Auckland Futures Growth Model 2012

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Executive Summary

The Auckland Council growth model is a strategic component of policy planning within the Auckland Council. The growth model is based on population projections and comprises two parts, a Residential Futures Model and a Business Futures Model. The outputs of these models provide a probable pattern of development given underlying demand and supply conditions. The modelled outputs were used for the development of the Auckland Council's 2012 – 2022 Long-term Plan, various Asset Management Plans and the Development Contributions Policy.

The Auckland Residential Futures Model is a 'scenario model' that provides a spatial simulation of possible residential growth, generating population, household and dwelling projections at 2006 meshblock level to 2051. The Auckland Business Futures Model provides a spatial simulation of possible business growth, producing employee and floor space projections by local board and economic sector to 2051.

This report outlines the inputs and operations of these models, their key assumptions and the limitations and issues arising from them.

1.0 Introduction

Auckland Council's Research, Investigations and Monitoring Unit (RIMU) is responsible for developing and maintaining the residential and non-residential growth models for the Auckland Council and its Council Controlled Organisations. After the establishment of the Auckland Council, RIMU inherited seven different models from the former Auckland territorial local authorities. Each model was unique in the manner in which it worked and in its individual assumptions, output distribution and spatial scale. Given the heterogenous nature of the models it was not possible to combine them, hence a new model suited to Auckland Council requirements was required. The model had to achieve the following objectives:

1. Produce a predetermined series of outputs (units of demand) that were necessary for planning purposes
2. Produce outputs at a spatial scale that enabled aggregration into other spatial units[1]
3. Allow users to test different growth scenarios by adjusting model parameters (e.g. the amount of growth)
4. Incorporate the best information available to the Council at the time of development

In February 2011, Auckland Council commissioned Market Economics (ME) to develop a growth model capable of achieving the above objectives. The successful completion of this model would facilitate the development of a a consolidated and consistent view of growth across Auckland. Specifically, the model was to produce:

1. Projections of population, households, dwellings, employees and business floor space[2]
2. Projections at meshblock (2006 base) geography[3]
3. Annual outputs of the above projections to 2031 and every 5 years there-after to 2051

This report[4] describes the key inputs, assumptions, limitations and processes accompanying the two growth models. These models include the Auckland Residential Futures Model (ARFM) and the Auckland Business Futures Model (ABFM).

[1] This was required because at the time of the model development, the various planning catchments of Auckland Council's activities had not been determined. For Example, funding areas for Development Contributions.

[2] These were the key units of demand developed in conjunction with financial policy teams.

[3] This is required as the base year for the model coincides with the 2006 census. The 2006 census reflects the most accurate data set at the time of model development.

[4] The contents provided in this publication have been drawn from two reports produce by Market Economics Ltd, the *Auckland Residential Growth Modelling* and the *Auckland Business Growth Modelling* reports.

2.0 Residential Futures Model

The Auckland Residential Futures Model (ARFM) is a scenario model that provides a spatial simulation of possible residential growth "futures" based on given scenarios of demand and supply. The ARFM models the potential uptake of residential capacity based on anticipated growth in demand for residential dwellings. The outputs of the ARFM are annual projections of population, households and dwellings by meshblock (2006 base) to 2031, and five-yearly projections to 2051. The model has three main components including demand, capacity and the allocation process, each of which are discussed below.

2.1 Residential demand

The basic premise of the ARFM's demand module is that population growth drives the formation of new households, which in turn drives demand for new residential dwellings. There is also an inherent assumption that household preferences, in terms of location and housing style, change as households move through their life cycles.

By combining population projections by age-sex group with observed household formation trends and household composition (eg, single person, couples, families) and income, the ARFM produces projections for 47 household types. This is intended to provide a cross section of society with respect to household life cycles. The ARFM then analyses the distribution of these 47 household types by local board, and between detached and attached dwellings. This analysis is designed to identify likely shifts in household preferences for location and housing style in Auckland resulting from the anticipated ageing population.

The final outputs of the demand module are projections of demand for detached and attached dwellings by local board. The main components of the projections are described below.

2.2 Population

The underlying driver of residential demand in the ARFM is population growth. Population growth is driven by changes in fertility, mortality and migration. The ARFM incorporates three population projections by age-sex group for the region as a whole. These projections were a customer order and produced by Statistics New Zealand for Auckland Council. Statistics New Zealand's national and sub-national projections are based on a cohort component method[5]. The three population series produced used combinations of fertility, mortality and migration assumptions:

- **low projection:** assumes low fertility, high mortality and low migration;
- **medium projection:** assumes medium fertility, medium mortality and medium migration; and
- **high projection:** assumes high fertility, low mortality and high migration.

These projections were based on the estimated resident population as of 30 June 2006. M.E. updated them to incorporate Statistics New Zealand's population estimates for 2007 to 2011. The updated (2011 base) projections converge on the original projections by 2021 (illustrated in Figure 1 below).

[5] The cohort component method uses base population from the 2006 census and is projected forward by calculating the effects of deaths and migration within each age-sex group according to specified mortality and migration assumptions. More detail on the approach can be found on the Statistics New Zealand website, www.statistics.govt.nz

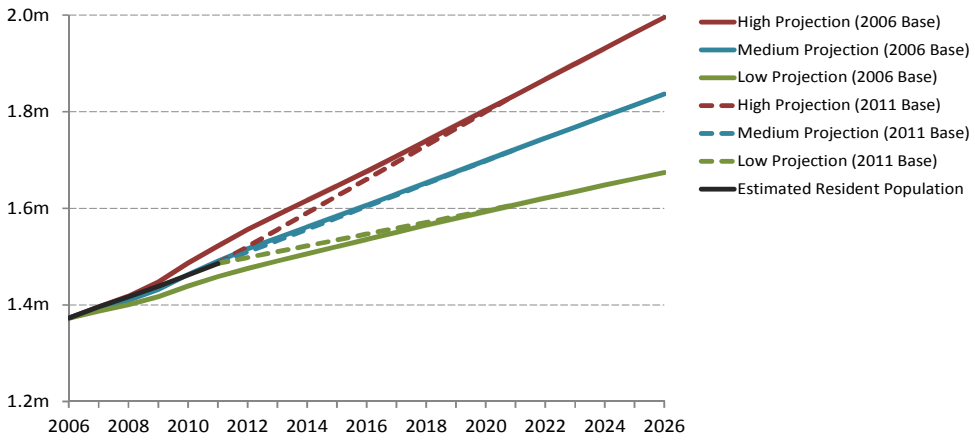

Figure 1: Population projections

2.3 Households

Each population projection series has a corresponding household projection. The household projections are derived by multiplying the projected populations by the 2006 census household formation trends for each age-sex group. This produces a matrix distribution of 47 household types that combine household preferences with dwelling types. Similarly, Statistics New Zealand publishes household projections based on the projected population and assumed living arrangement type rates for each age-sex group.

The ARFM method produces an estimate of 7800 (1.7%) less households than the Statistics New Zealand method in 2006. We believe that Statistics New Zealand overestimates the number of additional households; its household estimates for 2006 exceeded the number of private dwellings in approximately half of the area units contained in the Auckland council area. This is improbable, as a household is defined as a person living alone or two or more people living together in a private dwelling.

Household preferences for certain locations and housing choices are influenced by changes in household composition, income and age as households move through life cycles. The subsequent steps in the demand module distribute the total household projections across the 47 household types based on household composition, income and age of the head of the household in the 2006 census. Finally, the projections for the 47 household types are multiplied by their distribution across local boards, and between detached and attached dwellings in the 2006 census. In this way, the ARFM generates projections of household demand for detached and attached dwellings by local board that reflect underlying changes in population structure and associated household preferences.

2.4 Dwellings

The final component of the demand module is the projection of private dwellings by local board. A private dwelling accommodates a person or a group of people, but is not available to the public. The measure of private dwellings is distinct from the number of households because private dwellings include both occupied and unoccupied dwellings (eg, second homes or holiday homes).

The base number of private dwellings is drawn from the 2006 Census. As there is no census information for unoccupied dwellings, this study assumes that all unoccupied dwellings are private and that the ratio of detached to attached unoccupied dwellings is the same as for the occupied dwellings in the same meshblock.

Dwellings under construction on census night (7th March 2006) were also included in the estimate and treated in the same manner as unoccupied dwellings. This was done to align the dwelling estimates with the population and household estimates (at 30 June 2006), based on the assumption that most dwellings under construction on census night would have been completed in the three months before 30 June 2006.

