends to rise as workers are drawn towards jobs. Conversely, if the economy is poor, people tend to be drawn away. So predicting what growth we will see in the next two to three decades is not easy. However, where people may live, and where they may work within a region, is easier to predict since this tends to be dictated to some extent by policy. For HRM this policy is in the form of a MPS which – along with other supporting policies – indicates where population and employment are likely to be distributed throughout the Region.

Factors influencing population growth. The two main influences on population growth are natural increase (live births compared to deaths) and migration. Migration is classified as intra-provincial, inter-provincial, and inter-national. Based on long term trends in Nova Scotia, the Regional Plan is founded on the conclusion that natural increase will play only a small part of any population growth in the foreseeable future.

In order to evaluate land use scenarios as part of the MPS development, HRM held a series of public information sessions to gain an understanding of how the citizens of HRM envisioned their future growth. Prior to the consultation sessions the Regional Planning Committee prepared four initial generalized land use and settlement pattern scenarios (for the 2026 planning horizon) as an impetus for feedback and discussion (a fifth alternative was added later in the process). The information gathered through this consultation process was assessed by HRM staff using criteria that included environment, economy, settlement, transportation and costs[2].

The settlement patterns and land use scenarios are important in that they have a direct correlation to the amount and type of travel that takes place. Research tells us that as population (and employment) grows and spreads in a municipality there is a direct impact to the amount of travel that takes place (i.e. a work-related trip, a recreational trip, etc.).

The planning horizon was selected by HRM using the 2001 census information plus 25-years – a reasonable long term outlook for a regional planning exercise. The following sections provide a discussion of the population/dwelling unit and employment forecasts (Section 2.2) as well as a description of all the land use alternatives (Section 2.3).

2.2 Regional growth forecasts

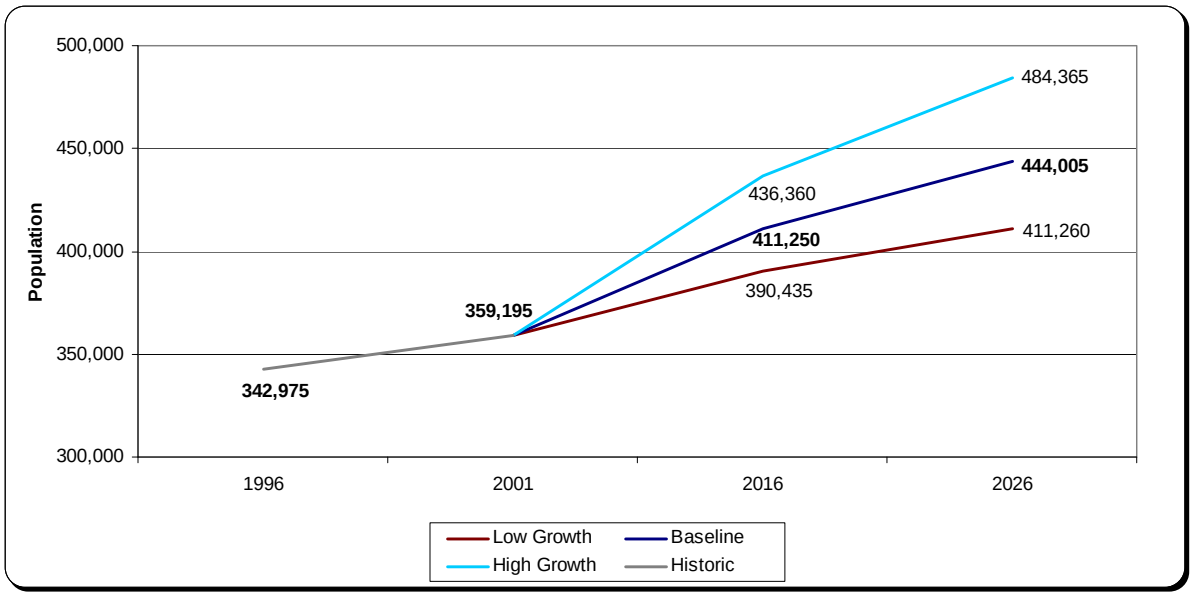
2.2.1 Population growth

The HRM consulted with Clayton Research (now Altus Group) in 2004[3] to develop population forecasts out to the 2026 planning horizon. This formed the basis of the estimates used in the Regional Plan. These forecasts built on past regional growth trends and data from Statistics Canada (2001 census data).

[2] A description of this process is provided in the November 9th, 2004 Council Report.
[3] Employment, Population and Housing Projections, Halifax Regional Municipality (Revised). Prepared by Clayton Research Associates Limited, August 2004.

Figure 1 illustrates Clayton's population trend that uses a range of values - low growth, base case growth, and high growth scenarios. Clayton identified the base case growth scenario as being the most-likely scenario. This growth scenario was carried forward for further use.

Figure 1 Regional Population Projection to 2026



The following table shows 2001 and projected regional population estimates and the relative change that was expected by the 2026 planning horizon.

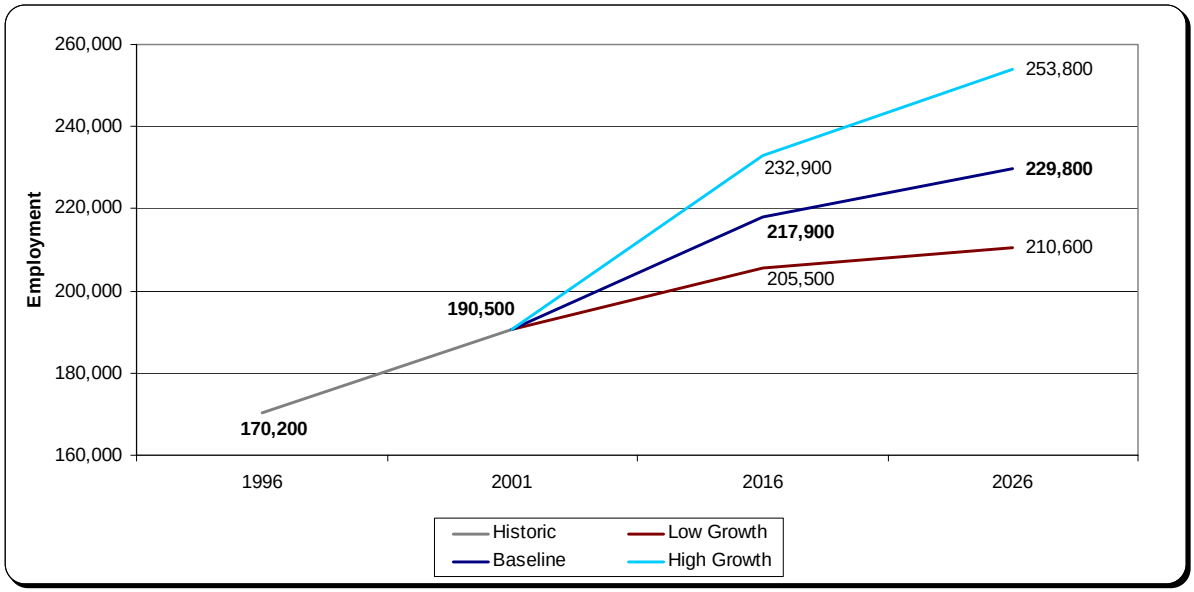
Table 1 Historic and projected regional population (2001-2026)

	Population	Increase over 2001
2001	359,195	~
2026	444,005	84,810

2.2.2 Employment growth

The estimate of future employment growth in HRM was also projected by Clayton Research as part of the Regional Planning effort. Similar to the population forecasting process, three potential growth scenarios were identified. The results are shown in Figure 2.

Figure 2 Regional Employment Projection to 2026



Based on these results, Clayton Research recommended that the mid-growth (base case) scenario be used for forecasting purposes (i.e. the most likely scenario) in the development of the Regional MPS. This rate of growth demonstrates a slightly higher growth than recorded between 1991 and 2001.

