Greater Wellington Regional Council

2013 WTSM Update

Technical Note 1:
Data Collection

January 2015

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Greater Wellington Regional Council

2013 WTSM Update

Technical Note

Quality Assurance Statement

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Introduction

The technical note is part of a series documenting the 2013 update of the Wellington Transport Models, which are maintained by Greater Wellington Regional Council (GWRC).

The transport models include the Wellington Transport Strategy Model (WTSM), which is a four stage model developed in 2001 and updated in 2006 and then again in 2011, as well as the Wellington Public Transport Model (WPTM) which is a more detailed public transport route choice model developed in 2011. It is worth noting that the 2011 update had to rely on estimated input land use as the National Census was delayed until 2013 due to the Canterbury earthquakes.

This note documents the collation and processing of the following observational data:

- Traffic counts on screenlines, by vehicle type, direction and time period;
- Vehicle travel times; and
- Inner city cordon count.

1. Definitions

1.1 Screenlines and Counts

1.1.1 Standard Screenlines

The screenlines adopted for the most recent 2011 WTSM update have been retained. This includes two new screenlines, one at Kapiti (K1) south of Waikanae and a second south of Wellington (W6) between the CBD and Newtown/Island Bay.

There are 16 screenlines in total which are illustrated in Figure 1 and Table 1, both at the end of this section. Figure 2 shows the screenlines in Wellington city.

To improve comprehension, tidality descriptions of "inbound" and "outbound" have also been used and this relates to in and out of the Wellington CBD, adopted to retain consistency with the standard convention used for WTSM.

1.1.2 Additional Counts

In addition to the counts on screenlines, several key locations have been historically considered. The traffic counts that are not on screenlines are listed in Appendix A without a screenline reference.

It is planned that these additional counts will be considered on a link-basis during the model validation but excluded from the screenline reporting.

1.1.3 Counts Not Used

GIS layers were provided by GWRC for traffic counts and screenlines. These included two spot counts on Hutt Road, one between Beaumont Ave and Dowse Drive (count 54), and the second between Udy and Wakefield Streets (count 55). We understand these may have been additionally sourced to check issues during the 2011 validation.

Counts at these locations were not readily available so these locations are currently excluded from the count dataset. Should the need subsequently arise, additional count data will be sought.

1.1.4 Final Dataset

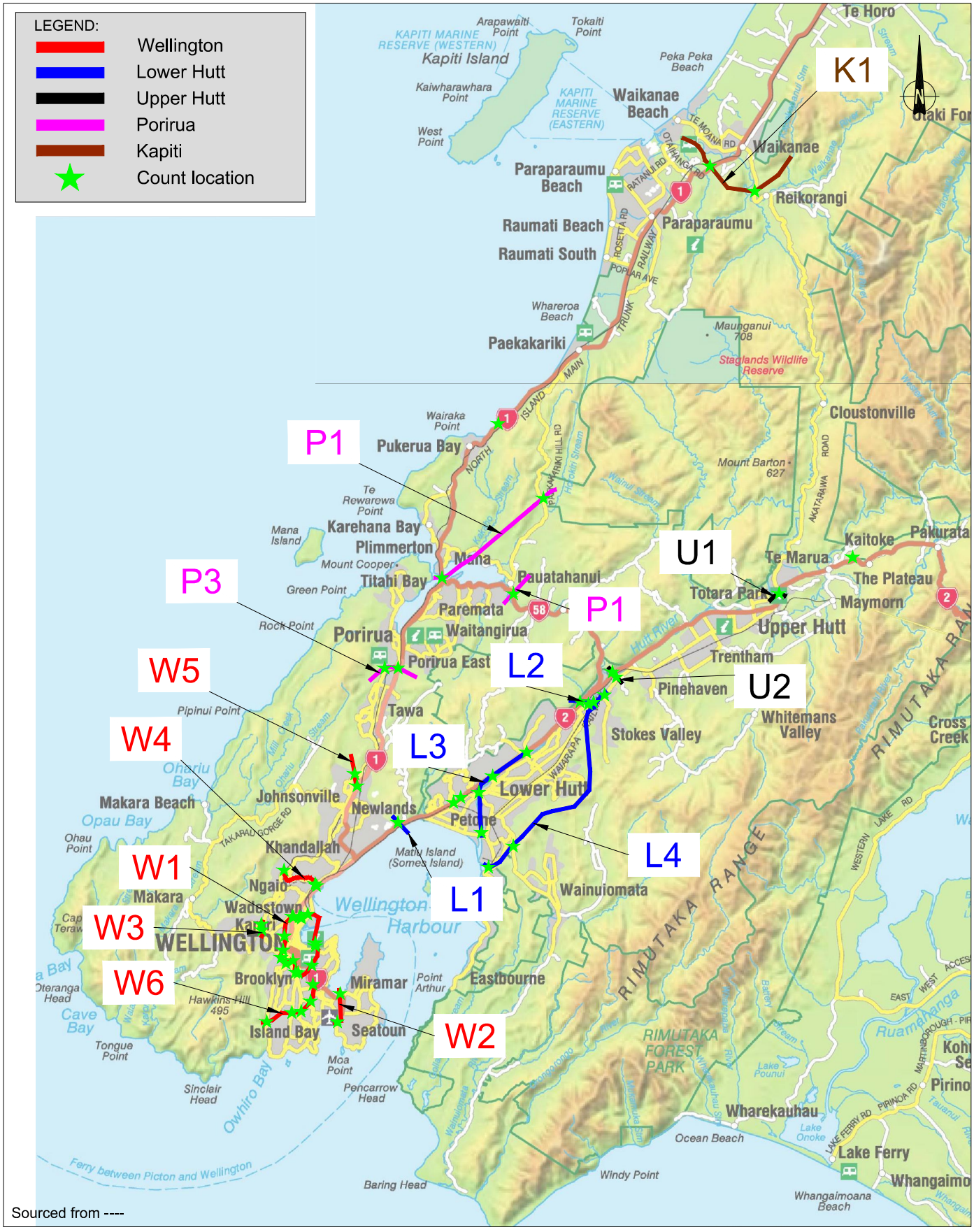
The screenlines are listed in the table below and illustrated with count locations in Figure 1.

The full list of traffic count locations is provided in Appendix A. This includes the site identifier, the count direction (north / south, east / west), location, the screenline the count is on, and the equivalence between travel direction and inbound / outbound screenline reporting. Note that for state highways, data from different sources (and years) had to be combined – see section 2.3 for further details.

Area	Screenline	Sub-Screenline	Description	No. of Links
Wellington City	W1		CBD	31
		W1A	South CBD	10
		W1B	North CBD	11
		W1C	West CBD	4
		W1D	East CBD	6
	W2		Miramar	4
	W3		Karori	4
	W4		Thorndon	6
	W5		Churton Park	4
	W6		Island Bay	10
Lower Hutt	L1	L1	Ngauranga to Petone	2
	L2	L2	Lower to Upper Hutt	4
	L3	L3	Lower Hutt	8
	L4	L4	Wainui-Stoke	6
Upper Hutt	U1	U1	Upper Hutt North	2
	U2	U2	Upper Hutt South	4
Porirua	P1	P1	Porirua North	4
	P2	P2	SH58 West	2
	P3	P3	Porirua South	4
Kapiti	K1	K1	Kapiti	4

Table 1: Traffic Screenlines

The “number of links” is included to show the number of modelled roads crossing each screenline – each direction is a separate “link”.



Tuesday, 28 January 2014 0 20mm

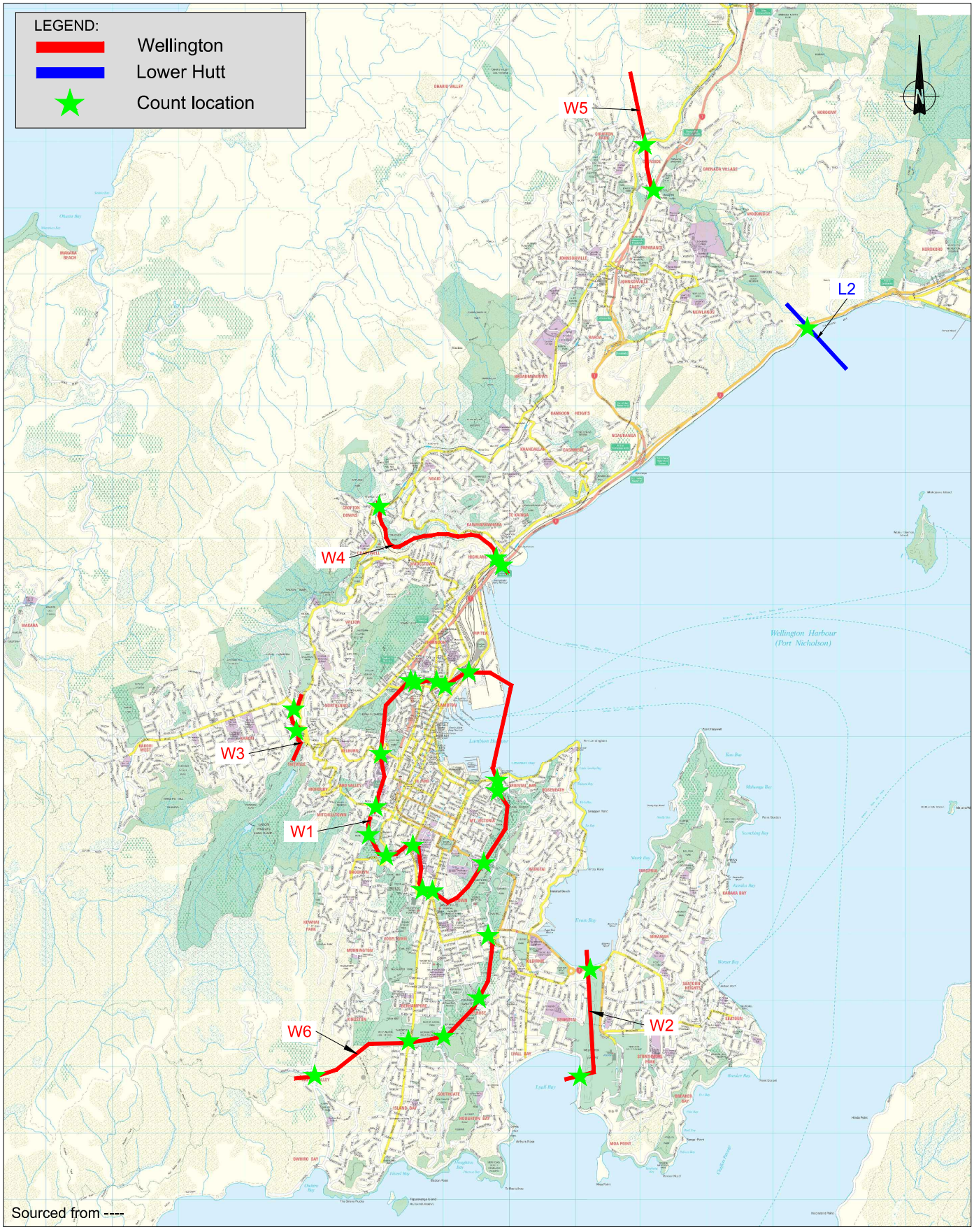
Screenlines

TDG

1

SCALE: 1:300,000 @ A4

G:\11000-11999\11900-11999\11992 GWRC 2013-15 Model Scoping\Drawings\11992_C_1A.dwg



Tuesday, 28 January 2014 0 20mm

Screenlines - Wellington City

TDG

2

SCALE: 1:80,000 @ A4

G:\11000-11999\11900-11999\11992 GWRC 2013-15 Model Scoping\Drawings\TN1\11992_C_2A.dwg

1.2 Weekday Average

Average weekday traffic counts were produced using data from Monday to Friday inclusive.

1.3 Vehicle Types

Except for the state highway network, traffic counts were requested and provided in their raw Metrocount format. These were processed using the TNZ 1999 categories, which extracts data into 14 classes (the 14th class being unclassifiable). The equivalence between these 14 vehicle classes and light, medium, and heavy vehicles is shown in the following table.

Class	Axles	Axle Configuration	Aggregate	Model Equivalence
1	2	o-o (short)	1 (Car & LCV)	Light
2	3	o-o-o (short towing)		
	4	o-o-oo (short towing)		
3	2	o--o (long)	2 (MCV)	Medium
4	3	o-oo	3 (HCV1)	Heavy
5	3	o-o--o		
6	4	oo--oo		
7	4	o--o-o--o		
		o-o--oo		
8	5	o--oo-o--o	4 (HCV2)	Heavy
		o-oo--oo		
9	6	o-oo--ooo		
10	6	o-oo-o--oo		
11	7	o-oo--oo--oo (B-train)		
		o--oo-oo--oo (T & T)		
		o-oo--oo-o--o (A-train)		
12	6 - 8	oo--oo-o--o		
		oo--oo-o--oo		
		oo--oo-oo--oo		
13	8-9	o-oo--ooo-oo (B-train)		
		o-oo-ooo-o--o (A-train)		
		o-oo-oo-o--oo (A-train)		
		o-oo--ooo--ooo (B-train)		

Table 2: Axles to Vehicle Type Equivalence

The model represents medium and heavy vehicles together (i.e. classes 3 to 13 combined). These are grouped and are often referred to simply as “heavy” vehicles.

