

Note

Subject	LGWM Central Case Do Minimum Testing
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1 Introduction

This note summarises the results from initial Do Minimum model testing that has been undertaken provide evidence to support the development of the LGWM 'Case for Change' report.

The note is structured as follows:

- forecasting context
- brief summary of assumptions
- high level summary of changes in trips, focusses on trips to Wellington CBD and region wide trips (WTSM¹)
- forecast changes in highway and public transport volumes by corridor (WTSM)
- forecast changes in car and PT travel times for selected routes (WTSM)
- forecast changes in public transport volumes from WPTM²
- forecast changes in public transport capacity, patronage and levels of service

2 Context

The assumptions documented in this report, and the resulting forecast outcomes, represent a particular view of the future – called the 'central case future' - made at one point in time. This future was developed to provide some initial high-level information to support the development of the LGWM case for change.

It is acknowledged that that is inherent uncertainty in any forecasts, relating to a number of factors such as the extent to which these assumptions might be realised, the extent to which people's actual behavioural response matches what is forecast, the extent to which assumed causal relationships will continue to hold true and uncertainty associated with the impacts of technological advances.

When interpreted and used in documents such as the LGWM case for change, the outputs presented in this note are expressed as indicative ranges as opposed to specific values, in order to account for the acknowledged uncertainty relating to such forecasts.

Furthermore, this document only summarises on one view of the future. Subsequent testing for LGWM will look at alternative futures in order to understand the extent to which different views of the futures and assumptions might change impacts and network performance.

In this sense the information presented in this report is initial work that will be expanded upon and developed in the future.

¹ WTSM = Wellington Transport Strategy Model

² WPTM = Wellington Public Transport Model

Whilst numbers are presented as absolute numbers / percentage, changes should be taken as indicative and considered in terms of ranges (+/- 10%) given acknowledged future uncertainty and model error bounds when forecast out towards 2026, 2036 and beyond.

3 Assumptions

The underlying central case future assumptions that underpin the development of the current Do Minimum forecasts can be split into four types:

- demographic assumptions – population, employment, households
- economic assumptions – vehicle operating costs, GDP, housing
- policy based assumptions – PT fares, cost of parking
- infrastructure assumptions – committed projects and assumed completion dates

Table 1 below is a summary of the resulting changes between the base year and forecast future years, either expressed in percentage terms (growth in population / employment) or indexed to 2013 (in real terms).

Table 1 Forecast growth rates in WTSM, 2013 to 2046

	2026	2036	2046
Population	10%	15%	19%
Employment	9%	13%	16%
Households	12%	20%	27%
GDP / capita	1.20	1.40	1.62
Car ownership	1.05	1.08	1.11
VoT (Work)	1.20	1.40	1.62
VoT (Non-work)	1.16	1.32	1.50
Vehicle operating costs	1.07	1.14	1.21
PT Fares	1.05	1.10	1.15
Wellington CBD parking (HBW)	1.5	2.04	2.58
Wellington CBD parking (Non-work trips)	1.20	1.40	1.62
TDM	1% (50:50)	2% (50:50)	3% (50:50)
HCV	1.26	1.46	1.67

Population and employment assumptions

The population projections, developed from ID population forecasts³ that are broadly equivalent to Statistics NZ ‘medium’ growth, show that regional population is forecast to increase by 19% out to 2046.

At a more detailed level, **Table 2** below shows the forecast population growth split into Wellington’s suburbs.

Table 2 Forecast regional population growth, by area, 2013 and 2046

TA	2013	2046	Absolute growth (2013 to 2046)	Percentage growth (2013 to 2046)	Percentage of forecast regional growth in population
Wellington East	37,000	42,000	5,000	14%	4%
Wellington South	35,000	42,000	7,000	20%	7%
Wellington West	33,000	36,000	3,000	9%	3%
Wellington North	64,000	80,000	16,000	25%	18%
CBD and fringe	32,000	50,000	18,000	56%	20%
Rest	288,000	334,000	46,000	16%	48%
Total	489,000	585,000	95,000	19%	100%

³ <http://forecast.idnz.co.nz/wellington> (and corresponding data for other TAs)

It shows that overall population is forecast to grow by 84,000 (17%) between 2016 and 2046, with over half of this growth forecast to occur in Wellington City. Within Wellington City itself, growth is likely to be focussed in and around the Wellington CBD or in the green-field areas of the Northern Suburbs, a continuation of existing trends.

The employment projections show employment growing by 16% between 2016 and 2043. This is lower than the forecast percentage growth in population over the same period; whilst it is assumed that the percentage of persons aged over 65 still working is likely to increase, overall this is offset by an ageing population, with the net result being that the labour force participation rate declines through time.

Table 3 below shows employment growth by area between 2013 and 2046.

Table 3 Forecast regional employment growth, by area, 2013 and 2046

TA	2013	2046	Absolute growth (2016 to 2046)	Percentage growth (2016 to 2046)	Percentage of growth in jobs
Wellington East	11,000	13,000	2,000	22%	6%
Wellington South	11,000	13,000	2,000	18%	5%
Wellington West	6,000	7,000	1,000	19%	3%
Wellington North	16,000	19,000	3,000	15%	6%
CBD and fringe	95,000	116,000	22,000	24%	57%
Rest	98,000	107,000	9,000	9%	23%
Total	235,000	275,000	39,000	16%	100%

Over 40% of current jobs in the Wellington Region are located in Wellington CBD and environs. The employment projections suggest that nearly 60% of future growth in employment is likely to be located in the CBD, increasing the number of jobs in the CBD by around 20,000.

3.1 Economic assumptions

In terms of the economic assumptions:

- values of time are forecast to increase at a rate equal to the Treasury forecast for growth in GDP per capita (1.8% per annum), resulting in values of time (work) increasing by a factor of 1.62 between 2013 and 2046 and values of time (non-work) increasing by a factor of 1.50 (GDP per capita growth and multiplier of 1.50)
- car ownership per capita – assumed to increase by 11% between 2013 and 2046, with the rate of growth slowing down through time
- vehicle operating costs – assumed to increase by 21% between 2013 and 2046, a function of relatively low forecast increases in fuel price combined with increasing vehicle efficiency and an increasing uptake of electric vehicles

3.2 Policy based assumptions

In terms of the policy based assumptions:

- it is assumed that PT fares will increase at a rate equal to GDP / capita and a multiplier of 0.25, based upon medium term trends and the continuation of the current policy settings, resulting in PT fares increasing by a factor of 1.15 between 2013 and 2046
- it is assumed that there will be no increase in commuter parking supply between 2013 and 2046, resulting in no increase in commuter (HBW) trips to Wellington CBD in the AM peak. In the absence of any parking

constraints in WTSM, the cost of parking is calibrated to achieve the desired outcome (no increase in commuter trips) with this “cost” representing both the monetary cost of parking and a range of other factors such as the perceived inconvenience of trying to find a car park

3.3 Infrastructure assumptions

In terms of the infrastructure assumptions, only the following committed schemes are assumed for the Do Minimum:

- Wellington City Bus Network improvements (implementation July 2018)
- Transmission Gully (construction started, opening 2021)
- Peka Peka to Otaki (construction started, opening 2020)

The following are **excluded**:

- Petone to Granada Link Road
- Regional Rail Plan (RS1 package of improvements)
- Integrated Fares and Ticketing

4 Incremental analysis

The revised assumptions were implemented incrementally to understand the impact that the changes have and identify those assumptions that have the greatest impacts.

