Projecting Community Change in the Richmond City Centre

A Community Lifecycle Approach

May 2007

URBAN FUTURES
Strategic Research to Manage Change

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Table of Contents

I. Overview

As part of its most recent Official Community Plan review, Urban Futures has been retained by the City of Richmond to conduct population projections for Richmond's City Centre, located in the north-western quadrant of the municipality. This technical report has been divided into two major sections. Section I outlines the methodological approach used to model the City Centre's future population. The modeling is based on a community lifecycle approach whereby the number and type of private residential dwellings, the occupancy and turnover of these dwellings, the timing of new construction, and the aging and natural increase of the existing population in private housing are the drivers to future community change. Section I details each of these major components individually as they relate to the community lifecycle model projections.

Section II begins with the assumptions for a baseline scenario, which recognizes both local and regional development trends. Three alternative development scenarios were also conducted for the City Centre, each focusing on the rate of development necessary for achieving a population of 120,000 residents in the City Centre by a specific date in the future. Estimates of projected housing stock in the community have been divided into three structure types (single detached, other ground oriented, and apartment dwellings), with estimates of the community's future population resident in that stock presented by eight broad age groups, in order to account for both dimensions of population growth and the underlying changes in its structure.

By definition, forecasting carries with it an element of uncertainty and, as such, the only statement that can be made with certainty is that no projection will ever be precisely correct. The purpose of these forecasts is therefore to present an examination of the factors that would bring about community change in the future, and determine how these changes would be reflected within the community's demography over long-range planning horizons. In this context, understanding the underlying approach, data and assumptions, is essential to understanding the results of the projections; all base data, methodological approach and assumptions regarding each aspect of the community lifecycle model have been explicitly outlined so that the impact of each can be understood. Detailed tables for each projection scenario have been included in the final section of the report.

II. Strategic Considerations

The baseline projection of population presented in the following sections of this report are intended to provide a framework for managing changes the future will bring to Richmond's City Centre given continuation of trends in the City Centre, the broader municipality and the metropolitan region. In this context, it is important to emphasize that long term projections such as these are more concerned with time periods than with specific dates, with orders of magnitude than with specific values, and with strategies rather than with detailed plans.

In the longest term, the baseline projection described in this report shows that within the next hundred years a continuation of historical trends would take the City Centre towards 120,000 residents, reaching this population in the first decade of the 22nd Century. Along its way the population of the City Centre will pass though a number of milestones, reaching 100,000 residents during the 2050s decade, 80,000 during the 2020s decade, and 60,000 during the 2010s decade.

Exactly when during the decade window each of these milestones will be attained will depend upon a number of factors, some of which will be under the City of Richmond's control, such as its rate of approval of apartment building permits, and some which will not be, such as migration to the region and the rate at which other municipalities approve new development.

In this vein it is necessary to acknowledge, for example, that the extent to which the City of Vancouver pursues its new "eco-density" initiative will have an impact on the specific year, but not on the decade, in which Richmond's City Centre attains these milestones. The baseline population projection does not explicitly reflect this new policy, as it is not reflected in the historical pattern of development within the region, nor are there any details as to how this policy will be implemented or how local communities and consumers will respond to it.

If the City of Vancouver aggressively pursues "eco-density" by stimulating apartment dwelling starts in Vancouver above the level that historical trends and current official plans would suggest, Richmond City Centre might not attain the 60,000 milestone until the end of the 2010s decade as Vancouver development would pre-empt some development in Richmond. If however "eco-density" merely replicates where historical trends and plans would have taken apartment starts in the City of Vancouver, then Richmond City Centre would attain the 60,000 milestone earlier, in the middle of the 2010s.

Having noted this variance in the specific date in which the City Centre might attain its population milestones, it is again essential to focus on the strategic nature of long term projections. While it will be important to monitor regional trends on a year by year basis to determine the level and rate of development applications that might come forward each year, this must be done within the context of strategies that guide the development of Richmond City Centre as it moves towards its capacity population of 120,000 over the next century.

III. The Community Lifecycle Modeling Process

A. General Methodological Approach

In the case of the Richmond City Centre, the community lifecycle model commences with data from the 2001 Census describing the community's existing housing stock and the demographic characteristics of its occupants. This provides the household and demographic points from which future changes can be modeled.

The stock of private dwelling units (excluding collective dwellings such as care facilities and university dormitories) is first differentiated by structure type, in this case by Statistics Canada's broad classifications of single detached, other ground oriented (which includes row homes, duplexes, and flats in detached duplexes), and apartment units. The structure type data are then further segmented by the demographic characteristics of the population resident in dwelling units of each structure type, in this case by single years of age and sex.

Having established the demographic characteristics of the base population resident in the dwelling stock, the next step in the modeling process is to consider the vital components of change, such as births into, and the aging and deaths of, the City Centre's existing residents. As an example, the age specific propensity of a woman to have a child is applied to the City Centre's existing female population by age to determine the total number of children that would be born into the community over the course of the year. Similarly, age and sex specific mortality rates are applied to the existing population to determine the number of deaths that would occur in the community each year. The surviving population would then grow one year older, forming the base population for the beginning of the following year.

The mobility of the City Centre's existing residents is the next component of community change to be considered; the number and age/sex composition of people who would move in to and out of the community over the course of a year is accounted for. This is a multi-step process, the first step being the calculation of the total number of *households* by structure type that would vacate their dwellings during the year; the second step being calculation of the corresponding number of *people*, again by age and sex, that would compose the outwardly-migrating households.[1]

This movement of existing residents out of the City Centre community results in unoccupied dwelling units that can be occupied by new residents. The number of vacated dwelling units by structure type is combined with age and sex profiles of inwardly-migrating households to estimate the number and composition of people who would move into the existing housing stock which had been vacated over the course of the year.

The final component in modeling community change is the construction of net new dwelling units.[2] The addition of new dwelling units to the community brings in new households with different demographic characteristics. As with the vacated existing stock, based on the structure type of the dwelling units being added, new units added to each community in a particular year are occupied using age and sex specific profiles for people moving into newly-constructed dwelling units of each structure type.

[1] Note that an annual demolition rate is applied to the stock of dwelling units by structure type, resulting in additional outwardly-moving households.

[2] To be consistent with the consideration of only occupied units in the existing stock of dwellings, a long-run vacancy component is subtracted from the number of newly-constructed units to determine the number of units that would be added to the occupied stock and be available for occupancy.

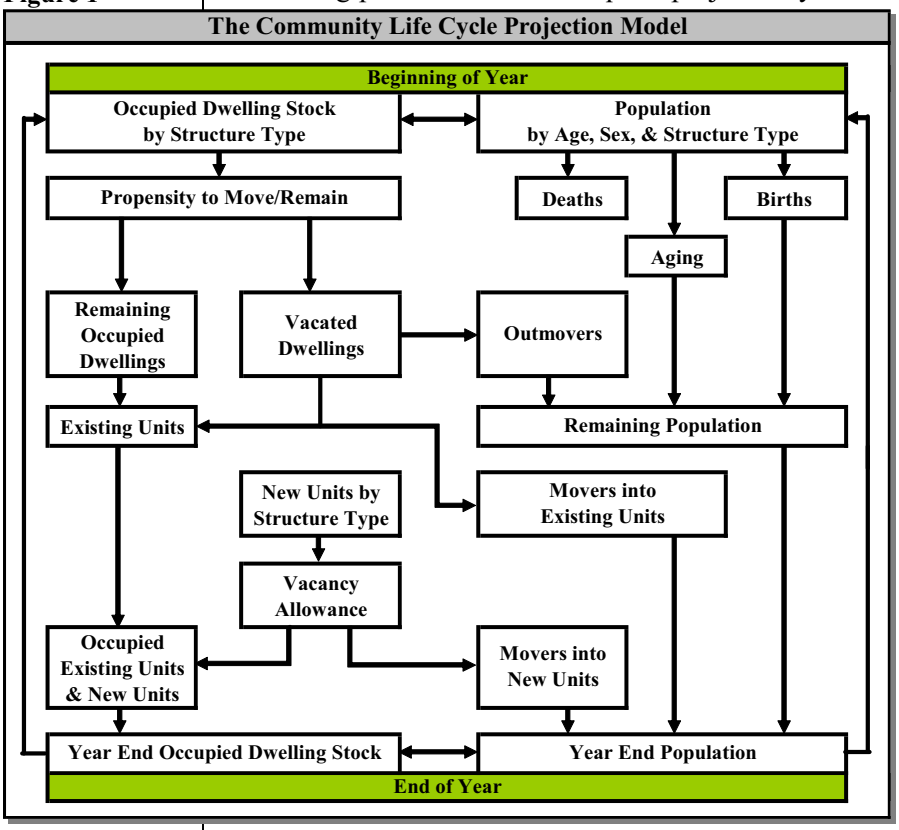
Once new units are occupied they become part of the community's existing housing stock; this then forms the base housing stock for the beginning of the following year. Similarly, people (described by age and sex) who move into these newly-constructed units become part of the City Centre's population, which in turn forms the base population, defined by age and sex, for the following year's iteration of the model.

In summary, the output of the Community Lifecycle Model comes in the form of iterative population change on an age, sex, and structure type of dwelling basis, as guided by the following four general factors:

1) the demographic processes of aging, births and deaths of existing residents;
2) the movement of existing residents out of their dwelling units;
3) the movement of new residents into recently-vacated units; and
4) the movement of new residents into new additions to the housing stock.

Figure 1 details the overall structure of the modeling process. Completing one iteration of the model yields output of housing and population change over the course of one year and establishes a starting point for each subsequent projection year. These iterations continue over the course of the modeling period to provide a long-term projection of how the City Centre community would grow and change over time.