Table 2 Historic and projected regional employment (2001-2026)

	Population	Increase over 2001
2001	190,500	~
2026	229,800	39,300

2.3 How the growth was allocated

2.3.1 Background

The initial four alternatives included a Base Case (status quo) and Alternatives A, B and C. Alternatives A, B and C were envisioned as all having a strong regional centre, a system of interconnected open-space corridors and a transit-focused solution to meet transportation demands. However, the settlement patterns ranged from the most compact in Alternative A to the least compact in Alternative C. In order to evaluate the benefits of combining Alternatives A and B, the Regional Planning Committee developed a fifth scenario using information gleaned from the initial public consultation process. This new scenario was called the Hybrid Alternative. In total, five land use scenarios were carried forward to the transportation demand modeling phase. These alternatives are listed below.

Alternative	Description
Base Case	status quo
Alternative A	most compact development
Alternative B	moderately compact development
Alternative C	least compact development
Hybrid Alternative	blend of Alternatives A & B

Although varied in their patterns, densities and other characteristics, each of the alternatives had the common objective of being positioned and designed to maximize the number of residents who might choose public transit for commuting and other trips. This was achieved, in part, by locating settlement nodes along planned regional transit corridors which include Bus Rapid Transit (BRT), rural express transit, and expansion of the harbour ferry network[4].

2.3.2 Allocating growth

The distribution of growth, or growth allocation, for each land use scenario was a separate but related part of the population and employment projections task, completed in mid-2004 by the HRM Regional Planning team. Their effort took into consideration both the forecasts provided by Clayton Research as well as the input gleaned from the public information sessions – and therefore do not result in the exact same population and employment numbers as shown in Section 2.2.

HRM staff determined that all of the land use scenarios would attempt to achieve a similar "target" regional population of about 444,000. The Regional Planning team then used this target population number to allocate the growth for each scenario using varied dwelling unit numbers, varied dwelling unit densities, and varied numbers of retail and non-retail employment. When finalized, McCormick Rankin Corporation then applied these scenarios to the transportation demand modeling.

Although the total population/dwelling unit and employment forecasts provided by the Regional Planning team were the same as the numbers applied in the transportation model, there were slight variations at the neighbourhood level. This was simply due to the technique used to distribute the numbers throughout the Region. The Regional Planning team used settlement nodes (a circular polygon) to identify changes in the demographic data for a particular location, whereas the HRM transportation demand model uses numbered traffic analysis zones (TAZ) which are irregularly shaped polygons. Both zonal systems are illustrated in Figures 3 through 6[5].

Due to the slightly different zonal boundaries of the two systems, McCormick Rankin Corporation translated the HRM forecast numbers from the circular nodes

[4] These transit corridors are illustrated in Map 1 of the HRM Regional Municipal Planning Strategy.
[5] The circular polygons are shown in colour and the numbered traffic analysis zones are grey and form the background of the image.

to the traffic zone system. The differences in values at the zonal level were small and had a negligible impact on the overall results of this planning study.

A summary of the five land use scenarios examined and the corresponding number of dwelling units (a basis for population) and employment (i.e. number of jobs) projections is contained in Table 3.

Table 3 Forecast demographic data by land use alternative

	2026 Planning Horizon		
	Population Target	Total Dwelling Units[1]	Total Employment[2]
Base Case	444,000	147,302	274,713
A		134,689	218,850
B		151,350	219,510
C		169,992	221,500
Hybrid		137,236	219,520

1 - data provided by HRM Planning Department
2 - data taken from the HRM Regional Plan Baseline Report, December 2002.

The Base Case alternative assumes the current settlement patterns, development densities and modal split remain unchanged and carry on out to the future 2026 planning horizon. This was expected to result in an increase in the amount of trip making that takes place throughout the Region. The other four land use alternatives assume more control over where development takes place (including type and density of development) as well as varying degrees of public transit service. As presented later in the report, Alternatives A, B, C and the Hybrid result in a reduced number of trips relative to the Base case and therefore result in less demand for increased roadway capacity.

2.3.3 What do the alternatives look like?

The HRM Regional Planning team developed settlement maps for the A, B, C and Hybrid Alternatives using their geographic information system (GIS)[6]. These are illustrated in Figures 3, 4, 5 and 6. Circular polygons are used to represent the amount of planned settlement (the larger the circle, the more settlement is envisioned). Each map also shows the numbered traffic analysis zones and their boundaries used in the transportation demand model. The traffic analysis zones are represented by the irregularly shaped polygons – with the exception of the Regional Planning team's large polygon situated over the urban core area of downtown Halifax and Dartmouth.

[6] It was not necessary to develop a settlement map for the Base Case alternative as the Regional Planning team worked with existing demographics within the traffic analysis zones.

