Update and Enhancement of Traffic Count Guide

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Traffic Design Group

An Important Note For The Reader

Contents

Executive Summary

Traffic monitoring on a nationwide basis is a complex activity. Estimation of the annual average daily traffic (AADT) for a road on the basis of a traffic count conducted over a particular week of the year, or even a particular day or part-day clearly has uncertainty of outcome. The purpose of this analysis and report was to examine the degree of precision of the estimation of AADT for one-off surveys of different durations conducted on different types of roads, categorised according to their traffic pattern.

The traffic patterns were determined based on the procedures used in the earlier Transit NZ "Traffic Stream Data" research project, this report repeating some of the earlier analysis but using the latest available continuous traffic count data for years 1998 and 1999, sourced from both Transit NZ and local authorities. The analysis tasks were undertaken in four main stages, which this report describes.

The primary focus of the first stage was the collection and processing of available continuous electronic traffic data into a standard format for classified and unclassified directional data. This included screening out numerous data inconsistencies and was a labour intensive task.

Stages 2, 3 and 4 involved undertaking various statistical analyses relating to week and day-of-week factors as for the previous project. In addition, the pattern of heavy vehicle flows (which resulted in week factors, for heavy vehicles), and partial day surveys (which resulted in average weekday factors for four periods of two or three hours duration) were examined.

The last stage of the research involved report writing, including the production of an update to the *Transit NZ Traffic Count Guideline* as the primary means of disseminating the key outcomes and outputs of this research. The updated Guideline, which includes additional comments on regular traffic monitoring programmes, has been prepared as an adjunct to this project report, and has been the subject of a peer review prior to presentation of the final published document.

Abstract

The measurement of traffic volumes on an extensive nationwide network is a very large task. It is not feasible to count all traffic on all roads all of the time. Considerable reduction or effort in the counting process can be achieved by identifying key factors that may allow for grouping of roads into similar groups. This project has derived nine major groups of roads based on the two-way hourly traffic pattern over the latest available two calendar years for continuous count/ classification sites on state highways and local roads. The was achieved using hierarchical cluster analysis in the same manner as the similar, ground-breaking project undertook in the mid 1990's using older data, and prior to the introduction of the four term school year.

Statistical analysis of the estimation of AADT for vehicle counts of 2-3 hours, 24 hours, and 168 hours duration was undertaken, as well as estimation of the heavy vehicle AADT for classified counts of one-week duration. Various summary tables and graphs are provided.

1   Background

Prior to the formation of Transfund New Zealand, Transit New Zealand commissioned a research project "Traffic Stream Data, Road Categories, Traffic Counting Strategies". This project itself followed on from the earlier National Roads Board Road Research Unit projects TC/1 and TC/2 which to an extent had delivered results of little practical benefit.

The Transit project (PR3-0025) utilised continuous data from Transit NZ and local authorities in examining the pattern of vehicle usage with the object of establishing categories of typical traffic patterns on different types of roads in a practical manner. The researcher, Dr Kelly Mara, utilised the then recent statistical analysis technique of hierarchical clustering and evaluated a number of different ways of categorising the traffic data for the different sites. The hope was that a categorisation technique could be found such that the appropriate traffic group category could be established from a regular one-week count (or less) duration. Fortunately, the research was able to identify a potentially suitable categorisation method based on the two-way hourly flows expressed as a proportion of the annual average daily traffic (AADT), using the median of the 168 values for each week of the year (excluding the Christmas/ New Year weeks).

Examination of these weekly profiles was undertaken by the Transit NZ project manager Dave Wanty, who established that there were reasonable differences between the groups such that the appropriate group was likely to be able to be derived from a standard week count. The suggested two parameter procedure and alternative procedures were then examined as part of the research that indicated that the suggested procedure was indeed reasonable as far as it was possible to tell. Accordingly, the remainder of that research as well as this current research project has used the median hourly two-way flows as the appropriate traffic pattern categorisation procedure. This resulted in less than three or fewer sites in some of the groups, but it was considered that this was primarily a reflection of the lack of available data rather than that these were atypical sites/groups.

Examination of the available directional flows was also undertaken in the Transit project but it was concluded that the use of directional flows was unlikely to yield a significantly better process.

The effectiveness of four different typical traffic counting strategies for each of the resulting traffic groups was then evaluated solely on the basis of one-week counts. This drew on the results of the previous TC/2 project which established only a minor gain in the precision of the AADT estimate from counting over a fortnight instead of a week, and very little further gain for counting of a single four week period. Due to the vast number of combinations for the multi-count strategies, the results needed to be summarised in a suitable manner with the 80th percentile of the AADT 98% confidence limits chosen. From this the relative likely error associated with each strategy for the different traffic groups was established.

A practical output for the estimation of AADT for a particular weekly count (or counts) were the Week Factor tables for each group, which included the standard deviation of the error estimate (both within sites, between sites, and overall). The within site variation was a measure of the variation of the week factor for each site with more than one year's data, while the between site variation was a measure of the variation in the week factors between sites in the same traffic group. Normally one would use the overall standard deviation, which utilises all the available site-years' data. The Week Factor tables were later amended to also include the week factors for weeks 12 to 17, excluding the data when Easter flows were recorded for that particular week (naturally depending on the year in question).

To provide some "connection" with the previous TC/2 project, three hourly periods were chosen for analysis, viz Friday 8-9am, 4-5pm and Saturday 11am-12 noon. Whereas previously TC/2 had reported the best week to count a certain hourly flow, this project considered the variability of the factors for the different weeks for the one-hour counts in the same manner as for the one-week counts. While the one-hour counts had a naturally high level of imprecision in estimating AADT, apart from the *rural recreational* groups there was a reasonably low variability in average factors across weeks of the year. Consequentially, the current research also investigated four partial day periods but of a more typical two or three hour duration.

As an adjunct to the original project brief, the Transit NZ project was extended to examine the estimation of AADT from single day counts. This arose from the need for Transit NZ to facilitate the National Traffic Database project that it was undertaking as part of the Land Transport Pricing Study managed by the Ministry of Transport. The estimation of the day factors incorporated the holidays with Sundays given that they have similar patterns. This research repeats that analysis but treats holidays separately from Sundays. Additionally, the annual variation in the group average day factors is reported.

Whereas the analysed data for the previous project (which consisted of the Transit Transpac files and local authority data) contained unclassified vehicle counts, much of the data supplied as a basis for this research was classified into either four vehicle lengths or 12/13 axle-based vehicle classes. Accordingly, this research project has also been able to examine the *heavy vehicle* flows, focusing on the week factors.

In conjunction with the Transit NZ research, a Traffic Count guideline was published, with the full title "A guide on Estimating AADT and Traffic Growth, and a Traffic Count Monitoring Programme Basis". This guideline was first published on 11 November 1994, and was specifically undertaken in order to disseminate the research results. Similarly, a paper was prepared and presented at the 1994 IPENZ Conference in February.

The guideline consisted of three parts, the first of which (10 pages) related to the research project, while the second (5 pages) also included some comments on traffic monitoring programmes derived from associated investigations undertaken by Dave Wanty, Transit NZ. The third part contained the appendices of the week factors and the median daily profiles for each of the traffic pattern control groups.

This research project includes both the updating of the various traffic analyses using 1998 and 1999 data and incorporation of the derived factors into a new guideline along with additional comments relating to traffic monitoring programmes. Again, the key output of the research project is the guideline itself, and not this research report *per se*.

2   Research Objectives

The objectives of the research project, as originally submitted in the research brief, are as follows (generally in order of priority):

- to update and amend the procedure to estimate the AADT, as currently specified in the Transfund adopted Transit NZ Traffic Count Guideline, for the urban arterial and rural road categories,
- to provide guidance on the implementation of traffic monitoring programmes based on the capabilities of the latest equipment, typical resource, costs, audit, and reporting requirements,
- to provide guidance on data quality and delivery,
- to determine the practicality of deriving estimates of AADTs from 2-hour, 4-hour and 8-hour surveys as typically undertaken for intersection improvements and commodity surveys,
- to determine the nature of the heavy vehicle usage for different road categories.

The updated Traffic Count Guideline is separate to this report as a stand-alone document for use by practitioners. It incorporates the research result, as well as other projects associated with traffic monitoring.

The rest of this report outlines each of the key processes of the research project in relation to the estimation of AADT from surveys of different duration, beginning with the data processing.

While the key results of the analyses are provided in the appendices attached to this report, there is a separate (voluminous) appendix document that contains analysis results for individual sites as well as detailed results for each traffic group for the various analyses undertaken.

3   Data Processing

3.1   Collation of Continuous Data

The nature of the research required the collection and collation of traffic flow data from sites operated on an essentially continuous basis at hourly intervals or better. The target years were 1998 and 1999 so as to yield the most recent data following the introduction of the four term school year (which became mandatory for 1996 onwards) and with subsequent improved harmonisation of the school terms. Initially the project was to limit itself to the available data through Transit NZ from the

following main sources:
- telemetry (principally dual loop) sites obtained from Transit NZ Head Office
- weigh-in-motion sites obtained from Transit NZ Head Office
- Transit NZ Auckland ATMS sites obtained from Serco
- Transit NZ Christchurch continuous sites obtained from Transit NZ Christchurch.

A questionnaire was sent to each of the territorial local authorities asking whether they also had any continuous traffic data available in a suitable electronic format. This survey determined that a number of Councils had semi-continuous data available, and a variation to the project was then agreed to, to use this non state-highway data, and to collate and include local authority data into the research.

A schedule of all of the sites with a summary of their location, group category, AADT, and number of count days of data for 1998 and 1999 is provided in Appendix A of this report.

3.2 Initial Data Processing

The task of initially processing the Transit NZ and local authority data into a suitable common format(s) was far larger than originally perceived and not assisted by some basic "glitches" in the data received.

A more comprehensive review of the difficulties and problems encountered are highlighted in Appendix B to this report. These relatively comprehensive notes can be expected to be of assistance to other researchers in 'cleaning' the data from a number of different sources, including:
- Transit NZ 'Mark 3' sites
- Transit NZ 'Mark 6' sites
- Transit NZ ATMS sites
- Transit NZ Christchurch Continuous sites
- Auckland City SCATS sites
- North Shore City sites
- Rodney District sites
- Kaipara District sites
- Tauranga District site - Cameron Road
- Wellington City site - Mt Victoria Tunnel (SH1)
- Clutha District site - Owaka/Clinton.

Other potential sites which were could not be usefully included in this research project were reported from:
- Hutt City
- Manukau City
- Transit NZ (Green Island Motorway).

It is somewhat disappointing that there is no data from provincial cities which could potentially show the traditional weekday lunchtime and late night shopping effects.

3.3   Main Data Processing

Having collated and cleaned the data as thoroughly as possible, the final data was processed to produce the requisite standard comma separated value formats for subsequent statistical analysis.

Essentially there were two types of standard .CSV format, one for hourly flow data and one for classified hourly flow data.

The hourly format was similar to the Transpac fixed format used in the previous project consisting of year, month, day, day of week, holiday, week number of valid number of hours, followed by the 24-hourly flows for direction A and the 24-hourly flows for direction B.

Previously, the only holidays included were the statutory holidays, the anniversary holiday for the region, and the period 25–31 December. Subsequently the statistical analysis identified the following as holidays 1–4 January, Waitangi Day, the Thursday before Good Friday to Easter Tuesday, Anzac Day, Queen's Birthday, Labour Day, 24–31 December, plus the local Anniversary Day.

Week number 2 was defined as beginning on the Monday after the first Sunday thus ensuring only 53 weeks for the year 2000.

A series of "one-stop-shop" standardised spreadsheets (9800VPH, 9800CVPH, 9900VPH, 9900CVPH, 99J0CVPH, 99AOVPH) have resulted which automatically produce various tables, graphs, and statistics for each direction and two-way totals.

The basis of these programs and spreadsheets, while modified and enhanced for this project, were created and evolved by the Traffic Design Group for a variety of projects.

Further details of these procedures are included, for completeness, in Appendix C to this report.

4   Statistical Analysis

4.1   Introduction

The final resulting CSV files were then subjected to analysis by Dr Kelly Mara, consultant statistician, using the same SPlus software as he used for the previous project and incorporatiing the latest Microsoft Windows version.

A list of the sites analysed, the computed AADT, and the number of valid days for each site year is provided in Appendix A.

The previous analysis was restructured to complete day's data (i.e. 24 hours of two-way data), but for this project where directional data were available, days with a total of 40 or more valid hours of data for both directions were treated as valid. This was principally required for the Auckland City SCATS sites which might otherwise have had insufficient valid data.

4.2 Traffic Group Validation/Determination

4.2.1 Procedure

An iterative procedure was used to derive the appropriate traffic group for each site.

The site years were initially compared with the median values of the ten groups from the previous research project. SPlus automatically selected the group with the lowest distance (measure of the 168 hourly differences) value. These were then examined and sites for which there were differences between the two site-years or differences with the previous or expected group were further investigated.

This involved comparing the least distance with distances to the other groups, and checking the validity of the data, particularly for the Auckland City SCATS sites. Following this, new group values were formed based on the new sites and the process repeated.

Examination at about the second iterative stage revealed that some "intervention" was likely to be needed to sensibly categorise some of the Auckland City SCATS sites, particularly those perceived to be commercial (CBD) or industrial roads. Two intervention options were considered, namely:

- averaging the Monday to Thursday hourly values and thereby effectively increasing the relative importance of the weekend flows in the determination of the distance discriminant, and
- subjectively predetermining those commercial and industrial sites and replacing the previous group (2 and 3 respectively) median values.

Ultimately, both options were used which resulted in sensible categorisation of the Auckland sites as well as rectifying some other oddities.

An interesting result of the new groupings was that (again) only one site was initially found to relate to the previous group 4 *urban other*, but which subsequently was allocated to another group. The residential streets in Auckland City were categorised into one of the two *urban arterial* groups as they exhibited a similar pattern. Accordingly, the previous group 4 was dispensed with.

The Auckland City CBD sites were different in that they had high flows on Friday and Saturday nights with one site along Queen Street having its peak flow towards Friday midnight, and were categorised into the new group 2.

4.2.2 Results

A summary of the new grouping is provided in the following Table 1a and Table 1b alongside the numbers for the previous research project, for convenience.

Note that three sites were allocated a different group for 1998 compared to 1999, viz site 19 (6b, 5), site 24 (6a, 6b) and site 65 (6a, 6b). Also, some sites were not included in the analysis but were categorised into the appropriate group. Two Kaipara District sites (66 and 75) were inadvertently missed but their output (along with the other Kaipara site 67) has been included in the appendices of the ADT tables

and week factor graphs. Four of the Transit telemetry sites were either not operating or only operating mainly in one direction only for 1999, viz sites 18, 34, 42, and 65 (the latter was included despite the somewhat lower recorded flows than usual when both directions were operating). Two sites (58 and 107) were somewhat affected by network capacity improvements undertaken in 1999 but only the latter site was analysed with little overall effect in the analysis results.

Table 1a: Group Allocations : Site-Year Summary

GROUP	LABEL	PREVIOUSLY		CURRENTLY		
		Sites	Site-Years	Sites	Site-Years	
					1998	1999*
1a	*Urban arterial (a)*	12	29	19	9	15
1a1,1a2	Auckland, other			16,3	6,3	12,3
1b	*Urban arterial (b)*	14	36	35	24	20
1b1,1b2	Auckland, other			23,12	12,12	11,9
2	*Urban commercial*	1	2	6	0	6
3	*Urban industrial*	3	6	4	0	4
4	*Urban other*	1	3	0	0	0
5	*Rural urban fringe*	3	10	7/8	7	8
6a	*Rural strategic (a)*	19	57	15/16/17	16	14
6b	*Rural strategic (b)*	30	105	20-23	21	20
7a	*Rural recreational "summer"*	3	12	3	3	3
7b	*Rural recreational "winter"*	5	19	9	9	7
ALL		91	279	121	89	97

*includes those sites predominantly 1999 but excludes the six SH 1N Rodney sites and SH 1S Green Island motorway site allocated but not included in the analysis.

Note also that the *urban arterial* groups were in some cases analysed with or without the sites in the Greater Auckland region as described above. The latter comprised 14 of the 24 Auckland City SCATS sites, all 7 of the North Shore City sites, all 16 of the Transit Auckland ATMS sites (including the Auckland Harbour Bridge site 87), plus the two single loop sites 55 and 79. The two telemetry sites on the outskirts of the Auckland southern motorway (7 and 72) were treated as "other".

Careful inspection of Table 1b (page 18) reveals that for a few sites, categorisation of the latest data resulted in a different allocation of the traffic group from the previous project. For example *rural urban fringe* attracted two/three sites (12,14 and partly site 19) that previously were allocated to the *rural strategic b* category. Usually however, there was little difference between in the distance discriminator values for the new compared to the old group, such that in practical terms either category could be chosen.

One resulting allocation that was interesting was that of the new site 76 (on state highway 25A), which was categorised as *rural recreational winter*, despite not being located near the North Island Central Plateau or Southern Alps (where the other sites in the category are located geographically near the main ski-fields). This outcome reinforces the fact that the names given to the groups are merely labels (and hence they have been consistently given in *italics* in this report).

Table 1b: Group Allocations : Sites

GROUP	LABEL	PREVIOUSLY*		CURRENTLY**	
				Sites	
		present sites	Other	1998	1999
1a1	*Urban arterial (a) : Auckland*	55	61, 67, 68, 71, 79, 81, 83	55,79,10, 97,98,99	55,79,102,104 107,108,121,122 123,132,136,138
1a2	*Urban arterial (a) : non Auckland*	3 [81], 4 [82] 115 [57]	111	81,82,73	81,82,73
1b1	*Urban arterial (b) : Auckland*		72, 75, 77, 80	08,84,86,87 89,90,91,92 93,94,95,96	103,104,105 117,124,125,126 127,128,137,139
1b2	*Urban arterial (b) : non Auckland*	57, 58, 59, 60, 51 [61], 54 [64] 112 [54]	91, 93, 99	46,54,57,58 59,60,62,64 69,71,83,85	46,59,60,62,63 64,69,71,85
2	*Urban commercial*		65		111,112,113,114,1 15,129
3	*Urban industrial*		63,64,100		131,133,134,135
4	*Urban other*		101		
5	*Rural urban fringe*	1,2 [47],7		01,07,47 12,14,72,77	01,07,47 12,14,72,77,19
6a	*Rural strategic (a)*	06,22,24,26,39 40,41,45,46 53 [65]	92,94,95,96,9 7,102,103,106 ,107	06,13,18,22 26,28,36,39 40,41,45,49 70,80,24,65	06,13,22 26,28,36,39 40,41,45,49 67,70,80
6b	*Rural strategic (b)*	5, 8 [74],10 [68] 12,13,14,15,16,17 ,18,19,20,21,23,2 5,27,28,30,31,33, 34,36,38,44,52,56	98,104,105,11 0	05,15,16,17 19,20,21,25 27,30,31,33 34,38,44,51 52,56,68,74 88	05,15,16,17 20,21,24,25 27,30,31,33 38,44,51 52,56,65,68,74
7a	*Rural recreational "summer"*	09,32,35		09,32,35	09,32,35
7b	*Rural recreational "winter"*	11,29,37,42,43		11,29,37,42 43,23,76,78 53	11,29,37 43,23,76,78
ALL		57	34	89	97

* relates to the old site numbers comprising the then telemetry sites 1-47, 52, 55-60, and 61, 64, & 65 that were renumbered 51, 54, & 53 respectively, plus local authority and Transit regional sites

Having fixed the group allocations, the median hourly flow profiles were reproduced for each group. These are given in Appendix C of the updated Traffic Count Guideline (Appendix K of this report).

