Population projections 2018-2051

for Thames-Coromandel District Council

June 2020

Infometrics

Economics put simply

Authorship

This report has been prepared by Nick Brunsdon

Email:

nick.brunsdon@infometrics.co.nz

Table of contents

Executive summary

Infometrics was commissioned to provide comprehensive employment, population, household, dwelling and rating unit projections for Thames-Coromandel District, covering the period 2018 to 2051. The purpose of the growth projections work is to review and update the councils' growth projections, taking into account elements such as historic and current trends, relevant land-use policies, and relevant national, regional and local level drivers.

These projections have been developed for the district overall, five community board areas and the main settlements. The population projections are driven by the demographic processes of ageing, births, deaths and net migration. These demographic processes enable a detailed projection of the population age structure. Net migration is projected by considered historic migration flows and future employment prospects. Historic migration provides an indication of future migration for retirement, education or lifestyle reasons. Future employment prospects provide an indication of future migration of people seeking jobs. This means that the population projection is driven by economic prospects.

Household projections are produced based on the projected age structure of the population and trends in household formation in different age groups. The number of households informs the number of occupied dwellings in the district. Quality issues with Census unoccupied dwelling data has prevented analysis of trends between Censuses, therefore it has been assumed that unoccupied dwellings such as holiday houses will remain steady into the future. Occupied and unoccupied dwellings are then combined with historic rating unit data to project the number of rating units.

Employment growth in Thames-Coromandel was flat coming of out the Global Financial Crisis, but picked up from 2013 onwards, growing from 11,300 in 2013 to 13,000 in 2019. A similar rate of growth is projected in the coming decade, with employment projected to reach 14,800 in 2030. Thereafter, employment growth is expected to continue, albeit at a slower rate, to reach 15,600 in 2051.

The population in Thames-Coromandel District has grown strongly since 2013, to reach 31,500 in 2019, driven by increased flows from Auckland and overseas. Under the medium projection, the population is projected to grow modestly to reach 33,100 in 2029, before easing back to 30,700 in 2051. Under the high scenario, the population grows to reach 34,200 by 2031, before plateauing and easing back slightly to 33,900 in 2051. Under the low scenario, the population grows slightly to 32,300 in 2029, before easing back to 28,100 in 2051.

Under the medium scenario, population growth in the coming ten years will be concentrated in the Mercury Bay Community Board area, with lesser growth in Coromandel-Colville and Tairua-Pauanui. Beyond 2030, a slight easing in population is projected in Thames, Coromandel-Colville and Whangamata.

Thames-Coromandel's population has aged considerably in the past ten years, with the over 65 age group growing from 23% of the population in 2009 to 32% in 2019. The over 65 age group will continue growing strongly in the near term to reach 40% in 2029, before growing more gently to reach 43% in 2051 under the medium scenario.

As a consequence of an ageing population, average household size is projected to decrease slightly, meaning that more houses are needed to house the same population, and thus the number of households grows from 14,200 in 2019 to 15,000 in 2028, before easing to 13,100 in 2051. Total dwellings are projected to grow from 25,600 in 2019 to 26,700 in 2030, before easing back to 25,600 in 2051. This is underpinned by an assumption that the number of unoccupied dwellings, typically holiday houses will remain static. Unoccupied dwellings are estimated to account for 44% of all dwellings in Thames-Coromandel.

The spread of dwelling growth across the district generally follows the spread of population growth, with the exception of Thames. Despite a steady population, the older age structure of the Thames Community Board area is driving down its average household size. This means that under the medium projection, the number of dwellings in Thames is projected to grow in the next ten years. Dwellings in Mercury Bay, Coromandel-Colville and Tairua-Pauanui are also projected to grow in the next ten years as their populations grow.

Rating units in the district are projected to grow as dwellings grow. Non-residential rating units are assumed to remain at current levels into the future. Rating units are projected to grow from 27,361 in 2019 to 27,400 under the medium scenario, 28,800 under the high scenario, and ease to 26,300 under the low scenario.

Infometrics recommends that Thames-Coromandel District Council adopts the medium projection scenario, recognising that growth is likely to be relatively low in the short term due to COVID-19, but that growth may resume to medium or high rates over the medium to long term.

Introduction

Infometrics was commissioned by Thames-Coromandel District Council (TCDC) to produce projections covering the period 2018 to 2051. The purpose of the projections is to review and update the councils' growth projections, taking into account elements such as historic and current trends, relevant land-use policies, and relevant national, regional and local level drivers. The projections inform each the council's 2021-2031 Long Term Plan (LTP) and 30-year infrastructure strategies.

Population projections form the cornerstone of this report, and are driven by employment projections. Households, dwelling and rating unit projections were also produced based on the projected population. This report describes the methodology employed in the projections and provides a summary of high-level findings at a district and community board level. It is accompanied by a detailed spreadsheet and interactive online tool which provides the projections with a greater level of detail and flexibility of analysis. Table 1 details the output areas and their hierarchy. These areas are defined by Stats NZ, and their definition system has been updated since TCDC's previous population projections in 2017. Previously Stats NZ defined areas within the district as Census Area Units, however these have been superseded by Statistical Area 2s (SA2s). SA2s have slightly different boundaries to reflect the expansion of urban areas. Stats NZ have defined urban-rural settlements within SA2 areas, and urban areas which are a combination of adjacent SA2s.

Table 1

Thames-Coromandel district projection output areas

Based on areas defined by Stats NZ

District	Community board	Statistical Area 2	Urban areas	Urban-Rural Settlements
Thames-Coromandel	Coromandel-Colville Community Board	Colville		
		Coromandel		
	Mercury Bay Community Board	Cooks Beach-Ferry Landing		
		Mercury Bay North		Matarangi
		Mercury Bay South		Hahei
		Whitianga North	Whitianga	
		Whitianga South		
	Thames Community Board	Thames	Thames	
		Thames North		
		Thames South		
		Totara-Kopu		
		Thames Coast		
		Kauaeranga		
		Matatoki-Puriri		
	Tairua-Pauanui Community Board	Hikuai		
		Pauanui		
		Tairua		
	Whangamata Community Board	Whangamata Rural		Onemana
		Whangamata		

The population projection uses a conventional cohort-component approach, which models the population in five-year age groups by sex. This is based on the Stats NZ 2018 Estimated Resident Population, which is in turn based on the 2013 Census, as suitable outputs from the 2018 Census have been delayed due to data quality issues. The model works by applying projected birth and death rates to each age-sex group, then ageing the population and adding in net migration. Net migration is projected in consideration of historic trends and projected need for workers to migrate into the district to fill jobs. Migration is varied across a low, medium and high scenario, in order

to produce low, medium and high population projections. These scenarios provide a range of plausible outcomes, convey the uncertainty associated with long term population projections, and enable planning for a range of scenarios.

