Post Opening Project Evaluation

Meta-analysis : Traffic Impacts

March 2009

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1. Introduction

Overview

1.1 The Highways Agency (HA) is responsible for improving the strategic highway network by delivering schemes within the Major Schemes Programme.

1.2 Before the decision to go ahead is made, these schemes are subject to a detailed appraisal that considers the following five over-arching objectives:

- Environment;
- Economy;
- Safety;
- Accessibility; and
- Integration.

1.3 As part of the Appraisal, it is usual for detailed modelling techniques to be used to predict how many vehicles will use the new road, the changes on other roads, as well as impacts on journey times. These predictions are fundamental in the justification of these schemes as they directly affect the predictions of economy and safety benefits as well as environmental impacts of schemes. These predictions also clearly explain the impacts of traffic change on key roads and on communities.

1.4 Accurate modelling is therefore crucial to understand the impacts of Major Schemes and to provide input to the many aspects of the appraisal process to justify their construction.

1.5 The HA therefore evaluates all schemes after opening to see if the traffic predictions and forecast impacts have been realised, and this process is known as **POPE (Post Opening project Evaluation)**. For each scheme, an individual report is prepared which details all of the predicted impacts and assesses whether these impacts have occurred.

1.6 POPE began in late 2001 and was implemented to evaluate all schemes within the Targeted Programme of Improvements (TPI), now termed the **Major Schemes (MS) Programme.**

The POPE Meta Report

1.7 As well as the reporting of all impacts in individual reports, the POPE process is designed to provide an information base to help improve the appraisal methods currently used in England, and this is undertaken by considering the combined impacts from all of the individual evaluations in the form of a **'Meta' Report**. A 'Meta' evaluation is therefore one which seeks to learn lessons from a number of evaluations so that general themes and trends can be determined.

1.8 The main objectives of the Meta Report are threefold:-

- To identify differences between targeted (predicted) and outturn benefits and impacts;
- To interpret these differences using evidence-based methods; and
- To provide feedback on lessons to be learnt.

1.9 For the 2008 'Meta' analysis, the main report has been developed from a number of theme **'daughter documents'**, namely a detailed assessment of five key areas so that key findings, lessons learnt and recommendations can be made in the areas of most concern to the HA. The five key areas are:

- Traffic Impacts;
- Economy;

- Safety;
- Environment; and
- Accessibility/Integration and Consultation.

1.10 In summary, the Meta Report brings together all POPE schemes to identify common themes in the data. It examines the relationship between scheme predicted and outturn benefits and impacts, across all the appraisal objectives.

1.11 The Highways Agency will use the outcomes from the Meta Report to inform their decision-making and 'appraisal' methods.

Traffic Modelling

1.12 This report is the 'daughter document' on the traffic impacts and presents the assessment of the physical impact of the schemes in terms of traffic flows and journey times. There are separate 'daughter documents' that addresses all the monetised outputs and the overall economic evaluation of the schemes as well as environmental, safety and consultation/accessibility issues.

1.13 After discussion with the Highways Agency TAME (Traffic Appraisal, Monitoring and Evaluation) section, which is the section of the HA that approves and reports on traffic modelling issues, the key areas of interest on the traffic impacts are to understand and explain the performance of the traffic modelling undertaken during the appraisal stage.

1.14 There is a significant amount of data on traffic modelling issues that has been discussed within the individual POPE reports, however, in order to retain a focus, and for the usefulness of this report to be maximised, a series of questions have been agreed between all parties that this report should seek to answer.

1.15 These questions are:

- ***Are the HA Traffic Models accurately estimating scheme traffic volumes?***
- ***What are the main reasons for under or over-estimating traffic volumes?***
- ***Are the schemes still successful in terms of monetary benefits despite under or over-prediction of traffic?***

1.16 This report specifically looks to address these issues and derive a series of lessons learnt and recommendations for the HA and Department for Transport (DfT) to consider as part of any revisions to the appraisal process.

The Schemes

1.17 In order to evaluate the predicted and outturn traffic flows, the schemes have been categorised into two broad groups as follows:

- **Bypass schemes**; and
- **Non- Bypass schemes** such as on-line and junction improvements.

1.18 For the evaluation of traffic impacts, this report considers all POPE schemes evaluated since 2001 and draws information from **37** POPE schemes.

1.19 It is mandatory within the POPE process to undertake evaluations One Year After (OYA) and Five Years After (5YA) the scheme has opened, however as the POPE process only started in 2002, and evaluated schemes that opened in mid 2002, there are very few schemes in the 5 Years After stage where the evaluations and approval have been completed, hence, the majority of the conclusions drawn have been for the One Year After stage.

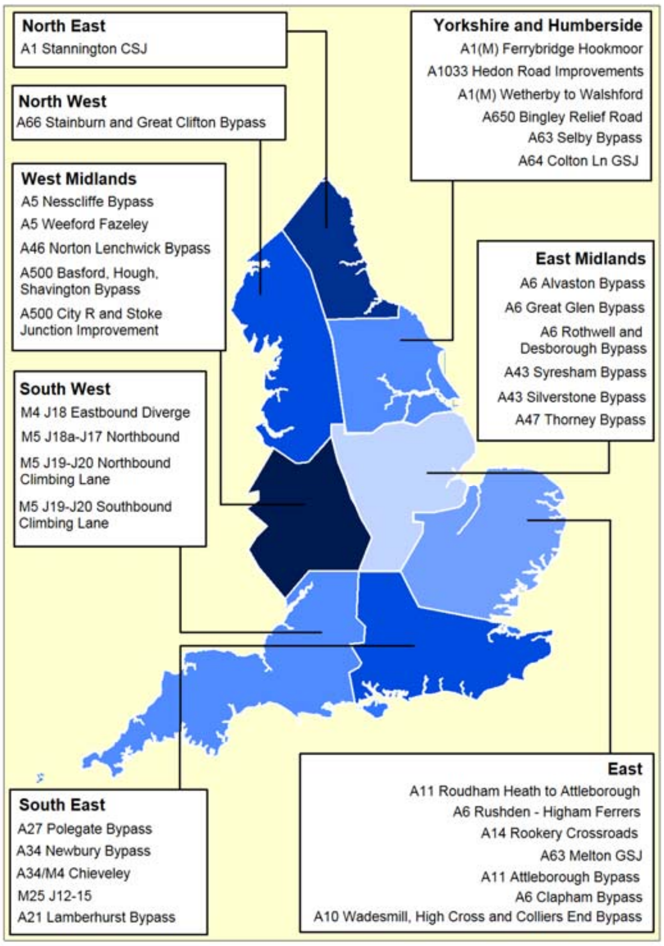
1.20 Table 1.1 summarises the sample of schemes that have been used within this daughter document, identified by evaluation period and by category. Figure 1.1 illustrates the locations of these schemes by region.

1.21 Table 1.1 shows that we have included one 5 Year After Evaluation and one 10 Year After Evaluation. These schemes are the A34 Newbury Bypass and A435 Norton Lenchwick schemes respectively. Although these schemes were not part of the TPI programme, it was considered that as traffic information was still available, they should be evaluated, and therefore these schemes have been included.

Table 1.1 – Number of Schemes used in Traffic Meta-Analysis

	Bypass Schemes	Junction Schemes	Online Schemes	Total
One Year After (OYA)	19	6	10	**35**
Five Years After (5YA)	1	0	0	**1**
Ten Years After (10YA	1	0	0	**1**
Total	21	6	9	**37**

Figure 1.1 – Location of Schemes



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Data Source and Availability

1.22 A comprehensive traffic data collection exercise is undertaken for all POPE schemes. This involves collating data from a number of sources and undertaking new data collection where required, before and after schemes open.

Predicted Traffic

1.23 Predicted traffic volumes data and information are taken from the following scheme assessment reports:

- Appraisal Summary Table (AST) and supporting information;
- Economic Assessment Report (EAR);
- Cost Benefit Analysis (COBA);
- Traffic Forecasting Report; and
- Model Validation Report.

1.24 For some POPE evaluations a number of the required reports or data sources including COBA are not available. This is generally for older schemes, where data has been lost. The table below shows details of information availability for the two key sources of predicted traffic flow information; Economic Assessment Reports and COBA/TUBA, and this shows us the total for all POPE schemes that are on-going, not just those that are completed, hence the total number of schemes exceeds the sample used for traffic impacts within this Report.

Table 1.2 - Report and Data Availability

Scheme	Available	% Available	Not Available	% Not Available
Economic Assessment Report	57	77%	17	23%
COBA/TUBA	47	64%	27	36%

1.25 The quality and range of information in the individual reports also varies, with some of them being sparse on comprehensive details. For some schemes there is a lack of clarity on:

- The extent of the model network;
- Predicted journey times; and
- What new developments or other roads schemes are included.

1.26 A further issue is that some schemes may have been assessed several times during their preparation and it is often unclear which stage a set of documents refers to. Consultants may also supply forecasts for scheme options that were not even built.

1.27 These issues tend to be for older schemes. Those that have been assessed more recently tend to have more detailed information available, but certainly the traffic report availability and content have implications for the level of certainty in the conclusions that POPE evaluations can make.

Outturn Traffic

1.28 We decide our assessment of traffic information needs by considering:

- Links that were forecast to have a significant change due to the scheme as reported in the Traffic Forecasting Reports;
- Discussion with the HA Project Sponsor and Local Authority to understand local perceptions and issues; whilst

- Ensuring that a sensible budget is maintained, i.e. a cost effective approach to data collection must be maintained.

1.29 The evaluation considers a wide area of potential impacts to allow for any strategic re-routing that may result from the scheme. Value for money considerations will mean links that are far from the scheme and unclassified road rat runs may be excluded from the analysis, and this is a general trend for the scheme appraisal stage also. Therefore the key is to identify and agree with the HA and local authority the links most likely to be impacted upon by the scheme.

1.30 Traffic flow data for the HA network is obtained from TRADs, which forms part of the wider HA website, HATRIS. Traffic data within TRADs is from a number of sources which can vary in quality, these are:

- National Traffic Control Centre data (NTCC)
- Motorway Incident Detection and Signalling data (MIDAS)
- Design Build Finance & Operate (DBFO) data
- Standalone ATCs operated by the HA
- Data obtained from local authorities, where they have counted on trunk roads.

1.31 Other HA data sources include:

- Journey times from the Journey Time Database (JTDB);
- Speed data from MIDAS; and
- Traffic Survey report (from scheme planning stage, if not too old)

1.32 The local authorities are also requested to supply ATC data for the roads in their area. In some cases the Local Authority may also be willing to install temporary counts at additional locations that have been identified as important.

1.33 Having assessed what survey data is available from the HA and local authority, additional supplementary surveys are carried out where required. This will generally include:

- ATCs (temporary tubes);
- Journey time surveys; and
- Classified turning counts (manual or video) at junctions for certain schemes where a particular requirement is identified.

1.34 Data is collected before scheme construction starts, one year after opening and five years after opening.

1.35 In our view, this gives the POPE evaluation team an excellent database of traffic counts and journey times on links expected to undergo a change after scheme opening as well as picking up on local issues brought up by local authorities.

1.36 In summary, the key issues are Report availability and ensuring that the detail within these reports is sufficient for us to understand the forecast changes in traffic volumes and journey times.

2. Are the HA Traffic Models Accurate?

Overview

2.1 This question is clearly a key concern for the HA, in that many aspects in the appraisal of schemes are dependent on the accuracy of the traffic models used at the time of the appraisal.

2.2 Typically, the predicted traffic volumes have been derived from traffic model forecasts, while the outturn flows are observed values derived from data collection undertaken for most schemes one year after the completion of the scheme.

2.3 In assessing these schemes there is a need to make a judgement as to whether a scheme has performed as predicted. The simplest method of making this comparison is to determine whether the outturn traffic flow lies within a particular threshold of the predicted flow in the opening year. In this case we have chose a value of **plus or minus 15%**, which is in accordance with the guideline target values for model validation defined within DMRB Volume 12.

2.4 As outlined in the previous section, these have been categorised into:

- Bypass schemes; and
- Non-bypass schemes, i.e. unction improvements or on-line widening.

2.5 The full list of schemes used, and their categorisation is shown in **Appendix A,** together with the predicted and actual traffic volumes for each scheme.

Bypass Schemes

2.6 Within the full set of schemes, there are a total of **21** bypass schemes that have been evaluated in the POPE process. **Table 2.1** - Bypass Schemes below lists these schemes, together with information on:-

- Whether the scheme has been evaluated as a One Year After (OYA) or 5 Year After (5YA); and
- The opening year of the scheme.