1.4 Model Time Periods

WTSM represents demand (trip ends, distribution, and modal split) at a daily level (24 hours). These demands are then factored to specific time periods for assignment to the road and public transport networks.

The time periods considered in the assignment, for which traffic counts are required to check the validation, are:

- AM peak, 0700 to 0900
- Interpeak, 0900 to 1600
- PM peak, 1600 to 1800

The assignment model outputs average hourly flows for these time periods.

Daily counts were also processed and tabulated as these provide useful checks of the overall demand matrix.

At some stage, average interpeak traffic counts representing the two hour period from 11:00 to 13:00 have been adopted for the validation instead of an average between 09:00 and 16:00. While it had been anticipated that average interpeak counts for both time periods would be assessed for suitability, counts on the state highways at the exact locations were not available (without commissioning specific counts). Hence there was greater reliance on previous traffic counts which eliminated the option of considering both time periods. The issues with state highway counts are outlined in section 2.3 of this report.

2. Traffic Count Processing

2.1 Overview

Traffic counts were sourced from:

- Local authorities
- NZTA

A significant data collection exercise was undertaken for the 2011 model update. This included commissioning counts at the exact locations on the screenlines.

A new approach was adopted for this 2013 update – GWRC worked with the local authorities to ensure counts were collected at the required locations as part of each authority's regular count programme. On the State Highway network, existing counts were utilised. This meant that in some cases, reliable 2013 data was not available, in which case data from other time periods, nearby locations or even relationships from 2011 counts, were used.

In summary:

- Traffic counts were not commissioned for the 2013 model update and existing data sources were utilised;
- Aside from the state highways, the standard traffic counts were available; and
- Some state highway counts in the exact locations were not available or not reliable and data had to be estimated using counts from nearby locations or other time periods, particularly for vehicles classification.

Because of the different issues with state highway and other counts, the processing is described separately below.

2.2 Processing Non State Highway Counts

All traffic counts were reviewed to check that:

- The specified tidality/direction was correct;
- The volumes through the day were as expected and there were no tube failures; and
- The weekday day-to-day variation appeared logical / acceptable.

Findings:

- Featherston Street NB (site 2) - Tube failure northbound on Tuesday at 13:00 as shown in Figure 3 below. The Tuesday count was therefore discarded completely in calculating weekday averages;

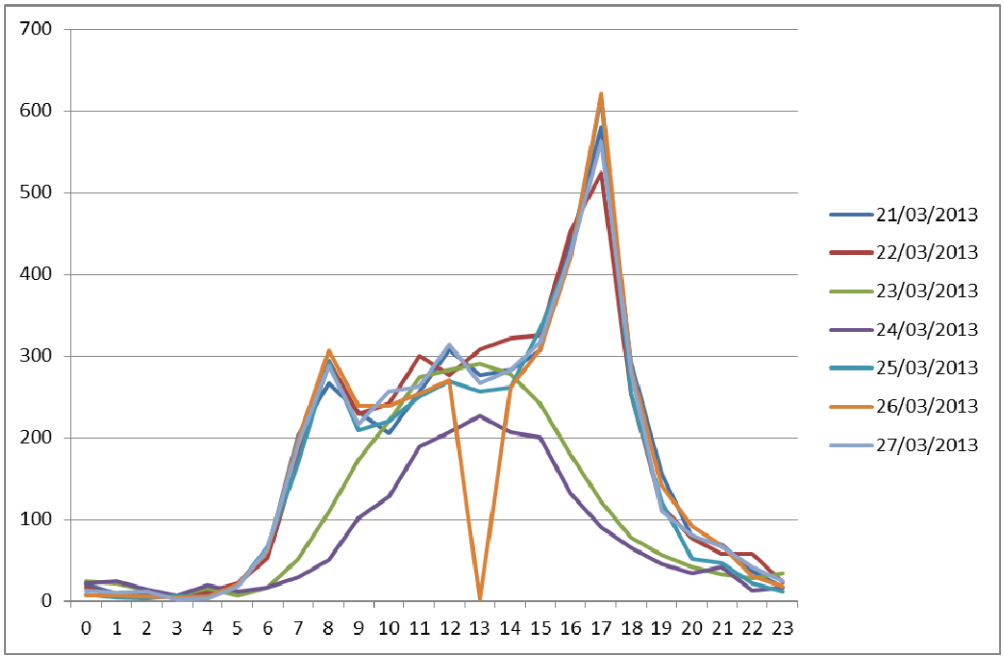


Figure 3: Traffic Count, Northbound Total Vehicles on Featherston St – Tube Failure Graphic

- Oriental Parade, EB & WB (site 10) – daily light vehicles on Monday were more than 15% lower than the following day (17% lower EB and 22% lower WB); and more than 20% lower than the Tuesday to Friday average. The data did not indicate a tube failure. The Monday count at site 10 appeared to be an outlier and was therefore excluded from average calculations;
- Tasman Street, NB & SB (site 14) – this count is lower than usual due to the detour from the Memorial Park Alliance (MPA) road works. The model should therefore be expected to overestimate at this location in the validation;
- Manchester Street, NB & SB (site 48) – tube failed between 11:00 and 13:00 on Sunday. No impact on data processing as weekend data not utilised; and
- Elizabeth Street (site 53, Reikorangi Road) – the count was not classified. Data from 2011 was used to separate light and heavy vehicles, which is described below.

2.2.1 Elizabeth Street (Reikorangi Road) – HCV Proportion

The 2013 count at Elizabeth Street (northern continuation of Reikorangi Road) was not classified. To estimate light and heavy vehicles separately, the vehicle proportions in the purpose-collected 2011 count were applied to the 2013 total volumes. The volumes counted in 2011 and the heavy vehicle proportions are tabulated below for reference.

Direction	Heavy	Light	Total	% Heavy
	AM PEAK			
SB	4	29	33	12%
NB	9	96	105	9%
Combined	13	125	138	10%
	INTERPEAK			
SB	3	57	61	6%
NB	6	60	66	10%

Direction	Heavy	Light	Total	% Heavy
Combined	10	117	127	8%[1]
	PM PEAK			
SB	4	107	111	4%
NB	6	62	68	9%
Combined	10	169	179	6%

Table 3: 2011 Count at Reikorangi Road

The heavy vehicle proportions for each peak period and direction were used. Outside of the model assignment peak periods (0700-0900, 1100-1300, and 1600-1800), the proportion of heavy vehicles for both directions combined in the interpeak period (8%) was used.

2.3 Processing State Highway Counts

As mentioned in section 2.1, a different approach was adopted for the 2013 update which was to use as much as possible existing data from the NZTA annual count programme, supplemented with a limited number of additional tube counts where no suitable data was available. Although this approach might lead to a slight decrease in accuracy as some of these counts are not at the exact location or might use vehicle type proportion data (light vs heavy) from other sources, this is largely offset by the wealth of data available (more sites available, longer time periods). This will allow for more detailed analysis of trends and variations both for this project and for future monitoring and updates of the transport model, as opposed to a one-week snapshot which doesn't provide as much context to identify potential anomalies.

The NZTA count programme was reviewed to match existing sites with WTSM screenline counts, and if none were available what inference could be made from other nearby counts. Given that a significant component of the model update is the development of a new heavy commercial vehicle (HCV) matrix, there was a strong emphasis on obtaining accurate data regarding the split between light and heavy vehicles on the state highway network.

NZTA uses three different types of counts with distinct uses and characteristics:

- **Tube count:** these are temporary counts, typically covering a one-week period with full vehicle classification;
- **Dual loop (or Piezo count):** generally permanent counts and therefore useful to analyse trends and seasonal variations. They also classify vehicles; and
- **Single loop:** similar to dual loop but only measure total volumes and do not classify vehicles. They are the most widely used across the state highway network.

The single loop counts presented an issue as they do not provide the split between light and heavy vehicles. For these sites, the vehicles proportions were obtained from other counts nearby if it was estimated that the traffic characteristics were similar (i.e. no major side roads or traffic / freight generator in-between). A limited number of additional tube counts were commissioned through NZTA where no suitable data was available. Finally, a

[1] Used for other time periods where data was not readily available

few sites were found to have questionable data, for which traffic volumes or vehicle type proportions from 2012 or 2011 were used.

The analysis therefore aimed at finding the right balance of using existing sources of data without unreasonable compromises on the quality of this data. For each WTSM count site, the following characteristics were considered:

- **Corresponding NZTA count**
- **Suitability in terms of location**
- **Time period covered:** volumes from March 2013 (Census month) were used in priority. If not available, the alternative period used was recorded to enable factoring to March 2013;
- **Total vehicle volumes:** check of total vehicle volume and its suitability, particularly compared with 2006 and 2011 tube counts undertaken for previous model updates**;**
- **HCVs volumes:** check of HCV proportions and its suitability, particularly compared with 2006 and 2011 counts.

The following section summarises the outcome of this analysis and presents what source of data was used for all state highway counts. The full analysis, including findings and final outcome is included in Appendix B.

2.3.1 SH1 Counts

16. Cobham Drive: Single loop and wrong location (west of Troy/Cobham roundabout whereas WTSM screenline is to the east) and June 2013 only. An additional tube count was carried out at the same location by NZTA but was found to have questionable accuracy. Therefore data from a tube count from March 2012 was used and factored to March 2013.

8. Mt Victoria Tunnel: Single loop on Patterson Street so a new tube count was commissioned, carried out in September 2013.

5. The Terrace: Single loops between Hawkestone and Tinakori interchanges. New counts were commissioned to obtain vehicles type proportions and carried out in October 2013. These counts had a questionable accuracy and were one direction only, so total volumes from the single loop were used, and the vehicle type proportions were sourced from the 2011 counts.

21. South of Ngauranga: Dual loop sites from NZTA (same data source as during the 2011 update), telemetry site 3 on SH1 and telemetry site 4 on SH2. There was however a discrepancy in the peak hour direction on telemetry site 3 where the profile changed overnight from August 2012 onward, suggesting a possible malfunction of this count. This was reported to NZTA. March 2012 was therefore used instead for the peak direction and factored to March 2013.

23. Churton Park: The count available at this location is a single loop so a new tube count was commissioned, carried out in September 2013.

39. Linden: Single loop at Tawa College was used for 2013 total volumes but vehicle type proportions were obtained from 2011 data.

43. Mana Bridge: Used telemetry site on Mana Esplanade.

45. North of Pukerua Bay: Used telemetry site at Paekakariki. This site is 5km further north than the actual screenline site but with very limited side-roads, the volumes were considered to be appropriate.

52. Kebble Drive: Single loop north of Lindale for total volumes but vehicle type proportions were obtained from Paekakariki telemetry site.

40. Manakau: Used single loop North of Waitohu River Bridge for total volumes and dual loop at Ohau for HCV proportion.

2.3.2 SH2 Counts

24. North of Ngauranga: This site was out of service for most of 2013 but was fixed in October of this year, so data from October 2013 was used.

25. South of SH58: This site has been discontinued so the dual loop count at Kelson further south was used. Both sites showed almost identical flows in 2011 as there are virtually no side roads in between, which is likely the reason why one of the sites was discontinued.

35. Western Hutt Road: Single loop, so used vehicle type proportion from the site at Kelson.

34. Fergusson Drive: Total volumes from single loop south of Akatarawa Road, vehicle type proportion were obtained from the 2011 tube count.

46. Rimutaka Hills: Dual loop at Rimutaka.

41. Mt Bruce: Dual loop at Konini.

2.3.3 SH58 Counts

37. SH58: Telemetry site 73, Pauatahunui East.

2.4 Adjustments – Year

For the following sites, the available traffic counts were for 2012 (not 2013):

- Paekakariki Hill Road (site 44);
- Cobham Drive (site 16);
- Kebble Drive, north of Lindale (site 52).

A single factor to adjust these counts from 2012 to 2013 was calculated and applied.

This factor (and the monthly adjustment factors described in the next section) was calculated from counts at Wellington NZTA telemetry sites, where continuous data is collected. Light vehicle continuous data was available (and applied) for the sites in the following table. The numbers shown are average annual daily traffic (an average day across the whole year) for both directions of travel combined, for 2012 and 2013. The growth

from 2012 to 2013 is also reported for each of the four sites and the combination of all sites.