The site details are included in Appendix A, divided into the main providers of the data and in approximate geographical order from north to south.

4.3 Estimation of Weekly Multipliers

4.3.1 Procedure

The week factors for each site-year were calculated in the same manner as for the previous project with two exceptions.

Firstly, the week was defined as a Monday to Sunday week (compared with Sunday to Saturday previously). Secondly, the week factors were produced with the Easter

long weekend excluded (defined as the six days from the Thursday before Good Friday to the Tuesday after Easter Monday).

The week factors are calculated by dividing the weekly ADT by the computed (annual) AADT. The latter is of necessity unadjusted to account for missing days or blocks of data, while the WADT required at least four valid days.

For convenience, the week factors for week 52 have also been output but the partial holiday weeks 1 and 53 were not output for the same reasons (large variations) as for the previous project.

4.3.2 Results

Graphs of the new week factors compared with the old week factors (and where appropriate the new heavy vehicle week factors) are provided for each group in the Appendix H.

For the urban groups in particular, these reveal the effect of the different school holiday periods. The effect is more noticeable for individual sites, with inner city sites having typically lower flows (week factors exceeding 1.0) and sites on the outskirts having typically higher flows (week factors below 1.0) during the school holidays.

For *rural recreational* sites, use of the old week factors for week 36 (during the previous August school holiday periods) could lead to an under-estimation of the AADT by around 30%. Accordingly, this research project is timely, and it further emphasises the worth of having local continuously monitored sites to identify changing trends.

The mean and standard deviation of the week factors for each group are provided in Appendix D of this report and also in the the updated Traffic Count Guideline.

4.4   Examination of Heavy Vehicle Week Factors

The week factor patterns for heavy vehicles for all the groups were also examined with a view to seeing whether they followed a similar pattern to those of light vehicles (as represented by the week factors for all vehicles established above).

4.4.1   Definition of heavy vehicle

A heavy vehicle was defined in relation to the four vehicle length bins, and the number of heavy vehicles was calculated as being the sum of 0%, 50%, 100% and 100% of vehicle flows in length bins 1, 2, 3 and 4, respectively. Accordingly, for the standard Transit NZ telemetry and WIM sites, the heavy vehicles were all those >11m in length plus half of those 5.5 – 11.0m in length. This definition is the standard one that Transit NZ applies to the dual loop telemetry sites. It is understood to be based on a limited number of visual observations but nevertheless is considered adequate for the week factors analysis.

For the Auckland ATMS sites for which the data were already split into light and heavy vehicles, it is understood that the heavy vehicles were defined as 100% of length bins 2,3 & 4, ie all vehicles exceeding 5.5 m in length.

For the North Shore sites the same definition applied as for the Transit telemetry sites, noting however that the L2 vehicle length bin was defined as vehicles 6.0 – 12.0m in length.

For the local sites counted using classifiers with vehicles classified into 12 or 13 bins, each class was assigned to a single length bin appropriate to the particular classification scheme (refer to the program code for specific details). The same relationship between length bins and heavy vehicles was then applied.

4.4.2 Results

The results for the analysis are given in Appendix E in a similar format to the standard week factors.

This information is presented graphically in Appendix H, where the heavy vehicle week factors are compared with the new week factors (all vehicles) for each of the main groups. Generally, for a good part of the year, the heavy vehicle week factors are similar to those for all vehicles. In the middle of the year though, the heavy vehicle flows are relatively lower, while towards Christmas (and around March) for the *rural* groups, the heavy vehicle flows apparently increase at a faster rate than for light vehicles.

However, this might be partly due to an increasing number of light vehicles towing trailers/caravans that, being longer than 5.5 m, are partially attributed to being heavy vehicles. Nevertheless, these trends are reasonably consistent with the widely held view that the cartage by road of agricultural and horticultural products is greatest during summer and early autumn, and least during winter.

The mean and standard deviation of the heavy vehicle week factors for each group are also provided in the updated Traffic Count Guideline.

4.5 Estimation of Day of Week Multipliers

4.5.1 Procedure

The day of week factors for each site-year were calculated in the same manner as for the previous project with two exceptions.

Firstly, whereas previously holidays were treated as Sundays, the reported day of week factors for this project exclude holidays and the holiday day factors are not separately reported. Note that holidays are also defined differently for this project, and are as specified earlier.

Secondly, whereas previously the day of week factors were based only on valid (complete) days and for which there were both weekend daily flows and at least two

weekday daily flows for the week in question, this project dispensed with the weekend days requirement as being unnecessary in practice.

4.5.2 Results

The results for the analysis are given in Appendix F and summarised in Table 2 and Table 3.

Table 2: Average Day of Week Factors

Group Day	Mon	Tue	Wed	Thu	Fri	Sat	Sun *
CURRENT							
1a1 *Urb Art a (Auck)*	0.98	0.95	0.93	0.92	0.88	1.17	1.37
1a2 *Urb Art. a (non Ak)*	1.01	0.98	0.95	0.94	0.89	1.09	1.24
1b1 *Urb Art b (Auck)*	0.99	0.96	0.95	0.93	0.89	1.13	1.31
1b2 *Urb Art. b (non Ak)*	1.00	0.97	0.94	0.93	0.88	1.11	1.30
2 *Urb CBD (Auck)*	1.02	1.00	0.97	0.94	0.86	1.07	1.34
3 *Urb Ind'l (Auck)*	0.85	0.85	0.84	0.84	0.84	1.84	2.66
5 *Rur Urb Fringe*	1.14	1.14	1.10	1.07	1.07	0.94	0.86
6a *Rur Strategic (a)*	1.05	1.01	0.99	0.97	0.97	1.09	1.10
6b *Rur Strategic (b)*	1.11	1.14	1.10	1.05	1.05	1.03	0.91
7a *Rur Rec Summer'*	1.07	1.17	1.13	1.05	1.05	1.11	0.88
7b *Rur Rec Winter*	1.15	1.25	1.21	1.12	1.12	1.03	0.82
PREVIOUS							
1a *Urb Arterial (a)*	1.03	0.95	0.94	0.92	0.87	1.11	1.30
1b *Urb Arterial (b)*	1.11	0.98	0.96	0.94	0.90	1.00	1.20
2 *Urb Commercial*	1.26	1.10	1.05	0.74	0.87	0.81	1.75
3 *Urb Industrial*	1.32	0.81	0.79	0.79	0.85	2.13	6.04
4 *Urb other*	1.06	1.03	1.00	0.95	0.90	0.89	1.25
5 *Rur Urb Fringe*	1.11	1.15	1.11	1.09	0.93	0.93	0.80
6a *Rur Strategic (a)*	1.05	1.02	1.00	0.99	0.88	1.08	1.02
6b *Rur Strategic (b)*	1.07	1.13	1.12	1.06	0.88	1.01	0.87
7a *Rur Rec Summer'*	1.04	1.14	1.15	1.07	0.87	1.07	0.88
7b *Rur Rec Winter*	1.12	1.26	1.25	1.17	0.88	0.99	0.77

* Included holidays as defined for the previous project

The results indicate relatively minor differences in the average day of week factors for most groups compared with the previous project, with the exception of *Urban Industrial* for which there is a comparatively much lower sample of sites. The *Urban Industrial* weekday factors are now very consistent, as might be expected, and both Saturday and Sunday factors are much higher than weekday factors, although less so than previously predicted. In this regard, the new results appear to be more realistic.

The day of week factors for groups 2 and 3 differed the most. Whereas previously group 2 consisted of a single site (Manukau), group 3 of three sites (two Manukau and one Invercargill) sites, and group 4 of a single (Invercargill) site, the replacement groups 2 and 3 consisted solely of Auckland City sites (and group 4 no longer occurred).

A noticeable change is evident for Fridays that previously had a similar day factor across the urban and rural groups, of around 0.88. For this project, however, the Friday day factors for the rural groups were substantially higher, representing relatively lower flows on Fridays as compared with the week as a whole, than

previously reported. Naturally, there were also differences for Sundays due to the change in their definition, where previously they incorporated holiday effects.

The results also reveal little differences in the day factors for those *urban arterials* within Greater Auckland compared to outside of Auckland, which is again evident in the relative 95% error of the day of week factors given in Table 3.

Table 3: Relative 95% Error in the Day of Week Factors

Group Day	Mon	Tue	Wed	Thu	Fri	Sat	Sun *
CURRENT							
1a1 *Urb Art a (Auck)*	0.06	0.03	0.03	0.03	0.03	0.07	0.09
1a2 *Urb Art. a (non Ak)*	0.05	0.04	0.03	0.03	0.03	0.05	0.07
1b1 *Urb Art b (Auck)*	0.04	0.02	0.02	0.03	0.03	0.04	0.05
1b2 *Urb Art. b (non Ak)*	0.04	0.03	0.02	0.03	0.03	0.04	0.05
2 *Urb CBD (Auck)*	0.06	0.06	0.05	0.05	0.06	0.12	0.24
3 *Urb Ind'l (Auck)*	0.10	0.08	0.09	0.08	0.10	0.24	0.26
5 *Rur Urb Fringe*	0.12	0.08	0.06	0.06	0.06	0.09	0.11
6a *Rur Strategic (a)*	0.07	0.06	0.04	0.07	0.05	0.07	0.09
6b *Rur Strategic (b)*	0.10	0.07	0.06	0.05	0.09	0.07	0.12
7a *Rur Rec Summer'*	0.18	0.12	0.11	0.11	0.15	0.14	0.21
7b *Rur Rec Winter*	0.17	0.17	0.18	0.11	0.15	0.13	0.19

As might be expected, the relative errors are greatest for the *urban industri*al and *rural recreational* groups, and particularly on Sundays. For the other groups, the variation in the day factors (compared to the weekly ADT) throughout the year is reasonably low, typically being only 3-5% for weekdays on urban roads and 5-9% for weekdays on rural roads.

Appendix I graphs the variation in the Wednesday day factors for the different groups. Two graphs are provided, viz *urban* and *rural*, with group 5 *rural urban fringe* repeated for convenience. The graphs indicate that the effect of the school holidays on the day of week factors (for Wednesday at least), while minor is still noticeable. At these times (around weeks 15/16, 25/26 and 40/41), the weekday day of week factors are typically lower.

Again, as might be expected, the graphs suggest that the relative error of the day of week factors is likely to be lower if holiday periods are avoided when undertaking a day count. On this basis, if only a day count is undertaken, it appears that a "reasonable" estimate of the AADT could be determined by multiplying the observed ADT by the annual average day of week factor and then by the week factor for the particular week.

Alternatively, one could potentially compute the factor for the particular day (or equivalent) from historical records of suitable continuous count sites, and derive the AADT directly. While this approach might be suitable on a local basis, it is impractical to undertake on a national basis with different years of data and varying Easter and other holidays. However, this approach is potentially a natural extension of the shift in the 1990's from the use of month factors to week factors in recognition of the variation in week factors within different months. The same gain in accuracy of AADT estimation is unlikely to be achieved in moving further from week to daily

factors (not to be confused with day of week factors). It is also questionable as to whether consecutive daily flows are wholly independent, more so than flows on consecutive weeks being independent of each other.

The mean and standard deviation of the day factors for each group are also provided in the updated Traffic Count Guideline.

4.6 Estimation of Partial Day Multipliers

4.6.1 Procedure

As an extension to the previous project, the derivation of partial day factors was examined with a view to their potential use for vehicle composition and commodity surveys and possibly intersection turning count surveys, all of which are undertaken manually.

Initially, analysis for each weekday of each of the three hour periods 9:00 am – 12 noon and 1:00 – 4:00 pm corresponding to the LTSA National Vehicle Composition surveys [undertaken February to May 2000] was undertaken.

Examination of the results identified that the variances were large, arising from many weeks having missing days for the periods involved (particularly the Auckland SCATS sites). Consequently, a more robust approach of summing the (non-holiday) Monday to Thursday and dividing by the number of valid hours was undertaken and this approach gave reasonable results.

Accordingly, the idea of undertaking the analysis for short periods on particular days was dropped as impractical, and instead analysis focussed on four periods, viz Monday – Thursday 7:00 – 9:00 am, 9.00 am – 12 noon, 1:00 – 4:00 pm and 4:00 – 6:00 pm.

It is to be noted that the aim of this analysis is to determine the likely error (variance) in the estimate of the weekly ADT for each of the four periods, and consequentially the error in AADT. The typical multiplier value to use for any hourly flow(s) can be derived from the group average median hourly flow profiles given in the appendices. For example, the peak two-way flow for an *urban arterial* site is approximately 9% of the AADT, that is a multiplier of around 11.

Due to the large variances, it was considered that analysis of partial days for heavy vehicles for *urban arterial* and *rural roads* was of little practical benefit. In particular, the loads associated with the heavy vehicles were not known (let alone type of heavy vehicle) and accordingly the distinguishing between light and heavy vehicles has been of necessity somewhat arbitrary. In this regard, it is understood that Stage 4 of the Transfund research project investigating loading data and its use in pavement management systems will be addressing this issue.

4.6.2 Results

The results of this analysis are given in Appendix G and summarised in Table 4 below.

Table 4: Mean and Error Partial Weekday (Monday-Thursday) Factors

Mon-Thu part day	1a	1b	2	3	5	6a	6b	7a	7b
MEAN									
7am - 9am (2 hours)	5.63	7.31	7.86	5.57	8.61	8.40	10.2	16.9	13.8
9am - 12pm (3 hours)	5.66	5.17	5.77	4.13	5.59	4.74	5.17	4.84	5.24
1pm - 4pm (3 hours)	5.10	4.60	5.22	3.72	5.49	4.41	4.89	4.08	4.76
4pm - 6pm (2 hours)	5.78	6.00	6.36	5.97	6.64	5.99	6.88	7.77	7.91
Relative 95% ERROR									
7am - 9am (2 hours)	0.12	0.11	0.18	0.16	0.18	0.23	0.18	0.26	0.23
9am - 12pm (3 hours)	0.06	0.05	0.11	0.10	0.10	0.07	0.07	0.13	0.13
1pm - 4pm (3 hours)	0.05	0.05	0.10	0.12	0.11	0.08	0.10	0.14	0.16
4pm - 6pm (2 hours)	0.05	0.04	0.09	0.14	0.08	0.08	0.07	0.12	0.12

The table indicates that the weekday morning peak period exhibits more variation throughout the year in the two-way traffic flows than the other periods examined, which generally have similar levels of precision.

Generally, the within-group variation is small compared to the differences between the groups, indicating that the determination of the traffic group based on a one-week count is likely to be independent of the particular week, with the possible exception of weeks 2 and 52 around Christmas and New Year.

Not surprisingly the *urban arterial* (1a and 1b) sites have the least variation with an error in the prediction of the weekly average daily traffic of only around 5%. This is only slightly worse than that reported in Table 3 for a whole day Tuesday to Friday count on *urban arterials* (of around 3%) suggesting that the partial weekday error might have been even better had Mondays been excluded.

The average partial weekday relative 95% errors for the *rural strategic* sites are similarly only slightly worse (2% absolute) than those for a whole day's survey. However, the overall error in the AADT for such a short-term count would nevertheless be high (typically 20% or more).

Appendix J graphs the variation in the average Monday–Thursday 4–6 pm period part-day factors for the different groups. Two graphs are provided, viz *urban* and *rural*, with group 5 *rural urban fringe* repeated for convenience. The graphs indicate that the effect of the school holidays on the day of week factors (for Wednesday at least) is noticeable. At these times (around weeks 15/16, 24 and 40/41), and similar to the day of week analysis results for Wednesday, the weekday PM peak period part-day factors are typically lower. Curiously, the mid-year dip, which is greatest for *the rural recreational* groups, appears to be one week earlier than for the Wednesday graphs. This could be potentially attributable to a number of factors, including the difference in when the mid-year break occurred in each of 1998 and 1999.

The graphs also suggest that the relative error of the part-day factors is likely to be lower if holiday periods are avoided when undertaking a part-day count.

The mean part-day factors for each group are also provided in the updated Traffic Count Guideline.

5 Conclusions and Recommendations

5.1 Summary

This research project has involved substantial data review and analysis from which useful practical results have been obtained.

The reproduction of the week factors has supported the view that traffic patterns throughout the year have significantly changed as a result of the change to a four term school year.

There has also been an effect on the day of week factors, although generally not necessarily a statistically significant effect.

A number of additional analyses have been successfully undertaken from which practical outputs have also been obtained. These include:
- the provision of week factors for heavy vehicles, and
- the provision of part-day factors for an average Monday-Thursday.

Along with the above revisions, these have been incorporated into the updated Traffic Count Guideline, along with additional comments in relation to regular traffic monitoring programmes.

5.2 Recommendations

As a result of this reseach project, the following recommendations are made:

1. That complimentary copies of the associated Traffic Count Guideline are provided to each road controlling authority and other suitable organisations, with the covering letter requesting feedback to a designated person within Transfund NZ.

2. That Transfund NZ also provide each of the road controlling authorities that supplied continuous data for the research, with a copy of the additional table of ADT's and graph of the week factors for each appropriate site-year.

3. That Transfund NZ retains the separate large Appendix Volume as well as the electronic copies of the various documents.

4. That every road controlling authority be encouraged to operate at least one continuously monitored traffic site, which would enable a better understanding of traffic patterns at a local level and would also provide the basis for improving the level of precision in the derivation of the group factors nationally, in the event that further research is undertaken in the future.

5. That each year, Transit NZ be requested to output and publish the group average week factors based on the continuous sites processed within their Traffic Monitoring System database.

6. That Transfund NZ consider auditing the practice of those road controlling authorities whose traffic volumes typically comprise a significant element in new project justification, specifically with respect to their regular traffic monitoring and the derivation of AADT.

