1. PURPOSE

The purpose of this note is to document the procedure followed to assign vehicle trips to the road network, and to report on the model validation after assignment.

2. INTRODUCTION

In this application intersections have been explicitly modelled during the assignment process, where the delay is a function of the approach flow and the conflicting flows. This is true also of signals as the cycle time and phase splits are internally calculated, rather than being user defined. The assignment technique that has been applied as an incremental assignment.

3. ASSIGNMENT PARAMETERS

Loading Profile

The trip matrices that result from the trip generation, trip distribution and mode split phases have been assigned to the road network using an incremental time dependent assignment procedure with multiple iterations and loading profiles as shown in **Table 1**. The profiles have been derived from 15-minute counts in the study area.

In this procedure, traffic is loaded in time slices onto the network at flow rates that approximate the traffic flow profile over the time period being modelled. Interzonal time and distance and toll matrices are extracted (or skimmed) during the assignment process. These are weighted sums corresponding to the skim points on the loading profile and are fed back into the distribution and mode split phases.

The assignment procedure is explained in the TRACKS user manual. To summarise, in each iteration a proportion of the matrix is loaded according to the loading profile derived from traffic counts over the period (i.e., **Table 1** profiles. As a consequence the profiles for each period are different. Where there are a number of iterations before a skim (i.e. iterations 1 through 7 in the AM Peak period) the process is effectively an incremental assignment for that proportion (81%) of traffic, but with the start times and delays as calculated at the end of the previous skimmed iteration. Times and distances are accumulated at the skim point. If iterations are successively skimmed, then the assignment is an 'all or nothing' assignment for the proportion being loaded e.g. iteration 10 with 6% being loaded.

The profile can be altered for future runs, but it must be kept constant for all assignments (do min and options) in any given year.

Assignment Parameters					Table 1
Morning Peak Period					
Assignment Increment	**% Trip Matrix Loaded**	**% of Peak Hourly Flow Rate**	**Steady State Time (Minutes)**	**Perceived Assignment Costs**	
1	11	0	0	Light Vehicles	Heavy Vehicles
2	11	0	0		
3	11	0	0		
4	11	0	0		
5	10	54	15		
6	10	0	0	32.47 ¢/min	32.73 ¢/min
7	11	75	15		
8	6	0	0		
9	6	87	15	17.00 ¢/km	74.00 ¢/km
10	6	93	15		
11	5	98	30		
12	1	99	15		
13	1	100	15		
Interpeak Period					
1	12	0	0	Light Vehicles	Heavy Vehicles
2	12	0	0		
3	12	0	0		
4	12	0	0		
5	12	0	0		
6	11	0	0		
7	10	0	0	32.47 ¢/min	32.73 ¢/min
8	10	91	15		
9	1	92	15		
10	1	93	15	17.00 ¢/km	74.00 ¢/km
11	2	95	15		
12	2	97	15		
13	1	98	15		
14	1	99	15		
15	1	100	15		
Evening Peak Period					
1	10	0	0	Light Vehicles	Heavy Vehicles
2	10	0	0		
3	10	0	0		
4	10	0	0		
5	10	0	0		
6	10	0	0		
7	10	0	0	32.47 ¢/min	32.73 ¢/min
8	10	0	0		
9	7	87	15		
10	3	90	15		
11	2	92	15	17.00 ¢/km	74.00 ¢/km
12	1	93	30		
13	2	95	15		
14	4	99	15		
15	1	100	15		

Network Links

Travel Journey times will be established by a combination of link times and delays at intersections. The simplest form of calculating journey times in the 1960's and 70's was where all delay (link and intersection) was attributed to a link. Volume/delay relationships were derived for various types of road. Selection of the appropriate curve was made on the basis of a number of variables that physically describe the road.

Results from more recent surveys have allowed 'link only' delays to be empirically separated from intersection delays. The volume delay relationships used in this study will be for delays on links only and were based on those analytically derived by Akcelik:(1991) using a time dependent Davidson model. As a result, these curves give 'link only' delays, allowing intersection delays to be separately calculated. The J_A parameter, or friction factor, in Akcelik's equation for travel time was set for each link type so that Vcapacity/Vfree flow = 0.5. This is consistent with standard traffic theory and Fisk's behavioural model and matches data surveyed in Wellington. As a result these curves give 'link only' times, allowing intersection delays to be separately calculated. Each link in the network is given a volume delay curve depending of the speed limit, function and characteristic of the road the link represents. A steady state period of one hour was used.

Akcelik's formula is:

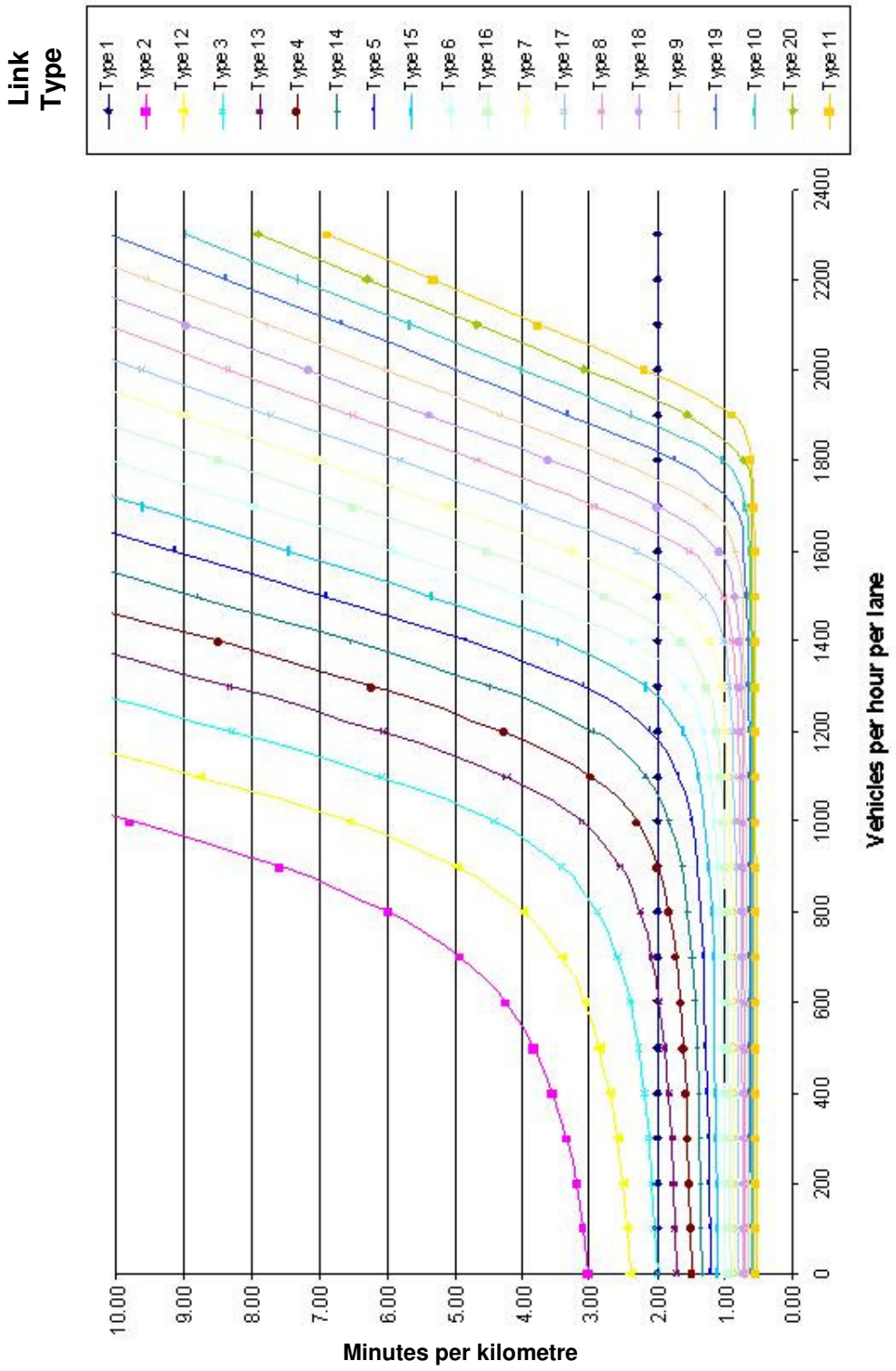
$$t = t_O \left\{ 1 + 900\, r_f \left[(x - 1) + \left((x-1)^2 + (8 J_A x) / (Q t_O r_f) \right)^{1/2} \right] \right\}$$

Where:

t	=	travel time per unit distance (secs/km)
t_o	=	minimum (zero flow) travel time per unit distance (e.g., secs/km)
J_A	=	delay (side friction, level-of-service(LOS)) parameter
x	=	q/Q = degree of saturation
q	=	demand (arrival) flow rate (veh/sec)
Q	=	capacity (veh/sec) per lane
r_f	=	ratio of flow period T_f, to minimum travel time t_o

Twenty curves were developed with free flow times at 5km/hr intervals. The capacities and J_A values used for each curve are given below. Curve number 1 is a flat line for a **Figure 2**. Each link in the network was allocated a curve from an assessment of the free flow speed, its capacity and the environmental conditions of the link.

New future links should be coded by assessing the environment in which the link will operate, and choosing a curve with an appropriate free flow speed and capacity, given the way in which link with a similar curve operate under current traffic condition.



Waikato Regional Transportation Model Gabites Porter Traffic Design Group	**Volume – Delay Curves**	**Figure 1**

Network Intersections

Each intersection on the road network is coded explicitly. The coding adopted in TRACKS to represent the different types of approach control is:

Type 0	-	Not controlled, has priority
Type 1	-	No controls marked, non priority
Type 2	-	Merge
Type 3	-	Roundabout
Type 4	-	Give Way, non-priority
Type 5	-	Stop, non-priority
Types 6,7	-	Signals
Types 8,9	-	Signals

a) Priority Intersections

Delays at priority intersections are calculated at the movement level. That is, left, right and through movements on all legs have delays calculated specifically.

The approach lanes at each intersection are coded as one of eight movement types as shown below. The opposing traffic flows are calculated from the intersection geometry, determined from the link coordinates.

1. Left, Through and Right
2. Left and Right
3. Left
4. Left free
5. Left and Through
6. Through
7. Through and Right
8. Right

The way each lane type was treated came from the publication titled, “Performance Analysis of Priority Intersections - A Practitioner’s Guide” by Gabites Porter:(1991).

A queuing theory model is used to calculate the delays. The queuing theory formulation adopted is that described by Fisk:(1989), which uses an M/M/1 model (indicates a queuing system with negative exponential distributions for arrival headway and service times, with one service channel) and a coordinate transformation approximation to allow for over-saturated conditions.

The formulation is:

$$d = \begin{cases} r/\mu\,(1 - r) & \text{steady state conditions, } r<1 \\ (r - 1)\,T/2 & \text{deterministic conditions, } r>1 \end{cases}$$

Where:

r = q_2 / μ

$$\mu = \frac{q_1 e^{-q_1 t}}{1 - e^{-q_1 b}}$$

T = duration of time period over which a steady state is assumed
q_1 = major road flow rate
q_2 = minor road flow rate, always defined as approach being delayed
t = critical gap
b = move-up time for minor road traffic.
μ = mean service rate
r = traffic intensity

Fisk shows that the delay equation can be written:

$$d = \frac{-(2 + \mu t - r\mu t) + \sqrt{(2 + \mu t - r\mu t)^2 + 8r\mu t}}{4\mu} + \frac{1}{\mu}$$

when the coordinate transform is included and this formulation is used. The default critical gaps and move-up times used are included in **Table 2**. Other assignment parameters included in the model are reported in **Table 3**.

Intersections: Critical Gap and Move-Up Times **Table 2**

Lane Type	Critical Gap (sec)	Move-up Time (sec)
Left turn-non-priority	5.0	3.0
Left turn-priority	5.0	3.0
Thru/Right-non-priority	5.0	3.0
Thru/Right-priority	5.0	3.0
Merge	3.0	2.0
Roundabout	4.0	3.0
Bottleneck	3.0	2.0

NB: a bottleneck is automatically recognised at a node where the number of lanes leaving the node is less than the number of lanes entering the node.

Intersections: Other Parameters **Table 3**

Parameters	Factor
Tracking Headway	1.2 seconds
Lane Sharing Convergence Parameter	0.01000
Number of external iterations	50
Number of internal iterations (lane sharing algorithm)	200

b) Roundabouts

Delays at roundabouts are calculated using the formulae described in the SIDRA 5 User Manual.

c) Signalised Intersections

Delays at signalised intersections are calculated according to turning movements using the formulations in ARR123, including equations 6.4, 6.3 and 6.1 shown below. While ARR123 is the basis for SIDRA it does not give exactly the same results, especially for the more recent versions of SIDRA.

A general formula for the average delay per vehicle, d (in seconds) is

$$d = D/q \qquad \textbf{eqn (6.4)}$$

Where:

D = total delay (veh/hr/hr)

q = flow rate (veh/s)

$$D = \frac{qc\ (1 - u)^2}{2\ (1 - y)} + N_0 x \qquad \textbf{eqn (6.3)}$$

Where:

qc = average number of arrivals in vehicles/cycle
q = flow (veh/sec)
c = cycle time (sec)
u = green time ratios = g/c
y = flow ratio = q/s
s = saturation flow (veh/sec)
N_o = average overflow queue (vehicles)
x = q/Q = degree of saturation

$$N_0 = \begin{cases} \frac{QT_f}{4}\left[z + \sqrt{z^2 + \frac{12(x - x_0)}{QT_f}}\right] & \text{for } x > x_0 \\ 0 & \text{for } x \le x_0 \end{cases} \qquad \textbf{eqn (6.1)}$$

Where:

Q = capacity (veh/hr)
T_f = flow period (hours)
z = x - 1
x_o = degree of saturation below which the average overflow queue is approximately zero = 0.67 + sg/600

Signalised intersections were modelled specifically and each required a SIDRA input data file.

d) Geometric Delays

The delays calculated above are the stopped delays for vehicles. As vehicles decelerate to stop or negotiate a corner a geometric delay is encountered. The geometric delay is calculated from the formulations in Gabites Porter:(1991).

4. MODEL CONVERGENCE

Assignment and Validation Loop

Time and distance matrices are required as inputs for trip distribution. As assigning the trips to the network generates these matrices, after each assignment the trip distribution needs to be re-run and the trips re-assigned until the time and distances matrices converge.

In practice, it is unlikely that absolute convergence occurs. The assignment and distribution steps are run iteratively until the totals of both the time and distance matrices between successive runs remain close to each other and relatively constant.

The totals for the time and distance matrices for two successive Assignment/Distribution Loops (after many previous runs) are shown below in **Table 4** where:

TVM = Total Vehicle Minutes

TVK = Total Vehicle Kilometres

Model Convergence — **Table 4**

PERIOD	AM Peak		Interpeak		PM Peak	
	TVM	TVK	TVM	TVK	TVM	TVK
Last Run	50639	25320	58443	29222	52412	26206
Previous Run	50641	25320	58441	29220	52415	26207
Absolute Difference	-2	0	2	2	-3	-1
% Diff	<0.000%	0%	0.003%	0.007%	<0.000%	<0.000%

The percentage change in generalised user cost between consecutive loops should be less than 1%. As the total vehicle minutes and total vehicle kilometres change less than 1% between runs (shown above), and unit time and distance costs are constant between runs, generalised user cost also changes less than 1% between runs.

When validating the model it is difficult to get a long series of runs prior to convergence because of the continual changing of the model components to get a better fit, even though these changes were often small. In general the model re-converged after two or three iterations. The periods were then run several times after convergence and remained stable.

For any model, if the network is heavily congested, convergence may not occur. Although the network is currently stable, when any changes are made to the network (e.g. option testing or land use), then convergence must be checked to ensure the network is still stable. In the unlikely event of the network not stabilising, modifications will have to be made to the network so that it will converge. These modifications should then be incorporated into the option or year being tested.

Another check on the assignment convergence stability is that the proportion of links in the entire network with flows changing less than 5% from the previous iteration, and consecutive iterations with proportions greater than 95% (EEM Worksheet 8.4).

Link Flow Convergence

The EEM requirement for link flow stability details that 95% of all links should not change by more than 5% between the ultimate and penultimate distribution/assignment convergence loops. The percentage of total links with changes of less than 5% for the three modelled periods is shown in **Table 6** below.

Model Convergence				Table 5
Period	**Criteria**	**Links**	**Percentage**	**Less than 5%**
AMP	0% - 2.5%	17197	96.40%	97.85%
	2.5% - 5%	258	1.45%	
	> 5%	384	2.15%	
Total		**17839**	**100**	
INP	0% - 2.5%	17213	96.49%	97.87%
	2.5% - 5%	246	1.38%	
	> 5%	380	2.13%	
Total		**17839**	**100**	
PMP	0% - 2.5%	16880	94.62%	96.28%
	2.5% - 5%	295	1.65%	
	> 5%	664	3.72%	
Total		**17839**	**100**	

5. TRAVEL TIME VALIDATION

Between the 3rd and 30th March 2009, 11 regional and six urban travel time routes where surveyed. The results were incorporated into the Waikato Regional Transport Model to validate travel times in the morning peak, inter peak and evening peak periods. The locations of the regional routes are presented in **Figure 2** and the urban Hamilton routes are indicated on **Figure 3**.

A summary of the model versus survey travel times is included here as **Table 6** and **Table 8**. These tables detail the surveyed mean, maximum, minimum and standard deviations for each route within the Hamilton Urban Area and the Waikato Regional Area. The also detail the percentage difference and absolute difference between the modelled journey times and the surveyed average journey times.

In **Appendix One** to this Technical Note cumulative travel time plots are presented for each route and period. **Appendix Two** contains the full travel time validation output files from the TRACKS model.

In all three periods journey validation for regional routes were very good and easily met any EEM criteria. Difficulties arose however with the validation of the inner Hamilton routes. These surveys were undertaken during the construction phase leading up to the 2009 V8 Supercar Race Meeting in Hamilton and were in many instances affected by detours, maintenance work and general road reconstruction in heavily trafficked areas. Even though these surveys occurred 4-6 weeks prior to the actual race, preparations on the roads making up the race circuit started two months before the race and therefore included the survey period. The window of opportunity for undertaking these surveys meant that these surveys had to occur at this even though some interruption was inevitable.

These interruptions to normal traffic flow had their greatest effect during the AM and PM Peak periods when traffic density was at its greatest and congestion amplified. Most Inter Peak Hamilton routes were satisfactory as this interruption affected fewer vehicles and general congestion levels were less.

Where interruption occurred, a 'kick' in the surveyed journey route travel profile occurred that could not be replicated by the model. In most instances, if this exaggerated surveyed delay were to be removed the modelled travel profile would follow the unaffected surveyed profile. These interruptions are not truly indicative of the operation of the Hamilton network and have been removed where they could be positively identified as resulting from construction.

Surveyors indicated that significant delay occurred due to either diverted traffic or reconstruction at the following locations:

1. Road works along Avalon Drive
2. Road works at Greenwood/Killarney Roundabout
3. Tristram St reconstruction and diversion
4. Tristram/London traffic signal re-phasing
5. Tristram – Norton route reduced to one lane
6. Te Rapa/Wairere traffic signal re-phasing and repairs
7. Road works along Grey St (operating at 30kph and closed in some instances)
8. Road works along Victoria St (operating at 30kph closed in some instances)
9. Traffic diverted to Anglesea St route
10. Anglesea St reduced to 1 lane between London and Bryce
11. Traffic lights at Mill/Angelsea operating incorrectly
12. Ohaupo/Kahikatea traffic signals operation issues being repaired
13. Bridge St affected by diverted traffic
14. Re-construction along Heaphy Tce.
15. Peachgrove Rd from Galloway St affected by diversion.

