OPUS INTERNATIONAL CONSULTANTS AND ARUP

WELLINGTON TRANSPORT MODELS

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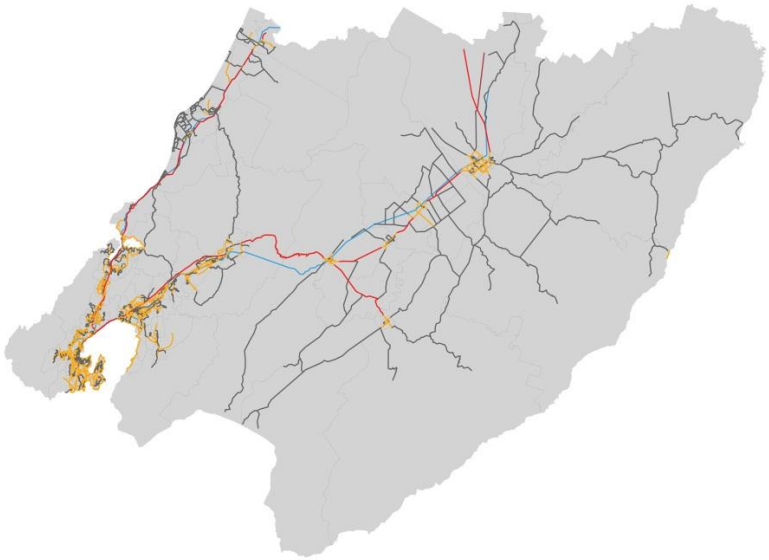

TN24: Baseline Forecasting Report

Date: December 2012

ARUP OPUS

Wellington Transport Models

TN24: Baseline Forecasting Report

prepared for

Greater Wellington Regional Council

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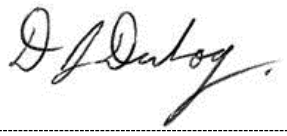

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This report takes into account the particular instructions and requirements of our client. It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

John Bolland:
(Peer Reviewer) _____

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Contents

1 Introduction

Opus International Consultants Limited (Opus) and Arup Australia (Arup) were commissioned by Greater Wellington Regional Council (GWRC) to rebase the existing 2006 Wellington Transport Strategy Model (WTSM) to a new base year of 2011. Review and validation of the resulting WTSM 2011 base model is detailed in a separate technical note (TN18).

In addition to this base 2011 scenario, a series of baseline future scenarios were developed for 2021, 2031 and 2041, which include forecasting assumptions in terms of:

- Land use – detailed in TN29 Demographic Input to WTSM (the medium demographic projections were used for these forecasts);
- Infrastructure improvement – detailed in TN23 Future Year Base Networks and Services; and
- Input parameters (GDP growth, fuel price increases, PT fare increases, effect of TDM etc) – detailed in TN15.

The purpose of this report is to present model outputs from these baseline future year scenarios, including key factors relating to travel demand in the region. The report generally follows the contents of the baseline forecasting report for the 2006 model update published by SKM and GWRC in 2008. However, the main difference is that this report focuses on just one baseline forecasting scenario detailed in TN23 whereas the 2008 SKM report compared two forecast scenarios (a do-minimum and do-something). The remainder of the report is structured as follows:

- Chapter 2: Private Trips Analysis;
- Chapter 3: Heavy Commercial Vehicle Trips Analysis;
- Chapter 4: Road Network Statistics;
- Chapter 5: Public Transport Boarding;
- Chapter 6: Regional Land Transport Strategy Measures; and
- Chapter 7: Conclusions.

2 Private Trips Analysis

2.1 Person Trips

Table 2-1 tabulates the modelled regional daily weekday person trips (excluding HCVs) in total and by purpose for 2011, 2021, 2031 and 2041. Figure 2-1 presents the statistics graphically. Note that Home-Based refers to a trip to or from home.

The results show a steady increase in person trips between 2011 and 2041 of 16%; by way of comparison the population growth over the same period is 12%. Education trips show a small decline which is due to an aging population and reducing household sizes meaning fewer school-aged children.

Shopping and other non-work related trips increase 13-17% between 2011 and 2041, whereas employers, business and commuting trips increase by some 22% between 2011 and 2041. The different growth rates are due to higher growth over the same period in working adults than non-working adults.

Table 2-1: Person Trips in Total and by Purpose

	2011	2021		2031		2041	
Purpose	**Trips**	**Trips**	**% Diff***	**Trips**	**% Diff***	**Trips**	**% Diff***
Home-Based Work	280,763	317,904	13%	334,267	19%	340,940	21%
Home-Based Education	98,993	97,489	-2%	95,068	-4%	96,755	-2%
Home-Based Shopping	329,525	352,986	7%	379,734	15%	386,185	17%
Home-Based Other	424,620	448,319	6%	470,429	11%	481,158	13%
Non-Home Based Other	549,549	587,722	7%	615,294	12%	629,115	14%
Employers Business	179,817	204,185	14%	213,808	19%	219,753	22%
Total	**1,863,266**	**2,008,604**	**8%**	**2,108,600**	**13%**	**2,153,905**	**16%**

* percentage difference in trips relative to 2011

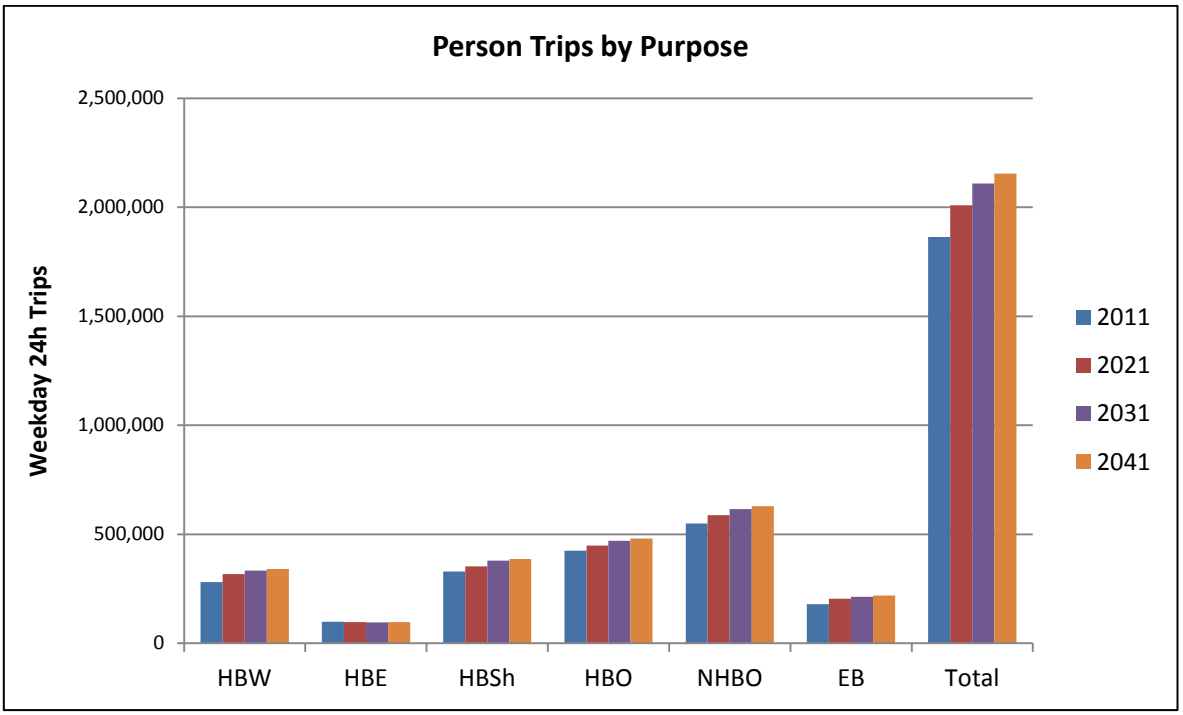

Figure 2-1: Person Trips in Total and by Purpose

2.2 Private Vehicle and Public Transport Trips by Mode and Mode Shares

The private vehicle and regional public transport (PT) trips and mode share in 2011, 2021, 2031 and 2041 are presented as follows:

- Number of trips and percent change between 2011 and the forecast years by period and mode (Table 2-2);
- Private vehicle and PT mode share by period (Table 2-3); and
- Graphical representation of the AM peak mode share by year (Figure 2-2).

Table 2-2 shows that, as expected, the largest absolute increases occur with private vehicle (car) trips where the 2011 base is around 5 times greater for private vehicle than PT in the AM peak. There are reasonably uniform increases in trips to 2041 with slight changes in mode choice at a regional level where PT mode share rises slightly between 2011 and 2021 before falling back slightly in 2031 where it remains constant until 2041. This is reflective of a car related costs increasing at a sharper rate than PT costs between 2011 and 2021 and the introduction of the Wellington Roads of National Significance (RoNS) post 2021 making it more affordable to drive in from the Kapiti Coast than to take the train.

These trends will be related to the relative costs of travel by the two modes, and particularly by road travel times, which affect both car and bus travel costs.

Table 2-2: Private Vehicle and PT Trips –Comparison with 2011

Period	Mode	2011	2021		2031		2041	
		Trips	Trips	% Diff	Trips	% Diff	Trips	% Diff
AM	Car	158,829	172,985	9%	184,145	16%	188,619	19%
	PT	29,667	34,742	17%	33,419	13%	33,176	12%
IP	Car	145,698	157,428	8%	167,761	15%	171,428	18%
	PT	8,880	9,432	6%	9,050	2%	9,161	3%
PM	Car	187,843	202,663	8%	216,661	15%	221,377	18%
	PT	23,140	27,048	17%	26,380	14%	26,079	13%

* Percentage difference in trips relative to 2011

The mode shares as given in Table 2-3 and Figure 2-2 are between private vehicle (car) trips and PT trips, and do not include active modes or car passengers. The data shows that any changes to the mode share between modelled years are 1% at most.

Table 2-3: Private Vehicle and PT Mode Share

Period	Mode	2011	2021	2031	2041
AM	Car	84%	83%	85%	85%
	PT	16%	17%	15%	15%
IP	Car	94%	94%	95%	95%
	PT	6%	6%	5%	5%
PM	Car	89%	88%	89%	89%
	PT	11%	12%	11%	11%
Annual	Car	93%	93%	94%	94%
	PT	7%	7%	6%	6%

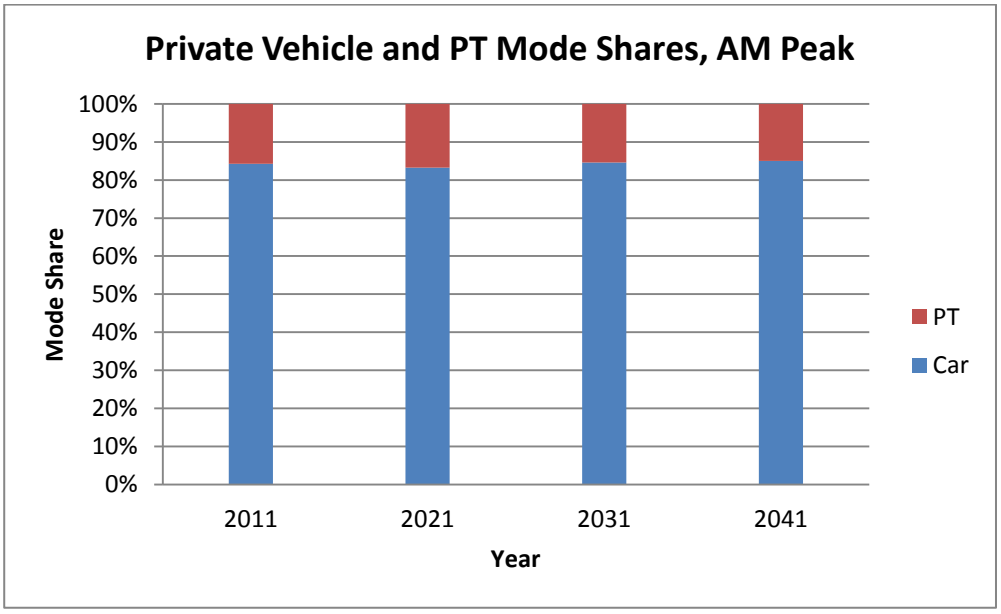

Figure 2-2: AM Peak Private Vehicle and PT Mode Shares

2.3 AM Private Vehicle and PT Trips by Mode and Mode Shares by Territorial Authority

This section presents the number of private vehicle and PT trips along with the mode share during the AM peak for 2011 and the forecast years. This data is presented by Territorial Authority (TA) of origin and destination. Note that the three Wairarapa TAs have been combined in this analysis. The tables and figures presented in this section include:

- Table 2-4 and Table 2-5 show the number of AM peak trips by private vehicles and PT for 2011 and the forecast years by territorial authority origin and destination, respectively;
- Table 2-6 and Table 2-7 show the mode share for private vehicles and PT during the AM peak for 2011 and the forecast years by territorial authority origin and destination, respectively;
- Figure 2-3 and Figure 2-4 show how the PT mode share varies for 2011 and the forecast years in each TA by TA origin and destination, respectively; and
- Table 2-8 summarises the percentage of private vehicle and PT trips that occur entirely within one TA for 2011 and the forecast years.

Table 2-4 shows continued growth in trips from all TAs, but that the magnitude of the growth varies by TA. There is lower growth in trips from Upper Hutt, Hutt, and Porirua, and to a lesser extent Wairarapa, than from Wellington City and Kapiti. This is primarily driven by the forecast growth in population. Note that this data does not include trips from outside the region so the sum of the TA figures does not match those in Table 2-2.

PT trips from Kapiti show a very high initial growth rate between 2011 and 2021 (+27% over 2011 levels), but falls away substantial with the introduction of Wellington RoNS in 2031 (+13% over 2011 levels).

For destinations, Table 2-5, the major influence on increases in AM peak trips to each TA over 2011 will be growth in employment, and differences by mode will be associated with relative improvements to each. The low growth in PT trips to Hutt, Upper Hutt and Porirua is the most noticeable feature, though the numbers of trips are low. The Petone to Grenada project is a contributor to this reduction, resulting in changing in trip patterns and mode as a result of this significant linkage between the Hutt and Tawa/Porirua. It is also predicted that there will be very little growth in population/land use while there is also increased car ownership, combined with a levelling out of fuel price relative to efficiency and increased PT fares.

Table 2-4: AM Peak Private Vehicle and PT Trips by TA Origin –Comparison with 2011

Period	Mode	2011	2021		2031		2041	
		Trips	Trips	% Diff*	Trips	% Diff*	Trips	% Diff*
Wellington	Car	67,966	75,609	11%	82,624	22%	88,155	30%
	PT	15,292	18,696	22%	18,805	23%	18,971	24%
Porirua	Car	14,683	15,671	7%	16,385	12%	16,103	10%
	PT	3,205	3,530	10%	3,214	0%	3,095	-3%
Kapiti	Car	13,458	14,861	10%	16,594	23%	17,773	32%
	PT	1,948	2,467	27%	2,194	13%	2,333	20%
Lower Hutt	Car	32,346	34,302	6%	35,660	10%	34,945	8%
	PT	6,325	6,933	10%	6,433	2%	6,142	-3%
Upper Hutt	Car	12,819	13,586	6%	13,815	8%	13,421	5%
	PT	2,179	2,318	6%	2,103	-4%	2,012	-8%
Wairarapa	Car	13,094	13,885	6%	14,273	9%	13,422	3%
	PT	710	791	11%	664	-6%	617	-13%
Region	Car	154,366	167,914	9%	179,350	16%	183,818	19%
	PT	29,660	34,735	17%	33,412	13%	33,170	12%

* Percentage difference in trips relative to 2011

Table 2-5: AM Peak Private Vehicle and PT Trips by TA Destination – Comparison with 2011

Period	Mode	2011	2021		2031		2041	
		Trips	Trips	% Diff*	Trips	% Diff*	Trips	% Diff*
Wellington	Car	72,558	78,937	9%	85,490	18%	91,201	26%
	PT	22,900	27,635	21%	26,735	17%	26,651	16%
Porirua	Car	13,249	14,345	8%	15,329	16%	15,038	13%
	PT	1,241	1,281	3%	1,185	-5%	1,145	-8%
Kapiti	Car	12,598	13,792	9%	14,784	17%	15,794	25%
	PT	1,159	1,241	7%	1,147	-1%	1,226	6%
Lower Hutt	Car	31,212	33,880	9%	35,616	14%	34,845	12%
	PT	2,945	3,089	5%	2,864	-3%	2,757	-6%
Upper Hutt	Car	11,227	12,238	9%	12,858	15%	12,494	11%
	PT	1,003	992	-1%	958	-4%	908	-9%
Wairarapa	Car	13,520	14,721	9%	15,273	13%	14,447	7%
	PT	412	497	21%	524	27%	482	17%
Region	Car	154,366	167,914	9%	179,350	16%	183,818	19%
	PT	29,660	34,735	17%	33,412	13%	33,170	12%

* Percentage difference in trips relative to 2011

The changes in AM peak mode shares are small for trips both from TAs (Table 2-6, Figure 2-3), and to TAs (Table 2-7, Figure 2-4). As noted previously for regional results, this reflects the relative changes in PT versus car costs and the introduction of RoNS after 2021.

