



TN12 - WELLINGTON TRANSPORT ANALYTICAL TOOLS 2019-21 UPDATE – DATA ANALYSIS – LAND USE

PREPARED FOR GREATER WELLINGTON REGIONAL COUNCIL

April 2021

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Greater Wellington Regional Council

TN12 - Wellington Transport Analytical Tools 2019-21 update – Data Analysis – Land Use

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TA name	0-4 years	5-9 years	10-14 years	15-19 years	20-24 years	25-29 years	30-34 years	35-39 years	40-44 years	45-49 years	50-54 years	55-59 years	60-64 years	65-69 years	70-74 years	75-79 years	80-84 years	85 years and over	Total
Porirua City	2753	3224	3561	3762	3724	3710	3528	3244	2844	2424	2074	1764	1474	1184	924	674	424	274	23877
Upper Hutt City	2753	3224	3561	3762	3724	3710	3528	3244	2844	2424	2074	1764	1474	1184	924	674	424	274	23877
Lower Hutt City	2753	3224	3561	3762	3724	3710	3528	3244	2844	2424	2074	1764	1474	1184	924	674	424	274	23877
Wellington City	2753	3224	3561	3762	3724	3710	3528	3244	2844	2424	2074	1764	1474	1184	924	674	424	274	23877
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North Harbour Region	2753	3224	3561	3762	3724	3710	3528	3244	2844	2424	2074	1764	1474	1184	924	674	424	274	23877
Greater Wellington Authority	2753	3224	3561	3762	3724	3710	3528	3244	2844	2424	2074	1764	1474	1184	924	674	424	274	23877

Step 3

The sub total values were increased or decreased (proportionally) horizontally, to equal the adjusted 'total' column value e.g. all of the Otaki SA2 sub total values equal the new adjusted total column.

TA name	0-4 years	5-9 years	10-14 years	15-19 years	20-24 years	25-29 years	30-34 years	35-39 years	40-44 years	45-49 years	50-54 years	55-59 years	60-64 years	65-69 years	70-74 years	75-79 years	80-84 years	85 years and over	Total
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Greater Wellington Authority	2753	3224	3561	3762	3724	3710	3528	3244	2844	2424	2074	1764	1474	1184	924	674	424	274	23877

Step 4

The SA2 sub total values were then adjusted (proportionally) vertically to equal the TA sub total value e.g. the multiple '5-9 years' values in Kapiti SA2 units, were adjusted to equal the Kapiti TA '5-9 year' single value.

TA name	0-4 years	5-9 years	10-14 years	15-19 years	20-24 years	25-29 years	30-34 years	35-39 years	40-44 years	45-49 years	50-54 years	55-59 years	60-64 years	65-69 years	70-74 years	75-79 years	80-84 years	85 years and over	Total
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Greater Wellington Authority	2753	3224	3561	3762	3724	3710	3528	3244	2844	2424	2074	1764	1474	1184	924	674	424	274	23877

Equals below

TA name	0-4 years	5-9 years	10-14 years	15-19 years	20-24 years	25-29 years	30-34 years	35-39 years	40-44 years	45-49 years	50-54 years	55-59 years	60-64 years	65-69 years	70-74 years	75-79 years	80-84 years	85 years and over	Total
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Greater Wellington Authority	2753	3224	3561	3762	3724	3710	3528	3244	2844	2424	2074	1764	1474	1184	924	674	424	274	23877

Step 5

The previous steps were then repeated for the lower units i.e. SA1 to equal the adjusted SA2 data, then the Meshblock data to equal the adjusted SA1 data.

At this stage of the land use processing, population is "Census Usually Resident Population" (CURP). All other data has the same CURP definition. CURP is the count of New Zealand people who usually live, and are present, in New Zealand on Census night. This count excludes visitors from overseas and excludes residents who are temporarily overseas on Census night.

The resulting land use totals (usually resident basis) by TA are shown in the following table.

Table 2-1: Key Land Use Metrics by TA

TA	Population, CURP	Households	Total Employed	Employed Full time	Employed Part time	Unemployed	Not in the Labour Force	Total Labour Force Status	Employed, Workplace
Kapiti Coast District	53,673	21,753	25,227	18,792	6,435	1,596	17,565	44,388	16,806
Porirua City	56,559	17,838	28,227	22,524	5,703	2,379	12,513	43,119	17,610
Upper Hutt City	43,980	15,870	23,139	18,582	4,557	1,434	10,845	35,418	13,602
Lower Hutt City	104,532	37,161	54,900	43,563	11,337	3,987	24,510	83,397	41,841

TA	Population, CURP	Households	Total Employed	Employed Full time	Employed Part time	Unemployed	Not in the Labour Force	Total Labour Force Status	Employed, Workplace
Wellington City	202,737	74,841	121,191	96,453	24,738	7,719	40,965	169,875	137,007
Masterton District	25,557	9,936	12,690	9,420	3,270	705	7,194	20,589	10,980
Carterton District	9,198	3,645	4,734	3,492	1,242	240	2,484	7,458	3,375
South Wairarapa District	10,575	4,335	5,685	4,239	1,446	237	2,736	8,658	4,119
Total	506,811	185,379	275,793	217,065	58,728	18,297	118812	412902	245,340

Comparisons to 2013 are provided in section 5.2.1 of this report.

Note population totals vary slightly depending on the tabulation used (e.g.: regional totals, SA2 summed to region, meshblocks summed to region, etc).

2.2 Factoring to Estimated Resident Population

Future year land use projections (population, households, etc) in the Wellington region are made on the basis of the Estimated Resident Population (ERP). ERP relates to a count on 30th June of each year rather than Census night (March). ERP includes:

- The count of residents in NZ on Census night (CURP);
- Plus residents missed by Census (net Census undercount) estimated through post-enumeration surveys;
- Plus residents temporarily overseas on Census night; and
- Plus births, deaths and net migration between Census night and 30 June 2018.

The different population definitions are illustrated in the figure below (source: Statistics NZ website).

