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Project Appraisal Guidelines for National Roads Unit 16.0 - Estimating AADT on National Roads

PE-PAG-02038
October 2016

PE Planning & Evaluation

Technical

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This document has been authorised by the Director of Professional Services, Transport Infrastructure Ireland. For any further guidance on the TII Publications system, please contact the following:

Contact: Standards and Research Section, Transport Infrastructure Ireland
Postal Address: Parkgate Business Centre, Parkgate Street, Dublin 8, D08 DK10
Telephone: +353 1 646 3600
Email: infoPUBS@tii.ie

TII Publications

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Contents Table

Glossary

AADT	Annual Average Daily Traffic
ATC	Automatic Traffic Count
JTC	Junction Turning Count
NRA	National Roads Authority
PAG	Project Appraisal Guidelines
TII	Transport Infrastructure Ireland
TMU	Traffic Monitoring Unit (TII Permanent Traffic Counter)
WADT	Weekly Average Daily Traffic

Definitions

Annual Average Daily Traffic (AADT)

The total two-way traffic volume passing a point or segment of a road for one full calendar year, divided by the number of days in a year (365).

Weekly Average Daily Traffic (WADT)

The total two-way traffic 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 two-way 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 TII TMU which provides 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 14 days during a neutral period) combined with permanent TII TMU, 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

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

Short period traffic data provides traffic flow information for various time periods (e.g. 6 hours, 12 hours, 24 hours, 7 days etc.). Expansion can be applied to modelled or observed data, and whilst it is possible to extrapolate short period traffic counts to AADT, this process needs to take account of seasonality and other factors which influence the expansion factors that are used, and should be supplemented by Automatic Traffic Counts (ATCs).

AADT is an essential dataset for Transport Infrastructure Ireland (TII) that is used as an input to scheme appraisal, 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.

This document sets out the process for calculating AADT for use in traffic models, road planning and pavement design. This document updates the previous PAG Unit 16.1 published in 2012, and supersedes the National Roads Authority (NRA) document “RT 201- Expansion Factors for Short Period Traffic Counts”.

The TII network of permanent automatic traffic counters (i.e. Traffic Monitoring Units) should be used for project appraisal purposes. Where TII TMU data is not available, scheme specific localised period traffic counts should be carried out. The traffic data collection will be outlined in the Project Appraisal Plan, approved by TII.

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 Localised Period Count Method is most appropriate for conversion of traffic modelling outputs to AADT. Sections 5 and 6 of this PAG Unit explain these methods in greater detail.

2. Factors Effecting Estimation of AADT

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.

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 6 hour count (minimum time period), 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 observed data, expansion factors can be formulated to predict the relationship between short period traffic counts and AADT.

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

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

TII TMUs continuously record traffic flow data at over 280 locations on the national and regional road network. The data is processed and uploaded to the TII website within minutes. This extensive network of permanent counters provides a valuable source of AADT data for roads throughout the country.

3. Alternative Methods for Estimating AADT

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 traffic counts to support Project Appraisal, two methods are presented in this Unit as follows:

- **Permanent Counter Method** - Reference to nearby permanent TII TMU which provides at least 12 months of data; or
- **Localised Period Count Method** - Use of localised period counts (minimum 14 days during a neutral period) combined with nearby permanent TII TMU.

TII TMUs are located throughout the national and regional road network, and data is publically available on the TII website. As such, the Permanent Counter Method is the most reliable for generating AADT estimates.