Table 2-6: AM Peak Private Vehicle and PT Mode Share by TA Origin

Period	Mode	2011 Trips	2021 Trips	2031 Trips	2041 Trips
Wellington	Car	82%	80%	81%	82%
	PT	18%	20%	19%	18%
Porirua	Car	82%	82%	84%	84%
	PT	18%	18%	16%	16%
Kapiti	Car	87%	86%	88%	88%
	PT	13%	14%	12%	12%
Lower Hutt	Car	84%	83%	85%	85%
	PT	16%	17%	15%	15%
Upper Hutt	Car	85%	85%	87%	87%
	PT	15%	15%	13%	13%
Wairarapa	Car	95%	95%	96%	96%
	PT	5%	5%	4%	4%
Region	Car	84%	83%	84%	85%
	PT	16%	17%	16%	15%

Table 2-7: AM Peak Private Vehicle and PT Mode Share by TA Destination

Period	Mode	2011 Trips	2021 Trips	2031 Trips	2041 Trips
Wellington	Car	76%	74%	76%	77%
	PT	24%	26%	24%	23%
Porirua	Car	91%	92%	93%	93%
	PT	9%	8%	7%	7%
Kapiti	Car	92%	92%	93%	93%
	PT	8%	8%	7%	7%
Lower Hutt	Car	91%	92%	93%	93%
	PT	9%	8%	7%	7%
Upper Hutt	Car	92%	93%	93%	93%
	PT	8%	7%	7%	7%
Wairarapa	Car	97%	97%	97%	97%
	PT	3%	3%	3%	3%
Region	Car	84%	83%	84%	85%
	PT	16%	17%	16%	15%

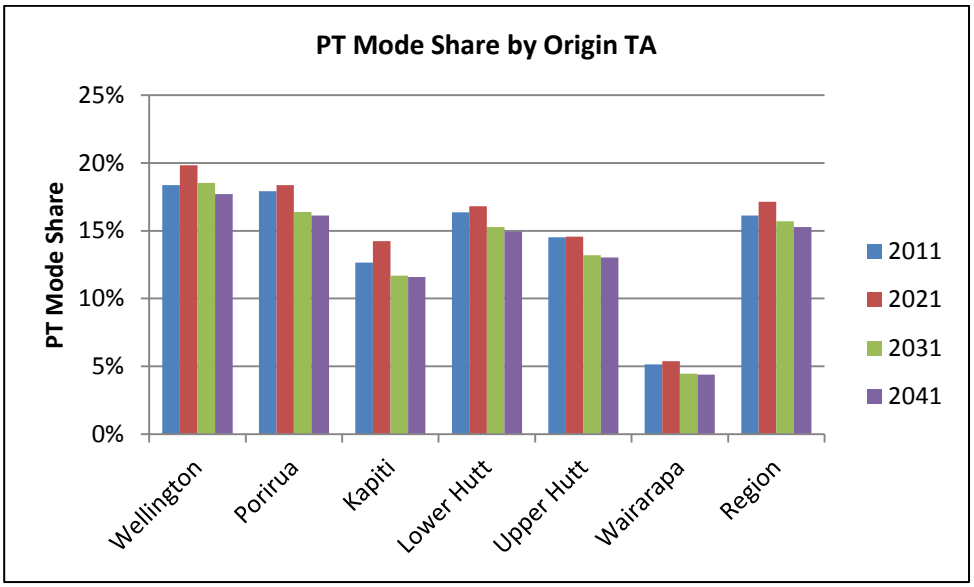

Figure 2-3: AM Peak Private Vehicle and PT Mode Share by Origin TA

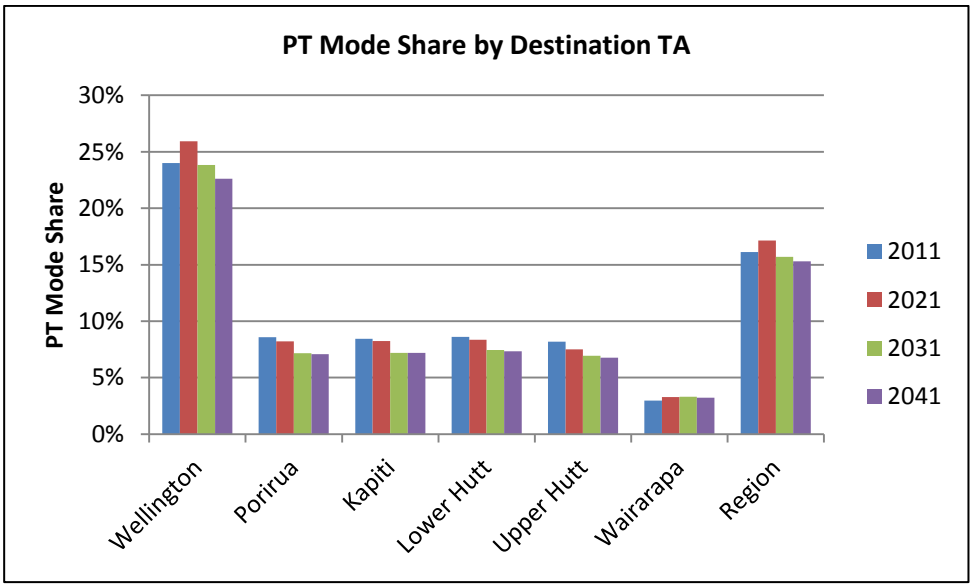

Figure 2-4: AM Peak Private Vehicle and PT Mode Share by Destination TA

Table 2-8 gives the percentage of AM peak trips that remain within each TA as a proportion of the total trips with an origin in each TA. For example, in 2001 89% of trips originating in Wellington City remain within the City while the remaining 11% are destined for a different TA. Generally the car proportions are higher than for PT, the exception being Wellington City. This is not unexpected given that it is for the AM peak where PT usage is dominated by commuting trips and relatively high rail usage for longer trips.

Table 2-8: Percentage of AM Peak Private Vehicle and PT Intra-TA Trips by TA

Period	Mode	2011 Trips	2021 Trips	2031 Trips	2041 Trips
Wellington	Car	89%	89%	87%	88%
	PT	96%	95%	95%	95%
Porirua	Car	63%	64%	61%	61%
	PT	28%	24%	25%	24%
Kapiti	Car	85%	85%	81%	81%
	PT	41%	34%	38%	38%
Lower Hutt	Car	74%	75%	72%	71%
	PT	35%	32%	31%	31%
Upper Hutt	Car	68%	69%	69%	68%
	PT	35%	31%	32%	32%
Wairarapa	Car	96%	96%	95%	96%
	PT	50%	47%	50%	48%
Region	Car	82%	82%	81%	81%
	PT	66%	66%	67%	68%

2.4 Commuting Trips by Mode and Mode Share

The daily commuting home based work trips in one direction during the AM peak by mode for 2011, 2021, 2031 and 2041 are presented as follows:

- The total number of trips by each mode (Table 2-9 and Figure 2-5); and
- Mode share for commuting trips (Table 2-10 and Figure 2-6).

Table 2-9 and Figure 2-5 shows that commuting by car increases more than PT in both absolute and percentage terms, though the percentage increases are quite similar. This will be related to all the key drivers of travel, but particularly increasing car ownership over time and to how the relative costs of travel by car and PT change.

Active mode commuting trips (walking and cycling) increase at a lower rate than car or PT, which reflects increasing car ownership, and the wider spread of population and employment growth resulting in longer trips being made.

Table 2-9: Daily Commuting Trips (HBW/AM Peak) by Mode –Comparison with 2011

Mode	2011 Trips	2021 Trips	2021 % Diff*	2031 Trips	2031 % Diff*	2041 Trips	2041 % Diff*
Car	209,146	233,995	12%	252,330	21%	261,262	25%
PT	46,976	57,605	23%	56,127	19%	54,569	16%
Active	25,903	27,811	7%	27,450	6%	26,851	4%
Total	282,025	319,411	13%	335,908	19%	342,681	22%

* Percentage difference in trips relative to 2011

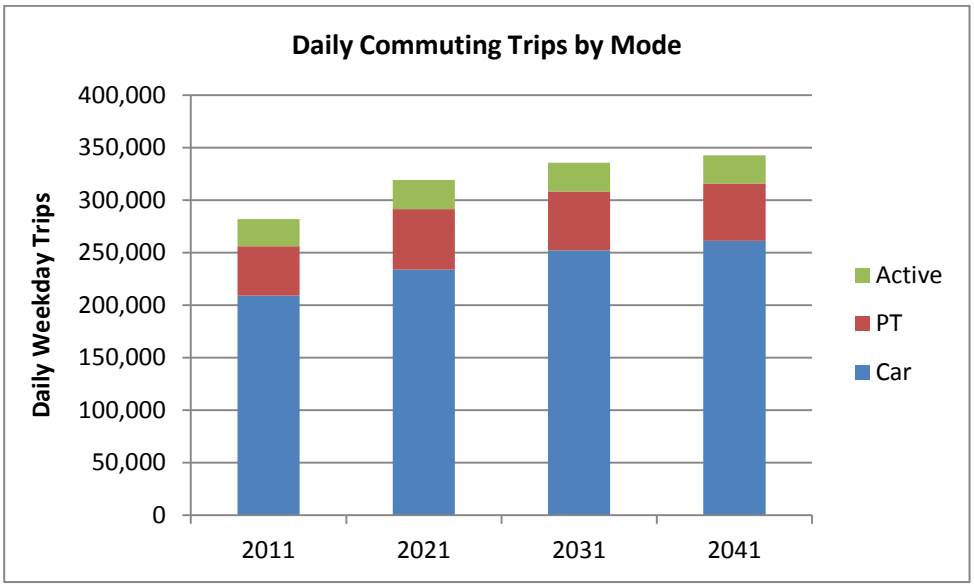

Figure 2-5: Daily Commuting Trips (HBW/AM Peak) by Mode

Table 2-10 and Figure 2-6 show that, similar to the above results, there are small changes in mode shares for commuting trips between 2011 and the forecasts.

Table 2-10: Daily Commuting Mode Share

Mode	2011	2021	2031	2041
Car	74%	73%	75%	76%
PT	17%	18%	17%	16%
Active	9%	9%	8%	8%

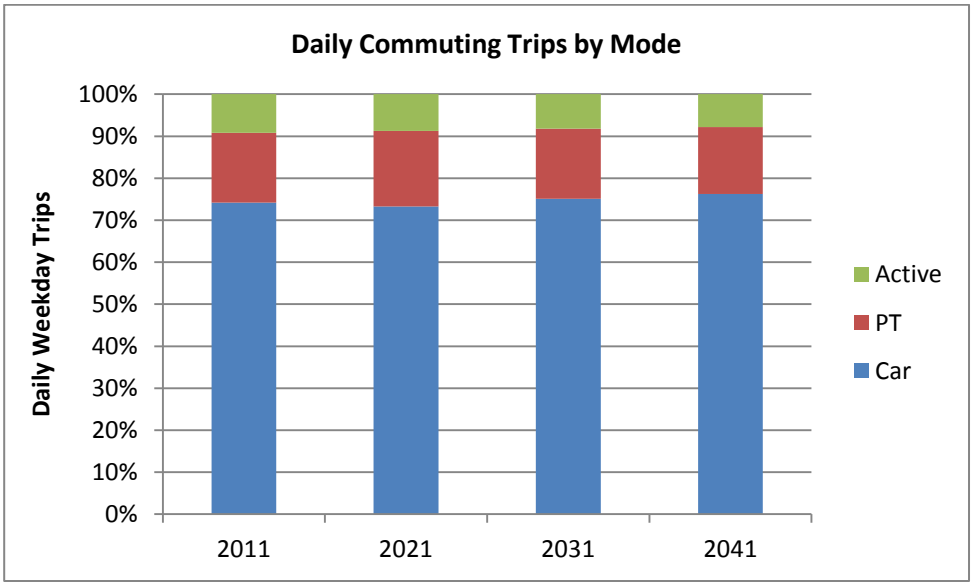

Figure 2-6: Daily Commuting Mode Share

2.5 AM Peak Trips to the CBD by Mode and Mode Shares

AM peak trips to the Wellington CBD from each Territorial Authority are summarised in this section, as follows:

- Table 2-11 contains the number of trips private vehicles and PT from each TA to the CBD; and
- Table 2-12 and Figure 2-7 summarises the mode share (split between private vehicles and PT) for trips to the CBD from each Territorial Authority.

Table 2-11 shows that AM peak trips to the Wellington CBD generally increase by both car and PT, which is a reflection of ongoing growth in CBD employment. The largest absolute increases are from within Wellington City, which is a reflection of continued growth within the City, including a higher rate within the CBD itself (though the absolute numbers are low).

The initial increases between 2011 and 2021 are greater for PT than car, which is a reflection of the relative increase in car and PT costs with car costs increasing at a faster rate than PT fares. However, PT travel to the Wellington CBD between 2021 and 2041 then flattens out for trip originating in Wellington while Kapiti Coast PT demand nearly halves. Again, as mentioned earlier in the text is a direct result of the introduction of the RoNS projects which forecast to greatly reduce travel times down SH1 in Wellington.

Table 2-11: AM Peak Private Vehicle and PT Trips to Wellington CBD by TA Origin – Comparison with 2011

TA	Mode	2011	2021		2031		2041	
		Trips	Trips	% Diff*	Trips	% Diff*	Trips	% Diff*
Wellington	Car	21,088	22,696	8%	24,626	17%	27,102	29%
	PT	9,255	11,982	29%	12,252	32%	12,052	30%
Porirua	Car	1,481	1,431	-3%	1,448	-2%	1,501	1%
	PT	1,741	2,093	20%	1,919	10%	1,835	5%
Kapiti	Car	424**	401	-5%	526	24%	597	41%
	PT	1,002	1,439	44%	1,184	18%	1,256	25%
Lower Hutt	Car	2,847	2,680	-6%	2,950	4%	3,024	6%
	PT	3,237	3,740	16%	3,541	9%	3,355	4%
Upper Hutt	Car	682	566	-17%	601	-12%	618	-9%
	PT	906	1,003	11%	916	1%	877	-3%
Wairarapa	Car	27*	18	-31%	14	-47%	13	-51%
	PT	28	20	-30%	13	-54%	13	-53%
Region	Car	26,548	27,792	5%	30,164	14%	32,854	24%
	PT	16,168	20,276	25%	19,825	23%	19,388	20%

* Percentage difference in trips relative to 2011
**number appears low but is consistent with the forecasting report prepared by SKM in 2008.

Table 2-12 and Figure 2-7 show that there are generally only small changes in car and PT mode shares from the TAs closer to the CBD (Hutt, Porirua, Wellington), and more significant changes from the outlying TAs particularly Wairarapa and Kapiti. Again the reason for this can be attributed to the impact of Wellington RoNS.

Table 2-12: AM Peak Private Vehicle and PT Mode Share to Wellington CBD by TA Origin

TA	Mode	2011 Trips	2021 Trips	2031 Trips	2041 Trips
Wellington	Car	69%	65%	67%	69%
	PT	31%	35%	33%	31%
Porirua	Car	46%	41%	43%	45%
	PT	54%	59%	57%	55%
Kapiti	Car	30%	22%	31%	32%
	PT	70%	78%	69%	68%
Lower Hutt	Car	47%	42%	45%	47%
	PT	53%	58%	55%	53%
Upper Hutt	Car	43%	36%	40%	41%
	PT	57%	64%	60%	59%
Wairarapa	Car	49%	48%	52%	50%
	PT	51%	52%	48%	50%
Region	Car	62%	58%	60%	63%
	PT	38%	42%	40%	37%

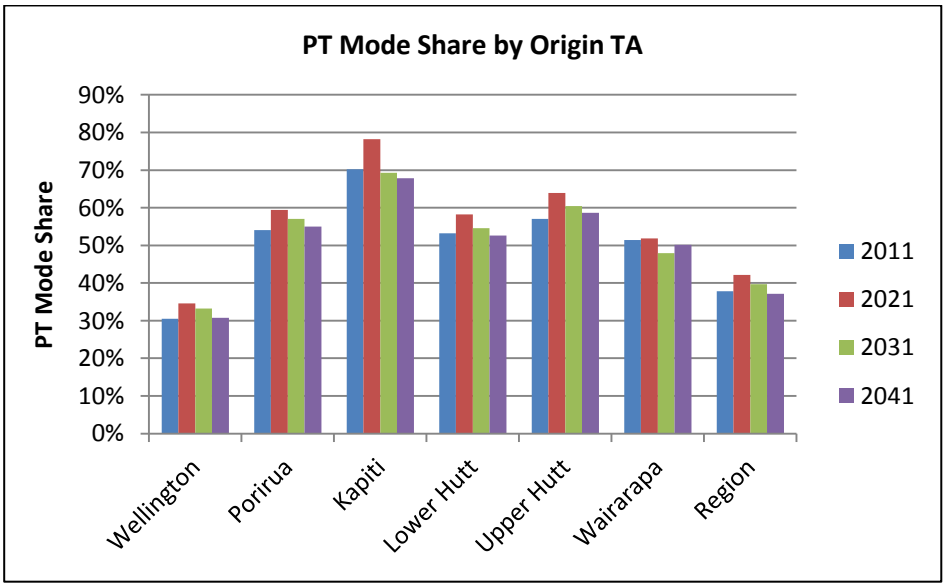

Figure 2-7: AM Peak Private Vehicle and PT Mode Shares to Wellington CBD by TA

3 Heavy Commercial Vehicle Trips

This section presents data on Heavy Commercial Vehicle (HCV) trips; in doing so it is important to understand that these trips are modelled as a fixed demand matrix in a particular year, that is, they do not vary with changes to the transport system.

3.1 HCV Trips by Period

Table 3-1 gives total HCV trips by period in 2011 and the forecast years while Figure 3-1 shows the inter peak 2-hour average HCV trips graphically.

These show that HCV trips increase uniformly from 2011 to 2041 in all three modelled periods to be 67% higher by 2041. In contrast person trips are forecast to increase by 16% respectively over the same time. The growth in HCV trips is generated not only by demographic growth, particularly employment, but also by growth in the economy.

Employment is forecast to grow by 15% between 2011 and 2041, while growth in the economy is measured in terms of the Gross Domestic Product (GDP) per capita which is assumed to increase at 1.8% per annum. The combined effect is annual growth in HCV trips of about 2.2% p.a. from 2011 to 2041.

Table 3-1: HCV Trips by Period –Comparison with 2011

	2011	2021		2031		2041	
Peak	Trips	Trips	% Diff*	Trips	% Diff*	Trips	% Diff*
AM	10,557	13,319	26%	15,477	47%	17,625	67%
IP	9,519	11,991	26%	13,930	46%	15,785	66%
PM	9,074	11,462	26%	13,320	47%	15,195	67%

* Percentage difference in trips relative to 2011

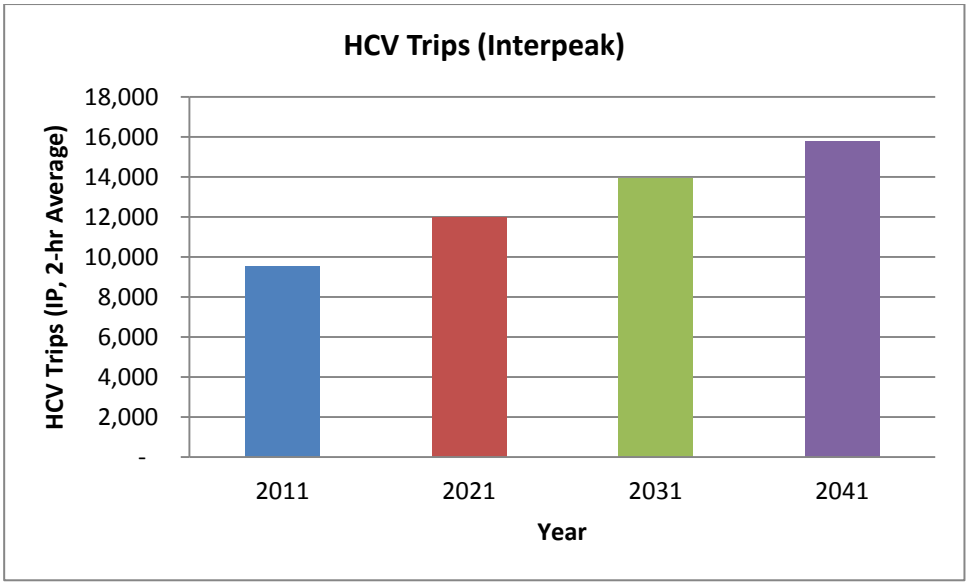

Figure 3-1: HCV Trips, Inter Peak 2-hour Average

3.2 HCV Trips by TA

Table 3-2 gives the inter peak HCV trips by TA of origin in 2011 and the forecast years. Figure 3-2 shows this graphically.

The growth in HCV trips is fairly evenly spread reflecting the even spread in employment growth generally and in the type of employment. Kapiti and Wellington are forecast to experience a higher growth rate (78-88%) and the remaining districts lower growth rates (48-59%). Predictions for growth in employment for others areas is low and as a result, HCV trips are lower relative to Wellington and Kapiti.