Next, the growth in household demand for detached and attached dwellings was added to the base number of private dwellings. This yielded projections of **underlying** (population driven) demand for private dwellings by local board. While this is an appropriate method for estimating demand for private dwellings in the long-term, observed residential growth may differ significantly from underlying demand in the short to medium term. This has been the case following the global financial crisis and subsequent economic downturn. Residential dwelling consents have dropped well below the underlying demand projections, as economic constraints have slowed the building of new dwellings and formation of new households.

This situation is possible in spite of the population continuing to grow at the anticipated rate. Individuals may elect to return to family households or delay decisions to form new households, while individuals and families may choose to form multi-person and multi-family households in order to share living costs. The converse can also be true. In times of economic expansion, it is possible for building activity to run ahead of underlying demand, driven by speculative investment in residential development (as occurred between the 2001 and 2006 Censuses).

To avoid confusion, the short to medium-term deviations from the long-term underlying demand is referred to as the **effective** (economic driven) demand. ME used council building consent data to update the estimates of private dwellings for 2007 to 2011, so that the estimates reflect effective demand over this period. Auckland Council provided ME with monthly residential building consents by building type and meshblock from 1999 to 2010. ME analysed the relationship between building consents and completions (revealed by the growth in private dwellings between the 2001 and 2006 censuses). This work was used to calibrate the ARFM, aligning growth with current development levels.

Statistics New Zealand uses building consents to update its national dwelling estimates. The building consent data is lagged by six months to allow for buildings to be completed and added to the total private dwelling stock. This may have yielded an acceptable estimate for New Zealand historically, however the growing significance of apartment developments in Auckland (see Figure 2) means that a uniform lag of six months for all building types is likely to underestimate the time to completion in many instances.

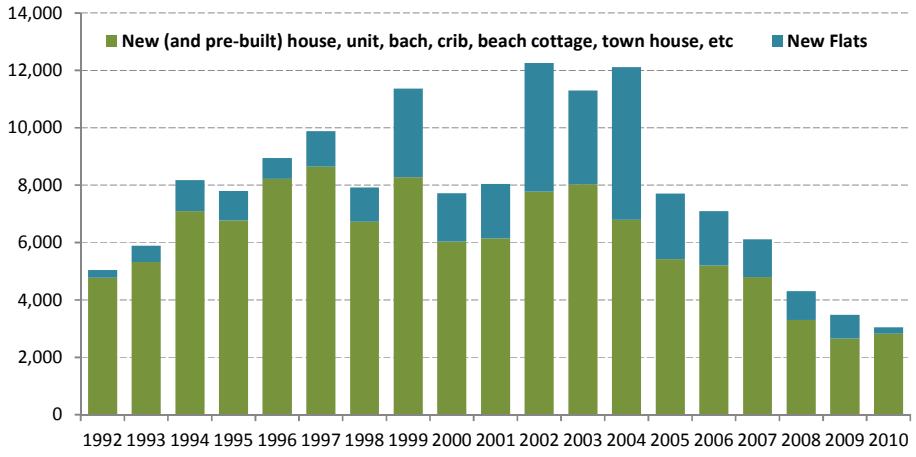

Figure 2: Residential dwelling consents for Auckland region 1992 - 2010

ME used regression analysis to determine the average time from consent to completion by building type. The outcome of this analysis (Table 1) is largely consistent with the findings of ME and Harrison Grierson in their study of the Adequacy of the Auckland Region's Residential Land Supply (2008) (see Table 2). By applying the average time from consent to completion by building type, ME was able to update its estimates of private dwellings for 2007 to 2011 to reflect the effective demand over this time.

Table 1: Average time from building consent to completion

Building Type	Months
New (and pre-built) house, unit, bach, crib, beach cottage, town house, etc (1 unit)	6
New (and pre-built) house, unit, bach, crib, beach cottage, town house, etc (2-10 units)	6
New (and pre-built) house, unit, bach, crib, beach cottage, town house, etc (11-20 units)	6
New (and pre-built) house, unit, bach, crib, beach cottage, town house, etc (21-50 units)	6
New (and pre-built) house, unit, bach, crib, beach cottage, town house, etc (51-100 units)	6
Resited Houses (1 unit)	6
Resited Houses (2-10 units)	6
Resited Houses (11-20 units)	6
New Flats (1 unit)	20
New Flats (2-10 units)	16
New Flats (11-20 units)	14
New Flats (21-50 units)	16
New Flats (51-100 units)	21
New Flats (101-200 units)	24
New Flats (201+ units)	27
Demolitions (1 unit)	6
Demolitions (2-10 units)	6
Demolitions (11-20 units)	6
Demolitions (21-50 units)	6
Demolitions (51-100 units)	6

Table 2: Development process (in months)

Typology	Average building construction to CCC (or proxy)	Average time to gain titles for further subdivision
Subdivision: 2 lot infill	3	0
Subdivision: 3-4 lots	4.5	0
Subdivision: 5-15 lots (single stage)	4.5	0
Subdivision: 16-50 lots (single stage)	4.5	0
Subdivision: 51+ lots (single stage)	4.5	0
Integrated: subdivision & volume/spec builder (10-20 units)	4.5	0
Integrated: subdivision & volume/spec builder (20+ units)	4.5	0
Single storey detached house (architecturally designed)	6	0
Single storey detached house (volume/spec builder)	4.5	0
Single storey detached house (pre-designed/kit homes)	3	0
Two storey detached house (architecturally designed)	6	0
Two storey detached house (volume/spec builder)	4.5	0
Two storey detached house (pre-designed/kit homes)	3	0
Two storey terraced house group (up to 8 dwellings)	7	0
Low rise multi-unit apartment (up to 4 storeys, 50 units)	12	5
Low rise multi-unit apartment (up to 4 storeys, 51+ units)	14	5.5
Mid rise multi-unit apartment complex (up to 6 storeys)	15	6
High Rise multi-unit development (up to 18 storeys)	20	6.5
High rise multi-unit development (over 18 storeys)	30	6.5
Vacant Lot	4.5	0

*CCC: Code Compliance Certificate

Through model development, it was decided that the dwelling outputs should incorporate the three short-term scenarios of effective demand (see Figure 3). The user is thus able to select when/if and how the dwelling shortfall is recovered. The effective demand projections were constructed using information from two reports produced by the Department of Building and Housing[6] and Infometrics Ltd[7]. The reports provided an overview of the housing market conditions in the building and housing sector.

Each scenario, termed effective dwelling demand, is designed as a short to medium term deviation from the long-term underlying demand. Three scenarios of effective demand are listed below:[8]

- **low effective demand**: based on the building consent projections to 2016 provided to Council by Infometrics (lagged by six months to allow for buildings to be completed);
- **medium effective demand**: based on Infometrics' building consent projections to 2014 and continued expansion of year-on-year growth by 1600 dwellings a year to 2016;
- **high effective demand**: growth of 4000, 6000 and 8000 dwellings in 2012, 2013 and 2014 respectively.

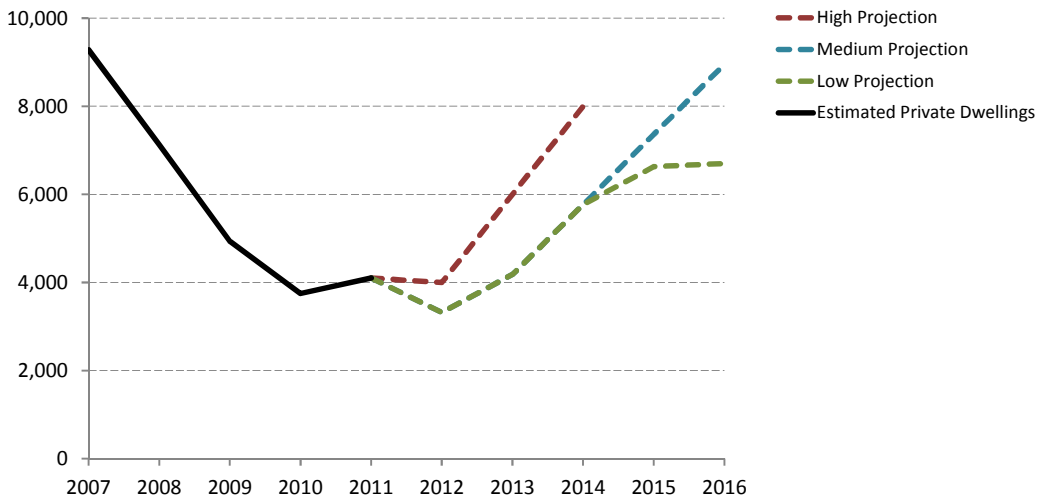

Figure 3: Effective demand projections (annual growth)

Finally, the ARFM enables the user to select various scenarios for the recovery of the current shortfall to underlying demand (illustrated in Figure 4). The recovery option can be selected at five-year increments, ranging from 2021 to 2051. The model will then spread the recovery of the dwelling shortfall over the selected time period. A 'no return' option is included as an option. Under this scenario, from 2016 the year-on-year growth is the same as the underlying scenario's, however the shortfall experienced prior to 2012 is not recovered.

