

The background image shows a busy urban street in Wellington, New Zealand. In the foreground, a white car is driving towards the camera, with other vehicles and traffic lights visible. The middle ground features a green bus and a blue truck. The background is dominated by a steep hillside covered in numerous colorful houses, with a large green hill in the distance under a clear sky.

TN9 - WELLINGTON TRANSPORT ANALYTICAL TOOLS 2019-21 UPDATE – MODEL INPUT PARAMETERS

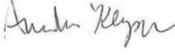
PREPARED FOR GREATER WELLINGTON REGIONAL COUNCIL

November 2020

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Rev No.	Date	Description	Signature or Typed Name (documentation on file)			
			Prepared by	Checked by	Reviewed by	Approved by
0	18/11/20	Draft for Review	AK	JEB	GC	JEB
1	27/11/20	First Issue	AK	JEB	GC	JEB
2	27/01/21	Second Issue	AK	JEB	GC	JEB
3	08/03/21	Final Issue	AK	JEB	GC	JEB

Greater Wellington Regional Council

TN9 - Wellington Transport Analytical Tools 2019-21 update – Model Input Parameters

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1. Introduction

This technical note details the process used to update the input parameters into the Wellington transport models (WTSM – Wellington Transport Strategic Model and WPTM – Wellington Public Transport Model), as part of their 2018 update. These parameters are used in WTSM to calculate the generalised costs of travel for all modes (light and heavy vehicles, public transport, and active modes) and therefore impact on the trip distribution, mode choice, and route calculation components of the model. In WPTM, they inform the access mode choice, public transport mode choice, and route of public transport users. The following sections summarise how each parameter was calculated in previous model updates (2011 and 2013) referring to previous documentation, and describes the approach used for the update to 2018.

This note also documents the methodology adopted to project these parameters into the future when forecasting with both models.

The calculation detailed in this note apply to the interim 2018 version of WTSM (225 zones) which is still largely based on the existing version of the models. They will need to be revised as part of the full 2018 model update, based on a new household travel survey, demand segmentation, costs representations and 2018 \$ costs.

2. WTSM Input Parameters Update

2.1 Summary

The approach used to update the WTSM economic input parameters to 2018 was largely consistent with the methodology used in the 2011 and 2013 updates. For this reason, reference is made to *TN5 – Input Parameters* from the WTSM 2013 update, which summarises the approach used in earlier updates. The approach used to update these to 2018 is detailed below.

As per the current version of WTSM, all nominal costs are rebased to 2001 dollars by adjusting for inflation. This is to scale back these costs in a way that the trip distribution and modal split components of WTSM could respond to properly, as the model was calibrated on 2001 values. The adjustments were made using the Consumer Price Index (CPI), leading to a factor of 0.70 for 2018.

It must be noted that some parameters have historically been based on values from the Economic Evaluation Manual (EEM) from Waka Kotahi, and this update also relies on the latest 2018 version of the EEM. A new guidance manual has been issued in August 2020 (Monetised Benefits and Costs Manual) which supersedes the EEM. However all values and methodologies used in this parameter update are identical in both documents, and references to the EEM have been kept for simplicity.

The full 2018 model rebuild will be expressly based on the Monetised Benefits and Costs Manual.

2.2 Vehicle Operating Costs

2.2.1 2011 and 2013 Model Updates Methodology

The vehicle operating costs (VOC) in WTSM are based on values from Appendix A5 of the Waka Kotahi NZ Transport Agency Economic Evaluation Manual (EEM) and include the following components:

- Base costs: fuel and oil, tyres, maintenance and repairs (M&R), depreciation
- Road surface condition/roughness
- Congestion
- Stoppages (VOC due to bottleneck delay)
- Changes in speed

These costs are combined into two main categories: fuel-related costs and non-fuel-related costs. Different costs are calculated for light vehicles, light vehicles on "Employer Business" trip purpose, and heavy vehicles. The reason for dividing vehicles in this way is based on the following assumptions:

- Home-based and Other trip purposes only perceive the variable component of their operating costs, i.e. the cost of fuel, including GST (15%)

- Business and Commercial Vehicle users perceive the full operating cost, including maintenance and depreciation, but excluding GST

Some of these cost components vary in function of the road category, gradient or speed/congestion, but they are implemented in WTSM as fixed parameters. Therefore, in order to calculate network-wide values, several assumptions had to be made regarding average speed, gradient, and other parameters. These were adopted for the 2006 model update and were left unchanged for the 2011 and 2013 updates. However, the monetary values in the EEM at the time were for July 2008 \$, and needed to be adjusted to 2013. This was done as follows:

- CPI was used to adjust non-fuel costs (factor of 1.11)
- CPI Petrol was used to adjust fuel component of VOC (factor of 1.23)

More detail on the assumptions and the calculations used to derive the base VOC in 2006 and 2011 can be found in section 3 of TN15 – Input Parameters from the 2011 model update.

