NRA
An tÚdarás um Bóithre Náisiúnta
National Roads Authority

Project Appraisal Guidelines

Unit 16.1 Estimating AADT on National Roads

August 2012

Project Appraisal Guidelines

Unit 16.1
Estimating AADT on National Roads

Version	Date	Comments
1.0	August 2012	New Guidance

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Glossary

AADT	Annual Average Daily Traffic (typically measured in vehicles)
ATC	Automatic Traffic Counter
TMU	Traffic Monitoring Unit (alternative term for ATC)
AM Peak	The hour in which traffic flow peaks in the morning period
Inter Peak Period	That period which lies between the AM Peak and PM Peak (includes the afternoon and the overnight period)
PM Peak Period	The hour in which traffic flow peaks in the evening period

Definitions

Annual Average Daily Traffic (AADT)
The total volume passing a point or segment of a road for one year, divided by the number of days in the year.

Weekly Average Daily Traffic (WADT)
The total volume passing a point or segment of a road for one full week (Monday to Sunday), divided by the number of days in the week (7).

Average Weekday Traffic
The total volume passing a point or segment of a road for one full working week (Monday to Friday), divided by the number of days in the working week (5).

Permanent Counter Method
Reference to nearby permanent NRA Automatic Traffic Counters which provide at least 12 months of data, used to estimate AADT based on a short period traffic count.

Localised Period Count Method
Use of local traffic counts (minimum 7 days during a neutral period) combined with permanent NRA Automatic Traffic Counters, used to estimate AADT based on a short period traffic count

Generic Expansion Factor Method
A method of extrapolating short period traffic counts to longer periods, or to other count periods using a series of standard indices.

1. Why Estimate AADT

1.1. Annual Average Daily Traffic (AADT) is the average number of vehicles, calculated over a period of one year, passing a point on a road each day. It is expressed in terms of vehicles per day.

1.2. Short-period traffic counts provide vehicle information on a much shorter period for a segment of road for a period of 1 hour, 12 hours, 24 hours, 7 days or longer. Whilst it is possible to extrapolate short period counts to AADT, this process needs to take account of seasonality and other factors which influence the expansion factors that are used.

1.3. AADT is an essential dataset for the National Roads Authority (NRA) that is used for input to environmental models, road planning studies, and pavement design. The use of inappropriate methodology during the AADT estimation process may lead to unrealistic results during scheme appraisal.

1.4. This document sets out the process for calculating AADT for use in traffic models, road planning and pavement design. This document supersedes the NRA document "RT 201- Expansion Factors for Short Period Traffic Counts". RT 201 was prepared in the 1970's and is no longer appropriate for use given the changes in travel behaviour over the last 35 years.

2. Factors Effecting Estimation of AADT

2.1. AADT is best calculated by using a long sample set of data, preferably a full year, taking account of missed days and seasonality, and dividing the information by the total number of recorded days.

2.2. Expansion Factors are used to estimate AADT based on counts that cover a period of less than one year. The time period can comprise a 1 hour count, 12 hour count, 24 hour count, 7-day count or a count covering a number of months of traffic flow at a particular point. Based on an analysis of available data, expansion factors can be formulated to predict the relationship between traffic flows from short time periods and AADT values.

2.3. In developing a process for expanding short period counts to AADT, A number of variables have been considered which can influence the factors to be used, including:

- Geographical Location;
- Road Type
- Seasonality: and
- Day of Week.

2.4. The NRA permanent Automatic Traffic Counters (ATC's) record daily 24-hour 2-way vehicle flows with the results published on the NRA website (www.nra.ie). This extensive network provides a valuable source of AADT data for roads throughout the Country. A sample range of the NRA permanent ATC's was interrogated to demonstrate the impact of the variables listed above on the relevant factor to

extrapolate AM Peak Hour Flow to AADT. The results of this analysis for each of the variables outlined above are presented below.

Geographical Location

2.5. AM Peak to AADT expansion factors have been examined for approximately 100 NRA Permanent Traffic Counter sites. The resulting factors are presented thematically in Figure 16.1.1.

2.6. The data shows that the major urban areas show lower expansion factors than more rural areas of the country. This demonstrates that, in general, roads in proximity to large urban centres produce proportionally higher peak flows and thus lower AADT expansion factors. Notwithstanding this, there can be significant variation in expansion factors from specific counters within regions.

2.7. The results confirm that the geographical location of any road will strongly influence the factors used for the estimation of AADT. As such, local data will always be required to produce robust forecasts.

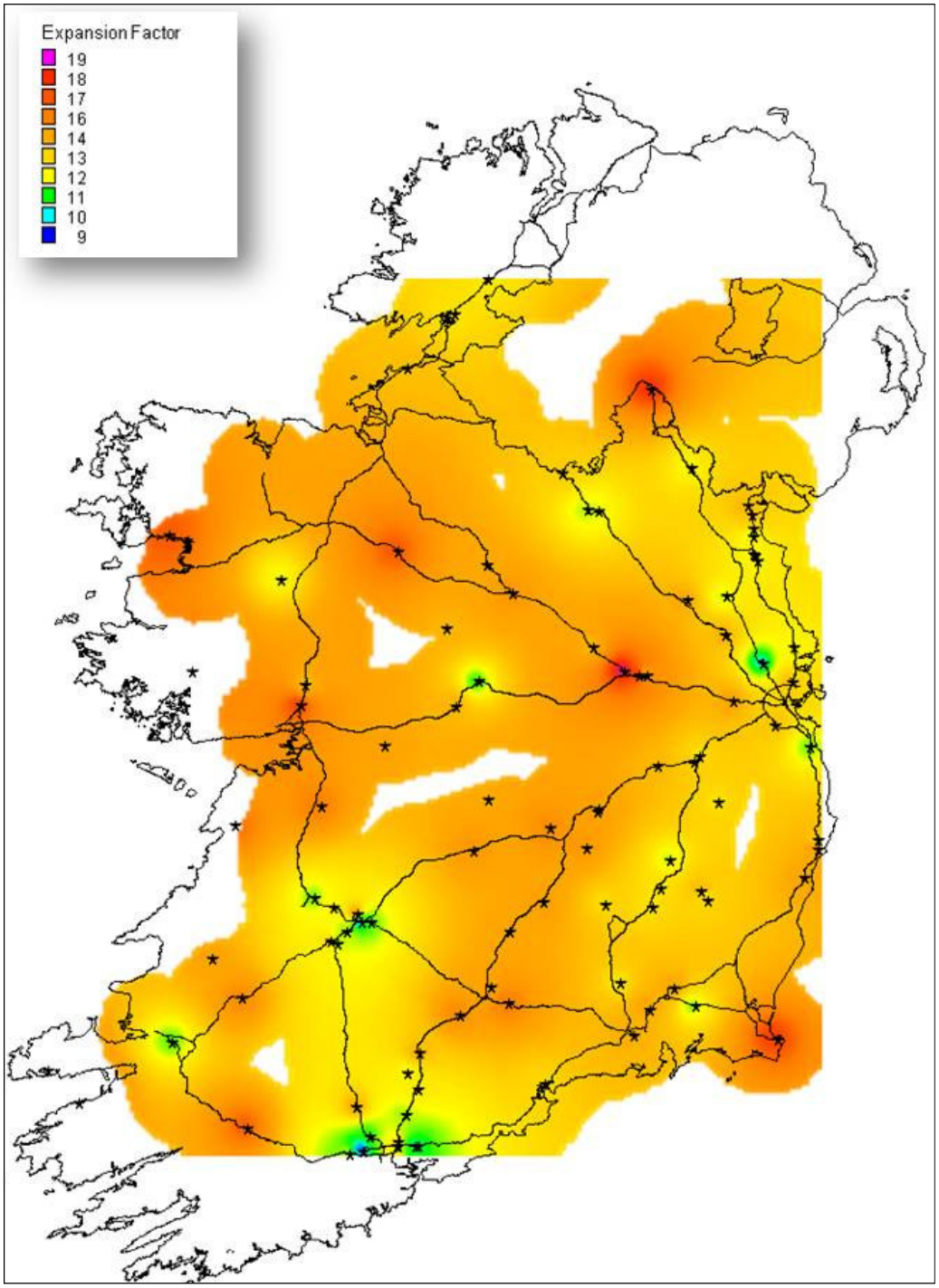


Figure 16.1.1: Expansion Factor for AM Peak Hour by Geographical Area – Based on a sample of 100 NRA Permanent Count Sites

Road Type

2.8. A random sample of National Primary, National Secondary and Regional roads and relevant expansion factors are presented in Figure 16.1.2. Expansion factors range from 11 to 18 across the full sample, which is a typical range outside urban areas. The data suggests that there is no obvious influence of road type in the resulting expansion factors from AM Peak Hour to AADT.