Figure 3 Alternative A settlement

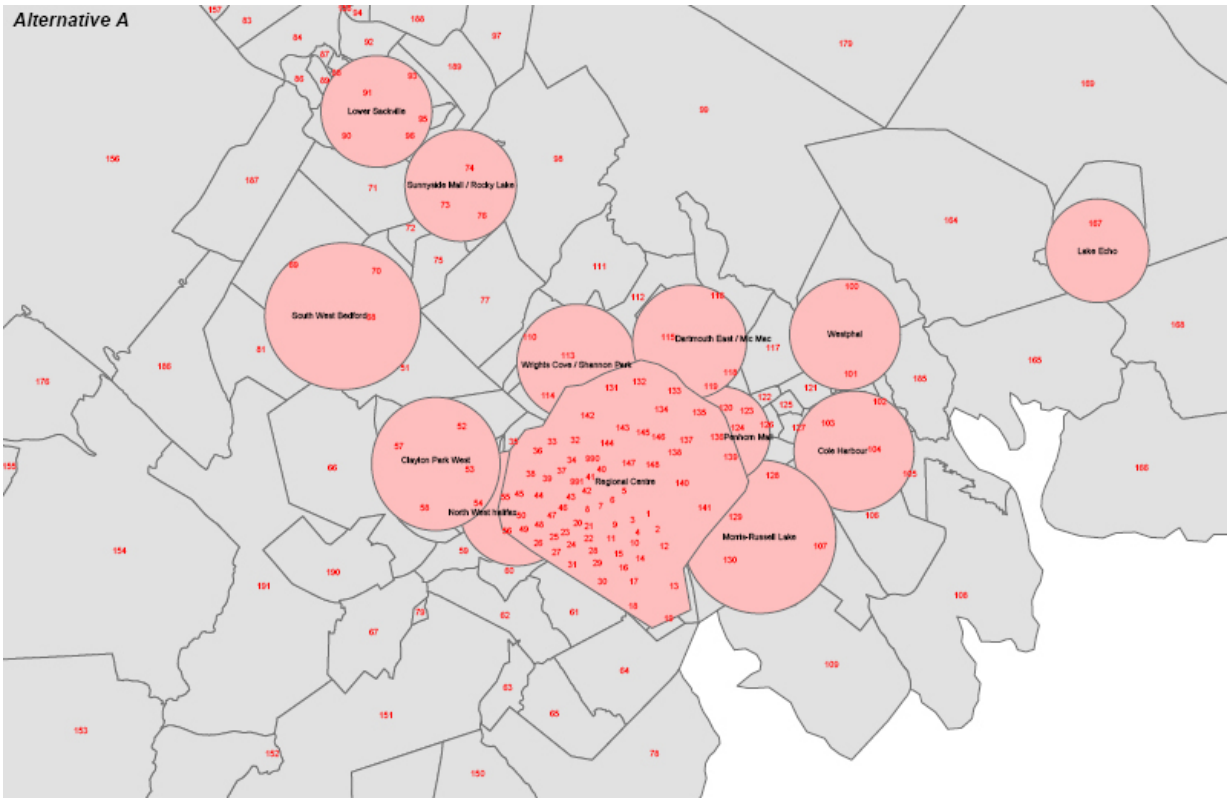


Figure 4 Alternative B settlement

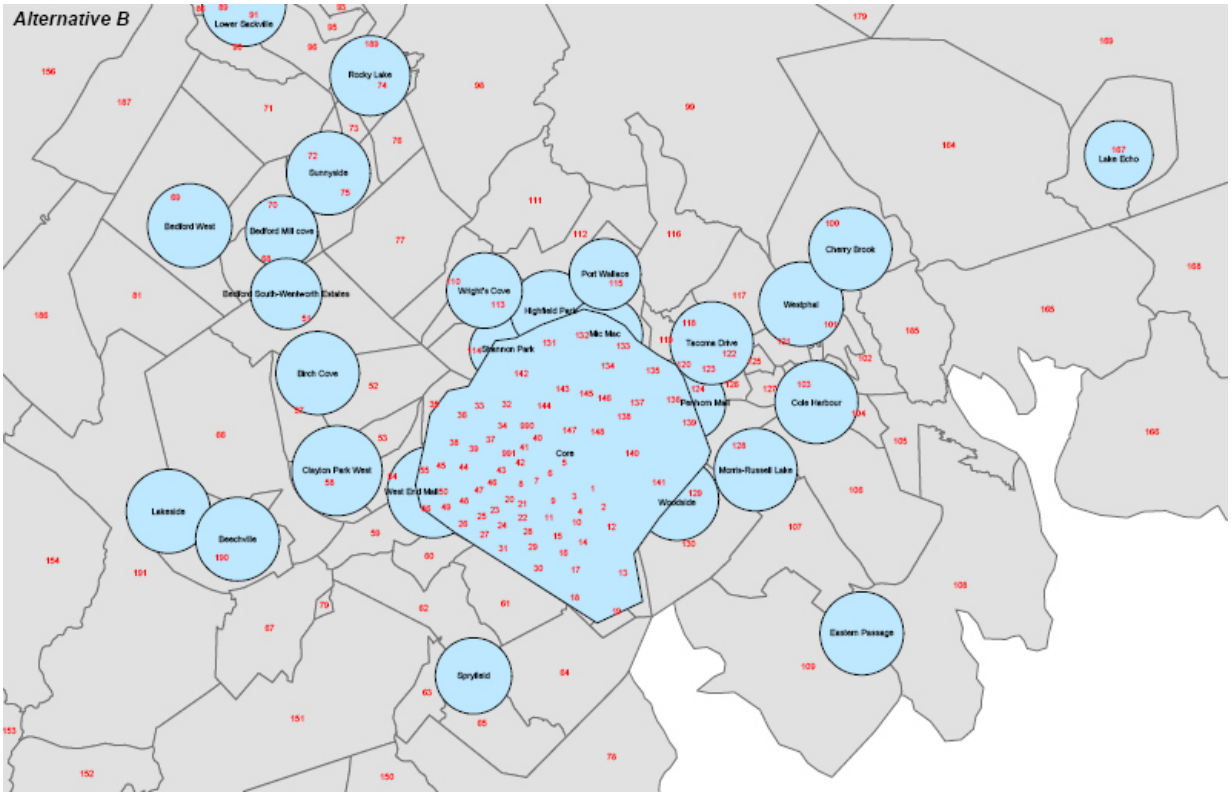


Figure 5 Alternative C settlement

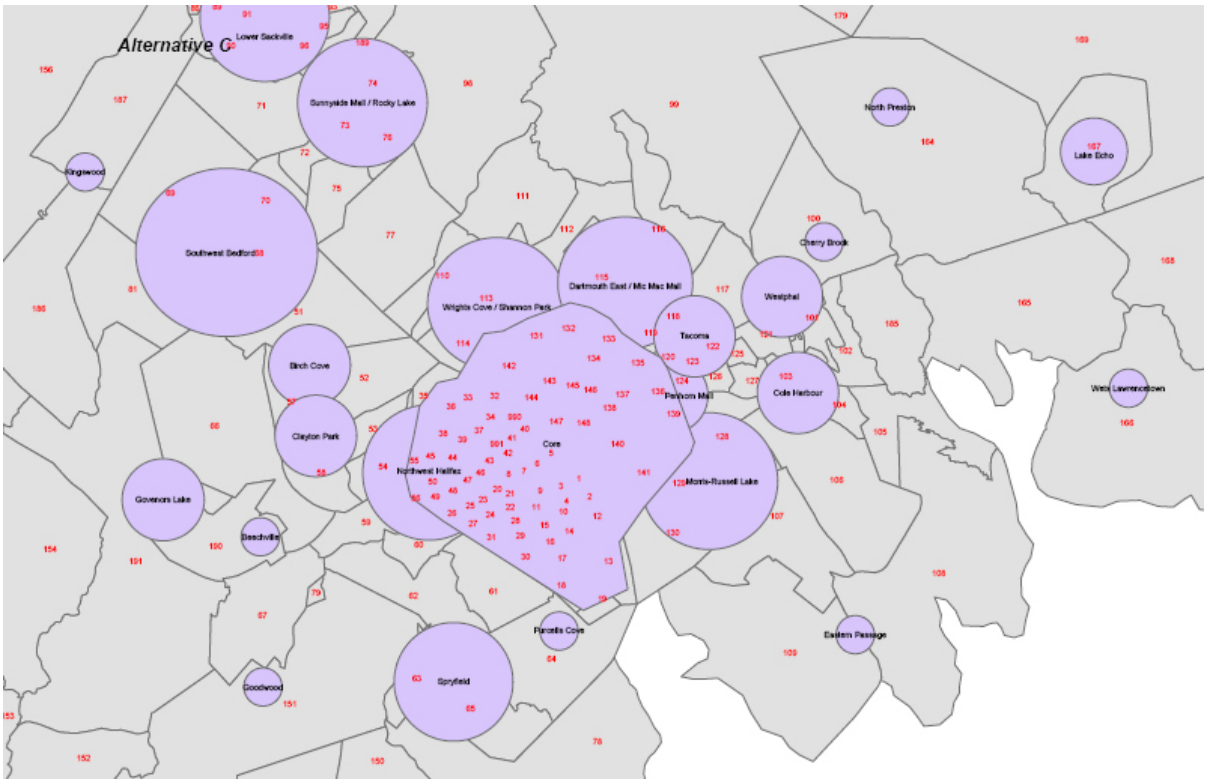
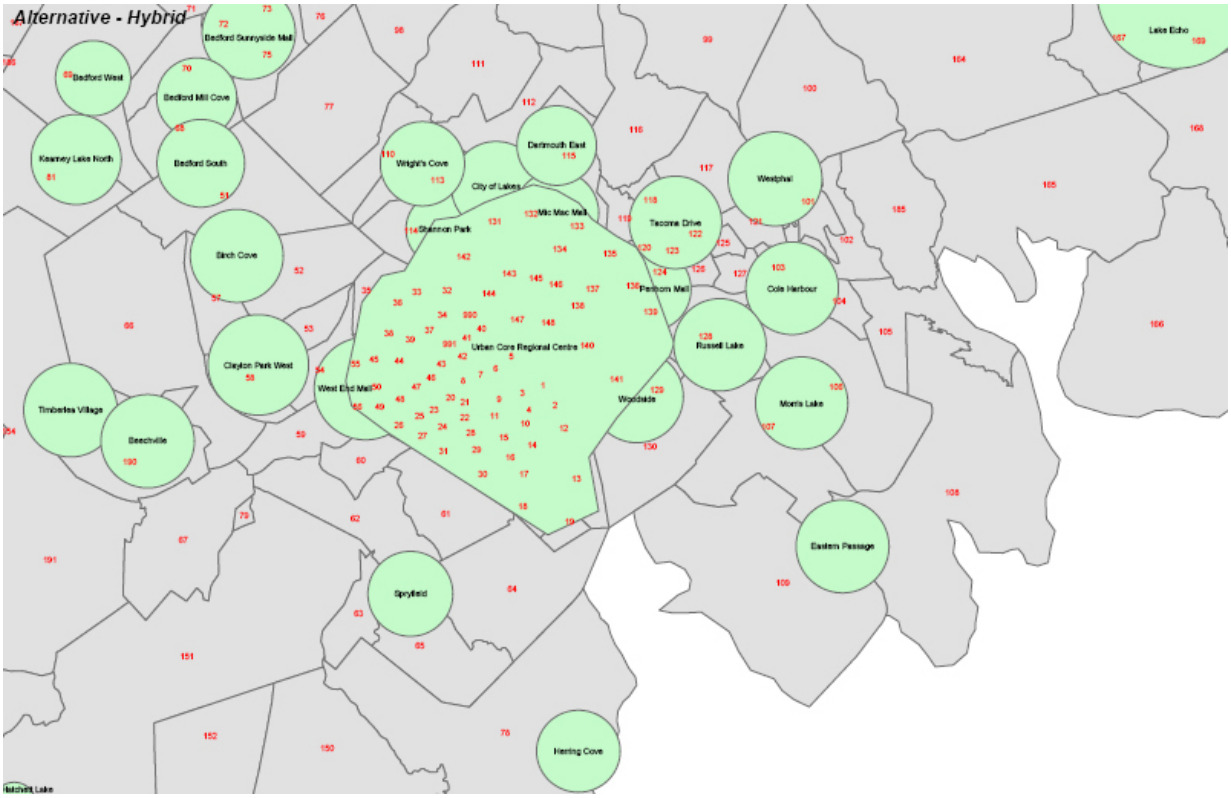