2.2.2 2018 Update

The VOC that was calculated for the 2013 update was based on cost component values from the EEM. Since then, the EEM has updated both the cost component values and the percentage cost breakdown. The base costs are lower, particularly the cost of fuel. Updating the VOC using the 2013 methodology with these updated costs results in significantly lower final VOC, with fuel costs roughly halving compared with the 2013 model once adjusted for 2001 \$. These values are presented in Table 1 under “Updated EEM Base.”

Because these values are so different from those used to calibrate WTSM, a different approach was used to calculate VOC for the interim model. The final VOC values calculated in 2013 were uplifted to 2018 \$ using the following factors:

- CPI was used to adjust non-fuel costs (factor of 1.06)
- CPI Petrol was used to adjust fuel component of VOC (factor of 0.95)

While this leads to the VOC values used in the model differing from values in the EEM, it must be noted that EEM values are principally to be used for economic evaluation purposes. By definition, the appropriate values to be used in WTSM are the one that lead to the best representation of observed behaviours and applying revised EEM values would likely lead to a significant impact on trip distribution and modal share. It is therefore recommended that this alternative approach is used for the interim 2018 WTSM update, while the full WTSM rebuild during Stage 2 of the project will provide an opportunity to realign the model with EEM suggested values.

The resulting 2018 values for VOC are as shown in the table below under “Uplifted 2013 Values” in nominal 2018 \$ and 2001 \$.

Table 1: WTSM 2018 Vehicle Operating Costs

Class	Updated EEM Base		Uplifted 2013 Values	
	2018 Nominal (c/km)	Adjusted to 2001 (c/km)	2018 Nominal (c/km)	Adjusted to 2001 (c/km)
Light Vehicles - Employer Business, Fuel	11.87	8.32	20.70	14.49
Light Vehicles - Employer Business, Non-Fuel	17.80	12.46	17.69	12.39
Light Vehicles - Employer Business, Total	29.67	20.78	38.38	26.88
Light Vehicles - Other Purposes	13.36	9.56	23.28	16.30
Heavy Vehicles, Fuel	79.70	55.81	126.02	88.25
Heavy Vehicles, Non-Fuel	75.08	52.58	61.80	43.28
Heavy Vehicles, Total	154.77	108.39	187.82	131.53

2.3 Values of Time

2.3.1 2011 and 2013 Model Updates Methodology

The values of time in WTSM are based on values from the EEM expressed by different modes and trip purposes, combined with proportions from the 2001 Wellington Household Travel Survey.

The values of time in the EEM are expressed in July 2002 \$. For the 2011 and 2013 updates, these values of time were uplifted to March 2011 and March 2013 using GDP per capita growth from Statistics NZ.

More details on the assumptions and the calculations used to derive the base values of time in 2011 can be found in section 2 of *TN15 – Input Parameters* from the 2011 model update.

2.3.2 2018 Update

The same method was applied for the interim 2018 model, with the EEM values of time allocated to the different trip modes and purposes and the proportion from the 2001 Household Travel Survey used to estimate the WTSM values per trip purpose and car availability. GDP growth per capita was again used to uplift the values of time to March 2018, resulting in an uplift factor of 1.82. While the EEM now provides update factors for the Value of Time (with a value of 1.5 to factor to 2018), this approach was adopted for the 2018 interim WTSM for consistency with the earlier versions of the model. EEM values will be considered for the full update of the model. The resulting values of time used in the interim model are shown in the table below.