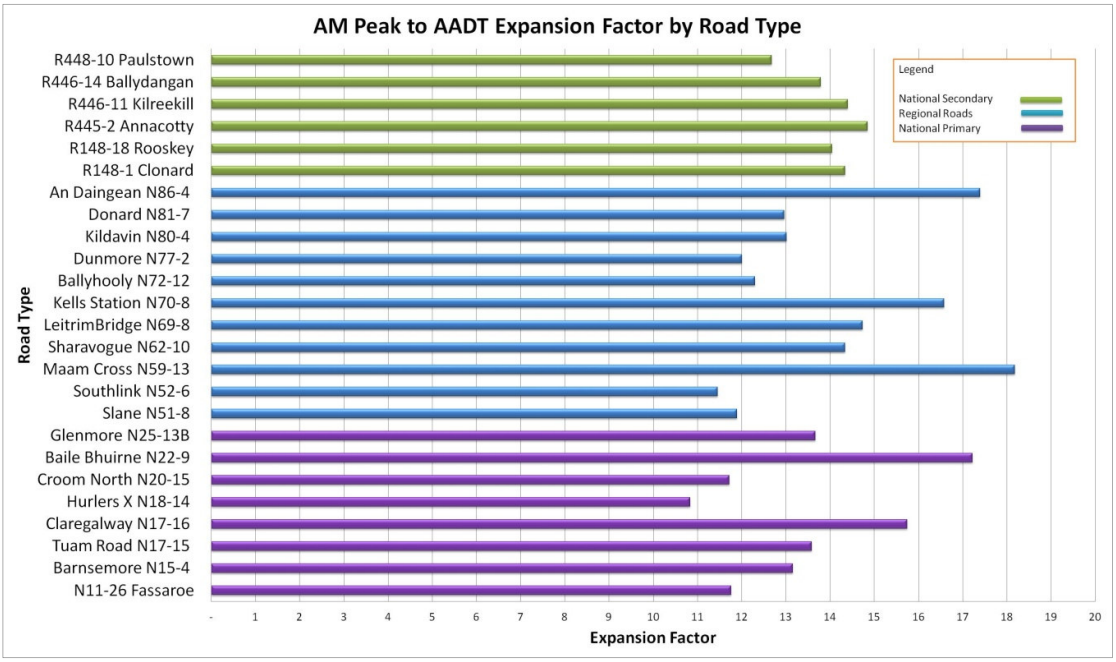


Figure 16.1.2: Expansion Factor from AM Peak Hour to AADT by Road Type

Day of Week

2.9. The amount and type of traffic will vary throughout the week, with resultant impact upon the relevant expansion factor. The number of commercial vehicles will decrease on weekends, while, depending on the road, traffic volumes can be quite high on Fridays, as a result of increased inter-urban traffic.

2.10. Figure 16.1.3 below shows a weekly flow profile based on data from the network of NRA Permanent Traffic Counters. The data shows a gradual increase in the 24-hour traffic flow from Monday through to a peak on Friday, with a reduction in total flows at weekends.

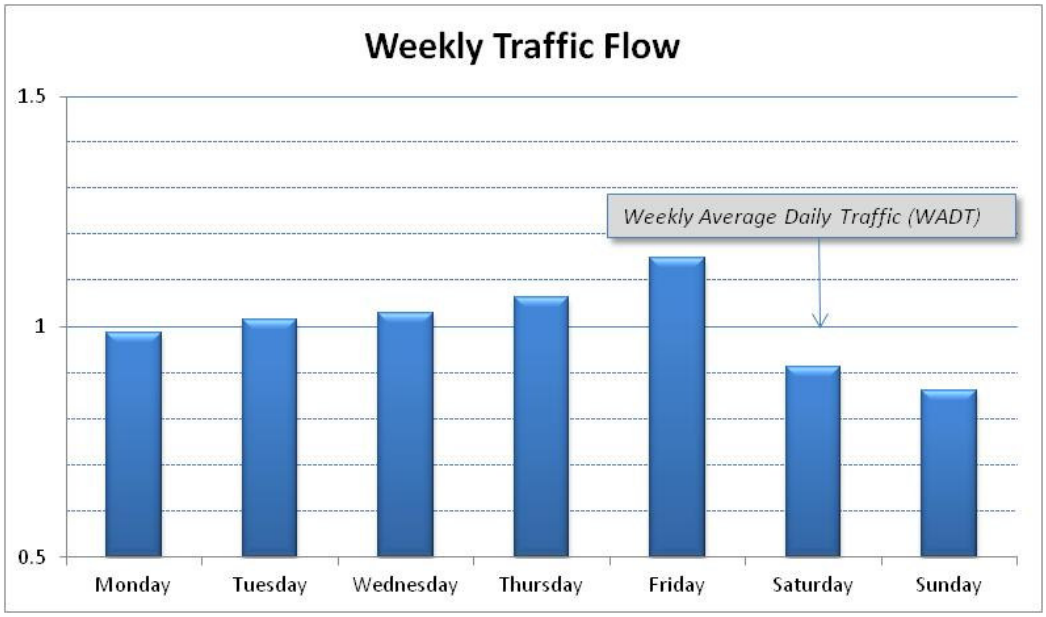


Figure 16.1.3: Weekly Flow Profile as a Proportion of WADT

2.11. The data above shows that Monday to Wednesday provide a good representation of traffic flow on an average weekday. Flows between Thursday and Sunday show significant variation around the Weekly Average Day.

Seasonality

2.12. Seasonality is a measure of the variability in traffic flow at different times of the year. The effects of seasonality are most evident in tourist areas where traffic flows can be significantly higher in the summer months, a pattern not repeated elsewhere.

2.13. A sample set of nine sites were chosen based on four typical traffic count seasons as follows:

- Winter: Dec-Jan
- Spring: Feb-May
- Summer: June-Aug
- Autumn: Sept-Nov

2.14. The weekday AM peak factor was determined for the nine random sites around the country, and a summary of the results is shown in Figure 16.1.4. The results show a considerable range of expansion factors from AM Peak to AADT by season across all sites. It is therefore concluded that the month and season in which traffic surveys are carried out can strongly influence the expansion factor generated to estimate the AADT, and hence the effects of seasonality should be included in any estimation of AADT.

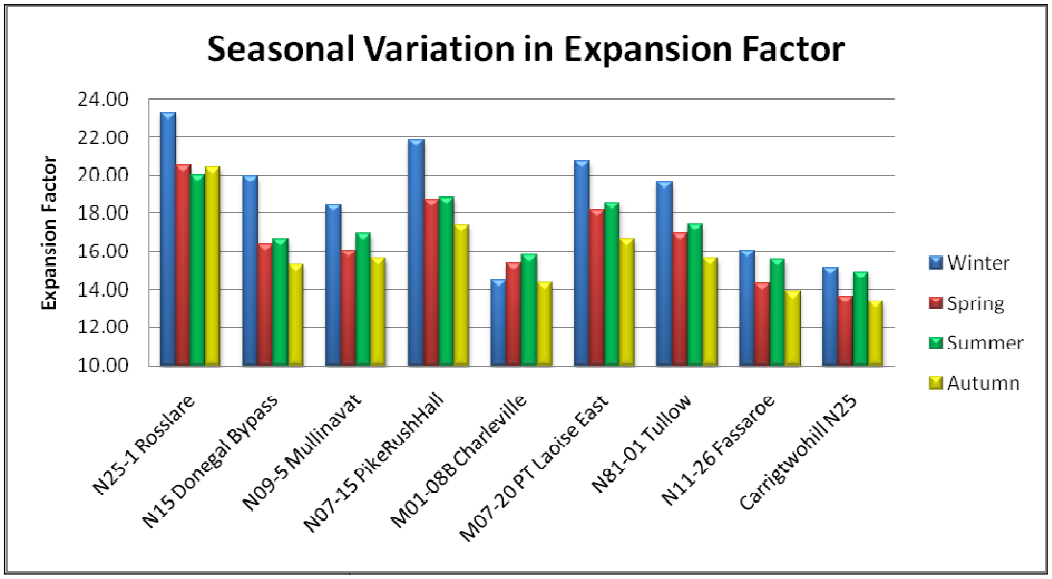


Figure 16.1.4: Expansion Factor from AM Peak Hour to AADT by Season

Summary

2.15. As demonstrated, there are a number of variables that influence the expansion factor derived from traffic flows. Therefore, it is essential that these variables be accounted for when using short term traffic counts to estimate AADT. The key factors that need to be considered are:

- Geographical Location;
- Month of Year; and
- Day of Week

3. Alternative Methods for Estimating AADT

3.1. In the past, RT201 has been used to enable estimation of AADT from short period traffic counts. The data in that document is outdated and does not take account of local conditions – as such it is no longer appropriate for use in scheme appraisal. Where there is a requirement for calculation of specific time periods from short period counts to support Project Appraisal, two methods are presented in this Unit as follows:

- Reference to nearby permanent NRA Automatic Traffic Counters which provide at least 12 months of data [**Permanent Counter Method**]; or
- Use of localised period counts (minimum 7 days during a neutral period) combined with nearby permanent NRA Automatic Traffic Counters [**Localised Period Count Method**];

3.2. NRA permanent Automatic Traffic Counters are located throughout the national road network, and data is made published at www.nra.ie. As such, the Permanent Counter Method is the most reliable and continuous source of information for generating AADT estimates.

3.3. Where an NRA counter is not available nearby, it is necessary to undertake localised period counts over at least 7 days. These localised period counts can then be used to estimate period flows, which can subsequently be extrapolated to AADT using a selection of permanent NRA counters in the region. This is the Localised Period Count Method.

3.4. Where the extrapolation of short period counts is required to support analysis and where extrapolated data does not form part of scheme project appraisal, then the use of generic expansion factors is permitted. This is referred to as the **Generic Expansion Factor Method**, and is outlined in *PAG Unit 16.2.2: Expansion Factors for Short Period Traffic Counts*.

3.5. The Generic Expansion Factor Method can be used for short period counts where nearby data is not available, and where the collection of localised period counts is not justified. This would normally be the case where data is required for high level studies only, and where outputs will not be used as the basis for Project Appraisal or any form of local capital investment.

3.6. For the purpose of this PAG Unit, short period traffic counts are defined as counts of duration less than 7 days. The flowchart in Figure 16.1.5 should be used to inform the most appropriate means of developing AADT estimates from short period traffic counts in different circumstances.