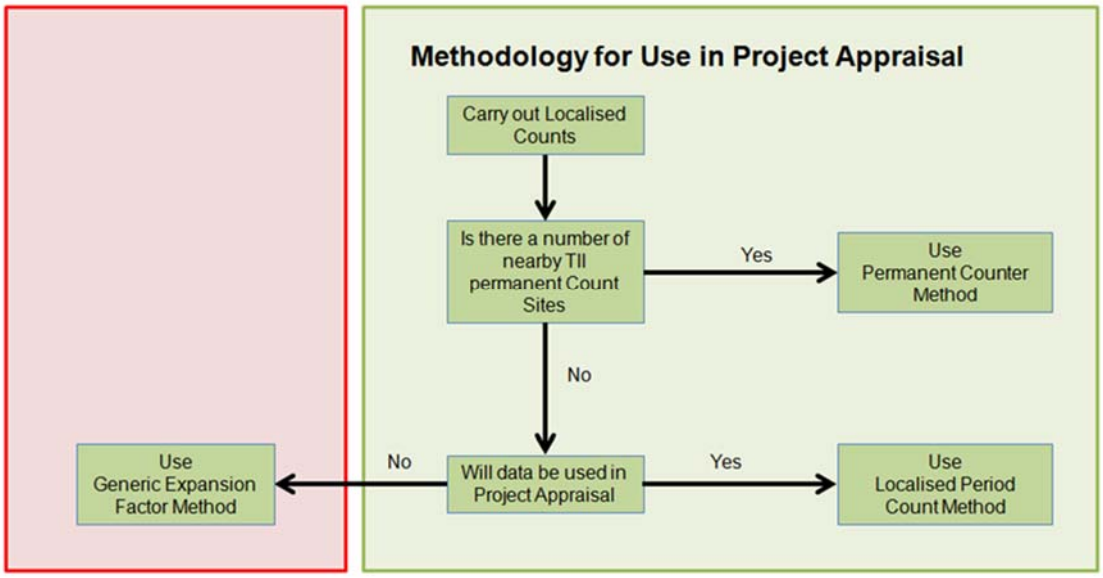
Where a TII TMU is not available nearby, it is necessary to undertake localised period counts over 14 days. These localised period counts can then be used to estimate period flows, which can subsequently be extrapolated to AADT using a selection of permanent TII counters in the region. This is the Localised Period Count Method.

Where the extrapolation of short period traffic counts is required to support analysis only and 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 16.1: Expansion Factors for Short Period Traffic Counts.

The Generic Expansion Factor Method can be used for short period traffic 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.

For the purpose of this PAG Unit, short period traffic counts are defined as counts of duration less than 14 days. The flowchart in Figure 16.0.1 should be used to inform the most appropriate means of developing AADT estimates from short period traffic counts in different circumstances.