Summary of Hamilton Journey All Peaks — **Table 6**

AMP PEAK			ACCUMULATED TIME (In Seconds)							
			OBSERVED					MODELLED		
Journey		Distance (km)	Minimum	Average	Max	Avg Tbl 1	Std Dev	Time	Abs Diff	% Diff
HAMILTON ROUTES	H1NB	13.7	1203	1379	1581	1234	170	1443	64	4.44%
	H1SB	13.6	1113	1225	1399	1108	135	1272	47	3.67%
	H2EB	20.7	1342	1838	2170	2124	267	1713	-125	-7.28%
	H2WB	20.6	1520	1913	2440	2165	344	1775	-138	-7.79%
	H3EB	6	545	609	693	576	60	617	8	1.29%
	H3WB	6	642	747	1060	661	199	662	-84	-12.75%
	H4EB	7.6	734	975	1422	955	273	938	-37	-3.92%
	H4WB	7.6	723	824	971	769	100	933	108	11.63%
	H5NB	5.5	501	612	715	565	84	664	52	7.85%
	H5SB	6	570	631	702	563	55	649	18	2.83%
	H6aEB	4.1	345	469	609	536	95	442	-26	-5.97%
	H6aWB	4.1	281	518	755	831	209	565	47	8.31%
	H6bNB	1.6	142	205	288	205	53	201	-4	-1.95%
	H6bSB	1.6	200	212	224	188	19	215	4	1.76%
	H6cEB	1.6	23	167	311	366	93	146	-20	-13.79%
	H6cWB	1.6	100	250	310	300	59	258	8	3.00%

Summary of Hamilton Journey All Peaks											Table 6 Cont.
INTER PEAK			ACCUMULATED TIME (In Seconds)								
			OBSERVED					MODELLED			
Journey		Distance (km)	Minimum	Average	Max	Avg Tbl 1	Std Dev	Time	Abs Diff	% Diff	
HAMILTON ROUTES	H1NB	13.7	1087	1219	1152	1325	99	1302	84	6.44%	
	H1SB	13.6	1232	1264	1160	1306	29	1239	-25	-1.99%	
	H2EB	20.7	1601	1651	1640	1715	47	1627	-24	-1.49%	
	H2WB	20.6	1607	1797	1738	2149	223	1644	-154	-9.36%	
	H3EB	6	590	627	601	666	38	582	-45	-7.66%	
	H3WB	6	612	706	698	792	70	627	-79	-12.58%	
	H4EB	7.6	782	874	848	1074	120	892	18	2.04%	
	H4WB	7.6	721	772	783	815	36	877	105	12.03%	
	H5NB	5.5	549	663	622	737	79	636	-27	-4.32%	
	H5SB	6	587	650	609	733	63	629	-21	-3.36%	
	H6aEB	4.1	404	431	403	468	20	430	-1	-0.30%	
	H6aWB	4.1	379	383	346	387	7	421	38	8.94%	
	H6bNB	1.6	167	206	219	269	36	211	6	2.72%	
	H6bSB	1.6	232	257	235	282	38	250	-7	-2.77%	
	H6cEB	1.6	47	187	396	327	93	153	-34	-22.35%	
	H6cWB	1.6	144	216	294	324	44	198	-18	-8.99%	
PMP PEAK			ACCUMULATED TIME (In Seconds)								
			OBSERVED					MODELLED			
Journey		Distance (km)	Minimum	Average	Max	Avg Tbl 1	Std Dev	Time	Abs Diff	% Diff	
HAMILTON ROUTES	H1NB	13.7	1278	1550	1438	1876	237	1467	-83	-5.69%	
	H1SB	13.6	1362	1504	1418	1708	158	1581	77	4.85%	
	H2EB	20.7	1866	1926	1964	1982	42	1837	-89	-4.83%	
	H2WB	20.6	1941	2265	2232	2649	307	1865	-400	-21.45%	
	H3EB	6	655	767	728	929	112	725	-42	-5.74%	
	H3WB	6	703	787	728	871	71	671	-115	-17.19%	
	H4EB	7.6	1122	1346	1144	1756	313	1175	-171	-14.58%	
	H4WB	7.6	818	987	909	1074	112	1002	15	1.52%	
	H5NB	5.5	617	703	684	769	63	714	11	1.55%	
	H5SB	6	626	714	678	802	65	695	-20	-2.82%	
	H6aEB	4.1	379	529	486	663	107	656	127	19.38%	
	H6aWB	4.1	615	686	663	783	90	499	-187	-37.51%	
	H6bNB	1.6	149	243	210	351	105	196	-47	-23.87%	
	H6bSB	1.6	205	242	219	295	52	280	38	13.70%	
	H6cEB	1.6	220	257	239	320	59	237	-20	-8.51%	
	H6cWB	1.6	161	224	239	303	43	214	-10	-4.58%	

Summary of Regional Journey All Peak															Table 7
24 HR Regional			Accumulated Time (In Seconds)												
			Observed				Modelled								
			24 Hour				AM Peak			Inter Peak			PM Peak		
Journey		Distance (km)	Minimum	Average	Max	Std Dev	Time	Abs diff	% diff	Time	Abs diff	% diff	Time	Abs diff	% diff
REGIONAL ROUTES	R1EB SH2	154	6545	6904	7151	299	7007	103	1.47%	6926	22	0.32%	7081	177	2.50%
	R1WB SH2	154.1	6845	6869	6893	31	7035	167	2.37%	6926	57	0.83%	7342	473	6.45%
	R2aNB SH1	67.9	2842	2909	2964	61	2810	-99	-3.51%	2836	-73	-2.58%	2916	7	0.25%
	R2aSB SH1	67.7	2807	2903	2999	126	2816	-87	-3.09%	2811	-93	-3.30%	2824	-79	-2.80%
	R2cNB SH1	17	688	735	768	29	712	-23	-3.19%	696	-39	-5.67%	704	-31	-4.38%
	R2cSB SH1	17	692	729	786	38	692	-37	-5.28%	689	-39	-5.70%	738	10	1.32%
	R2dNB SH1	33.4	1225	1483	2045	201	1456	-27	-1.86%	1445	-38	-2.62%	1472	-11	-0.78%
	R2dSB SH1	33.4	1197	1465	1769	158	1441	-24	-1.63%	1437	-28	-1.97%	1452	-13	-0.87%
	R3aNB SH1B	29.3	1197	1264	1379	104	1340	76	5.69%	1341	77	5.71%	1352	88	6.52%
	R3aSB SH1B	29.3	1149	1253	1405	132	1351	98	7.28%	1346	93	6.88%	1349	96	7.13%
	R3bNB SH1B	17	769	816	862	56	796	-21	-2.60%	795	-21	-2.68%	801	-15	-1.86%
	R4EB SH29	60.1	2583	2600	2617	24	2570	-30	-1.16%	2553	-47	-1.83%	2569	-31	-1.20%
	R4WB SH29	60	2430	2553	2772	184	2529	-25	-0.97%	2529	-25	-0.97%	2567	14	0.53%
	R5NB SH1	31.5	1308	1395	1538	105	1351	-44	-3.23%	1351	-45	-3.30%	1357	-38	-2.80%
	R5SB SH1	31.5	1268	1355	1510	91	1346	-9	-0.69%	1345	-11	-0.79%	1351	-4	-0.29%
	R6NB SH32	118	4682	5039	5358	338	5132	92	1.80%	5133	93	1.82%	5137	98	1.90%
	R6SB SH32	118	5020	5138	5256	165	5133	-5	-0.10%	5134	-4	-0.08%	5137	-2	-0.03%
	R7NB SH1	58.6	2665	2668	2671	2	2668	-1	-0.03%	2681	13	0.47%	2818	149	5.31%
	R7SB SH1	58.6	2508	2710	2863	95	2680	-30	-1.12%	2673	-37	-1.38%	2713	3	0.10%
	R8NB SH1	56.7	2076	2076	2076	0	2073	-3	-0.14%	2081	5	0.25%	2092	16	0.76%
	R9NB SH5	122	4865	5111	5357	336	5143	32	0.62%	5154	43	0.83%	5373	261	4.86%
	R9SB SH5	122	5052	5161	5332	142	5210	49	0.93%	5137	-24	-0.47%	5179	18	0.35%
	R10aNB SH27	45	1640	1731	1838	100	1702	-28	-1.67%	1706	-25	-1.46%	1715	-16	-0.93%
	R10aSB SH27	45	1663	1740	1869	113	1706	-34	-2.02%	1702	-38	-2.24%	1703	-37	-2.19%
	R10bNB SH27	47.5	1992	2079	2166	113	2081	2	0.08%	2080	1	0.03%	2101	22	1.05%
	R10bSB SH27	47.5	2030	2139	2284	118	2089	-50	-2.41%	2081	-58	-2.79%	2091	-48	-2.31%
	R11aNB SH3	52.8	2308	2415	2522	146	2396	-19	-0.80%	2374	-40	-1.70%	2389	-26	-1.08%
	R11aSB SH3	52.8	2319	2372	2423	52	2369	-3	-0.14%	2376	4	0.17%	2415	43	1.78%
	R11bNB SH39	70.3	2828	2876	2942	59	2880	4	0.15%	2881	5	0.16%	2883	7	0.25%
	R11bSB SH39	70.4	2903	2906	2909	4	2894	-12	-0.40%	2898	-8	-0.28%	2907	1	0.05%

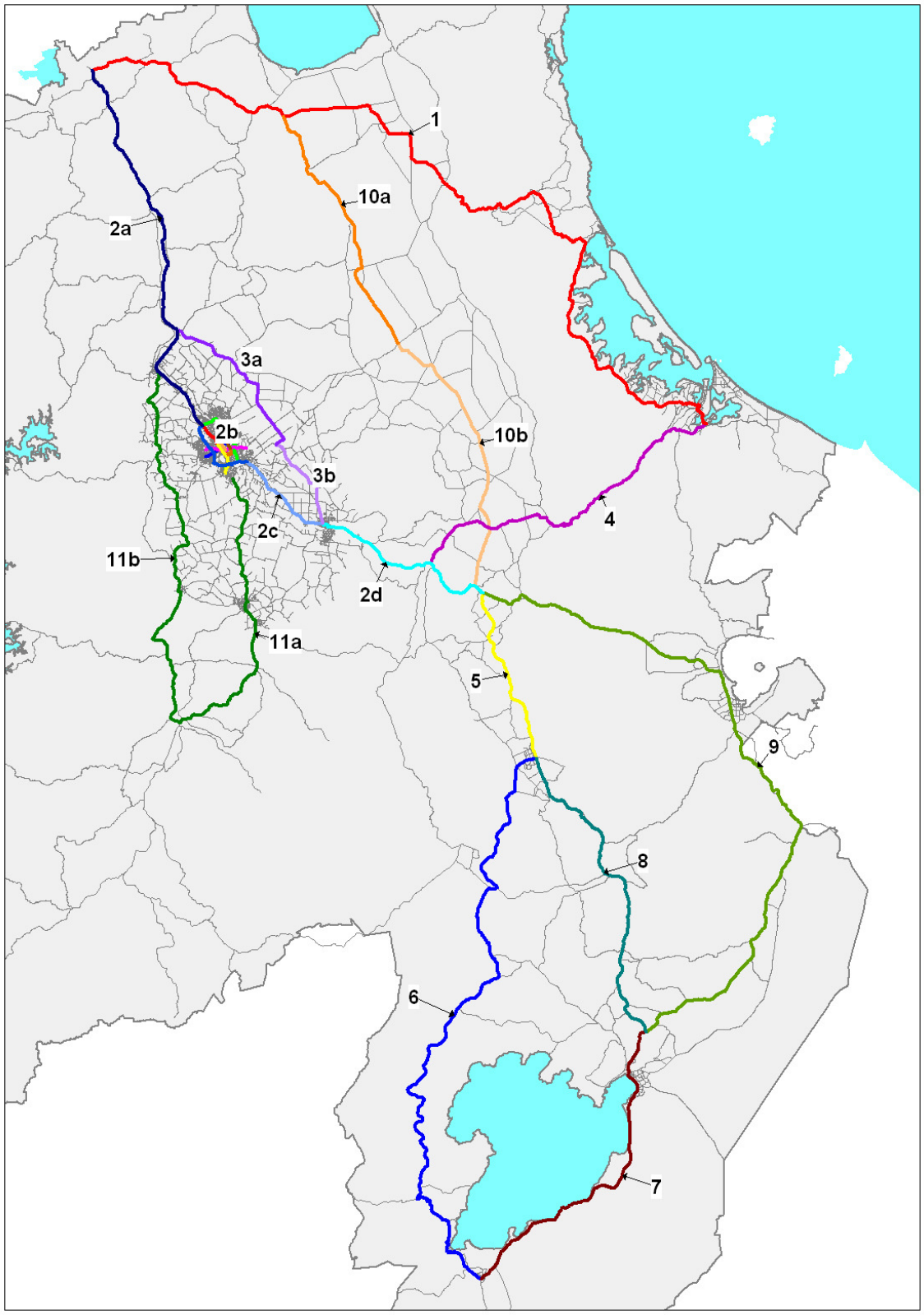
Travel time survey runs were captured in March 2008 over a four week period and include runs taken across Monday through Friday. Analysis of the raw travel time data compared the Friday travel times versus Monday through Thursday travel times for the same run and direction we found that in 17 instances the Friday had a greater travel time and in 16 instances it had a lesser travel time. As such Friday data was considered to reflect average conditions. Travel time results published in 'Hamilton Congestion Monitoring Pilot Study' (May 2009) by Beca Infrastructure support this findings, with Friday results not being consistently higher or lower then other weekdays.

Further analysis of the travel time data, considered the level of variability in travel times within the two hour morning peak period of 7:00am to 9:00am. It is evident that the urban runs which commenced between 7:00 and 7:30am were 15-20% shorter than those which commenced after 7:30am, however given that the assigned periods are two hour models it was appropriate that the survey result represent the two hour average which is the case in the analysis included in this report.

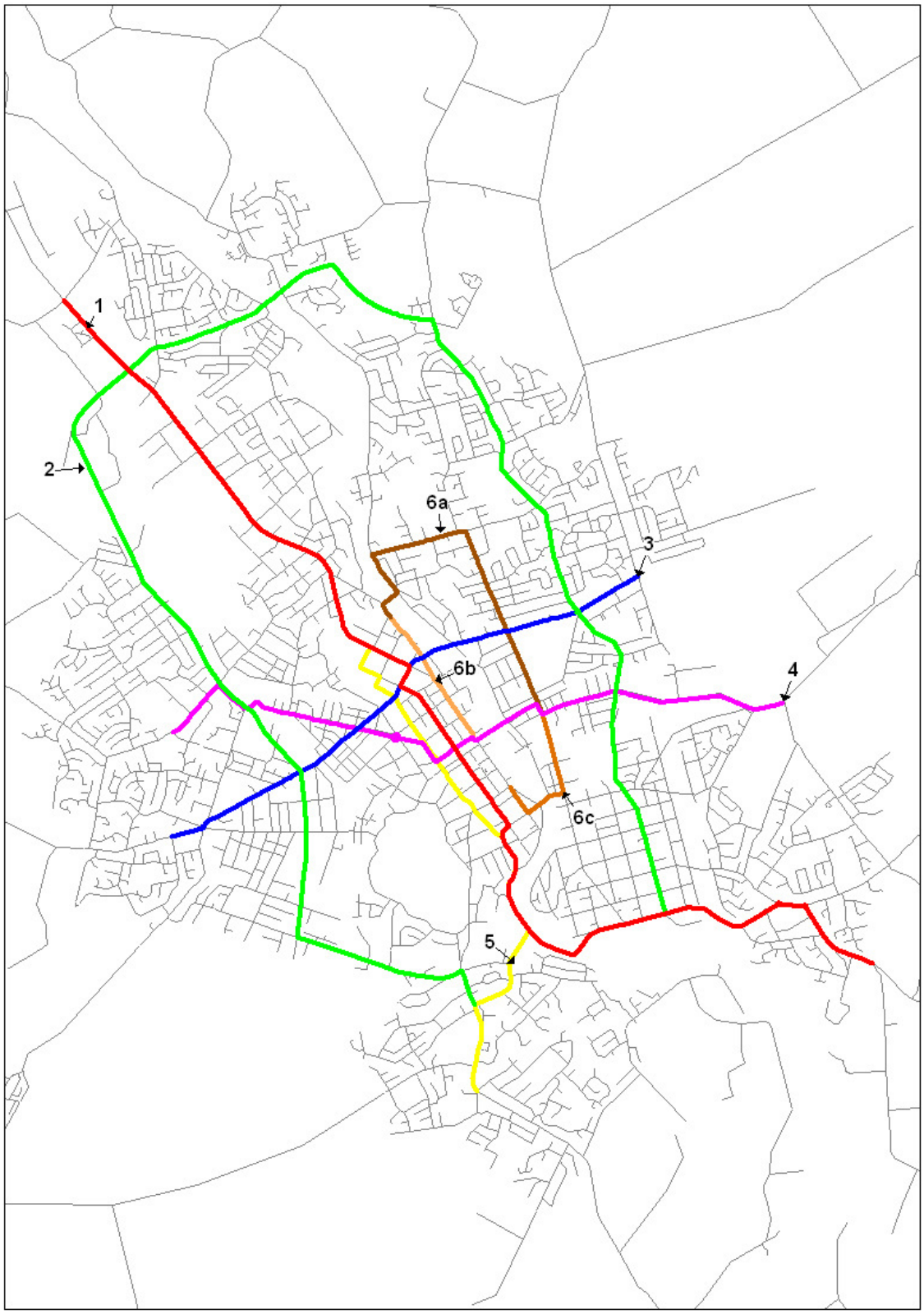
Checks have been undertaken to compare the variability in travel time runs in urban areas between peak periods. Regional route 7 passes through Taupo and the Taupo urban area component corresponds with route 3 as reported in the "Taupo Transportation Model Validation Report" (April 2007) prepared by Gabites Porter Consultants.

The variation in this route between periods was found to be 70 seconds from the Taupo survey data collected in 2006. Given that the travel time for this route is on average 45 minutes, this variability throughout the course of the day of approximately one minute is considered to be negligible. Similarly, regional route 9 passes through Rotorua and the Rotorua urban area component corresponds with parts of routes 1B and 2 as reported in the "Rotorua Transportation Model Validation Report" (August 2007) prepared by Gabites Porter Consultants.

The variation in these routes between tidal flow and non-tidal flow direction in peak periods was found to be approx 60 seconds from the Rotorua survey data collected in 2007. Given that the travel time for this route is on average 85 minutes, this variability throughout the course of the day of approximately one minute is also considered to be negligible. Any such variations between modelled periods in Hamilton are addressed through the urban travel time surveys.



Waikato Regional Transportation Model Gabites Porter Traffic Design Group	**Regional Surveyed Travel Time Routes in Waikato Study Area (R1-R11B)**	**Figure 2**



Waikato Regional Transportation Model Gabites Porter Traffic Design Group	**Hamilton Surveyed Travel Time Routes (H1-H6c)**	**Figure 3**

6. VALIDATION AGAINST TRAFFIC COUNTS

Network Validation

Network flow comparisons are tested using a number of statistical measures. Traffic counts were grouped into cordons, or screenlines, and the following measures calculated:

- Comparisons of individual links
- Comparisons of total trips over each screenline
- Percentage difference
- Correlation coefficient
- % Root mean square
- GEH.

Guidelines for each of the above criteria were obtained from NZTA's Economic Evaluation Manual and listed in **Table 8.**

The correlation coefficient is a first order measure of the co-relation, using the formula:

$$P_{x,y} = \frac{\frac{1}{n} \Sigma (x_i - \bar{x}_i)(y_i - \bar{y}_i)}{\sigma_x \sigma_y}$$

Where:

Σ	=	Sum of…
X	=	Variable X (observed traffic)
Xi	=	The mean of variable x (observed traffic)
Y	=	Variable y (modelled traffic)
Yi	=	The mean of y (modelled traffic)
σ_x	=	The standard deviation of x (observed traffic)
σ_y	=	The standard deviation of y (modelled traffic)
n	=	Number in sample

The GEH is a form of the Chi-squared statistic that incorporates both relative and absolute errors. It is designed to be more tolerant of the large percentage differences in lower flows. The form of the statistic is:

$$GEH = \sqrt{\frac{2(m-o)^2}{m+o}}$$

Where **m** is the modelled flow and **o** is the observed count.

It should be noted that where the model assignments are other than one hour, the traffic volumes have been adjusted for GEH comparisons.

The available traffic counts have been arranged into screenlines where possible. In many cases there are roads on a screenline that have not been counted and hence these have had to be omitted. In other cases it was not been possible to create screenlines and hence the extra counts are grouped in the area in which they occur.

The locations of the screenlines and spot counts used for validation against are included in **Figure 4** and **Figure 5** (all traffic), and in **Figure 6** and **Figure 7** (heavy vehicles only).

A summary of the cordon results can be found below in **Table 9**, **Table 10** and **Table 11** for the morning, inter and evening periods respectively. Corresponding scatterplots for all links in each period are shown in **Figure 8, Figure 9** and **Figure 10**, with full cordon outputs in **Appendix Three**. Note that the heavy vehicle only cordons are reported in these tables and figures as well as the all traffic screenlines.

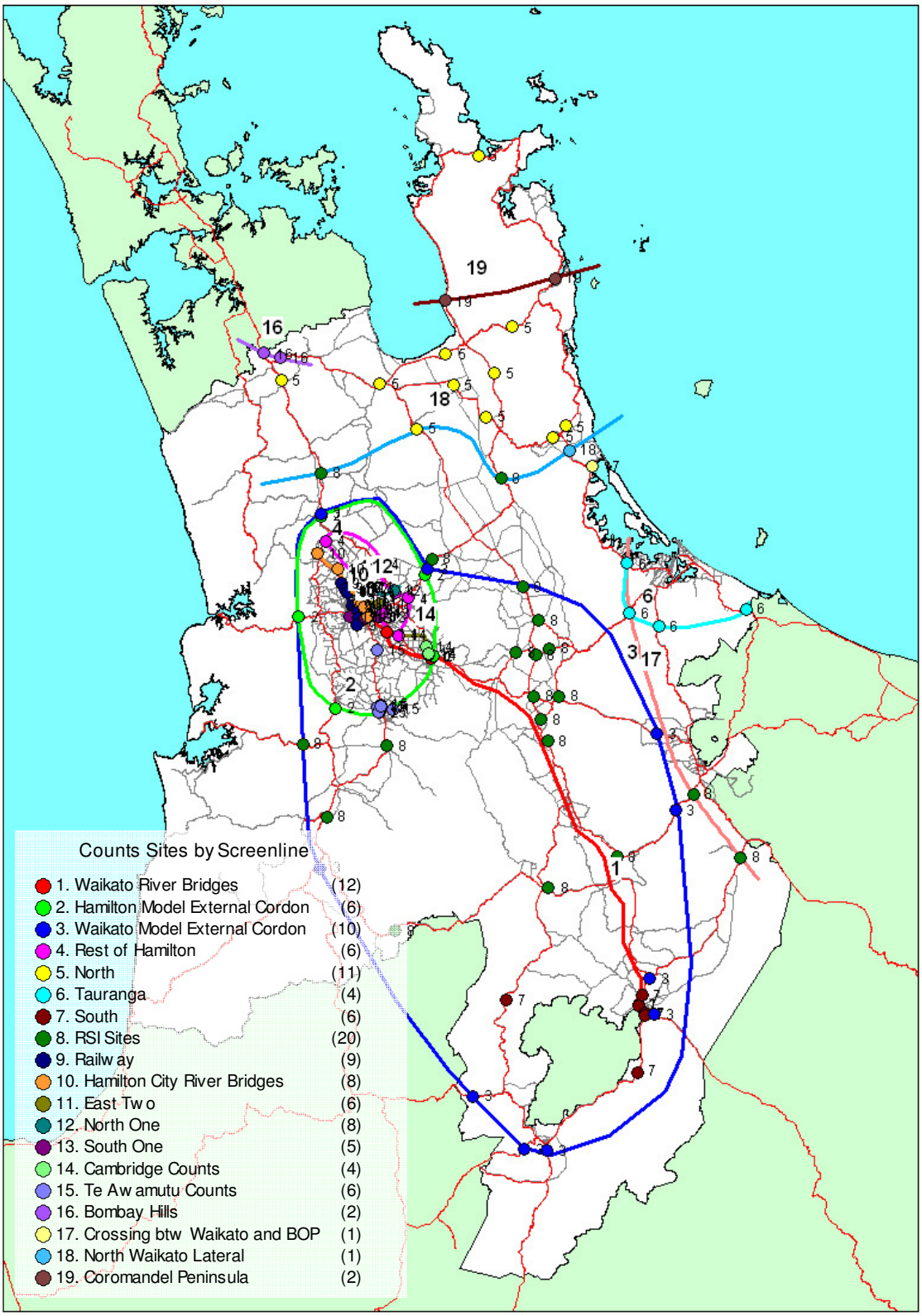
Model Traffic Flow Validation Guidelines			Table 8
Screenline Totals			
Traffic Flow	± 10%		
Correlation Coefficient	>0.85		
% RMS	<30		
GEH	<4 in most cases		
Individual Links (vpd)	**24 Hour**	**1hr Period**	
0-10,000	± 60%	± 300	
10-20,000	± 40%	± 400	
20-30,000	± 30%	± 600	
30-50,000	± 20%	± 750	
50,000 +	± 20%	± 1,000	
GEH	<5	<10	<12
(Modified for 1hr flows only)	60%	95%	100%

Validation of cordon flows was generally very good for all vehicles. Heavy goods vehicle cordon validation was also generally very good. In some instances however validation did not meet EEM criteria but these criteria are set up to reflect all vehicle validation rather than the more difficult specific vehicle trip validation. Indeed, the validation of specific vehicle types is not dealt with but the EEM unless models are of a "local" nature and required specific vehicle class validation as part of the analysis.

