



To: Mayor Kelly and Members of the District Boundary Review Committee

From: Cathy Mellett Acting Clerk/Manager, Office of the Municipal Clerk

Date: January 5, 2010

Re: Final Report - HRM population and population distribution to July 2009 and projections to December 2012

Attached please find the final report submitted by Environics Research for the HRM population estimates for July 2009 (current) and to December 31, 2012. The final report outlines the methodology and data sources used by Environics and HRM to arrive at the population projections and the highest level (total) population projections for HRM for July 2009 (current) and projected to December 2012.

HRM has been provided with full tables of the population projections to the DA (dissemination area) level. Dissemination areas have been developed by Census Canada to describe the smallest areas of population within a region like HRM. There are 575 dissemination areas within HRM and generally they are a few city blocks and bounded by streets or other natural divisions. Defining DA's can be challenging in more rural areas but HRM staff are very familiar with working with the DA's within HRM and the most challenging areas where DA's cross existing polling districts or have geographic challenges.

Environics and HRM staff are available to review the finding with the Committee at your earliest convenience. HRM staff would be ready to provide the committee with the finding re: growth to 2009 for the current polling districts as well as to describe the areas of current and future growth based on the work undertaken by HRM and Environics. A formal presentation would serve to provide much greater detail and clarity for the committee on the results and how those results will be used in Phase 2 of the District Boundary Review process in aligning boundaries based on population and growth as required of HRM by the Nova Scotia Utility and Review Board.

Please advise as to your wishes so that travel plans can be discussed with staff from Environics.

Overview of Estimates and Projections of Population and Potential Voters in Halifax Regional Municipality Estimates for July 1, 2009 and December 31, 2012

Submitted to Halifax Regional Municipality
December 16, 2009

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Preface

This report does not contain many of the deliverables especially the detailed data or estimates and projections deliverables. These were delivered in separate files or reports that have not been repackaged here.

1. Objectives of the Project

In compliance with the HRM Charter, the HRM is undertaking an electoral district review. In order for the HRM to complete the review, they are in need of a population estimate for July 1, 2009 and a projection for December 31, 2012. In addition, HRM requires analysis of data, specifically, population migration, birth and death rate trends, Statistics Canada data and other required information in the form of a final report, including the methodology. These estimates and the final report will be used by HRM staff as the basis for creating electoral district scenarios as part of the electoral district review. In developing the final report, HRM requires analysis and dissemination of the population estimates and projections and also the number of persons in the electorate. The analysis should include information on birth and death rate trends, population migration, Statistics Canada data (voting eligibility) and other relevant information required.

2. Deliverable Components: Data Files and Reports

The following are the components of the deliverables roughly in the order delivered electronically to HRM over the period September 2009 to late November 2009.

1. Report entitled "A Note on the Population Growth in the Halifax Regional Municipality" (prepared by Dr. Doug Norris) on the larger scale trends, based mainly on Census data. This was delivered in an email on November 9th, 2009. A revised version with a slight change in numbers was sent to HRM in late November.
2. This document entitled "Overview of Estimates and Projections of Population and Potential Voters in Halifax Regional Municipality Estimates For July 1, 2009 and December 31, 2012" .
3. Estimates for July 1, 2009 for households and population at the DA level. This was delivered in an email on November 9th, 2009.
4. Estimates for July 1, 2009 for the population 18 years of age plus and estimates of the electorate at the DA level.
5. Projections for December 31, 2012 for households and population at the DA level.
6. Projections for December 31, 2012 for the population 18 years of age plus and estimates of the electorate at the DA level.
7. Summary (point form) of the methods used to estimate and project the 4 deliverables just noted.

8. Estimates of the number of university students in university residences that are eligible voters for July 1, 2009. This was delivered with a statement of data and methods used.
9. Following the final report, EA will meet with HRM on site in January or February 2010 to provide a presentation of the final estimates and projections. At that time, EA will brief HRM staff members on the results of the estimates and projections project and provide consultation and insight into the methods used and the results.
10. NSUARB hearings. As a final phase to the project, Environics Analytics Group will provide consultative support to HRM leading up to and during the NSUARB hearings. Environics Analytics Group will be generally available to defend the estimates and projections methodology and will be able to answer questions pertaining to the final deliverables.