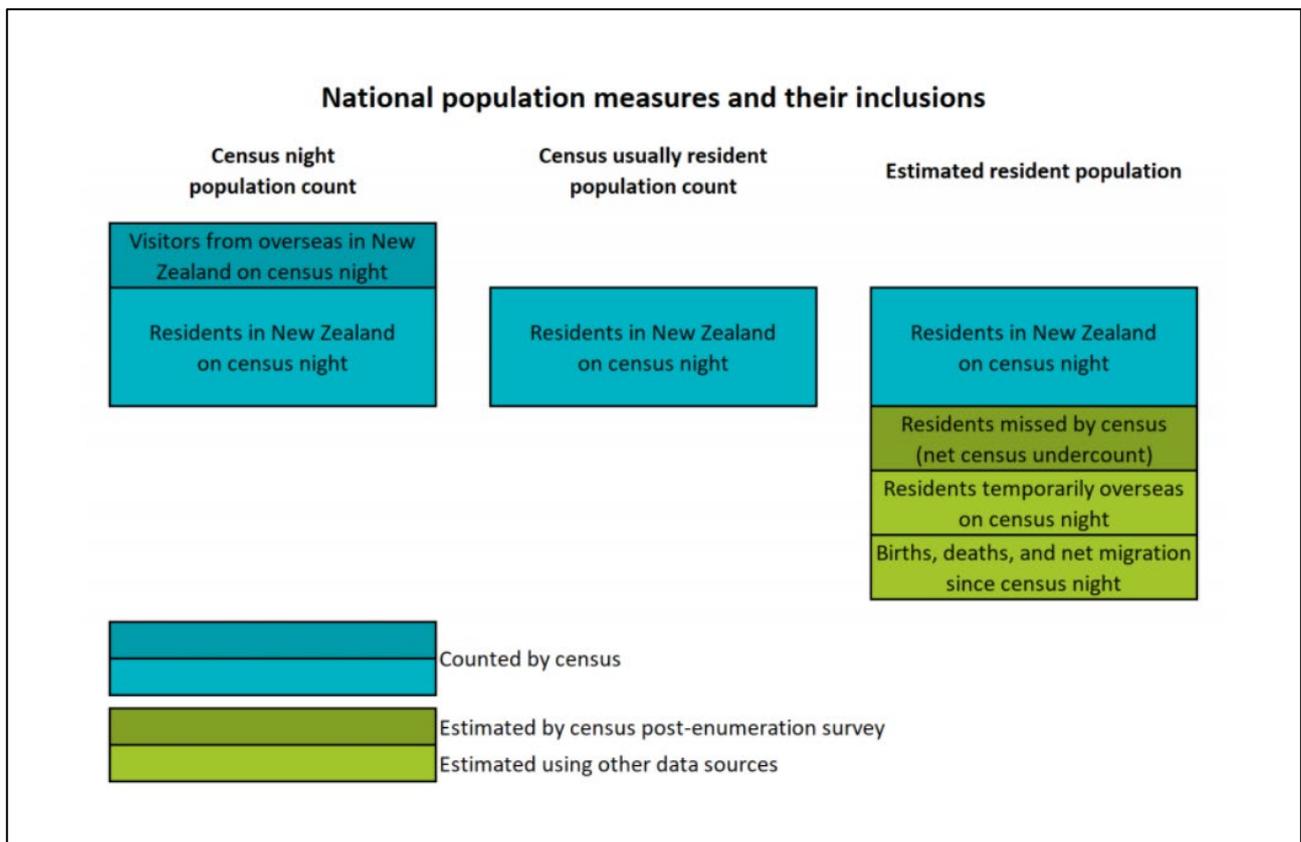


Figure 2-1: Population Definitions

In order to be aligned with land use projections, the transport model land use inputs are based on ERP and the CURP data obtained from Statistics NZ must be converted.

However, ERP population is only available for SA2's and cannot be obtained at the models' zonal definition level. The approach used to factor the CURP-based model land use presented in the previous section to the ERP definition is as follows:

- Both CURP and ERP population totals for SA2's were obtained from Statistics NZ;
- There is no perfect match between SA2's and the 813 internal zones (excluding external and special generators such as port and airport) used in the revised transport models, with some zones overlapping or being divided by SA2 boundaries. Therefore an intermediate sector system was set up to aggregate both zones and SA2's and allow setting up a look-up between the two. This led to the region being divided into 136 sectors, with an example of aggregation shown in Figure 2-2.

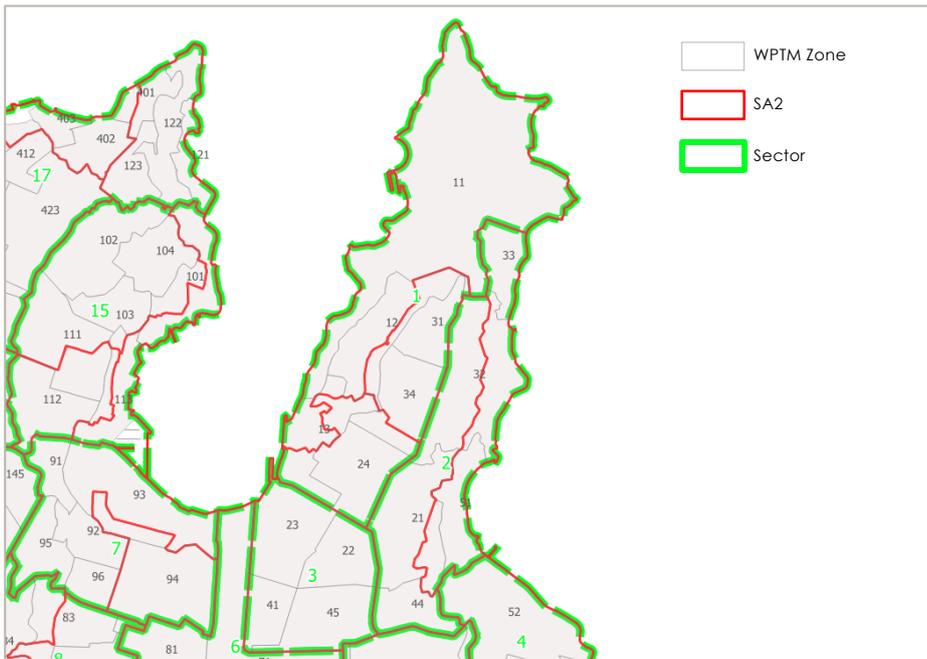


Figure 2-2: Sectors - SA2's to zone

- SA2 CURP and ERP population totals were summed up to sector level, and the resulting conversion factor was derived for each sector. Resulting factors lead to an average population increase per sector of 3.6% (with a minimum of 2% and a maximum of 8%);
- The factor for each sector was then applied to the population totals for all zones within it.

ERP is only available for total population and not for the more disaggregate categories such as population by age groups, work and study status or income bands. As a result the same factors applied to total population were applied to each population subcategory, as well as to number of households.

Finally, the CURP definition also relates to zonal employment by industry (i.e March Census night rather than mid-year). Employment data is not available for the ERP definition. In addition, the adjustment factors estimated above cannot be applied as employment data relates to the workplace address (i.e. the zone where employment is located and not where workers live). Employment was therefore adjusted by calculating the total increase in population from CURP to ERP at the regional level and applying it to all model zones.

The resulting totals for population, households and employment, aggregated by territorial authority is shown in the following table.

Table 2-2: CURP to ERP Total by Territorial Authority

TA	Population			Households			Employment		
	CURP	ERP	% Diff	CURP	ERP	% Diff	CURP	ERP	% Diff
Wellington	202,707	211,178	4.2%	74,811	77,974	4.2%	136,982	142,153	3.8%
Porirua	56,562	58,847	4.0%	17,838	18,547	4.0%	17,607	18,272	3.8%
Kapiti Coast	53,673	55,152	2.8%	21,753	22,349	2.7%	16,806	17,440	3.8%
Upper Hutt	43,974	45,374	3.2%	15,870	16,377	3.2%	13,590	14,103	3.8%
Lower Hutt	104,517	108,524	3.8%	37,161	38,589	3.8%	41,841	43,421	3.8%
Wairarapa	45,333	46,825	3.3%	17,916	18,504	3.3%	18,480	19,178	3.8%
Total	506,766	525,899	3.8%	185,349	192,339	3.8%	245,306	254,567	3.8%

It is noted that there is a small (45) difference in the total Census Usually Resident population in the table above compared with Table 3-1 Table 2-1. This will be associated with obtaining data from different tabulations which will have slightly different base three rounding. The difference is inconsequential.

3. School Roll – Primary and Secondary

3.1 Source Data

School roll data was downloaded from the "Education Counts"¹ Ministry of Education website. This provided numbers of students at each school for 2018, listing the region, and the school type (primary, secondary, etc). Note this excludes tertiary education, which is sourced, processed, and reported separately.

A map of school locations was also sourced from the Ministry of Education through ArcGIS online. This was used to geocode the schools in the Wellington Region listed in the Ministry of Education dataset.

3.2 Processing

The school system is made up of schools of different types and structures. The different school types within the study area from the school roll data includes:

- Full Primary
- Composite (Year 1-15)
- Contributing
- Intermediate
- Secondary (Year 9-15)
- Secondary (Year 7-15)
- Special School
- Teen Parent Unit

The school types were condensed and tabulated into four types:

- Primary (includes Full Primary and Contributing)
- Intermediate
- Secondary (includes Secondary Year 9-15 and Year 7-15)
- Composite (Year 1-15)

Special schools and Teen Parent Unit types were removed as was Te Aho o Te Kura Pounamu which is a correspondence school.

