TN7 - WELLINGTON TRANSPORT ANALYTICAL TOOLS 2019-21 UPDATE – PARKING UPDATES

PREPARED FOR GREATER WELLINGTON REGIONAL COUNCIL

February 2021

Stantec | JACOBS

QUALITY STATEMENT

PROJECT MANAGER	PROJECT TECHNICAL LEAD
Ali Siddiqui	Julie Ballantyne

PREPARED BY

Chris Hendrickson, Vinh Pham, Julie Ballantyne, Tony Wicker

24/02/2021

CHECKED BY

Julie Ballantyne

24/02/2021

REVIEWED BY

Geoffrey Cornelis

24/02/2021

APPROVED FOR ISSUE BY

Julie Ballantyne

24/02/2021

CHRISTCHURCH

Hazeldean Business Park, 6 Hazeldean Road, Addington, Christchurch 8024
PO Box 13-052, Armagh, Christchurch 8141
TEL +64 3 366 7449, FAX +64 3 366 7780

REVISION SCHEDULE

Rev No.	Date	Description	Signature or Typed Name (documentation on file)			
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1	8.12.20	First Draft for Comment	TW	JB	GC	JB
2	17.12.20	Draft for Comment				
3	24.02.21	Final, addressing comments	CH, VP, TW, JB	JB	GC, AK	JB

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Greater Wellington Regional Council

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1.   Council Parking

Council-operated parking data was obtained from Wellington City Council, Hutt City Council and Upper Hutt City Council.

Wellington City council parking data is based on WCC's *Parking Policy Review Background Information and Issues report* dated January 2020. This report summarised parking in the Wellington CBD and outer suburbs, including metered, time restricted, coupon, resident, and unrestricted parking. As this was the most relevant information available, it is assumed that this document is representative of 2018 parking.

Upper Hutt City Council and Hutt City Council parking data was received in excel sheets as requested.

1.1.1   Commercial Parking

Information on commercial parking spaces was obtained through operator websites. Where data was not available online, the operators were contacted directly requesting the information. Again, the advertised information for commercial parking is generally for the current year (2020). It is assumed that this is representative of 2018 parking.

Commercial parking data was obtained from the following operators:

- Wilson Parking
- Care Park
- Parallelparking
- Prime Parking
- SecuraPark
- Hope Gibbons Parking

1.1.2   Private Parking

Private parking includes parking not directly available to the public, such as parking in commercial buildings provided to employees, and private parking in residential buildings. This information was sourced from WCC's *Parking Policy Review Background Information and Issues report* for private parking in central Wellington.

1.2   Parking Data – Supply and Charges

The resulting parking supply for Wellington City by suburb is summarised in Table 2-1 below by private, public, and residents-only. Coupons have been included in public parking.

Table 2-1: Parking Supply by Surburb in Wellington City – Private/Public/Residents

Suburb	Private	Public	Residents Permits	Total	Proportion (Total)
CBD	8,335	5,584	0	13,919	47%
Te Aro	0	2,594	180	2,774	9%
Te Aro - Courtenay	1,947	382	0	2,330	8%
Cuba / Willis	1,835	363	0	2,198	7%
Parliament	1,383	166	0	1,549	5%
Mount Victoria	0	1,069	420	1,489	5%
Thorndon	0	1,033	390	1,423	5%
Mount Cook	0	950	320	1,270	4%
Kelburn	0	795	420	1,215	4%
Pipitea	0	831	0	831	3%
Clifton	0	216	200	416	1%
Oriental Bay	0	179	0	179	1%
Kilbirnie	0	42	0	42	0%

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Suburb	Private	Public	Residents Permits	Total	Proportion (Total)
Total	**13,500**	**14,206**	**1,930**	**29,636**	

The data reveals:

- The Wellington CBD has the most parking supply with approximately 14,000 spaces, accounting for just under half of the total. This is followed by Te Aro, Te Aro – Courtenay, and Cuba / Willis which each have between 2000 and 3000 spaces;

- Half the parking is public (including on and off-street parking), while just under half is private off-street parking;

- There is a small amount of resident-only coupon parking. This has not been carried forward into the modelling as this supply is not available to non-residents. Parking supply and charges will be predominantly used for the non-home end of the trip and influence modal choice (car versus public transport).

The same parking supply information is tabulated below by off and on-street facilities by suburb. The suburb order is the same as the previous table, from the largest supply (top) to the least (bottom).

Table 2-2: Parking Supply by Surburb in Wellington City – On versus Off Street

Suburb	Off Street	On Street	Total
CBD	12,816	1,103	13,919
Te Aro	872	1,902	2,774
Te Aro - Courtenay	2,067	263	2,330
Cuba / Willis	1,948	251	2,198
Parliament	1,468	81	1,549
Mount Victoria	0	1,489	1,489
Thorndon	210	1,213	1,423
Mount Cook	250	1,020	1,270
Kelburn	0	1,215	1,215
Pipitea	831	0	831
Clifton	0	416	416
Oriental Bay	74	105	179
Kilbirnie	42	0	42
Total	**20,578**	**9,058**	**29,636**

Almost 70% of the parking supply is off-street, with 30% on-street.

In terms of parking charges, over all car parks in the wider Wellington CBD, the average daily flat charge, hourly charge and early-bird discount charge is shown below in Table 2-3.

Table 2-3: Average Parking Charges in the Wider Wellington CBD

Average Daily Flat Charge	Average Hourly Charge	Average Early-bird Charge
$28	$5.50	$19

The minimum and maximum hourly charges for different park types are shown in Table 2-4, along with the maximum daily charge and maximum early-bird charge.

Table 2-4: Minimum and Maximum Charges for Wellington Parks

Parks	Minimum Hourly Charge	Maximum Hourly Charge	Minimum Daily Flat Charge	Maximum Daily Flat Charge	Minimum Early-bird Charge	Maximum Early-bird Charge
All of Wellington CBD	$1	$12	$6	$48	$11	$30
On-Street	$1.50	$4.50	$12	$12	-	-
Off-Street	$1	$12	$6	$48	$11	$30

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Parks	Minimum Hourly Charge	Maximum Hourly Charge	Minimum Daily Flat Charge	Maximum Daily Flat Charge	Minimum Early-bird Charge	Maximum Early-bird Charge
Public	$1	$12	$6	$48	$11	$30
Private	-	-	-	-		-

- The flat cost in Wellington ranges from $6 to $48 maximum / flat rate per day with the hourly cost ranging from $1 to $12. Early-bird pricing ranges from $11 to $30 flat rate over the day. The area in Wellington CBD with the lowest flat rate is Te Aro, whilst the highest is Wellington CBD. Mount Cook holds the lowest hourly charge, and Wellington CBD has the highest;

- For on-street parking, the hourly charge ranges from $1.50 to $4.50, with a maximum flat charge of $12. The parks with this $12 flat fee also have the option for two hours free before users are required to pay the daily charge. For off-street parking, the hourly charge ranges from $1 to $12, with a maximum daily flat charge of $48. Early-bird rates for off-street parking ranges from $11 to $30, with most off-street parking sites offering the early-bird discount;

- For public parks, the hourly charge ranges from $1 to $12, with a maximum daily flat charge of $48. There is no data for the charge ranges for private car parks.

2. Parking Sectors

When using parking data in WTSM, the data by suburb will be aggregated to sectors. This is because parking location and final destination may not be within the same zone. The time/distance between parked vehicles and ultimate destinations will be examined when up-to-date Household Travel Survey data becomes available. Using sectors also dampens variation between one parking facility and another.

Sector were formed based on the Wellington City parking zones. The parking sectors are defined by the following principles:

- Using the Central city parking zones for the carpark within the CBD area, including the following sectors:

  o Central Business District / Lambton

  o Te Aro / Courtenay

  o Upper Cuba Street / Willis Street

  o Parliament precinct

- Using the Wellington Coupon Parking Zone for the carparks outside the CBD area, including:

  o Clifton

  o Kelburn

  o Mount Cook

  o Mount Victoria

  o Wider Te Aro

  o Thorndon

  o Train station and Westpac stadium

- The parking zones are shown in the Figure 3-1 and Figure 3-2 below.

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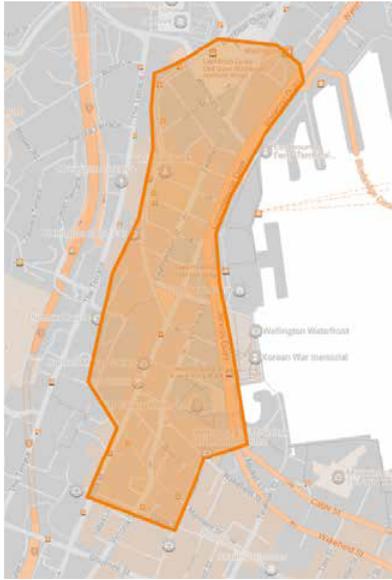
Lambton / CBD Parking Zones

Parliament Parking Zones

Te Aro / Courtenay Parking Zones
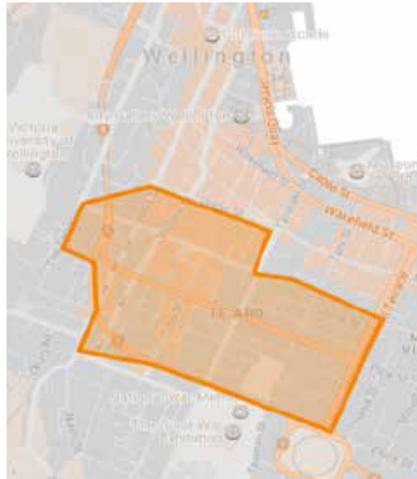
Upper Cuba / Willis St Parking Zones

Figure 3-1: Central City Parking Zone Maps (Source: WCC)

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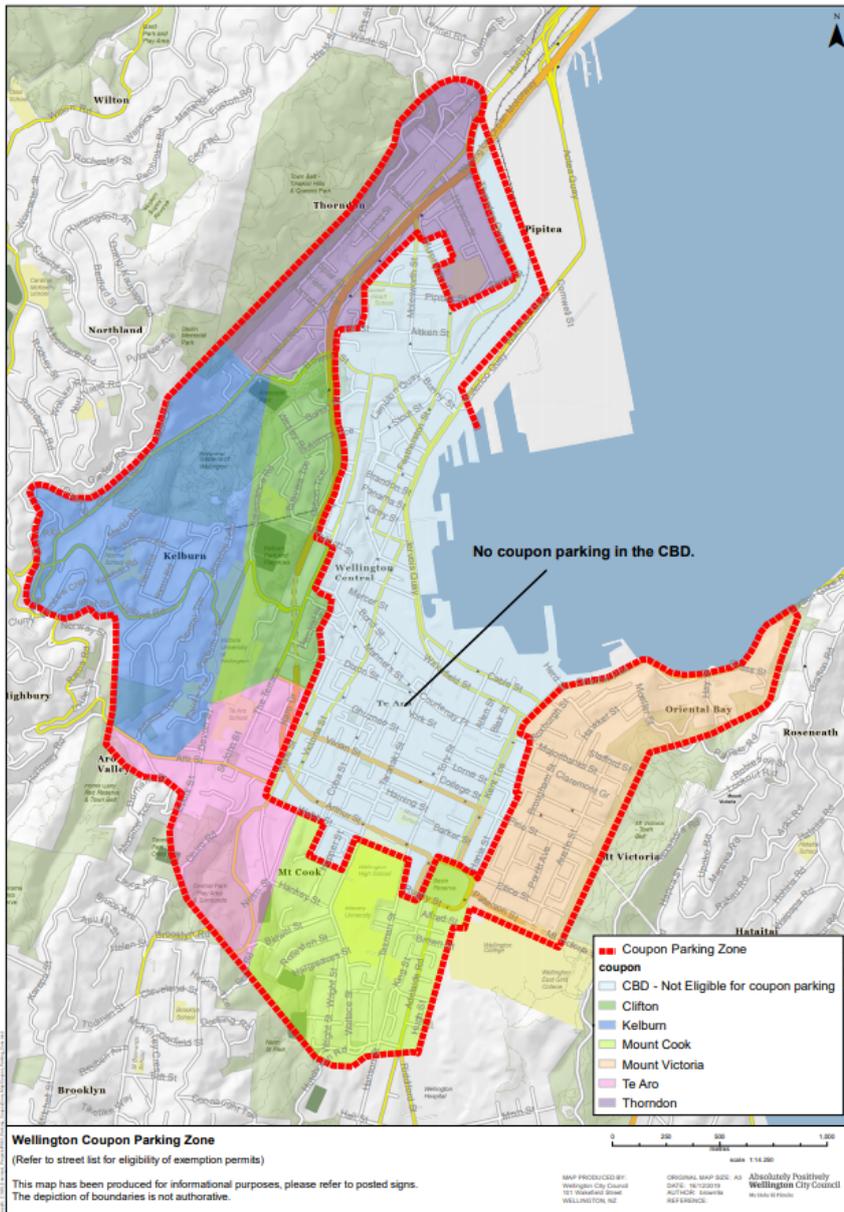
Figure 3-2: Wellington Coupon Parking Zone Map (Source: WCC)

Some parking data was only reported in total and not by area. This included time restricted on-street (275 spaces), metered off-street (830 spaces), and private off-street parking (13,500 spaces). Off-street spaces were allocated to sector using 2018 Census Journey to Work at the workplace end, private and company car drivers only. On-street spaces were allocated using retail employment (March 2018 definition rather than June). In both cases, proportions were calculated by area and the total spaces allocated on that basis.

