SURREY
COUNTY COUNCIL
*Transport for Surrey*

# POOLEY GREEN UNDERPASS & ASSOCIATED MITIGATION MEASURES

## Modelling Report

No. FS 24532

Project Title: Pooley Green Underpass & Associated Mitigation Measures

Document Title: Modelling Report

Client Reference:

Date: 05 November 2010

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Sign ......... ......................

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Amendment List

| Iss. / Rev. | Iss. / Rev Date | Amended Pages |
|---|---|---|
| 2 | 05/11/10 | 23 – 25, 40, 54 - 55 |
| | | |
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# 1 INTRODUCTION

## 1.1 Background

1.1.1 The Airtrack major scheme, promoted by *BAA*, aims to provide a direct rail link to Heathrow from London Waterloo, Guildford, Reading and the wider hinterland of south-west London, Surrey and Berkshire.

1.1.2 Within the county of Surrey, this will require the re-construction of the existing Staines railway station and a new chord in Staines town centre, which will link the existing Windsor line with lines to Guildford and Reading.

1.1.3 Moreover, the Airtrack scheme will see the increase usage of existing rail lines. In particular, the rail line between Staines and Virginia Water has four level crossings. From east to west, these are: Thorpe Road; Vicarage Road; Station Road; and Prune Hill. Already the level crossings can be closed to traffic and pedestrians for 26 minutes out of an hour during peak periods[1]. This creates an accessibility issue for local residents, particularly at Thorpe Road, Vicarage Road and Station Road, as these are situated in urban areas near to Egham and Staines town centres. The introduction of Airtrack will see an increase in level crossing closure of up to 33 minutes out of an hour during peak periods[2].

## 1.2 Mitigation Measures

1.2.1 To reduce the impact of Airtrack on the local highway, an underpass at Vicarage Road level crossing, near Egham, has been proposed at the Airtrack Level Crossing Subgroup. The underpass would allow vehicles to travel under the rail line, unhindered by the passage of trains.

1.2.2 Other mitigation measures have also been considered to accompany the underpass, as listed below and shown in **Figure 1.1**:

- Traffic calming along B388 Vicarage Road to assist in the enforcement of a reduced speed limit of 20mph required for the passage of vehicles through the underpass due to its design constraints; and
- The enhancement of the operation of Runnymede Roundabout.

1.2.3 This report outlines the transport modelling undertaken to determine the feasibility of the underpass and associated mitigation measures, together with an assessment into its impact on vehicular traffic.

## 1.3 Objectives

1.3.1 The objectives of the transport modelling are to:

- Develop a base year macroscopic highway model suitable to forecast and test the proposed mitigation measures;
- Produce forecast year models to test the implementation of the underpass and associated mitigation measures, and to compare with the non-construction of the underpass which maintains the existing level crossing arrangement but with revised downtime;

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[1] Barrier time closure extracted from *Count On Us* surveys conducted on behalf of *BAA* provided in an email to William Bryans from Geoffrey Hill dated 06/11/09.
[2] Airtrack scheme barrier time closure calculated from forecasts provided by Geoffrey Hill on behalf of *BAA* in an email to Abigail Fielder dated 04/03/10. It must be noted that barrier closure time varies between the level crossings.

- Analyse the impact of the underpass and its feasibility;
- Use the modelling results to assist in the identification of any further mitigation measures required or other recommendations; and
- Determine to total trip abstraction required at the level crossings to mitigate against the Airtack scheme.

## 1.4 Study Area

1.4.1 The study area is shown in **Figure 1.1**. It is centred on the towns of Egham and Staines. It encompasses both the Surrey boroughs of Runnymede and Spelthorne, as well as a small part of Berkshire and Greater London to the north.

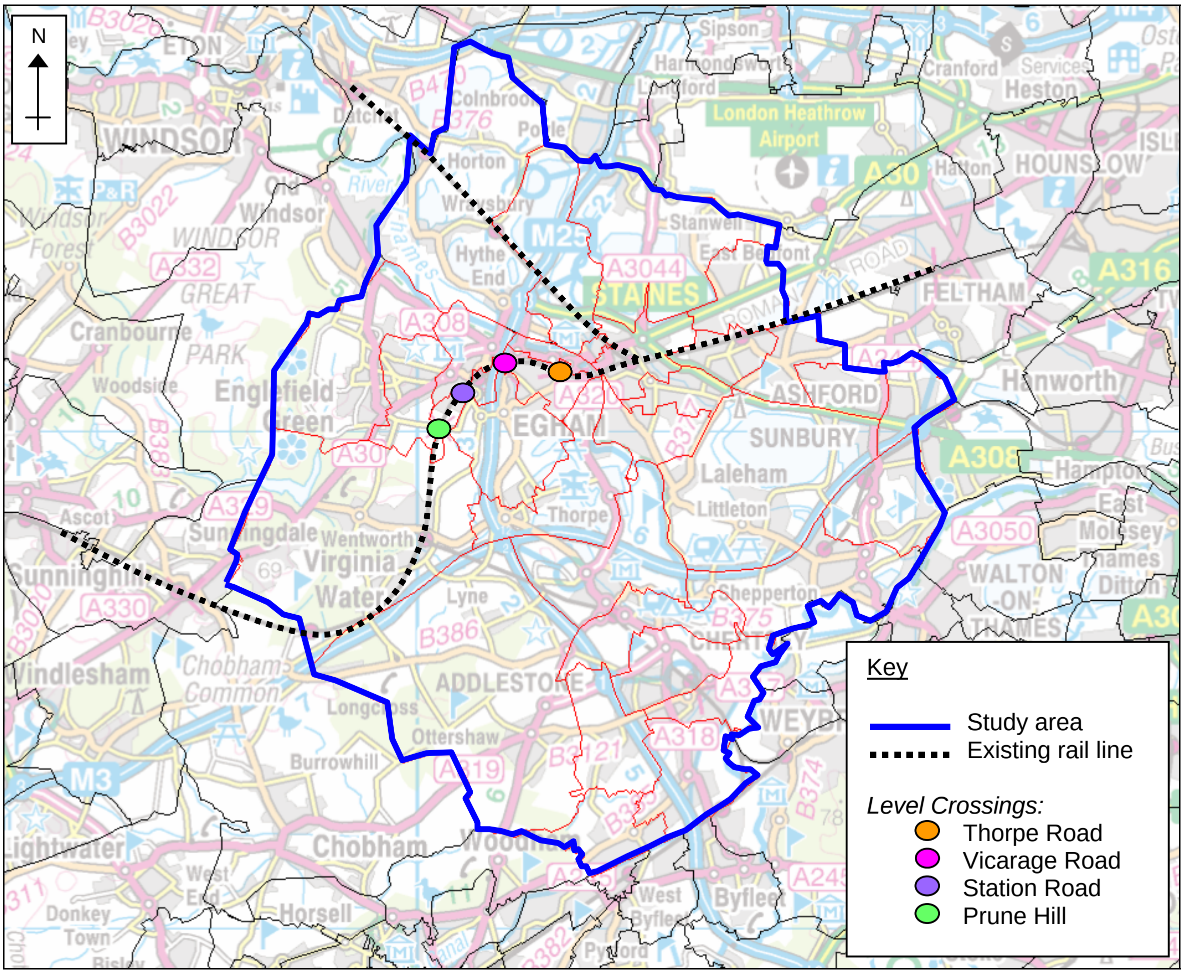


**Figure 1.1: Study area**

## 1.5 Scenarios

1.5.1 Six scenarios have been created as described below and listed in **Table 1.1**.

i. **Scenario 1 (do-nothing)**: this is the forecast situation without the Airtrack scheme. Hence the level crossing facilities do not include Airtrack trains, but they do reflect the future estimation of train schedules as shown in **Appendix A**.

ii. **Scenario 2 (do-minimum)**: this maintains the Vicarage Road level crossing facility to manage vehicle and train travel at the same level. The downtimes for level crossings, resulting from Airtrack's increased use of the rail line, have been reflected in this model scenario. The modelled timings are listed in **Appendix A**.

iii. **Scenario 3 (do-something)**: this replaces the Vicarage Road level crossing facility with an underpass so that road traffic travels at a different level to that of the trains, and is unhindered. Traffic calming along B388 Vicarage Road, between its junction with B3407 High Street and Egham Sports Centre, has accompanied the underpass to manage its design constraints. As with scenario 2, the downtimes for level crossings from Airtrack's usage of the rail line have been reflected.

iv. **Scenario 4 (do-something)**: this is the same as scenario 3 together with enhancements to Runnymede Roundabout.

v. **Scenario 5 (do-something sensitivity test)**: this is the same as scenario 3 but a 40% increase in green time has been applied to B3407 The Avenue approach to Runnymede Roundabout. Cycle times, however, remain the same as the base situation.

vi. **Scenario 6 (do-something sensitivity test)**: this is the same as scenario 3 but the traffic calming along B388 Vicarage Road, which accompanies the underpass, is removed. Thus a 30mph speed limit is maintained through the underpass.

| Mitigation | Base | Sc. 1 | Sc. 2 | Sc. 3 | Sc. 4 | Sc. 5 | Sc. 6 |
|---|---|---|---|---|---|---|---|
| Airtrack observed level crossing schedule | ✓ | × | × | × | × | × | × |
| "Pre-Airtrack" level crossing schedule | × | ✓ | × | × | × | × | × |
| "Post-Airtrack" level crossing schedule | × | × | ✓ | ✓ | ✓ | ✓ | ✓ |
| Vicarage Road Underpass | × | × | × | ✓ | ✓ | ✓ | ✓ |
| B388 Traffic Calming | × | × | × | ✓ | ✓ | ✓ | × |
| Runnymede Roundabout improvements | × | × | × | × | ✓ | × | × |
| Increased green time for B3407 The Avenue approach to Runnymede Roundabout | × | × | × | × | × | ✓ | × |

**Table 1.1: Scenario definition**

# 2 MODEL DEVELOPMENT

## 2.1 Modelling Program & Model Definition

2.1.1 The OmniTRANS modelling program, version 5.0.34 was used, together with SINTRAM version 4.0 (100426), for this study.

2.1.2 SINTRAM is Surrey County Council's strategic highway model, which encapsulates the road network of Surrey and surrounding local authorities; at a national level the model incorporates all strategic roads within Great Britain.

2.1.3 The model was enhanced within the study area to facilitate the analyses of the underpass. The required calibration of the model is described in the subsequent sections.

2.1.4 The model was developed for the base year 2005 and forecast years 2016 and 2031. It is a highway only model and assigns the vehicle classes: car, light goods vehicle (LGV) and heavy goods vehicle (HGV).

2.1.5 Two time periods were represented within the model:

- AM peak hour (08:00 – 09:00); and
- PM average peak hour (16:00 – 19:00).

## 2.2 Assignment Method

2.2.1 A fixed trip equilibrium assignment was performed using the Method of Successive Averages (MSA) with Burrell type perturbations. Using a spread factor of 2, the assignment was run for 70 iterations to ensure stability. The number of iterations was kept consistent for the base and each scenario.

## 2.3 Observed Traffic Data

2.3.1 Traffic data was obtained from *Surrey County Council's* database of manual classified turning counts and automatic traffic counts, and count and roadside interview (RSI) data collected by *Count On Us* on behalf of *BAA*. The latter data was provided to *Surrey County Council* by Geoffrey Hill. This observed data was used to enhance the base model within the study area, as described below.

## 2.4 Revised Zoning System

2.4.1 The original zoning system in the study area was too coarse to model the impact of the level crossing versus an underpass. Analyses of the RSI data, presented in **Appendix B**, showed that a large proportion of trips were local[3]. As a result, zones 386, 390 and 391 were split into two, following as closely as possible the railway line. This provided zone connections either side of the level crossings for the local area.

2.4.2 **Figure 2.1** shows the revised zone plan for the study area. Zones 386, 390 and 391 have been reduced, whilst zones 538, 539 and 540 have been added. All zone modifications have maintained the census output area boundaries.

[3] Approximately 45% of all recorded vehicle trips at Station Road, Vicarage Road and Thorpe Road level crossings, were less than 3 miles in distance (07:00 – 19:00). This was calculated based on the model's zoning system and centroid positioning.

2.4.3 Consequently, the original base matrices had to reflect the new zone plan. The origins and destinations of the original zones were apportioned to the new zone boundaries by their population which were derived from the 2001 census.

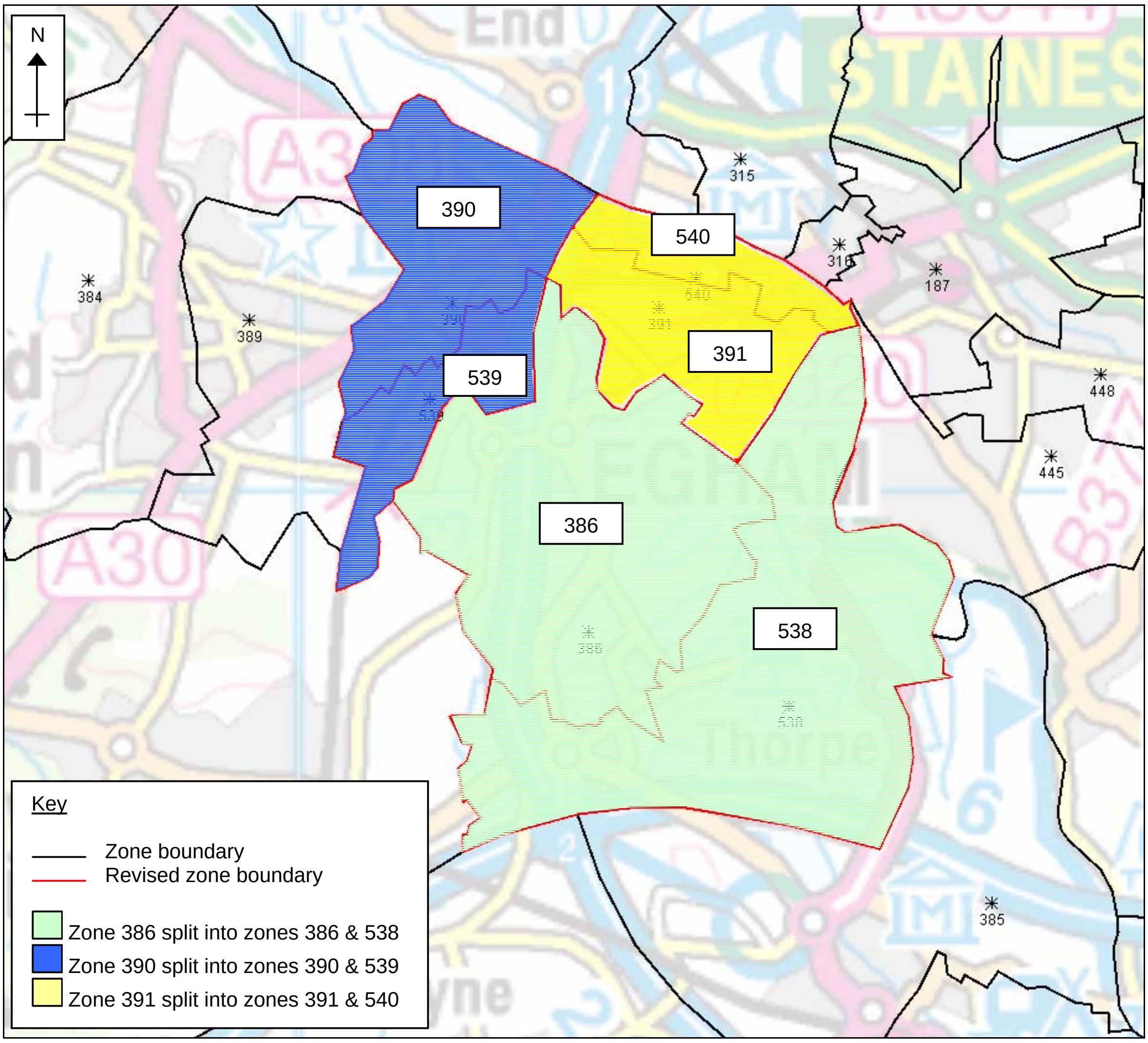


**Figure 2.1: Revised zone plan in the study area**

2.5 <u>Network Audit & Level Crossing Replication</u>

2.5.1 The model's highway network was audited for the entire study area. This involved ensuring that key junctions were included and defined correctly, and that link types reflect on-street conditions.

2.5.2 Moreover, the model did not include the four level crossings within the study area (as shown in **Figure 1.1**):

i) Thorpe Road;

ii) Vicarage Road;

iii) Station Road; and

iv) Prune Hill.

2.5.3 Consequently, the level crossings were simulated within the model using dummy signalised crossroads. Two stages were compiled: the first being for road traffic and the second for the trains. Thus the first stage represents the time when the crossing is open to road traffic, and the second stage refers to when the crossing is closed to road traffic. The observed signal timings were acquired from survey data collected by *Count on Us* on behalf of *BAA*, and are listed in **Appendix A**, together with an explanation of how they were acquired and employed within the model.

## 2.6 Calibration

2.6.1 The SINTRAM (v4.0) base matrices were developed and calibrated for the entire county of Surrey. It is not surprising then that the matrices had to be progressed further to provide adequate replication of observed conditions within the study area. This was achieved by two means described below.

2.6.2 Firstly the roadside interview (RSI) survey data provided by *BAA* was used to enhance the 2005 base matrices. RSI surveys collected origin and destination data by vehicle class and time of day at the following locations:

- B3376 Thorpe Road northbound at the level crossing;
- B388 Vicarage Road northbound at the level crossing; and
- Station Road northbound at the level crossing.

2.6.3 The existing base matrices were calibrated to observed flows at these locations using the program's matrix estimation routine. Screenline matrices were then compiled at these locations before omitting these identified trips from the calibrated base matrices. This enabled the trips identified from the screenline matrices to be replaced with those from the observed RSI data. In this way, the subsequent matrices inherited the observed RSI trip distribution.

2.6.4 Secondly, the model was populated with Surrey County Council's observed traffic flows, as listed in **Table 2.2**. The base year is 2005, and, where possible, data from this or adjacent years were inserted. Matrix estimation was then performed to provide a good reflection of observed traffic flow in the study area.

2.6.5 **Tables 2.1** and **2.2** present a comparison between observed and modelled flows in accordance with the *Department for Transport's* (DfT) guidance for the AM peak hour and average PM peak hour respectively.

2.6.6 A screenline has also been established which follows the railway line between Prune Hill and Thorpe Road level crossings.

2.6.7 **Figures 2.2** and **2.3** show the modelled flows plotted against the observed, which helps visualise the goodness of fit. An $R^2$ value greater than 0.95 is considered to indicate that the model reflects observed traffic flows well.

2.6.8 Further guidelines for model validation are set out in the *'Traffic Appraisal in Urban Areas*[4]*'*. Its validation acceptability guidelines are summarised in **Appendix C**, for reference.

2.6.9 The modelled 08:00 to 09:00 AM peak hour meets acceptability criteria when observed and modelled link flows are compared, as shown in **Table 2.1** and in **Figure 2.2**. The A320 Chertsey Road northbound is the only location which does not meet both criterions with a GEH value of 7.7. The B388 Thorpe Lea Road southbound and B3407 The Avenue meet the GEH criterion but just fall short of achieving the flow criteria.

[4] Highways Agency (1996), Design Manual for Roads and Bridges, Traffic Appraisals of Road Schemes, Volume 12a, Section 2, *'Part 1: Traffic Appraisal in Urban Areas'*, Chapter 4: Model Development.

2.6.10 The screenline results, however, show an overestimation of flow across the railway line in both directions of travel. This is also true for the modelled average peak hour, 16:00 – 19:00.

2.6.11 Similarly the acceptability guidelines are met for the comparison of observed with modelled flows of the average PM peak hour, as shown in **Table 2.2** and **Figure 2.3**. The criteria were not met, however, for the A30 Egham Bypass and Prune Hill in the westbound direction of travel. The GEH criterion is also not achieved for Prune Hill in the eastbound direction of travel.

2.6.12 In the achievement of these traffic flows, a few parameters had to be altered from their typical representation. These are listed below, and were only employed after other avenues had been exhausted.

- The link type for Prune Hill was set for a 20mph speed limited road. Although the actual limit is higher, observed speed data obtained from CJAMS (described below in **Section 2.7**) showed that during the AM peak hour (08:00 - 09:00) the average speed was 22mph in 2005, and during the PM peak (16:00 - 19:00) it was between 19 to 24mph. Prune Hill is essentially a rural lane that is winding, narrow and travels along steep gradients in places. Only with this link type could the base model come near to reflecting the low flow of vehicles which use this route. Moreover the link type will remain consistent for each scenario.

- The modelled delay value for the A30 Egham Bypass approach arm to Runnymede Roundabout was restricted to a maximum calibrated impedance value of 400 seconds. Without this, vehicles were not using the A30 here to access Runnymede Roundabout and it resulted in unrealistic routeing.

| ID | Location | Direction | Observed Flow | Modelled Flow | GEH | Absolute Difference | % Difference | GEH Criterion | Flow Criterion |
|---|---|---|---|---|---|---|---|---|---|
| 1 | B388 Vicarage Road | Westbound | 502 | 596 | 4.0 | 94 | 19% | ✓ | ✓ |
| 2 | B388 Vicarage Road | Eastbound | 410 | 416 | 0.3 | 6 | 1% | ✓ | ✓ |
| 3 | A30 The Glanty | Southbound | 2192 | 1981 | 4.6 | -211 | -10% | ✓ | ✓ |
| 4 | A308 The Causeway | Westbound | 975 | 943 | 1.0 | -32 | -3% | ✓ | ✓ |
| 5 | A308 The Causeway | Eastbound | 996 | 992 | 0.1 | -4 | 0% | ✓ | ✓ |
| 6 | B3376 Thorpe Road | Northbound | 455 | 449 | 0.3 | -6 | -1% | ✓ | ✓ |
| 7 | B3376 Thorpe Road | Southbound | 319 | 375 | 3.0 | 56 | 18% | ✓ | ✓ |
| 8 | Station Road | Northbound | 278 | 331 | 3.0 | 53 | 19% | ✓ | ✓ |
| 9 | Station Road | Southbound | 265 | 356 | 5.2 | 91 | 34% | ✓ | ✓ |
| 10 | A30/M25 On-slip | Northbound | 2430 | 2201 | 4.8 | -229 | -9% | ✓ | ✓ |
| 11 | B388 Thorpe Lea Road | Northbound | 504 | 486 | 0.8 | -18 | -4% | ✓ | ✓ |
| 12 | B388 Thorpe Lea Road | Southbound | 759 | 641 | 4.5 | -118 | -16% | ✓ | × |
| 13 | A320 Chertsey Lane | Northbound | 894 | 677 | 7.7 | -217 | -24% | × | × |
| 14 | A320 Chertsey Lane | Southbound | 643 | 645 | 0.1 | 2 | 0% | ✓ | ✓ |
| 15 | Pooley Green Road | Westbound | 113 | 155 | 3.6 | 42 | 37% | ✓ | ✓ |
| 16 | Pooley Green Road | Eastbound | 165 | 219 | 3.9 | 54 | 33% | ✓ | ✓ |
| 17 | A30 Egham Bypass | Westbound | 952 | 919 | 1.1 | -33 | -3% | ✓ | ✓ |
| 18 | A30 Egham Bypass | Eastbound | 877 | 773 | 3.6 | -104 | -12% | ✓ | ✓ |
| 19 | A308 Windsor Road | Westbound | 689 | 771 | 3.0 | 82 | 12% | ✓ | ✓ |
| 20 | A308 Windsor Road | Eastbound | 1139 | 1153 | 0.4 | 14 | 1% | ✓ | ✓ |
| 21 | B3407 The Avenue | Northbound | 861 | 897 | 1.2 | 36 | 4% | ✓ | ✓ |
| 22 | B3407 The Avenue | Southbound | 734 | 864 | 4.6 | 130 | 18% | ✓ | × |
| 23 | Prune Hill | Eastbound | 222 | 244 | 1.4 | 22 | 10% | ✓ | ✓ |
| 24 | Prune Hill | Westbound | 170 | 214 | 3.2 | 44 | 26% | ✓ | ✓ |
| | | *Total* | *17544* | *17298* | *1.86* | *-246* | *-1.4%* | *23* | *21* |
| | | | | *Average GEH* | *3.5* | | *% Met Criteria* | *96%* | *88%* |
| | Screenlines (railway line from Prune Hill to Thorpe Road level crossings) | Northbound | 1405 | 1590 | 4.8 | 185 | 13% | × | × |
| | | Southbound | 1216 | 1391 | 4.8 | 175 | 14% | × | × |