AVERAGE DAILY TRAFFIC BY SITE					
	Paekakariki	**Tawa**	**Terrace Tunnel**	**Paterson Street**	**All Sites**
2012	21,439	40,517	47,936	36,190	146,082
2013	21,408	41,193	48,223	37,341	148,165
% Growth, 2012 to 2013	-0.1%	1.7%	0.6%	3.2%	1.4%

Table 4: 2012 and 2013 Daily Counts at Telemetry Sites – Yearly Growth

The four sites show quite different growth patterns between the two years, ranging from a 0.1% reduction at Paekakariki to a 3.2% increase at Paterson Street. As a relationship / factor is required, the 2012 and 2013 counts at each site are plotted in the following figure, with the linear trend line.

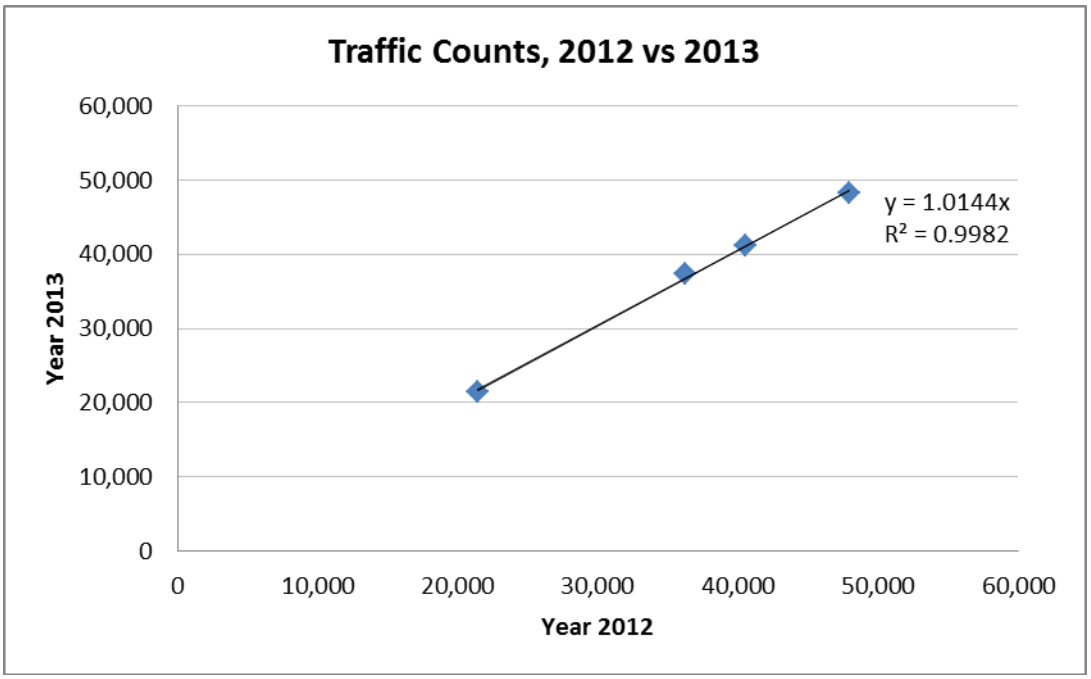


Figure 4: Yearly Variation, 2012 vs 2013 Traffic Counts at Four Telemetry Locations

The slope of the trend line for the four sites indicates 1.4% growth. This factor was therefore applied to 2012 counts to adjust them to represent 2013.

2.5 Adjustments – Seasonality

WTSM is generally understood to represent the month of March (as the input land use data from Census is collected in March and traffic counts for previous updates focussed on March). However strategic models of this type, by necessity, include data from a wider timeframe and often do not rigidly represent a single month. The month of March was identified and used to represent traffic volumes in the 2013 update.

While the vast majority of traffic counts were collected during March (and March 2013), a few represented different months. The following table lists the traffic counts that were NOT collected in March 2013. The seasonal pattern was therefore assessed and factors calculated to adjust these counts to the month of March.

Site ID	Location	Year	Month
8	Mt Vic Tunnel - Patterson St (Sth of Basin Reserve)	2013	Sep
9	Hawker St	2013	May
16	Cobham Drive	2012	Mar
23	Churton Park - Grenada Interchange	2013	Sep
24	SH2 N of Nga	2013	Oct
44	Paekakariki Hill Road	2012	Nov
48	Manchester St	2013	May
52	Kebble Drive - Nth of Lindale	2012	Mar
53	Elizabeth Street	2013	Apr
8	Mt Vic Tunnel - Patterson St (Sth of Basin Reserve)	2013	Sep

Table 5: Traffic Counts NOT Collected in March 2013

In addition to the telemetry sites listed in the previous section where light vehicles were enumerated, heavy vehicle counts were available for the following telemetry sites:

- Ngauranga SH1, telemetry site 3
- Ngauranga SH1, telemetry site 4
- Mana
- Paekakariki (telemetry site 47)
- Ohau (telemetry site 56)

An index was set such that for the month of March, the value was one. The index for other months was calculated relative to March based on the average daily traffic volume (both directions of travel combined), by telemetry site, and for light and heavy vehicles separately. This monthly / seasonal variation index is plotted below for light vehicles and in the subsequent figure for heavy vehicles. The same information is provided in Table 6 and Table 7 for light and heavy vehicles respectively.

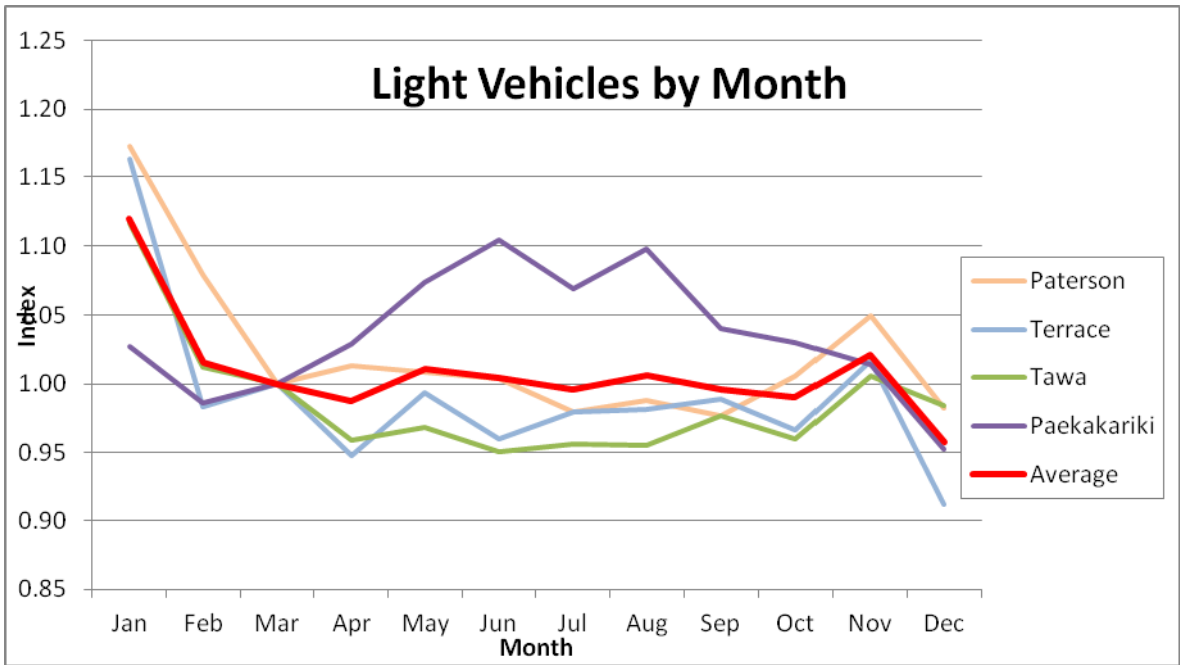


Figure 5: Monthly Variation for Light Vehicles

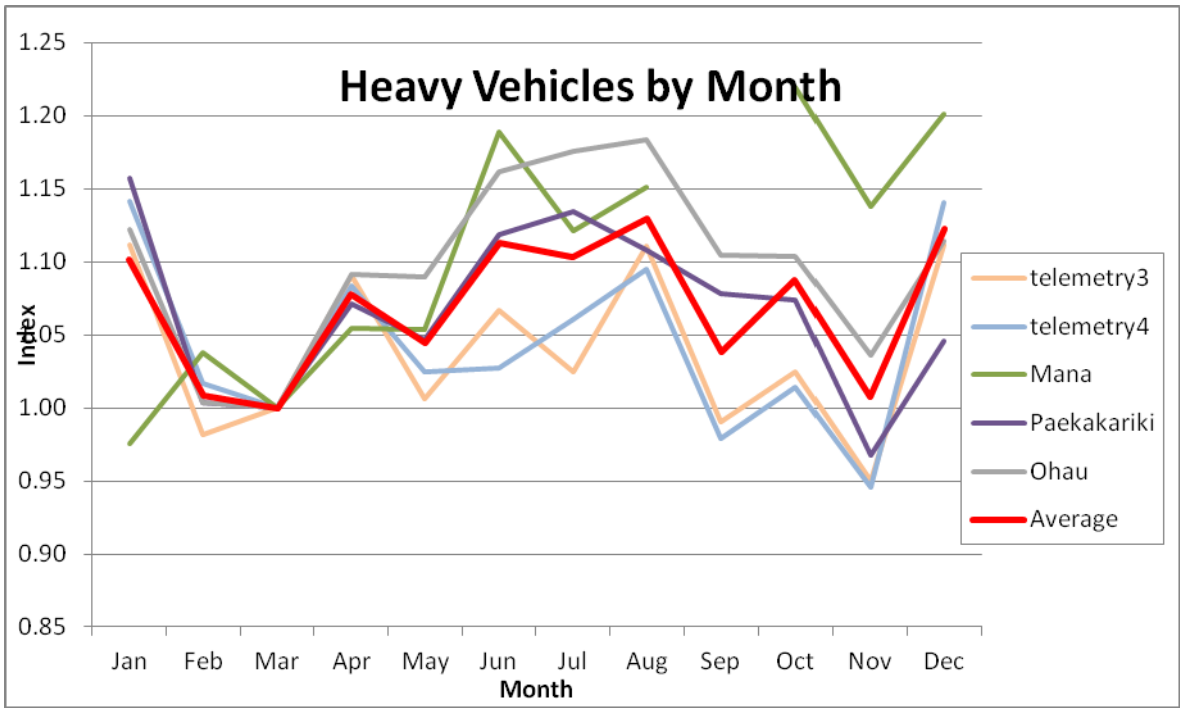


Figure 6: Monthly Variation for Heavy Vehicles

Note that for heavy vehicles at the Mana site, data was not available for the month of September (missing from graph).

LIGHT VEHICLES SEASONAL INDEX												
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Paterson	1.17	1.08	1.00	1.01	1.01	1.00	0.98	0.99	0.98	1.01	1.05	0.98
Terrace	1.16	0.98	1.00	0.95	0.99	0.96	0.98	0.98	0.99	0.97	1.02	0.91
Tawa	1.12	1.01	1.00	0.96	0.97	0.95	0.96	0.96	0.98	0.96	1.01	0.98
Paekakariki	1.03	0.99	1.00	1.03	1.07	1.10	1.07	1.10	1.04	1.03	1.01	0.95
Average	1.12	1.02	1.00	0.99	1.01	1.00	1.00	1.01	1.00	0.99	1.02	0.96

Table 6: Seasonal Variation Index – Light Vehicles

HEAVY VEHICLES SEASONAL INDEX												
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Telemetry3	1.11	0.98	1.00	1.09	1.01	1.07	1.02	1.11	0.99	1.02	0.95	1.11
Telemetry4	1.14	1.02	1.00	1.08	1.02	1.03	1.06	1.09	0.98	1.01	0.95	1.14
Mana	0.98	1.04	1.00	1.05	1.05	1.19	1.12	1.15	-	1.22	1.14	1.20
Paekakariki	1.16	1.00	1.00	1.07	1.05	1.12	1.13	1.11	1.08	1.07	0.97	1.05
Ohau	1.12	1.00	1.00	1.09	1.09	1.16	1.18	1.18	1.10	1.10	1.04	1.11
Average	1.10	1.01	1.00	1.08	1.04	1.11	1.10	1.13	1.04	1.09	1.01	1.12

Table 7: Seasonal Variation Index – Heavy Vehicles

The index value averaged for each month across all the sites was adopted.

The values in the above tables were applied to traffic counts collected in different months to adjust them to represent March conditions.

2.6 Validation Dataset

The final traffic count validation dataset is provided in Appendix C. These counts have been checked for tube failures etc and adjusted to represent March 2013 conditions (through the application of year and seasonality / month factors).