Acknowledgments

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Transit NZ Traffic Count Guideline "A guide on Estimating AADT and Traffic Growth, and a Traffic Count Monitoring Programme Basis", authored by D. K. Wanty, November 1994

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APPENDICES

Appendix A — Site Details

A.1 TRANSIT NZ telemetry sites (North Island)

LOCATION	Stn SH/RP	Site no.	Grp cat.	1998 AADT	1998 days	98 HV AADT	1999 AADT	1999 days	99 HV AADT
NORTHLAND/AUCKLAND									
Kawakawa south	1N/111	18	6a	5101	356	400	n/a	n/a	n/a
Wellsford north	1N/240	17	6b	7076	365	472	7098	363	474
Hatfields Beach	1N/290	77	6b	13666	355	760	14206	362	833
Auckland Harbour Bridge	1N/331	55	1a	149235	333	n/a	148878	195	n/a
Panama Rd overbridge	1N/347	79	1a	102852	279	n/a	104101	359	n/a
Drury Park Estate	1N/367	7	5	40486	135	3003	45584	200	3621
Drury south WIM	1N/379	48	n/a						
Bombay	1N/382	72	5	27562	301	2639	29136	359	2819
WAIKATO/BAY OF PLENTY									
Mangatawhiri	2/3	74	6b	11608	326	1104	11938	364	1204
Waihi west	2/91	34	6b	6409	364	534			
Neavesville	25A/11	76	7b	2766	360	231	3165	244	262
Kaihere	27/11	33	6b	4259	343	602	4419	364	667
Taupiri north	1N/434	19	6b/5	1613	343	1679	16284	339	1688
Karapiro: s Hydro turnoff	1N/492	20	6b	12111	292	1150	12318	285	1155
Lichfield	1N/531	21	6b	7887	237	1102	7807	328	1198
Tokoroa north WIM	1N/546	51	6b	7580	157	1112	7994	352	1210
Halletts Bay	1N/642	42	7b	5335	125	611			
Te Kuiti south	3/86	16	6b	3428	358	426	3643	363	452
West Lake Taupo	32/44	43	7b	648	357	67	675	329	79
Te Puna west	2/141	65	6a/b	11979	333	686	9143	122	486
Te Puke west WIM	2/176	49	6a	15026	361	1275	15493	364	1377
Ohinepanea	2/204	13	6a	3851	345	535	3994	358	539
Tarukenga	5/34	15	6b	4449	303	385	4619	363	403
Waipa	5/57	41	6a	5869	364	502	6007	312	518
Kaimai	29/34	12	6b	6243	358	696	6519	364	748
Te Ngae, Rotorua	30/149	64	1b	32534	325	1262	32736	362	1308
Lake Rotoma	30/191	22	6a	2886	365	262	2892	104	267
Paengaroa	33/30	14	5	4158	359	512	4275	344	533
GISBORNE/HAWKE BAY									
Ormond	2/429	26	6a	2250	363	217	2349	363	228
Tangoio	2/631	24	6a/b	1646	310	223	1736	365	265
Te Pohue	5/230	23	7b	2295	361	301	2495	355	345
Napier south	50/8	58	1b	12529	358	685	(14519)	(362)	
TARANAKI/WANG-MANA.									
Tongaporutu	3/171	78	7b	1618	341	260	1749	197	275
Tariki	3/267	6	6a	6833	359	538	6976	57	581
Waitotara east	3/370	5	6b	3169	364	326	3173	363	264
Hawera west	45/100	71	1b	3827	254	369	3683	228	271
Norsewood overbridge	2/755	25	6b	3358	313	444	3549	363	473
Hihitahi	1N/739	29	7b	4242	363	591	4470	236	610
Sanson west	1N/848	38	6b	11142	357	1030	11512	354	1040
Ohau south	1N/907	56	6b	13505	318	968	13985	360	1018
Manawatu Gorge	3/489	30	6b	5855	227	522	6156	322	547
Horopito	4/135	37	7b	1429	335	173	1573	362	179
Upokongaro south	4/227	28	6a	1921	229	136	1996	179	157
WELLINGTON									
Clareville north	2/897	80	6a	7898	237	438	8091	365	438
Rimutaka	2/937	1	5	4481	359	199	4679	289	208
Pukerua Bay	1N/958	47	5	20630	325	1034	21536	312	1057
Ngauranga SH1	1N/987	81	1a	39716	287	750	40572	345	791
Ngauranga SH2	2/979	82	1a	41927	287	1026	42113	345	1059
Belmont	58/9	73	1a	11498	350	327	11684	241	164

A.2 TRANSIT NZ telemetry sites (South Island)

LOCATION	Stn SH/RP	Site no.	Grp cat.	1998 AADT	1998 days	98 HV AADT	1999 AADT	1999 days	99 HV AADT
NELSON/MARL/TASMAN									
Hira	6/100	36	6b	2512	358	285	2675	204	286
Stoke s Hays Corner	6/123	60	1b	23358	268	840	25030	365	962
Murchison north	6/236	35	7a	1373	313	170	1466	361	176
□									
	1S/144	9	7a	1863	362	220	2146	363	242
	1S/287	52	6b	5614	358	441	5866	355	480
	74/7	59	1b	21272	353	419	21518	365	421
	1S/389	68	6b	6882	324	839	7279	364	913
	1S/505	69	1b	18570	297	820	18251	263	946
	1S/522	31	6b	4620	364	606	4772	363	782
	7/108	32	7a	962	231	145	1007	357	149
	73/64	11	7b	1165	363	91	1318	362	97
	6/395	39	6a	723	304	63	739	330	58
	6/454	70	6a	2013	277	178	2044	365	176
	7/239	40	6a	965	274	129	1081	352	124
OTAGO/SOUTHLAND									
Green Island motorway	1S/712	63	1b				20255	137	960
Milton south	1S/765	27	6b	5030	364	502	5616	81	663
Alexandra south	8/336	44	6b	1648	364	134	1718	360	140
Gore east	1S/854	45	6a	3559	336	338	3678	356	358
Tay St, Invercargill	1S/922	62	1b	10438	341	276	10363	365	278
Winton south	6/1147	46	6a	3596	356	282	3724	350	296

A.3 Other state highway sites analysed (1998 only)

LOCATION	Stn SH/RP	Site no.	Grp cat.	1998 AADT	1998 days	98 HV AADT	1999 AADT	1999 days	99 HV AADT
TNZ AUCKLAND ATMS									
Constellation Dr	1N/319		n/a						
Tristram	1N/323	91	1b	59222	347	3436			
Northcote	1N/326	90	1b	69201	335	3969			
Esmonde Rd	1N/328	89	1b	83061	353	4477			
Auckland Harbour Bridge	1N/330	87	1b	131860	228	16067			
Shelly Beach/St Mary Bay	1N/332	86	1b	124281	336	5658			
Wellington St	1N/334	84	1b	55358	354	3374			
Spaghetti Junction	1N/336	92	1b	131363	352	7853			
Gillies Ave	1N/337	93	1b	149816	355	9914			
Greenlane	1N/340	94	1b	124523	334	8859			
Ellerslie	1N/342	95	1b	111330	358	7619			
Mt Wellington	1N/345	96	1b	75783	357	4379			
Papatoetoe I/C	1N/351	8	1b	69770	346	5598			
Manukau I/C	1N/355	10	1b	58107	345	4858			
Takanini I/C	1N/361		n/a						
Western Springs	16/6	97	1a	81639	347	3893			
Waterview	16/8	98	1a	64647	351	3512			
Te Atatu I/C	16/11	99	1a	62386	346	3418			
Lincoln Rd I/C	16/14	100	n/a						
Mangere Bridge	20/12		n/a						
WELLINGTON CITY									
Mt Victoria Tunnel	1N/996	83	1b	36595	346	n/a			
TNZ CHRISTCHURCH									
Arthur's Pass	73/146	53	7b	1144	296	n/a			
Waimak Twin Bridges	1S/323	54	1b	31340	258	n/a			
Curletts Road	73/7	57	1b	29153	209	n/a			

A.4 Other local sites (and SH sites categorised but not analysed)

LOCATION	Stn SH/RP	Site no.	Grp cat.	1998 AADT	1998 days	98 HV AADT	1999 AADT	1999 days	99 HV AADT
KAIPARA DISTRICT									
Tangawahine Valley		66					(57)	(252)	
Tomarata Rd		67	6a				90	189	34
Kaiiwi Lakes Rd		75					(26)	(275)	
RODNEY DISTRICT*									
Wellsford south	1N/258	141	6b				8197	275	n/a
Warkworth south	1N/270	142	6b				12205	276	n/a
Orewa north	1N/293	143	5				16638	299	n/a
Orewa south bridge	1N/295	144	6a				31271	282	n/a
Silverdale north	1N/297	145	5				39066	279	n/a
south of East Coast Road	1N/303	146	5				19175	265	n/a
NORTH SHORE CITY									
Glenfield:Speedy-Coronation		102	1a				25659	674	347
Wairau:Tristram-Archer		103	1b				25283	884	308
Albany Hwy:Rosedale-Pr		104	1a				12419	389	325
Mokoia:Balmain-Roseberry		105	1b				22038	553	325
Lake:Eversleigh-Bardia		106	1b				30033	734	343
East Coast:Spencer-JD		107	1a				26956	1204	317
East Coast:Sunrise-Wsr		108	1a				27282	808	184
AUCKLAND CITY									
Queen:Victoria-Wellesley		111	2				19277	305	n/a
Quay:Tinley-Britomart		112	2				30455	303	n/a
Wellesley:Queen-Albert		113	2				12634	257	n/a
Victoria:Hobson-Nelson		114	2				18506	346	n/a
Albert:Victoria-Wyndham		115	2				15980	248	n/a
Wyndham:Hobson-Albert		116	n/a						
Franklin		117	1b				9296	356	n/a
Bassett:n Remuera		121	1b				6147	317	n/a
Ranfurly:w Manukau		122	1a				4786	342	n/a
Ranfurly:e Manukau		123	1b				4789	340	n/a
Stokes		124	1b				9614	351	n/a
Kingsway		125	1b				1555	352	n/a
Manukau:n Greenlane		126	1b				30374	348	n/a
Greenlane:w Wheturangi		127	1b				28479	334	n/a
Gt South:at Greenlane		128	1b				20700	343	n/a
Dominion:at Balmoral		129	1b				37434	338	n/a
Morrin		131	3				10924	190	n/a
Ireland		132	3				7953	362	n/a
Bowden		133	3				2387	211	n/a
Neilson: w Capt. Springs		134	1a				21735	362	n/a
Vestey: e Great South		135	3				4087	361	n/a
Carbine at Bowden		136	2				23222	192	n/a
EPH: w Mt Wgtn H'way		137	1b				38561	359	n/a
Mt Albert: e Pah		138	1b				20526	361	n/a
Gt North: n Herdman		139	1b				46932	362	n/a
TAURANGA DISTRICT									
Cameron Rd: McLean-Harr.		85	1b	16349	311	n/a	16483	246	n/a
CLUTHA DISTRICT									
Owaka to Clinton road		88	6b	869	131	230			

Notes
- Figures in brackets indicate the values were derived from the separate analysis spreadsheet.
- The Rodney sites were not utilised in the factor analyses
- n/a in the road group category indicates that the data for the site was either unavailable or insufficient to categorise the traffic pattern for the site (e.g.some ATMS sites)
- n/a in the HV ADT field indicates heavy vehicle flows were not available

Appendix B
Collation issues for evaluation of continuous data

Transit NZ Mark 3 Sites

These are sites that use the Golden River Marksman Series 3 traffic recorder. The applied monthly data occasionally contained data for partial days or problem data which had an "*" (asterisk) inserted in the first column. These had to be manually edited which was relatively simple for where partial days had occurred.

A number of sites suffered from an old "hexadecimal conversion" problem which was thought had been resolved earlier. This necessitated isolating the offending (week) data, and importing into a specially created spreadsheet, exporting back the correctly converted data (in text format) and inserting back into the .DAT file replacing the corrupt data.

A number of monthly files had blocks of repeated data which was another problem seldom encountered before. While easily picked up by the processing computer program, this nevertheless added to the time taken to "clean" the Transit NZ data.

A number of files contained the occasional very long or very short record which typically resulted in a missing channel of data which the computer program again picked up.

More difficult to initially detect and certainly to correct were sites where the loops in one direction (channel) were 'playing up' prior to ultimately 'dying'. This problem was alleviated by an adjustment to the computer program to output on the screen for each month the number of complete days data processed for each channel. Any differences were then investigated which firstly needed inspection of the output file to isolate the days involved. The channel interval data then needed manual editing in a manner which would ensure that the resultant daily directional flow was less than the tolerance allowed (eg zero) such that the computer program automatically assumed that the corrupted days data was effectively missing.

There were also some data glitches common to a high number or all of the Mark 3 telemetry sites. These included funny non-numeric characters in the June 1998 files that possibly occurred when the data was written onto the supplied CD ROM. There were no archived files for January 1999 apart for the special Auckland Harbour Bridge Mark 3 sites. This necessitated a delay to the data processing to incorporate the January 2000 data instead, and also required adjustments to the computer program and creation of additional analysis spreadsheets.

It was also observed that there was no data for 8 May 1999 but this unusual situation did not create any processing difficulties.

At the end of 1999, Transit NZ undertook two changes to the standard data format. As the data supplied did not contain the leader information for each weekly data block, a special header had to be inserted and the program altered accordingly.

It is pleasing however, that the latter of the two format changes resulted in a more consistent format in common with the Mark 6 and other sites.

A few of the Mark 3 sites were also upgraded to Mark 6 sites during 1998/99. Again this required particular attention and further program changes.

With respect to the Auckland Harbour Bridge site (55) it was noticed that Transit had added a sensor output to record for each 15 minute interval the number of seconds the central two lanes were operating in the tidal flow direction. The main computer program was then required to be modified accordingly, instead of having to update the previously created AHB site program. Subsequent examination of the supplementary Transpac output data revealed that the directional hourly flow apparently exceeded 9999 vph at times, thereby overflowing the allowable four digit space.

However, further investigation indicated that occasionally there were recorded lane flows exceeding 700 vehicles in the quarter hour typically coinciding with >900 seconds recorded in the movable median barrier switch sensor columns. The peak period also shifted and there were a number of hours suspiciously missing between the end of one week's data and the start of the next weekly data download, at which time the recorded clock is synchronised if need be. Accordingly, manual deletion of the offending quarter hours was needed plus the creation of a program to modify the recorded times as appropriate for the remaining and otherwise good data.

Transit NZ Mark 6 Sites

Many of the above Mark 3 problems were common to the Mark 6 sites. However, because of the large size of the Mark 6 files, the problems took longer to rectify, noting that the MSDOS standard Editor was used rather than a specialist text editor.

Furthermore, the June 1998 problem took an inordinate amount of time to resolve for the two Ngauranga sites due to coinciding with an unexpected two minute interval during the peaks.

Transit NZ ATMS Sites

The source of this data was a Serco database supplied on a CDROM. A query function had been formulated to output the hourly directional data into short and long vehicles for all the sites. When executed this created a mammoth data file for 1996-1999.

A program was written to disaggregate this into four annual files and another created to then process the data for each site. An adjustment was necessary for the hour ending midnight that had been incorrectly recorded for the hour ending 00-00 on the next day. Accordingly, the final hour of the Millennium is missing in the analysis. Note that bins L2 and L4 were deemed to be zero with the number of short/long vehicles input into the L1/L3 bins, respectively.

It has since been discovered that the directional data for each of the four standard vehicle length bins could in fact have been supplied, and should be requested in conjunction with the supply of data from this source in future.

Transit NZ Christchurch Continuous Sites

For many years Transit NZ Christchurch have counted semi-continuously at the Northern Motorway (Waimakariri Twin Bridges) and Curletts Road loop sites using the HSL loop detector.

Data from both of these sites were evaluated as part of the previous research project and so were again incorporated. A CD-ROM of all the Transit Christchurch data cassette files up to mid 1999 was provided along with the processing printout records and outputs - unfortunately no more convenient data files were available. Examination confirmed that the last quarter hour of each day was ignored by the standard Transit processing program so once again a program was required to be written. Furthermore, the relevant parts of the relevant cassette files had to be extracted into a site file(s). It transpired that the records were at times wrong and some of the files also missing and which were not available elsewhere. Transit Christchurch were also unable to provide the data for the remainder of 1999 prior to the analysis.

A timing fault was also identified for the Otira site and due to its sporadic operating status, this additional semi-continuous site was not included. However, the semi-continuous site at Arthur's Pass has been included in this project and should allow in due course for interesting comparisons following opening of the Otira Viaduct in November 1999 and completion of the major road works at Candys Bend in late 2000.

Auckland City SCATS Sites

Auckland City Council have been collecting continuous quarter hour flows over a number of years, with data at a total of over 200 intersections now collected.

After examination of all these, traffic count data from a subset of these were requested comprising a mix of residential, industrial, arterial and central business district streets. Peter Hall, Auckland City (now retired) created a batch file for each of their three computers to compile the relevant detector data in weekly blocks from 5 April 1999 to 9 April 2000.

The intersection layouts were subsequently supplied as necessary for the program created to combine the detectors into the two directions. It transpired that there were some discrepancies and missing detector data, and while a few intersections had count loops on the departure legs, often there was not a left turn only detector appropriate to the departure direction. However the pattern rather than the actual traffic volume is the focus of attention for this project and consequently the use of the SCATS detector flows was considered acceptable. The created processing program also identified two files with the wrong weeks data which was easily rectified. An additional weeks data (29 March – 4 April 1999) would also have later been desirable due to Easter occurring at the beginning of the school holidays in

1999 (Good Friday being 2 April) but at the end of the school holidays in 2000 (Easter Monday being 24 April followed by Anzac Day). Instead the week beginning Monday 3 April 2000 was substituted for the previous week in order to "capture" the last week of the first term. Consequentially only the last week of the April school holiday was included and only the end of the Easter long weekend).

North Shore City Sites

The source of the data for a number of sites in North Shore was a Scott Technical Instruments database, from which the raw data for seven sites were eventually supplied on a CD-ROM.

As the data structure was the converse in effect of the Transit NZ telemetry sites, a processing program had to be created, and which also adjusted for the use of NZ Standard Time in the STI database.

Once again the program checks revealed some inconsistencies which resulted in a few weeks of data needing to be deleted from two of the sites.

Furthermore it became evident that the date was consistently out by one day for one of the sites.

Rodney District Sites

The data for six continuous sites on the state highway in Rodney District were also provided by Serco.

The data for 1999 were generally in monthly files containing the directional flows per fifteen minute interval. The main processing program was again modified to accommodate this different data format.

Kaipara District Sites

Data for four sites in Kaipara District was supplied by Duffill Watts and King in a convenient format. It was necessary to modify the missing data check in the main processing program due to the low flows but otherwise processing was straightforward.

Tauranga District Site

Data for the Cameron Road (between McLean and Harrington) loop site were supplied by Council in a series of spreadsheets effectively comprising an electronic weekly/fortnightly printout. These were cut and pasted into a spreadsheet and processed to create the standard hourly flow output format.

Wellington City Site

Data for the Mt Victoria Tunnel loop site were supplied by Council with a program created to process the initial sample week file. Unfortunately the format for the

weekly files for the previous 12 months was a different format requiring program modifications. Apart from that there were no further processing difficulties.

Clutha District Site

Data for the Owaka-Clinton portable classifier site were supplied in weekly files. After confirming that the FHWA-7 classification scheme was utilised, processing was relatively straightforward, with each of the 13 classes assigned to one of the four vehicle length bins.

Other Potential Sites

It had been expected that continuous data would be available from Hutt City Council from their loop sites on the bridges and by Hutt Hospital (analysed in the previous project). However due to technical difficulties and the nature of the counting contract, examination of the available files showed that they were too sporadic to be included.

Manukau City had only very recently begun to collect continuous data at a few sites. Similarly the Transit NZ Green Island motorway site did not become fully operational until October 1999 and furthermore has an unusual site layout. Like the six Rodney sites while it was included in the analysis it was able to be categorised into one of the subsequently nine traffic pattern groups.