**Table 2.1: Comparison of observed with modelled link flows and screenlines for the AM peak hour (08:00 – 09:00)**

* The values that are underlined are flows captured at the four level crossings

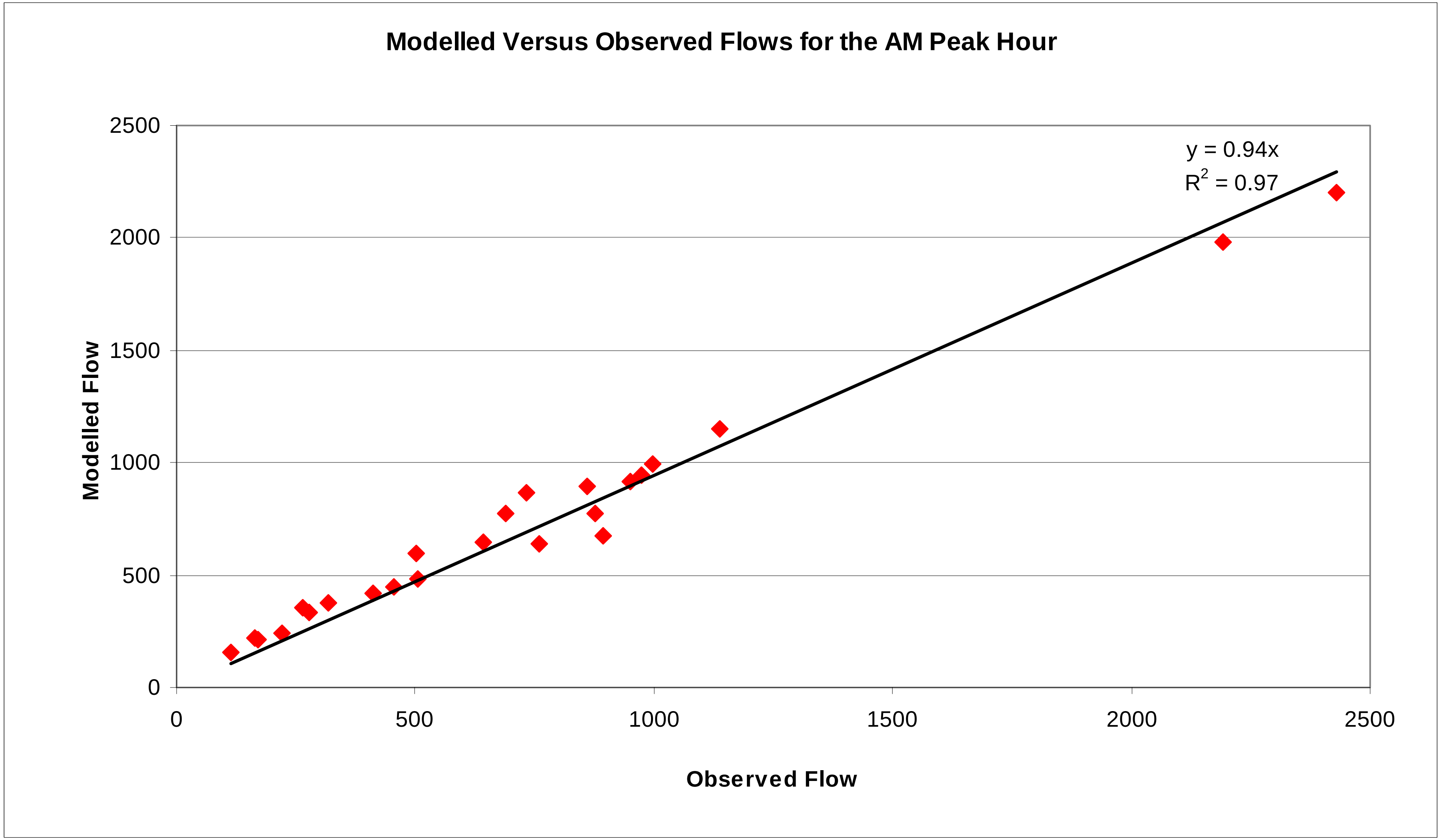


**Figure 2.2: Comparison plot of modelled against observed link flows with best-fit regression line and correlation coefficient (*R*) for the AM peak hour**

| ID | Location | Direction | Observed Flow | Modelled Flow | GEH | Absolute Difference | % Difference | GEH Criterion | Flow Criterion |
|---|---|---|---|---|---|---|---|---|---|
| 1 | B388 Vicarage Road | Westbound | 378 | 374 | 0.2 | -4 | -1% | ✓ | ✓ |
| 2 | B388 Vicarage Road | Eastbound | 536 | 480 | 2.5 | -56 | -10% | ✓ | ✓ |
| 3 | A30 The Glanty | Southbound | 1865 | 1700 | 3.9 | -165 | -9% | ✓ | ✓ |
| 4 | A308 The Causeway | Westbound | 1216 | 1258 | 1.2 | 42 | 3% | ✓ | ✓ |
| 5 | A308 The Causeway | Eastbound | 668 | 585 | 3.3 | -83 | -12% | ✓ | ✓ |
| 6 | B3376 Thorpe Road | Northbound | 339 | 378 | 2.1 | 39 | 12% | ✓ | ✓ |
| 7 | B3376 Thorpe Road | Southbound | 353 | 440 | 4.4 | 87 | 25% | ✓ | ✓ |
| 8 | Station Road | Northbound | 232 | 291 | 3.7 | 59 | 25% | ✓ | ✓ |
| 9 | Station Road | Southbound | 281 | 364 | 4.6 | 83 | 30% | ✓ | ✓ |
| 10 | A30/M25 On-slip | Northbound | 2118 | 2188 | 1.5 | 70 | 3% | ✓ | ✓ |
| 11 | B388 Thorpe Lea Road | Northbound | 523 | 479 | 2.0 | -44 | -8% | ✓ | ✓ |
| 12 | B388 Thorpe Lea Road | Southbound | 376 | 471 | 4.6 | 95 | 25% | ✓ | ✓ |
| 13 | A320 Chertsey Lane | Northbound | 643 | 713 | 2.7 | 70 | 11% | ✓ | ✓ |
| 14 | A320 Chertsey Lane | Southbound | 816 | 761 | 2.0 | -55 | -7% | ✓ | ✓ |
| 15 | Pooley Green Road | Westbound | 121 | 76 | 4.5 | -45 | -37% | ✓ | ✓ |
| 16 | Pooley Green Road | Eastbound | 178 | 213 | 2.5 | 35 | 20% | ✓ | ✓ |
| 17 | A30 Egham Bypass | Westbound | 1179 | 911 | 8.3 | -268 | -23% | ✗ | ✗ |
| 18 | A30 Egham Bypass | Eastbound | 859 | 796 | 2.2 | -63 | -7% | ✓ | ✓ |
| 19 | A308 Windsor Road | Westbound | 834 | 876 | 1.4 | 42 | 5% | ✓ | ✓ |
| 20 | A308 Windsor Road | Eastbound | 907 | 932 | 0.8 | 25 | 3% | ✓ | ✓ |
| 21 | B3407 The Avenue | Northbound | 562 | 562 | 0.0 | 0 | 0% | ✓ | ✓ |
| 22 | B3407 The Avenue | Southbound | 612 | 688 | 3.0 | 76 | 12% | ✓ | ✓ |
| 23 | Prune Hill | Eastbound | 100 | 181 | 6.8 | 81 | 81% | ✗ | ✓ |
| 24 | Prune Hill | Westbound | 153 | 290 | 9.2 | 137 | 90% | ✗ | ✗ |
| | | *Total* | *15849* | *16007* | *1.3* | *158* | *1.0%* | *21* | *22* |
| | | | | *Average GEH* | *3.2* | | *% Met Criteria* | *88%* | *92%* |
| Screenlines (railway line from Prune Hill to Thorpe Road level crossings) | | Northbound | 1102 | 1333 | 6.6 | 231 | 21% | ✗ | ✗ |
| | | Southbound | 1270 | 1465 | 5.3 | 195 | 15% | ✗ | ✗ |

**Table 2.2: Comparison of observed with modelled link flows and screenlines for the average PM peak hour (16:00 – 19:00)**

* The values that are underlined are flows captured at the four level crossings

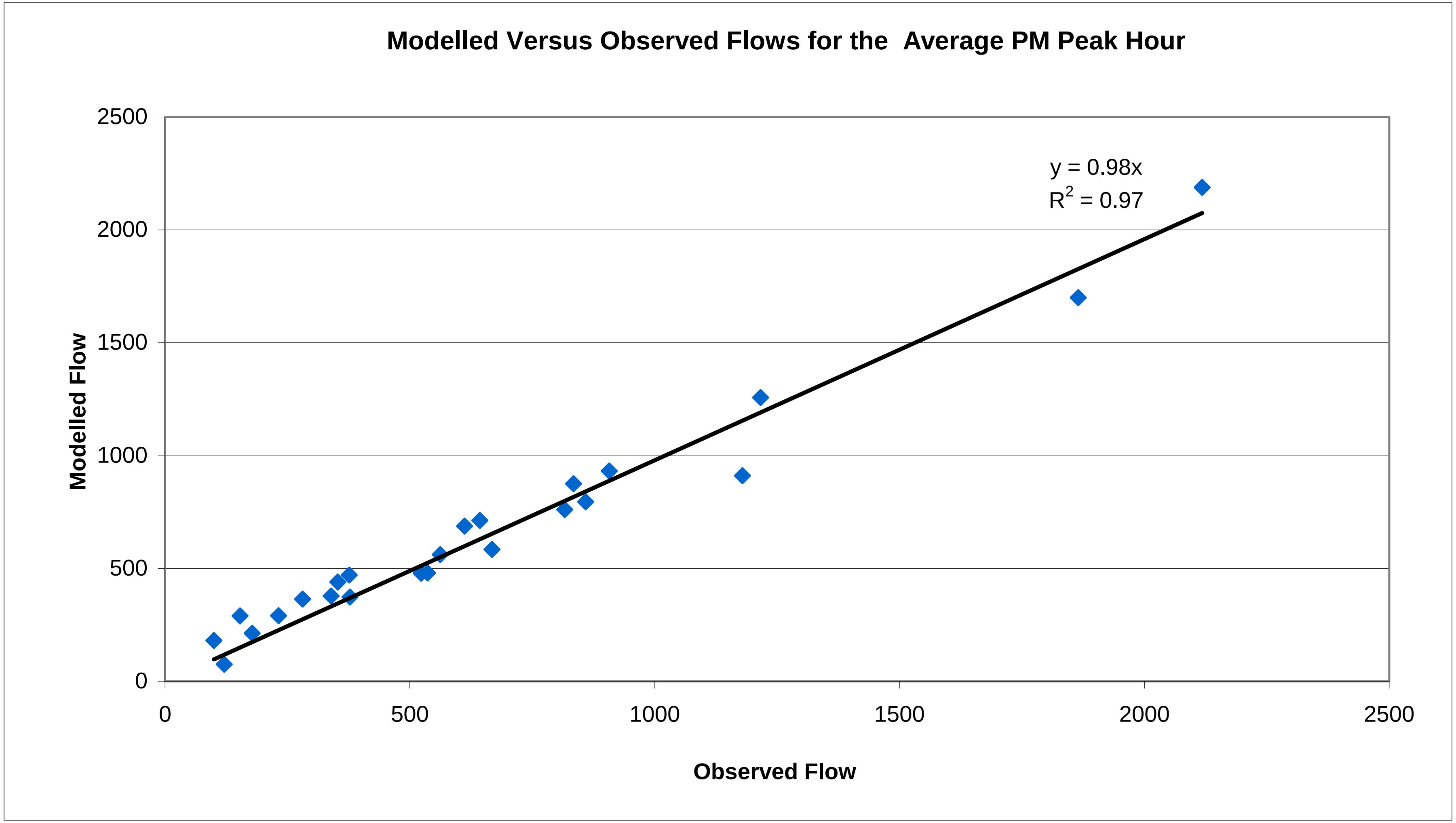


**Figure 2.3: Comparison plot of modelled against observed link flows with best-fit regression line and correlation coefficient (*R*) for the average PM peak hour**

## 2.7 Validation

2.7.1 Independent assessment of the validity of the model was conducted. This involved comparing observed journey times, from the Congestion and Journey-time Acquisition and Monitoring System (CJAMS), with those from the model. CJAMS is developed by Motts MacDonald and holds observed journey time information from global positioning systems. Data has been obtained from CJAMS for the entire year 2005, for the AM peak hour (08:00 – 09:00) and the average of the PM peak period (16:00 – 19:00).

2.7.2 **Figure 2.4** displays the selected routes for comparison which all bisect a level crossing. A route which crosses the Prune Hill level crossing has not been presented, because observed speeds from CJAMS were used to calibrate the link types in this location. The validation exercise must remain an independent assessment.

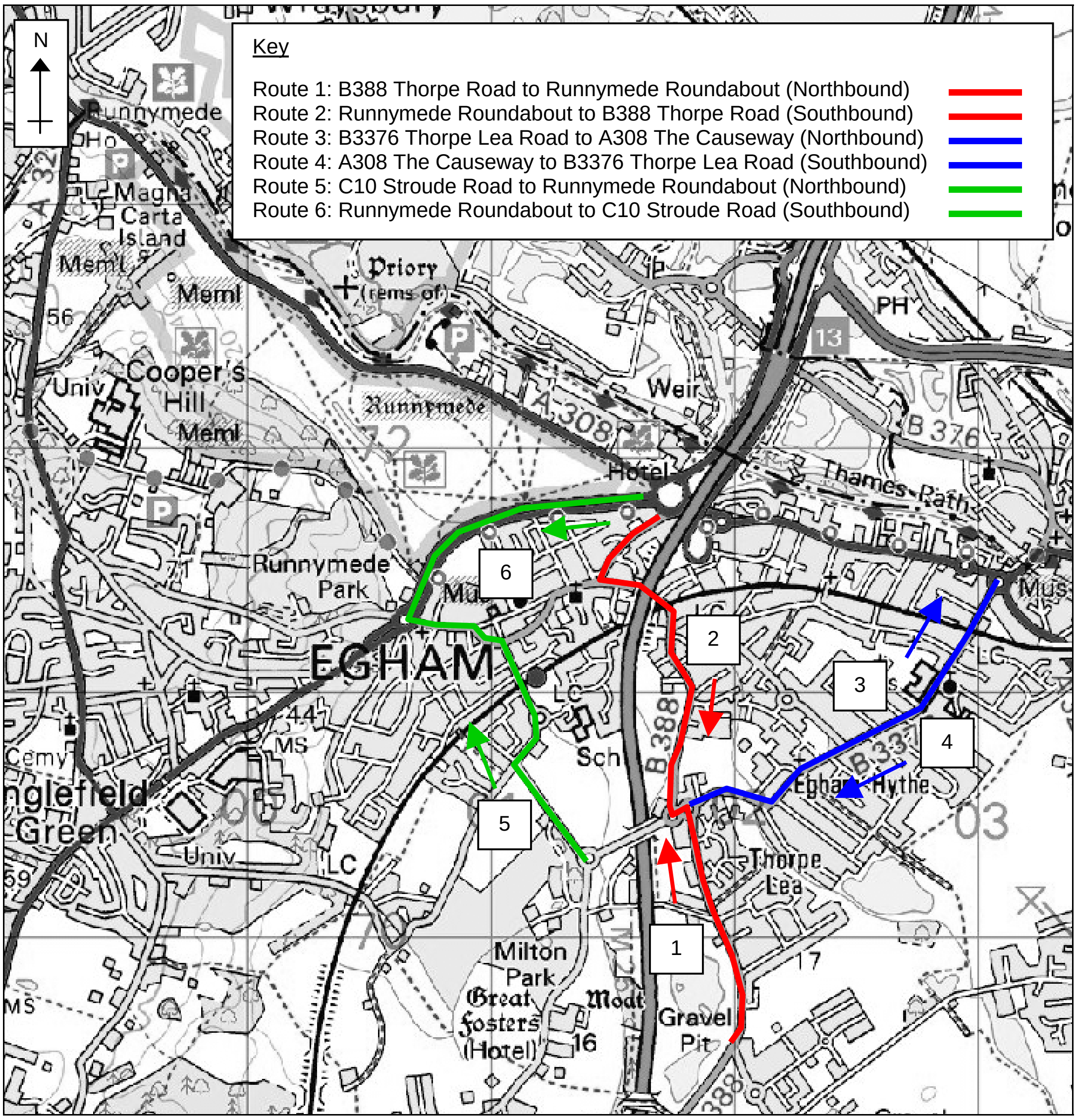

**Figure 2.4: Journey time routes**

2.7.3 **Tables 2.3** and **2.4** present the comparison between observed and modelled journey times for the AM peak hour 08:00 – 09:00, and average PM peak hour 16:00 – 19:00, respectively. It shows that the modelled journey times are very similar to those that are observed. The only route that does not meet the criteria is route 5 from B388 Vicarage Road to Runnymede Roundabout northbound. With a modelled journey time of 349 seconds, it is 20 seconds short of the 95% lower confidence interval.

2.7.4 **Figures 2.5** and **2.6** show the modelled journey times graphically displayed against the confidence intervals for the observed values.

2.7.5 Overall, the model is considered to be a good representation of the observed highway network, and to be an adequate tool for the assessment of an underpass at Vicarage Road level crossing as well as associated mitigation measures.

| Route | Observed | | | | Modelled Journey Time | Absolute Difference | % Difference | < 1 Minute Difference | Within 15% Difference | Within CI | Met Criteria |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Journey Time | Standard Deviation | 95% Upper CI | 95% Lower CI | | | | | | | |
| 1 | 389 | 195 | 347 | 431 | 415 | 25 | 7% | ✓ | ✓ | ✓ | ✓ |
| 2 | 298 | 94 | 276 | 321 | 340 | 42 | 14% | ✓ | ✓ | ✗ | ✓ |
| 3 | 341 | 177 | 236 | 447 | 298 | -43 | -13% | ✓ | ✓ | ✓ | ✓ |
| 4 | 244 | 128 | 195 | 293 | 224 | -20 | -8% | ✓ | ✓ | ✓ | ✓ |
| 5 | 407 | 243 | 358 | 455 | 358 | -48 | -12% | ✓ | ✓ | ✓ | ✓ |
| 6 | 327 | 108 | 297 | 356 | 358 | 31 | 9% | ✓ | ✓ | ✗ | ✓ |
| | | | | | | | **Total** | **6** | **6** | **4** | **6** |
| | | | | | | | | | | | **100%** |

**Table 2.3: Comparison between observed and modelled journey times along selected routes during the AM peak hour (08:00 – 09:00)**

| Route | Observed | | | | Modelled Journey Time | Absolute Difference | % Difference | < 1 Minute Difference | Within 15% Difference | Within CI | Met Criteria |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Journey Time | Standard Deviation | 95% Upper CI | 95% Lower CI | | | | | | | |
| 1 | 356 | 175 | 322 | 390 | 376 | 19 | 5% | ✓ | ✓ | ✓ | ✓ |
| 2 | 299 | 101 | 284 | 314 | 311 | 13 | 4% | ✓ | ✓ | ✓ | ✓ |
| 3 | 218 | 71 | 194 | 242 | 222 | 4 | 2% | ✓ | ✓ | ✓ | ✓ |
| 4 | 210 | 128 | 175 | 246 | 214 | 3 | 2% | ✓ | ✓ | ✓ | ✓ |
| 5 | 417 | 227 | 369 | 466 | 349 | -69 | -16% | ✗ | ✗ | ✗ | ✗ |
| 6 | 321 | 131 | 289 | 353 | 352 | 31 | 10% | ✓ | ✓ | ✓ | ✓ |
| | | | | | | | **Total** | **5** | **5** | **5** | **5** |
| | | | | | | | | | | | **83%** |

**Table 2.4: Comparison between observed and modelled journey times along selected routes during the average PM peak hour (16:00 – 19:00)**

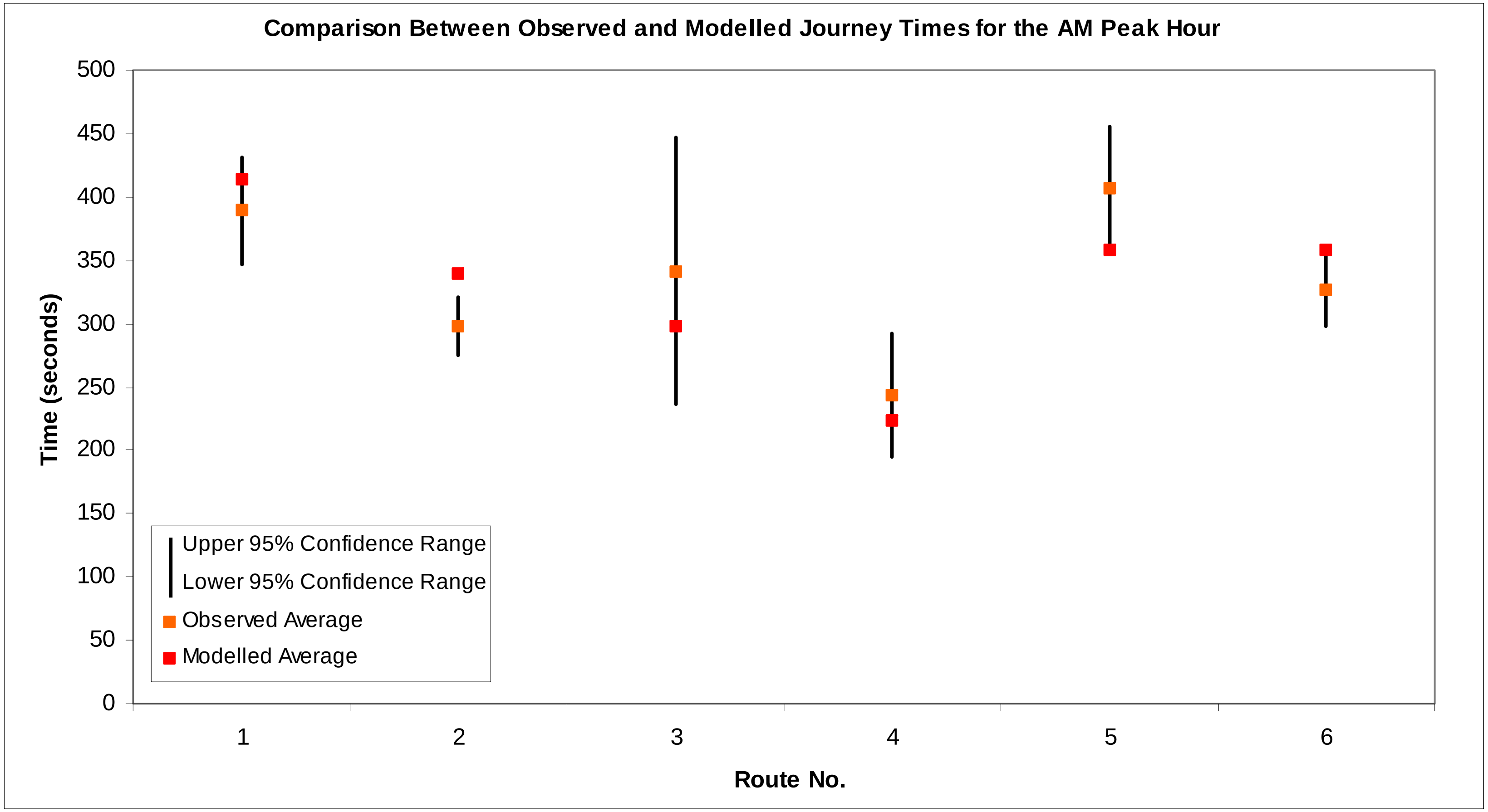


**Figure 2.5: Comparison between observed and modelled journey times along selected routes during the AM peak hour (08:00 – 09:00)**

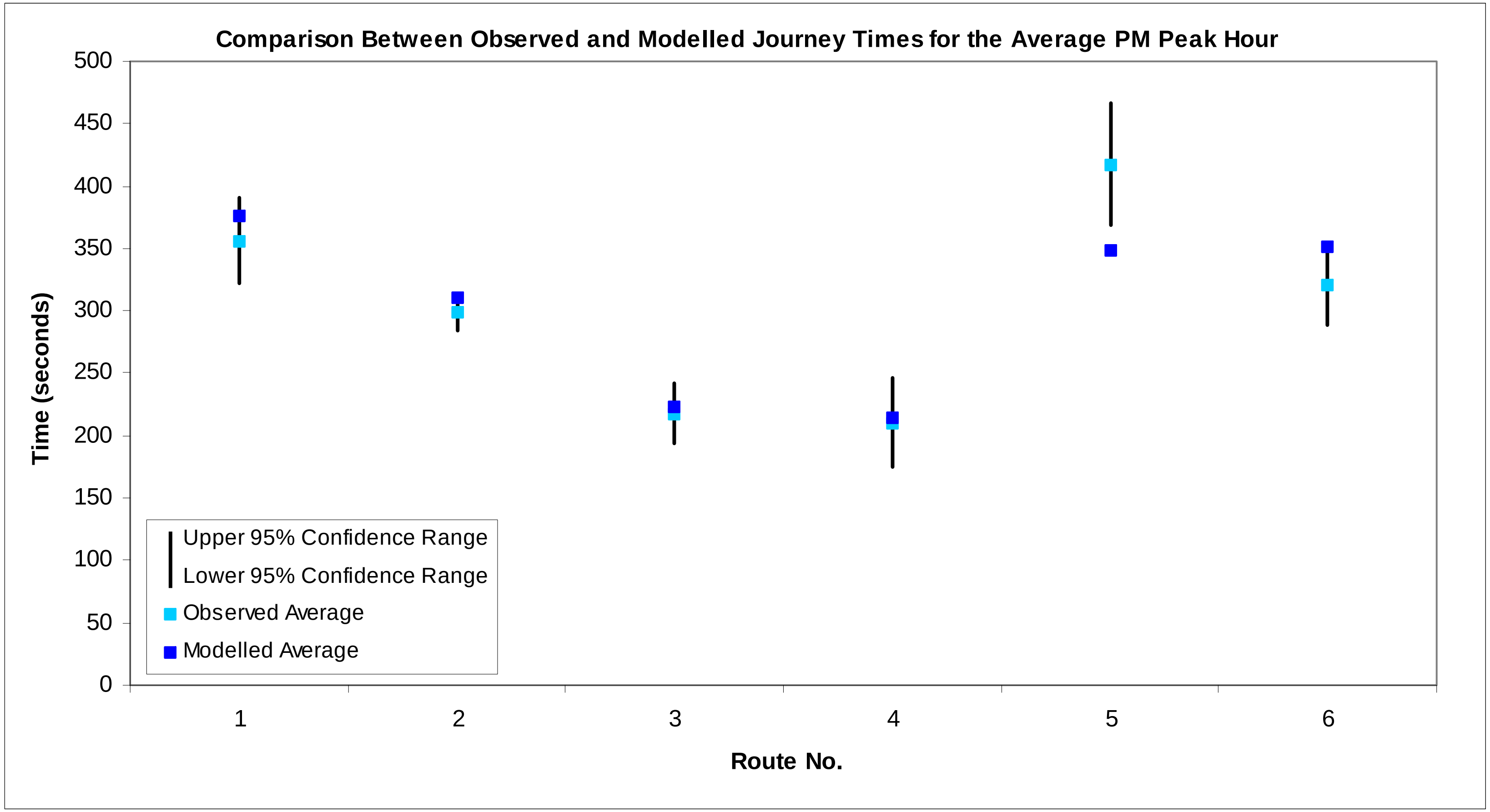


**Figure 2.6: Comparison between observed and modelled journey times along selected routes during the average PM peak hour (16:00 – 19:00)**

# 3 FORECASTING

## 3.1 Forecast Years

3.1.1 Two forecast years have been created to represent the opening year and design year, respectively:

- 2016; and
- 2031.