Table 2: WTSM 2018 Values of Time (c/min)

Purpose	Car Availability	WTSM 2018 Nominal Values of Time (c/min)	2018 Values of Time adjusted to 2001 (c/min)
Home-Based Work	Captive	15.80	11.07
	Competition and Choice	21.19	14.84
	Combined	21.08	14.76
Home-Based Education	Captive	10.37	7.26
	Competition and Choice	15.74	11.02
	Combined	15.55	10.89
Employer Business	Captive	71.33	49.95
	All	65.82	46.09
Other	Captive	13.44	9.41
	Competition and Choice	19.11	13.38
	Combined	18.89	13.23

2.4 Wellington CBD Parking

2.4.1 2011 and 2013 Model Updates Methodology

Parking costs are taken into account in WTSM for two Wellington CBD areas, lower and upper, which are shown in the figure below. Different costs are applied for work-related (commuting and business) trips and other purpose trips. The actual costs applied in the model are a function of the proportion of trips that pay, derived from the 2001 Household Travel Survey, i.e. they are a weighted average of those that pay and those that don't.

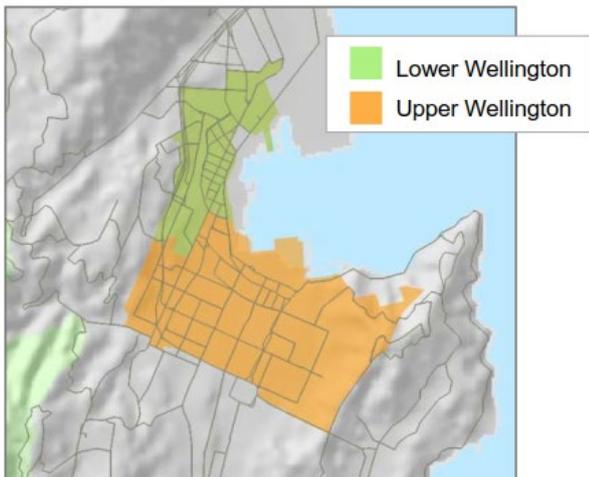


Figure 1: CBD Parking

For the 2011 update, limited information was available on the source of parking costs used in the 2001 and 2006 models. Furthermore, in 2001 Wellington City Council (WCC) operated all parking buildings in the CBD, but these were sold and became privately operated after 2004. Hence it was not possible to obtain information on historical increases from 2001 to 2006, and then to 2011.

After some investigation it appeared that parking costs were updated for 2006 using information available from WCC, assuming a 25% increase in cost for commuter parking and a 50% increase for other purpose parking. In addition, an assumed 20% increase in the proportion of cars that pay for parking compared with 2001 was applied.

For the 2011 update, a further 50% increase in the cost of commuter parking was applied, which led to costs that were consistent with parking charges applied by the main private parking operator in Wellington. For other purpose trips, the costs were left unchanged as metered on-street parking charges had not changed since 2006.

For the 2013 WTSM update, no change to the proportion of people paying for parking was assumed. Comparison of private operator (Wilson) charge increases between 2011 and 2013 was used to uplift the cost of commuter parking, which showed increases of 2% for casual parking and 7% for all day (or 1% per year for casual parking and 3.5% per year for all day). Metered on-street parking was identical to 2011.

2.5 2018 Update

It must be noted that as part of the 2018 WTSM update, there is a separate task to look at an improved representation of parking costs and capacities in the Wellington CBD and other areas. This alternative approach and its impact on model results is presented in 'TN7 – Parking'.

For the interim 2018 WTSM, the same approach was used as in 2013. No change to the proportion of people paying for parking was assumed. Comparison of private operator (Wilson) charge increases from 2013 was used again to uplift the cost of commuter parking. As the model update is occurring in 2020, parking prices from 2020 were used to get an annual increase and 2018 prices were interpolated. Parking showed an increase of 5% per year for casual parking and 6% per year for all day between 2013 and 2020, a steeper increase than between 2011 and 2013.

The resulting parking charges are shown in the table below.

Table 3: WTSM 2018 Parking Charges

Parking Sector	WTSM 2018 Nominal Parking Cost per Trip (\$)	2018 Parking Cost per Trip Adjusted to 2001 (\$)
Home-Based Work – Lower Wellington	7.37	5.16
Home-Based Work – Upper Wellington	11.92	8.35
Employer Business – Lower Wellington	1.05	0.74
Employer Business – Upper Wellington	1.87	1.31
Other Purposes – Lower Wellington	0.86	0.61
Other Purposes – Upper Wellington	1.73	1.21

The parking charges in Table 3 will be used in the interim 2018 WTSM update if the recalculated charges un-calibrate/un-validate the model.