¹ <https://www.educationcounts.govt.nz/statistics/schooling/student-numbers/6028>

The total primary and secondary school rolls and their corresponding territorial authorities are shown in the table below, for each of the four types of school.

Table 3-1: School Roll Summarised by Territorial Authority Areas by School Types

Territorial Authority	Primary	Intermediate	Secondary	Composite (Year 1-15)
South Wairarapa District	1,063	-	428	-
Carterton District	752	-	-	115
Masterton District	2,293	515	2,404	76
Hutt City	9,449	1,405	5,416	1,207
Upper Hutt City	3,577	898	3,195	25
Kapiti Coast District	5,082	-	3,176	305
Porirua City	6,273	352	2,279	293
Wellington City	15,754	2,506	11,520	2,104
Total	44,243	5,676	28,418	4,125

The following definitions were applied to produce the primary and secondary school roll for each zone:

- “Primary” – students in Year 1 to Year 6 inclusive; and
- “Secondary” – students in Year 7 to Year 15 inclusive.

This means that some students in Year 7 and 8 attending a primary school are allocated to the “secondary” category; Intermediate schools all sit within the “secondary” category; and students at Composite schools were allocated to the primary and secondary categories based on their Year. This ensured consistency with the 2013 model inputs and is a clear definition.

For the 2018 model rebuild, it is worth relabelling “primary” as “Year 1 to 6” and “secondary” as Year 7 to 15” to avoid confusion.

3.3 2018 Primary and Secondary School Roll

The resulting 2018 school roll is tabulated below by territorial authority.

Table 3-2: Primary and Secondary School Roll in Model Definitions by Territorial Authority

Territorial Authority	Primary (Year 1-6)	Secondary (Year 7-15)	Total
South Wairarapa District	826	665	1,491
Carterton District	668	199	867
Masterton District	2,061	3,227	5,288
Hutt City	9,019	8,458	17,477
Upper Hutt City	3,373	4,322	7,695
Kapiti Coast District	4,027	4,536	8,563
Porirua City	5,404	3,793	9,197
Wellington City	14,114	17,770	31,884
Total	39,492	42,970	82,462

No further adjustment is applied, for example factoring from March to mid-year, as the school roll data does not appear to relate to one specific month.

3.4 Comparison with 2013

The 2018 primary and secondary school roll was compared with 2013 for each of the 225 zones to identify any anomalies. This did identify a few issues including that Te Aho o Te Kura Pounamu was a correspondence school and should be omitted and that “primary” was not primary schools per se, but students in Years 1 to 6 inclusive.

The primary and secondary school roll for WTSM by Territorial Authority for 2013 and 2018 are tabulated below.

Table 3-3: Comparison of 2018 and 2013 Primary and Secondary School Roll

Territorial Authority	2013		2018		Difference	
	Primary (Year 1-6)	Secondary (Year 7-15)	Primary (Year 1-6)	Secondary (Year 7-15)	Primary (Year 1-6)	Secondary (Year 7-15)
Wairarapa	3,372	3,969	3,555	4,091	183	122
Hutt City	8,606	8,675	9,019	8,458	413	-217
Upper Hutt City	3,104	4,408	3,373	4,322	269	-86
Kapiti Coast District	3,656	4,172	4,027	4,536	371	364
Porirua City	5,053	3,917	5,404	3,793	351	-124
Wellington City	13,188	16,690	14,114	17,770	926	1,080
Total	36,979	41,831	39,492	42,970	2,513	1,139

This shows that enrolment generally increases aside from secondary schools in Hutt and Porirua Cities where a reduction is reported. In both cases, the reduction is numerically small and not considered significant.

4. School Roll – Tertiary

4.1 Source Data and Processing

Tertiary roll was requested from the Ministry of Education.

The definition in the current model was unclear so full-time equivalent (FTE) students were requested. A comparison of the supplied 2018 FTE tertiary students with the model data for 2006 and 2013 is provided below. The problem is obvious from the significant reduction in the total – the definition used in the model is not FTE.

Table 4-1: Initial Tertiary School Roll by Territorial Authority

Territorial Authority	Tertiary Student Roll		
	2006	2013	2018
Carterton District	0	0	160
Masterton District	469	459	285
Hutt City	11,225	5,362	2,555
Upper Hutt City	0	197	160
Kapiti Coast District	2,433	2,825	1,005
Porirua City	4,063	4,919	3,300
Wellington City	32,755	37,628	24,150
Total	50,945	51,390	31,615

The raw 2006 and 2013 data was sent to the Ministry of Education and the definition queried. It was confirmed that the definition currently in the model is a "count of students". Updated data was supplied for 2018 by the Ministry of Education.

The following notes were provided with the data:

- Data relates to students enrolled at any time during the year with a tertiary education provider in formal qualifications of greater than 0.03 EFTS (more than one week's full-time duration);
- Data excludes all non-formal learning and on-job industry training;
- Data includes those private training establishments that received Student Achievement Component funding, and/or had students with student loans or allowances, and/or Youth Guarantee programmes;
- Students are counted in each sub-sector they enrol in, so the sum of the various sub-sectors may not add to the total;

- Students are counted in each territorial authority and once in the total, so the sum of the various territorial authorities may not add to the total;
- International students are those studying here without New Zealand/Australian citizenship or permanent residence status. Students studying off-shore at tertiary education providers that are registered in New Zealand are considered international students unless they hold New Zealand citizenship; and
- Data in this table, including totals, have been rounded to the nearest five to protect the privacy of individuals, so the sum of individual counts may not add to the total.

The data supplied included the longitude/latitude of each institution. These were mapped in GIS and the 2018 roll aggregated to model zones. Both the 225 current meshblock-based zone system and the SA1-based zone system were processed simultaneously.

Private institutions were no longer identified by name and address but listed as “Private Training Establishments” with a latitude/longitude. This made comparisons with previous years more challenging.

Tai Poutini Polytechnic has a location in Lower Hutt, but the Wellington City location was listed as “not applicable”. This is consistent with the raw 2013 data. As the 2018 role was only 20 students, Tai Poutini Polytechnic in Wellington City was excluded.

4.2 2018 Tertiary Student Count

The resulting tertiary roll by Territorial Authority is shown in the table below. The data for 2006 and 2013 is also tabulated – noting the information tabulated below was produced from the raw files rather than the data processed by model zone.

Table 4-2: Tertiary Student Count by Territorial Authority

Territorial Authority	Tertiary Student Count			Diff, 2018 - 2013
	2006	2013	2018	
Carterton District	0	0	340	340
Masterton District	469	459	460	1
Lower Hutt City	11,225	5,362	4,905	-457
Upper Hutt City	0	197	335	138
Kapiti Coast District	2,433	2,825	1,510	-1,315
Porirua City	4,063	4,919	4,260	-659
Wellington City	32,755	37,628	37,540	-88
Total	50,945	51,390	49,350	-2,040

The magnitude of the 2018 tertiary student count is clearly the appropriate definition. Comparison with previous years and by zone is provided in the next section as a cross-check.

No further adjustment is applied, for example factoring from March to mid-year, as the school roll data does not appear to relate to one specific month.

4.3 Comparison with 2006 and 2013

While in total and by territorial authority, the 2018 tertiary student count aligns well with the figures for 2006 and 2013, there was significant variation by model zone (225 zones). Robust investigation of the difference by institution was hampered by the 2018 data being supplied in a different format and with private institutions no longer individually identified by name. Nevertheless, checks by model zone and institution have been carried out and are reported here.