## 3.2 Future Year Network Changes

3.2.1 The following changes have been made to all future year model networks to reflect committed major highway schemes, and minor schemes within the immediate study area, that will be in position in 2016 and 2031.

- M25 junction 16 to 13 carriageway widening from dual 3 lanes to dual 4 lanes in each direction.
- M25 junction 27 to 30 carriageway widening from dual 3 lanes to dual 4 lanes in each direction.
- A3 Hindhead Improvement which includes a new dual 2 lane road of 6.5km with tunnels, and a new "Hazel Grove" grade-separated junction south of the existing Hindhead crossroads.
- Traffic calming along the entire stretch of Pooley Green Road between B3376 Thorpe Lea Road and B388 Vicarage Road.

3.2.2 All other network changes reflect the individual scenarios being modelled, as defined in **Section 1.5**. The modelled level crossing downtimes are provided in **Appendix A**, and have been determined from level crossing information provided by Geoffrey Hill on behalf on *BAA*[5].

## 3.3 Waitrose and Travelodge Development Site

3.3.1 A Waitrose store with a gross floor area of 3,372$m^2$ and a 60-room Travelodge hotel is due to be opening within the next 12 months. It will be situated in the Church Road shopping precinct on Ardale Way car park in Egham town centre.

3.3.2 Given its close proximity to the Vicarage Road level crossing, its agreed predicted trip generation from the development's approved Transport Assessment, as shown in **Table 3.1**, has been included in the forecasting methodology.

[5] Observed level crossing operations were provided in an email to William Bryans dated 06/11/09 and to Gemma Thomas on 06/04/10, both from Geoffrey Hill. Revised forecasted level crossing operations were provided in an email to Abigail Fielder dated 04/03/10 from Geoffrey Hill.

| Time Period | Arrivals | Departures |
|---|---|---|
| *Waitrose* | | |
| 08:00 – 09:00 | 122 | 49 |
| 16:00 – 17:00 | 167 | 182 |
| 17:00 – 18:00 | 158 | 182 |
| 18:00 – 19:00 | 102 | 124 |
| Average PM peak hour (16:00 – 19:00) | 142 | 163 |
| *Travelodge* | | |
| 08:00 – 09:00 | 6 | 13 |
| 16:00 – 17:00 | 6 | 6 |
| 17:00 – 18:00 | 9 | 6 |
| 18:00 – 19:00 | 9 | 5 |
| Average PM peak hour (16:00 – 19:00) | 8 | 6 |
| *Total Trip Generation for Modelled Time Periods* | | |
| AM peak hour (08:00 – 09:00) | 128 | 62 |
| Average PM peak hour (16:00 – 19:00) | 150 | 169 |

**Table 3.1: Agreed trip generation for 2010 (opening year when the planning application was granted)**

## 3.4 Forecasting Methodology

3.4.1 To generate 2016 and 2031 demand matrices, growth factors were derived from TEMPRO version 5.4. The TEMPRO software is supplied by the *DfT* and provides summaries of National Trip End Model (NTEM) forecast data for transport planning purposes. The forecasts include population, employment, trip ends and households by car ownership.

3.4.2 In this instance, trip end growth was simply calculated by taking the ratio of the forecast year divided by the base year. The all-purpose origin/destination forecasts for car drivers have been used to forecast the car vehicle trip ends. Whereas, the non-home based employers business forecast have been employed to generate forecast trip ends for LGV and HGV users. The resultant growth factors have be used to create forecast matrices using the Furness method for each modelled user group.

3.4.3 Due to the limited changes in travel cost from the proposed mitigation measures, the forecast demand was fixed.

# 4 SCENARIO TESTING & ANALYSES

## 4.1 Introduction

4.1.1 Basic analyses of the different scenarios and forecast years have been undertaken and are presented in this section. The following measures were acquired from the model to assist with this.

- Link flows;
- Link average travel speeds;
- Link travel times;
- Highway capacity;
- Vehicle kilometres travelled; and
- Junction delay.

4.1.2 **Sections 4.2** to **4.7** present direct outputs from the model. Commentary regarding the output and the impact of each scenario on the highway is provided in the subsequent **Sections 4.8** to **4.13**.

4.1.3 Please note that not all scenarios have required to be evaluated to the same level of detail.

4.1.4 Moreover, scenario 4 was not assessed within the model due to continuing queries regarding its design and the detail required for its representation.

## 4.2 Overall Impact at the Level Crossings

4.2.1 **Table 4.1** presents network performance measures at each of the level crossings for all modelled scenarios and forecast years. These results present the best evaluation of all the scenarios.

4.2.2 The average speed represents the travel speed along the section of road calculated from its flow and allocated speed/flow curve. It therefore does not consider delay from the level crossings. The speed/flow curve reflects road width, road type, lanes, speed limit and its situation, for example if it is situated in an urban or rural environment.

4.2.3 The junction delay is the average delay per vehicle at the level crossing.

| Scenario | AM Peak Hour (08:00 – 09:00) | | | Av. PM Peak Hour (16:00 – 19:00) | | |
|---|---|---|---|---|---|---|
| | Flow (vph) | Average Speed (kph) | Junction Delay (seconds) | Flow (vph) | Average Speed (kph) | Junction Delay (seconds) |
| **Thorpe Road Northbound** | | | | | | |
| 2005 Base | 437 | 42.0 | 43.5 | 439 | 41.8 | 32.4 |
| 2016 Scenario1 (DN) | 464 | 41.5 | 39.9 | 399 | 42.5 | 32.8 |
| 2016 Scenario 2 (DM) | 413 | 42.3 | 64.5 | 324 | 43.7 | 58.4 |
| 2016 Scenario 3 (DS) | 427 | 42.1 | 65.1 | 347 | 43.4 | 58.7 |
| 2016 Scenario 4 (DS) | - | - | - | - | - | - |
| 2016 Scenario 5 (DS) | 421 | 42.2 | 64.8 | 321 | 43.8 | 59.2 |
| 2016 Scenario 6 (DS) | 451 | 41.7 | 66.3 | 356 | 43.2 | 58.6 |
| 2031 Scenario 1 (DN) | 560 | 39.9 | 42.6 | 520 | 40.5 | 35.3 |
| 2031 Scenario 2 (DM) | 511 | 40.8 | 69.1 | 459 | 41.5 | 62.0 |
| 2031 Scenario 3 (DS) | 513 | 40.7 | 69.4 | 463 | 41.4 | 62.1 |
| 2031 Scenario 4 (DS) | - | - | - | - | - | - |
| 2031 Scenario 5 (DS) | 505 | 40.8 | 69.3 | 433 | 41.9 | 62.3 |
| 2031 Scenario 6 (DS) | 431 | 42.0 | 65.3 | 475 | 41.3 | 61.8 |
| **Thorpe Road Southbound** | | | | | | |
| 2005 Base | 343 | 43.4 | 43.5 | 434 | 42.0 | 32.4 |
| 2016 Scenario1 (DN) | 382 | 42.7 | 39.9 | 534 | 40.4 | 32.8 |
| 2016 Scenario 2 (DM) | 328 | 43.7 | 64.5 | 480 | 41.3 | 58.4 |
| 2016 Scenario 3 (DS) | 343 | 43.4 | 65.1 | 481 | 41.2 | 58.7 |
| 2016 Scenario 4 (DS) | - | - | - | - | - | - |
| 2016 Scenario 5 (DS) | 335 | 43.6 | 64.8 | 507 | 40.8 | 59.2 |
| 2016 Scenario 6 (DS) | 378 | 42.8 | 66.3 | 475 | 41.3 | 58.6 |
| 2031 Scenario 1 (DN) | 488 | 41.0 | 42.6 | 631 | 38.8 | 35.3 |
| 2031 Scenario 2 (DM) | 437 | 41.8 | 69.1 | 545 | 40.2 | 62.0 |
| 2031 Scenario 3 (DS) | 448 | 41.7 | 69.4 | 547 | 40.2 | 62.1 |
| 2031 Scenario 4 (DS) | - | - | - | - | - | - |
| 2031 Scenario 5 (DS) | 453 | 41.6 | 69.3 | 569 | 39.8 | 62.3 |
| 2031 Scenario 6 (DS) | 349 | 43.3 | 65.3 | 527 | 40.5 | 61.8 |
| **Vicarage Road Northbound** | | | | | | |
| 2005 Base | 628 | 38.6 | 51.6 | 422 | 42.1 | 42.0 |
| 2016 Scenario1 (DN) | 553 | 39.9 | 76.1 | 361 | 43.1 | 79.5 |
| 2016 Scenario 2 (DM) | 598 | 39.1 | 58.0 | 409 | 42.3 | 62.7 |
| 2016 Scenario 3 (DS) | 548 | 19.8 | 0.0 | 433 | 21.7 | 0.0 |
| 2016 Scenario 4 (DS) | - | - | - | - | - | - |
| 2016 Scenario 5 (DS) | 669 | 17.7 | 0.0 | 519 | 20.4 | 0.0 |
| 2016 Scenario 6 (DS) | 670 | 38.0 | 0.0 | 547 | 40.1 | 0.0 |
| 2031 Scenario 1 (DN) | 631 | 38.6 | 81.1 | 475 | 41.3 | 87.5 |
| 2031 Scenario 2 (DM) | 692 | 37.6 | 62.9 | 518 | 40.6 | 70.6 |
| 2031 Scenario 3 (DS) | 655 | 18.0 | 0.0 | 521 | 20.4 | 0.0 |
| 2031 Scenario 4 (DS) | - | - | - | - | - | - |
| 2031 Scenario 5 (DS) | 640 | 18.1 | 0.0 | 640 | 18.3 | 0.0 |

| Scenario | AM Peak Hour (08:00 – 09:00) | | | Av. PM Peak Hour (16:00 – 19:00) | | |
|---|---|---|---|---|---|---|
| | Flow (vph) | Average Speed (kph) | Junction Delay (seconds) | Flow (vph) | Average Speed (kph) | Junction Delay (seconds) |
| 2031 Scenario 6 (DS) | 759 | 36.4 | 0.0 | 660 | 38.3 | 0.0 |
| **Vicarage Road Southbound** | | | | | | |
| 2005 Base | 590 | 39.3 | 51.6 | 596 | 39.3 | 42.0 |
| 2016 Scenario1 (DN) | 505 | 40.7 | 76.1 | 656 | 38.4 | 79.5 |
| 2016 Scenario 2 (DM) | 576 | 39.5 | 58.0 | 679 | 38.0 | 62.7 |
| 2016 Scenario 3 (DS) | 504 | 20.5 | 0.0 | 677 | 17.8 | 0.0 |
| 2016 Scenario 4 (DS) | - | - | - | - | - | - |
| 2016 Scenario 5 (DS) | 508 | 20.4 | 0.0 | 657 | 18.1 | 0.0 |
| 2016 Scenario 6 (DS) | 698 | 37.5 | 0.0 | 874 | 34.8 | 0.0 |
| 2031 Scenario 1 (DN) | 585 | 39.3 | 81.1 | 783 | 36.2 | 87.5 |
| 2031 Scenario 2 (DM) | 661 | 38.1 | 62.9 | 816 | 35.6 | 70.6 |
| 2031 Scenario 3 (DS) | 613 | 18.5 | 0.0 | 800 | 15.0 | 0.0 |
| 2031 Scenario 4 (DS) | - | - | - | - | - | - |
| 2031 Scenario 5 (DS) | 530 | 20.1 | 0.0 | 767 | 15.3 | 0.0 |
| 2031 Scenario 6 (DS) | 798 | 35.7 | 0.0 | 989 | 32.8 | 0.0 |
| **Station Road Northbound** | | | | | | |
| 2005 Base | 322 | 43.8 | 38.2 | 233 | 45.2 | 26.8 |
| 2016 Scenario1 (DN) | 349 | 43.4 | 29.5 | 244 | 45.1 | 28.9 |
| 2016 Scenario 2 (DM) | 327 | 43.7 | 54.1 | 203 | 45.8 | 68.7 |
| 2016 Scenario 3 (DS) | 335 | 43.6 | 54.3 | 195 | 45.9 | 69.0 |
| 2016 Scenario 4 (DS) | - | - | - | - | - | - |
| 2016 Scenario 5 (DS) | 332 | 43.7 | 54.8 | 214 | 45.6 | 68.0 |
| 2016 Scenario 6 (DS) | 314 | 43.9 | 53.0 | 160 | 46.5 | 66.5 |
| 2031 Scenario 1 (DN) | 349 | 43.4 | 30.2 | 257 | 44.9 | 28.6 |
| 2031 Scenario 2 (DM) | 334 | 43.7 | 54.7 | 234 | 45.3 | 68.7 |
| 2031 Scenario 3 (DS) | 332 | 43.6 | 55.1 | 233 | 45.3 | 70.1 |
| 2031 Scenario 4 (DS) | - | - | - | - | - | - |
| 2031 Scenario 5 (DS) | 350 | 43.4 | 56.5 | 228 | 45.4 | 69.9 |
| 2031 Scenario 6 (DS) | 315 | 43.9 | 53.8 | 182 | 46.1 | 67.3 |
| **Station Road Southbound** | | | | | | |
| 2005 Base | 335 | 43.5 | 38.2 | 348 | 43.5 | 26.8 |
| 2016 Scenario1 (DN) | 456 | 41.5 | 29.5 | 499 | 41.0 | 28.9 |
| 2016 Scenario 2 (DM) | 421 | 42.1 | 54.1 | 428 | 42.1 | 68.7 |
| 2016 Scenario 3 (DS) | 427 | 42.0 | 54.3 | 436 | 42.0 | 69.0 |
| 2016 Scenario 4 (DS) | - | - | - | - | - | - |
| 2016 Scenario 5 (DS) | 451 | 41.6 | 54.8 | 405 | 42.5 | 68.0 |
| 2016 Scenario 6 (DS) | 376 | 42.8 | 53.0 | 365 | 43.2 | 66.5 |
| 2031 Scenario 1 (DN) | 505 | 40.7 | 30.2 | 476 | 41.3 | 28.6 |
| 2031 Scenario 2 (DM) | 444 | 41.6 | 54.7 | 422 | 42.2 | 68.7 |
| 2031 Scenario 3 (DS) | 462 | 41.4 | 55.1 | 461 | 41.6 | 70.1 |
| 2031 Scenario 4 (DS) | - | - | - | - | - | - |
| 2031 Scenario 5 (DS) | 508 | 40.6 | 56.5 | 455 | 41.7 | 69.9 |
| 2031 Scenario 6 (DS) | 413 | 42.2 | 53.8 | 387 | 42.8 | 67.3 |
| **Prune Hill Westbound** | | | | | | |
| 2005 Base | 184 | 25.9 | 5.0 | 339 | 23.4 | 4.5 |
| 2016 Scenario1 (DN) | 398 | 22.3 | 5.6 | 554 | 20.0 | 5.5 |
| 2016 Scenario 2 (DM) | 432 | 21.7 | 7.2 | 537 | 20.2 | 9.5 |
| 2016 Scenario 3 (DS) | 441 | 21.5 | 7.2 | 533 | 20.3 | 9.5 |
| 2016 Scenario 4 (DS) | - | - | - | - | - | - |
| 2016 Scenario 5 (DS) | 381 | 22.6 | 7.0 | 512 | 20.6 | 9.4 |
| 2016 Scenario 6 (DS) | 401 | 22.2 | 7.1 | 529 | 20.3 | 9.4 |
| 2031 Scenario 1 (DN) | 487 | 20.7 | 5.8 | 585 | 19.4 | 5.5 |
| 2031 Scenario 2 (DM) | 470 | 21.0 | 7.3 | 553 | 20.0 | 9.6 |
| 2031 Scenario 3 (DS) | 492 | 20.7 | 7.3 | 573 | 19.6 | 9.7 |
| 2031 Scenario 4 (DS) | - | - | - | - | - | - |
| 2031 Scenario 5 (DS) | 461 | 21.1 | 7.2 | 568 | 19.7 | 9.6 |

| Scenario | AM Peak Hour (08:00 – 09:00) | | | Av. PM Peak Hour (16:00 – 19:00) | | |
|---|---|---|---|---|---|---|
| | Flow (vph) | Average Speed (kph) | Junction Delay (seconds) | Flow (vph) | Average Speed (kph) | Junction Delay (seconds) |
| 2031 Scenario 6 (DS) | 470 | 21.0 | 7.3 | 568 | 19.7 | 9.6 |
| **Prune Hill Eastbound** | | | | | | |
| 2005 Base | 303 | 23.9 | 5.0 | 164 | 26.4 | 4.5 |
| 2016 Scenario1 (DN) | 387 | 22.6 | 5.6 | 207 | 25.7 | 5.5 |
| 2016 Scenario 2 (DM) | 385 | 22.6 | 7.2 | 241 | 25.1 | 9.5 |
| 2016 Scenario 3 (DS) | 371 | 22.9 | 7.2 | 243 | 25.0 | 9.5 |
| 2016 Scenario 4 (DS) | - | - | - | - | - | - |
| 2016 Scenario 5 (DS) | 371 | 22.9 | 7.0 | 256 | 24.8 | 9.4 |
| 2016 Scenario 6 (DS) | 390 | 22.6 | 7.1 | 273 | 24.5 | 9.4 |
| 2031 Scenario 1 (DN) | 357 | 23.1 | 5.8 | 216 | 25.5 | 5.5 |
| 2031 Scenario 2 (DM) | 374 | 22.8 | 7.3 | 242 | 25.0 | 9.6 |
| 2031 Scenario 3 (DS) | 359 | 23.1 | 7.3 | 232 | 25.2 | 9.7 |
| 2031 Scenario 4 (DS) | - | - | - | - | - | - |
| 2031 Scenario 5 (DS) | 344 | 23.3 | 7.2 | 230 | 25.2 | 9.6 |
| 2031 Scenario 6 (DS) | 409 | 22.2 | 7.3 | 263 | 24.7 | 9.6 |

**Table 4.1: Modelling results for the level crossings**

## 4.3 Flow Difference Plots

4.3.1 Flow difference plots have been presented for the following assessments:

- 2016 AM peak hour, scenario 2 (do-minimum) minus scenario 1 (do-nothing) in **Figure 4.1**;
- 2016 average PM peak hour, scenario 2 (do-minimum) minus scenario 1 (do-nothing) in **Figure 4.2**;
- 2031 AM peak hour, scenario 2 (do-minimum) minus scenario 1 (do-nothing) in **Figure 4.3**;
- 2031 average PM peak hour, scenario 2 (do-minimum) minus scenario 1 (do-nothing) in **Figure 4.4**;
- 2016 AM peak hour, scenario 3 (do-something) minus scenario 2 (do-minimum) in **Figure 4.5**;
- 2016 average PM peak hour, scenario 3 (do-something) minus scenario 2 (do-minimum) in **Figure 4.6**;
- 2031 AM peak hour, scenario 3 (do-something) minus scenario 2 (do-minimum) in **Figure 4.7**; and
- 2031 average PM peak hour, scenario 3 (do-something) minus scenario 2 (do-minimum) in **Figure 4.8**.