Table 3-2: Inter Peak HCV Trips by TA Origin –Comparison with 2011

	2011	2021		2031		2041	
TA	Trips	Trips	% Diff*	Trips	% Diff*	Trips	% Diff*
Wellington	4,018	5,188	29%	6,071	51%	7,168	78%
Porirua	1,253	1,571	25%	1,818	45%	1,987	59%
Kapiti	688	921	34%	1,080	57%	1,291	88%
Lower Hutt	1,984	2,365	19%	2,703	36%	2,939	48%
Upper Hutt	654	808	24%	936	43%	1,012	55%
Wairarapa	922	1,138	23%	1,321	43%	1,388	51%

* Percentage difference in trips relative to 2011

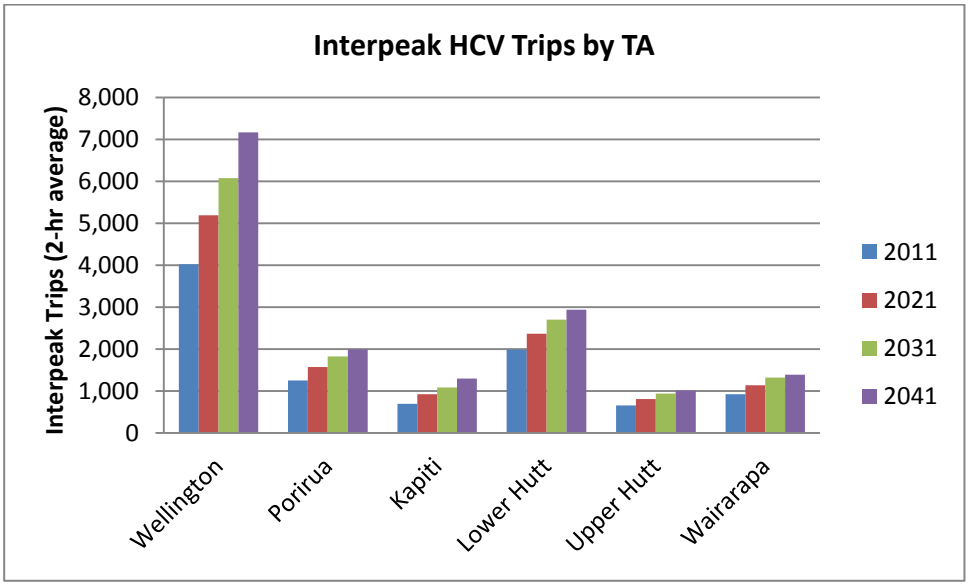

Figure 3-2: HCV Trips by TA Origin, Inter Peak 2-hour Average

4 Road Network Statistics

4.1 Network Statistics

The following road network statistics for 2011, 2021, 2031 and 2041 have been summarised (excluding HCV's):

- Private vehicle trips (i.e. all trips by light vehicles);
- The amount of vehicle travel on the network in vehicle-kilometres (veh-km);
- The network travel time in vehicle-minutes (veh-min); and
- Average travel distance, time, and speed.

They are presented as follows:

- Statistics for each year and the differences between 2011 and each forecast year (Table 4-1); and
- In graphical form for the AM peak of 2011 and the forecast years the vehicle-km, vehicle-min, and average speed (Figure 4-1).

Table 4-1 shows that network travel (veh-km) and travel time (veh-min) by private vehicle (car) increase in all modelled time periods between 2011, 2021, 203 and 2041. There is a greater increase in travel time (veh-min) than vehicle kilometres travelled (veh-km) in the peak periods, which is reflected in lower average speeds, and suggests slight increases in peak period congestion.

This also occurs in the inter peak period but to a lesser extent; the inter peak average speed changes by -3% by 2041 compared with -4% in the two peak periods.

The average trip distances change only slightly in all cases.

Table 4-1: Road Network Statistics –Comparison with 2011

	2011	2021		2031		2041	
	Value	Value	% Diff*	Value	% Diff*	Value	% Diff*
AM							
Car Trips	158,829	172,985	9%	184,145	16%	188,619	19%
Veh-min	1,581,648	1,681,548	6%	1,867,656	18%	1,985,292	26%
Veh-km	1,261,876	1,332,437	6%	1,508,200	20%	1,527,282	21%
Av Time (min)	10.0	9.7	-2%	10.1	2%	10.5	6%
Av Distance (km)	7.9	7.7	-3%	8.2	3%	8.1	2%
Av Speed (kph)	47.9	47.5	-1%	48.5	1%	46.2	-4%
IP							
Car Trips	145,698	157,428	8%	167,761	15%	171,428	18%
Veh-min	958,878	1,003,518	5%	1,150,908	20%	1,170,900	22%
Veh-km	853,552	885,820	4%	1,014,403	19%	1,015,942	19%
Av Time (min)	6.6	6.4	-3%	6.9	4%	6.8	4%
Av Distance (km)	5.9	5.6	-4%	6.0	3%	5.9	1%
Av Speed (kph)	53.4	53.0	-1%	52.9	-1%	52.1	-3%
PM							
Car Trips	187,843	202,663	8%	216,661	15%	221,377	18%
Veh-min	1,678,146	1,778,178	6%	2,035,578	21%	2,119,194	26%
Veh-km	1,329,354	1,396,065	5%	1,594,075	20%	1,610,572	21%
Av Time (min)	8.9	8.8	-2%	9.4	5%	9.6	7%
Av Distance (km)	7.1	6.9	-3%	7.4	4%	7.3	3%
Av Speed (kph)	47.5	47.1	-1%	47.0	-1%	45.6	-4%

* Percentage difference relative to 2011

Figure 4-1 shows graphically the changes in AM peak private vehicle network travel (veh-km), travel time (veh-min) and average speed between 2011 and the forecast years. The impact of the RoNS projects is evident between 2021 and 2031 with the increase in average speeds on the network. While this increase is small (1kph), when analysed with consideration of the increase in traffic, it shows that the RoNS project does provide a substantial improvement in the network when you consider that these results relate to the entire region.

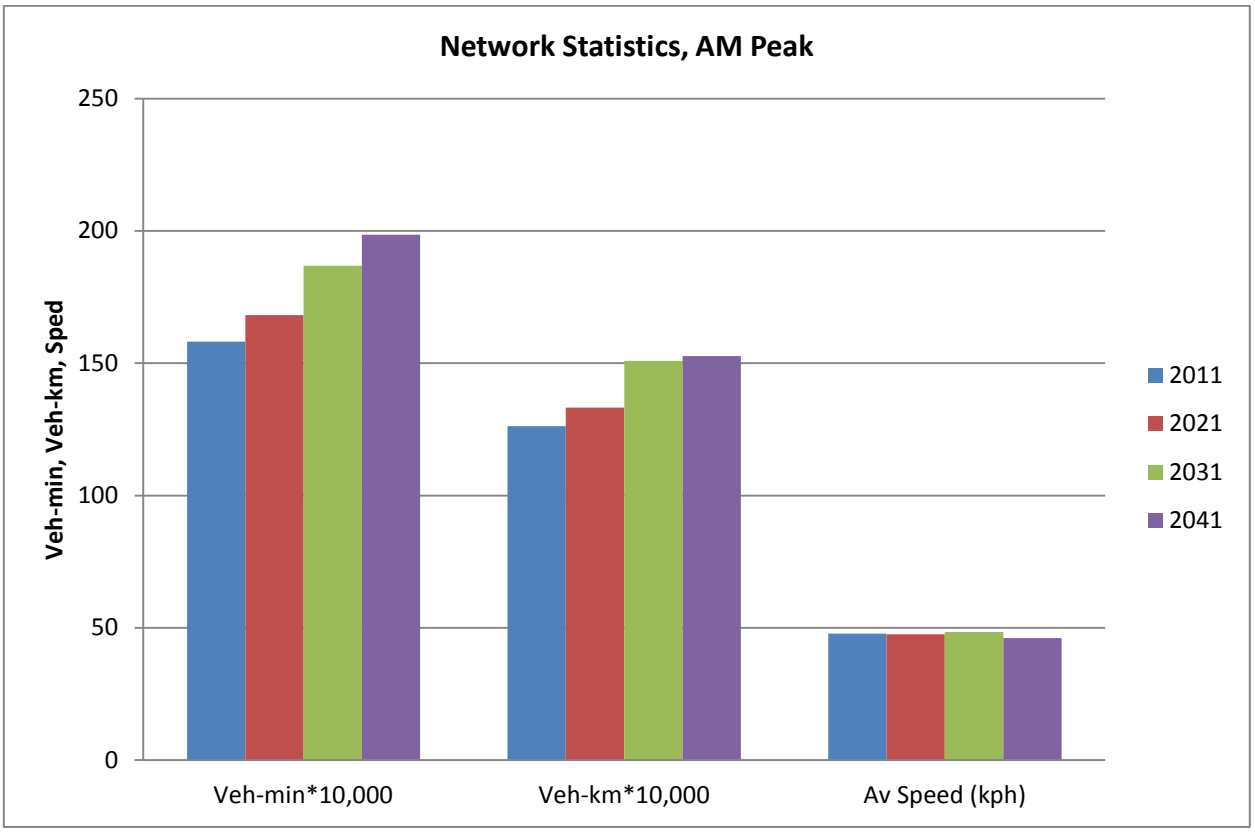

Figure 4-1: Network Statistics, AM Peak

4.2 Traffic Volumes Across Screenlines

Traffic volumes across the screenlines used in model validation have been extracted from the models and compared.

Figure 4-2 shows the location of the screenlines and Appendix A contains the traffic volumes crossing the screenlines for 2011 and the forecast years.

The first table in Appendix A shows that the traffic volumes increase across all screenlines in all three modelled time periods. The magnitude and rate of growth varies; some of the largest increases occur across the Northern Porirua screenline (W1) in all three modelled periods. The growth across most screenlines is around 20-30% by 2041, but some have markedly lower increases.

W4 (south of Ngauranga) and L1 (SH2 north of Ngauranga) have low growth in the peak directions, for example 3-5% in the AM peak southbound in 2026. The other Hutt corridor screenlines (L2, L3, L4, and U2) also have lower growth in the peak directions, though not noticeably so.

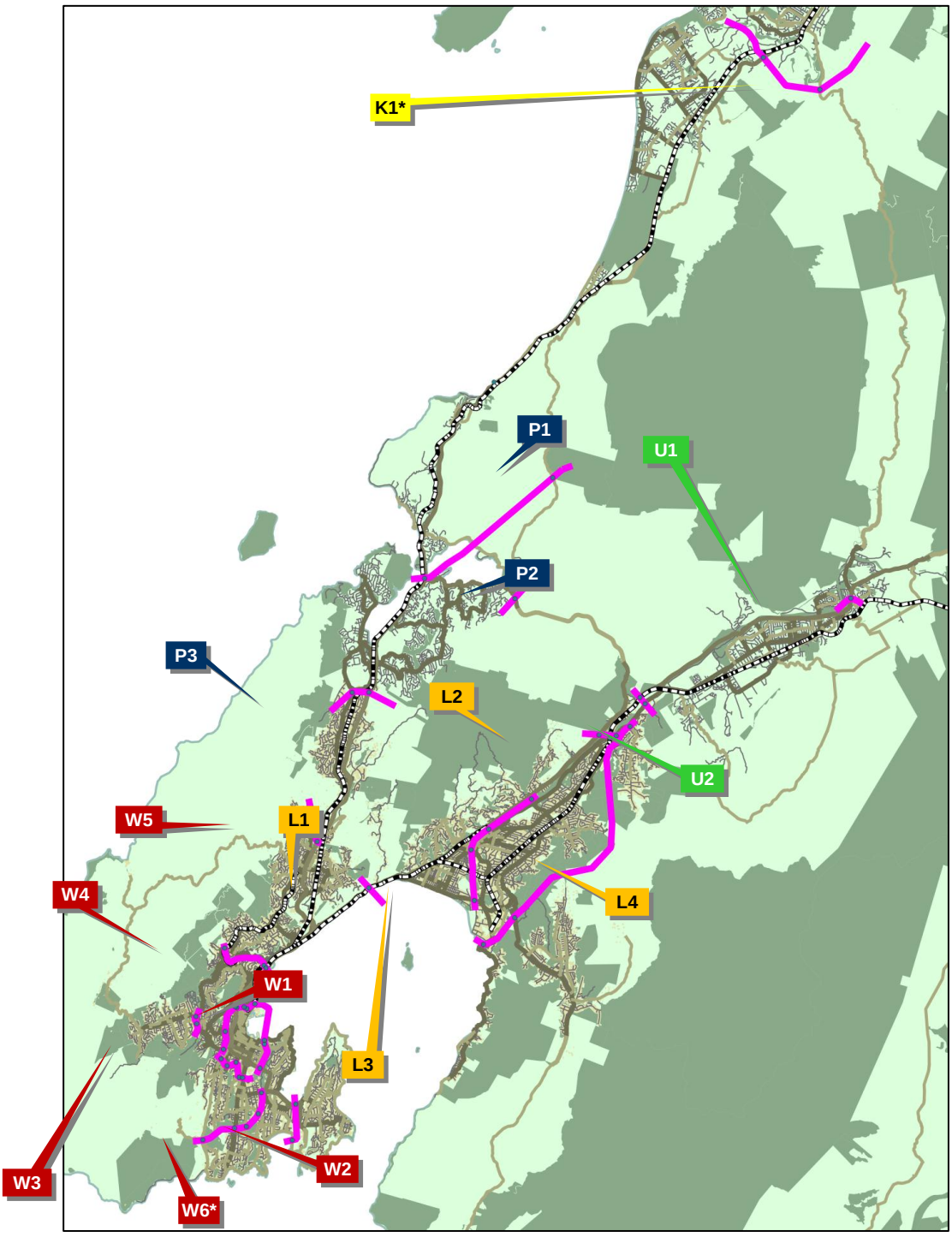

Figure 4-2: Screenline Locations

4.3 Travel Times

The cumulative travel times on SH1 (Waikanae to Wellington CBD)[1] and SH2 (Upper Hutt to Wellington CBD) southbound in the AM peak for 2011 and the forecast years are shown in Figure 4-3 in and Figure 4-4 respectively.

[1] Note – routes have been kept the same even with the introduction of Transmission Gully. This was to make the comparisons easier so 2031 and 2041 routes still follow the old coastal route.

On the existing SH1:

- All forecasts show similar travel time to 2011 until about 15 km (just north Paekakariki Hill Road), at which point the SH1 RoNS begin to exert influence; and
- 2031 shows significant improvement in travel times with a slight decline evident in 2041 as increasing demand begins to erode the gains made by the introduction RoNS post 2021.

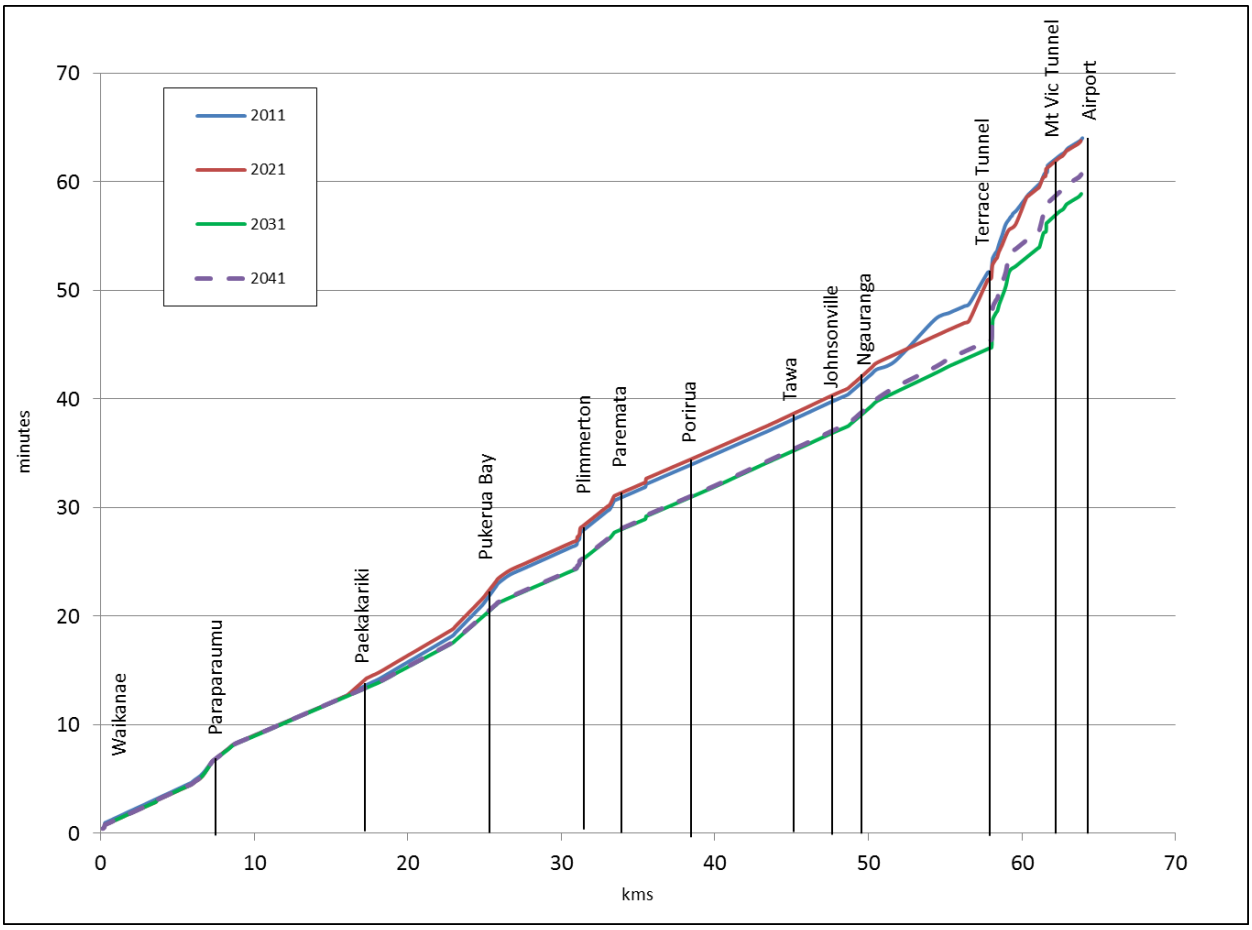

Figure 4-3: Travel Time, SH1, Waikanae to Wellington, Southbound, AM Peak

On SH2:

- The travel times between the start of the route at Upper Hutt to about 24km, between Petone and Ngauranga, are similar with the cumulative forecast times within a minute of that in 2011; and
- At this point the forecast travel times improve as RoNS begin to take effect. As noted above L1 screenline south of Petone on SH2 indicates a decrease in forecast volumes resulting from demand being drawn onto the Petone to Grenada link.