Figure 1 and **Figure 2** below show changes in car trips, PT trips and mode share to Wellington CBD in the AM peak as the Do Minimum scenario is incrementally developed.

Green signifies an increase in the indicator (car trips, PT trips, PT mode share) as a result of the particular change; **Red** signifies a decrease.

In terms of the introducing changes between 2013 and 2036, land use is updated first (with all other parameters on the X axis to the right kept at 2013 levels), followed by car ownership (with remaining parameters still kept at 2013 levels) with all other parameters changed in turn with the HBW factor being the final parameter that is updated.

Figure 1 Incremental change in car and PT trips to Wellington CBD, 2013 to 2036, resulting from the application of revised assumptions

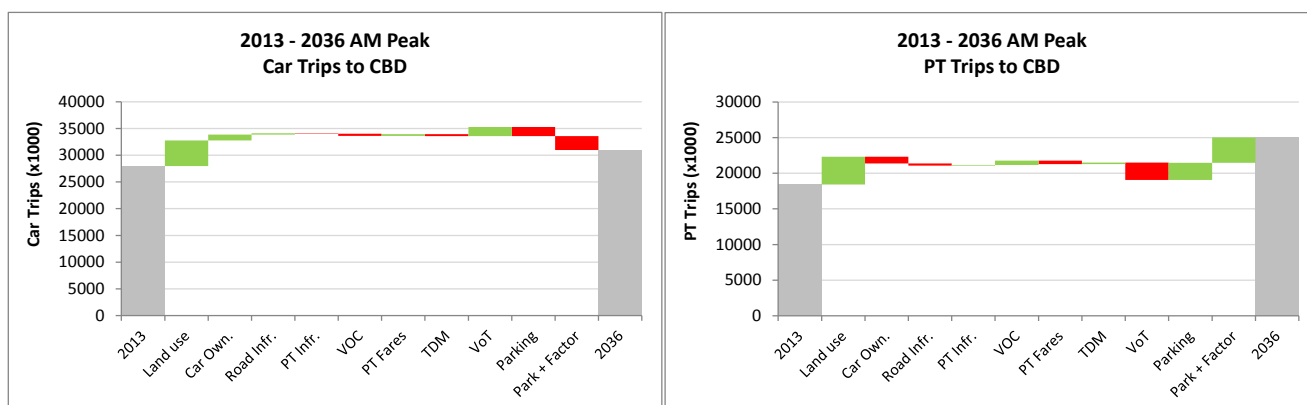
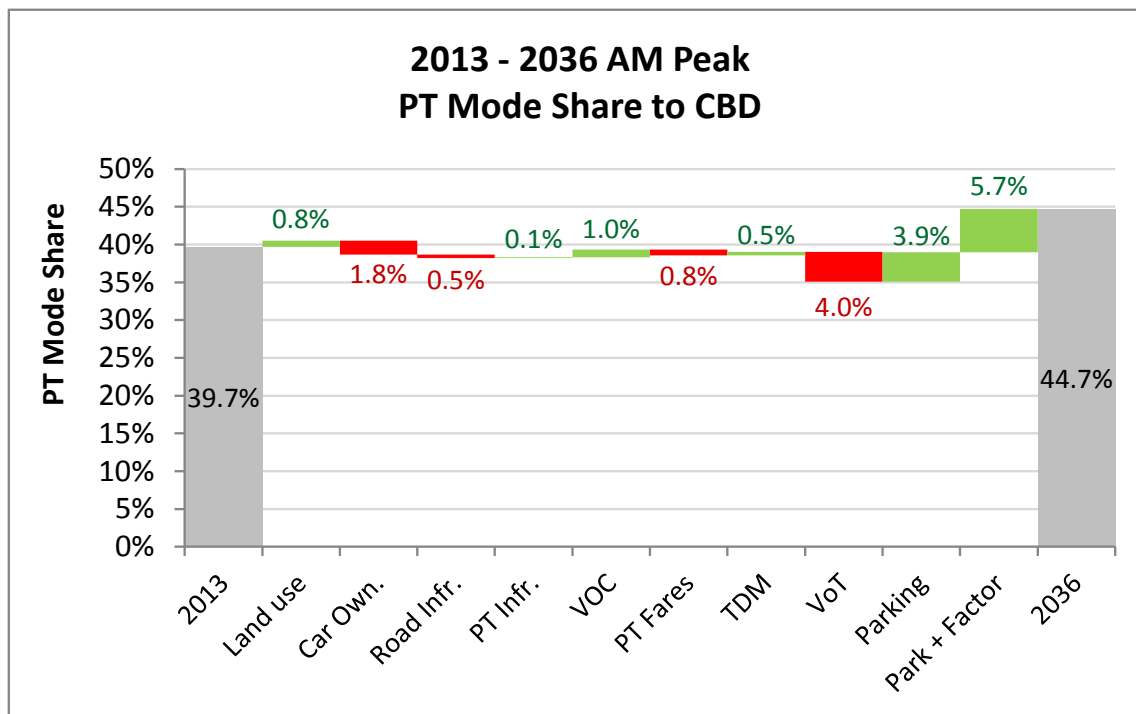


Figure 2 Incremental change PT mode share to Wellington CBD, 2013 to 2036, resulting from the application of revised assumptions



Below is a summary of the incremental approach to updating modelling assumptions between 2013 and 2036:

- growth in population and employment (land use) between 2013 and 2036 results in an increase in overall demand to Wellington CBD; the PT mode share to Wellington CBD increases slightly, a result of population growth being focussed on areas of existing good public transport coverage and increasing congestion on the arterial routes into Wellington meaning that (relative to travelling by car) PT is slightly more attractive
- trip rates are a function of population, employment and household category; once the change in land use between 2013 and 2036 is applied, the remaining parameter and assumption updates will only affect trip distribution, trip timing and modal share (car, PT, active modes) and will not change the total number of daily trips
- car ownership is assumed to increase slightly, which results in car availability increasing and, as a result, more people travel by car, reducing PT mode share by 1.8% points
- roading infrastructure – essentially Transmission Gully – further shifts the balance towards car, reducing PT mode share by a further 0.5%
- vehicle operating costs (VoC) and PT fares are assumed to increase at a similar rate, the net impact being that both cancel each other out resulting in a negligible impact in terms of PT mode share
- assumptions relating to the effectiveness of soft TDM measures generating modal shift from car to other modes (cycling, walking, PT, working from home) result in a small increase in PT mode share to Wellington CBD (0.5%)
- increasing GDP is assumed to lead to increased values of time; this results in a significant drop in PT mode share (4%) because
 - increasing values of time reduce the pain of paying the car running costs, parking charges, tolls etc
 - because dollar costs make up a greater proportion of total generalised cost for car than for PT, VoT increases slice more off car generalised cost than PT generalised cost, making travelling by car more attractive relative to travelling by PT
- increasing the cost of parking in line with GDP and a multiplier of 1.2 results in a 3.9% increase in PT mode share, effectively cancelling out the decrease in PT mode share due to increasing values of time; the net result after this penultimate incremental change is that forecast 2036 PT mode share to Wellington CBD is 0.7% lower (39.0%) than the current PT mode share (39.7%)

- the final incremental change is an additional cost factor that is calibrated to broadly constraint HBW trips to Wellington CBD in the AM peak at 2013 levels; this factor does not specifically represent the cost of parking, rather it represents the perceived cost / inconvenience of driving and finding a car park in the CBD, factors that might not necessarily be fully captured by a strategic model like WTSM; this final parameter results in a 5.7% shift in trips to Wellington CBD from car to PT

5 Initial high level results

This section outlines some of the initial high level results from the Do Minimum forecasts, focussing on absolute, percentage and per capita changes car and PT trips.

It presents results at three levels of detail:

- All trips, region wide
- Trips to, from and within Wellington City TA boundary
- Trips to / from Wellington CBD

5.1 Region

Table 4 below shows the change in car trips, PT trips and VKT between 2013 and 2026, 2036, 2046 in both absolute, percentage and per-capita terms.

Table 4 Forecast change in car trips, PT trips and VKT within Wellington Region, 2013 to 2046

	2013	2026	Diff	% Diff	2036	Diff	% Diff	2046	Diff	% Diff
AM peak										
Car trips	161,000	178,000	17,000	11%	185,000	24,000	15%	192,000	31,000	19%
PT trips	32,000	35,700	3,700	12%	38,600	6,600	21%	41,700	9,700	30%
VKT	1,426,000	1,654,000	228,000	16%	1,716,000	290,000	20%	1,751,000	325,000	23%
Car trips / capita	0.329	0.332		1%	0.329		0%	0.328		0%
PT trips / capita	0.065	0.067		2%	0.069		5%	0.071		9%
VKT/ Capita	2.913	3.082		6%	3.050		5%	2.993		3%
Inter-peak										
Car trips	152,000	171,000	19,000	13%	180,000	28,000	18%	188,000	36,000	24%
PT trips	9,400	9,900	500	5%	10,400	1,000	11%	10,800	1,400	15%
VKT	1,004,000	1,201,000	197,000	20%	1,255,000	251,000	25%	1,281,000	277,000	28%
Car trips / capita	0.311	0.319		3%	0.320		3%	0.321		3%
PT trips / capita	0.019	0.018		-4%	0.018		-4%	0.018		-4%
VKT/ Capita	2.051	2.238		9%	2.230		9%	2.190		7%
Evening peak										
Car trips	194,000	217,000	23,000	12%	228,000	34,000	18%	236,000	42,000	22%
PT trips	25,500	28,700	3,200	13%	31,200	5,700	22%	33,500	8,000	31%
VKT	1,508,000	1,787,000	279,000	19%	1,862,000	354,000	23%	1,901,000	393,000	26%
Car trips / capita	0.396	0.404		2%	0.405		2%	0.403		2%
PT trips / capita	0.052	0.053		3%	0.055		6%	0.057		10%
VKT/ Capita	3.081	3.330		8%	3.309		7%	3.250		5%
Annual (*1000)										
Car trips	396,000	445,000	49,000	12%	468,000	72,000	18%	487,000	91,000	23%
PT trips	29,200	31,800	2,600	9%	33,800	4,600	16%	35,800	6,600	23%
VKT	2,764,000	3,290,000	526,000	19%	3,434,000	670,000	24%	3,505,000	741,000	27%
Car trips / capita	0.809	0.829		3%	0.832		3%	0.832		3%
PT trips / capita	0.060	0.059		-1%	0.060		1%	0.061		3%
VKT/ Capita	5.7	6.1		9%	6.0		8%	5.9		6%

Focussing on high level patterns and change through time:

- during peak periods, PT trips are forecast to grow at a rate almost twice as fast as car trips, resulting in an above per capita increase in PT trips (9% out to 2046) and a no per capita increase in car trips, due to increasing highway capacity constraint at peak times and parking constraint (Wellington CBD)
- during the Inter-peak, car trips are forecast to increase at a faster rate than PT trips, with a small per capita increase in car trips and small per capita decrease in PT trips, due to lower levels of congestion in the Inter-peak compared to the peak periods (though inter-peak congestion will increase through time) and lower levels of parking constraint
- across all time periods, the rate of growth of car trips is forecast to decrease through time whilst the rate of growth in PT trips remains relatively constant – this is thought to be a function of increasing highway network constraints spreading through time from the peak periods to the inter-peak and reducing rates of increase in car ownership
- at an annual level, car and PT forecast growth rates are relatively similar (in percentage terms) with small per capita increases in trips made by both modes
- in terms of VKT, there is a per capita increase in VKT from 2013 to 2026 of 9%, largely driven by inter-peak growth in trips and VKT; in subsequent years, increasing congestion in the inter-peak starts to impose a constraint on growth in car trips in the inter-peak, resulting the rate of growth in VKT/capita decrease through time to 6% in 2046 (compared with 2013)

Focussing on changes between 2013 and 2036, the model forecasts show the following, at a regional level:

- a 15% forecast increase in car trips and 21% increase in PT trips in the AM peak; in per capita terms this represents no significant increase in car trips / capita during peak times but a 9% increase in PT trips / capita
- PT trips increase at a faster rate than car trips due to highway network capacity constraints at peak times, resulting in increased travel times, and parking constraints in Wellington CBD
- VKT increases by 23% (compared to a 15% increase in car trips) and VKT / capita increases by 5%, suggesting that average car trip length might increase, a function of:
 - a low rate of increase in vehicle operating costs and PT fares (distance based) and a higher rate of increase in fixed costs (parking in Wellington CBD) resulting in PT becoming slightly more attractive relative to car for shorter distance trips but the private car becoming more attractive for certain long distance trips, particularly where the origin / destination is not Wellington CBD or where there is no convenient public transport alternative
 - some trip re-distribution, whereby parking constraint in Wellington CBD results in some people changing their destination choice and making longer distance commuter trips from, for example, Miramar to Lower Hutt
- during the Inter-peak, forecast growth in car trips (18%) is greater than growth in PT trips (11%), a result of less frequent PT services in the Inter-peak, lower levels of highway congestion, lower parking charges in Wellington CBD and a different trip distribution patterns (a lower proportion of trips go to Wellington CBD compared with the AM peak) which tends to favour the private car
- in per capita terms, inter-peak car trips increase by 3% whilst inter-peak VKT increases by 7%
- in the PM peak the pattern is similar to the AM peak – higher forecast growth in PT trips (22%) compared with car trips (18%) due to highway network capacity constraints and parking constraints in Wellington CBD

5.2 Wellington City

Table 5 below shows the forecast change in car trips, PT trips and VKT between 2013 and 2026, 2036, 2046 in both absolute, percentage and per-capita terms

Table 5 Forecast change in car trip, PT trips and VKT to / from / within Wellington City, 2013 to 2046

	2013	2026	Diff	% Diff	2036	Diff	% Diff	2046	Diff	% Diff
AM Peak										
Car trips	72,000	80,000	8,000	11%	83,000	11,000	15%	86,000	14,000	19%
PT trips	25,400	29,700	4,300	17%	32,500	7,100	28%	35,400	10,000	39%
VKT	744,000	829,000	85,000	11%	847,000	103,000	14%	858,000	114,000	15%
Car trips / capita	0.365	0.348		-5%	0.343		-6%	0.340		-7%
PT trips / capita	0.129	0.129		0%	0.134		4%	0.140		9%
VKT/ Capita	3.767	3.604		-4%	3.500		-7%	3.391		-10%
Inter-peak										
Car trips	62,000	72,000	10,000	16%	75,000	13,000	21%	78,000	16,000	26%
PT trips	6,000	6,700	700	12%	7,100	1,100	18%	7,500	1,500	25%
VKT	514,000	594,000	80,000	16%	618,000	104,000	20%	634,000	120,000	23%
Car trips / capita	0.314	0.313		0%	0.310		-1%	0.308		-2%
PT trips / capita	0.030	0.029		-4%	0.029		-3%	0.030		-2%
VKT/ Capita	2.603	2.583		-1%	2.554		-2%	2.506		-4%
Evening peak										
Car trips	82,000	92,000	10,000	12%	96,000	14,000	17%	99,000	17,000	21%
PT trips	20,600	24,200	3,600	17%	26,600	6,000	29%	28,900	8,300	40%
VKT	784,000	893,000	109,000	14%	918,000	134,000	17%	934,000	150,000	19%
Car trips / capita	0.415	0.400		-4%	0.397		-4%	0.391		-6%
PT trips / capita	0.104	0.105		1%	0.110		5%	0.114		10%
VKT/ Capita	3.970	3.883		-2%	3.793		-4%	3.692		-7%
Annual (*1000)										
Car trips	165,000	188,000	23,000	14%	197,000	32,000	19%	205,000	40,000	24%
PT trips	21,000	24,100	3,100	15%	25,900	4,900	23%	27,800	6,800	32%
VKT	1,422,000	1,633,000	211,000	15%	1,691,000	269,000	19%	1,731,000	309,000	22%
Car trips / capita	0.835	0.817		-2%	0.814		-3%	0.810		-3%
PT trips / capita	0.106	0.105		-1%	0.107		1%	0.110		3%
VKT/ Capita	7.2	7.1		-1%	7.0		-3%	6.8		-5%

Focussing on high level patterns and change through time:

- Similar to the regional trends presented in the previous section, PT trips to / from / within Wellington City are forecast to grow at twice the rate of car trips (in percentage terms) at peak times between 2013 and 2046, with the differential between car / PT growth rates increasing through time due to increasing highway network constraints in peak periods
- In the Inter-peak, car trips initially increase at a rate faster than PT trips but this differential decreases through time due to increasing congestion during the inter-peak, resulting in similar growth rates in 2046
- VKT per capita is forecast to decrease slightly through time (5% to 2046), with the greatest decrease during the AM peak (10% to 2046); PT trips per capita are forecast to increase by 9% between 2013 and 2046 during peak periods but decrease slightly during the inter-peak (2%) leading to an overall increase of 3% between 2013 and 2046

Focussing on changes between 2013 and 2036, the model forecasts show the following, looking at trips to / from / within Wellington City

- a 15% increase in car trips and 28% increase in PT trips in the AM peak, which equates to a 6% decrease in car trips per capita and 4% increase in PT trips / capita (when compared against Wellington City population forecasts)

- PT trips increase at almost twice the rate of car trips due to highway network constraints, parking capacity constraint in Wellington CBD and the proximity of population growth areas to high frequency public transport
- In the inter-peak, car and PT trips increase at relatively similar rates (21% and 18% respectively) with slight decreases in per capita growth rates for both modes
- the evening peak is similar to the AM peak, with PT growth rates twice as high as car growth rates

5.3 Wellington CBD

Table 6 below shows the change in car trips, PT trips and VKT between 2013 and 2026, 2036, 2046 in both absolute, percentage and per-capita terms for trips to / from / within Wellington CBD.

Table 6 Forecast change in car trip, PT trips and VKT to / from / within Wellington CBD, 2013 to 2046

	2013	2026	Diff	% Diff	2036	Diff	% Diff	2046	Diff	% Diff
AM Peak										
Car trips	30,000	33,000	3,000	10%	33,000	3,000	10%	33,000	3,000	10%
PT trips	20,800	24,300	3,500	17%	26,900	6,100	29%	29,600	8,800	42%
Total	51,000	57,000	6,000	12%	59,000	8,000	16%	62,000	11,000	22%
VKT	369,000	409,000	40,000	11%	409,000	40,000	11%	408,000	39,000	11%
Inter-peak										
Car trips	20,000	23,000	3,000	15%	24,000	4,000	20%	24,000	4,000	20%
PT trips	3,900	4,300	400	10%	4,600	700	18%	4,900	1,000	26%
Total	24,000	28,000	4,000	17%	28,000	4,000	17%	29,000	5,000	21%
VKT	201,000	235,000	34,000	17%	241,000	40,000	20%	247,000	46,000	23%
PM peak										
Car trips	31,000	34,000	3,000	10%	34,000	3,000	10%	35,000	4,000	13%
PT trips	16,600	19,500	2,900	17%	21,600	5,000	30%	23,800	7,200	43%
Total	48,000	53,000	5,000	10%	56,000	8,000	17%	59,000	11,000	23%
VKT	359,000	405,000	46,000	13%	409,000	50,000	14%	413,000	54,000	15%
Annual (*1000)										
Car trips	57,000	64,000	7,000	12%	65,000	8,000	14%	66,000	9,000	16%
PT trips	15,400	17,700	2,300	15%	19,400	4,000	26%	21,000	5,600	36%
Total	72,000	81,000	9,000	13%	84,000	12,000	17%	87,000	15,000	21%
VKT	587,000	678,000	91,000	16%	692,000	105,000	18%	705,000	118,000	20%