3. Further Checks on Traffic Counts

3.1 Accuracy of Induction Loops

One of the mechanisms to count traffic, particularly used on state highways, is inductive loops. For the 2013 update, the question was asked by the peer reviewer how accurate induction loops are in classifying vehicles. An assessment was undertaken to answer this question, which is reported in Appendix D.

In summary, it proved very problematic to prearrange particular induction loops to be turned on for specific time periods, at which time a manual count would be undertaken in parallel. Induction loop and manual counts were eventually obtained/collected for two sites. The results indicated there was no pattern (induction loops over or under counting) and the difference in total vehicles as well as heavy vehicles was somewhat surprising. The only conclusion that could be drawn is that it is likely that induction loops will underestimate the number of heavy vehicles. To draw watertight conclusions, this exercise would need to be repeated at a significant number of sites, and evaluate longer timeframes, which is beyond the scope of this model update.

The outcome of this check is that there is a high degree of uncertainty in the counts from induction loops, however, the error is likely to remain similar over time.

3.2 Comparison with Previous Years

A comparison between 2013 traffic counts and those collated for the 2011 update was undertaken to identify any major differences. The comparison between 2013 and 2011 counts showed relatively large changes or decreases in traffic volume for some sites. Some of these changes can be explained by the change in site location (the 2011 update used specifically collected counts whereas the 2013 update relied on available information), others required further investigation. The following subsections list the sites with changed locations and discuss the large changes in traffic volume.

3.2.1 Count Site Location Changes

There were some changes in survey locations for counts in 2013, with greater use of data collected for other purposes. These sites were:

- Bowen Street (Site 4)
- Terrace Interchange (Site 5)
- Tasman Street (Site 14)
- Adelaide Road (Site 15)
- Churchill Drive (Site 42)
- Reikorangi Road (Site 53)

The figures below detail the location change, where the count locations in 2011 are marked in blue and 2013 locations in red.

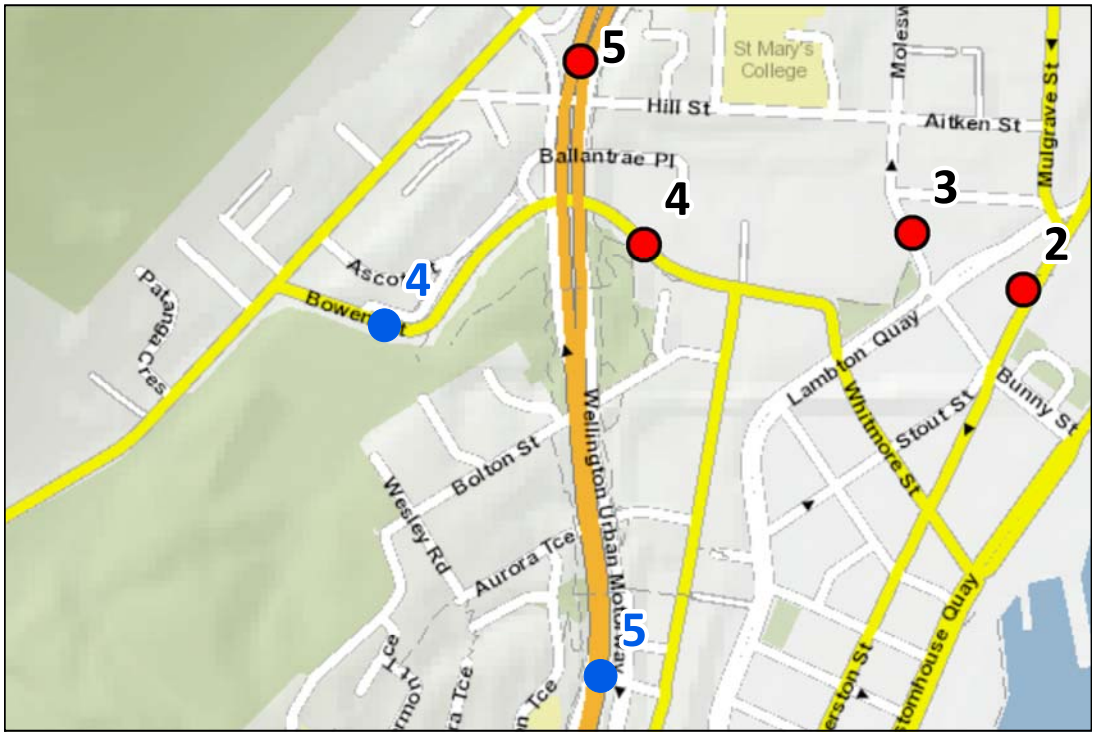


Figure 7: Modified Count Locations – Bowen / Terrace

The change of location for the Terrace (site 5) is associated with the 2013 update using existing NZTA count sites, whereas in 2011, tube counts were specifically undertaken.

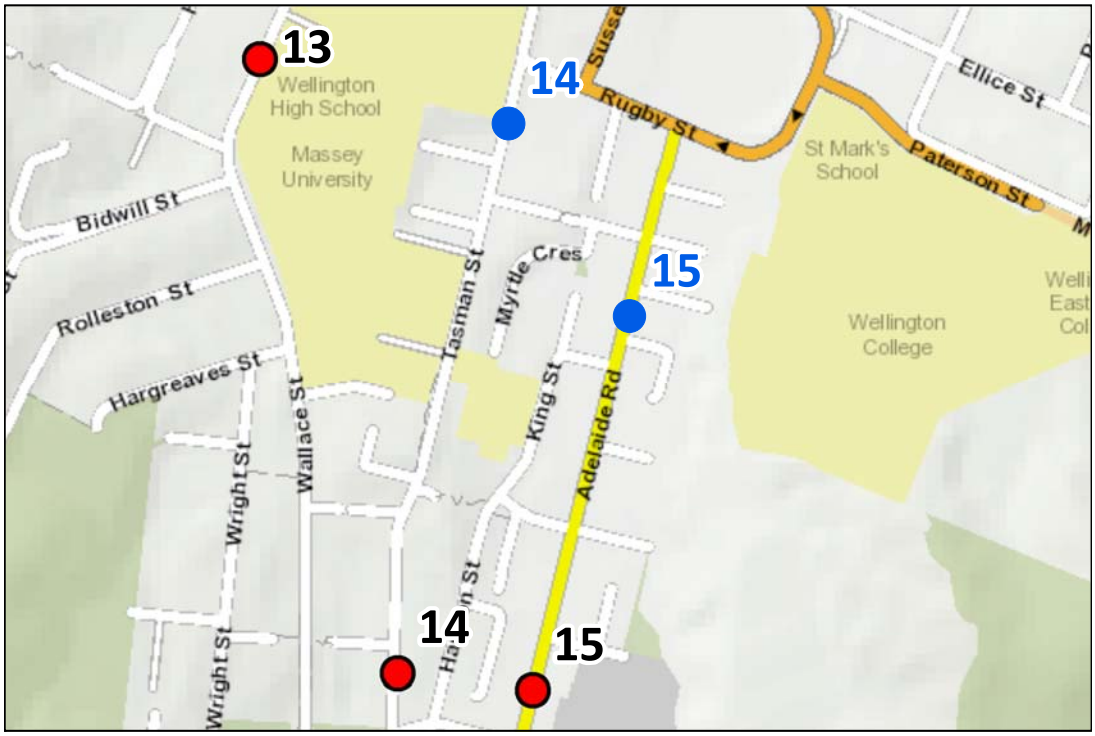


Figure 8: Modified Count Locations – Tasman / Adelaide

The slightly different count location on Tasman Street and Adelaide Road is not expected to cause any issues in the model validation.

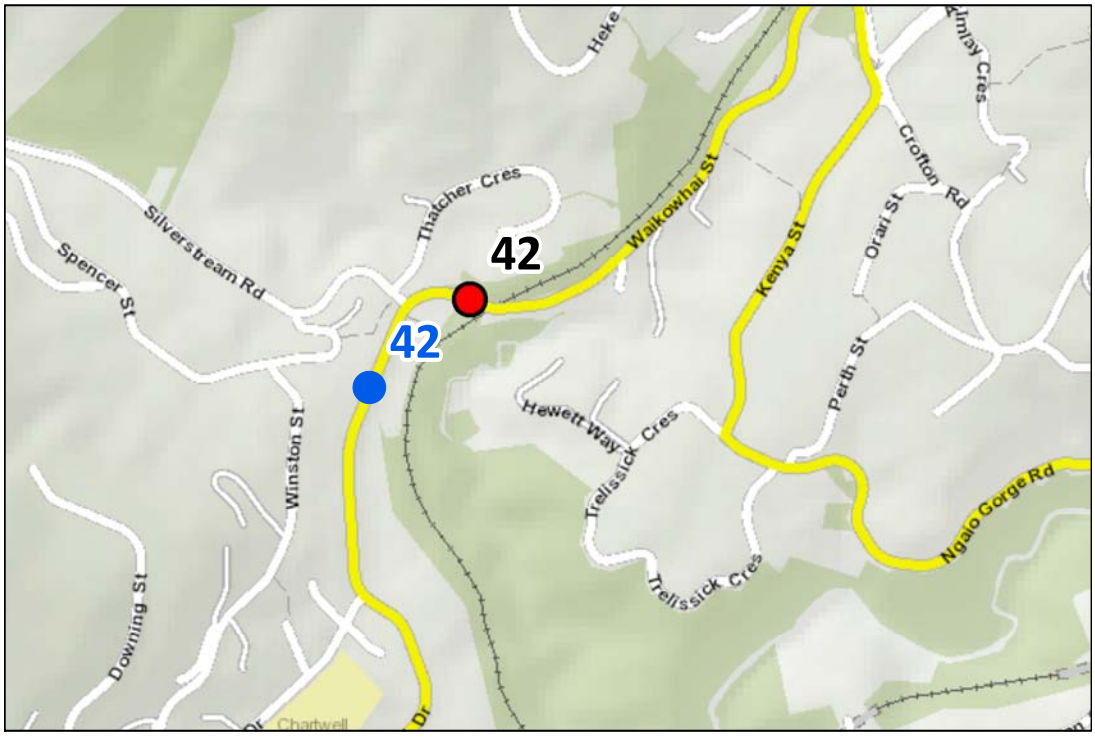


Figure 9: Modified Count Locations – Churchill

While in 2011, site 42 was counted on Churchill Drive south of Silverstream Road. In 2013, data was available for Waikowhai Street, just north of Silverstream Road. This is not expected to generate any issues.

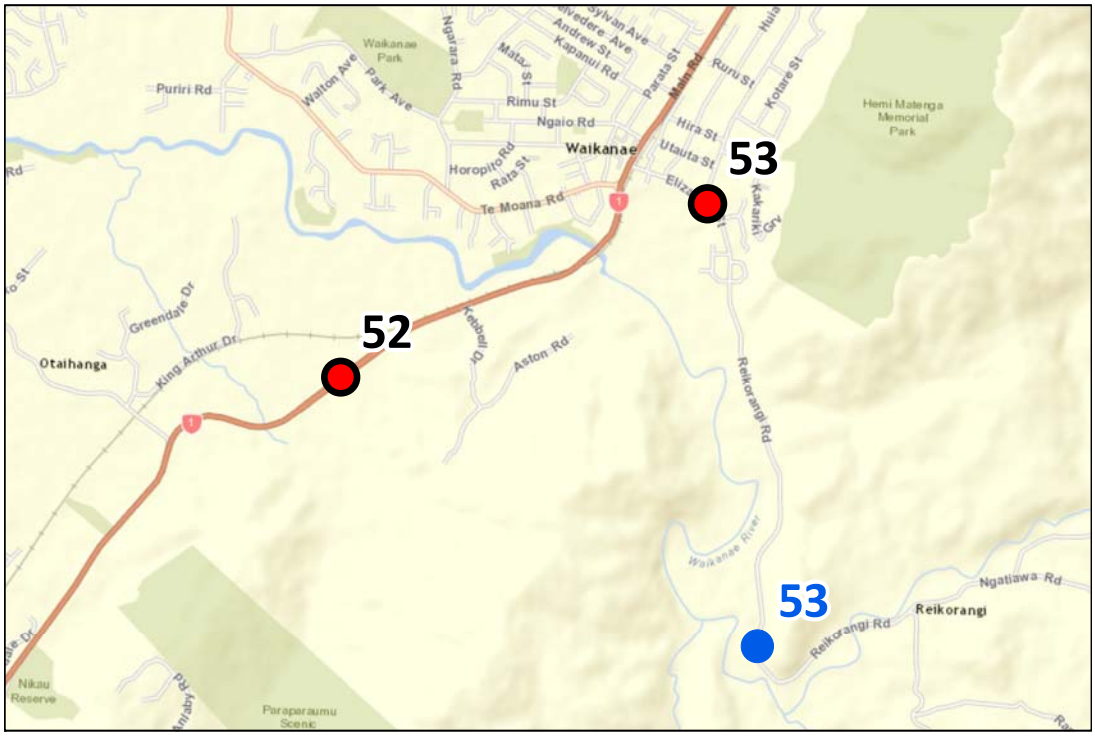


Figure 10: Modified Count Locations – Reikorangi

The 2013 count for Reikorangi (site 53) is actually on Elizabeth Street, where data was available. This is not expected to generate any issues.

