Stats NZ
Tatauranga Aotearoa

# Proof of concept:

# Subnational dwelling completion and stock estimates

## Introduction to experimental modelled series



This data should not be considered final, and we advise against using the data in decision-making.

New Zealand Government

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Stats NZ Tatauranga Aotearoa
Wellington, New Zealand

Contact
Stats NZ Information Centre: info@stats.govt.nz
Phone toll-free 0508 525 525
Phone international +64 4 931 4600

www.stats.govt.nz

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# Purpose

This proof of concept aims to determine whether we could use existing data sources to produce quarterly estimates of residential dwelling completions and private dwelling stock at a subnational (territorial authority) level. This information would allow for a better understanding of the housing supply available around New Zealand between census periods and the amount of construction activity being undertaken to build houses.

As part of this work we are releasing experimental estimates of subnational dwelling completion and dwelling stock and the methodology used in this investigative work.

We are releasing these experimental estimates to stimulate discussion about how dwelling completions and subnational dwelling stock could be measured in future, and to gather feedback on the value of this work and improvements that could be made to the methodology.

## Your feedback requested

We welcome your comments about the experimental estimates and methodology used.

To send your feedback, see Proof of Concept – Subnational dwelling completions and stock estimates.

We'd like your feedback on:

- How useful this information is
- What you might use these estimates for
- What additional information you would like included
- What enhancements would make these estimates most useful
- Any suggestions for improvement

## Considerations

This data should not be considered final and we advise against using it in decision-making. This is a work-in-progress and likely to change as the methodology is refined and other input data sources considered.

This experimental work is not a commitment to producing an ongoing time series or further developing this work. It is designed as a test of what is possible and to get feedback on whether this work is of value and should therefore look to be prioritised and resourced.

This work could potentially be superseded in future by alternative data sources (eg a comprehensive property location register, census coverage of council final inspections, and/or code compliance certificates).

This work focuses solely on residential/private housing supply. It currently excludes any work on housing stock reduction, housing demand, occupancy, affordability, suitability, or security of tenure. If appropriate, future work could potentially look at the relationship between supply and demand (ie accounting for unoccupied dwellings and impacts of demolitions, and the supply of non-residential dwellings).

Assumptions built into the current models would need to be further scrutinised, tested, and refined if this work was progressed.

Due to the design of this preliminary model, estimates for small areas that have little dwelling construction activity are heavily influenced by work undertaken in other territorial authority areas and may be less reliable.

Estimates for 2015 onwards are more reliant on modelling, and may be less reliable than earlier estimates.

# Background

There has been a long-standing need for subannual and subnational information about the number of dwellings built over time, and the size of the dwelling stock across New Zealand. Currently, this level of detail is only available from the New Zealand Census of Population and Dwellings. Summaries of current information sources are outlined below.

## Currently available dwelling supply data sources

### Building Consents Issued

Building Consents Issued is currently the most informative subannual and subnational dataset on construction activity in New Zealand. It reports on the monthly number of new dwellings[1] consented for subnational areas including regions, territorial authorities, and Auckland wards. However, this doesn't answer the question of whether all the consented dwellings get built (ie the proportion of consented dwellings cancelled) or how long this takes (ie the lag between when a dwelling is consented and construction has been completed).

The national number of new dwellings consented is the black line in figure 1.

### Final inspections and code compliance certificates

A building consent is required before a dwelling can be built. After the dwelling is built, councils carry out a final inspection before a code compliance certificate can be issued. There is currently no standardised approach for the collection of data about final inspections and code compliance certificates. It is also unclear whether these are a good reflection of when a dwelling is completed and available for occupation. Anecdotal information indicates that people sometimes live in dwellings that don't yet have a code compliance certificate, and may not apply for one until the dwelling is to be sold.

### Value of Building Work Put in Place

Value of Building Work Put in Place is a quarterly estimate of the value of building work. This value is estimated based on Building Consents Issued and the Quarterly Building Activity Survey (QBAS). QBAS is a survey of high-value building projects. Currently, new dwellings with an estimated value of at least $900,000 are included.

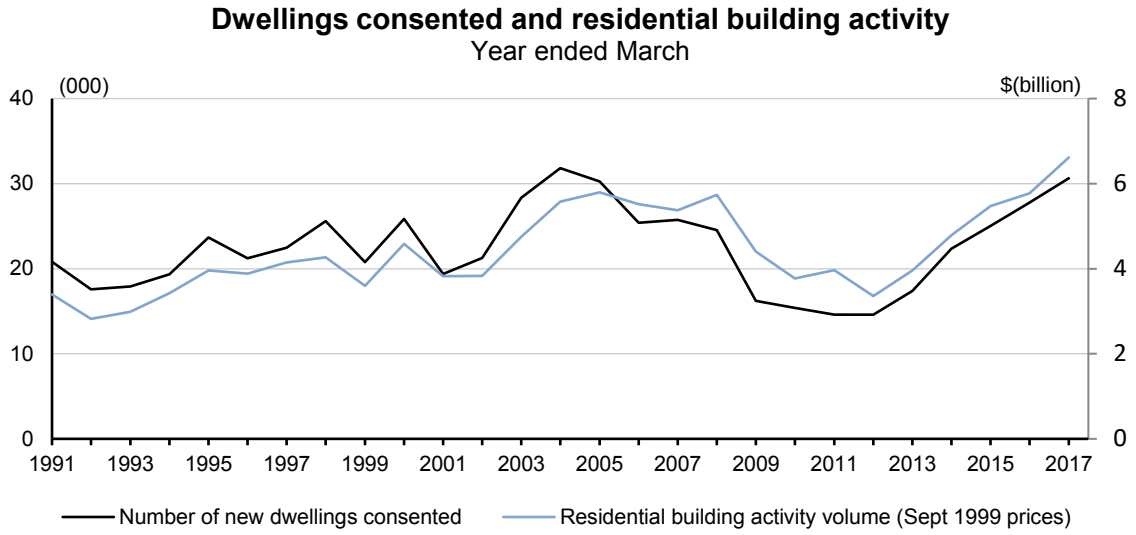
Value of Building Work Put in Place estimates are also deflated using capital goods price indexes to produce a volume measure of building activity. Figure 1 shows that, over time, the value of building work put in place volume measure appears to have increased relative to the number of new dwellings consented, perhaps because new dwellings are now more complex to build.

While the primary purpose of this survey is to collect values for use in the estimation of quarterly Gross Domestic Product, it also records whether a project is eventually finished or cancelled, and

[1] 'New dwellings' includes houses, apartments, townhouses, flats, minor household units, and licence-to-occupy retirement village units.

the quarter in which this happens. This means it could be useful for producing estimates about the number of new dwellings completed.