[6] New Zealand Housing Report 2009/2010: Structure, Pressures and Issues, September 2010, Department of Building and Housing. Note, as of 1st July 2012, the Department of Building and Housing have been incorporated into the Ministry of Business Innovation and Employment.

[7] Infometrics Forecast reports, July 2011, Infometrics Ltd.

[8] Medium effective demand is the default setting.

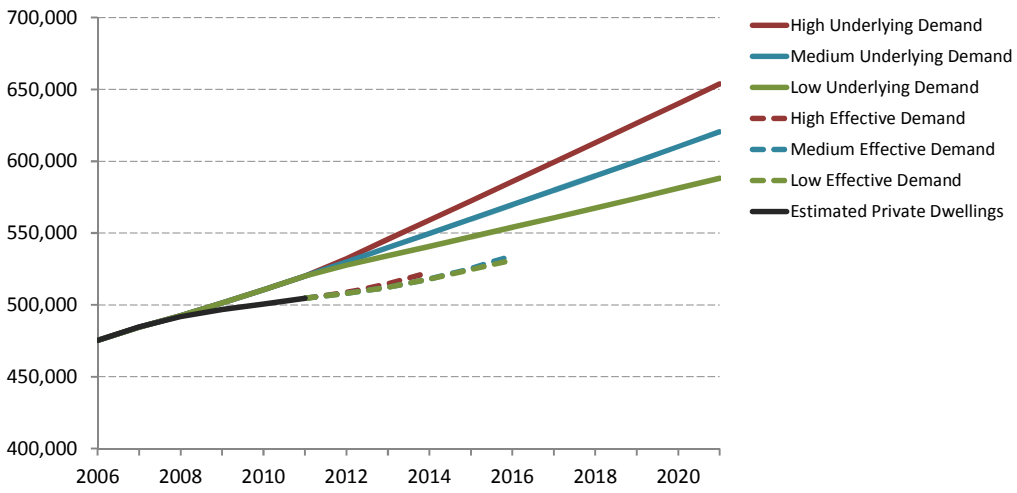

Figure 4: Underlying and effective demand projections

3.0 Residential Supply

3.1 Residential capacity model

An input residential capacity model was built alongside the ARFM to represent the 'supply' side of the growth equation. This model enables Auckland Council (the user) to incorporate updates to planning and future growth in the residential capacity input for the ARFM. The ARFM represents the uptake of this supply by allocating the projected population demand to the identified residential capacity.

The residential capacity model is designed to incorporate future capacity, derived from the Council's plans to accommodate anticipated residential growth. Each area of intended growth can be defined spatially using a 2006 meshblock geography. The user then assigns each growth area an intended area type, dwelling intensity (detached or attached - see table 3 below), timing and total residential threshold. In the absence of user-defined areas, the residential capacity model defaults to using the findings from the ARC: Capacity for Growth Study 2006[9].

Table 3: Default Intensity by area type

Area Type	Detached	Attached
Business Area	0%	100%
Future Urban	50%	50%
Future Urban Rural Town	75%	25%
Greenfield	50%	50%
Growth Centre	0%	100%
Growth Node	75%	25%
Intensive Corridor	0%	100%
Rural	100%	0%
Suburban	100%	0%

3.2 Capacity for Growth Study 2006

The residential capacity model uses the *Capacity for Growth Study 2006* as the starting point to analyse residential capacity in Auckland. The study draws together a range of residential land supply datasets for the Auckland region (current to March 2006) and uses a GIS application to identify, assess and capture sites that are suitable for additional development. The key datasets are:

- 2006 colour digital aerial photography
- 2006 digital cadastral database (parcel boundaries)
- Digital District Plan zoning (from territorial authorities)
- Zoning density assumptions (checked with territorial authorities)
- Zoning development controls (yard set-backs, access way requirements etc.)
- Quotable value New Zealand (QVNZ) dwelling data
- Building footprints

[9]The Auckland Regional Council, Capacity for Growth Study 2006.http://www.aucklandcouncil.govt.nz/SiteCollectionDocuments/aboutcouncil/planspoliciespublications/technicalpublications/tr2010014capacityfogrowthstudy2006.pdf

Each parcel of land (or group of parcels in some cases) was identified and captured as an individual data point, and described in terms of its zoning, density and area. This information was used to identify eight categories of residential land available for development:

- **Vacant Land:** any residential zoned land parcel that did not contain buildings in 2006.
- **Vacant Potential Land:** any parcel of residential land that has a site size greater than 2000m² with one or more residential buildings on it and includes a portion of undeveloped or vacant land.
- **Infill:** any residential zoned site smaller than 2000m² that can accommodate one or more additional dwellings on the front or rear of the site.
- **Refill:** any residential zoned land that is suitable for the removal and replacement of the original house with more than two town-houses (to the maximum permitted density).
- **Business Land Redevelopment:** any business zoned land that makes provision for some residential zoning (i.e. mixed use). The residential component has been calculated as a percentage of the total permitted floor space.
- **Special Areas**: capacity in greenfield areas with Structure Plans, eg, Stonefields (Mount Wellington Quarry).
- **Rural Towns:** data on available capacity within rural towns from the 2006 study has been applied as the best estimate of available land.
- **Rural Residential:** any rural parcels that are zoned in a manner that allows subdivision to create sites smaller than 8 hectares.

In some cases, parcels were identified as having both infill and refill capacity. In practice, however, only one form of development can take place (ie, they are mutually exclusive). For the purposes of the residential capacity model, ME assumed that:

- if a parcel was identified as having both infill and refill potential and the rates improvement value is greater than 30 percent of the rates capital value, infill development is more likely to occur; or,
- if a parcel was identified as having both infill and refill potential and the rates improvement value is less than or equal to 30 percent of the rate capital value, refill development is more likely to occur.

The logic behind this assumption is that if the existing dwelling(s) on a parcel represent a significant portion (over 30 percent) of the total value, it will not make financial sense for a developer to demolish the existing building and refill the site. In this circumstance, it is more likely that a developer will keep the existing building and infill the site. Conversely, if the value of improvements on a parcel is below a certain threshold (assumed to be 30 percent of the total value), a developer may stand to benefit from demolishing the existing building and refilling the site to the maximum permitted density.

Finally, ME used the parcel zoning data to distinguish between capacity for detached and attached dwellings for all forms of capacity identified in the study. This was based on the assumption that developers have a financial incentive to develop to the maximum densities permitted by parcel zonings. It was also assumed that there are no other impediments preventing the developer from maximising the development potential of each land parcel. These assumptions were necessary to produce a single, comprehensive analysis of residential capacity across the Auckland region. The data was then consolidated at the meshblock level and incorporated in the capacity model as a snapshot of available capacity in 2006.

3.3 Legacy supply

The existing supply in the model is informed by *Plan Change 6: Auckland Regional Growth Strategy 2050*,[10] inherited growth models and planning developments allowed for in the district plans, plan changes, structure plans and concept plans of the former territorial authorities of the Auckland region. The existing supply information does not therefore reflect the Auckland Plan as the growth information was required in advance of the completion of the Plan.[11]

To derive the supply information, RIMU utilised the legacy growth models and sought feedback from Auckland Council's Area Spatial Planning, City Transformation and Operative Plans teams. The teams verified the dwelling supply capacity for each growth area within the Auckland region. This process identified the current plan status of each area, including any requirements for a plan change or variation that would rezone areas of growth. Through this exercise, planners determined whether the dwelling capacity is feasible and the timing of the release of capacity for each area of growth. This information was incorporated into the residential capacity supply model.[12]

[10] Auckland Regional Growth Forum, Auckland Regional Growth Strategy 2050 http://www.arc.govt.nz/albany/fms/main/Documents/Auckland/Aucklands%20growth/Auckland%20regional%20growth%20strategy.pdf

[11] The Auckland Plan was adopted by Auckland Council in March 2012. The supply side component of both models is yet to be amended. Given the land use changes in the spatial plan that occurred between its development, consultation and adoption coupled with its policy direction which utilised a high growth scenario and a 70/40 split, the distribution and level of growth will be significantly different to the outputs of the existing models. Note that s. 80(2)(b) of the Local Government (Auckland Transitional Provisions) Act 2010 stated that the Auckland Council is deemed to have adopted the regional growth strategy and that it remains in effect until the Council adopts the spatial plan (s. 80(3)).