Figure 1



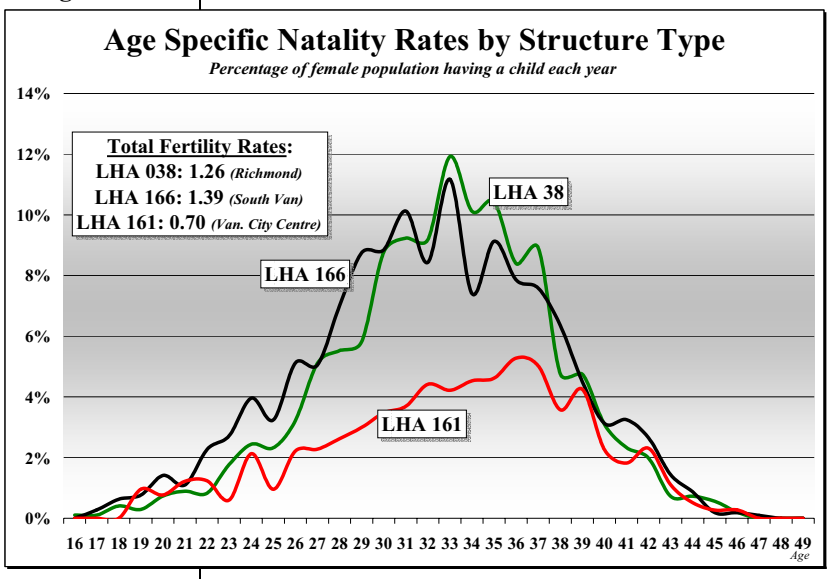
B. Data Components for Richmond's City Centre

In keeping with the order in which components are accounted for in the lifecycle model, examination of the inputs for Richmond's City Centre commences with a look at the age specific natality and mortality rates that are used to project the natural components of change, followed by consideration of the age composition of people moving out of and into existing and new dwelling units by structure type. As the model accounts for each of these inputs individually, the data used for each will be outlined independently.

1. Natality and Mortality

Just as a woman's propensity to have a child varies over the course of her lifetime, it is also reasonable to assume that her propensity to have a child also varies by the structure type of dwelling in which she resides. However, given the available vital statistics data, the link between natality and structure type of dwelling cannot be explicitly accounted for, as the type of dwelling unit in which a woman resides when she gives birth is not recorded on a child's birth certificate. Therefore, in order to account for differences in the age specific pattern of childbearing between different structure types, various communities in the Lower Mainland where particular housing structure types predominate can be considered.

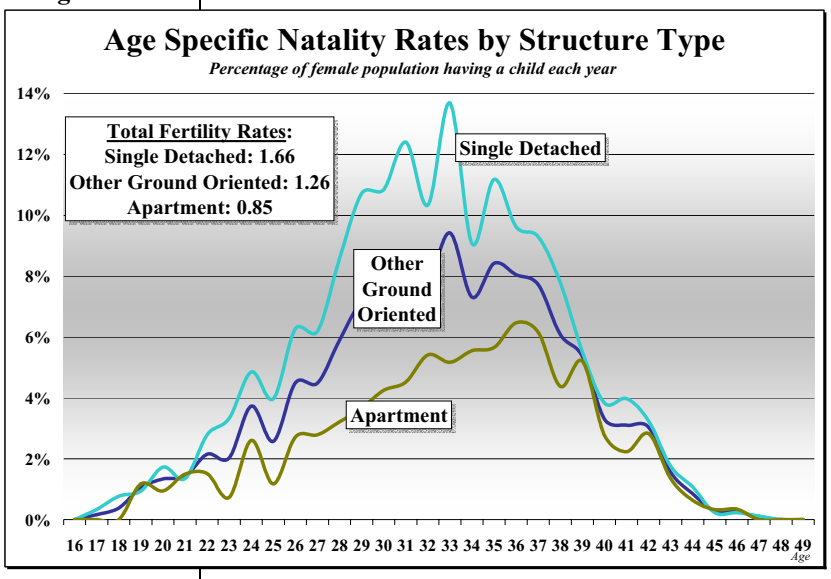
Figure 2



Two communities within the region provide good examples of how the patterns of natality differ between areas with different housing stock characteristics: the city of Vancouver's Downtown/Fairview neighbourhoods (Local Health Area 161), where apartments predominate; and South Vancouver (LHA 166), which is predominantly a community of single detached homes. The Downtown/Fairview neighbourhood had a 2006 total fertility rate (TFR, or the total number of children a woman could expect to have during her lifetime) of 0.70 (Figure 2). The dwelling stock in this part of Vancouver is predominantly apartments, which account for 97 percent of all dwellings (based on the 2001 Census). Additionally, a significant number of the traditional single family homes in the Fairview area have been converted to multi-family dwellings.

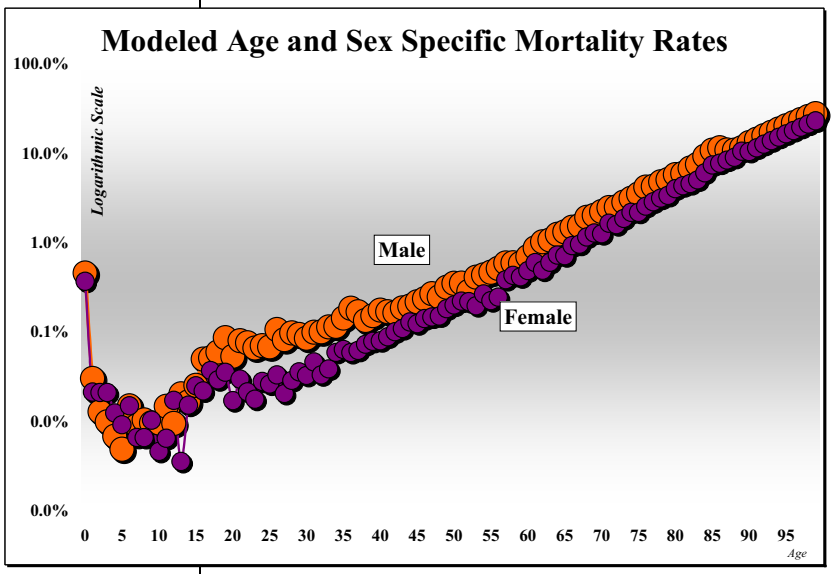
By contrast, LHA 166 in the southeast corner of the City of Vancouver (bounded to the north by 41st Avenue and to the west by Granville and Angus Streets) is comprised predominantly of single detached homes. The TFR of 1.39 children per woman in 2006 was almost two times the TFR in the Downtown/Fairview neighbourhood. While the general age specific pattern of childbearing is similar between the two profiles, (with the greatest share of women having kids generally being between the ages of 31 and 36) the difference in the total number of children each woman would typically have (the TFR) is in part a reflection of the composition of the dwelling stock within each community. Relative to these two communities, the City of Richmond (LHA 038) had a TFR of 1.39 in 2006, with the age specific pattern closely following that of South Vancouver.

Figure 3



For the purposes of forecasting the future number of births, the profile of natality for each of these two areas was used in conjunction with 2006 age specific fertility data for the city of Richmond to develop age and structure type specific profiles of natality for the City Centre (Figure 3). While maintaining the same general age specific pattern, the resulting TFR for females living in single detached dwellings was 1.66, ground oriented 1.26, and for females in apartments it was 0.85. With natality rates becoming relatively stable in the recent past, the total fertility rates are expected to fall only marginally over the projection period. The profile of having kids is also expected to change slightly in the coming years, continuing the trend towards postponing childbearing that has been seen over the past two decades.

Figure 4



Unlike fertility rates, the age specific pattern of mortality exhibits far less variance across different geographic regions or different types of private dwellings, largely due to the widely-accessible nature of Canada's health care system. In order to represent the slightly longer life expectancy seen in the City of Richmond, the age and sex specific pattern of mortality for the Greater Vancouver Regional District (GVRD) was adjusted downwards. Additionally, to recognize historical declines in mortality rates (and increasing life expectancies), age specific mortality rates were trended downwards over time, albeit at slower rates than have prevailed historically.

The age specific pattern of mortality shown in Figure 4 is characterized by relatively high mortality rates in the first year of life, followed by low rates from age two through the mid-teen years. Rates increase significantly during the late teenage years and then more moderately over the family-rearing stage of the lifecycle until retirement age is reached. From this point mortality rates again begin to increase more significantly. Note the logarithmic scale used to present the mortality rates: with 60 year olds having a one percent mortality rate and 90 year olds having a ten percent mortality rate. It was assumed that a mortality rate of 100 percent was achieved for the population aged 100 plus.