Apart from the Terrace Interchange (site 5), the change in survey locations did not result in any large changes in traffic volumes.

However, due to the construction around Memorial Park, the traffic volume on Tasman Street (site 14) is significantly reduced in 2013 compared with 2011. This will need to be considered in the model validation – the model should overestimate the flow on Tasman Street.

3.2.2 Sites with Large Differences

Five other sites had relatively large changes in traffic volumes, which are discussed in the following sections.

Thorndon Quay (Site 2)

The 2013 count at this site is 15% lower compared to that used for the 2011 validation.

It is understood that the 2011 count at this location was initially provided by TDG. However, due to an unexpectedly low traffic volume, it was eventually replaced by a count obtained from Wellington City Council (WCC), which was consistent with counts sourced from Opus at the same location.

When comparing the 2013 count against the original 2011 count TDG provided, the results show a 15% increase in traffic, which is equally unlikely. It would appear that seasonal differences at this location may be quite considerable. Without further information, the decision was made to adopt the current 2013 count, which is 15% lower compared to the count used in the previous update.

Retaining the 2013 count at Thorndon Quay, which is significantly lower than 2011, may need to be revisited during model validation.

SH2 Ngauranga (Site 21)

The 2013 count at this site was 6% lower compared to that used for the 2011 validation.

Further investigation showed that the 2011 count used in the validation was captured in September, which had volumes significantly higher compared to that observed in March of the same year. Since the 2013 count was obtained during the month of March, when comparing the March 2011 against March 2013 counts, the difference reduced to 3%, though still showing a decrease for 2013.

Without further information, the decision was made to adopt the current 2013 count, which is 6% lower compared to the count used in the 2011 update.

SH2 North of Ngauranga (Site 24)

The 2013 counts at this site was 17% lower comparing to that used for the 2011 validation, and especially for the southbound movement (26% reduction). This was traced back to this

site being out of service for a while, and potentially suffering from calibration issue once it was back in operation.

2013 Counts are significantly lower than the 2011 counts. This may require further consideration during the model validation, potentially using more recent data.

Kebble Drive (Site 52)

The 2013 NZTA count at this site is 14% lower compared to the 2011 tube counts used for validation.

Counts from NZTA at this location showed no significant changes between 2011 and 2013. Moreover, the 2011 NZTA counts were constantly lower than the 2011 tube counts, indicating potential inaccuracy in the tube counts. Since this site was not used for validation in the 2011 model update, the change in the 2013 count will not create any continuity issues with the previous update.

Cobham Drive (Site 16)

The tidality for counts at this location was significantly different in 2013 compared with that in 2011. Further investigation indicated that this was due to a directional issue in the 2011 count processing, and the 2013 counts had the correct orientation.

4. Vehicle Travel Times

4.1 Travel Time Routes

Historically, WTSM modelled travel times have been compared against observed for the following six strategic routes.

Route	Direction	Route Description
1	N	Wellington Airport to Waikanae Railway Station
1	S	Waikanae Railway Station to Wellington Airport
2	N	Wellington Rail Station to Upper Hutt Rail Station via Old Hutt Rd
2	S	Upper Hutt Rail Station to Wellington Rail Station via Old Hutt Rd
3	W	SH58 Paremata Haywards Rd Westbound
3	E	SH58 Paremata Haywards Rd Eastbound
4	N	Courtenay Place to Karori
4	S	Karori to Courtenay Place
5	N	Island Bay to Wellington Railway Station
5	S	Wellington Railway Station to Island Bay
6	N	Wainuiomata Rd to Hutt Rd Northbound
6	S	Hutt Rd to Wainuiomata Rd Southbound

Table 8: WTSM Travel Time Routes

These routes are illustrated in the following figure.

Tuesday, 23 September 2014 □□□□□□□□□□ 20mm

WTSM Vehicle Travel Time Routes

11

SCALE: 1:300,000 @ A4

G:\11000-11999\11900-11999\11992 GWRC 2013-15 Model Scoping\Drawings\TN1\11992_C_3A.dwg

Observed vehicle travel times were collected in March 2013 by Beca on behalf of NZTA.

Data was supplied for five days from Monday 4 March to Friday 8 March 2013 inclusive. Journey times for one 'run' on each weekday were provided, resulting in five observations in total per route. Start times varied by day of the week and route. For the AM peak, start times ranged from 07:00 to 8:15, for the interpeak they ranged from 10:00 to 11:15, and for the PM peak, from 16:00 to 17:15. Irrespective of the start time, the routes were evaluated within a two hour period. It is worth noting that the interpeak travel times are collected in the period from 10:00 to 12:00 whereas the traffic counts focus on 11:00 to 13:00. This is not expected to be an issue for model validation.

Beca provided processed results reporting distance, speed limit, and observed travel times (including start and end times) for each route segment, for each day of the week (weekdays), and for the three peak periods (AM, interpeak, and PM peak).

Although the routes surveyed are generally the same as the WTSM routes, there are some localised differences, such that no observed data was collected for a couple of small sections in the WTSM routes - the missing segments are noted in section 4.2.

4.2 Processing

The supplied observed data was tabulated to produce weekday average, minimum and maximums travel times for each WSTM route and model time period.

Issues with missing sections of Route 4 include:

- Route 4 NB, missing data for Jervois Quay / Whitmore Street;
- Jervois Quay (Taranaki – Waterloo) not surveyed for Route 4 – observed data from Route 5 used;
- Whitmore (Waterloo – Featherston) not covered by any observations – observed travel time estimated;
- Route 4 SB, missing data for section Whitmore / Jervois / Cable / Taranaki;
- Whitmore (Stout – Waterloo) not covered by any observation – observed travel time estimated;
- Jervois / Cable (Waterloo – Taranaki) not covered as part of Route 4 – observed data from Route 5 used;
- Taranaki (Cable-Wakefield) not covered by any observations – observed travel time estimated.

The road sections that do not have any observed travel times are relatively small. The missing data is not considered to adversely affect the model validation.

4.3 Validation Dataset

The average travel times for each route (by direction) are provided in the following tables for each model peak period, including the minimum and maximum travel times (distance also reported in the AM peak table only).

AM PEAK					
	Length (m)	**Observed Ave (mins)**	**Observed Speed (kph)**	**Observed Min (mins)**	**Observed Max (mins)**
Route 1N	64319	58	66	52	69
Route 1S	64240	81	47	60	115
Route 2N	32809	31	63	26	40
Route 2S	32703	44	45	34	55
Route 3W	15115	14	63	13	18
Route 3E	15126	15	62	14	15
Route 4N	9082	22	25	16	30
Route 4S	7876	19	26	13	29
Route 5N	7287	16	27	12	23
Route 5S	7517	20	23	15	26
Route 6N	10688	21	31	16	25
Route 6S	10952	21	32	16	25

Table 9: Observed AM Peak Travel Time by Route and Direction

INTERPEAK				
	Observed Ave (mins)	**Observed Speed (kph)**	**Observed Min (mins)**	**Observed Max (mins)**
Route 1N	56	69	52	60
Route 1S	55	70	51	61
Route 2N	32	62	28	36
Route 2S	27	73	25	30
Route 3W	15	62	13	17
Route 3E	15	62	13	17
Route 4N	20	27	17	25
Route 4S	18	31	15	21
Route 5N	15	29	12	20
Route 5S	16	29	11	21
Route 6N	14	47	13	15
Route 6S	15	45	14	16

Table 10: Observed Interpeak Travel Time by Route and Direction

PM PEAK				
	Observed Ave (mins)	**Observed Speed (kph)**	**Observed Min (mins)**	**Observed Max (mins)**
Route 1N	68	57	55	92
Route 1S	68	57	53	87
Route 2N	35	57	28	44
Route 2S	33	59	29	39
Route 3W	13	68	13	14
Route 3E	15	62	13	16
Route 4N	26	21	21	34
Route 4S	21	26	18	25
Route 5N	18	24	13	26
Route 5S	19	24	12	26
Route 6N	15	44	13	17
Route 6S	18	37	14	21

Table 11: Observed PM Peak Travel Time by Route and Direction

5. Inner City Cordon

As well as vehicle counts, person trips travelling to and from the Wellington CBD were surveyed in 2013. The mode of transport covered by these surveys included:

- Pedestrian trips
- Cycling trips
- Vehicle trips, and
- Public transport trips

These surveys were under taken at various locations and times, aiming to cover all person trips to form an inner city cordon. Details on the types of survey undertaken are listed below.

- Pedestrian cordon surveys, at 21 sites on the CBD cordon, for the AM peak period (07:00 to 09:00), Monday to Friday for a week in March 2013;
- Cycle cordon surveys, at 21 sites on the CBD cordon, for the AM peak period (07:00 to 09:00), Monday to Friday for a week in March 2013;
- Vehicle occupancy surveys, at 21 sites on the CBD cordon, for AM peak period (07:00 to 09:00), Tuesday to Thursday for a week in March 2013;
- Golden Mile pedestrian surveys, at 22 sites on Golden Mile streets, for mid-day period (12:00 to 14:00), Monday to Sunday for a week in March 2013;
- Railway screenline pedestrian surveys, at 8 sites outside of railway stations, for the AM peak period (07:00 to 09:00), Monday to Friday for a week in March 2013;
- Commuter cycle surveys, at 5 intersections in Newtown, Kilbirnie, Kelburn, Thorndon and Ngauranga, for the AM peak period (07:00 to 09:00), Monday to Friday for a week in March 2013;
- Waterfront pedestrian surveys, at 10 sites where pedestrians cross Customhouse Quay, for the AM peak period (07:00 to 09:00), Monday to Friday for a week in March 2013;
- Recreational cycle surveys, at 3 intersections in Thorndon, Kilbirnie and Lyall Bay, for the AM period (09:00 to 13:00), Saturday to Sunday for a week in March 2013;
- Public transport screenline pedestrian surveys, at 17 bus stops around the CBD as well as total patronage for ferry, rail and cable car, for the AM peak period (07:00 to 09:00), one weekday in March 2013.

Given that these surveys do not represent a watertight cordon for all modes, their use in the model validation will be limited to spot checks.

Appendix A

Traffic Count Locations

Count ID	Direction	Unique Site ID	Location	Screenline	Sub-screenline	Direction
1	N	1-N	Waterloo Quay	W1	B	O
1	S	1-S	Waterloo Quay	W1	B	I
2	N	2-N	Featherston St	W1	B	O
2	S	2-S	Featherston St	W1	B	I
3	N	3-N	Molesworth St	W1	B	O
4	E	4-E	Bowen St	W1	B	I
4	W	4-W	Bowen St	W1	B	O
5A	I	5A-S	The Terrace Interchange - Hawkestone Interchange - SB On Ramp	W1	B	I
5A	D	5A-N	The Terrace Interchange - Tinakori - NB Off Ramp	W1	B	O
5	D	5-N	The Terrace Interchange - Hawkestone Interchange mainline	W1	B	O
5	I	5-S	The Terrace Interchange - Hawkestone Interchange mainline	W1	B	I
6	N	6-N	Kelburn Pde	W1	C	I
6	S	6-S	Kelburn Pde	W1	C	O
7	E	7-E	Aro St	W1	C	I
7	W	7-W	Aro St	W1	C	O
8	D	8-N	Mt Vic Tunnel - Patterson St (Sth of Basin Reserve)	W1	D	I
8	I	8-S	Mt Vic Tunnel - Patterson St (Sth of Basin Reserve)	W1	D	O
9	N	9-N	Hawker St	W1	D	O
9	S	9-S	Hawker St	W1	D	I
10	E	10-E	Oriental Pde	W1	D	O
10	W	10-W	Oriental Pde	W1	D	I
11	N	11-N	Ohiro Rd	W1	A	I
11	S	11-S	Ohiro Rd	W1	A	O
12	N	12-N	Brooklyn Rd	W1	A	I
12	S	12-S	Brooklyn Rd	W1	A	O
13	N	13-N	Taranaki St	W1	A	I
13	S	13-S	Taranaki St	W1	A	O
14	N	14-N	Tasman St	W1	A	I
14	S	14-S	Tasman St	W1	A	O
15	N	15-N	Adelaide Rd Nth	W1	A	I
15	S	15-S	Adelaide Rd Nth	W1	A	O