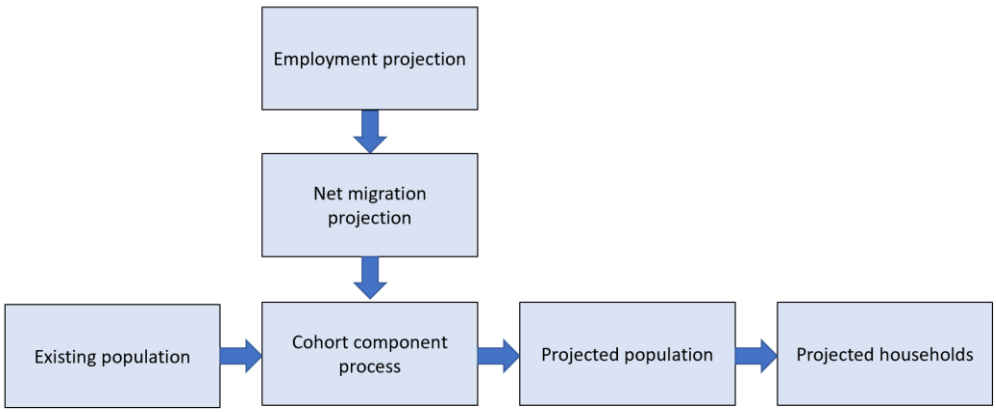
These projections were developed over the period November 2019 to February 2020, using the best information available at the time. These projections do not account for the effect of COVID-19, however the recommendation of which scenario to adopt discusses the expected impact of COVID-19 on the district, and makes a recommendation in consideration of COVID-19.

Our approach

This section describes our projection approach in broad terms and is intended for technical and non-technical audiences. A detailed methodology is also provided in the appendix for technical audiences.

We apply a unique approach to projecting population, by first projecting employment, which in turn informs volumes of net migration. In this sense our population projections are informed by the economic prospects of the area. From here, we follow a conventional cohort component approach to project population and households, before translating changes in households into dwelling demand. This process is summarised in the diagram in Chart 1. The distribution of the projected population across Statistical Area 2s and settlements within the district is based on projected dwelling capacity, which is in turn based on where residential development is expected to take place in the district. Identification of areas with potential to accommodate future residential development was informed by the district plan zones in the Appeals Version of the Thames-Coromandel Proposed District Plan and discussions with council planning staff.

Chart 1



Employment

Employment, the number of filled jobs in the district, is forecast using a combination of two approaches for the short-term and long-term. Unlike population, only a single projection scenario for employment has been produced.

The short-term forecast covers the period from 2020 to 2025. Export focused industries are projected with a national model, which reflects the broad economic conditions. Service and construction industries are projected based on recent local economic and population trends.

The long-term forecast covers the period from 2025 to 2051, and is based on modelling of the interactions between industries and our view of broad economic conditions using a general equilibrium model. This includes expectations of macro-economic factors such as interest rates as well as environmental factors such as carbon prices.

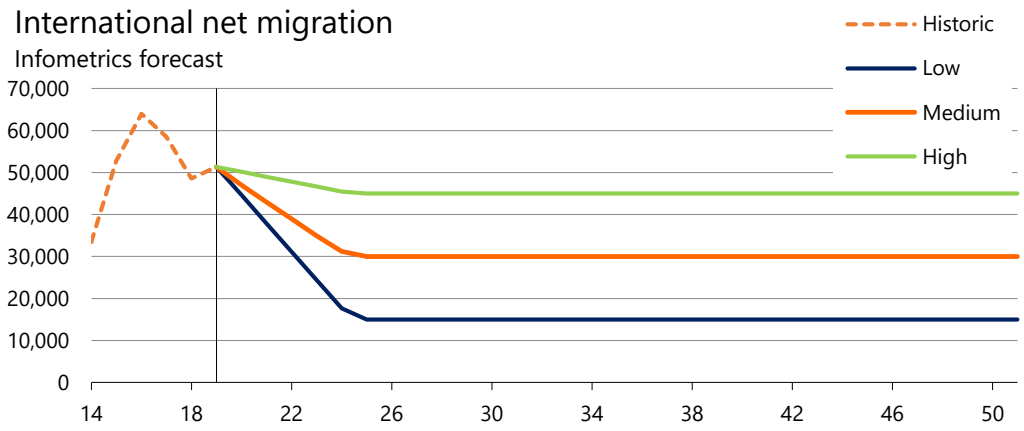
Migration

Migration is the permanent movement of people, including those moving between districts in New Zealand or to and from other countries. Net migration is how much an area gains from migration – for example if 150 people come to Thames-Coromandel and 100 people leave, then net migration is 50.

In developing a projection for Thames-Coromandel, we project the population for New Zealand overall, including international net migration – net migration from overseas into New Zealand. This is an important first step as it determines the size of the net migration 'pie' to be shared across New Zealand. When we project Thames-Coromandel's population, we consider what share of the net migration 'pie' it is likely to get in the future. We do this by considering historic trends, especially people moving to Thames-Coromandel for lifestyle reasons, and the future outlook, especially people moving to Thames-Coromandel for a job.

We forecast long term international net migration to New Zealand by considering a wide range of factors affecting the New Zealand and global economy. While net migration to New Zealand has reached over 60,000 people per year in recent years, this is unlikely to be achieved for a sustained period in future. However, with steady employment growth projected and an ageing population, we expect sustained positive net migration well into the future, aided by favourable work visa conditions. Between 2018 and 2024, we adopt The Treasury's forecast, which shows a transition from 50,000 in 2018 to 35,000 in 2024. Beyond this, we project a level of 30,000 to be maintained out to 2051. Our low and high scenarios represent net migration levels 50% lower and higher than the medium scenario respectively – this is based on the range that Stats NZ provide for their projections. This is plotted below in Chart 2.

Chart 2



Shares of the national net migration 'pie' are apportioned out to territorial authorities using a mix of two approaches. Firstly, historic migration trends are used to forecast the volume of non-employment driven migration, such as people moving towns for retirement. Secondly, forecast labour market shortfalls are used to forecast the volume of employment driven migration, such as people moving towns for a new job. Labour market shortfalls are assessed with consideration taken of the projected age structure of the local population, labour force participation and unemployment rates, and regional labour supply. For both employment and non-employment driven migration, Stats NZ's projected age and sex profile of migrants to the district is assumed.