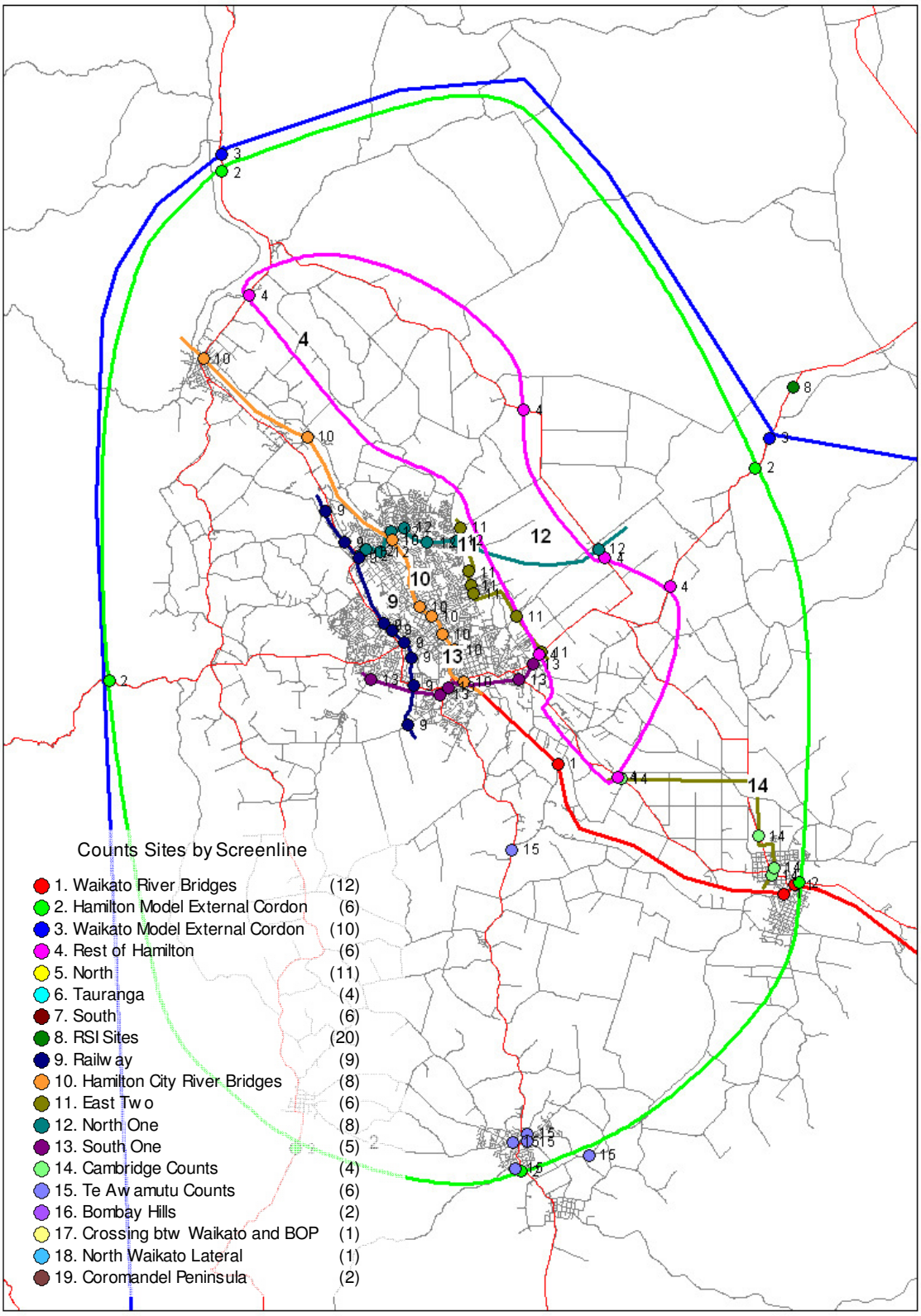
The number of heavy vehicles on many routes is low. In some instances cordons are not complete screenlines with "holes" in areas and in the case of regional areas some minor routes are not included therefore resulting in some collection of heavy vehicle flow along the routes represented in the model. For these reasons it is unreasonable to simply look at the percentage of flow variation in directional cordon totals. The All RSI cordon totals are a better representation of whether the model is correctly producing HGV movement. For individual cordons the use of the GEH would be a more appropriate indicator of fit when regarding these low vehicle numbers.

One screenline that failed to meet EEM criteria in all periods was Screenline 9 – Railway. This cordon has historically been very difficult to get the flows across it correct. It is believed that a large element of this discrepancy has to do with the sign posting of the SH route and it's use by drivers not knowing the Hamilton area well.

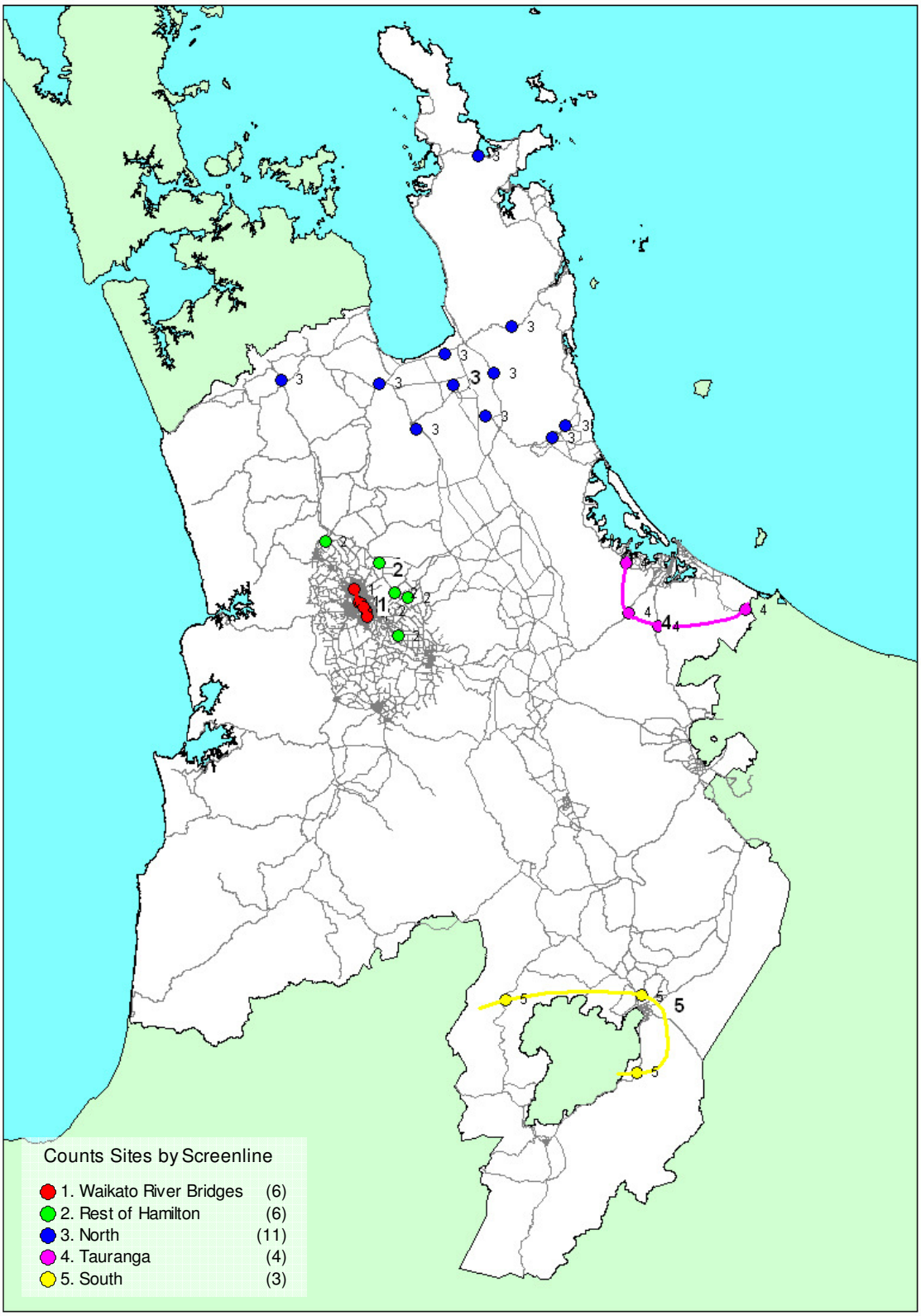
Several other individual screenlines did not meet criteria during individual periods but this may be more due to the 'holes' in the screenlines and as such represent flow within an area rather than a true screenline.



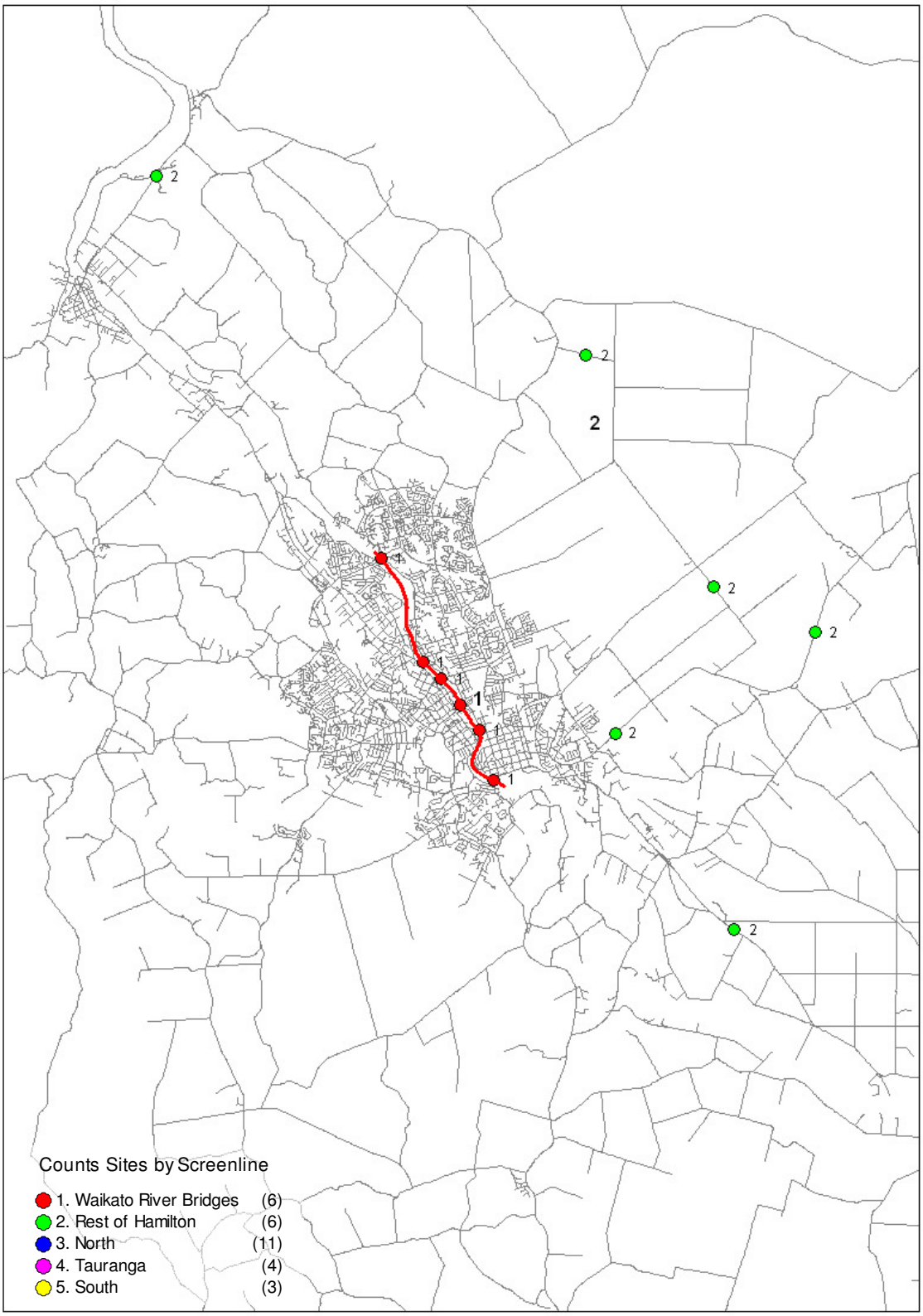
Waikato Regional Transportation Model	**Waikato Model Screenline Locations**	**Figure 4**
Gabites Porter Traffic Design Group		



Waikato Regional Transportation Model	**Waikato Model Screenline Locations Inset**	**Figure 5**
Gabites Porter Traffic Design Group		



Waikato Regional Transportation Model Gabites Porter Traffic Design Group	**Waikato Model Screenline Locations for Heavy Vehicles**	**Figure 6**



Waikato Regional Transportation Model Gabites Porter Traffic Design Group	**Waikato Model Screenline Locations for Heavy Vehicles Inset**	**Figure 7**

Morning Peak Validation

Morning Peak Network Screenline Validation			Table 9
Screenline 1 – Waikato River Bridges			
	Forward		Back
Count	17858		12497
Volume	17323		12566
Change	-535		69
%	97		101
Correlation Coefficient	.982		.982
%RMS	13.11		10.14
GEH	2.9		.4
GEH Total	1.9		
GEH Link Grouping	< 5	< 10	< 12
% in GEH Group	91.7	100	100
Screenline 2 – Hamilton Model External Cordon 2			
	Forward		Back
Count	4404		3792
Volume	4523		3561
Change	119		-231
%	103		94
Correlation Coefficient	.988		.985
%RMS	11.38		14.63
GEH	1.2		2.7
GEH Total	.9		
GEH Link Grouping	< 5	< 10	< 12
% in GEH Group	100	100	100
Screenline 3 – Hamilton Model External Cordon 3			
	Forward		Back
Count	4578		4439
Volume	4704		4543
Change	126		104
%	103		102
Correlation Coefficient	.982		.952
%RMS	20.58		33.67
GEH	1.3		1.1
GEH Total	1.7		
GEH Link Grouping	< 5	< 10	< 12
% in GEH Group	85.7	100	100
Screenline 4 – Rest of Hamilton			
	Forward		Back
Count	3265		3881
Volume	3320		3950
Change	55		69
%	102		102
Correlation Coefficient	.991		.992
%RMS	11.02		11.82
GEH	.7		.8
GEH Total	1.0		
GEH Link Grouping	< 5	< 10	< 12
% in GEH Group	100	100	100

Morning Peak Network Screenline Validation			Table 9 Cont.
Screenline 5 – North			
	Forward		Back
Count	3440		3585
Volume	3894		3660
Change	454		75
%	113		102
Correlation Coefficient	.933		.991
%RMS	32.87		18.85
GEH	5.3		.9
GEH Total	4.4		
GEH Link Grouping	< 5	< 10	< 12
% in GEH Group	63.6	100	100
Screenline 6 – Tauranga			
	Forward		Back
Count	3063		2976
Volume	3303		2719
Change	240		-257
%	108		91
Correlation Coefficient	1.000		.943
%RMS	9.31		19.17
GEH	3.0		3.4
GEH Total	.2		
GEH Link Grouping	< 5	< 10	< 12
% in GEH Group	100	100	100
Screenline 7 – South			
	Forward		Back
Count	3664		3559
Volume	3618		4237
Change	-46		678
%	99		119
Correlation Coefficient	.975		.973
%RMS	20.95		33.70
GEH	.5		7.7
GEH Total	5.1		
GEH Link Grouping	< 5	< 10	< 12
% in GEH Group	83.3	100	100
Screenline 8 – Total			
	Forward		Back
Count	39686		34135
Volume	40585		34151
Change	899		16
%	102		100
Correlation Coefficient	.988		.979
%RMS	17.29		17.92
GEH	3.2		.1
GEH Total	2.4		
GEH Link Grouping	< 5	< 10	< 12
% in GEH Group	84.6	100	100

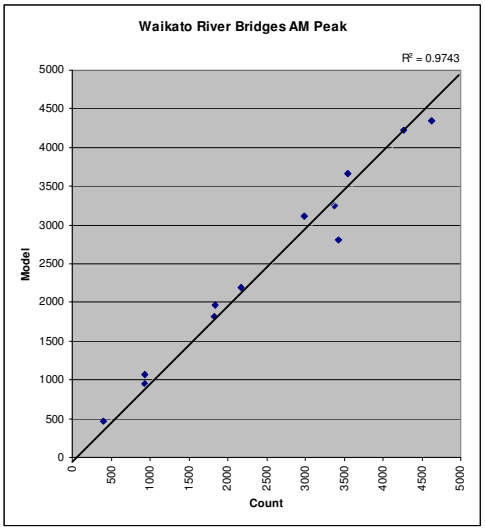
Morning Peak Network Screenline Validation			Table 9 Cont.
Screenline 9 – Railway			
	Forward		Back
Count	10580		8879
Volume	10198		8139
Change	-382		-740
%	96		94
Correlation Coefficient	.981		.906
%RMS	15.36		34.55
GEH	2.7		5.7
GEH Total	5.8		
GEH Link Grouping	< 5	< 10	< 12
% in GEH Group	66.7	88.9	88.9
Screenline 10 – Waikato River Bridges			
	Forward		Back
Count	14440		8775
Volume	14097		8991
Change	-343		216
%	98		102
Correlation Coefficient	0.980		0.988
%RMS	9.92		9.42
GEH	2.0		1.6
GEH Total	.6		
GEH Link Grouping	< 5	< 10	< 12
% in GEH Group	100	100	100
Screenline 11 – East Two			
	Forward		Back
Count	1547		2581
Volume	1502		2522
Change	-45		-59
%	97		98
Correlation Coefficient	.928		.937
%RMS	26.03		21.06
GEH	.8		.8
GEH Total	1.2		
GEH Link Grouping	< 5	< 10	< 12
% in GEH Group	83.3	100	100
Screenline 12 – North One			
	Forward		Back
Count	6133		7370
Volume	6024		7833
Change	-109		463
%	98		106
Correlation Coefficient	.930		.857
%RMS	28.91		33.64
GEH	1.0		3.7
GEH Total	2.1		
GEH Link Grouping	< 5	< 10	< 12
% in GEH Group	71.4	85.7	85.7

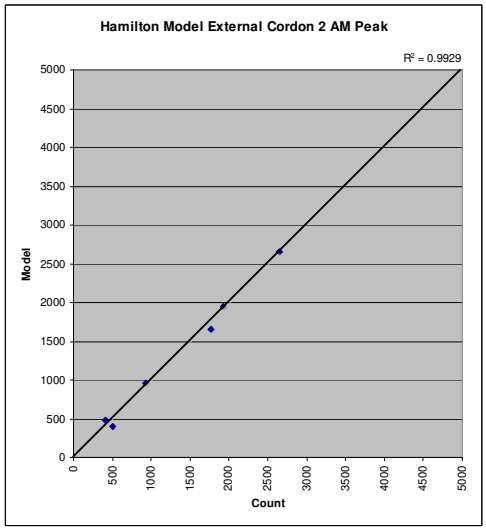
Morning Peak Network Screenline Validation			Table 9 Cont.
Screenline 13 – South One			
	Forward		Back
Count	8037		4860
Volume	8192		5127
Change	155		267
%	102		105
Correlation Coefficient	.937		.968
%RMS	25.52		23.54
GEH	1.2		2.7
GEH Total	2.6		
GEH Link Grouping	< 5	< 10	< 12
% in GEH Group	60	80	100
Screenline 14 – Cambridge Counts			
	Forward		Back
Count	3392		3558
Volume	3151		3700
Change	-241		142
%	93		104
Correlation Coefficient	.997		.995
%RMS	11.63		9.52
GEH	3.0		1.7
GEH Total	.9		
GEH Link Grouping	< 5	< 10	< 12
% in GEH Group	100	100	100
Screenline 15 – Te Awamutu Counts			
	Forward		Back
Count	3241		2784
Volume	3359		2789
Change	118		5
%	104		100
Correlation Coefficient	0.995		0.993
%RMS	11.14		13.48
GEH	1.5		.1
GEH Total	1.1		
GEH Link Grouping	< 5	< 10	< 12
% in GEH Group	100	100	100
Screenline 16 – Bombay Hills			
	Forward		Back
Count	2345		2370
Volume	2394		2526
Change	49		156
%	102		107
Correlation Coefficient	1.000		1.000
%RMS	4.18		13.16
GEH	.7		2.2
GEH Total	2.1		
GEH Link Grouping	< 5	< 10	< 12
% in GEH Group	100	100	100

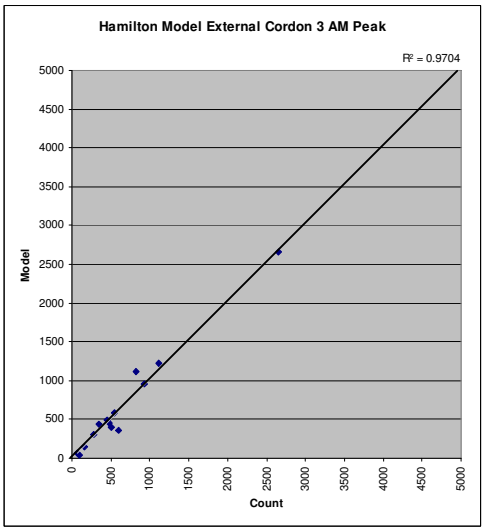
Morning Peak Network Screenline Validation			Table 9 Cont.
Screenline 17 – Crossing btw Waikato and BOP			
	Forward		Back
Count	2752		2505
Volume	2876		2409
Change	124		-96
%	105		96
Correlation Coefficient	.977		.853
%RMS	20.11		35.82
GEH	1.7		1.4
GEH Total	.3		
GEH Link Grouping	< 5	< 10	< 12
% in GEH Group	60.0	100.0	100.0
Screenline 18 – North Waikato Lateral			
	Forward		Back
Count	1790		1855
Volume	1923		1705
Change	133		-150
%	107		92
Correlation Coefficient	.937		.922
%RMS	27.73		27.74
GEH	2.2		2.5
GEH Total	.2		
GEH Link Grouping	< 5	< 10	< 12
% in GEH Group	50.0	100.0	100.0
Screenline 19 – Coromandel Peninsula			
	Forward		Back
Count	284		440
Volume	207		342
Change	-77		-98
%	73		78
Correlation Coefficient	-1.000		1.000
%RMS	60.12		38.71
GEH	3.5		3.5
GEH Total	4.9		
GEH Link Grouping	< 5	< 10	< 12
% in GEH Group	100.0	100.0	100.0