Figure 16.0.1: Approaches for Estimating AADT

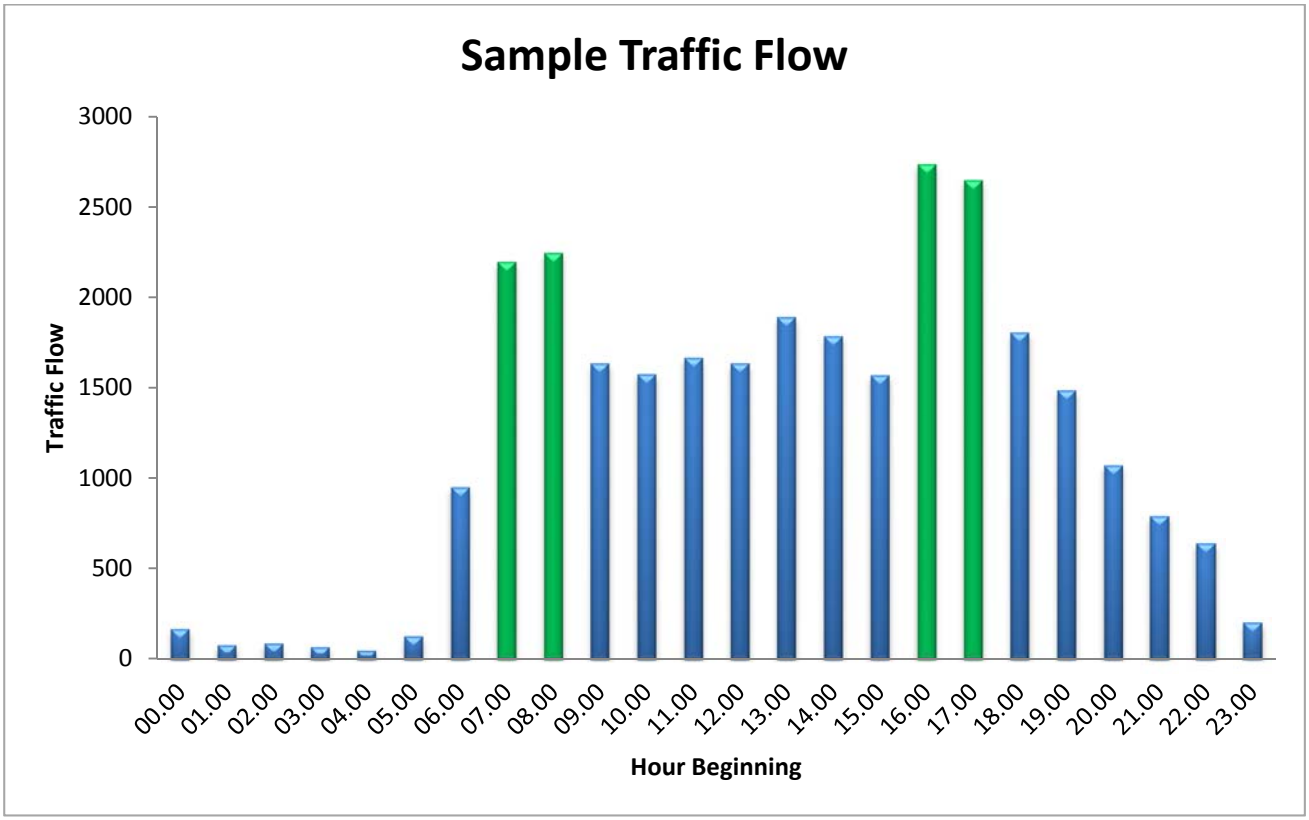


4. Specifying Short Periods

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 use characteristics and the profile of traffic in the area before scheduling traffic counts.

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 16.0.2 shows an example of peak hours spreading over more than one hour.

Figure 16.0.2: Weekday Flow profile showing peak periods



In order to ensure an unbiased sample, short period traffic counts (both ATCs and JTCs) 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 December and 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 may be necessary to undertake the surveys again at a neutral time.

For the purpose of data collection, with reference to guidance supplied in UK Department for Transport WebTAG Unit M1.2 and the TII PAG Unit 5.2, neutral periods have been defined as Monday to Thursday during the following periods:

- Late March and April – excluding the weeks before and Easter;
- May - excluding the Thursday before and all of the week of the Bank Holiday;
- September – excluding school holidays or return to school weeks;
- October – excluding the Thursday before and all of the week of the Bank Holiday; and
- All of November.

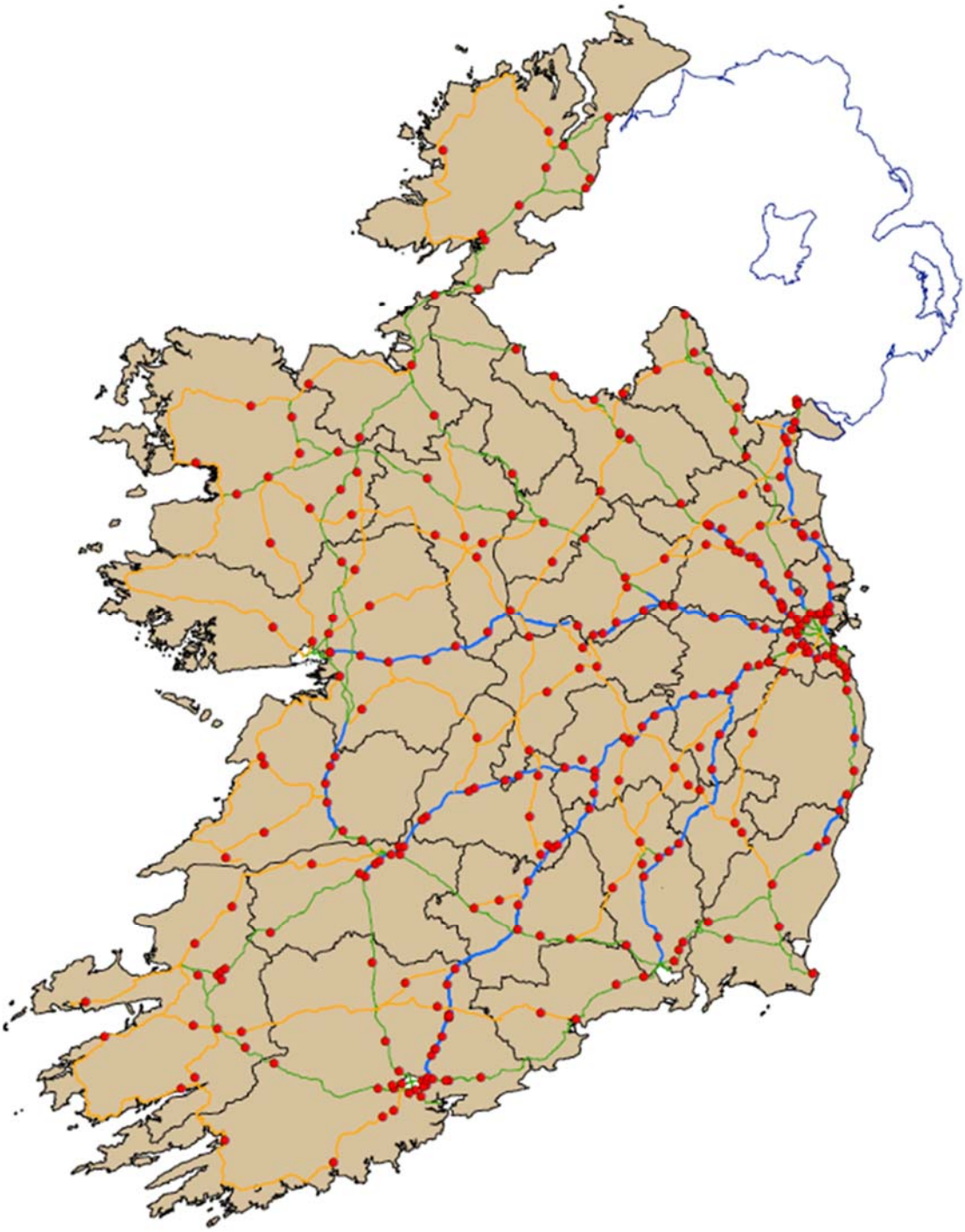
Bank Holidays (and the days before and after it) should be avoided. Neutral periods should be used unless alternatives are agreed in advance with TII.