[12] Within both models, the greatest sensitivity is to the capacity data provided, either in terms of the capacity identified in the *Capacity for Growth Study 2006* or as the supply provided to the model from users. This provides a limit to possible growth in any given location. If growth is prevented in one location, pressure is intensified in another.

4.0 The Allocation Process

4.1 The allocation of households to dwellings

The ARFM's allocation process models the potential uptake of residential capacity using a given scenario of demand. The allocation is performed at the local board level first, then at the area unit level and finally at the meshblock level. This scalar framework is primarily designed to ensure that the capacity provided by greenfield areas (without existing populations) attracts growth. It also reflects the decision-making process that households undertake when selecting a residence (starting with a broad area that takes in places of work, school and play, before narrowing the search to suburbs and finally streets).

The model allocates growth sequentially by year and dwelling type (starting with detached dwellings). An outline of the local board-level allocation process is presented in Figure 5. There are nine key steps within the allocation process:

1. Accommodate as much demand for detached dwellings in 'first choice' local boards as capacity will allow.
2. Unsatisfied demand is either:

   (a) used to intensify through attached dwellings in first choice local boards (step 6); or

   (b) translated into demand for detached dwellings in second choice local boards (step 3).

3. Accommodate as much demand for detached dwellings in second choice local boards as capacity will allow.
4. Unsatisfied demand is either:

   a) Forced to intensify through attached dwellings in first choice local boards (step 6) *if capacity allows*; or

   b) Translated into demand for detached dwellings in second choice local boards (step 5).

5. Repeat step 3:[13] Accommodate as much demand for detached dwellings in second choice local boards as capacity will allow. Unsatisfied demand is used to intensify through attached dwellings in first choice local boards (step 6).
6. Accommodate as much demand for attached dwellings in first choice local boards as capacity will allow.
7. Accommodate as much demand for attached dwellings in second choice local boards as capacity will allow.
8. Accommodate as much demand for attached dwellings in third choice local boards as capacity will allow.
9. Accommodate the balance of demand for attached dwellings based on residual capacity in local boards.

[13] The allocation process contains an iteration of steps 2 and 3 to accommodate feedback relationships in the model.

Figure 5: Flow chart of the Local Board-level allocation process

A core assumption of the allocation process is what happens when the capacity for detached dwellings runs out in first choice local boards (step 2). In these circumstances, households can either adopt a more intensive living arrangement (i.e. intensify) or move to another local board (ie, shift). Location quotients[14] were utilised to calculate each of the 47 household type's local board choices (ie, preferences), and estimate the average propensity to intensify for each local board.

Within the ARFM, the location quotient provides an indication of each household type's preference for a particular local board within the region. This is the origin of the first and second choice local boards. For example, a map of location quotients for couples aged 15-29 years and in the top income quintile (Figure 6) suggests that these households prefer to live near their upper-income, CBD-based jobs. Contrast this with the map of location quotients for two parent families, aged 15-29 years and in the lowest three income quintiles (Figure 7).

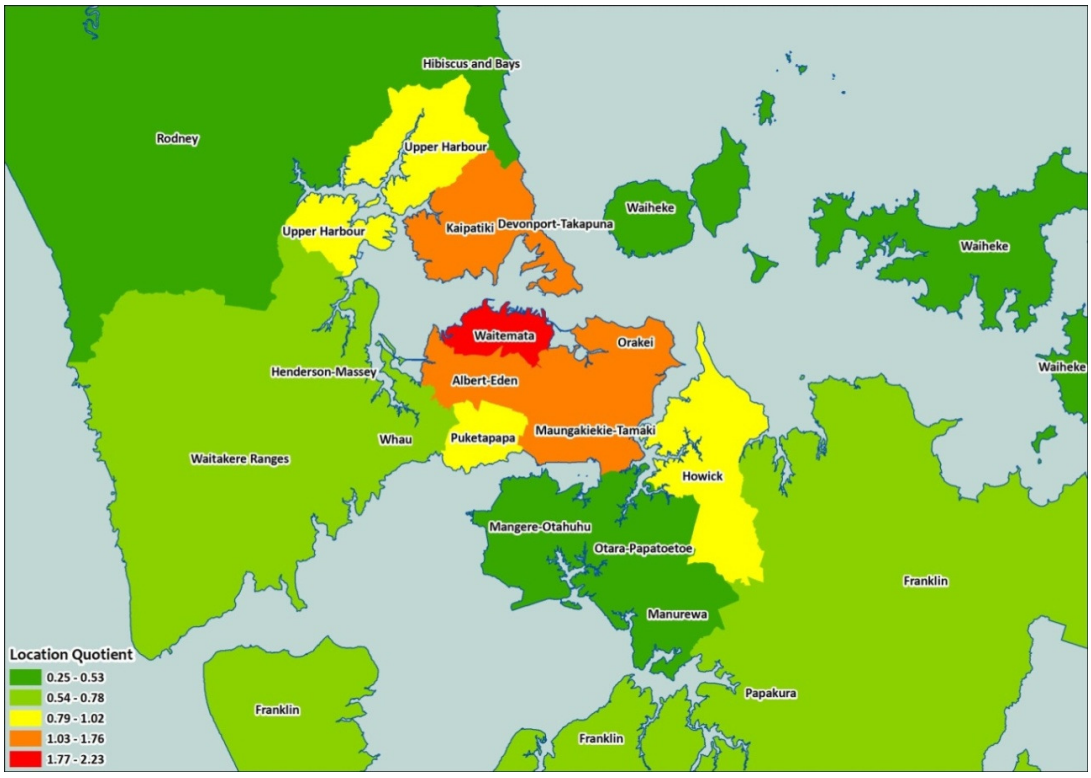

Figure 6: Location quotients for couples, 15-29 Years, Q5

[14] Location quotients are commonly used analytical tools that compare a local area to a larger reference area according to a chosen characteristic. In this instance, location quotients were used to quantify the prevalence of a particular household type in a local board relative to the region as a whole. A location quotient of less than one indicates that the household type comprises a smaller proportion of the total households in the local board than it does in the region as a whole. Conversely, a location quotient of greater than one indicates that the household type is over-represented in the local board compared to the region as a whole.