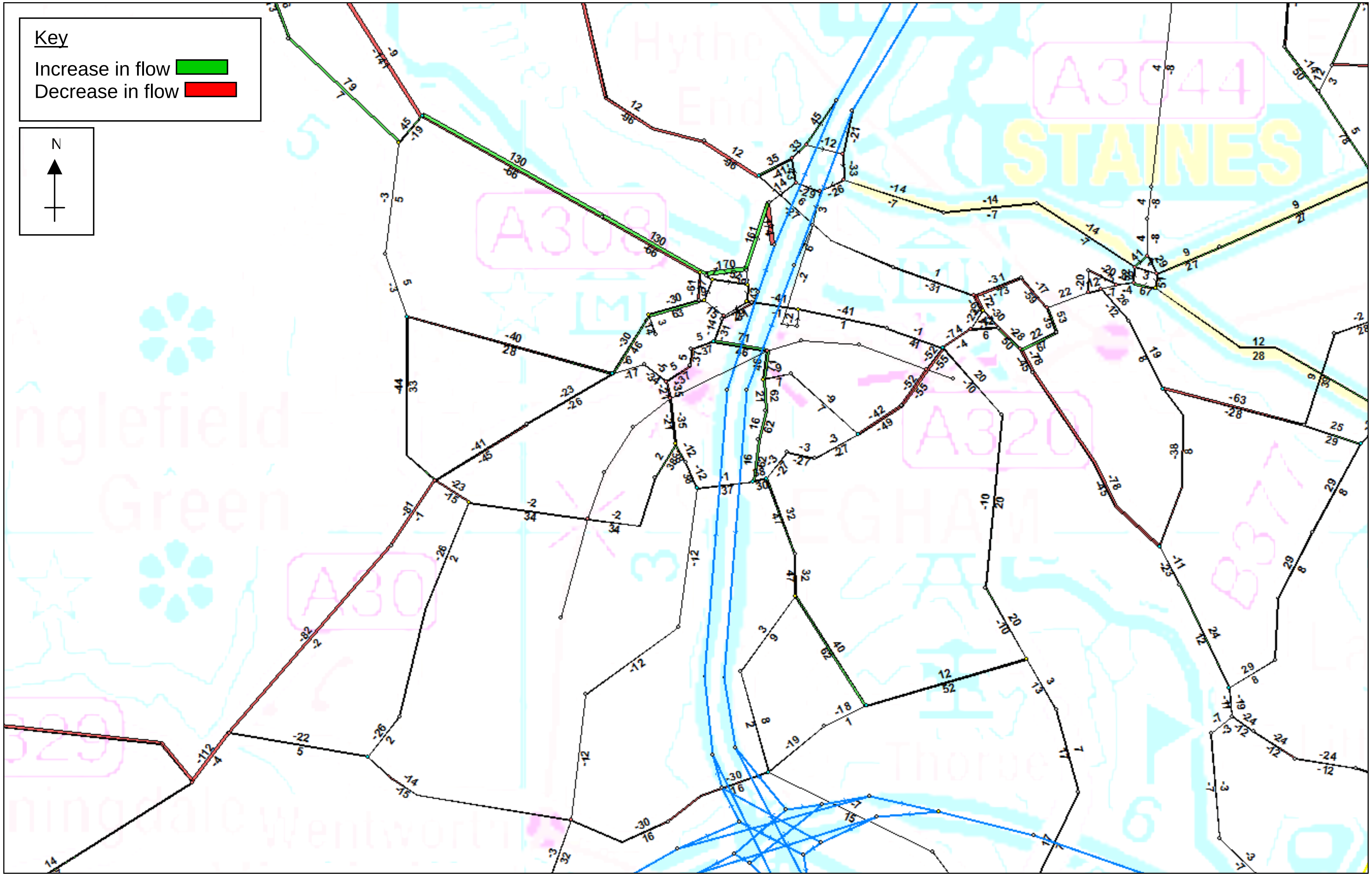


**Figure 4.1: Difference in flow between scenario 2 (do-minimum) and scenario 1 (do-nothing) for the 2016 AM peak hour**

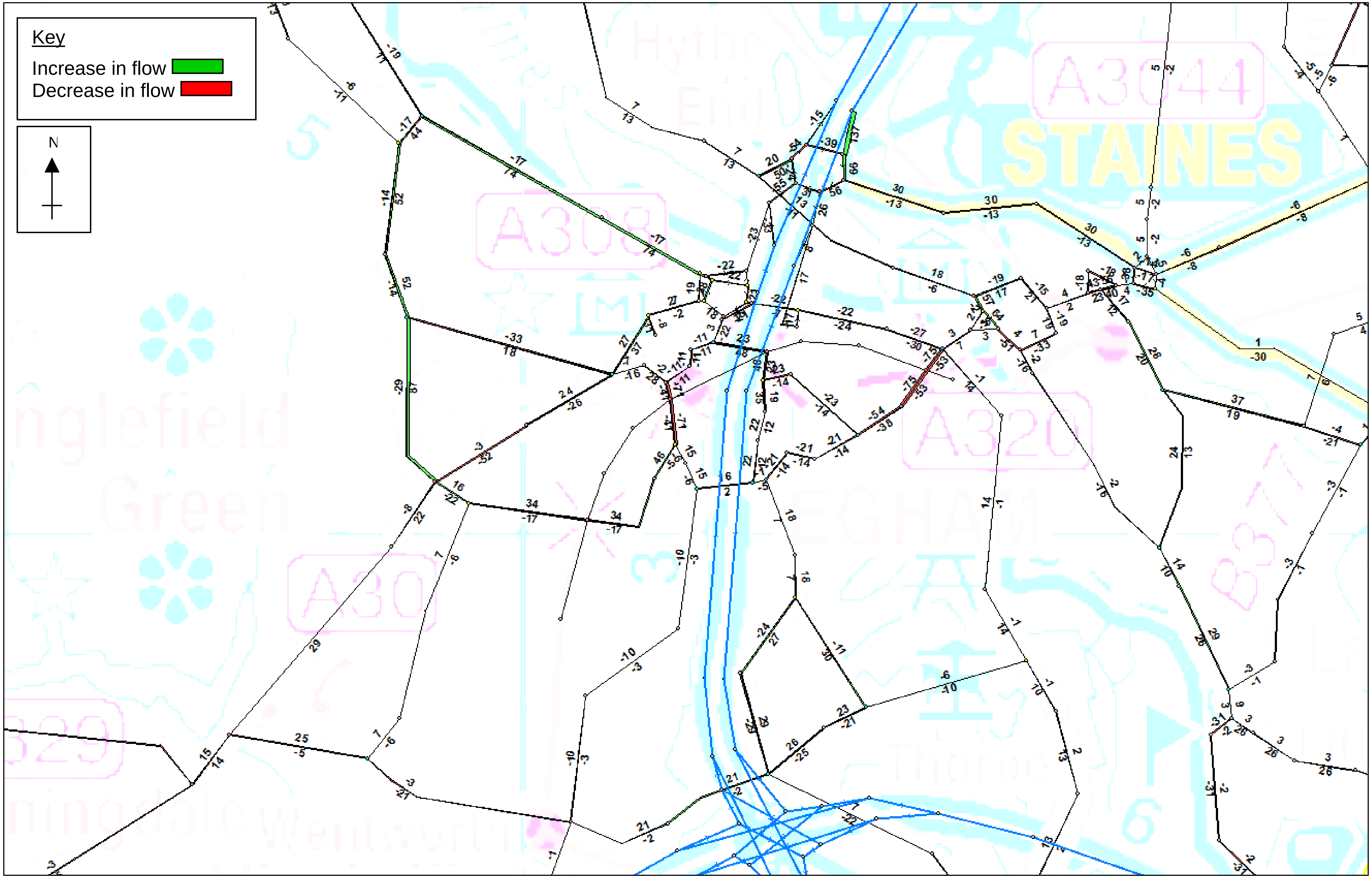


**Figure 4.2: Difference in flow between scenario 2 (do-minimum) and scenario 1 (do-nothing) for the 2016 average PM peak hour**

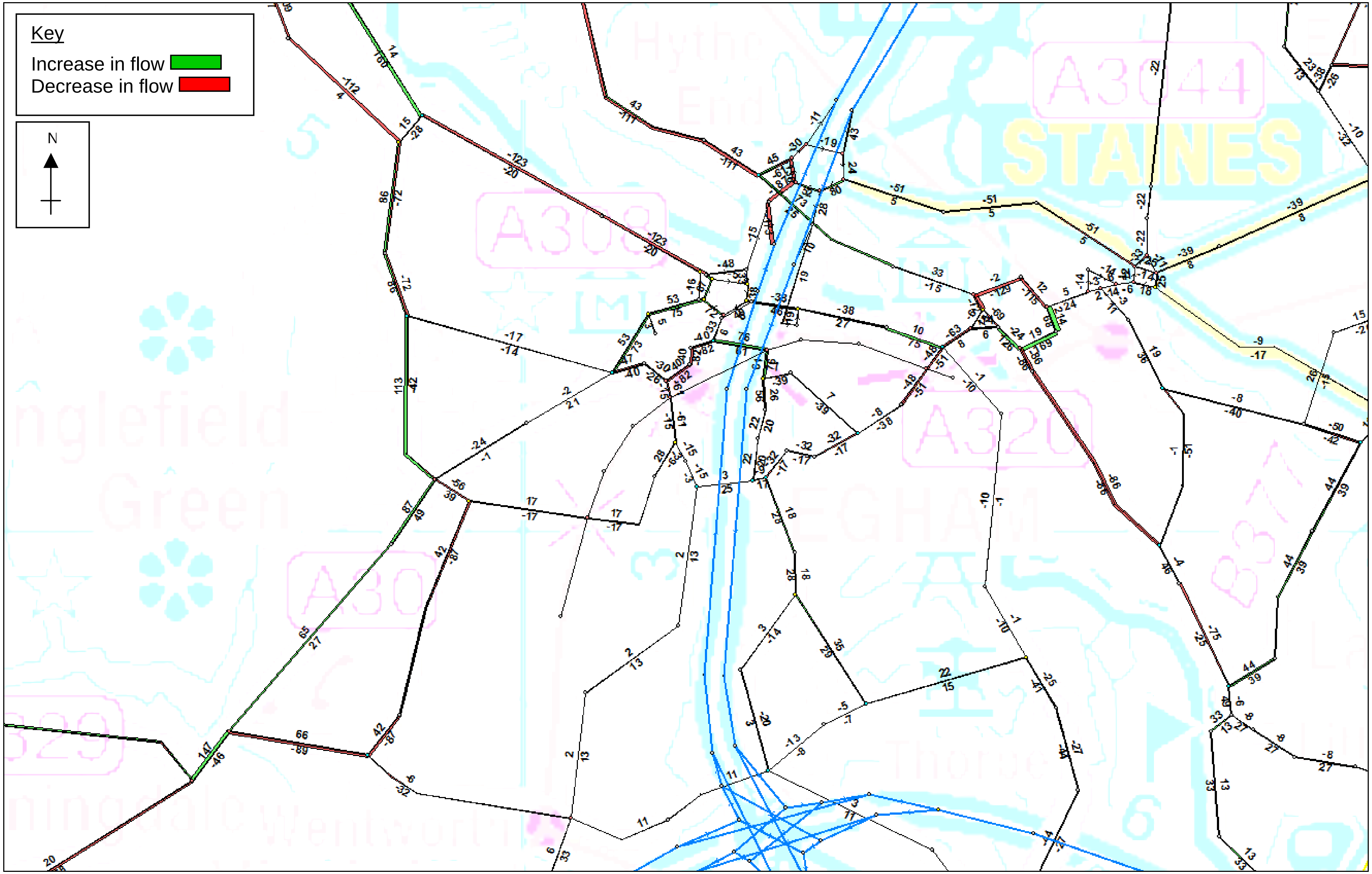


**Figure 4.3: Difference in flow between scenario 2 (do-minimum) and scenario 1 (do-nothing) for the 2031 AM peak hour**


**Figure 4.4: Difference in flow between scenario 2 (do-minimum) and scenario 1 (do-nothing) for the 2031 average PM peak hour**

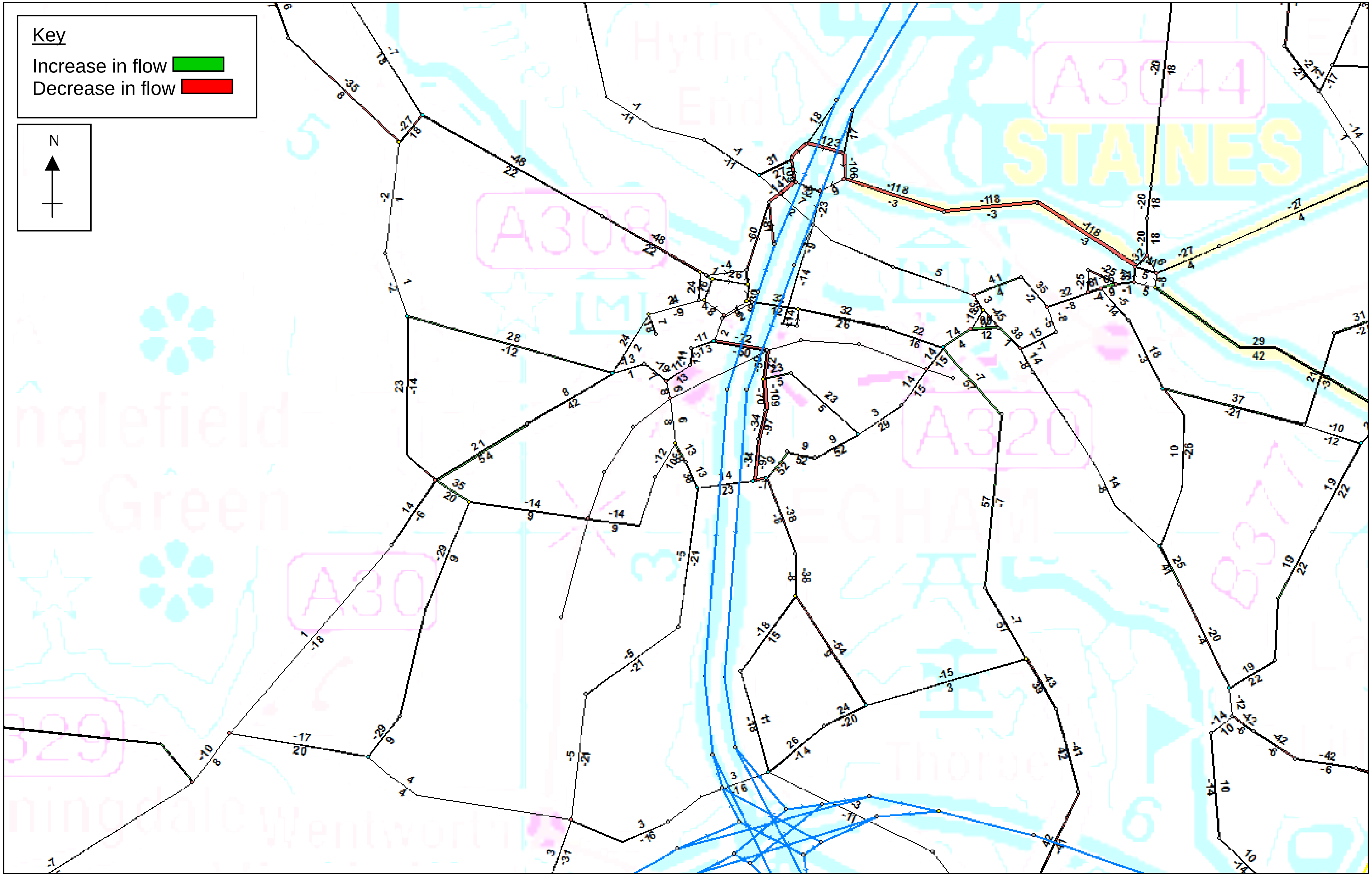


**Figure 4.5: Difference in flow between scenario 3 (do-something) and scenario 2 (do-minimum) for the 2016 AM peak hour**

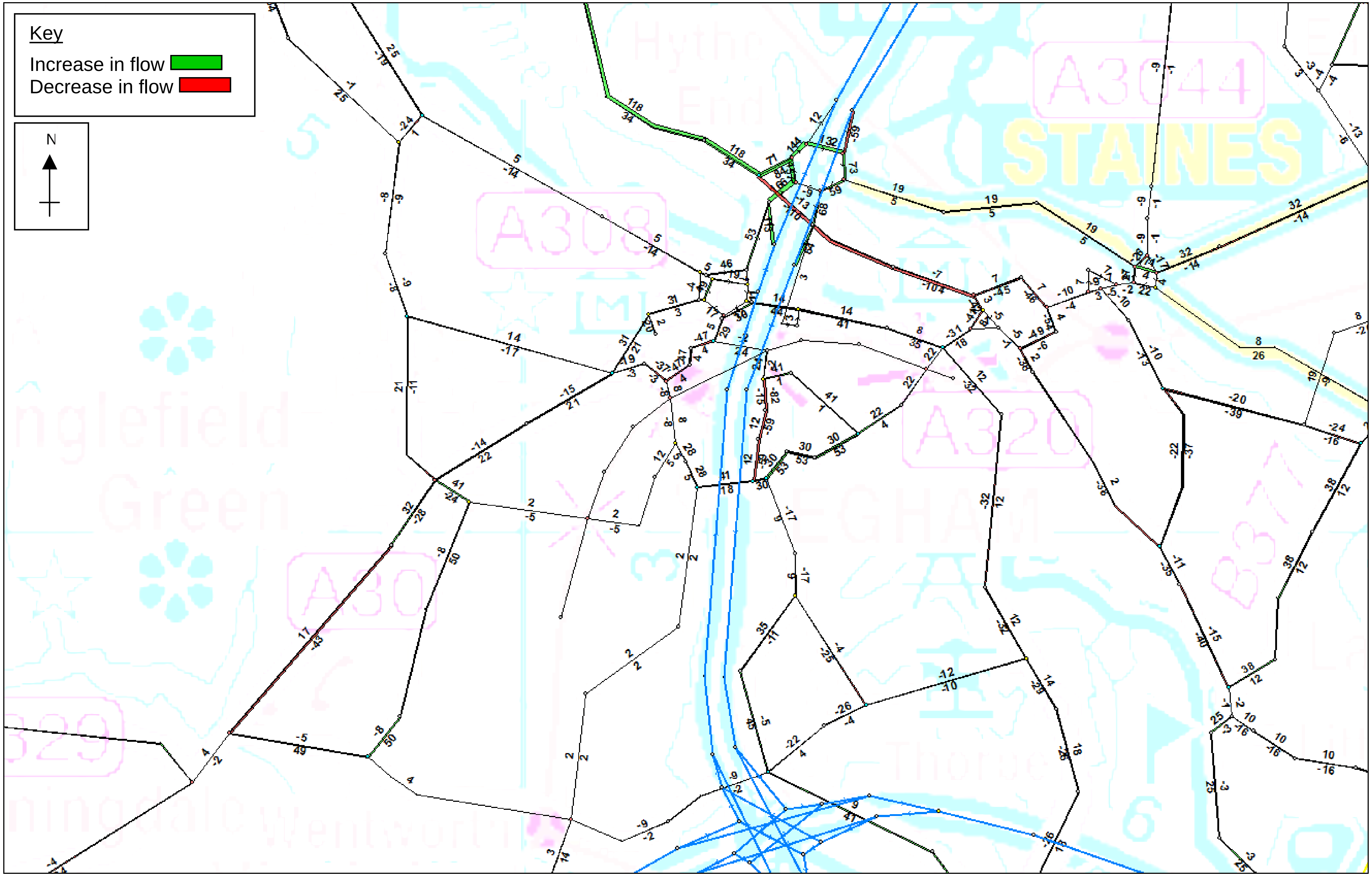


**Figure 4.6: Difference in flow between scenario 3 (do-something) and scenario 2 (do-minimum) for the 2016 average PM peak hour**

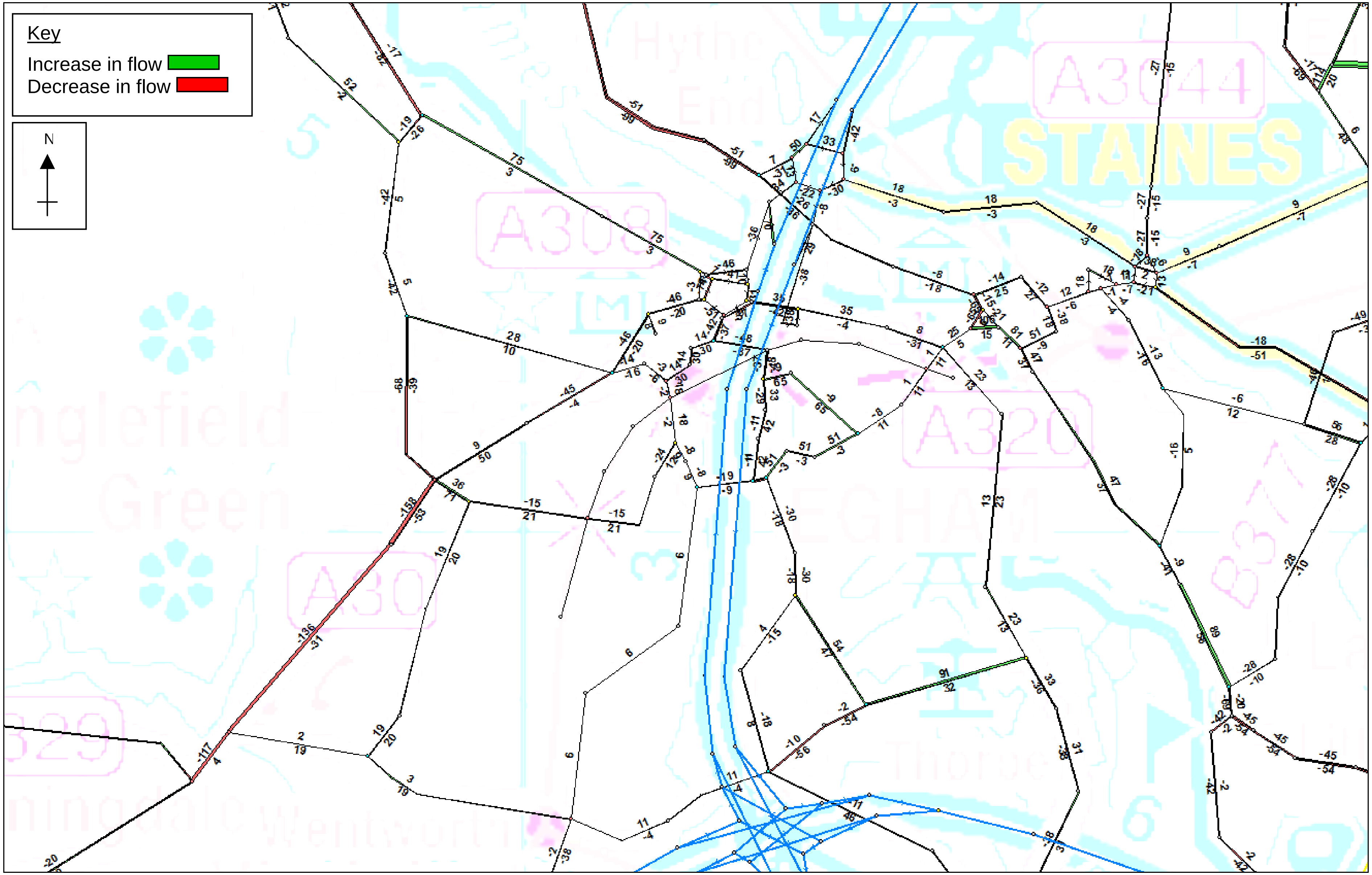


**Figure 4.7: Difference in flow between scenario 3 (do-something) and scenario 2 (do-minimum) for the 2031 AM peak hour**

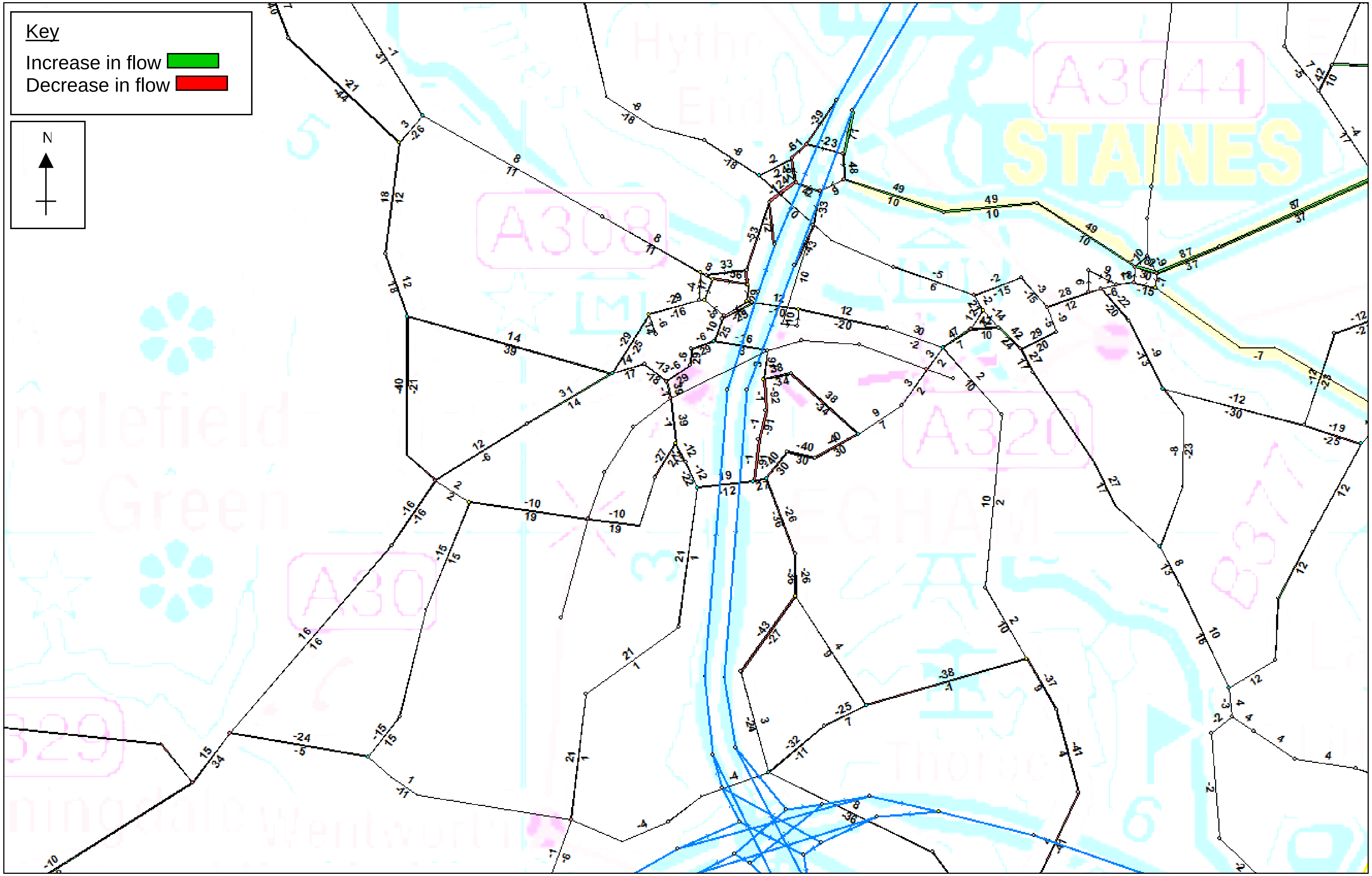


**Figure 4.8: Difference in flow between scenario 3 (do-something) and scenario 2 (do-minimum) for the 2031 average PM peak hour**

## 4.4 Journey Time Comparisons

4.4.1 The journey times for the validated routes described in **Section 2.7** and shown in **Figure 2.4**, have been extracted for the model scenarios 1 to 3 and are presented in **Table 4.2**.