The sectors formed are listed in the table below.

Table 3-1: Parking Sectors

Sector Name	Sector No.
Central Business District	1
Clifton	2
Cuba / Willis	3
Kelburn	4
Mount Cook	5
Mount Victoria	6

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Sector Name	Sector No.
Parliament	7
Te Aro	8
Te Aro - Courtenay	9
Thorndon	10
Train Station	11

It is noted that there will be a 12th sector, which will be the rest of the modelled area.

The zone to sector correspondence is shown graphically in the figure below. The first figure uses the circa 820 zone system to be used for the Demand Model developed in Stage 2 of this project. These zones are based on Statistical Area 1's (SA1). The current WTSM 225 zone system to parking sectors is shown in Figure 3-4, using the same colour scheme for the parking sectors. The parking sectors developed can be formed at either the 225 (meshblock based) or 820 (SA1 based) zone systems.
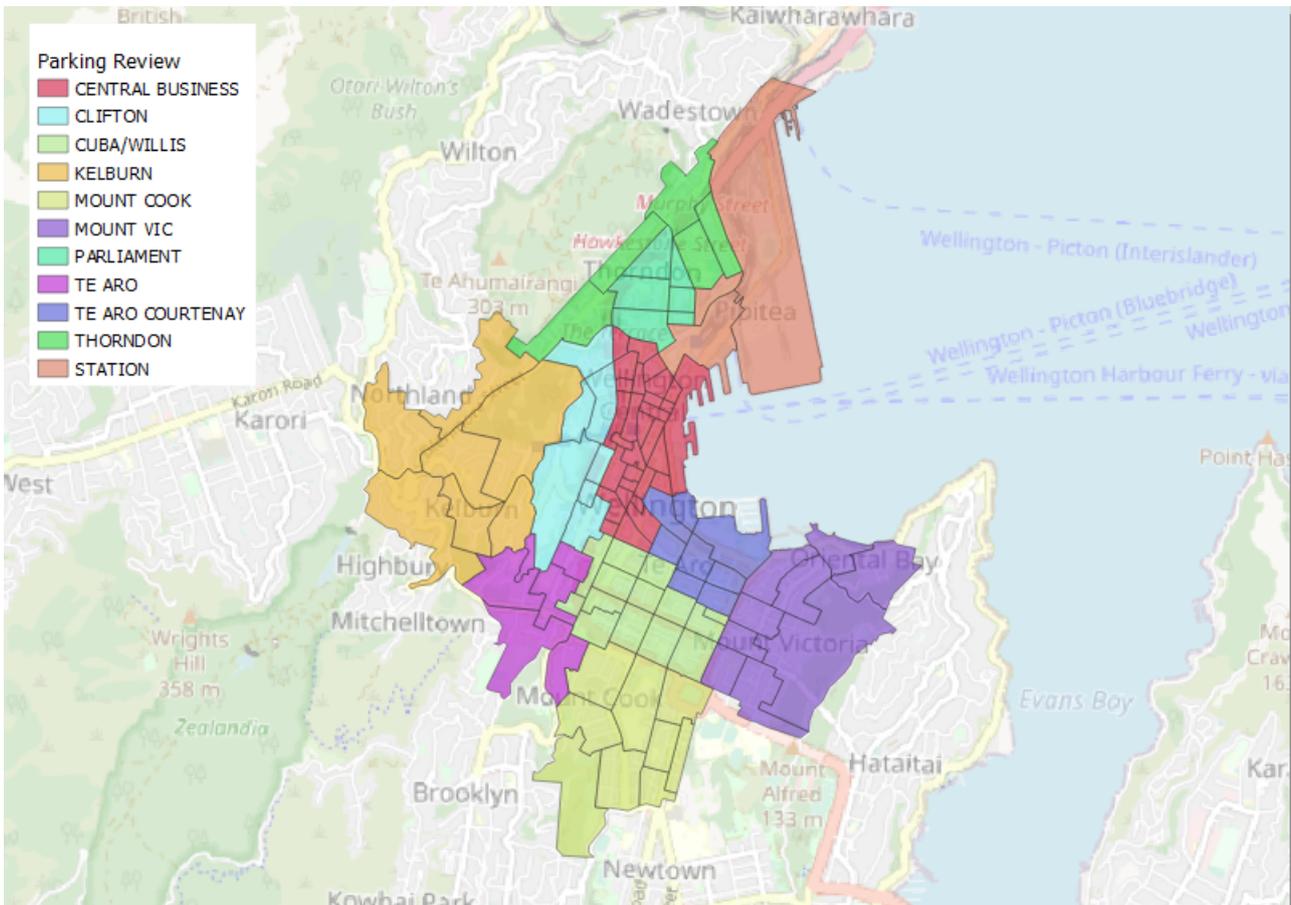
Figure 3-3: Parking Sectors in WTSM (SA1-based zoning)

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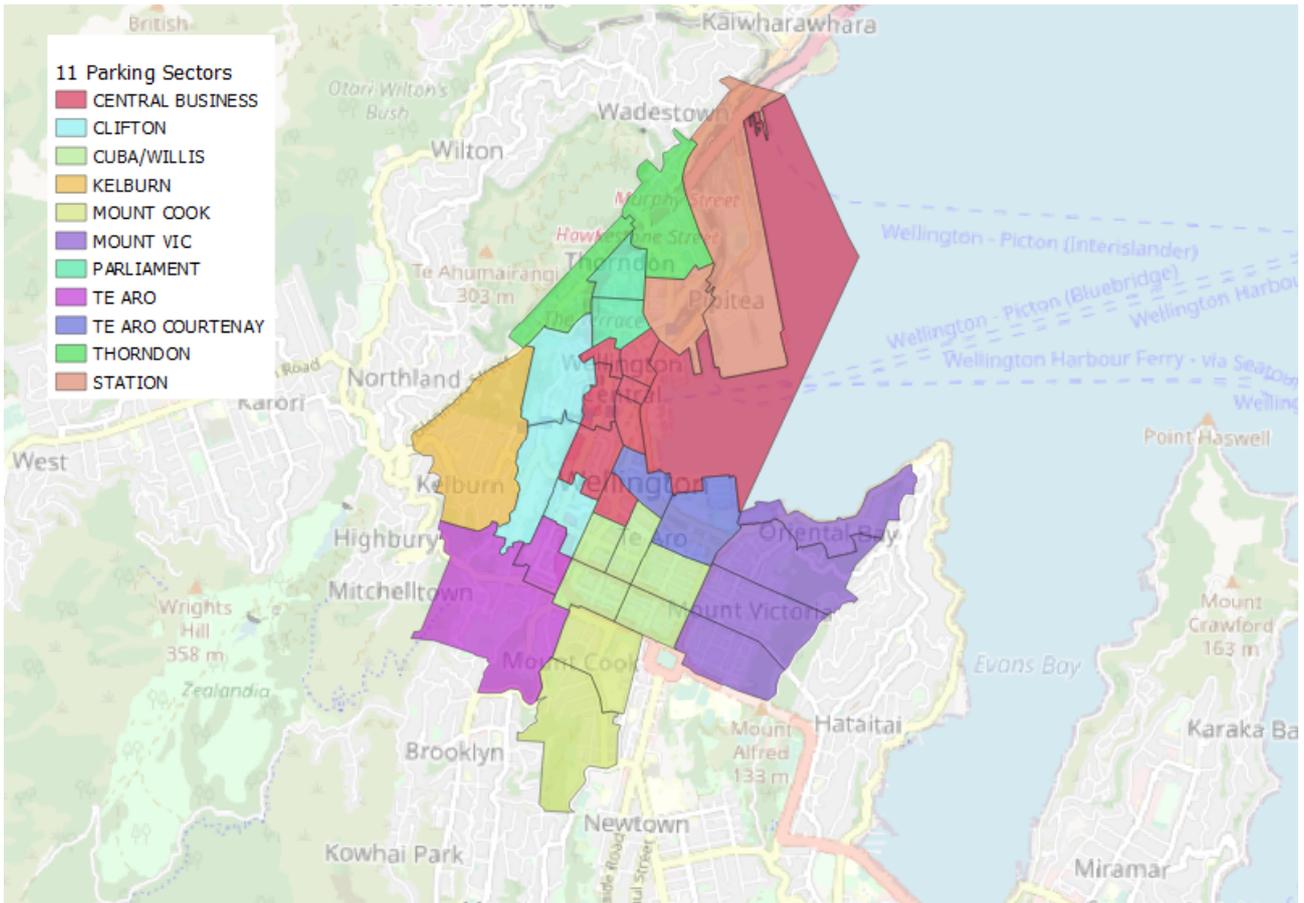
Figure 3-4: Parking Sectors in WTSM (225-zone system)

Visually, there appears to be a significant difference in the Central Business District parking sector between the two zone systems (820 verses 225). This relates to a change in meshblock boundary, which included a large part of the Harbour in 2013 (225 zone) compared with the 2018 Census boundaries. While visually different, there is no material difference in the parking sectors formed by aggregating 225 or 820 zones.

The number of 2018 on-street, off-street and workplace/employer provided private spaces by sector are shown in the following table. The 1930 residents only spaces have been removed from the parking dataset, as reported in the previous section.

Table 3-2: Parking Supply by Sector

Sector Name	Sector No.	Number of Parking Spaces			Total
		Private	Public		
		Off-Street		On-Street	
Central Business District	1	8,335	2,184	847	11,366
Clifton	2			216	216
Cuba / Willis	3	1,835	1,622	756	4,212
Kelburn	4		642	795	1,437
Mount Cook	5		250	700	950
Mount Vic	6		83	1,121	1,204
Parliament	7	1,383	361	81	1,825
Te Aro	8			550	550
Te Aro - Courtenay	9	1,947	1,024	983	3,954
Thorndon	10		47	91	438
Train Station	11		865	688	1,553
Total		**13,500**	**7,078**	**7,128**	**27,706**

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3. Allocation of Supply/Charges to Trip Purposes

The number of parking spaces and associated charges in the wider Wellington CBD need to be allocated to trip purpose. The process of allocating spaces to trip purpose is described in this section.

3.1 2013 Parking Data in WTSM

While trip purposes for the updated 2018 version of the Demand Model have not been defined yet (this is a Stage 2 task), the current version of WTSM includes the trip purposes shown in the following table and the aggregation in the second column.

Table 4-1: Trip Purposes for Parking Charges

Current WTSM Trip Purposes	Aggregated Trip Purposes for Parking
Home-based work (HBW)	Commuting (HBW)
Home-based Education (HBED)	Rest
Home-based Shopping (HBSH)	
Home-based Other (HBO)	
Non-Home Based Other (NHBO)	
Employers Business (EB)	Business (EB)

This purpose grouping is logical as it segregates longer duration (commuting) trips, trips with less price sensitivity (business trips), and the rest. These aggregated trip purposes will be retained for parking in the updated Demand Model as it is logical and practical for aligning different data sources.

The current version of WTSM has parking charges specified for three sectors, which are the Upper CBD, Lower CBD, and the rest of the modelled area. There are no parking charges currently applied outside Wellington CBD.