2. Migration Into and Out of the Community

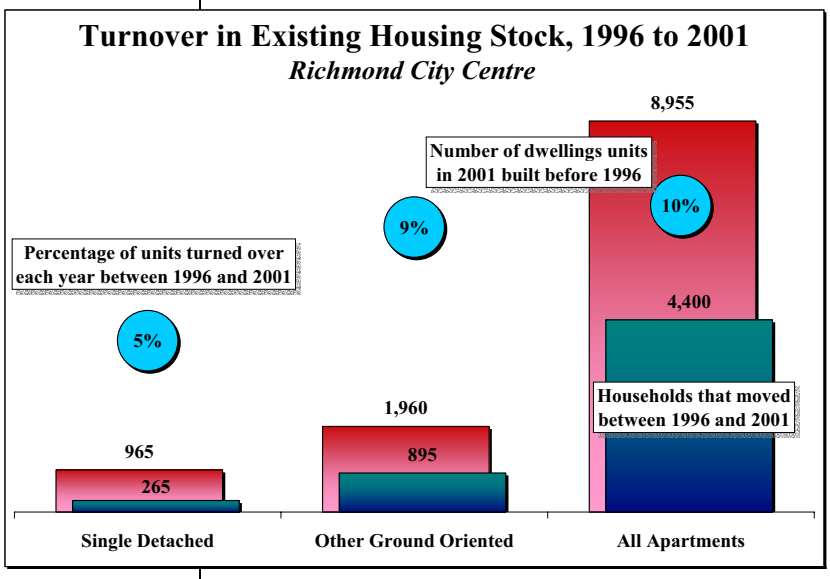
The next component is modeling migration out of and into the City Centre's existing housing stock. As indicated above, this is a multi-stage process, beginning with the estimation of the total

number of *households* (by the structure type of dwelling in which they reside) that would move out of the community each year. From this point, the composition of the *people* moving with these outwardly-migrating households is determined. Once the number of outwardly-moving households has been determined, new residents moving into newly-vacated units can be added to the resident population on an age, sex, and structure type specific basis.

i. Households Moving Out of Existing Dwellings

In order to determine the turnover of the existing dwelling stock, household mobility status data from the 2001 Census was tabulated for the various structure types and periods of construction for the City Centre. The mobility status data from the Census identifies the total number of dwelling units in the community in 2001 that were occupied by households that moved over the 1996 to 2001 period (Figure 5).

Figure 5



The mobility status data for the City Centre community shows that in 2001 there were 8,955 occupied apartments in the City Centre, of which 4,400 were occupied by households that did not occupy them five years earlier (that is, in 1996). This indicates that 49 percent of these apartment units turned over between 1996 and 2001, an average of just under ten percent per year.

As would be expected, this turnover rate varied across structure types; the high degree of mobility seen in apartments is contrasted by relatively low mobility rates for family style single detached homes. The corresponding five-year turnover rate for single detached units was 28 percent (five percent per year) and for other ground oriented dwellings almost 46 percent (nine percent per year). Within the lifecycle model, these structure type specific turnover rates are used to determine the total number of units which would be expected to change occupants each year.

Having determined the total number of dwelling units that would reasonably turnover on an annual basis, the next step involves consideration of the age specific profiles of people moving out of, and into, the City Centre's existing dwelling stock. While the Census questionnaire asks respondents to indicate the type of dwelling unit they are currently living in, as well as the location of their residence both one and five years earlier, it does not explicitly ask for the structure type of the dwelling in which the respondent lived previously. As such, data on the type of housing people move out of is not explicitly available from the Census.

Given the demographic focus of these projections, a proxy measure for the age profile of people moving out of their dwelling units by structure type was used. For the City Centre, it was assumed the profiles of out-movers would generally resemble those of households who moved into the region as a whole between 1996 and 2001. In this context, the general factors influencing a household's decision to move out of a dwelling unit were assumed not to be specific to the community from which the household is moving, but more influenced by external factors such as a desire to be closer to family, work, school, or simply to purchase a specific type of home. As

these factors are more indicative of personal choices and preferences rather than specific community structure, the regional demographic profile of movers for each structure type was considered a good proxy for the profiles of people moving out of the City Centre each year.

Figure 6 and Table 1 outline the age specific profiles used to move people out of dwellings in the City Centre. While the profile of movers from apartments is younger than the ground oriented structure types, it is also much more concentrated in the 20 to 35 year old age range. The share of movers under the age of 15 is smallest in apartments, at 12.1 percent (versus 23.6 percent in single detached and 21.5 percent in other ground oriented), and the share of out-movers aged 55-plus is greatest in apartments, accounting for 12.9 percent of all movers (compared to only 8.9 percent in single detached and 9.5 percent in other ground oriented).

Figure 6

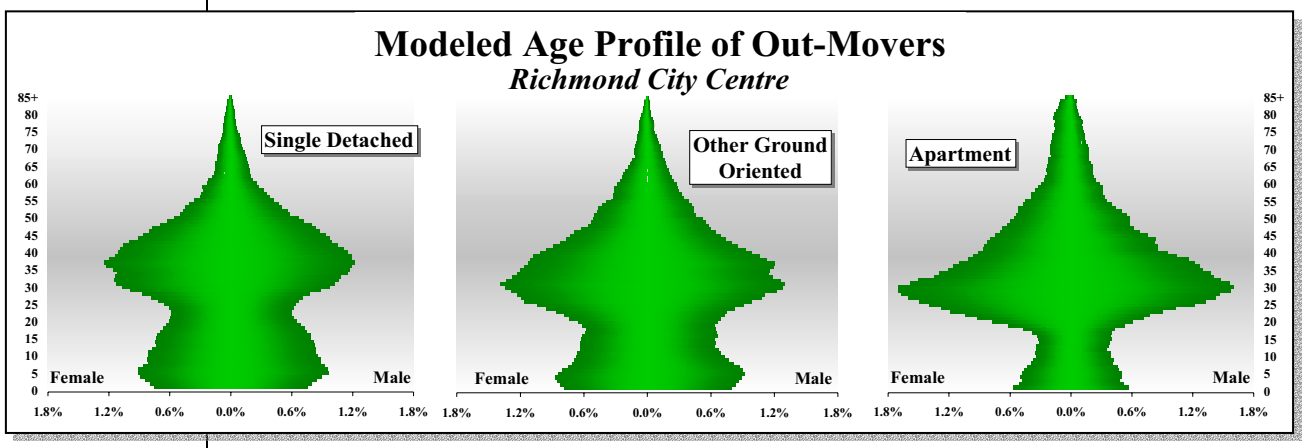


Table 1

Modeled Age Profile of Out-movers
Richmond City Centre

Age Group	Single Detached	Other Ground Oriented	Apartment
0-14	24%	21%	12%
15-24	13%	14%	14%
25-34	19%	24%	30%
35-44	22%	20%	20%
45-54	13%	11%	12%
55-64	5%	6%	6%
65-74	3%	3%	4%
75-84	1.0%	1.0%	2.3%
85+	0.2%	0.2%	0.7%

Data: GVRD; 1996-2001 movers; total period of construction

The profile of mobility for ground oriented dwellings exhibits a significantly different shape from that for apartments, showing the predominance of families living in ground oriented types of housing. Furthermore, the differences are generally reflective of lifecycle related issues, as the younger population is typically characterized by a greater degree of mobility as they move for employment or education opportunities, and as such, tend to occupy apartments which are held in rental tenure or involve a much smaller capital investment than ground oriented units.

More specifically, the profile of out-movers from single detached units shows the 35 to 54 age group accounting for 35 percent of movers, compared to 31 percent from other ground oriented and 32 percent for apartments. Similarly, the under-25 group (the 35 to 54 year olds' children) accounted for 37 percent of single detached movers compared to 35 percent of other ground oriented and 26 percent of apartment movers.

The final piece of information needed to move people out of their dwellings is the *number* of people that would vacate each unit. As the community grows and changes over time, so too does the average number of people per household (PPU). As such, it is reasonable to assume that as the average size of a household changes within the community, so too would the average size of outwardly-migrating households. Thus, with the most recent Census for the City Centre providing the base year household sizes (2001), the number of people in outwardly-moving

households becomes a function of the average number of persons per unit in each structure type in the community in projected years.

As would be expected, the size of mover households is smallest in apartments, at 2.22 persons per unit, versus movers from single detached units at 3.71 persons, as these are typically occupied by parents and their children. The number of persons per unit in mover households in other ground oriented units more closely resembled that of single detached units at 3.36 persons.

Combining the annual number of units that would turn over in the community, the age and sex specific profiles, and average sizes of the out-migrating households yields estimates of the number of people by age, sex, and the structure type of the dwelling from which they would move. These movers are subtracted from the resident population in private dwellings during the course of a year, with their housing being freed up for new residents to occupy.

ii. Households Moving Into Existing Dwellings

The next component to account for is the size, age and sex compositions of the households that would move into units vacated in the previous step. As the Census *does* provide detailed demographic information on those moving into various types of dwelling units, data specific to Richmond was used (Figure 7 and Table 2)[3].

Figure 7

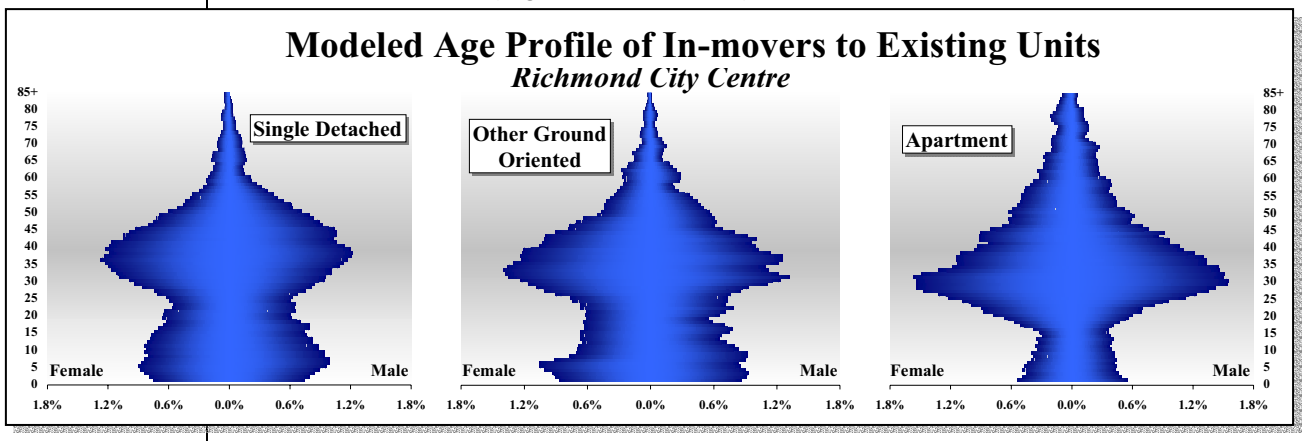


Table 2

Modeled Age Profile of In-movers to Existing Dwellings
Richmond City Centre

Age Group	Single Detached	Other Ground Oriented	Apartment
0-14	24%	24%	13%
15-24	14%	13%	13%
25-34	17%	20%	25%
35-44	23%	23%	22%
45-54	15%	12%	12%
55-64	4.4%	5.3%	7.6%
65-74	2.6%	2.0%	4.4%
75-84	0.9%	0.8%	2.8%
85+	0.0%	0.0%	0.0%

Data: Richmond, 1996-2001 movers; pre-1996 construction

Similar to the out-mover profiles, the profile of people moving into single detached homes is somewhat older than those moving into other ground oriented homes or apartments. While 78 percent of in-movers to single detached dwellings would be under the age of 45, 22 percent would be over the age of 45. This compares to a younger profile for other ground oriented where 81 percent were under the age of 45 and 19 percent were over the age of 45.