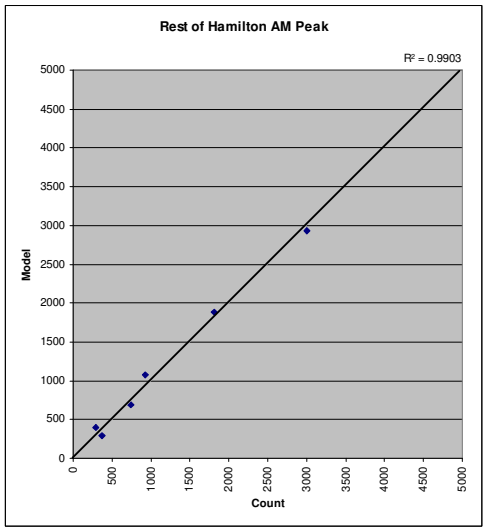
Morning Peak Network Screenline Validation			Table 9 Cont.
Screenline 1 – Waikato River Bridges (Heavy Vehicles)			
	Forward		Back
Count	418		263
Volume	347		358
Change	-71		95
%	83		136
Correlation Coefficient	.775		.831
%RMS	47.06		57.71
GEH	2.6		3.9
GEH Total	.6		
GEH Link Grouping	< 5	< 10	< 12
% in GEH Group	83.3	100	100
Screenline 2 – Rest of Hamilton (Heavy Vehicles)			
	Forward		Back
Count	335		387
Volume	403		431
Change	68		44
%	120		111
Correlation Coefficient	.953		.956
%RMS	35.22		36.32
GEH	2.5		1.5
GEH Total	2.8		
GEH Link Grouping	< 5	< 10	< 12
% in GEH Group	66.7	100	100
Screenline 3 – North (Heavy Vehicles)			
	Forward		Back
Count	567		617
Volume	568		659
Change	1		42
%	100		107
Correlation Coefficient	.954		.976
%RMS	28.78		23.68
GEH	.1		1.2
	.9		
GEH Link Grouping	< 5	< 10	< 12
% in GEH Group	100	100	100
Screenline 4 – Tauranga (Heavy Vehicles)			
	Forward		Back
Count	376		375
Volume	411		428
Change	35		53
%	109		114
Correlation Coefficient	.970		.966
%RMS	18.72		22.47
GEH	1.2		1.9
GEH Total	2.2		
GEH Link Grouping	< 5	< 10	< 12
% in GEH Group	100	100	100

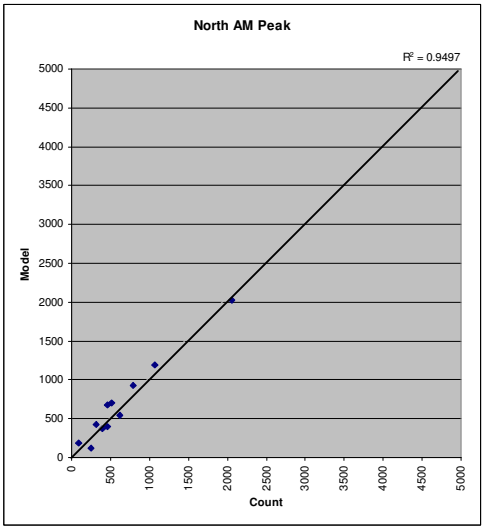
Morning Peak Network Screenline Validation			Table 9 Cont.
Screenline 5 – South (Heavy Vehicles)			
	Forward		Back
Count	126		117
Volume	83		66
Change	-43		-51
%	66		56
Correlation Coefficient	.613		.417
%RMS	77.61		101.81
GEH	3.1		3.7
GEH Total	4.8		
GEH Link Grouping	< 5	< 10	< 12
% in GEH Group	66.7	100	100
Screenline 6 – Other RSI (Heavy Vehicles)			
	Forward		Back
Count	1163		1189
Volume	1205		1136
Change	42		-53
%	104		96
Correlation Coefficient	.872		.910
%RMS	43.57		32.20
GEH	.9		1.1
GEH Total	0.2		
GEH Link Grouping	< 5	< 10	< 12
% in GEH Group	92.3	100	100
Screenline 7 – All RSI (Heavy Vehicles)			
	Forward		Back
Count	2985		2948
Volume	2990		3083
Change	5		135
%	100		105
Correlation Coefficient	.906		.918
%RMS	35.07		34.27
GEH	.1		1.7
GEH Total	1.3		
GEH Link Grouping	< 5	< 10	< 12
% in GEH Group	91.1	100	100

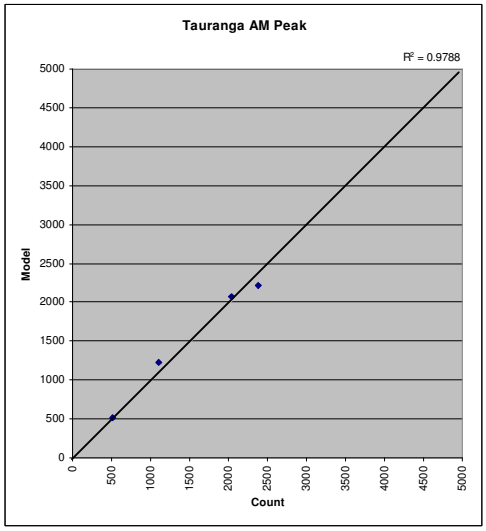




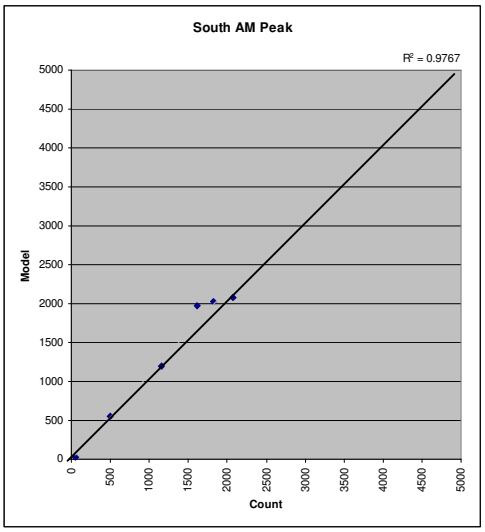


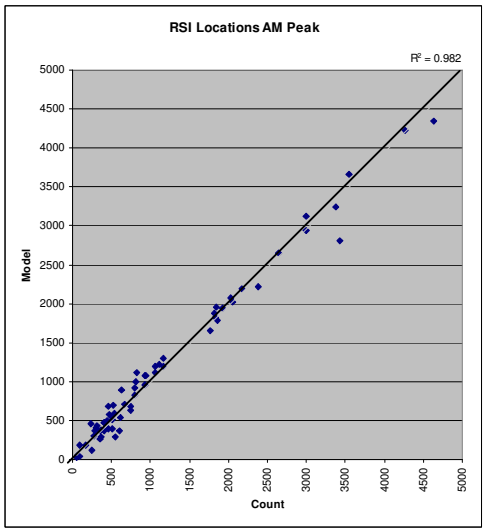


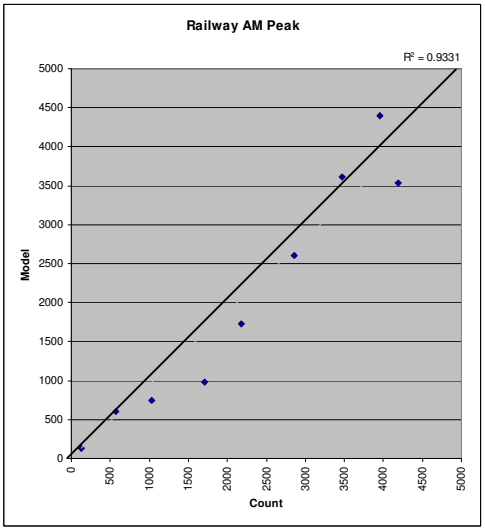


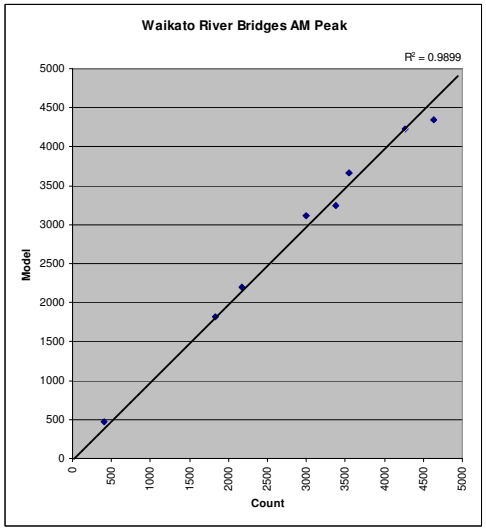


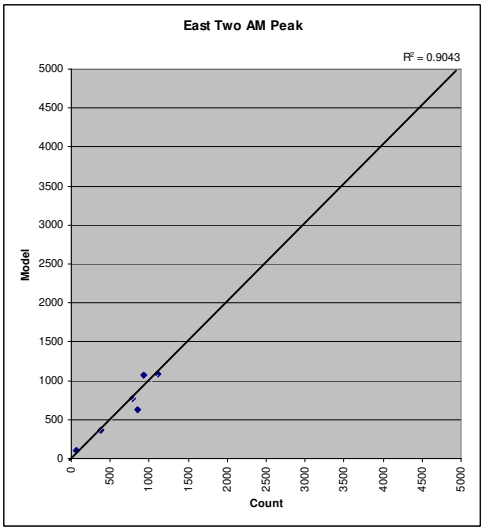
Waikato Regional Transportation Model Gabites Porter Traffic Design Group	**Morning Peak Screenline Scatterplots**	**Figure 8**

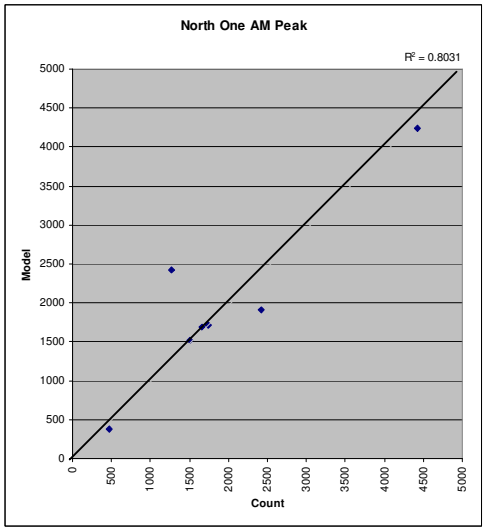




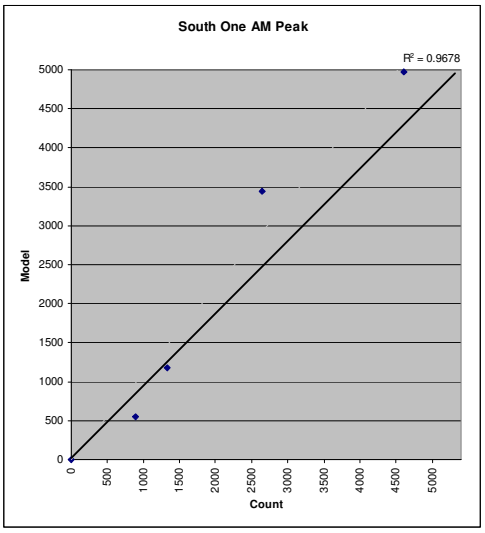


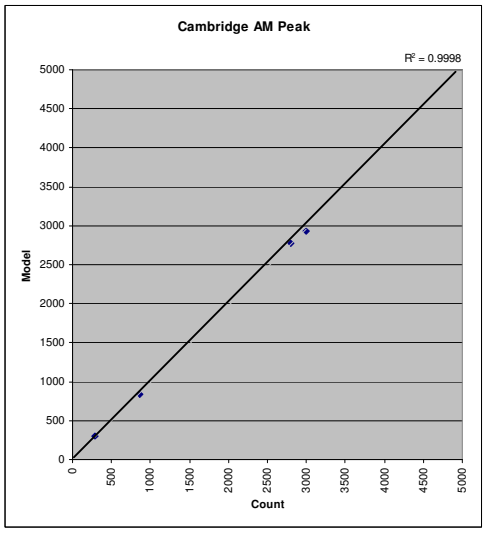


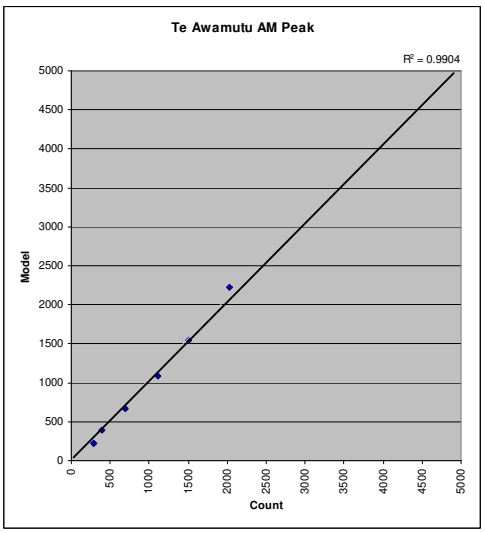


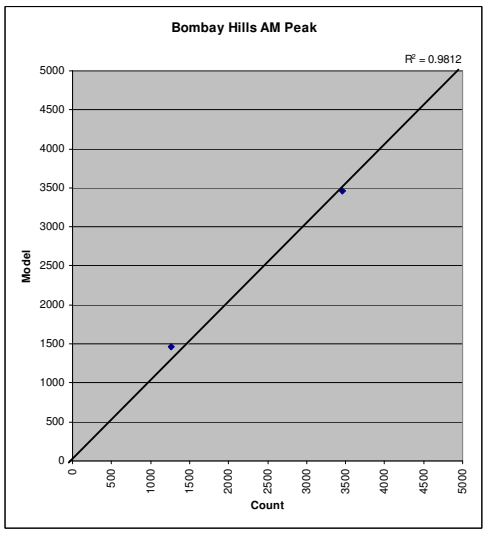


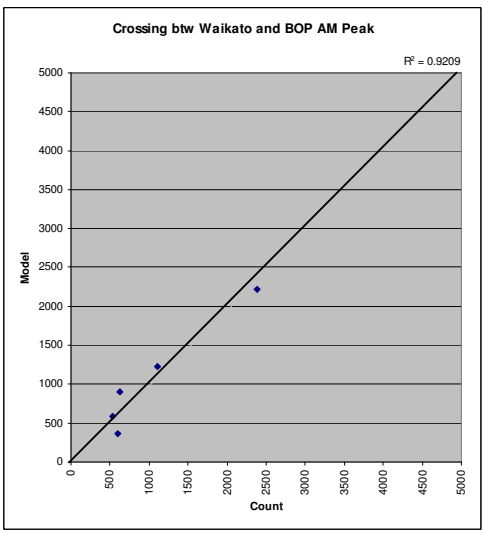
Waikato Regional Transportation Model Gabites Porter Traffic Design Group	**Morning Peak Screenline Scatterplots**	Figure 8 Cont.

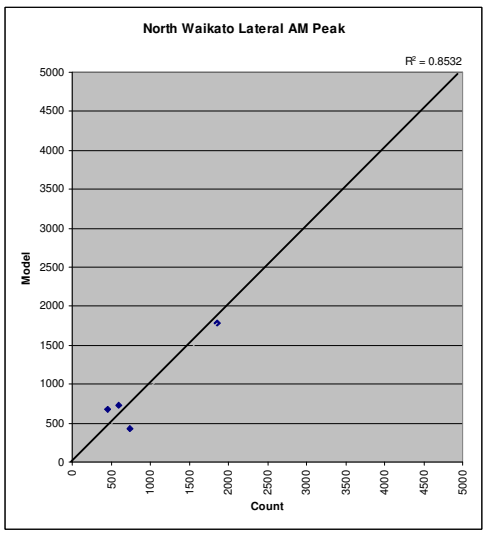




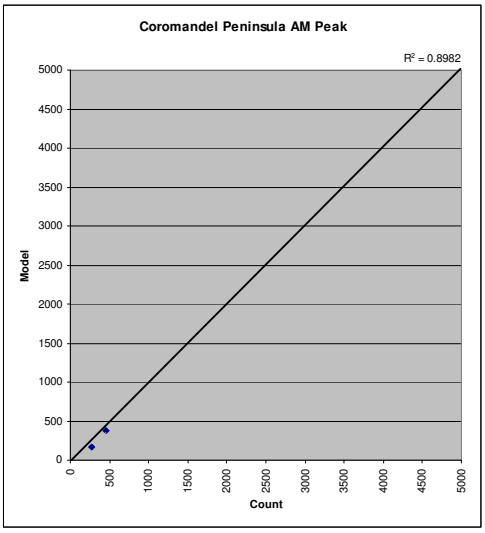


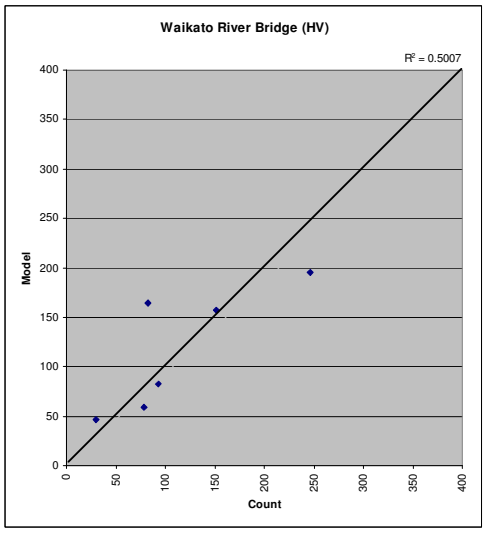


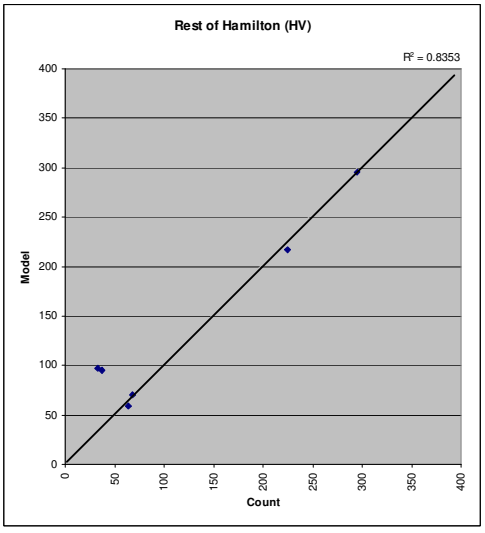


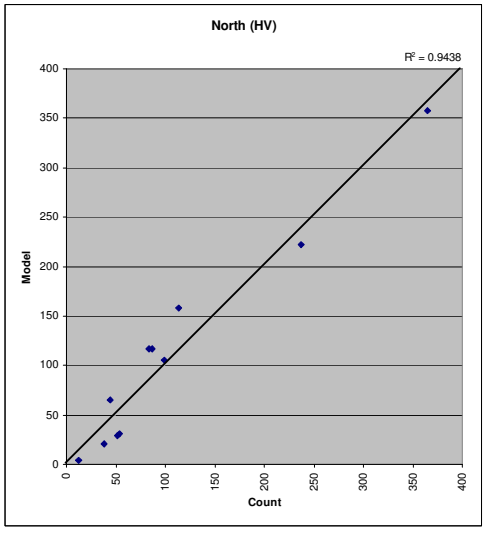


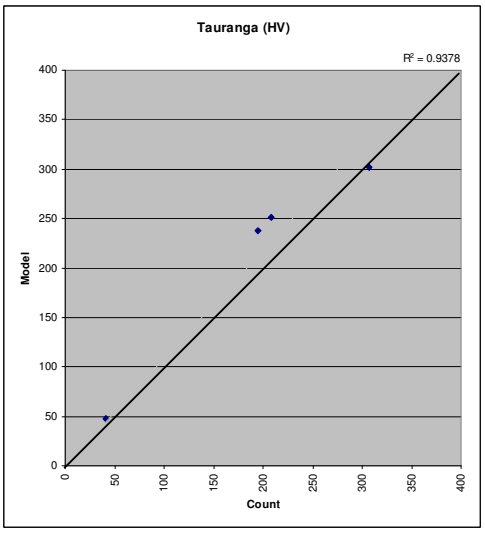
Waikato Regional Transportation Model Gabites Porter Traffic Design Group	**Morning Peak Screenline Scatterplots**	Figure 8 Cont.

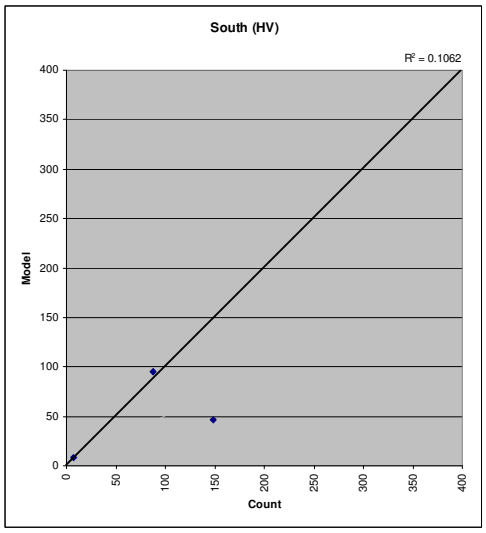




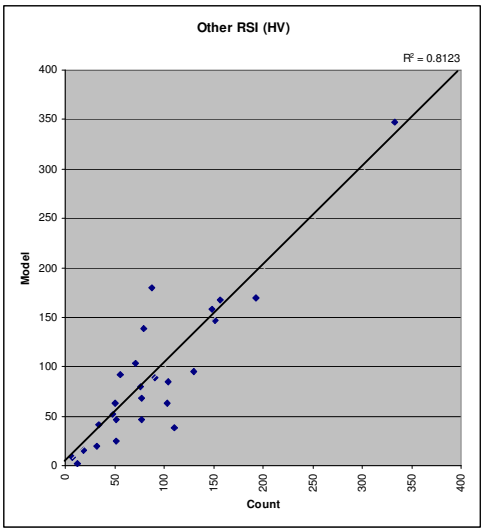


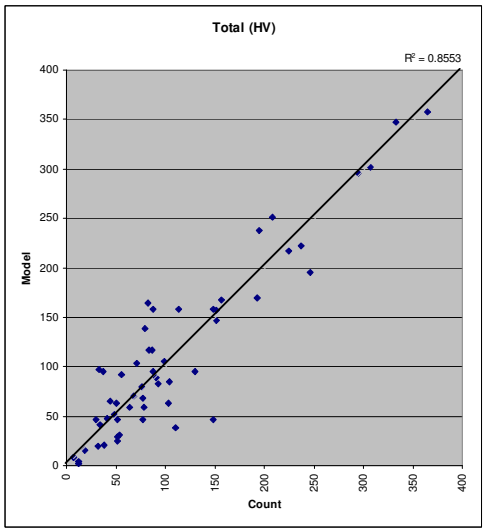






Waikato Regional Transportation Model	**Morning Peak Screenline Scatterplots**	Figure 8 Cont.
Gabites Porter Traffic Design Group		





Waikato Regional Transportation Model Gabites Porter Traffic Design Group	**Morning Peak Screenline Scatterplots**	Figure 8 Cont.