Count ID	Direction	Unique Site ID	Location	Screenline	Sub-screenline	Direction
16	D	16-N	Cobham Drive - Cobham Drive (Sth of Evans Bay Pde)	W2		I
16	I	16-S	Cobham Drive - Cobham Drive (Sth of Evans Bay Pde)	W2		O
17	N	17-N	Moa Point Rd	W2		I
17	S	17-S	Moa Point Rd	W2		O
18	N	18-N	Chaytor St	W3		O
18	S	18-S	Chaytor St	W3		I
19	N	19-N	Birdwood St	W3		O
19	S	19-S	Birdwood St	W3		I
20	E	20-E	Hutt Rd	W4		O
20	W	20-W	Hutt Rd	W4		I
21	D	21-N	SH1 south of Ngauranga	W4		O
21	I	21-S	SH1 south of Ngauranga	W4		I
22	N	22-N	Middleton Rd	W5		O
22	S	22-S	Middleton Rd	W5		I
23	D	23-N	Churton Park - Grenada Interchange	W5		O
23	I	23-S	Churton Park - Grenada Interchange	W5		I
24	D	24-N	SH2 N of Nga	L1		O
24	I	24-S	SH2 N of Nga	L1		I
25	D	25-N	SH2 Sth of 58	L2		O
25	I	25-S	SH2 Sth of 58	L2		I
26	N	26-N	Eastern Hutt Rd	L2		O
26	S	26-S	Eastern Hutt RD	L2		I
27	E	27-E	Kennedy Good Bridge	L3		O
27	W	27-W	Kennedy Good Bridge	L3		I
28	E	28-E	Melling bridge	L3		O
28	W	28-W	Melling bridge	L3		I
29	E	29-E	Ewen Bridge	L3		O
29	W	29-W	Ewen Bridge	L3		I
30	E	30-E	Waione St	L3		O
30	W	30-W	Waione St	L3		I
31	E	31-E	Stokes Valley Rd	L4		O
31	W	31-W	Stokes Valley Rd	L4		I
32	N	32-N	Wainui Hill Rd	L4		I
32	S	32-S	Wainui Hill Rd	L4		O

Count ID	Direction	Unique Site ID	Location	Screenline	Sub-screenline	Direction
33	N	33-N	Marine Drive	L4		I
33	S	33-S	Marine Drive	L4		O
34	D	34-N	Furgusson Drive	U1		O
34	I	34-S	Furgusson Drive	U1		I
35	D	35-N	Western Hutt Road	U2		O
35	I	35-S	Western Hutt Road	U2		I
36	N	36-N	Eastern Hutt Rd	U2		O
36	S	36-S	Eastern Hutt Rd	U2		I
37	D	37-N	SH58	P2		I
37	I	37-S	SH58	P2		O
38	N	38-N	Main Road	P3		O
38	S	38-S	Main Road	P3		I
39	D	39-N	Linden - Tawa College	P3		O
39	I	39-S	Linden - Tawa College	P3		I
40	D	40-N	Manakau - Nth of Waitohu River Bridge			
40	I	40-S	Manakau - Nth of Waitohu River Bridge			
41	D	41-N	Mt Bruce			
41	I	41-S	Mt Bruce			
42	N	42-N	Waikowhai St	W4		O
42	S	42-S	Waikowhai St	W4		I
43	D	43-N	Mana Bridge - Paremata Bridge	P1		O
43	I	43-S	Mana Bridge - Paremata Bridge	P1		I
44	N	44-N	Paekakariki Hill Road	P1		O
44	S	44-S	Paekakariki Hill Road	P1		I
45	D	45-N	Nth of Pukerua Bay - PAEKAKARIKI - Telemetry Site 47			
45	I	45-S	Nth of Pukerua Bay - PAEKAKARIKI - Telemetry Site 47			
46	D	46-N	Rimutaka Hills			
46	I	46-S	Rimutaka Hills			
47	N	47-N	Crawford Rd	W6		I
47	S	47-S	Crawford Rd	W6		O
48	N	48-N	Manchester St	W6		I
48	S	48-S	Manchester St	W6		O
49	N	49-N	Mt Albert Rd	W6		I

Count ID	Direction	Unique Site ID	Location	Screenline	Sub-screenline	Direction
49	S	49-S	Mt Albert Rd	W6		O
50	N	50-N	Adelaide Rd	W6		I
50	S	50-S	Adelaide Rd	W6		O
51	N	51-N	Happy Valley Rd	W6		I
51	S	51-S	Happy Valley Rd	W6		O
52	D	52-N	Kebble Drive - Nth of Lindale	K1		O
52	I	52-S	Kebble Drive - Nth of Lindale	K1		I
53	E	53-E	Elizabeth Street	K1		I
53	W	53-W	Elizabeth Street	K1		O
56	N	56-N	High St			
56	S	56-S	High St			

Appendix B

Detailed Analysis of 2013 State Highway Traffic Counts

DATE	2nd February 2014
AUTHOR	Geoffrey Cornelis
SUBJECT	WTSM 2013 Update – State Highway Traffic Counts
FILE NUMBER	TP/19/07/15-v1

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1. Introduction

This note details the requirements for traffic counts on the Wellington region State Highway network for the Wellington Transport Strategy Model (WTSM) 2013 update, and matches these with counts currently available from NZTA annual traffic data collection.

The purpose of this exercise is to highlight what WTSM locations have a corresponding NZTA count with data of sufficient quality, what inference could be made from other nearby counts when more data is needed, and what additional tube counts might be required for locations where no sufficient data exists currently.

Given that a significant component of the model update will be the development of a new HCV (heavy commercial vehicle) matrix based on observed movements, there will be a strong emphasis on obtaining accurate data regarding the split between light and heavy vehicles on the State Highway (SH) Network.

Update 02-02-14: *For each site, the outcome of the recommended course of action and the data that was used for inclusion in the final 2014 screenlines is noted. This document therefore serves as a reference of what State Highway traffic counts have been used for the 2014 WTSM validation and the reason behind using this data and discarding data from other counts that were not deemed suitable.*

2. Type of Traffic Counts and Adopted Methodology

The following analysis uses three different types of counts with different uses and characteristics, especially regarding vehicle classifications (although the final classes used in the model are only light and heavy vehicles so the different sub-classes based on length or number of axles have no importance in this case):

- Tube count: these are temporary counts, typically covering a one-week period with full vehicle classification. They were used for most of the 2006 model built and 2011 model update counts.

- Dual loop (or at some locations Piezo Counts): these counts used by NZTA are generally permanent counts which collect data during the whole year and are therefore useful to analyse trends and seasonal variations. They also classify vehicles and therefore provide the breakdown of light and heavy vehicles.

- Single loop: these counts used by NZTA are similar to dual loop but only measure total volumes and do not classify vehicles. They are the most widely used across the SH network. Following a meeting with Neil Beckett and Anandita Pujara from NZTA, it was understood that the split between heavy and light vehicles is estimated by carrying out a one-week tube count at these locations and applying the ratio of light/heavy to the whole year. In the Wellington City area were traffic volumes are too high to use tube counts, HCV split from nearby dual loops is used. However analysis of the traffic counts downloaded from the NZTA website show that a proportion of 5% of HCV seemed to be applied to all single loop sites.

In addition, some camera feeds can also be used to manually count light and heavy vehicles at selected location, although it is not proposed to use this source in this analysis. Following some concerns from the peer reviewer, a limited number of these camera feeds may however be used to evaluate the reliability of dual loop counts in classifying light and heavy vehicles, particularly at low speed, but this is a separate piece of work.

In 2006 and 2011, all of the WTSM State Highway count locations were surveyed using a 1-week tube counts. For this update, a different approach was adopted to use as much as possible existing data from NZTA annual count programme. Although there might be a slight decrease in accuracy as some of these counts are not at the exact location required or might use vehicle split data from another nearby site, it is deemed that this will be largely offset by the wealth of data available (more sites available, whole years of data). This will allow for more detailed analysis of trends and variations, as opposed to a one-week snapshot which doesn't provide as much context to identify potential anomalies.

The following analysis therefore aimed at finding the right balance of using existing sources of data without unreasonable compromises on the quality of this data. For each WTSM count site, the following characteristics are highlighted:

- **Corresponding NZTA count reference and location**
- **Suitability in terms of location**
- **Time period covered:** volumes from March 2013 (census month) are used in priority. If not available, the period used instead is noted.
- **Total vehicle volumes:** a brief description of the existing total vehicle volume data and its suitability, particularly compared with data from 2006 and 2011 tube counts that were undertaken for previous model updates.
- **HCVs volumes:** a brief description of the existing HCV split data and its suitability, particularly compared with data from 2006 and 2011 counts. If the existing data is not suitable, alternative sources are suggested.
- **Action:** the recommended course of action based on this analysis, with a colored frame indicating the availability of data (green: use existing data / orange: use existing data provided it is available / red: need additional count).

The graphs and tables which have been used in this analysis are included in Appendix A. Traffic daily profiles for a number of sites are also included in Appendix B.

3. SH1 Counts

16. Cobham Drive

NZTA Site: 01N01078 Cobham Drive
Location: wrong location, should be east of Troy/Cobham roundabout
Period: June 2013 only
Total Volumes: flows are too low compared with tube counts from 2011 and 2006, likely due to wrong location.
HCVs: HCV split at this site seem to be fixed at 5%, which indicates that this is a single loop count. This contradicts the NZTA Traffic Data Booklet and information from Neil Beckett (NZTA), who mentioned that there was a dual loop site on Cobham.

Action: Check with NZTA if dual loop data is available. Can then use 2011 tube count factored using 2011-2013 NZTA data, or put new tube down.

Outcome: *An additional tube count was carried out at the same location by NZTA but was found to have a questionable accuracy. Therefore data from the March 2012 tube count was used and factored to March 2013.*

8. Mt Victoria Tunnel

NZTA Site: 01N01076 Paterson St
Location: Ok
Period: Ok - March 2013
Total Volumes: Ok
HCVs: **S**ingle loop, so fixed at 5%. 2006 and 2011 volumes are quite different in peak direction so using previous years is not recommended. HCV split can be obtained from Cobham Drive if available.

Action: Total volumes OK, HCV split from Cobham Drive if available.

Outcome: *due to unavailability of recent vehicle split on Cobham and potential difference in traffic characteristics, a new tube count was commissioned, carried out in September 2013.*

5. The Terrace

NZTA Site: Hawkestone Interchange & Tinakori Off Ramp
Location: Ok
Period: Ok – March 2013
Total Volumes: Ok
HCVs: Single loop, so fixed at 5%. 2011 split much lower than 2006 so cannot use time series. However for both years the HCV split is similar to % at Ngauranga so can use 2013 Ngauranga split (with adjustment using WCC counts on Hutt Rd and Waterloo Quay), or possibly camera feeds. Neil Beckett also mentioned that a dual loop might have been installed here following some roadwork which led to closure of this section of SH1, although it has never been used. Check

Action: Check if there is a usable dual loop site. If not, get total volumes from Hawkestone Interchange sites, and HCV split from Telemetry sites at Ngauranga, with possible adjustments from nearby WCC counts.

Outcome: *New counts were commissioned to obtain vehicles splits and carried out in October 2013. These counts had a questionable accuracy and were one direction only, so total volumes from the single loops were used, and the vehicle splits were sourced from the 2011 counts.*

21. South of Ngauranga

NZTA Site: Ngauranga Telemetry Sites 3 and 4 (these sites were already used for the 2011 update)
Location: Ok

Period: Ok - March 2013

Total Volumes: Ok, except AM Peak southbound which is lower than in previous years. Analysis shows that March is consistent with the rest of 2013 in showing significantly lower levels of traffic than 2011 in the AM peak in the southbound direction on SH1 (See Figure B.1 in Appendix B). This will need investigating as it is unlikely such a drop has occurred in reality. Check with NZTA. Volumes from SH2 is more consistent.

HCVs: Split generally consistent with 2011, although volumes are lower. Analysis shows that this is consistent with the rest of 2013. Again unrealistically low volumes of HCV in the AM Peak on SH1 southbound (See Figures B.2 in Appendix B). Same issue as total volume.

Action: Telemetry Sites 3 and 4 were already used for the 2011 update so they should be used again for this update. However there is an issue in the AM Peak for SH1 southbound, which shows an unrealistic drop in traffic between 2011 and 2013. This will need to be investigated.

Outcome: *Dual loop sites from NZTA (same data source as during the 2011 update), telemetry site 3 on SH1 and telemetry site 4 on SH2. The discrepancy in the peak hour direction on telemetry site 3 where the profile changed overnight from August 2012 onward suggests a possible malfunction of this count. This was reported to NZTA but no appropriate explanation has been provided to date. March 2012 was therefore used instead for peak direction.*

23. Churton Park

NZTA Site: 01N11062 Grenada Interchange
Location: Ok

Period: Ok – March 2013

Total Volumes: Similar to 2006 but high compared with 2011 tube counts. Analysis of loop data show that March 2013 is consistent with the rest of the year so seasonality is not an issue. However the 2011 tube counts are significantly lower than NZTA loop counts for the same year which would explain this inconsistency.