2.7 These schemes are geographically diverse and also range from small town bypasses to major schemes such as the A34 Newbury Bypass and hence provide a good sample set to derive lessons learnt for this type of investment.

2.8 It should be noted that the majority of these 21 schemes had opening dates between 2002 and 2004, and hence were appraised in the 1990’s before POPE had begun. Therefore, there were issues with obtaining many reports used in the appraisal of these schemes as detailed in the previous section. However, sufficient information was available for these evaluations to be meaningful.

Table 2.1 - Bypass Schemes

Scheme Name	Report Stage	Actual Opening
A1(M) Wetherby to Walshford	OYA	2004
A1(M) Ferrybridge - Hook Moor	OYA	2006
A10 Wadesmill, High Cross and Colliers End Bypass	OYA	2004
A21 Lamberhurst Bypass	OYA	2005
A27(T) Polegate Bypass and A22 New Route	OYA	2002
A34 Newbury Bypass	5YA	1998
A43 Silverstone Bypass	OYA	2002
A43 Syresham Bypass	OYA	2002
A46 Norton Lenchwick Bypass	10YA	1995
A47 Thorney Bypass	OYA	2006
A5 Nesscliffe Bypass	OYA	2003
A5 Weeford Fazeley	OYA	2005
A500 Basford, Hough, Shavington Bypass	OYA	2003
A6 Alvaston Bypass	OYA	2003
A6 Clapham Bypass	OYA	2002
A6 Great Glen Bypass	OYA	2003
A6 Rothwell and Desborough Bypass	OYA	2003
A6 Rushden – Higham Ferrers	OYA	2003
A63 Selby Bypass	OYA	2004
A650 Bingley Relief Road	OYA	2003
A66 Stainburn and Great Clifton Bypass	OYA	2002

2.9 A Bypass scheme typically constitutes three routes considered as part of an assessment, that is:-

- **Old Route** – The bypassed route;
- **Bypass** – The route of the new bypass; and
- **Corridor** – The combined bypass route and bypassed route.

2.10 **Table 2.2** presents a summary of whether the outturn traffic volumes lie within the plus or minus 15% threshold of the predicted flow in the opening year for each of the bypass schemes.

2.11 For this assessment, the predicted traffic volumes have been derived from traffic model forecasts reported in the Traffic Forecasting Report for that scheme at the Order Publication Report (OPR) stage. This OPR stage represents the documents used at the Public Inquiry, and hence when the decision to continue is justified.

2.12 The outturn traffic volumes for the schemes listed in Table 2.2 are derived from traffic counts undertaken on the key links one year after opening, except two schemes for which 5 and 10 year counts are available.

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2.13 A value of standard deviation relative to the mean has been calculated for the bypass schemes. The standard deviation indicates how a set of data clusters around its mean, i.e. it show how far on average the predicted flows are away from the mean. For this analysis the standard deviation is expressed as a percentage difference compared to the mean to allow for a comparison between different data sets.

Table 2.2 - Comparison of Predicted and Observed Flows of Bypass Schemes

Scheme Name	Old Route Within 15%	Bypass Within 15%	Corridor Within 15%
A1(M) Wetherby to Walshford	+	OK	OK
A1(M) Ferrybridge - Hook Moor	-	OK	-
A10 Wadesmill, High Cross and Colliers End Bypass	+	+	+
A21 Lamberhurst Bypass	-	OK	OK
A27(T) Polegate Bypass and A22 New Route	OK	OK	OK
A34 Newbury Bypass	OK	+	+
A43 Silverstone Bypass	OK	+	+
A43 Syresham Bypass	OK	+	+
A46 Norton Lenchwick Bypass	-	OK	OK
A47 Thorney Bypass	-	+	OK
A5 Nesscliffe Bypass	OK	OK	OK
A5 Weeford Fazeley	-	OK	OK
A500 Basford, Hough, Shavington Bypass	+	+	+
A6 Alvaston Bypass	+	-	OK
A6 Clapham Bypass	OK	-	-
A6 Great Glen Bypass	-	-	-
A6 Rothwell and Desborough Bypass	+	n/a[1]	n/a[1]
A6 Rushden – Higham Ferrers	+	+	+
A63 Selby Bypass	OK	+	OK
A650 Bingley Relief Road	OK	-	OK
A66 Stainburn and Great Clifton Bypass	+	OK	+

Table note: OK =predicted and outturn are within +/- 15% of observed, + = outturn is larger than predicted by >15% and - = outturn is less than predicted by >15%

Old Route

2.14 Appendix A shows the predicted and outturn traffic volumes for the old or bypassed road in detail and Table 2.2 summarises whether they are within, above or below the ±15% threshold.

[1] Predicted traffic volumes not available

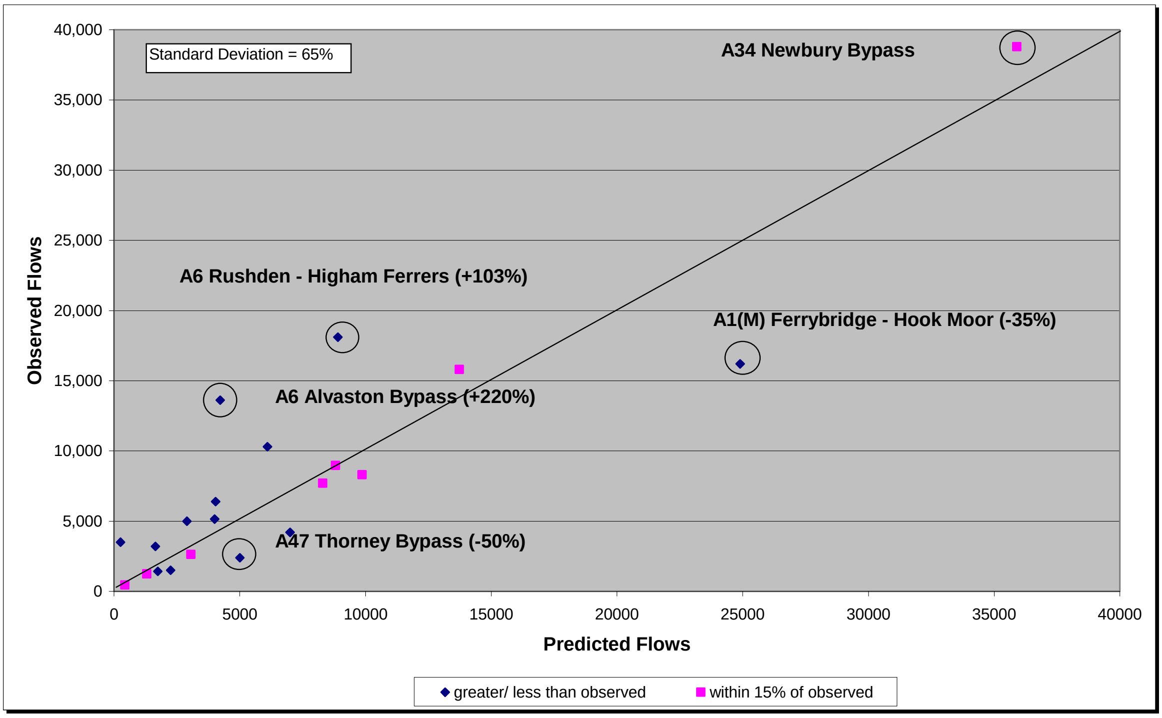
2.15 The results shown in Table 2.2 show that:

- Of the 21 bypass schemes evaluated, 7 (or 33%) have outturn traffic volumes on the bypassed road within 15% off those predicted;
- 8 schemes (38%) had outturn traffic volumes 15% higher than predicted; and
- 6 schemes (29%) had outturn traffic volumes 15% lower than predicted.

2.16 Table 2.2 does not seek to address the reasons for these differences, which are assessed later in this Report. The balanced split however, suggests there is not a particular bias towards under or over prediction.

2.17 A graph of the comparison between predicted and outturn traffic volumes on the old road are shown in Figure 2.1 below.

Figure 2.1 - Old Route – Comparison between Predicted and Observed Traffic Flows (AADT)



2.18 Each scheme is represented as a point (dot) on the above graph (Figure 2.1). Schemes with outturn traffic flows within a 15% threshold of the predicted flows are shown as pink dots on the graph. The blue dots are representative of old road volumes outside the 15% threshold. Schemes below the 45 degree line (drawn on the graph) have over-predicted traffic volumes and those schemes above the 45 degree line have under-predicted volumes.

2.19 The graph shows that over half of the scheme models have under-predicted traffic volumes on the old route and of these 12 under-predictions, 7 are under-predicted by more than 15%. Examples include schemes on the A6 (such as Rushden and Alvaston) where there is more than double the predicted traffic. Conversely, the A47 Thorney Bypass has 50% less traffic on the old route than originally predicted.

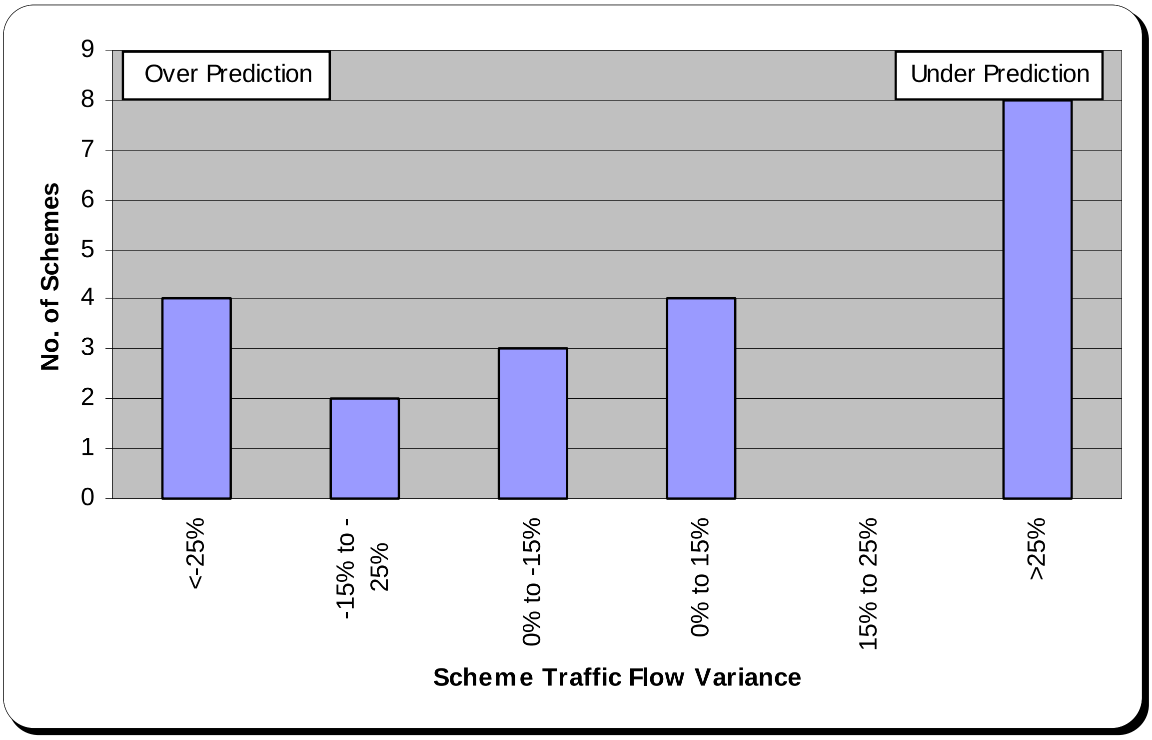
2.20 The standard deviation indicates how a set of data clusters around its mean, i.e. it show how far on average the predicted flows are away from the mean. For this analysis the standard deviation is expressed as a percentage of the mean to allow for a comparison between different data sets. The standard deviation for the old route has been calculated at 65%.

2.21 The reasons for the over and under-predictions of traffic volumes are investigated in **Section 3**.

2.22 **Figure 2.2** below gives an indication of the degree to which schemes are under or over-predicting traffic volumes, again comparing outturn and predicted traffic volumes against a ±15% threshold, 15-25% threshold and >25% threshold. The main points to note here are:

- The pattern shown does not reflect a 'normally' distributed pattern that might have been expected. If it had been normally distributed, most schemes would have outturn traffic volumes that are reasonably close to the predictions, with fewer schemes as outliers;
- The pattern shown reflects a variation from the average which is relatively large as two-thirds of schemes have outturn traffic volumes that are more than 15% different to their forecasts;
- The majority of the schemes that have outturn traffic volumes above those predicted (under-predicting) are significantly above the 25% threshold, whereas those over-predicting reflect a closer fit; and
- The smaller residual flows on the old route can lead to large percentage changes without that necessarily meaning that the prediction is out by that much in absolute terms.