4.4.2 **Table 4.3** presents the difference between journey times from scenario 2 (do-minimum) and scenario 1 (do-nothing).

4.4.3 **Table 4.4** presents the difference between journey times from scenario 3 (do-something) and scenario 2 (do-minimum).

| Route | Observed | Base | 2016 | | | 2031 | | |
|---|---|---|---|---|---|---|---|---|
| | | | Sc.1 Do-Nothing | Sc. 2 Do-Minimum | Sc. 3 Do-Something | Sc.1 Do-Nothing | Sc. 2 Do-Minimum | Sc. 3 Do-Something |
| *AM Peak Hour 08:00 – 09:00* | | | | | | | | |
| 1 | 389 | 415 | 464 | 443 | 464 | 609 | 623 | 576 |
| 2 | 298 | 340 | 390 | 377 | 395 | 522 | 514 | 501 |
| 3 | 341 | 298 | 325 | 329 | 375 | 410 | 430 | 410 |
| 4 | 244 | 224 | 221 | 244 | 246 | 266 | 288 | 269 |
| 5 | 407 | 358 | 434 | 422 | 432 | 484 | 473 | 478 |
| 6 | 327 | 358 | 419 | 408 | 414 | 482 | 470 | 475 |
| *Average PM Peak Hour 16:00 – 19:00* | | | | | | | | |
| 1 | 356 | 376 | 418 | 404 | 423 | 534 | 498 | 505 |
| 2 | 299 | 320 | 369 | 352 | 392 | 448 | 430 | 474 |
| 3 | 218 | 222 | 248 | 266 | 266 | 289 | 311 | 305 |
| 4 | 210 | 222 | 217 | 240 | 241 | 225 | 247 | 250 |
| 5 | 417 | 349 | 455 | 495 | 539 | 606 | 620 | 624 |
| 6 | 321 | 362 | 469 | 507 | 550 | 612 | 624 | 630 |

**Table: 4.2: Journey time comparison along validated routes between scenarios (in seconds)**

| Route | Sc. 2 Do-Minimum Minus Sc. 1 Do-Nothing | |
|---|---|---|
| | 2016 | 2031 |
| *AM Peak Hour 08:00 – 09:00* | | |
| 1 | -21 | 14 |
| 2 | -14 | -8 |
| 3 | 5 | 19 |
| 4 | 24 | 23 |
| 5 | -12 | -11 |
| 6 | -11 | -12 |
| *Average PM Peak Hour 16:00 – 19:00* | | |
| 1 | -13 | -36 |
| 2 | -17 | -18 |
| 3 | 19 | 22 |
| 4 | 23 | 22 |
| 5 | 40 | 14 |
| 6 | 38 | 12 |

**Table 4.3: The difference between scenario 2 do-minimum and scenario 1 do-nothing journey times along validated routes (in seconds)**

| Route | Sc. 3 Do-Something Minus Sc. 2 Do-Minimum | |
|---|---|---|
| | 2016 | 2031 |
| *AM Peak Hour 08:00 – 09:00* | | |
| 1 | 21 | -46 |
| 2 | 18 | -14 |
| 3 | 45 | -19 |
| 4 | 2 | -19 |
| 5 | 10 | 5 |
| 6 | 5 | 5 |
| *Average PM Peak Hour 16:00 – 19:00* | | |
| 1 | 18 | 8 |
| 2 | 40 | 44 |
| 3 | 0 | -6 |
| 4 | 2 | 3 |
| 5 | 44 | 4 |
| 6 | 43 | 6 |

**Table 4.4: The difference between scenario 3 do-something and scenario 2 do-minimum journey times along validated routes (in seconds)**

## 4.5 Select Link Analyses

Select link analyses have been performed to assess the composition of flow across Prune Hill level crossing as listed below.

i) **Figure 4.9** presents a plot showing the routes of traffic that travels via Prune Hill level crossing in both directions in the base AM peak hour model.

ii) **Figure 4.10** presents a plot showing the routes of traffic that travels via Prune Hill level crossing in both directions in the base average PM peak hour model.

iii) **Figure 4.11** presents the difference between 2016 scenario 1 and the base flow which travels via Prune Hill level crossing for the AM peak hour.

iv) **Figure 4.12** presents the difference between 2016 scenario 1 and the base flow which travels via Prune Hill level crossing for the average PM peak hour.

4.5.2 In 2016, traffic flow through Prune Hill level crossing increases in all scenarios compared with the 2005 base situation. The plots suggest that the main reason for this is that vehicles are avoiding the congested areas around Egham and Runnymede roundabout. This phenomenon is consistent in all future year scenarios, and is apparent of fixed, as opposed to variable, demand forecasting.

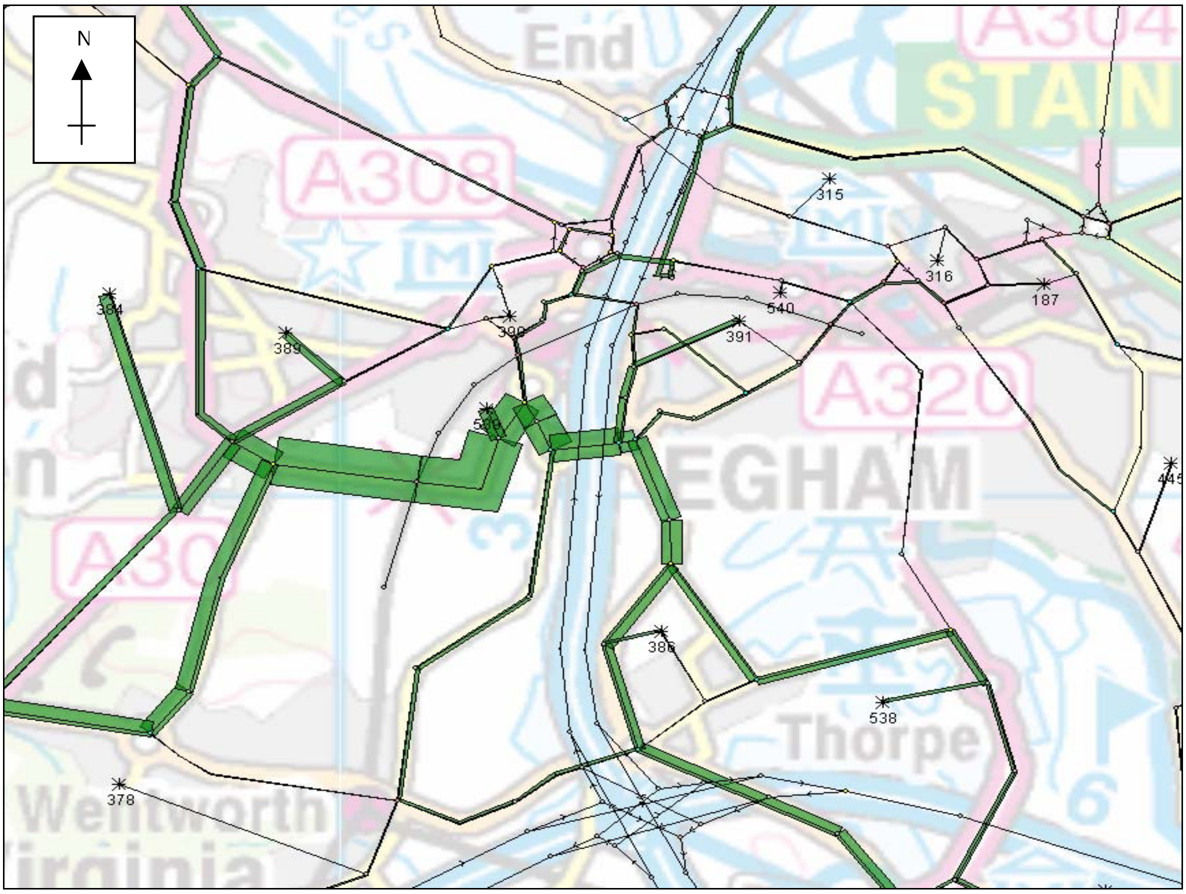


**Figure 4.9: Select link plot of two-way travel at Prune Hill level crossing in the AM peak hour base model**

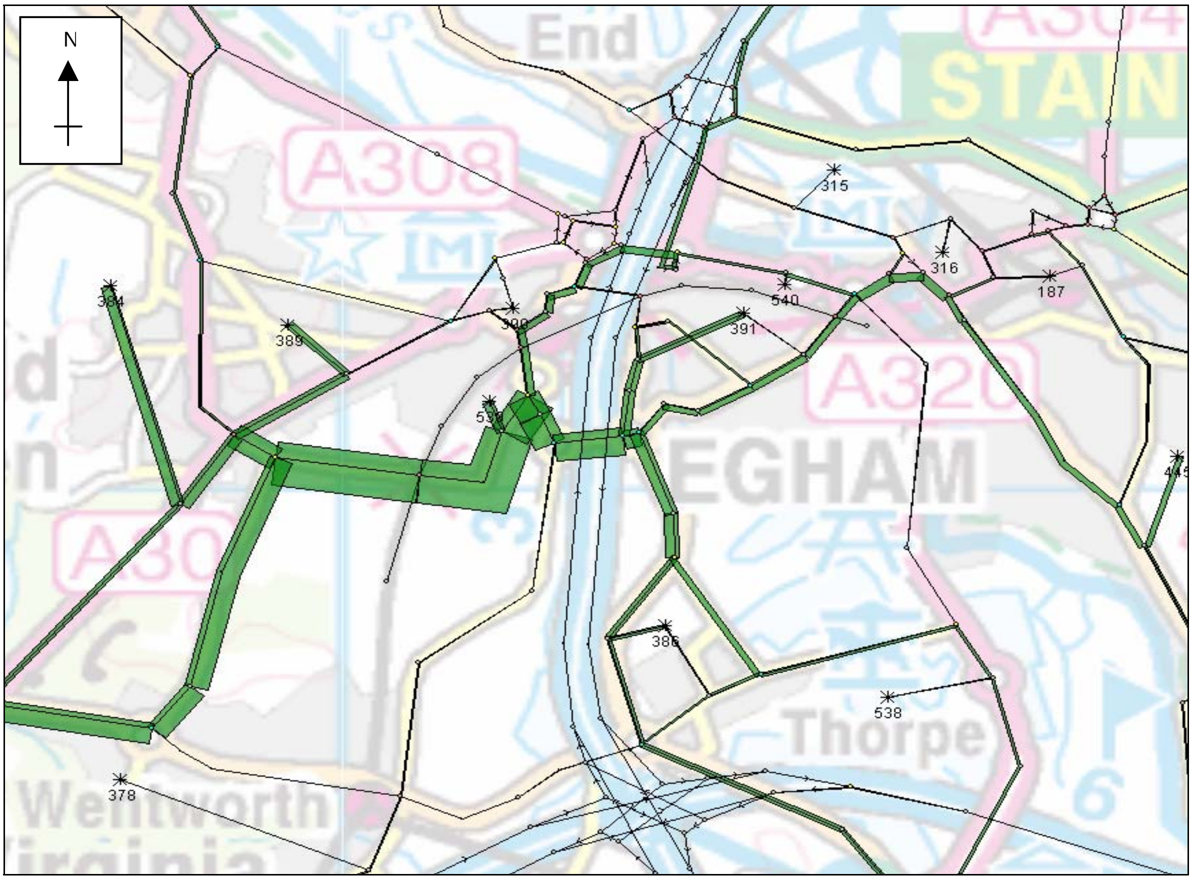


**Figure 4.10: Select link plot of two-way travel at Prune Hill level crossing in the average PM peak hour base model**

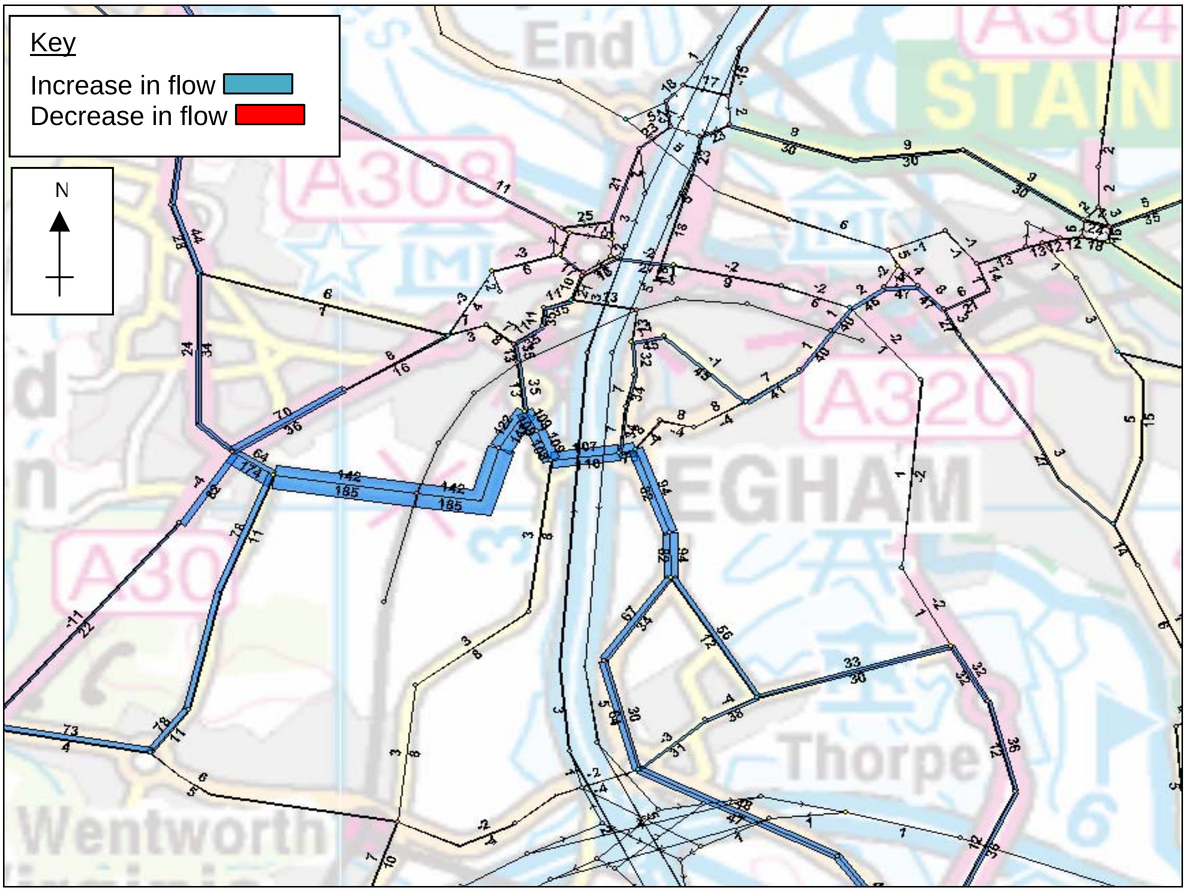


**Figure 4.11: The difference between 2016 scenario 1 and the base flow through Prune Hill level crossing for the AM peak hour**

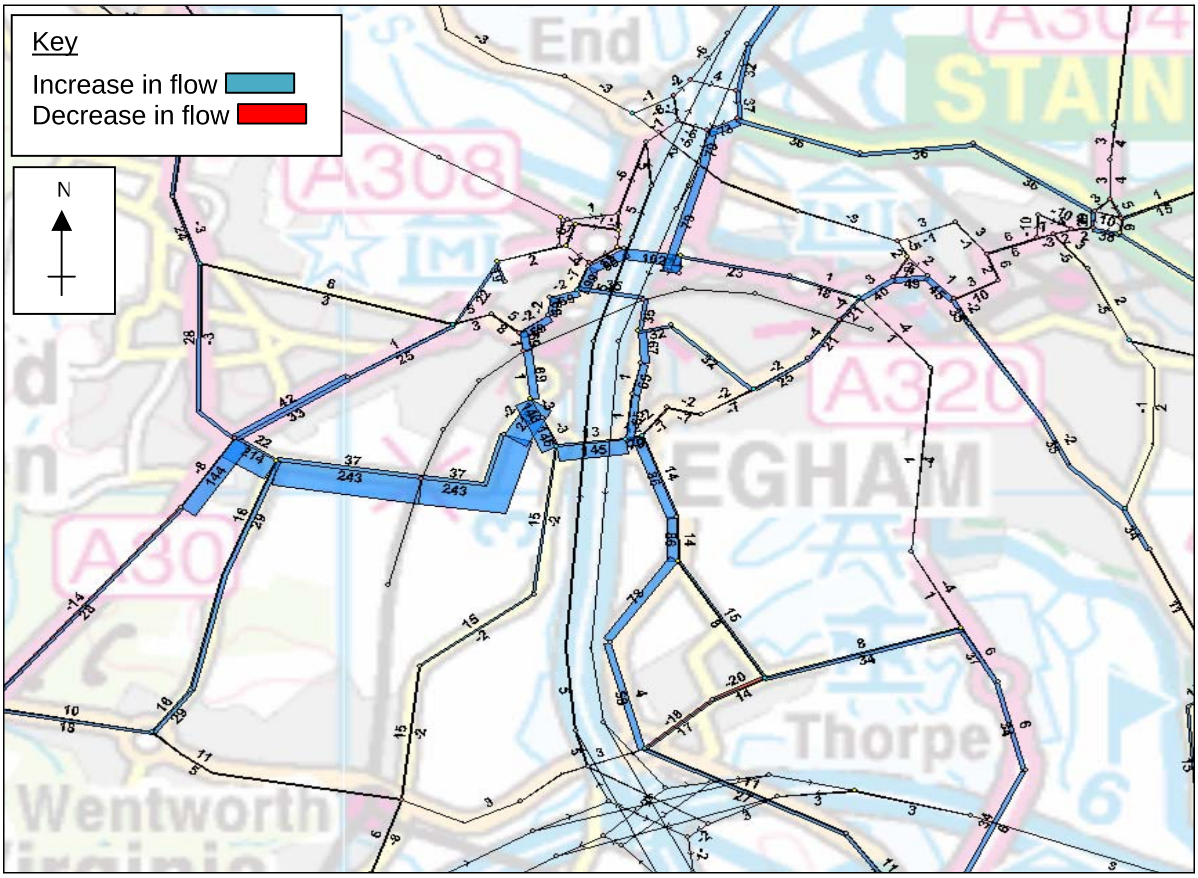


**Figure 4.12: The difference between 2016 scenario 1 and the base flow through Prune Hill level crossing for the average PM peak hour**

## 4.6 Mini-Roundabout Junction of B3407 High Street with B388 Vicarage Road

4.6.1 **Table 4.5** presents the maximum reported volume capacity ratio (VCR) for the mini-roundabout junction situated west of Vicarage Road level crossing, for each model scenario and forecast year.

4.6.2 In all instances in the AM peak hour, the maximum VCR is for the right turn from B388 Vicarage Road to B3407 High Street north. In the average PM peak hour, however, apart from in the 2031 Scenario 6, the greatest VCR were for the right turn movement from B3407 High Street north to B3407 High Street west. In the 2031 Scenario 6, this movement had a VCR of 0.54, but a larger VCR of 0.58 was given for the ahead movement from B3207 High Street west to B388 Vicarage Road.

4.6.3 In all the model scenarios and time periods, the traffic flow through this junction was not limited by its capacity.

| Scenario | AM Peak Hour (08:00 – 09:00) | Average PM Peak Hour (16:00 – 19:00) |
|---|---|---|
| 2005 Base | 0.49 | 0.40 |
| 2016 Scenario1 (DN) | 0.70 | 0.62 |
| 2016 Scenario 2 (DM) | 0.61 | 0.59 |
| 2016 Scenario 3 (DS) | 0.70 | 0.59 |
| 2016 Scenario 4 (DS) | - | - |
| 2016 Scenario 5 (DS) | 0.85 | 0.61 |
| 2016 Scenario 6 (DS) | 0.62 | 0.51 |
| 2031 Scenario 1 (DN) | 0.73 | 0.67 |
| 2031 Scenario 2 (DM) | 0.72 | 0.66 |
| 2031 Scenario 3 (DS) | 0.70 | 0.65 |
| 2031 Scenario 4 (DS) | - | - |
| 2031 Scenario 5 (DS) | 0.84 | 0.65 |
| 2031 Scenario 6 (DS) | 0.63 | 0.58 |

**Table 4.5: Maximum VCR for mini-roundabout junction of B3407 The Avenue with B388 Vicarage Road**

## 4.7 B3407 The Avenue Arm of the Runnymede Roundabout

4.7.1 **Table 4.6** presents the volume capacity ratios (VCR) for B3407 approach to Runnymede Roundabout for each model scenario and forecast year.

| Scenario | AM Peak Hour (08:00 – 09:00) | Average PM Peak Hour (16:00 – 19:00) |
|---|---|---|
| 2005 Base | 0.84 | 0.93 |
| 2016 Scenario1 (DN) | 0.83 | 0.93 |
| 2016 Scenario 2 (DM) | 0.82 | 0.93 |
| 2016 Scenario 3 (DS) | 0.83 | 0.93 |
| 2016 Scenario 4 (DS) | - | - |
| 2016 Scenario 5 (DS) | 0.75 | 0.91 |
| 2016 Scenario 6 (DS) | 0.83 | 0.93 |
| 2031 Scenario 1 (DN) | 0.81 | 0.96 |
| 2031 Scenario 2 (DM) | 0.84 | 0.94 |
| 2031 Scenario 3 (DS) | 0.81 | 0.96 |
| 2031 Scenario 4 (DS) | - | - |
| 2031 Scenario 5 (DS) | 0.71 | 0.91 |
| 2031 Scenario 6 (DS) | 0.82 | 0.95 |

**Table 4.6: VCR for B3407 The Avenue approach arm to Runnymede Roundabout**

4.7.2 In the AM peak hour, the VCR is just below 0.85, apart from in scenario 5 when the green time for this approach is increased by 40%. A similar reduction in VCR in scenario 5 compared with the other scenarios is also displayed in the average PM peak hour, due to this increase in green time. The results for the average PM peak hour, however, shows that flow here is limited by the junction capacity as the VCR is above 0.9 in all cases.

4.8 Scenario 1: Do-Nothing

4.8.1 Scenario 1 (the do-nothing) is the forecast situation without the Airtrack scheme.

*Level Crossing Analyses (Table 4.1)*

4.8.2 The only apparent difference between the base and do-nothing scenario at Thorpe Road level crossing is a small increase in flow due to forecasting.

4.8.3 At Vicarage Road level crossing in the southbound direction, however, in the AM peak hour, the average delay per vehicle here increases by up to 32% from 52 seconds in the base, to 76 seconds in 2016 and 63 seconds in 2031. Moreover, during the average PM peak hour, the delay increases by up to 52% from 42 seconds in the base to 80 seconds in 2016 and 88 seconds in 2031. In the northbound direction of travel, this results in a decrease of 75 vehicles in the AM peak hour, and 42 vehicles in the PM peak, in 2016. In 2031, flows are similar to the base situation due to traffic growth. This is similar for the southbound direction of travel, apart from during the average PM peak hour in 2016 when the flow increases by 60 vehicles. The large increase in delay at this crossing, compared to the other crossings, and other scenarios, is a result of the reduced number of closures of the crossing coupled with the longer amount of time that the barrier is closed. Thus vehicles have a longer time waiting for the barrier to reopen than at Thorpe Road and Station Road level crossings, and also compared with the base and do-minimum scenario 2.