5. TII Permanent Counter Method

5.1 Availability of Data

TII 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 280 counters located on the road network. Figure 16.0.3 shows a map of the network of traffic counters as at March 2016.

Figure 16.0.3: TII Permanent Traffic Counters (March 2016)



Data from TII TMU sites is reported on the TII website.

(https://www.nratrafficdata.ie/c2/gmapbasic.asp?sgid=ZvyVmXU8jBt9PJE$c7UXt6).

The following information is presented for each year from data collected from the permanent traffic counters:

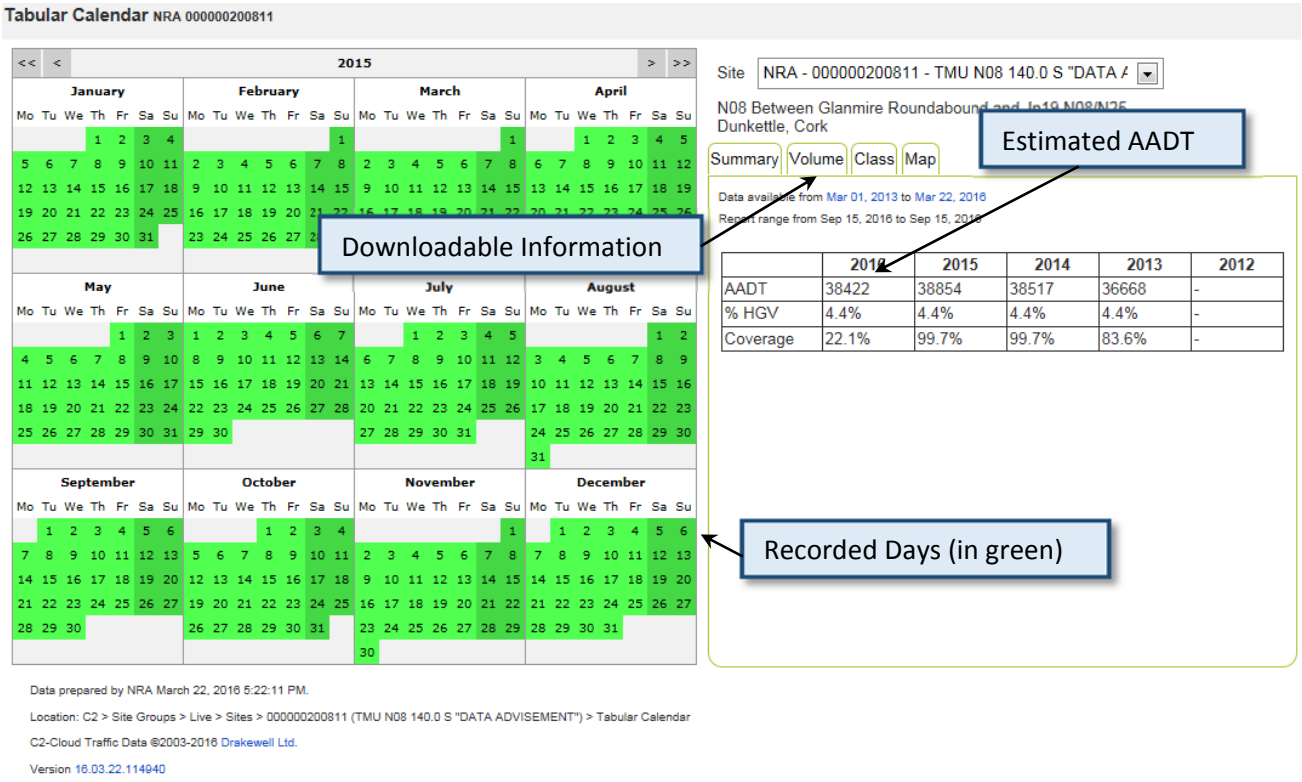
- An estimate of current year AADT;
- An aggregate value for Heavy Vehicle percentage;
- Coverage (number of days) of data collected (% of current year data collected);
- Data for previous years.