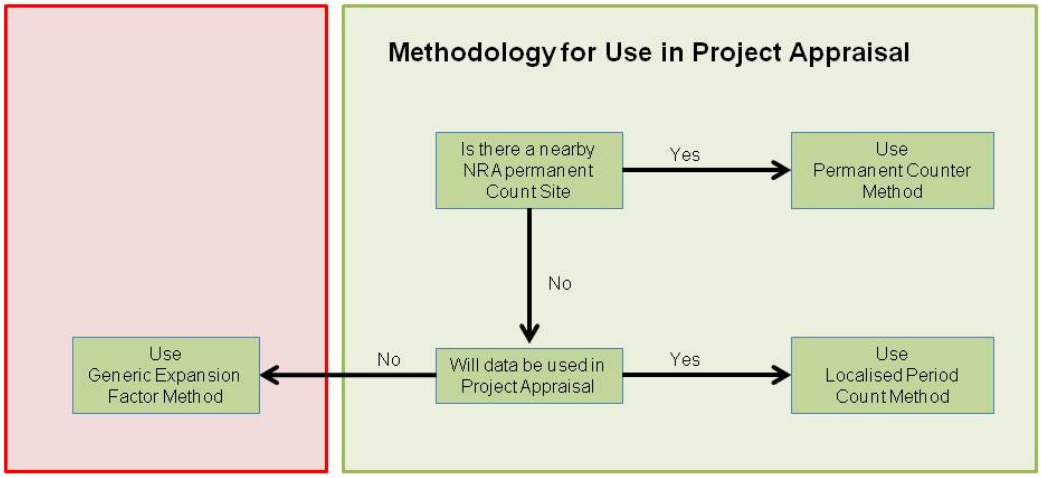


Figure 16.1.5: Approaches for Estimating AADT from Short Period Counts

3.7. It is noted that the methods set out for extrapolation of short period traffic counts to AADT is equally applicable to traffic modelling outputs, which typically represent short periods. In the case of traffic models, it is likely that the analysis is being undertaken to inform some form of capital investment, and hence the Permanent Counter Method or Localise Period Count Method is most appropriate for conversion of traffic modelling outputs to AADT.

4. Specifying Short Periods

4.1. The count period (or traffic modelling period) ultimately depends on the traffic profile

in the area being studied. It is generally common to include a selection of peak periods (such as the morning and evening peak periods) along with a representative hour from the inter-peak period. Note that weekend counts may be required when dealing with areas of high retail land use. Care should be taken to understand the surrounding land uses and the profile of traffic in the area before scheduling traffic counts

4.2. The choice of peak hours will be informed by an analysis of traffic flow data in the area. In some instances the AM and PM peak periods may last longer than a one hour period. In this case, multiples of the peak hours can be used to calculate the peak period vehicle flow. Figure 16.1.6 shows an example of peak hours spreading over more than one hour.

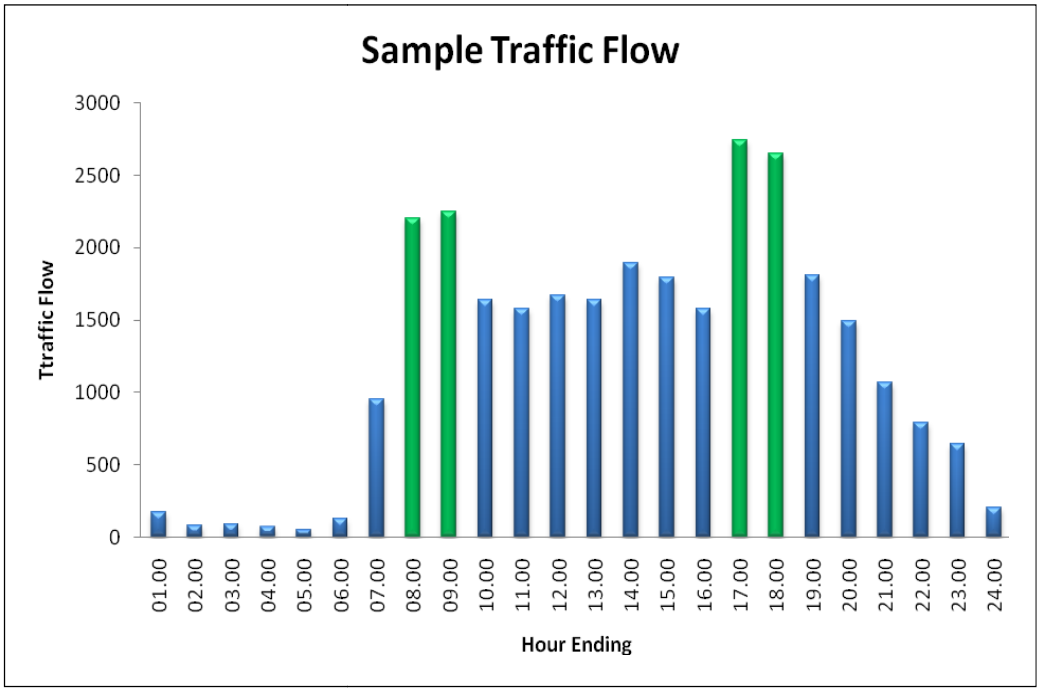


Figure 16.1.6: Weekday Flow profile showing peak periods

4.3. In order to ensure an unbiased sample, short period traffic counts should be carried out during a "neutral", or representative month, avoiding main and local holiday periods, local school holidays, mid terms and any other abnormal traffic periods. Where a study area is impacted by a third level institution, surveys should also avoid exam periods (which can occur in late January and during May and June) as well as the longer holiday periods throughout the year. Other periods to avoid include local festivals or unusual events, which may influence traffic at a local level; where an unusual event (including severe weather) occurs during traffic surveys it will be necessary to undertake the surveys again at a neutral time.

4.4. Neutral periods should be used unless alternatives are agreed in advance with the NRA. Bank Holidays (and the days before and after it) should be avoided and engineering judgment should be used when considering the period between St. Patricks Day and Easter. These periods should be adhered to unless otherwise agreed in advance with the NRA.

4.5. The following Neutral Periods are defined:

- Mid. January – May (excluding bank holidays and other holiday periods); and
- Mid. September – November (excluding bank holidays and other holiday periods).

5. NRA Permanent Counter Method

Key Features

5.1. The NRA Permanent Counter Methods uses information from the network of NRA traffic counters to facilitate the expansion of short period traffic counts to AADT. The inherent assumptions in using the NRA Permanent Counter Method are:

- That the short period count is taken on a representative day;
- That there is a high level of certainty that the traffic flow profiles in the location of the short period count are not significantly different to those where the NRA Permanent Counter is located; and
- That the site of the short period count is geographically close to the site where the NRA Permanent Counter is located.

Availability of Data

5.2. The NRA has a network of permanent traffic counters on National Primary and Secondary roads, with a number of counters located on regional roads, generally where a bypass has been constructed and the former road has been reclassified. There are in excess of 160 existing counters, with this network set to expand significantly over the coming years. Figure 16.1.7 shows a map of the network of traffic counters as at January 2012.

