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Warwickshire County Council

Stratford-on-Avon Strategic Transport Assessment

Phase 2 Modelling Report

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1 Executive Summary

1.1 Summary

Arup have been commissioned by Warwickshire County Council (WCC) and Stratford on Avon District Council (SDC) to undertake testing of two different approaches to the allocation of housing and employment as part of the emerging Core Strategy (CS), specifically:

- Allocation of 2,750 dwellings and 8Ha of employment within a Sustainable Urban Extension (SUE) to the south east of Stratford-upon-Avon as well as redevelopment of land to the north west of Stratford town centre, known as the Stratford Regeneration Zone (SRZ) for approx. 700 dwellings and 25 Ha of land on the northern edge of the town for employment across two additional sites.
- Allocation of 5,000 dwellings and 18Ha of employment in a New Settlement (NS) at Gaydon/Lighthorne Heath (G/LH).

1.2 Stages of Assessment

Two core options for the allocation of housing and employment have been tested. The SUE impacts have been tested within the Stratford-upon-Avon PARAMICS model. The NS impacts have been tested within both the M40 and Warwick and Leamington Wide Area (WLWA) PARAMICS Models.

Stratford-upon-Avon SUE Testing

Testing of the SUE has been undertaken through the completion of the following steps:

- The 2021 model has been forecast to 2028 and extended to include the route to the M40 from the southeast of Stratford, via the B4086 and the A429, to create a new Reference Case
- The 2028 Reference Case model has been amended to reflect the proposals contained within the Stratford Regeneration Zone (SRZ) and associated employment sites.
- The 2028 SRZ model has been amended to include provision for the SUE to the southeast within the modelling. Two potential alignments for the ERR have been included within the modelling, both involve delivery of a new section of road between the A422 and the B4086 then diverge as follows:
    - **ERR Option 1 -** B4086 Main Street, Tiddington and A439 Warwick Road/Ingon Lane including the elevated bridge section above the River Avon floodplain.
    - **ERR Option 2 -** Improving the alternative ERR route via the B4086 linking with the A429 at Wellesbourne.
- The aforementioned 2028 SUE models, inclusive of the ERR alignments, have been amended further to include the Town Centre Improvements (TCI) which consist primarily of the schemes proposed during the earlier STA analysis undertaken within the PARAMICS model.

- After an initial assessment was undertaken to understand the potential implication of delivering the two potential ERR alignment scenarios, as well as more detailed impact analysis of the preferred options, sensitivity testing was undertaken to understand:
    - The potential for delivering an HGV restriction across Clopton Bridge and the potential impacts thereof;
    - The potential implications of delivering additional development to the south of Stratford (SOS) with and without the ERR and SUE.

New Settlement Testing Overview

Testing of the impacts of the allocation of a New Settlement (NS) within the Gaydon and Lighthorne Heath (G/LH) areas has been undertaken via the following, staged, approach:

- The trip generation and distribution assumptions were first included within the M40 corridor model, inclusive of Junction 12 proposals, and a review of the network performance was undertaken.
- Proximate and localised mitigation measures were then proposed and tested within the M40 PARAMICS model.
- Following the M40 corridor testing, outputs from the corridor model, pertaining to the movement of development trips across the M40 and B4100, were fed into the Warwick and Leamington Wide Area (WLWA) model.
- The WLWA model testing was undertaken inclusive of the sites and mitigation measures identified during the recent stages of the Warwick District Council Strategic Transport Assessment.
- An initial review of the network performance, once the development demand had been included within the model network, was undertaken and some initial mitigation measures were proposed.
- The WLWA model inclusive of the NS and mitigation measures was then also run and the outputs from all scenarios were assessed.

1.3 Scenario Overview

1.3.1 Stratford SUE

The purpose of the testing undertaken within the Stratford-upon-Avon model was to understand the impacts of the allocation of the Stratford Regeneration Zone (SRZ) Policy as well as the delivery of a Sustainable Urban Extension (SUE) to the southeast of Stratford-upon-Avon.

The SRZ policy comprises the redevelopment of land within Stratford-upon-Avon to facilitate the delivery of 700 dwellings as well as the allocation of 25Ha proposed employment across two areas on the periphery of the Stratford-upon-Avon network, partly to relocate businesses from the SRZ.

The SUE proposals adopted within the modelling assume the delivery of 2,750 dwellings alongside 8 Ha B1 Employment.

A secondary set of scenarios have been tested whereby an additional 2,000 houses have been allocated on land to the south of Stratford (SOS). Subsequent testing

was then undertaken to understand the impacts of the removal of the ERR and then the SUE iteratively.

1.3.2 New Settlement At Gaydon Lighthorne Heath

The assumptions pertaining to the delivery of the NS at G/LH include the delivery of 5,000 dwellings alongside 18Ha of B1 employment. Testing of the localised impacts of the NS has assumed that the proposed scheme at J12 will be completed prior to the delivery of the NS.

1.4 Mitigation Measures

Throughout the course of the testing iterative reviews of the network performance have been undertaken and, where appropriate, additional mitigation has been included or existing schemes have been optimised.

1.4.1 SUE Mitigation

The mitigation measures included within the SUE testing include:

- Delivery of an Eastern Relief Road
- Delivery of the majority of the measures proposed within the earlier STA work which form the Town Centre Improvements (TCI), namely:
    - Signalisation/reconfiguration of the Evesham Road/Evesham Place roundabout
    - Signalisation of the Bridgeway Gyratory
    - Signalisation/reconfiguration of the Banbury Road/Shipston Road roundabout
    - Signalisation/reconfiguration of the Tiddington Road/Swan's Nest Lane/Banbury Road junction
    - High Street and Grove Road to become northbound (NB) only
    - Rother Street to become southbound (SB) only
- In addition to the schemes proposed as part of the initial TCI Works, schemes have also been proposed at the Shipston Road/Trinity Way and the Shipston Road/Clifford Road roundabouts. The current proposals involve substantial widening of both roundabouts and the delivery of two lanes NB and SB between the two junctions.

1.4.2 New Settlement Mitigation

The mitigation measures proposed through the NS testing include:

- Introduction of a new NB slip onto the M40 from the B4451 which omits the need for vehicles to turn right from the B4451 NB to access the M40. The left turn from the B4451 SB is still currently maintained and vehicles merge prior to merging onto the M40. Further review of this configuration is required and such an arrangement may potentially be replaced by an arrangement which involves signalisation of the right turn from the B4451 SB towards the M40 NB on-slip.
- Introduction of signals at the NB off-slip of J13, queue detectors have been used to ensure that queuing does not propagate back onto the M40 mainline.

- Introduction of Managed Motorway (MM) All Lanes Running (ALR) between J13 and J14.
- Introduction of Ramp Metering on the J13 SB on-slip
- Widening of the circulating carriageway and all approaches to the Fosse Way/A452 roundabout, provision of two lane exit flares on the Fosse Way in both directions.
- Further enhancements to Grey's Mallory, including revision of the lane markings between the B4100 WB and Europa Way NB, and addition of a third lane to accommodate more traffic movements from Europa Way SB to the B4100 EB.
- Addition of a left turn slip from Oakley Wood Rd NB to Harbury Lane WB

1.4.3 Further Mitigation

Despite the identification of the schemes outlined previously, most of the outputs that have been assessed thus far are based on a small number of iterations as far as the identification and optimisation of the proposed mitigation measures is concerned. It is highly likely that, during future stages of the assessment, additional mitigation measures will be identified which will further reduce the proposed impacts and improve the overall level of network operation. Potentially such future schemes that may be defined include delivery of ramp metering at J13 and signalisation of the B4100/Fosse Way roundabout.

1.5 Testing Overview

The following presents the initial conclusions alongside any future considerations and recommendations based on each individual stage of the assessment.

1.6 Stage 1 – SUE Testing

The first stage of testing focussed on the impact assessment of the SRZ and SUE allocations alongside two potential options for the ERR both with and without the Town Centre Improvement schemes, a refined set of mitigation measures delivered within the town centre and surrounding area.

The conclusions drawn from this first stage of testing have been summarised as follows:

- That the ERR Option 2 alignment is unlikely to sufficiently mitigate the potential impacts of locating the SUE to the southeast of Stratford-upon-Avon
- That there are impacts attributable to the adoption of the SRZ policy that would likely benefit from further investigation and, potentially, focussed mitigation.
- That both ERR Option 1 scenarios (with and without TCI measures) appear to be able to facilitate the additional demand assigned to the network as a result of the SUE.
- That the inclusion of the TCI measures, in addition to the ERR, results in the most improved network conditions when compared to those present within the 2028 Reference Case.

A more detailed review of the impacts on town centre 'through trips' and the impacts on key links within the town revealed the following initial conclusions:

- That, compared to the 2028 SRZ only scenario, the introduction of the ERR is likely to result in a reduction in the number of through trips within the town centre.
- That, during the PM period, the introduction of the TCI measures alongside the ERR is likely to result in a level of 'through trips' which is not dissimilar to the level experienced within the 2028 Reference Case.
- The introduction of measures along Seven Meadows Road and Trinity Way has the potential to complement the ERR implementation in providing improved conditions for vehicles travelling East to West and vice versa between Evesham Road, the proposed ERR and onwards to the M40.
- The impacts are more noticeable within the PM than the AM because the network is much closer to capacity during the PM period and, as a result, vehicles are more likely to reassign away from major routes in response to existing congestion effects. It is likely that, in the AM, when the magnitude of demand approaches the levels observed during the PM period these effects would be replicated within the AM network.
- That, compared to the 2028 SRZ only scenario, the introduction of the ERR is likely to result in a reduction in the number of vehicular movements on some key links within the town centre whilst others will remain broadly static.
- The inclusion of ERR Option 1 provides the possibility of delivering an HGV restriction on Clopton Bridge with minimal impact on HGV or other user-classes.
- Analysis of the flow differences across the town centre indicated that additional restrictions could potentially be added to Church Street, Chapel Street and High Street to reduce the magnitude of the predicted reassignment but it is likely that this would lead to a reduction in the level of network performance when compared to the current level which is already at a lower level than the 2028 Reference Case.

It is recommended that future stages of the assessment should, where possible; reflect the following recommendations and points of consideration:

- An isolated assessment of the impacts of the SRZ policy application, specifically in terms of localised impacts on delay and queuing, should be undertaken with a view to determining a localised mitigation strategy to accompany the SRZ, to lessen the impact of the SRZ prior to the inclusion of the SUE/ERR and TCI measures.
- Further analysis to ascertain the benefits of the delivery of the TCI measures, at least to some extent, alongside the SRZ policy but without including the SUE or ERR would assist in identifying the potential benefits that are unlocked by delivering the TCI measures irrespective of whether the SUE/ERR is progressed.
- Sensitivity testing regarding the mode shift parameters should be undertaken and this analysis should be supported by some initial feasibility assessments regarding the provision of public transport (PT) measures. Furthermore, the feasibility of delivering the PT measures

alongside the TCI and any future mitigation measures should be undertaken to understand how reasonable it is to assume that such measures could be delivered.

1.7 Stage 2 – South of Stratford Sensitivity Test

Detailed sensitivity testing was undertaken whereby an additional 2,000 dwellings were allocated on land to the south of Stratford (SOS), specifically to the west of the B4632 and to the east of Long Marston.

Based on the outcome of the SOS sensitivity testing the following conclusions have been identified:

- The additional development can be delivered to the south of Stratford without the need for a substantial increase in the level of mitigation over and above that which is proposed through the ERR and TCI measures.
- That the delivery of the ERR or mitigation of a similar scale is required irrespective of whether the SUE is included within the network or not.

It is recommended that further analysis of the potential for delivering development to the south of Stratford is undertaken inclusive of a complete review of the potential network impacts to enable a more refined mitigation strategy to be developed that complements the proposals since, at this stage, testing has involved including the development alongside a series of largely pre-determined mitigation measures.

1.8 Stage 3 – New Settlement Localised Testing

Trip generation associated with the NS was initially assigned within the M40 corridor PARAMICS model inclusive of current J12 proposals.

Based on the initial testing undertaken within the M40 PARAMICS model the following conclusions have been drawn:

- That the access strategy delivered alongside the development should include at least 4 junctions between the site and the B4100, two of which could tie into junctions that are anticipated to be delivered through the existing J12/B4100 proposals, the existing priority junction just north of Winyates Rd could also be retained plus one or two new junctions north of Lighthorne Heath.
- That, as a minimum, the following localised mitigation measures are likely to be required to minimise impacts on the B4100 and M40 as a result of the inclusion of the development:
    - Introduction of a new NB slip onto the M40 from the B4451 which omits the need for vehicles to turn right from the B4451 NB to access the M40.
    - Introduction of signals at the J13 NB off-slip.
    - Introduction of Managed Motorway (MM) All Lanes Running (ALR) between J13 and J14.

It is recommended that any future, more detailed testing within the M40 model should be undertaken on an extended model which includes the Chesterton Road/Harbury Lane route from the proposed development site as this route runs

parallel to the M40 and B4100 and it is likely that more Warwick-bound traffic, will reassign along this route. These are not accounted for within the current extent of the model.

Similarly, additional impact analysis is likely to be required to establish the wider impacts of the NS on areas such as Bishops Itchington, Southam and Kineton. At this stage the traffic movements between the NS and these areas are predicted to be relatively small in comparison to the M40 and Warwick/Leamington bound trips which comprise approximately 85% to 95% of the total NS traffic movements across the model network. Detailed analysis of the potential impacts in these areas will need to be considered during any future stage of assessment.

1.9 Stage 4 – New Settlement Strategic Testing

Once the M40 corridor modelling was completed trip movements associated with the NS were extracted from the M40 model and transposed into the WLWA model which already included the current WDC Local Plan development and traffic mitigation measures.

Based on the outcome of the first phase of this strategic, cumulative, assessment the following conclusions have been drawn:

- That, as a minimum, the following strategic mitigation measures, should be considered for delivery alongside the development at Lighthorne:
    - Implementation of MM ALR south of M40 J13 to J12
    - Signalisation of the J13 NB off-slip
    - Widening of the circulating carriageway and all approaches to the Fosse Way/A452 roundabout, provision of two lane exit flares on the Fosse Way in both directions.
    - Further enhancements to Grey's Mallory, including revised lane markings between the B4100 WB and Europa Way NB, and addition of a third lane to accommodate more traffic movements from Europa Way SB to the B4100 EB.
    - Addition of a left turn slip from Oakley Wood Rd NB to Harbury Lane WB
- In addition to the aforementioned schemes provision for Ramp Metering at the J13 SB on-slip is likely to be required, this is partly attributable to the proposed development trips but is also likely to be triggered by the improvements at J12 and the fact that this scheme will encourage existing and future traffic to travel between J13 and J12 via the M40 rather than the B4100 as is currently the case.
- Initial findings from the assessment undertaken within the WLWA model, inclusive of WDC Local Plan considerations, indicate that inclusion of the NS development at Gaydon/Lighthorne Heath is likely to have an adverse effect on the road network within Warwick and Leamington.
- Despite the implementation of the mitigation measures, journey times are observed to increase, as are queues and delays at key locations within the model network.
- When considering the network conditions, post-implementation of the WDC STA mitigation measures, further attention is likely to be required, at least, in the following areas:

    - Longbridge Island
    - Europa Way Corridor, and;
    - Oakley Wood Road/Tachbrook Road corridors.
- Improvements in these areas will result in wider network improvements as the reassignment of vehicles in response to the congested conditions will be reduced.

The analysis that has been completed to date has adopted robust assumptions regarding the level of trip generation associated with the development of a NS at G/LH and, specifically, the distribution across the Warwick and Leamington road network. As a result, it is reasonable to conclude that the results presented thus far represent a worst case.

Further stages of the cumulative impact assessment of the NS and WDC Local Plan Allocations combined should consider the following:

- Further iterations of the mitigation measures to understand the level of mitigation that can be achieved under the current conditions which are considered to reflect a 'worst case'
- More detailed refinement of the distribution, potentially with sensitivity testing, would be beneficial to understand what the potential range of impacts may be depending upon the level of interaction of NS trips and the local Warwick and Leamington road network.
- More detailed refinement of the mitigation assumptions as well as a review of the potential for draw between the proposed housing in the WDC area and the proposed employment delivered as part of the NS should be considered as it would potentially reduce the trip generation figures that are being assigned to the WLWA model by minimising the risk of double counting in this area.
- Consideration should be given to the assumptions that have been applied pertaining to the level of mode shift and internalisation levels.

Refinement of the distributions that have been adopted would also be likely to result in more refined outputs being extracted from the modelling for a number of reasons:

- The level of interaction between the NS and the WLWA internal road network appears very high with almost 50% of all new trips feeding directly onto the WLWA internal road network; a review as to how reasonable this is would be unlikely to increase this value and may result in a reduction. Furthermore, testing of the potential range of distributions may offer a solution in so far as it allows the level of impact across a range of scenarios (from high to low level NS ~ WLWA interaction) to be identified.
- The distribution does not account for the potential draw between the NS and the sites allocated as part of the WDC Local Plan. A significant proportion of the employment anticipated to serve the WDC allocated housing sites is located to the north of Warwick and Leamington whilst a large proportion of the houses are located to the south of Warwick. Therefore it is reasonable to assume that some of the trips that would otherwise travel northwards along the Europa Way Corridor and through Leamington, would elect to travel southwards in response to the employment provision afforded by the NS and the existing Jaguar Land Rover site. Whilst the net trip generation effect of the NS is

always likely to generate more WLWA inbound trips than it is to attract trips, the incremental benefits of drawing traffic away from the Europa Way corridor would be likely to reduce the level of impact compared with that which has been presented within the current round of testing.

Finally, the recent WDC STA Phase 3 Report outlines the possibility of a Park & Ride site being delivered to the south of Warwick and Leamington. The potential for the NS settlement to provide services which complement these aspirations and thus, the potential for greater levels of mode shift from car based trips should also be considered.

2 Introduction

2.1 Scope

Arup have been commissioned by Warwickshire County Council (WCC) and Stratford on Avon District Council (SDC) to undertake testing of two different approaches to the allocation of housing and employment as part of the emerging Core Strategy (CS), specifically:

- Allocation of 2,750 dwellings and 8Ha of employment within a Sustainable Urban Extension (SUE) to the south east of Stratford-upon-Avon as well as redevelopment of land to the north west of Stratford town centre, known as the Stratford Regeneration Zone (SRZ) for approx. 700 dwellings and 25 Ha of land on the northern edge of the town for employment across two additional sites.
- Allocation of 5,000 dwellings and 18Ha of employment in a New Settlement (NS) at Gaydon/Lighthorne Heath (G/LH).

Further information on the scenario assumptions adopted within the modelling has been provided within Section 2 of this report.

2.2 Study Objectives

The over-arching objective of this work is to determine the impact of delivering either of the aforementioned allocation options on the local transport infrastructure network. Secondly, the assessment seeks to determine any appropriate mitigation measures likely to be required to facilitate the delivery of the respective housing allocations and highlight any significant issues likely to pose risks or barriers to the delivery thereof. In addition there are a number of additional objectives linked to this which are outlined as follows.

Within Stratford-upon-Avon:

- To assess the impact of the SRZ policy on the local, Stratford-upon-Avon road network:
- To determine an outline mitigation strategy to accompany the SUE assuming the delivery of an Eastern Relief Road (ERR).
- To assess the likely impacts of adopting one of either two options concerning the potential alignment of the ERR, namely:
    - **ERR Option 1 -** Between B4086 Main Street, Tiddington and A439 Warwick Road/Ingon Lane including the elevated bridge section above the River Avon floodplain.
    - **ERR Option 2 -** Improving the alternative ERR route via the B4086 linking with the A429 at Wellesbourne.
- To understand the potential for the delivery of the SUE and associated ERR and mitigation measures to contribute to a number of wider policy objectives in the area, namely:
    - The potential to deliver traffic relief to the Town Centre and ‘Historic Spine’ areas;
    - The potential for facilitating the reallocation of road space for pedestrian enhancements;
    - The potential to deliver the reallocation of road space to bus priority.

    - The ability to restrict HGV movements across Clopton Bridge
- To identify the potential implications of delivering additional development within the area south of Stratford.

Within Gaydon/Lighthorne Heath and the wider Warwick & Leamington Road network:

- To identify the potential, localised, mitigation measures that are necessary to accompany a New Settlement (NS) in the Gaydon/Lighthorne Heath (G/LH) area;
- To understand the wider implications of allocating development in this manner, specifically in the context of the emerging WDC CS aspirations and the associated mitigation strategy thereof.
- To begin to identify, through this cumulative WDC/SDC assessment, any wider mitigation measures that may be necessary to accompany the allocation of the NS.

2.3 Study Areas

The potential location of the two sites within the SDC boundary means that the impacts of each option are likely to manifest in different areas of the District. Whilst the delivery of the SRZ/SUE and ERR policy objectives are most likely to affect the local Stratford-upon-Avon road network, the effects of the NS are most likely to manifest firstly along the B4100/M40 strategic corridors and then, secondly, within the area to the South of Warwick and Leamington.

These assumptions are based on the premise that the primary focus of SUE generated growth will be Stratford-upon-Avon due to its close proximity whilst the NS will have a broader focus informed by the proximity of both the M40 and the large urban conurbations of Warwick and Leamington since these are the closest and most accessible towns. Because of this the study area has been compartmentalised depending upon which development allocation is being considered.

Thus, the focus of the study area when considering the impacts of the SRZ/SUE and ERR option is that which is encompassed by the, extended, Stratford-upon-Avon model network. An overview of the coverage of this model is provided within **Figure 1** on the following page.

The focus of the study area when considering the impacts of the G/LH New Settlement is primarily around the M40/B4100 corridors within which the site is encompassed. In addition, the impacts on the wider Warwick and Leamington road network are also a material consideration.

As a result, proximate impact analysis has been undertaken using the M40 corridor PARAMICS model whist the wide area ‘cumulative’ assessment has been undertaken using the Warwick and Leamington Wide Area (WLWA) model. The coverage of the M40 and WLWA PARAMICS models has been illustrated within the following **Figure 2** and **Figure 3** respectively.