Note: Below we refer to **"the main deliverable data"** – which included items above numbered 3, 4, 5, and 6 as a package that we sent to HRM as one Excel spreadsheet file in a November 24th, 2009. (The file was in an email to HRM from Robert Dominico).

3. Estimation and Projections Methodology

The methodology and techniques used to complete this project for the HRM closely followed those outlined in the proposal originally created for this project. The EAG team employed many of the techniques implemented for the production of their annual DEP (Demographic Estimation and Projections) data product, which generates national estimates and projections at all geography scales, including the Dissemination Area (DA), for hundreds of variables. Due to refinements recently applied in the 2010 DEP and additional datasets provided by the HRM some modifications to the standard DEP process have been made for this particular project.

The following section outlines the data techniques applied by the EAG team to arrive at the final 2009 and household, population, and electorate estimates and projections generated for the HRM. This section is broken out into two major parts. The first part describes the data collection and preparation stages of the project, while the second part outlines the modeling techniques applied at the Census Tract (CT) and DA geographies to arrive at the 2009 estimates and 2012 projections. **For those non-technical readers it is sufficient to read only the bolded portions of the rest of this section 3.**

3.1 Data Collection and Preparation

The data sets used for the project are listed and described in Appendix 1 of this document.

As a first stage of the project, **all relevant datasets were assembled, cleaned and checked to ensure that they were in the appropriate formats.** The data involved in this analysis includes all relevant census data. EAG maintains full versions of both the 2001 and 2006 for all census and postal geographies, as well as estimates of growth rates at the Census Subdivision (CSD), CT and DA geographies for pertinent census variables. The Centre for Spatial Economics (C4SE) (our long term supplier of these data) was subcontracted to produce CSD level 2009 and 2012 population by age totals. TeleAtlas land use and transportation infrastructure datasets were also used by EAG. The HRM provided EAG with a wide variety of datasets pertaining to local development and land use. **Many of the census variables and**

TeleAtlas datasets are used to produce synthetic variables at the DA and CT scales. These variables are ones that are very helpful in estimations and projections exercise but they do not appear naturally and must be constructed from other natural variables.

The synthetic variables created by EAG are of three types: density, mathematical potential, and gradient. The density measurements created are based on households and population per possible usable land unit (i.e. only land area where residential units can be legally constructed is considered usable). "Mathematical potentials" are synthetic variables constructed for small geographical units on the map (each DA) by EAG using different 'distance decay functions' to estimate the closeness to areas that need to be taken into account. In this case the attributes that need to be taken into account are areas that have distinctive features and/or have been growing in the past such as: population, households, population and household growth, transportation (especially highway) infrastructure, and employment/business. The last synthetic variable type, gradients are analogous to the slope of terrain and are computed by measuring a DA or CT's growth rate against its neighbours. These allow us to anticipate the location and direction of settlement growth. **All of these synthetic variables along with other non-synthetic variables are used to generate a special abstract 'growth attraction score' for each CT or DA in the HRM.** Once the attraction score is generated the estimation and projection process can begin. However it should be noted that for later periods these artificial variables have to be recomputed given the previous period's estimates.

3.2 Modeling Methods and Procedures

The primary purpose of this project was to estimate potential voters, or the electorate, at the small spatial scale. EAG generated electoral estimates and projections by estimating the population of Canadian citizens age 18+. In order to accomplish this, it is important to take account of three key variables: the population per se, the age distribution of the population (the reason that EAG needed to generate detailed CT and DA scale population-by-age estimates) and Canadian citizenship. Clearly persons who are too young and/or persons who are foreigners are not eligible to vote. Special attention was given to the handling of collective dwellings and in particular seniors housing. EAG deals with collective housing as a group and additional information provided by HRM on new seniors housing was used to estimate 2009 collective dwelling population.