The forecasts shows the following:

- between a 10% and 20% increase in car trips to / from Wellington CBD in all time periods, with the majority of this increase occurring between 2013 and 2026 and lesser increases between 2026/36 and 2036/46
- PT trips to / from Wellington CBD increase by 17% between 2013 and 2026 in the AM peak and PM peak, with the percentage growth increasing to 29% between 2013 and 2036 and over 40% between 2013 and 2046
- Between 2013 and 2046, total annual combined car / PT trips to / from the CBD increase by 21% - whilst this rate of increase is slightly lower than the corresponding rate of increase in Wellington City's population (but higher than the forecast increase in regional population over the same period), it excludes growth in walking / cycling trips that, based on recent trends and the proposed location of future population growth in the vicinity of Wellington CBD, could see significantly higher growth rates than those that are forecast for car / PT trips

6 Indicative highway volumes

Table 7 below show forecast changes in AM peak, Inter-peak and PM peak highway volumes (respectively) between 2013 and 2036 crossing the Wellington CBD cordon.

Volumes are provided separately for the inbound direction, outbound direction and combined.

The cordon follows the line of the inner-city bypass and includes the major arterials of Aotea Quay, Murphy Street / Molesworth Street, Bowne Street, Terrace off-ramp, Terrace Tunnel exit / entrance, Willis Street, Victoria Street, Taranaki Street, Adelaide Road, Mt Victoria Tunnel, Oriental Parade.

Table 7 Forecast change in highway cordon crossing volumes, 2013 to 2036

	Inbound				Outbound				Combined			
	2013	2036	Diff	%	2013	2036	Diff	%	2013	2036	Diff	%
AM peak (7am to 9am)	30,750	33,500	2,750	9%	17,000	20,400	3,400	20%	47,650	53,950	6,300	13%
Inter-peak (11am to 2pm)	16,850	20,250	3,400	20%	15,200	18,900	3,700	24%	32,050	39,100	7,050	22%
PM peak (4pm to 6pm)	20,850	24,600	3,750	18%	27,300	31,200	3,900	14%	48,150	55,900	7,750	16%

In terms of the differences between 2013 and 2036:

- growth in AM peak (13%) and PM peak (16%) cordon crossing volumes is forecast to be lower than corresponding growth in Inter-peak (22%) cordon crossing volumes, driven by network constraints at peak times
- in the peak directions, AM peak inbound and PM peak outbound, cordon crossing volumes are forecast to increase by 9% and 14% respectively

Additional analysis will be undertaken during the next stage of LGWM using the AIMSUN model to understand in greater detail the changes in traffic volumes between 2013 and future forecast years.

7 Indicative PT volumes

Table 8 below show forecast changes in PT volumes crossing the Wellington CBD cordon between 2013 and 2036, by direction.

Volumes are provided separately for the inbound direction, outbound direction and combined. The cordon is identical to the highway cordon, except that it also includes the Hataitai bus tunnel.

Table 8 PT volumes crossing Wellington CBD cordon, by direction and time period, 2013 and 2036

	Inbound				Outbound				Combined			
	2013	2036	Diff	%	2013	2036	Diff	%	2013	2036	Diff	%
AM peak (7am to 9am)	20,600	26,600	6,000	29%	2,400	2,800	400	17%	23,100	29,400	6,300	27%
Inter-peak (11am to 2pm)	2,200	2,600	400	18%	2,550	2,900	350	14%	4,750	5,500	750	16%
PM peak (4pm to 6pm)	2,850	3,400	550	19%	15,550	20,250	4,700	30%	18,400	23,650	5,250	29%

In terms of the differences between 2013 and 2036:

- growth in AM peak inbound (29%) and PM peak outbound (30%) peak direction cordon crossing PT volumes is forecast to be 2 to 3 times higher than corresponding highway cordon crossing volumes (Table 7 above)

- conversely, inter-peak PT cordon crossing volumes are forecast to increase at a slower rate than inter-peak highway cordon crossing volumes

8 Indicative highway travel times

Table 9 below shows forecast changes in highway travel times between 2013 and 2036 for selected routes during the AM peak, Inter-peak and PM peak, by direction.

Table 9 Forecast changes in highway travel times, 2013 to 2036

		Percentage increase 2013 to 2036			Percentage increase 2013 to 2036
Airport to Johnsonville (northbound)	AM	30%	Johnsonville to Airport (southbound)	AM	30%
	IP	10%		IP	15%
	PM	20%		PM	25%

The results show the following:

- average AM peak travel times between the Airport and Johnsonville (via SH1) in both directions are forecast to increase by nearly 30%; whilst WTSM does not model travel time variability, an increase in average travel time implies that congestion during the whole 7am to 9am time period is getting worse and as a result travel time variability would increase
- similarly in the PM peak, average travel speeds in both directions between the Airport and Johnsonville are forecast to increase by between 20% and 25%; in the Inter-peak, travel times are only forecast to increase by 10% to 15%, a reflection of the fact that forecast future congestion is not forecast to be as severe as in the AM peak and PM peak
- the fact that AM peak and PM peak travel times are forecast to increase at a faster rate than inter-peak travel times supports the increases in traffic volumes show in the previous section where AM peak and PM peak traffic volumes are forecast to grow at a slower rate than Inter-peak traffic volumes, with this difference driven by increasing congestion during peak period constraining growth in traffic volumes
- WTSM only represents an average across the 7am to 9am period and does not model how travel time reliability might change through time; however, it is thought that:
 - Highway travel times during the ‘peak of the peak’ would likely deteriorate at a faster rate than those shown in the table above
 - similarly, variation in travel times from day to the next would also be likely to change at a significantly higher rate than might be implied by the percentages in the table above

It is recommended that more detailed highway travel time analysis be undertaken in AIMSUN at later stages in the LGWM process to further understand potential changes in highway travel times between 2013 and any forecast future years.

9 Indicative bus travel speeds

Table 10 below shows bus travel speeds for the following bus routes:

- Island Bay to Grenada (and vv)
- Seatoun to Karori (and vv)
- Airport Flyer

Due to the comprehensive changes being made to the Wellington City bus networks in 2017, it is difficult to undertake meaningful comparisons between 2013 and 2026 modelled bus travel speeds

Therefore the analysis below focusses on bus travel speeds between 2026, 2036 and 2046, with the 2026 travel speeds presented together with the forecast percentage change between 2026 and 2036/2046 respectively.