Parking charges by sector and purpose in the current version of WTSM are shown in the following table. It is noted that the calculation of average parking charges for the 2001 model build cannot be located, just the final values. So during updates of the model, including the 2013 update, an average increase in charges was applied. This is documented in technical notes for the various updates.

Table 4-2: Parking Charges in 2013 WTSM

Sector No.	Sector Definition	Parking Charges in 2013 WTSM, 2001$		
		HBW	EB	Rest
1	Rest	0	0	0
2	Lower CBD	4.29	0.73	0.6
3	Upper CBD	6.93	1.3	1.2

Note these parking charges are in 2001 dollars.

The historic approach to produce approximate 2018 parking charges (in 2001 dollars) is documented in Technical Note 9: Economic Parameters. The parking charges and sectors in Table 4-2, updated to 2018 charges as per Technical Note 9, will be the fallback for the 2018 validation of current WTSM. These values will be used if the recalculated parking charges for the new sector system, documented in the next section, un-validate the model. If this is the case (i.e. the current model does not validate with updated parking charges/sectors), the new parking charges and sectors will only be introduced in the Demand Model built in Stage 2 of this project.

3.2 2018 Parking Data

3.2.1 Assumptions

The parking charges and supply documented in Section 2 of this report have been allocated to the 12 sector system (the 12th sector being the rest of the modelled area) in Section 3. In calculating average charge and supply, the following assumptions were made:

- Only parking in the wider Wellington CBD has been included as consistent data was not available for all other town centres in the region;

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- Resident only parking was excluded as the focus is improving modal choice, which particularly effects morning peak vehicle trips into the CBD (and vice versa for the evening peak);

- For facilities where charges were not readily available, the average from all sites with specified charges was applied. The calculation of the average is shown in Table 4-3;

- Coupon parking was allocated as "long" duration although there is currently two hours free. This is discussed further below;

- Where the maximum duration was less than 480 minutes (8 hours), this was allocated as "short/medium" duration parking;

- Monthly parking charges were converted to daily by dividing by 22 average weekdays per month;

- For facilities with a range of monthly charges, the average was taken;

- For parking facilities with hourly and longer term rates (either maximum flat rate, monthly, or early bird discounts), it was assumed that 50% of the spaces were available for hourly use and 50% for long term/daily in calculating the aggregate parking charge. There is no data for the split between short/medium and long term use, so 50/50 is a practical assumption. When up-to-date Household Travel Survey data becomes available, relative use of different parking facilities by trip purpose can be revisited.

3.2.2   Calculation of Daily Charges

For monthly-only parking where the charge was not readily available, the average of available sites was adopted. The facilities used in this calculation are shown in the following table.

Table 4-3: Calculation of Average Monthly-Only Parking Charge

Parking Facility	Monthly Parking Charge ($)
10 Brandon Street	400
11 Victoria Street Parking centre	400
138 The Terrace	320
21 Manners Street	300
30 Allen Street	600
45 Boulcott Street	280
5-11 Gilmer Terrace	320
81 Molesworth Street	480
90 Tory Street	280
Customs House, 17 Whitemore Street	360
Kiwi Wealth House, 94 Featherston Street	360
Leftbank Carpark, 185 Victoria Street	360
Pringle House, 142 Wakefield Street	260
Sirocco Apartments, 8 Church Street	380
Technology One House, 86 Victoria Street	400
Average	**366.67**

Table 4-3 contains 2020 published values, which are assumed to reflect 2018 in the absence of other data.

This average charge was allocated to the following facilities which offer monthly-only parking:

- Thorndon Quay (3 spaces)

- Mowbray Street (13 spaces)

- 10 Tory Street (45 spaces)

The decision-making process to calculate a daily parking charge per facility is shown in Figure 4-1.

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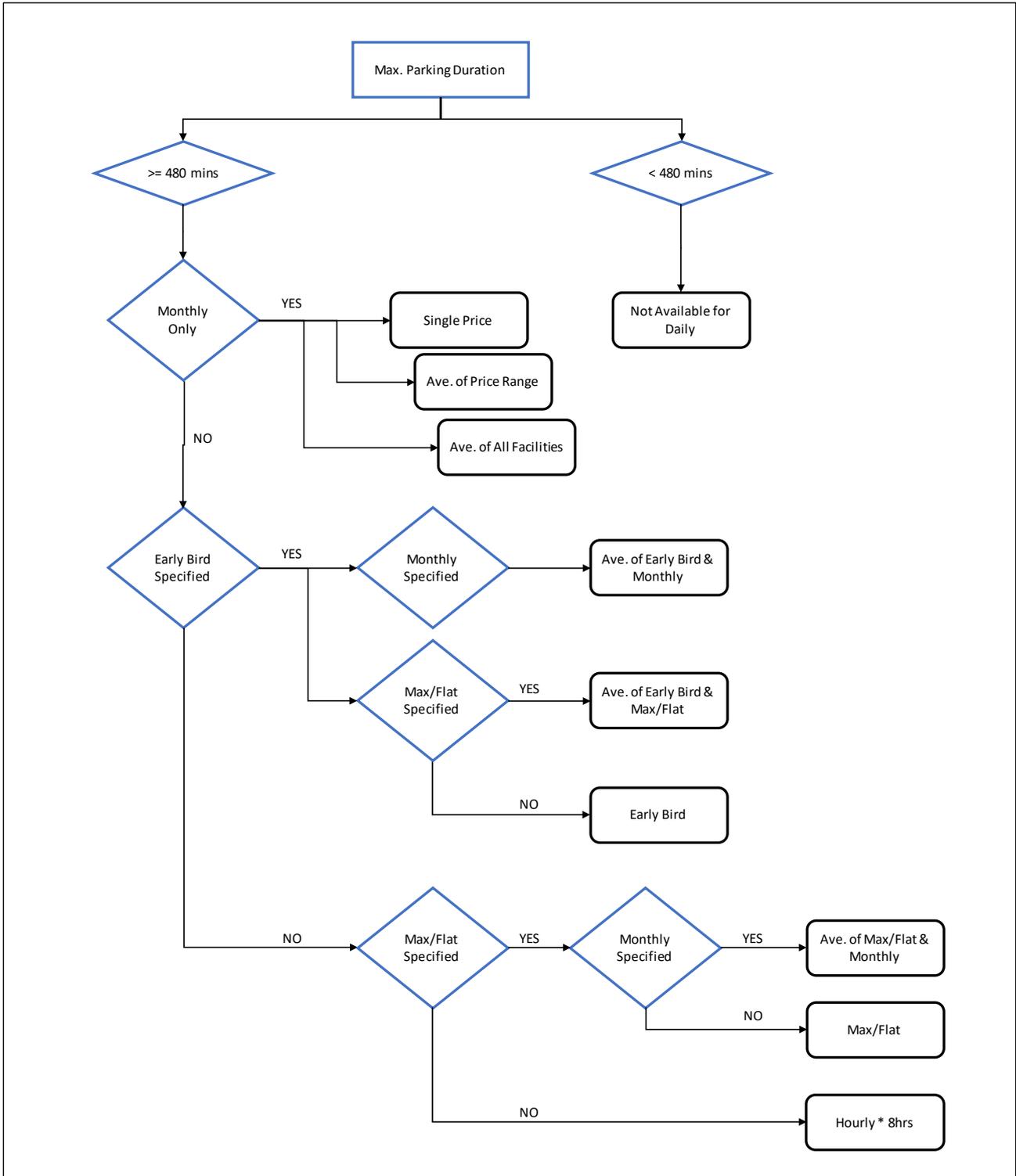
Figure 4-1: Decision Process for Calculating Daily Parking Charge Per Facility

3.2.3 Process of Allocating to Trip Purpose

The next step in the process was to allocate facilities to trip purposes. This was achieved by allocating facilities firstly to different types of parking, the parking type defined based on a combination of paid/free, on or off-street, and maximum duration of stay. The definition of the parking types is shown in the following table.

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Table 4-4: Parking Types

On or Off Street	Payment	Duration	Parking Type
On Street	Free	Short/medium Duration	On-Street Free
	Paid	Short/medium Duration	On-Street Paid
		Short/medium or Long Duration	
		Long Duration	
Off Street	Paid	Short/medium Duration	Off-Street Paid
		Short/medium or Long Duration	
		Long Duration	
	Employer Provided		Off-Street Workplace/Employer

Assumptions made include:

- Facilities with a maximum duration of stay less than 480 minutes (8 hours) were allocated as "short/medium" duration;

- "Time restricted" spaces were allocated as "short/medium" duration;

- Coupon parking was allocated as "long" duration even though the first two hours is free. This was because there is a modest (with respect to other facilities) daily charge so these spaces are likely to be popular with commuters. In the absence of other data, it was therefore considered likely that coupon parking would be filled by regular commuters first. These spaces could be used by residents, however, there is no parking occupancy survey data available, and hence this has not been considered.

Supply was aggregated by sector into the parking types shown in Table 4-4.

Charges were similarly aggregated by sector into parking types although a weighted average of spaces by facility was included as well as:

- For short/medium duration parking, a "per hour" charge was calculated using the hourly rates;

- For long duration parking, a "per day" charge was calculated using the daily rates;

- For short/medium or long duration parking, per hour and per day charges were calculated. For facilities falling into this category, in the absence of further information, half the parking was assumed to be short/medium and half long duration to calculate weighted average charges.

The spaces in each parking type were then allocated to the aggregated trip purposes (commuting, business, and rest) using proportions from the 2001 Household Travel Survey (HTS). While this survey is dated, more recent information is not available and the 2001 HTS is only used for aggregation and weighting. This process has been designed to be updated when a recent HTS is available.

Table 4-5: Trip Purpose Proportion by Parking Type, 2001 HTS

Parking Type, 2001 HTS	Proportion in 2001 HTS			
	Commuting	Business	Rest	Total
Public Unmetered On-Street	10.3%	18.5%	71.2%	100%
Public Metered On-Street	7.6%	19.5%	73.0%	100%
Public Off-Street	37.8%	14.8%	47.3%	100%
Work/Employer's Carpark	58.8%	20.7%	20.4%	100%

For vehicle trips that parked at their destination, the following characteristics were excluded in calculating the above proportions from the 2001 HTS:

- Weekends;

- Commercial vehicles;

- Destinations outside the wider CBD; and

- Drop off, residential, and forecourt/drive-through parking.

Commercial vehicles were excluded as this category includes trucks and the parking supply is applicable to private vehicle trips in the model. However there are some car driver and car passenger

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trips (separate to taxi) in the 2001 Household Travel Survey specified as "commercial vehicle" trip purpose that should have perhaps been reclassified as "business" and included. This would slightly increase the business proportion for each type of parking by 1 to 3.5 percentage points (for example, for public unmetered on-street, this would increase from 18.5% to 22.0%). As the proportion of parking type by trip purpose needs to be recalculated using up-to-date Household Travel Survey data in Stage 2 of the project, commercial vehicles have not been included as this stage.

To allocate spaces identified as available for the "rest" of the trip purposes (i.e. excluding commuting and business), proportions from the 2001 HTS were again calculated and applied. The proportion of each trip purpose that sits within the "rest" category was calculated for car trips parked in the wider CBD (using the exclusions listed in the bullet point list above). For simplicity reasons, parking type was not considered. Commercial vehicles were excluded, escort trips were grouped with their primary trip purpose, so commuting includes home-based work plus home-based work (escort). In all the calculations involving the 2001 HTS, expanded trips have been used.

Table 4-6: Proportion of "Rest" of the Trip Purposes, 2001 HTS

Proportion in 2001 HTS				Total
HBED	HBSH	HBO	NHBO	
4.8%	16.7%	21.4%	57.2%	100.0%

The process of calculating the supply (spaces) by trip purpose for each sector is shown diagrammatically in the following figure.