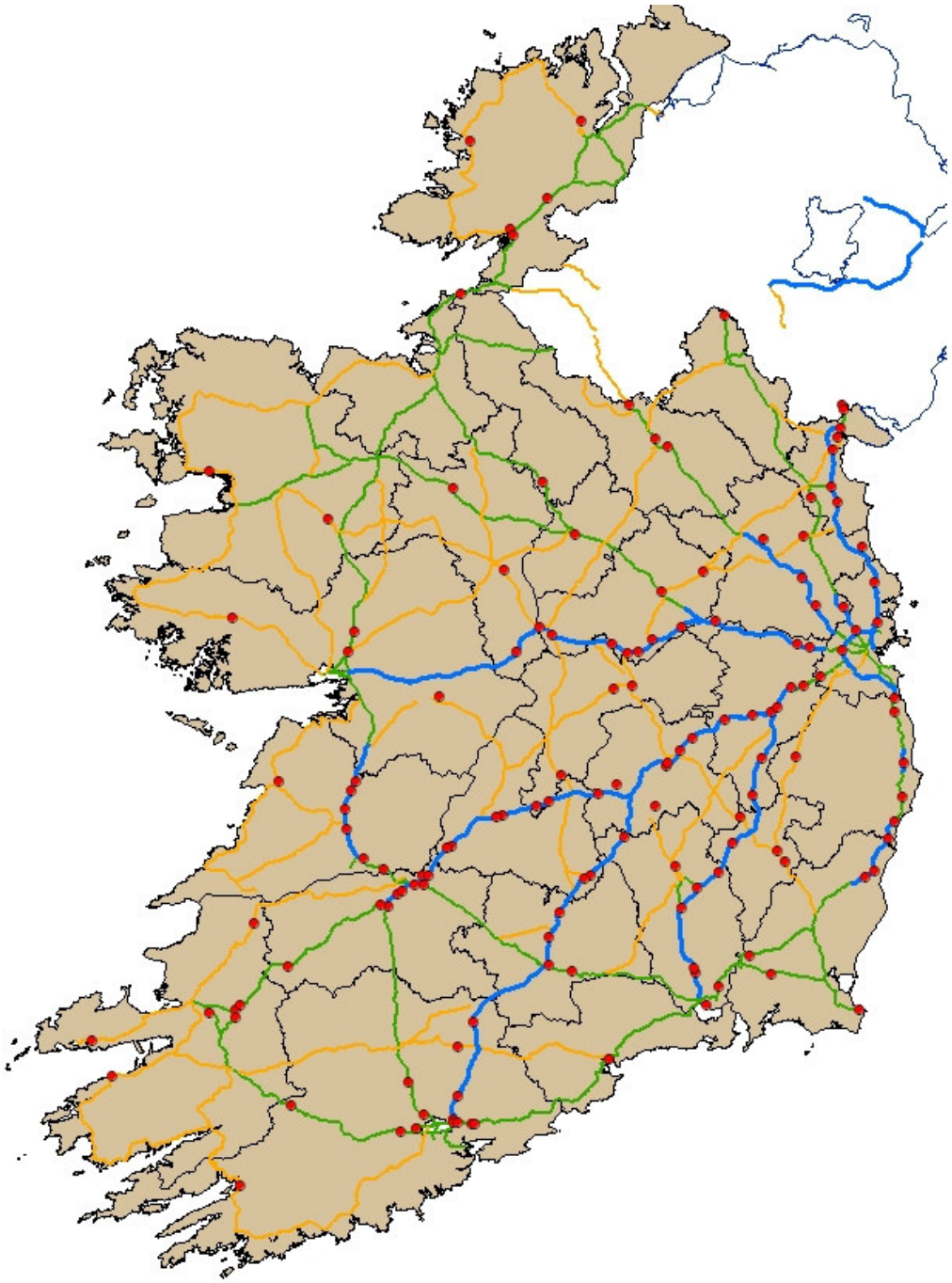


Figure 16.1.7: NRA Permanent Traffic Counters (January 2012)

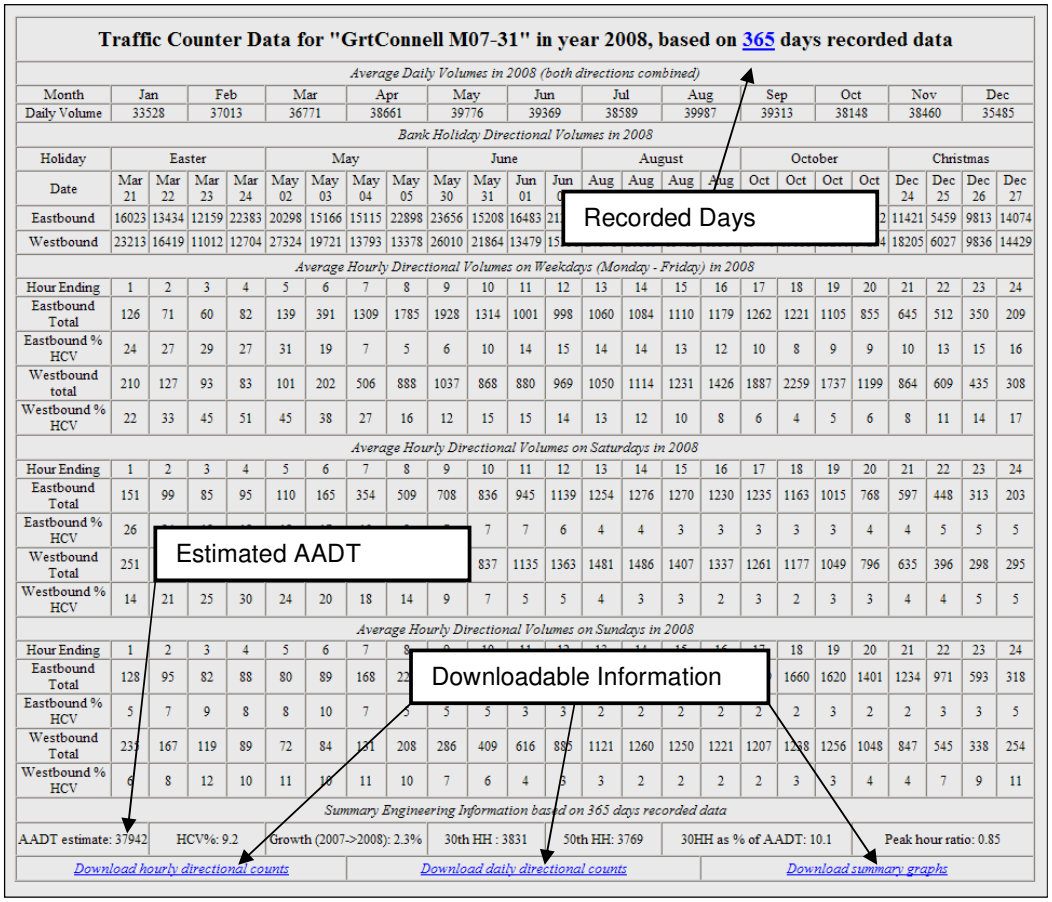
5.3. Data from NRA Permanent Traffic Counters is reported on the NRA website (see http://www.nra.ie/NetworkManagement/TrafficCounts). This data is updated regularly by the NRA. The following information is presented for each year:

- Average daily traffic volumes (2-directional);
- Bank Holiday directional volumes by day;
- Average hourly directional volumes on weekdays;
- Average hourly directional volumes on Saturdays;
- Average hourly directional volumes on Sundays;
- Average Heavy Vehicle percentage for weekdays, Saturdays and Sundays by hour;
- The 30th and 50th Highest Hour (HH);
- An estimate of AADT;
- An aggregate value for Heavy Vehicle percentage;
- The total traffic growth based on the previous year of data for that site; and
- The Peak Hour Ratio.

5.4. In addition, there are additional downloadable Excel spreadsheets, with hourly directional traffic counts, daily directional traffic counts, as well as summary graphs.

5.5. For various reasons, including maintenance and faults, the counters may not record a full year's data. While the AADT estimate accounts for seasonality, the estimate will be more accurate when it is based on a larger number of recorded days. Therefore, to reduce the element of seasonal variations, it is suggested that a minimum of 270 days data be required when using estimated AADT values from the permanent counters

5.6. An extract from the summary data is presented below in Figure 16.1.8.



Traffic Counter Data for "GrtConnell M07-31" in year 2008, based on 365 days recorded data

Average Daily Volumes in 2008 (both directions combined)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily Volume	33528	37013	36771	38661	39776	39369	38589	39987	39313	38148	38460	35485

Bank Holiday Directional Volumes in 2008

Holiday	Easter				May				June				August				October				Christmas			
Date	Mar 21	Mar 22	Mar 23	Mar 24	May 02	May 03	May 04	May 05	May 30	May 31	Jun 01	Jun	Aug	Aug	Aug	Aug	Oct	Oct	Oct	Oct	Dec 24	Dec 25	Dec 26	Dec 27
Eastbound	16023	13434	12159	22383	20298	15166	15115	22898	23656	15208	16483	21								2	11421	5459	9813	14074
Westbound	23213	16419	11012	12704	27324	19721	13793	13378	26010	21864	13479	15								4	18205	6027	9836	14429

Average Hourly Directional Volumes on Weekdays (Monday - Friday) in 2008

Hour Ending	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Eastbound Total	126	71	60	82	139	391	1309	1785	1928	1314	1001	998	1060	1084	1110	1179	1262	1221	1105	855	645	512	350	209
Eastbound % HCV	24	27	29	27	31	19	7	5	6	10	14	15	14	14	13	12	10	8	9	9	10	13	15	16
Westbound total	210	127	93	83	101	202	506	888	1037	868	880	969	1050	1114	1231	1426	1887	2259	1737	1199	864	609	435	308
Westbound % HCV	22	33	45	51	45	38	27	16	12	15	15	14	13	12	10	8	6	4	5	6	8	11	14	17

Average Hourly Directional Volumes on Saturdays in 2008

Hour Ending	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Eastbound Total	151	99	85	95	110	165	354	509	708	836	945	1139	1254	1276	1270	1230	1235	1163	1015	768	597	448	313	203
Eastbound % HCV	26									7	7	6	4	4	3	3	3	3	3	4	4	5	5	5
Westbound Total	251									837	1135	1363	1481	1486	1407	1337	1261	1177	1049	796	635	396	298	295
Westbound % HCV	14	21	25	30	24	20	18	14	9	7	5	5	4	3	3	2	3	2	3	3	4	4	5	5

Average Hourly Directional Volumes on Sundays in 2008

Hour Ending	1	2	3	4	5	6	7	8										18	19	20	21	22	23	24
Eastbound Total	128	95	82	88	80	89	168	22										1660	1620	1401	1234	971	593	318
Eastbound % HCV	5	7	9	8	8	10	7	3	5	5	3	3	2	2	2	2	2	2	3	2	2	3	3	5
Westbound Total	233	167	119	89	72	84	131	208	286	409	616	885	1121	1260	1250	1221	1207	1238	1256	1048	847	545	338	254
Westbound % HCV	6	8	12	10	11	10	11	10	7	6	4	3	3	2	2	2	2	3	3	4	4	7	9	11

Summary Engineering Information based on 365 days recorded data

AADT estimate: 37942 | HCV%: 9.2 | Growth (2007->2008): 2.3% | 30th HH : 3831 | 50th HH: 3769 | 30HH as % of AADT: 10.1 | Peak hour ratio: 0.85

Download hourly directional counts | Download daily directional counts | Download summary graphs

Figure 16.1.8: Sample Data from NRA Website

Methodology for Estimating AADT using the NRA Permanent Counter Method

5.7. The key requirement with NRA Permanent Counter Method is to ensure that the short period traffic counts are sufficient to enable a robust representation of AADT. This is particularly relevant for the NRA Permanent Counter method, as such is likely to form the basis of capital investment for larger schemes.