Interpeak Validation

Interpeak Network Screenline Validation			Table 10
Screenline 1 – Waikato River Bridges			
	Forward		Back
Count	12187		13306
Volume	12125		13478
Change	-692		172
%	95		101
Correlation Coefficient	.951		.980
%RMS	17.50		10.71
GEH Total	4.4		1.1
GEH Total	2.2		
GEH Link Grouping	< 5	< 10	< 12
% in GEH Group	66.7	100	100
Screenline 2 – Hamilton Model External Cordon 2			
	Forward		Back
Count	4049		3985
Volume	3959		4187
Change	-90		202
%	98		105
Correlation Coefficient	.961		.985
%RMS	19.91		14.33
GEH	1.0		2.2
GEH Total	.9		
GEH Link Grouping	< 5	< 10	< 12
% in GEH Group	100	100	100
Screenline 3 – Hamilton Model External Cordon 3			
	Forward		Back
Count	4929		5065
Volume	4931		4957
Change	2		-108
%	100		98
Correlation Coefficient	.986		.984
%RMS	21.29		21.13
GEH	.0		1.1
GEH Total	.8		
GEH Link Grouping	< 5	< 10	< 12
% in GEH Group	92.9	92.9	100
Screenline 4 – Rest of Hamilton			
	Forward		Back
Count	3057		3146
Volume	3341		3421
Change	284		275
%	109		109
Correlation Coefficient	.995		.995
%RMS	15.69		14.30
GEH	3.6		3.4
GEH Total	4.9		
GEH Link Grouping	< 5	< 10	< 12
% in GEH Group	100	100	100

Interpeak Network Screenline Validation			Table 10 Cont.
Screenline 5 – North			
	Forward		Back
Count	4061		4357
Volume	4319		4528
Change	258		171
%	106		104
Correlation Coefficient	.957		.965
%RMS	30.26		27.29
GEH	2.8		1.8
GEH Total	3.3		
GEH Link Grouping	< 5	< 10	< 12
% in GEH Group	63.6	100	100
Screenline 6 – Tauranga			
	Forward		Back
Count	2719		2685
Volume	2968		3107
Change	249		422
%	109		116
Correlation Coefficient	.990		.944
%RMS	15.05		36.13
GEH	3.3		5.5
GEH Total	6.3		
GEH Link Grouping	< 5	< 10	< 12
% in GEH Group	75.0	100	100
Screenline 7 – South			
	Forward		Back
Count	4344		4878
Volume	4373		4114
Change	29		-764
%	101		84
Correlation Coefficient	.961		.999
%RMS	17.73		20.17
GEH	.3		8.1
GEH Total	5.5		
GEH Link Grouping	< 5	< 10	< 12
% in GEH Group	83.3	100	100
Screenline 8 – Total			
	Forward		Back
Count	37253		38132
Volume	36954		38646
Change	-299		514
%	99		101
Correlation Coefficient	.968		.976
%RMS	20.44		18.99
GEH	1.1		1.9
GEH Total	.6		
GEH Link Grouping	< 5	< 10	< 12
% in GEH Group	78.3	98.6	100

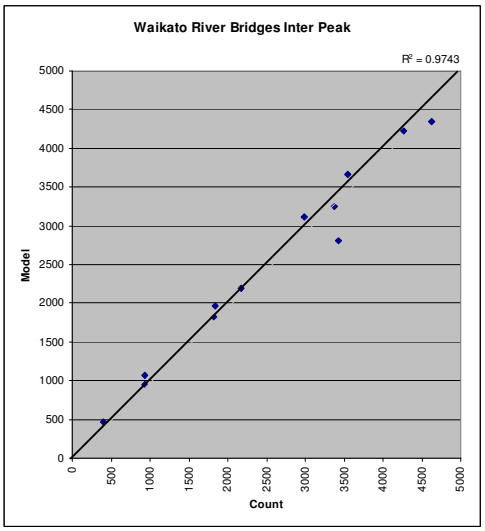
Interpeak Network Screenline Validation			Table 10 Cont.
Screenline 9 - Railway			
	Forward		Back
Count	8128		8022
Volume	7335		7097
Change	-793		-925
%	90		88
Correlation Coefficient	.972		.960
%RMS	21.73		24.94
GEH	6.4		7.5
GEH Total	9.8		
GEH Link Grouping	< 5	< 10	< 12
% in GEH Group	44.4	100	100
Screenline 10 – Waikato River Bridges			
	Forward		Back
Count	9423		9855
Volume	9005		10217
Change	-418		362
%	96		104
Correlation Coefficient	.940		.984
%RMS	16.12		9.36
GEH	3.1		2.6
GEH Total	.2		
GEH Link Grouping	< 5	< 10	< 12
% in GEH Group	75.0	100	100
Screenline 11 – East Two			
	Forward		Back
Count	1475		1532
Volume	1546		1656
Change	71		124
%	105		108
Correlation Coefficient	.918		.994
%RMS	32.35		12.84
GEH	1.3		2.2
GEH Total	2.5		
GEH Link Grouping	< 5	< 10	< 12
% in GEH Group	83.3	100	100
Screenline 12 – North One			
	Forward		Back
Count	6233		5630
Volume	5942		5290
Change	-291		-340
%	95		94
Correlation Coefficient	.984		.966
%RMS	16.44		24.45
GEH	2.6		3.3
GEH Total	4.1		
GEH Link Grouping	< 5	< 10	< 12
% in GEH Group	71.4	85.7	100

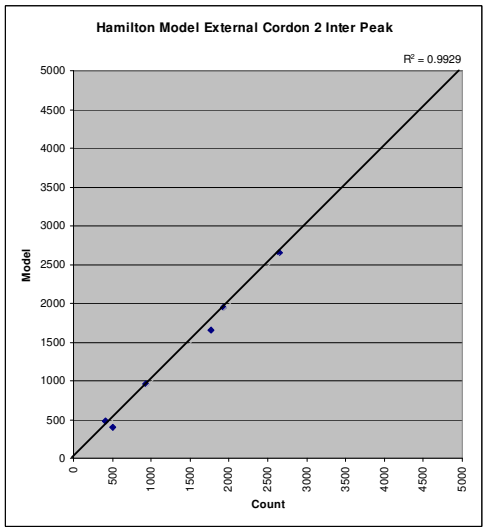
Inter Peak Network Screenline Validation			Table 10 Cont.
Screenline 13 – South One			
	Forward		Back
Count	4805		5926
Volume	5169		5646
Change	364		-280
%	108		95
Correlation Coefficient	.906		.922
%RMS	33.375		34.29
GEH	3.7		2.6
GEH Total	.6		
GEH Link Grouping	< 5	< 10	< 12
% in GEH Group	60.0	60.0	80.0
Screenline 14 – Cambridge Counts			
	Forward		Back
Count	2578		2808
Volume	2858		2853
Change	280		45
%	111		102
Correlation Coefficient	.996		.998
%RMS	15.12		6.19
GEH	3.8		.6
GEH Total	3.1		
GEH Link Grouping	< 5	< 10	< 12
% in GEH Group	100	100	100
Screenline 15 – Te Awamutu Counts			
	Forward		Back
Count	2520		2611
Volume	2676		2649
Change	156		38
%	106		101
Correlation Coefficient	.905		.892
%RMS	34.66		40.68
GEH	2.2		.5
GEH Total	1.9		
GEH Link Grouping	< 5	< 10	< 12
% in GEH Group	83.3	83.3	100
Screenline 16 – Bombay Hills			
	Forward		Back
Count	2964		3038
Volume	3037		2982
Change	73		-56
%	102		98
Correlation Coefficient	1.000		1.000
%RMS	4.93		3.69
GEH	.9		.7
GEH Total	.1		
GEH Link Grouping	< 5	< 10	< 12
% in GEH Group	100	100	100

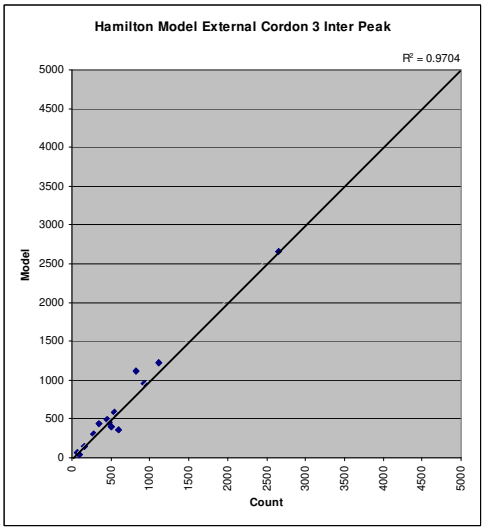
Inter Peak Network Screenline Validation			Table 10 Cont.
Screenline 17 - Crossing btw Waikato and BOP			
	Forward		Back
Count	2543		2505
Volume	2715		2829
Change	172		324
%	107		113
Correlation Coefficient	.994		.979
%RMS	18.77		42.31
GEH	2.4		4.4
GEH Total	4.8		
GEH Link Grouping	< 5	< 10	< 12
% in GEH Group	80.0	100	100
Screenline 18 – North Waikato Lateral			
	Forward		Back
Count	2055		2072
Volume	2214		2181
Change	159		109
%	108		105
Correlation Coefficient	.987		.988
%RMS	22.46		18.69
GEH	2.4		1.7
GEH Total	2.9		
GEH Link Grouping	< 5	< 10	< 12
% in GEH Group	75.0	100	100
Screenline 19 – Coromandel Peninsula			
	Forward		Back
Count	466		435
Volume	403		484
Change	-63		49
%	86		111
Correlation Coefficient	1.000		1.000
%RMS	40.86		23.95
GEH	2.2		1.7
GEH Total	.3		
GEH Link Grouping	< 5	< 10	< 12
% in GEH Group	100	100	100

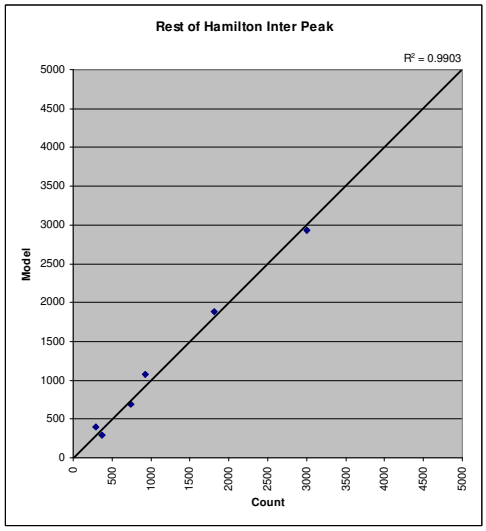
Inter Peak Network Screenline Validation			Table 10 Cont.
Screenline 1 – Waikato River Bridges (Heavy Vehicles)			
	Forward		Back
Count	291		310
Volume	395		394
Change	104		84
%	136		127
Correlation Coefficient	.667		.794
%RMS	69.26		53.34
GEH	4.0		3.2
GEH Total	5.0		
GEH Link Grouping	< 5	< 10	< 12
% in GEH Group	83.3	100	100
Screenline 2 – Rest of Hamilton (Heavy Vehicles)			
	Forward		Back
Count	356		409
Volume	435		462
Change	79		53
%	122		113
Correlation Coefficient	.969		.960
%RMS	33.09		32.82
GEH	2.8		1.8
GEH Total	3.2		
GEH Link Grouping	< 5	< 10	< 12
% in GEH Group	66.7	100	100
Screenline 3 – North (Heavy Vehicles)			
	Forward		Back
Count	650		723
Volume	605		659
Change	-45		-64
%	93		91
Correlation Coefficient	.961		.962
%RMS	25.38		26.37
GEH	1.3		1.7
GEH Total	2.1		
GEH Link Grouping	< 5	< 10	< 12
% in GEH Group	100	100	100
Screenline 4 – Tauranga (Heavy Vehicles)			
	Forward		Back
Count	364		396
Volume	478		508
Change	114		112
%	131		128
Correlation Coefficient	0.986		0.993
%RMS	39.53		35.02
GEH	3.9		3.7
GEH Total	5.4		
GEH Link Grouping	< 5	< 10	< 12
% in GEH Group	100	100	100

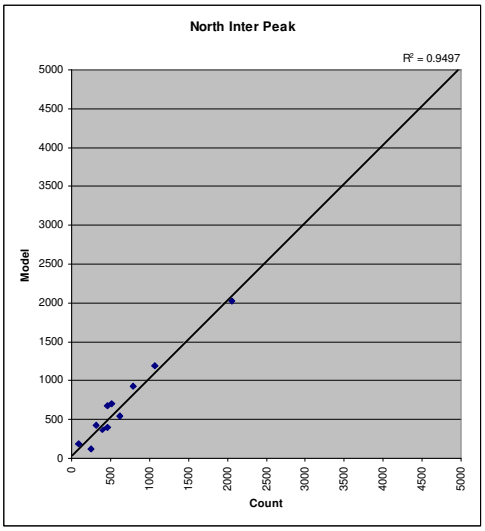
Inter Peak Network Screenline Validation			Table 10 Cont.
Screenline 5 – South (Heavy Vehicles)			
	Forward		Back
Count	128		160
Volume	110		104
Change	-18		-56
%	86		65
Correlation Coefficient	.450		.499
%RMS	91.53		88.32
GEH	1.2		3.4
GEH Total	3.3		
GEH Link Grouping	< 5	< 10	< 12
% in GEH Group	66.7	100	100
Screenline 6 – All RSI (Heavy Vehicles)			
	Forward		Back
Count	3106		3368
Volume	3279		3355
Change	173		-13
%	106		100
Correlation Coefficient	.910		.914
%RMS	35.64		33.39
GEH	2.2		.2
GEH Total	1.4		
GEH Link Grouping	< 5	< 10	< 12
% in GEH Group	89.1	100	100

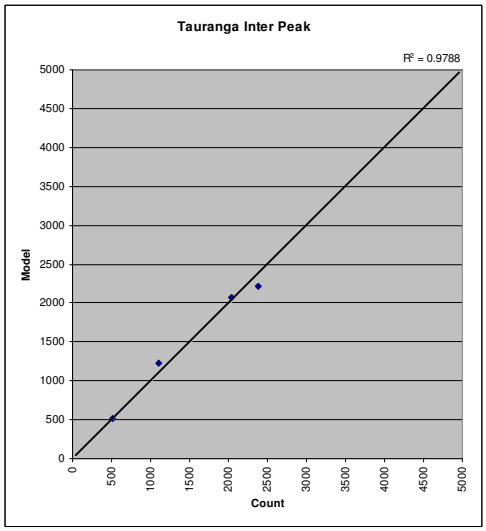




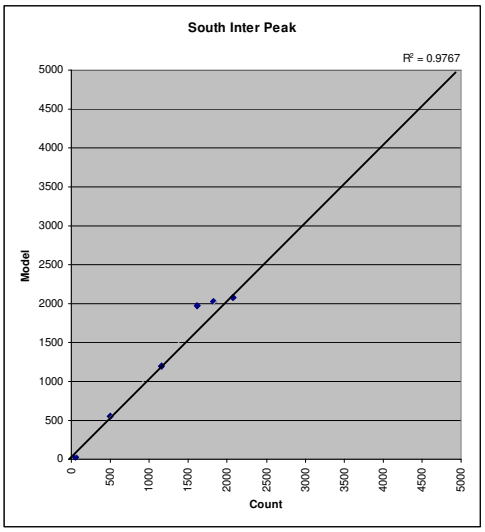


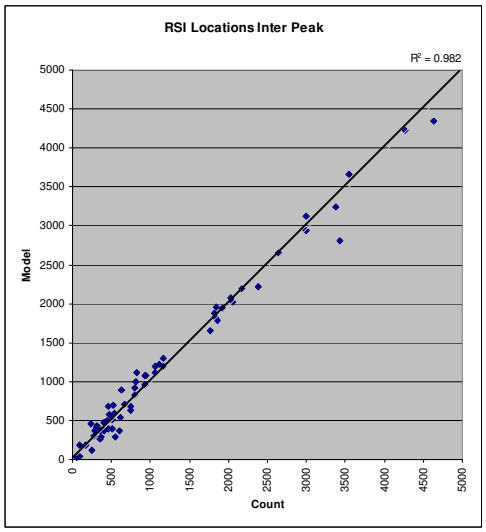


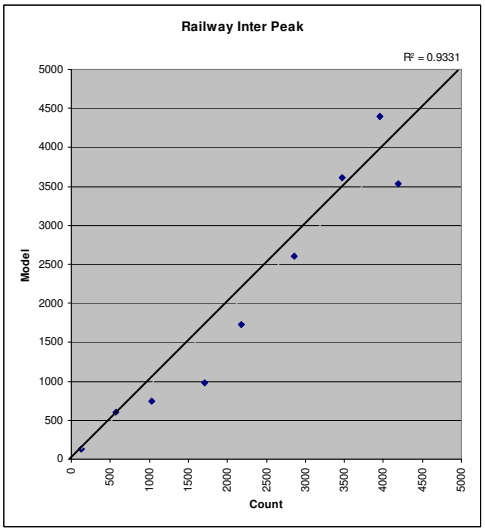


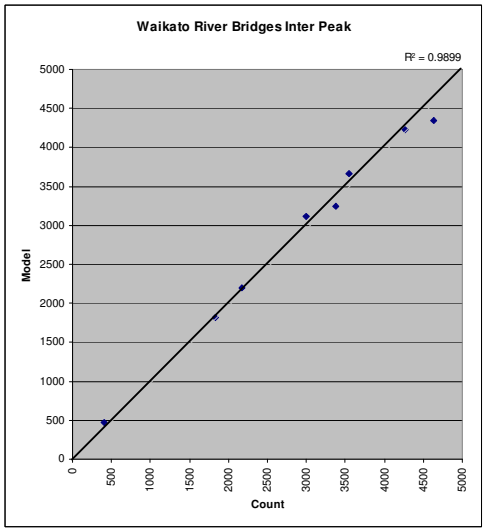


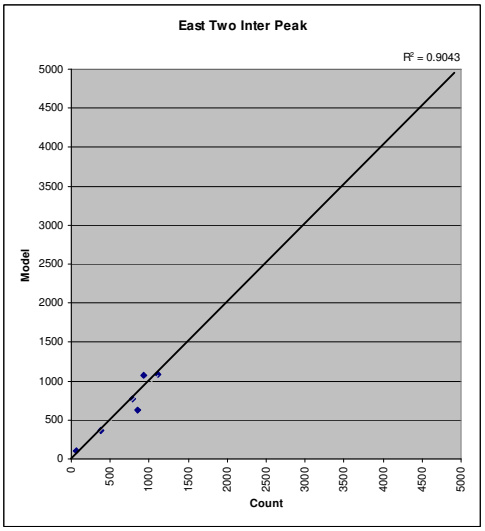
Waikato Regional Transportation Model	**Interpeak Screenline Scatterplots**	**Figure 9**
Gabites Porter Traffic Design Group		