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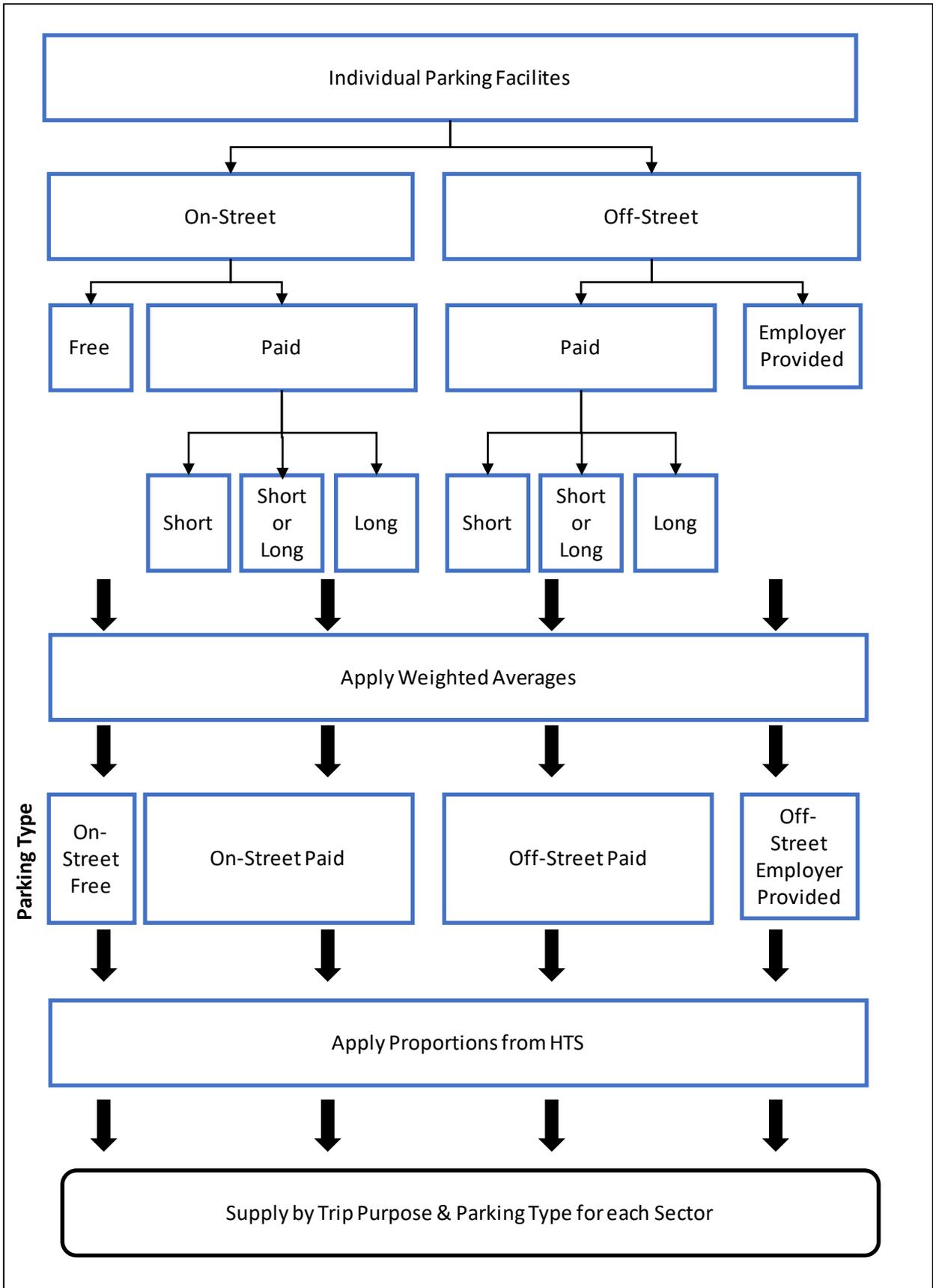
Figure 4-2: Process for Allocating Spaces to Trip Purpose

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The process for calculating the parking charge by trip purpose and sector was the same as for the supply, aside from weighting by the number of spaces. In addition, the following logic was applied:

- Employer provided parking has no charge perceived by the driver. So on-street free and employer provided parking charges are zero which is included in the weighted average. This will result in parking charges lower than might be expected;

- It was assumed commuters would pay a daily parking charge. This is reinforced from the 2001 HTS where the average duration of stay was 5.8 decimal hours as shown in Table 4-7;

- For business and the "rest" trip purpose, the average duration of stay from the 2001 HTS was calculated and applied to hourly parking charges. These are tabulated in Table 4-7;

- For off-street paid parking used by commuters, the average of the daily charge for long and "short/medium or long" stay parking was used;

- For off-street paid parking used by business or the "rest" trip purpose, the average hourly charge for short/medium and "short/medium or long" stay parking was calculated. This was multiplied by the average duration of stay for each purpose calculated from the 2001 HTS.

Table 4-7: Average Duration of Stay, Weekdays, Private Vehicles Parked in Wider-CBD, 2001 HTS

Metric	Commuting	Business	Rest
Daily Trips, 2001 HTS	23,881	15,565	43,937
Average Duration of Stay (hh:mm:ss)	05:48:17	01:38:54	01:33:21
Average Duration of Stay (decimal hours)	5.80	1.65	1.56

For the average duration of stay, the following was excluded from the expanded 2001 HTS:

- Weekends;

- Commercial vehicles;

- Destinations outside the wider CBD; and

- Drop off, residential, and forecourt/drive-through parking.

3.2.4 Anomalies in Parking Facility vs Trip Purpose

Applying the process outlined in Section 4.2.3 produced parking spaces and charges in each of the 11 sectors for the four different parking types (on-street free, on-street paid, off-street paid, off-street employer provided). It also resulted in some anomalies/inconsistencies that needed adjustment, which is explained in this section. These inconsistencies are associated with using averages and disconnects between the parking supply information and the 2001 Household Travel Survey.

As an example of an anomaly, the 2001 HTS reported 2.1% of commuters parking a private vehicle in the wider CBD in on-street metered facilities. the HTS also showed the average duration of stay for commuting trips to the CBD was almost six hours. Today, on-street metered parking has a maximum duration of one to two hours. While it is possible some will commute to the CBD and stay for less than two hours, this sub-group will likely be very small. Commuters using on-street metered parking were therefore set to zero, and the other proportions recalculated.

The changes introduced to address these types of inconsistency are listed below.

Similar to the example above, a small number of on-street free spaces were allocated to the commuting trip purpose (from the 2001 HTS) which has an average duration of stay of six hours. However, these spaces are time-restricted to a maximum of two hours. The on-street free spaces for the commuting trip purpose, shaded grey in the table below, were therefore set to zero, and the spaces re-allocated in proportion to Business and Rest purposes.

Table 4-8: Anomaly – On-Street Free Parking

Sector	On-Street - Free					
	Spaces			Charge per Trip, 2020 $		
	Commuting	Rest	Business	Commuting	Rest	Business
1, Core CBD	28	196	51	0	0	0

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Two issues occurred for on-street paid spaces, as shown in Table 4-9 (grey shading). These issues are related to mismatches between parking available in each sector and the application of city-wide proportions.

For commuting, spaces were allocated in sectors where there was no long duration on-street paid parking available, evident through the calculated charge being zero. In this case, the spaces for commuting were set to zero and reallocated to the other purposes.

The second problem was spaces allocated for Business/Rest purposes in sectors where there was no on-street paid short/medium duration parking. This occurs because the 2001 HTS had people on Business/Rest trip purposes parking in on-street metered parking, however in some sectors, there is no short/medium term on-street paid parking. This is a consequence of using dated aggregate data and applying it at a relatively fine geographic level. While its possible these trips could use long term parking, it seems less likely and this would result in large parking charges being calculated and applied (as we are working on averages). To address this, these spaces were reallocated to commuting in these sectors.

Table 4-9: Anomaly – On-Street Paid Parking

| Sector | On-Street - Paid | | | | | |
| | Spaces | | | Charge per Trip, 2020 $ | | |
	Commuting	Rest	Business	Commuting	Rest	Business
1	43	417	111	0	7	7.42
2	16	158	42	10.5	7	7.42
3	57	551	147	0	6.22	6.59
4	60	580	155	10.5	0	0
5	53	511	136	10.5	0	0
6	85	818	218	10.5	2.33	2.47
7	6	59	16	0	7	7.42
8	42	401	107	10.5	0	0
9	75	717	191	0	7	7.42
10	30	285	76	10.5	0	0
11	52	502	134	0	6.22	6.59

The resulting supply by sector and trip purpose is shown in Table 4-10 with the average parking cost by sector and trip purpose provided underneath in Table 4-11. After applying the above adjustments, the following parking spaces and charges were produced for the 11 sector system.

Table 4-10: 2018 Parking Supply by Sector and Trip Purpose by 11 Sectors

Suburb	Sector	HBW	EB	HBED	HBSH	HBO	NHBO
Central Business District	1	5731	2229	162	570	728	1947
Clifton	2	16	42	8	26	34	90
Cuba / Willis	3	1694	779	83	291	372	995
Kelburn	4	1038	95	14	51	65	174
Mount Cook	5	795	37	6	20	25	67
Mount Vic	6	116	230	41	143	183	490
Parliament	7	950	357	25	87	111	296
Te Aro	8	550	0	0	0	0	0
Te Aro - Courtenay	9	1533	763	79	278	354	948
Thorndon	10	409	7	1	4	5	13
Train Station	11	327	273	45	160	203	545

Table 4-11: 2018 Average Parking Charge by Sector and Trip Purpose (2020$) by 11 Sectors

Suburb	Sector	HBW	EB	HBED	HBSH	HBO	NHBO
Central Business District	1	9.0	5.0	5.0	5.0	5.0	5.0

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Suburb	Sector	HBW	EB	HBED	HBSH	HBO	NHBO
Clifton	2	10.5	7.4	7.0	7.0	7.0	7.0
Cuba / Willis	3	6.0	4.0	6.0	6.0	6.0	6.0
Kelburn	4	20.0	12.4	11.7	11.7	11.7	11.7
Mount Cook	5	9.0	1.7	1.6	1.6	1.6	1.6
Mount Vic	6	15.0	4.0	3.0	3.0	3.0	3.0
Parliament	7	10.0	8.0	6.0	6.0	6.0	6.0
Te Aro	8	10.5	0.0	0.0	0.0	0.0	0.0
Te Aro - Courtenay	9	8.0	5.0	6.0	6.0	6.0	6.0
Thorndon	10	30.0	9.9	9.3	9.3	9.3	9.3
Train Station	11	20.0	7.0	7.0	7.0	7.0	7.0

This highlighted some weaknesses:

- The Te Aro sector only has commuting parking. In a parking-constrained scenario, this would mean only work trips could terminate in the Te Aro sector which is clearly incorrect. This sector needs to be combined with adjacent sectors to incorporate parking for each trip purpose;

- There are other sectors with quite small numbers of parking spaces (Clifton, Mount Cook, and Thorndon) which also need to be combined with adjacent sectors;

- There are some significant variations across the sectors in the charge per trip considering each trip purpose separately. For example, commuting parking ranges from $6 per trip in Cuba/Willis to $30 in Thorndon;

- There are significant variations in the charges between the sectors. For example, $1.7 and $1.6 for Mount Cook for business and education. This is driven by the parking at Massey University which is $1 per hour.

As a consequence, the 11 sectors were aggregated into five sectors. The final parking spaces and charges per sector and trip purpose are tabulated in the next section.

3.2.5   Aggregated Parking Supply/Charges by Trip Purpose

The aggregated five sector system is illustrated below. Note that the model has been set up with a flexible re-definable sector system described in Section 6. In the model, there will be a sixth sector which represents the rest of the modelled area.

The sector grouping was developed so that the different types of parking were available in each sector and this was accomplished by aggregating geographically adjacent sectors.