2.6 PT Fares

2.6.1 2011 and 2013 Model Updates Methodology

For the 2011 update, a new fare matrix was produced which mirrored the Metlink fare zones and structure, common to all PT modes. This approach allowed a more dynamic process than the simple factoring used in the previous version, with the potential to easily recalculate the fare matrix for different transit lines or fare policies when forecasting, including integrated fares.

For the 2013 version of the model, this more complex matrix calculation was fully included as part of a standard model run that used discount factors per zones travelled to obtain the final discounted fare for each origin-destination (O-D). As a result, the PT fare matrix is always an accurate representation of the average fare paid for each O-D pair on the network.

Metlink tariffs were updated so that the full fare paid was uplifted to March 2013. In addition, some adjustments were made to reflect the larger uptake of Snapper card use in 2013, and the corresponding decrease in cash payment. Factors of 18% reduction in cash use during the morning peak and 13% during the inter peak were obtained from analysis of the Go Wellington ETM (electronic ticketing machine) data. Bus versus rail patronage proportions during the AM peak and inter peak were also updated using Metlink patronage data.

2.7 2018 Update

The same approach as the 2013 update was used in 2018. The Metlink fare structure was updated to reflect changes in fares and the discounts available. For example, the Platinum Plus card was discontinued in 2014. The proportions of people using each type of ticket were also updated based on 2019 ETM (electronic ticketing machine) data. PT fares were deflated to 2001, using the same factor of 0.70 as for other parameters.

In addition, interpeak fares were discounted by 25% network-wide in July 2018. While the model is intended to represent March 2018 demand, both the public transport network and electronic data used for validation are from 2019 post network changes. It was therefore decided to apply this inter peak discount for consistency. It must also be noted that the discount apply to the 9am-3pm period, whereas Inter peak in WTSM runs from 9am to 4pm. This was not anticipated to have any significant impact on costs however.

The resulting PT full fares and discount coefficients for both the AM peak and Inter peak are shown in the table below (in 2018 \$ and 2001 \$).

Table 4: WTSM 2018: PT Full Fares and Discount Coefficients

No. of Zones	Full Fare, Nominal Value	Full Fare, Adjusted to 2001	AM Peak Discount Coeff.	Inter Peak Discount Coeff.
0	\$2.50	\$1.75	0.73	0.44
1	\$2.50	\$1.75	0.62	0.46
2	\$4.00	\$2.80	0.66	0.46
3	\$5.00	\$3.50	0.70	0.48

No. of Zones	Full Fare, Nominal Value	Full Fare, Adjusted to 2001	AM Peak Discount Coeff.	Inter Peak Discount Coeff.
4	\$5.50	\$3.85	0.68	0.56
5	\$6.50	\$4.55	0.72	0.60
6	\$8.50	\$5.95	0.68	0.55
7	\$9.50	\$6.65	0.68	0.63
8	\$10.50	\$7.35	0.72	0.59
9	\$12.00	\$8.40	0.70	0.59
10	\$13.00	\$9.10	0.72	0.59
11	\$15.00	\$10.50	0.69	0.59
12	\$16.00	\$11.20	0.69	0.59
13	\$17.50	\$12.25	0.69	0.59
14	\$19.00	\$13.30	0.69	0.59

3. WPTM Input Parameters Update

3.1 Values of Time

Values of time in WPTM are derived from WTSM, with the same breakdown per trip purpose and car availability. The values of time in WPTM use the EEM values of time by trip purpose, which reflect equity between modes. Because the EEM gives values of time in 'resource' cost units, the values have been converted to 'user' cost units, which are 15% higher than resource cost units (Table A11.1 in the EEM). More details on these adjustments, including their impact on travel patterns, can be found in TN5 – Model Input Parameters, Appendix A – WPTM Values of Time Corrections from the 2013 update.

The 2013 values of time for WPTM have been uplifted to 2018 using GDP/capita growth.