HCVs: Single loop, so fixed at 5%. Widely different HCV split in 2011 and 2006.

Action: New tube count here, as there is a long gap between Ngauranga and Mana Bridge with no HCV data and time series are too erratic to use.

Outcome: *A new tube count was commissioned, carried out in September 2013.*

39. Linden

NZTA Site: 01N01058 Tawa College
Location: Ok

Period: Ok – March 2013

Total Volumes: Very similar to 2006, 2011 volumes are quite different (same as Churton Park).

HCVs: Single loop, so fixed at 5%. 2006 and 2011 splits are similar and 2006 split also consistent with Churton Park, which seems to indicate the 2011 count at Churton Park might be faulty.

Action: Use total volumes from Tawa College Site and split from new Churton Park tube counts.

Outcome: *Single loop at Tawa College was used for 2013 total volumes but vehicle split was obtained from 2011 data.*

43. Mana Bridge

NZTA Site: 01N01050 Paremata Bridge - Telemetry site 01N01049
Location: Ok

Period: Ok – March 2013

Total Volumes: Significant increase in total traffic between 2011 and 2013 (roughly 10%) if using Paremata Bridge count. Analysis of loop data show that March 2013 is consistent with the rest of the year so seasonality is not an issue. However the 2011 tube counts are significantly lower than NZTA loop counts for the same year which would explain this increase. Data from Telemetry site 01N01049 - Mana Esplanade which is 1km further north is actually much more consistent so this would be a more suitable count. Photo from the 2011 tube count will need to be checked to ensure where it was located.

HCVs: Paremata Bridge is Single loop, so fixed at 5%. Use Telemetry site 01N01049 Mana Esplanade.

Action: Use Telemetry site 01N01049 for both total volumes and HCV split.

Outcome: *Used telemetry site on Mana Esplanade.*

45. North of Pukerua Bay

NZTA Site: 01N01036 Paekakariki Telemetry site 47
Location: 5km too far North

Period: Ok - March 2013

Total Volumes: Ok, although higher than 2011 (not counted in 2006). There is another site (01N01042) to the south of the screenline which shows similar figures so the slightly incorrect location of this count does not seem to be an issue. Analysis of NZTA loop counts show that there has indeed been in increase in traffic during the interpeak and in the non-peak direction, but the 2011 tube counts seem low in the peak direction. March 2013 is representative of annual average.

HCVs: Consistent with 2011 although slightly higher as well

Action: Use Telemetry site at Paekakariki. Although it is slightly too far north, this does not impact on the counted volumes as there are very limited side roads on this section of SH1.

Outcome: *Used telemetry site at Paekakariki.*

52. Kebble Drive

NZTA Site: 01N01021 North of Lindale
Location: 2km too far South but suitable as very limited side roads and activity on this section of SH1.

Period: Only January available in 2013 but this is widely different from annual average, so March 2012 used instead. NZTA program shows that there has been a tube count carried out in April 2013 but this is not on the website.

Total Volumes: Generally lower than 2011. Again NZTA loop data from 2011 is different from the tube counts carried out in September 2011, which is the reason for this inconsistency.

HCVs: Single loop, so fixed at 5%. 2011 HCV split is consistent with North of Pukerua Bay so can use this site.

Action: Contact NZTA to obtain the April 2013 tube count. If not available, use single loop, with HCV split from Pukerua Bay.

Outcome: *Single loop north of Lindale for March 2012 total volumes but vehicle splits were obtained from Paekakariki telemetry site.*

40. Manakau

NZTA Site: 01N00998 Nth of Waitohu River Bridge

Location: 2km too far South but suitable as very limited side roads and activity on this section of SH1.

Period: Ok - March 2013

Total Volumes: Consistent with 2011 counts.

HCVs: Single loop, so fixed at 5%. Can use split from site 01N00988 (Ohau) further north.

Action: Use Manakau single loop site for total volumes and Ohau site for HCV split.

Outcome: *Used single loop North of Waitohu River Bridge for total volumes and dual loop at Ohau for HCV split.*

4. SH2 Counts

24. North of Ngauranga

NZTA Site: 00210978

Location: OK

Period: N/b: 1 week tube count in end of January 2013. S/b: no 2013 data yet so used September 2012. NZTA program from previous years show that this count seems to be surveyed only during the second half of the year.

Total Volumes: Generally lower than 2011.

HCVs: Ok compared with 2011, although a bit low in peak direction.

Action: Use this site with possible seasonal adjustment. Ask NZTA for 2013 data for the northbound direction if available.

Outcome: *This site was out of service for most of 2013 but was fixed in October of this year, so data from October 2013 was used. Issue with counts being significantly too low, to be investigated with NZTA.*

25. South of SH58

NZTA Site: 00200963

Location: Ok

Period: March 2012. No data in 2013, ask NZTA if there will be some data collected. If no 2013 data available, use site 00210965 Kelson which shows almost identical volumes in previous years.

Total Volumes: 2012 data consistent with previous years.

HCVs: Single loop, so fixed at 5%. Split from Kelson site can be used.

Action: Query NZTA about availability of 2013 data later in the year. If not available use Kelson site instead. For HCV split, use Kelson site.

Outcome: *This site has been discontinued so the dual loop count at Kelson further south was used. Both sites showed almost identical flows in 2011 as there are virtually no side roads in-between, which is likely the reason why one of the site was discontinued.*

35. Western Hutt Road (this site was already used for the 2011 update)

NZTA Site: 00210962 Manor Park Rd
Location: Ok

Period: Ok - March 2013

Total Volumes: Consistent with 2011 counts.

HCVs: Single loop, so fixed at 5%. The NZTA Traffic Data Booklet shows a dual loop site further north (00200957 Craigs Flat) but this shows only 5% as well. If not available use either Kelson or 2011 split.

Action: Use this site for total volumes and either Craig's Flat, Kelson or 2011 data for HCV split.

Outcome: *Single loop, so used vehicle split from the site at Kelson. The count used in 2011 was actually based on the standard 5% heavy vehicle proportion.*

34. Fergusson Drive

NZTA Site: 00200949 South of Akatarawa Road
Location: Ok

Period: Ok - March 2013

Total Volumes: Consistent with 2011 counts.

HCVs: Single loop, so fixed at 5%. Other available counts are Kelson to the south and Rimutaka Hills to the north but both of these counts show different split and it is therefore difficult to tell which one would be more relevant for this location. It can however be argued that given the low volumes of HCVs at this site (less than 100 veh per two hour period in 2011), using the 2011 split would provide a sufficient level of accuracy.

Action: Use the single loop data for total volume and 2011 counts for HCV split. If this is deemed not accurate enough, a new tube count will be necessary.

Outcome: *Total volumes from single loop south of Akatarawa Road, vehicle split were obtained from the 2011 tube count.*

46. Rimutaka Hills

NZTA Site: 00200937 Telemetry Site 01
Location: Ok

Period: Ok - March 2013
Total Volumes: Consistent with 2011 counts.
HCVs: Consistent with 2011 counts.

Action: Use this site for total volumes and HCV split.

Outcome: *Used dual loop at Rimutaka, telemetry site 1.*

41. Mt Bruce

NZTA Site: 0020080 Konini
Location: Ok
Period: Ok - March 2013
Total Volumes: Consistent with 2011 counts.
HCVs: Consistent with 2011 counts.

Action: Use this site for total volumes and HCV split.

Outcome: *Used dual loop at Konini.*

5. SH58 Counts

37. SH58

NZTA Site: 05800009 Telemetry Site 73
Location: Ok
Period: Ok - March 2013
Total Volumes: Consistent with 2011 counts.
HCVs: Consistent with 2006 counts, lower than 2011.

Action: Use this site for total volumes and HCV split

Outcome: *Used Telemetry site 73, Pauatahunui East.*

Appendix C

2013 Traffic Count Dataset

Count Site	Location	Ref	AM, 0700-900 (2 hour)		IP, 1100-1300 (2 hour)		PM, 1600-1800 (2 hour)		Daily (24 hours)	
			Lights	Heavies	Lights	Heavies	Lights	Heavies	Lights	Heavies
1	Waterloo Quay	1-N	1041	191	1465	267	3358	336	13858	1887
1	Waterloo Quay	1-S	3093	447	1537	243	1902	234	13728	1992
2	Featherston St	2-N	426	20	536	23	958	49	3878	172
2	Featherston St	2-S	3259	329	1570	171	1940	180	13472	1307
3	Molesworth St	3-N	842	100	902	81	1516	160	7448	688
4	Bowen St	4-E	1242	129	533	42	769	51	5064	461
4	Bowen St	4-W	555	28	437	29	911	45	4249	233
5	The Terrace Interchange - Hawkestone Interchange mainline	5-N	2772	106	2570	164	6126	180	25547	1632
5	The Terrace Interchange - Hawkestone Interchange mainline	5-S	5266	186	2540	122	2928	60	24146	1163
5A	The Terrace Interchange - Tinakori - NB Off Ramp	5A-N	1122	42	890	56	1232	36	7383	470
5A	The Terrace Interchange - Hawkestone Interchange - SB On Ramp	5A-S	1060	38	596	28	686	14	5022	242
6	Kelburn Pde	6-N	1320	148	909	101	1040	116	7392	744
6	Kelburn Pde	6-S	706	111	788	125	1217	199	6778	904
7	Aro St	7-E	860	34	498	34	791	25	4809	210
7	Aro St	7-W	531	44	479	51	909	47	4779	332
8	Mt Vic Tunnel - Patterson St (Sth of Basin Reserve)	8-N	3018	58	2257	29	2446	23	19590	223
8	Mt Vic Tunnel - Patterson St (Sth of Basin Reserve)	8-S	2305	91	2116	50	2811	79	19022	507
9	Hawker St	9-N	124	6	139	7	314	6	1387	38
9	Hawker St	9-S	427	10	118	4	182	6	1363	37

Count Site	Location	Ref	AM, 0700-900 (2 hour)		IP, 1100-1300 (2 hour)		PM, 1600-1800 (2 hour)		Daily (24 hours)	
			Lights	Heavies	Lights	Heavies	Lights	Heavies	Lights	Heavies
10	Oriental Pde	10-E	1040	41	1166	58	1840	67	9405	449
10	Oriental Pde	10-W	1650	79	986	57	1294	42	8645	463
11	Ohiro Rd	11-N	334	6	133	5	284	3	1527	27
11	Ohiro Rd	11-S	364	6	189	6	473	3	2138	31
12	Brooklyn Rd	12-N	1461	100	579	76	767	58	5733	494
12	Brooklyn Rd	12-S	449	88	572	108	1304	113	5723	739
13	Taranaki St	13-N	1196	48	867	45	846	25	7230	264
13	Taranaki St	13-S	1385	53	1235	66	1571	66	11075	474
14	Tasman St	14-N	269	6	109	4	146	3	1060	31
14	Tasman St	14-S	63	3	96	4	172	5	812	36
15	Adelaide Rd Nth	15-N	1881	135	1338	81	1272	76	10511	638
15	Adelaide Rd Nth	15-S	714	87	1003	84	1359	94	7993	667
16	Cobham Drive	16-N	3606	264	2397	227	2675	223	21446	1815
16	Cobham Drive	16-S	2857	148	2744	130	3920	130	24487	937
17	Moa Point Rd	17-N	324	26	341	27	408	25	2513	160
17	Moa Point Rd	17-S	287	25	325	23	433	16	2462	138
18	Chaytor St	18-N	599	53	755	72	1655	64	7515	406
18	Chaytor St	18-S	1738	134	847	54	929	42	7423	453
19	Birdwood St	19-N	177	14	208	11	478	13	2126	88
19	Birdwood St	19-S	746	21	230	11	308	11	2466	87
20	Hutt Rd	20-E	1070	121	1582	185	3183	343	13208	1374