Figure 1



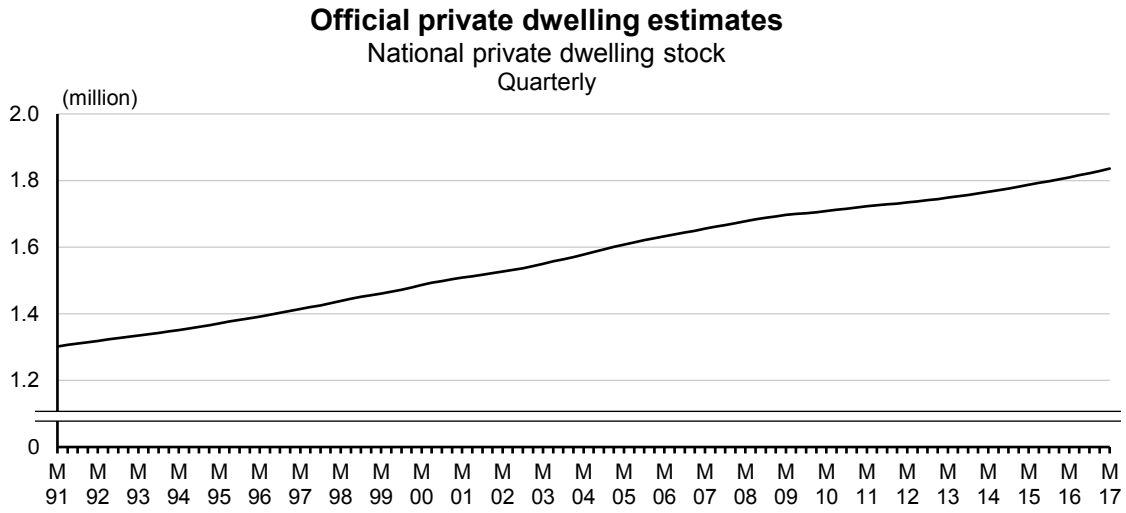

Source: Stats NZ

## Dwelling and household estimates

Dwelling and Household Estimates provides quarterly national estimates of New Zealand's dwelling stock between census periods. It extrapolates out from the most recent census using building consent numbers lagged by six months and multiplied by a weighting factor (eg to allow for demolitions, consents not fulfilled, unconsented dwellings). However, it currently only produces national stock estimates, the weighting factor can only be recalculated after each census, and the analysis in this paper indicates that the six-month construction lag on consents issued is now too short.

Following each census (ie 1991, 1996, 2001, 2006, 2013), the estimates are revised to match census private dwelling counts in the March quarter of the relevant year. For example, estimates for 2013–18 will be revised after 2018 Census data becomes available.

Figure 2




Source: Stats NZ

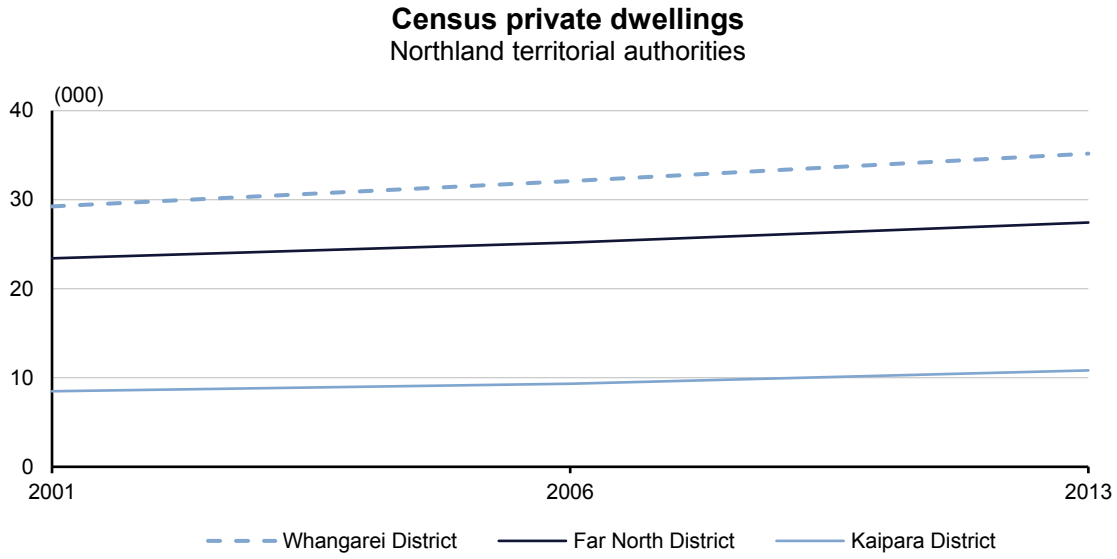
## New Zealand Census of Population and Dwellings

The New Zealand Census of Population and Dwellings is the official count of how many people and dwellings there are in New Zealand. It takes a snapshot of the people in New Zealand and the places where they live. The census is normally carried out every five years, except for a seven-year-gap between 2006 and 2013 due to the 2011 Christchurch earthquake.

Census does not capture any information on whether unoccupied dwellings are private or non-private dwellings. Dwelling and household estimates assume all unoccupied dwellings are private, therefore for the purposes of all discussions in this paper we have assumed the same.

The census provides a very detailed snapshot of dwelling stock in New Zealand, but its infrequent nature limits its usefulness, particularly when a few years have lapsed since the last census was completed.

Figure 3




Source: Stats NZ

# Dwelling completion methodology

We currently have limited access to territorial authority data on final inspections and code compliance certificates, so we focused on what Building Consents Issued and the Quarterly Building Activity Survey (QBAS) could tell us about dwelling completion and therefore, stocks. We tested whether we could link dwelling consents to QBAS responses, and whether the linked data could then inform a model to estimate subnational dwelling completions and stock when responses weren't captured in QBAS.

We estimated quarterly dwelling completions from the March 1998 quarter to the March 2017 quarter, and dwelling stock estimates from the March 2001 quarter to the March 2017 quarter. This allowed us two opportunities to confront our methodology against the subnational dwelling stock counts produced by census in 2006 and 2013.

## Data sources

### Building Consents Issued

Stats NZ holds a dataset of building consents issued from April 1990 onwards, collected to produce Building Consents Issued. For each building consent, we know the number of new dwellings consented, and the month in which the building consent was issued. We recognised that if we could add information about whether and when these consents were completed, and use a model to estimate this information when it isn't available, then we could calculate the number of new dwellings completed.

We only included building consents that were for new residential dwellings (ie houses, apartments, townhouses, flats, minor household units, and licence-to-occupy retirement village units), and excluded alterations and additions.

We counted each new dwelling separately. For example, a building consent for one apartment building with 50 apartments would be counted as 50 new dwellings.

New dwellings consented are therefore the underlying frame for our estimates.

Currently we have access to two datasets to inform on consent cancellations and completion time frames:

- Quarterly Building Activity Survey (QBAS) is designed to estimate the Value of Building Work Put in Place but also records when a project is cancelled or completed as specified by the respondent
- Christchurch final inspection dates, code compliance certificates, and building consent statuses (eg lapsed or cancelled) in a test dataset supplied by Christchurch City Council's Monitoring and Research team.

When data was available from both sources, we prioritised the QBAS over the Christchurch data to ensure consistent treatment of multi-stage building projects.

## Quarterly Building Activity Survey (QBAS)

The QBAS data is available from the June 1996 quarter onwards. Table 1 shows the range of building consent values for which we hold QBAS data over time.

For multi-stage projects, with multiple building consents captured in QBAS, we assumed that none of the stages was completed until the final stage had completed. Future work may require this assumption to be refined.

QBAS was redesigned at the end of 2014 to remove lower value building projects captured from a random sample because they were not economically significant, their value and progress could be accurately modelled using building consents issued, it reduced the questionnaire burden on respondents, and moved away from sample estimates (which can be relatively volatile) to administrative data use. In recent quarters approximately 1,800 residential construction projects were surveyed in QBAS.