Figure 1 - Stratford-upon-Avon PARAMICS Model Coverage

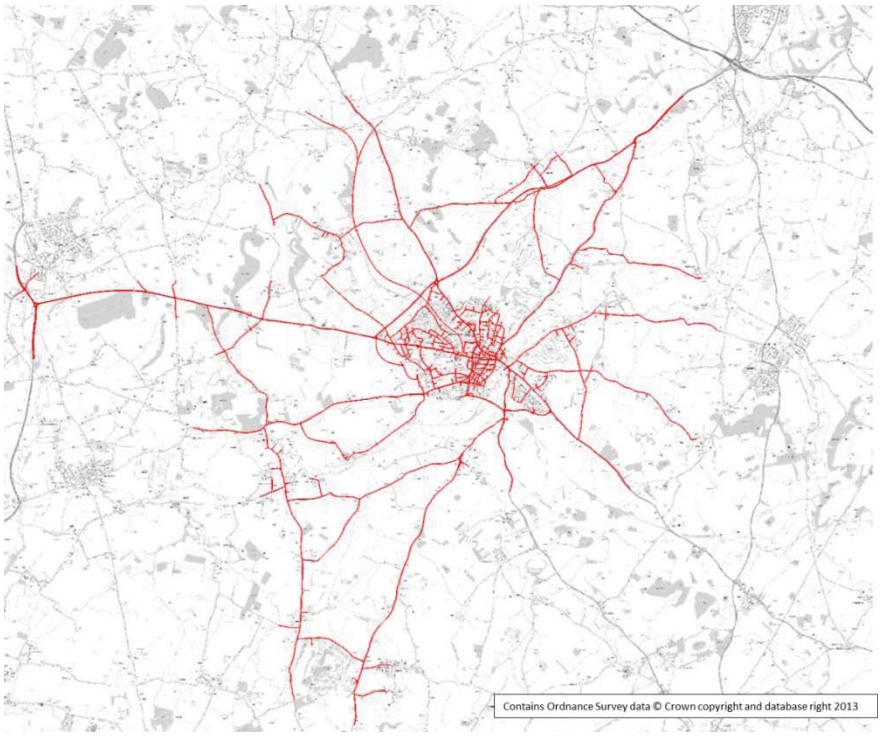


Figure 2 -Warwick and Leamington PARAMICS model Coverage

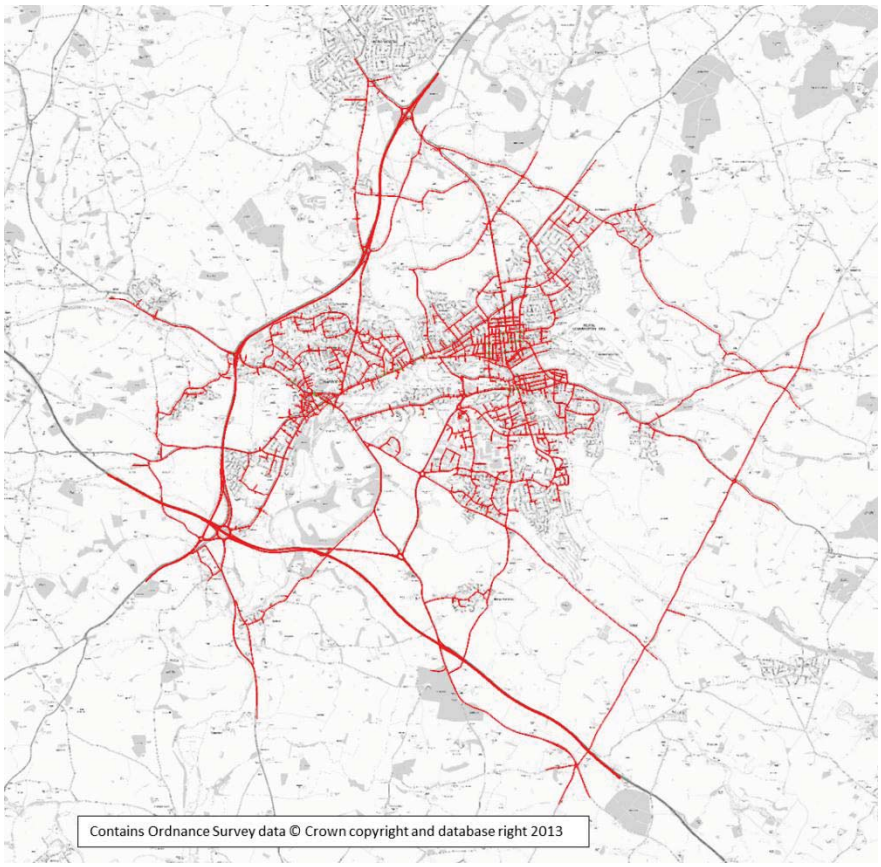
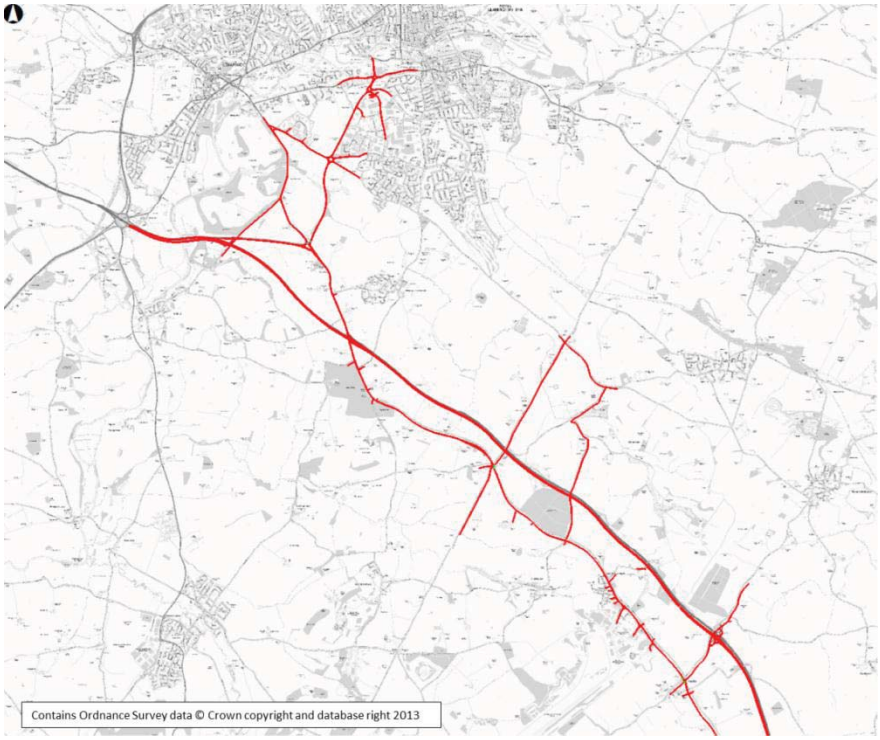


Figure 3 –M40 PARAMICS model Coverage



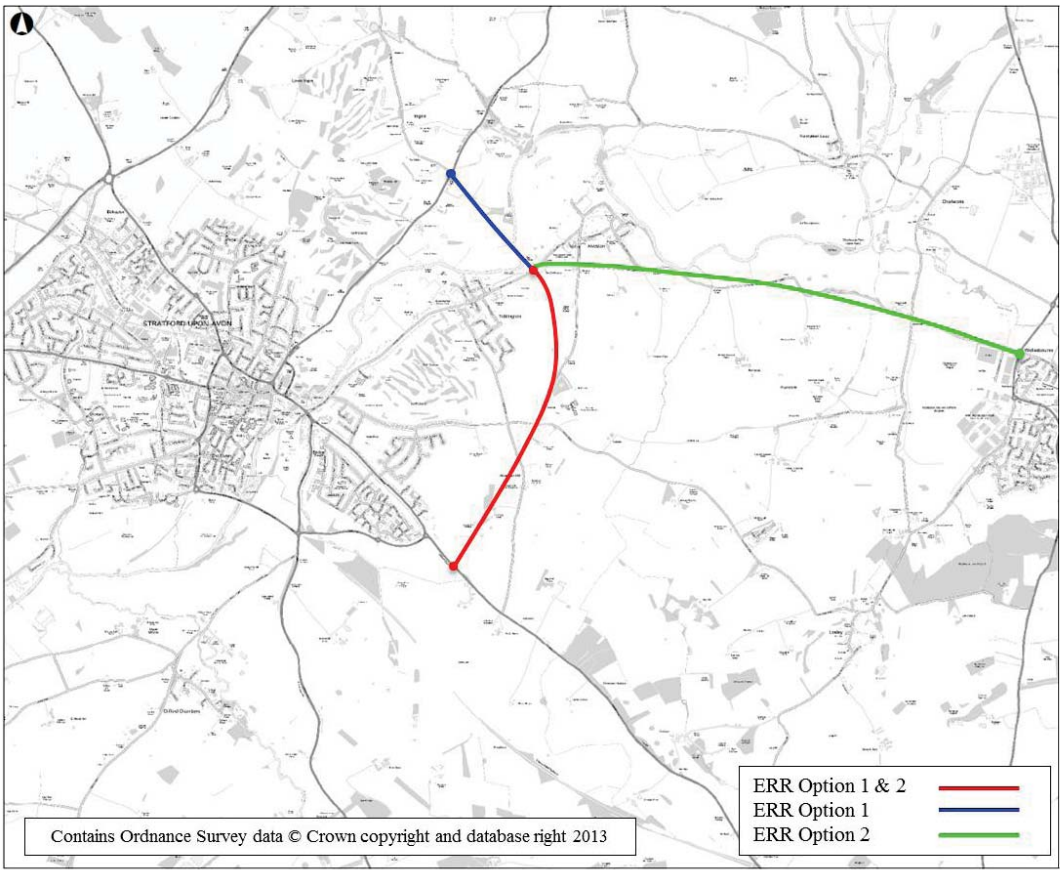
2.4 ERR Alignment Options

One of the objectives of this study is to understand the implications of delivering an ERR via one of two possible alignments. Two potential options for the alignment of the ERR have been proposed to accompany the delivery of the SRZ/SUE proposals. The potential alignments to be tested are as follows:

- **ERR Option 1 -** B4086 Main Street, Tiddington and A439 Warwick Road/Ingon Lane including the elevated bridge section above the River Avon floodplain.
- **ERR Option 2 -** Improving the alternative ERR route via the B4086 linking with the A429 at Wellesbourne.

The alignment of these two options is illustrated within the **Figure 4** on the following page.

Figure 4 –ERR Alignment Options



3 Scenario Development

The following sets out the process undertaken to derive the key PARAMICS model scenarios.

The term 'Reference Case' refers to the forecast conditions that provide the point of reference against which the comparisons of various impacts across key scenarios are determined. The reference case is considered to be reflective of those conditions that are likely to occur irrespective of the CS considerations and allocated sites. It includes all known committed developments as well as any associated transport infrastructure measures.

3.1 Stratford-upon-Avon Reference Case Amendments

The horizon for the Core Strategy testing extends to the 2028 future year. Initially, the Stratford-upon-Avon model existed only to a forecast year of 2021. Furthermore, the network contained within the existing Stratford-upon-Avon PARAMICS model was not sufficient to allow refined testing of the ERR option 2 alignment to be undertaken. As a result, the existing 2021 Stratford-upon-Avon PARAMICS had to be extended to encompass a wider area of network and then reforecast to the 2028 year.

3.1.1 Model Extension

The first phase of developing an appropriate Stratford-upon-Avon 2028 Reference Case was to extend the Stratford-upon-Avon PARAMICS model to include the B4086 between Stratford-upon-Avon and the A429 and then the A429 between the B4086 to just south of Longbridge Island.

An overview of the area included within the model extension is provided within **Figure 5** on the following page.

This extension was undertaken by incorporating two new category types within the existing model:

- 50 mph, Urban, Minor links to represent the extended section of the B4086 from West of Alveston to the A429.
- 50mph, Highway Minor links to represent the section of the A429 from the B4086 to a point just south of Longbridge Island

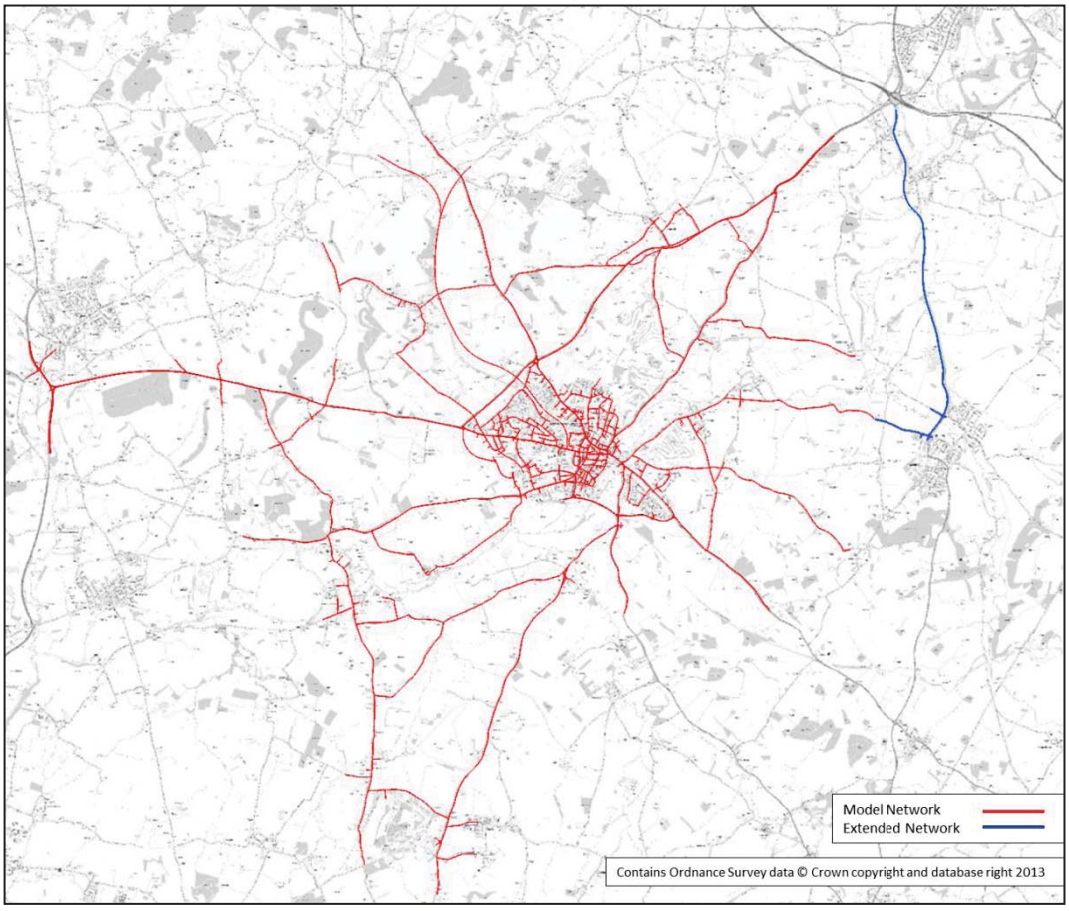
This extension has been calibrated to ensure that the effect on routing within the model network is kept to a minimum. This was determined through GEH analysis of the varying model scenarios. The locations selected for the comparisons between the original and extended model network flows are illustrated within **Figure 6** on the following page.

The model extension was calibrated through the use of cost factors applied to the area of the extension. The purpose of the cost factor is to reflect the residual delay on the network from the interaction with that does not exist within the model as it was never originally calibrated and validated to that extent.

A series of scenarios were produced which contained incremental increases in the cost factors attributed to the links comprising the extended network. Cost factor

tests were undertaken for 1.0 (default), 1.5 and 2.0. The outcome of the GEH comparisons of all three scenarios is presented within **Appendix A** of this report.

Figure 5 –SuA PARAMICS Model Network Extension

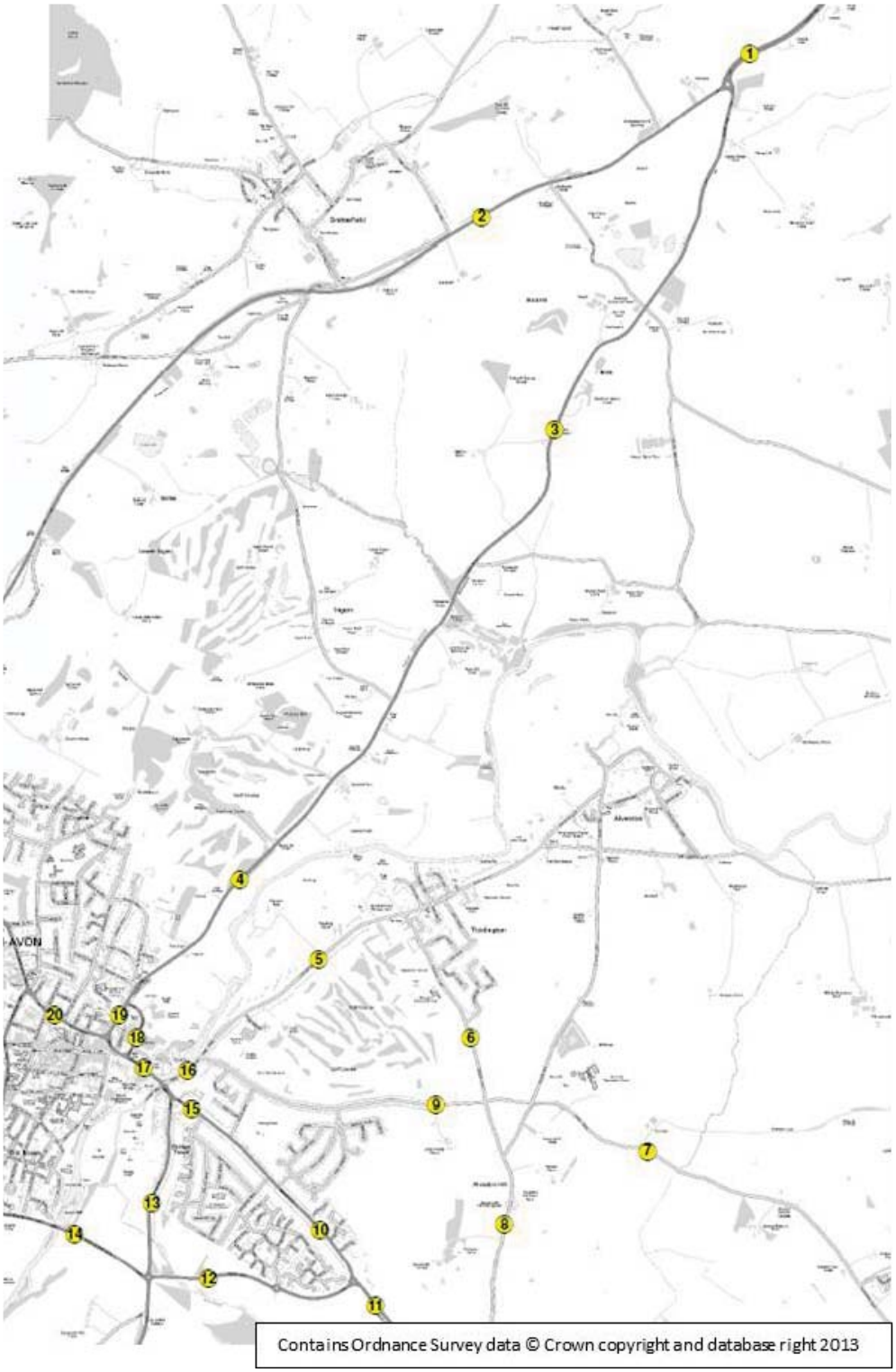


Based on the analysis presented within **Appendix A**, a scenario was adopted whereby a cost factor of 1.5 was retained along the length of the extended network. 1.5 was chosen as it allowed a reflection of delay on the network that was not currently being modelled without being over-prescriptive.

The analysis referred to previously is based on the impact on the 2021 demand levels rather than the 2028 demand levels as the greater the level of congestion on the network the more likely traffic is to utilise the extended network.

Since the model was never calibrated and validated to be inclusive of the extended sections of network the results from this testing should be considered as providing a broad indication of the likely impacts of adopting the various Eastern Relief Road (ERR) options. More conclusive analysis would require the model to be recalibrated and revalidated to include the elements of extended network but this would not be possible to achieve in the current timescales for reporting.

Figure 6 – SuA Model Extension - GEH Analysis Locations



3.2 2028 Reference Case Forecasting

The process followed to update the existing Stratford-upon-Avon 2021 model network to be reflective of the likely 2028 conditions built upon the work completed during the recent 2021 Model update and so it is recommended that

this report is read in conjunction with the Technical Note produced to summarise the previous model update[1].

The purpose of the original model update was to account for additional developments within the area as well as key changes to the network, namely:

- A revised junction arrangement between the A3400 Birmingham Road and Hamlet Way which enables an additional left turn lane from the Birmingham Road into the Tesco Superstore car park located just off the Birmingham Road.
- The new Shottery Link Road, also known as the Stratford Western Relief Road (SWRR) which joins the B439 Evesham Road, at the junction with Luddington Road, with the A46 at the junction with the A422 Alcester Road.
- The Land West of Shottery Development (circa 800 dwellings to be split across two pockets north and south of the site enclosed by the SWRR)
- Land off Bishopton Lane (circa 160 dwellings) to be located to the West of Bishopton Lane, a toucan crossing facility is to be located approximately 180m to the south of the proposed new site access junction as well.

The original update involved amending the 2021 demands to include the new developments. On this occasion the purpose of the update is to reforecast these demands to 2028 levels.

The forecasting methodology adopted is an historic methodology that has been applied during a number of previous updates of the model. TEMPRO and NTEM factors were extracted for the 2015 to 2028 forecast horizon and applied to the adapted 2015 demands.

The demand levels and distribution for each development was extracted directly from the PARAMICS models associated with the respective developments. These totals were then compared to the current levels of internal growth allocated within the model through TEMPRO analysis. In the PM period there was no additional growth so these developments could simply be considered as 'in addition to' whilst in the AM a small amount of residual internal growth had been retained. This growth was removed as it is now superseded by Committed Development Demands. In the PM no internal growth was present so no further adjustments were made.

An overview of this process is provided within the following **Table 1**:

Table 1 – Stratford-upon-Avon Committed Growth totals

	0700 to 0800	0800 to 0900	1600 to 1700	1700 to 1800
Bishopton	77	101	46	85
Shottery	303	497	442	546
Total	380	598	488	631
Periodic	978		1119	
Previous Internal Growth	744		603	
Revised Internal Growth	0		0	

The resultant levels of demand now assigned within the revised 2028 Reference Case model are presented within **Table 2** on the following page.

[1] 227548-00 TN001 Stratford-upon-Avon 2021 Model Update, Arup, 30 November 2012

Table 2 – Stratford-upon-Avon Amended Demands

	0700 to 0800	0800 to 0900	1600 to 1700	1700 to 1800
Background	9534	14730	13993	15404
HGV	792	813	825	527
Com Dev.	1241	769	2150	1259
Growth	522	575	531	528
Hourly Demand	12089	16887	17499	17718
Periodic Demand	28976		35217	
2011 Demand	26519		32550	
Growth from 2011(%)	**9.27%**		**8.19%**	
TEMPRO Factors	8.57%		9.85%	

The previous table demonstrates that the level of growth assigned within the model is greater than the 2028 levels predicted by TEMPRO in the AM but marginally lower within the PM, however, since these demand levels are going to be exceeded by the addition of sites allocated through the Core Strategy there was little benefit in incorporating the additional, TEMPRO informed, internal growth to simply remove it again during the development of the first Core Strategy test.

Thus, at this stage, the demand levels included within the 2028 Reference Case are considered a robust and reflective basis from which the various CS options can be derived.

3.3 Warwick & Leamington Reference Case

The Reference Case conditions pertaining to the assessment of impacts of a proposed NS at G/LH were defined as those which included the most recent Core Strategy aspirations of the neighbouring Warwick District Council (WDC).

As a result, the Reference Case for the initial testing of the impacts on Warwick and Leamington was based on the most recent WDC CS model which contained the Revised Allocation strategy as well as 27 proposed mitigation measures.