Figure 2.2 - Old Route - Number of Schemes Under or Over-Predicting Traffic Flows



Bypass Route

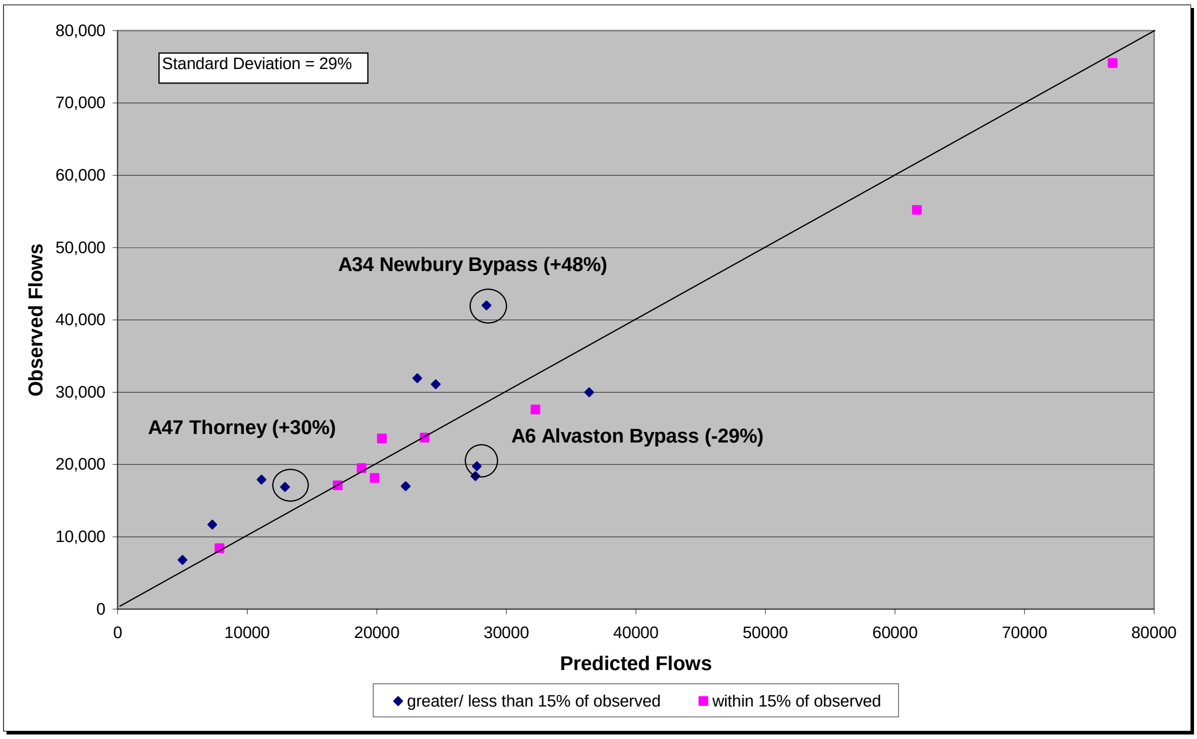
2.23 The results shown in **Table 2.2** for the Bypass itself show that:

- Of the 20 bypass schemes evaluated, 8 (or 40%) have outturn traffic volumes on the bypassed road within 15% off those predicted;
- 8 schemes (40%) had outturn traffic volumes 15% higher than predicted; and
- 4 schemes (20%) had outturn traffic volumes 15% lower than predicted.

2.24 This distribution shows that although the predictions are nearer the outturn volumes than for the old route comparison, there are twice as many schemes where the outturn traffic volumes are above those predicted as below those predicted.

2.25 **Figure 2.3** below shows the comparison between the predicted and outturn traffic volumes on the bypass route.

Figure 2.3 - Bypass Route – Comparison between Predicted and Observed Daily Traffic Flows (AADT)



2.26 The same colour coding is used as for the previous diagram for the old road, i.e. schemes with observed traffic flows within a 15% threshold are shown as pink dots on the graph, whereas the blue dots represent scheme flows outside the 15% threshold.

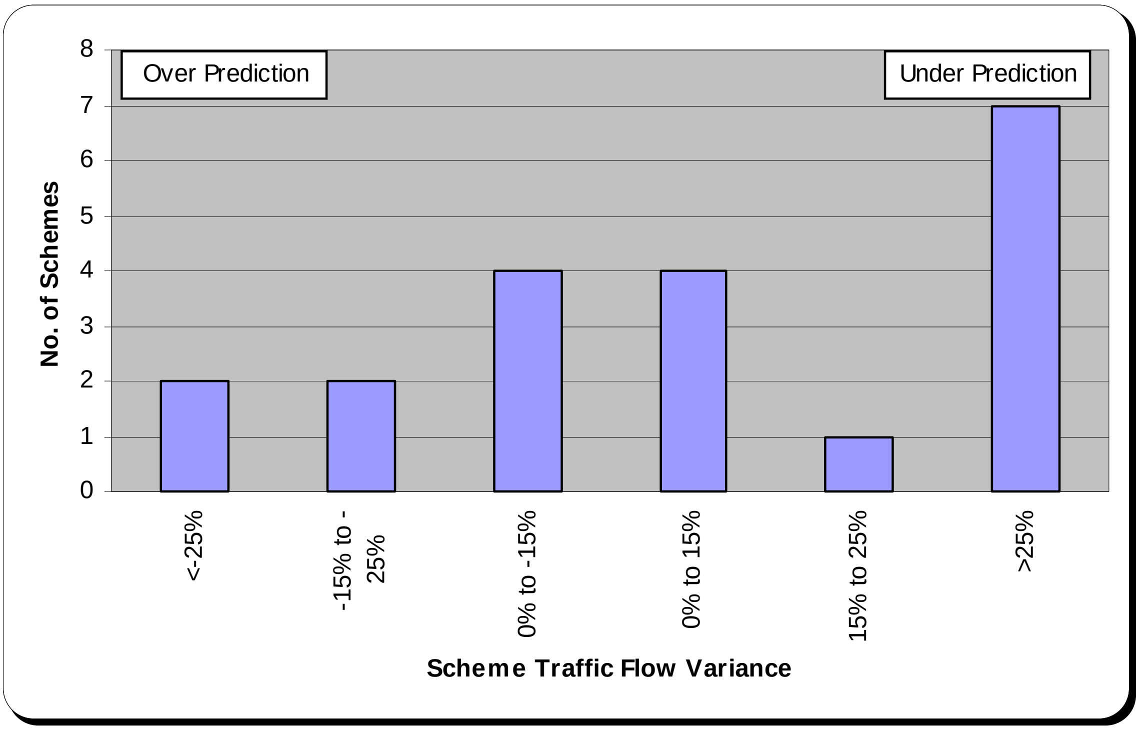
2.27 Figure 2.3 reflects the higher proportion of the bypass schemes under-predicting, i.e. the outturn traffic volumes are higher than those predicted.

2.28 For this analysis the standard deviation is expressed as a percentage of the mean to allow for a comparison between different data sets. The standard deviation relative to the mean for the new bypass route has been calculated at 29%, which means a better correlation than for the old route analysis which showed a higher figure of 65%.

2.29 **Figure 2.4** below gives an indication of the degree to which schemes are under or over-predicting traffic volumes, again comparing outturn and predicted traffic volumes against a ±15% threshold, 15-25% threshold and >25% threshold. The main points to note here are:

- A significant proportion of schemes have predicted and outturn traffic volumes that are reasonably close;
- A large number of schemes (35%) show differences of greater than 25%, and the majority of these have outturn traffic volumes above those predicted (under-predicting).

Figure 2.4 - Bypass Route - Number of Schemes Under or Over-Predicting Traffic Flows



Corridor

2.30 The results in **Table 2.2** for the corridor (i.e. the addition of both the old road and the bypass) show that:

- Of the 20 bypass schemes evaluated, 10 (or 50%) have outturn traffic volumes on the bypassed road within 15% off those predicted;
- 7 schemes (35%) had outturn traffic volumes 15% higher than predicted; and
- 3 schemes (15%) had outturn traffic volumes 15% lower than predicted.

2.31 This distribution shows that although the predictions across the narrow corridor are the closest of all the comparisons, there is still a significant proportion of schemes where the outturn traffic volumes are above those predicted.

2.32 This distribution of differences suggests there is a slight bias towards under-prediction, i.e. outturn traffic volumes exceeding predictions.

2.33 **Figure 2.5** below shows the comparison between the predicted and outturn traffic volumes across the corridor.

2.34 This indicates that 60% of scheme traffic models under-predicted traffic volumes for the corridor, and 40% over-predicted. Local re-assignment issues between the old road and the bypass on schemes identified such as A47 Thorney Bypass and A6 Alvaston Bypass have very good correlation between observed and predicted traffic volumes when considering the wider corridor.

2.35 **Figure 2.6** below gives an indication of the degree to which schemes are under or over-predicting traffic volumes, again comparing outturn and predicted traffic volumes against a ±15% threshold, 15-25% threshold and >25% threshold. The main points to note here are:

- When considering the corridor, the distribution of the comparison is more 'normally' distributed, with the majority of the schemes within 15%; and
- There are still a reasonably high number of schemes (around 25%) that show differences of greater than 25%, and the majority (20%) have outturn traffic volumes above those predicted (under-predicting).

2.36 For this analysis the standard deviation is expressed as a percentage of the mean to allow for a comparison between different data sets. For the corridor, the standard deviation relative to the mean is 27%, showing better correlation than for the new bypass route and for the old route.

Figure 2.5 - Bypass Corridor – Comparison between Predicted and Observed Traffic Flows (AADT)

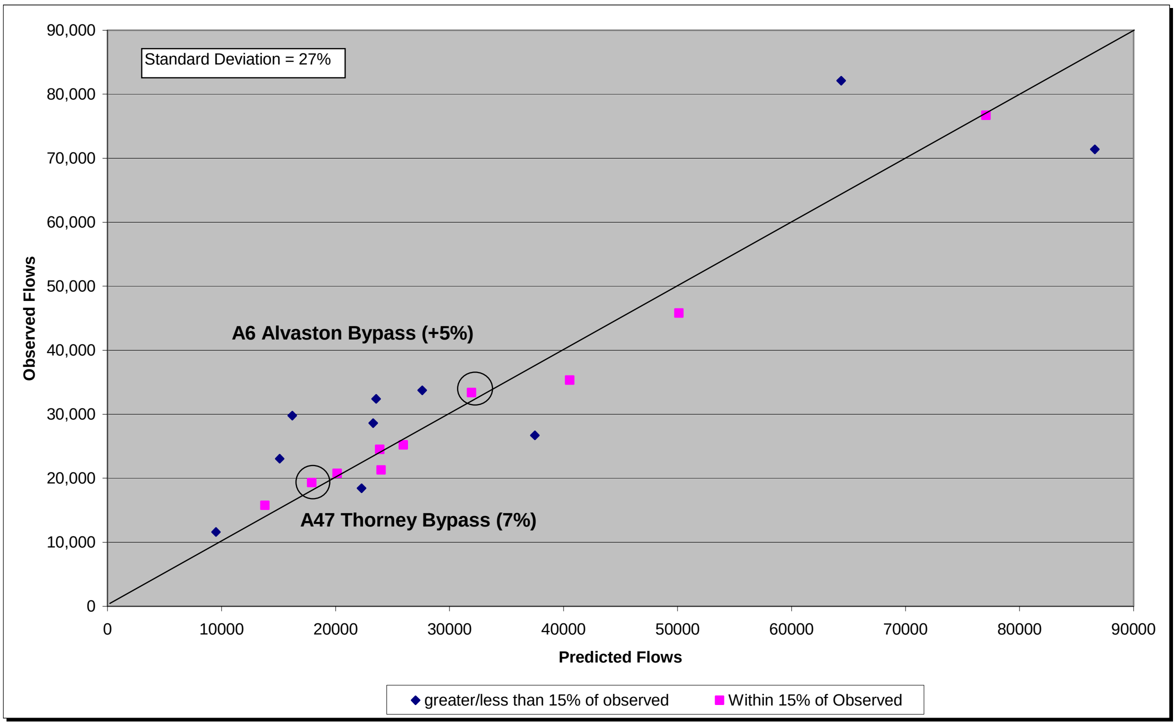
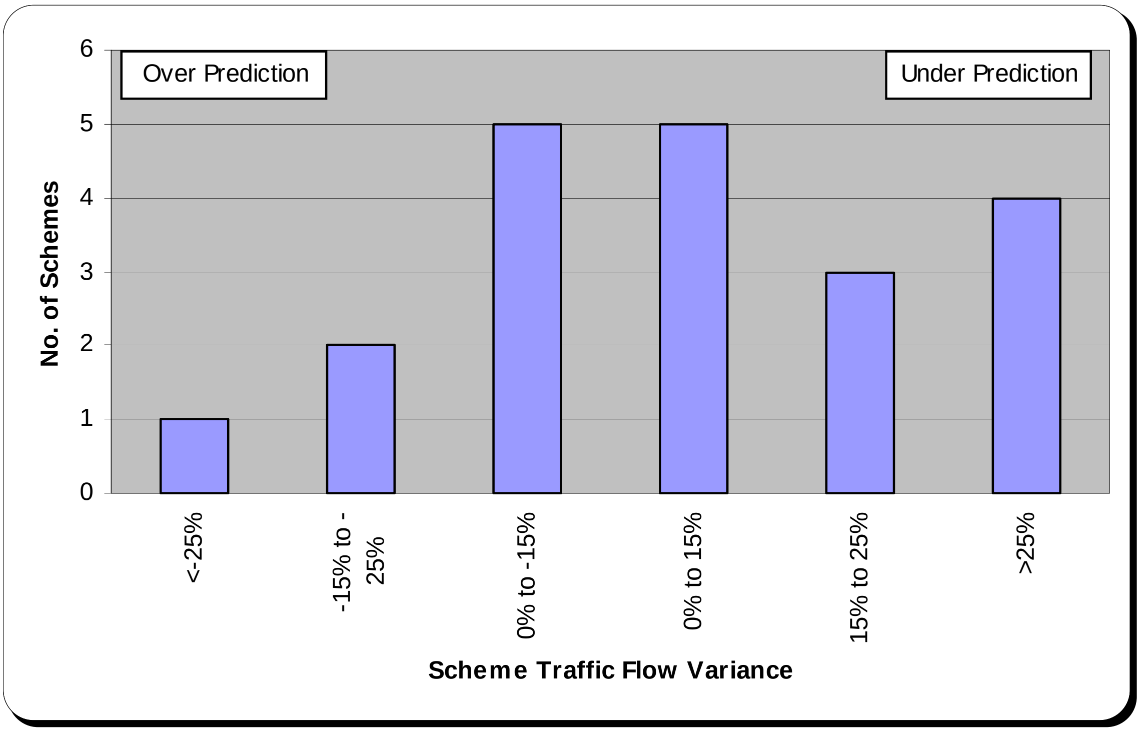