Appendix C
Main data processing procedures

There were two values for the valid number of hours, for directions A and B respectively. For some of the sites, the analysis program assumed they were the same. Consequently some further manual editing of the CSV files results was undertaken where expedient.

For the classified sites, the hourly flow was replaced by the four vehicle length bin flows for each hour (ie 96 direction A flows followed by 96 direction B flows).

Each file generally has a header line containing the site filename and site location.

A series of related analysis spreadsheets were formed based on the one main analysis spreadsheet into which the CSV files were imported. In the case of the two Ngauranga sites (3 and 4) the two halves of each CSV file were imported and recombined such that a SH1 (southbound and northbound) and SH2 (southbound and northbound) were created (as sites 81 and 82 respectively).

The two-way ADTs and day/week factors for each site year are produced in the Appendix Volume along with the graphs of the Monday-Sunday week factors (including Easter).

The resultant clean CSV files are now of immediate use in a form readily able to be incorporated in databases such as the Transit NZ traffic information database.

Furthermore the main processing program (CVGRCSV3) which has been substantially modified and enhanced can now readily process most of the pre-1998 Transit telemetry data into the same convenient format and similarly the associated programs can handle most other traffic data formats.

Appendix D.1 — Group Average Week Factors

Week	1a1	1a2	1b1	1b2	2	3	5	6a	6b	7a	7b
beg Mon.	urb art Ak	u art x Ak	urb art Ak	u art x Ak	urb cbd Ak	urb ind'l Ak	rur urb fr.	rur strat a	rur strat b	r rec sum	r rec win
2	1.343	1.172	1.236	1.073	1.282	1.682	0.886	0.833	0.851	0.510	0.696
3	1.127	1.056	1.074	1.032	1.118	1.155	0.924	0.910	0.947	0.628	0.838
4	1.043	0.997	1.007	0.987	1.023	1.015	0.906	0.889	0.946	0.713	0.804
5	1.043	1.006	1.019	0.973	1.063	1.034	0.945	0.961	0.981	0.847	0.970
6	1.047	0.977	1.033	0.993	1.054	1.158	0.881	0.915	0.925	0.852	0.840
7	0.979	0.961	0.989	0.969	1.008	1.066	0.971	0.944	0.977	0.830	1.008
8	0.970	0.958	0.974	0.956	0.984	1.081	0.991	0.948	0.949	0.834	0.980
9	0.986	0.974	0.978	0.960	0.970	1.271	0.982	0.957	0.988	0.891	1.004
10	0.975	0.963	0.976	0.980	0.995	1.028	0.985	0.984	0.989	0.973	1.009
11	0.978	0.981	0.989	0.986	1.050	1.000	1.021	0.973	1.007	0.988	0.994
12	0.971	0.968	0.990	0.958	1.026	1.019	0.985	0.982	0.988	1.020	1.041
13	0.992	0.985	0.987	0.974	1.051	1.021	1.048	1.022	1.053	1.054	1.145
14	0.980	0.999	0.975	0.977	0.974	0.912	1.084	1.044	1.074	1.176	1.205
15	1.084	1.009	1.053	0.985	0.950	1.187	0.923	0.985	0.891	0.861	0.915
16	1.041	0.982	1.033	0.979	0.988	1.066	0.954	0.958	0.900	0.872	0.880
17	0.982	0.984	0.996	0.973	0.969	1.054	1.027	0.998	0.996	1.047	1.018
18	1.001	0.994	1.013	0.985	0.976	1.041	1.096	1.062	1.075	1.198	1.237
19	1.027	0.999	1.023	0.996	1.020	1.119	1.078	1.077	1.079	1.285	1.262
20	1.023	1.002	1.020	1.009	1.076	1.093	1.122	1.098	1.101	1.317	1.273
21	0.994	0.991	1.011	1.011	1.090	1.037	1.099	1.107	1.121	1.342	1.305
22	1.036	1.012	1.027	1.016	1.131	1.069	1.107	1.092	1.083	1.325	1.215
23	1.053	1.012	1.051	1.049	1.097	1.016	1.048	1.089	1.044	1.159	1.095
24	1.074	1.030	1.071	1.045	1.141	1.113	1.089	1.138	1.087	1.274	1.184
25	1.030	1.017	1.034	1.037	1.044	0.993	1.109	1.152	1.126	1.393	1.282
26	1.037	1.013	1.009	1.033	1.053	0.978	1.107	1.137	1.106	1.348	1.261
27	1.082	1.019	1.042	1.045	1.063	1.080	1.039	1.107	1.035	1.182	1.087
28	1.093	1.010	1.050	1.044	1.057	1.035	0.988	1.061	0.965	1.091	0.964
29	1.053	1.005	1.034	1.042	1.040	1.037	1.063	1.121	1.063	1.320	1.131
30	1.037	1.009	1.030	1.062	0.983	1.037	1.149	1.167	1.162	1.455	1.312
31	1.021	1.010	1.022	1.055	1.071	1.061	1.128	1.163	1.163	1.429	1.247
32	1.019	1.004	1.017	1.031	1.058	1.063	1.110	1.135	1.135	1.433	1.148
33	1.006	1.007	1.011	1.031	1.109	1.071	1.121	1.136	1.135	1.408	1.167
34	1.023	1.006	1.024	1.023	1.093	1.065	1.116	1.140	1.130	1.404	1.128
35	1.019	1.002	1.024	1.022	1.089	1.057	1.096	1.149	1.095	1.326	1.130
36	1.005	0.990	1.027	1.013	1.072	1.026	1.061	1.104	1.070	1.307	1.092
37	1.017	0.999	1.025	1.019	1.198	1.103	1.076	1.108	1.095	1.317	1.108
38	1.019	1.000	1.021	1.013	1.168	1.103	1.056	1.095	1.062	1.208	1.090
39	1.035	0.990	1.020	1.009	1.063	1.023	0.984	1.024	0.956	1.008	0.960
40	1.033	0.985	1.021	0.998	1.074	1.004	0.933	0.981	0.918	0.924	0.886
41	1.008	1.002	1.001	1.009	1.078	1.028	1.023	1.043	1.022	1.099	1.023
42	0.985	0.996	0.987	0.989	1.073	1.040	1.051	1.065	1.085	1.241	1.172
43	1.019	0.998	1.025	0.979	1.059	1.077	0.955	0.966	0.949	0.954	0.949
44	1.067	1.039	1.063	0.998	1.118	1.131	0.963	1.008	0.967	0.946	0.990
45	1.006	0.964	1.009	0.968	1.041	1.075	1.053	1.024	1.069	1.125	1.168
46	0.992	0.966	0.972	0.978	1.030	1.049	0.983	0.993	0.997	0.899	1.052
47	0.985	0.961	0.955	0.959	1.041	1.031	0.969	0.975	1.011	1.034	1.042
48	0.988	0.951	0.986	0.934	1.041	1.004	0.981	0.969	0.995	1.049	1.012
49	0.985	0.937	0.960	0.930	0.988	1.032	0.970	0.987	1.001	1.065	1.078
50	0.997	0.921	0.957	0.907	0.994	1.016	0.954	0.956	0.987	1.069	1.079
51	1.008	0.920	0.951	0.909	0.980	1.027	0.951	0.950	0.982	0.997	1.045
52	1.137	1.021	1.025	0.944	1.051	1.065	0.809	0.851	0.790	0.681	0.733
avg 3-51	1.020	0.991	1.011	0.997	1.050	1.057	1.026	1.038	1.030	1.113	1.078
median	1.019	0.998	1.019	0.996	1.053	1.041	1.027	1.024	1.022	1.091	1.079
NOTE	Factors exclude Easter period defined as Thursday before Good Friday to Easter Tuesday										
site-years	18	6	23	21	6	4	15	30	41	6	16

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Appendix D.2 — Group Std Deviation Week Factors

Week	1a1	1a2	1b1	1b2	2	3	5	6a	6b	7a	7b
	urb art Ak	u art x Ak	urb art Ak	u art x Ak	urb cbd Ak	urb ind'l Ak	rur urb fr.	rur strat a	rur strat b	r rec sum	r rec win
2	0.285	0.106	0.148	0.098	0.158	0.058	0.122	0.133	0.095	0.084	0.105
3	0.160	0.055	0.080	0.065	0.072	0.027	0.066	0.093	0.096	0.127	0.095
4	0.099	0.041	0.053	0.038	0.056	0.053	0.059	0.145	0.104	0.179	0.137
5	0.086	0.034	0.059	0.040	0.050	0.038	0.055	0.040	0.069	0.113	0.098
6	0.081	0.015	0.052	0.060	0.083	0.115	0.090	0.066	0.079	0.128	0.157
7	0.047	0.008	0.061	0.061	0.053	0.103	0.020	0.074	0.043	0.067	0.087
8	0.045	0.035	0.045	0.044	0.071	0.135	0.068	0.056	0.039	0.050	0.066
9	0.054	0.005	0.047	0.034	0.085	0.450	0.017	0.069	0.034	0.058	0.101
10	0.030	0.021	0.051	0.038	0.067	0.040	0.071	0.048	0.035	0.068	0.080
11	0.034	0.006	0.042	0.040	0.058	0.049	0.026	0.099	0.029	0.085	0.191
12	0.065	0.012	0.058	0.039	0.062	0.023	0.037	0.055	0.040	0.090	0.085
13	0.052	0.022	0.047	0.020	0.043	0.053	0.032	0.045	0.056	0.078	0.071
14	0.023	0.016	0.038	0.028	0.048	0.002	0.028	0.038	0.044	0.012	0.098
15	0.157	0.005	0.136	0.019	0.127	0.115	0.036	0.101	0.037	0.060	0.054
16	0.108	0.021	0.077	0.017	0.148	0.070	0.063	0.061	0.045	0.085	0.083
17	0.045	0.012	0.060	0.024	0.150	0.053	0.085	0.063	0.093	0.169	0.144
18	0.058	0.021	0.056	0.014	0.162	0.037	0.038	0.052	0.044	0.081	0.096
19	0.120	0.009	0.099	0.022	0.155	0.034	0.042	0.071	0.045	0.065	0.114
20	0.087	0.027	0.081	0.029	0.052	0.062	0.039	0.076	0.053	0.058	0.091
21	0.049	0.022	0.057	0.023	0.056	0.034	0.045	0.087	0.057	0.028	0.096
22	0.094	0.020	0.079	0.024	0.104	0.035	0.064	0.114	0.081	0.212	0.212
23	0.056	0.029	0.054	0.039	0.047	0.071	0.033	0.082	0.040	0.053	0.078
24	0.079	0.012	0.071	0.031	0.056	0.154	0.073	0.097	0.104	0.200	0.190
25	0.064	0.028	0.060	0.040	0.049	0.121	0.081	0.110	0.089	0.054	0.163
26	0.066	0.048	0.051	0.031	0.051	0.161	0.055	0.119	0.073	0.070	0.150
27	0.117	0.011	0.065	0.039	0.055	0.060	0.060	0.095	0.080	0.106	0.149
28	0.127	0.020	0.062	0.039	0.048	0.028	0.032	0.079	0.060	0.047	0.255
29	0.094	0.021	0.086	0.035	0.071	0.040	0.072	0.127	0.110	0.229	0.175
30	0.072	0.033	0.073	0.077	0.080	0.009	0.061	0.097	0.056	0.106	0.115
31	0.070	0.021	0.066	0.064	0.085	0.019	0.038	0.118	0.068	0.166	0.163
32	0.061	0.020	0.062	0.034	0.067	0.050	0.040	0.093	0.056	0.083	0.154
33	0.036	0.019	0.046	0.029	0.080	0.043	0.042	0.097	0.045	0.063	0.142
34	0.060	0.020	0.059	0.027	0.027	0.033	0.045	0.097	0.054	0.055	0.142
35	0.070	0.036	0.071	0.035	0.043	0.056	0.045	0.131	0.053	0.054	0.184
36	0.050	0.008	0.061	0.023	0.052	0.019	0.050	0.086	0.044	0.051	0.156
37	0.060	0.015	0.063	0.042	0.091	0.130	0.033	0.073	0.044	0.080	0.138
38	0.060	0.023	0.061	0.031	0.092	0.100	0.038	0.060	0.062	0.059	0.137
39	0.101	0.020	0.056	0.027	0.044	0.022	0.061	0.061	0.075	0.072	0.158
40	0.127	0.006	0.071	0.025	0.061	0.044	0.028	0.040	0.029	0.031	0.092
41	0.051	0.008	0.053	0.025	0.066	0.028	0.069	0.083	0.086	0.203	0.162
42	0.043	0.016	0.050	0.019	0.078	0.097	0.037	0.050	0.046	0.063	0.086
43	0.064	0.023	0.057	0.023	0.050	0.111	0.021	0.076	0.035	0.089	0.103
44	0.110	0.026	0.096	0.031	0.071	0.047	0.023	0.051	0.050	0.046	0.188
45	0.086	0.013	0.075	0.038	0.054	0.095	0.048	0.044	0.053	0.042	0.111
46	0.064	0.016	0.057	0.040	0.064	0.072	0.031	0.061	0.062	0.035	0.106
47	0.103	0.012	0.043	0.038	0.085	0.096	0.033	0.056	0.094	0.033	0.049
48	0.111	0.012	0.066	0.027	0.090	0.096	0.036	0.045	0.035	0.064	0.079
49	0.107	0.008	0.056	0.024	0.064	0.093	0.025	0.068	0.027	0.050	0.077
50	0.127	0.008	0.070	0.024	0.068	0.082	0.023	0.036	0.033	0.051	0.064
51	0.135	0.013	0.070	0.027	0.063	0.108	0.024	0.043	0.041	0.059	0.061
52	0.236	0.091	0.064	0.070	0.062	0.057	0.053	0.062	0.063	0.071	0.108
avg 3-51	0.079	0.019	0.063	0.034	0.073	0.074	0.046	0.076	0.058	0.084	0.122
median	0.070	0.020	0.060	0.031	0.064	0.053	0.040	0.073	0.053	0.065	0.111
NOTE	Factors exclude Easter period defined as Thursday before Good Friday to Easter Tuesday										

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Appendix D.3 — Group Relative 95% Error Week Factors

Week	1a1	1a2	1b1	1b2	2	3	5	6a	6b	7a	7b
	urb art Ak	u art x Ak	urb art Ak	u art x Ak	urb cbd Ak	urb ind'l Ak	rur urb fr.	rur strat a	rur strat b	r rec sum	r rec win
2	0.425	0.180	0.240	0.183	0.246	0.069	0.275	0.320	0.223	0.331	0.303
3	0.284	0.105	0.149	0.127	0.128	0.046	0.143	0.204	0.203	0.405	0.228
4	0.191	0.083	0.106	0.076	0.110	0.104	0.131	0.325	0.219	0.503	0.340
5	0.166	0.068	0.116	0.082	0.095	0.073	0.116	0.084	0.140	0.267	0.202
6	0.154	0.032	0.101	0.122	0.157	0.199	0.205	0.144	0.170	0.300	0.374
7	0.096	0.017	0.123	0.126	0.104	0.193	0.041	0.157	0.088	0.161	0.173
8	0.094	0.072	0.092	0.092	0.145	0.249	0.136	0.119	0.082	0.121	0.134
9	0.110	0.010	0.097	0.071	0.175	0.708	0.034	0.144	0.069	0.131	0.201
10	0.061	0.043	0.104	0.078	0.136	0.078	0.145	0.098	0.071	0.141	0.159
11	0.069	0.013	0.085	0.082	0.110	0.098	0.050	0.204	0.057	0.172	0.385
12	0.134	0.025	0.118	0.082	0.121	0.046	0.076	0.112	0.081	0.177	0.164
13	0.105	0.044	0.096	0.041	0.082	0.104	0.060	0.088	0.106	0.148	0.124
14	0.047	0.031	0.079	0.058	0.099	0.005	0.051	0.072	0.082	0.021	0.162
15	0.289	0.009	0.259	0.039	0.267	0.194	0.079	0.206	0.083	0.138	0.119
16	0.207	0.042	0.150	0.036	0.300	0.131	0.132	0.128	0.099	0.194	0.190
17	0.092	0.025	0.120	0.048	0.309	0.100	0.166	0.126	0.187	0.324	0.282
18	0.116	0.042	0.111	0.028	0.332	0.071	0.070	0.097	0.082	0.135	0.155
19	0.233	0.019	0.194	0.044	0.303	0.061	0.077	0.132	0.083	0.101	0.180
20	0.170	0.053	0.158	0.057	0.096	0.113	0.069	0.138	0.096	0.089	0.144
21	0.099	0.044	0.113	0.046	0.103	0.065	0.083	0.157	0.102	0.041	0.147
22	0.182	0.040	0.154	0.048	0.184	0.065	0.115	0.209	0.150	0.320	0.350
23	0.106	0.058	0.102	0.075	0.085	0.139	0.062	0.150	0.077	0.092	0.143
24	0.146	0.024	0.133	0.060	0.098	0.277	0.133	0.171	0.191	0.315	0.321
25	0.124	0.056	0.116	0.078	0.094	0.244	0.145	0.192	0.157	0.078	0.254
26	0.128	0.095	0.101	0.060	0.096	0.328	0.100	0.209	0.132	0.105	0.238
27	0.216	0.021	0.125	0.075	0.103	0.111	0.115	0.171	0.155	0.180	0.274
28	0.232	0.040	0.118	0.076	0.090	0.054	0.064	0.149	0.125	0.086	0.529
29	0.179	0.041	0.167	0.068	0.136	0.077	0.135	0.227	0.206	0.346	0.310
30	0.139	0.065	0.141	0.146	0.163	0.017	0.106	0.167	0.097	0.146	0.176
31	0.136	0.042	0.130	0.122	0.159	0.035	0.067	0.203	0.116	0.233	0.261
32	0.119	0.040	0.122	0.066	0.127	0.094	0.073	0.164	0.098	0.116	0.267
33	0.071	0.038	0.091	0.056	0.145	0.080	0.075	0.171	0.079	0.089	0.243
34	0.117	0.040	0.115	0.053	0.050	0.062	0.081	0.170	0.095	0.078	0.252
35	0.137	0.072	0.139	0.068	0.079	0.106	0.082	0.228	0.097	0.081	0.325
36	0.099	0.016	0.119	0.045	0.097	0.037	0.094	0.155	0.083	0.078	0.286
37	0.118	0.029	0.122	0.081	0.152	0.236	0.061	0.132	0.081	0.121	0.250
38	0.118	0.046	0.119	0.061	0.157	0.182	0.073	0.109	0.117	0.099	0.251
39	0.196	0.041	0.110	0.053	0.084	0.044	0.125	0.119	0.157	0.144	0.328
40	0.246	0.011	0.139	0.051	0.114	0.088	0.060	0.081	0.063	0.067	0.209
41	0.101	0.016	0.107	0.050	0.123	0.054	0.135	0.159	0.168	0.368	0.317
42	0.086	0.032	0.101	0.038	0.144	0.187	0.070	0.095	0.085	0.102	0.146
43	0.126	0.047	0.111	0.047	0.094	0.206	0.044	0.158	0.074	0.187	0.217
44	0.207	0.049	0.180	0.062	0.127	0.083	0.048	0.102	0.103	0.097	0.380
45	0.170	0.027	0.148	0.078	0.104	0.177	0.091	0.087	0.099	0.075	0.190
46	0.129	0.034	0.117	0.083	0.125	0.138	0.063	0.123	0.125	0.077	0.202
47	0.209	0.025	0.090	0.079	0.164	0.186	0.069	0.115	0.185	0.064	0.093
48	0.224	0.025	0.133	0.058	0.172	0.192	0.073	0.092	0.071	0.123	0.157
49	0.217	0.016	0.116	0.051	0.129	0.181	0.053	0.137	0.054	0.094	0.142
50	0.256	0.017	0.146	0.054	0.136	0.161	0.048	0.075	0.067	0.096	0.118
51	0.267	0.029	0.147	0.059	0.128	0.210	0.050	0.091	0.084	0.119	0.117
52	0.416	0.178	0.125	0.149	0.118	0.108	0.132	0.145	0.161	0.209	0.295
avg 3-51	0.153	0.039	0.125	0.068	0.140	0.137	0.089	0.146	0.112	0.158	0.229
median	0.136	0.040	0.118	0.061	0.127	0.104	0.076	0.144	0.097	0.121	0.209
NOTE	Factors exclude Easter period defined as Thursday before Good Friday to Easter Tuesday										