The development and performance of this network as well as the development and scheme assumptions therein has been documented within the WDC Phase 3 STA Report[2].

The demand levels contained within the current WLWA Phase 3 STA model are summarised within **Table 3** on the following page.

[2] 211429-19.R12 – WDC STA – Phase 1 Assessment Report, Arup, May 2013

Table 3 - WLWA 2028 Scenario Demands

Demand	0700 to 0800	0800 to 0900	0900 to 1000	1600 to 1700	1700 to 1800	1800 to 1900
Background	32244	35102	28519	38377	40134	32731
HGV	1554	1330	1768	1155	682	851
Education	731	8114	1615	2347	1363	910
Com Dev.	1845	1128	1807	2462	1913	2882
General Growth	3866	0	2081	1930	772	3731
WDC Local Plan Growth	4388	4987	3335	4196	5489	3940
TOTAL	**44627**	**50660**	**39125**	**50465**	**50353**	**45045**

3.4 M40 Reference Case Development

WCC are currently promoting a highway scheme within the vicinity of the proposed site for the new settlement. The scheme being promoted involves substantial reconfiguration of the local highway infrastructure, including, amendments and signalisation of both M40 J12 off/on-slips, provision of two lanes westbound from M40 J12 SB-off slip to the point of access of the Heritage Motor Centre, located along the B4100 Banbury Road. The route between the M40 and the Heritage motor centre has also been subject to substantial realignment and capacity enhancements. Full details of the proposals are available via the WCC M40J12 consultation website[3].

In order that the testing of the proposed new settlement was inclusive of the most up-to-date plans regarding proposals at M40J12 and the B4100, the latest M40 J12 scheme model was used as the Reference Case network.

This model does not include the Myton Road/Banbury road roundabout as that was included during a later extension of the PARAMICS model network. ***As a minimum, future testing of the impacts of the proposed NS should be undertaken in the extended M40 PARAMICS model network which includes the Myton Road/Banbury Road roundabout and, potentially, consideration should be given to increasing the model coverage further so that the Chesterton Road/Harbury Lane route into Warwick and Leamington, from the site, can also be assessed.***

The current M40 Reference Case model scenario is also inclusive of a considerable level of demand associated with existing 'extant' planning permissions in place at the Jaguar Land Rover (JLR) and Aston Martin Lagonda (AML) sites which are in close proximity to the proposed NS. 2011 Base model demands and the Forecast Reference model demand have been summarised within the following **Table 4** and **Table 5** respectively:

[3] http://m40j12.wordpress.com/

Table 4 2011 M40 Demands

Summary:	0600 to 0700	0700 to 0800	0800 to 0900	0900 to 1000	1600 to 1700	1700 to 1800	1800 to 1900
M1 (Background)	2620	7242	11408	7140	9657	10349	7704
M2 (SRN)	1552	3136	5267	5255	5015	5763	5803
M3 (HGV)	299	377	541	720	455	506	366
M4 (JLR)	1440	2477	1133	598	2188	1511	561
Total	5911	13232	18349	13713	17315	18129	14434
Non-SRN/HGV	4060	9719	12541	7738	11845	11860	8265
Non-SRN/HGV /JLR	2919	7619	11949	7860	10112	10855	8070

Table 5 Reference M40 Demands

Summary:	0600 to 0700	0700 to 0800	0800 to 0900	0900 to 1000	1600 to 1700	1700 to 1800	1800 to 1900
M1 (Background)	2620	7242	11408	7140	9657	10349	7704
M2 (SRN)	1739	3514	5901	5888	5633	6474	6519
M3 (HGV)	333	420	603	802	507	564	408
M4 (JLR)	1440	2477	1133	598	2188	1511	561
M5 (JLR Extant)	379	893	389	0	702	521	227
M6 (Growth)	210	580	915	572	802	858	640
TOTAL	6721	15126	20349	15000	19489	20277	16058
Non-SRN/HGV	4649	11192	13845	8310	13348	13239	9132
Non-SRN/HGV /JLR	3163	8242	12926	8515	6942	7896	7566

Currently there have been no assumptions regarding peak spreading in this area.

The 0600 to 0700 hour demands should be excluded from further analysis as the STA trip rates that allocate demand to employment and housing only extend across the 0700 to 1000 and 1600 to 1900 time periods. The current Reference Case demands have not been capped since this would substantially reduce the impact of the JLR extant planning permission trip generation.

Comparisons of forecast growth levels between model scenarios tends to focus on the internal growth rather than growth in strategic, HGV or similar trip types (i.e. education where applicable). This is because these trips are less likely to be subject to peak spreading.

The forecast levels of growth contained within the 2028 Reference Case have been summarised within **Table 6** on the following page.

Table 6 2011 to Reference M40 Demand Summary

Period	2011	2028	Growth
0700 to 1000	29998	33347	11.2%
1600 to 1900	31970	35719	11.7%

Given that this particular area represents a cross boundary location between Stratford District and Warwick District it is proposed that the TEMPRO growth factor for Warwickshire is adopted to inform any forecasting or capping procedures. The relevant TEMPRO factors for the 2011 to 2028 forecast period are summarised within the following **Table 7**.

Table 7 2011 to 2028 TEMPRO Factor Summary

Period	Level	Name	Origin	Destination	Average	NTEM
AM	County	Warwickshire	1.0591	1.0992	1.07915	1.191919
PM	County	Warwickshire	1.0989	1.0771	1.088	1.199225

The above table demonstrates that the demand assumed within the current Reference Case model, when considering local growth levels, exceeds the levels predicted by interrogation of the TEMPRO database but does not exceed NTEM adjusted TEMPRO which acts as the cap for growth within the model.

It is reasonable to conclude that the current Reference Case demand levels, which have not been subject to capping and are inclusive of a substantial increase in demand due to the inclusion of demand associated with the JLR extant planning permission, are suitable proxy demands for the 2028 scenario testing.

3.5 Core Strategy Scenario Forecasting

In light of the various options proposed for the allocation of housing within Stratford District, it was necessary to produce a set of forecast demands for each of the proposed Core Strategy scenarios.

A series of core strategy scenarios were required for both the SUE and NS options. The forecasting of each of these scenarios was undertaken specifically using the models which cover the respective study areas.

3.6 Stratford SUE Scenario Development

There are a number of objectives that were intended to be addressed during the initial phase of the Stratford-upon-Avon SUE STA testing. Namely:

- The impact of the SRZ Policy application on the Stratford-upon-Avon transport infrastructure;
- The impact of the SUE allocation, on the Stratford-upon-Avon road network, with respect to the two potential options for the alignment of the ERR
- The performance of the above options inclusive of additional mitigation proposals as identified during the earlier phase of SDC STA work.
- The feasibility of delivering additional development, alongside the SUE and ERR, south of Stratford

As a result, a series of scenarios were required to address the aforementioned objectives.

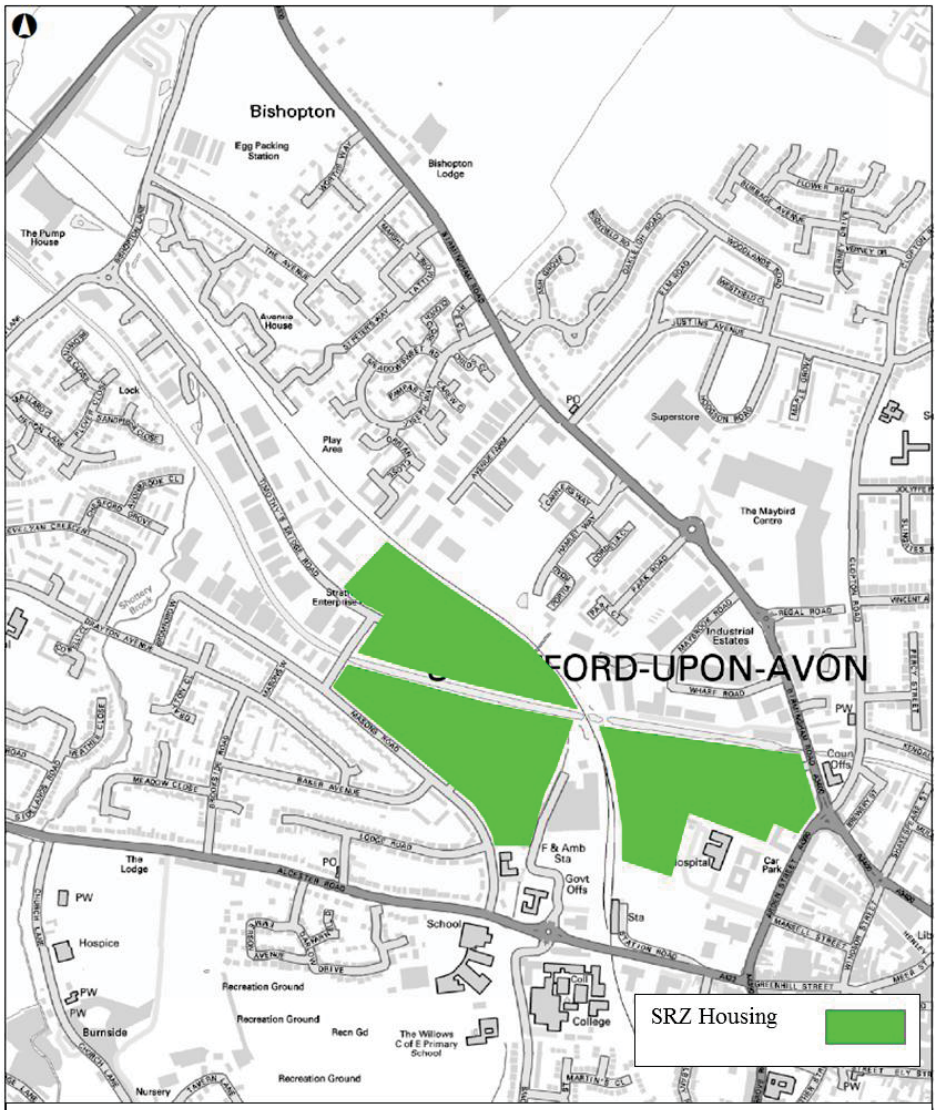
The derivation of these scenarios has been detailed within the following section of this report.

3.7 Stratford Regeneration Zone

The first scenario derived from the Stratford-upon-Avon 2028 Reference Case was the 2028 SRZ scenario. It was understood that the SRZ policy was looking to re-allocate land within Stratford-upon-Avon for housing and relocate existing and proposed employment from that area to areas which are on the periphery of the existing SuA road network.

The initial assumption for the allocation of housing is that 700 dwellings will be delivered within the areas outlined within the following **Figure 7**:

Figure 7 - SRZ Housing Allocation Areas



In addition to the housing, two areas have been identified as being required to accommodate the re-allocated and proposed employment, these areas (Area 1 and Area 4) have been illustrated within the following **Figure 8**:

Figure 8 - SRZ Employment Allocation Areas

The proposed split of employment to be delivered within Area 1 (15 Ha gross) was assumed as follows:

- B1 = 30%
- B2 = 40%
- B8 = 30%

The proposed split of employment to be delivered within Area 4 (10 Ha gross) was assumed to be as follows:

- B1 = 50%
- B2 = 20%
- Sui generis, e.g. car showrooms = 30%

3.7.1 Trip Generation

The trip rate assumptions used to derive and assign trip generation values to the proposed sites was informed by WCC. The housing trip rates were based on the standard housing trips rates that are adopted by WCC across the county, these trip rates, on a per dwelling basis, are presented within the following **Table 8**:

Table 8 - WCC STA Dwelling Trip Rates

	In	Out	Total
0700 to 0800	0.078	0.329	0.407
0800 to 0900	0.120	0.480	0.600
1600 to 1700	0.348	0.116	0.464
1700 to 1800	0.480	0.120	0.600

The initial assumptions regarding mode shift involved a 15% shift towards public transport as part of the delivery of the site. This assumption has been applied consistently across the dwelling trip generation process adopted for both SRZ and SUE housing elements and it is felt that this represents a high level of mode shift. ***It is recommended that, during more detailed stages of the assessment of this, or any option which includes assumptions pertaining to mode shift, includes sensitivity testing of this parameter to understand the significance and potential consequences of the respective mode shift assumptions.***

The resultant trip generation values assigned within the modelling, to reflect the demand accrued on the network as a result of the 700 dwellings has been summarised within the following **Table 9**:

Table 9 – SRZ Housing Trip Generation Figures

	In	Out	Total
0700 to 0800	46	196	242
0800 to 0900	71	286	357
1600 to 1700	207	69	276
1700 to 1800	286	71	357

These trip generation values were assigned across three zones within the PARAMICS model (36, 35 and 33) based on a 33% split across all three.

Trip rates for the various employment elements where provided by WCC and are presented for the AM and PM time periods within the following **Table 10** and **Table 11** respectively:

Table 10 - SRZ AM Employment trip rates (per $100m^2$)

	0700 to 0800		0800 to 0900	
	In	Out	In	Out
B1:	0.72	0.11	1.62	0.12
B2:	0.32	0.13	0.44	0.21
B8:	0.10	0.08	0.10	0.06

Table 11 - SRZ AM Employment trip rates (per $100m^2$)

	1600 to 1700	1700 to 1800

	In	Out	In	Out
B1:	0.14	1.12	0.11	1.51
B2:	0.23	0.35	0.11	0.39
B8:	0.08	0.12	0.03	0.09

An assumption of 40% net coverage was applied when considering the build out of both Area 1 and Area 4. In view of the lack of available information, experience from other sites in Warwickshire suggests that this assumption was reasonable at the time of undertaking the modelling. The trip rates were factored according to the prospective land use percentages as well as an allowance of 15% for mode shift. The resultant trip generation figures are summarised within the following **Table 12** and **Table 13** for Area 1 and Area 4 respectively:

Table 12 – Employment Area 1: Net Trip Generation

	In	Out	Total
0700 to 0800	128	36	164
0800 to 0900	235	48	283
1600 to 1700	53	174	227
1700 to 1800	30	216	246

Table 13 – Employment Area 4: Net Trip Generation

	In	Out	Total
0700 to 0800	217	40	257
0800 to 0900	461	54	515
1600 to 1700	59	323	382
1700 to 1800	41	427	467

3.7.2 SRZ Demand Amendments

The trip generation associated with the zones in which the SRZ housing is assumed to be delivered has also been removed from the model matrices. This is because these trips are to be displaced by the proposed housing and will be re-allocated to areas 1 and 4 outlined previously. The trip generation figures, derived specifically based on the proposed land usages, have been adopted rather than the existing modelled trip totals for the supplanted trips since the new trip generation values are more reflective of the proposed land uses compared to those which currently exist within the model.

The total number of trips removed from the model as a result of the reallocation of the employment land, has been summarised, by zone, for both AM and PM time periods within the **Table 14** and **Table 15** respectively:

Table 14 - SRZ Employment: AM Supplanted trip totals

Zone	0700 to 0800		0800 to 0900	
	In	Out	In	Out
33	142	12	151	8
35	41	29	99	75
36	132	56	307	130
Total	**315**	**96**	**557**	**212**

Table 15 - SRZ Employment: PM Supplanted trip totals

Zone	1600 to 1700		1700 to 1800	
	In	Out	In	Out
33	95	98	137	123
35	57	59	62	113
36	116	178	115	226
Total	**268**	**336**	**314**	**461**

3.7.3 SRZ Demand Summary

The trip generation figures assigned to the model as a result of the inclusion of the SRZ policy, as well as the net trip generation that these values represent, once the impact of the supplanted trips has been considered, are presented within **Table 16** and **Table 17** respectively:

Table 16 - SRZ Total Trip Generation

	In	Out	Total
0700 to 0800	417	278	695
0800 to 0900	815	396	1211
1600 to 1700	327	600	927
1700 to 1800	363	754	1117

Table 17 - SRZ Net Trip Generation

	In	Out	Total
0700 to 0800	73	201	274
0800 to 0900	118	294	412
1600 to 1700	215	104	319
1700 to 1800	292	111	403

3.8 SRZ Demand Allocation

3.8.1 Peak Spreading

Historically, demands allocated to the Stratford-upon-Avon model have been subject to peak spreading which is informed by the interpolation of existing growth rates by hour into forecast hourly growth rates. The existing growth rates

have been derived using observed annual cordon count data that is collected by WCC. A full overview of the process that underpins peak spreading within the modelling is provided within the 2021 Model Update Report[4].

Since growth in background demands and committed developments have been subjected to peak spreading it appears reasonable that the same assumptions should be applied to the demand allocated within the model as a result of the implementation of the SRZ policy.

However, the likelihood for peak spreading to occur is dependent upon the premise that vehicles will elect to retime their journeys in response to adverse network conditions present within the period that they would most like to depart.

Since the SuA PARAMICS model only covers 2 hours for both AM and PM time periods it is only possible to consider peak spreading over the same periods. Otherwise, retiming of trips into the 'post-peak' hour would simply mean the removal of demand from the model which is an approach which would be difficult to justify.

When reviewing the demand levels within the current 2028 Reference Case, it is difficult to see how further peak spreading could be justified within the PM period. There is very little difference in the magnitude of demand that is being assigned within the model during either the 16:00 to 17:00 or 17:00 to 18:00 hour. Thus, it is unrealistic to assume that trips assigned within the model during the PM Peak hour would choose to retime into the preceding hour when the levels of congestion are likely to be comparable between both hours. If that is the case, it is more likely that the trips will simply depart within the originally intended departure window.

The hourly demand levels, assigned within the 2028 Reference Case, are illustrated within the following **Table 18**:

Table 18 - 2028 Reference Case, Demands by Matrix Levels

	0700 to 0800	0800 to 0900	1600 to 1700	1700 to 1800
Background	9534	14730	13993	15404
HGV	792	813	825	527
Com Dev.	1241	769	2150	1259
Growth	522	575	531	528
Hourly Demand	12089	16887	17499	17718

The previous table illustrates the parity in demand levels between the PM pre-peak and peak hours. As a result no additional account of peak spreading has been incorporated when assigning the SRZ demand into the model.

When considering the AM, demands within the 07:00 to 08:00 hour are considerably lower than those within the 08:00 to 09:00 hour. As a result, some account of peak spreading has been incorporated within the assignment of SRZ demand into the model during the AM period

The historic peak spreading proportions that have previously been adopted, during the AM period, are presented within **Table 19** on the following page.

[4] MID3176.R001 Stratford-upon-Avon Model Update Report, 2015 & 2021 Scenario Years, JMP Consultants, August 2011

Table 19 – Stratford-upon-Avon Forecast Peak Spreading Proportions AM (07:00 to 09:00)

Period	Proportion
07:00 to 08:00	97%
08:00 to 09:00	7%

If the aforementioned proportions were adopted in entirety this would lead to a substantial reassignment of SRZ demand into the pre-peak hour. In order to reduce this propensity, the process has been applied to only 50% of the predicted growth in trips. The remaining 50% of the demand is assigned to the model in line with original SRZ trip generation totals.

The initial and adjusted SRZ demand totals that have been adopted within the modelling are summarised within **Table 20**:

Table 20 - SRZ Modelled Demand Totals

	07:00 to 08:00	08:00 to 09:00	16:00 to 17:00	17:00 to 18:00
Unadjusted*	693	1209	927	1116
Peak Spread*	1233	669	927	1116

**Demand totals vary from initial trip generation values as a result of the rounding process involved in translating trip generation figures into model demands.*

3.8.2 Demand Summary

The resultant demand levels assigned within the 2028 Stratford-upon-Avon plus SRZ scenario are outlined within the following **Table 21**:

Table 21 - SRZ Model Demand Summary

	07:00 to 08:00	08:00 to 09:00	16:00 to 17:00	17:00 to 18:00
Background	9225	14176	13730	15093
HGV	757	780	797	507
Com Dev.	1758	1040	2751	1628
Growth	522	575	531	528
SRZ	1233	669	927	1116
Total	13495	17240	18736	18872
Periodic	30735		37607	
Growth	15.90%		15.54%	

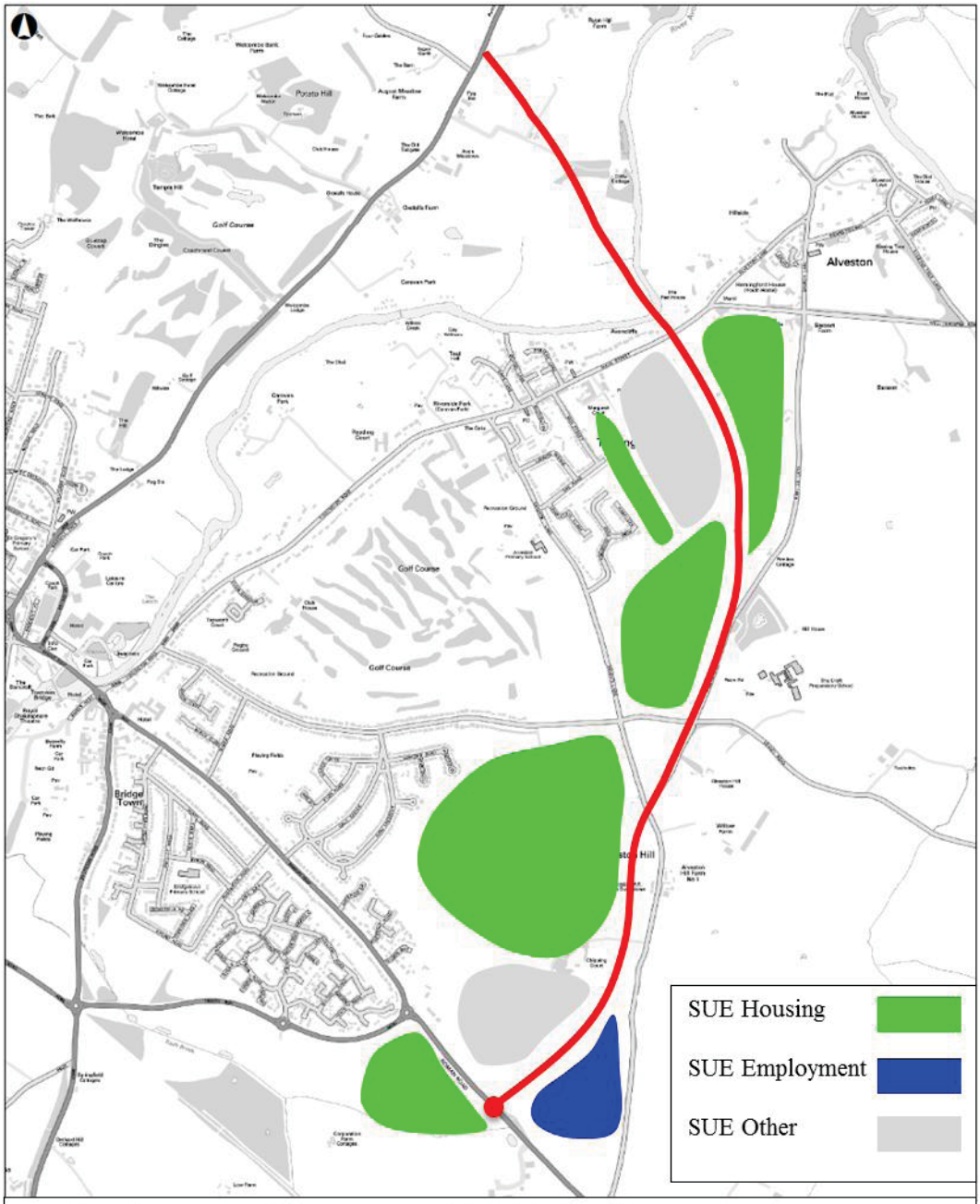
3.9 Sustainable Urban Extension Demands

Following the completion of the 2028 Stratford-upon-Avon plus SRZ scenario, demands were then forecast inclusive of the SUE trip generation assumptions.