Of note, the variation in 2018 was also apparent comparing 2013 to 2006. So variation in the location of tertiary student counts is not unusual. It does make checking more challenging, however.

The tertiary student count by 225 model zone for 2006, 2013 and 2018 is shown graphically with bar charts below.

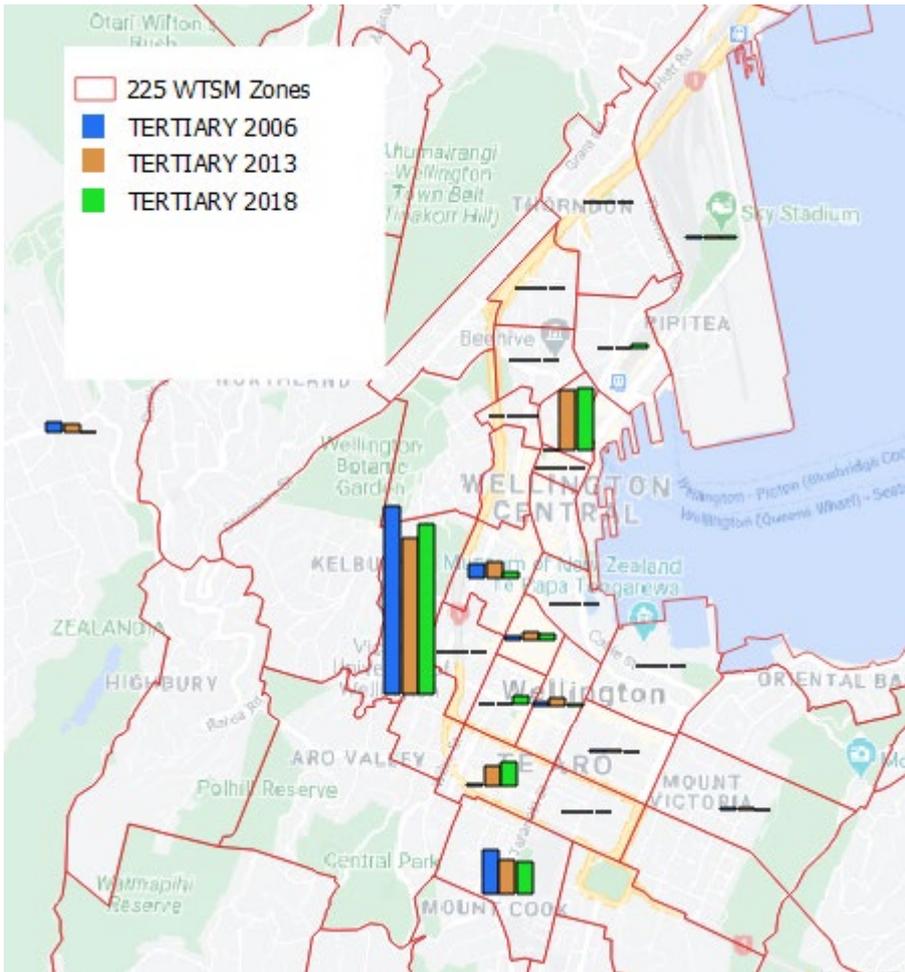


Figure 4-2: Tertiary Student Count for 2006, 2013 and 2018 by 225 Model Zone – CBD

The largest numbers are shown at Victoria University main campus in Kelburn (zone 55), which had circa 19000 students in 2006, 16000 in 2013, and 17000 in 2018. This diagram also shows no students in 2006 at the Lambton Quay Victoria University location (zone 63), which hosts around 6000 students in both 2013 and 2018.

Rescaled bar graphs from removing Victoria University of Wellington main campus from the analysis is shown in the figure below.

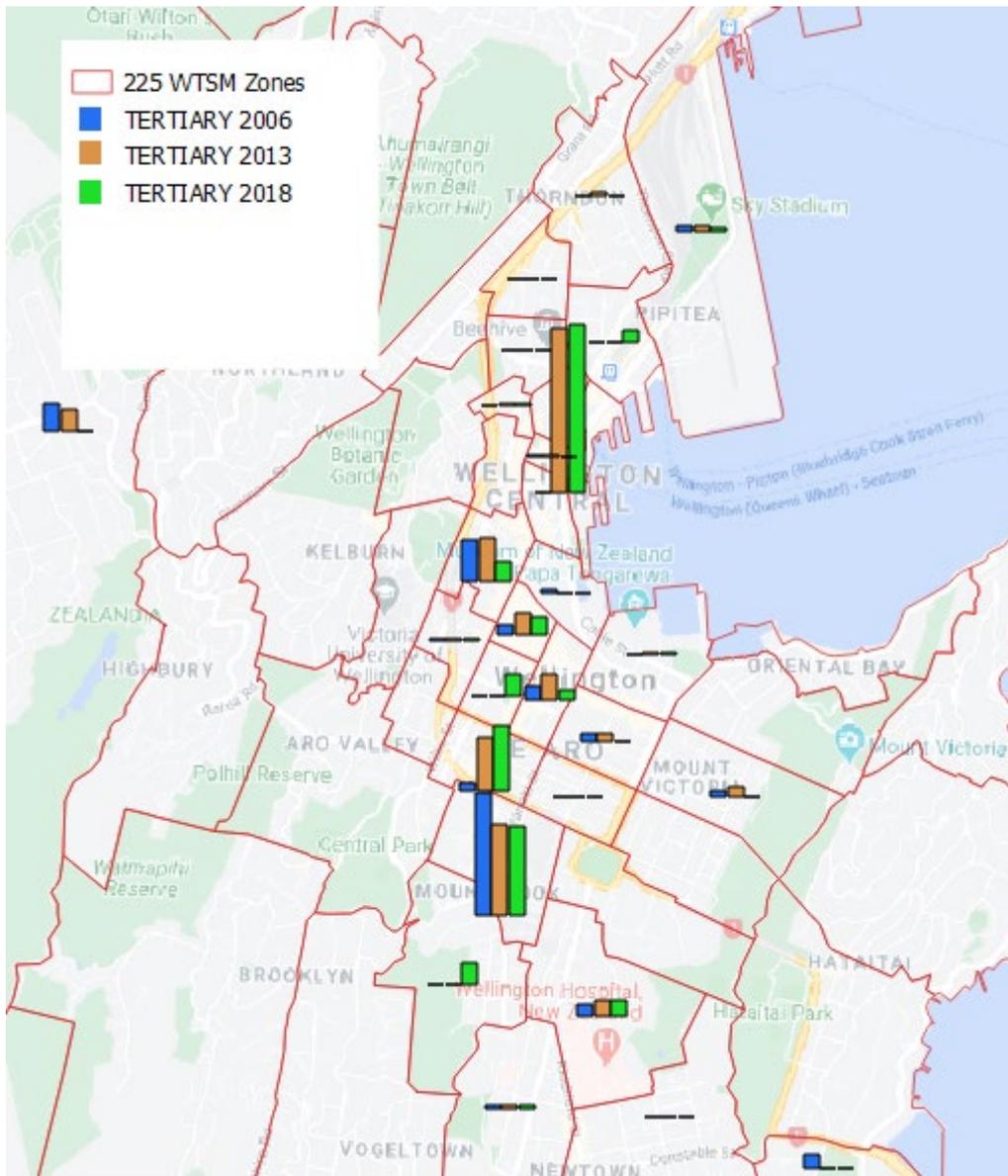


Figure 4-3: Tertiary Student Count for 2006, 2013 and 2018 by 225 Model Zone – CBD excluding Victoria Main Campus

The largest difference (top right) is the Lambton Quay Victoria University (zone 63) discussed above. The next largest difference is Massey University on Wallace Street, which has similar numbers in 2013 and 2018 but much lower in 2006. The Vivian Street campus (zone 51) for Victoria University was functional by 2013 but not in 2006 and represents the third largest difference.