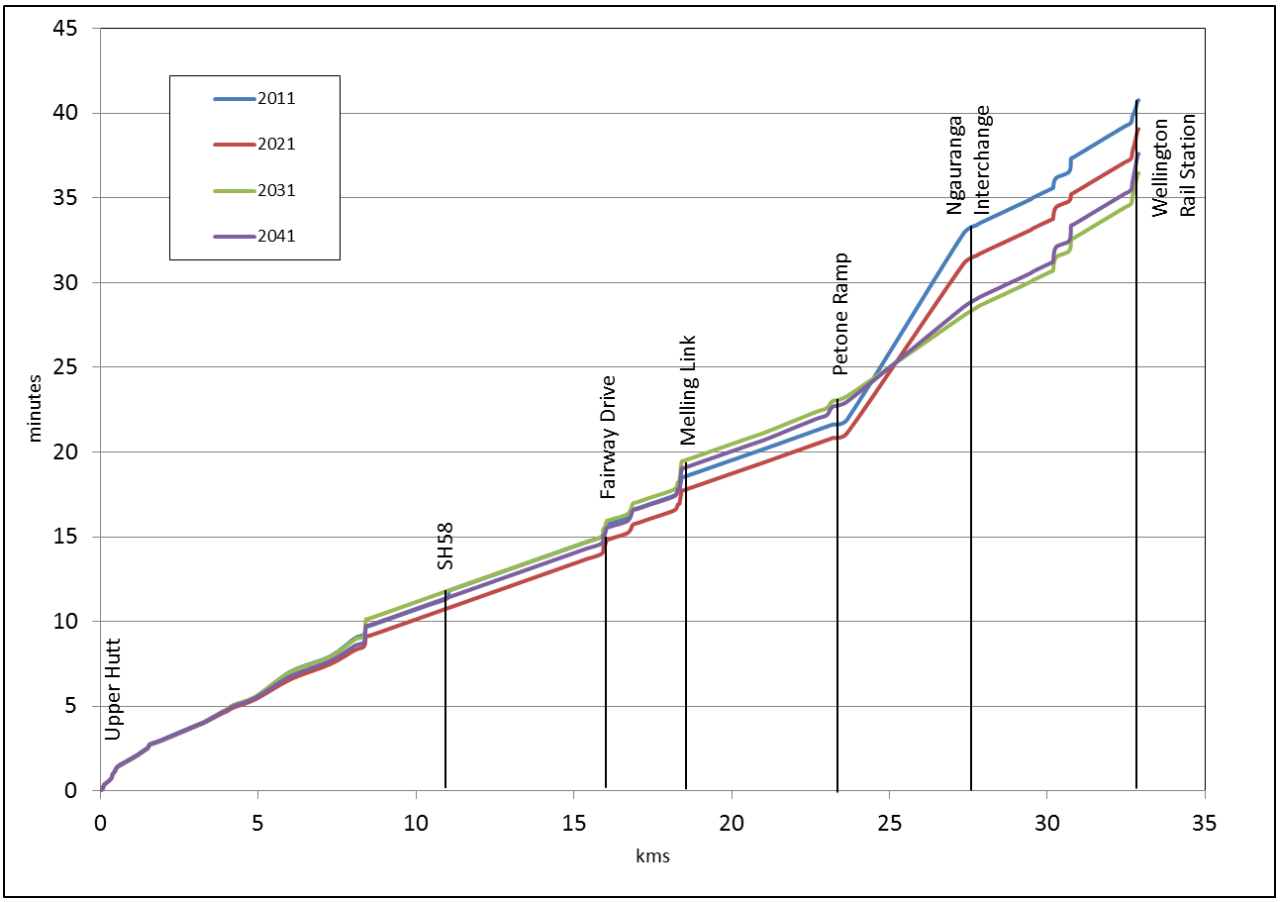

Figure 4-4: Travel Time, SH2, Upper Hutt to Wellington, Southbound, AM Peak

4.4 Congestion Points

Information on congestion points in the network are given in two ways:

- Volume-to-capacity ratios at identified key congestion points; and
- Plots of level of service (LOS).

Key congestion points have been identified in the 2011 network and are measured in terms of volume to capacity ratio. In some cases these show up in the model as extending over some distance, and the location presented below is representative of the wider congestion point.

The volume-to-capacity ratio at these sites has also been determined for 2011 and the forecast years and is summarised in Table 4-2 and Figure 4-5.

These show that there is a marked improvement at the following locations:

- The Terrace Tunnel - due to tidal flow arrangement; and
- SH1 in the vicinity of Mana – which will be due to the traffic taken off SH1 by Transmission Gully.

At other locations there is little or no improvement in congestion level:

- The effect of the additional lane on SH1 south of Ngauranga is small as the extra capacity due to the post 2021 RoNS gives rise to higher traffic volumes;
- There is an initial sharp increase between 2011 and 2021 in VC ratios the Mt Victoria Tunnel area before reducing sharply with the construction of the Mt Victoria Tunnel Duplication; and
- SH2 by Petone becomes worse after 2021 due to increased volumes as a result of the Grenada to Petone Project and the interaction and attraction to the Petone interchange.

Table 4-2: Volume-to-capacity Ratios at Key Bottlenecks, AM Peak

	2011	2021	2031	2041
Mt Victoria Tunnel	1.0	1.2	0.9	0.9
Terrace Tunnel	1.0	1.0	0.7	0.7
SH1 (south of Ngauranga)	1.0	0.8	0.9	0.9
SH1 (north of Ngauranga)	0.7	0.8	0.7	0.7
SH2 (north of Ngauranga)	1.0	1.0	1.0	1.0
SH2 Western Hutt Rd (by Petone)	0.7	0.7	0.9	0.9
SH2 Western Hutt Rd (north of Fergusson Dr)	0.9	0.9	0.9	0.9
SH1 (north of Mana Bridge)	0.5	0.6	0.4	0.4

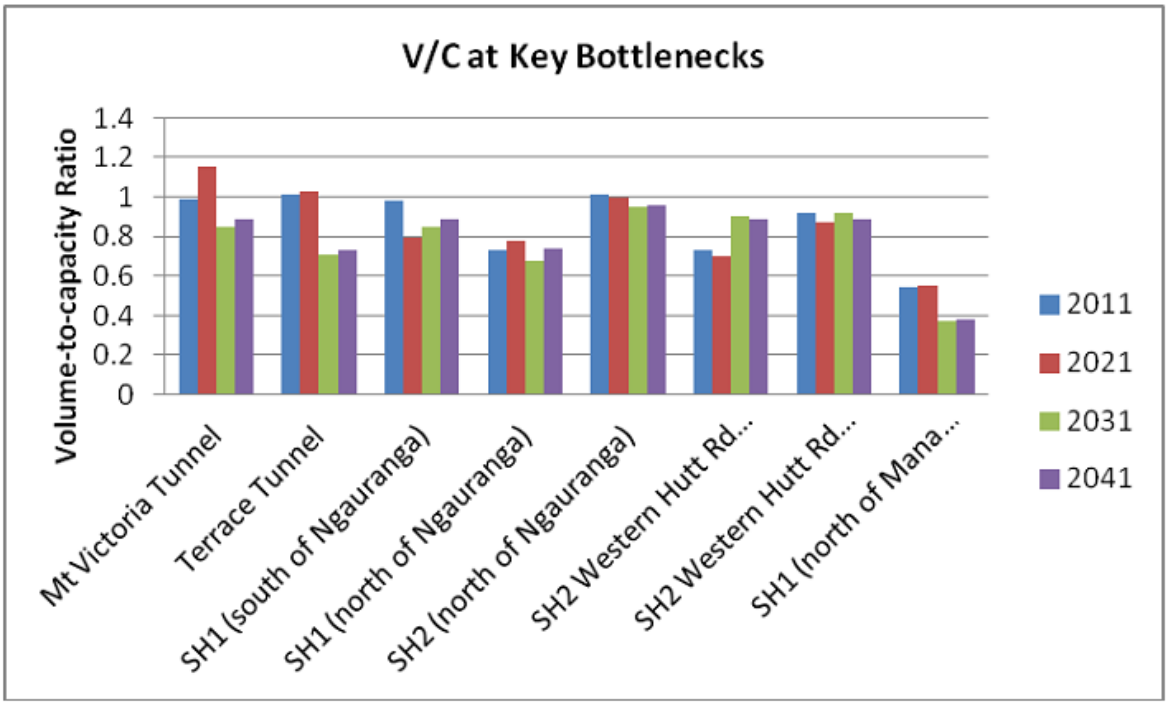

Figure 4-5: Volume-to-capacity Ratios at Key Bottlenecks, AM Peak

The level of service (LOS) has been determined for each link in the network, and then grouped into three categories:

- LOS A or B (free flow conditions, corresponding to volume-to-capacity ratio of < 0.40);
- LOS C or D (interrupted conditions corresponding to volume-to-capacity ratio between 0.40 and 0.80); and
- LOS E or F (congested conditions corresponding to volume-to-capacity ratio of >0.80).

Plots of the network showing these three categories are given in Appendix B. Three plots are given for each year/network showing the CBD and surrounds, the Ngauranga-Petone area, and Porirua-Kapiti-Hutt.

5 Public Transport Boardings

Table 5-1 gives total bus boardings, rail boardings by line, and rail alightings at Wellington Station in 2011 and the forecast years.

Table 5-1: PT Boardings –Difference with 2011

	2011	2021		2031		2041	
	Value	Value	% Diff*	Value	% Diff*	Value	% Diff*
Bus Boardings							
AM	17,025	20,236	19%	19,655	15%	19,527	15%
IP	5,924	6,502	10%	6,195	5%	6,300	6%
PM	12,487	17,106	37%	15,046	20%	14,900	19%
Rail Boardings							
AM							
Johnsonville	1,452	1,986	37%	2,016	39%	2,062	42%
Hutt	6,418	7,046	10%	6,509	1%	6,357	-1%
Kapiti	5,443	6,793	25%	6,242	15%	6,389	17%
Total	13,313	15,825	19%	14,767	11%	14,808	11%
IP							
Johnsonville	325	373	15%	371	14%	392	21%
Hutt	1,024	1,071	5%	1,045	2%	1,029	0%
Kapiti	1,067	1,199	12%	1,116	5%	1,164	9%
Total	2,416	2,643	9%	2,532	5%	2,585	7%
PM							
Johnsonville	1,193	1,532	28%	1,592	33%	1,623	36%
Hutt	4,642	5,045	9%	5,037	9%	4,880	5%
Kapiti	4,263	3,990	-6%	4,850	14%	4,929	16%
Total	10,098	10,567	5%	11,479	14%	11,432	13%
Rail Alightings at Wellington Station							
AM	9,858	12,006	22%	10,853	10%	10,873	10%
IP	778	853	10%	834	7%	861	11%
PM	861	900	5%	1,119	30%	1,160	35%

* Percentage difference relative to 2011

Bus boardings show a substantial increase between 2011 and 2021 reflecting the fact that car vehicle operating costs (VoC) increase at a faster rate than PT fares. However, this flattens out after 2021 with the introduction of the Wellington RoNS. The same pattern is reflected across all periods.

The pattern of PT patronage growth is then repeated on rail with substantial increases up to 2021 and flat growth between 2021 and 2041. The Johnsonville line in particular experiences a large surge (+37%) in the morning peak by 2021 which perhaps reflect the combination of lower increases in PT fares than VoC and increasing congestion from car traffic. This is counterbalanced by the low growth in the Hutt and Kapiti Coast – low growth in the Hutt is driven by low population growth while low growth in Kapiti Coast after 2021 is driven by the introduction of the RoNS.

6 Regional Land Transport Strategy Measures

This section presents selected modelled outputs as measures related to RLTS objectives and comments on the change from 2011. The objectives commented on are:

- Assist economic and regional development;
- Improve access, mobility and reliability;
- Protect and promote public health; and
- Ensure environmental sustainability.

The Safety and Personal Security objective has not been considered here as this requires crash rates to be allocated to every link in every network modelled, including changes in rates resulting from safety improvements.

6.1 Assist Economic and Regional Development

The average cost of travel per kilometre and per trip are the measures used for Economic and Regional Development on the basis that lower cost/km or /trip are positive effects. These have been considered by mode (private vehicle, PT and HCV) and modelled period. Cost has been defined as the generalised cost, so includes time and operating costs, parking costs, fares, and inconvenience costs (eg PT transfers).

Table 6-1 and Table 6-2 give the costs per kilometre and per trip respectively for 2011 and each forecast year while Figure 6-1 and Figure 6-2 present the data graphically. These statistics are weighted by the trips made in each case.

PT costs per km and per trip are significantly higher (approximately 2 times in the peaks and approximately 3 times in the inter peak) than car costs, some of which will be due to the high weighting placed on walking to and from PT, waiting for PT and transferring between services. The PT costs do however drop between 2011 and 2021 due to impacts associated with the Wellington City Bus Review.

HCV costs experience similar change to vehicles with slight increases in forecasting, which is largely due to the generalised minutes and the HCV value of time being high.

Table 6-1: Travel Cost per Kilometre (generalised minutes/km)

Mode	Period	2011	2021	2031	2041
Vehicle	AM	2.50	2.85	2.89	3.17
	IP	2.35	2.70	2.77	3.00
	PM	2.49	2.84	2.91	3.17
PT	AM	4.52	4.39	4.50	4.52
	IP	6.21	5.91	5.95	5.95
	PM	5.13	4.76	4.74	4.72
HCV	AM	2.42	2.75	2.81	3.08
	IP	2.29	2.62	2.71	2.94
	PM	2.38	2.72	2.80	3.05

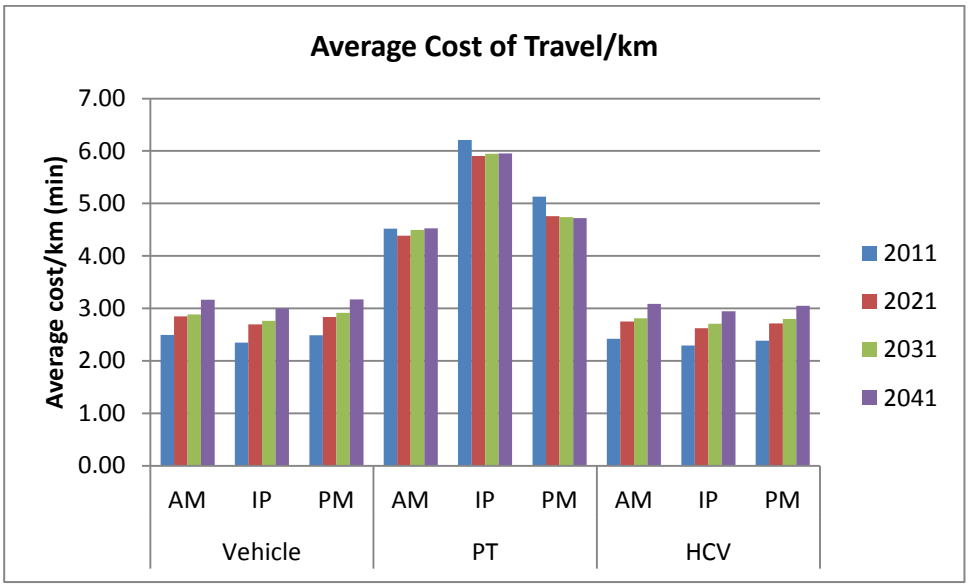

Figure 6-1: Travel Cost per Kilometre (generalised minutes/km)

Table 6-2: Travel Cost per Trip (generalised minutes/trip)

Mode	Period	2011	2021	2031	2041
Vehicle	AM	20.82	23.05	24.67	26.72
	IP	15.03	16.58	18.12	19.27
	PM	18.68	20.75	22.60	24.30
PT	AM	65.52	66.23	64.60	65.32
	IP	68.72	71.96	71.75	72.01
	PM	73.24	72.23	70.50	70.94
HCV	AM	25.39	29.18	29.34	31.98
	IP	24.01	27.82	28.18	30.39
	PM	26.17	30.23	30.57	33.31

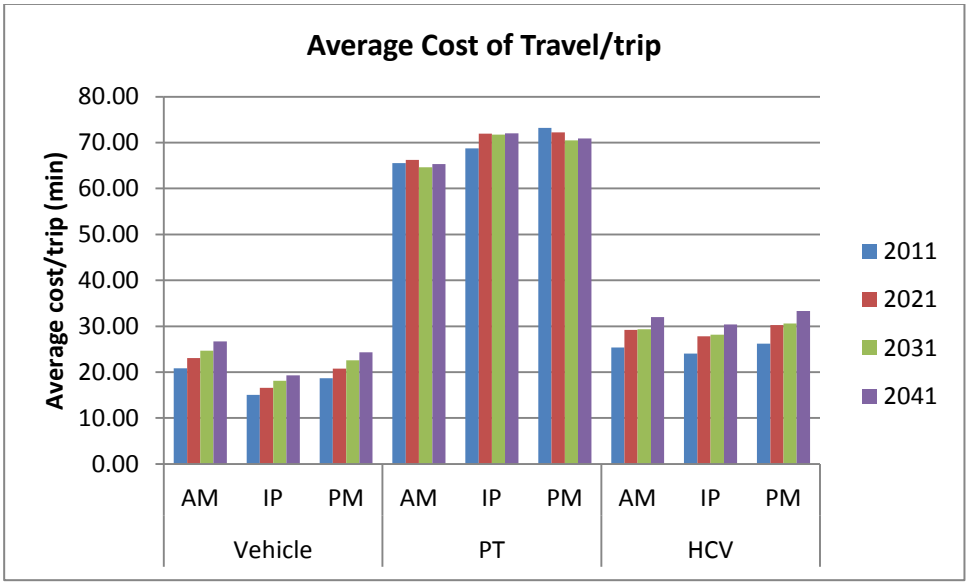

Figure 6-2: Travel Cost per Trip (generalised minutes/trip)

6.2 Improve Access, Mobility and Reliability

The access, mobility and reliability objective has been measured in two ways:

- Average speed by mode and time period; and
- Vehicle-kilometres of travel below level of service (LOS) D, where LOS D reflects the level at which congestion can significantly impact on travel time reliability.

Table 6-3 and Figure 6-3 show the average speeds for 2011 and the forecast years.

This shows that car speeds slowly deteriorate for each modelled year, although this is less pronounced between 2021 and 2031 (there is actually a slight increase in the AM Peak) because of the implementation of the RoNS.

The HCV speeds are higher than those for car as HCVs generally use a higher proportion of the strategic network which has higher speed levels.

The average PT speeds are based on journey time including access and egress time (walking to and from PT), waiting time and time on the bus, train or ferry. These components of journey time have a significant effect and account for much of the difference between private vehicle and PT speeds. The average PT speeds decreases slightly over time, although there is a small increase between 2011 and 2021, caused by the Wellington City Bus Review resulting in slightly lower waiting times for most passengers.

Table 6-3: Average Speed (kph) by Mode and Period

Mode	Period	2011	2021	2031	2041
Vehicle	AM	47.9	47.5	48.5	46.2
	IP	53.4	53.0	52.9	52.1
	PM	47.5	47.1	47.0	45.6
Bus	AM	20.1	21.0	20.6	19.8
	IP	25.2	25.6	25.0	24.7
	PM	20.5	21.8	20.7	20.0
Rail	AM	51.6	50.6	50.0	50.0
	IP	51.2	51.8	52.2	52.2
	PM	54.1	53.1	53.1	53.1
HCV	AM	51.2	51.3	51.6	49.3
	IP	59.0	59.3	58.1	57.5
	PM	51.7	51.6	50.5	48.8

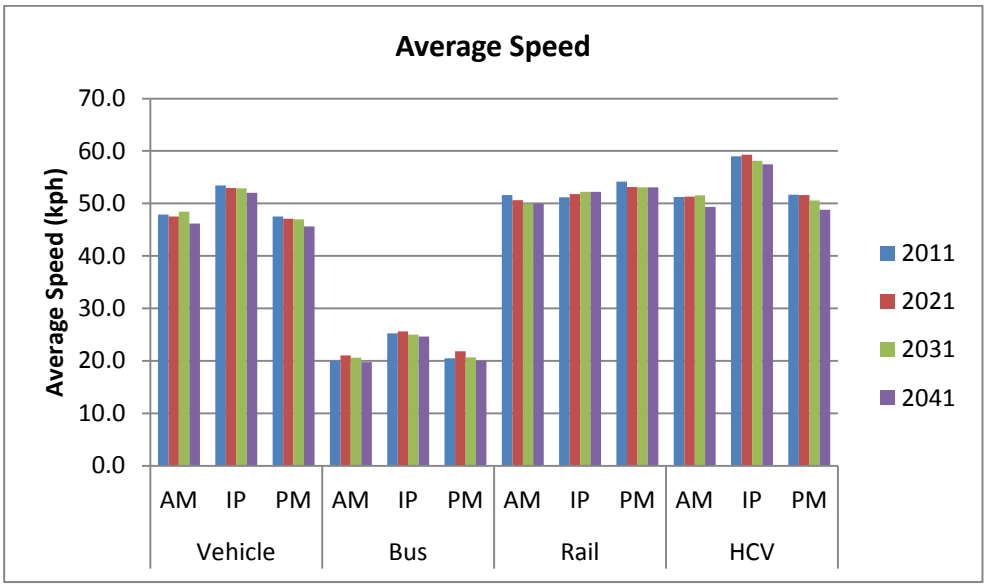

Figure 6-3: Average Speed by Mode and Period

Table 6-4 gives the amount of travel (measured as veh-km) occurring in congested conditions (i.e. worse than LOS D) by TA and in total in 2011 and the forecast years for each of the modelled periods. Figure 6-4 and

Figure 6-5 show this graphically for the region by each modelled period and in the AM peak for each TA, respectively.