Table 1

| Quarterly Building Activity Survey residential value boundaries | | |
|---|---|---|
| Quarter sampled into QBAS | Building consent value range | |
| | Random sample | Full coverage |
| 1989 Q3 – 1996 Q2 | $10,000 to $214,999 | $215,000 and above |
| 1996 Q3 – 1997 Q4 | $30,000 to $214,999 | $215,000 and above |
| 1998 Q1 – 2008 Q2 | $35,000 to $599,999 | $600,000 and above |
| 2008 Q3 – 2014 Q4 | $45,000 to $1,199,999 | $1,200,000 and above |
| 2015 Q1 – 2016 Q1 | None | $800,000 and above |
| 2016 Q2 – present | None | $900,000 and above |

## Christchurch final inspections data

Currently our model only incorporates final inspections data for Christchurch, supplied by Christchurch City Council's Monitoring and Research team.

The Christchurch data in particular is needed to ensure that our model behaves correctly following the 2010 and 2011 earthquakes, which caused an unprecedented level of building activity in the city. We use the Christchurch data for consents issued from 2011 onwards.

For any consents in the Christchurch data where the final inspection date is unavailable, the code compliance certificate issue date is used instead.

Since 2009, the median difference between the quarter of completion reported in the Christchurch and QBAS data is zero. This means that they agree on average. Before then, the Christchurch data had the completion one quarter later than the QBAS data on average. This could be because final inspections tended not to happen until sometime after a dwelling was effectively complete, or it could be because QBAS respondents tended to report that a dwelling was completed too early.

Initial analysis indicates that final inspection and QBAS data may not be as consistent with each other in some parts of the country as they are in Christchurch (ie final inspections for some parts of the country may report a later completion than QBAS on average). If this work was to be

progressed the difference in reported time of completion between QBAS and council final inspection dates would need to be further investigated.

## Models

For each dwelling consent, we need two variables:

- cancellation: the probability the consented dwelling(s) didn't progress to completion
- lag: how many months elapsed from when the dwelling(s) were consented until they were completed.

From these variables we can derive:

- the number of new dwellings completed (eg if 100 new dwellings had a 2 percent chance of cancellation, then we would expect 98 of them to have been completed)
- the quarter of completion (eg a consent issued in January 2016, lagged by nine months, would be completed in the October 2016 quarter).

We used the QBAS and Christchurch data, once linked to the building consent records, to build models which can predict these variables. The models were trained using data from 2015 and earlier. We couldn't use data for consents issued in 2016 or 2017, because data for consents that were issued this recently would skew the lag and cancellation estimates downwards.

We found that certain periods of history have behaved differently from others. We built such periods into the models to ensure that our estimates reflect changes over time.

The models account for a difference in behaviour between houses and other types of dwelling (eg apartments, townhouses, flats, minor household units, and licence-to-occupy retirement village units).

The models take into account the effect of the estimated project value stated on the building consent(s), deflated to September 1999 prices using the capital goods price index for residential construction.

The models are described in the following two sections.

All the model parameter estimates were strongly significant due to the size of the dataset used for modelling. Further research is required to assess the stability and practical significance of the estimates over time.

## Model for cancellation

We predicted cancellation using a logistic regression model. Table 2 summarises this model.

The model treats consents issued before 2004, in 2009 to 2011, or after 2014, as the baseline. Compared with this baseline, the model predicts that dwellings consented between 2004 and 2008 were more likely to be cancelled, while those consented between 2012 and 2014 were less likely to be cancelled. The predicted cancellation rate peaks in 2008.

Houses are less likely to be cancelled than other types of dwellings.

The higher a project's deflated value, the higher the likelihood of cancellation, although this effect is greater for houses than for other types of dwelling.

Table 2

| Parameters for the logistic regression model predicting probability of cancellation | | | |
|---|---|---|---|
| Parameter | Estimate | Standard Error | Wald Chi-Square |
| Intercept | -10.09 | 0.48 | 435.6 |
| Consented 2004 to 2006 | 0.30 | 0.07 | 18.2 |
| Consented in 2007 | 0.54 | 0.10 | 28.5 |
| Consented in 2008 | 0.90 | 0.10 | 81.7 |
| Consented 2012 to 2014 | -0.52 | 0.09 | 37.0 |
| Consented in any other time period | 0.00 | 0.00 | |
| Not a house | 6.86 | 0.74 | 85.1 |
| $Log_{10}$ of deflated project value | 1.23 | 0.09 | 190.4 |
| $Log_{10}$ of deflated project value if not a house | -1.22 | 0.13 | 84.9 |

## Model for lag

We predicted lag using a generalised linear model. Table 3 summarises this model.

The model treats consents issued between October 1999 and March 2003 as the baseline. The model predicts that dwellings consented before this baseline were completed more quickly, while dwellings consented after were completed more slowly. The predicted time to completion peaked in 2008.

Houses are completed more quickly than other types of dwelling.

The higher a project's deflated value, the longer the time to completion, although this effect is smaller for houses than for other types of dwelling.

As we built and refined the model, we found the lags for some territorial authorities are statistically significantly different from the rest of the country. We built such areas into the model, and grouped them with any nearby areas that behave similarly. The model predicts that, compared with most of the country, dwellings are:

- completed more quickly in Hamilton, Matamata-Piako, Waipa, Tauranga, Selwyn, and Waimakariri territorial authorities
- completed more slowly in Far North, Whangarei, Kaipara, Thames-Coromandel, Wellington, Kaikōura, Buller, Grey, and Christchurch territorial authorities.

Christchurch has a separate parameter in the model to ensure that the post-earthquake final inspections data for Christchurch doesn't affect other parts of the country.

Table 3

| Parameters for the generalised linear model predicting lag to completion in months | | | |
|---|---|---|---|
| Parameter | Estimate | Standard Error | Wald Chi-Square |
| Intercept | -43.81 | 0.78 | 3121.1 |
| Consented Sep 1999 or earlier | -1.08 | 0.13 | 68.1 |
| Consented Oct 1999 to Mar 2003 | 0.00 | 0.00 | |
| Consented Apr 2003 to Sep 2003 | 1.06 | 0.24 | 20.2 |
| Consented Oct 2003 to Sep 2006 | 2.11 | 0.13 | 246.4 |
| Consented Oct 2006 to Mar 2008 | 2.91 | 0.16 | 316.0 |
| Consented Apr 2008 to Dec 2008 | 3.64 | 0.24 | 233.6 |
| Consented Jan 2009 to Jun 2009 | 2.29 | 0.31 | 55.4 |
| Consented Jul 2009 or later | 0.45 | 0.13 | 12.2 |
| Not a house | 28.07 | 1.24 | 511.1 |
| $Log_{10}$ of deflated project value | 9.83 | 0.15 | 4477.2 |
| $Log_{10}$ of deflated project value if not a house | -5.34 | 0.22 | 567.1 |
| Christchurch | 1.95 | 0.09 | 445.5 |
| Hamilton, Matamata-Piako, and Waipa | -1.44 | 0.19 | 58.22 |
| Kaikoura, Buller, and Grey | 2.87 | 0.57 | 25.09 |
| Far North, Whangarei, Kaipara, and Thames-Coromandel | 1.38 | 0.18 | 59.80 |
| Queenstown and Dunedin | 1.37 | 0.22 | 37.85 |
| Selwyn and Waimakariri | -0.70 | 0.21 | 11.02 |
| Tauranga | -1.96 | 0.20 | 97.29 |
| Wellington | 1.37 | 0.22 | 38.07 |

## Variables assessed for modelling use

For the purposes of this proof of concept, only variables available from the building consents dataset were used to predict dwelling completions.