Count Site	Location	Ref	AM, 0700-900 (2 hour)		IP, 1100-1300 (2 hour)		PM, 1600-1800 (2 hour)		Daily (24 hours)	
			Lights	Heavies	Lights	Heavies	Lights	Heavies	Lights	Heavies
20	Hutt Rd	20-W	3497	508	1557	176	1484	130	12735	1539
21	SH1 South of Ngauranga	21-N	4522	200	4634	258	10470	232	45593	1678
21	SH1 South of Ngauranga	21-S	10702	260	4708	236	5980	178	44297	1607
21A	Ngauranga SH1 - Telemetry Site 3	21A-N	1924	102	2366	116	5526	88	23481	759
21A	Ngauranga SH1 - Telemetry Site 3	21A-S	5890	118	2324	112	2788	98	21721	758
21B	Ngauranga SH2 - Telemetry Site 4	21B-N	2598	98	2268	142	4944	144	22113	919
21B	Ngauranga SH2 - Telemetry Site 4	21B-S	4812	142	2384	124	3194	82	22578	851
22	Middleton Rd	22-N	310	31	395	33	731	36	3581	216
22	Middleton Rd	22-S	784	47	412	28	517	19	3669	181
23	Churton Park - Grenada Interchange	23-N	3058	108	2988	106	7289	83	29262	826
23	Churton Park - Grenada Interchange	23-S	6480	127	2960	116	3675	81	28477	899
24	SH2 N of Nga	24-N	4469	348	3774	437	6598	339	33096	2661
24	SH2 N of Nga	24-S	5340	548	3625	472	4241	198	33112	3171
25	SH2 Sth of 58	25-N	2110	132	1668	104	4256	132	17662	873
25	SH2 Sth of 58	25-S	4436	184	1752	112	2406	88	17647	929
26	Eastern Hutt Rd	26-N	812	88	910	98	2646	162	9562	721
26	Eastern Hutt Rd	26-S	2696	183	860	86	1089	74	9420	697
27	Kennedy Good Bridge	27-E	2297	117	935	103	1750	80	10624	678
27	Kennedy Good Bridge	27-W	1620	106	1012	82	2337	61	10868	558
28	Melling Bridge	28-E	1869	55	1328	45	1888	47	11400	329
28	Melling Bridge	28-W	1736	65	1477	60	2232	63	12404	435

Count Site	Location	Ref	AM, 0700-900 (2 hour)		IP, 1100-1300 (2 hour)		PM, 1600-1800 (2 hour)		Daily (24 hours)	
			Lights	Heavies	Lights	Heavies	Lights	Heavies	Lights	Heavies
29	Ewen Bridge	29-E	2170	144	2230	131	3217	214	16952	988
29	Ewen Bridge	29-W	2672	227	2022	142	2437	162	15630	1052
30	Waione St	30-E	1595	178	1696	279	2378	237	13246	1669
30	Waione St	30-W	2210	248	1741	255	2009	159	13365	1610
31	Stokes valley Rd	31-E	698	51	858	54	2249	67	8816	366
31	Stokes valley Rd	31-W	2072	119	752	78	974	68	8237	585
32	Wainui Hill Rd	32-N	2734	178	903	60	983	56	10058	601
32	Wainui Hill Rd	32-S	645	70	928	70	2836	184	9946	639
33	Marine Drive	33-N	877	33	516	24	519	24	4270	187
33	Marine Drive	33-S	338	38	546	22	915	26	4238	196
34	Furgusson Drive	34-N	626	100	964	104	2254	78	8646	937
34	Furgusson Drive	34-S	1944	80	864	88	1082	76	8346	855
35	Western Hutt Road	35-N	1920	120	1638	102	4124	126	16568	817
35	Western Hutt Road	35-S	3946	164	1644	104	2228	82	16427	864
36	Eastern Hutt Rd	36-N	987	64	700	64	1646	51	6890	395
36	Eastern Hutt Rd	36-S	1466	67	621	68	1094	42	6544	391
37	SH58	37-S	1606	64	678	44	1344	60	7110	341
37	SH58	37-N	1410	80	668	44	1540	46	7131	345
38	Main Road	38-N	1263	54	1066	53	1228	36	8078	347
38	Main Road	38-S	1100	73	1136	56	1618	32	8525	345
39	Linden - Tawa College	39-N	2206	162	2224	210	5298	172	21255	2016

Count Site	Location	Ref	AM, 0700-900 (2 hour)		IP, 1100-1300 (2 hour)		PM, 1600-1800 (2 hour)		Daily (24 hours)	
			Lights	Heavies	Lights	Heavies	Lights	Heavies	Lights	Heavies
39	Linden - Tawa College	39-S	4570	178	2142	200	2690	132	20599	1930
40	Manakau - Nth of Waitohu River Bridge	40-N	870	102	908	106	1136	90	6824	863
40	Manakau - Nth of Waitohu River Bridge	40-S	782	96	792	102	1108	86	6329	848
41	Mt Bruce	41-N	176	26	202	40	192	32	1341	263
41	Mt Bruce	41-S	102	28	170	30	260	22	1274	214
42	Waikowhai St	42-N	544	20	454	36	984	30	4351	177
42	Waikowhai St	42-S	1073	46	489	30	788	17	4681	179
43	Mana Bridge - Paremata Bridge	43-N	1150	94	2114	92	3198	94	14959	805
43	Mana Bridge - Paremata Bridge	43-S	3066	96	1768	94	1940	86	14916	829
44	Paekakariki Hill Road	44-N	88	14	99	18	255	39	955	145
44	Paekakariki Hill Road	44-S	112	184	54	64	85	87	499	657
45	Nth of Pukerua Bay - Paekakariki - Telemetry Site 47	45-N	972	132	1196	132	2674	126	11301	1080
45	Nth of Pukerua Bay - Paekakariki - Telemetry Site 47	45-S	2130	142	1104	132	1308	118	10567	1140
46	Rimutaka Hills	46-N	250	28	348	32	670	30	2880	217
46	Rimutaka Hills	46-S	426	22	272	28	358	26	2449	201
47	Crawford Rd	47-N	1267	80	997	68	1323	59	8685	499
47	Crawford Rd	47-S	885	103	953	120	1451	97	8169	885
48	Manchester St	48-N	242	11	92	5	130	6	942	46
48	Manchester St	48-S	116	7	116	11	236	10	1156	69
49	Mt Albert Rd	49-N	389	12	119	6	169	6	1410	55
49	Mt Albert Rd	49-S	85	6	113	8	270	13	1260	58

Count Site	Location	Ref	AM, 0700-900 (2 hour)		IP, 1100-1300 (2 hour)		PM, 1600-1800 (2 hour)		Daily (24 hours)	
			Lights	Heavies	Lights	Heavies	Lights	Heavies	Lights	Heavies
50	Adelaide Rd	50-N	1101	161	624	46	735	38	5569	437
50	Adelaide Rd	50-S	414	42	641	49	1228	64	5771	349
51	Happy Valley Rd	51-N	664	35	282	30	389	20	2590	178
51	Happy Valley Rd	51-S	256	35	252	43	604	42	2545	249
52	Kebble Drive - Nth of Lindale	52-N	904	124	1314	146	2138	101	10444	1001
52	Kebble Drive - Nth of Lindale	52-S	1768	118	1308	156	1359	122	10306	1110
53	Elizabeth Street	53-E	27	3	65	4	114	5	550	43
53	Elizabeth Street	53-W	78	10	63	8	76	9	555	54
56	High St	56-N	498	32	595	44	1700	47	6314	272
56	High St	56-S	1569	45	525	35	679	24	5710	234

Appendix D

Assessment of Induction Loop Count Accuracy

1. Accuracy of Induction Loop Counts

One of the mechanisms to count traffic, particularly used on state highways, is inductive loops. For the 2013 update, the question was asked by the peer reviewer how accurate induction loops are in classifying vehicles. An assessment was undertaken to answer this question, which is reported in this section.

Discussions with NZTA were undertaken, and eventually, two locations were identified:

- Murphy Street (SH1 ICB below Molesworth Street Overpass); and
- Cobham Drive (SH1 north of Tacy St Retail Park).

Induction loop data was provided by NZTA for Murphy Street for 16/09/2013 to 25/09/2013. NZTA also provided video footage for 12 hours for 17/09/2013. The video footage was reviewed and a manual count undertaken.

Induction loop data was also provided by NZTA for Cobham Drive for 14/10/2013 to 23/10/2013. Manual surveys were conducted for two time periods on 16/10/2013, from 7:00 to 9:30 and 15:30 to 18:30.

It is worth noting that there is a difference in how vehicles are classified. Manual counts use vehicle types from the Austroads classification system while induction loops use vehicle length. This does complicate the comparison by vehicle type although it is accepted that both types of counts are used as "observed" to compare with modelled outputs. The equivalence adopted between vehicle types and the induction loop length categories is:

- MB (motorbike) = VS (very small);
- LV (light vehicle) = S+M (small + medium);
- HV (heavy vehicle) = L + VL (large + very large).

1.1 Murphy Street Comparison (Induction Loop vs Manual Count)

For Murphy Street, general issues and findings include:

- The video camera zoomed to a potential accident at 10:00 and remained in this position. So one of the three traffic lanes was not visible after 10:00. Only the two lanes closest to the centre barrier were visible for the full survey period;
- The timestamp for the induction loop data was found to be incorrect; this was revealed because the peak hour was 05:00. A transfer was applied to correct the times and dates; and
- The induction loops only picked up motorbikes during one 15 minute bin from the survey period in contrast to the manual survey. The general pick-up of motorbikes was poor.

A summary of the manual count of the video survey and the induction loop data is provided in the following table. Adjustments have been applied (removing the lane missing from the video from the loop count; and adjusting the time stamp on the loop count) to improve consistency between the datasets.

START TIME	VIDEO SURVEYS				INDUCTION LOOP SURVEYS				RATIO (VIDEO / INDUCTION)			
	MB	LV	HV	ALL	MB	LV	HV	ALL	MB	LV	HV	ALL
7	30	1,299	24	1,353	0	2,462	3	2,465	0	0.528	8.000	0.549
8	34	976	27	1,037	5	1,809	8	1,822	6.8	0.540	3.375	0.569
9	16	975	39	1,030	0	1,645	8	1,653	0	0.593	4.875	0.623
10	6	1,124	29	1,159	0	1,174	7	1,181	0	0.957	4.143	0.981
11	7	870	23	900	0	979	3	982	0	0.889	7.667	0.916
12	0	916	22	938	0	923	9	932	0	0.992	2.444	1.006
13	4	902	16	922	0	963	1	964	0	0.937	16.000	0.956
14	2	937	31	970	0	1,020	10	1,030	0	0.919	3.100	0.942
15	4	944	15	963	0	994	8	1,002	0	0.950	1.875	0.961
16	11	1,204	16	1,231	0	1,100	5	1,105	0	1.095	3.200	1.114
17	8	1,280	21	1,309	0	1,380	3	1,383	0	0.928	7.000	0.946
18	3	924	8	935	0	964	1	965	0	0.959	8.000	0.969
Totals	**125**	**12,351**	**271**	**12,747**	**5**	**15,413**	**66**	**15,484**	**-**	**0.857**	**5.807**	**0.878**

Table D1: Murphy Street Comparison of Manual and Induction Loop Counts

The differences not only in vehicle classification but also in the total count are significant. In summary:

- Total number of vehicles are overestimated in the induction loop count;
- Light vehicles are similarly overestimated; and
- Heavy vehicles are underestimated in the loop count.

1.2 Cobham Drive Comparison (Induction Loop vs Manual Count)

A summary of the manual count and the induction loop data is provided in the following table.

START TIME	MANUAL SURVEYS				INDUCTION LOOP SURVEYS				RATIO (MANUAL / INDCUTION)			
	MB	LV	HV	ALL	MB	LV	HV	ALL	MB	LV	HV	ALL
7	39	3098	43	3180	20	2738	17	2775	1.95	1.13	2.53	1.15
8	23	3025	45	3093	29	2666	63	2758	0.79	1.13	0.71	1.12
16	45	2907	33	2985	20	2776	21	2817	2.25	1.05	1.57	1.06
17	47	2977	22	3046	34	2752	14	2800	1.38	1.08	1.57	1.09
Totals	**154**	**12007**	**143**	**12304**	**103**	**10932**	**115**	**11150**	**1.59**	**1.10**	**1.60**	**1.10**

Table D2: Cobham Drive Comparison of Manual and Induction Loop Counts

The differences not only in vehicle classification but also in the total count are significant.

In summary:

- Total number of vehicles are underestimated in the induction loop count (they were overestimated at Murphy Street);
- Light vehicles are similarly underestimated in the induction loop count (they were overestimated at Murphy Street); and
- Heavy vehicles are underestimated in the loop count (same for Murphy Street).

1.3 Overall Findings / Summary

The following table summarises whether the induction loop counts are high or low for the two locations compared with the manual counts.

	INDUCTION LOOP COUNT IS	
	Murphy Street	**Cobham Drive**
Total Vehicles	High (+21%)	Low (-10%)
Light Vehicles	High (+25%)	Low (-9%)
Heavy Vehicles	Low (-75%)	Low (-20%)

Table D3: Summary Accuracy of Induction Loop Counts

These results make grim reading. There is (mostly) no pattern (over or under counting) and the differences are significant. The only conclusion that can be drawn is that it is likely that induction loops will underestimate the number of heavy vehicles.

To draw robust and watertight conclusions, this exercise would need to be repeated at a significant number of sites, and evaluated for longer timeframes. This is beyond the scope of this model update. It would be advantageous to undertake a separate, comprehensive review of automatic traffic count accuracy.