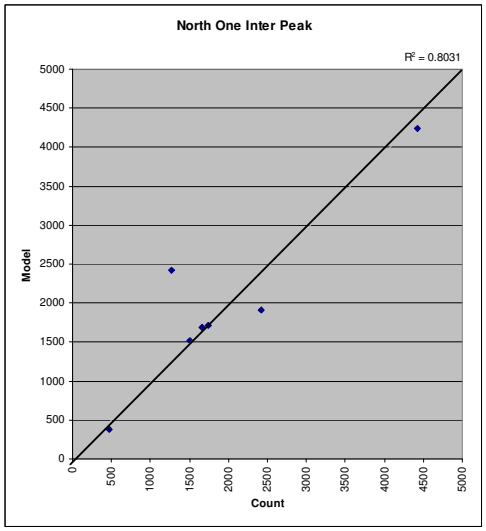




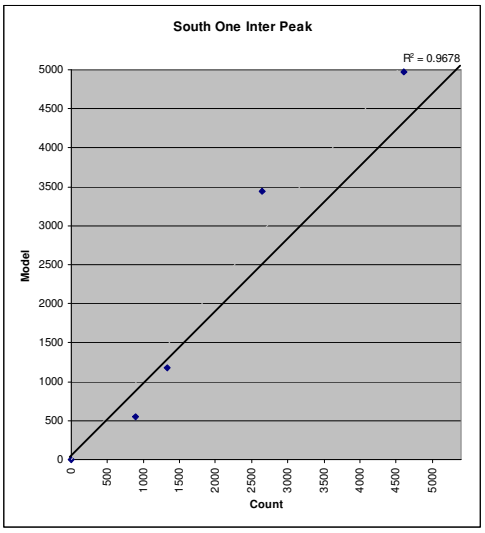


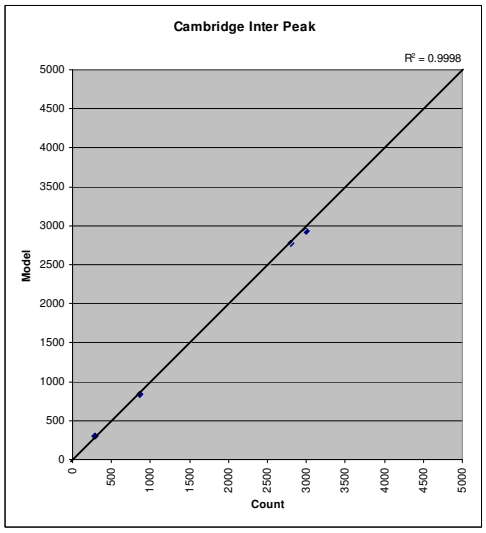


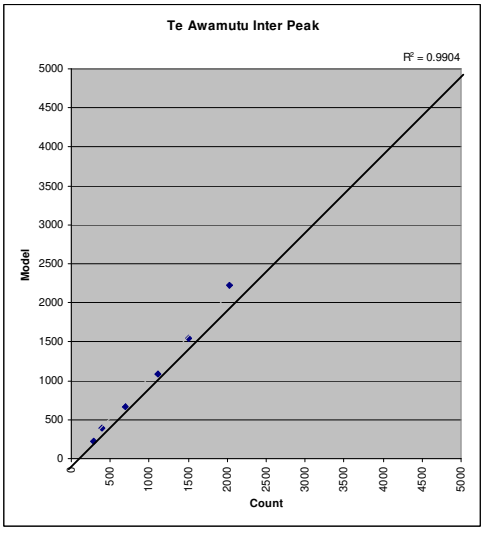


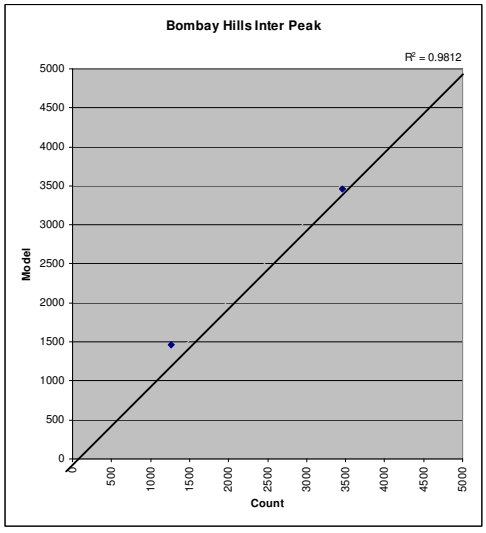


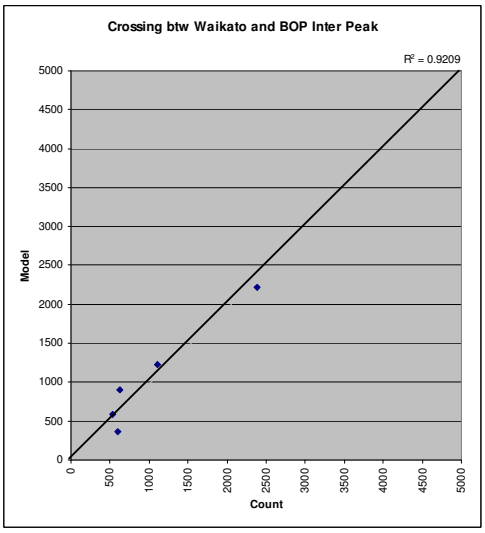
Waikato Regional Transportation Model	**Interpeak Screenline Scatterplots**	Figure 9 Cont.
Gabites Porter Traffic Design Group		

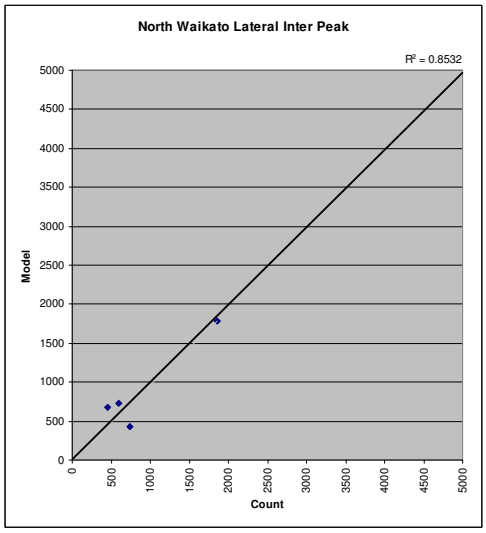




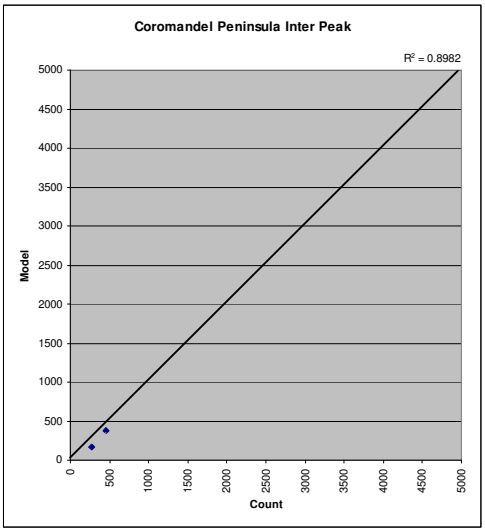


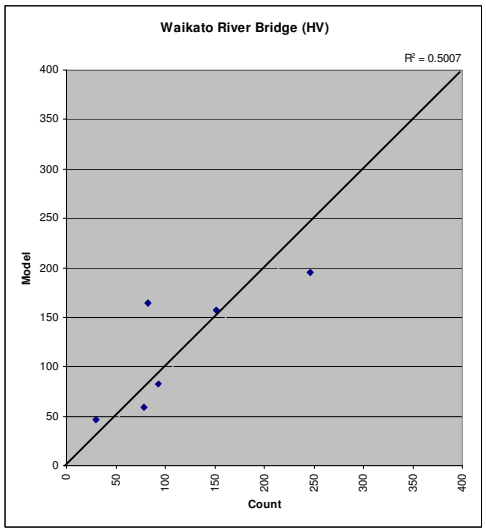


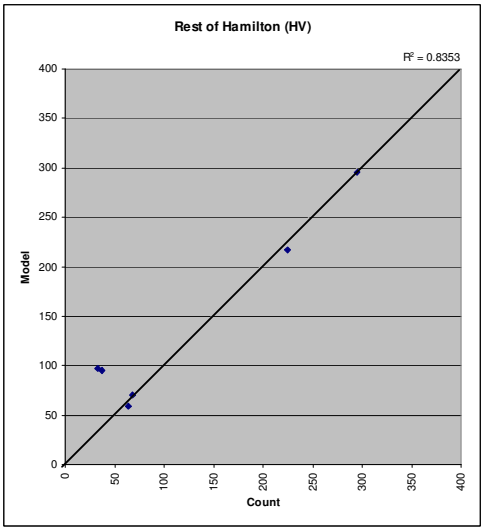


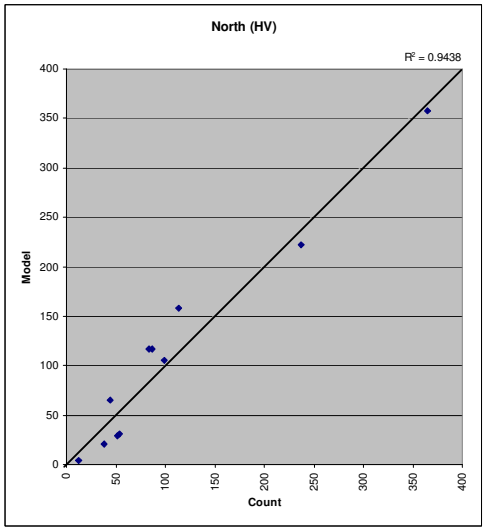


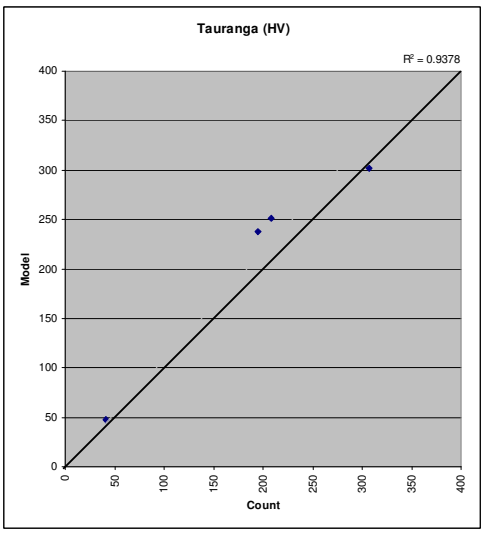
Waikato Regional Transportation Model Gabites Porter Traffic Design Group	**Interpeak Screenline Scatterplots**	Figure 9 Cont.

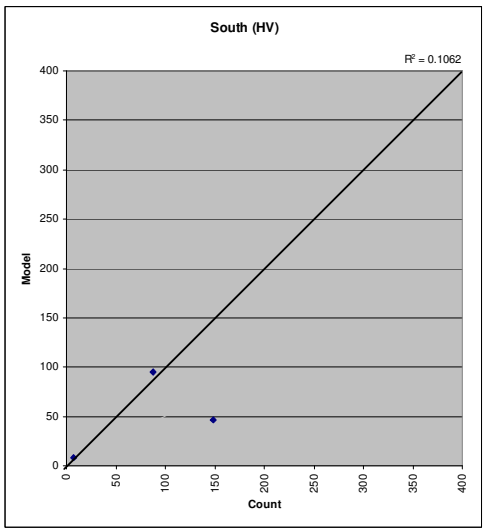




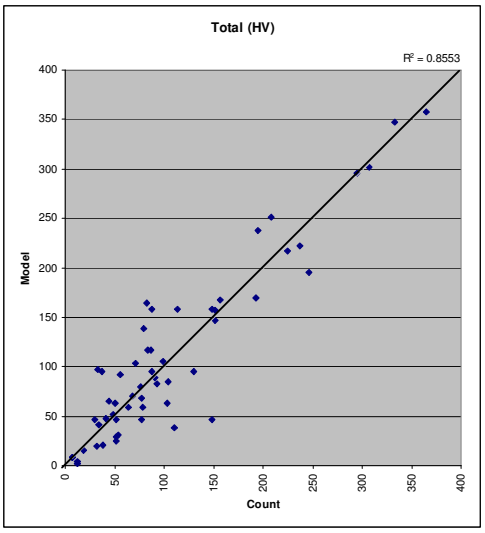








Waikato Regional Transportation Model	**Interpeak Screenline Scatterplots**	Figure 9 Cont.
Gabites Porter Traffic Design Group		



Waikato Regional Transportation Model Gabites Porter Traffic Design Group	**Interpeak Screenline Scatterplots**	Figure 9 Cont.

Evening Peak Validation

Evening Peak Network Screenline Validation			Table 11
Screenline 1 – Waikato River Bridges			
	Forward		Back
Count	15701		19654
Volume	14819		20708
Change	-882		1054
%	94		105
Correlation Coefficient	.968		.965
%RMS	13.66		17.20
GEH	5.0		5.2
GEH Total	.6		
GEH Link Grouping	< 5	< 10	< 12
% in GEH Group	91.7	100	100
Screenline 2 – Hamilton Model External Cordon 2			
	Forward		Back
Count	4553		5273
Volume	4441		5435
Change	-112		162
%	98		103
Correlation Coefficient	.985		.993
%RMS	12.88		8.55
GEH	1.2		1.6
GEH Total	.4		
GEH Link Grouping	< 5	< 10	< 12
% in GEH Group	100	100	100
Screenline 3 – Hamilton Model External Cordon 3			
	Forward		Back
Count	5924		6057
Volume	6429		6140
Change	505		83
%	109		101
Correlation Coefficient	.944		.990
%RMS	41.49		14.906
GEH	4.5		0.8
GEH Total	3.7		
GEH Link Grouping	< 5	< 10	< 12
% in GEH Group	78.6	92.9	100
Screenline 4 – Rest of Hamilton			
	Forward		Back
Count	4666		3923
Volume	4323		4046
Change	-343		123
%	93		103
Correlation Coefficient	.994		.995
%RMS	13.56		9.71
GEH	3.6		1.4
GEH Total	1.7		
GEH Link Grouping	< 5	< 10	< 12
% in GEH Group	100	100	100

Evening Peak Network Screenline Validation			Table 11 Cont.
Screenline 5 – North			
	Forward		Back
Count	5005		4548
Volume	5055		5087
Change	50		339
%	101		112
Correlation Coefficient	.979		.978
%RMS	24.037		23.93
GEH	0.5		5.5
GEH Total	4.2		
GEH Link Grouping	< 5	< 10	< 12
% in GEH Group	81.8	100	100
Screenline 6 – Tauranga			
	Forward		Back
Count	3489		4051
Volume	3632		4327
Change	143		276
%	104		107
Correlation Coefficient	.719		.972
%RMS	40.59		20.26
GEH	1.7		3.0
GEH Total	3.4		
GEH Link Grouping	< 5	< 10	< 12
% in GEH Group	75	100	100
Screenline 7 – South			
	Forward		Back
Count	5454		5153
Volume	5633		4876
Change	179		-277
%	103		95
Correlation Coefficient	.979		.991
%RMS	16.95		11.50
GEH	1.7		2.8
GEH Total	.6		
GEH Link Grouping	< 5	< 10	< 12
% in GEH Group	100	100	100
Screenline 8 – Total			
	Forward		Back
Count	44446		48427
Volume	43855		50922
Change	-591		2495
%	99		105
Correlation Coefficient	.962		.982
%RMS	22.51		19.76
GEH	2.0		7.9
GEH Total	4.4		
GEH Link Grouping	< 5	< 10	< 12
% in GEH Group	83.3	100	100

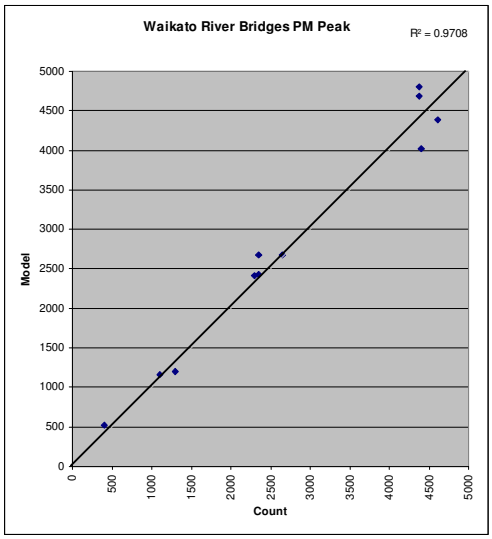
Evening Peak Network Screenline Validation			Table 11 Cont.
Screenline 9 – Railway			
	Forward		Back
Count	10368		11603
Volume	10671		10893
Change	303		-710
%	103		94
Correlation Coefficient	.852		.944
%RMS	37.21		21.67
GEH	2.1		4.7
GEH Total	2.0		
GEH Link Grouping	< 5	< 10	< 12
% in GEH Group	55.6	77.8	77.8
Screenline 10 – Waikato River Bridges			
	Forward		Back
Count	11018		15231
Volume	10638		16362
Change	-380		1131
%	97		107
Correlation Coefficient	.989		.951
%RMS	8.68		18.17
GEH	2.6		6.4
GEH Total	3.3		
GEH Link Grouping	< 5	< 10	< 12
% in GEH Group	100	100	100
Screenline 11 – East Two			
	Forward		Back
Count	2213		2451
Volume	2179		2211
Change	-34		-240
%	98		90
Correlation Coefficient	.988		.988
%RMS	17.08		15.15
GEH	.5		3.5
GEH Total	2.9		
GEH Link Grouping	< 5	< 10	< 12
% in GEH Group	100	100	100
Screenline 12 – North One			
	Forward		Back
Count	8937		7339
Volume	9093		6613
Change	156		-726
%	102		90
Correlation Coefficient	.977		.979
%RMS	18.74		20.63
GEH	1.2		6.1
GEH Total	3.2		
GEH Link Grouping	< 5	< 10	< 12
% in GEH Group	85.7	100	100

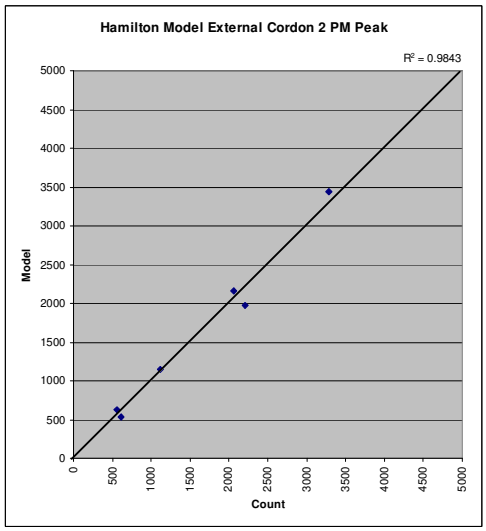
Evening Peak Network Screenline Validation			Table 11 Cont.
Screenline 13 – South One			
	Forward		Back
Count	6182		8747
Volume	5978		8882
Change	-204		135
%	97		102
Correlation Coefficient	.962		.975
%RMS	19.50		17.34
GEH	1.8		1.0
GEH Total	.4		
GEH Link Grouping	< 5	< 10	< 12
% in GEH Group	100	100	100
Screenline 14 – Cambridge Counts			
	Forward		Back
Count	4069		3703
Volume	3874		3526
Change	-195		-177
%	95		95
Correlation Coefficient	.995		.979
%RMS	9.94		16.99
GEH	2.2		2.1
GEH Total	3.0		
GEH Link Grouping	< 5	< 10	< 12
% in GEH Group	75	100	100
Screenline 15 – Te Awamutu Counts			
	Forward		Back
Count	3429		3729
Volume	3396		3987
Change	-33		258
%	99		107
Correlation Coefficient	.980		.986
%RMS	17.90		23.72
GEH	.4		2.9
GEH Total	1.9		
GEH Link Grouping	< 5	< 10	< 12
% in GEH Group	83.3	100	100
Screenline 16 – Bombay Hills			
	Forward		Back
Count	3635		3697
Volume	3875		3772
Change	240		75
%	107		102
Correlation Coefficient	1.000		1.000
%RMS	13.20		4.06
GEH	2.8		.9
GEH Total	2.6		
GEH Link Grouping	< 5	< 10	< 12
% in GEH Group	100	100	100

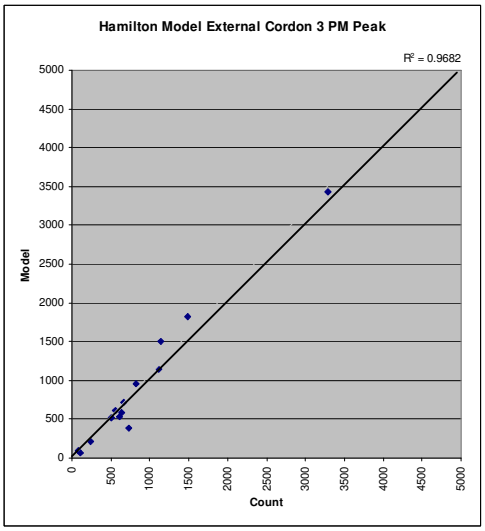
Evening Peak Network Screenline Validation			Table 11 Cont
Screenline 17 - Crossing btw Waikato and BOP			
	Forward		Back
Count	3210		3560
Volume	3434		3734
Change	224		174
%	107		105
Correlation Coefficient	.792		.996
%RMS	40.38		17.80
GEH	2.7		2.0
GEH Total	3.4		
GEH Link Grouping	< 5	< 10	< 12
% in GEH Group	80	100	100
Screenline 18 – North Waikato Lateral			
	Forward		Back
Count	2558		2391
Volume	2382		2589
Change	-176		198
%	93		108
Correlation Coefficient	.966		.928
%RMS	19.99		33.51
GEH	2.5		2.8
GEH Total	.2		
GEH Link Grouping	< 5	< 10	< 12
% in GEH Group	50	100	100
Screenline 19 – Coromandel Peninsula			
	Forward		Back
Count	577		430
Volume	598		341
Change	21		-89
%	104		79
Correlation Coefficient	1.000		1.000
%RMS	10.86		29.27
GEH	.6		3.2
GEH Total	1.5		
GEH Link Grouping	< 5	< 10	< 12
% in GEH Group	100	100	100

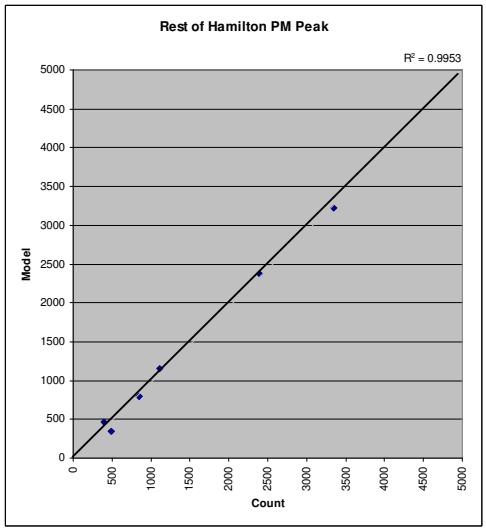
Evening Peak Network Screenline Validation			Table 11 Cont.
Screenline 1 – Waikato River Bridges (Heavy Vehicles)			
	Forward		Back
Count	333		494
Volume	302		290
Change	-31		-204
%	91		59
Correlation Coefficient	.767		.884
%RMS	46.35		59.21
GEH	1.2		7.3
GEH Total	6.2		
GEH Link Grouping	< 5	< 10	< 12
% in GEH Group	83.3	100	100
Screenline 2 – Rest of Hamilton (Heavy Vehicles)			
	Forward		Back
Count	318		333
Volume	407		400
Change	89		67
%	128		120
Correlation Coefficient	.939		.878
%RMS	43.74		45.48
GEH	3.3		2.5
GEH Total	4.1		
GEH Link Grouping	< 5	< 10	< 12
% in GEH Group	66.7	100	100
Screenline 3 – North (Heavy Vehicles)			
	Forward		Back
Count	556		513
Volume	633		596
Change	77		83
%	114		116
Correlation Coefficient	.969		.975
%RMS	36.25		31.12
GEH	2.2		2.5
GEH Total	3.3		
GEH Link Grouping	< 5	< 10	< 12
% in GEH Group	100	100	100
Screenline 4 – Tauranga (Heavy Vehicles)			
	Forward		Back
Count	299		328
Volume	377		389
Change	78		61
%	126		119
Correlation Coefficient	.898		.976
%RMS	42.54		26.34
GEH	3.0		2.2
GEH Total	3.8		
GEH Link Grouping	< 5	< 10	< 12
% in GEH Group	100	100	100