The SUE is to be located to the southeast of Stratford upon Avon in the area of land between the A422 Banbury Road to the south and the B4086 Main Street to the north.

The location of the housing and employment zones within the modelling has been illustrated within the following **Figure 9**:

Figure 9 - Stratford SUE Site Location



Contains Ordnance Survey data © Crown copyright and database right 2013

The SUE is to be accompanied by the delivery of a new Eastern Relief Road. Further details on the assumptions relating to the ERR are provided within the final section of this chapter.

3.9.1 Trip Generation

SDC have advised that the delivery of 2,750 dwellings and 8 Hectares of B1 type employment should be assumed when calculating the SUE trip generation.

The trips rates used to calculate the trip generation figures for the 2,750 dwellings are in line with those outlined earlier within **Table 8**. Consistent with the earlier SRZ scenario derivation, an allowance of 15% has been made to account for a shift in mode share.

The resultant SUE housing trip generation numbers adopted within the modelling have been summarised within the following **Table 22**:

Table 22 - SUE Housing Trip Generation

	In	Out	Total
0700 to 0800	183	769	951
0800 to 0900	281	1122	1403
1600 to 1700	815	270	1085
1700 to 1800	1122	281	1403

The B1 trip rates were provided by WCC and have been outlined within the following **Table 23**:

Table 23 - SUE B1 Employment Trip Rates

	In	Out
0700 to 0800	0.59	0.09
0800 to 0900	1.68	0.24
1600 to 1700	0.31	1.16
1700 to 1800	0.18	1.44

Subsequent to the adjustment for mode shift, the resultant trip generation figures assigned to the employment element of the SUE are presented within the following **Table 24**:

Table 24 - SUE Employment Trip Generation

	In	Out	Total
0700 to 0800	160	23	183
0800 to 0900	458	65	522
1600 to 1700	84	314	398
1700 to 1800	48	391	440

3.9.2 SUE Demand Summary

The net trip generation, assumed within the modelling as a result of the delivery of the SUE in whole, is summarised within the following **Table 25**:

Table 25 - SUE Net Trip Generation

	In	Out	Total
0700 to 0800	342	792	1134
0800 to 0900	738	1187	1925
1600 to 1700	898	585	1483
1700 to 1800	1170	672	1842

3.10 SUE Demand Allocation

3.10.1 Demand Redistribution

An initial assessment was undertaken to understand the relationship between the demand levels outlined within the previous **Table 25** and the NTEM adjusted TEMPRO predicted growth levels.

These comparisons were undertaken using only the demand totals associated with the internal trips within the model network. Demand associated with strategic movements or 'through trips', as well as HGV demands, was excluded from this analysis.

The 2011 to 2028 TEMPRO factors for Stratford District are presented within the following **Table 26**:

Table 26 2011 to 2028 TEMPRO Factor Summary

Period	Level	Name	Origin	Destination	Average	NTEM
AM	44UE2	Stratford-upon-Avon	1.0499	1.1215	1.0857	1.175089
PM	44UE2	Stratford-upon-Avon	1.1194	1.0779	1.09865	1.189105

Internal growth levels predicted as a result of the assignment of the SUE trip generation into the model was initially around 30% in the AM and 28% within the PM. This is considerably higher than the 17.5% and 18.9% predicted through the NTEM adjusted TEMPRO database factors for Stratford-upon-Avon.

Because of the high levels of growth it was decided that consideration should be given to the application of a 'capping' procedure informed by analysis of the TEMPRO database.

3.10.2 Guidance

Latest guidance on forecasting within transport models indicates that growth rates should be corrected to avoid double counting and that this 'correction' should be based on a view as to the plausible overall likely growth within an area, informed by TEMPRO, rather than whether a development, or set of developments, is interpreted as being 'additional'.

The purpose of this approach is to minimise the potential for over estimation of forecasts which could, in turn, lead to over-engineered solutions to problems that may not necessarily be realistic. Furthermore, if growth within the scenario models is allowed to remain too high there is a chance that one or more scenarios may be discounted on the basis that the demand impacts cannot be satisfactorily accommodated on the network irrespective of the proposed mitigation measures.

The relevant extracts from the WebTAG guidance (3.15.2) are outlined as follows:

> ***"Where a particular development proposal is likely to have a significant impact on demand for transport on one of the roads or rail services where transport measures are being considered, this should be allowed for by explicit modelling of trips associated with that development. Methods adopted for doing this need where possible to be consistent with***

> ***those set out in the Transport Assessment for the development. It is important to ensure that modal split assumptions are realistic in the context of current planning policy guidance. The growth factors applied to non-development trips may then have to be adjusted downwards, to avoid double-counting of trips within the model."***
>
> ***"Similarly, the correction of growth rates to avoid double-counting should be informed by a view as to the plausible overall population, household or employment growth in the zone, not by a local argument as to whether or not the development can be seen as "additional" in terms of the derivation of the TEMPRO figures."***

It is recommended that a sensitivity test be undertaken during the next stage of testing whereby unadjusted growth is assigned to the model network in order to identify further areas that may require additional mitigation. Such schemes would be difficult to secure in the short term as the growth levels required to trigger the need for these schemes is hard to justify. The purpose of any sensitivity test would be to provide an indication of any further mitigation that may be required over and above that which can be attributed, and delivered, by the developments allocated through the CS.

3.10.3 Redistribution Methodology

The application of the cap to the levels of growth within the model was based on NTEM Adjusted TEMPRO factor for Stratford-upon-Avon. As has been outlined previously, the AM and PM NTEM adjusted factors currently stand at **17.5%** and **18.9%** respectively.

Due to the relatively fixed nature of HGV trips across the network it was decided that these should be excluded from the calculations, including them could result in a reduction in HGV demand that may not necessarily be realised as a result of the inclusion of the CS allocation. Particularly as, at the moment, the detailed SUE site composition provided by SDC only focuses on housing and employment.

Furthermore, the original 2028 Reference Demands did not include any additional internal growth. This omission was intentional on the presumption that all growth that occurs in addition to committed developments is associated with the allocated sites, in this case, the proposed SUE. This approach is valid as analysis of the demands revealed that the growth within the models, before redistribution, exceeded or were close to exceeding TEMPRO predictions and, therefore, the internal element of the growth could be removed to reduce the potential for double counting.

The methodology for applying the capping procedure was as follows:

- HGV trips were excluded from the calculations.
- External growth was allocated via the standard TEMPRO/NTEM factoring methodology, and subsequently excluded from the calculations.
- The level of demand within the 2011 model, less HGV demand, was calculated alongside the baseline and forecast levels of internal demand. Internal demand is classified as those trips which have at least an origin or destination point located within the internal model network rather than external 'loading' zones.

- The level of internal demand likely to be assigned as a result of the interrogation of the TEMPRO database was calculated.
- The resultant level of demand assigned to the model as a result of the SUE was calculated.
- If the level of demand assigned within the model as a result of the SUE was in excess of the NTEM Adjusted TEMPRO predicted level then the net difference is assumed to be the volume of trips that redistribute as a result of the inclusion of the SUE.
- The redistribution of trips in response to the inclusion of the SUE was calculated by subtracting the aforementioned reduction proportionally across the background matrices. This was done by comparing the demand within the SUE matrices to the Background matrices. This process meant that the reduction in trips was targeted to those zones which had the highest level of interaction with the SUE rather than a generalised reduction.
- The reduction was calculated firstly by O-D (Origin – Destination) specific movements, secondly by O-D totals and finally proportionally across the entire matrix. The purpose of this approach is to ensure that the reductions that are applied are as focussed as possible. Simply reducing the entire matrix, proportionally, by the required level would result in a reduction in background trips in areas where there is little or no interaction with the SUE or other CS sites.

Redistributing trips in this manner means that reductions in the number of background trips are achieved on a zone by zone basis, informed by the level of interaction between the existing zones and the new SUE demands. This means that zones which had a high level of trip interaction with the SUE were likely to experience greater reductions in the background traffic generation totals than those with limited or no interaction with the SUE. This limits the potential for reductions in background trips to materialise in areas where there is little or no interaction with the SUE.

The impact of the redistribution procedure is outlined within **Table 27** on the following page.

The demands were not subjected to peak spreading since the redistribution procedure represents a sufficient level of restriction for this stage of the testing.

Table 27- TEMPRO Capping Overview

	07 to 08	08 to 09	16 to 17	17 to 18
Base Model Demand Net	10448	16083	15701	16849
Periodic	26531		32549	
Base Model Demand (excluding HGV & External Trips)	7234	12574	12400	13572
Periodic	19808		25971	
2028 Reference Demands (Less HGV& External)	9662	13063	14811	15022
Periodic	22725		29833	
2009 to 2028 Ref	***14.73%***		***14.87%***	
SUE Demands:	1134	1925	1483	1842
2028 + SUE Internal	10797	14988	16294	16864
Periodic	25784		33158	
2009 to 2028 + Revised Allocation	***30.17%***		***27.67%***	
TEMPRO NTEM Target	23276	17.51%	30883	18.91%
Reduction	-2509		-2276	
Hourly Reduction	-930	-1578	-1015	-1261
SuA + SUE Demand Totals (Internal)	9866	13409	15280	15604
Periodic	23275		30883	
2009 to 2028 + SUE Internal	***17.51%***		***18.91%***	
Total Demand (Including HGV & Growth)	13699	17586	19204	19453
Periodic	31285		38658	
Net Growth	**17.92%**		**18.77%**	

3.10.4 SUE Demand Summary

The resultant demands assigned within the model, following the completion of the redistribution procedure, are illustrated within the following **Table 28**:

Table 28 - SUE Demand Summary

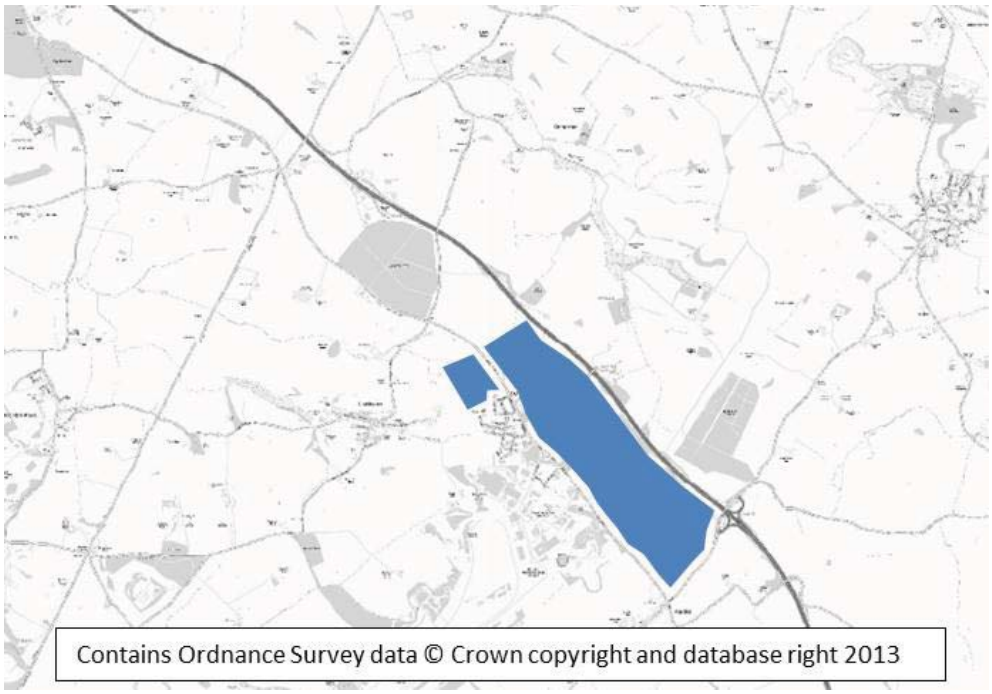
	07:00 to 08:00	08:00 to 09:00	16:00 to 17:00	17:00 to 18:00
Background	8294	12597	12716	13832
HGV	757	780	797	507
Com Dev.	1758	1040	2751	1628
Growth	522	575	531	528
SRZ	1233	669	927	1116
SUE	1134	1925	1483	1842
Total	13699	17586	19204	19453
Periodic	31285		38658	
Growth	17.92%		18.77%	

3.11 New Settlement Scenario Development

The production of scenarios to test the impact of the NS at G/LH required the forecasting of two sets of demands, one for assignment within the M40 PARAMICS model and then a subsequent set of demands to be assigned within the WLWA model.

The location of the new settlement is proposed on the area of land between the B4100 and the M40 near M40 J12. As has already been outlined previously, the proposed location of the new settlement is proximate to J12 scheme proposals being promoted at the moment which will significantly enhance the operational capacity of M40 J12. The proposed location of the new settlement is outlined within the following **Figure 10**:

Figure 10 - New Settlement at G/LH: Proposed Location



3.11.1 Trip Generation

SDC have advised that that the NS will comprise 5,000 dwellings and 18Ha B1 employment. 35% of the housing to be delivered is assumed to be social housing and so, as a result, an adjustment to the standard STA dwelling trip rate was required to account for this.

The TRICS trip rate for social housing was provided by WCC, per dwelling, and has been presented within **Table 29** on the following page.

Table 29 - Social Housing Trip Rates (Per Dwelling)

TIME	In	Out
07:00 to 08:00	0.06	0.17
08:00 to 09:00	0.07	0.23
09:00 to 10:00	0.11	0.16
16:00 to 17:00	0.20	0.14
17:00 to 18:00	0.27	0.17
18:00 to 19:00	0.31	0.15

An allowance of 20% was made to account for mode shift/internalisation which, when combined with the aforementioned social housing adjustment, resulted in the following trip generation totals being attributed to the housing element of the new settlement:

Table 30 - New Settlement: Housing Trip Generation Summary

	In	Out	Total
07:00 to 08:00	224	875	1100
08:00 to 09:00	325	1255	1580
09:00 to 10:00	374	634	1008
07:00 to 10:00	**923**	**2764**	**3687**
16:00 to 17:00	951	393	1344
17:00 to 18:00	1297	437	1734
18:00 to 19:00	1106	410	1516
16:00 to 19:00	**3355**	**1240**	**4594**

For the employment element, new TRICS trip rates were provide by WCC. These have been outlined, within the following **Table 31**:

Table 31 – New Settlement Employment trip rates (per 100m^2)

	In	Out
07:00 to 08:00	0.56	0.08
08:00 to 09:00	1.43	0.16
09:00 to 10:00	0.92	0.26
16:00 to 17:00	0.20	1.01
17:00 to 18:00	0.12	1.31
18:00 to 19:00	0.04	0.34

The trip rates were subject to the same 20% mode shift/internalisation adjustments prior to the assignment within the modelling. The resultant trip generation totals associated with the employment element of the NS are presented within **Table 32** on the following page.

Table 32 - New Settlement: Employment Trip Generation Summary

	In	Out	Total
07:00 to 08:00	302	41	343
08:00 to 09:00	780	86	867
09:00 to 10:00	498	143	641
07:00 to 10:00	**1581**	**270**	**1851**
16:00 to 17:00	110	547	658
17:00 to 18:00	66	711	777
18:00 to 19:00	21	184	205
16:00 to 19:00	**197**	**1442**	**1639**

The net trip generation associated with the NS is presented within the following **Table 33**:

Table 33 - New Settlement: Net Trip Generation Summary

	Residential		Employment		Total
	In	Out	In	Out	
0700 to 0800	224	875	302	41	1443
0800 to 0900	325	1255	780	86	2446
0900 to 1000	374	634	498	143	1649
0700 to 1000	923	2764	1581	270	5538
1600 to 1700	951	393	110	547	2002
1700 to 1800	1297	437	66	711	2511
1800 to 1900	1106	410	21	184	1721
1600 to 1900	3355	1240	197	1442	6233

3.11.2 New Settlement: Demand Adjustments

Allocating the demands that have been forecast for the NS, within the existing M40 model network would have resulted in the following growth levels:

Table 34 - M40 + New Settlement: Unadjusted Growth Forecast

Period	2011	2028	2028 + dev.	Growth
0700 to 1000	29998	33347	38885	29.63%
1600 to 1900	31970	35719	41952	31.22%

Analysis of the NTEM adjusted TEMPRO growth factors for Warwickshire County, covering the 2011 to 2028 period, reveals forecast growth levels of 19.1 and 19.9% for the AM and PM respectively. The previous Table demonstrates that the allocation of the NS demand would lead to a substantial ‘over-prediction’ in the traffic volumes contained within the modelling.

As a result it was necessary to make a number of additional amendments before the demands could be considered as being for purpose. It should be noted that it was not felt that adjustments pertaining to peak spreading were appropriate at this stage. This is because of the nature of traffic movements within the vicinity of the

development and specifically JLR and AML trip generation, both existing and proposed. The current travel pattern for demand generated by the JLR and AML sites is such that the network peak within the vicinity of the development occurs between 07:15 and 08:00 in the AM whilst within the PM it stretches across the 16:00 to 17:30 period. As a result it is highly unlikely that a considerable amount of retiming of journeys will occur as the development pre-peak hours represent the hours in which the network is most congested.

In order that the levels of growth within the model network could be considered to be reflective of the levels predicted by the NTEM adjusted TEMPRO factors, the following adjustments were applied to the Reference Case demands:

- Internal growth was removed from the model network
- Adjustments were made to the JLR/AML demand levels in response to the application of mode shift and internalisation factors attributed to the development trip generations.

The removal of internal growth was achieved by simply removing the demand levels associated with this trip type within the model network.

The adjustments to the proposed JLR/AML demand levels were intended to reflect the likelihood that these sites would be affected by the proximity of the proposed NS and, thus, would benefit from any proposed public transport infrastructure improvements. Furthermore, some account of the potential for synergy to be achieved between the location of housing on one side of the B4100 and employment on the other needed to be considered within the modelling.

In order that this could be achieved a review of the reduction in demand, associated with the housing element of the NS, was undertaken. The number of trips removed from the network as a result of the adoption of the 20% mode shift and internalisation values is summarised within the following **Table 35**:

Table 35 - New Settlement at G/LH: Internalisation and Mode Shift Impact (Housing Trip Generation)

Period	Before Int	After Int	Diff
07:00 to 10:00	5761	4609	1152
16:00 to 19:00	7178	5743	1436

The previous table demonstrates that over 1,150 trips are removed from the model network as a result of the application of these parameters. Whilst a number of the trips that are removed represent trips between the employment and housing within the boundary of the proposed NS it is likely that the JLR and AML trip generation will also be affected since PT infrastructure is likely to attract car based trips bound to and from the JLR/AML sites whilst internalisation measures and the relocation of JLR/AML staff to the proposed NS would also have an impact. In order that some account of these occurrences could be considered within the modelling a simplistic approach to the adjustment was undertaken whereby 50% of the reduction in trip generation of the NS housing area was applied to the JLR/AML matrices. Thus and AM and PM reduction in JLR/AML associated trip generation, of 576 and 718 was applied across the AM and PM periods respectively.

3.11.3 New Settlement Demand Summary

The resultant demand levels assigned within the M40 + NS at G/LH model scenarios is summarised within the following **Table 36**:

Table 36 – M40 2028 + NS at G/LH Demand Summary

Summary:	0600 to 0700	0700 to 0800	0800 to 0900	0900 to 1000	1600 to 1700	1700 to 1800	1800 to 1900
M1 (Background)	2620	7242	11408	7140	9657	10349	7704
M2 (SRN)	1739	3514	5901	5888	5633	6474	6519
M3 (HGV)	337	424	609	810	512	570	412
M4 (JLR)	1440	2217	1014	536	1913	1321	490
M5 (JLR Extant)	568	799	348	0	614	456	198
M6 (Growth)	210	0	0	0	0	0	0
M7 (NS)	0	1718	2841	1901	2338	2944	2100
TOTAL	**6914**	**14197**	**19281**	**14374**	**18329**	**19169**	**15323**

This results in the following growth levels:

Table 37 - M40 + New Settlement: Adjusted Growth Forecast

Period	2011	2028	2028 + dev.	Growth
0700 to 1000	29998	33347	37165	23.89%
1600 to 1900	31970	35719	40084	25.38%

Since the NTEM adjusted TEMPRO factors for growth are **19.1** and **19.9%** respectively for the AM and PM period s it is reasonable to assume that the growth levels presented within the previous table are reflective of these 2028 forecast levels.

3.12 WDC Local Plan – Cumulative Assessment Scenario Development

Once the outline M40 assessment was completed it was necessary to undertake a cumulative assessment whereby points of overlap between the M40 PARAMICS model and the WDC STA model were used to load traffic into the WDC STA model based on the flows extracted from the M40 model. This stage was necessary to create the relevant demand files that could be used within the cumulative assessment undertaken within the WLWA model network, inclusive of WDC's proposed allocations.

The level of development trips crossing the B4100 and M40 just east of Fosse Way was distributed across the WDC STA model based on the level of demand captured at those points within the M40 model.

A CITEware distribution was determined based on the location of the site, the loading points and the following combination of wards:

- Southam – North of M40

- Kineton – South of M40
- Warwick Gates – West of M40
- Banbury (Grimsbury) – East of M40

This distribution enabled demand to be assigned across the wider model network whilst the proportion of development trips entering the model was determined from the M40 model.

The CITEware distribution assigned to the development trips within the WDC STA model was compared to the distribution of the zones which represent the loading points to ensure that there was a correlation between the loading point and the final origin/destination. This stage was required to identify trips of a strategic nature that are restricted to the M40 loading points and, similarly, localised trips that relate to the B4100 were identified through this method.

For example, it is highly unlikely that trips entering the network at the M40 would travel along the Fosse Way and, similarly, it is likely trips of a strategic nature travelling towards the A46 and M40 will primarily enter the network via the M40 rather than the B4100.

The hourly trip generation attributed to the development, following the application of the WCC trips rates and mode shift/internalisation adjustments, are outlined previously within **Table 33**. In total the development is assumed to generate over 6400 and 7300 trips in the AM and PM respectively.

Of those 6400 and 7300 trips, around 4000 trips have been captured crossing over into the boundary of the WLWA model; this represented fewer than 65% of all trips created by the NS.

Within the AM 60% of these trips are predicted to load into the network via the M40 with the remaining 40% travelling along the B4100. Within the PM the split in trips loading via the B4100 and M40 is approximately 50/50.

The distribution adopted at the moment assumes that around 25% of the trips which enter the WLWA model network are destined for the M40 NB or the A46 either SB or NB. Thus, when considering the NS trips that enter the WLWA model network, approximately 75% are predicted to interact directly with the WLWA internal road network whilst 25% travel onwards via the A46 and M40.