They show that the amount of regional congested travel increases in the forecast years compared with 2011, especially between 2021 and 2031, for all three modelled periods although levels of congestion stay negligible during the inter peak.

This increase is particularly pronounced in the Wellington area with congested vehicle-km increasing by over 60% between 2021 and 2031. This is largely due to the RoNS projects to the north being completed and increasing demands on the Wellington network. The Hutt Valley experiences some deterioration as well which is largely due to the impact of the Petone to Grenada project around the interchange of SH2/Petone. In Porirua and Kapiti on the other hand, levels of congestion decrease, due to the implementation of the RoNS, with veh-km over LOS D almost disappearing.

The Wairarapa TA shows significant saturation of the network, but this can be explained by the fact that the model definition is coarser in this area with large zones and limited numbers of links. As a result, traffic generated by vast areas gets entirely loaded on a few locations on the State Highway network instead of being more evenly spread across the whole zone, resulting in unrealistically high levels of congestion. This issue is consistent with results from the 2006 model.

Table 6-4: Amount of Travel (Veh-km) in Congested Conditions (<LOS D)

	2011	2021		2031		2041	
	Value	Value	% Diff*	Value	% Diff*	Value	% Diff*
Wairarapa							
AM	20,569	55,956	172%	83,842	308%	79,897	288%
IP	-	-		224	-	-	-
PM	21,035	49,554	136%	82,139	290%	78,558	273%
Kapiti							
AM	8,143	7,474	-8%	-	-	309	-96%
IP	-	-	-	-	-	-	-
PM	8,592	6,950	-19%	676	-92%	1,035	88%
Hutt							
AM	4,902	6,381	30%	26,225	435%	24,778	405%
IP	-	-	-	208	-	207	-
PM	5,868	7,422	26%	31,993	445%	31,310	434%
Porirua							
AM	14,623	14,414	-1%	634	-96%	631	-96%
IP	-	-	-	-	-	-	-
PM	14,830	14,535	-2%	1,626	-89%	1,667	-89%
Upper Hutt							
AM	10,777	21,304	-98%	28,919	168%	27,648	157%
IP	-	-	-	8,161	-	4,976	-
PM	13,358	24,360	82%	42,910	221%	42,231	216%
Wellington							
AM	108,169	100,467	-7%	162,807	51%	194,942	80%
IP	6,070	8,433	39%	7,533	24%	7,911	30%
PM	84,873	85,020	0%	81,421	-4%	98,616	16%
Total							
AM	167,183	205,995	23%	302,427	81%	328,204	96%
IP	6,070	8,433	39%	16,125	166%	13,094	116%
PM	148,556	187,842	26%	240,764	62%	253,416	71%

* Percentage difference relative to 2011

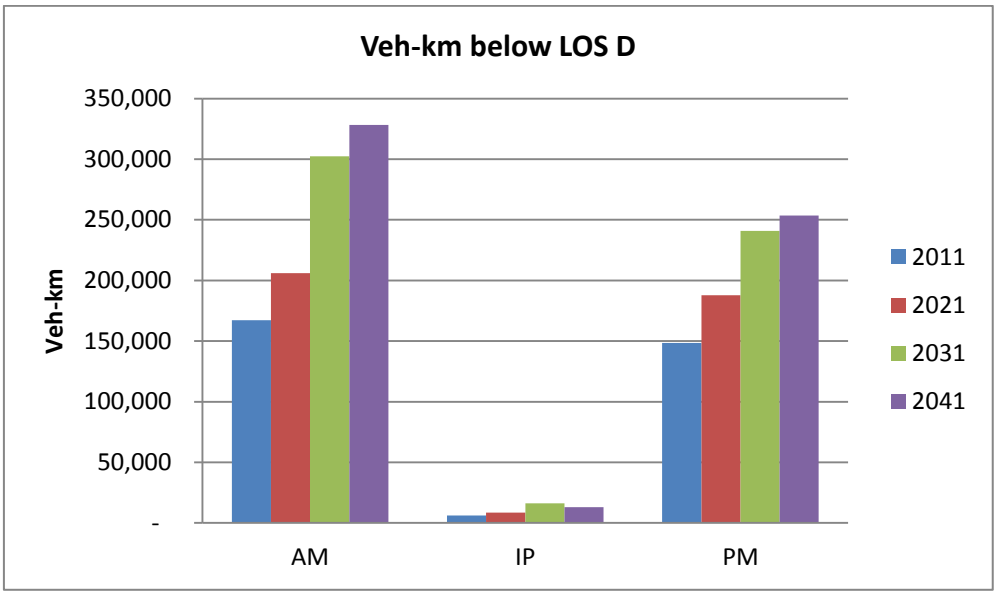

Figure 6-4: Amount of Travel (veh-km) in Congested Conditions (<LOS D)

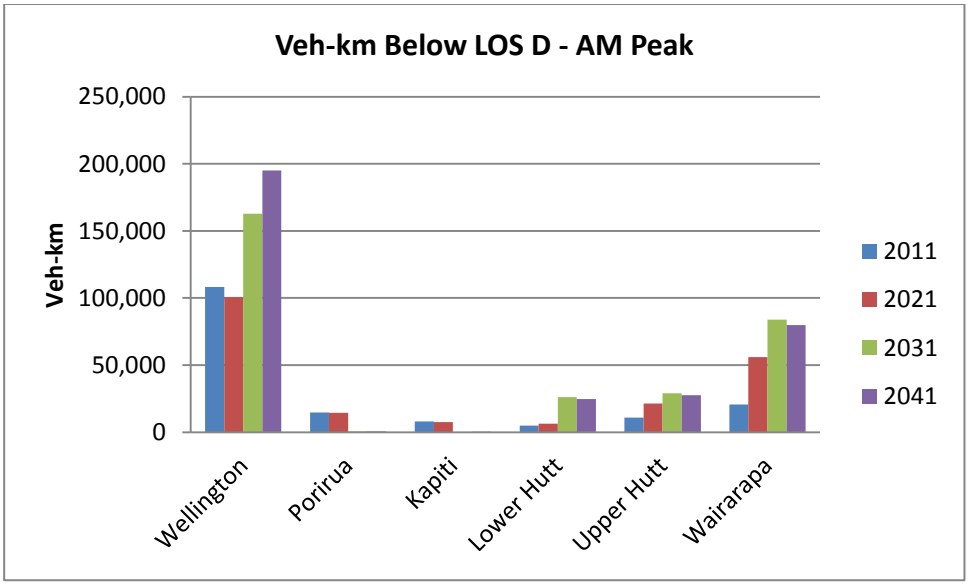

Figure 6-5: Amount of Travel (veh-km) in Congested Conditions (<LOS D) –By TA, AM Peak

6.3 Protect and Promote Public Health

Estimated emissions from private vehicles have been used as the measure for this objective. The estimated emissions are carbon monoxide (CO), nitrous oxide (NOx), particulates (PM10), and volatile organic compounds (VOC). These have been estimated at the regional level using the emissions factors and processes previously provided by GWRC.

The estimates are based on rates and forecasted reduction factors for 2016 and 2026 from the 2006 model update, extrapolated to 2031 and 2041. These reductions account for assumed improvements in vehicle technology and emissions requirements. It must

therefore be noted that these have been developed from information that is now dated and due to be revised.

Table 6-5 gives the estimated quantity of AM peak emissions of each type for car and HCV in each modelled period and Figure 6-6 shows these graphically. Note that the carbon monoxide car emissions have been divided by 10 in Figure 6-6 for presentational purposes.

As can be seen most of the estimated emissions reduce from 2011 to 2041. These effects are due to the assumed reductions in emissions rates; without them the estimates would increase in all cases.

Table 6-5: Estimated Emissions (AM Peak) – Kg

	Mode	2011	2021	2031	2041
CO	Car	9710.7	3393.2	2878.4	2948.3
	HCV	358.5	471.8	434.1	494.2
NOx	Car	1261.7	483.3	461.5	467.1
	HCV	1042.1	1292.1	1102.2	1250.5
PM10	Car	63.4	24.7	16.6	16.9
	HCV	172.6	227.3	189.3	214.4
VOC	Car	1247.9	498.4	452.4	463.7
	HCV	105	136.9	128.5	147.1

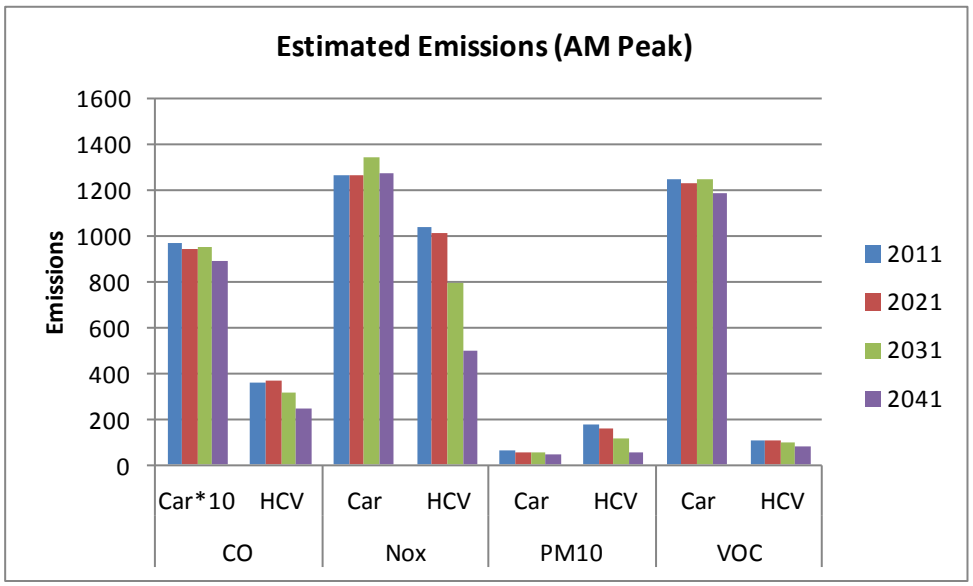

Figure 6-6: Estimated Emissions (AM Peak) –Kg

6.4 Ensure Environmental Sustainability

Environmental Sustainability has been measured in terms of estimated fuel usage and carbon dioxide (CO_2) emissions. Fuel usage has been estimated using rates given in the EEM for car, HCV and bus and for different driving conditions – base, congested,

bottlenecks and changes in speed. CO_2 in tonnes is estimated from fuel use (litres) as 2.7/1000.

As for emissions, assumed reductions in fuel usage rates are applied to the forecasts, which are in need of updating. Table 6-6 and n in fuel usage.

Table 6-7 give estimated AM peak fuel use and CO_2 emissions, respectively. Figure 6-7 and Figure 6-8 show these graphically. Fuel usage is given for each of the above vehicle types and driving conditions, except that the figure excludes buses for presentational purposes.

Forecast fuel use increases slightly for cars by 2021 and 2031 and then decreases in 2041 as the effects of accelerated vehicle efficiency (documented in TN15) start to have an impact. HCV fuel consumption increases steadily for each horizon year.

Table 6-6: Estimated Fuel Usage (AM Peak) (litres)

		2011	2021	2031	2041
Car	Base	136,451	139,004	145,064	112,904
	Congested	2,126	2,735	4,135	3,182
	Bottlenecks	5,440	5,345	2,985	3,668
	Speed Change	5,753	5,702	5,799	4,575
	Total	*149,770*	*152,785*	*157,983*	*124,329*
HCV	Base	44,124	56,348	64,344	72,843
	Congested	4,003	6,000	5,473	5,746
	Bottlenecks	373	488	414	649
	Speed Change	7,490	8,796	9,586	11,017
	Total	*55,990*	*71,633*	*79,817*	*90,255*
Bus	Base	2,988	3,267	3,238	3,195
	Congested	447	575	577	580
	Bottlenecks	18	19	22	31
	Speed Change	533	559	558	552
	Total	*3,986*	*4,419*	*4,395*	*4,357*

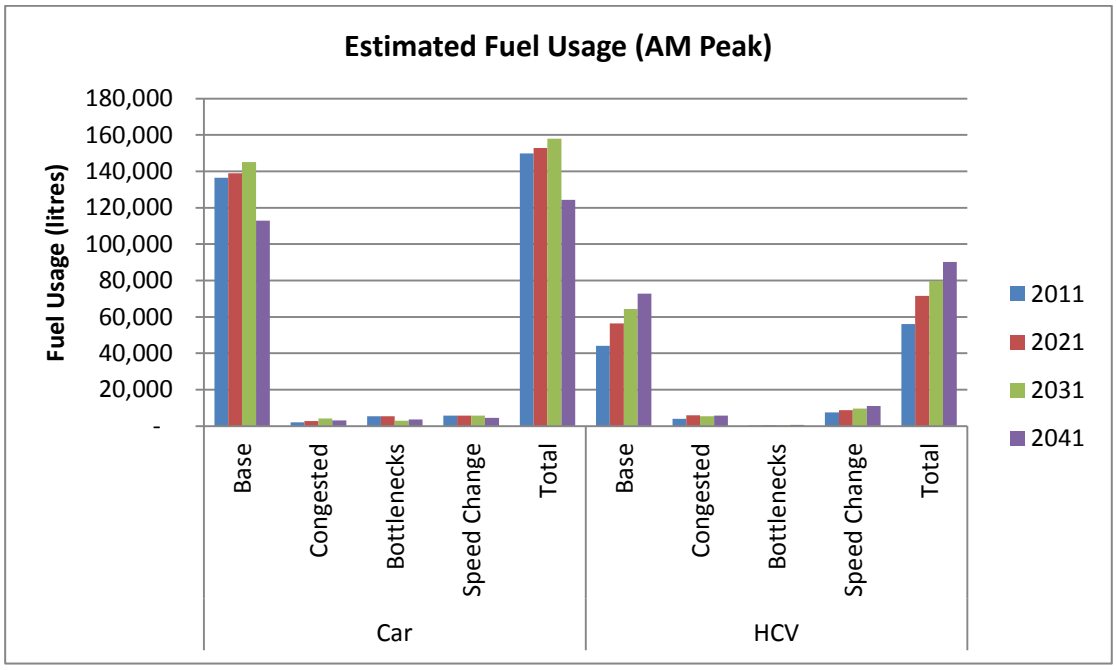

Figure 6-7: Estimated Fuel Usage (AM Peak) (litres)

Carbon dioxide (CO_2) emissions in 2021 are predicted to be around 9% higher than in 2011, and 15% higher by 2031, before decreasing to 4% in 2041, again due to reduction in fuel usage.

Table 6-7: Estimated AM Peak CO_2 Emissions (Tonnes)

	2011	2021	2031	2041
CO_2	566	618	654	591

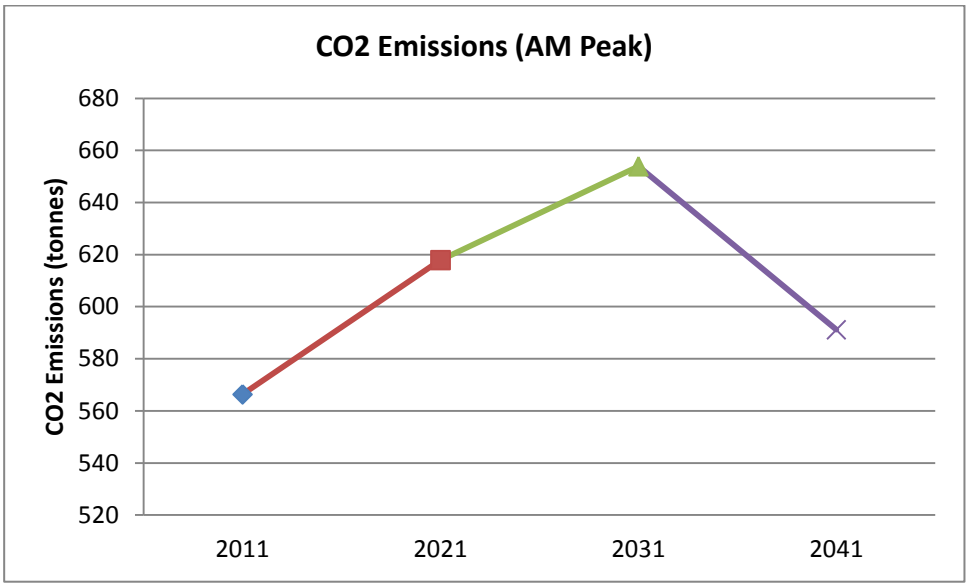

Figure 6-8: Estimated AM Peak CO_2 Emissions (Tonnes)

7 Conclusions

Analysis showed travel patterns and network performance between 2011 and 2041 are generally in line with results detailed in the Baseline Forecasting Report from 2008. The one exception is between 2011 and 2021 where there is much higher growth in PT demand as opposed to highway demand. This is largely caused by:

- Increasing levels of congestion; and
- Forecast VoC increasing at a faster rate than PT fares.

However, by far the largest change in the region is caused by the implementation of the RoNS which leads to improvements in traffic conditions and some shift of public transport users to cars, mostly for passengers travelling from Porirua and Kapiti to Wellington, largely in the period 2021-2031.

While the results showed strong demand for using Western RoNS once constructed it must be noted that car parking capacity constraints in the CBD are not taken into account i.e. forecast CBD parking charges were increased significantly but the parking supply was assumed to have expanded in step with demand. There is currently no mechanism in WTSM to constrain parking other than price so it advised that analysts closely monitor forecast parking demand and adjust their assumptions to match requirements for studies they are undertaking.