5.8. Firstly, it is necessary to identify which NRA Permanent counters can be used in the estimation process. A search of the NRA's website will identify traffic counters in the area of interest. From this, the nearest relevant counter, based on road type and daily flow profile should be identified. Engineering judgement should be used to determine whether the counter is in a location with similar traffic flow proportions. This can be checked by comparing the daily or weekly flow distribution.

5.9. Where there is any doubt regarding the appropriateness of a nearby counter, consideration should be given to the Localised Period Count Method (see Section 6). Such doubts will exist where:

- There is a large settlement between the NRA Permanent Counter and the location of the short period count which may influence travel patterns and/or the daily flow profile;
- Where the NRA Permanent Counter is on a different road class or route;

- Where there is a large distance between the location of the short period count and the NRA Permanent Counter (greater than 30km); or
- Where data from the NRA Permanent Counter is incomplete or old (greater than 2 years).

5.10. Where there is a requirement for expansion of short period counts from across a broad geographical area (as might be the case with traffic modelling outputs), then it is necessary that a selection of NRA Permanent Counters is used to provide a more representative sample.

5.11. It may be the case that data from various NRA Permanent Counters across an area shows that there is a high level of variation in flow profiles across that area. In such instances, it is necessary to extract a greater level of detail from the short period traffic counts (or indeed to model additional periods in the traffic model) such that a more robust regression can be developed. Care should be taken when considering the application of different expansion factors to different regions within traffic modelling outputs, as to do so might create imbalances in traffic flows across boundaries between adjacent areas. This could distort the subsequent economic appraisal.

5.12. When appropriate counters are identified (and combined in the case of multiple counters), it is then necessary to develop the expansion factors. This, in turn, raises the question as to how many count periods are required for the expansion. It is necessary to use at least 2 periods during a typical weekday for calculating AADT, and more preferable to use 3 periods as follows:

- AM Peak: Either the AM Peak Hour (08:00 to 09:00) or AM Peak Period (07:00 to 09:00 or 07:00 to 10:00);
- Inter Peak: Generally the Inter Peak Period (12:00 to 14:00); and
- PM Peak: Either the PM Peak Hour (17:00 to 18:00) or PM Peak Period (16:00 to 18:00 or 16:00 to 19:00);

5.13. The ultimate requirement is to ensure that an accurate representation of AADT can be established – in this regard a greater number of traffic count periods will yield an improved level of accuracy. In selecting the exact times for the short period counts, judgement should be taken on any factors which unduly influence traffic flows at certain times of the day. For example, significant congestion during an AM or PM Peak can lead to substantial reductions in link flows during certain periods, which can thereby influence the AADT calculation. In such cases, the use of traffic flows for those short periods of high congestion should probably be omitted. Analysis of available traffic data can assist with identifying such patterns.

5.14. In developing the expansion factors, a different method exists depending on the number of NRA Permanent Counters that are to be used. These are outlined below:

Use of a Single NRA Permanent Counter

5.15. A typical daily flow profile is generated for the weekday (or weekend day) for which the short period counts have been collated. This is generated by direct interrogation of the NRA Permanent Counter traffic information.

5.16. Data from the Permanent Counter should then be classified into Peak (comprising AM Peak and/or PM Peak) and Inter Peak. In performing this task, the following bands are suggested:

- AM Peak: The period from 06:00 to 10:00
- PM Peak: The period from 16:00 to 20:00
- Inter Peak: The period from 20:00 to 06:00 and 10:00 to 16:00

5.17. The Inter Peak covers the period during the middle of the day, and also the overnight period. It could be proposed to separate these periods. Note, however, that the overnight period represents a very low proportion of the overall traffic flow and short period counts from the overnight period should not be used to extrapolate to Inter Peak.

5.18. Likewise, where AM Peak and PM Peak traffic flows are similar in volume and composition, it may be appropriate to define a single period as 'Peak', which would cover the period 06:00 – 10:00 and 16:00 – 20:00.

5.19. An expansion factor for the short period count to each of these relevant periods should be developed from the data. To estimate the flow for a defined period (e.g. the AM Peak) from the short period count, the procedure is as follows:

$$AM_x = \left(\frac{Q_x}{Q_{PTC}}\right) X\ (AM_{PTC})$$

where

AM_x = Annual Average AM Peak (06:00 – 10:00) traffic flow at location *x*
AM_{PTC} = Annual Average AM Peak (06:00 – 10:00) traffic flow at Permanent Traffic Counter
Q_x = Short Period AM Peak traffic flow at location *x*
Q_{PTC} = Short Period AM Peak traffic flow at Permanent Traffic Counter. This should relate to the same Short Period as Q_x

5.20. Equivalent formulae are presented for Inter Peak (IP) and PM Peak (PM) as follows:

$$IP_x = \left(\frac{Q_x}{Q_{PTC}}\right) X\ (IP_{PTC}) \qquad\qquad PM_x = \left(\frac{Q_x}{Q_{PTC}}\right) X\ (PM_{PTC})$$

5.21. The result for all periods (AM, PM and Interpeak) is aggregated to give a value of AADT as follows:

$$AADT_x = (AM_X) + (IP_X) + (PM_X)$$

Use of Multiple NRA Permanent Counters

5.22. Where short period counts are to be expanded to AADT across a wider area (as is the case with traffic modelling), then it is often better to reference a number of NRA Permanent Counters. In such cases, the calculation of periodic expansion factors may yield a different result for each individual counter. Instead, a Regression Analysis should be used to estimate the best expansion factors that will provide a good level of fit to observed data.

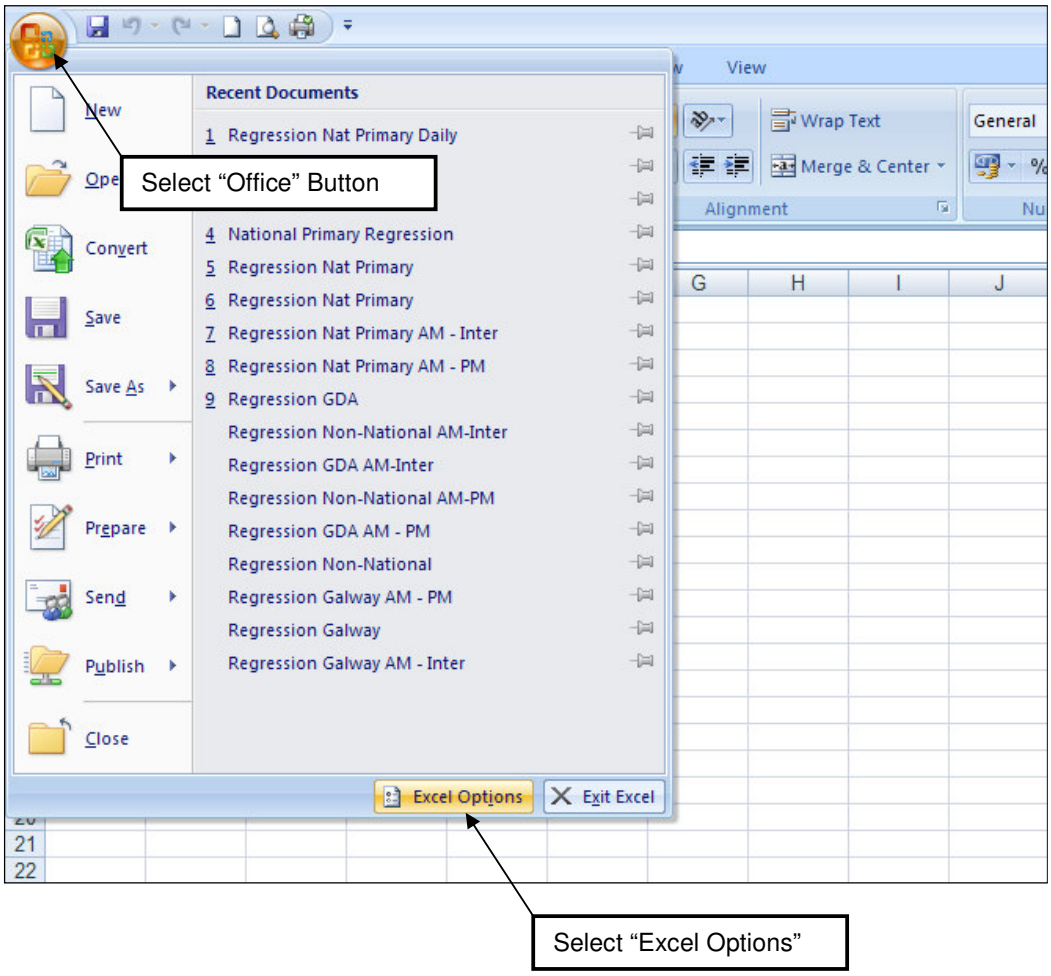
5.23. For regression analysis, the regression process seeks to calculate a, b, and c based on traffic flow profiles across a number of sites. Regression takes a group of random variables, thought to be predicting y, and tries to find a mathematical relationship between them. In the case of an AADT calculation, the estimated AADT will be plotted against the Observed AADT to determine the spread of individual results. The closeness of fit is calculated through the determination of the value of the Coefficient of Determination (r^2).

5.24. The coefficient of determination compares estimated and actual y-values, and ranges in value from 0 to 1. If r^2 is 1, there is a perfect correlation in the sample – there is no difference between the estimated y-value and the actual y-value. At the other extreme, if the coefficient of determination is 0, the regression equation is not helpful in predicting a y-value. A value of r^2 over 0.95 is generally accepted as within the confidence range.