4.8.4 There is little difference between vehicle flow and delay at Station Road for the northbound direction. In the southbound direction, however, flow increases by 121 vehicles in the AM peak hour, and 151 in the average PM peak hour, in 2016.

4.8.5 At Prune Hill level crossing, flow increases in both directions of travel and in both peak periods, despite junction delay being similar in the base and do-nothing scenario.

*Journey Time Analyses (Table 4.2)*

4.8.6 Compared with the base situation, all routes experience an increase in journey time during both modelled time periods and forecast years, apart from route 4, which is similar to the base. Route 4 is southbound along the B3376 Thorpe Road between the A308 and the B388.

4.9 Scenario 2: Do-Minimum

4.9.1 Scenario 2 (the do-minimum) is the forecast situation with Airtrack in operation which maintains the Vicarage Road level crossing facility. This is the same arrangement which currently operates but with different barrier down times to reflect the train schedule with the addition of Airtrack.

*Level Crossing Analyses (Table 4.1)*

4.9.2 In the do-minimum scenario 2, there is a large increase in delay at Thorpe Road, and Station Road level crossings compared with both the base and the do-nothing scenario 1. This leads to a decrease in flow in both directions at these locations during both modelled periods and forecast years, compared with the do-nothing scenario.

4.9.3 Conversely, at Vicarage Road level crossing, the delay reduces from 76 seconds in the AM peak hour do-nothing, to 58 seconds in the do-minimum. In the average PM peak hour, it reduces from 80 to 63 seconds. The delay reflects the barrier times provided by *BAA*, and it is unusual that the barrier down times here do not reflect the crossings both up and down stream, as with the other modelled scenarios.

4.9.4 At this location, delay has reduced despite increased train services. The projected timetable provided by *BAA* states that in the do-nothing scenario the barrier is closed 7 times in the AM and 6 times in the PM peaks. This rises to 11 and 10 times respectively in scenario 3 (and all other “post-Airtrack” scenarios). Conversely, the amount of time that the level crossing barrier is down during the peak hours is greater in “post-Airtrack” scenarios than the do-nothing “pre-Airtrack” scenario 1, but the delay reduces. The reason for this is that with the do-nothing “pre-Airtrack” scenario the number of closures is less, but the length of time that the barrier is down per closure is greater than that for “post-Airtrack” scenarios. Consequently, the impact on traffic is less time spent waiting for the barrier to reopen, and hence shorter delay in scenario 3 compared with scenario 1.

4.9.5 To reflect the reduction in delay at Vicarage Road level crossing compared with the do-nothing, traffic flow increases in both directions.

4.9.6 Junction delay increases by approximately 22% in the AM peak hour and 42% in the average PM peak hour at the Prune Hill level crossing from the do-nothing to the do-minimum scenario. Flow does not vary by much, however, because the delay is small (less than 10 seconds), particularly in the westbound direction of travel.

*Flow Difference Plots (Figures 4.1 to 4.4)*

4.9.7 The flow difference plots in **Figures 4.1** to **4.4**, which compares the flows of the do-minimum scenario 2 with the do-nothing scenario 1 on the local highway network, verifies the changes shown at the level crossings.

*Journey Time Analyses (Tables 4.2 and 4.3)*

4.9.8 In the do-minimum scenario 2, journey times mostly decrease from the do-nothing scenario 1 during both modelled time periods and forecast years. The exceptions are route 3, which increases by 5 and 24 seconds for 2016 and 2031 respectively in the AM peak hour, and by 19 and 23 seconds in the average PM peak hour, and route 4 which experiences increases of between 13 and 23 seconds. Both these routes pass through Thorpe Road level crossing, and the increase in delay is attributed to its increase in barrier closure.

4.9.9 In the average PM peak hour, the do-minimum also sees an increase in journey time along routes 5 and 6, compared with the do-nothing. These routes pass Station Road level crossing and similarly reflects the increase in barrier closure here. In the AM peak hour, however, the journey times are very similar (8 to 12 seconds less than the do-nothing) because other junctions, including the signalised junction of B3407 High Street with Station Road, performed better under the lower flow conditions.

## 4.10 Scenario 3: Do-Something

4.10.1 Scenario 3 (the do-something) is the forecast situation with Airtrack in operation but Vicarage Road level crossing is replaced with an underpass. The underpass is accompanied with traffic calming along B388 Vicarage Road, between its junction with B3407 High Street and Egham Sports Centre, to manage its design constraints.

*Level Crossing Analyses (Table 4.1)*

4.10.2 Since in scenario 3 an underpass replaces the level crossing at Vicarage Road, there is no delay to vehicles at this location. However, due its design constraints, the speed of vehicles through the underpass must be limited to 20mph. Consequently, the speed of vehicles here reduces from about 40kph to 20kph in both modelled time periods and forecast years. As a result, traffic flow through the underpass does not dramatically increase. In the AM peak hour, traffic flow reduces compared with the do-minimum, in both directions of travel. In the average PM peak hour, however, there is a small increase in flow of 14 and 4 vehicles in the northbound direction in 2016 and 2031 respectively. In the southbound direction there is a small reduction of 2 and 16 vehicles.

4.10.3 The underpass has not attracted trips away from the other level crossings. For example, B3376 Thorpe Road experiences similar traffic flow. In the AM peak hour, there is an increase of 14 vehicles in 2016 and 2 vehicles in 2031, in the northbound direction of travel along B3376 Thorpe Road. In the PM peak this is a 23 and 4 vehicles respectively. Similar small increases are apparent in the southbound direction too.

4.10.4 At Station Road level crossing little change in flow is repeated when comparing the do-something scenario 3 with the do-minimum scenario 2. Here flow in the northbound direction changes by a maximum of 8 vehicles during both modelled time periods and forecast years. There is a greater, but still relatively small, increase in vehicles in the southbound direction of travel. For instance, in the AM peak hour, flow increases by 18 vehicles and in the PM peak by 39 vehicles, in 2031.

4.10.5 Again there are similar flow levels at Prune Hill level crossing compared with the do-minimum scenario 2.

*Flow Difference Plots (Figures 4.5 to 4.8)*

4.10.6 The flow difference plots in **Figures 4.5** to **4.8**, which compares the flows of the do-something scenario 3 with the do-minimum scenario 2 on the local highway network, verifies the changes in flow at the level crossings which is discussed above.

*Journey Time Analyses (Tables 4.2 and 4.4)*

4.10.7 Compared with scenario 2 do-minimum, scenario 3 journey times along validated routes either are similar or increase in 2016 for both modelled time periods.

4.10.8 Routes 2 and 3, which encounter the proposed underpass at Pooley Green and its traffic calming, see an increase in journey time of about 20 seconds in each direction in the AM peak hour, and in the northbound direction during the average PM peak hour in 2016. In the southbound direction this increases to 40 seconds. The rise in travel time is due to the reduction of travel speed along the B388 through the underpass.

4.10.9 Although in 2031 AM peak hour, journey times along routes 2 and 3 are faster than scenario 2 do-minimum by 46 seconds in the northbound direction and 14 in the southbound direction. This is due to a reduction in junction delay at the B3407 approach to Runnymede Roundabout and the mini-roundabout junction of B3376 Thorpe Lea Road with B388. The difference in delay has resulted from a change in the balance of flow on the approaches to these junctions from the assignment.

4.10.10 The largest increase in travel time in the 2016 AM peak hour, however, is route 3 which crosses Thorpe Road level crossing. This is an increase of 45 seconds and is not attributed to the level crossing but that of the roundabout junction of A320 Chertsey Road with B3376 Thorpe Road and A308 The Causeway and Staines Bridge.

4.10.11 There is little difference in journey time between scenario 3 do-something and scenario 2 do-minimum for routes 5 and 6 which travel via Station Road level crossing. Apart from during the average PM peak hour in 2016, the maximum difference in journey time is 10 seconds. For the average PM peak hour in 2016, however, there is just over a 44 second increase in delay in each direction of travel which is due to more delay experienced at Egham Hill roundabout (junction of A30 Egham Bypass with B3407 High Street).

4.11 <u>Scenario 4: Do-Something</u>

4.11.1 Scenario 4 (the do-something) is the forecast situation as in scenario 3 (with Airtrack, Vicarage Road underpass and traffic calming) with the addition of improvements to Runnymede roundabout.

4.11.2 Unfortunately, due to ongoing queries regarding its design and the level of detail required in its replication, this scenario has not been assessed within the model.

4.12 <u>Scenario 5: Do-Something Sensitivity Test</u>

4.12.1 Scenario 5 (the do-something sensitivity test) is the forecast situation as in scenario 3 (with Airtrack, Vicarage Road underpass and traffic calming), but B3407 The Avenue approach to Runnymede is given a 40% increase in green time in each time period. Cycle times, however, have remained the same as in the base situation.

4.12.2 Thus stage 2 (green for B3407 The Avenue) increases from 12 seconds in AM peak hour to 17 seconds. In the average PM peak hour it increases from 7 to 10 seconds.

4.12.3 As a result, stage 1 (the circulatory carriageway of the roundabout receives green) reduces from 34 to 29 seconds in the AM peak hour, and from 40 to 37 seconds in the average PM peak hour.

*Level Crossing Analyses (Table 4.1)*

4.12.4 Comparing this with scenario 3 shows that more vehicles use the underpass in the northbound direction of travel. In 2016 there is an increase of 121 vehicles in the AM peak hour and 86 vehicles in the average PM peak hour. These trips have been attracted from more strategic routes; in the AM peak, in particular the model suggests that about 50 vehicles have been drawn from the A30.

4.12.5 In the southbound direction of travel, however, flows are similar or there is a small reduction. For example in the 2016 scenario 5 average PM peak hour there is a reduction of 20 vehicles, compared with scenario 3. Little or no change is expected in this direction of travel because the additional benefit from the increase in green time for B3407 The Avenue approach to Runnymede Roundabout only affects northbound travel.

*B3407 The Avenue Arm of Runnymede Roundabout VCR (Table 4.6)*

4.12.6 By increasing the green time of B3407 The Avenue approach to Runnymede roundabout, lowered the volume capacity ratio in both the AM peak hour and average PM peak hour, as shown in **Table 4.6**. This reduction in capacity enabled more vehicles to travel northbound via the B388 Vicarage Road.

## 4.13 Scenario 6: Do-Something Sensitivity Test

4.13.1 Scenario 6 (the do-something sensitivity test) is the forecast situation as in scenario 3 (with Airtrack and Vicarage Road underpass), but without the traffic calming along B388 Vicarage Road. Thus a 30mph speed limit was maintained through the underpass and the model link types along B388 Vicarage Road are the same as in the base situation.

*Level Crossing Analyses (Table 4.1)*

4.13.2 Comparing scenario 6 with scenario 3 shows large increases in flow along the B388 Vicarage Road in each direction of travel. For example, in the northbound direction, flow in scenario 6 in the AM peak hour year 2016 is 122 more than scenario 3 where the road through the underpass is limited to 20mph. In the southbound direction there is a bigger increase of 194 vehicles.

4.13.3 Because the speed limit is no longer reduced here, the journey time along this section of road reduces and falls below that when Vicarage Road level crossing is in place. As a result, more vehicles are attracted to this route.

4.13.4 The model suggests, however, that the increase in flow here are not local but longer distance trips extracted from the A320 at the point where it meets the B388 in Chertsey. Moreover, it is not the aim of the underpass to attract these longer distance trips but to provide a viable alternative for those people who live and work in the local area.

## 4.14 Further Sensitivity Tests

4.14.1 Three further sensitivity tests were conducted for the forecast year 2016, as described below:

1. A test that combined scenarios 5 and 6 which involves an underpass at Pooley Green but without traffic calming, together with a 40% increase in green time for B3407 The Avenue approach to Runnymede. This was also accompanied by user-defined delay at the junction of B388 Thorpe Road Lea with Ten Acre Lane. This was to deter the attraction of vehicles from A320 to travel via the underpass, and is the last point at which A320 traffic can access the B388 prior to the proposed underpass. Specified delay was applied of 0, 50 and 100 seconds, to the ahead movement from B388 Thorpe Road Lea south to north, and the right turn from Ten Acre Lane to B388 Thorpe Road Lea. Delay was capped at 100 seconds; beyond this, it would be very difficult to replicate that level of delay within a semi-rural area.
2. A test that replicated scenario 3, which is the Pooley Green underpass with its associated traffic calming, combined with an increase of the level crossing barrier down time for the “post-Airtrack” situation at Thorpe Road and Station Road level crossings by 5, 10 and 15 minutes in the modelled hours.

3. A test that replicated scenario 3, but closed all barrier controlled level crossings in Egham. This involved the closure of Thorpe Road, Station Road and Prune Hill level crossings, and was only conducted for the 2016 AM peak hour model.

4.14.2 The first sensitivity test was employed to deter A320 traffic from diverting to the underpass and to investigate if reducing the number of longer distance trips from using the proposed underpass would attract local trips to use it from the adjacent level crossing routes. It was found that there was a small abstraction of trips from Station Road and Prune Hill level crossings of a maximum of approximately 70 vehicles. There was virtually no abstraction, however, from Thorpe Road level crossing. It was found that increasing delay along B388 Thorpe Lea Road did not encourage sufficient use of Pooley Green underpass by local trips.

4.14.3 The second sensitivity test was conducted to assess the impact of train service unreliability and day-to-day perturbation of level crossing closures. For instance the closure of the barrier is manually controlled via CCTV and on some occasions it takes longer for the crossings to be free of traffic before it can be shut than others. The other reason is to determine whether the increased barrier closure will encourage use of the proposed underpass.

4.14.4 The modelling showed that Pooley Green underpass does experience an increase in flow due to the increase in delay at Thorpe Road and Station Road level crossings of a maximum of approximately 80 vehicles in a single direction. The attraction to the underpass is very much still constrained by both its traffic calming, Runnymede roundabout and the congested network which surrounds Egham. Thus, the increase in flow along B388 Vicarage Road is not sufficient to warrant an underpass. Furthermore, an increase in barrier down time of 5 minutes at Station Road and Thorpe Road level crossings shows that there is little difference in flow compared with scenario 3. Only when delay is 10 minutes or greater are the impacts significant, where flows along Thorpe Road and Station Road level crossings reduced by approximately 20% in the AM peak hour and 30% in the average PM peak hour. Delay at the level crossings increased by approximately 110% with an additional 15 minutes on the “post-Airtrack” level crossing barrier time for the modelled hours.

4.14.5 This increased total delay amounts to an average of 73 seconds per vehicle for traffic using Thorpe Road and 63 seconds for traffic using Station Road. Consequently, given the increased journey times due to the longer distances involved and the additional congestion trips would encounter, it is not worth many trips diverting to Vicarage Road. In addition, the higher the number of trips diverting increases the delay on the links and at the junctions on this alternative route, making it increasingly unattractive.

4.14.6 The final sensitivity test replicated the complete closure of all barrier controlled level crossings. Thus the only route across the railway line in Egham was provided at the proposed underpass, and was conducted to determine the maximum attraction of traffic to B388 Vicarage Road. It was found that approximately 900 vehicles in each direction used the underpass, a further 400 vehicles compared with scenario 3. Obviously, no vehicles used Thorpe Road, Station Road and Prune Hill level crossings. As a result, this also led to an increased usage of the A320 of approximately 150 vehicles in each direction.

4.14.7 A total of about 2350 are forecast to cross the Thorpe Road, Station Road and Prune Hill level crossing during the AM peak hour. Allowing for trips diverting to Vicarage Road and the A320, this leaves about 1100 trips rerouteing elsewhere around the network, bearing in mind that the modelling uses a fixed matrix approach. The reasons more trips do not use the Vicarage Road underpass are due to limited link capacity, congested junctions and longer distances.

4.15 Verification of Calculated Delay by OmniTRANS at Level Crossings

4.15.1 The calculated delay of level crossings by OmniTRANS was verified using LinSig, to ensure that the highway model is replicating the appropriate level of delay at level crossings. LinSig is an internationally recognised design and assessment tool for traffic signal junctions and urban networks, developed by *JCT Consultancy*.

4.15.2 The flows presented in the strategic model for the base and 2016 scenarios 1 to 3 for the AM and PM peak hours, together with their inputted signal timings, for all the level crossings, were fed into LinSig version 3. Each scenario and crossing was modelled in turn using LinSig. **Table 4.7** compares the flow weighted average delay calculated in LinSig and SINTRAM.

| Time Period | Scenario | Flow Weighted Av. Delay (secs) | | Difference (secs) |
|---|---|---|---|---|
| | | LinSig | SINTRAM | |
| *Thorpe Road Level Crossing* | | | | |
| AM | 2005 Base | 46.8 | 43.5 | -3.3 |
| | 2016 Scenario 1 (do-nothing) | 42.7 | 39.9 | -2.8 |
| | 2016 Scenario 2 (do-minimum) | 69.4 | 64.5 | -4.9 |
| | 2016 Scenario 3 (do-something) | 70.2 | 65.1 | -5.1 |
| PM | 2005 Base | 34.9 | 32.4 | -2.5 |
| | 2016 Scenario 1 (do-nothing) | 35.7 | 32.8 | -2.9 |
| | 2016 Scenario 2 (do-minimum) | 63.3 | 58.4 | -4.9 |
| | 2016 Scenario 3 (do-something) | 63.6 | 58.7 | -4.9 |
| *Vicarage Road Level Crossing* | | | | |
| AM | 2005 Base | 56.9 | 51.6 | -5.3 |
| | 2016 Scenario 1 (do-nothing) | 81.6 | 76.1 | -5.5 |
| | 2016 Scenario 2 (do-minimum) | 70.3 | 58.0 | -12.3 |
| | 2016 Scenario 3 (do-something) | n/a | n/a | n/a |
| PM | 2005 Base | 45.8 | 42.0 | -3.8 |
| | 2016 Scenario 1 (do-nothing) | 85.6 | 79.5 | -6.1 |
| | 2016 Scenario 2 (do-minimum) | 70.0 | 62.7 | -7.3 |
| | 2016 Scenario 3 (do-something) | n/a | n/a | n/a |
| *Station Road Level Crossing* | | | | |
| AM | 2005 Base | 40.7 | 38.2 | -2.5 |
| | 2016 Scenario 1 (do-nothing) | 31.7 | 29.5 | -2.2 |
| | 2016 Scenario 2 (do-minimum) | 58.0 | 54.1 | -3.9 |
| | 2016 Scenario 3 (do-something) | 58.2 | 54.3 | -3.9 |
| PM | 2005 Base | 28.5 | 26.8 | -1.7 |
| | 2016 Scenario 1 (do-nothing) | 31.2 | 28.9 | -2.3 |
| | 2016 Scenario 2 (do-minimum) | 73.2 | 68.7 | -4.5 |
| | 2016 Scenario 3 (do-something) | 73.6 | 69.0 | -4.6 |
| *Prune Hill Level Crossing* | | | | |
| AM | 2005 Base | 5.6 | 5.0 | -0.6 |
| | 2016 Scenario 1 (do-nothing) | 6.5 | 5.6 | -0.9 |
| | 2016 Scenario 2 (do-minimum) | 8.3 | 7.2 | -1.1 |
| | 2016 Scenario 3 (do-something) | 8.2 | 7.2 | -1.0 |
| PM | 2005 Base | 5.1 | 4.5 | -0.6 |
| | 2016 Scenario 1 (do-nothing) | 6.5 | 5.5 | -1.0 |
| | 2016 Scenario 2 (do-minimum) | 10.9 | 9.5 | -1.4 |
| | 2016 Scenario 3 (do-something) | 10.9 | 9.5 | -1.4 |

**Table 4.7: Comparison between LinSig and SINTRAM flow weighted average delay (in seconds)**

4.15.3 The delay values calculated by LinSig are similar to those from SINTRAM. The only exception is a 12 second difference experienced for the 2016 scenario 2. Moreover, it is not a direct comparison, because LinSig inserts a minimum intergreen of 2 seconds. Hence SINTRAM flow weighted average delay is always less than that calculated in LinSig. Intergreens were not given in SINTRAM because of the uncertainty of the collection of observed level crossing data and of the forecasting methodology. SINTRAM facilitates the exclusion of intergreens, whereas LinSig does not.

4.15.4 Given the presented differences in **Table 4.7**, it is considered that OmniTRANS provides a good reflection of delay at the level crossings.

4.16 Queue Lengths at the Level Crossings

4.16.1 SINTRAM records delay as a measure of time; it does not provide queue lengths as an output. Consequently the queue lengths presented in **Figure 4.13** have been acquired from the LinSig assessment described above in **Paragraph 4.15.3**.

4.16.2 There is little difference in queue lengths between 2016 scenarios 1, 2 and 3 at Thorpe Road level crossing. This is similar at Station Road and Prune Hill level crossings, during both time periods and in both directions of travel.

4.16.3 At Vicarage Road level crossing, however, queue lengths are much greater in scenario 1 (do-nothing) than in scenario 2 (do-minimum). For example, in the average PM peak hour the southbound queue length for scenario 1 is 75 vehicles, which reduces to 55 vehicles in scenario 2. This is a result of the differences in level crossing timings at this location as discussed in **Paragraph 4.9.3**. The level crossing barrier is closed less often in scenario 1, but for much longer periods of time, compared with scenario 2.

4.16.4 There are no queue lengths provided for scenario 3 at Vicarage Road level crossing because the level crossing is replaced by an underpass.

4.16.5 All level crossings experience an increase in queue length due to forecasting from the 2005 base to the future year 2016, with the exception of Thorpe Road level crossing in the northbound direction of travel during the PM peak period.

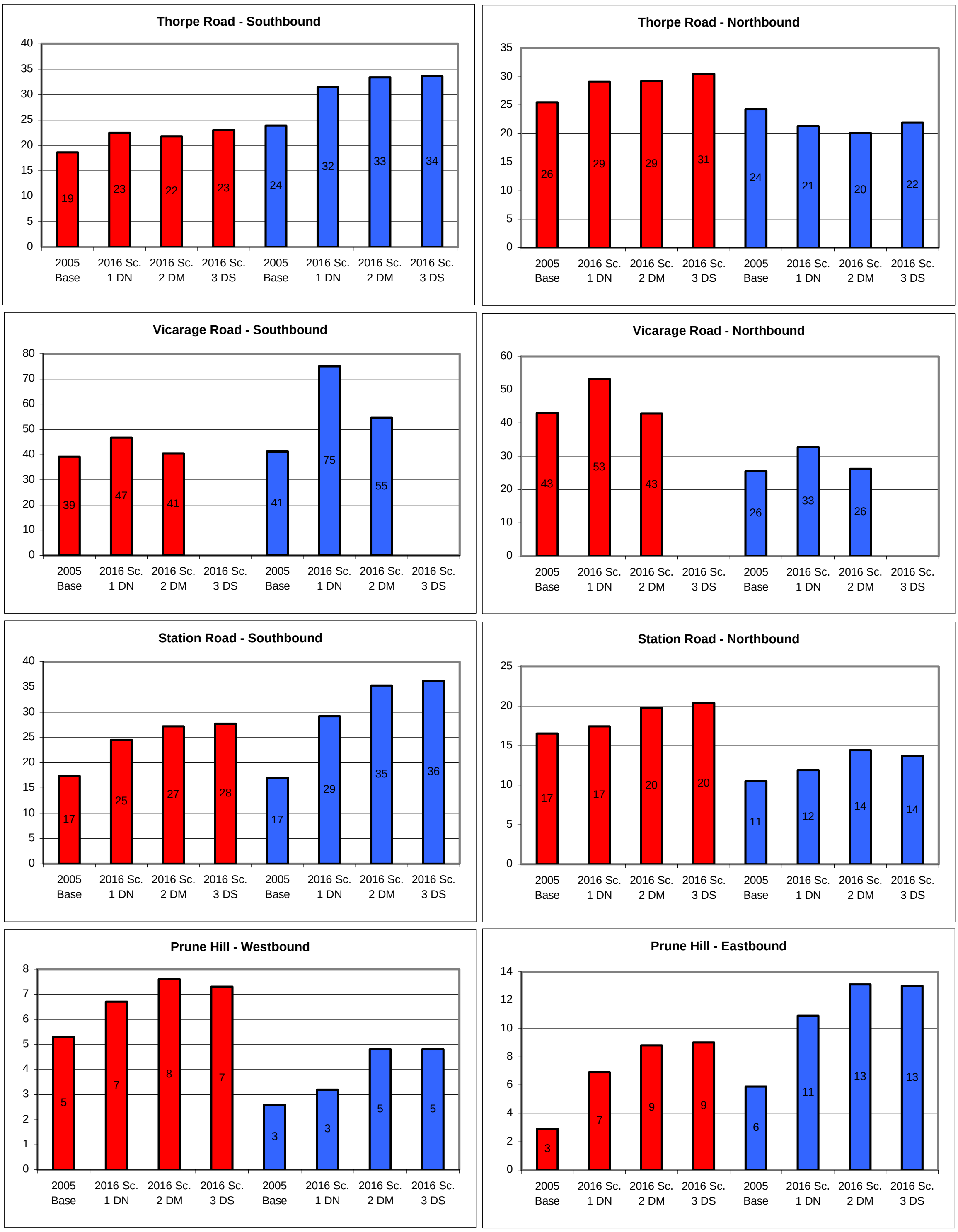


**Figure 4.13: Predicted queue lengths at each level crossing for the 2005 base and 2016 scenarios 1 to 3 (number of vehicles)**

*Red = AM peak hour (08:00 – 09:00)*

*Blue = average PM peak hour (16:00 – 19:00)*

## 4.17 Comparison of Average and Actual Barrier Closures

4.17.1 In order to understand whether modelling the level crossing closures using average times, as calculated using the methodology set out in **Appendix A**, has an impact on the traffic flows and delays in the OmniTRANS model, a sensitivity test was carried out using a S-Paramics microsimulation model for the B3376 Thorpe Road level crossing.