In addition, there are downloadable Excel spreadsheets, with hourly directional traffic counts, daily directional traffic counts, weekly volume and average week tables, as well as monthly volumes and average monthly tables. There is also a facility to review the counts based on classification of vehicle. A map is also provided to give a location of the TMU counter.

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 (or 74% coverage) data be required when using estimated AADT values from the permanent counters.

An extract from the summary data is presented below in Figure 16.0.4.

Figure 16.0.4: Sample Data from TII Website



5.2 Methodology for Estimating AADT using the TII Permanent Counter Method

The key requirement with TII 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 TII Permanent Counter method, as such is likely to form the basis of capital investment for larger schemes.

Firstly, it is necessary to identify which TII TMU sites can be used in the estimation process. A search of TII's website will identify traffic counters in the area of interest. From this, the nearest and most appropriately located 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.

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 TII TMU site and the location of the short period traffic count which may influence travel patterns and/or the daily flow profile;
- Where the TII TMU site is on a different road class or route;
- Where there is a large distance between the location of the short period traffic count and the TII TMU (greater than 30km); or
- Where data from the TII TMU is incomplete or old (greater than 2 years).

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

It may be the case that data from various TII TMU sites across an area shows that there is a high level of variation in flow profiles across the area which it is situated. 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.

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

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 and safety appraisals.

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: 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: Generally the Inter Peak Period (12:00 to 14:00); and
- PM: 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).

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 traffic counts, judgement should be taken on any factors

which unduly influence traffic flows at certain times of the day. The use of peak hour counts in areas of congestion needs careful consideration as the congestion 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, particularly the inter peak period which can be used for comparison with the morning and evening peak periods.

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

5.2.1 Use of Multiple TII TMU Sites

Where short period traffic 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 TII TMU sites. 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.

Regression analysis is a statistical process used to assess the relationship between a series of influential variables (x) and a particular outcome (y). In this case, regression analysis is used to predict an expected outcome (e.g. estimated AADT) on the basis of variables which are known to be influential e.g. peak hour flows. The regression analysis produces estimated AADT values which are plotted alongside observed AADT values to assess the variation that occurs.