Existing population

The starting point for our population projection is the StatsNZ Estimated Resident Population (ERP) for 2018, which is based on the 2013 Census. This is the most current suitable population data, as the ERP from the 2018 Census has been delayed due to data quality issues. We project the existing population using a conventional cohort component method. Under this approach, the starting population is grouped into cohorts consisting of five-year age groups by males and females. We draw upon Stats NZ's analysis of historic and expected trends in births and deaths in each age group and sex to inform how each cohort changes throughout the course of the projection.

Births and deaths are driven by a combination of factors – the age structure of the population, and age-specific birth and death rates. Projected age-specific birth and death rates are sourced from Stats NZ. In the case of births, Stats NZ project an easing in birth rates for women under the age of 35, and a slight increase in rates for women aged 35 years and older. Stats NZ project a steadily easing death rate across all age group, as life expectancy increases due to advances in medical care.

Households

Households are defined as one or more people living and sharing facilities in a private dwelling. To determine the number of households, we break the population into cohorts by age and sex (e.g. 70-74 year old females) and then apply rates to determine what type of household they reside in. Stats NZ has analysed trends around population and households to determine what proportion of each age and sex group lives in what household type, and how this is expected to change in future. For example, in 2013, 52% of 70-74 year old females were living in a couple household and 30% were living alone. Stats NZ projects that by 2038, 58% of people in that age-sex group will be living as a couple and 25% living alone. This is because people are expected to live longer (increased life expectancy), meaning that they are less likely to become widowers (living alone) in the 70-74 year old age group.

Once the population has been apportioned into a household type, the number of people living in each household type is divided by the average size of each household type to estimate the number of households. For example, the average size of a couple household is two people, so if there are 100 people in couple households, then there will be 50 couple households. This is done separately for each household type, then combined to produce the total number of households.

Dwellings

Dwellings are counted as occupied or unoccupied. It is assumed that there is one occupied dwelling for every household in the district. Thus, occupied dwellings are projected from household projections. Occupied dwellings include houses, apartments and retirement village units, but exclude institutional living arrangements such as rest homes or boarding houses. In comparing to Census data, it should be noted that our measure of occupied dwellings includes Thames-Coromandel residents who were away from home on Census night.

Unoccupied dwellings are predominantly holiday houses, but can also include houses that are empty and waiting for renovations or new occupants to move in. Unoccupied dwellings are counted in the Census, and this data is used to project them forward.

Quality issues with Census unoccupied dwelling data has prevented analysis of trends between Censuses, therefore it has been assumed that the number of unoccupied dwellings counted in the 2013 Census will remain constant into the future.

Rating units

Each unique property – residential or non-residential – in the district is counted as a separate rating unit. Rating units are an important indicator for TCDC as they effectively indicate the number of properties which the council can rate to fund their activities. Rating units are counted across five categories:

- Residential
- Residential lifestyle
- Rural industry
- Industrial and commercial
- Other

Two approaches are taken to projecting rating units. Dwelling projections are used to project residential and residential lifestyle rating units, as these types of rating units generally have a dwelling. An adjustment is made to account for some rating units having multiple dwellings, for example properties with a main house and a granny flat. A further adjustment was made to spread future dwelling growth into the residential and residential lifestyle categories, based on the ratio between each category in each SA2 area. For example, in Colville 66% future dwellings are expected to be on residential lifestyle rating units, but in Thames Central, 0% of future dwellings are expected on lifestyle rating units.

For non-residential rating units (rural industry; industrial and commercial; and other), because no historical data was available to assess trends in non-residential rating units, it is assumed that the number of rating units remains steady into the future, that is, there is no increase or decrease.

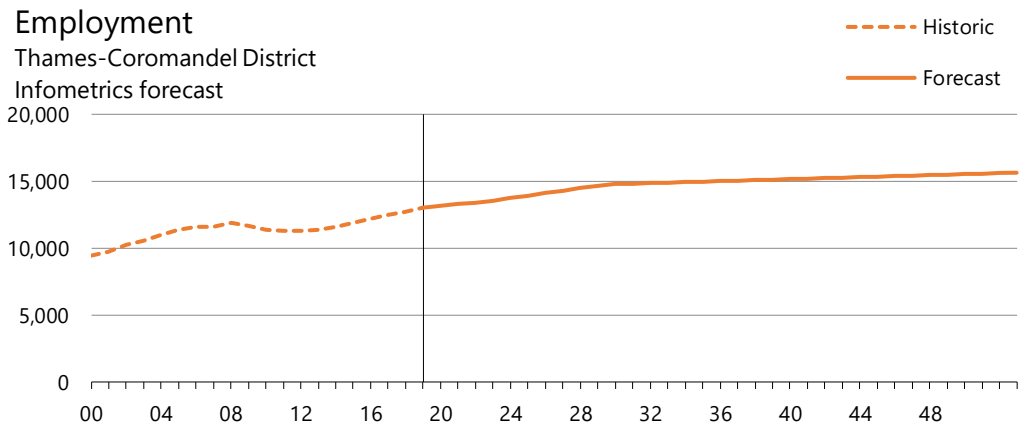
Findings

Employment

Employment growth in Thames-Coromandel was flat coming of out the Global Financial Crisis, but picked up from 2013 onwards, growing from 11,300 in 2013 to 13,000 in 2019. In our single employment projection scenario, a similar rate of growth is projected in the coming decade, with employment projected to reach 14,800 in 2030. Thereafter, employment growth is expected to continue, albeit at a slower rate, to reach 15,600 in 2051.

Throughout the projection period, the manufacturing, professional services, healthcare, and arts and recreation sectors are projected to continue growing. However, a flattening off of growth in construction, agriculture and retail is expected to weigh on future employment growth.

Chart 3

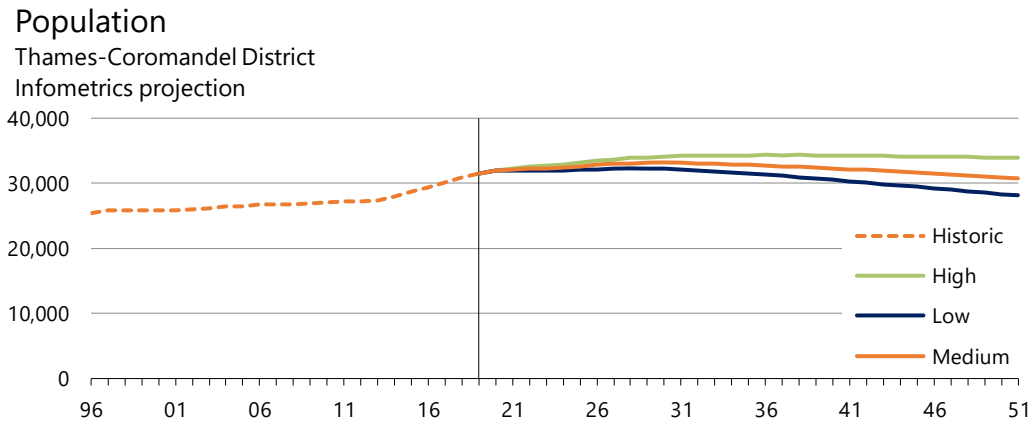


Population

Population growth in Thames-Coromandel District was relatively modest from 1996 to 2013, as the district grew from 25,400 to 27,300. From 2013, the rate of growth picked up, and the district reached 31,500 in 2019. The recent increase in growth was driven by increased flows from Auckland and overseas.