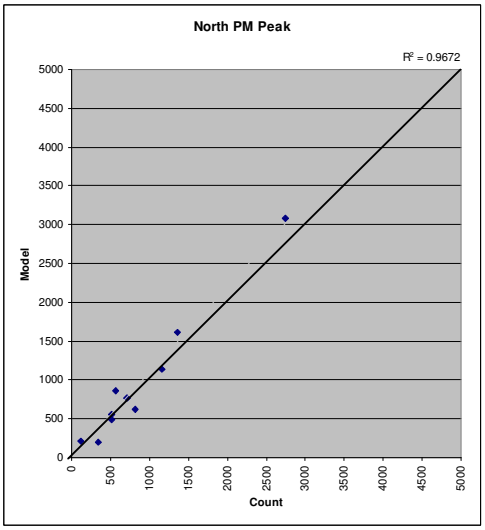
Evening Peak Network Screenline Validation			Table 11 Cont.
Screenline 5 – South (Heavy Vehicles)			
	Forward		Back
Count	120		125
Volume	93		97
Change	-27		-28
%	78		78
Correlation Coefficient	.155		.445
%RMS	121.92		91.17
GEH	1.9		1.9
GEH Total	2.6		
GEH Link Grouping	< 5	< 10	< 12
% in GEH Group	66.7	100	100
Screenline 6 – All RSI (Heavy Vehicles)			
	Forward		Back
Count	2738		3063
Volume	2890		2907
Change	152		-156
%	106		95
`Correlation Coefficient	.870		.807
%RMS	44.06		51.53
GEH	2.0		2.0
GEH Total	.0		
GEH Link Grouping	< 5	< 10	< 12
% in GEH Group	87.3	100	100

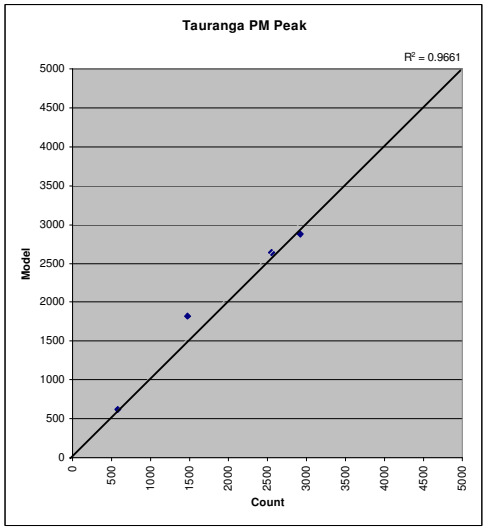




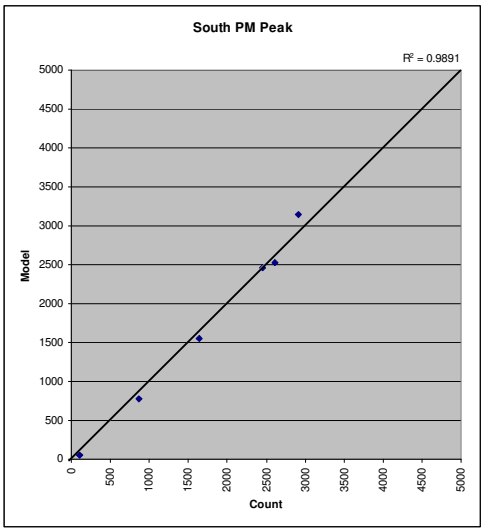


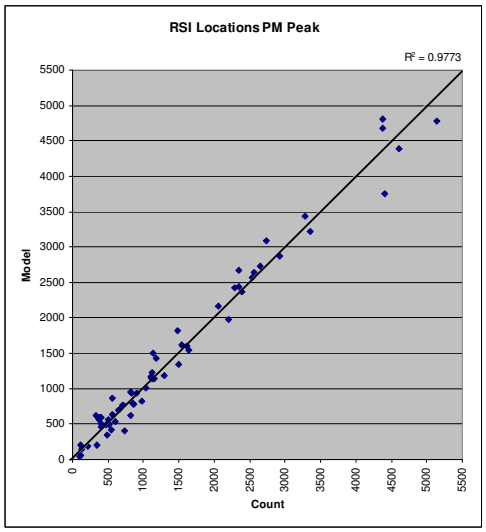


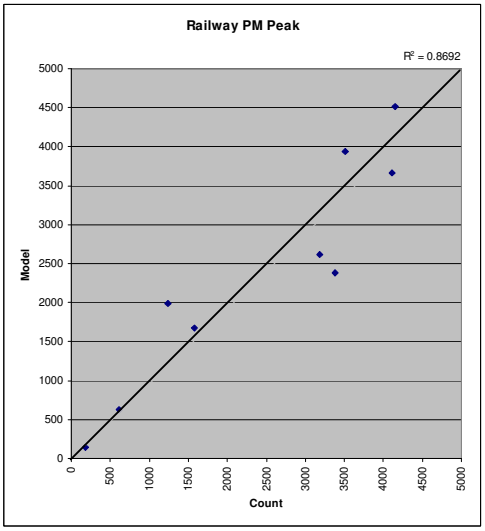


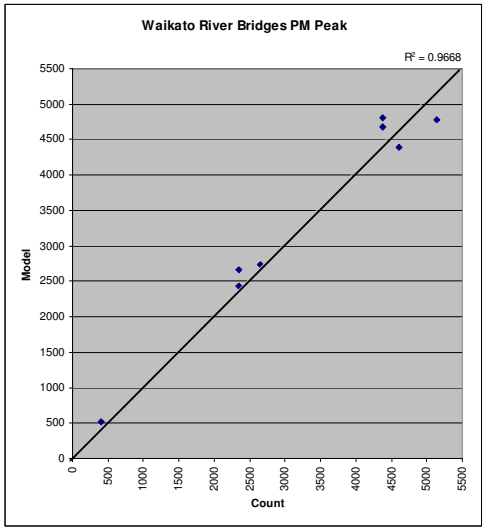


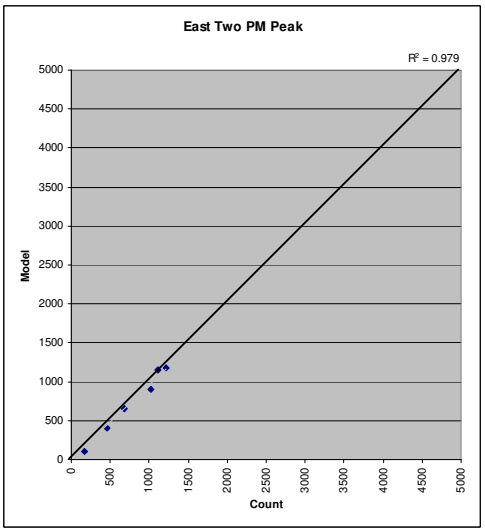
Waikato Regional Transportation Model Gabites Porter Traffic Design Group	**Evening Peak Screenline Scatterplots**	**Figure 10**

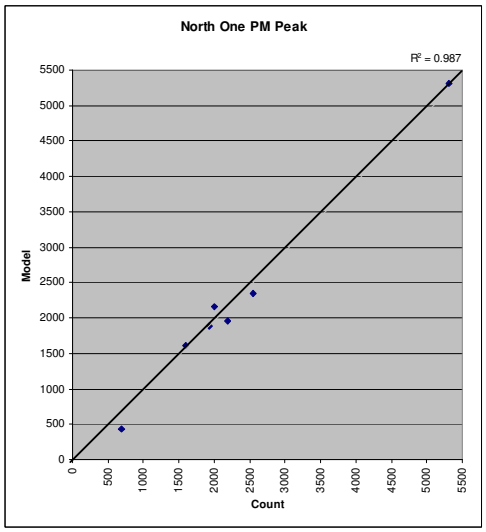




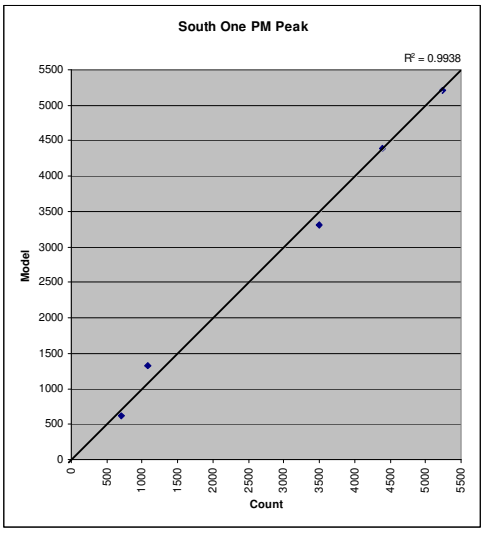


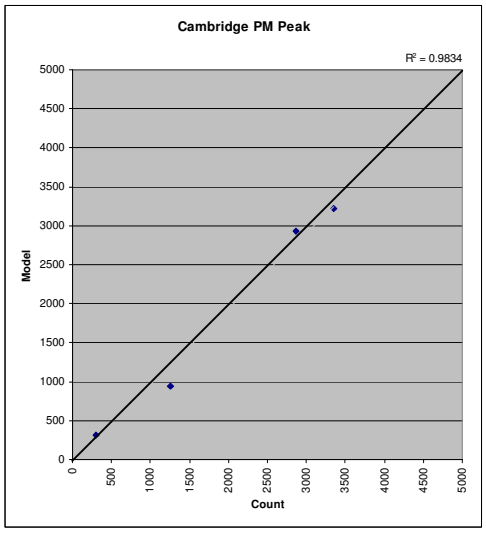


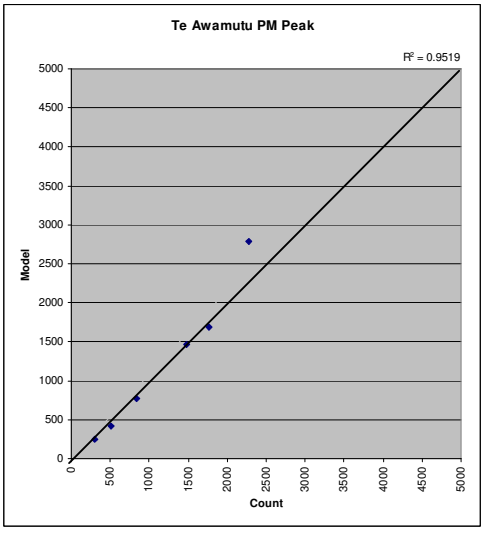


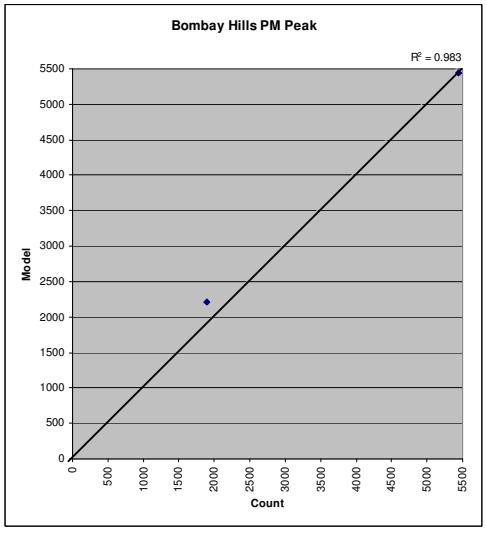


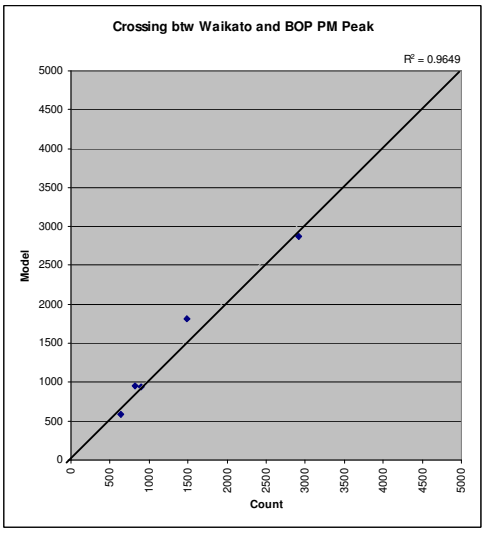
Waikato Regional Transportation Model Gabites Porter Traffic Design Group	**Evening Peak Screenline Scatterplots**	Figure 10 Cont.

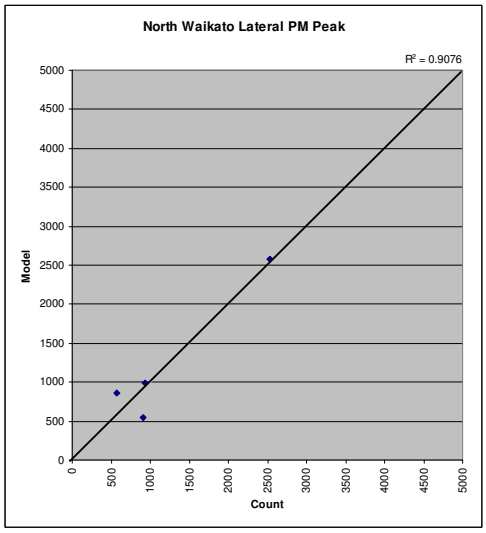




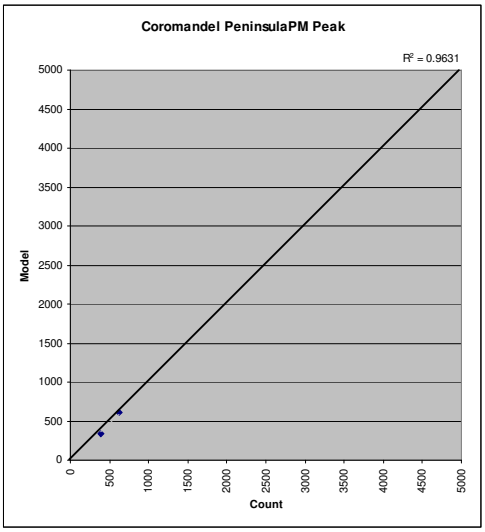


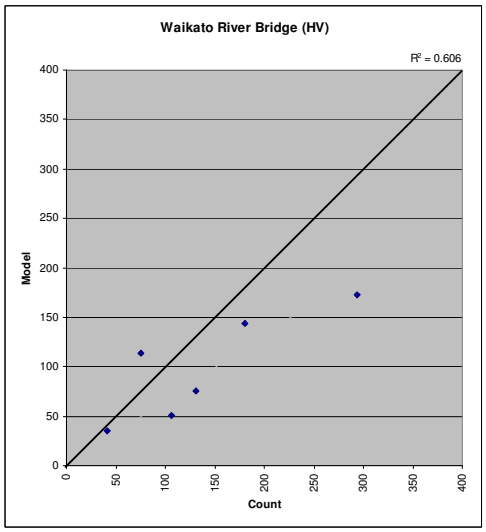


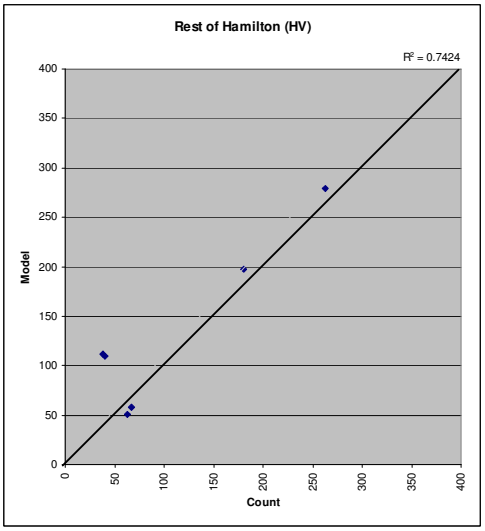


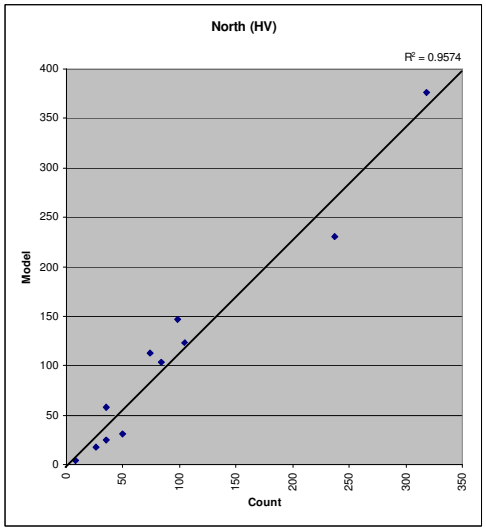


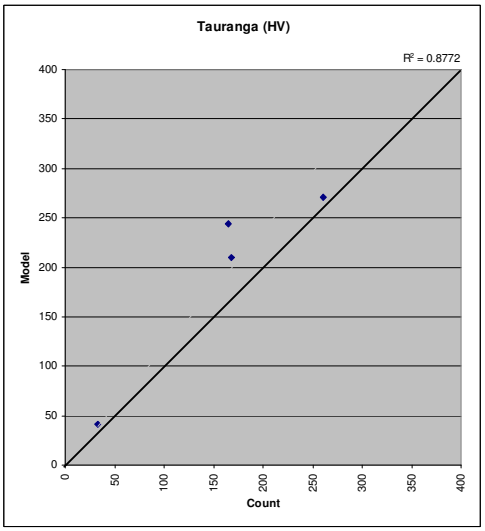
Waikato Regional Transportation Model Gabites Porter Traffic Design Group	**Evening Peak Screenline Scatterplots**	Figure 10 Cont.

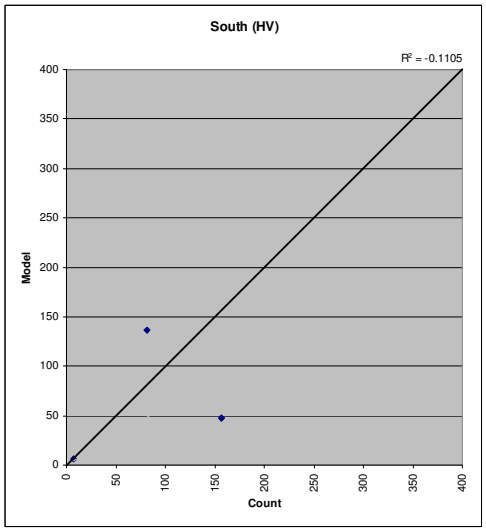




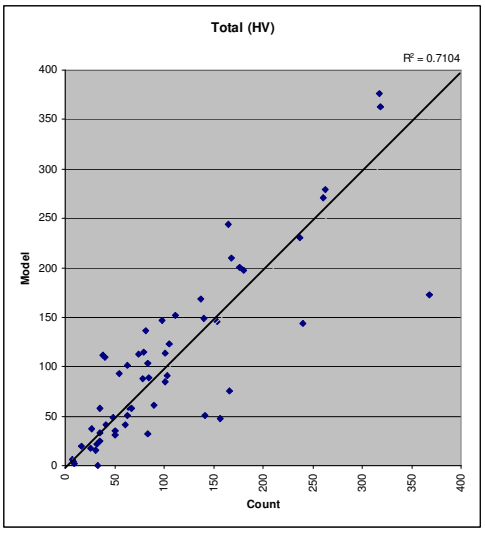








Waikato Regional Transportation Model	**Evening Peak Screenline Scatterplots**	Figure 10 Cont.
Gabites Porter Traffic Design Group		



Waikato Regional Transportation Model Gabites Porter Traffic Design Group	**Evening Peak Screenline Scatterplots**	Figure 10 Cont.

7. INTERSECTION MOVEMENT VALIDATION

At present, no validation has been included at a turning movement level. There are two reasons for this. Firstly, any requirement for validation at this level of detail must be considered on a project-by-project basis and as such forms part of the necessary local area validation required for any option assessment project work. Secondly, given that the base model is 2006 and that the model validation has taken place in 2009 it is difficult to reconcile the three year gap between validation year and data collection year, especially when collecting data at such a fine level of detail. On any given day traffic volumes fluctuate considerably and this has been taken into account in the traffic flow validation data collection.

When traffic volumes are then broken down further to a turning movement level and then back-projected by 3 years, these factors on top of the day-to-day and seasonal fluctuations make assessing appropriate volumes for validation very difficult. On this basis turning movement validation has been deferred but will be revisited on an as required basis in the project work associated with the WRTM.

8. HIS SECTOR-TO-SECTOR TRIP VALIDATION

In order to check that the modelled mean trip patterns match the observed HIS trip patterns an analysis of sector to sector trips has been undertaken. It was originally believed that this could be performed at a zonal level but it became evident during the initial analysis that the HIS results were too “lumpy” for any meaningful zone to zone comparison to take place.

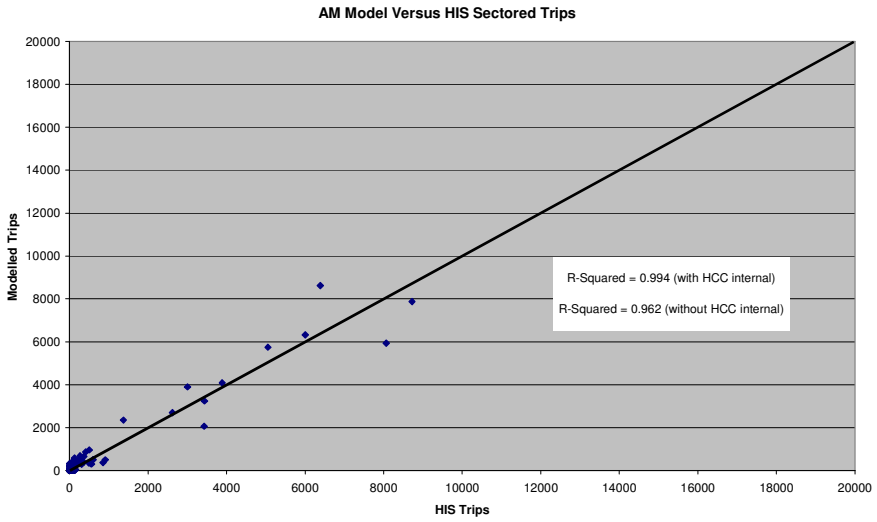
The sector analysis has been undertaken at TLA level and represents the trips for each modelled period between the nine TLA’s in the modelled area. The correlation between HIS and modelled inter-sectoral movements has been plotted and the R^2 correlation coefficient has been calculated for each period. Plots showing this correlation are shown in **Figure 11** and the model and HIS data is summarised in **Table 12**.