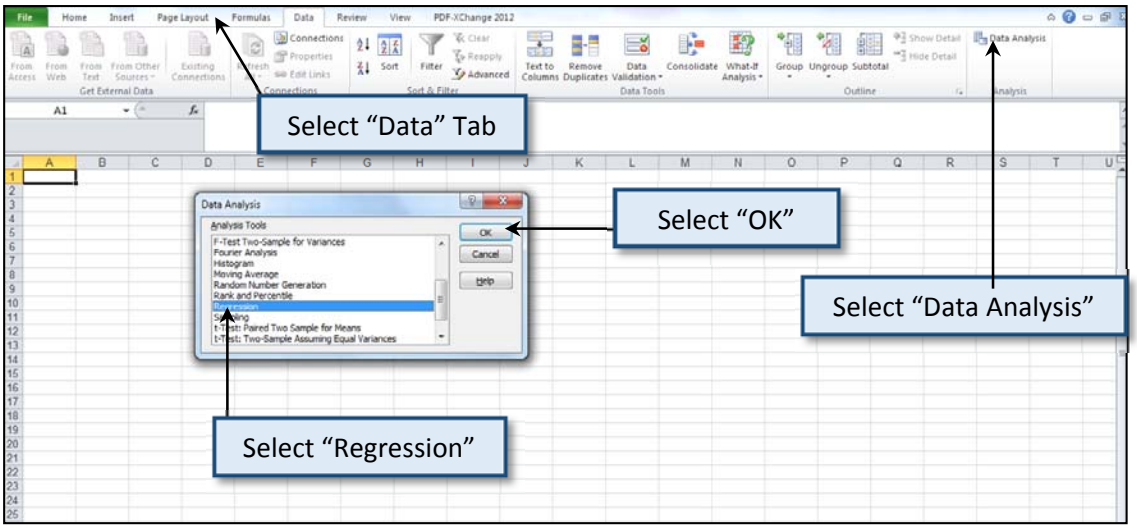
The closeness-of-fit is calculated according to the Coefficient of Determination (r2). The Coefficient (r2) ranges from 0 to 1, with 1 representing a perfect correlation, and zero representing no relationship between the variables. In line with standard statistical confidence levels, an r2 value of 0.95 or higher should be regarded as a valid statistical result.

The regression tool is an add-on to the standard Microsoft Excel programme. This section of the report details how to 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.

The regression analysis presented here was undertaken in the Microsoft Excel 2010 package using the data analysis tool. Regression analysis can however be undertaken in a number of other programmes.

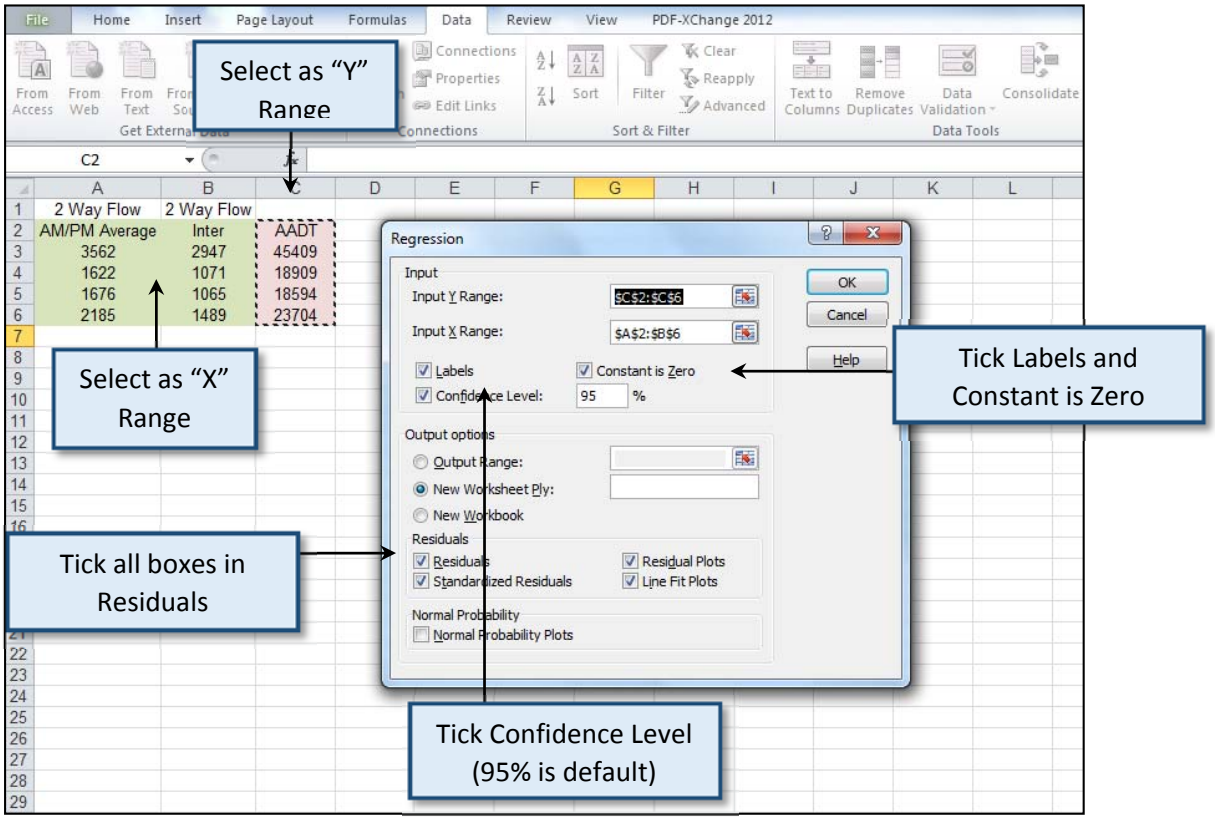
Step 1: The toolbar is found in the Data tab