Appendix A - Traffic Volumes Across Screenlines

Table 1: Modelled Car Screenline Totals

		AM Peak				Inter Peak				PM Peak			
SL No.	Description	2011	2021	2031	2041	2011	2021	2031	2041	2011	2021	2031	2041
W1A	*South CBD in*	*3,245*	*3,586*	*3,673*	*3,888*	*1,773*	*1,976*	*2,217*	*2,357*	*2,442*	*2,472*	*2,583*	*2,700*
W1A	*South CBD out*	*1,717*	*1,975*	*2,247*	*2,336*	*1,670*	*1,880*	*2,066*	*2,192*	*2,978*	*3,268*	*3,401*	*3,582*
W1C	*West CBD in*	*1,018*	*1,118*	*1,220*	*1,386*	*533*	*580*	*633*	*677*	*632*	*723*	*830*	*897*
W1C	*West CBD out*	*496*	*575*	*688*	*786*	*570*	*614*	*673*	*719*	*1,038*	*1,148*	*1,237*	*1,334*
W1D	*East CBD in*	*2,299*	*2,518*	*3,352*	*3,545*	*1,638*	*1,780*	*2,040*	*2,110*	*1,600*	*1,967*	*2,458*	*2,505*
W1D	*East CBD out*	*1,697*	*1,841*	*2,195*	*2,229*	*1,683*	*1,800*	*2,106*	*2,175*	*2,312*	*2,534*	*3,225*	*3,371*
W1B	*North CBD in*	*8,348*	*8,636*	*9,520*	*10,155*	*4,492*	*4,759*	*5,266*	*5,583*	*4,804*	*5,079*	*5,799*	*6,044*
W1B	*North CBD out*	*3,865*	*4,338*	*4,963*	*5,140*	*3,841*	*4,012*	*4,429*	*4,619*	*7,833*	*7,968*	*8,854*	*9,370*
W1	CBD in	14,910	15,859	17,765	18,974	8,436	9,095	10,156	10,728	9,477	10,241	11,670	12,145
W1	CBD out	7,774	8,729	10,093	10,491	7,764	8,305	9,274	9,704	14,161	14,918	16,718	17,656
W2	Miramar In	1,533	1,751	2,015	2,109	1,441	1,595	1,794	1,878	2,028	2,205	2,455	2,548
W2	Miramar Out	2,094	2,321	2,594	2,715	1,443	1,595	1,804	1,889	1,703	1,876	2,143	2,236
W3	Karori out	588	637	696	721	687	731	806	853	1,185	1,261	1,362	1,438
W3	Karori in	1,285	1,376	1,479	1,570	651	681	739	773	811	863	956	996
W4	Thorndon out	3,088	3,403	3,931	3,981	2,932	2,968	3,283	3,366	6,794	6,763	7,413	7,706
W4	Thorndon in	7,435	7,472	8,134	8,523	3,133	3,151	3,464	3,564	3,803	3,990	4,533	4,618
W5	Churton Park out	1,604	1,765	1,982	2,063	1,475	1,548	1,593	1,676	3,328	3,524	3,567	3,844
W5	Churton Park in	3,686	3,904	3,899	4,195	1,921	2,064	2,174	2,291	1,974	2,126	2,345	2,503
W6	Island Bay in	2,318	2,494	2,224	2,345	1,294	1,387	1,508	1,578	2,068	2,015	1,982	2,119
W6	Island Bay out	1,395	1,581	1,580	1,710	1,461	1,624	1,694	1,815	2,255	2,350	2,241	2,349
W	**Sub Total**	**47,711**	**51,291**	**56,393**	**59,398**	**32,637**	**34,745**	**38,288**	**40,113**	**49,588**	**52,135**	**57,385**	**60,160**
L1	Nga to Pet out	2,740	3,119	2,529	2,542	2,009	2,109	1,801	1,831	3,934	3,884	3,736	3,744
L1	Nga to Pet in	3,882	3,818	3,632	3,676	2,057	2,136	1,805	1,836	3,055	3,344	2,683	2,705
L2	Lower to Upper out	1,595	1,726	1,808	1,804	1,474	1,514	1,567	1,555	2,790	2,854	2,894	2,912
L2	Lower to Upper in	2,935	3,033	2,992	2,986	1,560	1,624	1,703	1,708	1,791	1,886	1,993	1,980
L3	Lower Hutt in	4,124	4,202	4,662	4,624	2,952	3,021	3,381	3,332	4,099	4,378	5,045	5,001
L3	Lower Hutt out	3,655	4,029	4,683	4,642	2,964	3,054	3,449	3,386	4,490	4,551	5,071	5,023
L4	Wainui-Stoke in	3,424	3,629	3,846	3,805	1,669	1,725	1,901	1,895	1,713	1,765	1,966	1,955
L4	Wainui-Stoke out	1,326	1,393	1,574	1,575	1,589	1,638	1,805	1,791	3,302	3,450	3,678	3,626
L	**Sub Total**	**23,680**	**24,950**	**25,726**	**25,654**	**16,274**	**16,819**	**17,411**	**17,334**	**25,174**	**26,112**	**27,066**	**26,947**
U1	Upper Hutt North in	1,149	1,152	1,194	1,151	728	803	957	941	885	63	1,270	1,254
U1	Upper Hutt North out	773	945	1,115	1,103	714	791	950	934	1,116	63	1,298	1,273
U2	Upper Hutt South out	1,701	1,950	2,394	2,374	1,385	1,445	1,720	1,698	2,117	2,063	2,377	2,342
U2	Upper Hutt South in	2,209	2,112	2,249	2,192	1,323	1,353	1,603	1,569	1,819	1,957	2,497	2,471
U	**Sub Total**	**5,832**	**6,159**	**6,952**	**6,820**	**4,150**	**4,391**	**5,230**	**5,141**	**5,937**	**4,146**	**7,442**	**7,339**
P1	Porirua North out	757	803	1,212	1,221	744	747	1,253	1,059	1,592	1,670	2,182	1,627
P1	Porirua North in	1,723	1,837	2,468	2,569	830	845	1,160	1,181	924	916	1,276	1,924
P2	SH58 west	806	770	1,180	1,203	544	571	647	661	872	1,033	929	924
P2	SH58 east	872	1,084	897	914	560	611	763	794	690	711	1,077	1,154
P3	Porirua South out	1,344	1,521	3,579	3,678	1,115	1,171	1,593	1,627	2,448	2,495	2,129	2,138
P3	Porirua South in	2,606	2,614	1,795	1,786	1,187	1,231	1,499	1,468	1,626	1,747	3,603	3,689
P	**Sub Total**	**8,108**	**8,629**	**11,132**	**11,370**	**4,980**	**5,176**	**6,915**	**6,789**	**8,153**	**8,571**	**11,195**	**11,457**
K1	Kapiti In	986	1,079	1,455	1,549	504	645	902	982	651	943	1,037	1,125
K1	Kapiti Out	632	859	949	1,030	589	676	723	762	945	977	1,325	1,399
K1	**Sub Total**	**1,618**	**1,937**	**2,404**	**2,579**	**1,092**	**1,321**	**1,625**	**1,744**	**1,596**	**1,920**	**2,362**	**2,524**
	TOTAL	**86,949**	**92,965**	**102,606**	**105,822**	**59,133**	**62,452**	**69,469**	**71,122**	**90,448**	**92,884**	**105,450**	**108,427**

Table 2: Modelled Car Screenline Totals Index (1.00 = 2011 total)

SL No.	Description	AM Peak				Inter Peak				PM Peak			
		2011	2021	2031	2041	2011	2021	2031	2041	2011	2021	2031	2041
W1A	*South CBD in*	*1.00*	*1.11*	*1.13*	*1.20*	*1.00*	*1.11*	*1.25*	*1.33*	*1.00*	*1.01*	*1.06*	*1.11*
W1A	*South CBD out*	*1.00*	*1.15*	*1.31*	*1.36*	*1.00*	*1.13*	*1.24*	*1.31*	*1.00*	*1.10*	*1.14*	*1.20*
W1C	*West CBD in*	*1.00*	*1.10*	*1.20*	*1.36*	*1.00*	*1.09*	*1.19*	*1.27*	*1.00*	*1.14*	*1.31*	*1.42*
W1C	*West CBD out*	*1.00*	*1.16*	*1.39*	*1.58*	*1.00*	*1.08*	*1.18*	*1.26*	*1.00*	*1.11*	*1.19*	*1.28*
W1D	*East CBD in*	*1.00*	*1.10*	*1.46*	*1.54*	*1.00*	*1.09*	*1.25*	*1.29*	*1.00*	*1.23*	*1.54*	*1.57*
W1D	*East CBD out*	*1.00*	*1.09*	*1.29*	*1.31*	*1.00*	*1.07*	*1.25*	*1.29*	*1.00*	*1.10*	*1.40*	*1.46*
W1B	*North CBD in*	*1.00*	*1.03*	*1.14*	*1.22*	*1.00*	*1.06*	*1.17*	*1.24*	*1.00*	*1.06*	*1.21*	*1.26*
W1B	*North CBD out*	*1.00*	*1.12*	*1.28*	*1.33*	*1.00*	*1.04*	*1.15*	*1.20*	*1.00*	*1.02*	*1.13*	*1.20*
W1	CBD in	1.00	1.06	1.19	1.27	1.00	1.08	1.20	1.27	1.00	1.08	1.23	1.28
W1	CBD out	1.00	1.12	1.30	1.35	1.00	1.07	1.19	1.25	1.00	1.05	1.18	1.25
W2	Miramar In	1.00	1.14	1.31	1.38	1.00	1.11	1.24	1.30	1.00	1.09	1.21	1.26
W2	Miramar Out	1.00	1.11	1.24	1.30	1.00	1.11	1.25	1.31	1.00	1.10	1.26	1.31
W3	Karori out	1.00	1.08	1.18	1.22	1.00	1.07	1.17	1.24	1.00	1.06	1.15	1.21
W3	Karori in	1.00	1.07	1.15	1.22	1.00	1.05	1.14	1.19	1.00	1.06	1.18	1.23
W4	Thorndon out	1.00	1.10	1.27	1.29	1.00	1.01	1.12	1.15	1.00	1.00	1.09	1.13
W4	Thorndon in	1.00	1.00	1.09	1.15	1.00	1.01	1.11	1.14	1.00	1.05	1.19	1.21
W5	Churton Park out	1.00	1.10	1.24	1.29	1.00	1.05	1.08	1.14	1.00	1.06	1.07	1.16
W5	Churton Park in	1.00	1.06	1.06	1.14	1.00	1.07	1.13	1.19	1.00	1.08	1.19	1.27
W6	Island Bay in	1.00	1.08	0.96	1.01	1.00	1.07	1.17	1.22	1.00	0.97	0.96	1.02
W6	Island Bay out	1.00	1.13	1.13	1.23	1.00	1.11	1.16	1.24	1.00	1.04	0.99	1.04
W	**Sub Total**	**1.00**	**1.08**	**1.18**	**1.24**	**1.00**	**1.06**	**1.17**	**1.23**	**1.00**	**1.05**	**1.16**	**1.21**
L1	Nga to Pet out	1.00	1.14	0.92	0.93	1.00	1.05	0.90	0.91	1.00	0.99	0.95	0.95
L1	Nga to Pet in	1.00	0.98	0.94	0.95	1.00	1.04	0.88	0.89	1.00	1.09	0.88	0.89
L2	Lower to Upper out	1.00	1.08	1.13	1.13	1.00	1.03	1.06	1.06	1.00	1.02	1.04	1.04
L2	Lower to Upper in	1.00	1.03	1.02	1.02	1.00	1.04	1.09	1.09	1.00	1.05	1.11	1.11
L3	Lower Hutt in	1.00	1.02	1.13	1.12	1.00	1.02	1.15	1.13	1.00	1.07	1.23	1.22
L3	Lower Hutt out	1.00	1.10	1.28	1.27	1.00	1.03	1.16	1.14	1.00	1.01	1.13	1.12
L4	Wainui-Stoke in	1.00	1.06	1.12	1.11	1.00	1.03	1.14	1.14	1.00	1.03	1.15	1.14
L4	Wainui-Stoke out	1.00	1.05	1.19	1.19	1.00	1.03	1.14	1.13	1.00	1.04	1.11	1.10
L	**Sub Total**	**1.00**	**1.05**	**1.09**	**1.08**	**1.00**	**1.03**	**1.07**	**1.07**	**1.00**	**1.04**	**1.08**	**1.07**
U1	Upper Hutt North in	1.00	1.00	1.04	1.00	1.00	1.10	1.31	1.29	1.00	0.07	1.44	1.42
U1	Upper Hutt North out	1.00	1.22	1.44	1.43	1.00	1.11	1.33	1.31	1.00	0.06	1.16	1.14
U2	Upper Hutt South out	1.00	1.15	1.41	1.40	1.00	1.04	1.24	1.23	1.00	0.97	1.12	1.11
U2	Upper Hutt South in	1.00	0.96	1.02	0.99	1.00	1.02	1.21	1.19	1.00	1.08	1.37	1.36
U	**Sub Total**	**1.00**	**1.06**	**1.19**	**1.17**	**1.00**	**1.06**	**1.26**	**1.24**	**1.00**	**0.70**	**1.25**	**1.24**
P1	Porirua North out	1.00	1.06	1.60	1.61	1.00	1.00	1.68	1.42	1.00	1.05	1.37	1.02
P1	Porirua North in	1.00	1.07	1.43	1.49	1.00	1.02	1.40	1.42	1.00	0.99	1.38	2.08
P2	SH58 west	1.00	0.96	1.46	1.49	1.00	1.05	1.19	1.21	1.00	1.18	1.06	1.06
P2	SH58 east	1.00	1.24	1.03	1.05	1.00	1.09	1.36	1.42	1.00	1.03	1.56	1.67
P3	Porirua South out	1.00	1.13	2.66	2.74	1.00	1.05	1.43	1.46	1.00	1.02	0.87	0.87
P3	Porirua South in	1.00	1.00	0.69	0.69	1.00	1.04	1.26	1.24	1.00	1.07	2.21	2.27
P	**Sub Total**	**1.00**	**1.06**	**1.37**	**1.40**	**1.00**	**1.04**	**1.39**	**1.36**	**1.00**	**1.05**	**1.37**	**1.41**
K1	Kapiti In	1.00	1.09	1.47	1.57	1.00	1.28	1.79	1.95	1.00	1.45	1.59	1.73
K1	Kapiti Out	1.00	1.36	1.50	1.63	1.00	1.15	1.23	1.29	1.00	1.03	1.40	1.48
K1	**Sub Total**	**1.00**	**1.20**	**1.49**	**1.59**	**1.00**	**1.21**	**1.49**	**1.60**	**1.00**	**1.20**	**1.48**	**1.58**
	TOTAL	1.00	1.07	1.18	1.22	1.00	1.06	1.17	1.20	1.00	1.03	1.17	1.20

Key:

Cordon information presented in italicise is a breakdown of W1 CBD in and CBD out.