While the deflated value of a project consent, some form of geographic differentiation, and differentiation between houses and other dwelling types, are useful predictors of the cancellation and lag in construction of new dwellings, it is likely there are other variables that may be of use.

Variables we considered but discarded because of limited additional usefulness include:

- accounting independently for each building type (eg differentiating apartments, townhouses, and retirement village units)
- accounting independently for each territorial authority (TA)
- accounting independently for each region
- accounting independently for each year a consent was issued
- floor area (because it is correlated with the deflated project costs)
- accounting for the region's level of consenting activity compared with history.

Variables we think may be worth investigating include:

- employment indicators (eg immigration of skilled labour, labour costs)
- economic indicators (eg Gross Domestic Product growth)

- financial indicators (eg interest rates, construction costs)
- seasonality impacts (eg timing of holidays, weather)
- localised impacts (eg natural disasters, new local government legislation).

## Considerations

Activity not covered by the modelled completions includes:

- non-residential dwellings (ie some people live in hostels, hospitals and other non-private dwellings not addressed in these estimates)
- non-consented building activity (ie new dwelling construction below the value of $5,000, or undertaken without a building consent)
- alterations (eg if someone built an addition onto a house).

Some limitations of these estimates include:

- Lower quality estimates for small areas. A lack of information for small areas (ie a territorial authority area where there is little new dwelling construction activity) means results are likely to be more volatile and are heavily influenced by activity in other parts of the country.
- Lower quality estimates in more recent years. More recent periods have greater uncertainty about what construction activity has been completed, meaning that a greater emphasis on modelling rather than actual completion dates is used in the estimates. The change in scope of QBAS in 2015, to only capture residential construction over $900,000, also means that greater reliance is made on modelling factors and high-value dwellings constructed post-2015 (except for in Christchurch).

## Potential enhancements

Some changes that might enhance these experimental estimates include:

- Additional data sources. Access to final inspection and code compliance certificate data from all councils might improve small area estimates and remove any bias introduced by the 2015 change in scope of QBAS. However, this depends on how well completion aligns between QBAS and final inspections. Preliminary analysis indicates that these align better in some territorial authorities than others.
- The use of a survival analysis model to estimate time lags for construction completion. For the purposes of timeliness in producing this proof of concept, we have used a simple linear model.
- Additional or alternative predictor variables within the models.

# Dwelling stock methodology

In Dwelling and Household Estimates, the quarterly number of private dwellings is estimated by interpolating between each census using the number of new dwellings consented (lagged by six months) as a proxy for dwelling completions. This number is multiplied by a weighting factor to make the estimates reconcile at each census. This weighting factor accounts for demolitions, new dwellings not counted in Building Consents Issued (eg temporary dwellings), and cancelled dwelling consents. A different weighting factor is calculated for each census. The latest weighting factor is used to extrapolate from the most recent census to the present, until the next census results are available at which point all estimates between the latest intercensal period are revised with updated weighting factors. This methodology is only applied at a national level.

We adapted the above approach to produce our experimental dwelling stock estimates at a subnational level. No lag was required, since the lag from consent to completion is already built into the estimates. We tested extrapolating forward census estimates to create dwelling stock counts using completion estimates both with and without weighting factors applied. We compared these results to the 2013 Census.

We found that extrapolating without applying weighting factors matched the 2013 Census more closely than extrapolating using weight factors. We also found that calculating weighting factors for every territorial authority resulted in unreasonably extreme weighting factors for some small territorial authorities. As a result, we chose to not use weighting factors when extrapolating forwards from the most recent census.

Therefore, our experimental estimates use weighting factors to interpolate between the 2001, 2006, and 2013 Censuses, but do not use weighting factors from 2013 onwards. This means we are not attempting to account for demolitions or non-consented dwellings in our post-2013 estimates, because to do so appears to make the estimates slightly worse.

It appears that, at a territorial authority level, it is generally better to not account for demolitions and non-consented dwellings than to account for them using weighting factors. However, it is important to recognise that this may not hold in extreme circumstances. For example following the 2011 Christchurch earthquakes a lack of information on demolitions resulted in a significant over-estimate of dwelling stock using this methodology until the numbers between the 2006 and 2013 Censuses could be revised by applying a weighting factor. Also, using this methodology, the demolitions in Christchurch during this time were smoothed between the full intercensal period (ie 2006 to 2013), rather than just the period after the earthquakes (ie 2011 to 2013).

It is likely that our post-2013 Christchurch estimates are too high, since they do not account for demolitions after the 2013 Census.

## Potential enhancements

Access to information on dwelling demolitions would enable more accurate estimates.

For Christchurch, our estimates currently don't attempt to account for lost dwelling stock due to the 2010 and 2011 earthquakes. However, this is partly taken into account by the 2013 Census. This could be further refined by incorporating work Christchurch City Council's Monitoring and Research team has done to identify how many completed new dwellings were replacing previous dwellings versus how many completely new additions to the dwelling stock. We could also

compare the dwelling stock change between the 2006 and 2013 Censuses with the number of dwellings completed to infer a number of dwellings demolished, and only apply this factor to estimates between 2011 and 2013 rather than the full 2006 to 2013 period.

While we have found that having separate weighting factors for every territorial authority does not work well, we could explore grouping similar territorial authorities together to avoid extreme weighting factors.

We could also explore ways to use a national estimate to inform the subnational estimates, for example:

- applying the same national weighting factor to every territorial authority
- constraining the territorial estimates so that they add up to a separately calculated national estimate.

# Dwelling completion estimates

This data should not be considered final, and we advise against using the data in decision-making.

This paper mainly presents results at a national level. For territorial authority statistics, please see the accompanying Excel tables.

## Summary

We estimate that, on average, it currently takes about ten months for a new dwelling to be completed after its building consent has been issued. This compares with an average of about six months in 1998 (which is built into the current Dwelling and Household Estimates).

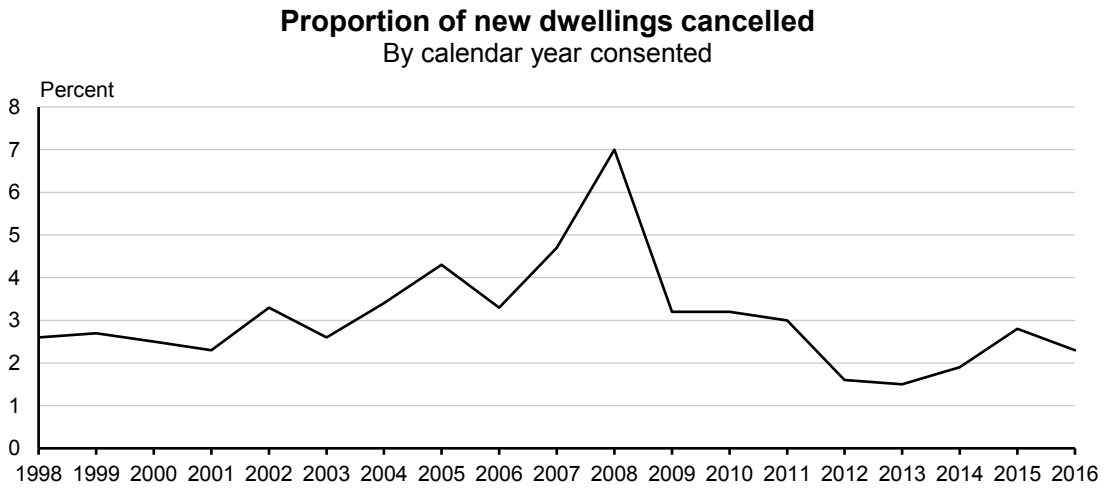
Typically, about 97 percent of consented new dwellings get built. The main exception was in 2008, when only 93 percent of consented dwellings were built, coinciding with the global financial crisis.