Figure 6 Hybrid Alternative settlement



3 Transportation Modeling

3.1 A brief history of transportation modeling in HRM

Planners build transportation models to analyze regional travel patterns under various scenarios of settlement, growth, changes in the roadway network, improvements in the use of public transit and other alternatives to the private automobile, and a variety of other infrastructure and policy measures. In order to be executed, transportation demand models require details on planned growth, patterns of population and employment, and data on the urban transportation system (desirably including all travel modes). The results of the model provide a simulated representation of how demand for travel will change, and the impacts of those changes on the transportation network. To operate properly, the model must first be calibrated and validated against a known baseline – a process discussed in more detail in Section 3.2 of this report.

In 1998 the HRM undertook the "GoPlan" Transportation Plan for the region and as part of that work had a consulting firm review the current transportation demand model at the time and calibrate it to the 1991 Census data. The geographic focus of the modeling effort was the Halifax peninsula and mainland areas. This model was termed the HRM "GoPlan".

The "GoPlan" model was then updated in 2000 / 2001 as part of the "Greenfields" study to reflect recent changes in land use and further refine the model parameters to ensure an accurate traffic assignment result.

In 2004, the Regional Planning efforts began with the use of the "Greenfields" model as its basic structure as it was HRM's model of choice for high-level transportation demand assessments at that time. McCormick Rankin Corporation were engaged by HRM to review and update the model to reflect recent changes in the roadway network and include additional traffic zones required to cover the entire geographic area of HRM. This resulted in the first regional transportation model since amalgamation.

3.2 Validating a demand model

As noted above, to properly execute a transportation demand model, it must first be validated against a known baseline. In this case, HRM had established the baseline planning horizon as 2001 given the available census data from Statistics Canada in the form of population (dwelling units), employment and data on the work trip.

Typically, demand models are calibrated at the corridor level using a demand forecast for the base year across a specific set of roads called screenlines (see Figure 7). Screenline locations are typically selected using geographic constraints such as a river, a railway line, or in the case of Halifax, the harbour. The base year model forecasts were then compared to observed volumes (from the same year) across a given screenline to ensure an adequate level of accuracy in the model. Adjustments were made to the model inputs and parameters when necessary to validate the screenline result. Part of McCormick Rankin Corporation's role was to take the updated transportation demand model (that

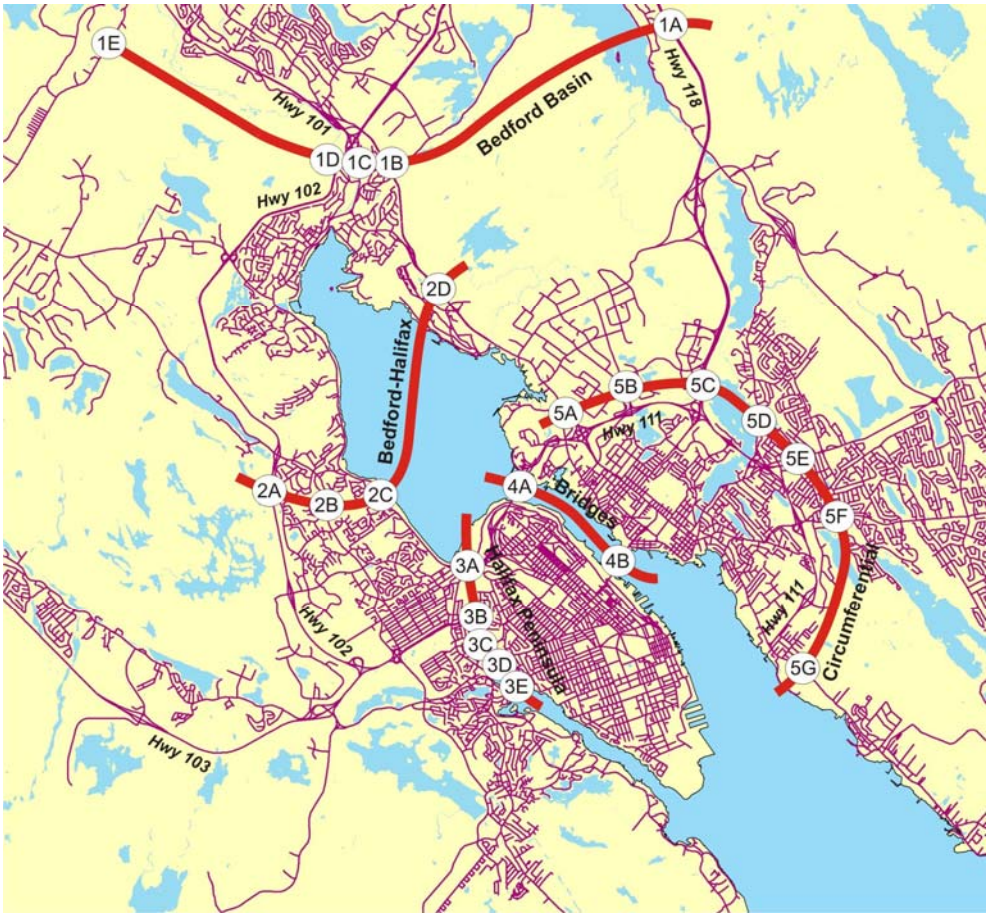
included the new geographic areas and roadway network updates) and validate the traffic volume results at the screenline level using traffic volume data provided by HRM for the 2001 count year.

The same calibration screenlines as those established in the “GoPlan” study were used. These are summarized in Table 4 and illustrated in Figure 7. The final calibration process resulted in modeled screenline volumes that fell well within the limits of recognized calibration guidelines used for these purposes.

Table 4 HRM Transportation Demand Model Screenlines

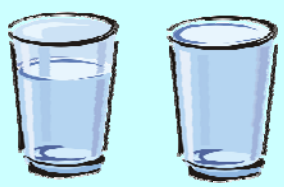
Screenline Name	Major Roadways Crossing Screenline						
1. Bedford Basin	1A - Hwy 118	1B - Bedford By-pass	1C - Bedford Hwy	1D - Hwy 102	1E - Lucasville Rd	~	~
2. Bedford-Halifax	2A - Hwy 102	2B - Dunbrack St	2C - Bedford Hwy	2D - Windmill Rd	~	~	~
3. Halifax Peninsula	3A - Kempt Rd	3B - Hwy 102/Bayers	3C - Mumford Rd	3D - Chebucto Rd	3E - Quinpool Rd	~	~
4. Bridges	4A - MacKay Bridge	4B - Macdonald Bridge	~	~	~	~	~
5. Circumferential Highway	5A - Victoria Rd	5B - Burnside Dr	5C - Hwy 118	5D - Waverley Rd	5E - Main St	5F - Portland St	5G - Pleasant St.

Figure 7 Screenline Locations Map



3.3 Measuring screenline performance

v/c explained
The volume-to-capacity ratio is a way of expressing the observed demand (approaching volume of traffic) in relation to the ultimate capacity of a particular facility. As the ratio approaches a value of 1.0, congestion increases, traffic slows, and the ability to handle additional vehicles is reduced. The v/c ratio thus provides an indicator of the residual capacity remaining on a facility. An analogy can be made to a glass of water. A glass that is half full would have a v/c ratio of 0.5. A glass that is entirely full has a v/c of 1.0. No more water can be contained, so excess water overflows. When the capacity of a roadway exceeds 1.0, traffic backs up.