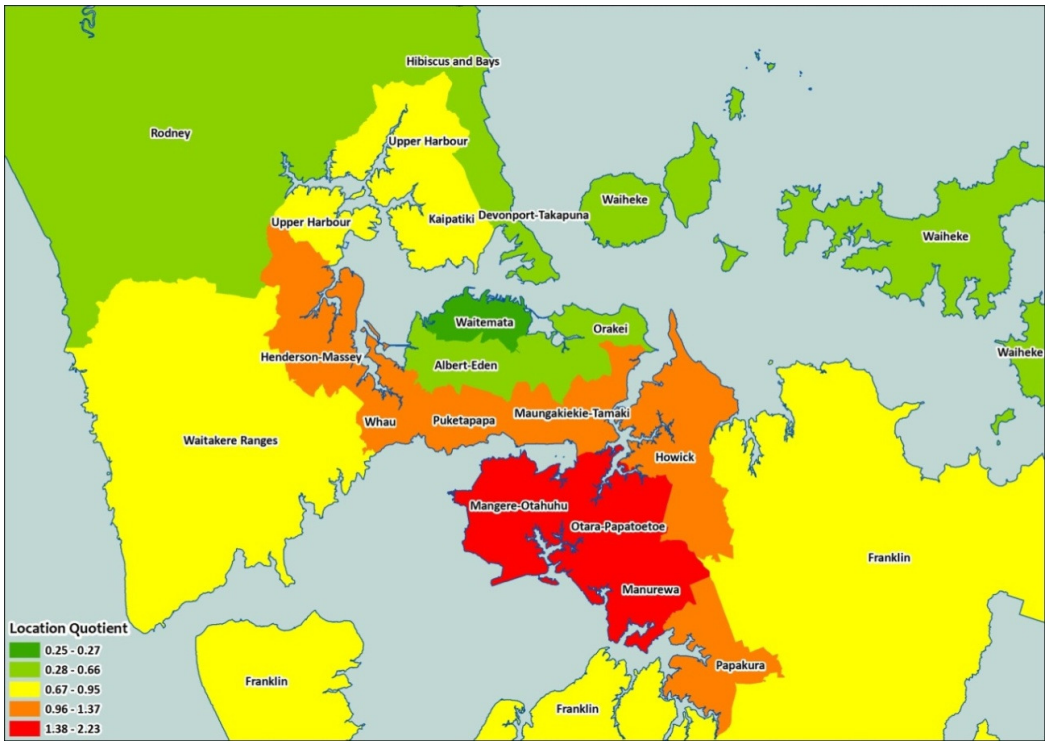

Figure 7: Location quotients for two parent families, 15-29 Years, Q1-Q3

The location quotients used to calculate the propensity to intensify for the 47 household types (ie, the probability that a household of a particular type will intensify, as opposed to shift, if there is no capacity for detached dwellings in its first choice local board, the next option is to either shift or to intensify). For example, if a household's location quotient is equal to one (i.e. the household type comprises the same proportion of the total households in the local board as it does in the region as a whole); it is assumed that the household has no particular preference for its first choice local board over another local board. Its propensity to intensify is therefore 50 percent (ie, there is an equal chance that the household will intensify or shift).

If, however, a household's location quotient is equal to two, it is assumed that the household's preference for its first choice local board is twice as strong as its preference for the rest of the region. The household's propensity to intensify is therefore 67 percent (ie, it is twice as likely that the household will intensify as it is that it will shift).

The propensities to intensify of the 47 household types were weighted by the number of households of each type in each local board to calculate the average propensity to intensify for each local board. This average propensity to intensify was then used to estimate the proportion of households (of all types) that choose to intensify if there is no longer capacity for detached dwellings in first choice local boards.

A second set of assumptions exist within the allocation process concerning how households that shift are allocated to other local boards. With reference to the nine steps outlined above, this is calculated in one of three ways:

i. In the first instance (steps 3, 5 and 7), households shift to second choice local boards in proportion to the distribution of the 47 household types across the local boards in the 2006 census. This means that the 2006 household distribution patterns drive the initial reallocation of households. Areas with high concentrations of a specific household type are assumed to attract growth of households of the same type.

ii. In the second instance (step 8), households that cannot be accommodated in their second choice local boards shift to third choice local boards in the manner described in step (i) above. However, their choice is restricted to only those local boards with remaining capacity.

iii. In the final instance (step 9), households that cannot be accommodated in their third choice local boards shift to other local boards in proportion to the residual capacity that exists to accommodate them.

This allocation process is repeated for all subsequent years in the model and assumes that all demand can be met within the year it arises in one form or another (unless all capacity for detached and attached dwellings in all locations is exhausted).

Once households have been allocated to dwellings at the local board-level, they are allocated to area units according to the following method:

1. Initial allocation to area units within local boards, based on local board-level growth rates. Where capacity does not allow additional households at the area unit level;

2. A second round, based on the initial demand for area units (from step 1 above), but restricted to area units with remaining capacity. Where there is residual demand;

3. A final round, based on residual capacity in area units within the same local board, captures the remaining demand (the preceding local board-level allocation ensures that demand and supply have already been matched).

Once households have been allocated to area units, they are distributed to meshblocks based on available capacity. Again, demand equates to supply at the area unit level so the totals will match and full allocation of meshblocks can occur.

The household projections are derived from the dwelling projections (from the allocation process described above) by adding the growth in dwellings at the meshblock level to the household estimates for 2011. This assumes a constant number of unoccupied dwellings, although the ARFM provides the ability to change this should Council choose to scenario model alternative futures.

5.0 Assumptions of the ARFM

Presented below is an outline of the assumptions used with the ARFM which are also used to underpin the financial planning with the Auckland council Long-term Plan:

- The basic premise of the demand component of the model is that population growth drives the formation of new households, which in turn drives demand for new residential dwellings.

- Consequently, the underlying driver of demand in the model is population growth. The model incorporates the most recent population projections produced by Statistics New Zealand for Auckland Council (2006 base).

- The anticipated population growth is used to produce projections for 47 different household types, based on observed rates for each population cohort in the 2006 Census. These households in turn drive demand for attached and detached dwellings based on revealed preferences for each household type in the 2006 Census.

- The level of underlying demand has been moderated in the early years of the model to reflect the slower rates of household formation and residential development in the current economic climate. The resulting projection of demand is termed effective demand.

- The existing land supply information is derived from a range of planning related documents. Development capacity is released at specified times in the residential capacity model. It is therefore assumed that prior to the date of the capacity release an enabling planning framework will have been developed and will be operational.

- The spatial allocation of demand only occurs where capacity is available (either as capacity identified in Gamble (2010) and/or capacity identified in the residential capacity model). Therefore, the model assumes that areas without capacity, or where capacity is exhausted over time, are subsequently unable to absorb future demand.

- The spatial allocation of demand assumes that household preferences, in terms of location and housing style, change as households move through their life cycles.

- The allocation process is iteratively scalar. Demand is allocated by local board level first, then at the area unit level and finally at the meshblock level. A key assumption when capacity for detached dwellings runs out in first choice local boards, households can either adopt a more intensive living arrangement (ie, intensify) or move to another local board (ie, shift). Location quotients are used to determine this process.

- The outputs of the model assume the successful interaction between planning policy, consumer demand and developer operations.

The default settings in the ARFM are:

- **medium** population projection[15];
- **medium** effective demand[16]; and
- return to underlying demand[17] by **2036** (20 years).

Table 4: Summary of projected population and dwellings in Auckland 2012 – 2022[18]

	2012	**2022**	**Change 2012- 2022**
Population	1,509,300	1,745,100	235,800
Dwellings	507,073	605,499	98,426

Source: Auckland Residential Futures Model V3 (February 2012)

[15] Medium population projection taken from a customised series produced by Statistics New Zealand for the Auckland Council in November 2010.

[16] Medium effective demand is based on Infometrics Ltd July 2011 Forecasts Report on building consent projections for the Auckland region from 2011 to 2016.

[17] The timeframe over which the model will assume to spread the recovery of the dwelling shortfall commencing in 2017.

[18] Auckland Residential Futures Model v3 (February 2012).

6.0 Business futures model

The Auckland Business Futures Model (ABFM) is a scenario model that provides a spatial simulation of possible business growth "futures" based on given scenarios of demand and supply. In essence, the ABFM models the potential uptake of business capacity based on anticipated growth in demand for employees and business floor space.

The final outputs of the ABFM are projections of employees and floor space by local board and economic sector, yearly to 2031 and five-yearly to 2051. The three main components of the model (demand, capacity and the allocation process) are discussed below.

6.1 Business demand

The ABFM incorporates customised versions of the Auckland Residential Futures Model (ARFM) and the Auckland Council Economic Futures Model (EFM, see 6.2 below) to produce projections of demand for employees and business floor space by local board and economic sector.

The ABFM retains the ARFM's ability to evaluate scenarios of residential demand by allowing the user to select the following settings:

- low, medium or high population projections driving underlying demand;
- low, medium or high effective demand projections of an economic recovery; and
- the year in which effective demand returns to underlying demand.

The ABFM replicates the local board-level residential allocation developed for the ARFM to produce population projections for Auckland that reflect any residential capacity constraints inherent in Council's plans. The resulting projections are assigned the age and sex attributes from Statistics New Zealand's (SNZ) population projections for Auckland Council, and input into the EFM to generate employment projections for 48 economic sectors.

6.2 Economic futures model

The EFM is a type of multi-regional economic input-output model. The model is multi-regional because that it captures economic and environmental implications of growth feedbacks between Auckland and the rest of the country. A key feature of the model is that it can be used to evaluate not only the direct economic and environmental effects of growth in final consumption, but also the associated indirect (ie, through supply-chain) and induced (ie, through consumer spending) economic and environmental effects.

The model is run using scenarios, and maps the growth path of each scenario, for 48 industries, in terms of major economic indicators (ie, gross output, value-added and employment) over 20 years from 2011 to 2031.

An application of the EFM typically involves an evaluation of a 'baseline' business-as-usual (BAU) scenario. This BAU scenario is developed on the premise that the economy continues to function in the same way as it has in recent times, with the scenario typically used as a point of comparison against which alternative growth scenarios may be assessed. The default settings of the EFM (on which the ABFM is based) are that of the BAU scenario.