With respect to household size, in-mover households to single detached and other ground oriented units are almost identical in size, with 3.47 people moving into single detached units and 3.46 people moving into other ground oriented units.

[3] Note that while the base in-mover profiles from the City Centre were used, it was necessary to consider these profiles against the regional profiles as a result of a small number of observations for some age and structure type combinations.

As would be expected, not only is the average size of households moving into apartments smaller than both ground oriented counterparts (2.20 PPU), the age profile is more heavily-weighted towards the younger age groups. People aged 25 to 34 (again representing labour force migrants and the mobility of young families) accounts for more than a quarter (47 percent) of those moving into apartments; compared to 40 and 43 percent into single detached and other ground oriented units respectively (Table 2). In addition, people under the age of 25 would account for 26 percent of movers into apartments, compared to 38 percent in single detached and 37 percent in other ground oriented dwellings. As a general comment, the in-mover profiles for each structure type again show the share of movers declining with increasing age; people over the age of 55 account for a relatively small proportion of all movers.

Combining the size and age characteristics of in-mover households with the number of recently-vacated dwellings by structure type accounts for demographic change that would arise from people migrating into and out of dwelling units in each community over time.

iii. Households Moving Into Newly-Constructed Dwellings

The final component of change accounted for in the community lifecycle model is the number and composition of people moving into newly-constructed dwellings.

Figure 8

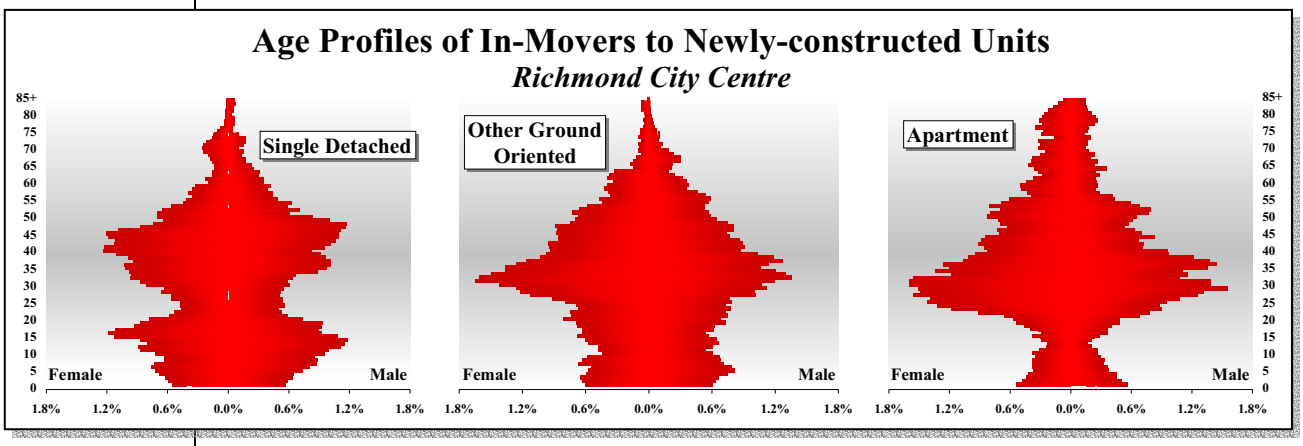


Table 3

Age Profile of In-movers to Newly-Constructed Dwellings
Richmond City Centre

Age Group	Single Detached	Other Ground Oriented	Apartment
0-14	21%	17%	10%
15-24	17%	13%	12%
25-34	13%	25%	23%
35-44	21%	22%	22%
45-54	19%	14%	15%
55-64	6.3%	7.0%	7.2%
65-74	3.7%	2.0%	5.2%
75-84	0.7%	0.4%	5.1%
85+	0.0%	0.0%	0.0%

Data: Richmond, 1996-2001 movers; 1996-2001 construction

The process of moving people into new dwellings is identical to that of moving people into existing dwellings. Although the same approach is employed, both the age profile and size of households moving into new dwellings differ from those moving into older (existing) dwellings. As such, new construction in Richmond's City Centre warrants specific attention.

Cross-tabulating the mobility status data from the Census with the dwelling's period of construction allows the profile of people moving into new dwelling units (constructed between 1996 and 2001) to be differentiated from those built before 1996 (existing units, Figures 8 and Table 3).[4]

[4] It is important to note that the jaggedness of the profiles results in part from a smaller number of households occupying newly-constructed dwellings in the City of Richmond between 1996 and 2001, and in part from Statistics Canada's random-rounding of data for confidentiality reasons whereby all numbers are forced to end in either a zero or a five.

Like the profiles used to move people into existing dwellings, the profiles used to move people into new units exhibit similar patterns across the three structure types, with newly-constructed single detached dwellings being generally more family-oriented than either other ground oriented units or apartments. For example, 21 percent of movers into new single detached dwellings, would be under the age of 15, compared to 17 percent in other ground oriented structures and only 10 percent in apartments. Similarly, the 45 to 54 age group accounts for a far greater share of movers into new single detached units, accounting for 19 percent of movers versus 14 and 15 percent in other ground oriented and apartment units respectively. For all structure types, people in the older age groups (those aged 65 plus) represent a relatively small share of all movers into new units.

As with the profile of people moving into existing units, households moving into new single detached units tend to be larger (4.07 persons per unit) than those moving into the other structure types. Interestingly, the Census data also shows that households moving into newly constructed single detached units tend to be larger than those moving into existing units: households moving into existing single detached units were 15 percent smaller (3.47 persons) than those in new units. Apartments showed the same pattern with households in new apartments being 11 percent larger (2.44 persons) than those in existing units (2.20 persons). Conversely, at 2.99 persons per unit, movers into new other ground oriented units tended to be smaller than those moving into existing units (3.46 persons per unit).

The above data was combined with the existing stock of dwelling units and population resident in those units in order to achieve scenarios of the future number and mix of dwelling units that could be added to the City centre in the coming years. The following sections outline these scenarios and the potential population implications thereof.

IV. Future Residential Development

A. The Baseline Scenario

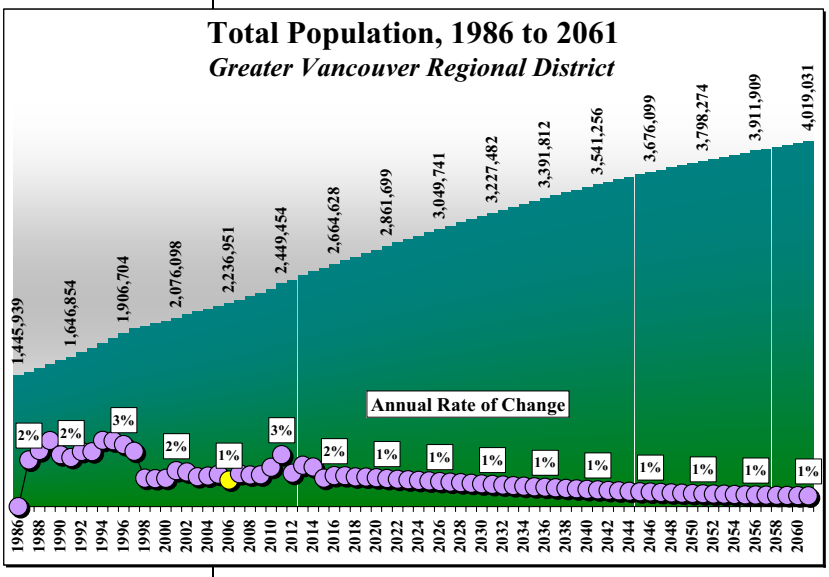
As the most recent detailed data describing people by age and dwelling units by type are from the 2001 Census, these data provide the base counts of occupied dwellings for Richmond's City Centre. In order to update these variables to the most recent year (2006), residential permit data from 2001 to 2006 from the City of Richmond Planning Department was used to determine the number of dwelling units by structure type that were added to the community. These units were added on an annual basis and the population was modelled until 2006 as per the data and assumptions outlined above to establish a 2006 population by age, sex and dwelling stock by structure type for the City Centre.