The performance of a roadway or system of roadways can be measured in several ways. From a road user's perspective, typical measures of performance include time spent waiting or reliability from one day to the next. These are typically subjective in nature. Technical performance measures tend to focus on the quantifiable aspects of performance such as delay time, vehicle density, the limitations of a roadway or transit service (i.e. its capacity) and the observed demand or number of users. When evaluating regional transportation planning issues, practitioners typically use volume and capacity as general performance indicators. This was the performance measure of choice for this study.

The performance of a roadway is expressed as the ratio of observed volume (demand) to the ultimate theoretical capacity of a particular facility. As this volume-to-capacity (v/c) ratio approaches a value of 1.0, congestion increases, traffic slows, and the ability to handle additional vehicles is reduced. The v/c ratio thus provides an indicator of the general performance of a facility.

The v/c ratio results are taken across a screenline as a whole for several reasons. Among them include:

- Transportation demand models are simply mathematical models developed to replicate, as well as possible, certain aspects of human travel behaviour. Obviously, human behaviour in general is highly complex - making it difficult to model with a high degree of accuracy <u>and</u> precision.
- Transportation demand models are planning tools intended to identify global movements from one neighbourhood to another. For a given trip (from an origin to destination), the modeller is most concerned with which screenline the trip crosses, and is less concerned about where the trip crosses the screenline.

If we use the harbour screenline as an example, in a planning study such as this, we were interested in the total number of trips occurring across the harbour and the total cross-harbour capacity as opposed to the specific bridge or lane use on each bridge. Of course, during any calibration or validation process in preparing a model, practitioners attempt to ensure the most reasonable level of accuracy possible, while understanding the limitations of the model.

The results of the future planning horizon scenarios are presented later in Section 5.

4 The Modeling Approach

4.1 The modeling approach

In relatively simple transportation studies with small study areas, the use of historical trend projections of travel demand is sometimes sufficient to provide a basis for a decision on a matter of relatively low importance. However, given the large area under study and the potential future growth that is expected, this study was both complex and of great importance. We used a transportation demand model as a tool of choice for modeling present and future year traffic patterns for this study. This modeling process accounts for anticipated regional population and employment growth, committed changes planned in the Regional roadway network, and shifts in travel demand from private cars to other modes – such as public transit. It also allows for present-day and future year identification of congestion issues and bottlenecks, the examination of the potential effects of various corridor upgrade options on general traffic, potential transit and congestion relief benefits, and changes in the number of vehicle trips resulting from any new land use scenario. This approach eliminated the need for “opinion” or “trend” analysis, reduced the risks associated with such forecasts, and facilitated the use of sensitivity analysis in the examination of issues of particular concern.

4.2 What was modeled?

As explained earlier in this report, five land use scenarios were evaluated using the Region’s transportation demand model. These included:

- Baseline - 2001 horizon
- Base Case Alternative - 2026 horizon
- Alternative A - 2026 horizon
- Alternative B - 2026 horizon
- Alternative C - 2026 horizon
- Hybrid Alternative - 2026 horizon

For each scenario, the critical time period of a typical weekday was modeled. This was the weekday afternoon peak hour.

4.3 The process

Our approach followed the traditional modeling process that is widely accepted by transportation planning practitioners across North America. In addition, the

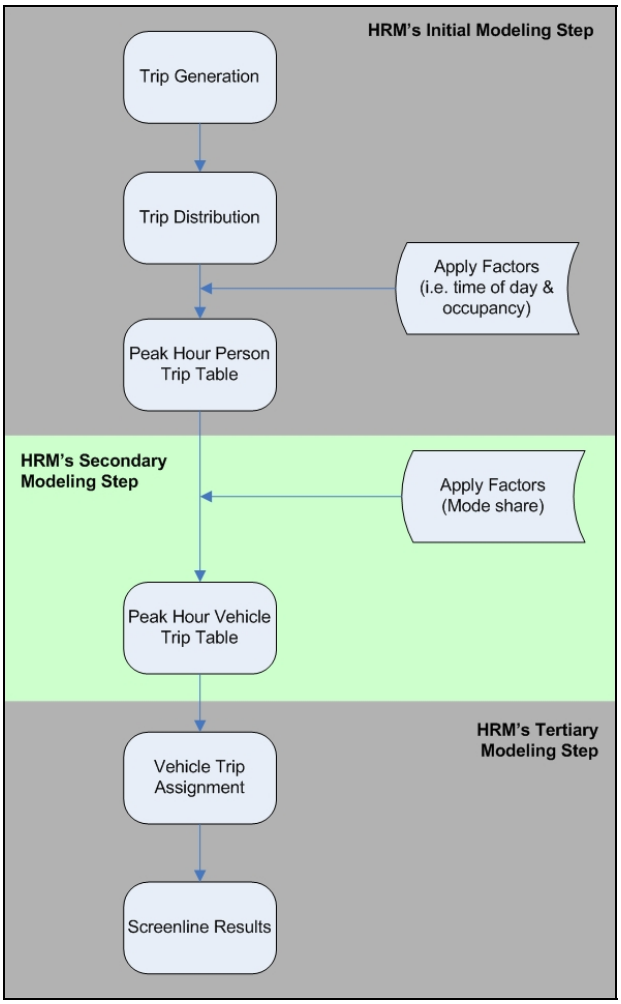
HRM guidelines were followed to execute the regional transportation demand model[7].

Once the Baseline 2001 planning horizon model was validated to current conditions, the following effort was carried out to build the 2026 planning horizon models for each of the five alternatives:

- Enter the land use data (i.e. dwelling units and employment) by traffic analysis zone;
- Modify the road network to reflect planned roadway improvements that were expected to take place between 2001 and 2026.

Once the 2026 planning horizon models were developed, they were executed using the Quick Response Software II (QRS II) tool. The HRM guidelines were followed to execute the models and the three key steps (i.e. initial, secondary and tertiary steps) are illustrated in Figure 8.

Figure 8 The HRM modeling process using the QRS II software



[7] "Revised Procedure for running QRSII Model". Memorandum prepared by Traffic and Transportation Services, Halifax Regional Municipality. December 12, 2000.

In the initial step of the process, the transportation demand model was used to calculate a total number of daily person-trips and determine how these trips are expected to be distributed throughout the Region. Time-of-day factors were then applied to yield a person-trip matrix for a weekday afternoon peak hour. We must note that person-trips are based on the expected population growth as well as the ability to access work, school, commerce, recreation or other daily needs. Therefore, regardless of the settlement pattern there will always be a need for mobility. It is how we manage this mobility that is important.

In the secondary step, person-trips were split among the mode choices (i.e. vehicle, public transit, walking, biking, and so forth). It is in this step where policy decisions can have a profound influence in how the future transportation network develops. As part of this process, vehicle trips were separated from all other trips using mode share factors – discussed in more detail in Section 6. In order to accommodate regional mobility via public transit there will be a need to invest in new and expanded transit services – investments that support the forecast mode share factors.

The final tertiary step explicitly evaluated the impacts of vehicle trips on the network. The Region's QRS II tool and model parameters were again used for this effort. The results were aggregated at the screenline level (discussed further in Section 5) to determine roadway constraints and identify potential roadway improvements to address these constraints. Clearly, the screenline results directly correlate to the mode split targets applied in Step 2. If the mode split targets are not realized, we expect that traffic demand will be higher than projected, and the need for additional roadway capacity will increase.

5 Findings of the Modeling Approach

5.1 Background

Under the new HRM Regional Plan, the Halifax peninsula is envisioned as the continued centre of economic and cultural life in the Region. Therefore, providing access to ensure the proper function and vitality of this important regional centre is both a challenge and a necessity. As such, we focused our presentation of results on the screenlines in the vicinity of the harbour and peninsula to ensure that future constraints are identified. This is not to say that the other areas of the region were not reviewed, only that the results identified roadway concerns closer to the urban and suburban areas.