Once all of the necessary pieces of data were cleaned, formatted, or calculated, the estimation and projection of households, population, population ages and the electorate followed in a multi-stage process. **The 2009 estimates were completed prior to starting in on the 2012 projections as they would become the starting point for the 2012 projections.** As is standard with the EAG DEP process, the **CT level estimates and projections are produced first and then used to 'control' the summations at the DA level. Furthermore, for both the CT and DA geographies the estimation and projection process was undertaken using the standard EAG DEP procedure modified to include the input from HRM provided local data. This allowed for the incorporation of detailed local data collected by the municipality and a reconciliation process with the regional targets established by EAG.**

To produce the 2009 household, population, age, and finally electorate estimates, a set of modified existing SQL EAG programs are used. The modifications were made to accommodate the inclusion of data supplied by HRM. **The local data provided by HRM were added into the growth allocation model to redefine the local drivers behind settlement growth in the model.** These programs are run sequentially with formalized stops and quality control checks so that potential errors are caught and do not affect later stages of the estimation process. First, **household counts for the CT are estimated using the 'growth attraction score' and the EAG CSD controls. Then this same process was done for the DAs where the CTs are used as the control for the DAs not the CSDs.** The CSD controls were done

especially for the HRM project and as previously mentioned became the target goals for the regional counts. **From the household estimates, the population count estimates were generated. Special rules were used regarding the population per household and the local level. Then the age distributions and the electorate counts were estimated for these populations.** These estimates are produced and controlled using what EAG refers to as a 'rake' and 'sprinkle' process. The 'rake' procedure is based on iterative proportional fitting (IPF) algorithms in which the row and columns are reconciled (for example with CTs and rows and ages as columns). In this process the row and columns totals are "known" for a matrix and the values of individual cells are estimated. The 'sprinkle' process is used to take non-integer values and convert them to integers without compromising the row and columns totals for a matrix or the pattern across the cells of the matrix.

Creating values that are now past values is called "estimation" and creating values for the future is called "projection". The process of projection of future households, population, population ages and the electorate is substantially the same as estimation. In the projection for 2012 the key 2009 data inputs are replaced by the appropriate December 31, 2012 data: permit data up to 2009 was replaced by EAG estimates from subdivision forecasts, etc. For this particular project, the 2009 estimates generated were used at the starting point for the projection process. CSD level 2012 projections by EAG and growth projections based on invaluable data provided by the HRM were used to produce control totals for the 2012 projections. The projection process used historical trends based on the 2009 estimates and augmented local level synthetic variables. These are similar in nature to the synthetic variables used for the 2009 estimates, but focus more on change over time. A new set of "growth attraction scores" were produced for the CT and DA geographies. **From these input datasets, a similar process (i.e. the 'rake' and 'sprinkle') to that implemented for the 2009 estimates was implemented for 2012, where the control totals and attraction scores were used to allocate households, population and electorate numbers to CT and DA geographies.**

Each output - households, population, population by age, and finally estimates of the electorate, went through a rigorous set of quality control checks. EAG has developed a set of procedures for ensuring the quality of estimates and projections. The first set of procedures test to see that all constraints are observed (i.e. sums are not exceeded, no negative values, all DAs or CTs have a value, etc.). The second set of procedures check to see if the estimates or projections are 'reasonable'. Here EAG produces a variety of graphical representations of the data including temporal graphs and maps. These graphics are used to ensure that estimates and projections are consistent with past trends and are logical given what is "known". Additionally, EAG uses Google Earth to determine areas where too much or little growth or change is occurring by overlaying translucent CT or DA polygons on top of aerial photographic imagery. Any outliers that are discovered from these quality control procedures are fed back into the process described above in an iterative fashion until the estimates are consistent and satisfactory.

4. Estimates and Projections

Environics Analytics has delivered estimates of the HRM electorate at the small dissemination area, DA, level of geography for July 1, 2009 and projections for December 31, 2012 households. In order for EA to deal with the electorate we had to do necessary preparatory work on estimates of other variables. We also used our EA projections of the age distribution of the HRM population as part of our data inputs. In order to complete the estimates for the July 1, 2009 electorate and projections of the December 31, 2012 electorate we went through these logical steps:

- estimate dwellings and households
- estimate population
- estimate populations by relevant age groups
- estimate electorate members

- *(side issue: estimate Canadian university students in residence)*

Each of the lower listed items makes use of the constraints set by the higher level data. We did these estimates at the level of the Census Division (HRM) and then Census Tract level and then using the bounds established at the level we did it for the DAs within the CTs as described in the methodology section above. The method simply required that the sum of the outputs at the DA level would necessarily be equal to the previously estimated larger level of geography within which the lower units nest.