All scenarios are established by generating future projections of the value of goods and services consumed by final demand categories (ie, household consumption, export consumption and gross fixed capital formation (GFCF)), over a 20 year period.

It is important to note that the EFM is not a crystal ball; no model can predict the future. The EFM simply evaluates economic and environmental impacts under a restricted set of consumption assumptions formulated as a scenario. Nevertheless, evaluation of each scenario provides critical insights into the potential economic and environmental trade-offs which may exist.

6.3 Model structure

Figure 8 below sets out the basic causal structure of the EFM model. It depicts the way in which outputs for a given year are derived from the model, based on data and assumptions for that same year.

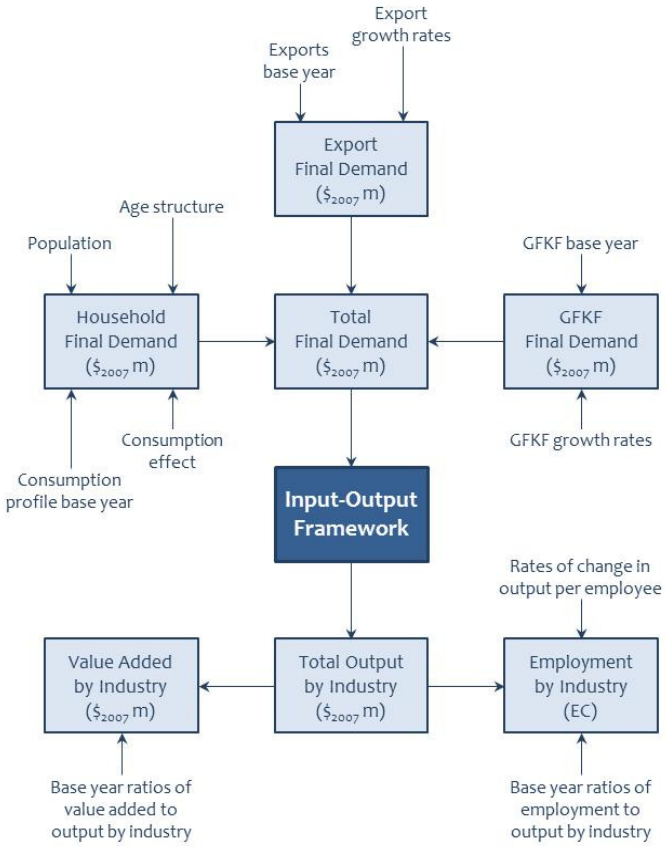

Figure 8: Causal structure of the EFM

As shown in the top half of the diagram, the primary drivers of the model are future estimates of final demand for goods and services. These estimates are, in turn, made up of three principal categories of final demand:

- consumption of goods and services by households;
- consumption of goods and services for the purposes of capital formation (GFKF); and
- exports of goods and services to other nations.

The methods employed to generate estimates of future final demand for the BAU scenario for Auckland and the rest of New Zealand are outlined further, below.

With estimates of total final demand for a given year, the input-output structure of the model is then able to generate estimates of total output for each of the 48 industry groups. The base input-output tables in the EFM have been generated by creating a national input-output table based on the latest 2006-2007 National Supply and Use Tables published by SNZ in 2011, and then regionalising the national table using the Generating Regional Input-Output Tables (GRIT) procedure.

Finally, industry output is translated to three major economic indicators: gross output by industry ($\$_{2007}$ m); value-added by industry ($\$_{2007}$ m); and employment by industry (employment counts). Initial estimates of employment are derived by multiplying the estimated output for each industry by the respective industry's base year ratio of employment to output. These estimates are then adjusted to account for estimated changes in multifactor productivity (MFP), measured as the change in output per worker. MFP growth rates were derived from national MFP data produced by SNZ, along with agglomeration elasticities produced by the New Zealand Transport Agency.

6.4 Scenario assumptions

This section sets out the BAU scenario assumptions incorporated within the EFM model with respect to the three principal categories of final demand: households, GFKF and exports. As noted above, these constitute the primary drivers of the model.

Households

Estimates of future household demand for goods and services are derived from projections of future population growth within Auckland and the rest of New Zealand. Except where qualified below for the consumption and population ageing effects, it is assumed that each person consumes a constant mix of goods and services. Thus, population growth results in a proportional increase in the amount of goods and services consumed.

The ABFM replaces the population projections for Auckland in the BAU scenario with the output of the ARFM, thereby enabling Council to evaluate countless scenarios of future employment based on the impact of residential supply on the future population of Auckland.

As the EFM model is based on a multi-regional framework, population growth in the rest of New Zealand also constitutes part of the household final demand driver. The estimates of population growth by age-sex cohort are derived from SNZ's Subnational Population Projections: 2006 (base)–2031 update series.

The household consumption effect has been incorporated in the EFM to account for the fact that over time, households have been consuming more per year. This trend is thought to be a result of several factors including increases in income through salary increases, leveraging off house price gains (i.e. debt based borrowing), redirection of income from savings to disposable income and increases in government transfers.

Population age structure also has important implications for consumption levels and economic growth. This is because each age group in a population tends to behave differently, with distinct economic consequences: the young require intensive investment in education and health, working-age adults supply labour and savings, and the aged require health care and retirement income. Therefore, when the relative size of each of these groups in a population changes, so does the relative intensity of these economic behaviours.

In order to account for the implications of changing demographics in the BAU scenario, differing consumption scalars are assigned to each population cohort. The value of total consumption for each person in the 5-9 year age group is, for example, assumed to be approximately 81.5 percent of that of a person in the 40-44 year age group. The scalars are derived from the New

Zealand Treasury's study on the implications of population ageing (Guest, Bryant and Scobie, 2003).

Gross fixed capital formation

Future GFCF estimates were generated by applying long-run average growth rates in capital formation to the base year GFCF estimates by industry, obtained from the multi-regional input-output table. The growth rates are determined from statistical time series (econometric) analysis. Selection of the time series technique applied depends on the underlying dynamic behaviour of the sector output being analysed. Where historical observations fluctuate around a long-run mean, stationary time series methods are applied (eg, the AMRA process). Where historical observations indicate a consistent upwards or downwards movement, non-stationary time series methods are used (eg, Holt's method). The data utilised in the time series analysis for GFCF is derived from SNZ's National Accounts Gross Fixed Capital Formation by Industry.

Exports

Like GFCF, future export projections are generated by applying the national long-run average growth rates for export commodities by sector to the 2006-2007 international export estimates obtained from the multi-regional input-output table. Again as with GFCF, the long run growth rates by export commodity are determined according to econometric analysis. The data utilised in this time series analysis is derived from SNZ's Harmonised System data in the case of commodity exports, and the Balance of Payments data in the case of exports of services.

6.5 Input into the ABFM

The EFM generates projections of employment for 48 economics sectors, five-yearly from 2011 to 2031. The ABFM uses the inherent ratios of employees to working-age population (defined as 15 to 69 years of age) to interpolate the intermediate years and extrapolate beyond 2031 to 2051 (based on projected trends for the period 2027-2031). Finally, the employee counts for the 48 sectors in the EFM are aggregated to the four key sectors in the ABFM (see Table 5) based on the primary spatial demand drivers (ie, population or industry) and business land requirements (ie, group 1, 2 or mixed) of each industry.

Table 5: Aggregation of 48 EFM sectors to 4 ABFM sectors

Production and distribution
Horticulture and fruit growing
Livestock and cropping farming
Dairy cattle farming
Other farming
Services to agriculture, hunting and trapping
Forestry and logging
Fishing
Mining and quarrying
Oil and gas exploration and extraction
Meat and meat product manufacturing
Dairy product manufacturing
Other food manufacturing
Beverage, malt and tobacco manufacturing
Textile and apparel manufacturing
Wood product manufacturing
Paper and paper product manufacturing
Printing , publishing and recorded media
Petroleum and industrial chemical manufacturing
Rubber, plastic and other chemical product manufacturing
Non-metallic mineral product manufacturing
Basic metal manufacturing
Structural, sheet, and fabricated metal product manufacturing
Transport equipment manufacturing
Machinery and equipment manufacturing
Furniture and other manufacturing
Electricity generation and supply
Gas supply
Water supply
Construction
Wholesale trade
Road transport
Water and rail transport
Air transport, services to transport and storage
Retail, hospitality, recreation and personal services
Retail trade
Accommodation, restaurants and bars
Cultural and recreational services
Personal and other community services
Commercial
Communication services
Finance
Insurance
Services to finance and investment
Real estate
Owner-occupied dwellings
Business services
Central government administration, defence, public order and safety services
Local government administration services and civil defence
Education and health
Education
Health and community services

6.6 Local board-level demand

The next step concerns the allocation of region-wide employment demand to local boards. This is achieved using the employee count (EC) by local board in 2011 (from SNZ's Business Demography Statistics) and adding shares of projected region-wide growth based on local board shares of:

1. existing employment by economic sector; and
2. projected population growth.