Select "Data Analysis"
From the List, Select "Regression"
Select "OK"



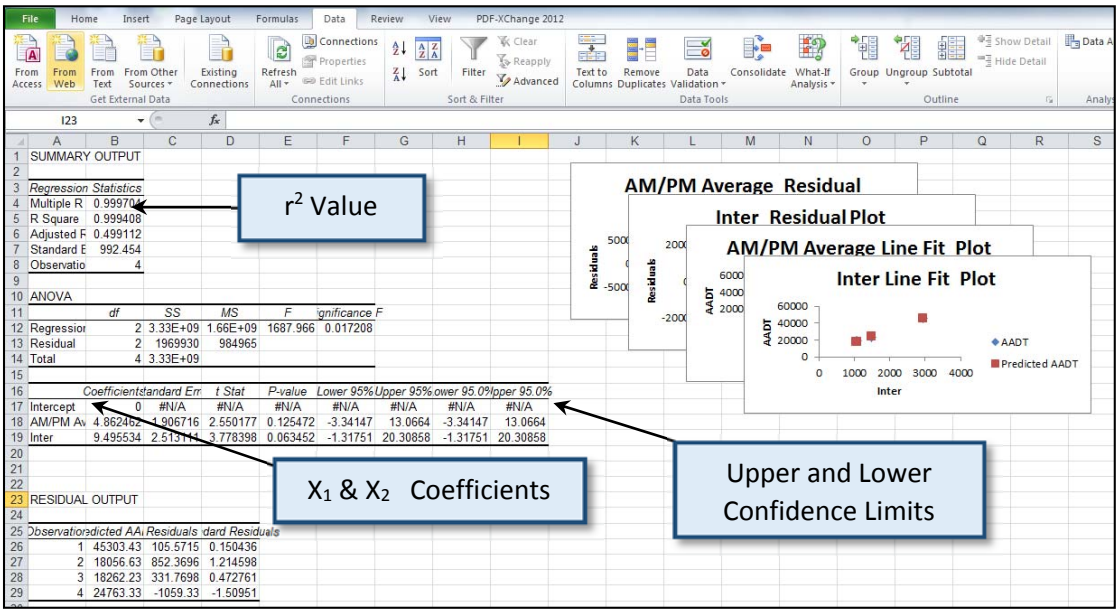
Step 2: Select the AADT column of data for the Y-Range

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 3: 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



Step 4: Apply the factors to the relevant peak flows to determine the AADT

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

Where

y = AADT Estimate
x1 = Peak Coefficient 1
x2 = Peak Coefficient 2
a = Peak Flow 1
b = Peak Flow 2