It is not helpful in this short, overview report to point out which DAs are growing the fastest or slowest or the ones that have the largest electorate. Such a discussion would require detailed tables of data and maps. This is easily done with the data that we have delivered but it is not done here. In this section we comment on the key data sets and growth rates and trends that were a major part of this project. This discussion is of the general issues, and trends at the level of the Census Division which is also known as the HRM.

4.1 Population Estimate for 2009

The data used to estimate and project HRM's population comes from three sources; the census for 2006, and two types of very relevant "estimation" population numbers from Statistics Canada. These estimates take into account the latest Census numbers so they are the main focus. These are the most up-to-date "final or revised estimates for 2008" and the "preliminary estimates" for 2009.

The preliminary estimates are undertaken first when all of the data required to do the best estimation job is not available, whereas the revised ones do. The Census has two deficiencies: the Census data which comes every 5 years is often old, and they have a non-trivial undercount of the order of 3%. All these datasets, and their many subcomponents (births deaths, migration, etc.) were studied and taken into account in our work.

The 'preliminary estimate' of growth in Nova Scotia from Statistics Canada for 2008-09 is 1598. This is lower than the 'preliminary estimate' of growth for Nova Scotia for 2007-08 of 2271 (Table 1). (It is expected that the best estimate of change is to compare 'preliminary estimates' rather than compare a 'preliminary estimate' for one year with a 'revised estimate' for the other year). This lower growth at the provincial level suggests a somewhat lower growth for 2008-09 for the HRM as well.

Table 1

Preliminary Estimates of Components of Population Growth, 2007-08 and 2008-09, Nova Scotia			
	2008-09 Preliminary	2007-08 Preliminary	Difference
Births	8,844	8,372	472
Deaths	8,596	8,333	263
Interprovincial IN	19,942	20,672	-730
Interprovincial OUT	21,197	20,789	408
Immigration	2,377	2,660	-283
Emigration	931	669	262
Return Emigrants	363	403	-40
Net temporary emigrants	474	473	1
Net Non Permanent Residents	1,270	428	842
Natural Increase	248	39	209
Net Interprovincial Migration	-1,255	-117	-1,138
Net International Migration	2,605	2,349	256
Total	1,598	2,271	-673

Source: 2007-08 2008 Annual Demographic Estimates: Canada, Provinces and Territories; 2008-09 2009 Annual Demographic Estimates: Canada, Provinces and Territories

In 2007-08 the revised estimate of growth for the HRM was 4185. It is expected that natural increase and net immigration will remain at about the same level in 2008-09 as in 2007-08. Together this adds just over 3000 to the population. If we are to assume lower growth for 2008-09 compared to 2007-08 (as suggested by the provincial trend), net internal migration to the HRM must be lower. For 2007-08 net internal migration (revised) for the HRM was 1144. Assuming a modest reduction in view of the slower provincial growth, we will assume net internal migration to the HRM will be 700 for 2008-09. This implies a total growth of 3700 for 2008-09 and therefore a 2009 population estimate of 395,879. A summary of the adjustment is given in Table 2.

Table 2

Summary of Adjustments to HRM Population		Re: 2009
	Statistics Canada	Environics Analytics Adjusted
Estimate of Population July 1, 2007	388,367	387,994
Growth 2007-08	6,198	4,185
Estimate of Population July 1, 2008	394,565	392,179
Growth 2008-09		3,815
Estimate of Population July 2009		395,994

4.2 Other Evidence of Population Growth

The Halifax Regional Municipality provided Environics Analytics with data on occupancy permits and CMHC building starts. The EA analysis of these data along with other census and related data suggest net new dwellings for 2006-2009 in the range of 7700-8000. Based on 2001 and 2006 census data showing the relationship between population growth and dwelling growth, this suggests a population increase of between 10,000-10,500. This indirect estimate of population growth is very approximate, but it is lower than the adjusted estimate of 2006-2009 HRM population implied by the EA adjusted population numbers (11,093). This provides additional evidence that the downward adjustments that EA made in the Statistics Canada estimates are likely in the right direction.