In order to determine the annual number of dwelling units by structure type that would be added to the City Centre after 2006, the baseline scenario considers a regional forecast of growth in housing occupancy demand and a trend based allocation of these dwelling units by structure type to areas within the GVRD. This approach recognizes Richmond's place within the larger region in terms of future regional demographic change, changing real estate market conditions, the city of Richmond's and other municipality's capacity to add new dwelling units in the coming years.

i. The Regional Context

As a first step, a population forecast was compiled for the Greater Vancouver Regional District (GVRD). Changes in age specific birth rates and mortality rates were considered with historical trend-based changes in migration to the region from international and domestic origins. The long-range modeling trends were extended to the year 2061 assuming changes in each of the components stabilize in the post 2031 period. Over the coming decades, the GVRD's population is projected to grow from 2.24 million people in 2006 to 4.02 million by 2061, a 1.78 million-person or 80 percent increase (Figure 9).

Figure 9

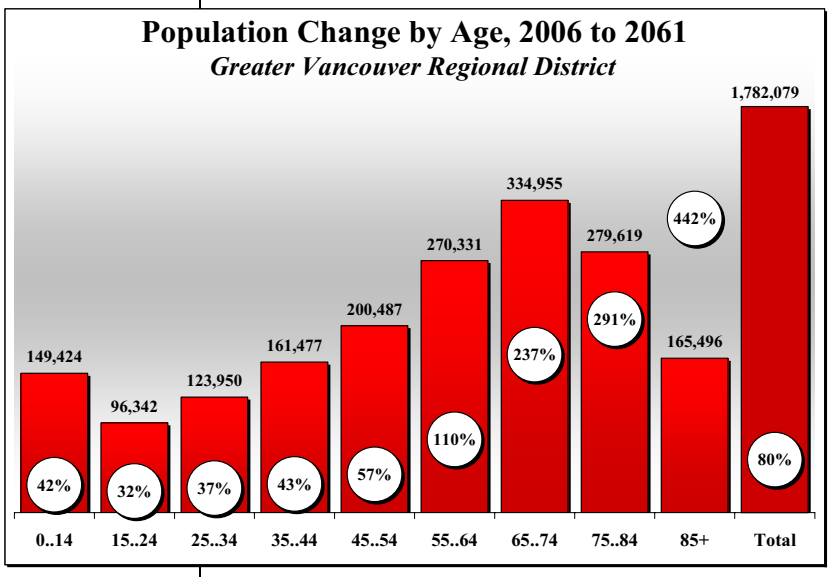


In part due to a significantly aging population and the large proportion of the post World War II Boom generation already falling outside the high fertility stage of the lifecycle in 2006, average annual additions to the GVRD's population are expected to average just over 30,000 people annually, compared to almost 40,000 people added each year between 1986 and 2006. Over this long-term projection, population growth is projected to fall into the one percent per year neighbourhood through 2061.

While the region's population would grow, it would change much more significantly. Of the 1.78 million additional residents to the GVRD between 2006 and 2061, 59 percent would be in the 55-plus age groups (Figure 10). The 65 to 74 group would experience the greatest absolute change, adding 334,955 people, while the 85-plus population would grow the most on a relative basis –

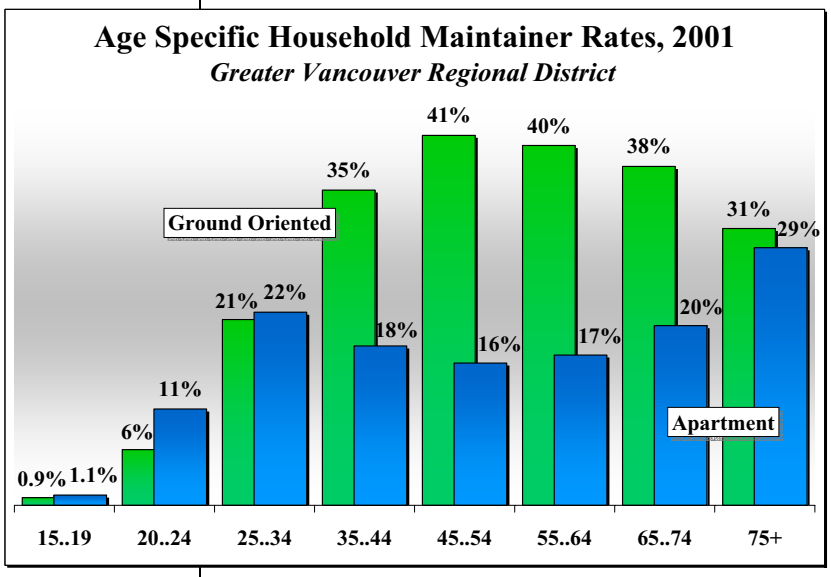
expanding by 442 percent. While all age groups are projected to grow over this period, the younger age groups would grow much more slowly due to the expected continued declines in birth rates, with longer life expectancies resulting in more people surviving into the oldest age groups.

Figure 10



The next step in the projection process was to combine the projection of population by age (illustrated in Figure 10) with the lifecycle pattern of housing demand. This is done by considering the lifecycle of housing occupancy, focusing on the person who is the primary household maintainer – or the person primarily responsible for the household's financial support. Dividing the number of household maintainers in an age group by the total number of people in the same age group yields the percentage of people in the age group who are household maintainers, a percentage defined as the household maintainer rate.

Figure 11



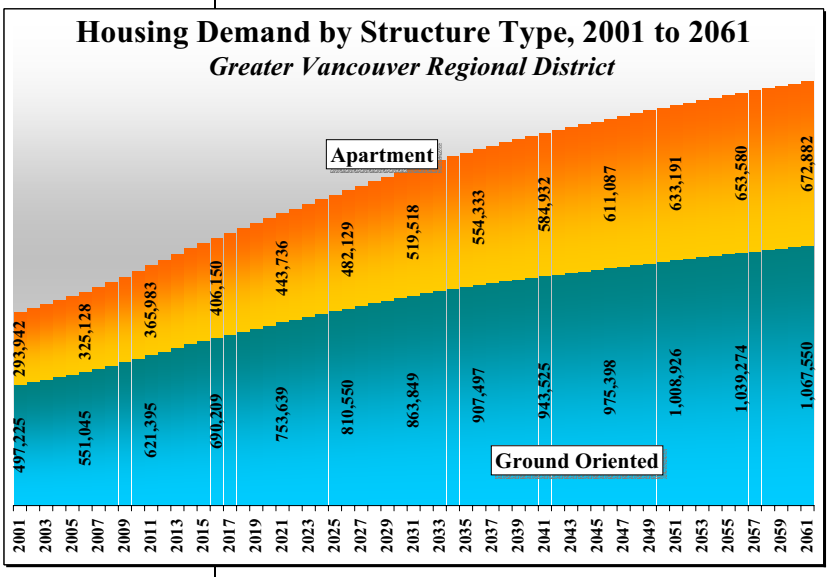
For example, according to the most recently-available Census data, there were 312,368 people aged 45 to 54 years living in private households in the GVRD in 2001, with 129,490 of them identified as household maintainers in ground oriented units. Thus, with 129,490 out of 312,368 45 to 54 year olds maintaining these types of households, the ground oriented maintainer rate for this age group was 41 percent (Figure 11).

Household maintainer rates show a strong lifecycle pattern, that demonstrates how preferences for different housing types change over the lifecycle. In the case of ground oriented household maintainer rates, increases are seen through the younger age groups where they peak in the prime family-rearing stage of the lifecycle. From there they decline through the older age groups as apartments become a greater housing choice for many people later in life. Apartments are also prominent in the younger age groups as people finish their post-secondary education and move into the labour force entry and family formation stages of the lifecycle.

Combining the age specific population projection with trends seen in age specific maintainer rates in the region, yields estimates of future housing occupancy demand: by 2061 demand for ground oriented units is expected to grow to 1.07 million units from 497,000 in 2001, a 570,000-unit or 115 percent increase (Figure 12). Growth in demand for apartment units would increase from 294,000 units in 2001 to 673,000 units, a 129 percent increase (379,000 additional units).

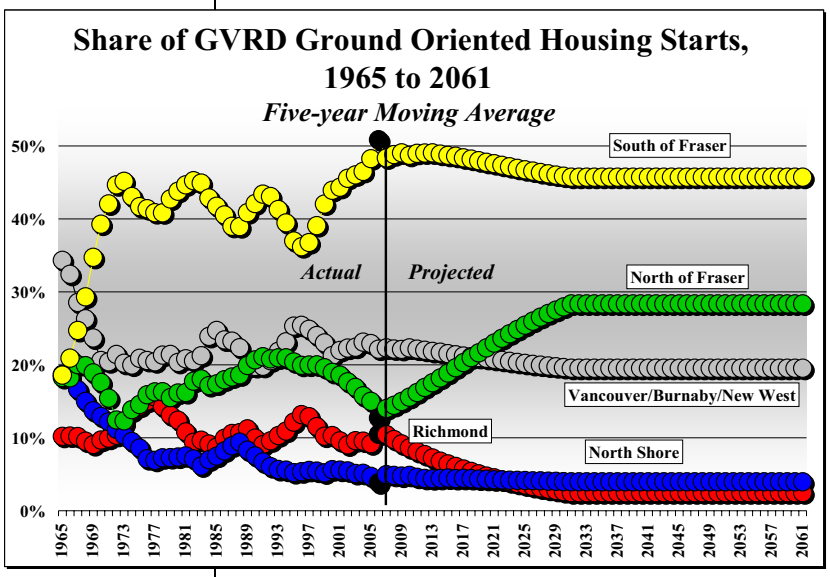
These housing demand projections provided the foundation to the baseline projection scenario for the Richmond City Centre model, as the next stage of the projection process was to determine the future spatial pattern of housing development throughout the region.