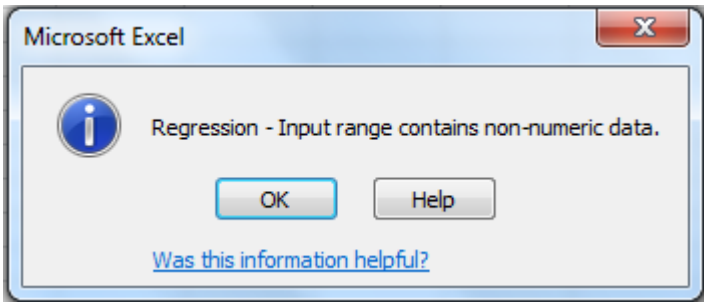
Sample

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

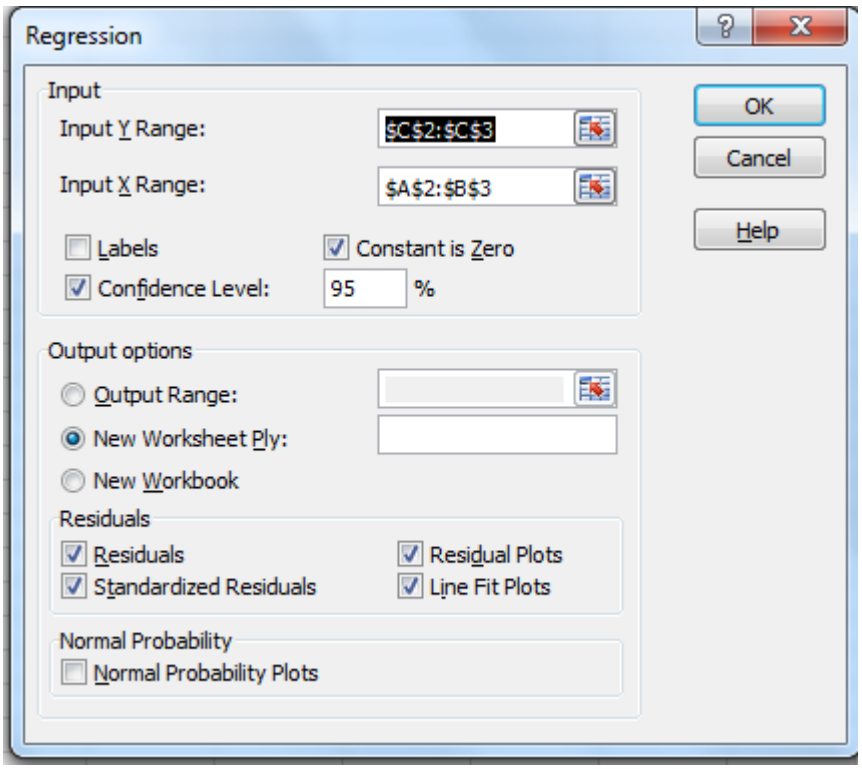
x1= AM/PM Peak Co-Efficient = 4.86
x2= Inter Peak Co-Efficient = 9.49

AADT = (4.86)*(2,350) + (9.49)*(1,370) = 24,435

A number of errors messages may appear when carrying out regression analyses, which are explained here.



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.



5.3 Use of a Single TII TMU Site

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

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

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 traffic counts from the overnight period should not be used to extrapolate to Inter Peak.

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.

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

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

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

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

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

6. Localised Period Count Method

6.1 Key Features

Where there is no TII TMU site 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 14 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 TII Permanent Count Method, but using TII counters that are not deemed to be immediately comparable to the location of the short period traffic count.

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 TII Permanent Counter is located;
- The site of the short period count is geographically remote (greater than about 30km) from the site where the TII Permanent Counter is located; or
- Where the value of the scheme being appraised is not greater than €20m.

This method therefore ensures that in those areas where there is some uncertainty regarding the appropriateness of the TII TMU sites used in the analysis, that a minimum of 14 days data is used in the estimation of AADT (or indeed flows for other time periods).

6.2 Methodology for Estimating AADT using the Localised Period Count Method

The first task is to install temporary counters that will record volumetric information over a period of at least 14 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.

Short period traffic count information is then extrapolated to a period of at least 14 days using the local period traffic count information. The method of expansion will be different depending on the number of period traffic counts.

6.2.1 Use of Multiple Period Counters

Where short period traffic 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.

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

6.2.2 Use of a Single Period Counter

The analysis process for a Single Period Counter is also outlined in Section 5 of this PAG Unit.

7. Reporting

Prior to undertaking any work on expansion factors, the proposed approach should be documented in the Project Appraisal Plan (reference PAG Unit 2.0: Project Appraisal Deliverables).

All supporting analysis in developing expansion factors should be outlined in the Traffic Modelling Report (PAG Unit 5.4: Transport Modelling Report). For Minor Projects (€5M to €20M), this should be included in the Project Appraisal Report.

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.

Bonneagar Iompair Éireann
Transport Infrastructure Ireland

Ionad Ghnó Gheata na Páirce,
Stráid Gheata na Páirce,
Baile Átha Cliath 8, D08 DK10, Éire

www.tii.ie

+353 (01) 646 3600

Parkgate Business Centre,
Parkgate Street,
Dublin 8, D08 DK10, Ireland

info@tii.ie

+353 (01) 646 3601