Looking ahead, under the medium projection, the population is projected to grow modestly to reach 33,100 in 2029, before easing back to 30,700 in 2051. Under the high scenario, the population grows to reach 34,200 by 2031, before plateauing and easing back slightly to 33,900 in 2051. Under the low scenario, the population grows slightly to 32,300 in 2029, before easing back to 28,100 in 2051.

Chart 4



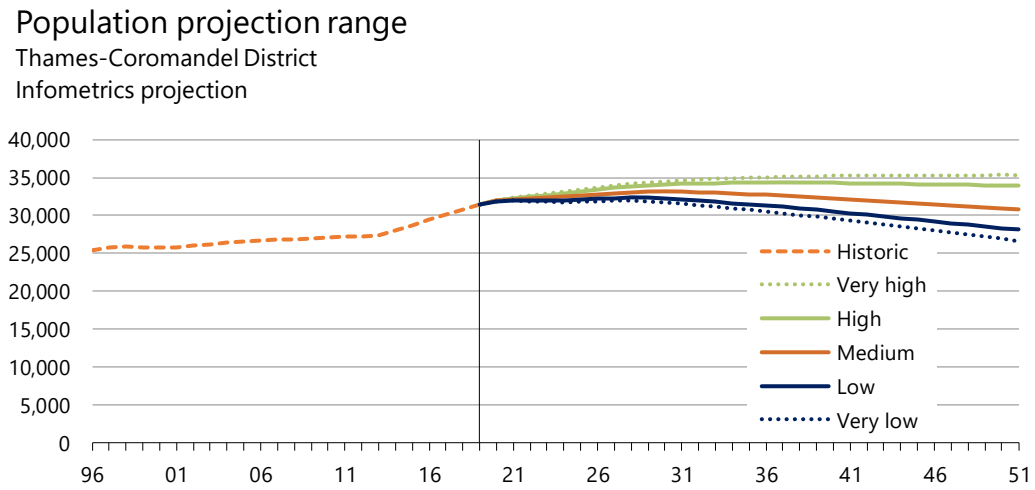
Sensitivity

The high and low scenarios presented prior represent the most likely range for Thames-Coromandel's population. They are produced with different scenarios for net migration, which is what tends to drive population change. The low, medium and high scenarios are suitable for use in planning as they represent a probable range for the district's population.

However, in addition to the three probable scenarios, we have provided two further scenarios, very high and very low. These scenarios are possible, but not likely to occur. They are based on extreme combinations of scenarios for birth rates, death rates and net migration. Providing them alongside the low, medium and high scenarios illustrates how sensitive the population projections are to different assumptions – this is known as of sensitivity testing. The very low and very high projections shouldn't be used on their own, but are useful to consider when using the low, medium and high projections.

The very low scenario is based on low net migration, low fertility rates, and high death rates. Under such a scenario, Thames-Coromandel's population grows slightly to 2029, before declining to 26,600 in 2051. The very high scenario is based on high net migration, high birth rates, and low death rates, which leads to strong growth in the next ten years, followed by gentle growth to 2051, to reach 35,300.

Chart 5



Population by Community Board

Projected population growth is distributed across the district by considering historic trends, future capacity for growth, and broader considerations such as the effect of sea level rise.

In the coming ten years, while population in the district overall is still growing, the strongest population growth is expect in Mercury Bay Community Board, growing from 9,288 in 2019 to 10,290 in 2029 under the medium projection. Modest growth is projected in Coromandel-Colville and Tairua-Pauanui, with growth in the latter concentrated around Pauanui specifically. A steady population is projected in Whangamata and Thames. Population in Whangamata is largely constrained by development capacity. In Thames, an ageing population with decreasing household sizes means that demand for new dwellings will continue, but these will accommodate a similar number of people as there are today – this is discussed in greater detail in the Households and Dwellings sections.

Beyond 2030, population across the district is projected to ease under the medium projection. Tairua-Pauanui and Mercury Bay are projected to have a slightly higher population in 2051 than today, up by 341 and 526 respectively. This growth largely takes place before 2030. Population in Coromandel-Colville and Whangamata is projected to ease slightly to 2051, down by 208 and 144 respectively. The population in Thames is projected to ease by 1,220 to 2051.

Table 2

Population by Community Board

Infometrics medium projection

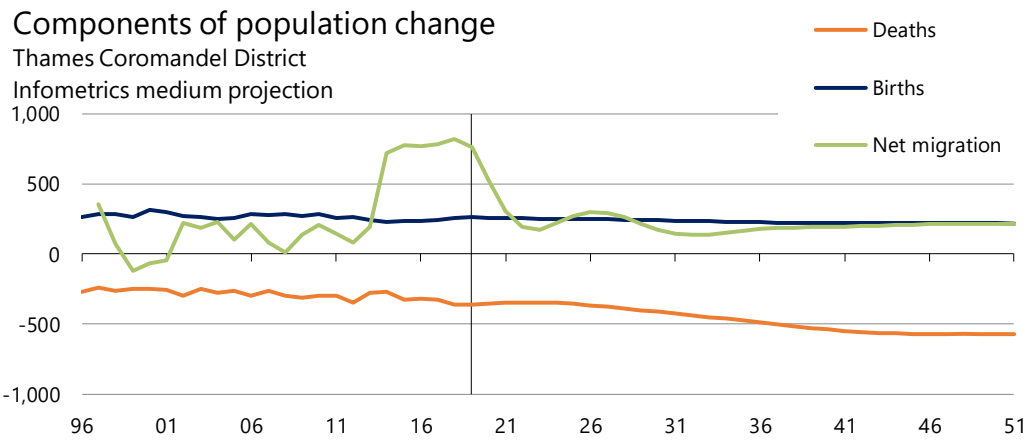
	2019	2051
Coromandel-Colville Community Board	3,403	3,195
Mercury Bay Community Board	9,288	9,813
Tairua-Pauanui Community Board	2,896	3,236
Thames Community Board	11,184	9,964
Whangamata Community Board	4,731	4,587
Total	**31,502**	**30,795**

Components of population change

Population change consists of three major components – births, deaths and net migration. The difference between births and deaths is often referred to as natural increase – that is, the ability for a population to grow 'naturally', or internally. In Thames-Coromandel, deaths have exceeded births since 2008, meaning that net migration is needed to merely maintain a population at a static level. The gap between births and deaths is expected to worsen, with 570 deaths and 218 births projected in 2051.