Figure 12



The GVRD was divided into five major sub-areas including Richmond, Vancouver / Burnaby / New Westminster, the North Shore, the North of Fraser and South of Fraser regions[5]. Several data components were used to allocate annual net additional dwelling units to each sub-area in the GVRD. The historical share of housing starts by structure type for each sub-region over the past four decades provided a starting point for the allocation. From this initial stage, residential capacity information, as well as development plans and policies for each sub-area were generally considered. These capacity and policy measures were taken from a range of sources, from local land use policies and plans to the GVRD's Strategic Plan (LRSP) and the Growth Management Strategy (GMS 5.0)[6]. In this context the projections of population and housing recognize both the demographic and economic realities of the functional GVRD region, and the local land use policies and objectives throughout the region.

Figure 13



Figures 13 and 14 show the historical and trend based projection of housing starts within the GVRD from 1965 to 2006. In terms of the ground oriented stock, the city of Richmond is projected to see its share of additional ground oriented starts decline, as the city's capacity to add additional ground oriented units becomes increasingly constrained.

The South of Fraser sub-area has experienced a significant increase in its share of the region's housing starts over the past decade, accounting for one-half of all ground oriented starts in 2006. Although not projected to experience the same increase in the share of the region's housing starts as it did between 1997 and 2006, the South of Fraser sub-area is still anticipated to retain the greatest proportion of ground oriented housing starts over the next six decades. This

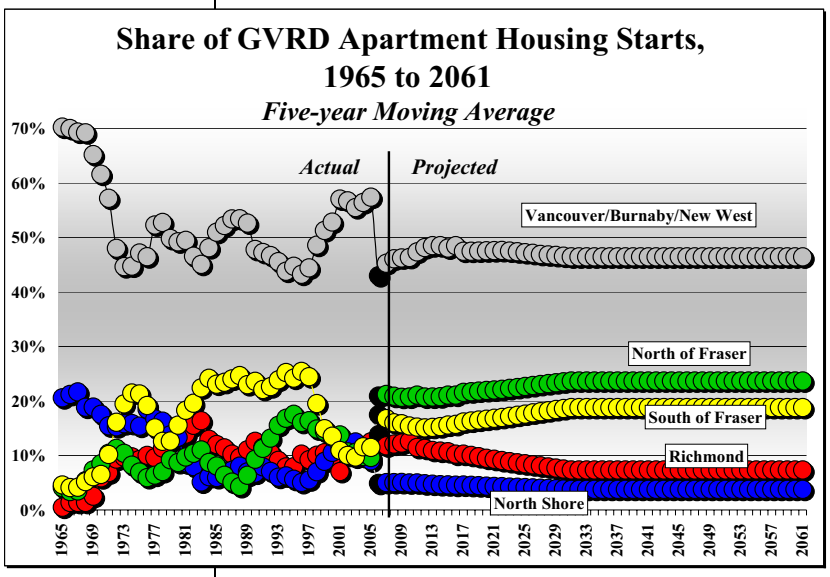
[5] North Shore includes North Vancouver District and City, Bowen Island, Lion's Bay, and West Vancouver; North of Fraser includes Anmore, Belcarra, Coquitlam, Port Coquitlam, Port Moody, Pitt Meadows, and Maple Ridge; and South of Fraser includes Langley District and City, Surrey, Delta, and White Rock.

[6] The Livable Region Strategic Plan, Tables 1 and 2, Current Growth Capacities: http://www.gvrd.bc.ca/growth/lrsp/tables.pdf .

sub-area's central location and considerable land capacity for ground oriented residential development will continue to focus new ground oriented capacity in this part of the GVRD.

The Vancouver/Burnaby/New Westminster sub-area is projected to see its share of the region's ground oriented development continue to decline over time. The North of Fraser sub-area is anticipated to experience a significant increase in its share of ground oriented building activity, from a recent low of 13 percent to up to 30 percent by 2031. Growth of this magnitude in the North of Fraser sub-area's share of housing starts is anticipated based on its location within the region and its potential residential land capacity (proposals for development in the Burke Mountain area are evidence of renewed building activity in this part of the region). The North Shore sub-area is expected to see its share of starts in the region decline slightly in the coming years, remaining relatively constant and under five percent over time.

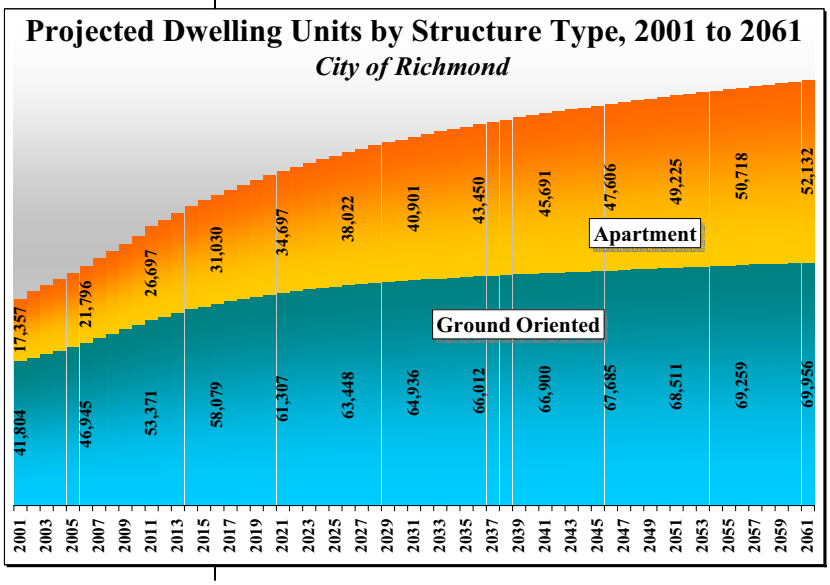
Figure 14



While expected to increase in terms of absolute numbers, Richmond's share of additional apartment starts is projected to decline slightly from its recent high of 14 percent in 2006, stabilizing at 7.3 percent over time.

Despite the rapid increase in the Vancouver/Burnaby/New Westminster sub-area's share of apartment starts in the late 1990's and early 2000's, this sub-area's share of apartment starts fell dramatically in 2006, and its expected to stabilize over the projection period, as the downtown reaches capacity for apartment construction and development continues to move eastward. The moratorium on conversion of non-residential uses to apartments in the downtown core in 2006 points to a slowing in development activity as available development sites build out. The North and South of Fraser sub-areas are projected to increase their share of regional apartment additions slightly over the next three decades as they add higher density residential capacity, while the North Shore is expected to account for the smallest share of apartment starts in the region, declining slightly over time.

Figure 15



Allocating the projected share of regional housing to the city of Richmond from the regional outlook would see the total dwelling stock in the City grow from 59,161 units in 2001 to 105,837 in 2031 and 122,088 by 2061. This addition of 62,927 dwellings over the projection period would represent a doubling of the City's 2001 housing stock (a 105 percent increase).

The ground oriented stock of dwellings would grow by 28,152 units, from 41,804 in 2001 to 69,956 in 2061 (Figure 15). This 67 percent growth in the ground oriented stock between

2001 and 2061 compares to a 200 percent increase in the number of apartments in the City over the same period under this baseline scenario. Growing from 17,357 units in 2001 to 52,132 by 2061, 34,775 new apartments would be added to the City over this period. This growth in apartments would see the apartment stock go from representing 29 percent of the City's housing stock in 2001 to 43 percent by 2061.

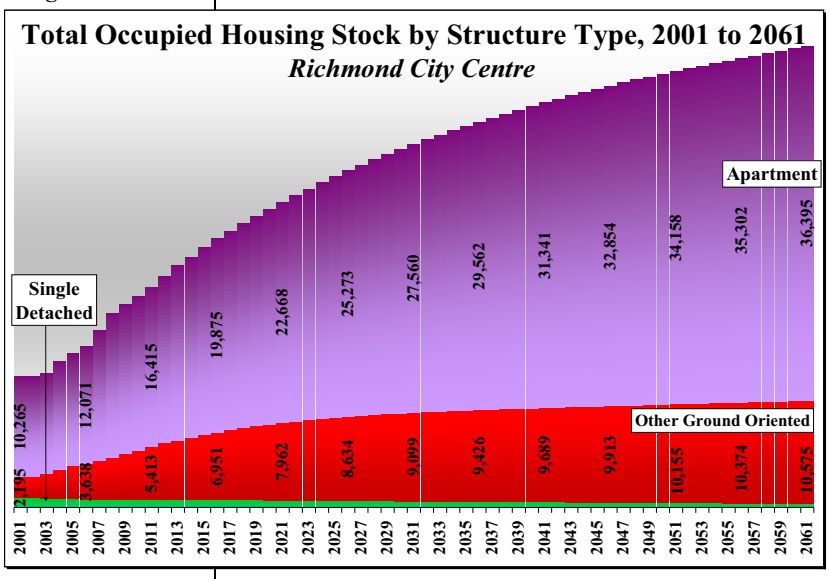
3. Richmond City Centre 2006 and 2061

In order to move from the City-wide allocation of housing units to the housing and population implications for Richmond's City Centre several data items were considered. The stock of dwellings by structure type in the City Centre and elsewhere in Richmond from the 2001 Census and additions between 1996 and 2001 served as a starting point to consider the allocation of future housing to the City Centre. Building permit and demolition data were considered to estimate changes in the distribution, size and composition of the housing stock between 2001 and today.

Based on these data as a starting point, 61 percent of Richmond's apartment stock was allocated within the City Centre community. Through discussions with the planning department about objectives to concentrate apartment development within the City Centre, this share was assumed to increase to 75 percent over the next decade, and be held constant thereafter. While only eight percent of the City's ground oriented stock was located within the City Centre in 2001, recent permit data showed a slightly greater share of ground oriented dwellings being built within the City Centre. It was therefore assumed that the City Centre would account for 30 percent of all net new ground oriented dwellings over the course of the projection period, the vast majority of which would be added in other ground oriented formats such as row homes. This was the final step in the dwelling unit allocation: determining the mix of ground oriented units added as single detached homes and other ground oriented dwellings (such as duplexes and town homes).