5.2 The 2026 horizon screenline results

Once the land use assumptions for each of the 2026 planning horizon alternatives were coded into the transportation demand model, McCormick Rankin Corporation executed the model assignment process and summarized the results at the screenline level. We provide the weekday afternoon peak hour volume and volume-to-capacity (V/C) ratios for each alternative in Table 5.

Table 5 Transportation model results by alternative and by screenline

	Screenline	Base Case		Alt A		Alt B		Alt C		Hybrid	
	Capacity	Volume	V/C	Volume	V/C	Volume	V/C	Volume	V/C	Volume	V/C
2. Bedford-Halifax	9,300	7,757	0.83	7,557	0.81	6,890	0.74	6,890	0.74	7,450	0.80
3. Halifax Peninsula	8,000	10,001	1.25	8,725	1.09	7,915	0.99	7,941	0.99	8,571	1.07
4. Bridges	6,200	6,122	0.99	5,550	0.90	5,444	0.88	5,460	0.88	5,711	0.92
5. Circumferential Highway	15,100	13,785	0.91	13,529	0.90	13,081	0.87	13,067	0.87	12,894	0.85

- a V/C ratio that is considered to be acceptable (< 0.80)
- a V/C ratio that is near or approaching capacity (0.80-0.99)
- a V/C ratio that is at or over capacity (> 0.99)

Again, in this report we only present the results for Screenlines 2 through 5 (in the vicinity of the peninsula) as they represent the major corridors that are nearing or operating at capacity. Based on the volume-to-capacity results (for all of the alternatives) it is clear that vehicular trip making will continue to grow – despite an expected drop in the percentage of vehicle trips (due to HRM's planned efforts to improve public transit). The continued vehicular growth will in turn reduce the available roadway capacity during the peak periods of the day out to the planning horizon.

The results shown in Table 5 indicate that the 2026 Base Case Alternative settlement pattern is expected to have the greatest negative impact on the screenline V/C ratios and confirms HRM's original thinking that current settlement patterns are not sustainable over the long term and would require significant roadway widening (or other initiatives) to accommodate growth. The other settlement pattern scenarios show a relative improvement over the Base Case. Alternatives B and C have the least impact at the screenline level.

5.3 HRM's preferred scenario

5.3.1 Background

In a separate exercise that followed the transportation modeling work conducted by McCormick Rankin Corporation, the HRM gathered the available data on each land use alternative with the goal of selecting a preferred alternative. This selection process incorporated information from many disciplines (i.e. sustainable practices, financial considerations, water servicing, and so forth). HRM staff therefore used the transportation modeling results as one consideration in the overall decision-making process. Once HRM was able to carry out their internal evaluation of all the alternatives, a recommendation was made to select the Hybrid alternative as the preferred land use scenario.

Strictly from a transportation perspective – and relative to the other land use settlement patterns – the Hybrid alternative screenline values appear to result in vehicle volumes that are neither the highest (as in Alternative A) or lowest (as in Alternatives B and C).

5.3.2 Where is the growth planned?

A general indication of the growth allocation for the Hybrid Alternative is shown in Figure 9. The focus is on land areas surrounding the Halifax harbour as this is were the majority of change is expected to take place over the next 25 years. Figure 9 uses histograms to show the relative change from 2001 to 2026.

Figure 9 The Hybrid Alternative **-** Changes in population and employment by district (2001-2026)

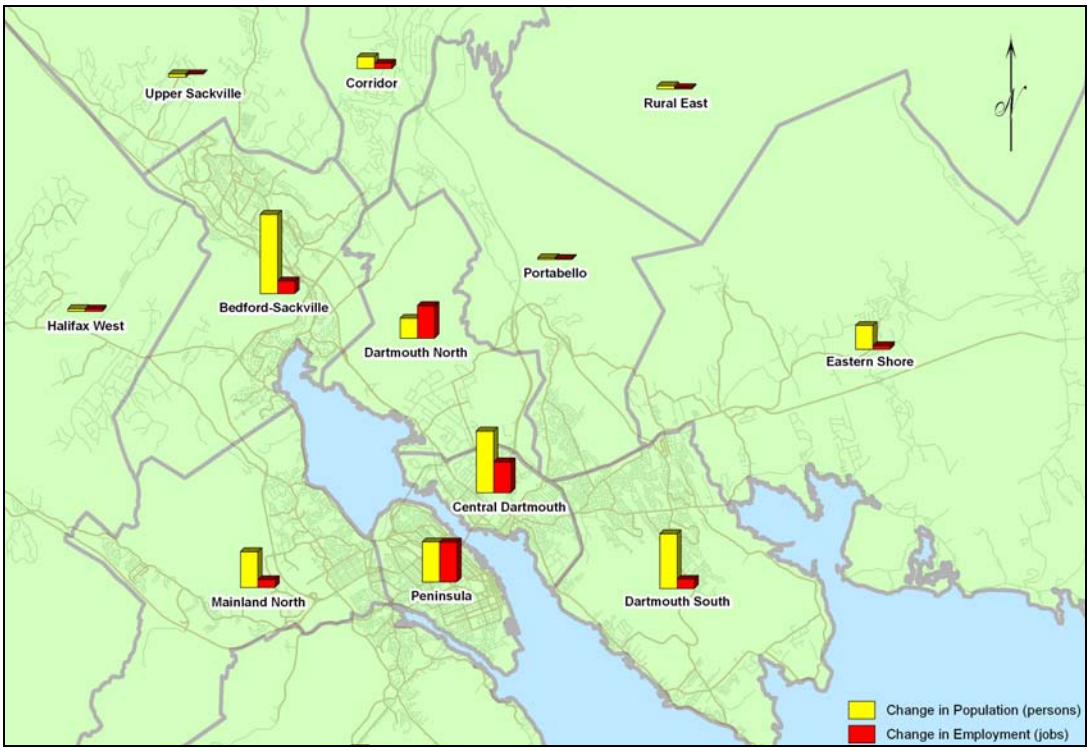


Figure 9 illustrates that population increases are planned to be focused on either side of the harbour (Dartmouth South, Central Dartmouth, Peninsula and Mainland North) and at the head of the Bedford Basin in Bedford-Sackville. Meanwhile, the majority of employment growth is intended to occur on the Peninsula, in Central Dartmouth and Dartmouth North (the Burnside area).

It is our understanding that new residential areas are planned in the Dartmouth South (i.e. Russell and Morris Lakes) and in Bedford-Sackville (i.e. Bedford South and West) districts. The remaining residential growth will occur in areas that are already developed and will likely occur as in-fill development and increased density.

5.3.3 Roadway improvement needs

Given the congested conditions expected on the roadway network (as presented in Table 5) – particularly in the case of the major roadways to/from the peninsula - HRM staff carried out supplementary transportation analyses of the Hybrid alternative to identify needed network improvements to support the planned growth. A summary of the findings that flowed from this work is presented below.

The HRM identified roadway network upgrades that were necessary to support the expected vehicular growth – growth that was expected to occur despite efforts to encourage the use of other modes (i.e. public transit). The HRM

termed these improvements as the "Regional capital roadway projects" and each improvement has been classified into one of the following three categories[8]:

Programmed – projects identified in the HRM three year capital budget;

Planned – projects anticipated to be built by the 2026 planning horizon (when needed); and

Future potential – projects identified to be constructed beyond the 2026 planning horizon.

The projects identified by HRM based on their supplementary analysis of the Hybrid alternative are contained in Table 6.