This method acknowledges that a portion of growth in each sector is the result of demand from the additional population in each location (for which the ARFM provides projections). The balance of demand growth arises from a number of factors (eg, inter-industry transactions,

capital formation, exports) that are captured collectively by growing the existing industry base in each location by the average (region-wide) growth rate for each sector.

The ABFM uses the input-output table in the Auckland Council EFM to estimate the share of each sector's output that is consumed by households, either directly or indirectly (through government spending on households) based on the shares consumed in the 2006-2007 financial year. Table 6 shows the share for each sector, adopted in the ABFM.

Table 6: Share of output consumed by households

Economic Sector	Share
Production and distribution	25%
Retail, hospitality, recreation and personal services	60%
Commercial	30%
Education and health	80%

The assumed shares largely follow expectations. The output of the education and health sector, and to a lesser extent the retail, hospitality, recreation and personal services sector, is primarily consumed by households. On the other hand, the output of the production and distribution, and commercial sectors is mostly consumed by sources other than households (business, government and exports).

The ABFM then adjusts the growth rates for the share of each sector consumed by households, based on the projected population growth in each local board relative to the region as a whole. For example, 30 percent of the growth factor for the commercial sector is either increased or decreased to reflect the extent to which the population in a given local board is projected to grow faster or slower than the region as a whole.

The balance of each sector (not consumed by households) is grown at the region-wide sector growth rates. The sum of the two represents the total demand by local board and economic sector in each year (in the absence of any supply-side constraints).

Because the ABFM contains estimates of supply-side limits to growth, the model incorporates feedback from the previous year's final (capacity constrained) allocation in each local board as the starting point for calculating demand in the following year. That way, the projection of demand in subsequent years does not depart from the pattern of growth simulated in previous years (as it would if, for example, demand in 2031 was based solely on the 2011 starting point).

7.0 Auckland Business Capacity Model

7.1 Business capacity

The Auckland business capacity model (ABCM) is an interactive model that enables Council to incorporate updates to its plans for providing business capacity in the ABFM. In short, the ABCM comprises three main parts:

- a snapshot of business capacity across the region in 2006, based on the *Capacity for Growth Study 2006*;
- an update of that picture to 2011, based on employee counts from SNZ's Business Demography Statistics; and
- a forward-looking view of capacity, based on Council's plans for accommodating future business growth.

Each of the components is discussed in greater detail below.

7.2 Business capacity out of the 2006 capacity for growth study

This study draws together a range of residential land supply datasets, a comprehensive description of which can be found in section 4.2 of this report. The study further classified business land according to the land area requirements of the business activities associated with each business land group:

- **Group 1** includes land extensive industrial activities such as manufacturing, construction, wholesale trade, and transport and storage.
- **Group 2** includes activities that are land intensive, such as retail trade; accommodation, cafes and restaurants; communication services; finance and insurance; property and business services; government administration and defence; and personal and other services.
- **Group 1 and 2 mixed** includes zones that permit both Group 1 and Group 2 type activities.

The ABCM assigns the attributes of the parcels, business areas and special areas in the study to the relevant meshblocks, so that the data can interact with the dynamic spatial definition of growth areas in the model. This meshblock-level supply dataset provided the basis for analysing the spatial relationship between employment by economic sector and business land by group, which in turn informed the update of capacity estimates to 2011, the incorporation of Council's plans for additional capacity, and the allocation process of the ABFM.

7.3 Update to 2011

The ABCM uses SNZ's Business Demography Statistics to update the picture of business capacity to 2011. This is achieved by removing any employment growth between 2006 and 2011 from the corresponding estimates of capacity in each growth area, first from the estimate of vacant capacity and finally from the estimate of redevelopment capacity (reflecting the increasing obstacles to development). Conversely, where employment declined between 2006 and 2011, it is added to the estimate of vacant capacity.

As the calculation of capacity in 2011 is based on the dynamic spatial definition of growth areas in the ABCM, the total estimate of capacity for Auckland will vary slightly as Council updates its spatial definitions.

7.4 Council plans for business growth

Finally, the ABCM is designed to incorporate projections of future capacity based on Council's plans to accommodate business growth. The ABCM allows Council to define growth areas spatially, by assigning a unique area name to the relevant meshblocks.

The user assigns each growth area its intended timing of development, total business threshold (maximum employee count) and composition by business land group (1, 2 or mixed). In the absence of user-defined business land group information, the model defaults to the 2011-base picture for a given growth area. Any additional capacity created by Council plans is added to the projections of employment capacity according to the timing and business land groups prescribed in the user interface.

Much like the residential model, the existing supply situation is informed by *Plan Change 6: Auckland Regional Growth Strategy 2050*; inherited growth models and planning developments allowed for in the district plans; and plan changes, structure plans and concept plans of the former territorial authorities of the Auckland region. It also does not reflect the Auckland Plan, as the growth information was required in advance of the plan being completed.

The final output of the ABCM is projections of employment capacity by local board and business land group, yearly to 2031 and five-yearly to 2051. These projections provide a scenario of business capacity for input into the ABFM.

8.0 Allocation process

The ABFM's allocation process models the potential uptake of business capacity based on a given scenario of demand. The interface between demand and capacity in the allocation process is the employee count by business land group and local board.

The projections of employment capacity are imported from the ABCM in the required format. The projections of employment demand (described in Section 6) are imported by economic sector and local board. The demand in a given year is then allocated to business land groups based on the final allocation in the previous year (starting with the estimates of employment by economic sector, business land group and local board in 2011 from the analysis of SNZ's Business Demography Statistics and the *Capacity for Growth Study 2006*).

The uptake of business capacity is then calculated for each year, in sequence, as outlined in figure Figure 9.

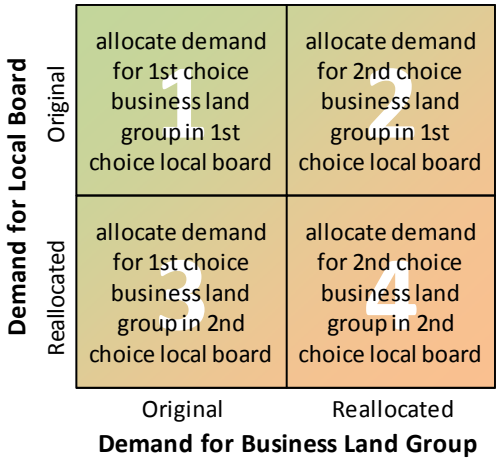

Figure 9: Key steps in the allocation process

Broadly speaking, there are four key steps within the allocation process:

1. Accommodate as much demand as capacity will allow in first choice business land groups in first choice local boards.

2. Accommodate as much unmet demand as remaining capacity will allow in second choice business land groups in first choice local boards.

3. Accommodate as much unmet demand as remaining capacity will allow in first choice business land groups in second choice local boards.

4. Accommodate as much unmet demand as remaining capacity will allow in second choice business land groups in second choice local boards.

A key assumption of the allocation process is that the share of employment that does not take place on business zoned land will remain constant over the model's timeframe. There are a number of reasons why employment occurs on land that is not zoned for business, for example schools and hospitals in special zones, and home businesses (including tradesmen that register their businesses to their home addresses).

The shares for each economic sector and local board (see Table 7) were derived from a meshblock-level analysis of employment by sector (sourced from SNZ's Business Demography Statistics) and business zoned land by group (sourced from the *Capacity for Growth Study 2006*) in 2006.