As in the other allocations, the pattern of newly-constructed dwellings between the 1996 and 2001 Censuses, the pattern of change seen in more recent permit data (2001 to 2006), and planning objectives for the City Centre were considered in the estimate of new ground oriented dwellings that would be in single detached and other ground oriented forms. It was assumed that within the City Centre 97 percent of ground oriented dwellings added in future years would be added as other ground oriented units and three percent as traditional single detached units.

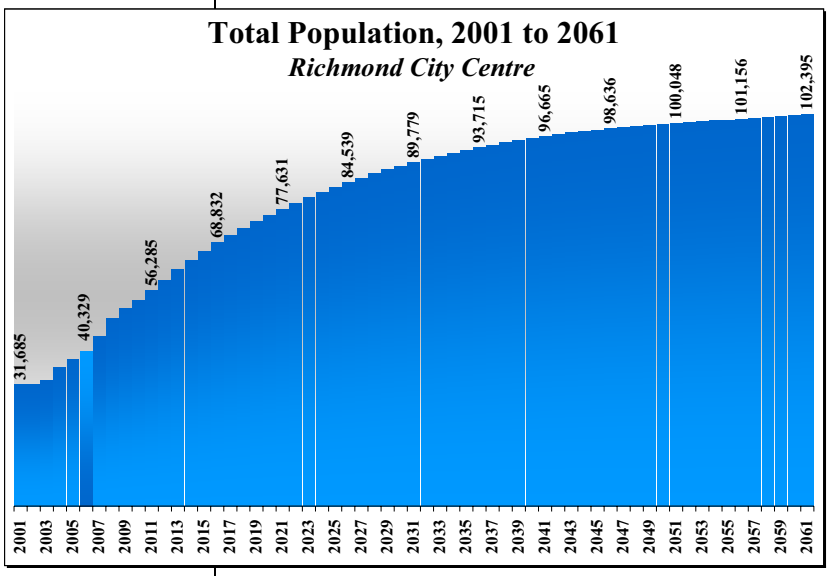
Figure 16



These assumptions, when combined with the regional projections would see the total dwelling stock in the City Centre grow from 16,554 units in 2006 to over 37,000 by 2031 and further to 47,000 by 2061 (Figure 16). Given planning objectives for the area, apartment units would see the greatest growth, adding just over 24,000 units. Other ground oriented units would grow by just under 7,000 units, while the number of single detached units would fall by 425 units between 2006 and 2061 as these units are converted to higher density uses.

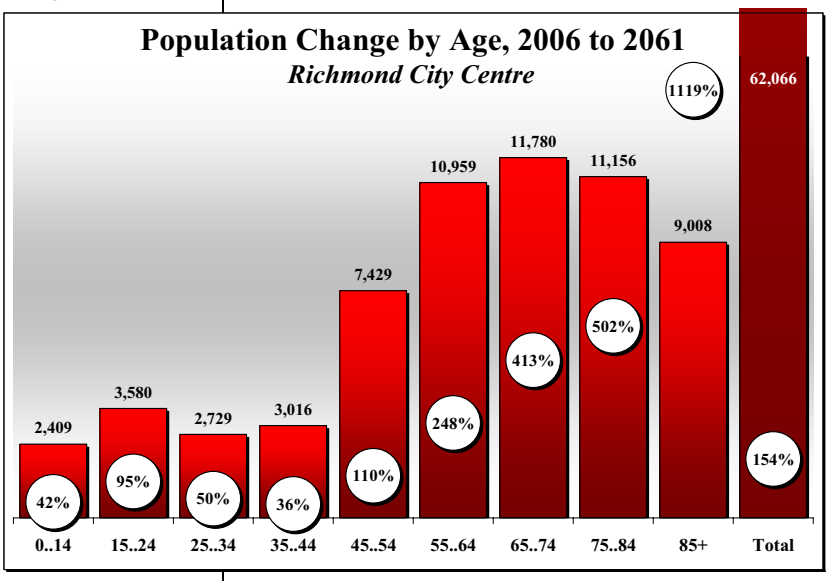
Once the future allocations of dwelling units by structure type were determined, it was possible to combine these estimates with the other processes of change in the Community Lifecycle Model as outlined in Section I of the report. Combining the aging, natality, mortality and mobility of the City Centre's resident population with additions to the community under the baseline development scenario would see the City Centre's population grow from 40,329 people today (2006) to just over 77,000 by 2021, almost 90,000 by 2031, and just over 102,000 by 2061 (Figure 17). Over the next 55 years the City Centre's population would grow by 154 percent, adding 62,066 new residents.

Figure 17



While growth would be in the range of three to six percent annually over the next decade, aging of the community's existing residents would combine with a slowing rate of housing expansion expected at the regional level. This would see annual growth rates fall to the one percent range by 2031 and further to 0.5 percent over the longer-term of the projection period.

Figure 18



While the population is expected to grow at a slower pace in the coming years, it will be characterized by much more dramatic changes in its composition. Figure 18 shows that while the population as a whole is expected to grow by 154 percent, the 55 and older age groups would grow by between 1.5 and seven times this rate; the 55 to 64 age group would grow by 248 percent, and the 85 plus age group would grow by 1119 percent. Note that this growth is in part due to there being a relatively small share of people over the age of 85 today.

The under 55 year old age groups would all grow more slowly than the population as a whole, the slowest being the 42 percent growth (3,334 additional people) in the population between the ages of 35 and 44. Slow growth in this age group would in part be the result of a significant share of the City Centre's population falling into this age group today, their aging out of it, and into subsequent age groups in the coming decades.

While the pace of change in the natural components of demography (natality and mortality) tend to change very slowly over time, the pattern of development within an area can alter the size and composition of a population much more rapidly. In order to provide a context for such changes in the pace of development within the City Centre, several alternative development scenarios were modeled. The following section details the approach and outcomes of three alternative development scenarios for the City Centre.

V. Alternate Development Scenarios

Three alternative development scenarios were modeled for the City Centre, each by changing the pace at which development would occur in the Municipality as a whole. Richmond's share of regional apartment development was increased beyond the baseline scenario to achieve a population threshold of 120,000 residents in three milestone years: 2061, 2076 and 2101. In order to determine the impact of a change in the pace of development alone, each of the other variables (natality, mortality and rate of household turnover) were all maintained at the same levels used in the baseline scenario. This approach allows us to isolate the impact that a change in rate of development would have on the City Centre's population alone.

A. Scenario I: 120,000 Residents by 2061

Achieving a population of 120,000 residents in the City Centre by 2061 under a community lifecycle approach would be the result of the City Centre's total dwelling stock increasing to 55,987 units by 2061 (Table 4). Between 2006 and 2061 the number of apartments would increase by 273 percent or 32,985 units. The number of ground oriented units would grow from 4,473 today to 10,985 by 2061 (a 146 percent increase). In order to achieve this number of dwelling units and population threshold by 2061 Richmond's share of regional apartments would have to average 12.1 percent over the projection period, 42 percent greater than the 8.5 percent under the baseline scenario. Average annual additions to the apartment stock would need to increase to 600 annually from the 440 units under the baseline scenario. In the same year the baseline scenario achieves a total population of 102,395 residents, 17,921 fewer (15 percent) than the 2061 development scenario.

Table 4

Baseline Scenario		**2006**	**2016**	**2026**	**2036**	**2046**	**2056**	**2061**
Trend allocation of regional housing	Richmond Share of Ground Oriented	10.5%	6.1%	3.3%	2.5%	2.5%	2.5%	2.5%
	Richmond Share of Apartment	13.8%	10.2%	8.3%	7.3%	7.3%	7.3%	7.3%
	City Centre Ground Oriented Units	4,473	7,735	9,334	10,031	10,430	10,817	10,985
	City Centre Apartment Units	12,071	19,875	25,273	29,562	32,854	35,302	36,395
	Total City Centre Units	16,544	27,610	34,607	39,593	43,284	46,119	47,381
	City Centre Population	**40,329**	**68,832**	**84,539**	**93,715**	**98,636**	**101,156**	**102,395**
2061 Scenario		**2006**	**2016**	**2026**	**2036**	**2046**	**2056**	**2061**
120,000 residents by 2061	Richmond Share of Ground Oriented	10.5%	6.1%	3.3%	2.5%	2.5%	2.5%	2.5%
	Richmond Share of Apartment	13.8%	12.5%	11.9%	11.9%	11.9%	11.9%	11.9%
	City Centre Ground Oriented Units	4,473	7,735	9,334	10,031	10,430	10,817	10,985
	City Centre Apartment Units	12,071	20,561	27,361	33,941	39,270	43,232	45,002
	Total City Centre Units	16,544	28,296	36,695	43,972	49,700	54,049	55,987
	City Centre Population	**40,329**	**70,480**	**89,427**	**103,727**	**112,796**	**117,967**	**120,307**

B. Scenario II: 120,000 Residents by 2076

Achieving a population of 120,000 residents in the City Centre by 2076 would be the result of the City Centre's dwelling stock increasing to 56,997 units by 2076 (Table 5). Between 2006 and 2076 the number of apartments would increase by 277 percent or 33,476 units. The number of ground oriented units would grow by 156 percent over the same period. In order to achieve the 120,000 population threshold by 2076, Richmond's regional share of annual additional apartments would have to average 10.6 percent over the projection period, 24 percent greater than the 8.6 percent under the baseline scenario. Average annual additions to the apartment stock would need to increase to 486 units annually. Under the 2076 scenario, the population in 2061

(the year that the baseline scenario was initially run) would be eleven percent higher (11,302 residents) than under the baseline scenario.