Figure 2.6 - Bypass Corridor - Number of Schemes Under or Over-Predicting Traffic Flows



Non-Bypass Schemes

2.37 Within the full set of schemes, there are a total of **16** Non-Bypass schemes that have been evaluated in the POPE process. **Table 2.3** below lists these schemes, together with information on whether the scheme has been evaluated as a One Year After (OYA) or 5 Year After (5YA), and the opening year of the scheme.

2.38 These schemes are geographically diverse and also range from small junction improvements such as the A1 Stannington grade separated junction to major motorway widening projects such as M25 Junction 12-15 widening, and hence provide a good sample set to derive lessons learnt for different types of investment.

2.39 Again, the majority of these 16 schemes had opening dates between 2002 and 2004 (at the start of the TPI Programme), and hence there were the same issues mentioned earlier, of the lack of data availability, given an appraisal timetable in the 1990's before POPE had begun.

2.40 All of the schemes within this dataset have traffic volume comparisons at the One Year After level, there were no Five Years After schemes programmed within this evaluation period.

Table 2.3 – Bypass Schemes: Evaluation Parameters

Scheme Name	Report Stage	Opening Year
A1 Stannington GSJ	OYA	2004
A14 Rookery Crossroads	OYA	2006
A34/M4 Chieveley	OYA	2004
A500 City R and Stoke Jn Imp	OYA	2006
A63 Melton GSJ	OYA	2006
A64 Colton Ln GSJ	OYA	2005
A1033 Hedon Road Improvements	OYA	2003
A11 Attleborough Bypass Improvement	OYA	2007
A11 Roudham Heath to Attleborough	OYA	2003
A2 Bean to Cobham Improvement Phase 1	OYA	2003
A46 Newark to Lincoln Improvement	OYA	2003
M25 J12-15	OYA	2005
M4 J 18 Eastbound Diverge	OYA	2005
M5 J18a - J17 Northbound (Hallen Hill)	OYA	2005
M5 J19 - J20 Northbound Climbing Lane (Tickenham Hill)	OYA	2006
M5 J19 - J20 Southbound Climbing Lane (Naish Hill)	OYA	2006

2.41 A non-bypass scheme is defined as either an:

- **Online scheme (O)** – improvement or widening; or
- **Junction scheme (J) -** normally Grade Separation.

2.42 There are **10 online** schemes and **6 junction** schemes used for the quantification of differences.

2.43 Appendix 1 shows the predicted and outturn traffic volumes for the Non-Bypass schemes in detail. **Table 2.4** provides a summary of whether the outturn traffic flows lie within the plus or minus 15% threshold of the predicted flow in the opening year for each of the junction and online schemes.

Table 2.4 - Summary of Predicted and Outturn Flows of Non-Bypass Schemes

Scheme Name	Scheme Type	Corridor Within 15%
A1 Stannington GSJ	J	OK
A14 Rookery Crossroads	J	OK
A34/M4 Chieveley	J	+
A500 City R and Stoke Jn Imp	J	-
A63 Melton GSJ	J	-
A64 Colton Lane GSJ	J	OK
A1033 Hedon Road Improvements	O	OK
A11 Attleborough Bypass Imp	O	OK
A11 Roudham Heath to Attleborough	O	OK
A2 Bean to Cobham Improvement Phase 1	O	OK
A46 Newark to Lincoln Improvements	O	+
M25 J12 – J15	O	OK
M4 J18 Eastbound Diverge	O	OK
M5 J18a – J17 Northbound	O	OK
M5 J19 – J20 Northbound Climbing Lane	O	OK
M5 J19 – J20 Southbound Climbing Lane	O	OK

Table note: OK =predicted and outturn are within +/- 15% of observed, + = outturn is larger than predicted by >15% and - = outturn is less than predicted by >15%

2.44 The results shown in Table 2.4 indicate that:

- Of the 16 non-bypass schemes evaluated, 12 (or 74%) have outturn traffic volumes within 15% off those predicted;
- 2 schemes (13%) had outturn traffic volumes 15% higher than predicted; and
- 2 schemes (13%) had outturn traffic volumes 15% lower than predicted.

2.45 This is significantly better than the comparisons for the Bypass schemes (50% across the corridor).

2.46 Of the 6 junction schemes assessed so far, three (50%) are within 15%, and two have observed traffic volumes at least 15% lower than predicted while one was greater than predicted.

2.47 This shows that the junction schemes have no significant bias towards under or over-prediction.

2.48 Of the 10 online schemes assessed, 9, or 90% were within a 15% threshold of the forecast. Despite the small sample of schemes, the online schemes seem to be estimating scheme flows more accurately.

2.49 **Figure 2.7** shows the relationship between the predicted traffic flow and observed traffic flow for junction and online schemes. Most schemes are located close to the 45 degree line indicating good correlation between predicted and observed flows.

2.50 A value of standard deviation has been calculated for the junction schemes and online schemes. It is expressed as a percentage of the mean to allow for a comparison between different data sets. Junction schemes have a standard deviation of 19% and online schemes are 18%. This compares to a 29% standard deviation for the bypass corridor, hence shows an improved correlation.

2.51 We have also taken a more detailed look at the possible reasons for schemes that show a significant difference between outturn and predicted traffic volumes, for example, the A46 Newark to Lincoln Improvement, which shows outturn traffic volumes 50% higher than predicted and A500 City Road junction, which shows traffic volumes 20% below predicted, and these reasons are outlined in **Section 3**.

2.52 **Figure 2.8** below gives an indication of the degree to which schemes are under or over-predicting traffic. This graph shows a typical 'normal' distribution curve with only two schemes significantly over-predicting corridor flows (>25%) - the A34/M4 Chieveley and A46 Newark to Lincoln Improvement.

Figure 2.7 - Non-Bypass Schemes – Comparison between Predicted and Observed Traffic Flows (AADT)

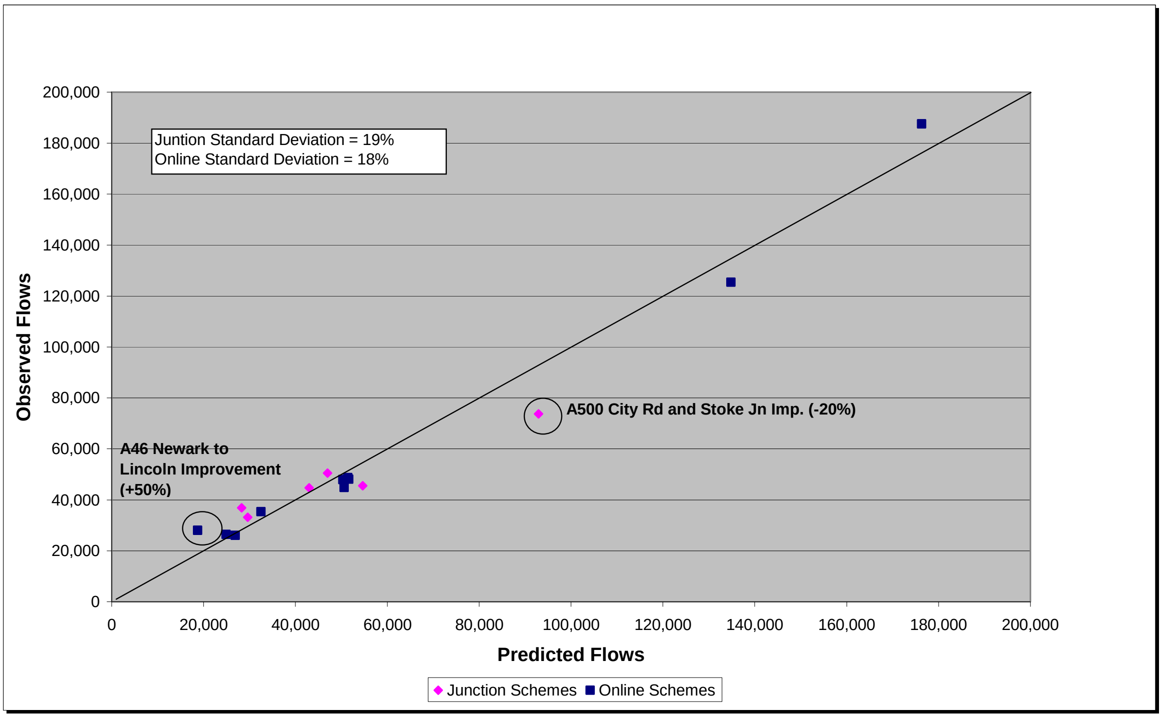
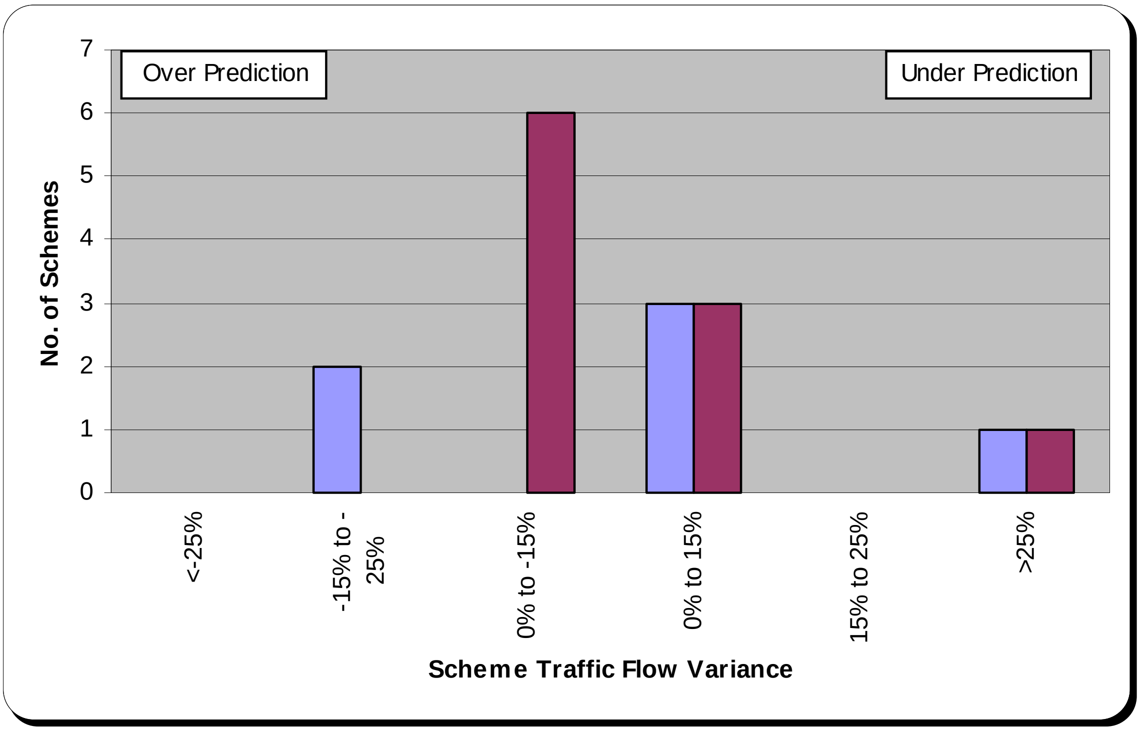


Figure 2.8 - Non-Bypass Corridor - Number of Schemes Under or Over-Predicting Traffic Flows



Journey Time Savings

2.53 We have also looked at whether conclusions can be drawn on the accuracy of journey time savings due to the scheme for the predicted and outturn scenarios. As part of the evaluation within POPE, journey time surveys are undertaken both before and after the opening of the scheme in the peak and inter-peak time periods, and by direction. Hence, we have excellent information on the outturn position.