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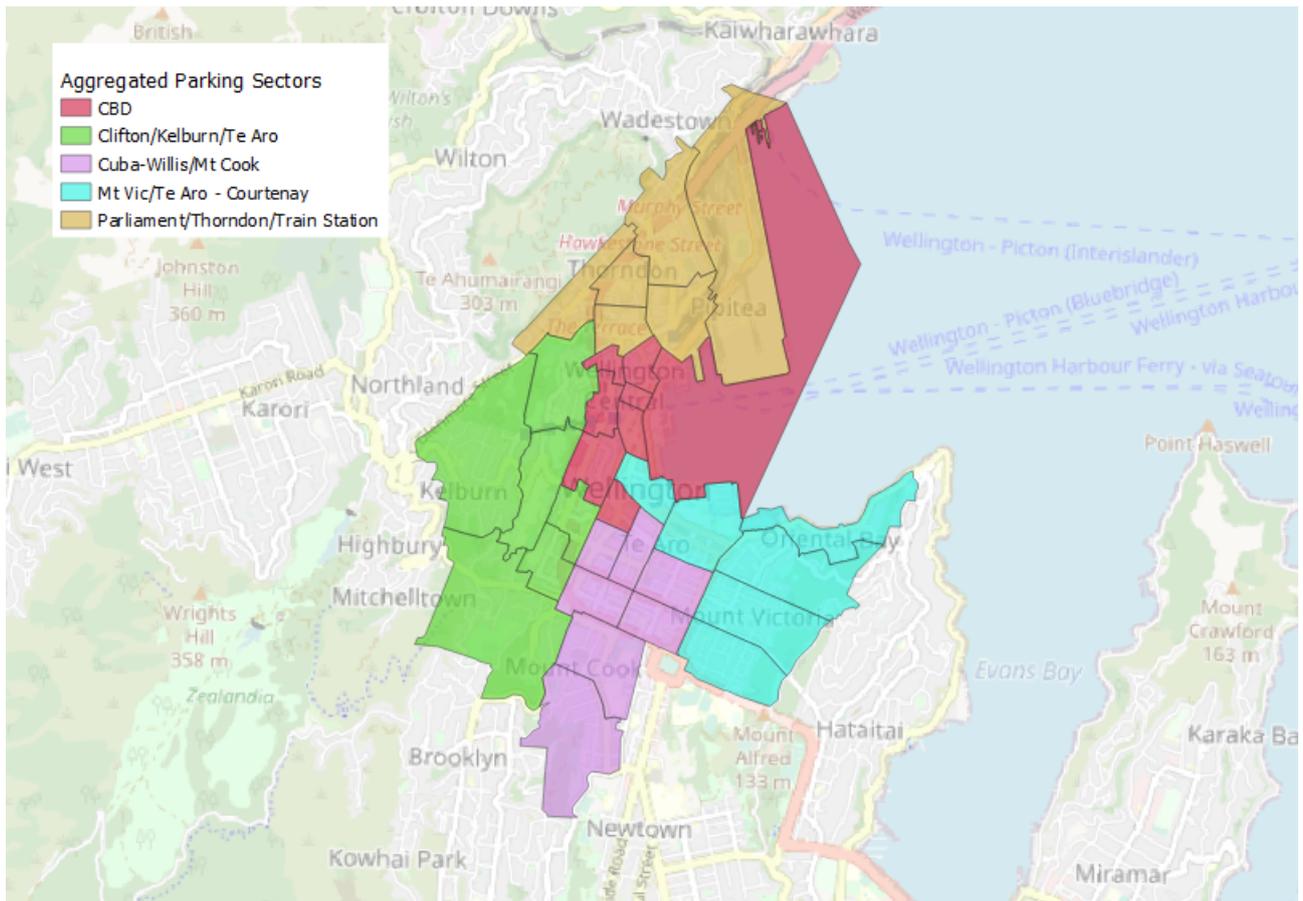
Figure 4-3: Aggregated (5) Parking Sectors in WTSM (225-zone system)

The supply by aggregated sector and trip purpose is shown in Table 4-13, with the average parking cost by sector and trip purpose provided underneath in Table 4-14.

Table 4-12: 2018 Parking Supply by Sector and Trip Purpose by 5 Sectors

Suburb	Sector	HBW	EB	HBED	HBSH	HBO	NHBO
CBD	1	5731	2229	162	570	728	1947
Clifton/Kelburn/Te Aro	2	361	399	69	242	308	825
Cuba-Willis/Mt Cook	3	1898	940	110	389	496	1328
Mt Vic/Te Aro - Courtenay	4	1725	977	117	411	525	1404
Parliament/Thorndon/Train Station	5	1383	702	82	290	370	990

Table 4-13: 2018 Average Parking Charge by Sector and Trip Purpose (2020$) by 5 Sectors

Suburb	Sector	HBW	EB	HBED	HBSH	HBO	NHBO
CBD	1	9.0	5.0	5.0	5.0	5.0	5.0
Clifton/Kelburn/Te Aro	2	20.0	9.0	9.0	9.0	9.0	9.0
Cuba-Willis/Mt Cook	3	6.0	4.0	5.0	5.0	5.0	5.0
Mt Vic/Te Aro - Courtenay	4	8.0	4.0	6.0	6.0	6.0	6.0
Parliament/Thorndon/Train Station	5	8.0	5.0	6.0	6.0	6.0	6.0

Note that in Stage 1 (revalidation of current 225 zone version of WTSM, 2001-based), the parking charges in Table 4-14 will need to be adjusted to 2001 dollars. The adopted adjustment factor is 0.68 (based on the Consumer Price Index) to reflect the inflation from 2001 to 2020, the adjusted parking rates are shown below.

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Table 4-14: 2018 Average Parking Charge by Sector and Trip Purpose (2001$) by 5 Sectors

Suburb	Sector	HBW	EB	HBED	HBSH	HBO	NHBO
CBD	1	6.12	3.4	3.4	3.4	3.4	3.4
Clifton/Kelburn/Te Aro	2	13.6	6.12	6.12	6.12	6.12	6.12
Cuba-Willis/Mt Cook	3	4.08	2.72	3.4	3.4	3.4	3.4
Mt Vic/Te Aro - Courtenay	4	5.44	2.72	4.08	4.08	4.08	4.08
Parliament/Thorndon/Train Station	5	5.44	3.4	4.08	4.08	4.08	4.08

In the generalised cost equation, parking charges are allocated equally to all vehicle occupants (driver and passengers) and halved such that it is represented in both the inbound and outbound trips.

4. Terminal Times

"Terminal times" are an allowance for the time taken to walk from a parked vehicle, or where you were dropped off, to your destination. They are added to the generalised cost of travel and form a key input to the distribution and modal share calculation.

Times were calculated for the wider CBD and the rest of the network, as it is expected access/egress legs between car parks and destinations will be longer in the CBD.

Times were also calculated separately for each of the aggregated trip purposes, as business trips, commuting trips and "rest" have different price sensitivity. Business trips are more likely to pay more for parking to reduce the person's overall travel time. In contrast, commuters will place greater emphasis on their out-of-pocket expenditure and are more likely to select cheaper parking albeit with longer access.

In the absence of up-to-date Household Travel Survey data, the expanded 2001 HTS has been used to calculate terminal times. Commercial vehicles were excluded, escort trips were grouped with their primary trip purpose, so commuting includes home-based work plus home-based work (escort). It is noted that only trip records are available and not trip legs (which are the mode-specific elements that make up a trip). This means details of walk-vehicle-walk trip are only available in aggregate. Hence a comprehensive calculation of terminal time is not possible and judgement is required.

In the following table, the proportion of vehicles parked within their destination zone by aggregated trip purpose are tabulated for wider CBD destinations and the rest of the network. Some trips relate to multi-modal journeys where a vehicle was used but not necessarily for the final trip leg. An example is parking your car at a rail station before traveling by train to your destination. These trips will be recorded as vehicle not parked in the same zone as the destination and will incorrectly inflate the proportions shown in Table 5-1. It is difficult to correct this without trip leg data and as judgement is being applied, this issue is merely noted.

Table 5-1: Vehicles Parking Within Destination Zone, 2001 HTS

	2001 Weekday Parked Vehicle Trips					
	Wider CBD Destinations			Rest of Network		
	Commuting	Rest	Business	Commuting	Rest	Business
Vehicle NOT parked in destination zone	7,022	8,190	1,229	1,050	4,142	252
Vehicle parked in destination zone	21,039	63,297	19,734	149,454	781,124	88,440
Total	28,061	71,487	20,963	150,503	785,266	88,692
Percentage NOT parking within destination zone	33%	13%	6%	1%	1%	0%

While the magnitude of the percentages may have changed since 2001, the relativity appears logical. This shows:

- Outside of the CBD, most people park their vehicle in the same location as their destination. For the few where this does not occur, it is likely some of will represent parking/destinations at zone boundaries;

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- Within the CBD, business trips are the most likely to park closest to their destination. This is followed by "rest" of the trips, representing shorter duration trips with less price sensitivity. Commuting trips in the CBD have the largest proportion, which is about a third, of trips that do not park in their destination zone.

This demonstrates the need for calculating terminal times separately for the CBD, and also by key trip purpose.

As noted above, component/leg data for each trip was not available from the 2001 HTS, so there is no observed data on the last walk leg of every trip. In the absence of data, the following practical assumptions were applied to calculate a terminal time:

- For Business trips:

  o If the duration of stay was less than 10 minutes, the terminal time was set to 2 minutes. This is because it seemed unlikely that the last walk leg will be long for a very short/medium duration trip.

  o If the duration of stay was 10 minutes or more, the terminal time was set to 5 minutes. This is because business trips are more likely to minimise unproductive time.

- For Commuting trips:

  o If they parked in the same zone as their destination:

    - If the duration of stay was less than 10 minutes, the terminal time was set to zero.   This is because a short/medium duration likely means they are waiting in a loading zone (for example);

    - If the duration of stay is 10 minutes or more, the terminal time was set to 10 minutes.

  o If they did not park in the same zone as their destination, the terminal time was set to 15 minutes.

- For Other trips:

  o If they parked in the same zone as their destination:

    - If the duration of stay was less than 10 minutes, the terminal time was set to zero.   This is because a short/medium duration likely means they are waiting in a loading zone (for example);

    - If the duration of stay is 10 minutes or more, the terminal time was set to 5 minutes. This is lower than for commuting trips as the duration of stay is less.

  o If they did not park in the same zone as their destination, the terminal time was set to 10 minutes.

The terminal times calculated using the above assumptions were then weighted by the number of trips (expanded) and the average calculated. Terminal times by aggregated trip purpose are provided below for the wider CBD and in the following table for the rest of the network.

Table 5-2: CBD Terminal Times

Heading	Commuting	EB	Other
Trip*Terminal Time	18:58:28	3:17:13	10:52:47
Trips	28,061	20,963	71,487
Average Terminal Time (hh:mm:ss)	0:10:58	0:04:12	0:04:36
Round to nearest minute (mins)	0:11:00	0:04:00	0:05:00

Table 5-3: Non-CBD Terminal Times

Heading	Commuting	EB	Other
Trip*Terminal Time	15:01:17	5:46:25	5:28:34
Trips	150,503	88,692	785,266
Average Terminal Time (hh:mm:ss)	0:09:40	0:04:26	0:04:03
Round to nearest minute (mins)	0:10:00	0:04:00	0:04:00

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In the generalised cost equation, these terminal times are applied at the attraction end and will apply separately for inbound and outbound journeys.

Terminal times can be revised when up-to-date Household Travel Survey data is available.

5. Model Script Improvements

5.1 Purpose

The current model has many parameters and equivalences (zones to sectors) that are hardwired and embedded into the multitude of macros/scripts that constitute the model. This task involved changing the model scripts to:

- Make it simpler to change input parking charges;

- Enabling the sectors for the parking charges to be re-specified; and

- Specifying input "terminal times" (walking time from a parked vehicle to the final destination) and incorporating these in the generalised costs for travel by car.

This has been implemented in the python version of WTSM.

5.2 Script Revisions

Parking charges are included as part of the generalised cost calculations undertaken in module `gcsub.py`. The current model assumes two parking sectors only (upper and lower CBD), and has hard-wired parking charges, values of time (VOT) and growth, and vehicle occupancies.

The improved model has the following features:

- User defined number of sectors stored external to the module;

- Parameter values for VOT, growth, etc., stored external to the module; and

- New parameter defining terminal access time, i.e., additional walk time from a car park to destination.

These enhancements are implemented by changes to the model script as follows:

- **`parget.py`:** this module reads in the control file parameters that specify a model run. New parameters have been added to control and specify variable sector parking. Details of these parameters can be found in Appendix A.

- **`gcsub.py`:** this module has been revised to accommodate variable sector parking charges and externally read parameters. Note that the original two sector parking is still included, and will be used if the model run control file does not contain the new parking parameters.

- **`parking.py`:** this is a new module and handles the reading and initialisation of externally held parking data. See Appendix A for more details. If no new parking parameters are specified in the model run control file, then this module initialises the data required for the old two sector parking model.

- **`run_wtsm2013.py`:** this module has been revised to call **`parking.py`** to initialise the parking data.