Table 6 HRM capital projects to accommodate vehicular growth

Programmed Projects	Planned Projects	Future Potential Projects
Lacewood Drive - Extend four lane width from Main Street to Joseph Howe Drive	**Bayers Road** - Widening to five or six lanes between the CN Rail overpass and Connaught Avenue and to four lanes between Connaught Avenue and Windsor Street	**Barrington Street** - Four lanes between the two bridges
Mount Hope Interchange and Extension of Mount Hope Avenue to Baker Drive	**Burnside Drive/Commodore Drive Intersection** - Addition of intersection approach lanes	**Beaver Bank By-pass**
Fairview Interchange Upgrade - Upgrades recommended in the *Bridge Capacity Study*[17]	**Wright Avenue Extension** - Extend Wright Avenue from Burnside Drive to Highway 118	**Highway 113** (Provincial)
Armdale Rotary Conversion and Chebucto Road Reversing Lane - Conversion of rotary to modern roundabout and upgrading of Chebucto/Mumford intersection to permit a reversible centre lane on Chebucto Road	**Highway 107 Extension** - Connect Akerley Boulevard to Highways 101 and 102 (Provincial)	**Highway 107** - Cherrybrook By-pass (Provincial)
	Herring Cove Widening - Four lanes on Herring Cove Road between Old Sambro Road and the Armdale Rotary	**MacKay Bridge Twinning and Connection to Bedford Highway**
	Mount Hope Avenue - Extension from Baker Drive to Caldwell Road	
	Bedford South Interchange	
	Middle Sackville Connector	
	Highway 101 Connector and Interchange (Provincial)	

Source: HRM Regional Municipal Planning Strategy, 2006.

[8] Halifax Regional Municipality: Regional Municipal Planning Strategy. Chapter 4. 2006.

6 The Role of Public Transit

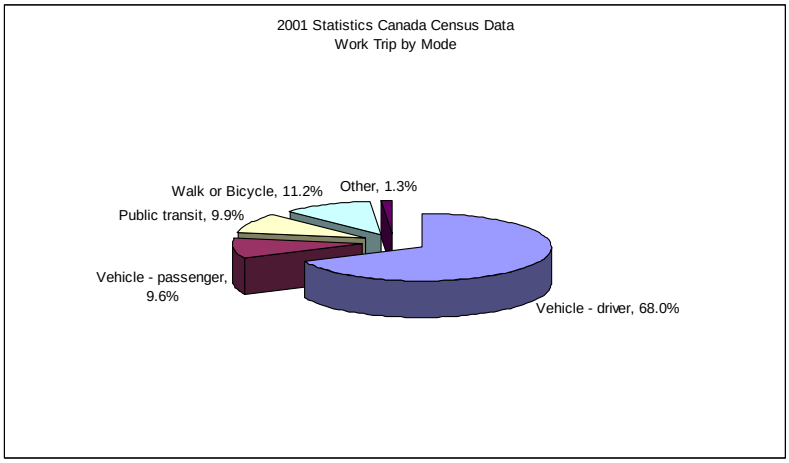
6.1 Background

The HRM Regional Plan sets out a critical role for public transit in servicing the future travel demand that results from the planned growth in the Hybrid alternative. This is not surprising and is in keeping with international trends in transportation planning which necessarily focus on developing sustainable urban transportation systems that focus on preserving liveable communities and significantly enhancing opportunities for people to travel using alternatives to the private car.

In assessing current levels of use of public transit, the HRM Regional Planners estimated that in 2001, region-wide average transit use during the evening peak hour represented a portion of the 18 percent mode share[9] of all person trips taking place during that time, regardless of the purpose of the trip. Trip purpose is important, since normally, transit is most effective in servicing the work trip, and usage levels reflect this fact in other Canadian municipalities. Of course, the work trip represents only a portion of all travel taking place during either peak hour of a typical weekday.

In order to gain a better understanding of the 18% mode share value we carried out a cursory review of both census and Metro Transit data. A review of the Statistics Canada Journey-to-Work survey for 2001 suggests that work-trips made on public transit in Halifax are in the order of 10% and the total non-vehicle mode of travel to work was about 21%[10]. A breakdown of the 2001 census data for all trips to work is illustrated in Figure 10.

Figure 10 2001 Census data showing work trip by mode of travel



[9] Our discussion uses the term mode share which we define as all modes of travel other than trips made in a vehicle.
[10] The 21% includes public transit, walking and bicycle modes.

Metro Transit provided ridership data for the year 2007 and, although not from the 2001 baseline year, it represents a reasonable estimate of current transit demand. It was determined from these data that the average weekday afternoon peak hour ridership (region-wide) was about 7,500 person-trips on a fleet of 206 buses. The total number of person-trips on the regional road network, as taken from the transportation demand model, totalled about 128,300. If we relate these two numbers and express the actual transit ridership as a percentage of all trips on the regional road network, the transit mode share is about 6% (for all trip types).

As stated earlier, typically we expect the transit share percentage of all trip types to be somewhat less than the work trips by transit - and such is the case. We have therefore concluded the total mode share percentage of 18% is made up of a portion of transit (about 6%) and the remaining include the walking and bicycle modes. As a result, for our demand modeling purposes we accepted the HRM baseline modal share use projections as being reasonable and incorporated them into our modeling efforts.

6.2 Setting a mode share target

6.2.1 Developing the targets

In a parallel exercise to our transportation modeling work, HRM engaged transit consultants Entra to develop forecast mode share targets. Initially, the HRM Regional Planning team developed future transit opportunity corridors (as shown in Map 1 of the Regional MPS) that attempted to connect the key settlement nodes in each of the land use Alternatives. Entra then used these transit opportunity corridors as a basis for the modal split analysis. Using knowledge developed through past experiences in planning studies for higher order transit services, Entra was able to develop – at the traffic zone level – mode share targets for each of the five land use Alternatives at the 2026 planning horizon.

6.2.2 The mode share results

The results developed by Entra were incorporated directly into the transportation model. As shown in Figure 11 the percent mode share targets were aggregated by sub areas that essentially radiate outward from the downtown (i.e. sub area “Centre” in Figure 11). The red colour denotes existing mode share and the yellow colour identifies the increase in mode share to meet the future targets.

Figure 11 Mode Share Targets for 2026 (by sub area) – Hybrid Alternative

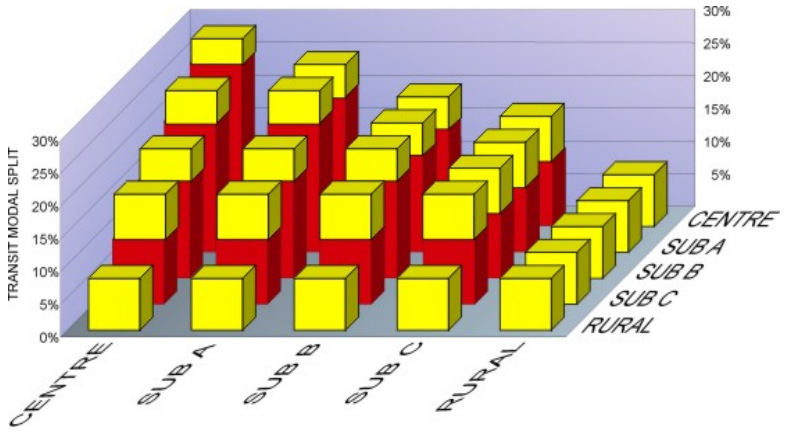


Figure 11 indicates that the highest mode share targets are expected for trips between all traffic analysis zones located in the "Centre" sub area (i.e. on the Halifax peninsula and downtown Dartmouth). The lowest mode share targets were established for all trips originating or destined to the rural areas of the Region. Overall, the average mode share (for all trips being made throughout the region) during the weekday afternoon peak hour (expected by the 2026 planning horizon) is 23%. The 23% modal share target is comprised of transit, walking and bicycle modes.

Such a target translates into an ambitious initiative that will require very substantial investments in active transportation (i.e. bicycle and trail facilities), public transit systems and the infrastructure associated with deploying that transit fleet effectively. If we assume all of the increase in modal share to be made by increases in public transit ridership, this would mean the current 6% transit share would increase to 11% by the 2026 planning horizon. Again this assumes that the combined percentage of walk and bike modes would remain at 12% (to yield a total of 23%). The details of such an increase are contained in Table 7.