We estimate that approximately 27,862 new dwellings were completed in the year ended March 2017. This compares with 30,626 dwellings consented in the same period.

## Estimated cancellation rate of consented dwellings

Typically, between 2 and 3 percent of consented new dwellings get cancelled, while the remaining 97 to 98 percent are eventually built. However, the percentage of cancellations has sometimes been higher or lower, as shown in Figure 4. For example in 2008, coinciding with the global financial crisis, only 93 percent of consented dwellings were completed.

Figure 4




Source: Stats NZ

In addition to calculating the cancellation rate we can also produce estimates of how much consented work is still under construction, as shown in table 4. Understandably, dwellings consented more recently are more likely to still be in progress.

Table 4

| Percentage of new dwellings cancelled, in progress, and completed, by calendar year issued | | | |
|---|---|---|---|
| Calendar year consented | Percentage of new dwellings by status (as at 31 March 2017) | | |
| | Cancelled[2] | In progress | Completed |
| 1998 | 2.6 | 0.0 | 97.4 |
| 1999 | 2.7 | 0.0 | 97.3 |
| 2000 | 2.5 | 0.0 | 97.5 |
| 2001 | 2.3 | 0.0 | 97.7 |
| 2002 | 3.3 | 0.0 | 96.7 |
| 2003 | 2.6 | 0.0 | 97.4 |
| 2004 | 3.4 | 0.0 | 96.6 |
| 2005 | 4.3 | 0.0 | 95.7 |
| 2006 | 3.3 | 0.0 | 96.7 |
| 2007 | 4.7 | 0.0 | 95.3 |
| 2008 | 7.0 | 0.0 | 93.0 |
| 2009 | 3.2 | 0.0 | 96.8 |
| 2010 | 3.2 | 0.0 | 96.8 |
| 2011 | 3.0 | 0.1 | 96.9 |
| 2012 | 1.6 | 0.0 | 98.4 |
| 2013 | 1.5 | 0.3 | 98.2 |
| 2014 | 1.9 | 1.8 | 96.4 |
| 2015 | 2.8 | 8.6 | 88.6 |
| 2016 | 2.3 | 50.6 | 47.2 |

## Estimated lag between dwelling consent and completion

Lag is a measure of how many months pass until a consented new dwelling is completed.

The lag starts in the middle of the month in which the dwelling was counted in Building Consents Issued. For most new dwellings, this is the month in which the only building consent was issued. However, for projects with multiple consents, this could be any of the months in which a consent was issued. More work is required to accurately estimate the time taken for projects with multiple consents.

The lag finishes in the middle of the quarter in which the dwelling was recorded as completed in QBAS, or on the exact date of completion in the Christchurch City Council data.

Since not all projects consented in a given time period have been completed yet:

- We only calculate lag for projects that have already completed (or are estimated to have completed).
- We summarise lag by year completed instead of year consented.

[2] It is assumed that all modelled cancellations have already happened. In reality, some of the modelled cancellations would not have happened yet as at 31 March 2017.

Table 5 shows the lag by year of completion. Please note, most of our completions data is only accurate to the nearest quarter, so small changes in the lag are not significant.

We estimate that the mean lag to completion has increased from six months in 1997 to 10 months in 2016, reaching as high as 12 months between 2007 and 2009.

Table 5

| Lag (in months (from consent to completion, by calendar year completed | |
|---|---|
| Calendar year completed | Months to completion |
| 1998 | 6 |
| 1999 | 7 |
| 2000 | 8 |
| 2001 | 8 |
| 2002 | 8 |
| 2003 | 9 |
| 2004 | 10 |
| 2005 | 11 |
| 2006 | 11 |
| 2007 | 12 |
| 2008 | 12 |
| 2009 | 12 |
| 2010 | 10 |
| 2011 | 9 |
| 2012 | 9 |
| 2013 | 9 |
| 2014 | 9 |
| 2015 | 9 |
| 2016 | 10 |
| 2017 | 10 |

## Estimated number of dwellings completed

For a full set of subnational estimates see the supporting Excel tables.

## Quarterly estimates

Our quarterly estimates begin in the March 1998 quarter, when an estimated 5,979 new dwellings were completed. This compares to 7,577 new dwellings estimated to have completed in the March 2017 quarter.

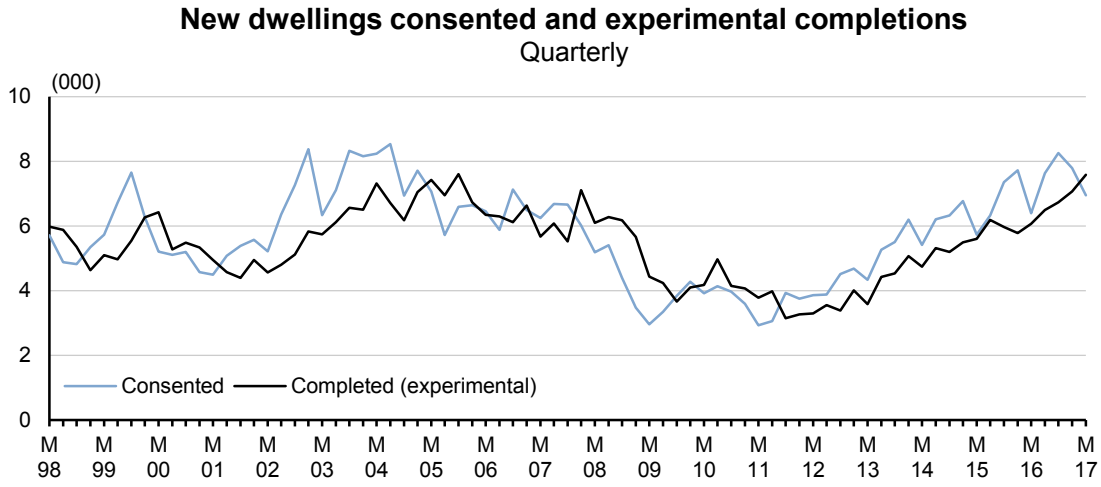
The series low was in the September 2011 quarter, when 3,149 new dwellings were completed. The number has increased significantly since then, due to an increase in the number of new dwellings consented.

The series peak was in the September 2005 quarter, when an estimated 7,604 new dwellings were completed.