2.54 Predictions of the impact of a on journey times are generally not reported within the forecasting reports, but have been traditionally summarised in the AST in terms of minutes saved in the peak and inter-peak periods.

2.55 For the majority of the schemes, the appraisals took place in the late 1990's. Hence, the guidance would have been the original WebTAG guidance published in 1998, whereby for the compilation of the AST, economic efficiency assessment should be presented as follows[2]:

> ***"The quantitative column shows the peak and interpeak journey time changes (in minutes) for trunk road users in the design year as a result of the proposed scheme."***

2.56 This means that predicted estimates of journey time savings reflect an as-yet hypothetical scenario, namely

- The year chosen to present journey time changes is the design year of the scheme, normally 15 years after opening; and
- The time saving is derived by the comparison of the Do Minimum and Do Something modelled journey time in the Design Year, i.e. the hypothetical situation without the scheme, and with the scheme.

2.57 Clearly, this 'Do Minimum' can not be measured, and the only outturn journey time savings that can be measured is the 'Before' year without the scheme, to proxy a 'Do Minimum' and the opening year with the scheme to proxy the Do Something.

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[2] Understanding the New Approach to Appraisal, 7. Economy
http://www.webtag.org.uk/archive/nata/understanding/7.htm#journey%20times%20and%20vocs , published 1998

2.58 This guidance was changed in 2001, whereby the GOMMMS guidance for this part of the AST from 2001 says:

> ***"For a road improvement which only benefits road users, this could be opening year peak and interpeak journey time changes in minutes, together with the number of road users per day who would be affected."***

2.59 Thus there was a significant change in the guidance from the **design year** to the **opening year**, which is clearly of importance for evaluation purposes as the opening year is directly measured within POPE, and the 'Before' outturn measurements can be used as the proxy to the Do Minimum predictions.

2.60 The latest guidance for this issue in WebTAG[3] and WebTAG[4] now says:

> ***"For a highway scheme which only benefits road users, this could be the total vehicle hours saved, and the opening year peak and inter-peak journey time changes in minutes."***

2.61 Unfortunately, however, whilst the new appraisals currently being undertaken reflect this approach, the schemes reviewed as part of this meta report generally show design year estimates of journey time savings.

2.62 For a number of evaluated schemes, several different ASTs have been compiled over the appraisal period. The reasons for compiling replacement ASTs are varied, but revisions of the journey time savings are a common factor as more accurate model runs become available. In some cases there may be very substantial changes between estimates. For example, the A5 Weeford Fazeley scheme which encompasses a 5km dual carriageway bypass and roundabout improvements to the new M6 Toll has a 1998 AST which predicts a design year saving of 11 minutes in the peak period, whereas the GOMMMS AST of 2001 gives an opening year saving in the peak of only 0.6 minutes.

2.63 A third issue, is that journey times and savings are generally not reported within the Forecasting Reports of schemes, and hence a simple, single number within the AST to reflect peak and inter-peak predicted journey time savings can be misleading as:

- We are unsure in which peak (AM or PM) and in which direction the estimates are shown for;
- It is not clear what hours represent the inter-peak; and
- In most cases, it is not clear what are the starting points and finishing points of the journey time estimates that these predictions are derived from.

2.64 The upshot of this means that although it is possible to show predicted and outturn journey time saving comparisons, any conclusions drawn from the results would be misleading given the non-measurable scenarios and lack of details for the predicted values.

2.65 It would be of value to the meta-analysis if comparisons of predictions with outturn findings is reported, then we could measure how successful these schemes are against their predictions and their contribution towards the HA targets for congestion reduction. However this has not been possible because of problems identifying a like-for-like basis for the comparison.

2.66 As part of the economic evaluation of schemes, interrogation of journey times for each link within the economic appraisal program COBA has been undertaken, which does enable some comparison of predicted and actual times, but this is time consuming and does reflect model estimates, hence more detail within the Forecast Report is recommended, even though this is a formal requirement, it is often not reported.

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[3] The Transport Economic Efficiency Sub-Objectives
http://www.webtag.org.uk/webdocuments/3_Expert/5_Economy_Objective/3.5.2.htm#1_8
[4] The Transport Economic Efficiency Sub-Objectives
http://www.webtag.org.uk/webdocuments/3_Expert/5_Economy_Objective/3.5.2.htm#1_8

Key Findings

The question was to assess how well HA traffic models were performing by the accuracy of their model predictions, i.e. whether the traffic volumes actually observed on a scheme link compares to that predicted. This has shown that:

For Bypass Schemes

- 43% of the outturn traffic volumes on the bypass are within 15% of the predicted traffic volumes. In general, the higher proportion of the remainder is under-prediction, i.e. the outturn traffic volumes are higher than predicted;
- 38% of the old route (bypassed) traffic volumes are within the 15% threshold, however, the balanced split between traffic volumes greater and less than this threshold suggests there is not a particular bias towards under- or over-prediction;
- 50% of the corridor traffic volumes are within a 15% threshold. The split between traffic volumes greater and less than this threshold suggests there is a bias towards under-prediction; and
- The standard deviation indicates how a set of data clusters around its mean, i.e. it show how far on average the predicted flows are away from the mean. For this analysis the standard deviation is expressed as a percentage of the mean to allow for a comparison between different data sets. The standard deviation from the mean is larger for the old route (65%) compared to the new route (29%) and corridor (27%).

For Non-Bypass Schemes

- 75% of the non-bypass traffic volumes are within the 15% of the predicted traffic flows on the corridor. The distribution of variance shows a typical 'normal' distribution shape (compared to the old and new route).
- Both online and junction schemes are predicting scheme traffic volumes quite accurately (12 out of 16 schemes assessed are within a 15% threshold), with less variation from the average for online schemes.
- The standard deviation relative to the mean is lower for the non-bypass schemes compared to the bypass schemes.

Journey Time Comparisons

- Unfortunately, predicted journey time savings are of limited use from this sample of schemes for the purposes of this evaluation. The design year is not formally specified in most ASTs, and although a small number of schemes specify the opening year journey time savings, there is little detail on the length of scheme that these apply to or details on the direction or hours used in the calculation.
- The guidance in webTAG for how this part of the AST should be completed has now changed from recommending journey time savings in the design year to the opening year, but it would still be advantageous for evaluation purposes if more detail was given within the scheme Forecasting Report, so that meaningful comparisons with the outturn situation could be made.

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3. Reasons for Under or Over-Predicting Traffic Volumes?

Overview

3.1 **Section 2** looked at the accuracy of the scheme traffic models. The next step is to build a better appreciation of the potential causes for the differences between outturn and predicted traffic volumes.

3.2 When undertaking this analysis, it has been necessary to review in detail all available reports to determine the predicted traffic volumes and the key assumptions on the modelling approach. As outlined in **section 2**, there have been issues on data availability regarding some early schemes in the Major Schemes Programme, and not all forecasting reports were available.

3.3 However, our analysis has taken a common sense view to determine the most likely reason for any significant differences between outturn and predicted traffic volumes. The outturn traffic volumes have been derived by traffic counts specifically for this purpose, and matched against the same locations for where predicted volumes are shown.

3.4 Given the number of schemes and the level of data availability, we have restricted our evaluation to the scheme itself and then looked for reasons within the scheme documentation to provide clues as to why any significant differences have occurred.

3.5 Within our sample of schemes for the assessment of traffic issues, we have considered 37 schemes, however in order to derive a robust view of traffic volume differences, we have concentrated our evaluation on those schemes where the differences between outturn and predicted traffic volumes exceed 15%. This gives a total of **18 schemes, or nearly 50% of the total sample**, which includes 14 bypass schemes and 4 non-bypass schemes.

3.6 In the schemes not assessed, we have looked at the approach adopted, and in most cases, the good correlation between outturn and predicted traffic volumes reflects a robust approach to the modelling, and growth profiles similar to the observed levels. In short, for these schemes:

- The forecasting of traffic has been in line with observed growth;
- The traffic model assigns traffic between the old and new routes in line with what was observed, although there are inevitably some slight under or over assignment, but within normal bounds of acceptability; and
- ‘External’ effects such as major land use change, other schemes etc are the same within the predicted forecasts and the actual situation.

3.7 However in some cases, there may have been competing errors, but when combined, the predicted traffic volumes are in line with outturn. In these cases, the ‘errors’ are similar to those identified in the next section.

3.8 It should also be noted, that comparing predicted and outturn traffic volumes in the opening year and explaining the differences is not a straightforward exercise, not least as in many cases, the predicted opening and actual opening year are not the same, and hence in order to derive predicted traffic volumes for the same year as our ‘after’ traffic counts, we have interpolated between the predicted opening year and forecast year (normally 15 years after opening).

3.9 In addition, we have tried to determine the most significant reason, and in the most part, these are easily identified. However, traffic modelling is complex, and in reality other smaller issues may have occurred, but we have no access to the scheme traffic models, and have had to make these judgements based on what has been reported within the Local Model Validation Report and Forecasting Reports. For the most part, these have provided sufficient information for us to derive robust reasons for traffic volume differences.

Reasons for Variance

3.10 A review of all bypass and non-bypass schemes highlighted five main potential causes for the variance in predicting opening year traffic volumes. These were:-

- Strategic routing assumptions;
- Local routing assumptions;
- Background growth assumptions
- Land use issues; and
- Other schemes that were assumed to be constructed within the traffic model that were not actually completed or schemes that were not modelled, but did actually get constructed.

3.11 **Table 3.1** below shows the percentage of schemes that either under or over-predict traffic by more than 15% due to the above reasons.

Table 3.1 – Reasons for Under or Over-Prediction of Traffic Flows

Outturn Flows Higher than Predicted (Under Prediction)	Potential Causes	Outturn Flows Lower then Predicted (Over Prediction)
6 Schemes (33%)	Strategic routing model issues	1 Scheme (6%)
2 Schemes (11%)	Local routing model issues	1 Scheme (6%)
2 Schemes (11%)	Background growth assumptions (lower/ higher)	1 Scheme (6%)
0%	Land Use issues	2 Schemes (11%)
0%	Other schemes not completed	3 Schemes (17%)

3.12 **Table 3.1** shows that the main cause of errors in traffic predictions is due to how the model has treated strategic and local traffic re-assignment with the scheme in place, in particular:

- 7 of the 18 schemes, or 39% have, in our opinion, a strategic re-assignment issue, and 6 of these 7 result in outturn traffic volumes higher than predicted, i.e. observed re-assignment onto the scheme has occurred, but has not been modelled;
- 3 of the 18 schemes (17%) have local re-assignment issues;
- 3 of the 18 schemes (17%) show differences between predicted and outturn volumes due to background traffic growth assumptions in the model being different from what has occurred; and

- 2 of the 18 (11%) schemes have land use assumptions being different from what has actually happened, and 3 have made assumptions regarding other schemes that are different from reality.

3.13 A more detailed break down of these causes, by scheme type, is addressed below.

Bypass Schemes

3.14 The reasons for the traffic variance are addressed as part of the POPE process and documented in each individual scheme report. This Meta analysis has drawn together the collective reasons from these individual evaluations.