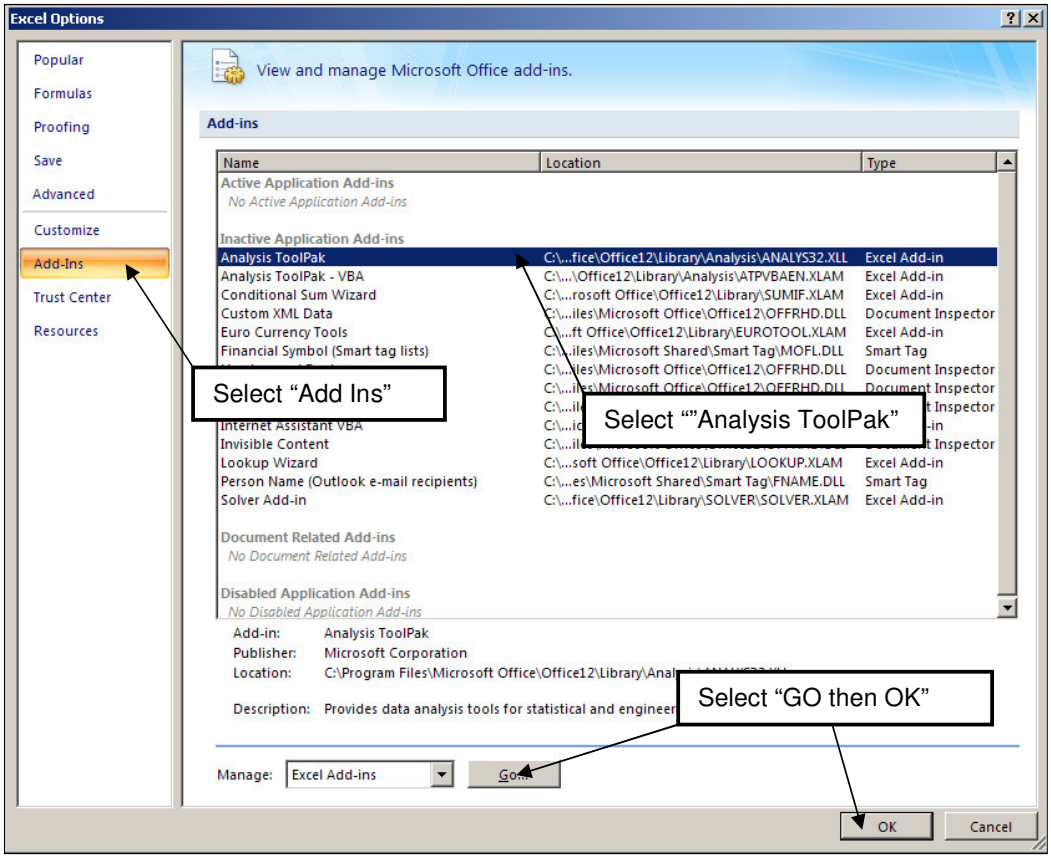
5.25. The regression tool is an add-on to the standard Microsoft Excel programme. This section of the report details how to (i) add the regression tool , and (ii) carry out a regression analysis. The data used can vary between 1 variable, such as AM-peak flow, to 3 variables, such as AM-Peak, PM-Peak and Inter-peak flows. Data can be averaged over a time period, a day or a number of years. The following steps detail how to use the regression toolkit.

5.26. The regression analysis presented here was undertaken in the Microsoft Excel 2007 package using the data analysis tool. Regression analysis can however be undertaken in a number of other programmes.

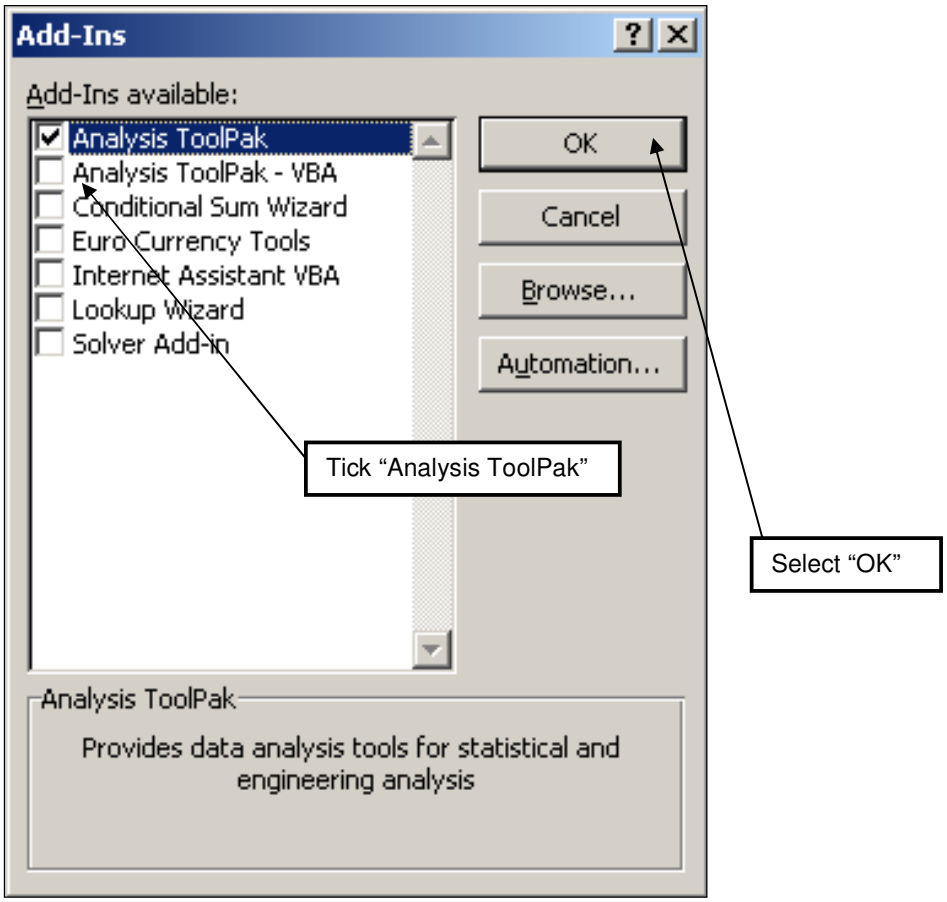
Step 1:	*Select "Office" Button* *Select "Excel Options*



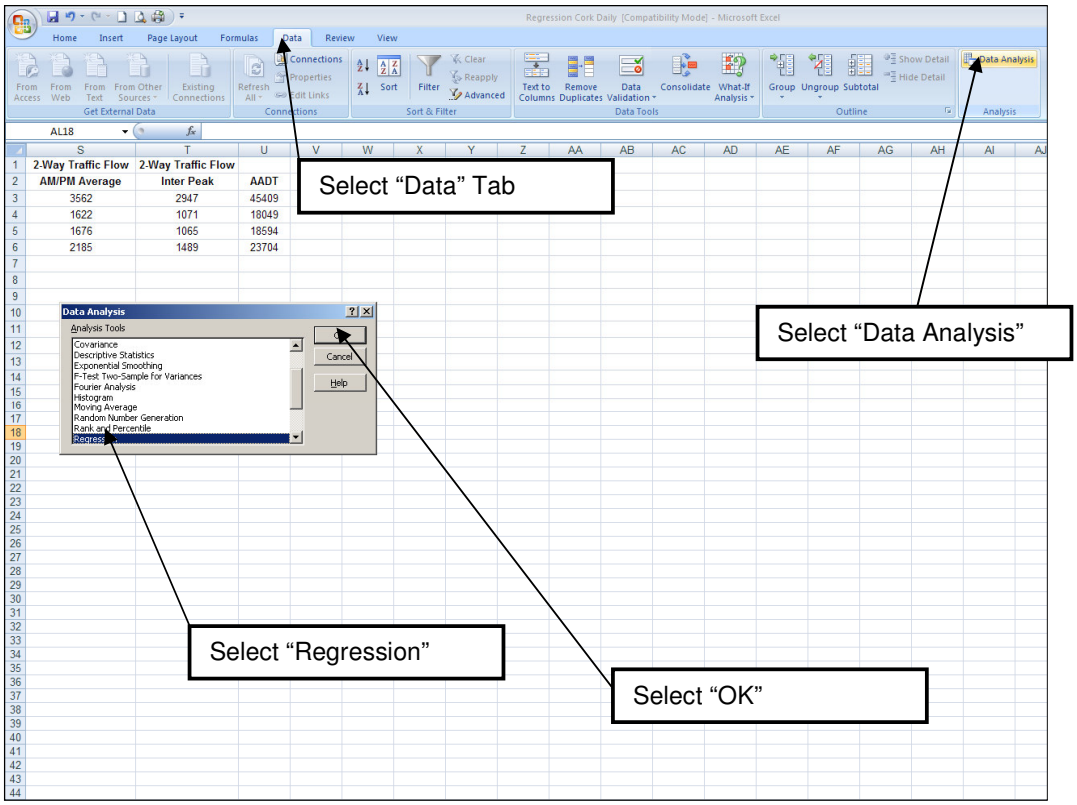
Step 2:	*Select "Add Ins"* *Select "Analysis ToolPak"* *Select "OK"*