4.3 Projected Population Growth 2009-2012

Over the last two years 2007-2009 population growth averaged close to 4000 annually or 1% a year. This follows slower growth over the period 2002-2007 but is similar to the growth in the late 1990s. Looking ahead to 2012, it is assumed growth will continue at a relatively high rate of about 1.0% a year. EAG's population projection for 2012 end-of-year is 410,032."

The details relating to the expected trends and our assumptions are set out in Table 3 below.

Table 3:

Summary of Trends to HRM Population to December 31, 2012		
Theme	Trend	EA Estimate / Projection
Population July 2009		395,994
Number of births (relative to recent past)	Constant	
Ageing (relative to recent past)	increase slightly	
Natural Increase (relative to recent past)	approx 1400 annually	
Migration (relative to recent past)	strong at 1400 annually	
Net Migration (relative to recent past)	increase slightly to approx 1800 annually	
Approx growth rate July 1, 2009 – December 31, 2012	3.6% or 1.0% annually	
Approx annual growth	4010	
Growth July 1, 2009 –December 31, 2012		14,038
Population December 31, 2012		410,032

4.4 Population by Age Group and Electorate Estimates and Projections

Since populations by age and estimates of the electorate were not addressed in our high level report entitled " A Note on Population Growth in the Halifax Regional Municipality" and have not yet been addressed in this report, some notes will be made here. The key age class be in the electorate was age 18 plus. The only other requirement is that electorate members must be Canadian citizens. So if we are able to estimate counts of age 18 plus persons then this

is a very helpful step. The age groups that demographers usually work with in this context are 5 year age cohorts up to age 84 and then 85 plus as the top group. In order to deal with the electorate the age group 15 to 19 had to be split into 2 groups; 18 and 19 in the electorate and 15-17 not in the electorate. We believe that our age distribution estimates are of relatively high quality and they are consistent over all relevant levels of geography. Then we had to estimate the number or % of persons who were (or were not) Canadian citizens taking age into account. This required estimates of external immigration that end up in the HRM and other non-recent immigrants that are non-citizens that moved into the HRM. There was reasonable data from the past to assist in this process.

For purpose of comparison with the statistics below we repeat our overall population estimates and projections. The increase in population in HRM over the 3 and half year period from July 1, 2009 to December 31, 2012 is 14,038. This period has a rate of growth of 3.55%, or an annual rate of growth of 1.00%. Interestingly the rate of growth of the 18 years plus group and the projected electorate grew a little faster. This is largely because the HRM is gaining population of migrants, largely from inside Canada and especially Atlantic Canada.

For July 1, 2009 we estimated that the number of persons 18 years plus in the HRM was 322,007. These persons are distributed over the CTs and DA of the HRM in a typical manner for a medium sized city. Halifax has nothing that is particularly distinct in this regard. They are not concentrated in particular areas – although most apartment blocks have large percentages of adults in them. The number of age 18 plus persons has been projected to increase by 14,795 to 336,802 by December 31, 2012. The rate of increase is 4.59% or at an annual rate of 1.29%.

We have estimated that the number of members of the electorate were 313,151 on July 1, 2009. We have projected this number to be 327,615 in December 31, 2012. This increase is 14,464 or 4.62% for the three and a half years (annual rate of increase will be 1.29% - the same as population 18 plus). The overall rate of increase in potential voters is slightly larger than the rate of increase in the population 18 years plus.

5. Additional Support from EAG

Environics Analytics Group will accept an invitation to come to HRM in January or February 2010 to do a presentation on our estimation and projection methods and findings to the city council or a committee thereof. We prefer to defend the methods ourselves rather than permit others to defend them on our behalf.

In addition we would be happy to provide assistance to any HRM technical, development or planning staffs should they need additional understanding of what data we used and what methods we used and did not use.

5.1 Students

If the Nova Scotia legislation changes in the future with respect to the ability of students in residence at universities to vote in the residence jurisdictions we would be happy to revise our estimates of students based on better assumptions than we were able to use in the project to date. We made the assumption that 50% of the non-Canadian students lived in university residences and proceeded to make our student count estimates and projections on that assumption. But if the legislation changes, and it becomes necessary to do a better job, we would be happy to change the assumptions in the spreadsheet that we have provided and rework the results. Alternatively, HRM technical staff can undertake the revisions easily.