3.15 **Table 3.2** identifies the primary reason for bypass schemes showing predicted Traffic volumes in excess of 15% of the outturn. A sample of **14** bypass schemes was used and the table shows:

- A brief description of whether the old road, bypass or corridor shows a significant (>15%) difference between the outturn and predicted traffic volumes;
- The primary reason for the differences; and
- A short commentary on the specific issues with this scheme.

Table 3.2 – Bypass Schemes - Reasons Potential Causes for Prediction Errors

Scheme	Outturn Traffic Volumes	Primary Reason	Reasons
A6 Great Glen Bypass	• Old route lower • Bypass lower • Corridor lower	Strategic re-assignment	This scheme was appraised before the opening of the A14, and after this opened, a good deal of strategic longer-distance movements on the A6 switched to the A14/M1 route to avoid congestion on the south side of Leicester. This was an observed response, as traffic volumes on the A6 dropped after the opening of the A14. The network for the appraisal of this scheme was locally based around the A6 scheme, and hence 'locked' this traffic onto the A6 route, thereby could not consider this strategic re-assignment effect.
A1(M) Ferrybridge - Hook Moor	• Old route lower • Bypass OK • Corridor lower	Strategic re-assignment	This scheme was originally appraised in 1992 but updated in 2001, however neither assessment fully considered the impacts of the opening of the A1-M1 link east of Leeds, which opened in 1999. This scheme has attracted some traffic from the A1 corridor into the M1 corridor, and this is shown by the predicted Do Minimum (from both the 1992 and 2001 predictions) showing higher flows than the observed before situation. The impact of the scheme itself has been modelled well, with the same re-

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Scheme	Outturn Traffic Volumes	Primary Reason	Reasons
			distribution effects modelled as observed.
A34 Newbury Bypass	• Old route OK • Bypass higher • Corridor higher	Strategic re-assignment	Although the traffic model used in the appraisal of this scheme covered a wide area, analysis of traffic counts across a wide screenline showed that re-assignment into the A34 corridor occurs from a number of strategic routes across southern Britain, and over a wider area than that modelled.
A43 Syresham & Silverstone Bypass	• Old route OK • Bypass higher • Corridor higher	Strategic re-assignment	The model networks used for these schemes were simple networks that included the A43 and village roads only. Hence, the model did not include traffic movement between M40 and M1 and this was a recognised response in that many vehicles use the M40 between London and Bicester, thus avoiding the congested southern sections of the M1, and then use the A43 to access the M1 corridor. This was shown by a 10% reduction on the M40 north of Junction 10. In addition, there was observed re-assignment from the A361 and A413 into this corridor which was not modelled.
A500 Basford, Hough, Shavington Bypass	• Old route higher • Bypass higher • Corridor Higher	Strategic re-assignment	Very little information exists on the modelling assumptions for this scheme, however, it is clear that there has been more re-assignment into the A500 corridor than modelled from roads outside the model area such as A51 and A534 which are the alternative routes to adjacent M6 junctions.
A1(M) Wetherby to Walshford	• Old route higher • Bypass OK • Corridor OK	Local re-assignment	The model and the observed traffic volumes show very little change in flows after the completion of this scheme, hence although national growth rates have been used to prepare predicted flows, these factors match what has actually happened. The old route is being used by more vehicles than predicted due to local re-assignment issues, and the fact that many drivers appear to be using the lightly-trafficked old route in preference to the quicker A1 route for local north-south movements
A6 Alvaston Bypass	• Old route higher • Bypass lower	Local assignment	The model for this scheme encompasses a wide area and hence re-assignment into the corridor is

Scheme	Outturn Traffic Volumes	Primary Reason	Reasons
	• Corridor OK		modelled well. However there has much less transfer to the new road from the old road than modelled, largely due to congestion at the A6/A511 (Raynesway) junction.
A47 Thorney Bypass	• Old route lower • Bypass higher • Corridor OK	Local re-assignment	The model used in the appraisal used an 'all-or-nothing' manual approach to assignment and assumed that no traffic to/from Thorney from elsewhere would use the bypass and would instead access the town from the eastern or western junction. In reality, however, a proportion of Thorney bound traffic uses the bypass to access the town at the central junction, and this results in an over-prediction of traffic on the old road and under-prediction on the bypass.
A6 Clapham Bypass	• Old route lower • Bypass lower • Corridor lower	Background traffic growth	This scheme was appraised in the late 1980's and used background traffic growth that was twice that has been observed in reality. Our analysis has shown that the Do Minimum predictions (before opening and any impact of the scheme) results in much higher flows predicted than actually observed. The growth used in the traffic model was reported to be 3.4% p.a. from the base year of 1986, compared to an actual observed growth in Bedfordshire of only 1.7%, thereby resulting in a 30% difference in background growth, very similar to the difference in predicted and actual traffic volumes.
A6 Rushden - Higham Ferrers	• Old route higher • Bypass higher • Corridor higher	Background traffic growth	The modelling for this appraisal was undertaken in 1990, and traffic growth within the model was assumed to be in line with National Road Traffic Forecasts from the time (NRTF89). Although these were proved to be high when compared to nationally observed data, at this local level, they were low. Rushden and this area grew rapidly in the 1990's, with population increasing by nearly 15% between 1991 and 2001 and hence the growth profile used in the model was too low given the big socioeconomic changes happening locally. This is proved by the Do Minimum predictions (i.e. no scheme) being higher than the equivalent 'before' traffic volumes by the same ratio as

Scheme	Outturn Traffic Volumes	Primary Reason	Reasons
			the Do Something (with scheme) and the observed 'after' situation.
A10 Wadesmill, High Cross and Colliers End Bypass	• Old route higher • Bypass higher • Corridor higher	Background growth assumptions	The original 1991 appraisal was updated in 2000 to reflect a delayed start, and to change the background traffic growth from NRTF89 to NRTF97. This NRTF97 growth profile has been shown to be too low nationally, and utilising this profile has reduced the predictions significantly. If the original NRTF89 forecasts had been used, then these would have proved to be accurate for this scheme, with predictions on the old road and bypass being very close to observed. In our view, however, another reason for the outturn traffic volumes being too high is the modelled assumption that Stansted Airport would be used by 8 million passengers per annum (mppa), whereas in reality the airport expanded at a much higher rate such that in 2005 it was operating at 22.3mppa
A650 Bingley Relief Road	• Old route higher • Bypass lower • Corridor OK	Other schemes	The model for this scheme had a wide geographical coverage and the future year predictions assumed that other schemes on the A650 and A65 would be constructed and opened, however these have not been constructed to date, hence contribute towards the re-assignment into this corridor that was predicted, but has not happened to the same degree. The Do Minimum compares very closely with the Before traffic volumes, hence the over-prediction is due to local re-assignment issues brought about by the additional schemes in the corridor as well as over-estimating the time benefits in the A650 corridor. Time savings between the before and after situation have shown to be significant along the A650 Bingley section, but less so when considering longer stretches of the A650, where additional traffic in the corridor has resulted in slower sections of A650 up and downstream of the improved section.
A21 Lamberhurst Bypass	• Old route lower • Bypass OK • Corridor OK	Other schemes	The traffic model predicted that all through traffic would re-route from the old road to the bypass and that 60% of cross-village traffic would re-route onto

Scheme	Outturn Traffic Volumes	Primary Reason	Reasons
			the bypass, but 40% would stay on the old road. However, on the day of opening, the old road through Lamberhurst was subject to stringent traffic management with capacity reductions (traffic calming) and speed limit changes. This has had the effect of discouraging use of the old road. The assumptions used in the model, although robust did not take full account of the impact of traffic management and hence the model over-predicts traffic on the old road
A46 Norton Lenchwick Bypass	• Old route higher • Bypass lower • Corridor OK	Other schemes	Again, the model for this scheme was prepared in the late 1980's and although had wide network coverage, the model was developed to model all proposed improvements in the corridor, including the proposed A435 Studley Bypass. This scheme was never constructed and hence less re-assignment into the corridor was observed than was modelled.

Non-Bypass Schemes

3.16 **Table 3.3** identifies the primary reason for non-bypass (junction improvements and on-line) schemes showing traffic volumes in excess of 15% of the outturn, however we only have a sample of **4** non-bypass schemes in this assessment.

Table 3.3 – Non-Bypass Schemes - Reasons Potential Causes for Prediction Errors

Scheme	Outturn Traffic Volumes	Primary Reason	Reasons
A46 Newark to Lincoln Improvement	• Outturn higher	Other schemes	The appraisal of this scheme was undertaken in 1992 and considered only the A46 Newark to Lincoln section and immediate side roads. However in 1995, the A46 Leicester Western Bypass (LWBP) was opened, and this has had the effect of re-assigning traffic into the A46 corridor for M1 – A1 traffic. As the A46 Newark to Lincoln improvement did not open until 2003, the Do Minimum predictions show traffic volumes much lower than observed, and no change after opening of the scheme, however, after opening there was some local re-assignment from parallel roads such as the A607 and the A113, however the impact of the opening of the A46 LWBP is the primary reason for the

Scheme	Outturn Traffic Volumes	Primary Reason	Reasons
			under-prediction.
A34/M4 Chieveley	• Outturn higher	Strategic re-assignment	This scheme is a grade separation across M4 Junction 13, and links directly to the A34 Newbury Bypass, however this scheme was modelled separately from Newbury Bypass. Hence the primary reason for the under-prediction on the A34 Newbury Bypass equally applies to this scheme in that there has been strategic re-assignment into the A34 corridor for a number of strategic routes across southern England that were not modelled.
A63 Melton GSJ	• Outturn lower	Land use assumptions	This scheme was appraised in 1998, and the nature of this scheme was that the mainline traffic volumes on the A63 are largely unaffected as the scheme re-aligns the junction and provides safer crossing facilities. However, the comparison of the Do Minimum predictions and outturn 'Before' traffic volumes shows that the outturn volumes are 17% lower than predicted. Further analysis showed that the opening year predictions were based on 'expected' land use changes in the area, however these have not yet happened, and hence the additional growth assumed has not occurred in the opening year, but is more likely to occur within a 5-year threshold. Other links adjoining the A63 also show outturn traffic volumes much lower than predicted for the same reason. This land use change may occur within a 5-year timescale and will be reviewed as part of the Five Year After POPE study.
A500 City Road and Stoke Road Junction Improvement	• Outturn lower	Land use assumptions	Although the traffic model is sufficiently wide to model re-assignment into the improved A500 corridor, assessment of the predicted traffic volumes shows that the Do Minimum predictions on the A500 are lower than the Before but similar on the side roads. Also the increase predicted on scheme opening was considerably larger than that observed. Closer examination of the assumptions show that the predictions contained a great deal of local land use improvement which has not been

Scheme	Outturn Traffic Volumes	Primary Reason	Reasons
			realised, and hence local growth has been substantially less than assumed in the predicted forecasts, largely due to the economic decline in Stoke since 2002, even though local TEMPRO forecasts shows positive growth.

Key Findings

The question was to find out how well traffic models performed and understand the reasons for any poor performance by looking at the primary causes for the under and over-prediction of traffic volumes. We have reviewed all 37 individual evaluations, but have concentrated our assessment on the 18 schemes that show a significant (>15%) difference between predicted and outturn traffic volumes.

Our review of the individual evaluations has shown:

- That there are five primary causes for the variance in predicting opening year traffic volumes, namely;
  - Strategic re-assignment issues;
  - Local re-assignment issues;
  - Background growth issues;
  - Land Use issues; and
  - Influence of other schemes.
- These issues also impacted on the 19 schemes not analysed in detail, but to a lesser extent than those schemes with significantly different predicted and outturn traffic volumes.
- Of the 18 schemes that show a significant difference:
  - 7 (or 39%) have, in our opinion, a strategic re-assignment issue. 6 of these 7 result in outturn traffic volumes higher than predicted, i.e. observed re-assignment onto the scheme has occurred, but has not been modelled, largely due to model size and/or lack of robust consideration of likely re-assignment impacts;
  - 3 (or 17%) have local re-assignment issues, whereby the split of traffic between the new and old roads has not been modelled accurately;
  - 3 (or 17%) show differences between predicted and outturn volumes due to background traffic growth assumptions in the model being different from what has occurred;
  - 2 (or 11%) schemes have land use assumptions different to what has actually happened; and
  - 3 (or 17%) have made assumptions regarding other schemes that are different from reality
- The primary reasons identified above help to explain the vast majority of the differences between predicted and outturn traffic volumes, and although difficult to measure with any confidence the level of newly generated or induced traffic does not appear significant.