Spot checks of large differences by zone also showed:

- the Karori campus of Victoria University was sold in 2017. This resulted in circa 1000 students in 2006 and 2013 dropping to zero by 2018;
- Natcoll on Kent Terrace (zone 42) is now Yoobee located on Bunny Street (zone 66); and
- The Taratahi Agricultural training centre (zone 225) appears in the data in 2018 but not 2006 or 2013 even though it seems to have been established for some time.

Even though there is quite a lot of variation in both the size and location of tertiary institutions between 2006, 2013 and 2018, the data is what it is. Spot checks have explained some anomalies and it is clear that variation must be expected from this data.

5. 2018 Census Land Use – 225 Zone Format

5.1 Data Processing

For the stage 1 deliverable of this project, the current version of WTSM (225 zones) will be run for the year 2018 and the validation confirmed. This means that 2018 Census land use by 225 zones in the categories used by the current model is required.

The land use categories input to the current model are listed below. The definitions are specified in "Technical Note 7: Production of WTSM 2013 Land Use Data" reported for the 2013 WTSM update.

- Population, Young Adult Part-Time Employed
- Population, Young Adult Other
- Population, Adult Full-Time Employed
- Population, Adult Part-Time Employed
- Population, Adult Other
- Population, Older Adult Full-Time Employed
- Population, Older Adult Part-Time Employed
- Population, Older Adult Other
- Households, 1 Adult Employed
- Households, 1 Adult Non-Employed
- Households, 2 Adults (Min of 1 Employed)
- Households, 2 Adults Neither Employed
- Households, 3+ Adults
- Employment, Manufacturing
- Employment, Retail
- Employment, Transport and Communications
- Employment, Services
- Employment, Other (Mining and Agricultural)

It is noted that the 2013 model update was based on Census Usually Resident Population, the same as all previous updates and the original model build. Subsequently, population was adjusted to Estimated Resident Population to align with forecasts, after confirming minimal impact on the 2013 model validation. Current WTSM therefore contains Estimated Resident Population.

The data listed above is not a standard Census release and is therefore produced by a custom/special request to Statistics NZ who run a programme to extract the tables. In addition, the correspondence from Australian and New Zealand Standard Industrial Classification (ANZSIC) 1996 to the ANZSIC 2006 definition was provided to update the WTSM extract procedure held by Statistics NZ.

The following adjustments were then made to the tables received.

Statistics NZ randomly round the actual numbers in data tables to base 3 before releasing them. No adjustment related to base 3 rounding will be made as the sum of all the zones for a category is close to the actual total supplied by Statistics NZ for the same category. That is, the base 3 rounding does not result in any substantial summation discrepancies.

Statistics NZ also suppress cells where the count is less than six. This does introduce issues in some categories which have many cells where the count is less than six. If the suppressed cells are set to zero, the sum of all the zones for that category is significantly less than the total supplied by Statistics NZ. To address this, the suppressed cells have been replaced with either zero or a small positive number.

The processing of the population data included:

- For zones with a suppressed total population, all age categories and the total were set to zero;
- For zones with a population value, if any age category contained a C, the C was replaced with the difference between the total provided by Statistics NZ and the sum of the non-C values divided by the number of suppressed cells. That is, the difference in the actual total and summation was allocated equally to all suppressed cells. If the summation of the categories already exceeded the actual total (due to base 3 rounding), then the suppressed cells were replaced with a zero; and
- For zones without any suppressed cells, any difference between the actual total provided by Statistics NZ and the sum was allocated in proportion. This is a correction for the base 3 rounding.

Households were processed with the same steps/process as for population. For households, however, a “remainder” category was provided for each zone. This represents households that could not be allocated to any category. The remainder was handled in step 3 of the processing, with these households allocated to categories in proportion.

For employment, the processing was the same as for population.

It is noted that this data represents the Census Usually resident Population definition. Factoring to ERP is covered in Section 5.3.

5.2 2018 Land Use at 225 Zone Format

5.2.1 2018 Population

In Table 5-1, the Wellington region population in 2018 is broken down into six categories – infants, children 5-10 years, children 11-16 years, young adults, adults and other adults.

Table 5-1: 2018 Population Census by Territorial Authority

2018 Population (CURP)							
Territorial Authority	Infants	Children 5-10 years	Children 11-16 Years	Young Adult Total	Adult Total	Older Adult Total	Population Total
South Wairarapa District	565	805	688	703	5,393	2,076	10,230
Carterton District	463	712	734	714	4,371	1,900	8,895
Masterton District	1,644	2,061	2,100	2,559	12,702	5,139	26,205
Lower Hutt City	7,012	8,779	7,965	11,879	55,627	13,270	104,532
Upper Hutt City	2,750	3,602	3,407	4,646	23,355	6,223	43,983
Kapiti Coast District	2,701	3,997	3,919	4,168	25,528	13,364	53,676
Porirua City	4,456	5,804	4,997	6,648	29,592	6,148	57,645
Wellington City	10,254	13,589	13,186	34,728	110,463	19,437	201,657
Total	29,845	39,350	36,995	66,045	267,031	67,557	506,823

Adults (comprising of full-time employed adults, part-time employed adults, and other adults) comprise 53% of the total, followed by young adults and older adults, which each make up 13%. Overall, about 21% of the Wellington region is under 16 years of age.

5.2.2 2018 Households

In Table 5-2 the household data in 2018 is broken down based on the criteria of number of adults in a household and their employment status. This aligns with the definitions required in the current version of WTSM.

Table 5-2: 2018 Household Census by Territorial Authority

2018 Households (CURP definition)						
Territorial Authority	1 Adult Employed	1 Adult Non-Employed	2 Adults (Min of 1 Employed)	2 Adults Neither Employed	3+ Adults	Household Total
South Wairarapa District	736	628	1,939	481	423	4,206
Carterton District	540	566	1,561	410	445	3,522
Masterton District	1,724	1,872	4,109	1,080	1,400	10,185
Lower Hutt City	5,816	5,325	15,286	2,922	7,807	37,155
Upper Hutt City	2,543	2,391	6,678	1,285	2,977	15,873
Kapiti Coast District	3,140	4,554	8,155	3,047	2,857	21,753
Porirua City	2,406	2,099	7,807	1,344	4,528	18,183
Wellington City	13,573	7,585	32,679	3,986	16,664	74,487
Total	30,478	25,020	78,214	14,554	37,099	185,364

The majority of households have two adults of whom at least one is employed, followed by those with 3+ adults.

5.2.3 2018 Employment (Workplace)

For employment, an issue was identified in the data provided by model zone. There are circa 245,000 jobs across the region as shown in Table 2-2. However, the data supplied by 225 zones summed to 196,000 jobs – a deficit of more than 45,000. As the model only requires input employment in five groups (“WTSM Industry”), the Census data supplied by meshblock, processed and aggregated to 780 zones, was used to produce the 225 zone employment data.

The allocation from 2006 ANZSIC categories to the model industry groups for workplace employment are shown in Table 5-3 below.

Table 5-3: Employment Types to WTSM Industries

ANZSIC (2006)	WTSM Industry
Agriculture, Forestry and Fishing	Other
Mining	Manufact
Manufacturing	Manufact
Electricity, Gas, Water and Waste Services	Manufact
Construction	Manufact
Wholesale Trade	Retail
Retail Trade	Retail
Accommodation and Food Services	Retail
Transport, Postal and Warehousing	TransCom
Information Media and Telecommunications	TransCom
Financial and Insurance Services	Services
Rental, Hiring and Real Estate Services	Services
Professional, Scientific and Technical Services	Services
Administrative and Support Services	Services
Public Administration and Safety	Services
Education and Training	Services
Health Care and Social Assistance	Services
Arts and Recreation Services	Services
Other Services	Services

The allocation (ANZSIC category to model industry group) was checked by comparing the aggregated 2018 employment data against the 2013 equivalent input to the model.