< 1.0 = blue
1.0-1.15 = yellow
1.15-1.5 = orange
> 1.5 = red

Appendix B - LOS Plots

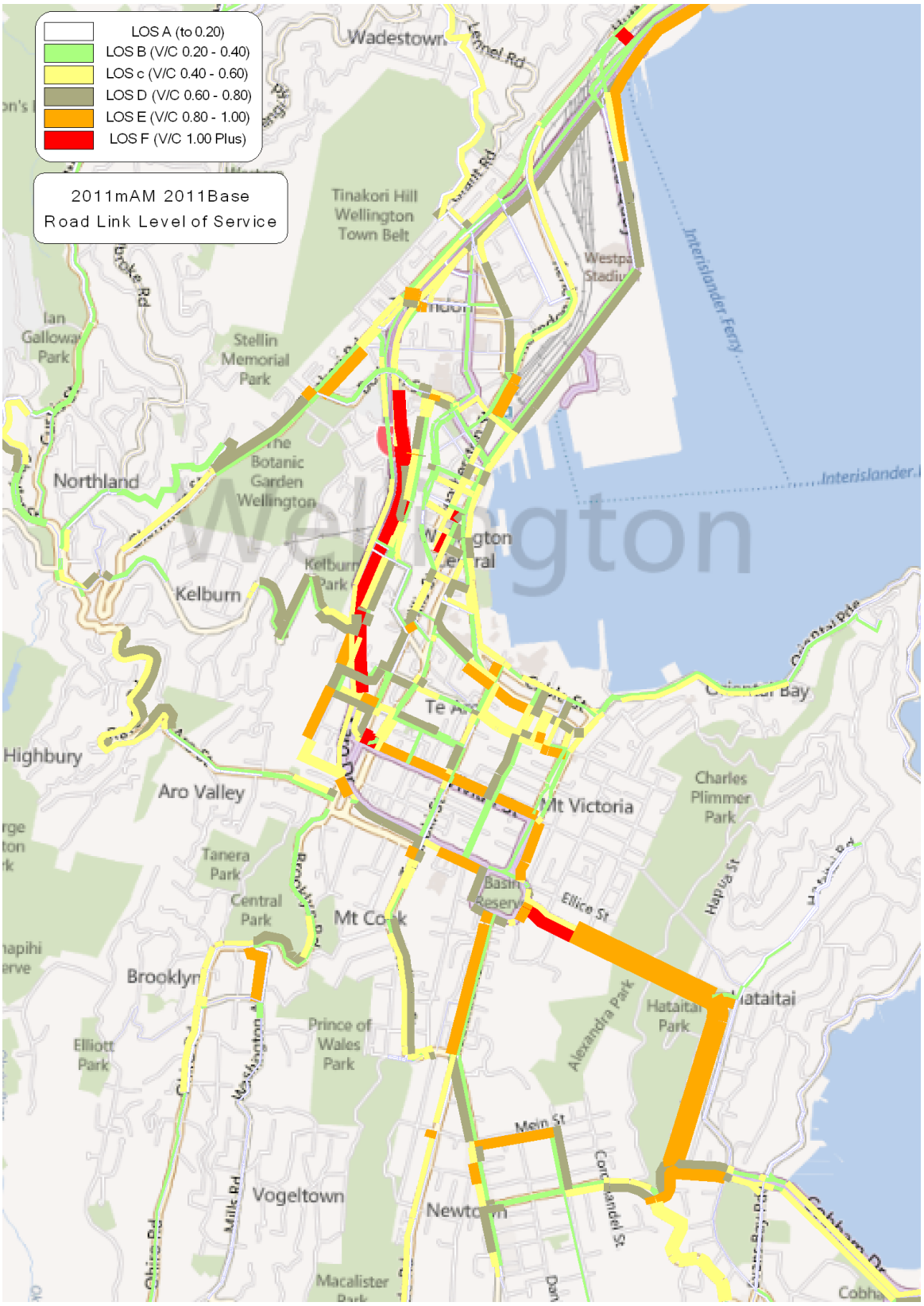

Figure 1: 2011 AM Peak LOS – CBD

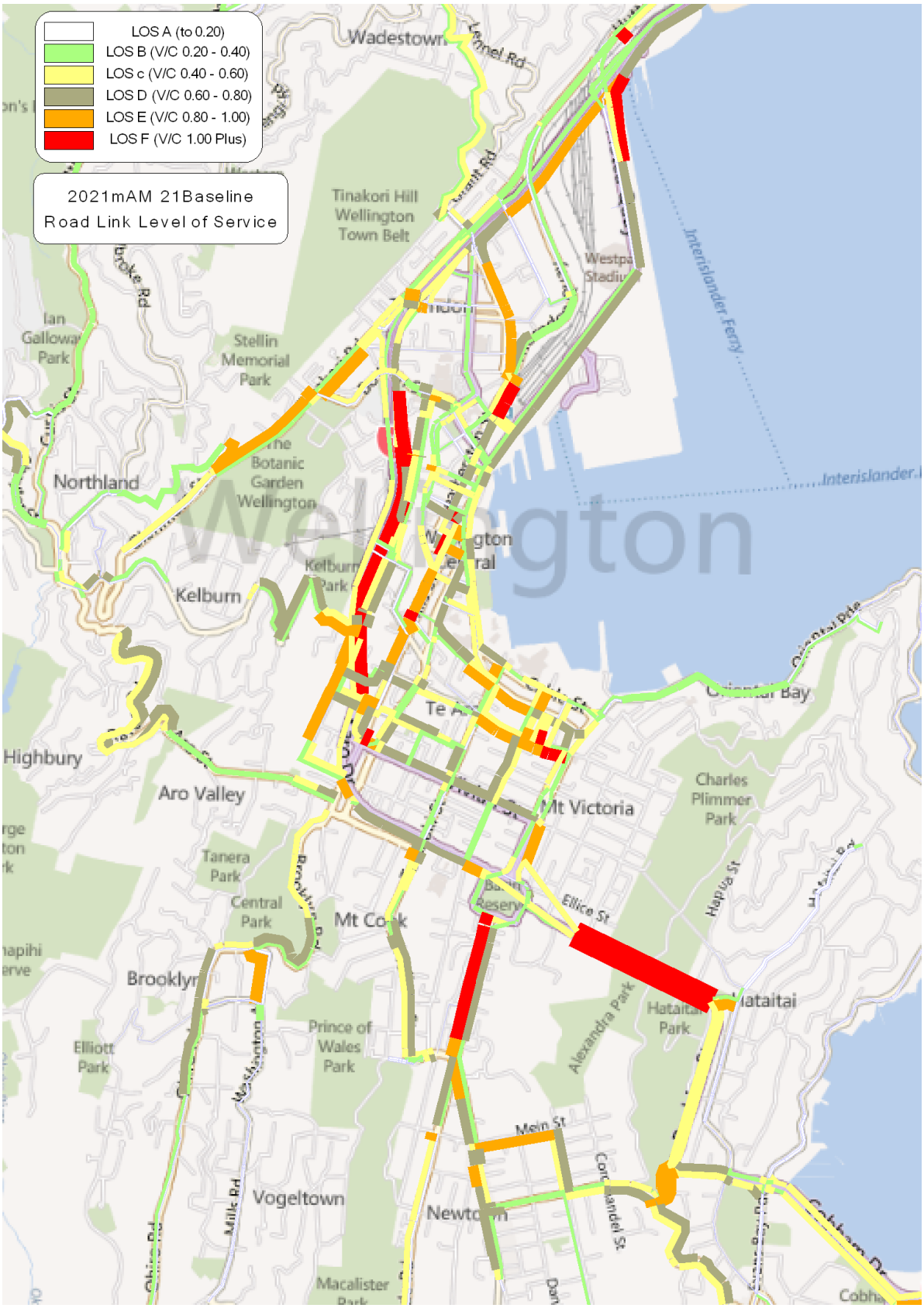

Figure 2: 2021 AM Peak LOS – CBD

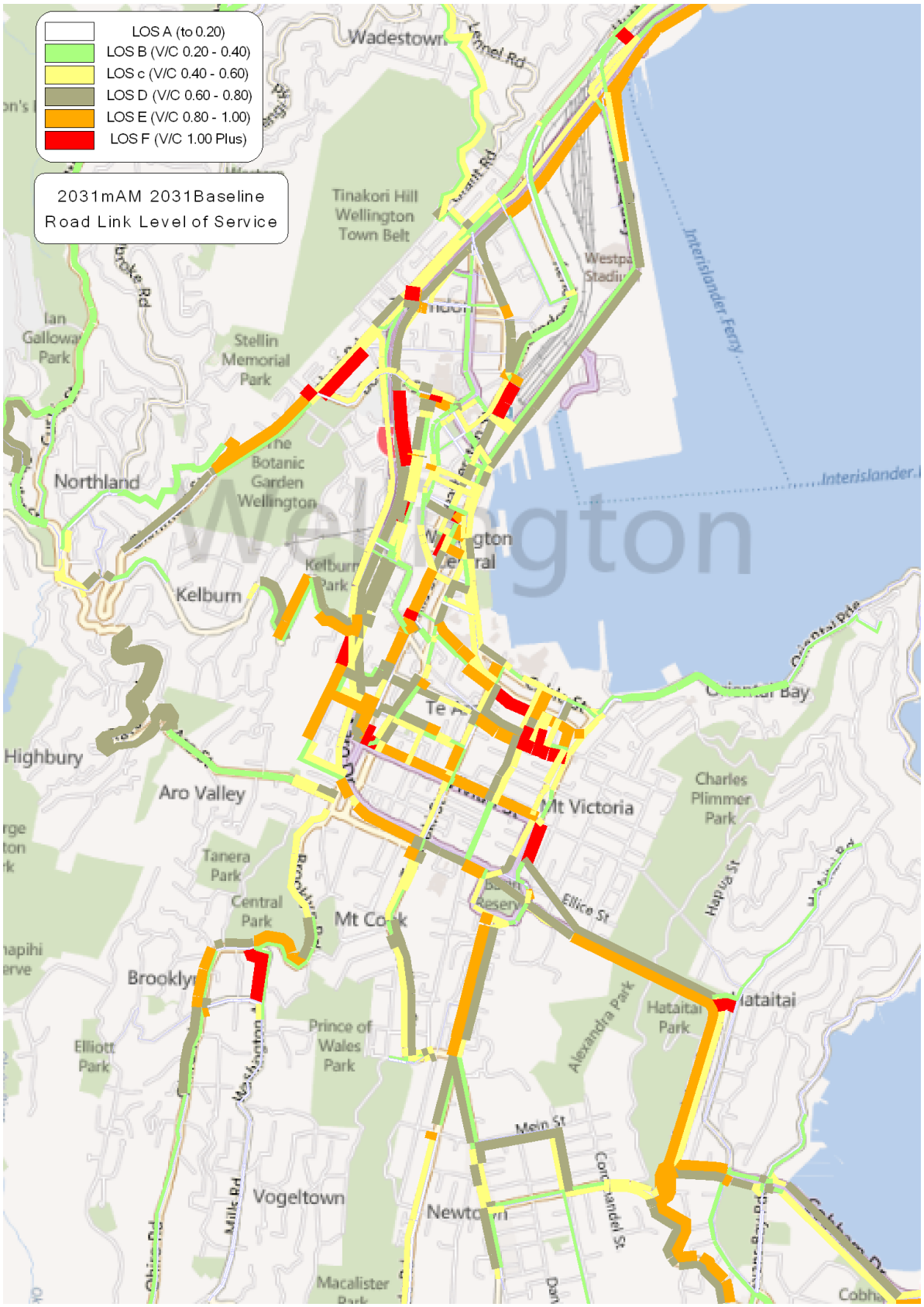

Figure 3: 2031 AM Peak LOS – CBD

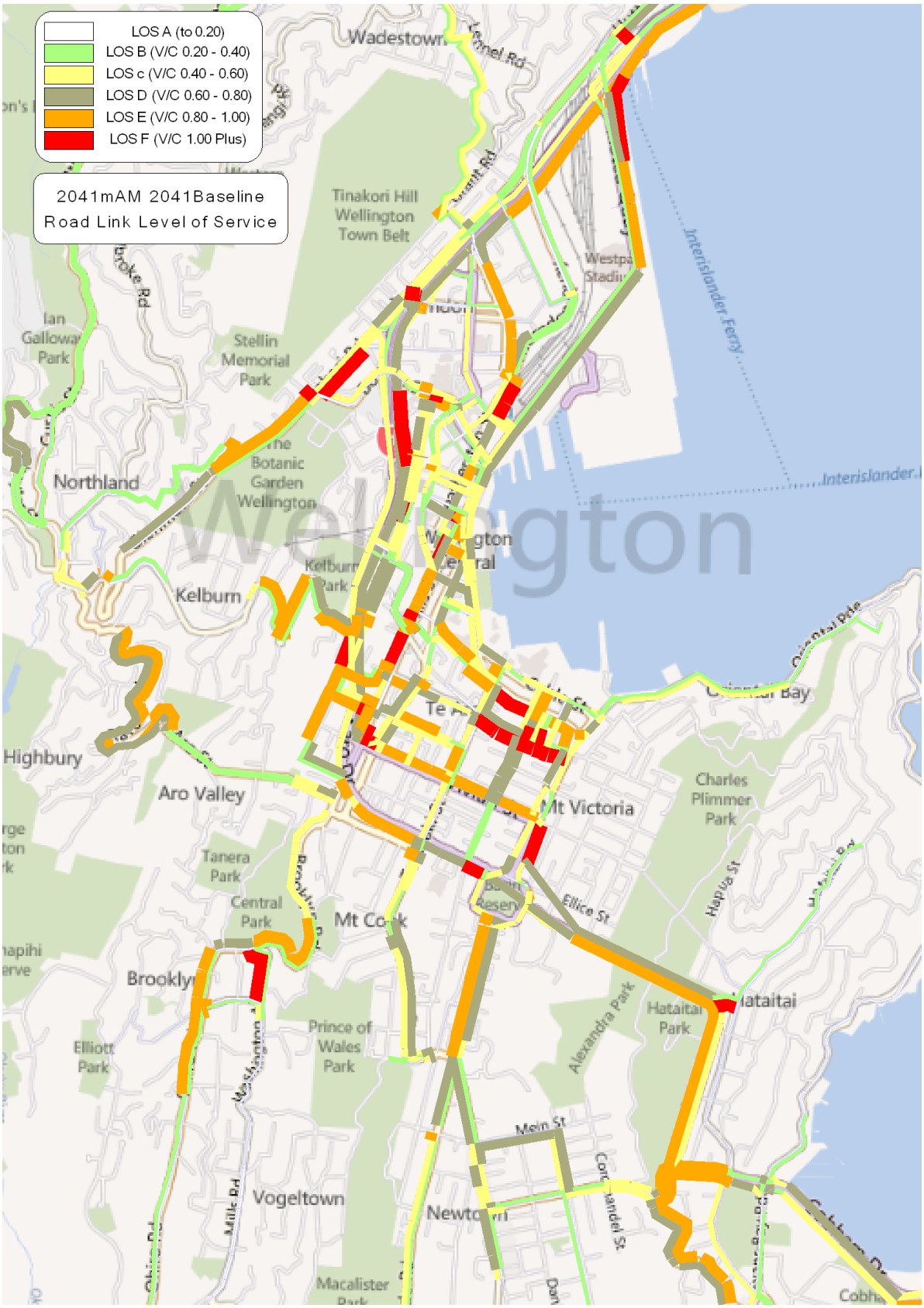

Figure 4: 2041 AM Peak LOS – CBD

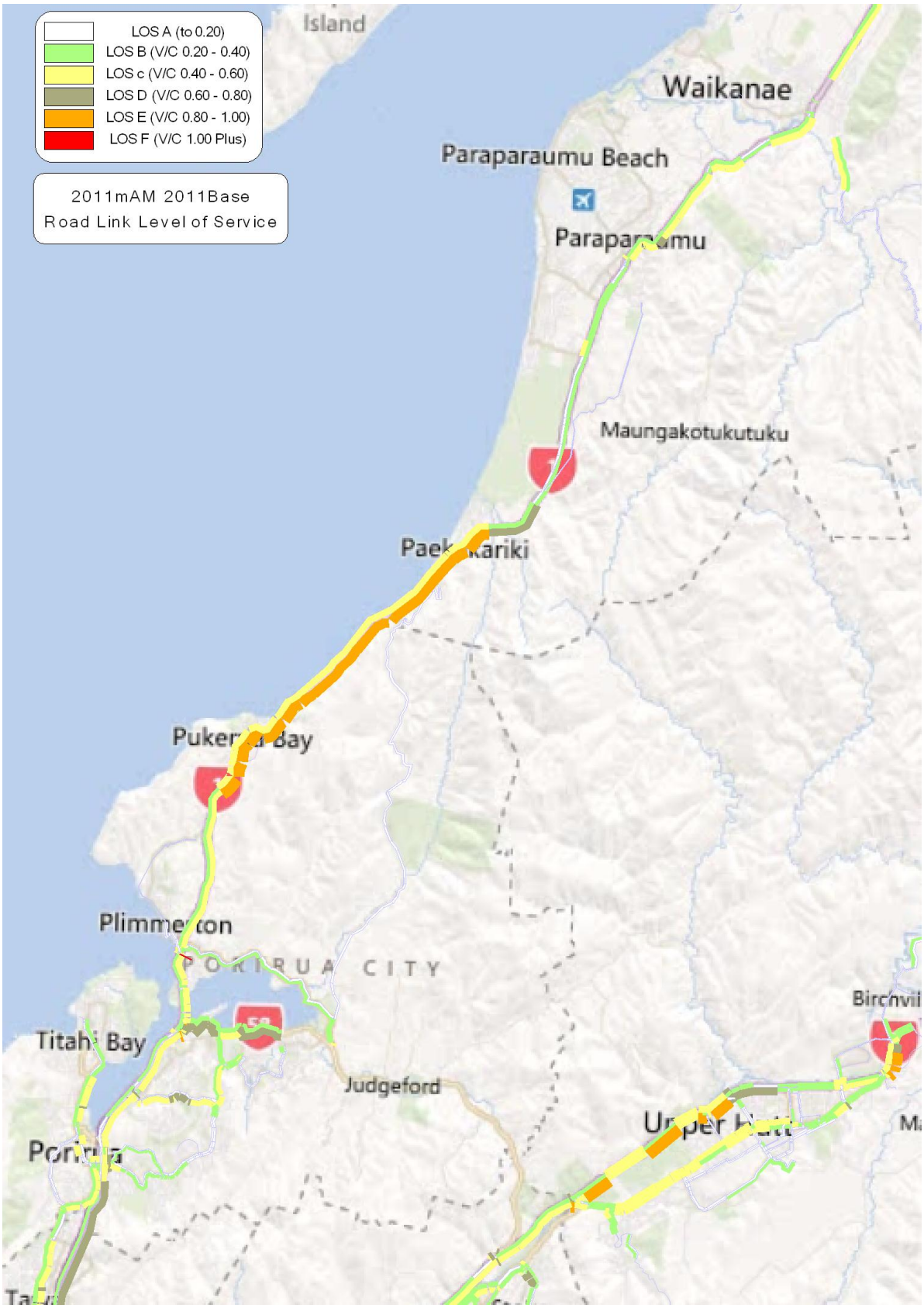

Figure 5: 2011 AM Peak LOS – Kapiti

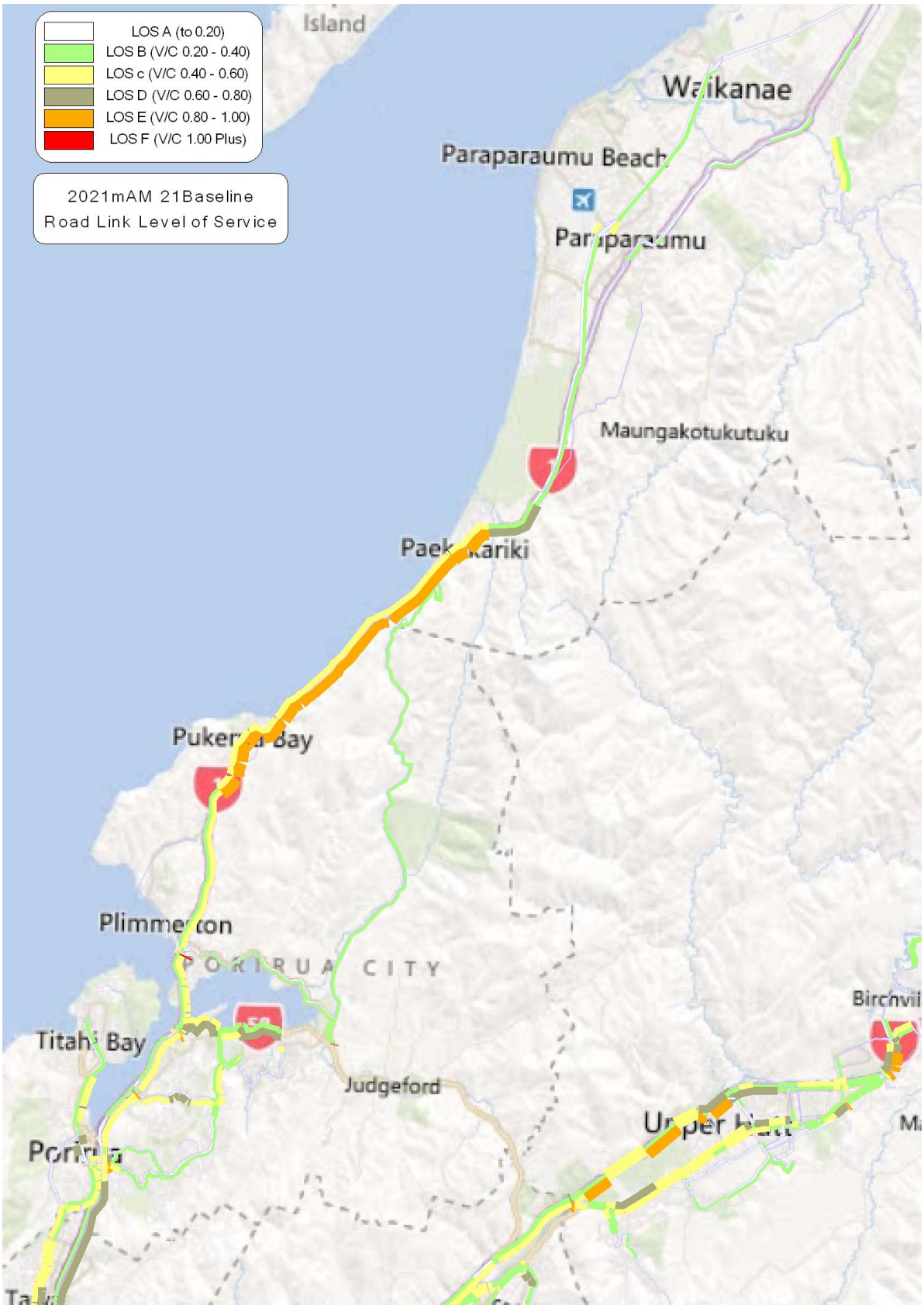