Table 5: WPTM 2013 Values of Time (\$/hr)

Purpose	Car Availability	VoT WPTM 2013 (\$/hr)	VoT WPTM 2018 (\$/hr)
AM Work	Captive	13.65	16.68
	Competition & Choice	13.65	16.68
AM Education	Captive	12.07	14.76
	Competition & Choice	12.07	14.76
AM Other	Competition & Choice	12.07	14.76
	Captive	12.07	14.76
AM Child	Captive	12.07	14.76
IP Work	Captive	13.65	16.68
	Competition & Choice	13.65	16.68
IP Education	Captive	12.07	14.76
	Competition & Choice	12.07	14.76
IP Other	Competition & Choice	12.07	14.76
	Captive	12.07	14.76
IP Child	Captive	12.07	14.76

3.2 PT Fares

Unlike WTSM, PT fares in WPTM are only represented during the assignment through flagfall and zones boundary crossing fares, with slight differentiation between modes. PT fares have increased slightly for some zones since 2013. However, once adjusted for inflation, there is not a significant change in fares in real dollars overall. Therefore, to update the 2013 PT fares for WPTM, the 2013 values were adjusted to 2018

\$ using CPI (as was used for the last update), and no other changes were made. The 25% Inter Peak discount was however applied for this period.

Table 6 : PT Fares

	Mode	2013			2018		
		Flagfall Line	Flagfall Node	Boundary	Flagfall Line	Flagfall Node	Boundary
AM Adult	Bus	0.00	1.95	-	0.00	2.06	
	Flyer	2.25	1.95	-	2.37	2.06	
	Rail	1.95	-	0.01	2.06		0.01
	Ferry	8.64	-	-	9.12		
AM Child	Bus	0.00	1.32	-	0.00	1.39	
	Flyer	1.94	1.32	-	2.05	1.39	
	Rail	1.02	-	-	1.08		
	Ferry	8.64	-	-	9.12		
IP Adult	Bus	0.00	1.62	-	0.00	1.28	
	Flyer	2.58	1.62	-	2.04	1.28	
	Rail	2.02	-	0.13	1.60		0.10
	Ferry	8.64	-	-	6.84		
IP Child	Bus	0.00	1.33	-	0.00	1.05	
	Flyer	1.93	1.33	-	1.53	1.05	
	Rail	0.93	-	-	0.74		
	Ferry	8.64	-	-	6.84		

4. WTSM Input Parameters Forecasting

4.1 Summary

As for the base year economic input parameters, the approach used to forecast these parameters for future years was intended to update the methodology used in the 2013 update. The forecasting approach will likely be revised during the second stage of this project following the model rebuild. It should also be reviewed and adjusted as appropriate for use of the models on specific project work, taking into account latest observed trends, transport policies and economic projections.

The following figure shows the resulting growth factors for all WTSM economic input parameters.