At this stage the assumptions pertaining to the distribution of demand across the WLWA model are very simplistic. This may potentially lead to an overestimation of the level of interaction between NS trips and the WLWA internal road network. ***It is recommended that more detailed analysis regarding the assumptions concerning the distribution of NS trips across the Warwickshire and wider area is undertaken during any, more detailed, testing of the potential impacts of the NS at G/LH.***

At this stage, in order that the initial assessment could be undertaken in a timely manner, the trip generation associated with the NS, and specifically its allocation within the WLWA model, assumes that these trips are likely to occur in addition to those which are created by the adoption of the strategy outlined within the Warwick Local Plan. Again this is a simplistic approach to the assignment of demand as it does not make any allowances for the interaction of trips between the proposed NS or the sites anticipated to be delivered as part of the WDC local plan. Part of the current premise concerning the delivery of the WDC local plan is that a

substantial amount of houses may be delivered to the south of Warwick and Leamington, specifically in and around the Europa Way corridor. There is a strong likelihood that there will be an interaction between these sites and the employment provision put forward as part of the NS at G/LH. As a result it is reasonable to conclude that the demands that have been adopted at this stage of the assessment provide a robust reflection of the likely impacts and that, further refinement of these assumptions is likely to result in a reduction in the impacts that are presented within the later stages of this report. ***It is recommended that more detailed analysis regarding the potential for the interaction between the proposed NS at G/LH and the sites proposed as part of the latest version of the WDC Local Plan is undertaken during any subsequent assessment stages involving the allocation of a NS at G/LH.***

The initial hourly demands that have been captured within the M40 PARAMICS model and translated into the WLWA model are summarised, alongside the existing WLWA model demands, within the following **Table 38**:

Table 38 - WLWA Model + NS Demand Totals

Demand	0700 to 0800	0800 to 0900	0900 to 1000	1600 to 1700	1700 to 1800	1800 to 1900
WLWA Demands	44627	50660	39125	50465	50353	45045
NS Demands	987	1770	1332	1273	1711	1616
% Growth*	2.33%	4.29%	3.73%	2.71%	3.54%	3.73%

**% Growth has been calculated after HGV movements have been removed from the demand totals.*

These demand totals have been assigned within the WLWA WDC STA Model using a separate matrix level which allows the identification of trips related explicitly to the NS at G/LH should this be necessary. Overall the allocation of the NS initially appears to result in growth in forecast demand levels of up to 4.3% which is a sizeable considering the substantial coverage that is included within the WLWA model network.

4 Mitigation Overview

4.1 Introduction

During the course of the earlier phase of STA work a number of mitigation measures have been identified through the modelling and impact analysis that will be required to accommodate the proposed growth levels. In addition, the network operation during the course of the assessment has been kept under review and, where necessary, additional mitigation measures have been included within the scenarios.

The following chapter sets out some of the mitigation measures assigned within the various modelling scenarios:

4.2 Stratford-upon-Avon SUE Mitigation

4.2.1 Stratford Eastern Relief Road (ERR)

All assumptions pertaining to the allocation of an SUE to the southwest of Stratford include the need for the delivery of the ERR in some format. Two potential alignment options have been tested.

Both options include the allocation of new road space/upgrading of existing road space between the A422 Banbury Road and the B4086 Main Street, Tiddington Each alignment option then diverges:

4.2.2 ERR Option 1

Option 1 involves the delivery of a new bridge across the River Avon which joins the B4086 Main Street with the A439 Warwick Road. The initial tie in is at the point where the ERR meets the B4086 Main Street at grade and then it is aligned north-westwards towards the A439 Warwick Road/Ingon Lane junction which in turn has been reconfigured into a four arm roundabout.

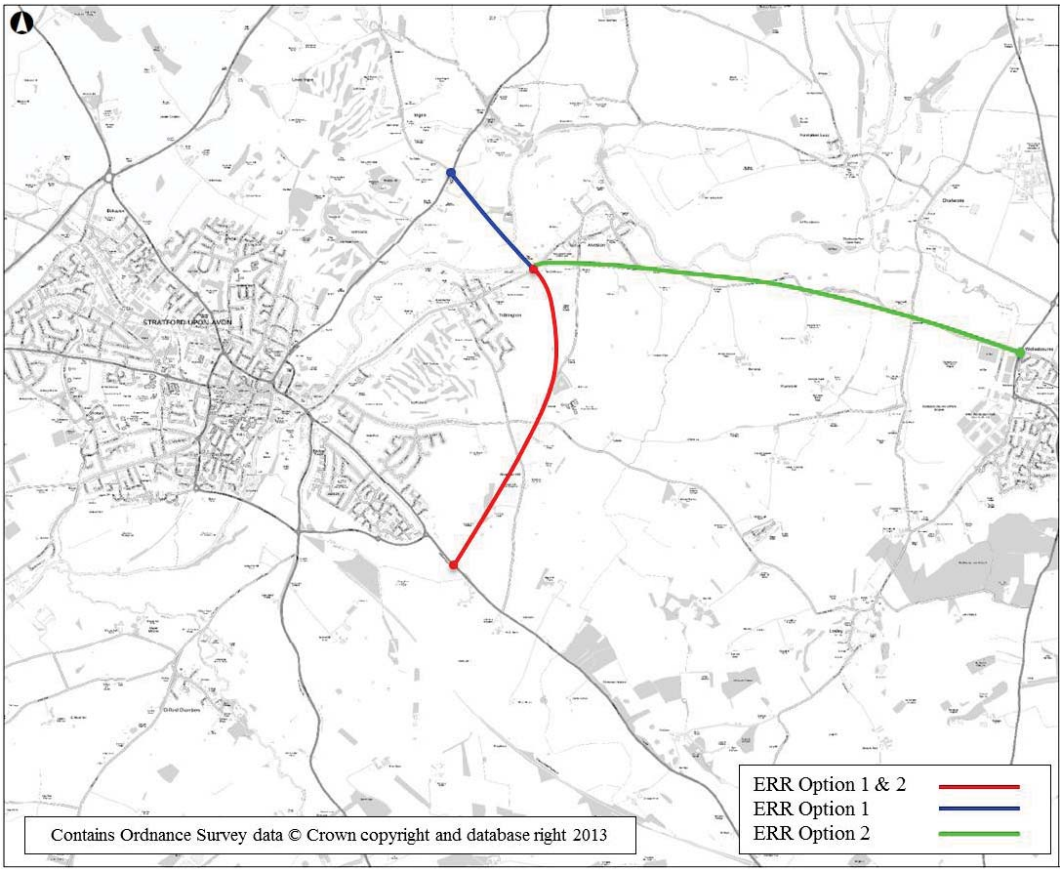
4.2.3 ERR Option 2

Involves the upgrading and, where necessary, the realignment of the B4086 up to the point where it links up with the A429. The intention being that the A429 will then provide a route northwards to the M40 and A46 Strategic Road Network.

An overview of the alignment options is provided within the **Figure 11** on the following page.

In addition to the inclusion of the two ERR options, additional testing was undertaken whereby the series of Town Centre Improvements (TCI) were also included within the model network. The TCI measures are those which were identified during the earlier STA work as being necessary to mitigate the impacts of growth on Stratford town centre.

Figure 11 - ERR Alignment Options



The TCI that have been included within the modelling are broadly in line with those that were determined during the initial phase of the STA work. Some minor amendments have been made to the proposed schemes to ensure that they lie within the existing highway boundary. The schemes, identified during the earlier phase of modelling, that have been carried forward into these models include the following:

- Signalisation/reconfiguration of the Evesham Road/Evesham Place roundabout
- Signalisation of the Gyratory
- Signalisation/reconfiguration of the Banbury Road/Shipston Road roundabout
- Signalisation/reconfiguration of the Tiddington Road/Swan's Nest Lane/Banbury Road junction
- High Street and Grove Road to become NB only
- Rother Street to become SB only

At this stage the only scheme that was not carried forward from the earlier work was the reconfiguration of the Windsor Street/Guild Street/Shakespeare Street roundabout. Initially this was because this area of the model network operation did not appear as problematic as had previously been the case. However, during later stages of the assessment large queues were observed in this area indicating that a consideration should be given to re-instating the scheme during any future stages of the assessment.

In addition to the the schemes outlined within the TCI, initial testing revealed that schemes would be required between the Shipston Road/Trinity Way and the

Shipston Road/Clifford Lane roundabouts. A scheme was proposed in this area which involved substantial widening of both roundabouts and the delivery of two lanes NB and SB between the two junctions.

4.3 New Settlement Mitigation Measures

4.3.1 M40 PARAMICS Localised mitigation measures

All of the WDC STA mitigation schemes that were identified during the Warwick District Strategic Transport Assessment were included within the M40 model, namely:

- Introduction of two lanes along the length of Europa Way from M40 J14 to Princes Drive.
- Signalisation of the Europa Way/Harbury Lane/Gallows Hill roundabout
- Signalisation and reconfiguration of the Shire's Retail Park roundabout into a hamburger arrangement.
- Signalisation of the Europa Way/Myton Road/Old Warwick Road roundabout.
- Widening of the approaches and exits to the Gallows Hill/Banbury Road junction

Despite the inclusion of these schemes within the model network it was still felt that the model was not operating to a satisfactory level. In response to this, the areas of the network around Gallows Hill as well as around the Shires Retail Park roundabout were left largely unconstrained for the purposes of this testing. The reason behind this was twofold:

1) To ensure that as many of the trips to and from the NS were able to be released onto the network, and thus ensuring that the localised mitigation strategy was appropriate and operating satisfactorily; and

2) To ensure that network constraints beyond J13 did not adversely affect the assignment of routes between the development and Warwick/Leamington via the B4100 and M40 as these values are directly translated into the WLWA model.

The access strategy associated with the development, at this stage, assumes the delivery of a new signalised cross roads to provide two new development access points along the B4100 to the north of Lighthorne Heath, retention of the priority junction just north of Winyates Road, two new access arms which tie into proposed junctions just outside the Heritage Motor Centre and the new junction proposed to bypass Gaydon roundabout. A link through the site, running parallel to the B4100, configured to discourage 'rat-running' (speeds set to 20mph, no signposting) to act as a distributor link for development trips.

After some initial runs of the model were completed, in addition to the aforementioned access strategy, the following local and strategic interventions were included within the modelling:

- Introduction of a new NB slip onto the M40 from the B4451 which omits the need for vehicles to turn right from the B4451 NB to access the M40. The left turn from the B4451 SB is still currently maintained

and vehicles merge prior to merging onto the M40. Further review of this configuration is required and such an arrangement may potentially be replaced by an arrangement which involves signalisation of the right turn from the B4451 SB towards the M40 NB on-slip.
- Introduction of signals at the NB off-slip of J13, queue detectors have been used to ensure that queuing does not propagate back onto the mainline.
- Introduction of Managed Motorway (MM) All Lanes Running (ALR) between J13 and J14.

Implementation of the aforementioned schemes appeared sufficient to ensure that network operation was maintained and the trip generation outputs where acceptable for translation into the WLWA model to inform the outline cumulative impact assessment.

A further review of the model indicated that there may be further benefits in investigating the implementation of ramp metering at the J13 SB on-slip as speeds on the mainline carriageway appear to drop, in spite of the implementation of MM ALR, due to the high level of demand predicted to use this junction to travel southwards to M40 J12 and the proximate developments including but not limited to the proposed NS.

4.3.2 WLWA Strategic Mitigation Measures

As has been mentioned previously, following the first iteration of the 2028 WDC STA + NS scenario, some areas were identified where additional mitigation measures or amendments to existing mitigation measures were perceived to be likely to deliver additional benefits and, potentially, improve the overall level of network operation. The initial mitigation measures identified and included within the modelling are outlined as follows:

- Implementation of MM ALR south of M40 J13
- Signalisation of the J13 NB off-slip
- Widening of the circulating carriageway and all approaches to the Fosse Way/A452 roundabout, provision of two lane exit flares on the Fosse Way in both directions.
- Further enhancements to Grey's Mallory, including revision of the lane markings between the B4100 WB and Europa Way NB, and addition of a third lane to accommodate more traffic movements from Europa Way SB to the B4100 EB.
- Addition of a left turn slip from Oakley Wood Rd NB to Harbury Lane WB

The mitigation measures outlined previously represent those which have been determined form a single iteration of the modelling; it is highly likely that further mitigation measures would be identified through additional iterations of the modelling, as would the potential for those which have been currently proposed to be further optimised.

At this stage, the purpose of identifying the impacts, both with and without mitigation measures included, is to determine how likely it is that additional mitigation measures can be identified and delivered which will further mitigate the likely impacts of the NS. These schemes have been included within the model

network in addition to those which have been proposed through the recent phase of the WDC STA.

4.3.3 Managed Motorways

The initial analysis has identified that the delivery of MM between J13 and J12 of the M40 is likely to be necessary when considering the impacts of delivering the NS. This corresponds with the outcome of analysis undertaken when testing the WDC CS allocations in so far as the WDC testing has indicated a need for the delivery of MM between at least J15 and J14 of the M40. It is highly unlikely that MM would be delivered between two junctions of the SRN due to the short distances involved. However, implementation of MM over a longer area is much more feasible and so it is likely that delivery of MM would be required along the length of J15 to J12 of the M40. Thus, the NS is likely to cement the need for MM across the wider corridor and, as a result, it is likely that delivery of the scheme as a whole would become more feasible, particularly as the NS would be expected to make a contribution to the delivery of MM in the area.

5 Results Analysis

5.1 Overview

The following sections of the report are intended to present the results obtained from the detailed testing undertaken with the Stratford-upon-Avon and Warwick & Leamington Wide Area models as well as the smaller M40 corridor model.

A tiered assessment has been adopted since the results analysis is still largely focussed on a strategic level assessment at this stage. The majority of results analysis that has been undertaken corresponds to the analysis undertaken during the earlier stage of the Stratford STA. However, as the level of detail required of the assessment has increased from that which was presented previously, there are some additional measures that have been included within this assessment such as the impact on queuing levels within the WLWA model. This analysis has been included to ensure consistency with the approach adopted when considering the impact assessment of the WDC CS measures. All of the measures used to inform the assessment are outlined as follows:

5.2 Model Stability

Due to the deterministic nature of assignment within PARAMICS it is possible for vehicles to continue to attempt to enter a network even when congestion has reached such an extent that the network is effectively 'grid-locked'. In some cases the grid-lock can occur due to problems that will require mitigation, in other cases it can be something as simple as vehicles entering a mini-roundabout from all three approaches at exactly the same time.

When a model becomes grid-locked vehicles still continue to be assigned to the network and so delay begins to increase exponentially. It should be acknowledged that these issues may be occurring due to a need for mitigation in one or more areas of the model but, if the models do not lock up every time it can be concluded that the problem is not severe enough to cause the network to cease to function. Furthermore, the fact that some model runs are completed without mitigation indicates that a mitigation strategy can only provide additional improvements and should be deliverable.. If it is model error causing the issues then these results should also be discounted due to the fact that they cannot be considered realistic.

It should also be acknowledged that experience gained elsewhere in the application of PARAMICS micro simulation modelling, in projects of a similar size, has highlighted that the level of instability within the models frequently improves as the options are looked at in more detail. Partly this is because of the fact that, as developments are progressed in isolation, more localised impacts are identified and mitigated than can be achieved during such a high level assessment and partly this is because the existing mitigation that has been proposed will be subject to further refinement and improvement beyond this stage of the assessment.

Ten model runs were initially undertaken, where model stability has been particularly poor, the propensity for a model to lock up (and thus to be considered to have failed), is assessed to allow the reliability of the model network across the various scenarios to be better understood.

Additional runs were then collected to ensure that, where practicable, model outputs were based on ten runs per time period.

5.3 Number of Runs

Network statistics analysis has been based, were appropriate, on 10 runs per scenario. Model runs deemed to have failed have been removed from the analysis wherever the opportunity was available to do so.

5.4 Network Wide Statistics

A number of statistics used in the analysis have been obtained from analysing each individual trip that has occurred within the network. This information is collected within PARAMICS through the Trips-all file and contains information specific to each individual trip that has been completed within the model period. This information is then aggregated and processed to provide the following comparative statistics:

- **Average Journey Time (seconds)** – The average travel time of a completed trip during the model simulation period.
- **Average Distance (Km)** – The average distance travelled by a vehicle that completed their journey during the model simulation period.
- **Average Speed (Km/h)** – The average speed travelled by all vehicles that completed a journey during the model simulation period.
- **Completed Trips (vehicles)** – The number of completed trips recorded during the model simulation.

5.5 Flow/Speed Analysis

On a number of occasions flow analysis has been undertaken to ascertain the changes in conditions, on links, between scenarios. In most cases, where this approach has been adopted, the outputs are based on the two-way totals and have been presented for the entire AM and PM model periods rather than on an hourly basis.

Total flow on links is calculated by totalling the number of vehicles travelling along a link during the model periods and then averaging this information across the 10 runs. Similarly, average speed has been calculated in a comparable manner albeit the average speeds by hour have been weighted by the relative levels of flow therein.

5.6 Average Maximum Queue Length Analysis

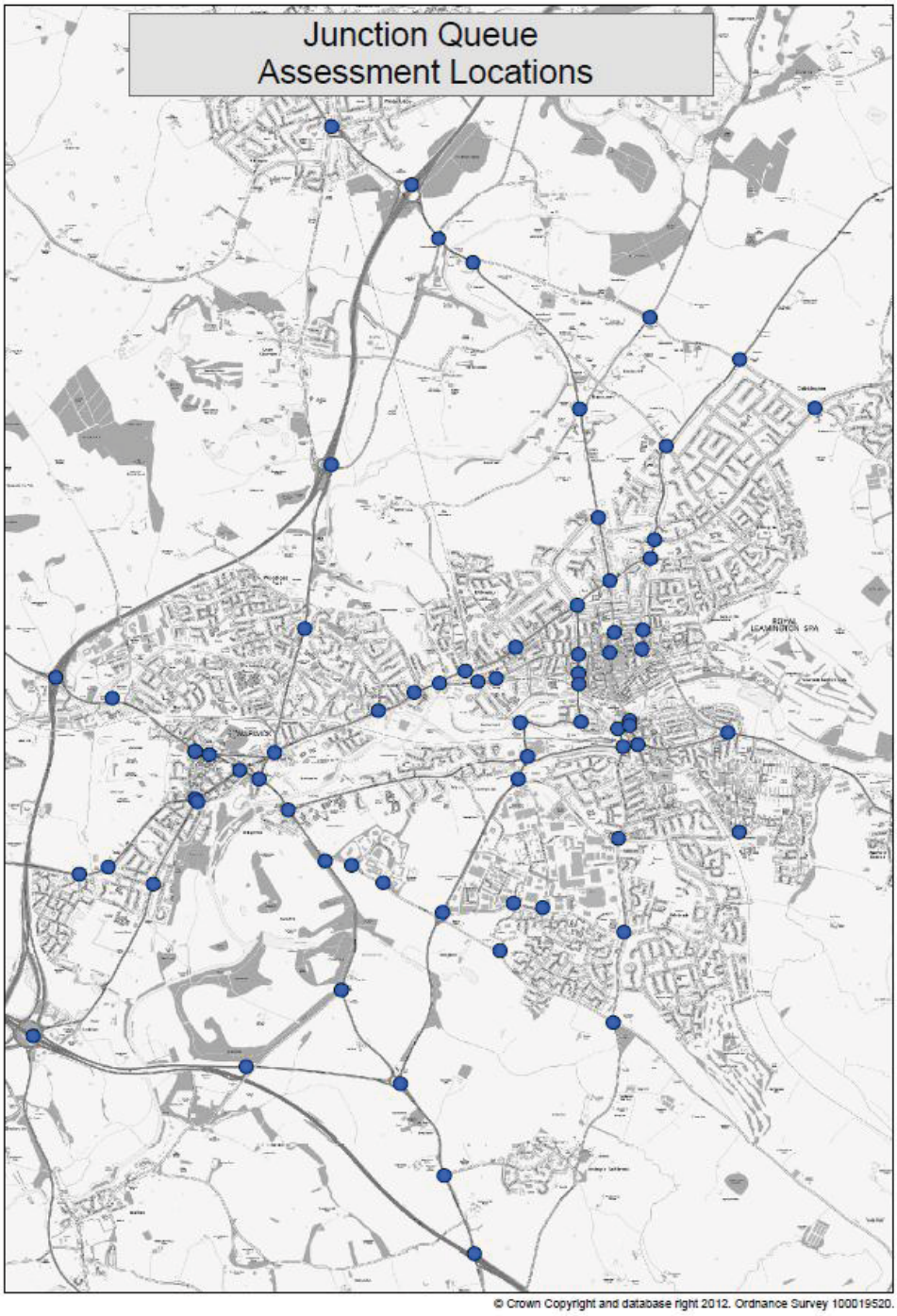
One of the most useful indicators of the overall level of network performance that has been adopted within the WDC STA analysis is the impact on Average Maximum Queue lengths across the entire model periods.

At this stage the analysis of queue lengths has been based on the average hourly maximum queue length. Results presented for each junction are based on the worst performing single approach. The hourly maximum for each individual model run has been calculated and then the average of all runs has been calculated

for each hour. The average of these values, across all model hours, is reported as the periodic average maximum queue length and is reported in vehicles.

The junctions for which average hourly maximum queue lengths have been calculated and compared are illustrated within the following **Figure 12**:

Figure 12 - Queue Assessment, Junction Locations



Junctions where queue differences have not been plotted on the maps simply represent junctions which did not trigger any of the assessment criteria across any one approach.

At this stage these results simply identify areas where further attention is required. A queue length increase of 50 vehicles does not necessarily mean that a scheme will not work, it may indicate that further optimisation of the layout or any signal times are required. Furthermore it may not account for improvements on other arms of the same junction which, when investigated further, may contain additional capacity which could be unlocked to reduce the queue length on the offending approach.