4.17.2 The individual level crossing barrier downtimes can be modelled within S-Paramics to the nearest minute. This enables the variability in both consecutive and length of closure to be replicated within a transport model. The OmniTRANS model, which is strategic in nature, does not have this functionality. Therefore, in order to assess the impact of simulating average, as oppose to individual, downtimes, a comparison was performed using the Staines S-Paramics model in the AM peak for the base year.

4.17.3 Two base AM peak models were created. The only difference being that, at Thorpe Road level crossing, one model had each individual barrier closure replicated, and the other had the barrier closures averaged for the peak hour (as in the OmniTRANS model). Both modelled barrier timings are based on the same observed dataset collected on Tuesday 10th March 2009 by *Count on Us Transportation Data Collection* on behalf of *BAA*.

4.17.4 The results from the S-Paramics models are shown in **Table 4.8**. It can be seen that where the level crossings were replicated using average downtimes, as in OmniTRANS, mean journey times and total network delay were higher, with a corresponding decrease in average speed.

| Network Performance | Individual Downtimes | Average Downtimes | Percentage Difference |
|---|---|---|---|
| Total demand (no. of vehicles) | 9841 | 9841 | 0% |
| Total completed trips (no. of vehicles) | 9816 | 9816 | 0% |
| Mean speed (mph) | 11.0 | 10.8 | -2% |
| Mean travel time for completed trips (mm:ss) | 04:22 | 04:27 | 2% |
| Total network delay (days) | 29.8 | 30.3 | 2% |

**Table 4.8: AM peak period S-Paramics results of the comparison between replicating individual and average level crossing downtimes at Thorpe Road**

4.17.5 Consequently the results illustrate that using averaged barrier timings provides higher levels of congestion than modelling the actual barrier downtimes, but the results are similar with a difference of only 2%.

4.17.6 This suggests that the method of level crossing replication within the OmniTRANS model is sufficient for this assessment work. If anything, OmniTRANS overestimates delays at the level crossings and thus reflects more of a worst-case scenario.

## 4.18 Cordon Assessment

4.18.1 An assessment of the proposed Pooley Green underpass had been performed using the full SINTRAM model (SINTRAM40_100426.Dev_Pooley), which was enhanced in the study area, as described in this report.

4.18.2 Due to concern regarding the limited benefits of the underpass apparent from this work, the model was cordoned to verify these findings.

4.18.3 The cordon was derived to limit route choice between major corridors in near proximity to the Egham area, as shown in **Figure 4.14** below.

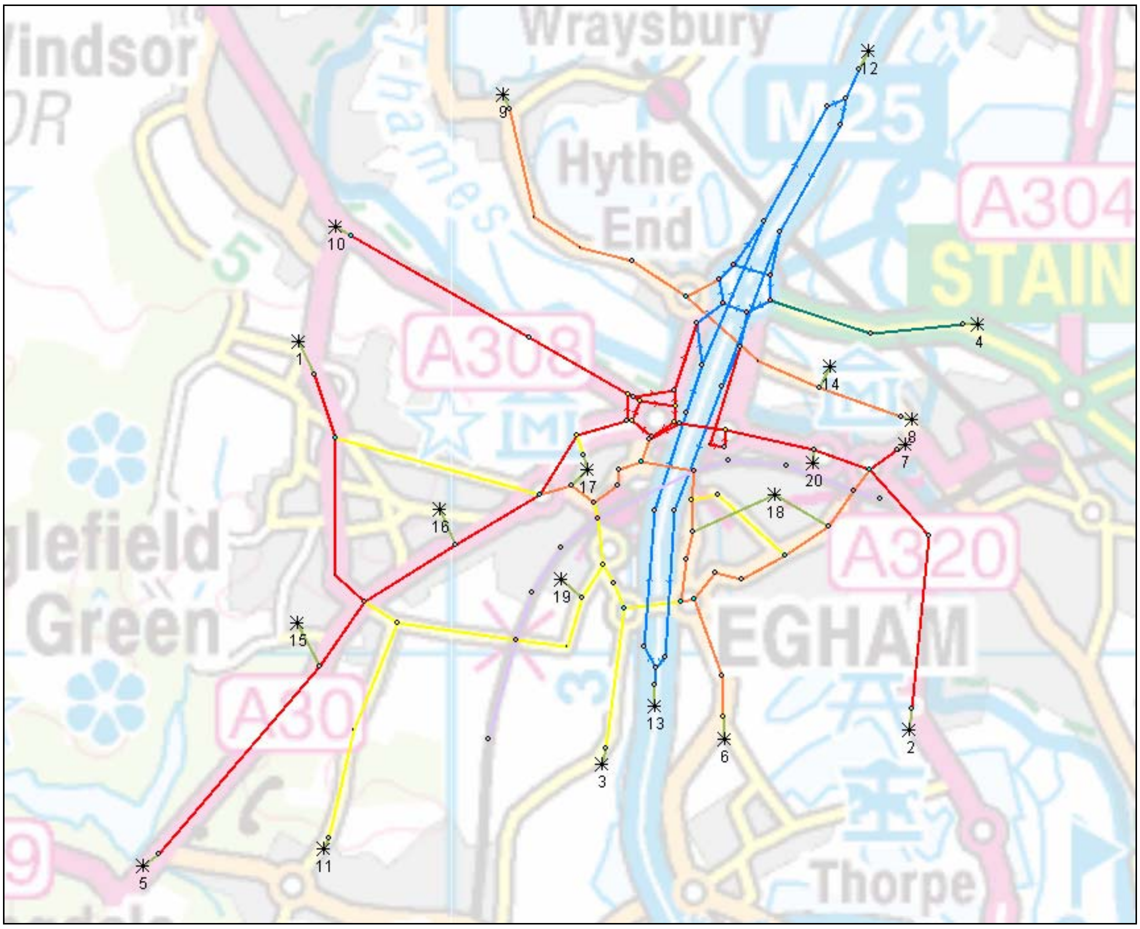


**Figure 4.14: Extent of the cordon**

4.18.4 The 2016 demand matrices for the entire model were regenerated for the cordoned area using OmniTRANS routines, and the assignment method described below. The matrices were acquired from the original 2016 do-nothing (scenario 1) network. The resulting AM peak hour (08:00 – 09:00) and average PM peak hour (16:00 – 19:00) matrices were employed for all of the three model scenarios, set out below.

- **Do-nothing**: this is the forecast situation without the Airtrack scheme. Hence the level crossing facilities do not include Airtrack trains, but they do reflect the future estimation of train schedules.

- **Do-minimum**: this maintains the Vicarage Road level crossing facility to manage vehicle and train travel at the same level. The downtimes for level crossings, resulting from Airtrack's increased use of the rail line, have been reflected in this model scenario.

- **Do-something**: this replaces the Vicarage Road level crossing facility with an underpass so that road traffic travels at a different level to that of the trains, and is unhindered. As with scenario 2, the downtimes for level crossings from Airtrack's usage of the rail line have been reflected. It must be noted, however, that traffic calming along B388 Vicarage Road has NOT been included.

4.18.5 As with the full model, a fixed trip equilibrium assignment was performed using the Method of Successive Averages (MSA) with Burrell type perturbations. Using a spread factor of 2, the assignment was run for 70 iterations.

4.18.6 **Table 4.9** shows the output from the cordoned model for the three scenarios.

| Scenario | AM Peak Hour (08:00 – 09:00) | | | Av. PM Peak Hour (16:00 - 19:00) | | |
|---|---|---|---|---|---|---|
| | Flow (vph) | Average Speed (kph) | Junction Delay (seconds) | Flow (vph) | Average Speed (kph) | Junction Delay (seconds) |
| *Thorpe Road Northbound* | | | | | | |
| Do-nothing | 589 | 39.5 | 42.0 | 632 | 38.8 | 35.2 |
| Do-minimum | 516 | 40.7 | 67.6 | 636 | 38.7 | 65.6 |
| Do-something | 517 | 40.7 | 67.5 | 652 | 38.5 | 66.1 |
| *Thorpe Road Southbound* | | | | | | |
| Do-nothing | 353 | 43.2 | 42.0 | 520 | 40.7 | 35.2 |
| Do-minimum | 322 | 43.8 | 67.6 | 510 | 40.8 | 65.6 |
| Do-something | 310 | 44.0 | 67.5 | 505 | 40.9 | 66.1 |
| *Vicarage Road Northbound* | | | | | | |
| Do-nothing | 518 | 40.4 | 77.8 | 291 | 44.3 | 86.7 |
| Do-minimum | 557 | 39.7 | 57.5 | 318 | 43.9 | 69.7 |
| Do-something | 641 | 38.4 | 0.0 | 403 | 42.5 | 0.0 |
| *Vicarage Road Southbound* | | | | | | |
| Do-nothing | 593 | 39.2 | 77.8 | 776 | 36.4 | 86.7 |
| Do-minimum | 593 | 39.2 | 57.5 | 811 | 35.9 | 69.7 |
| Do-something | 684 | 37.7 | 0.0 | 905 | 34.3 | 0.0 |
| *Station Road Northbound* | | | | | | |
| Do-nothing | 358 | 43.2 | 29.4 | 343 | 43.5 | 28.8 |
| Do-minimum | 349 | 43.4 | 54.1 | 309 | 44.0 | 68.8 |
| Do-something | 342 | 43.5 | 53.6 | 284 | 44.4 | 67.3 |
| *Station Road Southbound* | | | | | | |
| Do-nothing | 448 | 41.6 | 29.4 | 465 | 41.5 | 28.8 |
| Do-minimum | 411 | 42.2 | 54.1 | 402 | 42.5 | 68.8 |
| Do-something | 391 | 42.5 | 53.6 | 361 | 43.2 | 67.3 |
| *Prune Hill Westbound* | | | | | | |
| Do-nothing | 321 | 23.6 | 5.5 | 479 | 21.1 | 5.3 |
| Do-minimum | 313 | 23.7 | 6.9 | 469 | 21.3 | 9.2 |
| Do-something | 304 | 23.8 | 6.9 | 455 | 21.5 | 9.1 |
| *Prune Hill Eastbound* | | | | | | |
| Do-nothing | 342 | 23.3 | 5.5 | 227 | 25.3 | 5.3 |
| Do-minimum | 358 | 23.1 | 6.9 | 254 | 24.8 | 9.2 |
| Do-something | 366 | 22.9 | 6.9 | 268 | 24.6 | 9.1 |

**Table 4.9: Cordon results for the year 2016**

4.18.7 The results show that during the peak hours between 84 and 91 additional vehicles travel via the proposed underpass in each direction of travel in the do-something compared with the do-minimum scenario. The underpass has diverted a very small number of trips away from Thorpe Road level crossing (in the order of 5 to 10 vehicles in the southbound direction of travel). There is, however, more of an abstraction from Station Road level crossing of 7 to 25 vehicles for the northbound direction, and 20 to 41 vehicles in the southbound direction of travel, although the numbers of vehicles that have diverted from Station Road level crossing to the underpass remain low. It is similar at Prune Hill level crossing in the do-something compared with the do-minimum. Here, there is a reduction of 9 to 14 vehicles in the westbound direction. In the eastbound direction, there are 8 vehicles less in the AM peak hour, but an increase of 14 vehicles during the average PM peak hour.

4.18.8 **Table 4.10** compares the predicted traffic flow across level crossings for the cordoned model with that from the entire model. Because the traffic calming along Vicarage Road has been excluded from this assessment, the do-something scenario is equivalent to scenario 6 from the full model study.

| Flow (vph) | AM Peak Hour (08:00 – 09:00) | | | Av. PM Peak Hour (16:00 - 19:00) | | |
|---|---|---|---|---|---|---|
| | Cordon Model | Full Model | Difference | Cordon Model | Full Model | Difference |
| *Thorpe Road Northbound* | | | | | | |
| Do-nothing | 589 | 464 | 125 | 632 | 399 | 233 |
| Do-minimum | 516 | 413 | 103 | 636 | 324 | 312 |
| Do-something | 517 | 451 | 66 | 652 | 356 | 296 |
| *Thorpe Road Southbound* | | | | | | |
| Do-nothing | 353 | 382 | -29 | 520 | 534 | -14 |
| Do-minimum | 322 | 328 | -6 | 510 | 480 | 30 |
| Do-something | 310 | 378 | -68 | 505 | 475 | 30 |
| *Vicarage Road Northbound* | | | | | | |
| Do-nothing | 518 | 553 | -35 | 291 | 361 | -71 |
| Do-minimum | 557 | 598 | -41 | 318 | 409 | -91 |
| Do-something | 641 | 670 | -29 | 403 | 547 | -144 |
| *Vicarage Road Southbound* | | | | | | |
| Do-nothing | 593 | 505 | 88 | 776 | 656 | 120 |
| Do-minimum | 593 | 576 | 17 | 811 | 679 | 132 |
| Do-something | 684 | 698 | -14 | 905 | 874 | 31 |
| *Station Road Northbound* | | | | | | |
| Do-nothing | 358 | 349 | 9 | 343 | 244 | 99 |
| Do-minimum | 349 | 327 | 22 | 309 | 203 | 106 |
| Do-something | 342 | 314 | 28 | 284 | 160 | 124 |
| *Station Road Southbound* | | | | | | |
| Do-nothing | 448 | 456 | -8 | 465 | 499 | -34 |
| Do-minimum | 411 | 421 | -10 | 402 | 428 | -26 |
| Do-something | 391 | 376 | 15 | 361 | 365 | -4 |
| *Prune Hill Westbound* | | | | | | |
| Do-nothing | 321 | 398 | -77 | 479 | 554 | -75 |
| Do-minimum | 313 | 432 | -119 | 469 | 537 | -68 |
| Do-something | 304 | 401 | -97 | 455 | 529 | -74 |
| *Prune Hill Eastbound* | | | | | | |
| Do-nothing | 342 | 387 | -45 | 227 | 207 | 20 |
| Do-minimum | 358 | 385 | -27 | 254 | 241 | 13 |
| Do-something | 366 | 390 | -24 | 268 | 273 | -5 |

**Table 4.10: Flow comparison across level crossings between the full and cordoned model**

4.18.9 With the exception of Thorpe Road level crossing in the northbound direction of travel, the modelled flows are similar between the full and cordoned models.

4.18.10 Moreover, the full model shows a similar increase in flow northbound along Vicarage Road in the do-something (with underpass) compared with the do-minimum (without underpass) scenario. This has been estimated as 72 to 138 vehicles in the full model, compared with 84 to 85 vehicles in the cordon model. In the opposite southbound direction of travel, however, the full model reports a larger increase in flow with an underpass of 122 to 195 vehicles, compared with 91 to 94 vehicles in the cordon model.

4.18.11 **Table 4.11** compares the delay experienced at the level crossings for the cordoned model with that from the entire model.

4.18.12 It can be seen that there is very little difference in delay at the level crossings experienced in both models. The maximum difference is 7.5 seconds at Thorpe

Road during the average PM peak hour for the do-something scenario. This is due to the cordon model having a larger flow, as shown in **Table 4.10**.

| Junction Delay (seconds) | AM Peak Hour (08:00 – 09:00) | | | Av. PM Peak Hour (16:00 - 19:00) | | |
|---|---|---|---|---|---|---|
| | Cordon Model | Full Model | Difference | Cordon Model | Full Model | Difference |
| *Thorpe Road* | | | | | | |
| Do-nothing | 42.0 | 39.9 | 2.1 | 35.2 | 32.8 | 2.4 |
| Do-minimum | 67.6 | 64.5 | 3.1 | 65.6 | 58.4 | 7.2 |
| Do-something | 67.5 | 66.3 | 1.2 | 66.1 | 58.6 | 7.5 |
| *Vicarage Road* | | | | | | |
| Do-nothing | 77.8 | 76.1 | 1.7 | 86.7 | 79.5 | 7.2 |
| Do-minimum | 57.5 | 58.0 | -0.5 | 69.7 | 62.7 | 7.0 |
| Do-something | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| *Station Road* | | | | | | |
| Do-nothing | 29.4 | 29.5 | -0.1 | 28.8 | 28.9 | -0.1 |
| Do-minimum | 54.1 | 54.1 | 0.0 | 68.8 | 68.7 | 0.1 |
| Do-something | 53.6 | 53.0 | 0.6 | 67.3 | 66.5 | 0.8 |
| *Prune Hill* | | | | | | |
| Do-nothing | 5.5 | 5.6 | -0.1 | 5.3 | 5.5 | -0.2 |
| Do-minimum | 6.9 | 7.2 | -0.3 | 9.2 | 9.5 | -0.3 |
| Do-something | 6.9 | 7.1 | -0.2 | 9.1 | 9.4 | -0.3 |

**Table 4.11: Junction delay comparison at level crossings between the full and cordoned model**

4.18.13 Given the relatively small abstraction of traffic flow from Thorpe, Station and Prune Hill level crossings with the underpass in place at Vicarage Road, and the similarity of these results to that produced using the entire SINTRAM model, the main conclusions from the entire model assessment remain. These are summarised below:

- Due to the short distances typically travelled by those living and/or working locally, the proposed underpass does not attract sufficient numbers of trips away from the adjacent level crossings.

- Any attraction is further weakened by the fact that the highway network, which surrounds Egham to the north, is very congested and any re-routeing of trips away from their shortest path would involve travelling through Runnymede Roundabout and either the A30 or A320. Thus the cost of travelling via the underpass remains greater than travelling the most direct route via the remaining level crossings.

# 5 DISCUSSION OF RESULTS

5.1.1 The modelling work which has been undertaken suggests that the replacement of Vicarage Road level crossing with an underpass and associated traffic calming, as modelled in scenario 3, will not increase traffic flow along B388 Vicarage Road. In fact, traffic flow here will reduce compared with the do-minimum scenario 2, in 2016.

5.1.2 The intention of the underpass was to provide an unhindered route across the railway line for people who live and/or work locally. As shown, in the sensitivity test of scenario 6, the traffic calming situated along B388 Vicarage Road between its junction with B3407 High Street and Egham sports centre, restricts the number of vehicles that use this route. When the underpass is modelled with the traffic calming removed, the number of vehicles which traverse this route increases by more than 100 in each direction in 2016. However, the traffic calming is required to ensure that vehicles pass through the underpass at 20mph due its design constraints. Furthermore, the vehicles which were attracted to B388 Vicarage Road in scenario 6 previously travelled via A320 Chertsey Lane. The aim of the underpass is not to attract longer distance trips from higher classified roads, such as this or the A30, particularly as these routes are unaffected by the railway line.

5.1.3 Similarly, the model suggests that northbound traffic flow through the underpass is constrained by the junction capacity at B3407 The Avenue approach to Runnymede roundabout. Scenario 5 was a sensitivity test that increased B3407 The Avenue green time by 40%. This increased flow through Vicarage Road underpass, but only in the northbound direction. Again, the increased flow was drawn from more strategic roads and not from either Thorpe Road or Station Road level crossings.

5.1.4 The reason why trips are not being drawn to the underpass from the surrounding level crossings is the existing trip distribution of those vehicles which cross the level crossings in Egham. The level crossings from east to west serve the B3376, B388, C10 and D3191. Alternative routes that serve long distance trips are the A30, A308, A320 and the M25. These alternative routes are signed and unless users have good knowledge of the local area or have an origin or destination here, then they are unlikely to pass through Egham town centre or the level crossings that surround the town to its south. Additionally, observed roadside interview (RSI) data, as presented in **Appendix B**, shows that the majority of vehicles which cross Thorpe Road, Vicarage Road and Station Road level crossings are local. For example, nearly 60% of trips that cross Thorpe Road level crossing are less than 3 miles (5km) in length.

5.1.5 Consequently, for short trip distances, vehicles are not diverting away from their most direct route to travel via the proposed underpass and avoid a level crossing. The cost (or journey time) of doing this remains greater than the existing route. This is further hindered by the fact that Egham is surrounded to the north by major junctions, which include Runnymede roundabout and Staines Bridge roundabout, and the entire area is congested. Thus, diversion for short distance trips will not occur. A further illustration is those vehicles that travel 3 miles via B3376 Thorpe Road to reach their destination in Staines, will still travel via Thorpe Road level crossing and not Pooley Green underpass because the shortest route in distance still remains that with the least cost (and journey time). For example, the origin – destination data from the road side interview undertaken on the B3376 Thorpe Road (northbound), as presented in **Appendix B**, shows a concentration of origins in the Egham Hythe, and Pooley Green and Thorpe Lea areas with a concentration of destinations in the Staines area. The distance between Egham Hythe and Staines via Thorpe Road is less than 1.25 miles (2kms), but the distance for the same journey made via Vicarage Road level crossing / underpass is 3 miles (5km) and involves negotiating additional congestion on the network, notably Runnymede roundabout and the A308 The Causeway. Therefore, significant delay would need to be encountered before it would be worth trips diverting.

5.1.6 For these reasons, and the high costs that would be involved in constructing an underpass at Vicarage Road level crossing, a single underpass situated here is not the appropriate solution to the problem.

# 6 OTHER EFFECTS

6.1.1 The replacement of Vicarage Road level crossing with an underpass should provide benefit to train operations, which has not been quantified within this study.

6.1.2 Other benefits of an underpass, which have not been considered here, are safety and improved accessibility for all modes of travel, including walking and cycling.

# 7 MITIGATION TRIP ABSTRACTION

7.1.1 The number of vehicle trips that would need to be abstracted from the highway network to return vehicle delay to that in scenario 1 (pre-Airtrack "do-nothing") from scenario 2 (post-Airtrack "do-minimum") was calculated for the level crossings. The abstraction of trips is seen to represent the required success of proposed mitigation measures designed to ensure that the Airtrack scheme does not cause a negative impact to the highway network in Egham and its surrounding area.

7.1.2 The trip abstraction was calculated, for each level crossing and modelled time period, using the following method:

i) For each direction of travel, the flow was multiplied by the level crossing average delay to determine the total delay. This was acquired for the base, scenario 1 (do-nothing) and scenario 2 (do-minimum). The base total delay has been calculated for reference only.

ii) The total delay for scenario 1 was subtracted from scenario 2 to determine the amount of delay which would need to be reduced to achieve the level of delay experienced prior to the Airtrack scheme.

iii) This was finally divided by the average delay for scenario 2, to determine the total number of vehicles which would need to be abstracted to return total delay to scenario 1 levels.