Figure 6: 2021 AM Peak LOS – Kapiti

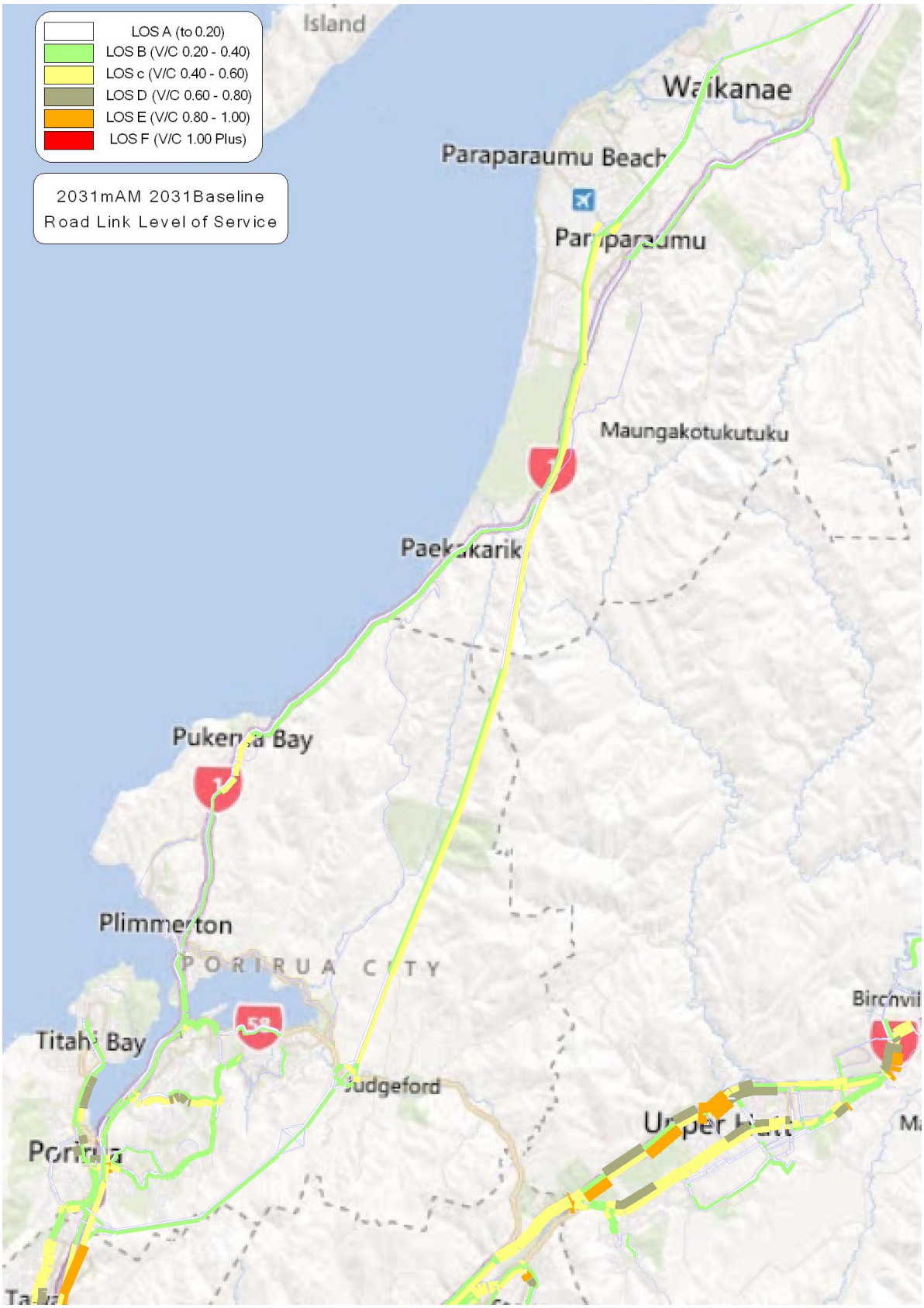

Figure 7: 2031 AM Peak LOS – Kapiti

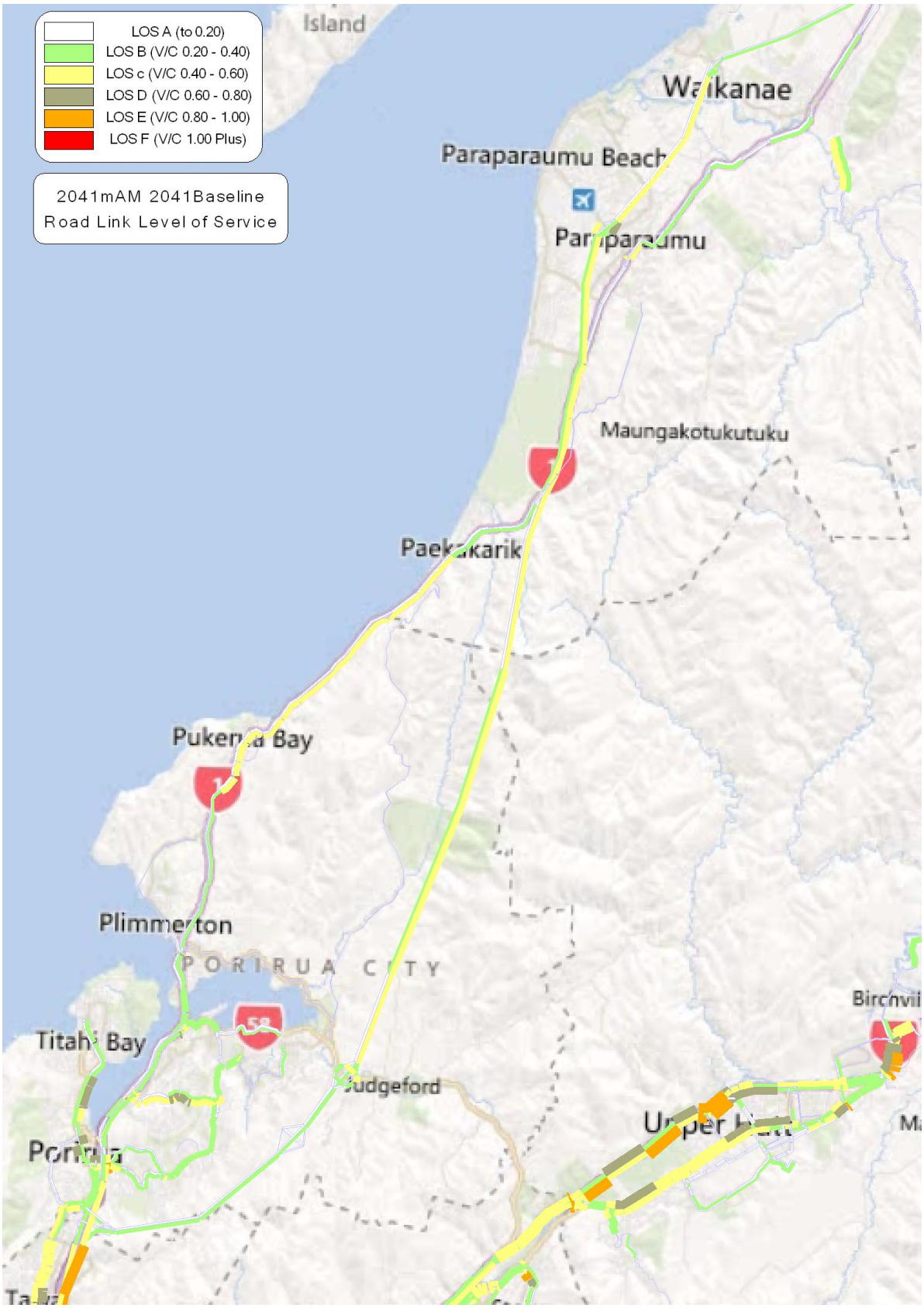

Figure 8: 2041 AM Peak LOS – Kapiti

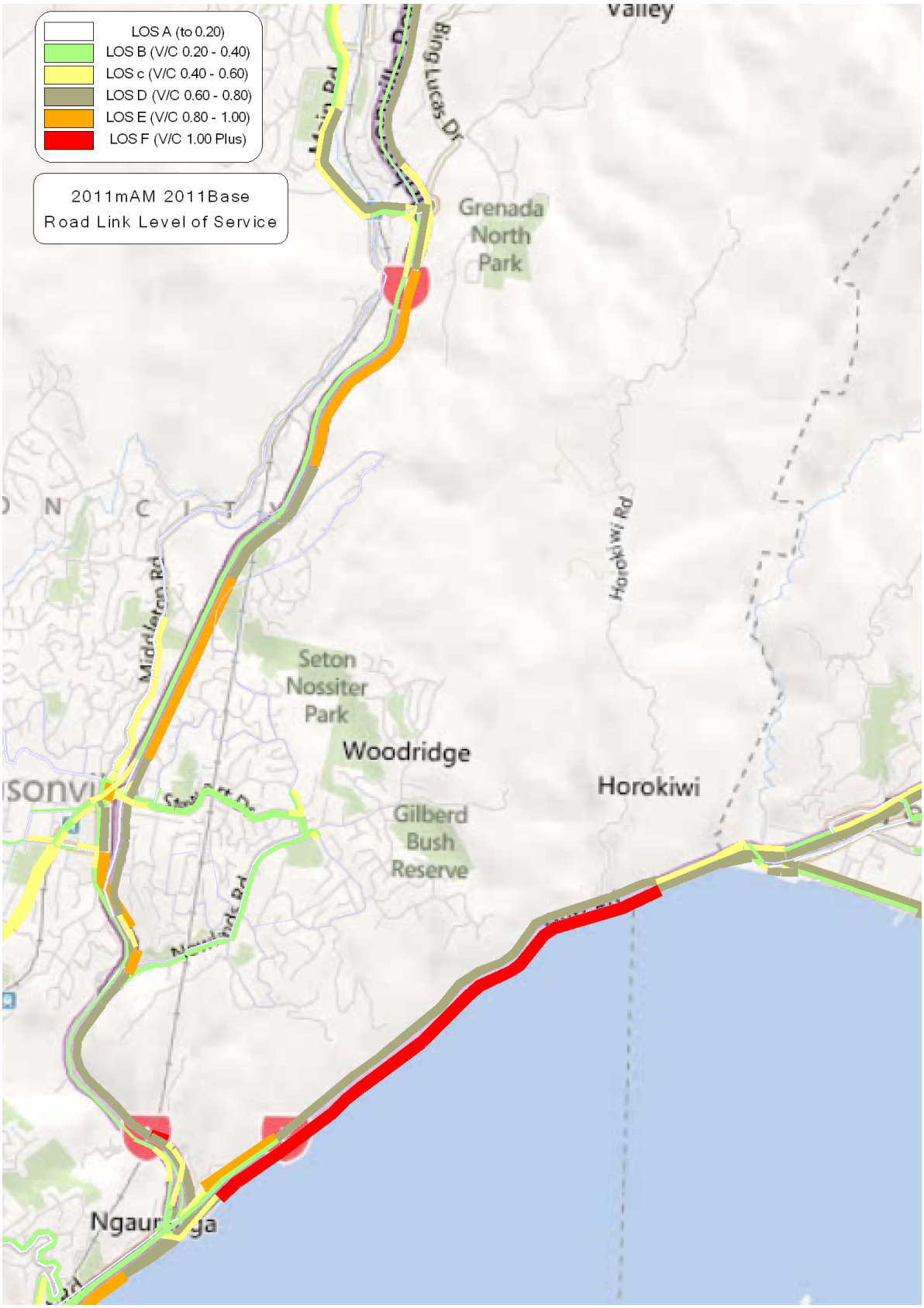

Figure 9: 2011 AM Peak LOS – Ngauranga

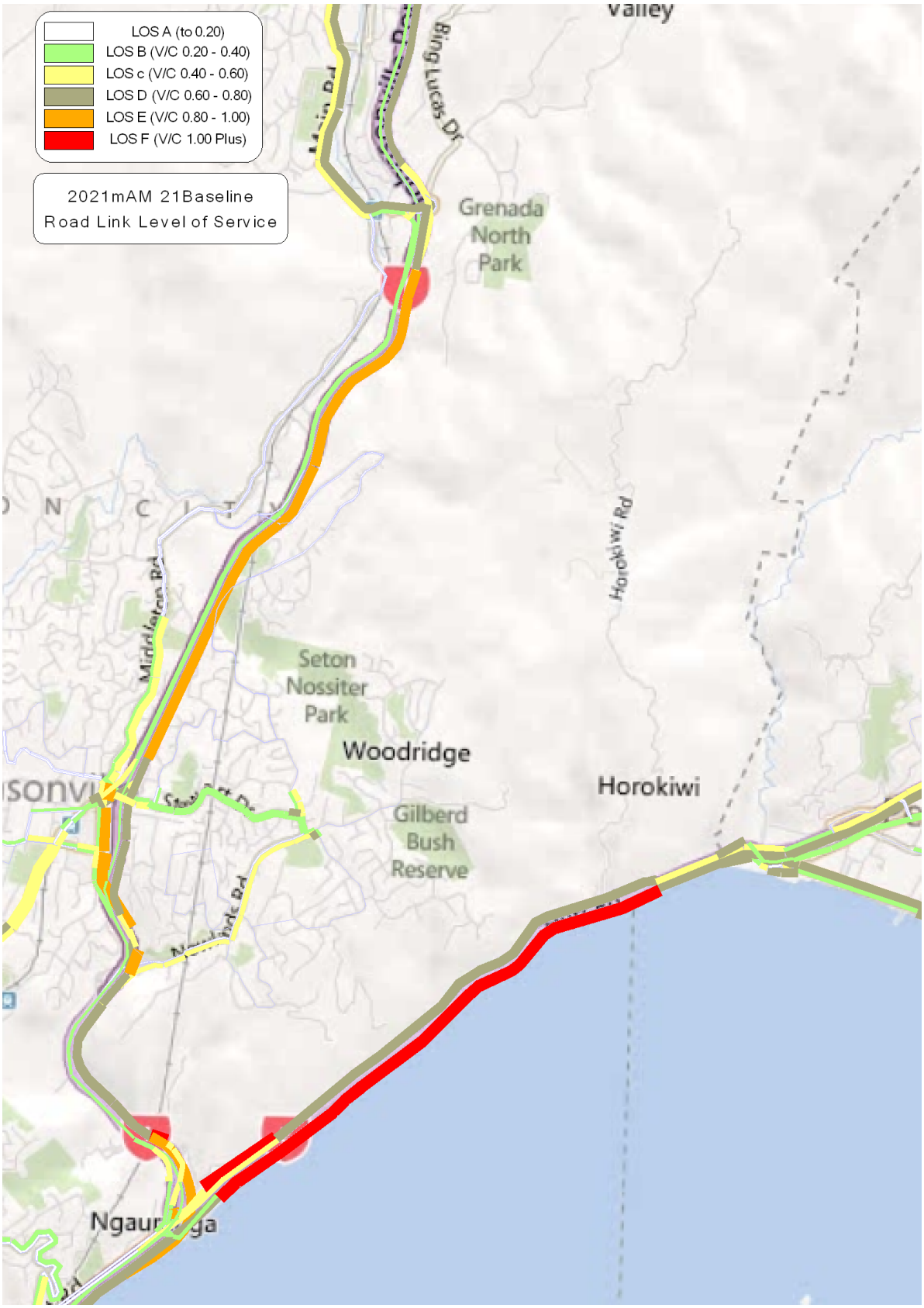

Figure 10: 2021 AM Peak LOS – Ngauranga

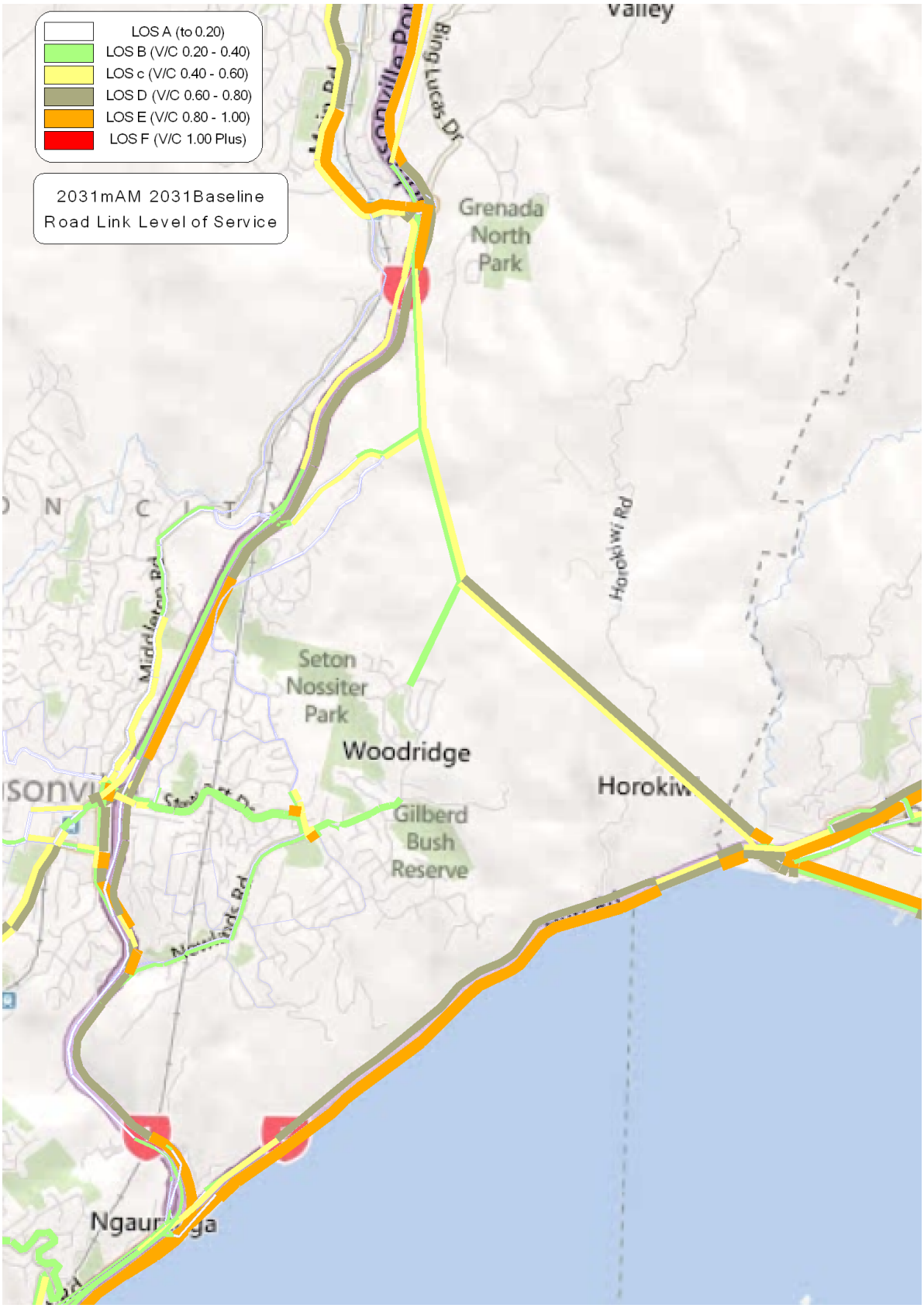

Figure 11: 2031 AM Peak LOS – Ngauranga

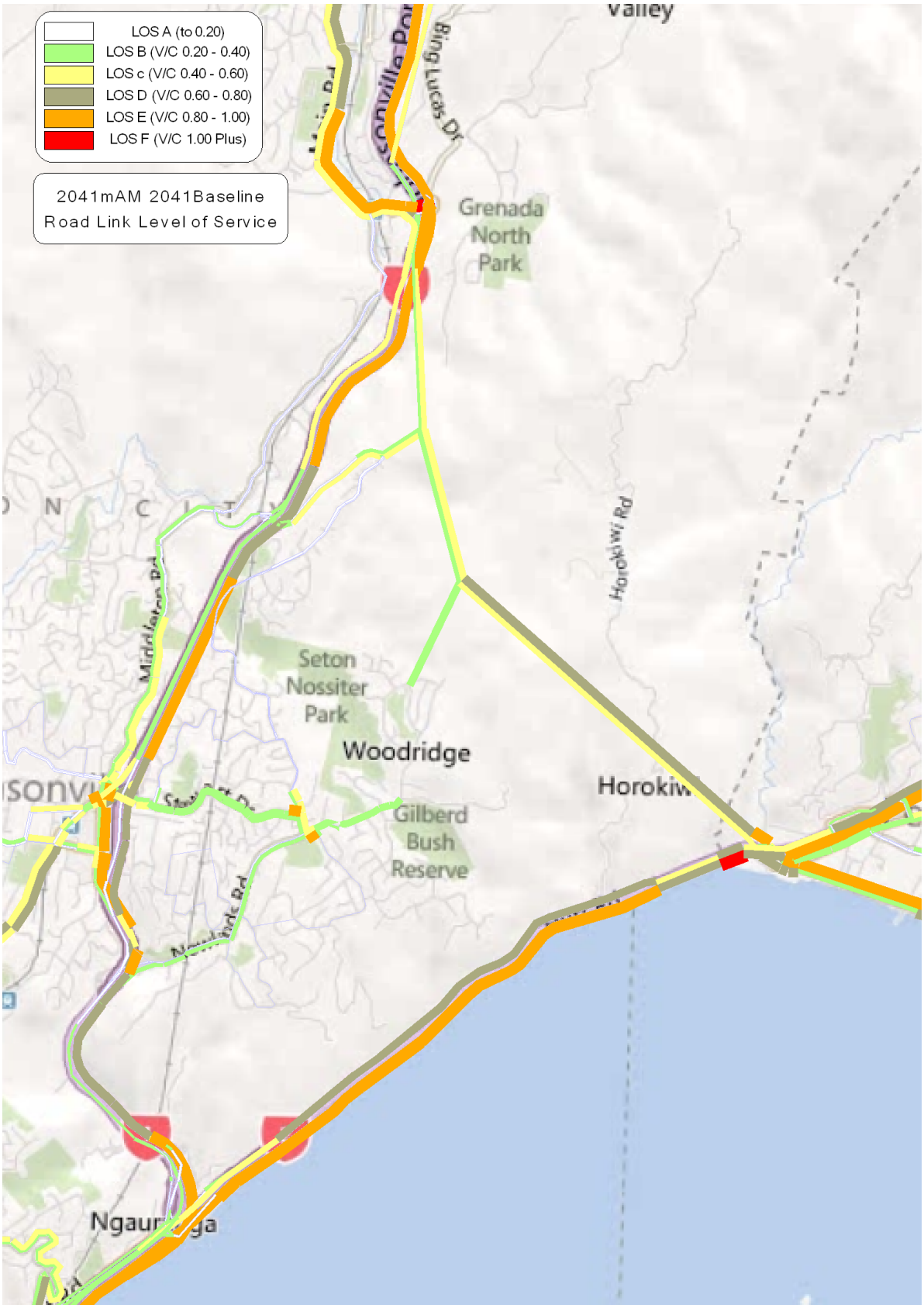

Figure 12: 2041 AM Peak LOS – Ngauranga