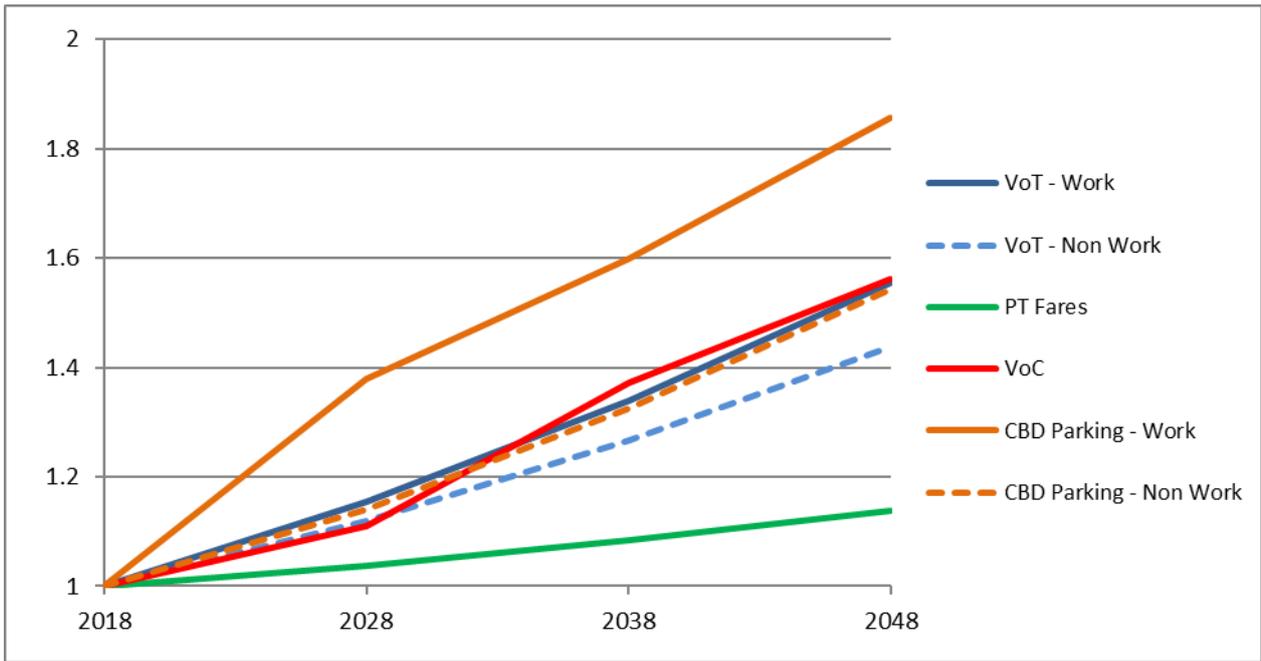


Figure 2: WTSM Economic Input Parameters Real Growth Indexed to 2018

Detail on the assumptions used to forecast these parameters is given in the following sections.

4.2 Values of Time

As for the 2013 update, the forecasted values of time were derived by applying projected increase in real GDP / labour force indexed to 2018, obtained from the NZ Treasury Fiscal Model forecasts¹. For non-work purposes, an elasticity factor of 0.8 was applied. This is the same approach used in the Auckland strategic transport models.

The resulting growth for both work and non-work purposes is illustrated in the figure below.

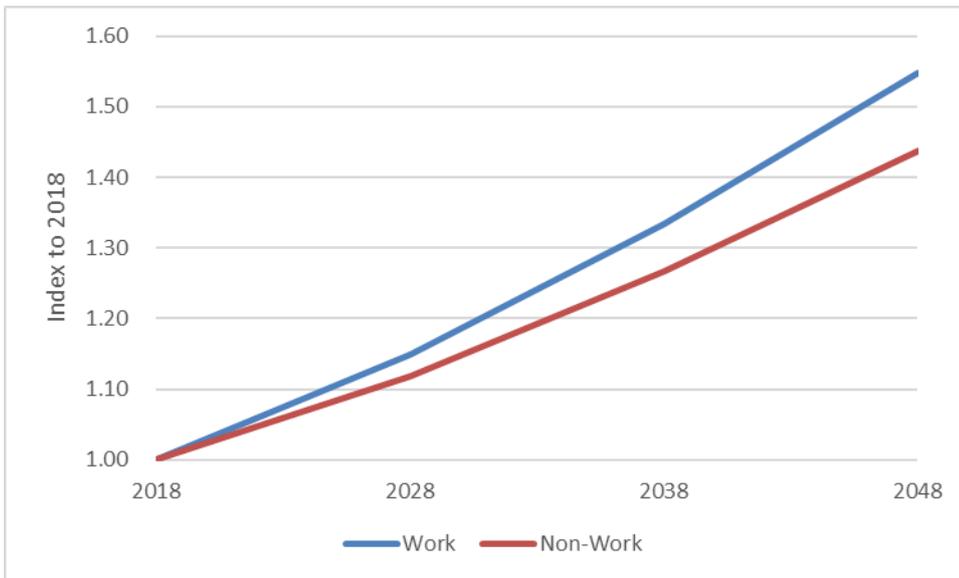


Figure 3: Values of Time Indexed to 2018

The forecasting adjustment factors and resulting values of time below have therefore been used for forecasting in WTSM.

¹ <http://www.treasury.govt.nz/government/longterm/fiscalmodel>

Table 7: WTSM Values of Time Forecast

Purpose	Car Availability	Forecasting Increase Factors			Values of Time Adjusted to 2001 (c/min)			
		2028	2038	2048	2018	2028	2038	2048
HBW	Captive	1.15	1.33	1.55	11.07	12.71	14.75	17.12
	Competition & Choice	1.15	1.33	1.55	14.84	17.05	19.78	22.96
	Combined	1.15	1.33	1.55	14.76	16.96	19.68	22.84
HBEEd	Captive	1.12	1.27	1.44	7.26	8.13	9.20	10.44
	Competition & Choice	1.12	1.27	1.44	11.02	12.34	13.96	15.85
	Combined	1.12	1.27	1.44	10.89	12.19	13.79	15.66
EB	Competition & Choice	1.15	1.33	1.55	49.95	57.39	66.61	77.30
	Captive	1.15	1.33	1.55	46.09	52.95	61.46	71.32
Other	Captive	1.12	1.27	1.44	9.41	10.53	11.92	13.53
	Competition & Choice	1.12	1.27	1.44	13.38	14.98	16.95	19.24
	Combined	1.12	1.27	1.44	13.23	14.80	16.75	19.02

4.3 Vehicle Operating Costs

The forecasting approach for vehicle operating costs is different for their fuel-related and non-fuel-related components. Non-fuel related costs are assumed to grow in line with CPI, and since CPI is also used to discount costs to 2001 \$, they consequently stay flat.