The number of new dwellings completed lags behind the number of new dwellings consented. However, spikes in the number of new dwellings consented tend not to translate into spikes in the

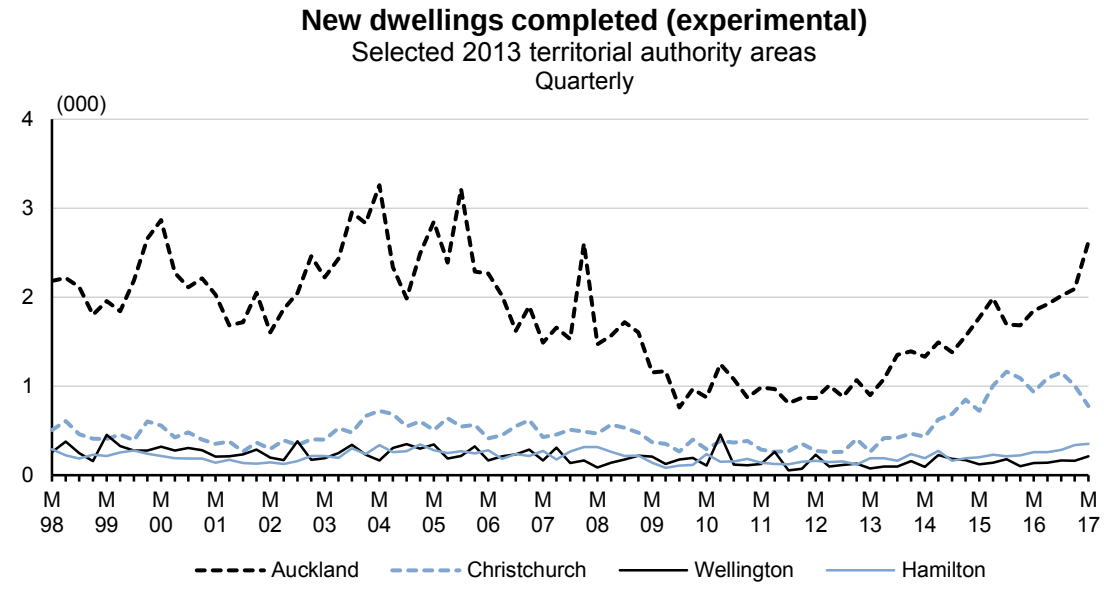
number of new dwellings completed. Instead, these dwellings are completed across a longer period of time.

Figure 5




Source: Stats NZ

Figure 6




Source: Stats NZ

## Annual estimates and historical comparison

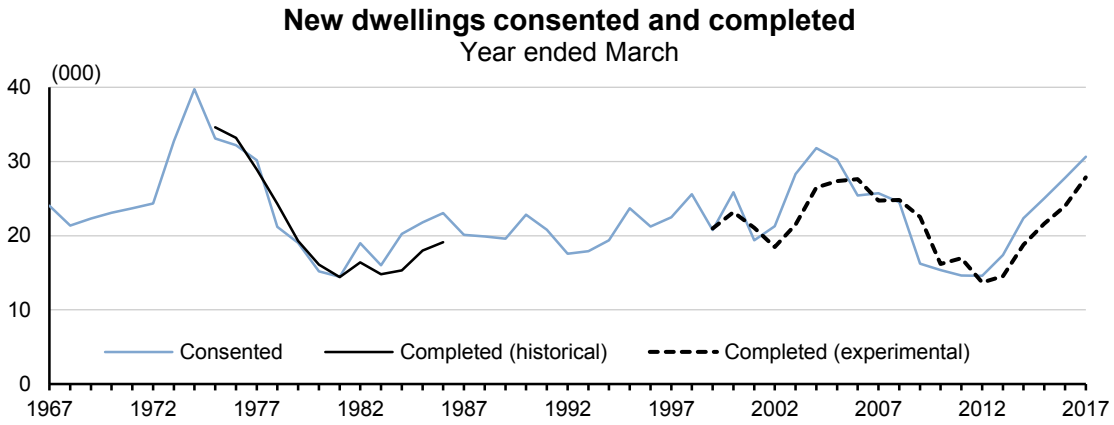
We estimate that 27,862 new dwellings were completed in the March 2017 year – below the peak in the previous building boom of 29,018 dwellings, completed in the September 2005 year.

From 1975 to 1986, we collected information about annual dwelling completions from local authorities, as shown in figure 7. Completions reached much higher levels in the mid-1970s than at any time in the past two decades. However, the total floor area of these dwellings was lower, as summarised in We're building bigger 40 years on.

While figure 7 gives the impression that the lag between consent and completion is higher over the past two decades than it was in the 1970s, this isn't necessarily the case. The 1974 peak in

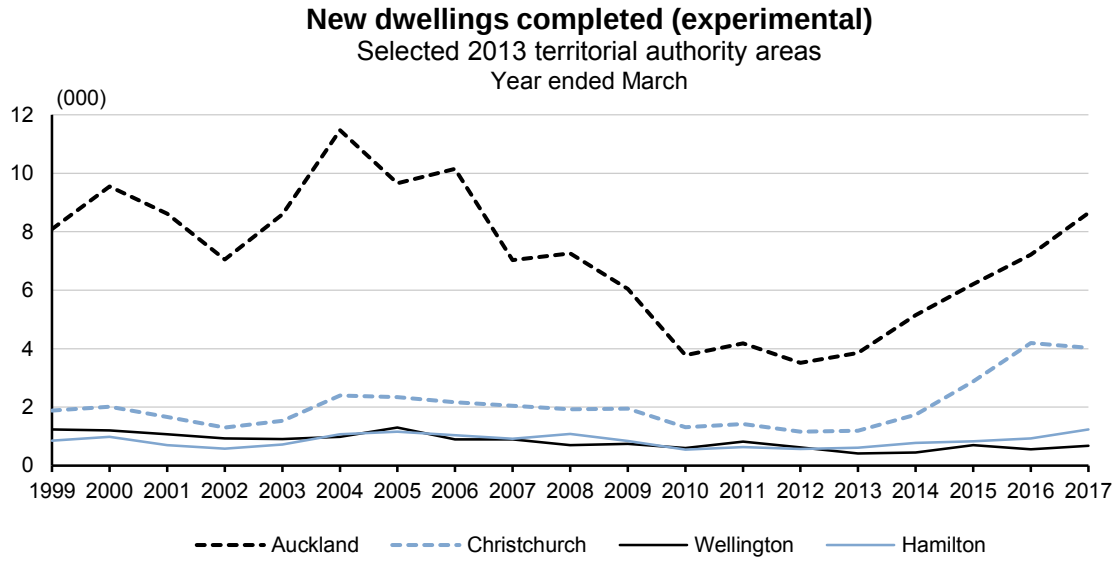
dwelling permits may have resulted in a backlog of work over the next few years, which caused the number of dwellings completed to be higher than the number of dwellings consented in some years.