Table 5-4: Employment by Industry, Compare 2013 and 2018

WTSM Industry	2013	2018	Diff, 2018 - 2013
Retail	45,788	42,027	-3,761
Manufact	29,051	32,340	3,289
TransCom	11,401	15,162	3,761
Services	145,281	151,833	6,552
Other	4,239	3,972	-267
TOTAL	235,760	245,334	9,574

The comparison above suggests a reduction in retail employment which seems unlikely. In fact, the issue is that the 2013 employment data was produced by Statistics NZ at a more disaggregate level and based on 1996 ANZSIC categories. So there is a slight discrepancy using the allocation shown in 2018 Employment (Workplace).

For employment, as issue was identified in the data provided my model zone. There are circa 245,000 jobs across the region as shown in Table 2-2. However, the data supplied by 225 zones summed to 196,000 jobs – a deficit of more than 45,000. As the model only requires input employment in five groups (“WTSM Industry”), the Census data supplied by meshblock, processed and aggregated to 780 zones, was used to produce the 255 zone employment data.

The allocation from 2006 ANZSIC categories to the model industry groups for workplace employment are shown in Table 5-5 below.

However, this discrepancy is considerably less than the 45,000 reduction in employment using the data as supplied.

Using the 2018 employment data processed at 780 zones (from meshblocks) and ANZSIC 2006 industry grouping equivalences, the resulting employment data is shown in Table 5-5.

Table 5-5: 2018 Employment Census by Territorial Authority

2018 Employment							
Territorial Authority	Other	Manufact	Retail	TransCom	Services	Employment Total	% by Territorial Authority
South Wairarapa District	864	597	935	162	1,357	3,914	1.60%
Carterton District	520	960	477	181	1,189	3,327	1.40%
Masterton District	1,488	1,972	2,116	347	5,317	11,239	4.60%
Lower Hutt City	126	8,861	8,690	2,210	21,948	41,835	17.10%
Upper Hutt City	123	2,726	2,501	612	7,624	13,586	5.50%
Kapiti Coast District	405	3,234	3,603	743	8,807	16,791	6.80%
Porirua City	124	3,969	3,587	926	10,352	18,959	7.70%
Wellington City	321	10,002	20,098	9,976	95,174	135,572	55.30%
Total	3,970	32,320	42,008	15,157	151,768	245,223	100%
% of Total	1.60%	13.20%	17.10%	6.20%	61.90%	100%	

The sector with the most employment is the services industry which represents 62% of workplace employment in the Wellington region in a range of service industries such as Financial and Insurance Services, Administrative and Support Services, Education and Training, etc.

The majority of employment, close to 55%, is located in Wellington City.

5.3 Factoring to Estimated Resident Population

The 2018 Census Usual Resident Population has been factored using the methodology described in 2.2 to obtain the 2018 Estimated Resident Population.

The factors calculated per Territorial Authority are listed in Table 5-6. Note there are slight differences in the adjustment factors shown in Table 2-2 (820 zone system) and Table 5-6 (225 zone system), which arises from rounding and processing differences. The differences are not consequential.

Table 5-6: CURP to ERP Factors

TA	CURP	ERP	Adjustment
Wellington	202,353	211,200	1.044
Porirua	56,949	58,900	1.034
Kapiti	53,676	55,200	1.028
Upper Hutt	43,983	45,400	1.032
Lower Hutt	104,532	108,600	1.039
Wairarapa	45,330	46,810	1.033
Total	506,823	526,110	1.038

These factors were applied to population and households by Territorial Authority. The total factor was then applied to workplace employment to bring all datasets to the mid-year definition.

The following table reports key metrics by Territorial Authority.

Table 5-7: CURP to ERP total by Territorial Authority (225 zone processing)

TA	Population			Households			Employment		
	CURP	ERP	% Diff	CURP	ERP	% Diff	CURP	ERP	% Diff
Wellington	201,657	210,474	4.4%	74,487	77,744	4.4%	135,572	140,731	3.8%
Porirua	57,645	59,620	3.4%	18,183	18,806	3.4%	18,959	19,680	3.8%
Kapiti Coast	53,676	55,200	2.8%	21,753	22,371	2.8%	16,791	17,430	3.8%
Upper Hutt	43,983	45,400	3.2%	15,873	16,384	3.2%	13,586	14,103	3.8%
Lower Hutt	104,532	108,600	3.9%	37,155	38,601	3.9%	41,835	43,427	3.8%
Wairarapa	45,330	46,810	3.3%	17,913	18,498	3.3%	18,480	19,183	3.8%
Total	506,823	526,103	3.8%	185,364	192,403	3.8%	245,223	254,555	3.8%

5.4 Comparison with 2013

5.4.1 2018 Vs 2013 Population (ERP)

Figure 5-1 to Figure 5-4 illustrate how the different categories of population in the Wellington region have changed from 2013 to 2018. The general trend that can be observed across the different age groups and across different districts is an increase in the numbers as can be expected. The overall population in the region increased by 7.5% from 489,481 to 526,103.