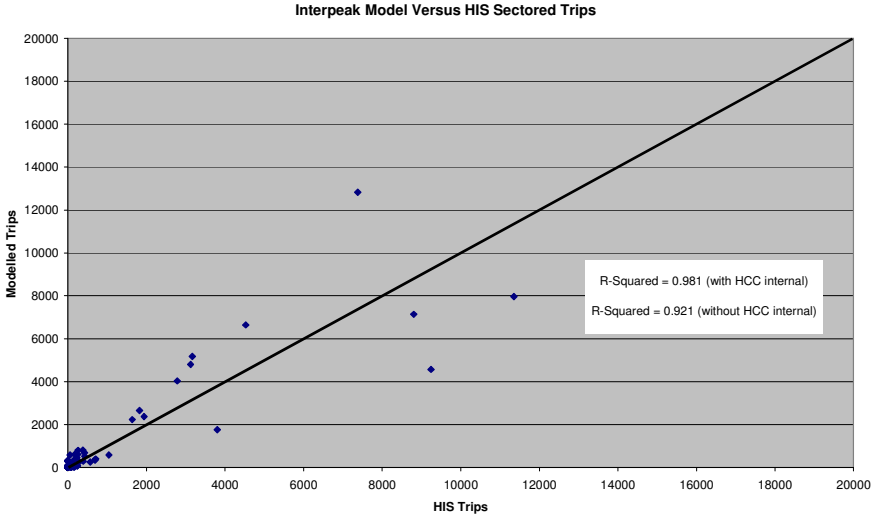
The level of correlation between the modelled and HIS results at section level is expected to be greater than 0.95 for each period at a TLA level. The following plots in **Figure 11** show that this has been exceeded in all cases and all three periods are very close to 0.95 when the largest value (Hamilton to Hamilton internal trips) is removed.

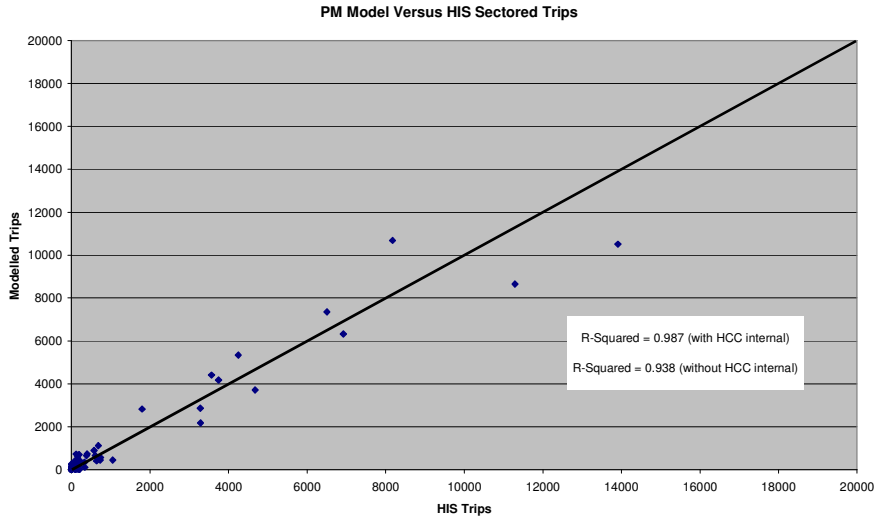
Whist there is some difference reported between the model and HIS for internal sectored movements, modelled traffic volumes in urban areas are replicating counts and trip lengths have been validated successfully also. This suggests that the residual internal trips implied in **Table 12** are likely to be negligible.

HIS versus Modelled Sector To Sector Trips By Period							Table 12
From TLA	**To TLA**	**AM Model**	**AM HIS**	**Int Model**	**Int HIS**	**PM Model**	**PM HIS**
Hamilton	Hamilton	42539	49030	30678	41081	50969	57502
Hamilton	Waipa	2344	1373	2647	1823	4404	3570
Hamilton	Waikato	3237	3439	4796	3123	7355	6506
Hamilton	Otorohanga	61	79	100	142	190	197
Hamilton	South Waikato	16	139	22	0	42	68
Hamilton	Thames-Coro	5	114	5	154	20	121
Hamilton	Hauraki	22	0	57	0	132	139
Hamilton	Matamata-Piako	506	603	606	175	1109	685
Hamilton	Taupo	56	0	68	81	91	0
Waipa	Hamilton	3897	3007	2369	1939	2821	1798
Waipa	Waipa	9633	13900	7969	11354	10508	13912
Waipa	Waikato	680	272	795	260	897	575
Waipa	Otorohanga	387	357	388	710	562	640
Waipa	South Waikato	82	0	68	239	106	0
Waipa	Thames-Coro	1	66	1	0	3	0
Waipa	Hauraki	4	0	5	0	19	0
Waipa	Matamata-Piako	415	78	302	127	450	1052
Waipa	Taupo	329	310	306	0	317	113
Waikato	Hamilton	6320	6005	4029	2781	3710	4677
Waikato	Waipa	867	417	802	383	696	194
Waikato	Waikato	5746	5054	6642	4528	5337	4248
Waikato	Otorohanga	22	0	20	167	24	0
Waikato	South Waikato	6	0	4	63	5	0
Waikato	Thames-Coro	68	0	58	0	103	0
Waikato	Hauraki	175	0	166	78	245	0
Waikato	Matamata-Piako	655	365	578	57	586	155
Waikato	Taupo	21	79	22	0	18	72
Otorohanga	Hamilton	107	129	81	0	106	338
Otorohanga	Waipa	496	910	344	689	448	731
Otorohanga	Waikato	17	0	21	0	24	0
Otorohanga	Otorohanga	2063	3431	1751	3802	2174	3286
Otorohanga	South Waikato	350	490	284	393	405	645
Otorohanga	Thames-Coro	0	0	0	0	0	0
Otorohanga	Hauraki	0	0	0	0	0	0
Otorohanga	Matamata-Piako	3	0	2	0	4	0
Otorohanga	Taupo	4	0	3	0	5	200
South Waikato	Hamilton	21	61	24	63	26	155
South Waikato	Waipa	64	0	68	232	96	0
South Waikato	Waikato	3	0	5	0	6	0
South Waikato	Otorohanga	330	535	280	0	411	209
South Waikato	South Waikato	2695	2619	2227	1638	2856	3282
South Waikato	Thames-Coro	0	0	0	0	0	0

HIS versus Modelled Sector To Sector Trips By Period							Table 12 (cont)
South Waikato	Hauraki	0	0	0	0	0	0
South Waikato	Matamata-Piako	1	0	1	0	1	0
South Waikato	Taupo	3	0	2	0	4	107
Thames-Coro	Hamilton	5	70	33	0	3	197
Thames-Coro	Waipa	1	0	3	0	1	0
Thames-Coro	Waikato	37	0	82	0	99	0
Thames-Coro	Otorohanga	0	0	0	0	0	0
Thames-Coro	South Waikato	0	0	0	93	0	0
Thames-Coro	Thames-Coro	8614	6385	12827	7383	10684	8172
Thames-Coro	Hauraki	304	565	681	420	649	384
Thames-Coro	Matamata-Piako	42	0	72	0	44	0
Thames-Coro	Taupo	0	0	0	0	0	0
Hauraki	Hamilton	114	125	85	0	29	95
Hauraki	Waipa	10	0	11	0	5	0
Hauraki	Waikato	211	0	177	96	142	0
Hauraki	Otorohanga	0	0	0	0	0	0
Hauraki	South Waikato	0	0	0	0	0	0
Hauraki	Thames-Coro	454	235	517	427	566	745
Hauraki	Hauraki	4084	3889	5177	3168	4173	3743
Hauraki	Matamata-Piako	470	307	454	226	323	216
Hauraki	Taupo	2	0	1	0	1	0
Matamata-Piako	Hamilton	953	503	579	1044	647	606
Matamata-Piako	Waipa	362	855	326	0	448	160
Matamata-Piako	Waikato	579	128	604	250	724	401
Matamata-Piako	Otorohanga	3	0	2	0	4	0
Matamata-Piako	South Waikato	1	0	0	0	1	0
Matamata-Piako	Thames-Coro	33	151	49	0	103	0
Matamata-Piako	Hauraki	286	313	440	217	718	120
Matamata-Piako	Matamata-Piako	7872	8723	7135	8802	8643	11294
Matamata-Piako	Taupo	293	101	253	570	340	333
Taupo	Hamilton	113	71	80	58	75	0
Taupo	Waipa	312	0	317	0	436	136
Taupo	Waikato	17	0	22	0	28	0
Taupo	Otorohanga	5	64	4	0	7	0
Taupo	South Waikato	3	118	2	0	5	0
Taupo	Thames-Coro	0	0	0	0	1	0
Taupo	Hauraki	1	0	1	0	4	0
Taupo	Matamata-Piako	316	207	257	290	370	74
Taupo	Taupo	5936	8068	4565	9241	6322	6924







Waikato Regional Transportation Model Gabites Porter Traffic Design Group	**HIS Sector to Sector Trip Validation**	**Figure 11**

9. RSI SECTOR-TO-SECTOR TRIP VALIDATION

In order to check that the modelled mean trip patterns match the observed Roadside Interview (RSI) trip patterns an analysis of sector-to-sector trips has been undertaken. As with the comparison between the model and the HIS, this has not been completed at a zonal level, and has instead been undertaken at a TLA level.

Two sets of RSI information was obtained – the first being the 6-hour traffic data from the six bridges in the Hamilton Urban Area, and the second being the 12-hour region-wide traffic data from the twelve stations situated between other key urban areas in Hamilton on the State Highway network. Please refer to the WRTM Roadside Interview documentation for further details.

The sector analysis has been undertaken at TLA level and represents the trips for each modelled period between the ten TLA's in the Waikato Region, and the areas outside the Region boundary. The correlation between RSI and modelled sector-to-sector movements has been plotted and the R^2 correlation coefficient has been calculated for each period. Plots showing this correlation are shown in **Figure 12** and the model and HIS data is summarised in **Table 13**.

The RSI values have been determined from the expanded RSI survey origin-destination results, which were geocoded to census meshblock and then aggregated to TLA.

The methodology for calculating the sector-to-sector trip patterns from the WRTM three step model, is as follows:

- A select link analysis was run at each of 18 RSI locations to produce a matrix recording vehicle trips for vehicles traveling through each of the 18 locations.
- A trip matrix was created for each period (AM peak, interpeak and PM peak) and each location (54 trip matrices in all)
- Factored AM peak, interpeak and PM peak matrices were added together to produce a single 12 hour trip matrix

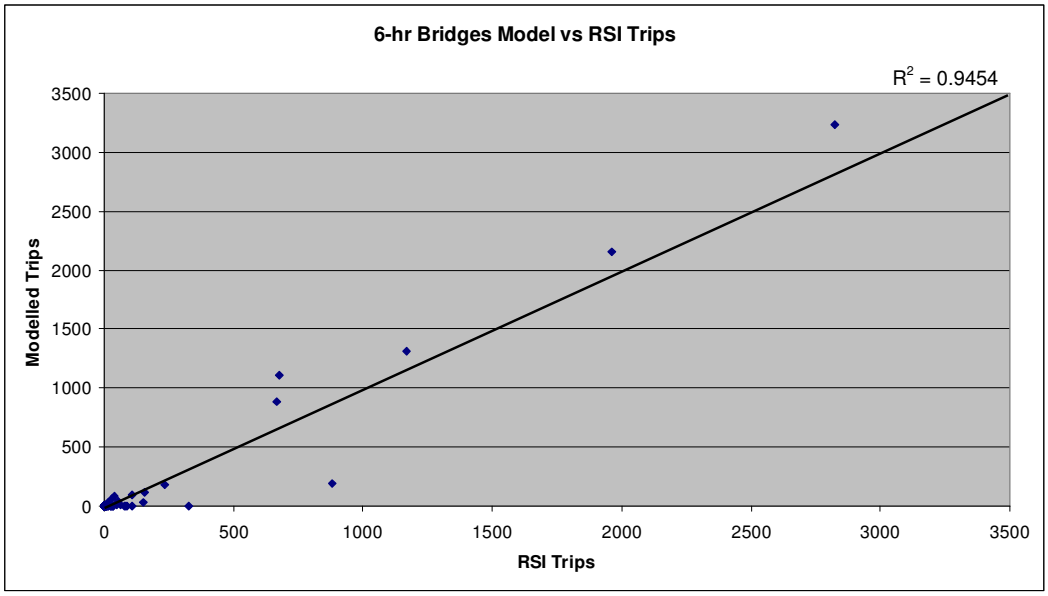
The level of correlation between the modelled and RSI for the Bridges traffic volume is greater than 0.99 at a TLA level. This is dominated by the close match in terms of Hamilton City to Hamilton City trips so this has been removed from the scatterplot in **Figure 12** and the resultant R-squared value remains very high at 0.94.

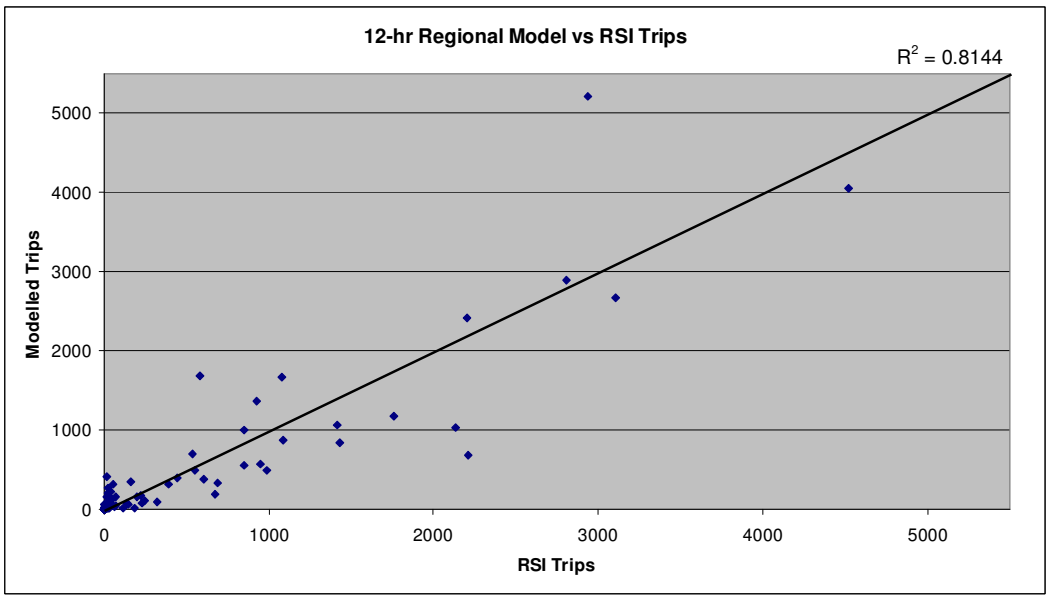
The regional screenline validation produces an R-squared value of 0.81,which indicates a strong relationship between the two sets of data. Given that the survey is a one-day snapshot that sampled up to a third of all vehicles, the results are not discouraging. Instead they indicate that the significant inter-regional movements from the RSI are being replicated by the model.

RSI versus Modelled Sector To Sector Trips					Table 13
From TLA	To TLA	Bridges Model (6Hr)	Bridges RSI	Other Stations Model (12hr)	Other Stations RSI
Hamilton City	Hamilton City	24310	24128	0	0
Hamilton City	Waipa District	669	886	0	0
Hamilton City	Waikato District	677	1112	0	0
Hamilton City	Otorohanga District	52	48	0	0
Hamilton City	Waitomo District	48	12	0	0
Hamilton City	Thames-Coromandel District	87	0	0	0
Hamilton City	Hauraki District	24	0	0	0
Hamilton City	Matamata-Piako District	84	0	0	0
Hamilton City	South Waikato District	31	0	0	0
Hamilton City	Taupo District	33	0	0	0
Hamilton City	Outside Waikato	327	3	0	0
Waipa District	Hamilton City	1963	2156	850	553
Waipa District	Waipa District	3	8	2810	2901
Waipa District	Waikato District	37	89	233	83
Waipa District	Otorohanga District	0	0	13	23
Waipa District	Waitomo District	0	0	3	10
Waipa District	Thames-Coromandel District	5	0	1	8
Waipa District	Hauraki District	0	0	5	20
Waipa District	Matamata-Piako District	5	0	113	17
Waipa District	South Waikato District	0	0	1	1
Waipa District	Taupo District	0	0	0	0
Waipa District	Outside Waikato	34	0	25	91
Waikato District	Hamilton City	2825	3238	3104	2676
Waikato District	Waipa District	30	59	390	319
Waikato District	Waikato District	106	101	1760	1176
Waikato District	Otorohanga District	0	2	17	15
Waikato District	Waitomo District	5	0	4	19
Waikato District	Thames-Coromandel District	6	0	2	19
Waikato District	Hauraki District	3	0	18	8
Waikato District	Matamata-Piako District	5	0	318	100
Waikato District	South Waikato District	3	0	8	39
Waikato District	Taupo District	0	0	0	0
Waikato District	Outside Waikato	24	0	24	272
Otorohanga District	Hamilton City	13	0	552	496
Otorohanga District	Waipa District	0	0	1415	1059
Otorohanga District	Waikato District	0	0	136	78
Otorohanga District	Otorohanga District	0	0	0	0
Otorohanga District	Waitomo District	0	0	0	0
Otorohanga District	Thames-Coromandel District	0	0	0	0
Otorohanga District	Hauraki District	0	0	1	2
Otorohanga District	Matamata-Piako District	0	0	25	16
Otorohanga District	South Waikato District	0	0	1	3
Otorohanga District	Taupo District	0	0	0	0
Otorohanga District	Outside Waikato	0	0	43	130
Waitomo District	Hamilton City	6	0	161	349
Waitomo District	Waipa District	0	0	220	173
Waitomo District	Waikato District	10	0	34	57

Evening Peak Network Screenline Validation					Table 13 (cont)
From TLA	To TLA	Bridges Model (6Hr)	Bridges RSI	Other Stations Model (12hr)	Other Stations RSI
Waitomo District	Otorohanga District	0	0	67	43
Waitomo District	Waitomo District	0	0	608	386
Waitomo District	Thames-Coromandel District	0	0	0	0
Waitomo District	Hauraki District	0	0	0	0
Waitomo District	Matamata-Piako District	0	0	6	23
Waitomo District	South Waikato District	0	0	1	2
Waitomo District	Taupo District	0	0	0	0
Waitomo District	Outside Waikato	0	0	28	167
Thames-Coromandel District	Hamilton City	151	28	20	205
Thames-Coromandel District	Waipa District	0	0	15	63
Thames-Coromandel District	Waikato District	3	0	6	45
Thames-Coromandel District	Otorohanga District	0	0	0	0
Thames-Coromandel District	Waitomo District	0	0	0	0
Thames-Coromandel District	Thames-Coromandel District	0	0	0	0
Thames-Coromandel District	Hauraki District	0	0	0	0
Thames-Coromandel District	Matamata-Piako District	0	0	0	0
Thames-Coromandel District	South Waikato District	0	0	0	0
Thames-Coromandel District	Taupo District	3	0	0	0
Thames-Coromandel District	Outside Waikato	0	0	1	14
Hauraki District	Hamilton City	157	122	69	152
Hauraki District	Waipa District	5	1	61	35
Hauraki District	Waikato District	0	0	31	19
Hauraki District	Otorohanga District	0	0	1	5
Hauraki District	Waitomo District	0	0	0	0
Hauraki District	Thames-Coromandel District	0	0	0	0
Hauraki District	Hauraki District	0	0	0	0
Hauraki District	Matamata-Piako District	0	0	0	0
Hauraki District	South Waikato District	0	0	0	0
Hauraki District	Taupo District	0	0	0	0
Hauraki District	Outside Waikato	0	0	2	11
Matamata-Piako District	Hamilton City	1170	1309	1081	1669
Matamata-Piako District	Waipa District	22	16	1432	845
Matamata-Piako District	Waikato District	13	30	688	338
Matamata-Piako District	Otorohanga District	0	0	22	21
Matamata-Piako District	Waitomo District	0	0	5	26

Evening Peak Network Screenline Validation					Table 13 (cont)
From TLA	To TLA	Bridges Model (6Hr)	Bridges RSI	Other Stations Model (12hr)	Other Stations RSI
Matamata-Piako District	Thames-Coromandel District	0	0	6	28
Matamata-Piako District	Hauraki District	0	0	53	46
Matamata-Piako District	Matamata-Piako District	0	0	2212	686
Matamata-Piako District	South Waikato District	3	0	0	0
Matamata-Piako District	Taupo District	0	0	0	0
Matamata-Piako District	Outside Waikato	6	0	56	321
South Waikato District	Hamilton City	234	180	533	699
South Waikato District	Waipa District	0	0	983	493
South Waikato District	Waikato District	8	8	146	68
South Waikato District	Otorohanga District	0	0	2	5
South Waikato District	Waitomo District	0	0	0	0
South Waikato District	Thames-Coromandel District	0	0	2	17
South Waikato District	Hauraki District	0	0	12	16
South Waikato District	Matamata-Piako District	0	0	242	107
South Waikato District	South Waikato District	0	0	0	0
South Waikato District	Taupo District	0	0	0	0
South Waikato District	Outside Waikato	6	0	42	229
Taupo District	Hamilton City	78	3	13	413
Taupo District	Waipa District	0	0	26	154
Taupo District	Waikato District	7	0	3	62
Taupo District	Otorohanga District	0	0	0	0
Taupo District	Waitomo District	0	0	185	21
Taupo District	Thames-Coromandel District	0	0	0	0
Taupo District	Hauraki District	0	0	0	0
Taupo District	Matamata-Piako District	0	0	8	55
Taupo District	South Waikato District	0	0	676	184
Taupo District	Taupo District	0	0	4520	4059
Taupo District	Outside Waikato	28	0	585	1682
Outside Waikato	Hamilton City	883	189	2938	5210
Outside Waikato	Waipa District	14	0	926	1370
Outside Waikato	Waikato District	65	9	850	1005
Outside Waikato	Otorohanga District	0	0	200	153
Outside Waikato	Waitomo District	0	0	442	396
Outside Waikato	Thames-Coromandel District	2	0	14	154
Outside Waikato	Hauraki District	0	0	23	58
Outside Waikato	Matamata-Piako District	2	0	950	565
Outside Waikato	South Waikato District	6	0	2133	1029
Outside Waikato	Taupo District	6	0	1090	878
Outside Waikato	Outside Waikato	105	0	2206	2412





Waikato Regional Transportation Model	**RSI Sector to Sector Trip Validation**	**Figure 12**
Gabites Porter Traffic Design Group		