Figure 7




Source: Stats NZ

Figure 8




Source: Stats NZ

## What proportion of the completion estimates are modelled?

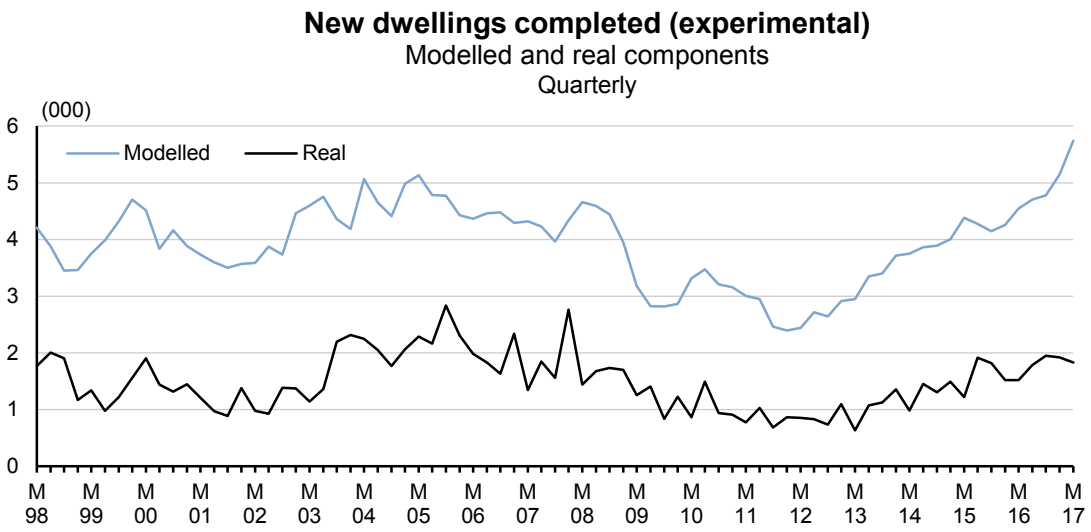
Figure 9 breaks our estimated number of new dwellings completed down into its modelled and real components. These two components are added together to reach the total number of completions shown in figure 5.

The modelled component consists of new dwellings for which we do not have QBAS or Christchurch data. It is an estimate of how many of these dwellings were completed each quarter.

The real component consists of new dwellings that the QBAS or Christchurch data indicate were completed. The composition of this data has changed over time, most notably in 2015 due to the QBAS methodology changes (summarised in table 1).

Notably, the recent surge in dwelling completions (particularly in Auckland) is driven by modelled data, while the real data has eased slightly.

Figure 9




Source: Stats NZ

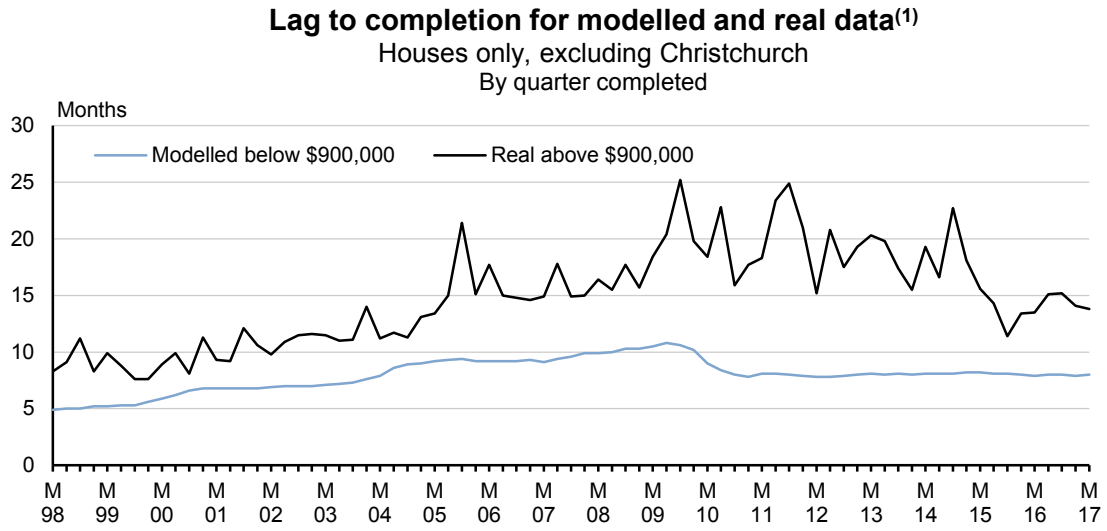
## Is the completion model accurate for the current building boom?

A key assumption of our model is that the lag to completion for dwellings consents valued below $900,000 is currently stable. However, such consents are no longer sampled into the Quarterly Building Activity Survey (QBAS), so we cannot test this assumption directly.

However, we can look at real data for dwelling consents valued *above* $900,000 to help confront this assumption. We do this for houses only, to prevent the lag being skewed by large apartment, townhouse, and retirement village projects. This comparison is shown in Figure 10.

Lower-value building projects were removed from QBAS in the March 2015 quarter. If the lag for high-value houses was longer now than in the December 2014 quarter then this would bring our assumption into question, as we would expect the lag to also have lengthened for lower-value houses. However, the lag for higher-value houses is shorter now than in the December 2014 quarter. This helps reassure us that it is appropriate to hold the lag for modelled consents steady since 2014.

Figure 10




1. To allow long-term comparisons despite QBAS coverage changes, modelled data is only shown for consents below $900,000, and real data is only shown for consents above $900,000 (both in March 2017 prices).

Source: Stats NZ

# Dwelling stock estimates

This data should not be considered final, and we advise against using the data in decision-making.

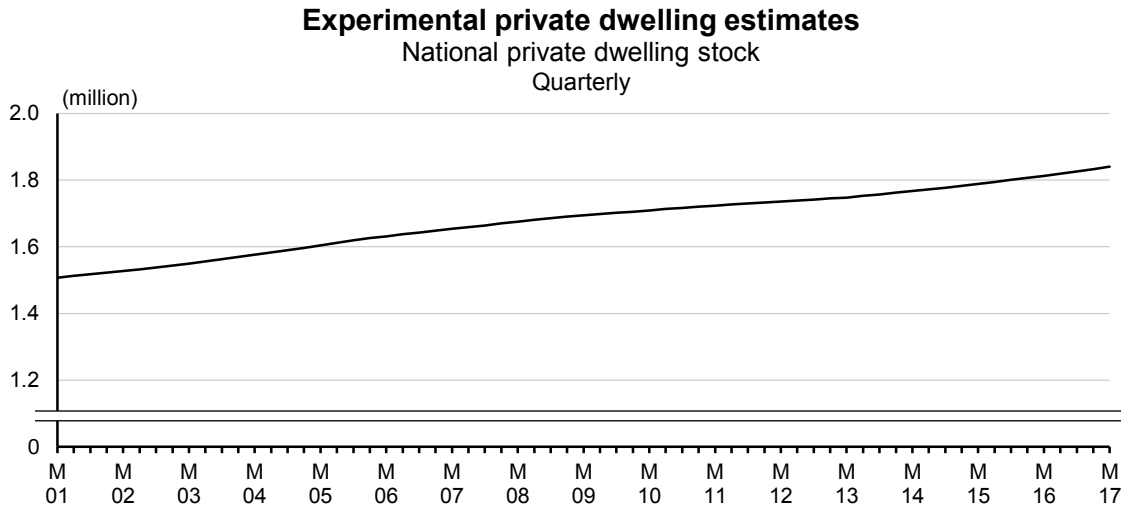
For a full set of subnational estimates see the supporting Excel tables.

## Overview

We estimate that, as at March 2017, New Zealand has 1,840,600 private dwellings – compared with an estimate of 1,836,000 in Dwelling and Household Estimates.