For fuel-related costs, the approach was largely consistent with the 2013 update. Fuel cost increase is dependent on two conflicting parameters: oil price increase and vehicle efficiency improvements. New sources of forecasts for these parameters were used for this update.

Petrol price forecasts were obtained from the Ministry of Transport National Land Transport Fund Revenue Forecasting Model. The latest version of this forecast available was from 2015.

Fuel efficiency forecasts were based on the 2015 Vehicle Fleet Emissions Model². This model provides actual and forecast vehicle kilometres travelled and fuel consumption, which were used to calculate vehicle efficiency.

Table 8: WTSM Vehicle Operating Cost Forecast

Area	Forecasting Increase Factors			Vehicle Operating Cost Adjusted to 2001 (\$)			
	2028	2038	2048	2018	2028	2038	2048
Light Vehicles - Employer Business, Fuel	1.10	1.37	1.56	14.49	15.93	19.88	22.62
Light Vehicles - Employer Business, Non-Fuel	1.00	1.00	1.00	12.39	12.39	12.39	12.39
Light Vehicles - Employer Business, Total	1.05	1.20	1.30	26.88	28.32	32.27	35.01
Light Vehicles - Other Purposes	1.10	1.37	1.56	16.30	17.92	22.37	25.45
Heavy Vehicles, Fuel	1.10	1.37	1.56	88.25	97.03	121.08	137.77
Heavy Vehicles, Non-Fuel	1.00	1.00	1.00	43.28	43.28	43.28	43.28
Heavy Vehicles, Total	1.07	1.25	1.38	131.53	140.31	164.36	181.05

² This model by Waka Kotahi was replaced by the Vehicle Emissions Prediction Model after 2015. The VEPM does not include the vkt and fuel consumption forecasts and is therefore not able to be easily used to calculate vehicle efficiency.

4.4 Wellington CBD Parking

The same approach used in the Auckland model and for the 2013 update of WTSM was retained, with parking charges adjusted based on GDP per capita increase, applying an elasticity of 1.2 for commuter travel (home-based work purpose) and 1.0 for other purposes.

Table 9 shows the resulting Wellington CBD parking prices used for forecasting in WTSM.

Table 9: WTSM Wellington CBD Parking Cost Forecast

Area	Forecasting Increase Factors			Wellington CBD Parking Cost Adjusted to 2001 (\$)			
	2028	2038	2048	2018	2028	2038	2048
HBW Lower Wellington	1.38	1.60	1.86	5.16	7.12	8.26	9.59
HBW Upper Wellington	1.38	1.60	1.86	8.35	11.51	13.36	15.51
EB Lower Wellington	1.15	1.33	1.55	0.74	0.85	0.98	1.14
EB Upper Wellington	1.15	1.33	1.55	1.31	1.51	1.75	2.03
Other Lower Wellington	1.15	1.33	1.55	0.61	0.70	0.81	0.94
Other Upper Wellington	1.15	1.33	1.55	1.21	1.39	1.61	1.87

4.5 PT Fares

PT fare increases were estimated using forecasted growth in GDP per capita from NZ treasury, and applying an elasticity of 0.25 obtained from analysis carried out by Ian Wallis. More detail on this methodology can be found in TN15 – Input parameters (section 5.3) from the 2011 WTSM update.

The resulting PT fare increase factors, which get applied to the whole fare matrix calculated in section 2.7, are shown in .

Table 10: WTSM PT Fares Increase Forecast

	2028	2038	2048
PT fare adjustment factors (using 0.25 elasticity)	1.04	1.08	1.14

5. WPTM Input Parameters Forecasting

5.1 Values of Time

Values of time in WPTM were uplifted to future years using the same approach as for WTSM, described in section 4.2. The increase in real GDP/labour force indexed to 2018 was applied, with an elasticity factor of 0.8 for non-work purposes. This resulted in the increase factors in Table 11.

Table 11: WPTM Values of Time Forecast

Car Availability	Forecasting Increase Factors		
	2028	2038	2048
Work	1.15	1.33	1.55
Non-Work	1.12	1.27	1.44

5.2 PT Fares

PT fares were uplifted to future years similarly to WTSM, using forecasted growth in GDP per capita and applying a 0.25 elasticity.