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Appendix E.1 — Heavy Vehicle Week Factors

Week beg Mon.	1a urb art a	1b urb art b	5 rur urb fr.	6a rur strat a	6b rur strat b	7a r rec sum	7b r rec win
2	1.174	1.081	1.115	1.042	1.021	0.828	0.982
3	0.981	0.986	0.954	0.931	0.977	0.776	0.899
4	0.963	0.965	0.957	0.911	1.000	0.803	0.943
5	0.998	0.984	0.965	0.948	0.941	0.870	0.944
6	0.969	0.966	0.959	0.940	0.947	0.895	0.963
7	0.918	0.899	0.933	0.889	0.893	0.830	0.980
8	0.930	0.898	0.967	0.918	0.899	0.847	1.003
9	0.923	0.908	0.937	0.920	0.923	0.865	1.038
10	0.938	0.918	0.930	0.908	0.912	0.901	1.010
11	0.949	0.958	0.965	0.950	0.941	0.923	1.067
12	0.913	0.917	0.922	0.913	0.909	0.949	1.019
13	0.936	0.910	0.948	0.934	0.932	0.972	1.085
14	0.981	0.959	0.972	0.998	0.967	0.996	1.066
15	1.008	0.949	0.930	0.988	0.847	0.842	0.945
16	0.978	0.966	1.071	0.955	0.921	0.914	0.956
17	0.946	0.940	1.045	0.975	0.945	0.976	1.024
18	0.955	0.974	1.022	1.031	0.979	1.022	1.157
19	0.970	0.989	1.030	1.057	1.009	1.072	1.139
20	0.978	1.019	1.052	1.087	1.017	1.088	1.182
21	0.955	1.003	1.022	1.065	1.035	1.069	1.142
22	1.001	1.028	1.050	1.073	1.032	1.126	1.152
23	1.043	1.102	1.120	1.137	1.096	1.167	1.101
24	1.035	1.121	1.146	1.161	1.151	1.261	1.199
25	1.012	1.089	1.092	1.138	1.153	1.233	1.187
26	1.003	1.052	1.062	1.168	1.165	1.161	1.181
27	1.041	1.167	1.086	1.210	1.169	1.211	1.170
28	1.082	1.150	1.097	1.243	1.169	1.241	1.111
29	1.050	1.152	1.132	1.237	1.183	1.210	1.170
30	1.048	1.139	1.180	1.243	1.202	1.288	1.137
31	1.004	1.105	1.123	1.166	1.205	1.233	1.154
32	1.022	1.062	1.086	1.138	1.149	1.185	1.083
33	1.028	1.061	1.101	1.130	1.145	1.173	1.069
34	1.024	1.058	1.105	1.142	1.138	1.206	1.028
35	1.005	1.048	1.078	1.159	1.131	1.172	1.080
36	0.989	1.027	1.056	1.049	1.076	1.136	1.078
37	0.990	1.007	1.042	1.038	1.078	1.148	1.062
38	1.011	1.034	1.040	1.057	1.038	1.120	1.055
39	0.968	1.028	0.988	1.006	1.009	1.053	0.975
40	0.912	0.991	0.958	0.995	0.967	1.047	0.957
41	1.024	0.994	0.964	0.989	0.989	1.026	0.978
42	0.980	0.981	0.953	0.970	0.984	1.031	0.991
43	0.954	0.970	0.914	0.955	0.943	0.956	0.948
44	1.078	1.066	1.004	1.027	0.994	1.036	1.036
45	0.939	0.977	0.960	0.952	0.936	0.976	0.982
46	0.942	0.976	0.912	0.913	0.933	0.927	0.928
47	0.934	0.941	0.923	0.879	0.947	0.942	0.914
48	1.001	0.937	0.896	0.886	0.944	0.924	0.933
49	1.004	0.919	0.862	0.915	0.909	0.911	0.947
50	1.009	0.904	0.845	0.873	0.883	0.882	0.864
51	1.009	0.897	0.830	0.880	0.857	0.849	0.845
52	1.423	1.130	0.956	1.054	0.975	0.805	0.961
Avg 3-51	0.986	1.002	1.004	1.021	1.012	1.029	1.038
Med 3-51	0.989	0.986	0.988	0.995	0.984	1.026	1.036
NOTE	Easter period excluded (Thursday before Good Friday to Easter Tuesday)						
site-years	14	32	15	30	41	6	15

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Appendix E2 — Std Devn. HV Week Factors

Week	1a urb art a	1b urb art b	5 rur urb fr.	6a rur strat a	6b rur strat b	7a r rec sum	7b r rec win
2	0.111	0.152	0.159	0.195	0.167	0.280	0.268
3	0.075	0.195	0.066	0.117	0.291	0.180	0.143
4	0.055	0.185	0.074	0.129	0.309	0.119	0.205
5	0.063	0.174	0.051	0.090	0.091	0.046	0.126
6	0.051	0.108	0.098	0.095	0.079	0.042	0.263
7	0.050	0.088	0.059	0.074	0.080	0.044	0.216
8	0.058	0.076	0.184	0.064	0.068	0.052	0.212
9	0.035	0.079	0.051	0.076	0.063	0.055	0.290
10	0.038	0.073	0.057	0.073	0.051	0.055	0.233
11	0.055	0.087	0.033	0.095	0.070	0.036	0.372
12	0.033	0.062	0.049	0.089	0.067	0.031	0.301
13	0.041	0.048	0.059	0.088	0.058	0.053	0.320
14	0.069	0.065	0.067	0.132	0.088	0.041	0.240
15	0.088	0.116	0.053	0.271	0.061	0.045	0.295
16	0.089	0.056	0.288	0.043	0.080	0.024	0.134
17	0.061	0.082	0.225	0.115	0.076	0.072	0.186
18	0.027	0.054	0.076	0.126	0.069	0.024	0.321
19	0.062	0.076	0.066	0.116	0.078	0.045	0.330
20	0.038	0.154	0.080	0.133	0.077	0.058	0.317
21	0.046	0.096	0.064	0.174	0.093	0.049	0.284
22	0.039	0.077	0.063	0.202	0.084	0.136	0.224
23	0.071	0.105	0.076	0.213	0.093	0.139	0.146
24	0.055	0.181	0.093	0.217	0.098	0.103	0.219
25	0.049	0.199	0.084	0.240	0.098	0.128	0.183
26	0.062	0.177	0.049	0.092	0.144	0.045	0.200
27	0.069	0.390	0.068	0.139	0.170	0.081	0.193
28	0.079	0.304	0.059	0.157	0.147	0.111	0.270
29	0.052	0.275	0.056	0.121	0.142	0.069	0.206
30	0.075	0.261	0.108	0.142	0.136	0.189	0.183
31	0.042	0.194	0.064	0.196	0.169	0.137	0.260
32	0.065	0.162	0.054	0.142	0.127	0.075	0.170
33	0.051	0.110	0.063	0.146	0.123	0.096	0.225
34	0.059	0.082	0.055	0.147	0.095	0.071	0.200
35	0.039	0.067	0.067	0.146	0.119	0.051	0.105
36	0.036	0.060	0.076	0.120	0.083	0.040	0.140
37	0.030	0.090	0.024	0.073	0.125	0.047	0.155
38	0.040	0.088	0.056	0.061	0.121	0.062	0.142
39	0.060	0.107	0.068	0.101	0.050	0.043	0.126
40	0.099	0.111	0.052	0.086	0.056	0.073	0.146
41	0.060	0.078	0.058	0.073	0.082	0.043	0.167
42	0.047	0.068	0.075	0.095	0.067	0.032	0.160
43	0.048	0.083	0.046	0.103	0.084	0.032	0.191
44	0.082	0.124	0.045	0.093	0.092	0.053	0.276
45	0.076	0.093	0.067	0.067	0.081	0.057	0.127
46	0.077	0.103	0.048	0.078	0.105	0.068	0.106
47	0.115	0.083	0.081	0.108	0.153	0.054	0.110
48	0.175	0.093	0.051	0.063	0.146	0.064	0.079
49	0.252	0.084	0.058	0.076	0.118	0.054	0.099
50	0.320	0.099	0.059	0.071	0.126	0.035	0.080
51	0.287	0.083	0.062	0.082	0.077	0.025	0.072
52	0.612	0.222	0.118	0.135	0.135	0.105	0.186
Avg 3-51	0.074	0.121	0.073	0.117	0.105	0.067	0.199
Med 3-51	0.059	0.093	0.063	0.103	0.091	0.054	0.193
NOTE	Easter period excluded (Thursday before Good Friday to Easter Tuesday)						

Appendix E.3 — Rel. 95% Error HV Week Factors

Week	1a	1b	5	6a	6b	7a	7b
	urb art a	urb art b	rur urb fr.	rur strat a	rur strat b	r rec sum	r rec win
2	0.189	0.280	0.285	0.373	0.327	0.676	0.546
3	0.152	0.395	0.138	0.251	0.595	0.464	0.319
4	0.114	0.384	0.154	0.283	0.619	0.297	0.434
5	0.127	0.354	0.105	0.190	0.193	0.106	0.266
6	0.104	0.223	0.205	0.203	0.166	0.093	0.547
7	0.109	0.195	0.126	0.166	0.178	0.107	0.440
8	0.124	0.168	0.381	0.140	0.151	0.122	0.423
9	0.076	0.173	0.108	0.165	0.137	0.127	0.558
10	0.082	0.158	0.122	0.161	0.111	0.123	0.460
11	0.115	0.181	0.068	0.200	0.149	0.078	0.698
12	0.072	0.136	0.107	0.194	0.147	0.066	0.591
13	0.087	0.106	0.125	0.188	0.123	0.108	0.591
14	0.141	0.136	0.137	0.264	0.182	0.083	0.451
15	0.174	0.245	0.114	0.548	0.143	0.108	0.624
16	0.182	0.116	0.538	0.090	0.175	0.053	0.280
17	0.130	0.174	0.430	0.236	0.161	0.147	0.364
18	0.056	0.110	0.149	0.244	0.141	0.047	0.555
19	0.127	0.153	0.128	0.219	0.155	0.085	0.580
20	0.078	0.302	0.153	0.244	0.152	0.106	0.536
21	0.096	0.192	0.125	0.328	0.180	0.091	0.497
22	0.078	0.150	0.120	0.376	0.163	0.241	0.389
23	0.136	0.191	0.135	0.374	0.170	0.239	0.264
24	0.107	0.323	0.162	0.373	0.170	0.163	0.365
25	0.096	0.366	0.154	0.422	0.171	0.207	0.309
26	0.124	0.336	0.092	0.157	0.248	0.078	0.339
27	0.132	0.669	0.126	0.231	0.290	0.133	0.329
28	0.146	0.529	0.107	0.252	0.251	0.179	0.486
29	0.098	0.477	0.099	0.195	0.239	0.113	0.353
30	0.143	0.459	0.184	0.229	0.225	0.294	0.321
31	0.084	0.351	0.113	0.336	0.280	0.222	0.451
32	0.126	0.304	0.100	0.249	0.220	0.127	0.315
33	0.099	0.208	0.114	0.258	0.215	0.163	0.421
34	0.114	0.156	0.099	0.257	0.167	0.118	0.389
35	0.077	0.128	0.125	0.251	0.210	0.088	0.195
36	0.073	0.117	0.144	0.228	0.154	0.070	0.260
37	0.061	0.179	0.045	0.141	0.232	0.081	0.292
38	0.080	0.170	0.108	0.115	0.233	0.110	0.269
39	0.123	0.208	0.137	0.201	0.099	0.082	0.258
40	0.218	0.224	0.109	0.173	0.116	0.140	0.304
41	0.118	0.158	0.121	0.147	0.167	0.084	0.342
42	0.096	0.139	0.157	0.197	0.136	0.062	0.322
43	0.100	0.171	0.100	0.217	0.179	0.068	0.402
44	0.152	0.233	0.089	0.181	0.185	0.102	0.532
45	0.162	0.190	0.139	0.140	0.173	0.116	0.259
46	0.164	0.211	0.104	0.171	0.226	0.146	0.228
47	0.246	0.177	0.175	0.245	0.322	0.115	0.240
48	0.350	0.199	0.114	0.141	0.310	0.138	0.169
49	0.502	0.182	0.134	0.166	0.260	0.119	0.210
50	0.635	0.218	0.140	0.162	0.286	0.080	0.184
51	0.569	0.185	0.149	0.186	0.179	0.059	0.170
52	0.860	0.392	0.246	0.256	0.276	0.261	0.386
Avg 3-51	0.150	0.235	0.145	0.226	0.207	0.130	0.379
Med 3-51	0.118	0.191	0.125	0.203	0.178	0.110	0.353
NOTE	Easter period excluded (Thursday before Good Friday to Easter Tuesday)						

Appendix F — Day of Week Factors : Summary

MEAN (weeks 2-51)			DAY OF WEEK					non-adj
Group	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon
1a	0.99	0.96	0.94	0.92	0.88	1.15	1.33	0.99
1a1	0.98	0.95	0.93	0.92	0.88	1.17	1.37	0.98
1a2	1.01	0.98	0.95	0.94	0.89	1.09	1.24	1.01
1b	1.00	0.97	0.95	0.93	0.88	1.10	1.30	1.01
1b1	0.99	0.96	0.95	0.93	0.89	1.13	1.31	0.99
1b2	1.00	0.97	0.94	0.93	0.88	1.11	1.30	1.01
2	1.02	1.00	0.97	0.94	0.86	1.07	1.34	1.04
3	0.85	0.85	0.84	0.84	0.84	1.84	2.66	0.85
5	1.14	1.14	1.10	1.07	0.88	0.94	0.86	1.14
6a	1.05	1.01	0.99	0.97	0.87	1.09	1.10	1.05
6b	1.11	1.14	1.10	1.05	0.82	1.03	0.91	1.11
7a	1.07	1.17	1.13	1.05	0.80	1.11	0.88	1.07
7b	1.15	1.25	1.21	1.12	0.78	1.03	0.82	1.15

STD DEVIATION		(population)						non-adj
Group	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon
1a	0.03	0.02	0.01	0.01	0.01	0.04	0.06	0.03
1a1	0.03	0.02	0.02	0.02	0.01	0.05	0.07	0.03
1a2	0.02	0.02	0.01	0.01	0.01	0.03	0.04	0.02
1b	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.06
1b1	0.02	0.01	0.01	0.02	0.02	0.03	0.05	0.02
1b2	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.06
2	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.09
3	0.04	0.03	0.04	0.03	0.04	0.22	0.35	0.04
5	0.07	0.04	0.03	0.03	0.03	0.04	0.05	0.07
6a	0.04	0.03	0.02	0.04	0.02	0.04	0.05	0.04
6b	0.06	0.04	0.03	0.02	0.04	0.04	0.05	0.06
7a	0.10	0.07	0.06	0.06	0.06	0.08	0.09	0.10
7b	0.10	0.11	0.11	0.06	0.06	0.07	0.08	0.10

95% RELATIVE ERROR		(2*sqrt(var)/mean)						non-adj
Group	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon
1a	0.06	0.03	0.03	0.03	0.03	0.07	0.09	0.06
1a1	0.07	0.04	0.03	0.03	0.03	0.08	0.10	0.07
1a2	0.05	0.04	0.03	0.03	0.03	0.05	0.07	0.05
1b	0.04	0.02	0.02	0.03	0.03	0.04	0.05	0.12
1b1	0.04	0.03	0.03	0.04	0.04	0.05	0.08	0.04
1b2	0.04	0.03	0.02	0.03	0.03	0.04	0.05	0.12
2	0.06	0.06	0.05	0.05	0.06	0.12	0.24	0.17
3	0.10	0.08	0.09	0.08	0.10	0.24	0.26	0.10
5	0.12	0.08	0.06	0.06	0.06	0.09	0.11	0.12
6a	0.07	0.06	0.04	0.07	0.05	0.07	0.09	0.07
6b	0.10	0.07	0.06	0.05	0.09	0.07	0.12	0.10
7a	0.18	0.12	0.11	0.11	0.15	0.14	0.21	0.18
7b	0.17	0.17	0.18	0.11	0.15	0.13	0.19	0.17

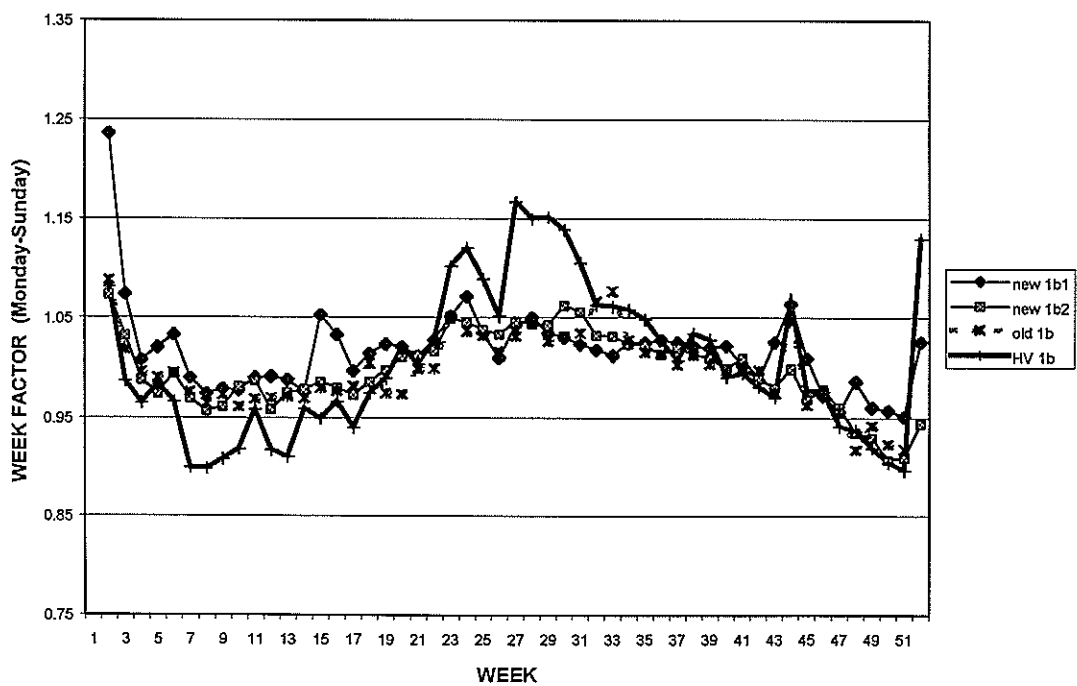| NOTES |
|---|
| The mean is the average for weeks 2-51 of the average day of week factors across site-years |
| The analysis excluded holidays, and those weeks with fewer than four valid days |
| The relative error is based on the variance of the group mean day of week factors for weeks 2-51 |
| The Monday values for groups 1b, 1b2, and 2 were adjusted for an atypical week (38 or 44) |
| Groups 1a1 & 1b1 only include those *urban arterial* sites within the Greater Auckland city area |
| Groups 1a2 & 1b2 only include those *urban arterial* sites outside the Greater Auckland city area |