The classification of differences used within the queue length analysis is outlined as follows:

- **Queue Reduction** (a reduction in queue lengths of greater than 5 vehicles)
- **Moderate Increase** (an increase in queue lengths of between 15 and 30 vehicles)
- **Severe Increase** (an increase in queue lengths of between 30 and 50 vehicles)
- **Very Severe Increase** (an increase in queue length of over 50 vehicles)

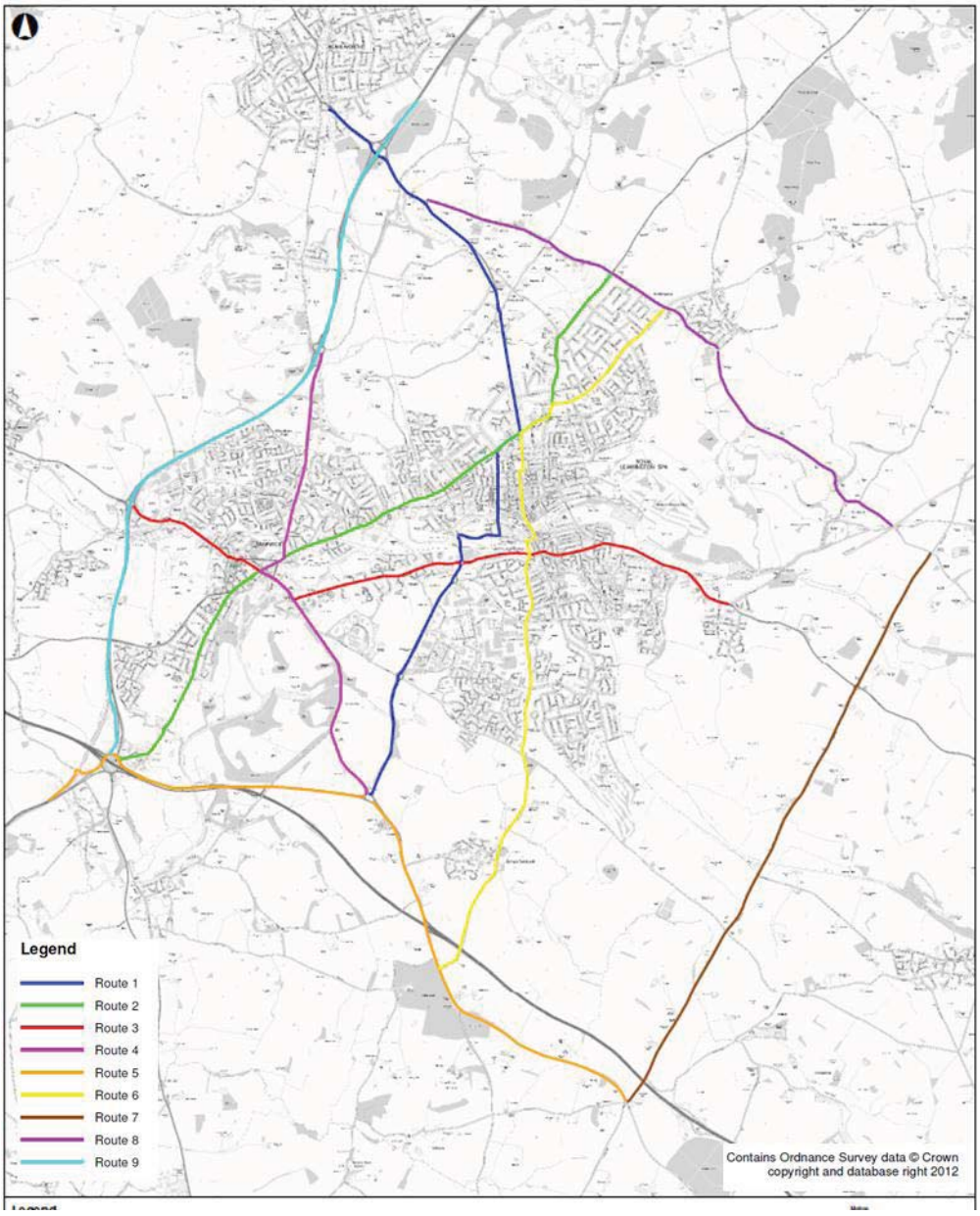
5.7 Detailed Journey Time Impact Analysis

In assessing the performance of the WDC STA scenarios, 9 key journey time routes have been defined within the modelling and the time it takes vehicles to traverse these routes has been collected and compared between scenarios. The increase in delay between scenarios, along key sections of the journey time routes, has then been classified as follows:

- **Delay Reduction -** A reduction in overall delay levels of -15% or more
- **No Significant Change -** A difference in journey times of between -15% and +15% falls within this category
- **Moderate Increase -** An increase in journey times of more than 15% but less than 25%
- **Severe Increase** – An increase in journey times of more than 25% but less than 50%
- **Very Severe Increase** – An increase in journey times of more than 50%

The outcome of these comparisons has been output in GIS format. The routes for which journey time data has been collected are illustrated within **Figure 13** on the following page.

Figure 13 - Journey Time Analysis Routes



5.8 Additional Analysis

In addition to the measures outlined previously, in some cases, specific types of analysis have been used to inform certain stages of the analysis. Where this has been necessary the method of extraction and the measures presented have been detailed within the relevant sections of this report.

6 Stratford SUE & ERR Testing

6.1 Introduction

The first stage of the assessment focussed on the impacts of delivering the SUE and ERR with and without the TCI measures.

There were a number of different objectives related to this phase of testing. These have been addressed through a staged approach which is outlined as follows:

- **Stage 1 –** Was intended to initially identify the potential impacts incurred by the adoption of the various scenarios and to assess how feasible the delivery of each of the ERR alignment options would be in terms of the overall impact on the levels of network performance;
- **Stage 2 –** Reviewed the potential impacts of each option in terms of the impacts on Stratford town centre and the 'Historic Spine'
- **Stage 3** – Undertook to ascertain the potential for the reallocation of road space to bus priority as a result of the implementation of one or more of the CS options;
- **Stage 4** – Assessed the potential of the options to facilitate an HGV restriction imposed on Clopton Bridge.

6.2 Test Scenarios

The following scenarios have been run and assessed, 10 times per AM (07:00 to 09:00) and PM (16:00 to 18:00) time period, and the outputs have been analysed in the following Section of this Report.

- 2028 Ref Case
- 2028 Stratford SRZ
- 2028 Stratford SRZ + SUE + ERR Op1
- 2028 Stratford SRZ + SUE + ERR Op1 + TCI
- 2028 Stratford SRZ + SUE + ERR Op2
- 2028 Stratford SRZ + SUE + ERR Op2 + TCI

6.3 Stage 1 – Stratford Regeneration Zone, (SRZ) ERR & SUE Testing

The first stage of the modelling was to assess the potential impacts of a number of different scenarios namely:

- 2028 Reference Case - Stratford-upon-Avon Extended PARAMICS model inclusive of all known committed developments, the Western Relief Road and TEMPRO/NTEM external Growth Forecasts[5].
- 2028 Stratford Regeneration Zone – As per the previous scenario with assumptions pertaining to the regeneration zone within Stratford-upon-Avon having also been included.
- 2028 SRZ plus SUE & ERR (Various) – The previous scenario with assumptions pertaining to the delivery of a Sustainable Urban Extension to the South East of Stratford-upon-Avon and an

[5] See "211439-19.TN025 Stratford PARAMICS 2028 Forecasting" for further details

accompanying Eastern Relief Road, based on two potential alignment options.

- 2028 SRZ plus SUE & ERR (various) + Town Centre Improvements – The previous scenario, amended to include the assumptions regarding the delivery of additional infrastructure measures within the centre of Stratford-upon-Avon.

The following provides an overview of the initial results extracted during the first phase of this assessment:

6.3.1 Model Stability

Each scenario was initially run 10 times per time period and the number of vehicles on the network was assessed to determine whether the model run could be considered as having 'locked-up'. Two distinct indicators of a model lock-up are too many vehicles left on the network at the end of the simulation period or a constant build-up of vehicles on the model network with no apparent dissipation.

During the AM two scenarios performed poorly when considering the model stability. The 2028 Stratford SRZ + SUE + ERR Op2 scenario failed to record a single successful run during the AM 07:00 to 09:00 period. Whilst the 2028 Stratford SRZ + SUE + ERR Op2 + TCI suffered instability during 30% of the AM runs.

The propensity for the model to fail increased substantially, across both of these scenarios, during the PM period. The initial outputs from the model stability analysis have been summarised as follows:

Table 39 - Model Stability Analysis

Time Period	2028 Ref Case	2028 SRZ	2028 Err Op1	2028 Err Op1 + TCI	2028 Err Op2	2028 Err Op2 + TCI
AM (07:00 to 09:00)	100%	100%	100%	100%	**0%**	**70%**
PM (16:00 to 18:00)	100%	70%	50%	70%	**0%**	**0%**

Analysis of the above table reveals that there is an unacceptable drop in the level of model stability when considering the second ERR alignment option.

To understand further the implications of these model runs, analysis of the vehicles on the network during each modelled 1 minute interval has been completed for all of the aforementioned scenarios. This has been presented for the AM and PM peak hours within **Figure 13** and **Figure 14** on the following page.

Analysis of **Figure 13** reveals that, during the AM peak hour, the number of vehicles on the network within the 2028 Stratford SRZ + SUE + ERR Op2 scenario never dissipates. It simply continues to build as more and more vehicles are loaded onto the network but the congestion levels are such that the network is essentially saturated and these trips are unable to travel through the model network, correspondingly, the number of vehicles on the network never reduces.

Figure 14 - AM Peak Hour (08:00 to 09:00), Vehicles on the Network

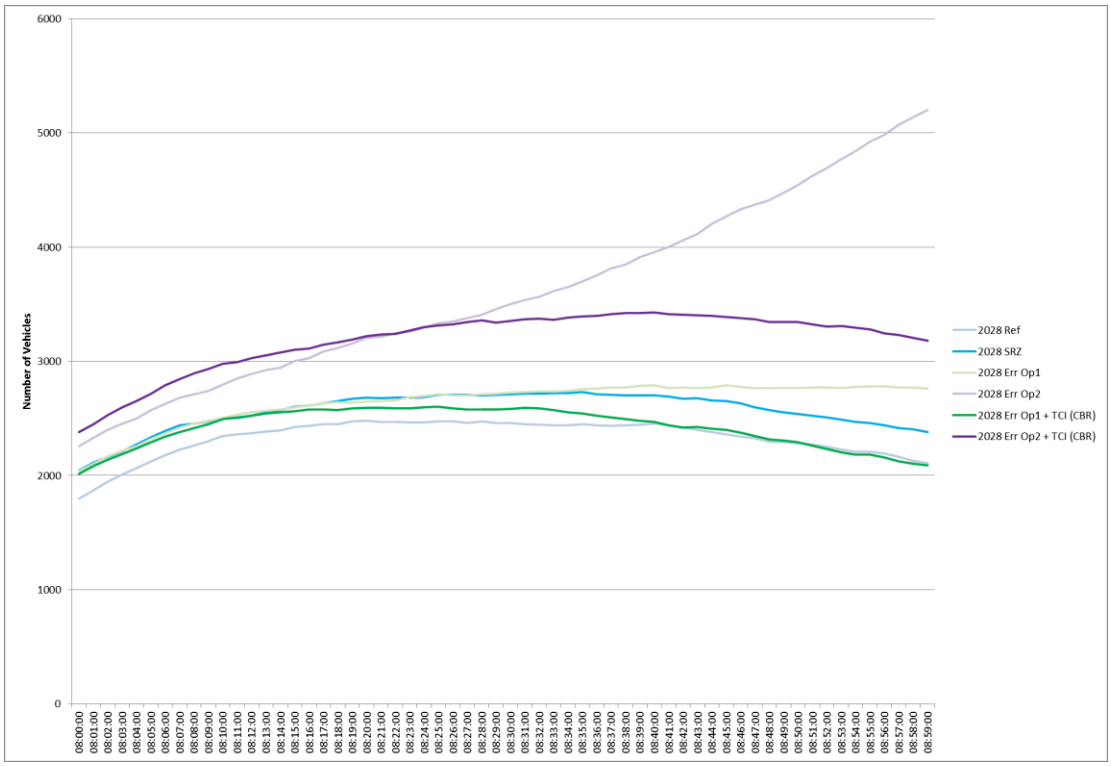


Figure 15 - PM Peak Hour (17:00 to 18:00), Vehicles on the Network

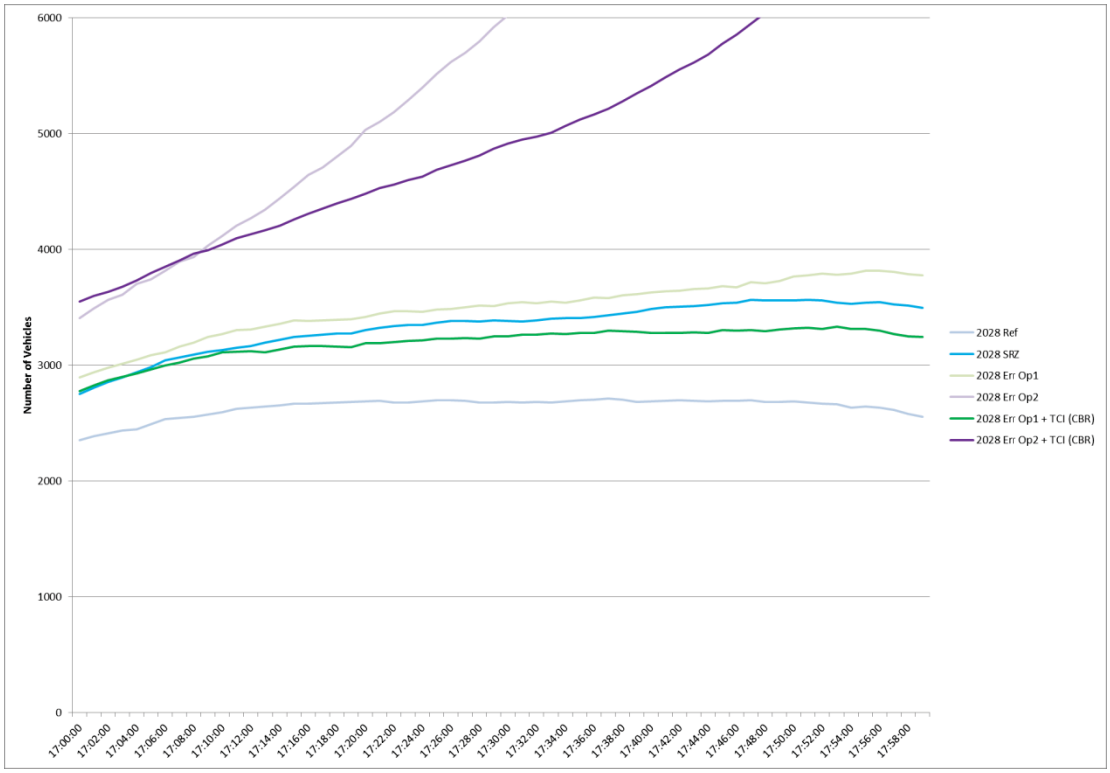


Figure 14 also reveals that the number of vehicles present on the network during the 2028 Stratford SRZ + SUE + ERR Op2 + TCI AM peak hour are significantly higher than those which are observed during the other scenarios. None of the scenarios which contain either the Option 1 ERR alignment or no ERR/SUE

assumptions peaks at more than 3000 vehicles on the network whilst the 2028 Stratford SRZ + SUE + ERR Op2 + TCI is consistently above 3000 vehicles for almost the entire of the AM peak hour. This is indicative of much higher levels of congestion within this model network compared to the alternative scenarios.

Analysis of **Figure 15** reveals that neither options which included the ERR Option 2 alignment are able to accommodate the demand levels predicted within the scenarios. In both scenarios the number of vehicles on the network can be observed to simply increase for the duration of the peak hour with no evidence of the network being able to dissipate the assigned traffic levels.

Based on the previous analysis it is reasonable to conclude that neither ERR scenario, which involves the ERR option 2 alignment, is able to accommodate the required demand levels assigned to the model network.

This indicates that the ERR is required to facilitate more than just the movements between the developments/southeast Stratford and the M40/A46 which is all that the ERR Option 2 is able to cater for.

6.3.2 Select Link Analysis

In order that the reason behind the apparent failure of ERR Option 2 to accommodate the additional demand level can be better understood, select link analysis of the movements across the ERR, within the two options, has been undertaken.

Select Link Analysis identifies the origin and destination of every completed trip within the model period that cross the link that has been chosen to inform the analysis. Two locations were chosen for this analysis:

- The ERR Option 1 location was selected as the mid-point of the newly proposed Bridge
- The ERR Option 2 location was selected as being the re-aligned section of the ERR located to the East of Alveston.

The location of these links has been illustrated within the **Figure 16** on the following page.

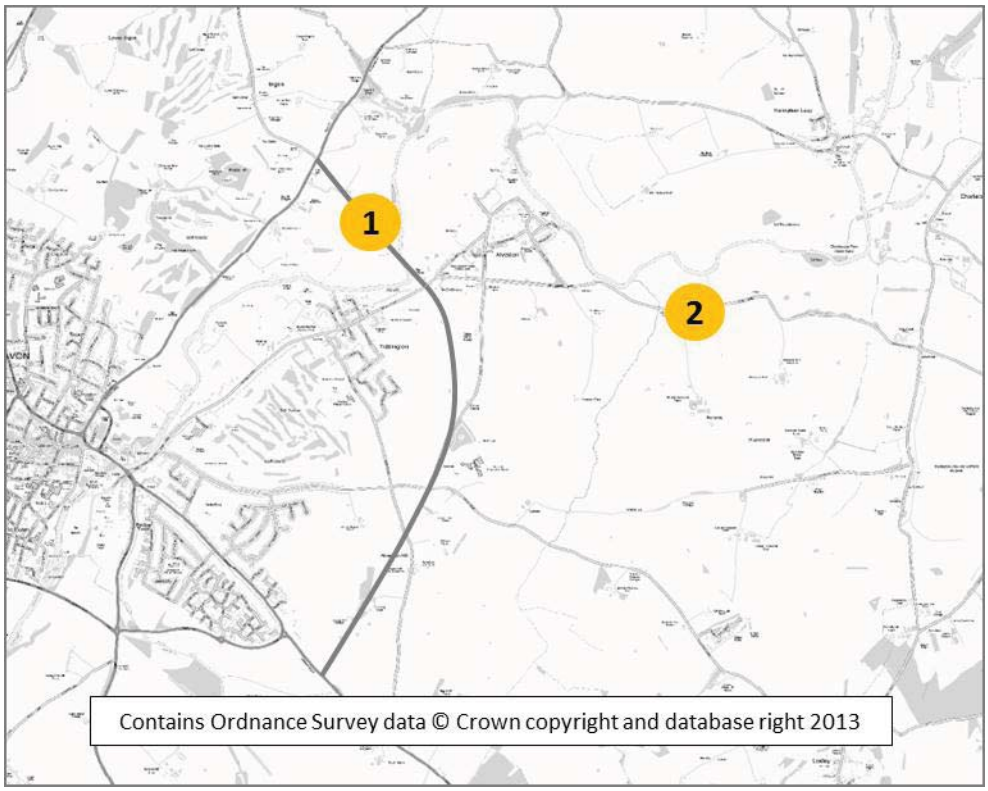
The total number of two way trips across both locations was identified and then the proportion of those trips which were travelling to or from the M40/A46 to the north was isolated out.

This analysis was undertaken for the PM peak hour (17:00 to 18:00) as this is the hour in which network performance appears to suffer the greatest level of impact.

The same analysis was undertaken for the 2028 Stratford SRZ scenario using the same location as has been identified for the assessment of the Option 2 alignment. The purpose of this assessment is to understand the underlying flow pattern in this area and how it is affected by the inclusion of the ERR and SUE.

The ERR scenarios which were chosen for the assessment were inclusive of the TCI measures so as to ensure that the best performing scenarios, as far as the ERR Option 2 analysis was concerned, were used to inform the analysis.

Figure 16 - ERR SLA Link Locations



The two-way flow levels at the two locations have been calculated for each of the three scenarios. Alongside the total flow, the numbers of vehicles that cross the locations with either an origin or destination associated with the zone which represents the route to Longbridge Island and the M40/A46 (zone 65) have also been calculated. These results have been presented, for the PM peak hour (17:00 to 18:00) within the following **Table 40**:

Table 40 - ERR SLA Outputs (17:00 to 18:00)

	Total Flow	M40/A46 (Zone 65)	%
SRZ	814.2	147.8	18.15%
ERR Op 1	1264.6	461.4	36.49%
ERR Op 2	675.7	150.5	22.27%

The previous table indicates that the ERR Option 2 alignment results in a drop in overall flow levels and only a very small increase in the number of trips interacting with zone 65. This is indicative of wider congestion effects preventing traffic from reaching this point in the network within the hour that is being considered.

Whilst the analysis of the SRZ and ERR Op2 presents outputs from an existing location within the model the ERR Op1 location represents an entirely new location. It is clear from this analysis the proposed ERR attracts a substantial amount of traffic that would otherwise be finding alternative routes through the network. Furthermore, only 36 ~ 37% of this traffic is associated with zone 65 which indicates that the new link road is accommodating trips travelling to and from a number of different locations.

The fact that 67% of trips using the ERR neither start or end at zone 65 is indicative of the wider strategic role that the new ERR is likely to play over and above simply facilitating the movements of trips from southeast Stratford to the SRN (Zone 65). The Option 2 alignment cannot deliver a similar level of benefit within the model network as it is constrained by the fact that it only improves the route between southeast Stratford and the SRN, no additional O-D movements are catered for to the same extent within Option 2 when compared to Option 1

It should be noted that there is a cost factor in place that will act to deter some traffic from using this link within the model. However, within all but the ERR Option 2 scenario, the classification of the route that is followed by the ERR Option 2 alignment is minor whilst in the ERR Option 2 test the route has been reclassified as major within the modelling, meaning that unfamiliar vehicles will now perceive the cost of travelling along the route as being half the original route cost within the alternative scenarios. This will reduce the impact of the cost factor but does not seem to result in increased usage of the ERR Op2 route.

It is apparent that the majority of the additional benefits that are unlocked by the delivery of the ERR through the Option 1 alignment concern the additional capacity that is provided by the new road and, specifically, the ability of the proposed alignment to provide an alternative route through the network for a number of trips not just those focussed on travelling to and from the SRN and southeast Stratford.

A review of the level and nature of trips that travel along the second location within the ERR Option 1 scenario reveals very little difference between the levels of flow in that scenario and the level and nature of flows extracted from the SRZ scenario. This information has been presented within the following **Table 41**:

Table 41 - ERR SLA Output: Location 2 only (17:00 to 18:00)

	Total Flow	M40/A46 (Zone 65)	%
ERR Op1	876.5	149.6	17.07%

The previous table demonstrated that the flows in the ERR Op1 scenario increase in this area, when compared to the SRZ flows but there is not a notable increase in the level of demand travelling to zone 65. This is likely to indicate that the additional traffic is travelling westbound to alternative destinations such as Wellesbourne and Kineton, etc. Additionally, these results also indicate that the increase in traffic travelling between the proposed SUE and zone 65 is likely to be borne by the ERR when the Option 1 Alignment is adopted. Clearly when the Option 2 Alignment is adopted this is not the case which means that some traffic must try and travel northwards from the SUE via Clopton Bridge and the town centre, these movements will contribute substantially to the problems that occur within the town centre network.

6.3.3 Summary

Based on the results presented previously it is reasonable to conclude that the ERR Option 2 Alignment should not be considered within the more detailed stages of analysis as it is unlikely that progressing with this option would yield acceptable results in terms of the impact of the SUE alongside the proposed ERR Alignment.

There are a number of reasons why the ERR Option 2 alignment appears to perform poorly when compared to the scenario in which the ERR Option 1 alignment is adopted, namely:

- That the ERR Option 2 alignment does not facilitate the same level of O-D movements as the ERR Op1 alignment;
- That the ERR Option 2 alignment is likely to lead to the reassignment of more traffic from the SUE via Stratford town centre than the Option 1 alignment;
- That the ERR Option 2 alignment does not serve to provide the same level of additional capacity as is provided by the ERR Op 1 alignment and this additional capacity is likely to be necessary to ensure that the additional demand created by the SUE can be accommodated within the transport network.