Note that a negative percentage means a decrease in average travel speeds.

Table 10 Forecast change in bus travel speeds, 2026 to 2046

	AM peak			Inter-peak			PM Peak		
	2026 average bus travel speed (kph)	+10yr	+20yr	2026 average bus travel speed (kph)	+10yr	+20yr	2026 average bus travel speed (kph)	+10yr	+20yr
Island Bay to Grenada	21	-4%	-6%	23	-1%	-3%	18	-3%	-6%
Grenada to Island Bay	19	-3%	-6%	22	-1%	-2%	20	-1%	-2%
Seatoun to Karori	17	-2%	-5%	19	-1%	-3%	17	-2%	-5%
Karori to Seatoun	19	-1%	-3%	19	0%	0%	18	-2%	-3%
Airport Flyer (to Airport)	27	-2%	-3%	34	-1%	-3%	21	-5%	-10%
Airport Flyer (from Airport)	21	-6%	-12%	33	0%	-1%	25	-3%	-7%

The model results show the following:

- peak period bus travel speeds across all routes range from 16.8kph to 27.2kph in 2026; inter-peak bus travel speeds are slightly faster, ranging from 18.8kph to 34.0kph
- between 2026 and 2036 / 2046, bus travel speeds deteriorate across all routes:
 - peak period average bus travel speeds deteriorate at a faster rate (between 2% and 12% over 20 yrs) than inter-peak bus travel speeds (between 0% and 3%); as the network operates at or near capacity during peak periods, only relatively small increases in traffic volumes is required to increase public transport travel times whereas in the inter-peak there is more spare capacity so public transport travel times deteriorate at a slower rate even through traffic growth rates could be similar (in percentage terms) between peak periods and the inter-peak
 - bus travel speeds on routes that use either Hutt Road (Island Bay to Grenada) or SH1 / SH2 (Airport Flyer) deteriorate at a faster rate than routes such as Seatoun to Karori that predominantly use local roads
- WTSM only represents an average across the 7am to 9am period and does not model how travel time reliability might change through time; however, it is thought that:
 - Bus travel speeds during the ‘peak of the peak’ would likely deteriorate at a faster rate than those shown in the table above
 - similarly, variation in travel speeds from one service or day to the next would also be likely to change at a significantly higher rate than might be implied by the percentages in the table above

During the next stages of LGWM, the AIMSUN model will be used to understand potential changes in bus travel speeds (and variability) in more detail.

10 Indicative WPTM public transport volumes

Analysis undertaken to date in this note has focussed on WTSM. This section summarises outputs from the Wellington Public Transport Model (WPTM).

WPTM differs from WTSM as follows:

- more detailed zone definition – 5 times as many zones
- fully observed matrices – developed from rail surveys, bus surveys and electronic ticket machine (ETM) data
- more sophisticated wait time and walk time functions

With this functionality, WPTM can be categorised as a ‘meso level’ model on a par with equivalent SATURN models or AIMSUN models.

Table 11 below summarises the forecast increase in PT boardings by mode between 2013, 2026, 2036 and 2046

Table 11 Forecast PT boardings by mode, WPTM, 2013 to 2046

PT Boardings by mode	2013	2026	2036	2046	2026	2036	2046
Bus - AM	18,700	21,900	23,500	25,100	17%	26%	34%
Rail - AM	13,300	15,100	16,500	18,100	14%	24%	36%
Total - AM	32,000	37,100	40,000	43,300	16%	25%	35%
Bus - IP	6,000	6,900	7,300	7,600	15%	21%	27%
Rail - IP	1,300	1,300	1,400	1,700	-4%	5%	23%
Total - IP	7,400	8,200	8,700	9,300	12%	18%	26%
Bus - PM	14,000	15,900	16,800	17,600	14%	20%	26%
Rail - PM	10,600	11,800	12,800	13,900	12%	21%	32%
Total - PM	24,500	27,700	29,600	31,500	13%	21%	29%

It shows the following:

- between 2013 and 2046, overall PT boardings are forecast to increase by 35% (AM peak), 26% (Inter-peak) and 29% (PM peak)
- in percentage terms, forecast growth is a little higher during the AM peak compared to PM peak
- rail boardings are forecast to grow by 36% in the AM peak and 32% in the PM peak, whilst bus boardings are forecast to grow by 36% and 32% in the AM peak and PM peak respectively

Table 12 below summarises forecast changes in rail boardings / alightings at Wellington station between 2013 and 2046:

Table 12 Wellington station rail boardings and alightings

Board / alight at Wellington station	2013	2026	2036	2046	2026	2036	2046
Boardings at Wellington station - AM	400	400	400	400	-3%	3%	11%
Alightings at Wellington station - AM	11,700	13,600	14,900	16,500	17%	28%	42%
Boardings at Wellington station - IP	200	200	300	300	-11%	1%	29%
Alightings at Wellington station - IP	600	600	700	800	1%	13%	32%
Boardings at Wellington station - PM	8,900	10,300	11,300	12,400	15%	26%	38%
Alightings at Wellington station - PM	400	400	400	400	3%	8%	16%

It shows that rail alightings in the AM peak and boardings in the PM peak are forecast to increase by around 40% between 2013 and 2046.

Table 13 below shows the forecast change in AM peak bus volumes crossing the Wellington CBD cordon, inbound, between 2013 and 2036, categorised by corridor / area:

- Southern / Eastern suburbs – Oriental parade, Elizabeth Street, Adelaide Road, Taranaki Street, Brooklyn Road
- Western suburbs – Aro Street, Salamanca Road, Bowen Street
- Northern suburbs and Hutt Valley – Molesworth Street / Murphy Street

Table 13 AM peak inbound Wellington CBD bus passenger cordon crossings

AM peak Inbound				
Area	2013	2036	Diff	% Diff
Southern / Eastern Suburbs	4,600	6,000	1,400	30%
Western suburbs	1,600	1,900	300	16%
Northern suburbs and Hutt Valley	2,700	3,300	600	23%
Total	9,000	11,200	2,300	25%

Focussing on the main suburbs:

- an extra 1,400 people are forecast to travel into Wellington CBD in the AM peak by bus in 2036 from Wellington's southern / eastern suburbs compared to 2013, a 30% increase
- in both absolute and percentage terms, the forecast increase in bus volumes between 2013 and 2036 in the AM peak, inbound, from other suburbs is lower
 - western suburbs – 250 increase (16%)
 - northern suburbs and Hutt Valley – 600 increase (23%)

Table 14 below shows the forecast change in PM peak bus volumes crossing the Wellington CBD cordon, outbound, between 2013 and 2036.