Additionally, the hard-wired zone ranges for:

- External zones (226 to 228), and

- Park and ride zones (30201 to 30299)

Have been parameterised and put into the model run control file as WTSM attributes:

- ExtZones

- PnRZones

The following modules have been revised to read/use the parameterised zone ranges:

- **`gcsub.py`**

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- `basegc.py`

- `futuregc.py`

- `parget.py`: if parameters ExtZones and/or PnRZones are not found in the control file then the parameters are initialised with the values as shown above.

5.3   Peak Spreading

The peak spreading module (`peaksprd.py`) calls two modules (`basegc.py` and `futuregc.py`) that recalculate generalised costs. These modules use two sectors (lower and upper CBD), as well as parking charges and weighted values of time in 2001 values. The parking charges by purpose and area are documented in Table 21 of "Update of the Wellington Strategy Model (WTSM) – WTSM Update Validation Report" dated June 2008 by SKM.

The peak spreading generalised cost modules have not been altered as they relate to 2001 values.

6.   Check 2018 WTSM Validation

The 2018 parking charges for the five sectors, deflated to 2001 dollars (see Table 4-15), were included in the current 225 zone version of WTSM with the terminal times (see Table 5-2 and Table 5-3). While the parking charges represent 2018 values, the remainder of the model inputs are for the year 2013. The purpose of this check is to determine if the updated parking charges and terminal times significantly un-validates the model.

It is noted that the parking charges and terminal times reported in this section were tested using an interim version of WTSM with modifications for park-and-ride. The version of WTSM used here (reference SG1.07) included skimmed car times on the p-connectors, an interim new curve to weight car and walk times together on p-connectors, and the original model split for car and walk on p-connectors. For this reason, the relativity between the results is considered, rather than the absolute values.

Morning, interpeak, and evening peak two-hour trips are tabulated below for car and public transport. Note that "car" trips are in units of persons and not vehicles, so these include passengers. Totals are provided as well as trips to the CBD. Inclusion of 2018 parking charges for five sectors (as per Table 4-15) and the terminal times reported in Table 5-2 and Table 5-3 is labelled as "Test 1".

Table 7-1: Modelled Trips, Reference Case and Inclusion of 2018 Parking and Terminal Times

Test:	References	Test 1	Difference, Test 1 - Reference	% Difference, Relative to Reference
Parking Charges	2013, 2 Sectors	2018, 5 Sectors		
Terminal Times	No	Yes		
AM Trips				
AM Car Trips	162,815	153,512	-9,302	-6%
AM PT Trips	32,255	44,021	11,766	36%
AM PT Mode Share	17%	22%	6%	
AM Trips to CBD				
AM Car Trips	27,838	23,658	-4,179	-15%
AM PT Trips	18,666	24,631	5,965	32%
AM PT Mode Share	40%	51%	11%	
IP Trips				
IP Car Trips	150,644	146,207	-4,437	-3%
IP PT Trips	9,470	13,660	4,190	44%
IP PT Mode Share	6%	9%	3%	
IP Trips to CBD				
IP Car Trips	20,379	19,423	-957	-5%
IP PT Trips	2,078	3,905	1,827	88%
IP PT Mode Share	9%	17%	7%	
PM Trips				
PM Car Trips	192,997	183,994	-9,002	-5%

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Test: Parking Charges Terminal Times	References 2013, 2 Sectors No	Test 1 2018, 5 Sectors Yes	Difference, Test 1 - Reference	% Difference, Relative to Reference
PM PT Trips	25,712	37,972	12,260	48%
PM PT Mode Share	12%	17%	5%	
PM Trips to CBD				
PM Car Trips	18,890	18,072	-818	-4%
PM PT Trips	2,694	5,042	2,348	87%
PM PT Mode Share	12%	22%	9%	

This shows that with the inclusion of the 2018 parking charges and terminal times, that:

- Total car trips in the AM and PM peak hours drop by around 9,000 per hour with a corresponding increase in public transport trips. The same pattern occurs in the interpeak, although the magnitude is about half;

- Car trips to the CBD also reduce. Comparing to the network wide, the relative reduction of CBD trips is much greater in the AM peak, following by the interpeak and the PM peak (reduction in total car trips versus car trips to the CBD); and

- There are significant increases in PT mode share, albeit based on numerically smaller numbers of trips.

It is worth highlighting that none of the figures in the above table are observed. However, based on the quantum of change for PT, it is extremely likely that the inclusion of both terminal times and 2018 parking charges will un-validate the model.

The following sensitivity tests were carried out:

- Parking charges were reset to 2013 with the two-sector system, and terminal times retained (Test 2);

- The terminal times were halved, and the 2018 parking charges retained for the five sectors (Test 3);

- The terminal times were set to zero and the 2018 parking charges retained for the five sectors (Test 4).

The results are provided below including the reference case and Test 1.

Table 7-2: Modelled Trips, Reference Case and Inclusion of 2018 Parking and Terminal Times

Test: Parking Charges Terminal Times	Reference 2013, 2 Sectors No	Test 1 2018, 5 Sectors Yes	Test 2 2013, 2 Sectors Yes	Test 3 2018, 5 Sectors Half	Test 4 2018, 5 Sectors No
AM Trips					
AM Car Trips	162,815	153,512	155,478	157,295	160,997
AM PT Trips	32,255	44,021	41,312	39,460	34,812
AM PT Mode Share	17%	22%	21%	20%	18%
AM Trips to CBD					
AM Car Trips	27,838	23,658	24,059	25,569	27,587
AM PT Trips	18,666	24,631	23,941	22,060	19,274
AM PT Mode Share	40%	51%	50%	46%	41%
IP Trips					
IP Car Trips	150,644	146,207	147,509	147,850	149,474
IP PT Trips	9,470	13,660	11,795	12,462	11,220
IP PT Mode Share	6%	9%	7%	8%	7%
IP Trips to CBD					

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Test:	Reference	Test 1	Test 2	Test 3	Test 4
Parking Charges	2013, 2 Sectors	2018, 5 Sectors	2013, 2 Sectors	2018, 5 Sectors	2018, 5 Sectors
Terminal Times	No	Yes	Yes	Half	No
IP Car Trips	20,379	19,423	19,997	19,671	19,945
IP PT Trips	2,078	3,905	2,699	3,583	3,182
IP PT Mode Share	9%	17%	12%	15%	14%
PM Trips					
PM Car Trips	192,997	183,994	186,512	187,753	191,194
PM PT Trips	25,712	37,972	34,282	33,549	29,061
PM PT Mode Share	12%	17%	16%	15%	13%
PM Trips to CBD					
PM Car Trips	18,890	18,072	18,655	18,357	18,578
PM PT Trips	2,694	5,042	3,666	4,560	3,985
PM PT Mode Share	12%	22%	16%	20%	18%

These sensitivity tests show:

- Test 1 compared with Test 2 shows the impact of changing the parking charges from 2018 back to 2013. The car trips in Test 2 increase compared with Test 1, however, they are still considerably lower than the reference case (which relates closely to 2013 validated results);

- Test 1 compared with Test 3 shows the impact of halving the terminal times but retaining 2018 parking charges. Car trips increase again in Test 3 compared with Test 1, getting closer to the reference case;

- Test 1 compared with Test 4 shows what happens if the terminal times are removed but the 2018 parking charges are retained. The Test 4 results have similar orders of magnitude of trips as the reference case, albeit Test 4 has slightly fewer car trips and more PT trips.

Based on this analysis, it was concluded that "Test 4" appeared to represent the best approach to ensure the 225-zone version of WTSM will validate. This means that:

- Terminal times should not be included in the 225-zone version of WTSM. These can be incorporated in the model rebuilt in Stage 2, at which point, Household Travel Survey data will be available to actually calculate the time from a parked vehicle to the final destination;

- 2018 parking charges at a five-sector level will be incorporated.

The validation of the road assignment was checked, based on observed 2013 traffic counts. The results for the reference case, Test 1, and Test 4 are provided below. Note it is the relativity that is the focus rather than achieving the validation criteria which are provided for context. Screenlines are provided in the first table, with individual links in Table 7-4, both of which are light vehicles only.

Table 7-3: Screenlines, Light Vehicles, 2013 Modelled vs Observed Percentage GEH Achieved

Test:			Reference			Test 1			Test 4		
Parking Charges			2013, 2 Sectors			2018, 5 Sectors			2018, 5 Sectors		
Terminal Times			No			Yes			No		
Criteria	Target		AM	IP	PM	AM	IP	PM	AM	IP	PM
	EEM	TMDG									
GEH<5		60%	50%	39%	54%	39%	32%	46%	61%	50%	54%
GEH<10		95%	93%	89%	82%	75%	71%	79%	89%	93%	79%
GEH<12		N/A	93%	93%	86%	86%	93%	89%	93%	100%	82%

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Table 7-4: Individual Link Flow, Light Vehicles, 2013 Modelled vs Observed Percentage GEH Achieved

Test:			Reference			Test 1			Test 4		
Parking Charges			2013, 2 Sectors			2018, 5 Sectors			2018, 5 Sectors		
Terminal Times			No			Yes			No		
Criteria	Target		AM	IP	PM	AM	IP	PM	AM	IP	PM
	EEM	TMDG									
GEH<5	60%	65%	50%	52%	43%	36%	43%	42%	45%	54%	43%
GEH<10	95%	85%	78%	83%	81%	73%	75%	82%	78%	79%	82%
GEH<12	100%	95%	85%	90%	88%	82%	86%	88%	83%	92%	90%
R²	N/A	>0.85	0.92	0.91	0.92	0.90	0.90	0.90	0.92	0.92	0.91

Test 1, with the 2018 parking charges and terminal times, clearly produces traffic flows quite different to observed. This supports the decision not to incorporate both terminal times and 2018 parking charges in the interim 225 zone version of WTSM.

Test 4, with 2018 parking charges only, produces modelled traffic flows considered acceptable. For screenlines, the AM and interpeak periods improve markedly compared with the 2013 parking charges. Individual links in the AM peak do not perform as well, although this is attributable to only five links on which the GEH has increased above five.

In the table below, the modelled and observed average light vehicle hourly flows for the CBD screenline are tabulated for the various scenarios from the AM, interpeak, and PM peak period assignments.

Table 7-5: CBD Average Hour Screenline Volumes, Light Vehicles, 2013 Modelled vs Observed

Scenario	Dir	AM			IP			PM		
		Obs	Mod	GEH	Obs	Mod	GEH	Obs	Mod	GEH
Reference	In	13,168	13,766	5.2	7,285	7,751	5.4	8,647	8,860	2.3
	Out	7,220	7,297	0.9	7,292	7,606	3.6	13,036	13,342	2.7
Test 1	In	13,168	11,958	10.8	7,285	7,726	5.1	8,647	8,949	3.2
	Out	7,220	7,397	2.1	7,292	7,785	5.7	13,036	12,299	6.5
Test 4	In	13,168	13,172	0.0	7,285	7,502	2.5	8,647	8,700	0.6
	Out	7,220	7,204	0.2	7,292	7,485	2.3	13,036	12,898	1.2

This shows:

- Comparing to the Reference case, Test 1 shows less car demand to the CBD in AM and Interpeak, hence, less car trip leaves the CBD in the PM peak as the consequence. As the result, Test 1 delivers the worse GEH results than the Reference case;

- Car trips decline slightly in Test 4 compared with the Reference case, producing a closer match to observed.

This reenforces that the 2018 parking charges can be incorporated without un-validating the model whereas the terminal times cannot be included in Stage 1 of the project.

7. Reconciliation with Let's Get Wellington Moving (LGWM)

In August 2020, various data was supplied by the LGWM team investigating commuter parking levies. This included a spreadsheet containing what appeared to be their main source of inventory data from Wellington City Council's Rating Information Database (RID).

In the early stages of this task, we investigated reconciling the two parking inventory databases (model vs LGWM), but this proved problematic. There were existing parking buildings in the database we had collated for the model update that were missing from the LGWM database. Furthermore, the majority of parking sites could not be matched because the addresses were recorded differently. For example, the facility at 70 Tory Street on the Care Park website is listed as "Unit 1-1 72 Tory Street" in the LGWM parking inventory. So only a line-by-line comparison would be possible, and even then, with different

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addresses and capacity specified, it is near impossible to fully reconcile these databases. So reconciling the databases was not carried out initially.

After issuing version 2 of this technical note for comment, the client requested that we revisit reconciling the model and LGWM parking databases, which is summarised in this section. The LGWM parking levy consultant supplied an updated database dated September 2020, in which they had remedied some of the missing facilities. We have also referenced a report titled "Wellington Commuter Parking Levy", draft report, version 2, dated 16 October 2020, by Colin Shields which includes an inventory summary. This report is subsequently referred to in this document as the "LGWM Parking Report".