Appendix 1: Data Sets Used in the Project

Environics Analytics used the following data sets in undertaking the estimates and projections for HRM.

1. Statistics Canada's Census for 2006 - CD, CSD, CT and DA level statistics for households and population by age
2. Statistics Canada's demographic estimates for the year 2008 at the Census Division (CD) and the Census Subdivision (CSD) levels of Geography: statistics for households and population by age
3. Environics Analytics Demographic Estimates and Projections (DEP) for the year 2009 and special/custom estimates by EAG for 2012, all at the CD, CSD, CT and DA level estimates for households and population by age
4. Via HRM a custom table from Statistics Canada of the number of electors at the DA level for June 2006 (this was the first table relating to these data given to us by HRM)
5. In late November 2009, via HRM, a custom table from Elections Nova Scotia showing this agency's estimates of the number of electors at the DA level for June 2009
6. GIS type data – largely related to land use in HRM and sent by HRM to EAG Some of these data we had already: TeleAtlas, Statistics Canada GIS boundary files

Data used for land use geographic potentials, as constraints, and as QC input data.

A. HRM Provided Data

1. Park Lands
 - 1.1. Cemeteries
 - 1.2. Provincial Parks
 - 1.3. Golf courses
 - 1.4. HRM parks
2. Water bodies
 - 2.1. Lakes
 - 2.2. Streams
3. Public Lands
 - 3.1. Government owned
 - 3.2. Transmission lines
 - 3.3. Schools
4. Transportation
 - 4.1. CN rail right of way
 - 4.2. Street centre lines
 - 4.3. Future transportation routes (within the next 3 years)
5. Hospitals
6. Dissemination Areas from Stats Canada transformed to HRM projection so compatible with the other GIS layers sent by HRM

B. Nova Scotia Department of Natural Resources

1. Water Bodies
 - 1.1. Swamps
 - 1.2. Wetlands

C. TeleAtlas Data (a supplier to Environics Analytics)

1. Park Lands
 - 1.1. Parks
 - 1.2. Recreational areas
2. Water bodies
3. Other
 - 3.1. General land use
 - 3.2. Institutions
 - 3.3. Retail centres

D. Statistics Canada (a supplier to Environics Analytics)

1. DA boundary files
2. Water bodies

7. Data used for Household, Population and Electorate Estimates and Projections especially HRM Residential Data up to 2009

These data were to be used to help us estimate where development had taken place in HRM at a small geographical scale in the period 2006 to 2009

1. Housing data, (including vacancy data), for 2005-2008 obtained from CMHC were also used for 2009 estimates
2. Seniors Residences as of 2009
3. University and College Campus Boundaries
4. Building Permits (various versions up to 2009)
5. College Campus Boundaries
6. HRM provided number of University residence beds

8. Data used for household, population and electorate estimates and projections especially HRM residential data in the 2009 -2012 period

Data from HRM (planning and development staff) relating to likely future development that may take place in HRM on the period 2009 - 2012. These data were to be used to help us estimate where development would be likely to take place in HRM at a small geographical scale in the period 2009 to 2012. These data included:

- projected building permit data for each DA (2009 – 2012)
- projected major subdivision data (2009 – 2012)
- projected new senior facilities (2009 – 2012)

9. Supplementary Data Sources Regarding Students

1. Dalhousie University website (<https://discover.dal.ca/dal/accommo/oncampus.ezc>)
 - 1.1. Student residence precise locations and number of beds
2. Saint Mary's University website (<http://www.smu.ca/administration/resoffic/welcome.html>)
 - 2.1. Student residence precise locations and number of beds
3. University of King's College website (http://www.ukings.ca/kings_4126.html)
 - 3.1. Student residence precise locations and number of beds
4. Mount Saint Vincent University website (<http://www.msvu.ca/en/home/campuslife/residencehousing/default.aspx>)
 - 4.1. Student residence precise locations and number of beds

Note - The university residence data was used to adjust the electorate counts for areas where there are high concentrations of students i.e. university residence locations.