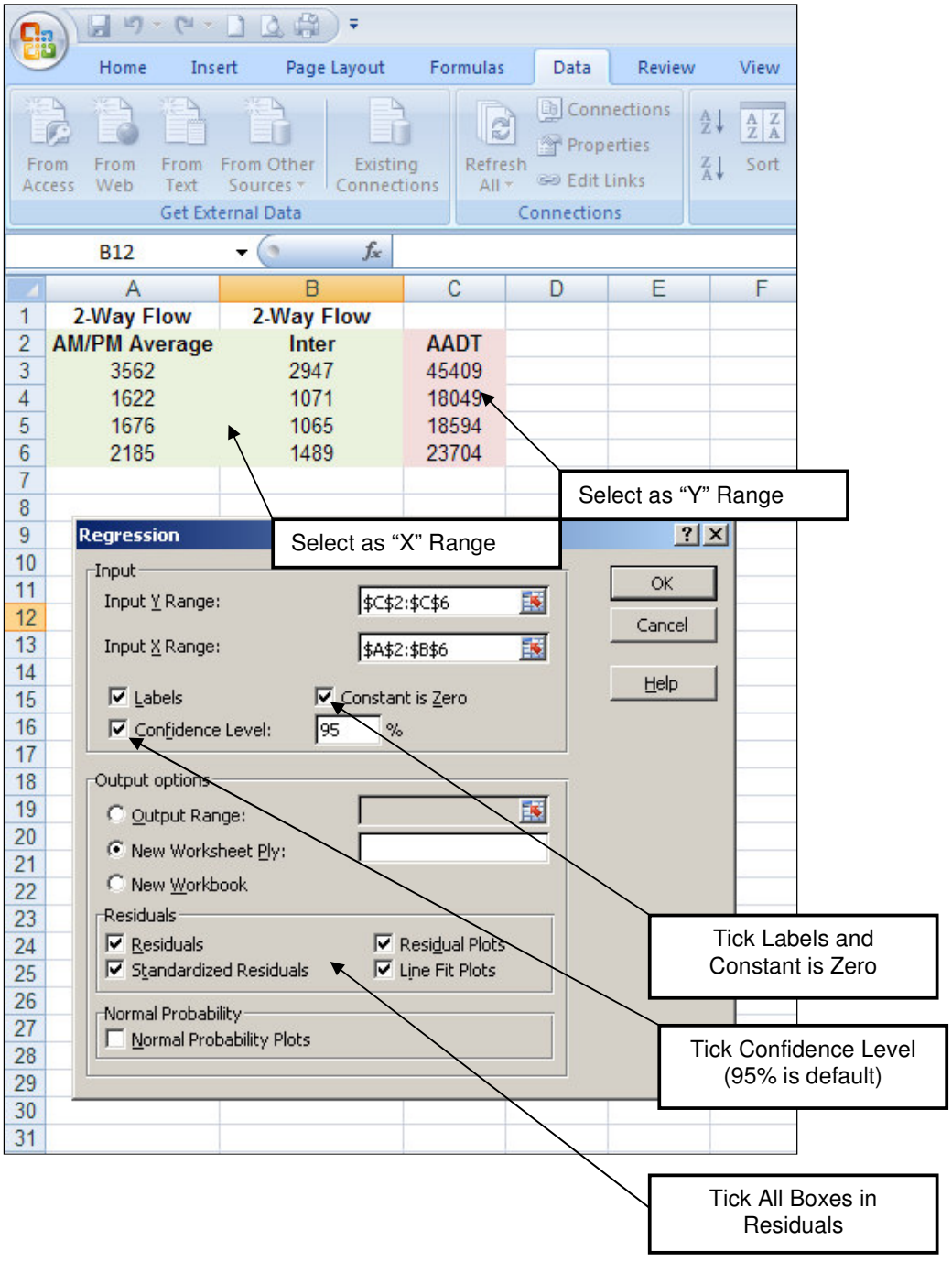
Step 3:	*From the Add In Menu Tick "Analysis ToolPak"* *Click "OK"* The Toolbar is now added to Excel, and is found in the "Data" Tab. These three steps need only be done once, to add the toolbar to Excel



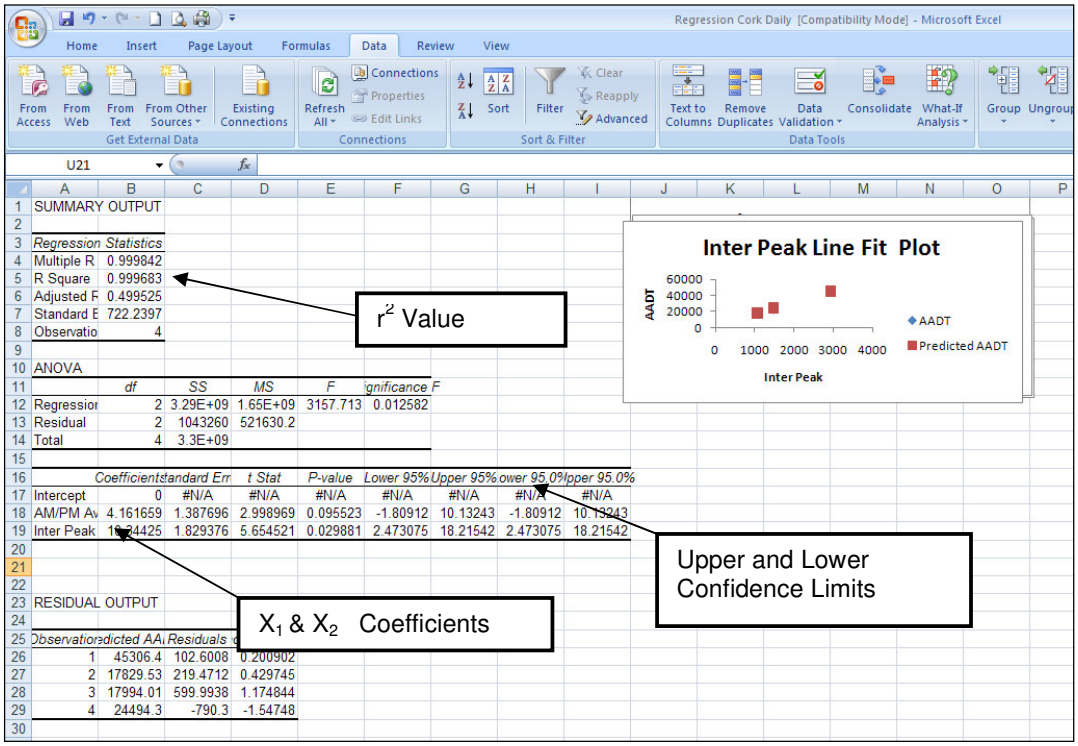
Step 4:	The Toolbar is found in Data Tab *Select "Data Analysis"* *From the List, Select "Regression"* *Select "OK"*



Step 5:	*Select the AADT column of data for the Y-Range* *Select the relevant Peak flow group/groups for the X-Range* *Ensure the Labels Option and Constant is Zero is ticked* *Tick Confidence Level (95% is the Default value)* *Tick all Options in the Residuals section* *Select "OK"*



Step 6:	A new worksheet will open with the Regression Results The third table will show the coefficients for each flow group r^2 is shown in the first table



	A	B	C	D	E	F	G	H	I
1	SUMMARY OUTPUT								
2									
3	*Regression Statistics*								
4	Multiple R	0.999842							
5	R Square	0.999683							
6	Adjusted F	0.499525							
7	Standard E	722.2397							
8	Observatio	4							
9									
10	ANOVA								
11		*df*	*SS*	*MS*	*F*	*gnificance F*			
12	Regressior	2	3.29E+09	1.65E+09	3157.713	0.012582			
13	Residual	2	1043260	521630.2					
14	Total	4	3.3E+09						
15									
16		*Coefficients*	*tandard Err*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*ower 95.0%*	*pper 95.0%*
17	Intercept	0	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
18	AM/PM Av	4.161659	1.387696	2.998969	0.095523	-1.80912	10.13243	-1.80912	10.13243
19	Inter Peak	9.24425	1.829376	5.654521	0.029881	2.473075	18.21542	2.473075	18.21542
20									
21									
22									
23	RESIDUAL OUTPUT								
24									
25	*Observatior*	*redicted AA*	*Residuals*						
26	1	45306.4	102.6008	0.200902					
27	2	17829.53	219.4712	0.429745					
28	3	17994.01	599.9938	1.174844					
29	4	24494.3	-790.3	-1.54748					
30									

Step 7:	Apply the factors to the relevant peak flows to determine the AADT

$$y = x_1 (a) + x_2 (b)$$

Where

y = AAWT Estimate
x_1 = Peak Coefficient 1
x_2 = Peak Coefficient 2
a = Peak Flow 1
b = Peak Flow 2
Assume that d (the factor from average weekday to AADT) = 0.9

Sample

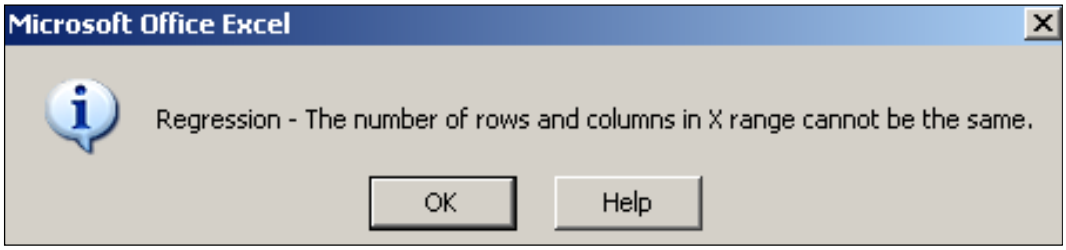
a = AM/PM Average Peak Flow = 2,350
b = Inter Peak Flow = 1,370

x1= AM/PM Peak Co-Efficient = 4.16
x2= Inter Peak Co-Efficient =10.34

AADT= (4.16)*(2,350) + (10.34)*(1,370) = 23,941

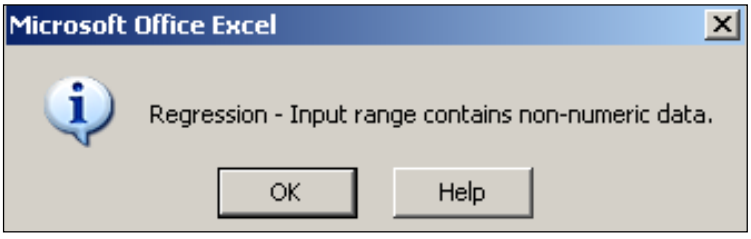
AADT = 23,942*0.9 = 21,548

5.27. A number of errors messages may appear when carrying out regression analysis, which are explained here. If you have only one set of data which you want to expand upon, an error may occur due to the lack of data. The following error will appear.