Table 14 PM peak outbound Wellington CBD bus passenger cordon crossings

PM peak outbound				
Area	2013	2036	Diff	% Diff
Southern / Eastern Suburbs	3,300	4,000	700	22%
Western suburbs	1,000	1,200	100	11%
Northern suburbs and Hutt Valley	1,900	2,300	400	21%
Total	6,300	7,500	1,300	20%

Focussing on the main suburbs:

- PM peak bus trips to Wellington southern / eastern suburbs and northern suburbs (including Hutt Valley) are forecast to increase by around 2025, although in absolute terms the increase will be twice as great for the southern / eastern suburbs (730) given the existing size of this catchment

11 PT capacity

As WTSM does not have the functionality to model the effects of public transport crowding in terms of people's behaviour (modal choice, service choice or time of day choice) it is important to understand the extent to which forecast increases in public transport volumes might change public transport levels of service.

Given that any public transport capacity issues would firstly manifest themselves in the AM peak, high level analysis of future forecast bus and rail patronage has been undertaken to understand the extent to which the future network can accommodate increased demands and how this additional demand might change levels of crowding on public transport.

11.1 Wellington City bus network

The new Wellington City bus networks, to be introduced in 2018, will:

- reduce the number of services along the Golden Mile at peak times by 30% due to the introduction of higher capacity buses
- result in less congestion and faster trips through the CBD due to a reduced number of buses running at peak times
- provide a more regular off-peak service to twenty-two suburbs
- provide a more reliable and punctual service

Overall, however, peak time capacity will remain unchanged although additional capacity will address known issues on key corridors where the bus network has reached capacity.

Figure 3 below shows, for all services crossing the Wellington CBD cordon between 7am and 9am and entering the Golden Mile:

- AM peak hour average load (passengers per bus service)
- AM peak hour average seated capacity
- AM peak hour average total capacity (seated + standing)

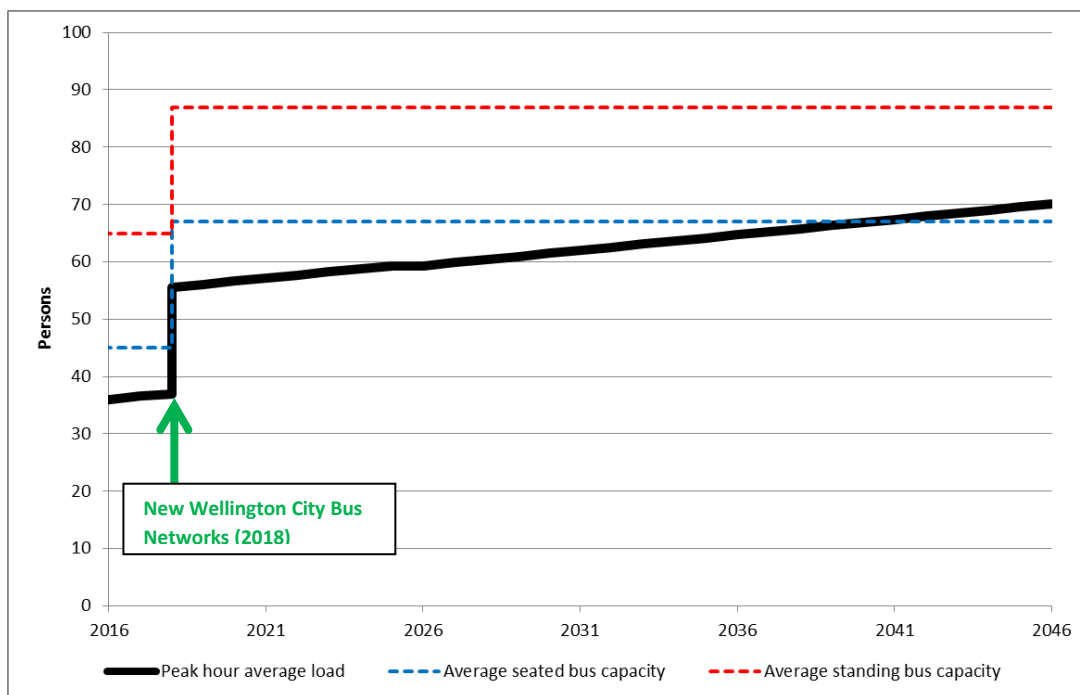
The gap between the black line and the blue dotted line represents spare seated capacity during the AM peak period (7am to 9am) whilst the gap between the black line and the dotted red line represents spare total capacity during the AM.

Patronage projections from 2018 onwards (after the introduction of Wellington City Bus Networks) are derived from the WTSM Do Minimum forecasts, with the modelled growth projections rounded as follows:

- Approximate 10% increase in bus patronage between 2013 and 2026
- Approximate 20% increase in bus patronage between 2013 and 2036
- Approximate 30% increase in bus patronage between 2013 and 2046

The purpose of this analysis is to provide an indication of the level of patronage growth that would place the network under stress at peak times and when this might occur.

Figure 3 AM peak hour average load, seated capacity and total capacity



The chart shows the following:

- Assuming no peak time bus network capacity increases at peak times after 2018, the average V/C ratio (seated capacity) across the network will gradually increase from its current level (84%) to 100% around 2038
- this would mean that (on average) every bus service during the AM peak period (7am to 9am) would have not free seated capacity

In reality, people will start to stand when the V/C ratio is in the range 85% to 100%; it is likely that if patronage growth were to follow or track above this forecast trend, there would be a situation in around 10 years time when peak time capacity problems on the network would require additional vehicle capacity to be added.

If this additional capacity were added in the form of additional service frequencies (and not larger buses), this would start to erode some of the travel time and travel time reliability benefits of having fewer buses on the Golden Mile.

11.2 Rail Network

Around 15,000 people currently alight from rail services every weekday morning at Wellington Station between 7am and 9am. Whilst there is spare capacity (both seated and standing) across the network on all lines during the peak period (7am to 9am), some services during the peak of the peak already operate at capacity and have people standing on arrival at Wellington Station.

Figure 4 below show the profile of alightings at Wellington Station between 7am to 9am, with a noticeable ‘peak within the peak’ between 8.10am and 8.30am, the period during which service loadings will be at their highest and people will be most likely to be standing.