6.3.4 Network-wide Performance Measures

Since the ERR Option 2 scenarios have now been discounted, analysis of the network wide performance measures outlined previously has focused on the Reference Case, SRZ and ERR Option 1 scenarios.

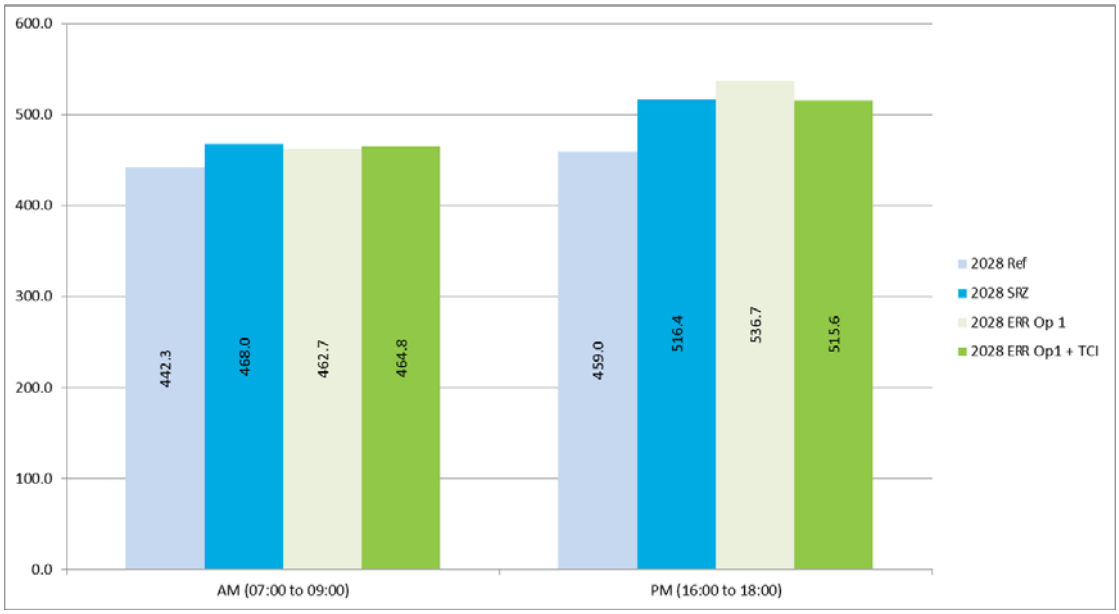
Analysis of the difference in the average journey times (in seconds) between the four scenarios has been illustrated within **Figure 17** on the following page.

Analysis of **Figure 17** reveals that, during the AM, there is an increase in the average journey time experienced by vehicles travelling within all networks when compared to the Reference Case. It is notable, however that the largest increase in journey times is between the Reference Case and the SRZ Option. This is most likely because the additional demand assigned to the model network as a result of the SRZ policy has not been accompanied by any associated mitigation strategy.

Since no changes have been made to the network in an attempt to accommodate the additional demand then it is reasonable to expect the levels of delay to increase. The increase in delay could potentially be reduced by the delivery of a focussed mitigation strategy to accompany the SRZ allocation. There is very little difference in the levels of delay experienced across the three key scenarios during the AM period. This indicates that the proposed mitigation, particularly the ERR Option 1, is able to, at least, accommodate the additional demand that is being assigned to the model as a result of the inclusion of the SUE proposals to the Southwest of Stratford-upon-Avon.

During the PM there is, again, an increase in the average journey times within the 2028 Ref Case and 2028 SRZ model networks. Similarly, there is an increase in the average journey times experienced within the 2028 Stratford SRZ + SUE + ERR Op1 network which is approximately 30% of the magnitude of increase between the 2028 Ref Case and 2028 SRZ scenarios. This indicates that the ERR Option 1 is able to partly mitigate the impacts of the SUE but the TCI measures are necessary to bring levels back down to those present within the 2028 SRZ scenario network.

Figure 17 - Average Journey Time (Seconds), 2028 Ref vs. 2028 SRZ vs. 2028 ERR Op 1 (with and without TCI)



Analysis of the changes in average journey distance across the four scenarios has been presented within the following **Table 42**:

Table 42 - Average Journey Distance (Km), 2028 Ref vs. 2028 SRZ vs. 2028 ERR Op 1 (with and without TCI)

	2028 Ref	2028 SRZ	2028 ERR Op 1	2028 ERR Op1 + TCI
AM (07:00 to 09:00)	7.4	7.5	7.6	7.6
PM (16:00 to 18:00)	6.7	6.8	6.9	6.9

Analysis of the above Table reveals very little difference between the four scenarios indicating that the options do not result in a substantial increase in journey distances as a result of vehicles reassigning to longer routes in an attempt to avoid the effects of congestion. There is a very minor increase in the overall average journey distance and this is to be expected as a result of the fact that the proposed developments tend to be located on the periphery of the model network and, thus, will inevitably increase average journey distances.

Analysis of the changes in average journey speed across the four scenarios has been presented within the following **Table 43**:

Table 43 - Average Journey Speed (Km/h), 2028 Ref vs. 2028 SRZ vs. 2028 ERR Op 1 (with and without TCI)

	2028 Ref	2028 SRZ	2028 ERR Op 1	2028 ERR Op1 + TCI
AM (07:00 to 09:00)	60.0	57.4	58.8	58.6
PM (16:00 to 18:00)	52.4	47.1	46.2	48.4

Analysis of the previous Table reveals that the impacts on journey speeds tend to correlate with the impacts on journey times, in so far as the largest increases are experienced between the 2028 Ref Case and 2028 SRZ scenarios. Notably, within the AM there is a small increase in journey speeds across both ERR Option 1 scenarios when compared to the 2028 SRZ scenario in spite of the additional SUE

demand. Within the PM there is also an increase in the average speeds achieved on the ERR Option 1 network when the town centre measures are included compared to the 2028 SRZ scenario network. Potentially this could indicate that the ERR Op1 networks perform better than the 2028 SRZ network but that improved journey times are not achieved as a result of longer trip lengths being incurred since the SUE is located on the periphery of the town network.

To gain a better indication of the relative performance of each option more detailed analysis around the level of completed trips within the model network has been undertaken and this has been summarised, for all four scenarios, within the following **Table 44** and **Table 45**, for the AM and PM respectively.

Table 44 - AM Trip Completion Analysis, 2028 Ref vs. 2028 SRZ vs. 2028 ERR Op 1 (with and without TCI)

	2028 Ref	2028 SRZ	2028 ERR Op 1	2028 ERR Op1 + TCI
Completed Trips	27715	28270	28981	29221
Demand	28976	30735	31285	31285
Trip Completion Ratio	95.6%	92.0%	92.6%	93.4%

Table 45 - PM Trip Completion Analysis, 2028 Ref vs. 2028 SRZ vs. 2028 ERR Op 1 (with and without TCI)

	2028 Ref	2028 SRZ	2028 ERR Op 1	2028 ERR Op1 + TCI
Completed Trips	33389	33941	34872	35172
Demand	35217	37607	38658	38658
Trip Completion Ratio	94.8%	90.3%	90.2%	91.0%

The previous tables present the total number of completed trips within the simulation period, the assigned demand and the trip completion ratio which is the ratio of completed trips as a function of the total assigned demand.

During both AM and PM periods it is clear that the ERR Option 1 inclusive of the TCI measures performs best. During both AM and PM time periods there are over 1000 more trips completed within the 2028 Stratford SRZ + SUE + ERR Op1 + TCI scenario when compared to the 2028 SRZ scenario.

Stage 1 – Conclusions

Completion of the first stage of option testing reveals the following:

- That the ERR Option 2 alignment is unlikely to sufficiently mitigate the potential impacts of locating the SUE to the southeast of Stratford-upon-Avon
- That there are impacts attributable to the adoption of the SRZ policy that would likely benefit from further investigation and, potentially, focussed mitigation.
- That both ERR Option 1 scenarios (with and without TCI measures) appear to be able to facilitate the additional demand assigned to the network as a result of the SUE.
- That the inclusion of the TCI measures, in addition to the ERR, results in the most improved network conditions when compared to those present within the 2028 Reference Case.

Whilst the inclusion of the ERR alongside the TCI measures appears to result in the most improved network conditions, further investigation is recommended to determine whether the additional improvements in network conditions are justifiable when considering the likely costs of delivering the TCI measures alongside the ERR.

Whilst there are impacts attributable to the SRZ that are identified within the modelling these impacts are unlikely to be sufficient to merit the need for the delivery of either the ERR or the TCI measures. Rather these impacts would likely benefit from the production of a localised mitigation strategy pertaining specifically to the localised impacts of the application of the SRZ policy. It is likely that these additional mitigation measures would result in further improvements in the conditions that have been presented thus far as so it is reasonable to consider the results presented to date, at least as far as the impact of the SRZ policy is concerned, reflect a worst case level of impact. ***It is recommended that such an investigation is undertaken at an appropriate stage of the determination of the CS.***

6.4 Stage 2 –Cordon, Flow and Speed Analysis

Having determined that the ERR Option 1 alignment is the preferred option, more detailed analysis was undertaken to ascertain the potential impacts on Stratford-upon-Avon town centre, that are likely as a result of the adoption of the ERR and SUE option either with or without the town centre improvements.

6.4.1 Cordon Analysis

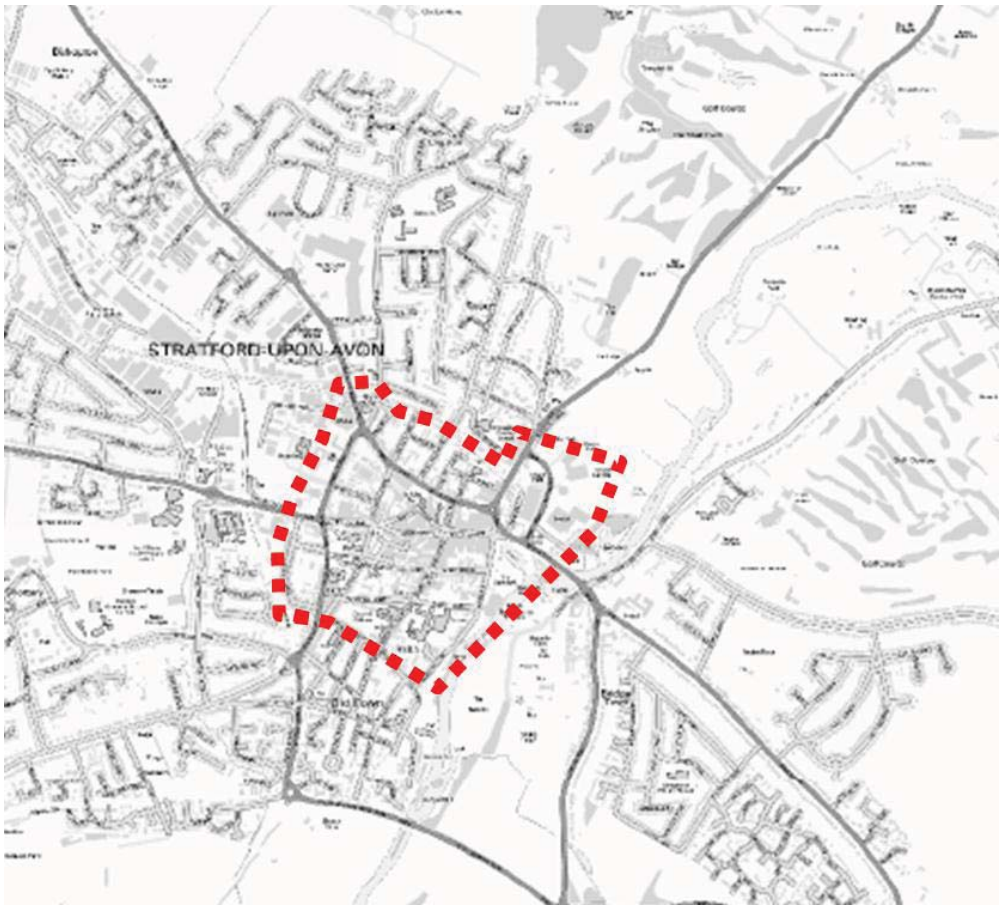
The first stage of this analysis was to determine the likely impact on 'through trips' as a result of the implementation of the SUE and accompanying ERR.

To enable this assessment to take place a cordon has been defined around the town centre and then the number of vehicles entering into that cordon has been calculated across both AM and PM time periods. The number of vehicles which have an origin or a destination within the cordon has then been calculated and this has been subtracted from the cordon entry flows. The remainder of vehicles can then be assumed to be 'through trips' as they are trips which enter into the town centre cordon but have a destination which lies outside of the cordon and, therefore, are travelling through the cordon.

The alignment of the cordon adopted within the modelling analysis is presented within the **Figure 18** on the following page. The cordon boundary results in 9 cordon entry points;

- Birmingham Road
- Clopton Road
- Great William Street
- Warwick Road
- Clopton Bridge
- Church Street
- Rother Street
- Grove Road
- Alcester Road

Figure 18 - Town Centre Cordon Alignment



Analysis of the difference in through trips along the aforementioned links, within the four key scenarios has been presented within the following **Table 46** and **Table 47** for the AM and PM time periods respectively.

Table 46 - AM 'Through Trip' Analysis, 2028 Ref vs. 2028 SRZ vs. 2028 ERR Op 1 (with and without TCI)

	2028 Ref	2028 SRZ	2028 ERR Op 1	2028 ERR Op1 + TCI
Birmingham Rd	380	449	425	398
Clopton Rd	69	61	54	48
Great William St.	52	24	27	29
Warwick Rd	257	254	298	319
Clopton Bridge	738	883	826	805
Church St	62	63	52	40
Rother St	7	6	9	0
Grove Rd	381	438	398	417
Alcester Rd	216	335	340	363
Total	**2162**	**2512**	**2427**	**2418**

Table 47 - PM 'Through Trip' Analysis, 2028 Ref vs. 2028 SRZ vs. 2028 ERR Op 1 (with and without TCI)

	2028 Ref	2028 SRZ	2028 ERR Op 1	2028 ERR Op1 + TCI
Birmingham Rd	494	539	549	493
Clopton Rd	58	48	48	40
Great William St.	74	63	74	69
Warwick Rd	481	494	522	519
Clopton Bridge	754	764	716	689
Church St	85	93	130	90
Rother St	8	7	11	0
Grove Rd	368	400	347	338
Alcester Rd	338	389	438	448
Total	**2659**	**2797**	**2834**	**2686**

It should be noted that the level of flow presented within the previous tables has been adjusted to remove trips which are travelling to or from zones which lie within the boundary. Without such an adjustment, the flows on Rother Street would be in the region of 100 vehicles per period rather than the 7 presented and the same is true of all links presented within the table.

Analysis of **Table 46** reveals that, within the AM, the SRZ results in the largest increase in through trips when compared to the Reference Case. Implementing the ERR Option 1 and SUE marginally reduces the number of through trips that travel across the town centre within the AM period when compared to the SRZ. This is indicative of the ERR providing some relief to the town centre, despite the additional demand that is assigned to the model as a result of the SUE.

Analysis of **Table 47** reveals that the inclusion of the TCI measures appears to reduce the number of 'Through Trips' that travel across the town centre when compared to the 2028 SRZ scenario. The magnitude of through trips within the 2028 Stratford SRZ + SUE + ERR Op1 + TCI scenario is not dissimilar from that which has been observed within the 2028 Reference Case. Notably the TCI measures result in reductions, when compared to the 2028 SRZ scenario, Along Birmingham Road, Clopton Bridge and Grove Road. There are a number of reasons behind these reductions, some of which have been outlined as follows:

- The TCI measures create more gaps within the Stratford Gyratory for traffic to enter via the Warwick Road which reduces the propensity for vehicles to reassign along Birmingham Road as a route into the town centre.
- The reconfiguration of the Seven Meadows Road junction with both Trinity Way and Evesham Place, proposed as part of the TCI measures, means that traffic is able to travel more freely between the Evesham Road and the ERR, via Seven Meadows Road and Trinity Way. This provides additional relief to the town centre and also results

in a reduction in flow levels along Grove Road NB as traffic is reassigning away from the town centre.

These impacts are more noticeable within the PM than the AM because the network is much closer to capacity during the PM period meaning vehicles are more likely to reassign away from major routes as result of existing congestion effects. It is likely that, in the AM, when the magnitude of demand approaches the levels observed during the PM period these effects would be replicated within the AM network.

6.4.2 Cordon Analysis Conclusions

Based on this cordon analysis presented previously, the following conclusions have been drawn:

- That, compared to the 2028 SRZ scenario, the introduction of the ERR is likely to reduce the number of through trips within the town centre.
- That, during the PM period, the introduction of the TCI measures alongside the ERR results in a level of 'through trips' which are not dissimilar to the level experienced within the 2028 Reference Case.
- The introduction of measures along Seven Meadows Road and Trinity Way has the potential to complement the ERR implementation by providing improved conditions for vehicles travelling East to West and vice versa between Evesham Road, the proposed ERR and the M40.
- The impacts are more noticeable within the PM than the AM because the network is much closer to capacity during the PM period and, as a result, vehicles are more likely to reassign away from major routes as result of existing congestion effects.
- It is likely that, in the AM, when the magnitude of demand approaches the levels observed during the PM period these effects would be replicated within the AM network.

6.4.3 Flow and Speed Analysis

As well as assessing the differences in the level of town centre 'through trips' between the various scenarios, a more detailed assessment has been undertaken to establish the potential changes in two-way flow and speed along key links within the town centre area. The purpose of this assessment is twofold:

- To understand to what extent each option would reduce traffic congestion on A3400 Bridgefoot and the town centre, and;
- To understand to what extent would each option enable road space to be reallocated for pedestrian priority in the town centre.

In order that an assessment of the scenarios could be completed, against the aforementioned criteria, analysis of the changes in two-way flows and speeds on key links within certain areas of the town was undertaken. The assessment compared the difference in flows and speeds between the 2028 SRZ scenario and the two ERR Option 1 scenarios (with and without TCI measures). The link locations have been categorised into two distinct locations, namely 'Bridgefoot and the Town Centre' and the main north/south section of 'The Historic Spine' route (High Street, Chapel Street and Church Street) plus some adjoining streets (Sheep Street, Chapel Lane, Bridge Street and Waterside). The link locations

specified within these two broad locations has been outlined within the following **Figure 19** and **Tables 48** and **49** respectively;

Figure 19 - Flow Difference Analysis: Link Locations

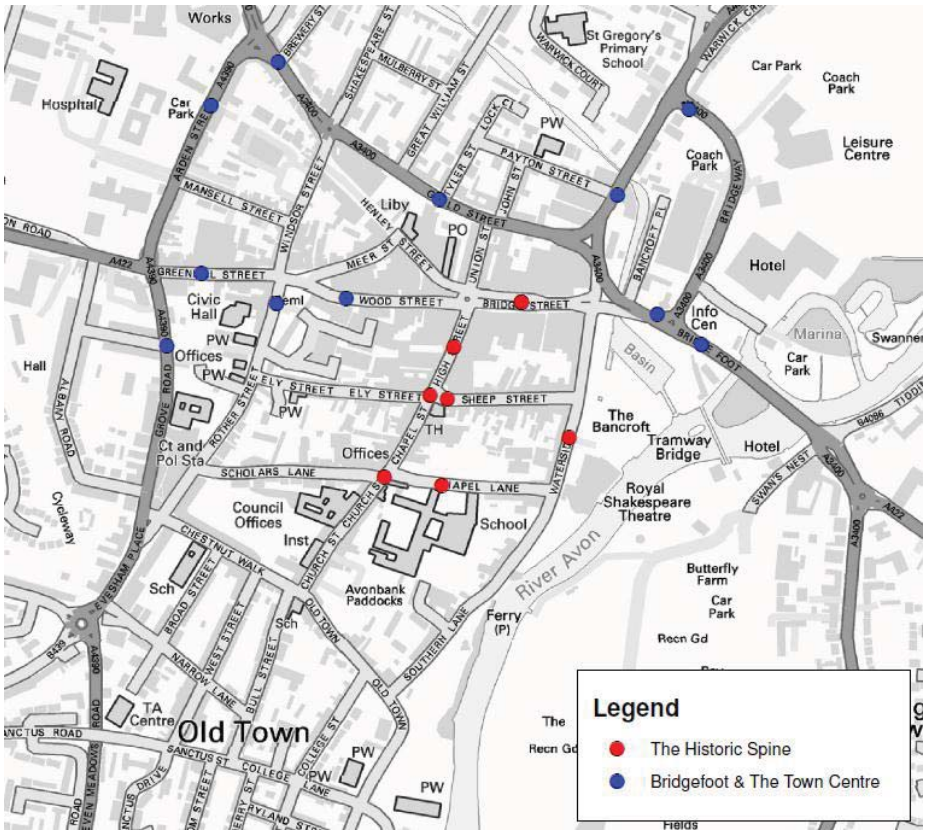


Table 48 - Bridgefoot and the Town Centre Link Locations

Location	Link
1	Bridgeway
2	Bridgefoot
3	Warwick Rd
4	Clopton Bridge
5	Guild Street
6	Bridge Street
7	Wood Street
8	Birmingham Road
9	Greenhill St
10	Arden St
11	Grove Road
12	Rother Street

Table 49 – The Historic Spine Link Locations

Location	Link

1	Bridge St
2	High St
3	Chapel St
4	Church St
5	Sheep St
6	Chapel Lane
7	Waterside

6.4.4 Impacts on Bridgefoot and the Town Centre

A comparison of the changes in two-way flows and speeds on key links within the town centre has been undertaken against the 2028 SRZ scenario and the two 2028 SUE ERR Option 1 scenarios. The comparisons have been undertaken across the entire AM (07:00 to 09:00) and PM (16:00 to 18:00) model periods. This provides a high level overview of the potential impacts of the various options whilst further, detailed analysis, can be undertaken using the directional information at a later stage of assessment should it be required.

2028 SRZ vs. 2028 SRZ + SUE + ERR Op1

Initial comparisons of the changes in two-way flow and speed between the 2028 SRZ and 2028 Stratford SRZ + SUE + ERR Op1 scenarios have been presented, for the AM within **Table 50** on the following page.

Analysis of **Table 50** reveals that, in the majority of cases, the flows on key links within the town centre either reduce or remain at a similar magnitude when the ERR and SUE are included within the network. Substantial reductions are achieved along Clopton Bridge and on some links within the gyratory where flows are observed to reduce by over 10% when compared to the 2028 SRZ flows. The only notable increase in flow levels between the 2028 SRZ and 2028 ERR Option 1 scenarios is along Guild Street. Potentially this increase could occur because the signalisation of the gyratory, alongside the relief provided by the inclusion of the ERR, when compared to the 2028 SRZ network conditions, serves to draw traffic which is travelling from the southeast to the M40 away from this area which, in turn, increases the attractiveness of the route between Clopton Bridge and Guild Street via Bridgefoot. In the AM the general flow of traffic is from the southeast to the north, this will increase as a result of the additional SUE trips on the network, this explains why flows go up on Guild Street and do not change significantly on the Bridgefoot section of the gyratory but they do reduce on the Warwick Road/Bridgeway sections of the gyratory.