Table 7 Existing and future transit ridership (afternoon peak hour)

	Peak Hour Transit Ridership	Peak Hour Trips by All Modes	Transit Mode Share
Baseline	7,500[A]	128,300	6%
2026	19,085	173,500	11%

A - data provided by Metro Transit, remaining numbers from Regional model

As shown in Table 7, an increase from the current 6% to 11% by 2026 translates into a future estimate of just over 19,000 trips per hour – nearly a three-fold increase over current levels. To put this number into perspective, current Metro Transit ridership is about 50,000 riders per day. Therefore, in order to carry 19,000 riders during the peak hour, substantial investments will have to be made in both the transit fleet and the infrastructure to accommodate it. It appears that Metro Transit has plans to meet the service goals necessitated by the Regional Plan assumptions by increasing spending on capital and operating costs by $20.5 million by the year 2015[11].

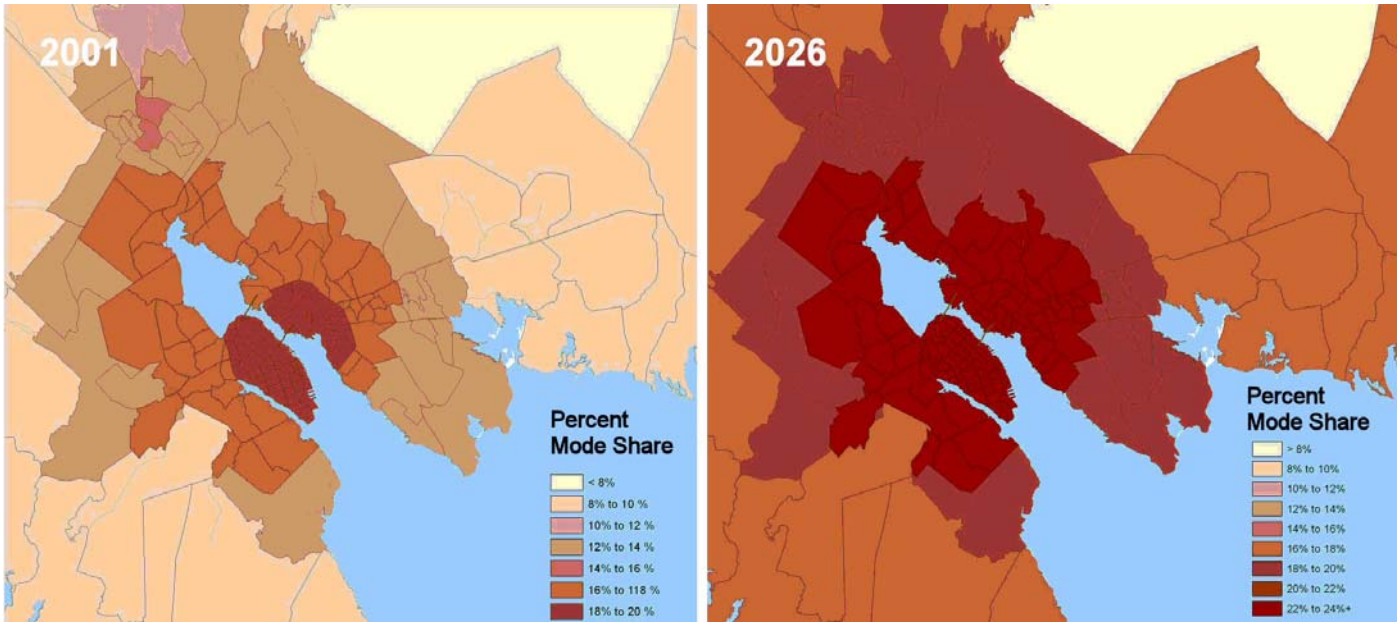
We emphasize the ambitious nature of the HRM modal split targets not because they are not achievable: with suitable investments and aggressive travel demand management policies, there is some likelihood that they might be reached – and Metro Transit has made efforts toward this end. However, it would be inappropriate not to consider the real possibility that – for a variety of reasons, and in particular because of the very substantial funding required to build a transit system capable of attracting and supporting such usage levels - the targets will not be achieved. Not achieving these targets means that additional roadway capacity for vehicles, such as a new harbour crossing, may be required

[11] HRM Metro Transit Five-Year Strategic Operations Plan (Supplemental Report to Halifax Regional Council), January 26, 2010.

earlier – perhaps much earlier - than would be the case if future modal shares were consistent with those goals.

In order to better articulate the required changes in the regional mode share (i.e. both transit and active modes) we identify the mode share percentage by traffic zone for both the 2001 baseline and the forecast 2026 scenarios in Figure 12.

Figure 12 Change from 18% to 23% Modal Share (2001 and 2026)



As illustrated in Figure 12, drastic increases in mode share must occur in the urban areas outside of the Capital District – such as mainland Halifax, the Bedford area, and Dartmouth (outside of the circumferential highway). Increases in modal share will also have to occur in the lower density, outlying suburban areas.

6.3 The implications of modal share targets

If the HRM cannot achieve the 2026 target modal share of 23%, other studies have shown that traffic congestion in the Region – and in particular on the Peninsula – will become intractable. Under such conditions and unless significant funds are invested in the expansion of road infrastructure in the region, commuters will suffer significant delay. Traffic congestion has also been shown to be a significant contributor to increased levels of CO_2e[12] emissions. Of course, if access to the Peninsula area becomes difficult and time consuming, it is also unlikely that the planned employment and residential growth in this area of the HRM will be realized. This would represent a significant failure of the planning process which carries with it real and important financial and broader economic consequences. Therefore, unless HRM revisits their population and employment

[12] Carbon monoxide equivalent is an international measure that accounts for all greenhouse gases into one unit.

allocation assumptions, it is our view that providing some form of dedicated transit corridor to/from the peninsula could play a key contributory role in achieving this target.

7 Concluding Thoughts

7.1 Transit implications

As presented in this report, it is expected that the growth in trips will continue to the planning horizon and beyond. If the municipality is to have an impact on managing this increase it will need to invest significantly in public transit initiatives.

Given the success of Metro Transit's Bus Rapid Transit (BRT) initiatives (to Sackville and Portland Hills) there seems to be a benefit in continuing to build this system. Metro Transit has outlined some of the details of this strategy in their 5-year Strategic Plan study.

In addition, and looking out further towards the planning horizon, higher order transit services on a dedicated corridor are required to service the major employment areas on the peninsula. Currently, HRM and Metro Transit are exploring opportunities such as express transit bus, high speed passenger ferries and commuter (heavy) rail concepts. It is expected that one or more forms of this type service will be needed to achieve the expected transit ridership numbers identified in the Regional Plan.

7.2 Long-term decision making

Without extraordinary expenditures and disruptions to existing neighbourhoods, there are limited opportunities to provide roadway widening for commuter cars onto and off of the peninsula. This fact is supported by numerous studies carried out in the recent past for HRM. If widening is to occur it should be focused on supporting bus transit (in the form of queue jump lanes or bus only lanes) or carpooling (in the form of high occupancy vehicle lanes) initiatives. This will have the added effect of minimizing the "footprint" of any roadway changes.

Roadway widening (whether for commuter cars or public transit) is not the only tool available to HRM to address the increased growth (and resulting travel demand) outlined in the Regional Plan. Consideration should be given to the incentives for drivers to move away from long commutes and single-occupant vehicle trips as outlined in the HRM Transportation Demand Management (TDM) Functional Plan report. These include:

- road pricing (in the form of cordon tolls for access to the peninsula, for example);
- managing parking availability on the peninsula (possibly through strategies like maximum parking requirements for developments as opposed to minimum parking requirements);
- employer education programs on the benefits of travel demand management (i.e. employer subsidies for public transit by their employees);

- completing a continuous network of active transportation links to/from the major employment areas on the peninsula (including enhanced bicycle lanes on routes that are comfortable for most);
- revisiting the central core planning approach set out in the Regional Plan (such as a more dispersed employment model that may reduce the impact on the peninsula's limited access to traffic capacity);
- neighbourhood or secondary area plans that focus on satisfying trip making needs at the local level (this may be achieved through more emphasis on mixed uses and the encouragement of in-fill developments).

Going forward, policy implementation will need to be monitored through regular updates to ensure the directives are being carried out in an effective manner. It is therefore necessary for HRM to identify when periodic reviews of the Plan are carried out.