Net migration has been strongly positive recently, aided by very strong net migration into New Zealand which has prompted direct international flows into the district as well as indirect flows from places like Auckland. As net migration eases at a national level in the coming years, it is also projected to ease in Thames-Coromandel and rest at a steady level. The main feature of the high and low projections is higher and lower net migration respectively, however migration does influence births and deaths, as migrants to the district may have children or die in the district in later years of the projection.

Chart 6



Age Structure

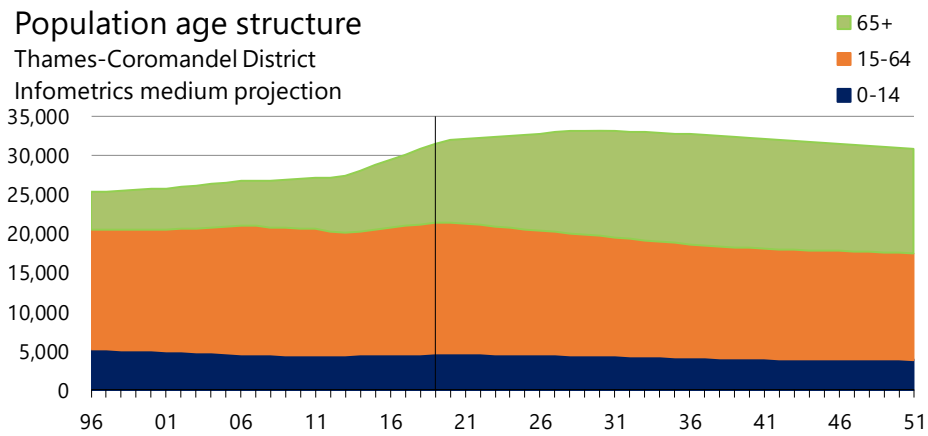
The process of population ageing is well advanced in Thames-Coromandel and taking place at a rapid rate. Thames-Coromandel's population growth over the past ten years was driven by the age group 65 years and older, who have grown from 23% of the

district's population in 2009 to 32% in 2019. The same trend is taking place nationally, but at much slower rates, with over 65's growing modestly from 13% of the population in 2009 to 16% in 2019.

Over the coming ten years, the last of the relatively numerous 'baby boomer' cohort will move into the 65 years and older age group, taking this age group from 32% of Thames-Coromandel's population in 2019 to 40% in 2029 under the medium projection. From this point onwards, the population will continue to age, but at a much slower pace, with over 65's growing to 43% of the population, or 13,300 in 2051 under the medium projection.

The number of youth (aged under 15) is projected to steadily decline from 4,600 in 2019 to 3,900 in 2051 as a result of easing net migration, births and population of childbearing age. The working age population aged 15-64 is also projected to ease, from 16,700 in 2019 to 13,600 in 2051.

Chart 7



Households

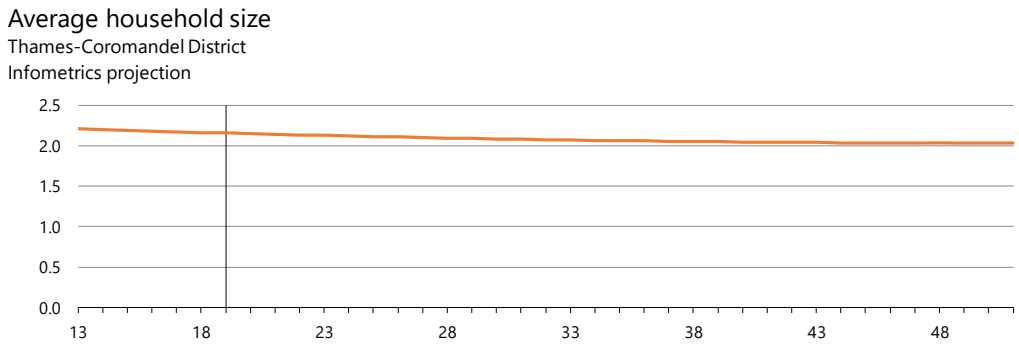
A combination of factors is projected to drive down the average size of households in Thames-Coromandel. The most critical of these is the changing age structure of the district's population and societal trends.

- An ageing population leads to growth in households of couples without children or persons living alone (such as widows), while growing life expectancy means that people are likely to spend longer in these household types.

- Societal trends include couples having fewer children (smaller families), greater numbers of childless couples, and growing numbers of women are delaying childbearing until they are older.

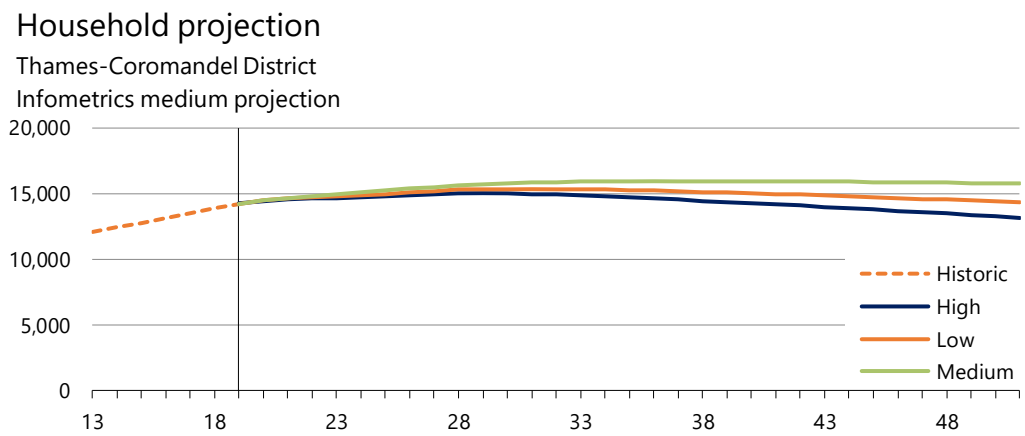
Combined, these trends all push down the average household size, from an estimated 2.1 persons per household in 2019 to 2.0 in 2051.