As automatic comparison was not possible, a line-by-line manual check of the largest car parks in the model database and September version of the LGWM database was carried out. This included parks with more than 100 spaces in the LGWM database. The objective was to identify any significant car parks that had been omitted from the model parking database, and then update it.

In the following table, facilities are listed where the number of spaces was updated in the model database to correspond with the LGWM parking inventory.

Table 8-1: Parking Spaces Adjusted in Model Database

Parking Facility	Original No. of Spaces	Updated No. of Spaces
Sky Stadium	750	800
2 Gilmer Terrace	107	215
70 Tory Street	474	432
Waring Taylor Street	134	316
North Terrace	600	299
9-13 Stout Street	311	293
2 Grey Street	106	266
Taranaki St Parking	300	245
26 Marion Street	86	200
Cable car Lane, 139 The Terrace	178	182
133 Tory Street	120	160
204 Victoria Street	109	150
24 Tory Street	103	103
13 Barnett Street	150	99
50 Tory Street	47	81
Readings on Wakefield	104	60
80 Boulcott Street	66	60
16 Mowbray Street	34	60
Station Car Park, 83 Waterloo Quay	81	51
61 Molesworth Street	79	50
15-21 Victoria Street Parking centre	64	42
57 Vivian Street	46	40
151 Cuba Street	33	40
Kiwi Wealth House, 94 Featherston Street	52	38
Pringle House, 142 Wakefield Street	44	37
151 Willis Street	33	35
47 Thorndon Quay	31	34
9 Kate Sheppard Street	32	25
17 Bute Street	50	21
24 Panama Street	34	19

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Parking Facility	Original No. of Spaces	Updated No. of Spaces
11 Garrett Street	50	8
Total	**4,408**	**4,461**

There is only a net increase of 53 parking spaces that have been added to the model database, however, the geographic distribution will have also been updated.

Using 70 (or 72) Tory Street as an example again, the Care Park website specifies there are 474 spaces which was originally entered in the model database. However, we understand the hotel at this address offers parking using the same facility. This could be the difference between the 474 spaces on the Care Park website and the 432 spaces in the LGWM parking database from rating information.

The following facilities were added to the model database based on reconciliation with the LGWM parking inventory.

Table 8-2: Parking Facilites Added to Model Database

Parking Facility	Spaces	Private/Public	Operator	On/Off Street
5 Gilmer Terrace	622	Public	Wilsons Parking	Off
147 Terrace Street	498	Public	Wilsons Parking	Off
11 Victoria Street	469	Public	Prime Parking	Off
149 The Terrace	381	Public	Wilsons Parking	Off
25 Jervois Quay	378	Public	Wilsons Parking	Off
28 Bond Street	350	Private	Private (West Plaza Hotel)	Off
159 Willis Street	307	Public	Wilsons Parking	Off
102 The Terrace	307	Public	WCC	Off
54 The Terrace	251	Private	Private	Off
88 Willis Street	242	Private	Private	Off
55 Cable Street	232	Private	Private (Staff parking for Te Papa)	Off
60 Victoria Street	198	Private	Private	Off
234 Wakefield Street	196	Public	Care Park	Off
100 Boulcott Street	41	Private	Private (Student Hall - Katharine Jermyn Hall)	Off
Total	**4,472**			

The total spaces in the various datasets are shown below. Figures from the Wellington City Council (WCC) "Parking Policy Review, Background Information and Issues Report" dated 21 January 2020 are provided in the first column. The off-street and the public/metered figures were extracted from Table 2 of this document, which focuses on the central city. Coupon and residents parking from the same document are also tabulated. The allocation of the LGWM spaces to parking type is from the LGWM Parking Report and direct comparison to the categories in the WCC policy document and the model database was not possible.

Table 8-3: Changes to Model Parking Inventory

Private/Public	On/Off Street	WCC Policy Document	Model Database, V1	LGWM Database	Diff, Model - LGWM	Model Database, V2	Diff, Model - LGWM
Public	Off	12,030	7,078	10,094	-3,016	10,264	170
Private	Off	13,500	13,500	11,956	1,544	13,500	1,544
Sub Total	***Off***	***25,530***	***20,578***	***22,050***	***-1,472***	***23,764***	***1,714***
Coupon	On	3,656	3,656	3,656		3,656	
Public/ Metered	On	3,270	3,472			3,472	
Residents/ Residential	On	2,300	1,930	4,329		1,930	

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Private/Public	On/Off Street	WCC Policy Document	Model Database, V1	LGWM Database	Diff, Model - LGWM	Model Database, V2	Diff, Model - LGWM
Retail	On			1,281			
Sub Total	*On*	*9,266*	*9,058*	*9,266*		*9,058*	*-208*
TOTAL		**34,756**	**29,636**	**31,316**	**-1,680**	**32,822**	**1,506**

Working from the top to the bottom of the table, over 3,000 public off-street spaces have been added to version 2 of the model database. This relates to the eight facilities added as well as the change in the number of spaces. It is noted that the WCC policy document still indicates more public off-street spaces than the LGWM and model databases.

Although there appears to be no change in the private off-street parking in the model database, six facilities have been added. The total number of spaces remains unchanged as the value in the WCC policy document has been adopted and allocated geographically using Census data (see paragraph under Figure 3-2).

The overall number of on-street parking spaces is almost the same in the three sources. "Residential" in the LGWM database appears to have a different definition than "residents" in the model database and WCC policy document.

The "resident" on-street spaces are included in Table 8-3 for comparison but will again be excluded from the figures input to the model as they are unlikely to be used for inbound car trips in the morning peak. Similarly, the two New World supermarket car parks have also been excluded from the model database.

The model database now has 1,506 spaces more than the LGWM database, a 5% difference. The model database has 1,934 spaces fewer (6%) than the WCC policy document.

Removing the residents-only parking, the supply by the original 11 sectors for private verses public, and on verses off-street is provided below for version 2 of the model database. This is an update of Table 3-2.

Table 8-4: Parking Supply by Sector – version 2 model database after LGWM reconciliation

Sector Name	Sector No.	Number of Parking Spaces			Total
		Private	Public		
		Off-Street		On-Street	
Central Business District	1	8,685	5,526	847	15,058
Clifton	2	-	-	216	216
Cuba / Willis	3	1,835	1,650	756	4,240
Kelburn	4	-	341	795	1,136
Mount Cook	5	-	250	700	950
Mount Vic	6	-	83	1,121	1,204
Parliament	7	1,383	325	81	1,789
Te Aro	8	-	-	550	550
Te Aro - Courtenay	9	1,597	1,154	983	3,734
Thorndon	10	-	47	391	438
Train Station	11	-	888	688	1,576
Total		**13,500**	**10,264**	**7,128**	**30,892**

The modified supply by aggregated sector and trip purpose is shown in Table 8-5, with the average parking cost by sector and trip purpose provided underneath in Table 8-6.

Table 8-5: Version 2, 2018 Parking Supply by Sector and Trip Purpose by 5 Sectors

Suburb	Sector	HBW	EB	HBED	HBSH	HBO	NHBO
CBD	1	7202	2797	240	847	1081	2893
Clifton/Kelburn/Te Aro	2	247	355	62	218	278	743
Cuba-Willis/Mt Cook	3	1909	944	111	391	499	1335

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Suburb	Sector	HBW	EB	HBED	HBSH	HBO	NHBO
Mt Vic/Te Aro - Courtenay	4	1568	923	116	409	522	1398
Parliament/Thorndon/Train Station	5	1378	700	82	289	369	987

Table 8-6: Version 2, 2018 Average Parking Charge by Sector and Trip Purpose (2020$) by 5 Sectors

Suburb	Sector	HBW	EB	HBED	HBSH	HBO	NHBO
CBD	1	9.0	5.0	6.0	6.0	6.0	6.0
Clifton/Kelburn/Te Aro	2	20.0	9.0	9.0	9.0	9.0	9.0
Cuba-Willis/Mt Cook	3	6.0	4.0	5.0	5.0	5.0	5.0
Mt Vic/Te Aro - Courtenay	4	8.0	4.0	6.0	6.0	6.0	6.0
Parliament/Thorndon/Train Station	5	9.0	5.0	6.0	6.0	6.0	6.0

The parking charges above need to be adjusted to 2001 dollars (applying a factor of 0.68 based on the Consumer Price Index to reflect inflation). The 2018/20 parking rates are shown below in 2001 dollars.

Table 8-7: Version 2, 2018 Average Parking Charge by Sector and Trip Purpose (2001$) by 5 Sectors

Suburb	Sector	HBW	EB	HBED	HBSH	HBO	NHBO
CBD	1	6.12	3.40	4.08	4.08	4.08	4.08
Clifton/Kelburn/Te Aro	2	13.60	6.12	6.12	6.12	6.12	6.12
Cuba-Willis/Mt Cook	3	4.08	2.72	3.40	3.40	3.40	3.40
Mt Vic/Te Aro - Courtenay	4	5.44	2.72	4.08	4.08	4.08	4.08
Parliament/Thorndon/Train Station	5	6.12	3.40	4.08	4.08	4.08	4.08

The 2018 model runs and validation checks have not been carried out using version 2 of the parking charges as the change is very minor.

8.   Summary

Parking supply and charges were collated for 2018/20. While information was requested from every Territorial Authority, only Wellington City, Hutt City and Upper Hutt City Districts provided data. All of the data received was tabulated, however, only Wellington City data has been processed for inclusion in the model.

A sector system based on Wellington City parking zones was developed and the parking supply and charges grouped into these sectors. The model requires supply and charges by trip purpose. In the absence of up-to-date data, the 2001 Household Travel Survey data was used to allocate facilities to trip purpose and calculate weighted average charges. This produced some inconsistencies due to the relatively small size of the sectors. The sectors were further aggregated to remove these inconsistencies, resulting in five sectors in the CBD plus a sixth representing the rest of the network.

Terminal times, the time from a parked vehicle to reach the final destination, were estimated for the CBD and remainder of the modelled area by trip purpose. Again, without the Household Travel Survey, judgement was used to estimate likely terminal times.

The python version of WTSM was modified to incorporate a sector system for parking supply and charges, which is redefinable, and to accommodate the terminal times which can vary by zone if required. Inputs that were previously hardwired in the scripts were modified and made accessible.

The 2018 parking charges and terminal times in the five sectors were used in the 2013 225 zone version of WTSM. Analysis of the model outputs showed that the terminal times significantly reduced the number of car trips beyond what was considered likely. Including the 2018 parking charges in the five sectors does not un-validate the model and can be incorporated for the 2018 revalidation of the 225-zone version of WTSM.

Subsequently, a reconciliation was carried out between the parking database for the model (referred to as version 1) and the LGWM parking inventory derived from WCC's Rating Information Database. This identified some parking facilities where the number of spaces was modified to match the LGWM

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parking inventory. In addition, fourteen facilities were added to the model database producing "version 2" and a modest change in the aggregated parking charges by purpose.

It is noted that when up-to-date Household Travel Survey data becomes available, that the weighting of the parking supply and charges by trip purpose and sector will need to be updated.

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Appendix A   Control File Changes for Parking

To accommodate the change from fixed to variable sector parking charges the model run control file, e.g., 90801_B02_T001.ctl, has been revised to include the following WTSM attributes:

```
ParkingCharges
```

```
ParkingVOT
```

```
ParkingVOTgrowth
```

```
ParkingOccupancy
```

```
ParkingMFs
```

```
ParkingPartition
```

```
ParkingTerminalTime
```

Each of these attributes is explained in detail in the following sections. All parking related data files are stored in:

```
\WAT\{model_version}\WTSM\Database\Parking
```

with the exception of the parking sector partition file, which is stored in:

```
\WAT\{model_version}\WTSM\Database\ensembles
```

Note that the original two sector parking partition (designated 'gp' in EMME) was hard-wired in the EMME databank, but is now defined and read from file:

```
\WAT\{model_version}\WTSM\Database\ensembles\default_gp.301
```

Parking related data and other variables are read and initialised via module **parking.py**.

A.1   ParkingCharges

Specifies the csv filename containing the parking charge ($) by sector by trip purpose.