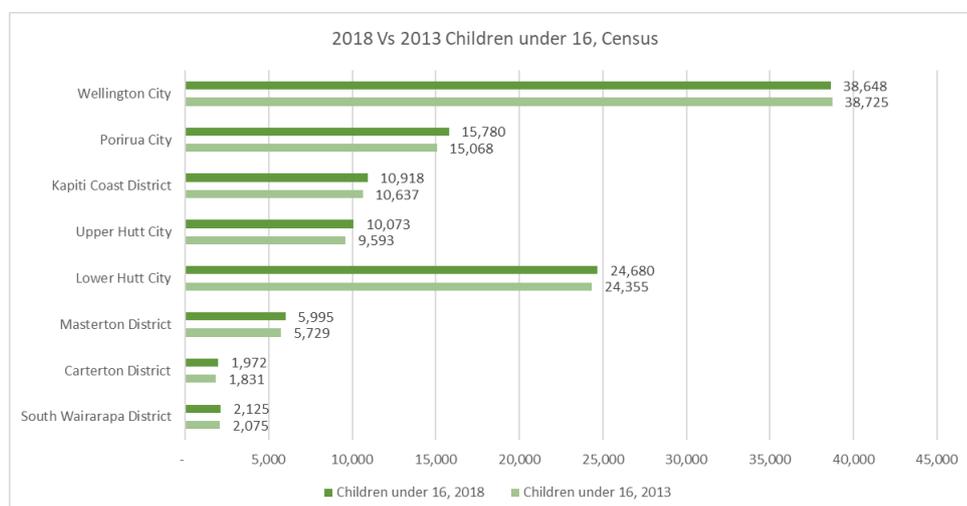


Figure 5-1: 2018 Vs 2013 Children Under 16 Years of Age

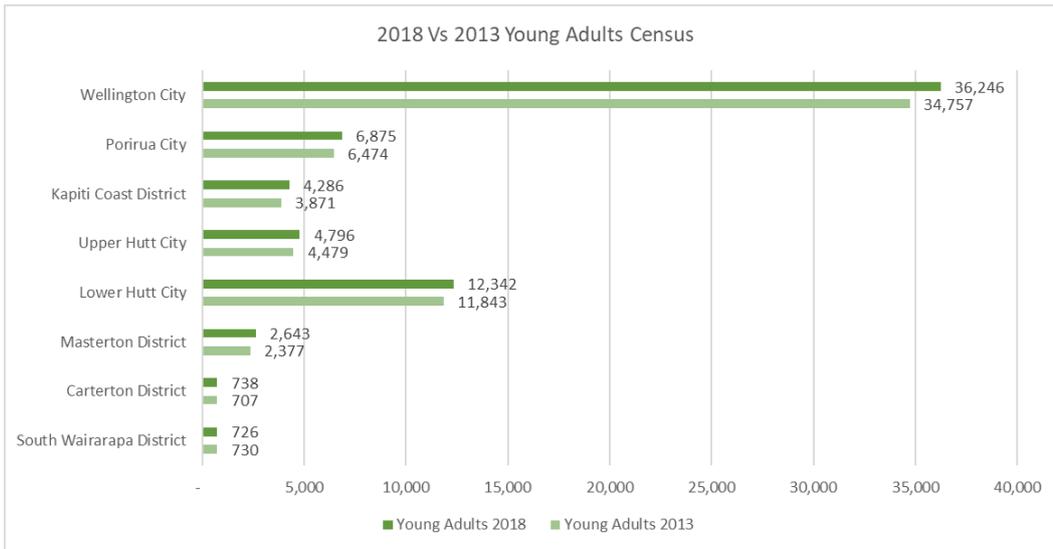


Figure 5-2: 2018 Vs 2013 Young Adults

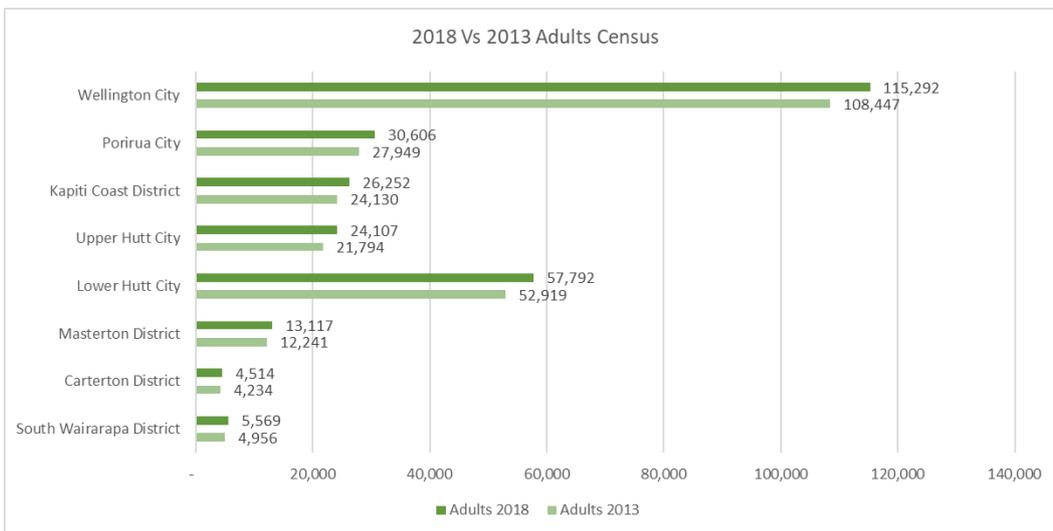


Figure 5-3: 2018 Vs 2013 Adults

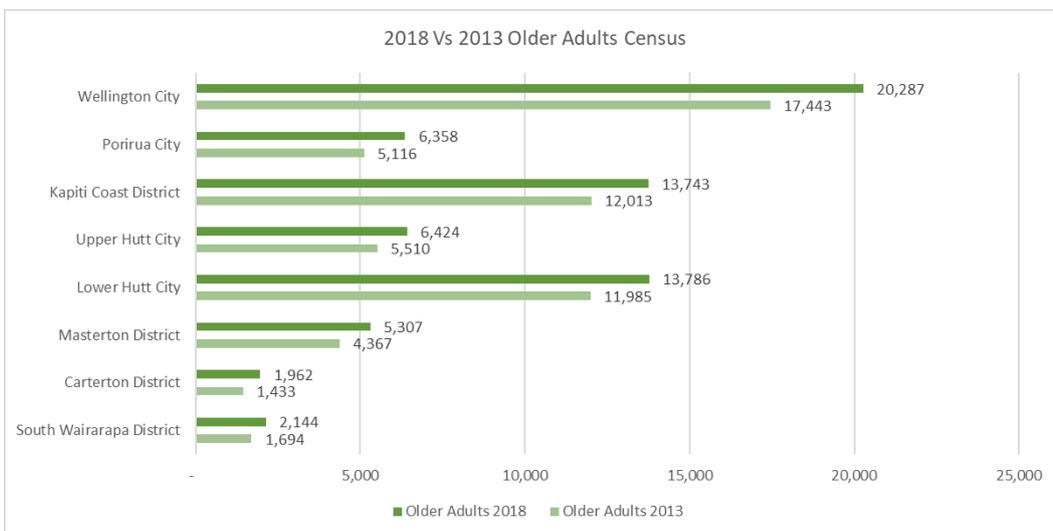


Figure 5-4: 2018 Vs 2013 Older Adults

The following observations are flagged as outliers and are discussed below.

The difference in Young Adults by employment status is shown in the following table for the 2013 Census results subtracted from 2018.

Table 5-8: 2018 Minus 2013 Population Differences (Young Adults)

Population				
Territorial Authority	Young Adults Full-Time Employed	Young Adults Part-Time Employed	Young Adults Other	Young Adults Total
South Wairarapa District	76	41	-121	-4
Carterton District	86	35	-90	30
Masterton District	315	127	-175	266
Lower Hutt City	986	599	-1086	499
Upper Hutt City	386	231	-300	317
Kapiti Coast District	537	181	-303	415
Porirua City	629	376	-603	402
Wellington City	2228	1535	-2273	1489
Total	5,242	3,124	-4,952	3,415

The 'Young Adults' category shows a total increase, however, the sub-category 'Young Adults Other' shows a decrease across all the districts. This is countered by large increases in the 'Young Adults Full-Time Employed' and 'Young Adults Part-Time Employed' which increased by 5242 (22%) and by 3124 (23%) respectively, whereas Young Adults Other decreased by 4952 (18%). This implies more young adults are employed. In case this was a processing issue, the impact was checked. The 2018 Young Adult categories were adjusted to reflect 2013 proportions (i.e. employed people reduced) and WTSM run to quantify the results. There was minimal change in the model output associated with shifting Young Adults out of the employed categories hence the 2018 data as supplied by Statistics NZ was retained.

The difference in Adults by employment status is shown in the following table for the 2013 Census results subtracted from 2018.

Table 5-9: 2018 Minus 2013 Population Differences (Adults)

Population				
Territorial Authority	Adults Full-Time Employed	Adults Part-Time Employed	Adults Other	Adults Total
South Wairarapa District	573	86	-47	613
Carterton District	328	69	-116	280
Masterton District	979	75	-179	876
Lower Hutt City	5,416	603	-1,146	4,873
Upper Hutt City	2,470	250	-406	2,313
Kapiti Coast District	2,550	337	-765	2,122
Porirua City	3,241	310	-894	2,657
Wellington City	9,407	653	-3,215	6,846
Total	24,964	2,384	-6,768	20,580

Similarly, the 'Adults' category shows a total increase, however, the sub-category 'Adults Other' shows a decrease across all the districts. This is countered by increases in the other two categories, 'Adults Full-Time Employed' and 'Adults Part-Time Employed' which increased by 24,964 (15%) and by 2,384 (7%) respectively, whereas 'Adults Other' decreased by 6,768 (11%). This is the same trend as discussed above for Young Adults. Either more people are employed now than in 2013, or the ability to allocate individuals to employment categories has changed in Census.

To check, the overall workforce employment status was compared and is shown in the figure below sourced from the Statistics NZ website.