Appendix G — Part-weekday Factors: Summary

MEAN (weeks 2-51)		average Monday to Thursday			
Group		7am-9am	9am-12pm	1pm-4pm	4pm-6pm
1a	urban arterial a	5.63	5.66	5.10	5.78
1a2	urban arterial a (non Auck)	5.62	5.84	5.32	5.87
1b	urban arterial b	7.31	5.17	4.60	6.00
1b2	urban arterial b (non Auck)	7.37	5.10	4.55	5.99
2	urban CBD (Auck)	7.86	5.77	5.22	6.36
3	urban industrial (Auck)	5.57	4.13	3.72	5.97
5	rural urban fringe	8.61	5.59	5.49	6.64
6a	rural strategic a	8.40	4.74	4.41	5.99
6b	rural strategic b	10.21	5.17	4.89	6.88
7a	rural recr. summer	16.94	4.84	4.08	7.77
7b	rural recr. winter	13.82	5.24	4.76	7.91
STD DEVIATION		(population)			
Group		7am-9am	9am-12pm	1pm-4pm	4pm-6pm
1a	urban arterial a	0.33	0.18	0.13	0.13
1a2	urban arterial a (non Auck)	0.26	0.15	0.13	0.17
1b	urban arterial b	0.39	0.12	0.11	0.13
1b2	urban arterial b (non Auck)	0.37	0.13	0.12	0.15
2	urban CBD (Auck)	0.72	0.32	0.26	0.30
3	urban industrial (Auck)	0.46	0.21	0.22	0.42
5	rural urban fringe	0.77	0.27	0.29	0.27
6a	rural strategic a	0.95	0.18	0.17	0.24
6b	rural strategic b	0.93	0.19	0.23	0.23
7a	rural recr. summer	2.22	0.30	0.29	0.46
7b	rural recr. winter	1.61	0.34	0.38	0.49
95% RELATIVE ERROR		(2*sqrt(var)/mean)			
Group		7am-9am	9am-12pm	1pm-4pm	4pm-6pm
1a	urban arterial a	0.12	0.06	0.05	0.05
1a2	urban arterial a (non Auck)	0.09	0.05	0.05	0.06
1b	urban arterial b	0.11	0.05	0.05	0.04
1b2	urban arterial b (non Auck)	0.10	0.05	0.05	0.05
2	urban CBD (Auck)	0.18	0.11	0.10	0.09
3	urban industrial (Auck)	0.16	0.10	0.12	0.14
5	rural urban fringe	0.18	0.10	0.11	0.08
6a	rural strategic a	0.23	0.07	0.08	0.08
6b	rural strategic b	0.18	0.07	0.10	0.07
7a	rural recr. summer	0.26	0.13	0.14	0.12
7b	rural recr. winter	0.23	0.13	0.16	0.12
NOTES					
The mean is the average for weeks 2-51 of the average partday factors across site-years					
The analysis excluded holidays, and those weeks with fewer than four valid days					
Relative error is based on the variance of the group mean partday factors for weeks 2-51					

Appendix H.1 — Week Factors : Groups 1a & 1b

WEEK FACTORS
Group 1a *Urban Arterial a*

Legend: new 1a1, new 1a2, old 1a, HV 1a

Y-axis: WEEK FACTOR (Monday-Sunday)
X-axis: WEEK
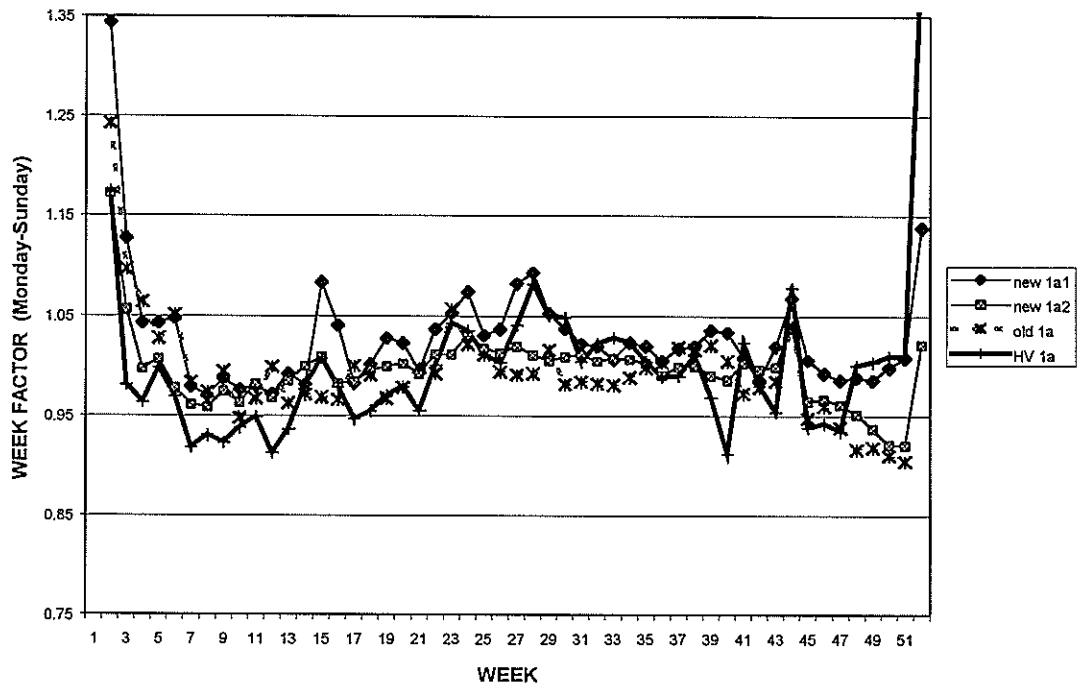
WEEK FACTORS
Group 1b *Urban Arterial b*

Legend: new 1b1, new 1b2, old 1b, HV 1b
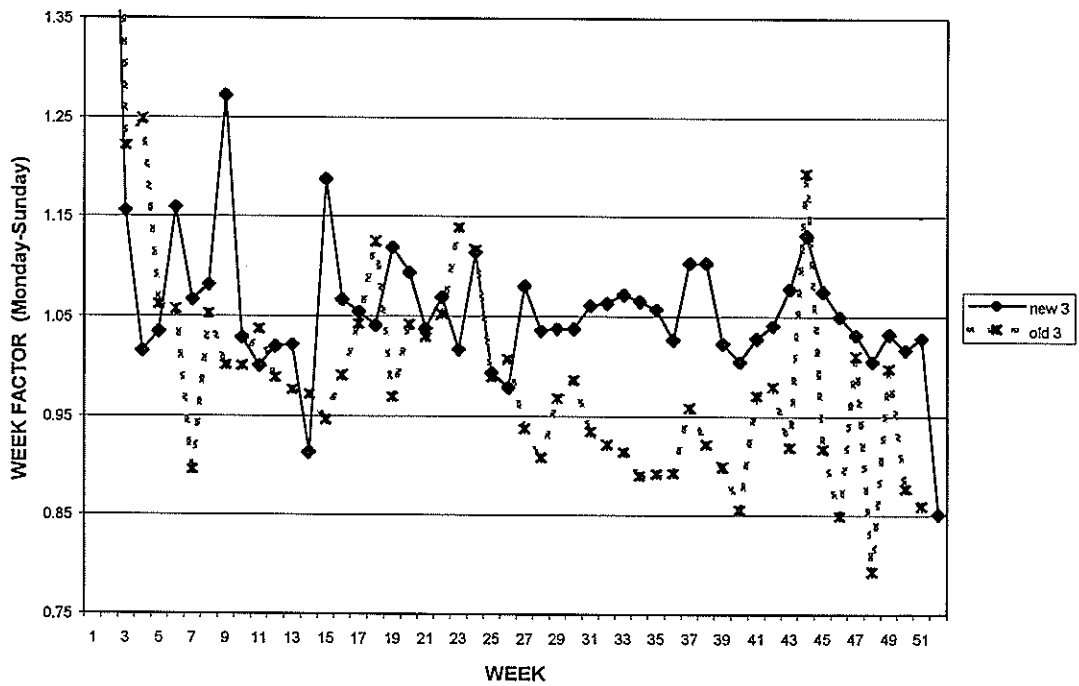
Y-axis: WEEK FACTOR (Monday-Sunday)
X-axis: WEEK

Appendix H.2 — Week Factors : Groups 2 & 3

WEEK FACTORS
Group 2 *Urban commercial*
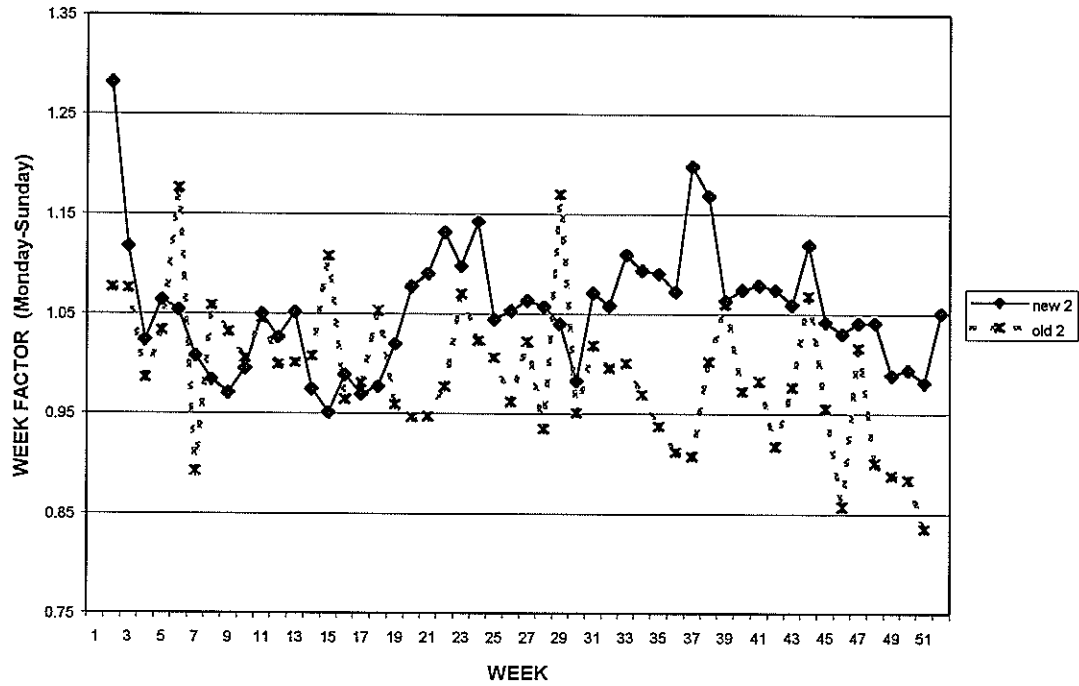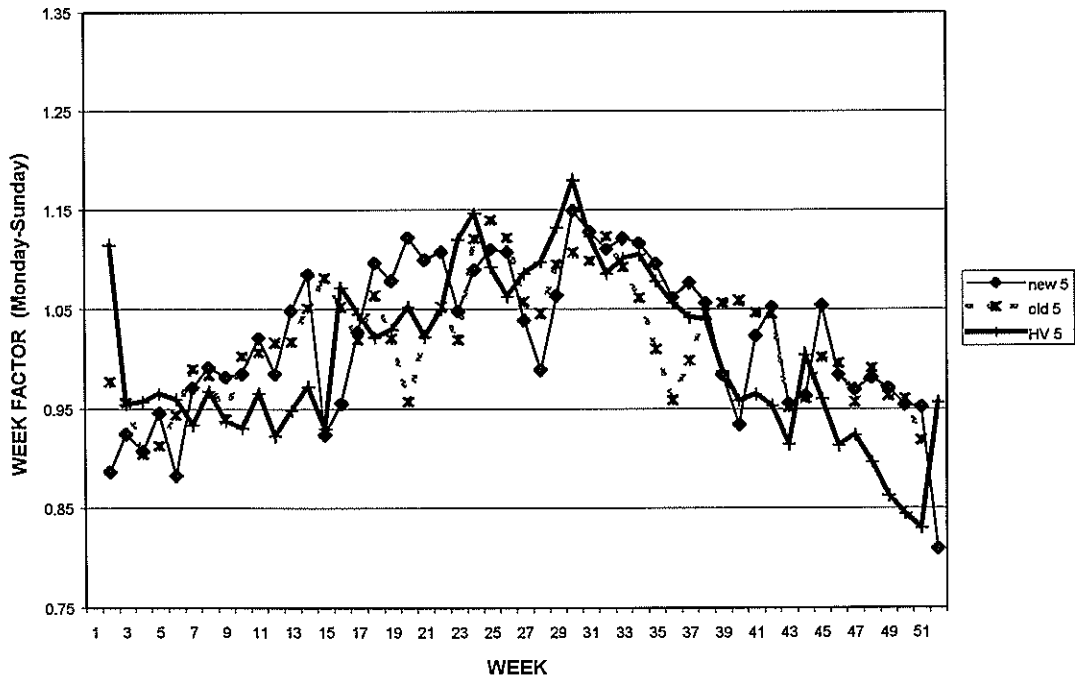

WEEK FACTORS
Group 3 *Urban industrial*

Appendix H.3 — Week Factors : Groups 4 & 5

WEEK FACTORS
Group 4 *Urban other*
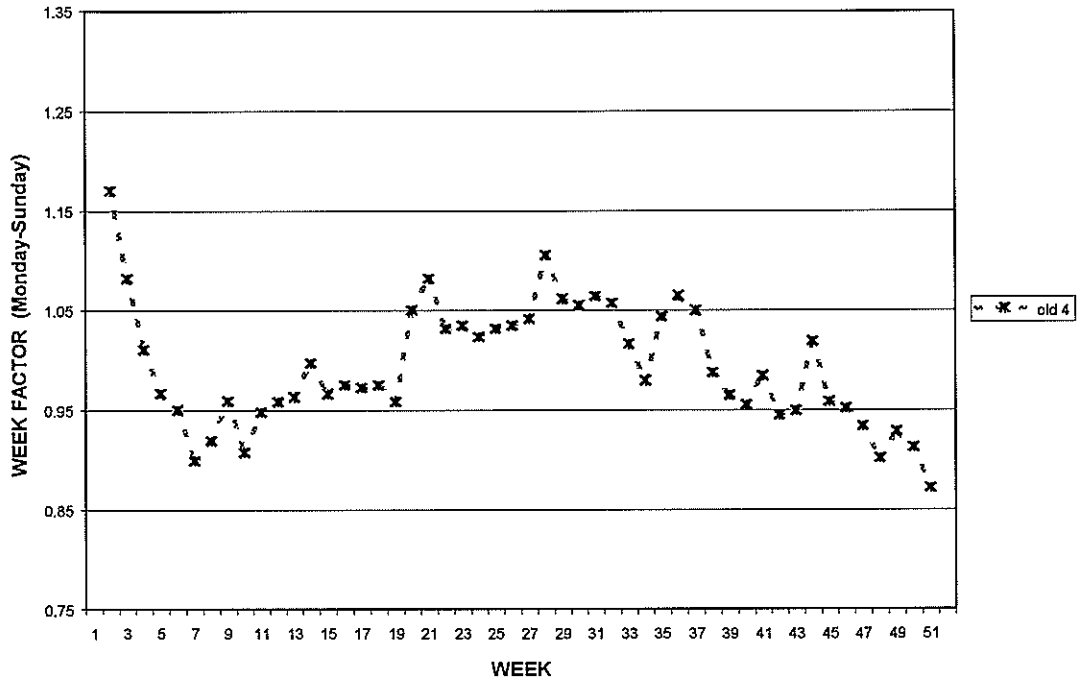
WEEK FACTORS
Group 5 *Rural urban fringe*