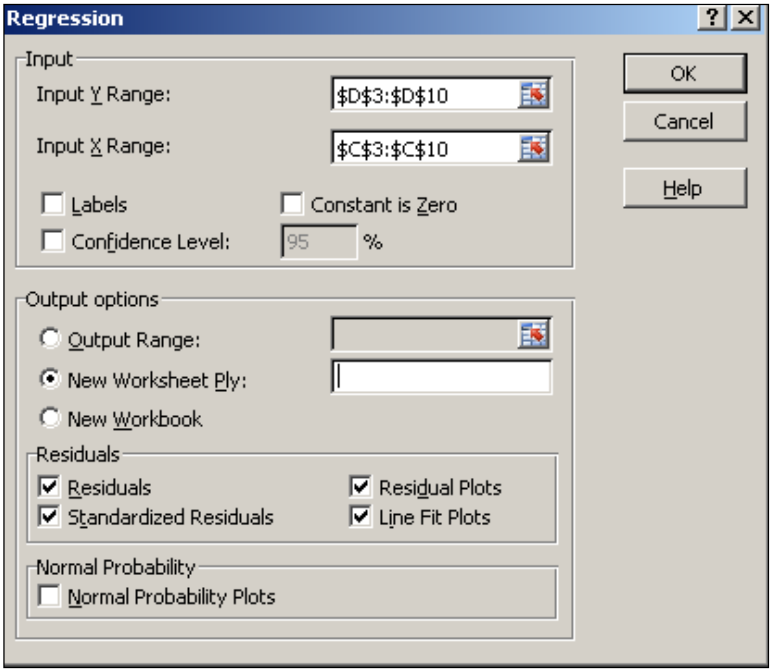


5.28. To overcome this error, there are a number of options. An additional year of data could be added to the dataset. Alternatively, a number of the same days either side of the survey date could be added to the data. If only one counter is available, it is preferable to use the methodology provided earlier in this section to develop the expansion formulae.

5.29. Another error that may appear is as follows:



5.30. This is simply a case of a box not ticked, as per Step 5 in the above guide. In the Input section, the box "Labels" needs to be ticked to allow information such as the name of the factor be input into the dataset.



6. Localised Period Count Method

Key Features

6.1. Where there is no NRA Permanent Counter located close to the location of the short period traffic count, but where the outputs of the expansion of local traffic counts will be used in scheme appraisal, it is necessary to undertake a further localised count that can account for the limited availability of local data. This approach comprises two steps:

- Firstly, the short period traffic count is extrapolated based on a localised period count which covers a period of at least 7 days. These localised period counts can then be used to estimate flows for that period; and
- This period flow is subsequently extrapolated to AADT using the NRA Permanent Count Method, but using NRA counters that are not deemed to be immediately comparable to the location of the short period traffic count.

6.2. This method is used where the results of the analysis are to be used in scheme appraisal, and where:

- The short period count is not taken on a representative day;
- There is a low level of certainty that the traffic flow profiles in the location of the short period count are similar to those where the NRA Permanent Counter is located;

- The site of the short period count is geographically remote (greater than about 30km) from the site where the NRA Permanent Counter is located; or
- Where the value of the scheme being appraised is not greater than €30m. Where this scheme value threshold is exceeded, it is necessary to install permanent counters in the study area such that a full year of data can be collected.

6.3. This method therefore ensures that in those areas where there is some uncertainty regarding the appropriateness of the NRA Permanent Count sites used in the analysis, that a minimum of 7 days data is used in the estimation of AADT (or indeed flows for other time periods).

Availability of Data

6.4. The collection of a localised period count requires the use of automatic traffic counting over a period of no less than one week. This can be achieved by a number of methods, including:

- Temporary tubes installed in the roadway;
- The use of radar or other forms of above ground detection; or
- Extraction of data from Urban Traffic Control Systems (SCOOT or SCATS)

6.5. For availability of data on NRA Permanent Counters that are used to extrapolate the localised period count, refer to section 5 of this document.

Methodology for Estimating AADT using the Localised Period Count Method

6.6. The first task is to install temporary counters that will record volumetric information over a period of at least 7 days in the vicinity of the location where the short period count has been collected. Where the traffic studies are concerned with a specific location on the road network, it is possible that this would provide the primary data, which is then extrapolated to AADT. For area-based studies, data collection might comprise the installation of a series of temporary counters in addition to other junction count information.

6.7. Short period traffic count information is then extrapolated to a period of at least 7 days using the local period traffic count information. The method of expansion will be different depending on the number of period traffic counts.

Use of a Single Period Counter

6.8. A typical daily flow profile is generated for the weekday (or weekend day) for which the short period count has been collated. This is generated by direct interrogation of the Period Counter.

6.9. Data from the Period Counter should then be classified into Peak (comprising AM Peak and/or PM Peak) and Inter Peak. In performing this task, the following bands are suggested:

- AM Peak: The period from 06:00 to 10:00

- PM Peak: The period from 16:00 – 20:00
- Inter Peak: The period from 20:00 to 06:00 and 10:00 to 16:00

6.10. Note here that the Inter Peak covers the period during the middle of the day, and also the overnight period. It could be proposed to separate these periods. Note, however, that the overnight period represents a very low proportion of the overall traffic flow and short period counts from the overnight period should not be used to extrapolate to Inter Peak.

6.11. Where AM Peak and PM Peak traffic flows are similar in volume and composition, it may be appropriate to define a single period as 'Peak', which would cover the period 07:00 – 11:00 and 16:00 – 20:00.

6.12. An expansion factor for the short period count to each of these relevant periods should be developed from the data. To estimate the flow for a defined period (e.g. the AM Peak) from the short period count, the procedure is as follows:

$$AM_x = \left(\frac{Q_x}{Q_{PTC}}\right) X\ (AM_{PTC})$$

where

AM_x = Annual Average AM Peak (06:00 – 10:00) traffic flow at location *x*
AM_{PTC} = Annual Average AM Peak (06:00 – 10:00) traffic flow at Permanent Traffic Counter
Q_x = Short AM Peak Period traffic flow at location *x*
Q_{PTC} = Short Period AM Peak traffic flow at Permanent Traffic Counter. This should relate to the same Short Period as Q_x

6.13. Equivalent formulae are presented for Inter Peak (IP) and PM Peak (PM) as follows:

$$IP_x = \left(\frac{Q_x}{Q_{PTC}}\right) X\ (IP_{PTC}) \qquad\qquad PM_x = \left(\frac{Q_x}{Q_{PTC}}\right) X\ (PM_{PTC})$$

6.14. The result for all periods (AM, PM and Interpeak) is aggregated to give a value of AADT as follows:

$$AADT_x = (AM_X) + (IP_X) + (PM_X)$$

where

$WADT_x$ = Weekly (Mon-Sun) average daily traffic volume at location x during the short period

Use of Multiple Period Counters

6.15. Where short period counts are to be expanded to AADT across a wider area (as is the case with traffic modelling), then it may become necessary to reference a number of Period Counters. In such cases, the calculation of periodic expansion factors will yield a different result for each individual counter. Instead, a Regression Analysis should be used to estimate the best expansion factors that will provide a good level of fit to observed data.

6.16. For regression analysis, the regression process seeks to calculate a, b, and c based

on traffic flow profiles across a number of sites. Regression takes a group of random variables and tries to find a mathematical function based on them. In the case of an AADT calculation, the estimated AADT will be plotted against the Observed AADT to determine the spread of individual results. The closeness of fit is calculated through the determination of the value of the Coefficient of Determination (r^2).

6.17. The coefficient of determination compares estimated and actual values, and ranges in value from 0 to 1. If r^2 is 1, there is a perfect correlation in the sample – there is no difference between the estimated actual value. At the other extreme, if the coefficient of determination is 0, the regression equation is not helpful in predicting a value. A value of r^2 over 0.95 is generally accepted as within the confidence range.

6.18. The regression analysis process is outlined in section 5 of this PAG Unit.

7. Reporting

7.1. Prior to undertaking any work on expansion factors, the proposed approach should be documented in the Traffic Modelling Plan (reference *PAG Unit 5.2: Construction of Transport Models*).

7.2. All supporting analysis in developing expansion factors should be outlined in the Traffic Modelling Report (*PAG Unit 5.6: Traffic Modelling Report*). For Non-Major Schemes, this should be included in the Project Appraisal Report (*PAG Unit 14: Non-Major Schemes*).

7.3. The importance of proper project planning in the preparation of expansion methodologies is stressed. For projects where the installation of additional permanent counters is necessary, it will be important that this is undertaken at an early stage in the project such that the data will be available during the detailed traffic studies.