4. Does Traffic Variance Matter?

4.1 **Sections 2 and 3** looked at the accuracy of the scheme traffic models and the potential reasons for under or over-estimating traffic volumes. This section asks the question whether the under or over prediction of traffic volumes in the models is reflected in the economic benefits, i.e. does model error matter?

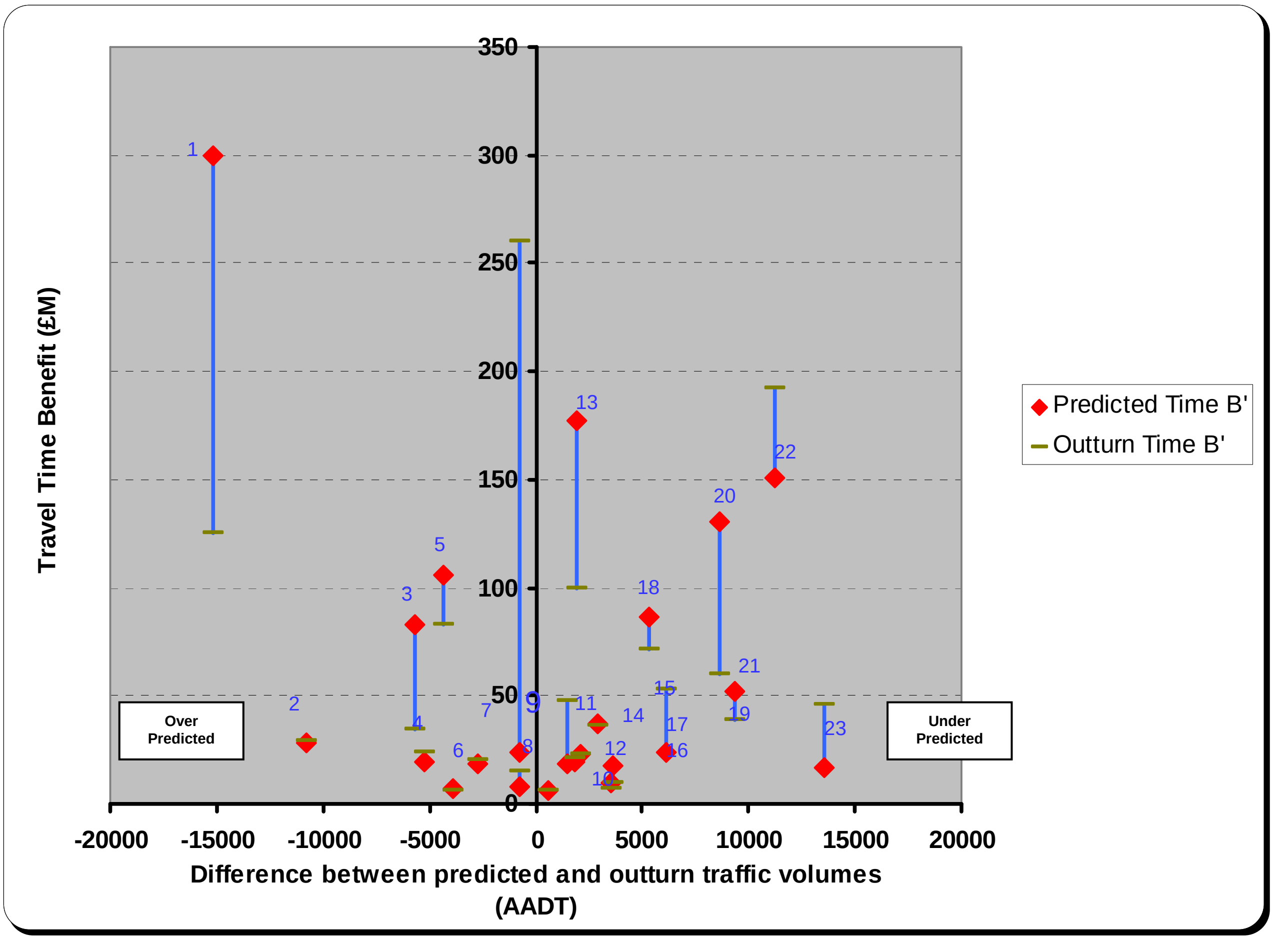
4.2 The list of the **24** schemes used in this analysis is shown in **Table 4.1** below. This includes 16 bypass schemes, 3 junction schemes and 5 online schemes. Each scheme has a unique reference number which is used to reference those schemes on the graphs below.

Table 4.1 – List of Schemes by type

Scheme Name	Scheme Type	Graph Ref. No. (Figure 4.1)
A1(M) Ferrybridge - Hook Moor	Bypass	1
A6 Clapham Bypass	Bypass	2
M4 Jn 18 Eastbound Diverge	Online	3
A27(T) Polegate Bypass	Bypass	4
A650 Bingley Relief Road	Bypass	5
A6 Great Glen Bypass	Bypass	6
A21 Lamberhurst Bypass	Bypass	7
A5 Weeford Fazeley	Bypass	8
A11 Roudham Heath to Attleborough	Online	9
A5 Nesscliffe Bypass	Bypass	10
A6 Alvaston Bypass	Bypass	11
A46 Norton Lenchwick Bypass	Bypass	12
A63 Selby Bypass	Bypass	13
A66 Stainburn and Great Clifton Bypass	Bypass	14
A1033 Hedon Road Improvements	Online	15
A64 Colton Ln GSJ	Junction	16
A1 Stannington GSJ	Junction	17
A10 Wadesmill, High Cross and Colliers End Bypass	Bypass	18
A43 Silverstone Bypass	Bypass	19
A34/M4 Chieveley	Junction	20
A46 Newark to Lincoln Improvement	Online	21
M25 J12-15	Online	22
A6 Rushden - Higham Ferrers	Bypass	23

4.3 **Figure 4.1** shows the relationship between the accuracy of the predictions of traffic volumes and the outturn travel time benefits. It shows how the outturn travel time benefits changed in response to the outturn traffic volumes that were observed for the scheme. One of the bypass schemes (A34 Newbury Bypass) is not included in the graph due to large predicted and outturn benefits, which skew the graph, but has been recognised as part of the analysis.

Figure 4.1 – Relationship between Traffic Volumes and Time Benefits



4.4 For this assessment, just the travel time elements of the benefits have been used. This way accident benefits are excluded, which may not be as related to traffic volumes in this analysis.

4.5 When comparing this relationship, what we would expect to see is time benefits to be **lower** than expected when traffic was over-predicted. That is, less traffic on the scheme would mean smaller time benefits.

4.6 In general for Bypass schemes:

- Those schemes that have less traffic then expected on the scheme (those on the negative side of the X axis) show a reduced time benefit to varying degrees. Except the A6 Clapham Bypass (ref. 2) which shows a significant increase in traffic on the scheme, but no effect on the outturn travel time benefits;
- Those schemes that have accurate predictions saw little change in their outturn time benefits, except A5 Weeford Fazely Bypass (ref. 8) and A6 Alvaston Bypass (ref. 11), where the outturn benefits are significantly higher than predicted;
- While those schemes that have more traffic than expected delivered higher time benefits, except for A63 Selby Bypass (ref. 13) and A10 Wadesmill (ref. 18) where travel time benefits are lower than predicted;
- In general, for the junction and online schemes, where traffic variation is more significant, travel time benefit were noted to be higher than predicted when traffic volumes were lower, i.e. less traffic on the scheme resulted in higher than expected time benefits (A11 Roudham

Heath to Attleborough (ref. 9)). The exception to this was the M4 Junction 18 Eastbound Diverge (ref. 3); and

- Similarly, those schemes with more traffic than predicted delivered lower time benefits.

Key Findings

The question asked whether the under or over prediction of traffic volumes in the models is reflected in the economic benefits of a scheme, i.e. how do the outturn travel time benefits changed in response to the outturn traffic volumes that were observed for the scheme.

- There was a marked difference in the outcome for bypass and non-bypass schemes, although some caution must be exercised given the low sample size of 7 for non-bypass schemes.
- In general, bypass schemes delivered better than expected travel time benefits when traffic volumes were higher.
- However, for junction and online schemes, where traffic variation is more significant, travel time benefit comparisons between predicted and outturn were also noted, with benefits being higher than predicted when traffic volumes were lower.

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5. Conclusions and Recommendations

Overview

5.1 This Section provides a summary of the lessons learnt and recommendations emerging from this Meta report. The main areas of assessment and the three key questions were:

- ***Lessons learnt in terms of data availability;***
- ***Are the HA Traffic Models accurately estimating scheme traffic volumes?***
- ***What are the main reasons for under or over-estimating traffic volumes?***
- ***Are the schemes still successful in terms of monetary benefits despite under or over-prediction of traffic?***

5.2 The lessons learnt and the recommendations outlined below are for the Highways Agency and Department for Transport (DfT) to consider as part of any revisions to the appraisal process.

Data Availability

5.3 POPE is a process which began in 2001, originally to evaluate schemes in what was termed the Targeted Programme of Improvements (TPI), now termed the Major Schemes (MS) Programme. These schemes opened from 2002 onwards, but the appraisals or justification for these schemes were undertaken in the 1990's well before POPE started. Therefore the evaluation team were dependent on the original appraisal material and reports being available, but unfortunately this was not always the case. For more recent schemes data is collected at the before stage.

Conclusions

- The POPE process has helped to archive all appraisal information and reports, so that they are available for the evaluation stage;
- This should include the main appraisal reports such as the final versions of the Data Collection Report, Local Model Validation Report and Forecasting Report, as well as any updated documents following the release of these reports;
- Before construction, it is necessary to agree with the Highways Agency and the Local Authorities the optimal locations from which to collect traffic information so that value-for-money is maximised; and
- The lack of clarity on certain issues within the Forecasting Report, such as the extent of the model network, predicted journey time savings on specific links and predicted traffic volume changes in the opening year, broken down by time period, has hindered the explanation of differences between predicted and outturn traffic volumes and journey times.

Are the HA Models Accurately Estimating Scheme Traffic Volumes?

5.4 This question necessitated analysis of whether a scheme has performed as predicted. The following methods of analysis were used to address this for all schemes:

- To determine whether the outturn traffic flow lies within a particular threshold of the predicted flow in the opening year, we have chosen a value of **plus or minus 15%**;
- To look at the degree to which schemes are under or over-predicting traffic volumes, we have considered the standard deviation of results from the 1:1 relationship of predicted against outturn traffic.

5.5 A total of 37 schemes were considered in this analysis and these have been categorised into:

- Bypass schemes (21); and
- Non-bypass schemes (16), i.e. Junction improvements or on-line widening.

Conclusions

- Emerging results indicate that there is a tendency for predicted traffic volumes to exceed outturn traffic on the new bypass (new road), but there is not a bias towards under or over-estimating traffic on the old route (bypassed route);
- For non-bypass schemes, all traffic remains in the same corridor, and hence has lower re-assignment from other roads, thereby making it easier to predict the correlation between predicted and outturn traffic volumes (75% of schemes show predicted and outturn traffic volumes within 15%);
- Predicted and outturn Journey time saving comparisons are very hard to make as the predicted journey time savings are not clearly reported and where estimates are available, they lack detail on where and when they apply and usually represent a hypothetical scenario in the design year, which makes comparison with actual values impossible.

What are the Reasons for Under or Over-Predicting Traffic Volumes?

5.6 From our sample of schemes, we have reviewed each individual POPE Report, and where possible undertaken further review in order to determine the key reasons for the variance between predicted and outturn traffic volumes.

5.7 The evaluation of reasons has concentrated the analysis on those schemes where the difference between predicted and outturn traffic volumes exceeded 15%

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Conclusions

- Clear reporting of model outputs has been an issue in determining the true cause of variance between predicted and outturn traffic volumes;
- Notwithstanding this caveat, our assessment has shown that the cause of variance can be summarised by five key areas:
  - **Strategic re-assignment** into the corridor not being modelled, and this is usually a function of model size not being sufficiently wide to enable re-assignment to be truly represented.
  - **Local re-assignment** into the scheme from the old road, or roads previously used by rat-running traffic, and this is due to either local unclassified roads not being modelled, or misjudgement of local traffic routeing after the scheme opens, such that more or less traffic stays on the old road than predicted leading to imbalances between the old and new road.
  - **Background traffic growth assumptions** also contribute to observed differences, as National Growth forecasts are used to derive growth factors for many schemes, and these have not always been accurate over time. NRTF89 was commonly used in traffic forecasting, and these forecasts did show higher traffic growth nationally than observed, and NRTF97 led to forecasts that were a little low nationally. In addition, the use of NRTF forecasts are not always representative of local growth, and our assessments have shown that local growth is invariably the more accurate determinant of traffic growth in a region.
  - **Other schemes** have been included in traffic modelling that have not yet been completed and this has led to predicted traffic volumes being higher than outturn in many cases. In addition, there is a tendency now for Local Authorities to be more aware of utilising traffic calming measures on a bypassed road, as invariably the road that is now bypassed is handed over to Local Authority control, and this can lead to less traffic using the old road than predicted; and
  - **Local land use issues** have also shown to have an effect in the variance of predicted and outturn traffic volumes. This is due to our comparison being made at the opening year, and the fact that many land use developments come to fruition many years after the opening of a new scheme. It will be interesting to review this reason when more 5-Year After evaluations are reported.
- The above reasons help to explain the primary reasons for the differences between predicted and outturn traffic volumes, however given the traffic data availability and reporting evidence there are inevitably a combination of these reasons operating on many schemes, and even competing reasons on schemes where a good correlation is currently shown. However, the reasons identified for each scheme are robust; and
- The primary reasons do explain the variance between predicted and outturn traffic volumes meaning that, in our view, the level of observable induced traffic is very small, and for most schemes not measurable.