Chart 8



A decreasing average household size means that more houses are needed to house the same population, and thus the number of households grows from 14,200 in 2019 to 15,000 in 2028, before easing to 13,100 in 2051. Under the medium scenario, households peak at 15,400 in 2030, before easing to 14,300 in 2051, just above the 2019 number. Under the high scenario, households peak at 15,900 in 2032, then ease back slightly to 15,800 in 2051.

Chart 9

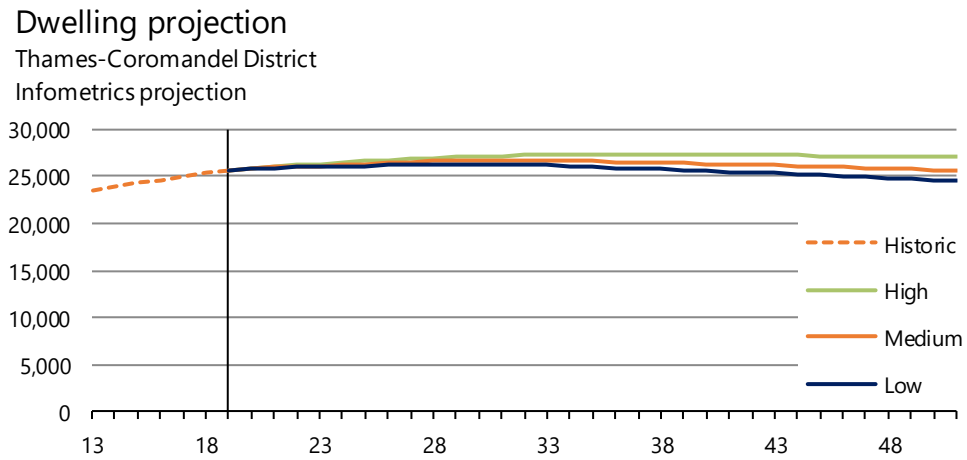


Dwellings

Dwellings are a measure of all houses in the district, whether they be occupied by households, unoccupied, or under construction. Unoccupied dwellings, typically holiday houses, are common in Thames-Coromandel, and areestimated to account for 44% of all dwellings in the district in 2019. Due to issues with comparability of Census data, no trend analysis of unoccupied dwellings was not possible, and therefore it has been assumed that the number of unoccupied dwellings will remain steady into the future. Each household is assumed to occupy one dwelling, so changes in population and household size drive the demand for dwellings. As population eases in a particular area, demand for occupied dwellings eases, and this is portrayed as a reduction in the number of occupied dwellings. In practice, these dwellings will continue to exist, but may be repurposed or eventually abandoned.

As of 2019, there are 25,600 dwellings in the district. Under the medium scenario this is projected to grow to 26,700 in 2030, before easing back to 25,600 in 2051. Under the low scenario, dwellings also peak in 2030, at 26,300, before easing back to 24,500 in 2051. In the high scenario, dwellings grow to reach 27,300 in 2036 before easing back slightly to 27,100 in 2051.

Chart 10



Dwellings by Community Board

Under the medium scenario, the number of dwellings in the district is projected to grow by 1,010 in the next ten years, with half of this taking place in Mercury Bay, and the remainder spread across Coromandel-Colville, Tairua-Pauanui and Thames. From 2030 onwards, no further dwelling growth is projected, and the number of dwellings across the district will ease. By 2051, there are projected to be slightly more dwellings in Mercury Bay and Tairua-Pauanui than in 2019. The number of dwellings in Thames, Whangamata and Coromandel-Colville is projected to ease slightly.

Table 3

Dwellings by Community Board

Infometrics medium projection

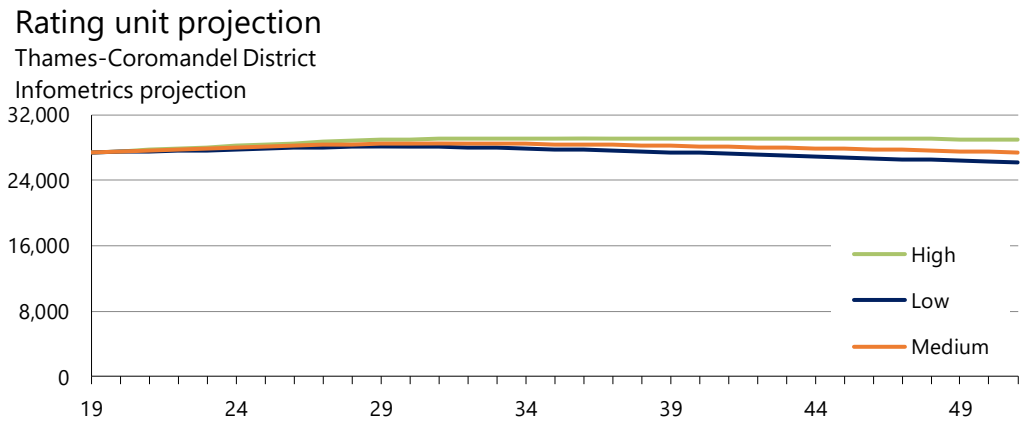
	2019	2051
Coromandel-Colville Community Board	2,504	2,471
Mercury Bay Community Board	8,243	8,567
Tairua-Pauanui Community Board	3,981	4,144
Thames Community Board	5,570	5,241
Whangamata Community Board	5,357	5,224
Total	**25,655**	**25,647**

Rating units

Rating units in the district are projected to grow as a consequence of population and dwelling unit growth. Due to a lack of time series data, we have assumed that non-

residential rating units will remain at current levels into the future. Rating units are projected to grow from 27,361 in 2019 to 27,400 under the medium scenario, 28,800 under the high scenario, and ease to 26,300 under the low scenario.

Chart 11



Under the medium scenario, residential rating units are projected to grow by 140, and residential lifestyle ease by 60.

Table 4

Thames-Coromandel District rating units

Infometrics medium projection

	2019	2051
Residential	23,671	23,811
Residential lifestyle	2,040	1,980
Rural industry	585	585
Industrial and commercial	1,039	1,039
Other	26	26
Total rating units	**27,361**	**27,441**

Scenario recommendation

TCDC have requested a recommendation as to which projection scenario should be adopted for their planning. Although the projections were prepared prior to COVID-19, the scenario recommendation provides an opportunity to account for the impact of COVID-19 in the use of the projections.