Table 5

Baseline Scenario		2006	2016	2026	2036	2046	2056	2061
Trend allocation of regional housing	Richmond Share of Ground Oriented	10.5%	6.1%	3.3%	2.5%	2.5%	2.5%	2.5%
	Richmond Share of Apartment	13.8%	10.2%	8.3%	7.3%	7.3%	7.3%	7.3%
	City Centre Ground Oriented Units	4,473	7,735	9,334	10,031	10,430	10,817	10,985
	City Centre Apartment Units	12,071	19,875	25,273	29,562	32,854	35,302	36,395
	Total City Centre Units	16,544	27,610	34,607	39,593	43,284	46,119	47,381
	City Centre Population	**40,329**	**68,832**	**84,539**	**93,715**	**98,636**	**101,156**	**102,395**

2076 Scenario		2006	2016	2026	2036	2046	2056	2061	2066	2071	2076
120,000 residents by 2076	Richmond Share of Ground Oriented	10.5%	6.1%	3.3%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%
	Richmond Share of Apartment	13.8%	12.2%	10.8%	9.7%	9.7%	9.7%	9.7%	9.7%	9.7%	9.7%
	City Centre Ground Oriented Units	4,473	7,735	9,334	10,031	10,430	10,817	10,985	11,149	11,304	11,450
	City Centre Apartment Units	12,071	20,506	27,083	32,852	37,218	40,464	41,914	43,227	44,442	45,547
	Total City Centre Units	16,544	28,241	36,417	42,883	47,648	51,281	52,899	54,377	55,746	56,997
	City Centre Population	**40,329**	**70,346**	**88,768**	**101,169**	**108,122**	**111,924**	**113,697**	**115,592**	**117,751**	**120,095**

C. Scenario III: 120,000 Residents by 2101

In order to achieve a population target of 120,000 residents in the City Centre by 2101 would require the City Centre's dwelling stock to grow by 40,028 units by 2101. Between 2006 and 2101 the number of apartments would increase by 268 percent or 32,441 units. The number of ground oriented units would grow by 169 percent over the same period. In order to hit this threshold by 2101, Richmond's share of annual additional apartments in the region would have to average 9.1 percent over the projection period, 5.8 percent greater than the 8.6 percent under the 2006 to 2061 baseline scenario. Average annual additions to the apartment between 2006 and 2061 stock would be 471 units, or seven percent greater than the 440 under the baseline scenario, resulting in a 2061 population that would be three percent higher than under the baseline scenario.

Baseline Scenario		2006	2016	2026	2036	2046	2056	2061
Trend allocation of regional housing	Richmond Share of Ground Oriented	10.5%	6.1%	3.3%	2.5%	2.5%	2.5%	2.5%
	Richmond Share of Apartment	13.8%	10.2%	8.3%	7.3%	7.3%	7.3%	7.3%
	City Centre Ground Oriented Units	4,473	7,735	9,334	10,031	10,430	10,817	10,985
	City Centre Apartment Units	12,071	19,875	25,273	29,562	32,854	35,302	36,395
	Total City Centre Units	16,544	27,610	34,607	39,593	43,284	46,119	47,381
	City Centre Population	**40,329**	**68,832**	**84,539**	**93,715**	**98,636**	**101,156**	**102,395**

2101 Scenario		2006	2016	2026	2036	2046	2056	2061	2066	2076	2086	2096	2101
120,000 residents by 2101	Richmond Share of Ground Oriented	10.5%	6.1%	3.3%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%	2.5%
	Richmond Share of Apartment	13.8%	11.3%	9.2%	7.5%	7.5%	7.5%	7.5%	7.5%	7.5%	7.5%	7.5%	7.5%
	City Centre Ground Oriented Units	4,473	7,735	9,334	10,031	10,430	10,817	10,985	11,149	11,450	11,722	11,965	12,070
	City Centre Apartment Units	12,071	20,291	26,186	30,960	34,348	36,861	37,983	39,000	40,795	42,362	43,849	44,512
	Total City Centre Units	16,544	28,026	35,520	40,991	44,778	47,678	48,969	50,150	52,246	54,084	55,813	56,582
	City Centre Population	**40,329**	**69,826**	**86,652**	**96,827**	**101,759**	**104,244**	**105,472**	**106,901**	**110,647**	**114,794**	**118,550**	**120,098**

VI. Sensitivity Testing

This section provides summary output of a selection of diagnostic tests conducted on the long-range demographic projections for Richmond's City Centre. It outlines the vectors used in the projections and provides insight into the relative impact of changing baseline vectors on the projected size and composition of the City Centre's future population. In order to determine the relative impacts of changes in each component, two important standards in sensitivity testing were maintained. The first being, that the impact of only one component was tested at any one time, with all other components remaining as they are in the baseline scenario. This allows the impact of each component to be determined, all other things remaining equal. The second was to ensure that relative changes in each component were equal in magnitude in order to assess the relative impact of the output compared to the baseline scenario. In this instance a relative change of ten percent was made for each variable (for example birth rates increasing by ten percent or average household size increasing by ten percent).

Three areas were identified for scenario testing, mobility and the size of inwardly and outwardly moving households, the natural aspects of population change (birth and death rates), and the share of future housing development in Richmond and the City Centre. The impact of each test is described below.

1. Mobility and Household Size

For the City Centre the structure type specific age profiles used to generate movers into and out of housing were tested for their impacts on the size and age composition of the projected population. Three tests were conducted for the impact of changes in household sizes: increasing average household size for in-movers into existing housing, increasing average household size for out-movers and, increasing household size for in-movers into new housing. Each was increased by ten percent.

The model responded appropriately to each of the tests, with the 2036 population being larger due to increases in household size moving in and smaller due to increases in those moving out. A ten percent increase in the size of in-mover households (single-detached 3.81, other ground oriented 3.80 and apartments 2.42 persons per unit) resulted in a less than proportionate increase in the total population, with the 2036 population being 4.4 percent greater. Increasing out-mover household sizes by ten percent resulted in a 0.06 percent smaller population in 2036, the result of a smaller difference between in and out-mover household sizes.

The impact of increasing household sizes for newly constructed households in the City Centre had a much smaller relative impact than for in-movers into existing housing: a ten percent increase in household size resulted in only a 0.7 percent increase in total population by 2036. The model also responded logically to this test, as the smaller impact is due to the small number of additional units added within a year relative to the large stock of dwelling units already present within the City Centre that were expected to turn over each year.

Given the generally younger profile of mobility, the impacts on the composition of the population tended to focus on the younger age groups. More specifically, with respect to increasing household sizes for in-movers, the 13 to 19 and 50 to 64 populations saw the greatest relative differences, the result of the prominence of the 20 to 30 population in the mobility profile, 30 years of aging, and having children between 2006 and 2036.

2. Birth and Mortality Rates

As with household size, the model responded appropriately to changes in natality and mortality rates. It was also found that the effects of increasing age and structure type specific birth rates on the communities' total population had a less-than-proportional impact on population: a ten percent change in birth rates for all age groups (increasing the total fertility rate to 1.83 in single detached, 1.38 in other ground oriented and 0.94 in apartments) resulted in a less than 0.5 percent change in total population by 2036. As would be expected, the greatest impact of changing birth rates was on the younger population, with the under 20 population being between five and nine percent larger by 2036 than under the baseline scenario.

Given the age and sex specific mortality rates used for the City Centre, a ten percent decline in mortality rates at all ages translates roughly into a 1.1 year increase in female life expectancies (a 1.3 percent increase) and a 1.4 year increase for males (1.7 percent). By 2036 the result of the ten percent decline in mortality rates was a 0.3 percent larger population relative to the baseline scenario. As would be expected, this was mostly reflected in the elderly population, with the City Centre population over the age of 65 being 2.3 percent larger by 2036 than in the baseline scenario.

3. Future Housing Development

As with changes in the size of households moving into and out of the City Centre, the pace of new development had a larger relative impact on total population compared to changes in either mortality or fertility rates. The first sensitivity test with respect to development was to increase Richmond's share of regional apartment housing starts. A ten percent increase in Richmond's share of apartment starts represented an average of 10.3 versus 9.4 percent of the GVRD's apartment starts being in Richmond between 2007 and 2036. A ten percent greater share of apartments to the municipality over the baseline scenario between 2007 and 2036 resulted in a 3.5 percent larger population in the City Centre by 2036. When combined with the aging of this population once they move into the City Centre, the age profile of mobility into new housing resulted in the greatest differences being seen between the ages of 35 to 49 (a 4.7 percent higher population) and the 50 to 64 population (3.9 percent higher).

The second test was to consider the impact of modifying the number of starts that would be seen in the City Centre over the projection period, holding Richmond's regional share as in the baseline scenario. Increasing the share of apartment development in the City Centre from 75 percent under the baseline scenario to 83 percent (a ten percent increase) of all apartments resulted in a 2.8 percent larger population by 2036. Similar to increasing the regional share of apartments, the greatest difference was seen in the population between the ages of 35 and 49, which was 4.3 percent greater than under the baseline scenario.

While forming a much smaller share of the current and projected housing stock, the impact of changing the ground oriented share of housing starts in the City Centre was also tested for its impact on the City Centre's population. The City Centre's share of new ground oriented housing was increased by ten percent from 30 to 33 percent of total starts in Richmond by 2017. This resulted in a 1.3 percent higher population by 2036. As would be expected, the smaller impact relative to changing the apartment share is due to the smaller contribution the new ground oriented stock makes to total net additions in the municipality in the coming years.