Are the schemes still successful in terms of monetary benefits despite under or over-prediction of traffic?

5.8 Even though we have quantified the accuracy of the scheme appraisal traffic models and identified the primary reasons for these differences, it is still important to ask whether these differences impact on scheme economic benefits, and whether any key decisions to develop a scheme would have changed if the outturn traffic volumes were more accurately modelled.

5.9 A total of 24 schemes were identified where both traffic volume differences and travel time benefits were known and these have been categorised into:

- Bypass Schemes (16); and
- Non-Bypass schemes, i.e. Junction improvements (3) or on-line widening (5).

Conclusions

- For bypass schemes showing greater variance in traffic volumes, there was generally more variance in travel time benefits. This suggests that for bypass schemes in particular, there is a direct relationship between accuracy of traffic forecasts and accuracy of travel time benefits. However, given that travel time benefits are a function of traffic volumes and time savings, this suggests that travel time savings must also be modelled acceptably;
- Where traffic variance was more significant, travel time benefits also varied significantly, but no scheme showed negative travel time benefits, or benefits so low that the decision to proceed with the scheme was compromised;
- For non-bypass schemes, where traffic variation is more significant, travel time benefit comparisons between predicted and outturn were also noted, with benefits being lower than predicted when outturn traffic volumes were higher. Again, however, even though benefits were lower, the BCR for the schemes where differences were observed were still above 2.0, hence the decision to proceed was also not compromised;
- In summary, in our view, the accuracy in traffic volume prediction does have implications for each scheme's travel time benefits and hence due regard should be exercised in accurate quantification of these predictions;
- Caution must be used in the interpretation of these results, due to the low sample sizes, particularly for non-bypass schemes.

Recommendations

5.10 In light of the key findings and lessons learnt, we have identified a number of recommendations to be considered by the Highways Agency and the DfT.

Traffic Data and Reporting Issues

- Adherence to current Guidance on traffic model development and reporting should be checked to ensure that evaluations can be cost effective and accurate reasons for differences fully explained;
- Given the lack of consistency within current reporting of journey time savings, it is recommended that base year journey time observations and opening year predictions are clearly reported in the Scheme Forecasting Report, but as this is within current guidance, it is important that this is checked for robustness and detail;
- In addition, Guidance should be prepared for future appraisals on what should be explicitly reported within Forecasting Reports, including peak hour and inter-peak journey time and saving predictions, clear identification over what part of the network these savings apply and commentary on the robustness of these savings compared to base year observations;
- Investigation of induced traffic impacts from the sample of schemes has generally failed to establish whether induced traffic is being observed. With the newer schemes now being evaluated, clarity is required in the Forecasting Report as to the level and distribution of induced traffic within the predictions, and Guidance should be enhanced to re-iterate this requirement; and
- Within Forecasting Reports, it is recommended that a clear description of the changes between the Do Something and Do Minimum traffic volumes is tabulated, clearly isolating the impacts of
  - Background traffic growth;
  - Local specific growth;
  - Re-assigned traffic;
  - Newly generated or induced traffic, and how this has been derived; and
  - Impact of any other consideration

POPE Process Issues

- POPE team involvement before construction is main source of appraisal documentation for subsequent evaluation purposes and this should continue; and
- Re-iteration of the need to archive all relevant Reports should be made to all Consultants and HA Project Sponsors for individual schemes;

Traffic Modelling Issues

- More detailed or clearer reporting of model development and traffic assignment issues is required. It is clear that this is set out in WebTAG, however more adherence to this guidance is recommended;
- A more clearly defined set of considerations should be set out for future traffic modelling exercises, which requires full justification of:
  - Network size to incorporate all reasonable re-assignment issues, both strategic and local;

- Use of both National Growth rates and TEMPRO local growth rates used to ensure the most appropriate growth rates for long distance and local movements is demonstrated; and
- different land use assumptions, the likelihood of specific developments progressing and impacts of non-development.

- A possible enhancement for more strategic schemes could be a two-tier model approach utilising Strategic National or Regional Model estimates of demand feeding into a more scheme specific modelling platform. The merits of considering this are recommended, bearing in mind the cost-effectiveness of additional modelling effort;
- The likelihood of local re-assignment should also be carefully considered, with due care taken of rat-running on un-modelled, unclassified links within the local area, which may re-route back onto modelled links after congestion is removed;
- The current WebTag guidance TAG Unit 3.15.5 – The Treatment of Uncertainty in Model Forecasting (July 2008) sets out Draft Guidance on Model 'Uncertainty', such that an Uncertainty log should be prepared for each scheme appraisal, a 'Core' scenario modelled with sensitivity tests and alternative scenarios also reported. This is an excellent advance in modelling uncertainty, and picks up on many of the issues previously identified within this Report, hence it is recommended that this new approach is adhered to for all future schemes;
- This approach could also be taken further to assist the decision-making process and this should be considered by the HA and DfT. Our recommendation would be to adopt a risk analysis approach to the treatment of uncertainty in traffic forecasting, similar to that usually associated with cost estimation, in particular:
  - Define all key risks and assumptions as defined in the uncertainty log. This should consider model development issues, base year issues, network assumptions used in forecasting, interaction with other schemes, and demand issues such as background growth, local growth and specific land use issues;
  - Continue with the sensitivity tests undertaken in the above approach to derive the impact of individual impacts;
  - From these sensitivity tests, a sensitivity function is defined, i.e. how does the change in this assumption affect the traffic forecasts;
  - Define a probability distribution for each uncertainty. This can be a little subjective, i.e. how likely is it that a complementary scheme will be constructed, however this is to quantify by how much do we consider that each key uncertainty may vary;
  - Combine all uncertainties, probability distributions and sensitivity functions into a risk model and relate variations back to the core scenario;
  - This enables a range of results to be determined, e.g. a P10 or P90 (where the traffic forecasts have a 10% and 90% chance respectively of being exceeded);

It is noted that this approach can only show the variation of traffic volumes, and not economic benefits. These would still need to be calculated using TUBA, but it would allow priority to be given to those schemes with narrower risk profiles, indicating a greater certainty of accurate predictions of traffic volumes;

It is recommended that this approach is explored, however, the Draft Guidance within WebTag, which will become mandatory in April 2009 does address the key reasons for traffic variance identified in this report.

Appendix A
Classification of Schemes

A.1 Scheme Details

Scheme Name	Junction Type	Category	Old Route				Bypass				Corridor			
			Predicted	Actual	Difference	Within 15%	Predicted	Actual	Difference	Within 15%	Predicted	Actual	Difference	Within 15%
A1(M) Wetherby to Walshford	Bypass	OYA	255	3,500	1272.5%	+	76804	75,500	-1.7%	OK	77059	76,700	-0.5%	OK
A1(M) Ferrybridge - Hook Moor	Bypass	OYA	24900	16,199	-34.9%	-	61700	55,193	-10.5%	OK	86600	71,392	-17.6%	-
A10 Wadesmill, High Cross and Colliers End Bypass	Bypass	OYA	2900	5,000	72.4%	+	20400	23,600	15.7%	+	23300	28,600	22.7%	+
A21 Lamberhurst Bypass	Bypass	OYA	7000	4,200	-40.0%	-	17000	17,100	0.6%	OK	24000	21,300	-11.3%	OK
A27(T) Polegate Bypass	Bypass	OYA	8300	7,700	-7.2%	OK	32250	27,600	-14.4%	OK	40550	35,300	-12.9%	OK
A34 Newbury Bypass	Bypass	5YA	35900	38,800	8.1%	OK	28461	42,000	47.6%	+	64361	82,100	27.6%	+
A43 Silverstone Bypass	Bypass	OYA	3056	2,633	-13.8%	OK	24552	31,101	26.7%	+	27608	33,734	22.2%	+
A43 Syresham Bypass	Bypass	OYA	435	458	5.3%	OK	23123	31,927	38.1%	+	23558	32,385	37.5%	+
A46 Norton Lenchwick Bypass	Bypass	10YA	4040	6,387	58.1%	+	19839	19,071	-3.9%	OK	23879	25,682	7.6%	OK
A47 Thorney Bypass	Bypass	OYA	5008	2400	-52.1%	-	12917	16900	30.8%	+	17925	19,300	7.7%	OK
A5 Nesscliffe Bypass	Bypass	OYA	1300	1,240	-4.6%	OK	18840	19,500	3.5%	OK	20140	20,740	3.0%	OK
A5 Weeford Fazeley	Bypass	OYA	2250	1,500	-33.3%	-	23700	23,700	0.0%	OK	25950	25,200	-2.9%	OK
A500 Basford, Hough, Shavington Bypass	Bypass	OYA	4000	5,150	28.8%	+	11100	17900	61.3%	+	15100	23,050	52.6%	+
A6 Alvaston Bypass	Bypass	OYA	4222	13,617	222.5%	+	27715	19,758	-28.7%	-	31937	33,375	4.5%	OK
A6 Clapham Bypass	Bypass	OYA	9866	8,300	-15.9%	OK	27611	18,400	-33.4%	-	37477	26,700	-28.8%	-
A6 Great Glen Bypass	Bypass	OYA	1743	1,430	-18.0%	-	22233	17,000	-23.5%	-	22281	18,430	-17.3%	-
A6 Rothwell and Desborough Bypass	Bypass	OYA	6100	10,300	68.9%	+								
A6 Rushden - Higham Ferrers	Bypass	OYA	8900	18,100	103.4%	+	7300	11,700	60.3%	+	16200	29,790	83.9%	+
A63 Selby Bypass	Bypass	OYA	8806	8970	1.9%	OK	5000	6,800	36.0%	+	13806	15,770	14.2%	OK
A650 Bingley Relief Road	Bypass	OYA	13734	15800	15.0%	OK	36390	30000	-17.6%	-	50124	45,800	-8.6%	OK
A66 Stainburn and Great Clifton Bypass	Bypass	OYA	1646	3,200	94.4%	+	7871	8,400	6.7%	OK	9517	11,600	21.9%	+
A1 Stannington GSJ	Junction	OYA	29,600	33,200	12.2%	OK								
A14 Rookery Crossroads	Junction	OYA	42,971	44,717	4.1%	OK								
A34/M4 Chieveley	Junction	OYA	28,300	36,900	30.4%	+								
A500 City R and Stoke Jn Imp	Junction	OYA	92,900	73,720	-20.6%	-								
A63 Melton GSJ	Junction	OYA	54,652	45,565	-16.6%	-								
A64 Colton Ln GSJ	Junction	OYA	47,000	50,553	7.6%	OK								
A1033 Hedon Road Improvements	Online	OYA	32,500	35,400	8.9%	OK								
A11 Attleborough Bypass Improvement	Online	OYA	24900	26,500	6.4%	OK				Not Relevant				
A11 Roudham Heath to Attleborough	Online	OYA	26,900	26,100	-3.0%	OK								
A2 Bean to Cobham Improvement Phase 1	Online	OYA	134,834	125,421	-7.0%	OK								
A46 Newark to Lincoln Improvement	Online	OYA	18,696	28,019	49.9%	+								
M25 J12-15	Online	OYA	176,333	187,590	6.4%	OK								
M4 Jn 18 Eastbound Diverge	Online	OYA	50,600	44,900	-11.3%	OK								
M5 J18a - J17 Northbound (Hallen Hill)	Online	OYA	51,400	48,696	-5.3%	OK								
M5 J19 - J20 Northbound Climbing Lane (Tickenham Hill)	Online	OYA	51,600	48,126	-6.7%	OK								
M5 J19 - J20 Southbound Climbing Lane (Naish Hill)	Online	OYA	50,300	47,988	-4.6%	OK								