As a result of COVID-19, international net migration is expected to fall to effectively zero over 2020 and 2021, and employment is forecast to fall by 9.0% nationally. The reduction in international net migration is unlikely to have a substantial direct effect on Thames-Coromandel, as the district predominantly gains from domestic migration. However, the reduction in employment in the district will lead to lower levels of domestic migration in the near term, as there will be less attraction for workers to migrate into the district. As a result, population growth over the next three years is likely to be commensurate with a low to medium projection scenario.

From 2024 onwards, growth can be expected to resume at a medium or high scenario growth rate, however the population level will be lower than projected in the medium or high scenario, due to lower growth at the start of the projection period.

The high scenario is not recommended, as the growth rate is unlikely to be achieved in the near term, and levels are unlikely to be achieved in the long term. While growth in the near term may be commensurate with the low scenario, it does not necessarily represent the long term prospects of the district, and its adoption may lead to investment decisions in the short term which preclude growth in the medium to long term. The medium projection scenario is recommended, as it provides best balance between representing the short and medium to long term outlook for the district, particularly the high level of uncertainty presented by COVID-19 and the ensuing recession.

Appendix – detailed methodology

Our methodology for the projections is described at a high-level in the section 'Our Approach'. This section provides a greater level of detail in how each specific component of the projection has been produced.

Employment

Short term forecasts (2020-2025)

In the first step of the process we develop forecasts of employment at the national level by 54 industries. Using econometric techniques, we develop approximately 50 separate statistical models for forecasting employment in each industry. The models draw on historic trends, patterns and relationships and extend these into the future.

Using machine learning we rank the models according to their track record of forecasting future employment in the industry. We can measure each model's forecasting ability by using historical data. For example, using data from 2000 to 2016 we can forecast employment to 2019 with each model and then compare the forecasts against actual numbers from 2017 to 2019. The model with the best track record is used to produce the final forecast for each industry to 2025. The industry forecasts are adjusted to ensure they are consistent with Infometrics' view of total employment growth over the forecast period.

In the second step we develop forecasts by territorial authority and region which are consistent with our national forecasts. We use a similar technique as in the national forecasts developing 50 models for each combination of 485 ANZSIC industries and 66 territorial authorities. Slightly different techniques are used for the various industries in the regions which accounts for different industry drivers.

The future performance of *agriculture, forestry, fishing, mining and manufacturing* industries are influenced predominately by macro-economic conditions which are not specific to local conditions. For example, a boost in forestry from strong demand in China is likely to benefit forestry in all regions. Hence the models we develop for these industries are driven by nationwide industry trends and the extent to which these trends historically deviate from the national. Using machine learning we choose the model which is most effective at mimicking and predicting these components.

The regional forecasts for the *service industries* (including trade, accommodation, education, health and professional services) consider more local drivers including population growth, local macroeconomic conditions and visitor numbers.

The regional forecasts for the *construction* industries incorporate Infometrics' forecasts of construction work-put-in-place from Infometrics' Regional Construction Outlook. They also take population growth into consideration.

After we have generated forecasts for each industry/territorial authority combination we ensure they are mathematically consistent with our national level industry forecasts.

Long term forecasts (2025+)

The method used in the short-term forecasts draws heavily on a statistical approach to forecasting: considers historic trends, patterns and relationships and extends these into the future. This statistical approach becomes less accurate with longer forecast horizons. We modify the forecasts from 2025 onwards to ensure consistency with the outputs of Infometrics' general equilibrium model of the New Zealand economy (ESSAM).

ESSAM considers the main inter-dependencies of industries in the economy, such as flows of goods from one industry to another, as well as the passing on of higher costs in one industry into prices and thence the costs of other industries. The model presents a picture or scenario of the economy for the target years (in our case 2030 and 2050) based on plausible assumptions of economic factors including international commodity prices, population growth, carbon price, automation, changes in energy efficiency, and substitution between four energy types (coal, oil, gas and electricity). ESSAM's estimate of employment by industry in 2030 and 2050 provides a benchmark for our long-term employment projections. Some of the key macro-economic assumptions used by the model are shown in the table below.

Table 5. ESSAM macro-economic assumptions and outputs

Indicator	2025-2030	2030-2050
Population	1.0%pa	1.0% pa
Labour force	0.7%pa	0.46%pa
GDP	2.9%pa	1.7%pa*
World trade	2.7%pa	2.5%pa
Oil price	US$110/bbl in 2030	US$110/bbl in 2050
Carbon price	NZ$100/tonne CO_2 in 2030	NZ$200/tonne CO_2 in 2050
Government consumption	2.1%pa	1.7% pa
Investment in dwellings	2.0%pa	1.0%pa
Public investment	3.0%pa	2.5%

* These are model results, not input assumptions.

Migration

Considering a wide range of factors affecting the New Zealand and global economy, we project long term international net migration to New Zealand. While recent historic levels in excess of 60,000 are unlikely to be achieved for a sustained period in future, with steady employment growth projected and an ageing population, we expect sustained positive net migration well into the future, aided by favourable work visa conditions. Between 2018 and 2024, we adopt The Treasury's forecast, which shows a transition from 50,000 in 2018 to 35,000 in 2024. Beyond this, we project a level of 30,000 to be maintained out to 2051. Our low and high scenarios represent net migration levels 50% lower and higher than the medium scenario respectively.

Migration is apportioned out to territorial authorities using a mix of two approaches. Firstly, historic migration trends are used to forecast the volume of non-employment driven migration, such as people moving towns for retirement. Secondly, forecast labour market shortfalls are used to forecast the volume of employment driven migration, such

as people moving towns for a new job. Employment driven migration is adjusted slightly to account for commuting patterns between districts. For both employment and non-employment driven migration, Stats NZ's projected age and sex profile of migrants to the district is assumed.

Labour market shortfalls

Labour market shortfalls exist when employers' need for labour exceeds the number of workers available at current wage rates. When labour market shortfalls exist in an area extra labour, and hence population, is attracted to the area.

We estimate future labour market shortfalls by separately considering the projected supply of labour and demand for labour (as measured by employment) and comparing them.

As our starting point for estimating the supply of labour we use Stats NZ's published population projections by 5-year age group and gender.

Labourforce participation rates (LFPR) by age and gender are projected based on Stats NZ national labour force projections. Then, historic LFPR for each regional council are analysed to identify their deviation from the national average. This deviation is applied to the national LFPR by age to project regional LFPR by age. Historic averages for the unemployment rate in each region are analysed and projected forwards. Our projected LFPR by age is applied to the Stats NZ population projection, and our projected unemployment rate is applied to this to estimate labour supply.