Appendix H.4 — Week Factors : Groups 6a & 6b

WEEK FACTORS
Group 6a Rural strategic a
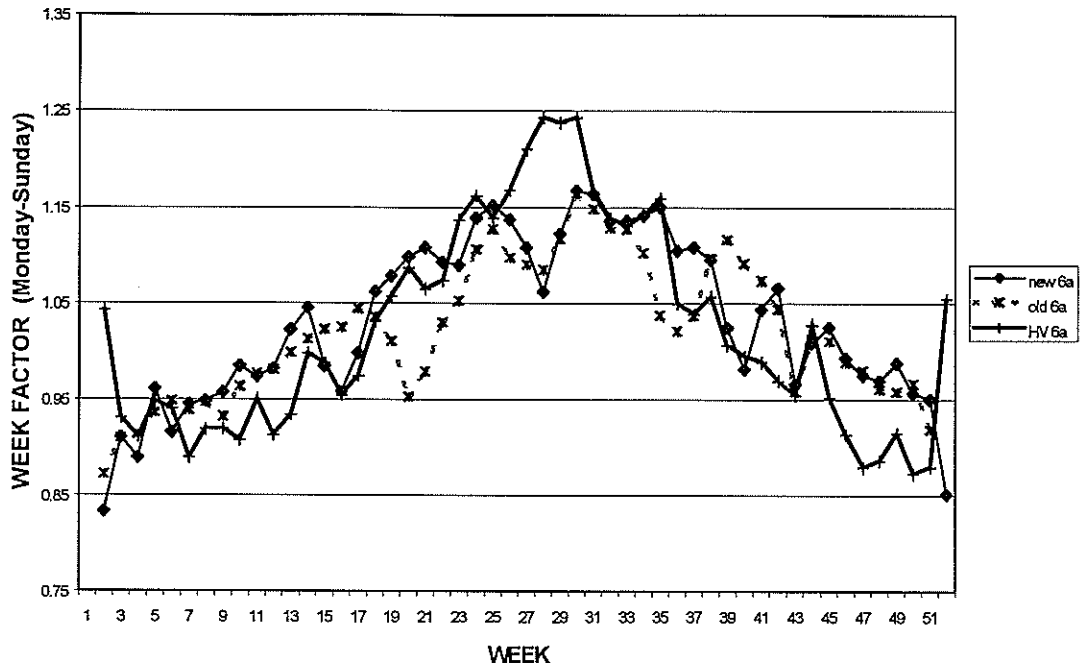
WEEK FACTORS
Group 6b Rural strategic b
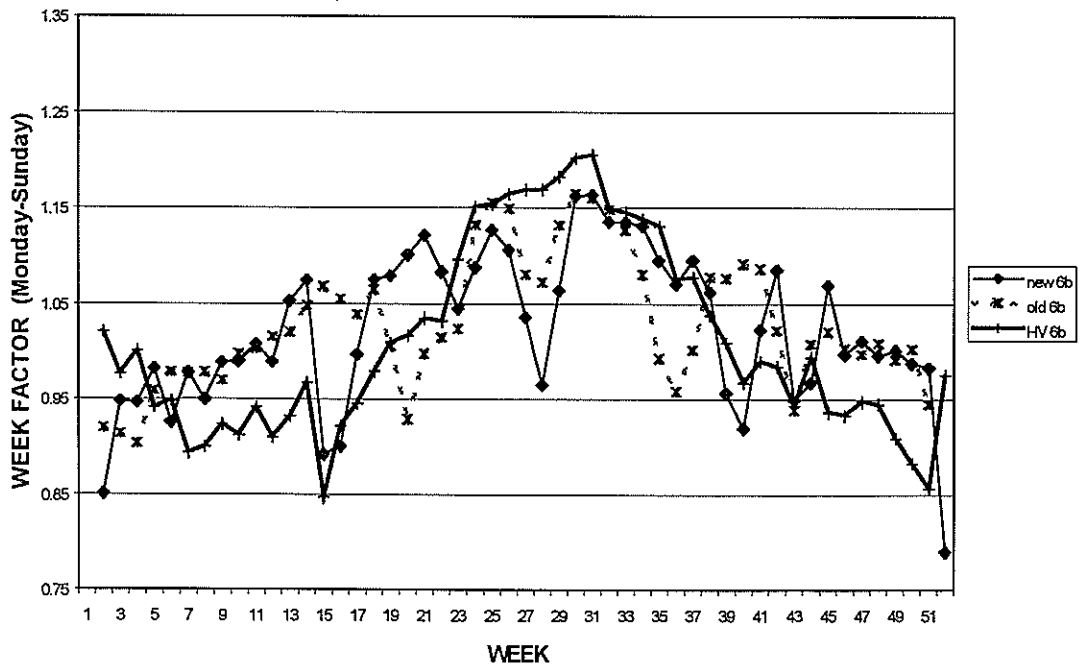
Appendix H.5 — Week Factors : Groups 7a & 7b

WEEK FACTORS
Group 7a *Rural recr. summer*

WEEK FACTORS
Group 7b *Rural recr. summer*
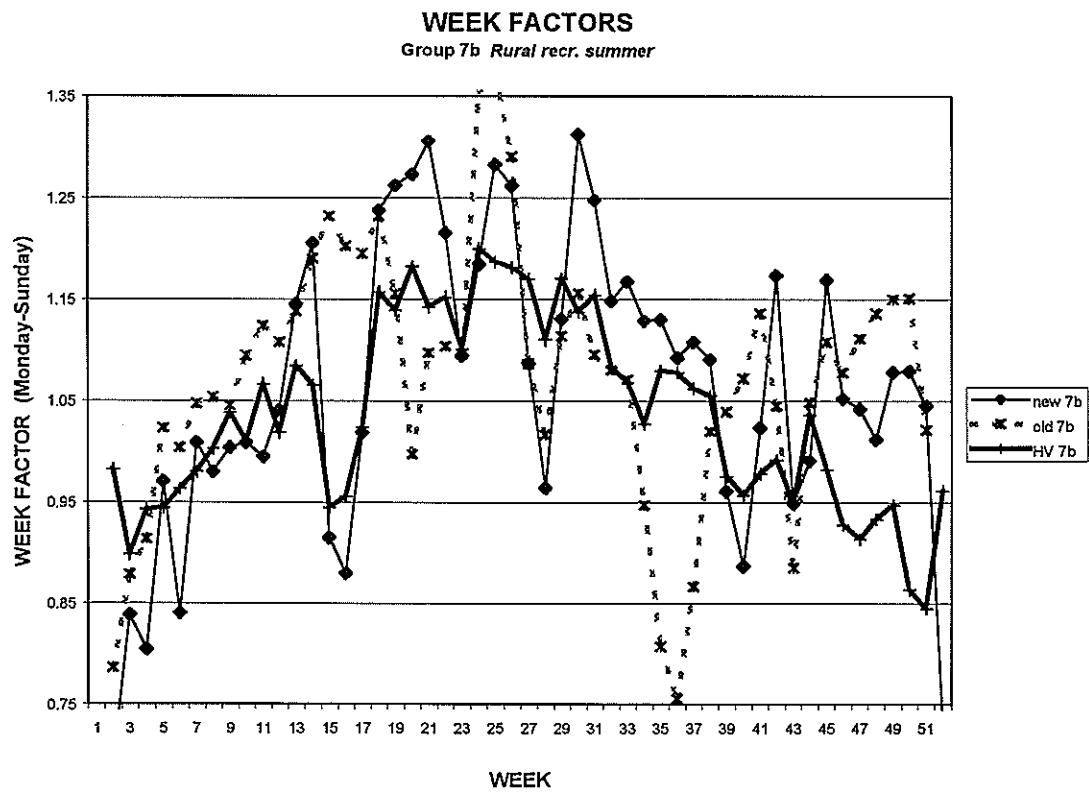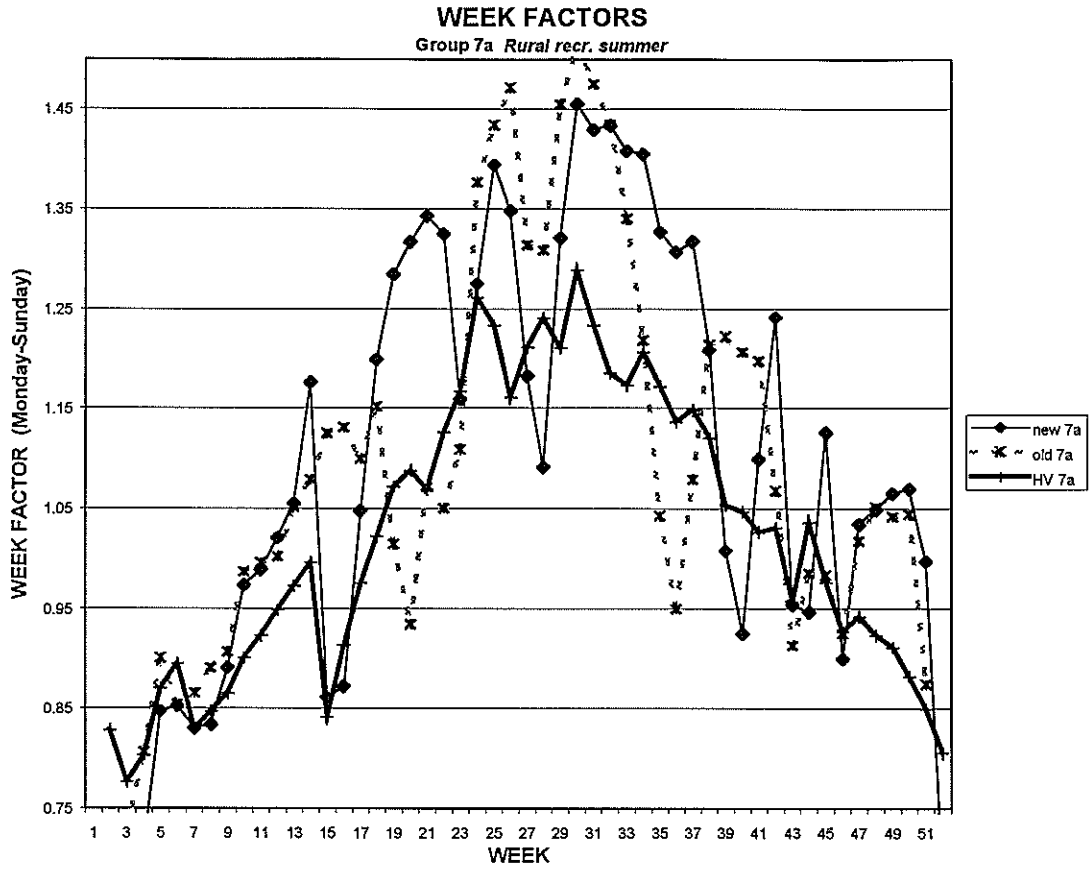
Appendix I — Day of Week Factors : Wednesday

DAY OF WEEK FACTOR
Wednesday

DAY OF WEEK FACTOR
Wednesday
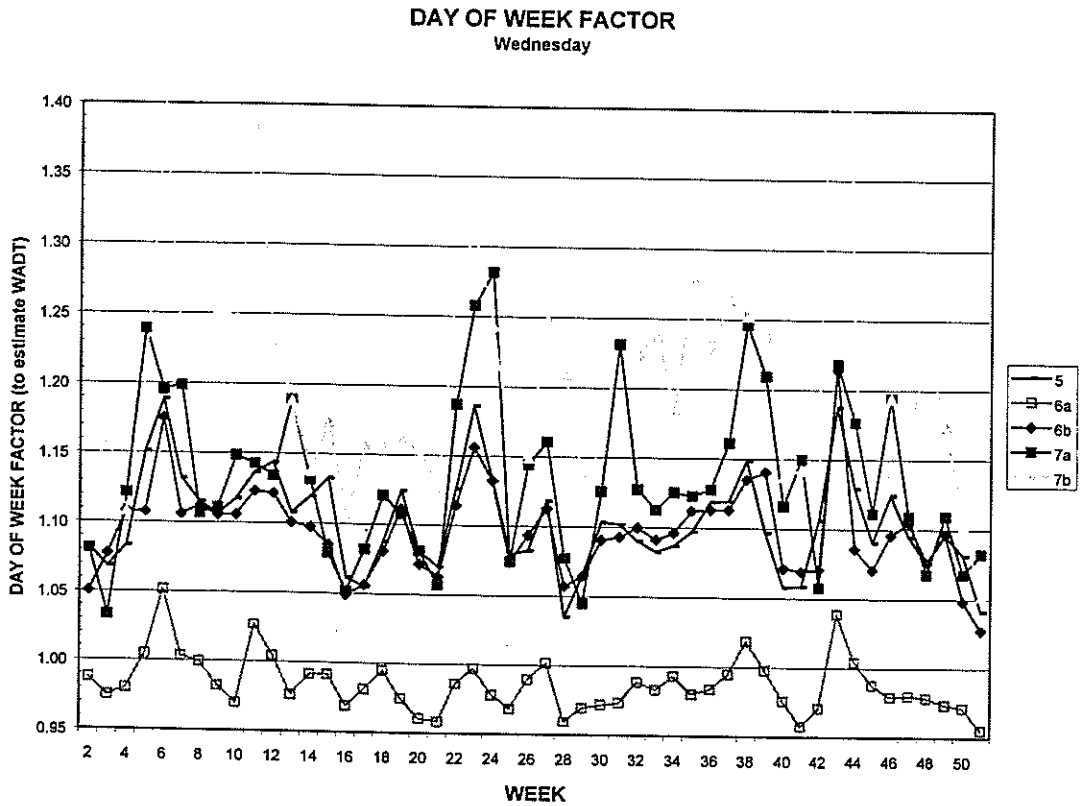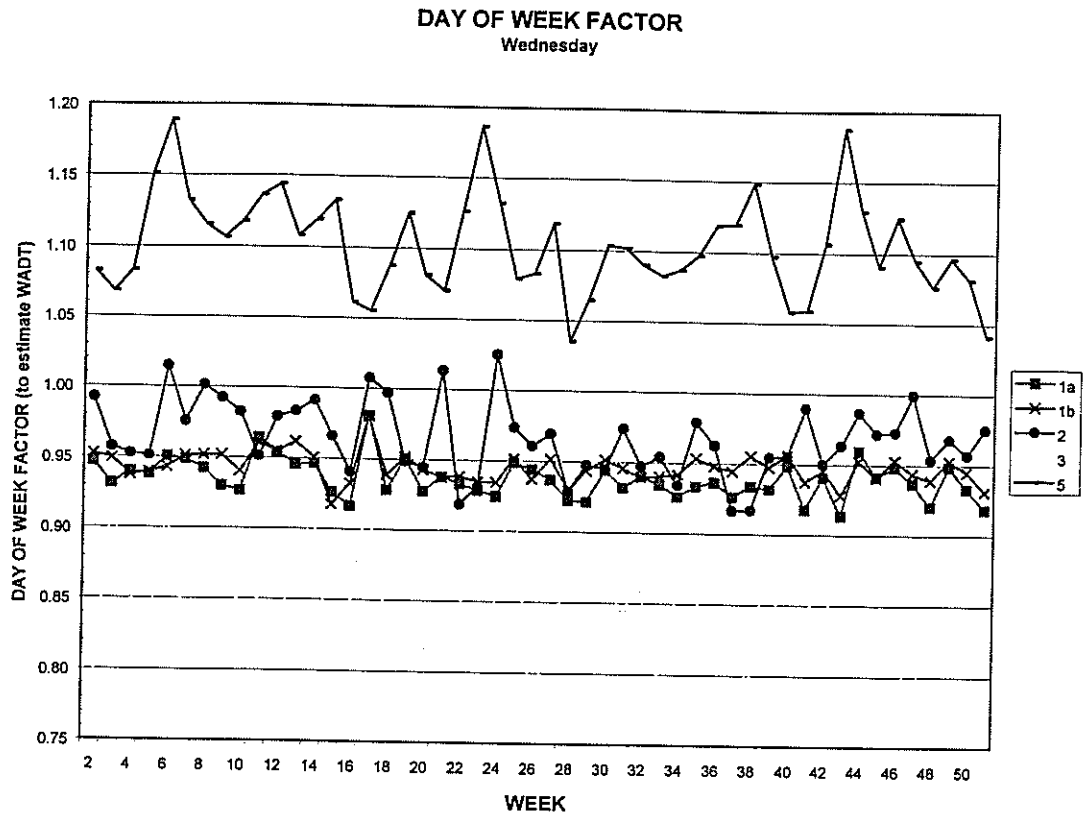
Appendix J — Part-Day Factors : Mon-Thu 4-6 pm