Table 7: Share of employment not on business zoned land

Local Board	Production and distribution	Retail, hospitality, recreation and personal services	Commercial	Education and health
Albert-Eden	19%	19%	17%	74%
Devonport-Takapuna	28%	12%	20%	79%
Franklin	71%	28%	45%	51%
Great Barrier	98%	99%	98%	98%
Henderson-Massey	14%	12%	14%	68%
Hibiscus and Bays	31%	29%	61%	78%
Howick	9%	23%	20%	58%
Kaipatiki	9%	9%	25%	59%
Mangere-Otahuhu	6%	11%	9%	58%
Manurewa	7%	23%	19%	71%
Maungakiekie-Tamaki	1%	6%	4%	35%
Orakei	28%	31%	36%	67%
Otara-Papatoetoe	7%	5%	10%	65%
Papakura	13%	10%	30%	56%
Puketapapa	15%	21%	34%	72%
Rodney	61%	41%	54%	50%
Upper Harbour	9%	10%	26%	41%
Waiheke	54%	42%	26%	57%
Waitakere Ranges	70%	48%	58%	74%
Waitemata	2%	4%	2%	43%
Whau	7%	12%	24%	68%
Auckland	**13%**	**13%**	**12%**	**60%**

Another core assumption relates to what happens when capacity for specific business land groups runs out within local boards (steps 2 and 4). In these circumstances, businesses first look for capacity in other business land groups in the same local board that will accommodate them. This is possible because businesses that usually locate in group 1 or group 2 can also locate in group 1 and 2 mixed.

Likewise, businesses that usually locate in group 1 and 2 mixed can locate in either group 1 or group 2 depending on the nature of the business activity. The ABFM uses ratios of employment by sector and business land group derived from analysis of SNZ's Business Demography Statistics and the Capacity for Growth Study 2006 to reallocate unmet demand for group 1 and 2 mixed to either group 1 or group 2 (see Table 8).

Table 8: Ratio of employment on business Land groups 1 and 2

Economic Sector	Group 1	Group 2
Production and distribution	80%	20%
Retail, hospitality, recreation and personal services	20%	80%
Commercial	25%	75%
Education and health	15%	85%

A further set of assumptions exist around how unmet demand is reallocated to other local boards when capacity in first and second choice business land groups runs out within first

choice local boards (steps **3** and **4**). In these circumstances, unmet demand is reallocated in one of three ways:

1. In the first instance, unmet demand is reallocated to other local boards based on the distribution of the initial demand.

2. In the second instance, unmet demand is reallocated to other local boards based on the combined distributions of initial demand and residual capacity.

3. In the final instance, unmet demand is reallocated to other local boards based solely on the residual capacity that exists to accommodate it.

Once demand has been allocated to business land groups and local boards, it is allocated to economic sectors in proportion to the initial demand, and the balance of (unmet) demand (residual) capacity is calculated.

This allocation process is repeated for all subsequent years in the model and assumes that all demand can be met within the year it arises in one form or another (unless all capacity for all business land groups in all locations is exhausted).

9.0 Floor space projections

Finally, the ABFM derives floor space ratios by economic sector and local board (see Table 9) from the industry ratios in the *Capacity for Growth Study 2006*, and applies them to the final (capacity constrained) employment projections to generate projections of floor space by economic sector and local board. The floor space ratios are held constant for the duration of the model timeframe. However, the ABFM incorporates the ability to adjust the ratios in a given year to reflect the potential to generate floor space productivity gains over time. Relevant time series data would need to be sourced and analysed in order to support any adjustment of these ratios.

Table 9: Average floor space ratios (sqm/EC)

Local Board	Production and distribution	Retail, hospitality, recreation and personal services	Commercial	Education and health
Albert-Eden	59.9	57.8	30.6	34.0
Devonport-Takapuna	107.5	51.0	27.5	48.5
Franklin	73.0	77.2	34.1	40.6
Great Barrier	81.7	60.3	25.1	39.5
Henderson-Massey	80.4	65.9	30.3	45.6
Hibiscus and Bays	66.7	51.3	27.2	28.2
Howick	80.6	62.9	26.9	31.0
Kaipatiki	73.5	71.0	28.5	29.3
Mangere-Otahuhu	109.8	71.6	34.8	46.4
Manurewa	84.1	79.0	43.0	33.7
Maungakiekie-Tamaki	72.5	69.8	24.3	34.6
Orakei	58.3	50.0	20.7	32.5
Otara-Papatoetoe	84.9	68.2	28.3	34.2
Papakura	77.6	70.2	30.7	36.9
Puketapapa	84.4	71.1	27.1	42.3
Rodney	70.2	58.5	28.6	33.7
Upper Harbour	71.3	70.8	26.9	36.1
Waiheke	81.7	60.3	25.1	39.5
Waitakere Ranges	73.7	74.9	32.1	25.4
Waitemata	93.2	44.8	21.9	49.2
Whau	76.9	71.0	29.3	37.9
Auckland	**81.7**	**60.3**	**25.1**	**39.5**

10.0 Assumptions of the ABFM

Presented below is an outline of the assumptions used with the ABFM which are also used to underpin the financial planning with the Auckland council Long-term Plan:

- The employment and floor space requirements of each industry is driven by growth in final demand for that industry's output, which is in turn driven by changes in household consumption, export consumption and gross fixed capital formation.
- Population and household growth projections are sourced from the ARFM and therefore incorporate the impact of residential capacity constraints.
- The model assumes that people consume a mix of goods and services based on their age, and that households consume on average more over time.
- Projections of export consumption and gross fixed capital formation are based on time series analysis of historical data.
- Employment growth beyond 2031 is based on the underlying relationship between employment and the working age population.
- Final demand is allocated to local boards based on the existing industry and anticipated population growth in each location in proportion to the degree to which households and businesses consume the output of each industry.
- The existing land supply information is derived from a range of planning related documents. Development capacity is released at specified times in the business capacity model. It is therefore assumed that prior to the date of the capacity release an enabling planning framework will have been developed and will be operational.
- The spatial allocation of demand only occurs where capacity is available (either as capacity identified in Gamble (2010) and/or capacity identified in the business capacity model). Therefore, the model assumes that areas without capacity, or where capacity is exhausted over time, are subsequently unable to absorb future demand.
- A key assumption of the allocation process is that the share of employment that does not take place on business zoned land will remain constant over the model's timeframe.
- Another core assumption pertains to what happens when capacity for specific business land groups runs out within local boards. In these circumstances, businesses first look for capacity in other business land groups in the same local board that will accommodate them.
- A further set of assumptions exist around how unmet demand is reallocated to other local boards as capacity in chosen business land groups runs. This is calculated based on combinations of the initial demand and residual capacity.
- Ratios of floor space per employee were derived for each economic sector and local board based on data in the Capacity for Growth Study 2006, and are held constant over the model timeframe (until such time as further research is undertaken).
- The outputs of the model assume the successful interaction between planning policy, business demand and developer operations.

The default settings in the ABFM are:

- **medium** population projection
- **EFM's BAU scenario** - that the economy continues to function in the same way as it has in recent times allows for a medium projection of exports and capital growth.

Table 10: Summary of employment and floorsapce projections in Auckland 2012 – 2022

	2012	2022	Change 2012- 2022
Employee Counts	688,700	792,600	103,900
Total gross floor area (thousand sqm)	37,137	42,216	5,079

Source: Auckland Growth Futures Model (25 October 2011)

11.0 Limitations

When using these models it is important to acknowledge their limitations. The first of these is just that; they are models. They are a simplification of reality that "selectively focuses attention on some aspects of that complex reality and ignores others" (Klosterman, 2012, p1). These models are built on a series of assumptions: population growth implies relationships between births, deaths and migration; and the spatial allocation of demand assumes effective planning policy occurs in set locations and times. The model outputs, for example residential dwellings in particular locations, is contingent upon a number of factors exogenous to the model (eg, availability of capital to fund the development). Given the range of complex and interconnected issues that must come together to create the places that the model represents, the outputs are inevitably subject to uncertainty.

Secondly, it follows that the outputs should not be interpreted as an exact forecast; they represent a possible future given underlying assumptions and data. Whilst the assumptions within the model are carefully formulated, the model outputs are perhaps best understood as guidelines and an indication of the overall trend. Accordingly, while the residential model produces outputs at a very fine spatial resolution, the aggregation of this data into larger areas is encouraged. This is because these models are increasingly susceptible to coding error and less reliable sample sizes (in respect of data inputs) with increasingly fine spatial resolutions. This is particularly important the further out the model projects.

11.1 Future updates

Each of the models will continue to be updated as new information is made available. This could occur in conjunction with the release of new building consent information, when the 2012 Capacity for Growth Study is completed or when new projections (in relation to the residential model in particular) are released by Statistics New Zealand. This updating will ensure that the model uses the best information at the time of development. The Auckland Council will continue to monitor and report on actual development levels against both sets of model outputs.

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