Suggested filename: `park$13_3a.csv`

> (where 13 = year, 3 = number of sectors, a = variant)

File format:

```
Sector, HBW,    EB,     HBED,   HBSH,   HBO,    NHBO
1,      0,      0,      0,      0,      0,      0
2,      4.29,   0.73,   0.60,   0.60,   0.60,   0.60
3,      6.93,   1.30,   1.20,   1.20,   1.20,   1.20
```

A.2   ParkingVOT

Specifies the csv filename containing the value of time ($/min) for captive and non-captive mode by trip purpose.

Suggested filename: `VOT1.csv`

> (where 1 = variant)

File format:

```
Type,           HBW,    EB,     HBED,   HBSH,   HBO,    NHBO
Captive,        0.100,  0.418,  0.066,  0.120,  0.120,  0.120
Non-Captive,    0.134,  0.453,  0.100,  0.120,  0.120,  0.120
```

A.3   ParkingVOTgrowth

Specifies the csv filename containing the value of time growth factor by year by trip purpose.

Suggested filename: `VOTgrowth1.csv`

(where 1 = variant)

File format:

Year,	HBW,	EB,	HBED,	HBSH,	HBO,	NHBO
13,	1.00,	1.00,	1.00,	1.00,	1.00,	1.00
26,	1.20,	1.20,	1.16,	1.16,	1.16,	1.16
36,	1.40,	1.40,	1.32,	1.32,	1.32,	1.32
46,	1.62,	1.62,	1.50,	1.50,	1.50,	1.50

A.4   ParkingOccupancy

Specifies the csv filename containing the vehicle occupancy by trip purpose.

Suggested filename: `Occupancy1.csv`

(where 1 = variant)

File format:

HBW,	EB,	HBED,	HBSH,	HBO,	NHBO
1.19,	1.09,	2.36,	1.35,	1.50,	1.39

A.5   ParkingMFs

Specifies the csv filename containing the matrix numbers used by module gcsub.py variable names for each trip purpose and time period. This file should not be changed; unless the model is restructured, and matrix usage revised.

Suggested filename: `mfs.csv`

File format:

t1,	t2,	t3,	t4,	t5,	t6,	r202,	r203,	r204,	r205
EB,	AM,	mf131,	mf132,	,	,	mf146,	mf17,	mf28,	mf34
HBED,	AM,	mf131,	mf132,	mf133,	mf134,	mf122,	mf17,	mf28,	mf34
HBO,	AM,	mf131,	mf132,	,	,	mf122,	mf17,	mf28,	mf34
HBSH,	AM,	mf131,	mf132,	,	,	mf122,	mf17,	mf28,	mf34
HBW,	AM,	mf131,	mf132,	mf133,	mf134,	mf122,	mf17,	mf28,	mf34
NHBO,	AM,	mf131,	mf132,	,	,	mf122,	mf17,	mf28,	mf34
EB,	IP,	mf135,	mf136,	,	,	mf147,	mf21,	mf35,	mf41
HBED,	IP,	mf135,	mf136,	mf137,	mf138,	mf126,	mf21,	mf35,	mf41
HBO,	IP,	mf135,	mf136,	,	,	mf126,	mf21,	mf35,	mf41
HBSH,	IP,	mf135,	mf136,	,	,	mf126,	mf21,	mf35,	mf41
HBW,	IP,	mf135,	mf136,	mf137,	mf138,	mf126,	mf21,	mf35,	mf41
NHBO,	IP,	mf135,	mf136,	,	,	mf126,	mf21,	mf35,	mf41

A.6   ParkingPartition

Specifies the filename of the EMME partition transaction file defining the parking sectors. This must be defined as partition 'j'.

Suggested filename: `gj3a.301`

(where 3 = number of sectors, a = variant)

Example file snippet:

```
t groups
a gj: 'Parking charge sector'
a gj1: 1
a gj1: 2
a gj1: 3
a gj1: 4
a gj1: 5
a gj2: 6
a gj2: 7
a gj3: 8
a gj3: 9
a gj3: 10
```

..etc.

Red = sector

Green=zone

A.7 ParkingTerminalTime

Specifies the filenames of the EMME matrix transaction file defining the parking terminal time by purpose by destination zone.

The file specifies the transaction file per purpose as follows:

```
HBW,TerminalTime13_3a_hbw.txt

EB,TerminalTime13_3a_eb.txt

HBED,TerminalTime13_3a_hbed.txt

HBSH,TerminalTime13_3a_hbsh.txt

HBO,TerminalTime13_3a_hbo.txt

NHBO,TerminalTime13_3a_nhbo.txt
```

The example shown above has different files per purpose but it is possible to re-use files.

Each transaction file defining terminal times should be like the example below. Note that the script reads the MD no. From the transaction file line 'a matrix=' so this line must be written as shown. Suggest that MD no.s 92 to 97 are used.

Suggested filename: `TerminalTime13_3a_hbw.txt`

(where 13 = year, 3 = number of sectors, a = variant)

Example file snippet:

```
c TerminalTime13_3a_hbw.txt

t matrices

d md92

c

c sector Time (minutes)

c 1 0.0

c 2 0.0

c 3 0.0

c

a matrix=md95    trip   0.0 TerminalTime(mins) - HBS

c O D Time

  all 1 0.0

  all 2 0.0

  all 3 0.0

  all 4 0.0

  all 5 0.0

  all 6 0.0

  all 7 0.0

  all 8 0.0

  all 9 0.0
```

..etc.

Appendix B   Comments and Responses

No.	Author	Comments (paraphrased)	Responses
1	Andy Ford, GWRC	Relating to supply/charges only being included for Wellington City (Section 2.1), agree WCC is focus and highest demand, but there are costs of parking elsewhere that need to be reflected - is the reason more that making changes to Wellington City might not completely unvalidate the model but in HCC and PCC it would?	Including charges for HCC and PCC would likely unvalidate the interim model, but not the model rebuild in Stage 2 of the project. The main reason parking supply and charges were not incorporated outside of central Wellington is that none of the Councils (aside from Hutt City and Upper Hutt City) could supply any data. The model has been set up to incorporate supply and charges if these can be provided. Supply/charges need to be allocated to trip purpose and weighted average charges calculated, so these are best incorporated during this project. If the data can be sourced, it can be used.
2	Andy Ford, GWRC	Keen to ensure analysis and improvements tally with LGWM consultant analysis of parking supply and charges (Section 2.2). LGWM parking document supplied.	Our previous review found inconsistencies, particularly parking buildings that did not appear to be included in LGWM. It proved impossible to reconcile the two datasets to the extent necessary to utilise the LGWM data. A section will be added to the report to cover our review of LGWM parking data.
3	Andy Ford, GWRC	For Table 2.2 (supply, Section 2.2), can (roughly) commuter and non-commuter parking be tabulated? Given we have specific charges for HBW and other purposes, need to split into HBW	The supply/charges are split into trip purpose in section 4 including commuting, business and the rest.
4	Andy Ford, GWRC	70% of parking is off-street with 30% on-street (Section 2.2). This must include some commuter parking as 30% is high.	This includes all parking, commuting, employer provided, on-street free/metered, coupon parking, etc.
5	Andy Ford, GWRC	5 sectors for the CBD seems appropriate (section 3) – is there value in adding dummy sectors into the rest of Wellington (i.e. HCC / PCC) to try and incorporate during Phase 2, or should this just be done in Phase 2? I am keen to get a better representation of the cost of parking in the likes of HCC, PCC etc, accepting that data is a challenge- it is a regional model after all.	This has already been completed. A fully flexible system has been set up and implemented. Each zone is allocated to a sector in a lookup table, and parking supply/charges by sector and trip purpose (commuting, business, rest) are then specified. Any sector system can be used. The entire internal modelled area is covered.
6	Ian Clark, Peer Reviewer	Also, I wonder if there is a problem in including average parking costs across the trip types (section 4). For example, some commuter parking may ultimately	We concur and this has been incorporated in the calculation of the average parking charge by trip purpose. As an example for commuting, some

		be a cost to the commuter, but if someone has a parking space at work, they may perceive the space to be free in terms of the factors affecting mode choice. (I recall making similar points around perceived parking costs for some people on work trips, for the airport module). This would either bring down the average perceived parking cost, or it could lead on to a suggestion around paid vs perceived free parking being split within the process currently set out within Figure 4-1. Either way, this issue could offset the terminal time issue (i.e. a lower average parking charge, if justifiable, could mean that a terminal time could potentially be retained without unvalidating the model.	people will pay while others have employer-provided parking which they perceive as free. The "average" parking cost weights zero cost with a non-zero cost using proportions from the 2001 HTS. The parking proportions will be updated once up-to-date HTS data is available.
7	Ian Clark, Peer Reviewer	The recommendations that emanate from section 5 include not progressing with the terminal times. This seems unfortunate, as on a practical level, it recently concerned me that as part of my comparisons of modelled car v PT travel times (for the LGWM work) the car times only included in vehicle times, while the PT times included walk and wait components – so the model wasn't comparing apples with apples. Clearly there is a simple way for me to overcome my issue (i.e. I could manually add a car walk time), but my point is that since car walk times at the destination (here termed terminal times) are real, it seems unusual that including a real issue in the model adversely affects the performance of the model. So I wonder if this matter (of terminal times) needs some further thought.	While terminal times (walk access/egress times) do exist in reality they are currently modelled by proxy through the times on the zone connectors – in the same way as any assignment model. So they're incorporated in an approximate way.

Altering the current model and specifically including terminal times would require the mode split model to be recalibrated, which is best delivered in Stage 2.

Terminal times will be specifically included in the model rebuild in Stage 2. |
| 8 | Andy Ford, GWRC | Provide comparison of 2013 and 2018 parking prices in WTSM (section 7), to again see if the growth correlates with the ~60% increase in the cost of commuter parking highlighted by the LGWM consultant | The 2013 parking charges are 2001 values with factors applied while the 2018 charges are first principles collation, so any 2013 vs 2018 comparison would highlight source/method differences rather than real-world changes.

Also, the 60% increase is for 2010 to 2020. Looking at 2013 to 2018 trends on the plot (LGWM parking report), it seems there is roughly a 35% increase nominal and 25% real. TN9 refers to a 5% annual increase in casual parking and 6% for all-day, so respectively 28% / 34% nominal, and 18% / 24% real increase. These figures align well. |
| 9 | Andy Ford, GWRC | The comparisons in Chapter 7 looking at different tests with 2013 / 2018 charges and different terminal times – assume that these tests use consistent | Yes.

Land use, network, and economic parameters are all 2013. |

		demographic inputs, so we are comparing like with like?	2018/20 parking charges are deflated to 2001 dollars. So there are 2013 and 2018 parking charges, both consistently expressed in 2001 dollars.
10	Ian Clark, Peer Reviewer	Tables 7-1 and 7-2 do not strictly provide info on the model validation (although tables 7-3 to 7-5 do). As I understand it, it is assumed that since the model currently validates reasonably (to overall trip totals by each mode) the changes in trip totals in the tables imply that the parking changes are leading to the model "unvalidating". As noted by Andy, I am then unclear if we are comparing all results in these tables to 2013 demographics and flows, and therefore whether the conclusion is valid (if there have been real changes in trip making between 2013 and 2018).	This analysis uses the current version of WTSM, which has 2001 dollar values and is validated to 2013. 2013 land use, network, and economic parameters was consistently used for the tests referred to. The difference is 2013 or 2018/20 parking charges, both in 2001 dollars. The 2018 parking charges will be used in the interim 2018 revalidation of 225 zone WTSM and the model rebuild in Stage 2.
11	Andy Ford, GWRC	Regarding the conclusions and proposed approach (section 8), I'm keen to see an initial 2018 validation focussing on trips to Wellington CBD and particularly comparing against observed PT – there has been a lot of growth between 2013 and 2018 mainly on PT to CBD, driven by net growth in commuter trips being accommodated via PT (possibly due to parking costs increasing); for example, cordon count data shows that PT to CBD increased by 3,000 (over 12%) between 2013 and 2018 . https://www.gw.govt.nz/assets/Transport /Regional-transport/Regional-Transport-Analysis/Wellington-cbd-cordon-survey-2019.pdf	Acknowledged. The 2018 parking charges will be incorporated (in 2001 dollars) for the interim validation check. The terminal times will not be included in Stage 1 as these will unvalidate the model (but will be included in Stage 2).