Table 12: WPTM PT Fares Increase Forecast

	2028	2038	2048
PT fare adjustment factors (using 0.25 elasticity)	1.04	1.08	1.14

Appendix A Comments and Responses

Please note that the comments below have been paraphrased in some places.

Question from **Client**:

Interested about the difference in VoC when using new EEM numbers, do we know why this is?

Response from Consultant:

Waka Kotahi were approached to discuss the difference in vehicle operating costs between two editions of the EEM but no detail could be provided. It must be noted that the full model rebuilt during Stage 2 of this project will allow realigning the model with more recent values from the Monetised Benefits and Costs Manual.

Question from **Client**:

Inter-peak PT fare discount of 25% was applied in 2018 (July). Although we are technically validating to 2018, however we are using the post 2018 bus networks so perhaps it makes sense to assume this discount was in place in March 2018; While this is not a 'pure' approach, we are building a model to be used in forecasting and therefore if we can calibrate to a change that occurred 6 month after March 2018 this would be preferable to ignoring it.

Response from Consultant:

Agreed, as this will ensure consistency with the network reflecting changes to the bus network post March 2018, as well as the demand used for validation and development of the Public Transport Model. The interpeak discount has therefore been included in both models.

Question from **Client**:

Parking and PT fares – how relevant are the elasticity assumptions? Can we compare what happened 2013 to 2018 to see if they are still valid? From a recent parking levy work commuter parking went up by 60% between 2013 and 2018, whilst PT fares have not gone up by that much.

Response from Consultant:

It would be very complicated to estimate elasticity of demand to changes in parking and public transport fares between 2013 and 2018, in isolation from other changes such as overall population and employment growth, increase in public transport demand, etc. We recommend that these elasticity figures are however reviewed during the next phase of the project.

Regarding the findings from the parking levy work, increase in charging of commuter parking was compared with the values presented in this report and was found to be consistent. For the 2013-2018 period, the percentage annual increases mentioned in Section 2.5 lead to a 34% real increase in all-day commuter parking (24% nominal) compared with 35% from the parking levy work (25% nominal).

Question from **Client**:

What about car ownership? Recently we have been using it as a proxy for car usage (which has remained flat or declined at a per capita level).

Response from Consultant:

Car ownership is not included in this Technical note, which is an update on similar notes from the 2011 and 2013 updates which did not include this component either, being mostly concerned with 'economic' parameters' feeding into the generalised costs calculation. For WTSM, car ownership is more of a parameter for the trip generation stage, i.e. part of "land use" (in the transport model sense of the word) and will be reported separately.

Question from Peer Reviewer:

I too am interested and marginally concerned about the VOC values being quite different to those in the EEM. I recognise that the values need to be those that give best representation of observed travel behaviour, but presumably EEM values have been updated for good reason, so it is of concern if the values being used have only historical justification

Response from Consultant:

See response from the first question. The issue for this simple update of the model is that implementing the new values from the EEM without further recalibration would lead to a significant response from the model in terms of distribution and modal choice. For this reason we recommend to use uplifted values from the 2013 model and use the newer value during the full rebuild in Stage 2.

Question from Peer Reviewer:

I wonder if there are two factors at play, as I'm also interested in the assumption that business and CV users perceive the full operating cost, including maintenance and depreciation. I would have suggested maintenance probably, but depreciation probably not. (For clarity, I accept that it's common practice to assume that the vast majority of car users only perceive costs as being fuel and parking, as the cost contributors to the overall generalised cost for mode split calculations)

Response from Consultant:

As per the previous response, this would be better addressed during the next stage of the project as it could potentially uncalibrated the model without further adjustment. This assumption will however be discussed during the model rebuild.

Question from Peer Reviewer:

I'm also interested in the discussion in the emails about the PT assumptions. If the data being validated to predates the 2018 changes being assumed in the model, then it would appear to be very difficult to validate the model.

Response from Consultant:

Both network (including bus) and observed demand that will be used for validation are from after the 2018 bus network changes. It is recognised that this will introduce some inconsistency with traffic figures used for validation which are from March 2018 (or factored to represent March 2018). However analysis carried out comparing March 2018 traffic volumes with other years did not show any significant variations (see TN4 – Data Analysis).

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