Work and labour force status for people in Wellington City, 2006–18 Censuses

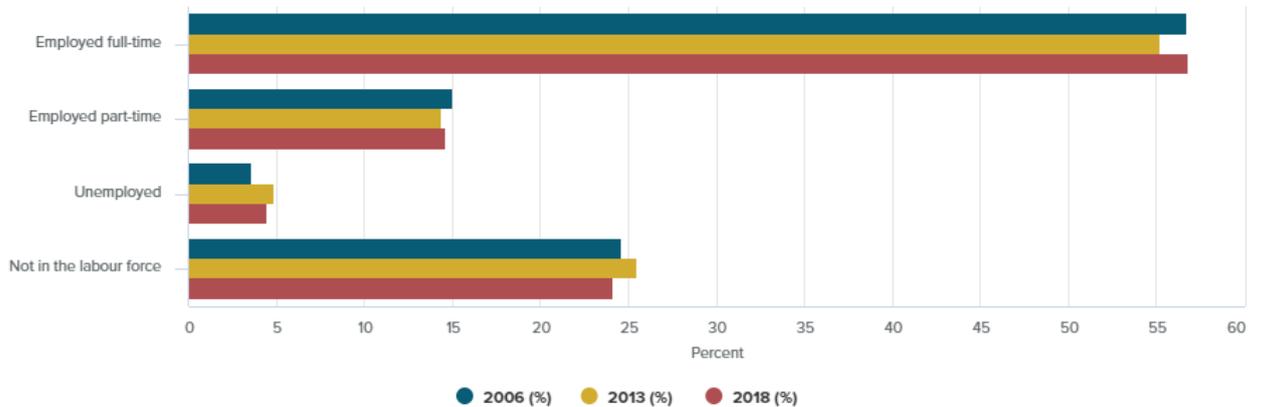


Figure 5-5: Workforce Status from Census for Wellington Region

This indicates more people are indeed employed in 2018 compared with 2013, with fewer people unemployed and fewer not in the labour force. The 2018 proportions were applied to total population, and it was confirmed the increase in employed Young Adults and Adults was approximately correct.

5.4.2 2018 Vs 2013 Households

In Table 5-10, the comparison of 2018 household data against the 2013 household data is presented using the categories in the current model.

Table 5-10: 2018 Minus 2013 Household Differences

Households						
Territorial Authority	1 Adult Employed	1 Adult Non-Employed	2 Adults (Min of 1 Employed)	2 Adults Neither Employed	3+ Adults	Household Total
South Wairarapa District	63	14	172	131	72	453
Carterton District	13	79	88	94	111	385
Masterton District	75	-6	81	99	282	532
Lower Hutt City	246	76	325	253	994	1,893
Upper Hutt City	227	54	192	50	515	1,038
Kapiti Coast District	199	166	296	116	650	1,427
Porirua City	65	108	277	106	580	1,137
Wellington City	114	366	1,003	422	2,228	4,134
Total	1,002	858	2,435	1,271	5,432	10,999

It can be observed that households in all categories show an increasing trend from 2013 and 2018 which is expected.

5.4.3 2018 Vs 2013 Employment

In the table below, the difference between 2018 and 2013 employment (workplace end) by WTSM category is shown.

Table 5-11: 2018 Minus 2013 Employment Differences

Territorial Authority	Employment					Employment Total
	Other	Manufact	Retail	TransCom	Services	
South Wairarapa District	-38	114	85	97	325	583
Carterton District	-163	47	11	80	342	317
Masterton District	51	380	-492	39	766	744
Lower Hutt City	25	270	-763	277	3,155	2,963
Upper Hutt City	-14	1,120	-167	316	1,503	2,758
Kapiti Coast District	-25	995	-144	335	2,231	3,393
Porirua City	-29	1,139	-224	403	1,843	3,132
Wellington City	74	434	-487	2,785	2,098	4,904
Total	-118	4,499	-2,181	4,332	12,262	18,794

The apparent decrease in retail and other employment is associated with the processing, as discussed in Section 5.2.3.

It is also noted that the 2013 Census employment data was not factored to represent mid-year although population and households were. Employment effectively 'distributes' trips and hence the relativity is the most important. But for this project, the 2018 Census employment has been adjusted to mid-year (ERP) for consistency. The differences in Table 5-11 are useful to consider the change in model outputs, but are not a completely like-with-like comparison.

6. Census Journey to Work and Journey to Education

Statistics NZ collects data on individual journeys to work and to education that include the home location, the work/education location, and the main travel mode used. For the Analytical Tools update, journey to work (JTW) and journey to education (JTE) data were processed at the TA level and the SA2 level.

To protect confidentiality, Statistics NZ suppresses very low values, replacing them with a C in the data. Due to the disaggregated nature of JTW and JTE data, there are many C's in the data, especially at the SA2 level. Assumptions, detailed below, were made to "fill" these C's with numbers of trips so that the data can be used for model calibration.

Processing began with JTW and JTE data at the TA-to-TA level for all TAs in the Wellington Region plus Tararua and Horowhenua Districts. C's were filled in such that the sum of all TA-to-TA trips would match the aggregate TA total trips, shown in Table . In addition to filling in C's, there were a number of trips with an undefined work location within the Wellington region. These trips were distributed among the TAs as described below.

Table 6-1: JTW and JTE Trip Totals by TA of Residence

Residential Territorial Authorities	Total JTW Trips	Total JTE Trips
Tararua District	8,757	4,110
Horowhenua District	14,472	6,720
Kapiti Coast District	25,227	11,199
Porirua City	28,227	15,408
Upper Hutt City	23,139	10,350
Lower Hutt City	54,900	25,422
Wellington City	121,194	55,116
Masterton District	12,690	5,541
Carterton District	4,734	1,998
South Wairarapa District	5,685	2,151

The following steps were undertaken to fill the C's in the data and distribute the undefined trips:

- Step 1: The number of suppressed trips (C's) were estimated for each residential TA as follows:
 - $C = (\text{TA total in Table}) - [(\text{Sum of all non-suppressed trips from each residence TA}) + (\text{Trips from each residence TA with unidentified work location})]$
- Step 2: The total trips for each TA-to-TA pair (total of all modes) was filled in as follows:
 - Any total with a value of C was replaced with a random seed between 0 and 1. All non-C values were preserved
 - Seeded totals were adjusted to add up to the estimated C totals for each TA (from Step 1). Again, all non-C values were preserved
- Step 3: The subtotals of trips by mode had many suppressed (C) values. These were given numbers of trips using the mode share proportions for the residential TA overall, such that all modes would add up to the new TA-to-TA totals;
- Step 4: The trips with undefined work location were distributed to each TA-to-TA pair in proportion to their existing total, and then distributed to each mode using the residential TA's mode share. This resulted in final values that preserved the total trips for each residential TA.

A very similar process was followed to fill in the SA2-to-SA2 data, using the TA-to-TA totals from the previous step as target totals, with the following differences:

- Trips with undefined work locations were in the data under "Wellington Region not further defined" and "not further defined" within each TA. It was understood that these are separate classifications, and that "Wellington Region not further defined" is not a total of each TA's undefined trips;
- To reduce the data to a more manageable size, SA2-to-SA2 data was limited to residential and work SA2s within the Wellington Region (as opposed to the TA-level data which included all work locations);
- In a few locations, due to the way undefined trips were distributed proportionally, too many undefined trips were allocated to SA2-to-SA2 pairs within the same TA, causing the new total to exceed the TA-to-TA target total. In these cases, rather than distribute a negative value to C's, the difference was set to zero. In these cases, there is a small difference between the final SA2-to-SA2 total and the TA-to-TA target total;

The final result of processing the JTW and JTE data is a full set of TA-to-TA and SA2-to-SA2 trips by main travel mode.

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