7.1.3 The results are shown in **Table 7.1**.

| **Scenario** | **AM Peak Hour (08:00 – 09:00)** | | | **Av. PM Peak Hour (16:00 - 19:00)** | | |
|---|---|---|---|---|---|---|
| | **Flow** | **Delay (s)** | **Total Delay (s)** | **Flow** | **Delay (s)** | **Total Delay (s)** |
| Thorpe Road Northbound | | | | | | |
| Base | 437 | 43.46 | 18976 | 439 | 32.37 | 14201 |
| Sc. 1 (DN) | 464 | 39.85 | 18501 | 399 | 32.84 | 13115 |
| Sc. 2 (DM) | 413 | 64.49 | 26610 | 324 | 58.42 | 18941 |
| *Sc. 2 – 1* | *-* | *-* | *8109* | *-* | *-* | *5826* |
| *Sc. 2 trip abstraction* | *126* | *-* | *-* | *100* | *-* | *-* |
| *Sc. 2 with mitigation* | *287* | *64.49* | *18501* | *225* | *58.42* | *13115* |
| Thorpe Road Southbound | | | | | | |
| Base | 343 | 43.46 | 14901 | 434 | 32.37 | 14047 |
| Sc. 1 (DN) | 382 | 39.85 | 15229 | 534 | 32.84 | 17529 |
| Sc. 2 (DM) | 328 | 64.49 | 21130 | 480 | 58.42 | 28061 |
| *Sc. 2 – 1* | *-* | *-* | *5900* | *-* | *-* | *10533* |
| *Sc. 2 trip abstraction* | *91* | *-* | *-* | *180* | *-* | *-* |
| *Sc. 2 with mitigation* | *236* | *64.49* | *15229* | *300* | *58.42* | *17529* |
| Vicarage Road Northbound | | | | | | |
| Base | 628 | 51.57 | 32383 | 422 | 42.04 | 17749 |
| Sc. 1 (DN) | 553 | 76.10 | 42056 | 361 | 79.46 | 28694 |
| Sc. 2 (DM) | 598 | 58.01 | 34714 | 409 | 62.74 | 25681 |
| *Sc. 2 – 1* | *-* | *-* | *-7342* | *-* | *-* | *-3012* |
| *Sc. 2 trip abstraction* | *-127* | *-* | *-* | *-48* | *-* | *-* |
| *Sc. 2 with mitigation* | *725* | *58.01* | *42056* | *457* | *62.74* | *28694* |
| Vicarage Road Southbound | | | | | | |
| Base | 590 | 51.57 | 30429 | 596 | 42.04 | 25073 |
| Sc. 1 (DN) | 505 | 76.10 | 38446 | 656 | 79.46 | 52139 |
| Sc. 2 (DM) | 576 | 58.01 | 33403 | 679 | 62.74 | 42616 |
| *Sc. 2 – 1* | *-* | *-* | *-5042* | *-* | *-* | *-9523* |
| *Sc. 2 trip abstraction* | *-87* | *-* | *-* | *-152* | *-* | *-* |
| *Sc. 2 with mitigation* | *663* | *58.01* | *38446* | *831* | *62.74* | *52139* |
| Station Road Northbound | | | | | | |
| Base | 322 | 38.19 | 12312 | 233 | 26.77 | 6250 |
| Sc. 1 (DN) | 349 | 29.52 | 10291 | 244 | 28.89 | 7046 |

| Scenario | AM Peak Hour (08:00 – 09:00) | | | Av. PM Peak Hour (16:00 - 19:00) | | |
|---|---|---|---|---|---|---|
| | Flow | Delay (s) | Total Delay (s) | Flow | Delay (s) | Total Delay (s) |
| Sc. 2 (DM) | 327 | 54.06 | 17700 | 203 | 68.70 | 13951 |
| *Sc. 2 – 1* | *-* | *-* | *7409* | *-* | *-* | *6905* |
| *Sc. 2 trip abstraction* | *137* | *-* | *-* | *101* | *-* | *-* |
| *Sc. 2 with mitigation* | *190* | *54.06* | *10291* | *103* | *68.70* | *7046* |
| Station Road Southbound | | | | | | |
| Base | 335 | 38.19 | 12796 | 348 | 26.77 | 9312 |
| Sc. 1 (DN) | 456 | 29.52 | 13464 | 499 | 28.89 | 14409 |
| Sc. 2 (DM) | 421 | 54.06 | 22765 | 428 | 68.70 | 29371 |
| *Sc. 2 – 1* | *-* | *-* | *9300* | *-* | *-* | *14962* |
| *Sc. 2 trip abstraction* | *172* | *-* | *-* | *218* | *-* | *-* |
| *Sc. 2 with mitigation* | *249* | *54.06* | *13464* | *210* | *68.70* | *14409* |
| Prune Hill Westbound | | | | | | |
| Base | 184 | 5.02 | 925 | 339 | 4.51 | 1529 |
| Sc. 1 (DN) | 398 | 5.62 | 2235 | 554 | 5.45 | 3020 |
| Sc. 2 (DM) | 432 | 7.18 | 3102 | 537 | 9.47 | 5088 |
| *Sc. 2 – 1* | *-* | *-* | *868* | *-* | *-* | *2068* |
| *Sc. 2 trip abstraction* | *121* | *-* | *-* | *218* | *-* | *-* |
| *Sc. 2 with mitigation* | *311* | *7.18* | *2235* | *319* | *9.47* | *3020* |
| Prune Hill Eastbound | | | | | | |
| Base | 303 | 5.02 | 1523 | 164 | 4.51 | 740 |
| Sc. 1 (DN) | 387 | 5.62 | 2173 | 207 | 5.45 | 1130 |
| Sc. 2 (DM) | 385 | 7.18 | 2764 | 241 | 9.47 | 2284 |
| *Sc. 2 – 1* | *-* | *-* | *591* | *-* | *-* | *1155* |
| *Sc. 2 trip abstraction* | *82* | *-* | *-* | *122* | *-* | *-* |
| *Sc. 2 with mitigation* | *303* | *7.18* | *2173* | *119* | *9.47* | *1130* |
| Total Trip Abstraction | | | | | | |
| ***Northbound*** | ***257*** | ***-*** | ***-*** | ***371*** | ***-*** | ***-*** |
| ***Southbound*** | ***259*** | ***-*** | ***-*** | ***368*** | ***-*** | ***-*** |
| ***Both directions*** | ***516*** | ***-*** | ***-*** | ***739*** | ***-*** | ***-*** |

**Table 7.1: Trip abstraction to attain nil-detriment impact of the Airtrack scheme**

7.1.4 At Vicarage Road level crossing, the barrier closure downtimes produce less delay with Airtrack in operation (in scenario 2) than without the Airtrack scheme (scenario 1). This has been explained further in **Section 4.9.3**. As a result, the total delay at Vicarage Road is less in scenario 2 than scenario 1 and negative abstraction values are shown in **Table 7.1**.

7.1.5 Regardless of this, at all the other level crossings, there is an increase in delay due to the Airtrack scheme.

7.1.6 In total, this assessment indicates that 516 vehicles will need to be abstracted at the level crossings in the AM peak hour (08:00 – 09:00), and 739 vehicles in the average PM peak hour (16:00 – 19:00), to ensure that Airtrack does not have a negative impact on the highway network within Egham and its surrounding area.

7.1.7 It must be noted, however, that the trip abstraction values cited above should be viewed as the maximum number of vehicles which would need to be removed to ensure a nil-detriment impact from the Airtrack scheme. This is because the method is simplistic. In particular, the delay at the crossing in scenario 2, in reality would reduce as the flow through the level crossings reduces. The reverse would also be true for an increase in flow. A change in delay resulting from trip abstraction has not been captured in the methodology applied above.

# 8 CONCLUSIONS

8.1.1 *Surrey County Council* have concerns regarding the increased length of level crossing closure to traffic in Egham due to Airtrack. As a result, the Council's strategic model was enhanced in the study area to assess the impact of various forecast scenarios on the highway network. The model was calibrated using observed traffic counts and roadside interview data. It achieved good flow and journey time validation, and is considered adequate for the assessment of the underpass and its associated mitigation measures.

8.1.2 Several scenarios were developed to assess the existing highway network, with and without Airtrack, and also proposed changes to the highway in an attempt to mitigate its impact. The scenarios were modelled for the forecast years 2016 and 2031.

8.1.3 The predominant scenario, presented as scenario 3, involved the replacement of Vicarage Road level crossing with an underpass, accompanied with traffic calming due to its design constraints.

8.1.4 The modelling work indicated that due to the short distances typically travelled by those living and/or working locally, as exhibited in the roadside interview surveys, the proposed underpass does not attract trips away from the adjacent Thorpe Road and Station Road level crossings. Any attraction is further weakened by the fact that the highway network, which surrounds Egham to the north, is very congested and any re-routeing of trips away from their shortest path would involve travelling through Runnymede Roundabout and either the A30 or A320. Thus, the cost of travelling via the underpass remains greater than travelling the most direct route via the remaining level crossings.

8.1.5 Consequently from this assessment, and the high monetary costs that would be involved in constructing an underpass at Vicarage Road level crossing, a single underpass situated here does not appear to be the appropriate solution to the problem, in terms of vehicle impact.

8.1.6 Finally, the number of vehicle trips that would need to be abstracted from the highway network to return vehicle delay to scenario 1 (pre-Airtrack "do-nothing") from scenario 2 (post-Airtrack "do-minimum") has been calculated for the level crossings. The abstraction of trips is seen to represent the required success of proposed mitigation measures designed to ensure that the Airtrack scheme does not cause a negative impact to the highway network in Egham and its surrounding area. It has been determined that a maximum total of 516 vehicles will need to be abstracted at the level crossings in the AM peak hour (08:00 – 09:00), and 739 vehicles in the average PM peak hour (16:00 – 19:00).

# 9 APPENDICES

## 9.1 Appendix A: Modelled Level Crossing Downtimes

9.1.1 The modelled level crossing downtimes, in **Table 8.1**, have been determined from level crossing information provided by Geoffrey Hill on behalf of *BAA*.

9.1.2 Observed level crossings operations were provided in an email to William Bryans dated 06/11/09, and to Gemma Thomas dated 06/04/10, both from Geoffrey Hill. These were used to calculate the crossing timings for the base situation.

9.1.3 Forecasted level crossings for the Airtrack scheme were provided in an email to Abigail Fielder dated 04/03/10 from Geoffrey Hill. These were revised timings. The "pre" results were used to calculate the crossing timings for scenario 1 (do-nothing), whilst the "post" timings were used for the scenario 2 to 6 (do-minimum and do-something models). "Pre" results reflect the observed level crossing barrier times collated by *Count on Us* in addition to *South West Trains* aspired services prior to Airtrack becoming live. Thus, "post" results are the predicted crossing barrier times with the addition of Airtrack.

9.1.4 For the PM base signal timings, these are an average of the PM period 16:00 to 19:00 to reflect that being modelled. For the do-nothing and do-something scenarios, however, the entire model time period was not available. For that reason, the predicted barrier timings for 17:00 to 18:00 have been used.

| **Level Crossing** | **No. of Times Barrier Shut** | **Total Time in Hour Barrier is Closed (mm:ss)** | **Modelled Timings (seconds)** | | |
|---|---|---|---|---|---|
| | | | **Vehicle Green Time** | **Train Green Time** | **Cycle Time** |
| *Base AM Peak Hour (08:00 – 09:00)* | | | | | |
| Thorpe Road | 10 | 26:00 | 204 | 156 | 360 |
| Vicarage Road | 10 | 26:06 | 203 | 157 | 360 |
| Station Road | 10 | 24:50 | 211 | 149 | 360 |
| Prune Hill | 10 | 08:25 | 310 | 50 | 360 |
| *Base Average PM Peak Hour (16:00 – 19:00)* | | | | | |
| Thorpe Road | 8 | 19:43 | 302 | 148 | 450 |
| Vicarage Road | 8 | 21:56 | 286 | 164 | 450 |
| Station Road | 8 | 18:37 | 310 | 140 | 450 |
| Prune Hill | 9 | 07:19 | 351 | 49 | 400 |
| *Scenario 1 (do-nothing) AM Peak Hour (08:00 – 09:00)* | | | | | |
| Thorpe Road | 8 | 22:01 | 285 | 165 | 450 |
| Vicarage Road | 7 | 27:35 | 278 | 236 | 514 |
| Station Road | 8 | 18:58 | 308 | 142 | 450 |
| Prune Hill | 12 | 09:24 | 253 | 47 | 300 |
| *Scenario 1 (do-nothing) PM Peak Hour (17:00 – 18:00)* | | | | | |
| Thorpe Road | 8 | 19:33 | 303 | 147 | 450 |
| Vicarage Road | 6 | 25:51 | 342 | 259 | 600 |
| Station Road | 7 | 17:32 | 364 | 150 | 514 |
| Prune Hill | 11 | 08:37 | 280 | 47 | 327 |
| *Scenarios 2 to 6 (do-minimum and do-something) AM Peak Hour (08:00 – 09:00)* | | | | | |
| Thorpe Road | 10 | 32:02 | 168 | 192 | 360 |
| Vicarage Road | 11 | 30:38 | 160 | 167 | 327 |
| Station Road | 10 | 29:06 | 185 | 175 | 360 |
| Prune Hill | 12 | 10:44 | 246 | 54 | 300 |
| *Scenarios 2 to 6 (do-minimum and do-something) PM Peak Hour (17:00 – 18:00)* | | | | | |
| Thorpe Road | 10 | 30:03 | 180 | 180 | 360 |
| Vicarage Road | 10 | 29:06 | 185 | 175 | 360 |
| Station Road | 8 | 29:41 | 227 | 223 | 450 |
| Prune Hill | 13 | 12:59 | 217 | 60 | 277 |

**Table 8.1: Modelled level crossing timings**

9.1.5 An example of the signal calculation is provided below for reference.

*Base AM peak hour (08:00 – 09:00) for Thorpe Road*

Total barrier open time = 34 minutes (= 60 minutes – 26 minutes)
Total barrier down time = 26 minutes
Number of times the barrier is down = 10

Stage 1 = open to vehicles = $\frac{34}{10}$ = 3 minutes 24 seconds (average time it is open to traffic)

Stage 2 = closed to vehicles = $\frac{26}{10}$ = 2 minutes 36 seconds (average time it is closed to traffic)

Therefore:-

| | | |
|---|---|---|
| Cycle time | = 6 minutes (3:24 + 2:36) | = 360 seconds |
| Stage 1 | = 3 minutes 24 seconds | = 204 seconds |
| Stage 2 | = 2 minutes 36 seconds | = 156 seconds |

9.1.6 The model represents traffic operations for a single hour within the AM and PM peak. Consequently, the signal timing values used in the model also reflects the average barrier closure operation for the same time periods. This is the most appropriate assessment of level crossing delay in this type of traffic model, particularly since there is daily fluctuation in barrier closures along the rail line, due to rail disruptions and the time it takes to clear the crossings of traffic, amongst other variables. Furthermore, modelled journey times along routes that pass across the level crossings showed a very good replication of those observed, as shown in **Section 2.7**. The method for calculating the level crossing times has been kept consistent between the base and each scenario, to ensure that the assessment is sound and that its impacts are evaluated appropriately.

## 9.2 Appendix B: Roadside Interview Analyses

9.2.1 Roadside Interview (RSI) data was collected by *Count On Us* on behalf of *BAA* at the following level crossing locations:

- Thorpe Road northbound;
- Vicarage Road northbound; and
- Station Road northbound.

9.2.2 The data was provided to *Surrey County Council* via an email from Geoffrey Hill to William Bryans dated 06/11/09.

9.2.3 An overview of observed trip length at each location for the observed period 07:00 to 19:00 hours is provided in **Figures 8.2** to **8.4** below.

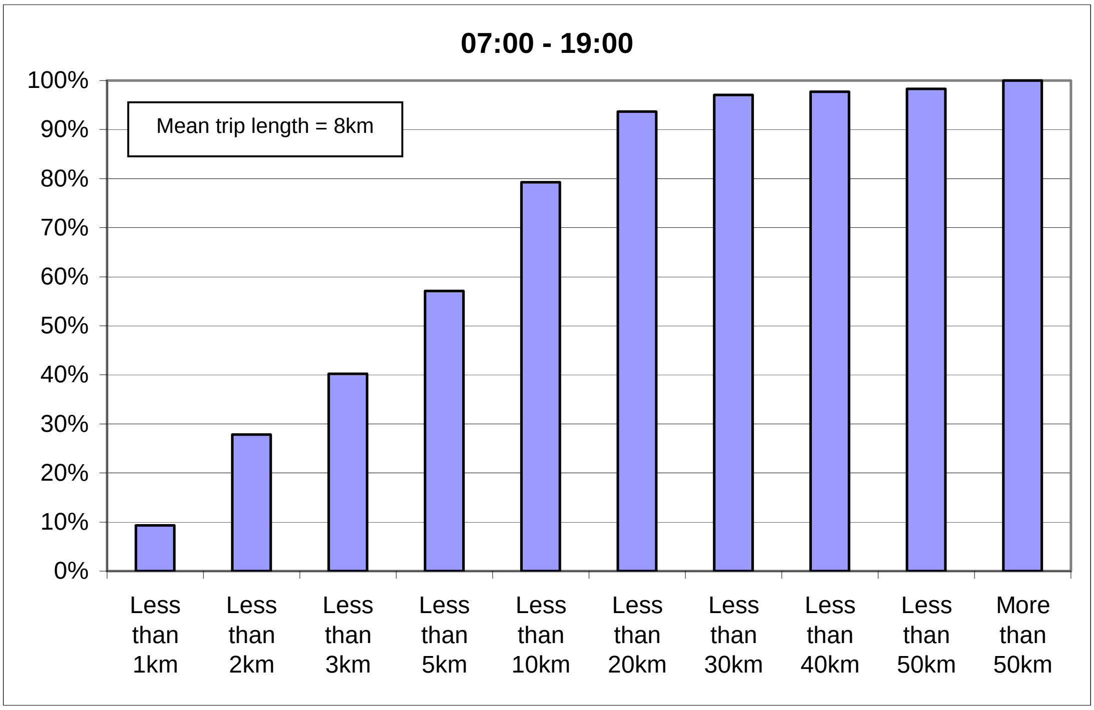


**Figure 8.2: Observed trip length distribution for Thorpe Road level crossing northbound (07:00 – 19:00)**

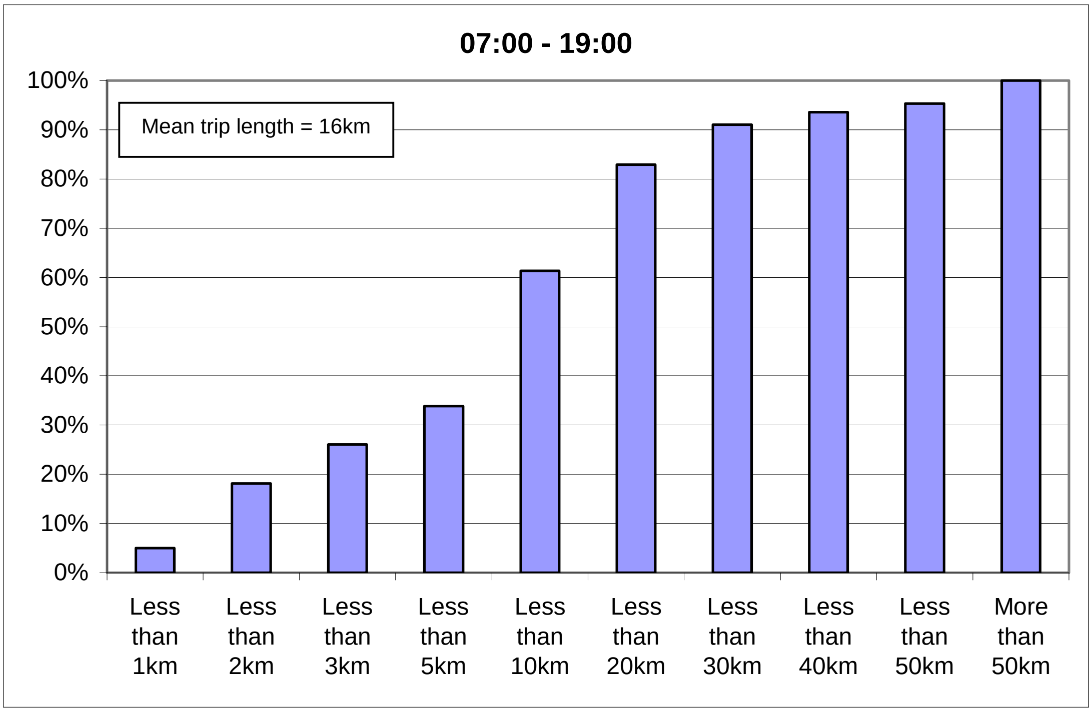


**Figure 8.3: Observed trip length distribution for Vicarage Road level crossing northbound (07:00 – 19:00)**

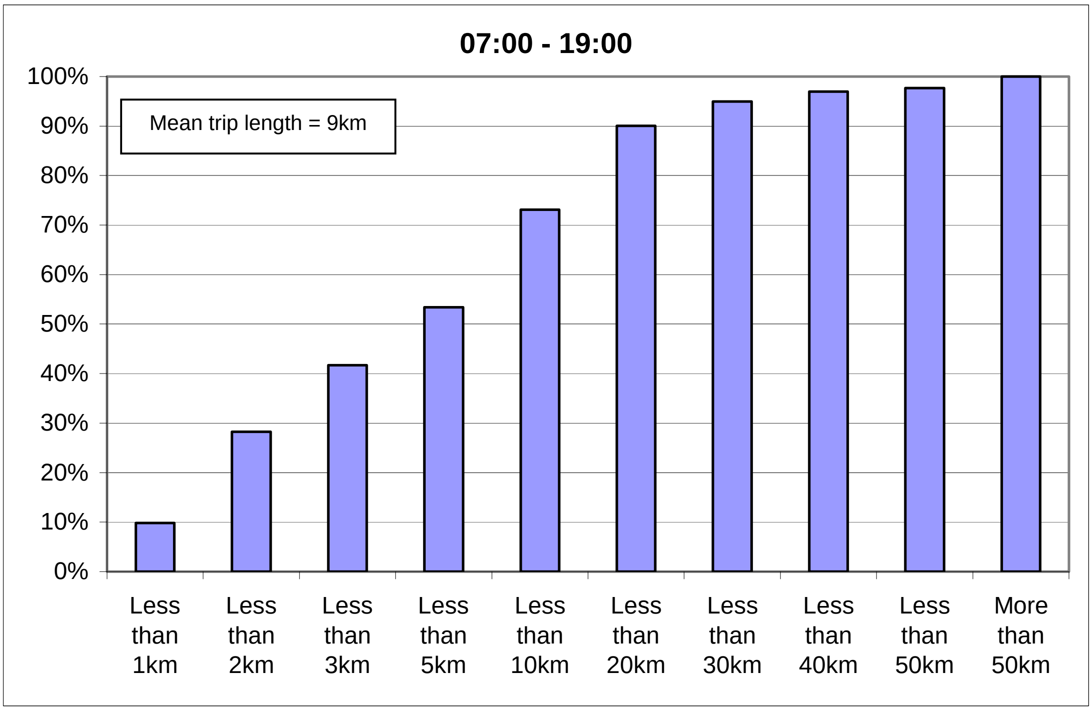


**Figure 8.4: Observed trip length distribution for Station Road level crossing northbound (07:00 – 19:00)**

## 9.3 Appendix C: Validation Acceptability Guidelines

9.3.1 Guidelines for model validation are set out in the *'Traffic Appraisal in Urban Areas*[6]*'*.

9.3.2 The standard method of comparison is to compare modelled values against observed.

9.3.3 The GEH statistic is recommended as a main indicator of comparison of traffic flows. It is a form of the Chi-squared statistic that incorporates both absolute and relative errors. The GEH statistic is defined as:

$$GEH = \sqrt{\frac{(M - C)^2}{(M + C) \times 0.5}}$$

Where $M$ = modelled flow, and
$C$ = observed flow.

General guidance on the GEH statistic is: a GEH below 5 represents a high level of acceptability, while those above 10 are viewed as unacceptable.

9.3.4 **Table 8.2** sets out the assignment acceptability guidelines, taken from the *'Design Manual for Roads and Bridges'*, which have been used to guide calibration and to check the validity of the model.

| Criteria and Measures | | Acceptability Guideline |
|---|---|---|
| *Assigned Modelled Hourly Flows Compared with Observed Flows* | | |
| 1. Observed flow < 700vph | Modelled flow within ±100vph | > 85% of cases |
| 2. Observed flow 700 – 2,700vph | Modelled flow within ±15% | |
| 3. Observed flow > 2,700vph | Modelled flow within ±400vph | |
| 4. GEH statistic for individual flows <5 | | |
| 5. GEH statistic <4 for screenline totals | | All (or nearly all screenlines) |
| 6. Total screenline flows (normally > 5 links) to be within 5% | | |
| *Modelled Journey Times Compared with Observed Times* | | |
| 7. Times within ±15% (or one minute, if higher) | | > 85% of cases |
| *All Comparisons should be Based on Directional Hourly Flows* | | |

**Table 8.2: Assignment acceptability guidelines**

[6] Highways Agency (1996), Design Manual for Roads and Bridges, Traffic Appraisals of Road Schemes, Volume 12a, Section 2, *'Part 1: Traffic Appraisal in Urban Areas'*, Chapter 4: Model Development.