This is done for each TA, enabling the balance between labour supply and demand (measured by employment) in each labour market region to be assessed. In periods when there is insufficient supply in a TA and across it's broader regional labour market to meet projected labour demand, the area is apportioned additional migration. The additional migration is apportioned to TA based on their share of the national labour market shortfall, but as this is constrained by our international net migration forecast, they may not necessarily receive enough migration to entirely fulfil their labour market shortfall. Our projected LFPR and unemployment rates are applied to the additional migration, reflecting that it is rarely possible to import only workers – workers tend to come with family members who may not be economically active such as stay at home parents and children, and some of those migrants may not gain employment immediately (spend a period of time unemployed).

Population

Population base

The appropriate population to use for council long term planning (LTP) purposes is estimated resident population (ERP). This represents all of the people who permanently reside in an area, and could be considered a 'maximum' as a proportion of them is likely to be away at any given point in time.

The base, or starting point, used in these projections is the 2018 Estimated Resident Population (ERP). This is produced by Stats NZ with the most recent available Census (2013), and births, deaths and migration that has been recorded since. An ERP based on the 2018 Census is expected to be released at the end of March 2020, too late for inclusion in this projection.

As most population projection parameters from StatsNZ are published for five-year intervals, our projection model also operates at five-year intervals, from 2018 to 2053. We then use a cubic-spine process to interpolate population to single years, and also incorporate the Stats NZ 2019 ERP in this process to produce a realistic projection while incorporating the most recent data available.

Fertility

Stats NZ publishes regional age specific fertility rates, for five-year age groups. This includes an open bounded 45+ age group, however we have chosen to only apply this to the 45-49 year age group. This ensures that a growing population beyond the age of fertility does not artificially inflate the projection of births. The impact is expected to be negligible, as between 2012 and 2014, there were an average of eight births per year to women aged 49 and over, nationally. Similarly we have ignored births under the age of 15 due to lack of reliable fertility rates, and again this is not significant as nationwide there were only 21 births to woman under the age of 15 annually on average between 2012 and 2014.

We have used the Stats NZ assumed sex ratio, of 105.5 males per 100 females born, throughout the projection period, which is based on the historic average ratio at the national level. This phenomenon is common around the world, and is understood to be a function of slightly higher miscarriage rates amongst females, not selective abortion.

Mortality

Projected age and sex specific mortality rates by TA from StatsNZ are applied to the population by age and sex to accurately project the number of deaths.

Distribution within district

Population is distributed across the district by considering historic settlement patterns and expectations of future residential development. Projections are produced for Statistical Area 2 areas (SA2) and selected settlements, made up of Statistical Area 1 areas. Both SA2 and SA1 areas vary widely in geographic size, but are defined by Stats NZ to have similar populations – SA2 tend to have populations of 1,000 to 3,000, and SA1 between 100 and 200. In the Infometrics projection model, population, households and dwellings at a SA2 level are projected using a full cohort component approach. For settlements made up of SA1 areas, these are modelled based on their historic and projected share of population, dwellings and households in their SA2 area.

The distribution is refined through an iterative process.

1) Each SA2's share of historic net migration to the district was used to apportion the district's projected net migration to each SA2. A full cohort-component approach was applied at an SA2 scale to produce initial SA2 population and occupied dwelling projections.

2) Unoccupied dwellings were projected based on historic trends evident in the 2006, 2013 and 2018 Census. Few clear trends could be identified due to variable data quality between Census, so for most SA2, a steady number of unoccupied dwellings is assumed into the future. This is added to the number of occupied dwellings to project the total demand for dwellings.

3) Projected dwelling demand was presented to council planning staff, and their feedback on where development was permitted and/or likely was used to refine the distribution of net migration such that projected dwellings could be accommodated by expected residential development in each SA2.

4) Historic trends, district plan zones, and discussions with council planning staff were used to project each settlement's share of population, dwellings and households in their SA2 area.

5) Draft settlement projections were provided to council staff, and feedback taken incorporated to refine each settlement's share of its SA2 area.

Households

Living arrangement types

The number of households at an SA2 and district level are projected by applying Living Arrangement Type Rates (LATR) to the projected population. Stats NZ projects LATR to 2038 off a 2013 Census base across two scenarios – A and B. The A scenario assumes that LATR remain constant into the future at 2013 rates, while the B scenario projects a linear change to 2038 based on observed historic trends and future expectations. These trends include delayed childbearing (discussed under fertility), decreased rates of single parenting, and life expectancy improvements enabling older persons to live independently for longer[1]. While we use the A scenario for sensitivity testing, we follow Stats NZ's recommendation to use the B scenario as it is considered more realistic. This means that LATR transition out to 2038, and we hold them constant at 2038 rates out to 2053.

Applying LATR to the population provides an estimate of the number of people in each living arrangement type; we then translate this into the number of households based on expected family structures – for example, couple households consist of two people. For other multi-person households, we following Stats NZ assumptions, and assume 2.6 persons per household. We then divide the number of people by the number of households to project average household size.

Due to rounding, our projected household size varies slightly from 2018 Census measures. This can arise for several reasons:

1) Census counts are randomly rounded to the nearest multiple of 3, or supressed entirely, to ensure confidentiality of Census respondents. However, Census outputs such as average household size are produced based on actual data – meaning that it is impossible for third parties to precisely replicate these outputs.
2) LATR projections are national, representing an average across NZ, so local patterns will differ – this can, for example, be driven by differences in ethnic makeup, with some non-European ethnic groups exhibiting a greater propensity to form multi-generational households, leading to larger households.

[1] Full discussion available here http://archive.stats.govt.nz/browse_for_stats/population/estimates_and_projections/NationalFamilyAndHouseholdProjections_HOTP2013base/Data%20Quality.aspx#Livingarrangementtyperates

3) Household sizes can change in response to non-demographic factors such as housing costs.

Dwellings

We assume that each household demands one private dwelling, a reasonable assumption used by other demographers[2]. In comparing to Census data, it should be noted that our measure of occupied dwellings includes residents who were away from home on Census night. Census measures of unoccupied dwellings in Thames-Coromandel varied widely between the 2006, 2013 and 2018 Census, preventing analysis of trends. We have assumed that unoccupied dwellings will remain constant into the future, and chosen to carry the number of unoccupied dwellings as of the 2013 Census into the future – effectively ignoring the 2018 Census.

Rating units

Rating units were projected across five categories. While residential and residential other could be related to dwelling projections, the ability to project non-residential rating units was far more limited as no time series data was available, preventing any analysis of trends. The number of dwellings tended to exceed the number of rating units, so an adjustment was applied based on the ratio between the two numbers in each SA2 area in 2019. Dwellings were apportioned as either residential or residential lifestyle rating units, based on the 2019 ratio for each SA2 area.

[2] Jackson et al (2014)