Figure 4 AM Peak alightings at Wellington Rail Station, 7am to 9am

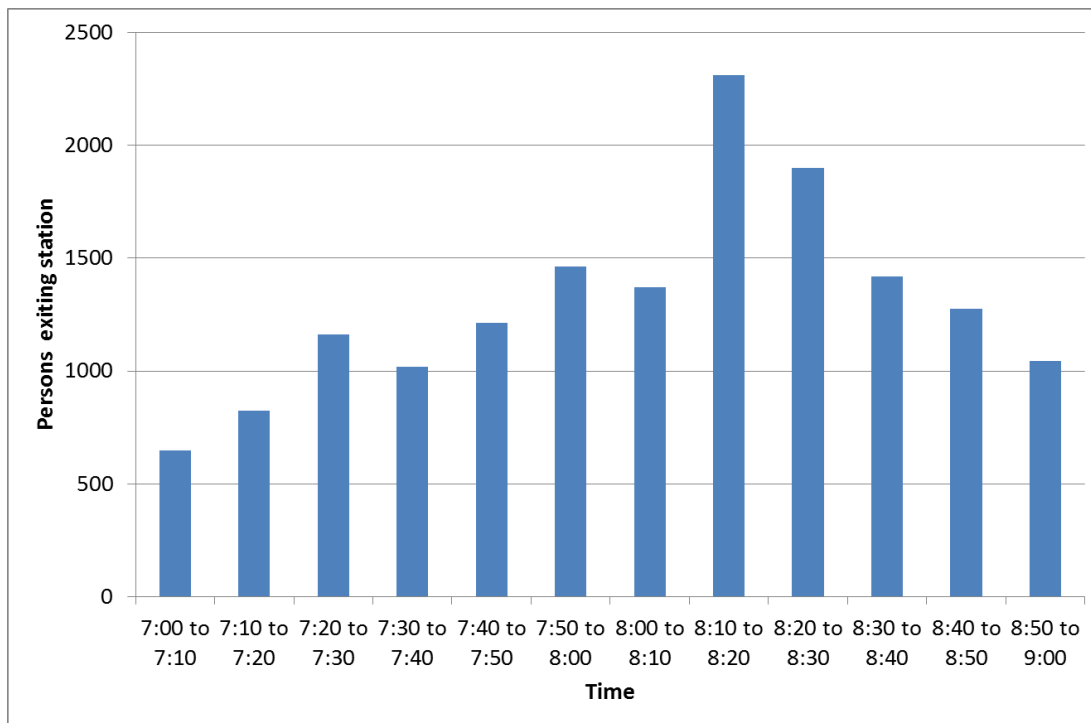


Figure 5 below shows the forecast patronage growth under a number of scenarios, together with accompanying assumed growth in available peak hour seated and total capacity.

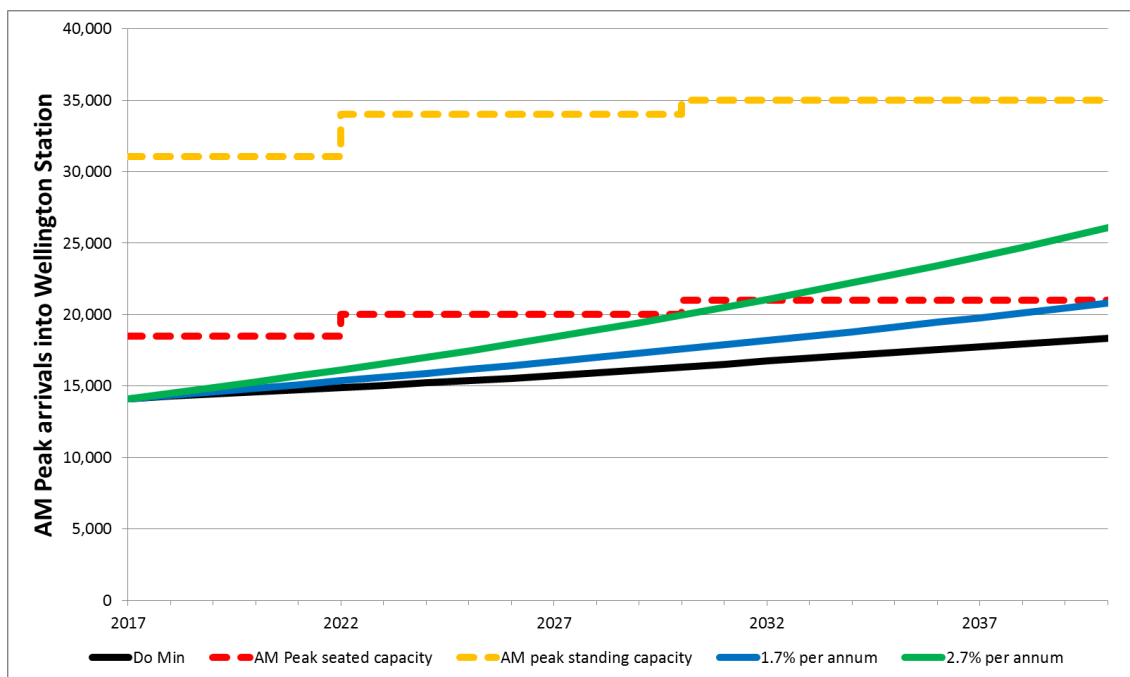
Patronage growth is reported as follows:

- Do Minimum – estimates derived from the Wellington Transport Strategy Model (WTSM) which assumes no integrated fares and ticketing nor any service frequency improvements (RS1); effectively a pessimistic Do Nothing scenario
- 1.7% per annum and 2.7% per annual growth trajectories, which present a range within which patronage growth is likely to sit, driven by background population / employment growth and rail infrastructure investment such as IFT and RS1 (which would deliver service frequency improvements)

Capacity improvements are mainly delivered through increased network frequency through faster travel times, improved timetabling and better utilisation of the existing fleet. The specific increases in capacity are assumed as follows:

- 2021/22 – increased frequency through RS1 and Wairarapa line fleet renewal
- 2030 – further frequency improvements delivered via infrastructure investment

Figure 5 Forecast rail capacity improvements and patronage growth, 2017 to 2040



The forecasts show the following:

- under a Do Minimum (Do Nothing on the rail network) future scenario, whilst patronage growth rates are forecast to exceed seated capacity growth rates over the period 2017 to 2040, there would still be some spare seated capacity across the AM peak on the network by 2040
- under a 1.7% pa growth scenario (equivalent to 45% growth between 2017 and 2040), AM peak arrivals into Wellington Station between 7am and 9am would equal available seat capacity by 2040, whilst under a 2.7% pa growth scenario (equivalent to 80% growth between 2017 and 2040) this ceiling would be reached around 2030

As some services during the ‘peak of the peak’ are currently standing room only and have little spare capacity, the majority of the growth in patronage forecast for the higher growth scenarios would have to occur earlier / later during peak (as capacity during the ‘peak of the peak’ would not be able to accommodate this increased) or would have to occur during the beginning of the Inter-peak.

The analysis presented above suggests that, depending on the rate of future rail patronage growth, there could be a situation in 10 to 20 year time when service capacity constraints at peak times could place downward pressure on rail patronage growth.