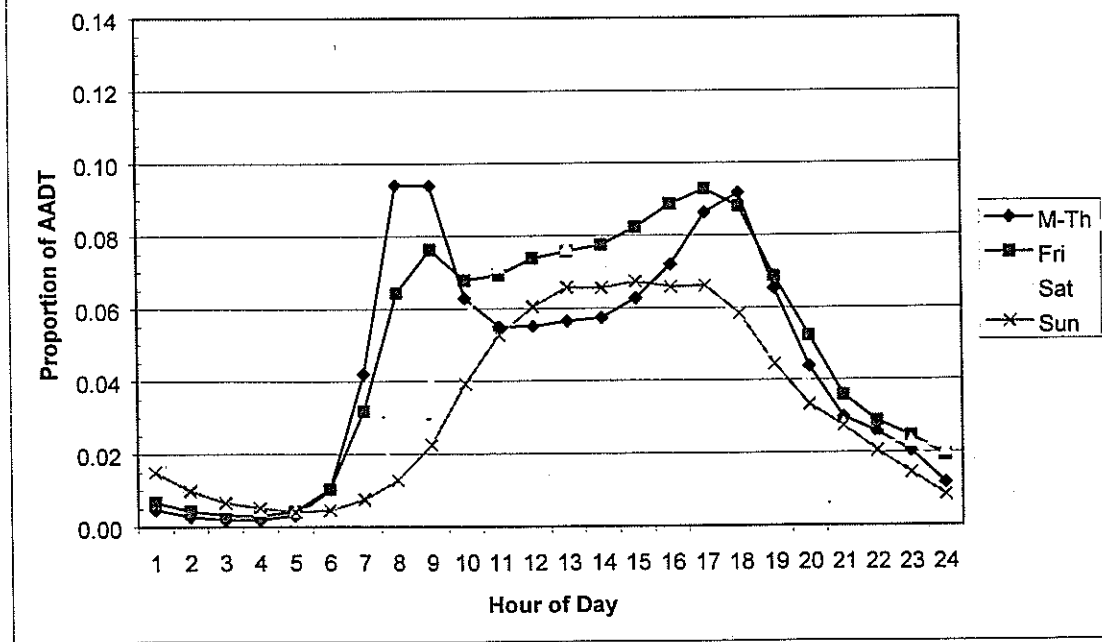**PARTDAY FACTORS**
Mon-Thu 4-6 pm

PARTDAY FACTORS
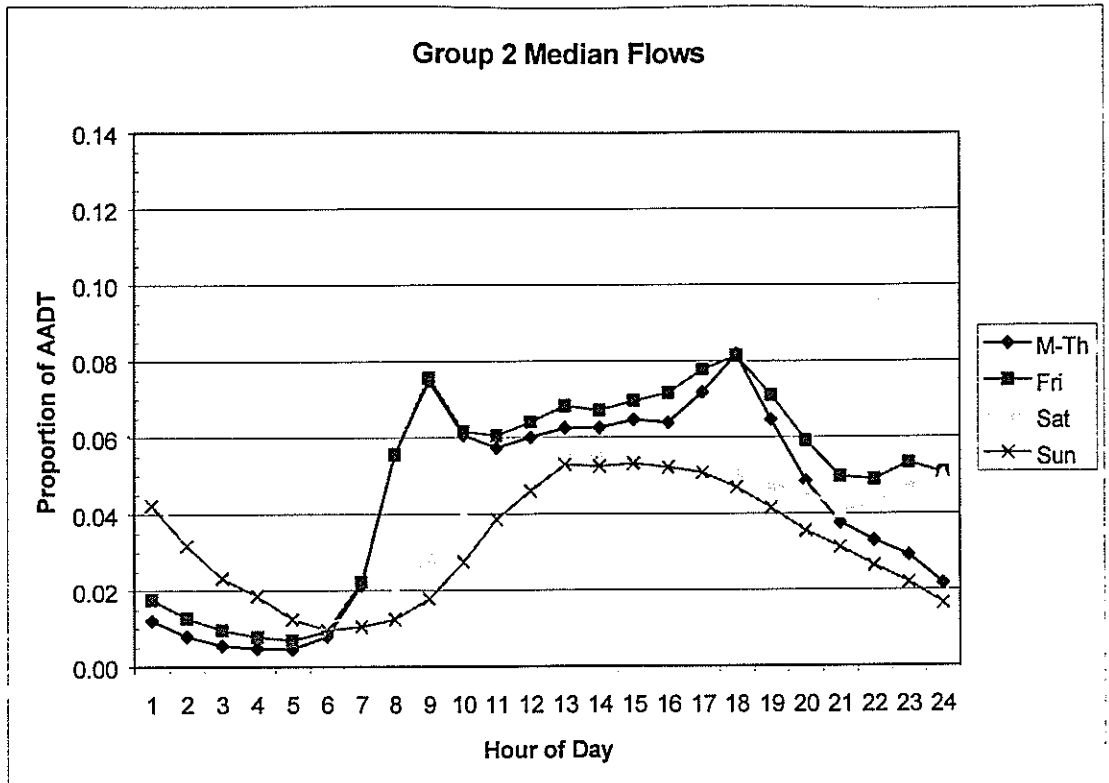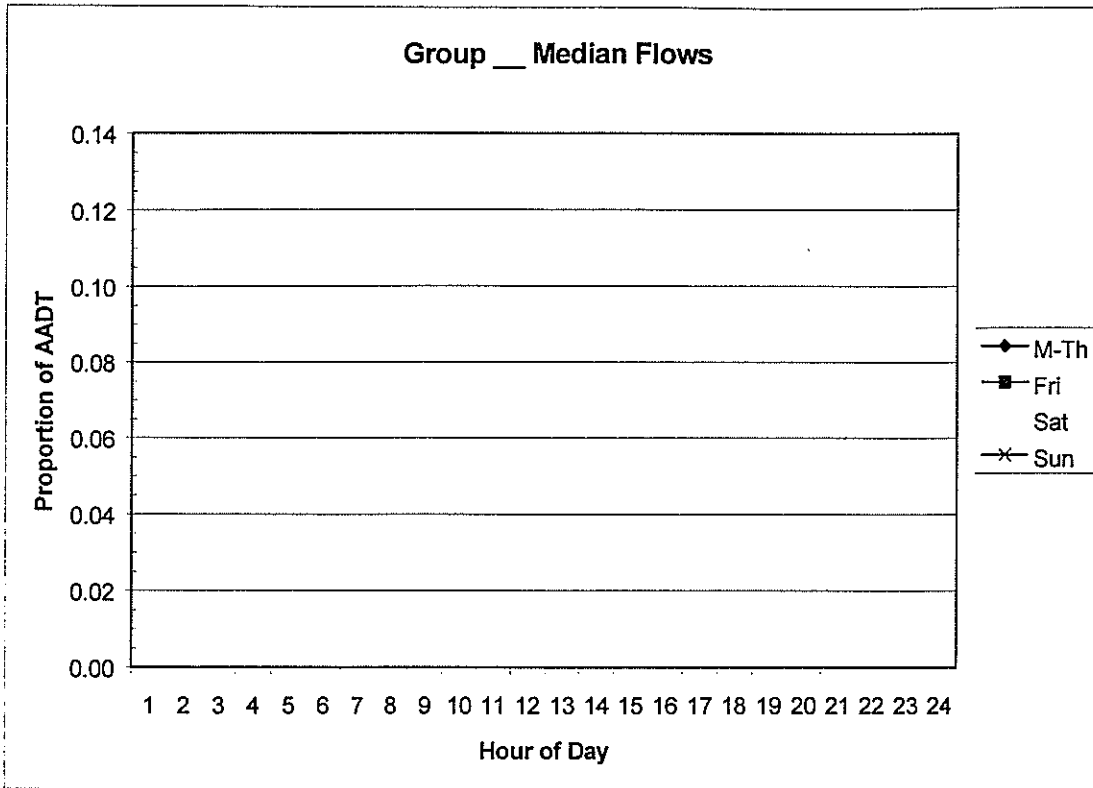Mon-Thu 4-6 pm

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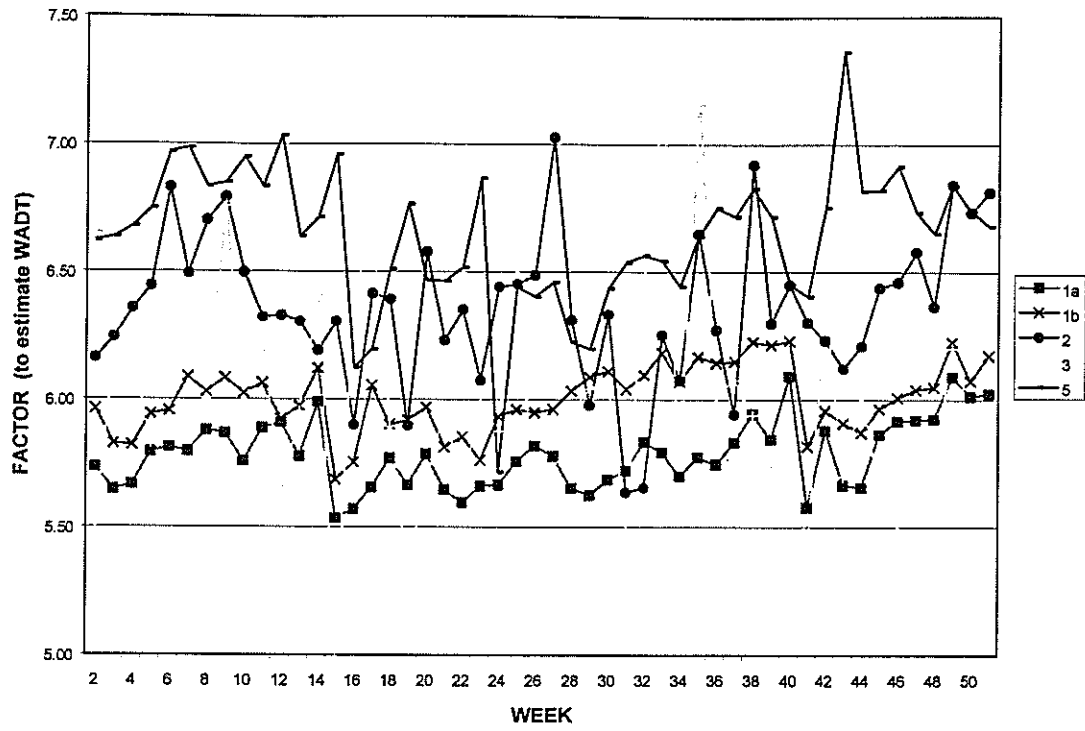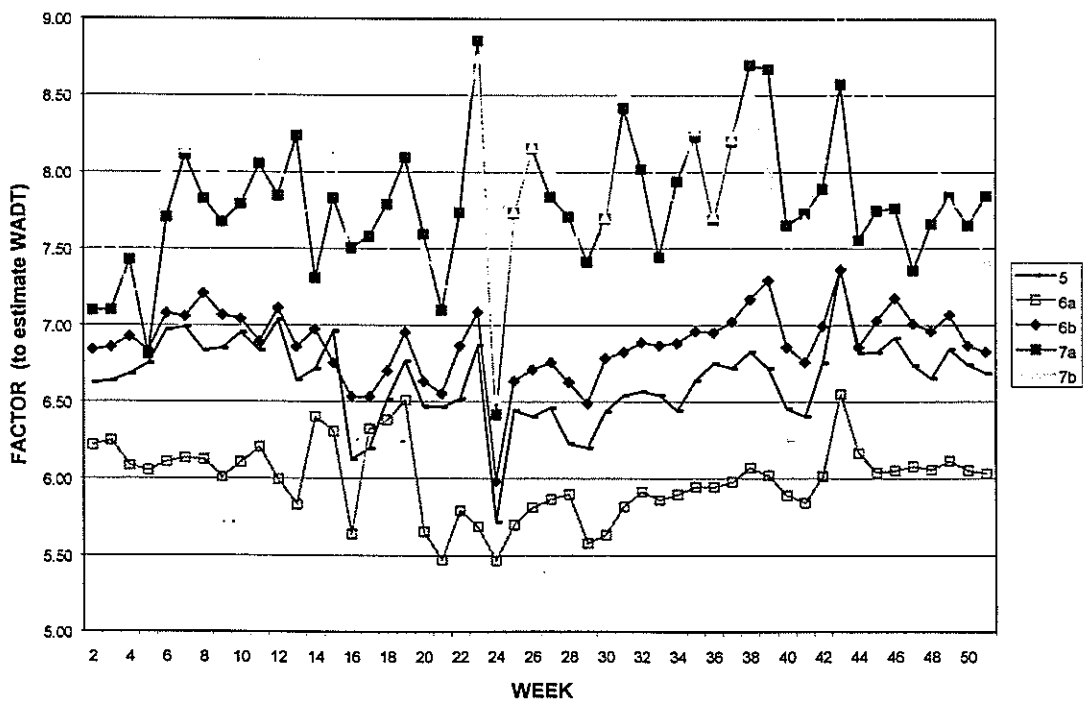
Appendix K — Group Median Profiles

Group 1a1 Auckland Median Flows

Group 1a2 Non-Auckland Median Flows
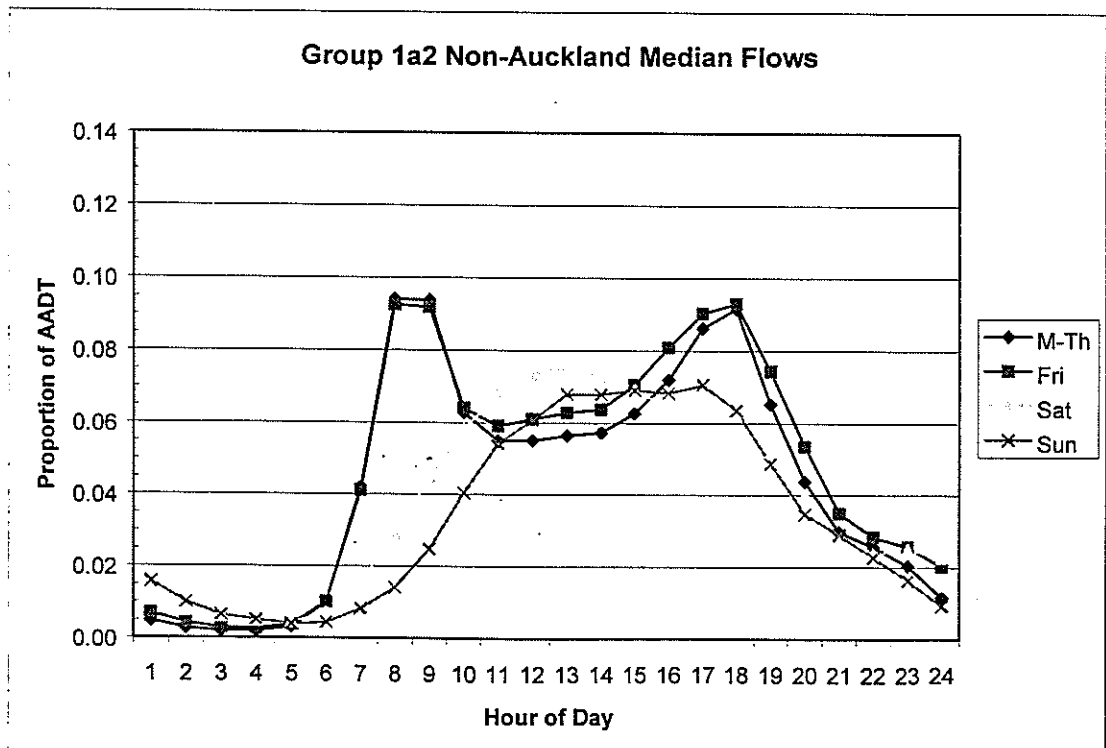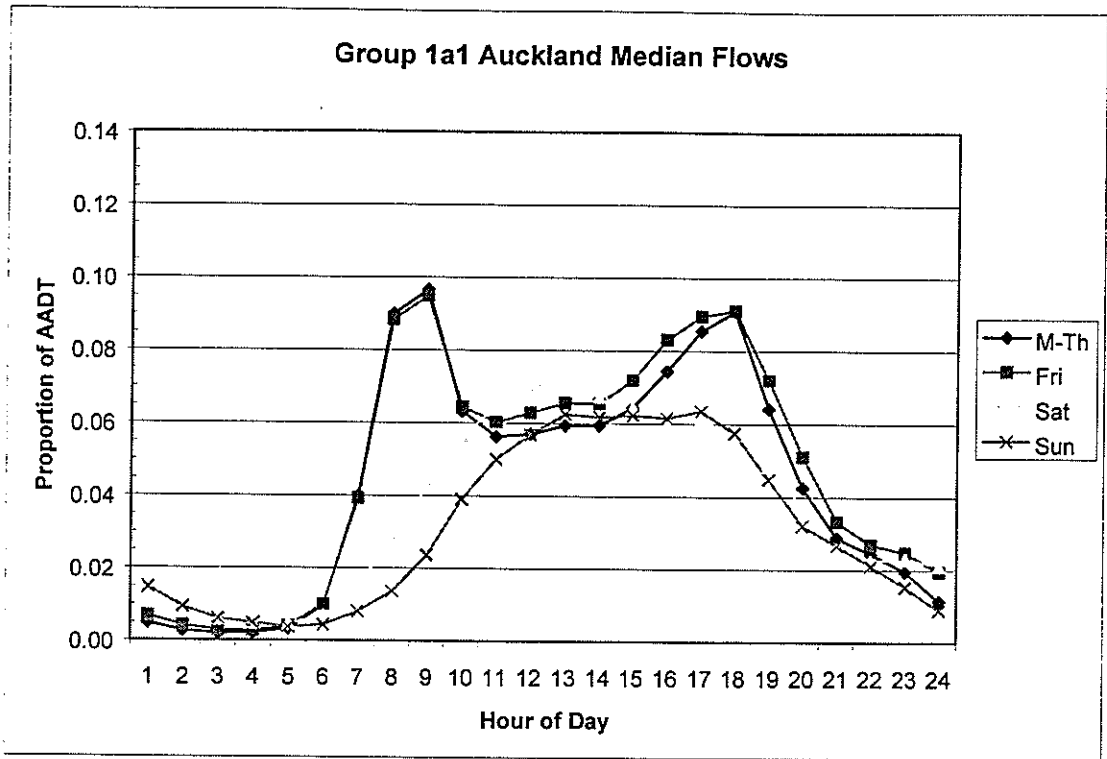
Group 1b1 Auckland Median Flows
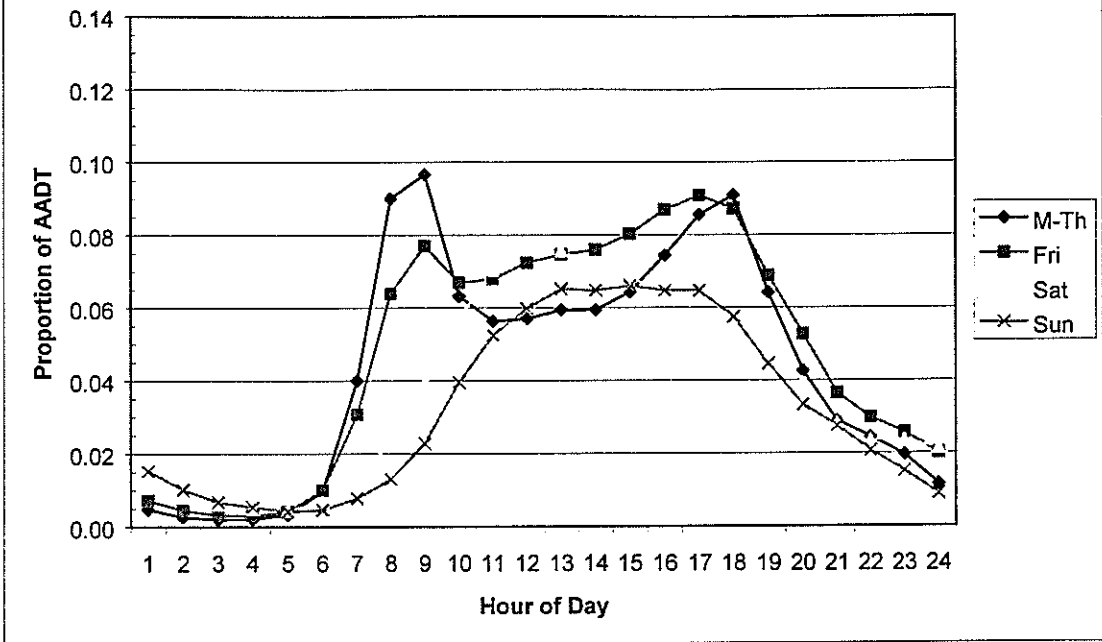
Group 1b2 Non-Auckland Median Flows

Group 2 Median Flows

Group 3 Median Flows

Group __ Median Flows
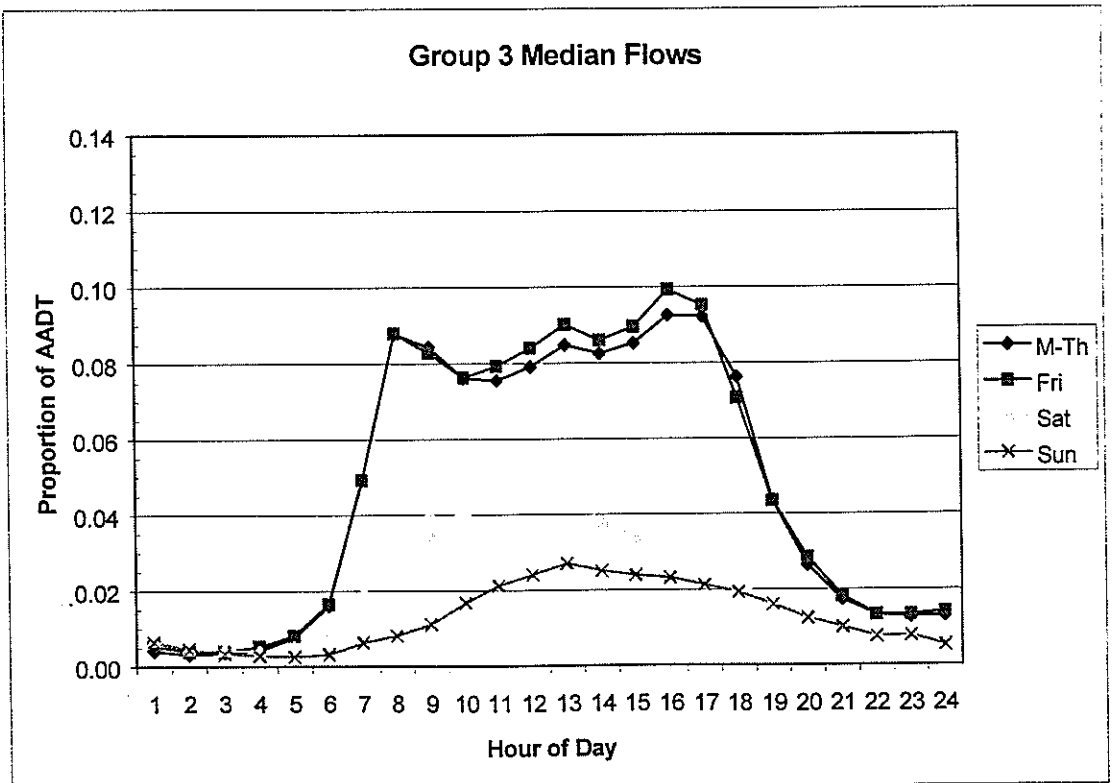
The above blank graph has been incorporated to allow you to graph & compare your own particular profile(s)

Group 5 Median Flows

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Group 6a Median Flows

Group 6b Median Flows

Group 7a Median Flows

Group 7b Median Flows