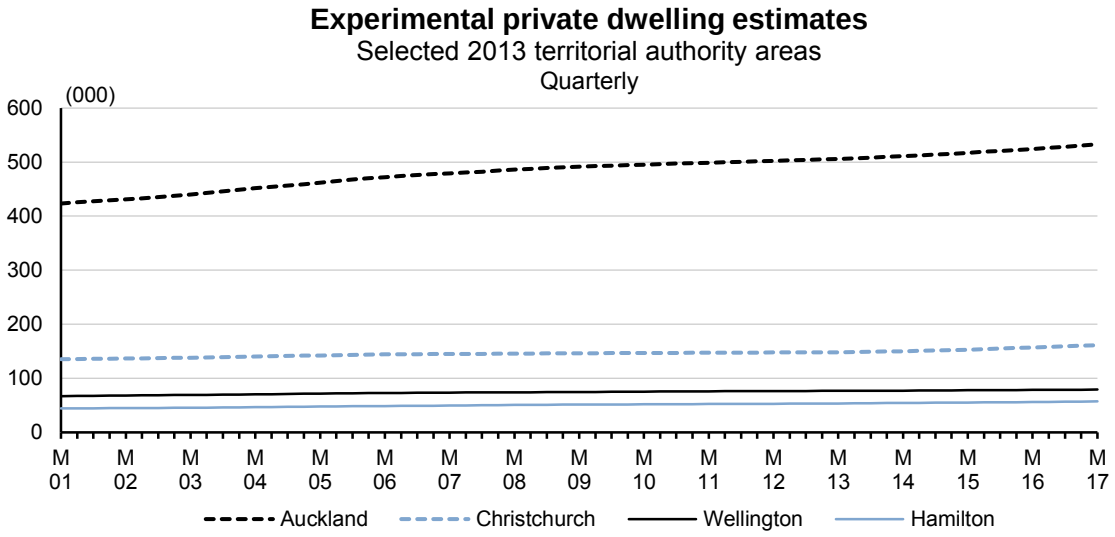
This includes an estimated 532,800 private dwellings in Auckland.

Figure 11




Source: Stats NZ

Figure 12




Source: Stats NZ

## Comparison

We used dwelling estimates from the Census of Population and Dwellings as a quality benchmark for all other estimates. However, it is important to note that Census dwelling estimates also have a degree of uncertainty. Census post-enumerations surveys found that:

- The 1996 Census had an undercount of 0.3 to 0.7 percent for private dwellings.
- The 2001 Census had an undercount of 0.1 to 0.3 percent for private dwellings.
- The 2006 Census had an undercount of 0.2 to 0.6 percent for private dwellings.

A private dwellings undercount measure is not available for the 2013 Census.

To compare methodologies, we can calculate estimates for 2013, as if we didn't know the final factors between the 2006 and 2013 census, and see how they compare to the 2013 Census, as shown in Table 6.

At a national level, our experimental estimate for March 2013 would have been 1.0 percent greater than the census count, compared with 0.4 percent for the official dwelling and household estimate. A significant reason our experimental estimate would have over-estimated dwelling stock compared to census is that we did not account for demolitions in Christchurch.

Table 6

| Comparison of dwelling stock estimates against Census 2013 | | |
|---|---|---|
| Methodology | Private dwellings as at March 2013 | Percentage difference from Census 2013 |
| Census 2013 | 1,747,400 | 0.0 |
| Extrapolate from Census 2006 using current Dwelling and Household Estimates methodology | 1,755,100 | +0.4 |
| Extrapolate from Census 2006 using experimental methodology (with weighting factors) | 1,766,900 | +1.1 |
| Extrapolate from Census 2006 using experimental methodology (without weighting factors) | 1,765,100 | +1.0 |

# Opportunities to extend this research

## Greater detail

Some additional measures and finer level detail could be produced if this work was extended. Opportunities include:

- Estimates by building type - cancellation rates, lag times, completion estimates, and stock estimates available separately for houses; apartments; retirement village units; and townhouses, flat and units.
- Completion and stock estimates for lower level geographic areas – producing estimates for areas such as Auckland Wards would require access to Auckland council final inspection and code compliance data.
- Cancellation and lag estimates for lower level geographic areas.
- Cancellation and lag estimates for shorter time periods (eg quarterly).
- Estimates of new dwellings still under construction – a quarterly measure of new dwellings that are still likely to be work in progress.
- Measures of uncertainty – confidence levels in different estimates produced.

## Greater scope

If this work was extended, some opportunities to expand the scope include:

- Making these measures more relatable to dwelling demand – this could include producing estimates of unoccupied dwellings and accounting for use of non-private dwellings.
- Producing comparable measures of dwelling demand growth – estimates of the population likely to be needing new private dwellings.
- Including non-residential dwellings – producing estimates of non-private dwelling supply (eg hostels, hospitals, prisons).
- Producing measures of dwelling destruction – looking for sources to inform on demolitions and therefore be able to estimate more accurately net dwelling changes.

# Glossary

Building type –type of building for which a consent has been issued (eg stand-alone house, apartment, townhouse).

Cancellation rate –proportion of building consents issued which progress to the point of completion.

Code compliance certificate – formal statement issued under section 95 of the Building Act 2004, that building work carried out under a building consent complies with that building consent.

Completion – dwelling construction activity reported as finished in the Quarterly Building Activity Survey (QBAS), a final inspection carried out by council, or a code compliance certificate issued by council.

Dwellings – self-contained permanent residences. Examples include houses, apartments, townhouses, granny flats, and licence-to-occupy retirement village units.

Final inspection – final inspection for plumbing, building and drainage work (once the work described in the building consent is complete).

Lag – time between a dwelling consent being issued and construction being completed.

Multi-stage project – a single construction project which had multiple building consents issued for different parts of the work undertaken (eg groundworks, fitout).

New dwellings – newly constructed houses, flats and apartments, including those at retirement villages.

Non-private/non-residential dwellings – may be available for use generally, or by virtue of occupation or study, special needs, or legal requirements. Such dwellings may have facilities (such as a dining room) that are for shared use. Examples include hospitals, nursing homes, boarding houses, and prisons.

Private dwelling – accommodates a person or a group of people, but is not available to the public. A private dwelling may be permanent or temporary. Permanent private dwellings include houses and flats, residences attached to a business or institution; baches, cribs, and huts. Caravans, cabins, tents, and other makeshift dwellings that are the principal or usual residence of households are classified as temporary private dwellings.

Temporary private dwelling - Caravans, cabins, tents and other makeshift dwellings that are the principal or usual residence of households are classified as temporary private dwellings, whether they are occupied or unoccupied. Park benches and other types of improvised shelter are counted as a dwelling if they are occupied by a person on census night.

Territorial authorities (TA) – territorial authorities are defined under the Local Government Act 2002 and related amendments. There are 67 territorial authorities – Auckland Council, 12 city councils, 53 district councils, and Chatham Islands Council.

Unoccupied dwelling – a dwelling is defined as unoccupied if it is unoccupied at all times during the twelve hours following midnight on the night of census data collection; and suitable for habitation.

Work in progress – the proportion of building consents issued in any given year which are still likely to be under construction (ie those that aren't cancelled or completed).

# References

## Building Consents Issued

Building Consents Issued – DataInfo+

Building Consents Issued – information releases

## Value of Building Work Put in Place

Value of Building Work Put in Place – DataInfo+

Value of Building Work Put in Place – information releases

## Dwelling and Household Estimates

Dwelling and Household Estimates – DataInfo+

Dwelling and Household Estimates – information releases

## Census of Population and Dwellings

Census

Standard terms for measures of dwellings, households, and families

## Other

Code compliance certificates

Typical council inspections of a building project