It is notable that the reduction in flow achieved on the majority of links within the Bridgefoot and the Town Centre areas are accompanied by either no change or a small increase in the average speeds on those sections of network.

Table 50 - AM (07:00 to 09:00) Flow and Speed differences 2028 SRZ vs. 2028 SRZ + SUE + ERR Op1 (Veh & Mph)

Loc	Link	Two-way flow (veh)		Dif		Two-way Speed (mph)		Diff (%)
		2028 SRZ	2028 + SUE ERR	ABS	%	2028 SRZ	2028 + SUE ERR	
1	Bridgeway	2560	2247	-313	-12%	12.9	14.9	15%
2	Bridgefoot	2104	2071	-33	-2%	12.5	12.9	3%
3	Warwick Rd	2966	2624	-342	-12%	26.9	29.0	8%
4	Clopton Bridge	4086	3350	-736	-18%	19.5	21.0	8%
5	Guild Street	2438	2538	100	4%	20.2	19.0	-6%
6	Bridge Street	2038	2039	1	0%	19.5	21.1	8%
7	Wood Street	1117	1073	-44	-4%	30.4	32.9	8%
8	Birmingham Rd	2875	2899	24	1%	18.1	17.5	-3%
9	Greenhill St	1301	1246	-55	-4%	18.0	20.3	12%
10	Arden St	1990	1920	-70	-4%	18.6	19.6	6%
11	Grove Road	1689	1513	-176	-10%	16.5	16.9	3%
12	Rother St	1095	967	-128	-12%	22.2	24.2	9%

Initial comparisons of the changes in two-way flow and speed between the 2028 SRZ and 2028 Stratford SRZ + SUE + ERR Op1 scenarios have been presented, for the PM period within **Table 51** on the following page.

Analysis of **Table 51** reveals less instances of a reduction in flow being achieved within the PM period when the ERR and SUE are included within the network when compared to the AM. Again a reduction in flow is achieved along Clopton Bridge but this time the flow levels on the Bridgeway and Warwick Road sections of the gyratory increase. This could be indicative of vehicles returning to the SUE site along this route, particularly as the flow levels on Guild Street continue to increase.

The average speeds on Clopton Bridge and links within the gyratory appears to have increased whilst the speeds on the links to the West of these areas have reduced.

Table 51 - PM (16:00 to 18:00) Flow and Speed differences 2028 SRZ vs. 2028 SRZ + SUE + ERR Op1 (Veh & Mph)

Loc	Link	Two-way flow (veh)		Dif		Two-way Speed (mph)		Diff (%)
		2028 SRZ	2028 + SUE ERR	ABS	%	2028 SRZ	2028 + SUE ERR	
1	Bridgeway	3064	3140	76	2%	8.1	8.7	8%
2	Bridgefoot	2180	2109	-71	-3%	9.9	11.1	12%
3	Warwick Rd	3463	3557	94	3%	21.3	23.1	9%
4	Clopton Bridge	4190	3978	-213	-5%	17.0	21.9	29%
5	Guild Street	2824	2998	174	6%	16.4	15.9	-3%
6	Bridge Street	2339	2621	282	12%	16.2	13.6	-16%
7	Wood Street	1435	1347	-88	-6%	26.5	23.2	-12%
8	Birmingham Rd	3493	3655	162	5%	11.8	10.8	-9%
9	Greenhill St	1798	1718	-80	-4%	12.8	12.0	-6%
10	Arden St	2663	2710	47	2%	12.7	11.3	-11%
11	Grove Road	2016	1831	-185	-9%	16.5	16.9	3%
12	Rother St	1431	1358	-74	-5%	22.2	24.2	9%

2028 SRZ vs. 2028 SRZ + SUE + ERR Op1 + TCI

In line with the previous analysis, the same comparisons of the changes in flow and speed on key links within the Bridgefoot and Town Centre Areas has been undertaken for the 2028 SRZ + SUE + ERR + Op1 + TCI scenario.

The changes in flow and speeds, observed within the AM and PM periods, have been illustrated within **Table 52** and **Table 53** on the following pages.

Analysis of **Table 52** reveals that, in the majority of cases, the implementation of the TCI measures alongside the SUE and ERR results in a reduction in the level of flow observed on key links within the area. Furthermore, compared to the level of flows observed within the 2028 SRZ + SUE + ERR + Op1 scenario are lower on all but 3 links within the AM period as a result of the inclusion of the TCI measures. Flows have increased along Rother Street and Greenhill Street, as well as a small increase along Wood Street, as a result of the addition of the TCI measures and this is likely to be directly attributable to the revised link arrangement at Grove Road and Rother Street. Since Grove Road is NB only and Rother St is SB only, Rother St must now carry the traffic that previously travelled SB along Grove Rd. Consequently some of this traffic which enters into the network from Arden Street must now travel along Greenhill Street and then turn right onto Rother Street whereas previously this traffic would have travelled straight across at the junction with Grove Road.

Table 52 - AM (07:00 to 09:00) Flow and Speed differences 2028 SRZ vs. 2028 SRZ + SUE + ERR Op1 + TCI (Veh & Mph)

Loc	Link	Two-way flow (veh)		Dif		Two-way Speed (mph)		Diff (%)
		2028 SRZ	2028 Op1 + TCI	ABS	%	2028 SRZ	2028 Op1 + TCI	
1	Bridgeway	2560	2165	-395	-15%	12.9	15.0	16%
2	Bridgefoot	2104	2039	-65	-3%	12.5	13.5	8%
3	Warwick Rd	2966	2326	-640	-22%	26.9	28.7	7%
4	Clopton Bridge	4086	3198	-889	-22%	19.5	14.2	-27%
5	Guild Street	2438	2293	-145	-6%	20.2	16.4	-19%
6	Bridge Street	2038	1988	-50	-2%	19.5	14.7	-25%
7	Wood Street	1117	1156	39	4%	30.4	33.9	12%
8	Birmingham Rd	2875	2834	-41	-1%	18.1	17.2	-5%
9	Greenhill St	1301	1425	124	10%	18.0	27.3	52%
10	Arden St	1990	1722	-268	-13%	18.6	18.7	1%
11	Grove Road	1689	1272	-417	-25%	16.5	6.5	-61%
12	Rother St	1095	1432	337	31%	22.2	23.5	6%

Analysis of **Table 52** indicates that, within the PM period, the implementation of the TCI measures alongside the SUE and ERR proposals results in a substantial reduction in flow levels (greater than 10%) within the following areas:

- Bridgeway
- Warwick Road
- Clopton Bridge
- Grove Road

Of particular interest are the reductions along Clopton Bridge and Grove Road. Whilst some of the reduction in flow along Grove Road could be attributable to the restriction of flow on this link to one-way, this does not correspond to the increase in flow along Rother Street. Overall, across the two links, there is a reduction of almost 700 vehicles within the PM period. The reduction along Clopton Bridge is also of a similar magnitude (750+ vehicles).

These reductions are matched by a corresponding reduction in the average speeds experienced along the links but this is likely to be at least partly attributable to the introduction of permanent signals at the end of Clopton Bridge and the fact that traffic on Grove Road only travels NB when the TCI measures are included and, thus, speeds are restricted by the signals at the end of Grove Road. Previous options which allowed traffic movements SB along Grove Road result in a higher

average speed as traffic travelling SB is able to travel more freely along Grove Rd SB and so results in higher average speeds.

Table 53 - PM (16:00 to 18:00) Flow and Speed differences 2028 SRZ vs. 2028 SRZ + SUE + ERR Op1 + TCI (Veh & Mph)

Loc	Link	Two-way flow (veh)		Dif		Two-way Speed (mph)		Diff (%)
		2028 SRZ	2028 Op1 + TCI	ABS	%	2028 SRZ	2028 Op1 + TCI	
1	Bridgeway	3064	2685	-378	-12%	8.1	10.5	30%
2	Bridgefoot	2180	2054	-126	-6%	9.9	14.3	44%
3	Warwick Rd	3463	2937	-527	-15%	21.3	27.7	30%
4	Clopton Bridge	4190	3421	-769	-18%	17.0	7.8	-54%
5	Guild Street	2824	2656	-168	-6%	16.4	12.6	-23%
6	Bridge Street	2339	2412	73	3%	16.2	13.1	-19%
7	Wood Street	1435	1585	150	10%	26.5	26.7	1%
8	Birmingham Rd	3493	3470	-23	-1%	11.8	12.1	2%
9	Greenhill St	1798	1981	183	10%	12.8	20.2	58%
10	Arden St	2663	2415	-248	-9%	12.7	13.6	6%
11	Grove Road	2016	1187	-830	-41%	16.5	6.5	-61%
12	Rother St	1431	1587	156	11%	22.2	23.5	6%

6.4.5 Impacts on the Historic Spine

A comparison of the changes in two-way flows and speeds on key links within the area of the 'Historic Spine' has been undertaken against the 2028 SRZ scenario and the two 2028 SUE ERR Option 1 scenarios. The comparisons have been undertaken across the entire AM (07:00 to 09:00) and PM (16:00 to 18:00) model periods.

2028 SRZ vs. 2028 SRZ + SUE + ERR Op1

Initial comparisons of the changes in two-way flow and speed between the 2028 SRZ and 2028 Stratford SRZ + SUE + ERR Op1 scenarios have been presented, for the AM and PM model periods, within **Table 52** and **Table 53** on the following page.

Analysis of **Table 52** reveals that there are very few differences in the levels of flow experienced between the 2028 SRZ and 2028 SRZ + SUE + ERR + Op1 scenarios during the AM model period. In all but one case the magnitude of difference between the two scenarios equates to less than 21 vehicles across the 2

hours which is unlikely to be considered a significant change. A reduction of 82 vehicles (13.6%) is observed along Church street and this is matched by a reduction in the speed on this link which indicates that the reduction is most likely to be attributable to vehicle reassignment in response to adverse conditions (i.e. queuing) rather than having anything to do with the inclusion of the ERR and SUE.

Table 54 - AM (07:00 to 09:00) Flow and Speed differences 2028 SRZ vs. 2028 SRZ + SUE + ERR Op1 (Veh & Mph)

Loc	Link	Two-way flow (veh)		Dif		Two-way Speed (mph)		Diff (%)
		2028 SRZ	2028 ERR Op1	ABS	%	2028 SRZ	2028 ERR Op1	
1	Bridge St	2038	2039	1	0.1%	14	14	1.9%
2	High St	1088	1070	-18	-1.7%	29	28	-4.4%
3	Chapel St	778	757	-21	-2.7%	15	10	-33.1%
4	Church St	602	520	-82	-13.6%	25	16	-38.8%
5	Sheep St	266	251	-15	-5.6%	26	27	3.7%
6	Chapel Lane	227	214	-13	-5.8%	34	34	0.3%
7	Waterside	43	51	8	18.2%	12	12	1.3%

Table 55 - PM (16:00 to 18:00) Flow and Speed differences 2028 SRZ vs. 2028 SRZ + SUE + ERR Op1 (Veh & Mph)

Loc	Link	Two-way flow (veh)		Dif		Two-way Speed (mph)		Diff (%)
		2028 SRZ	2028 ERR Op1	ABS	%	2028 SRZ	2028 ERR Op1	
1	Bridge St	2339	2621	282	12.0%	10	12	25.6%
2	High St	1489	1629	139	9.4%	25	17	-31.3%
3	Chapel St	1054	1302	248	23.5%	12	10	-20.2%
4	Church St	804	1121	317	39.4%	13	9	-32.2%
5	Sheep St	567	547	-21	-3.6%	18	19	4.2%
6	Chapel Lane	368	343	-25	-6.9%	30	32	6.5%
7	Waterside	28	73	44	155.3%	6	8	23.0%

Analysis of **Table 53** reveals that, in the majority of cases, the level of flow on links within the area of the historic spine increases as a result of the SUE and ERR. It is likely that this is symptomatic of the increased congestion levels within the town centre causing vehicles to reassign onto these more minor routes during busy periods.

Unlike the conditions observed within the AM, a drop in speeds along Church Street does not result in a drop in flow; in fact flow levels still increase in spite of the reduction in speeds. Whilst the demand levels associated with the SUE will undoubtedly have some influence on the changes in flow levels between the two

scenarios, the fact that there is not an increase in flow levels within the AM indicates that the interaction of traffic within the network is more complex when congestion levels are higher within the PM than is observed within the AM.

The results that have been extracted from the analysis of the areas within the 'historic spine' appear to indicate that the introduction of the ERR and SUE does not result in a drop in flow in these key areas and, within the PM, it results in an increase in flow across a number of key areas. More detailed analysis of the rationale behind this is required before detailed conclusions can be drawn but potentially these increases could be as a result of a combination of reasons including:

- Increased movements of SUE traffic within the area;
- Reassignment away from Grove Rd and Rother Street in response to adverse conditions on those links, particularly travelling northwards.

At this stage, it is recommended that further analysis of these impacts should be undertaken to ascertain what the likely reasons behind the increases in these areas.

2028 SRZ vs. 2028 SRZ + SUE + ERR Op1 + TCI

Initial comparisons of the changes in two-way flow and speed between the 2028 SRZ and 2028 Stratford SRZ + SUE + ERR Op1 scenarios have been presented, for the AM and PM model periods, within the following **Table 54** and **Table 55:**

Table 56 - AM (07:00 to 09:00) Flow and Speed differences 2028 SRZ vs. 2028 SRZ + SUE + ERR Op1 + TCI (Veh & Mph)

Loc	Link	Two-way flow (veh)		Dif		Two-way Speed (mph)		Diff (%)
		2028 SRZ	2028 Op1 + TCI	ABS	%	2028 SRZ	2028 Op1 + TCI	
1	Bridge St	2038	1988	-50	-2.4%	14	14	1.3%
2	High St	1088	1132	44	4.1%	29	28	-5.4%
3	Chapel St	778	987	209	26.9%	15	10	-30.3%
4	Church St	602	765	163	27.0%	25	15	-41.6%
5	Sheep St	266	267	2	0.6%	26	27	5.7%
6	Chapel Lane	227	206	-21	-9.4%	34	34	0.3%
7	Waterside	43	57	14	32.1%	12	12	1.3%

Table 57 - PM (16:00 to 18:00) Flow and Speed differences 2028 SRZ vs. 2028 SRZ + SUE + ERR Op1 + TCI (Veh & Mph)

Loc	Link	Two-way flow (veh)		Dif		Two-way Speed (mph)		Diff (%)
		2028 SRZ	2028 Op1 + TCI	ABS	%	2028 SRZ	2028 Op1 + TCI	
1	Bridge St	2339	2412	73	3.1%	10	13	28.7%
2	High St	1489	1638	148	10.0%	25	17	-31.6%
3	Chapel St	1054	1382	328	31.1%	12	10	-20.3%
4	Church St	804	1195	391	48.6%	13	9	-28.4%
5	Sheep St	567	533	-35	-6.2%	18	19	4.1%
6	Chapel Lane	368	347	-21	-5.8%	30	32	6.5%
7	Waterside	28	74	46	161.3%	6	8	23.0%

Analysis of the previous tables reveals that there is a similar impact on flows within the PM period across the area of the Historic spine when the TCI measures are included as was observed in the previous ERR Option 1 scenario. Interestingly, similar impacts are observable within the AM period when the TCI measures are included in so far as flows tend to increase along the High Street, Chapel Street and Church Street.

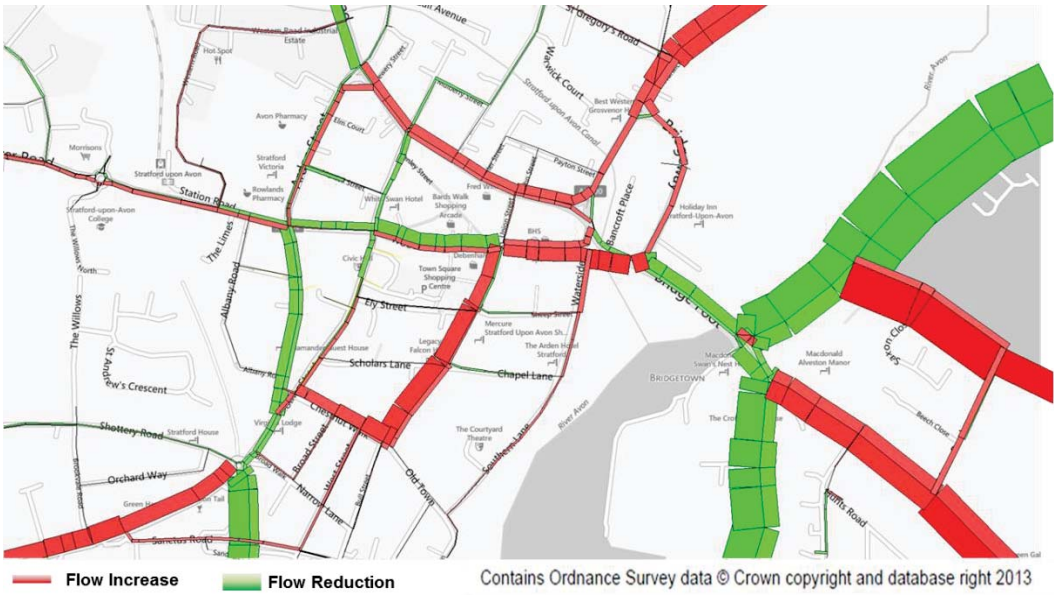
6.4.6 Flow Difference Analysis

In order to gain a better picture of the impact on movements across the town centre that occurs as a result of the inclusion of the ERR and SUE within the model, flow difference analysis has also been undertaken. At this stage the flow difference analysis has concentrated on the difference between the 2028 SRZ and 2028 SRZ + SUE + ERR Op1 scenario and, specifically, the differences that occur between these two scenarios during the PM period.

The reason these scenarios have been is that, by restricting the differences between scenarios to the inclusion of the SUE and ERR, the differences between the scenarios can be attributed to the ERR and SUE with more certainty than if the effects of the TCI measures are included within the analysis.

The total flow on all links within the 2028 SRZ scenario has been subtracted from the total flow on all links within the 2028 SRZ + SUE + ERR Op1 scenario, across the entire PM (16:00 to 18:00) period. The outcome of this analysis has been presented within **Figure 20** on the following page.

Figure 20 - PM (16:00 to 18:00) Flow Difference Plot, 2028 SRZ + ERR Op1 - 2028 SRZ



Analysis of the previous Figure reveals that there is an increase in the number of vehicles travelling west to East across Stratford town via Church St, Chapel Street and High Street. The inclusion of the ERR has resulted in reduced flows along Tiddington Road and Shipston Road towards the gyratory and it has, similarly resulted in reduced flows along Seven Meadows Road and Grove Road. It is likely that the presences of these vehicles and the inherent delay and congestion effects exerted on the local network is of sufficient magnitude, in the 2028 SRZ scenario, to discourage traffic which would elect to reassign onto the more minor routes. The inclusion of the ERR has reduced the demand for vehicular movements across Clopton Bridge and Grove road which, in turn, creates the gaps that appears to allow more traffic to assign along Church Road and Chapel Street.

It is reasonable to assume that some of this traffic could be encouraged to remain on the more major routes such as Grove Road and Guild Street by implementing restrictions along the Church Road, Church Street, Chapel Street areas.

Further consideration of the complexion of such restrictions and how they can be delivered in such a way as to ensure that the benefits of delivering the ERR are not reduced as a result of the inclusion of such restrictions, is likely to be required.

6.4.7 Flow Analysis Conclusions

Based on this third stage of assessment, the following conclusions have been drawn:

- That, compared to the 2028 SRZ scenario, the introduction of the ERR is likely to result in a reduction in the number of vehicular movements on some key links within the town centre whilst the magnitude of vehicles on others will remain broadly static.
- Without the TCI measures in place, Guild Street suffers an increase in flow across both AM and PM periods when the ERR and SUE are included whilst, in the PM, Birmingham Road and Bridge Street also suffer increases.

- The inclusion of the ERR is likely to trigger substantial reduction in flows along Clopton Bridge and Grove Road during both AM and PM time periods and these reductions are increased further by the inclusion of the TCI measures.
- Both ERR Options (with and without TCI improvements) result in an increase in the level of flow across key links within the historic spine, (i.e. Church Rd, Chapel St and High Street). This route appears to have become a preferential SW to NE route across the town centre and this displacement of traffic is likely to contribute to the reduction in flows. experienced along Grove Road. Analysis of the flow differences across the town centre indicates that additional restrictions could potentially be added to Church Street, Chapel Street and High Street to reduce the magnitude of this reassignments. ***Testing of such options would require more certainty as to which option for growth is likely to be progressed to minimise the number of additional scenarios which are reviewed.***

Overall both options for delivering the ERR, either with or without the TCI improvements, appear to change the pattern of vehicular movements across the town centre. The potential for reallocation of road space within the town centre, for further pedestrian priority measures, is likely to be reliant upon the final option for the allocation of development and, more specifically, the accompanying mitigation strategy. However, the early indications are that traffic levels on some of the more major routes appear to drop whilst some of the more minor routes become more favourable routes through the town. The introduction of further pedestrian priority schemes along some of the minor routes could be sufficient to 'push' traffic back onto the more major routes even if those routes are not necessarily the most direct.

Furthermore, since the analysis of the network wide performance measures within the 2028 SRZ + SUE + ERR Op1 + TCI indicates an improvement in conditions within the network, when compared to the 2028 SRZ scenario, it could be argued that some of the measures could be included within the network to the detriment of existing traffic movements whilst an acceptable level of overall network operation is still maintained.

6.5 Stage 3 – Reallocation of Road space to Bus Priority, Qualitative Review

At this stage it has not been possible to produce a specific model scenario to test the feasibility of reallocating road space to bus priority measures but, based on the analysis presented previously, the following points have been produced:

1) Since the ERR Option 2 alignment is not able to accommodate the necessary demand levels without further restrictions on PT measures there is no opportunity for Bus Priority to be delivered alongside this option for alignment

2) The ERR Option 1 alignment in isolation does not result in any changes to the internal road network within Stratford-upon-Avon. That network, particularly to the southwest and southeast, relies heavily on the operation of priority junctions and, specifically, roundabouts. The operation of the Seven Meadows Road/Evesham Place and Shipston Road/Banbury Road

roundabouts are of paramount importance to the overall level of network operation within both the immediate and wider areas. Both of these roundabouts have limited highway extent beyond their current footprint and, since the restriction of existing highway capacity is unlikely to yield acceptable impacts, it is reasonable to conclude that neither could be amended to accommodate additional bus priority measures.

3) It is likely that the only available bus priority measures that could be included within the network rely heavily on the presences of signals which could be configured to detect buses on approach and ensure that the optimum green time allocation strategy is afforded to the buses on the approach to one or more of the signalised junctions. Since the TCI measures include the reconfiguration of current, priority formation, junctions into signalised junctions it is apparent that these could be amended further to benefit the movement of buses across the network as has been outlined previously.

At this stage of the assessment it is felt that the ability to deliver additional measures to improve the movement of buses across the town, and specifically between the SUE and Stratford town centre, relies heavily on the delivery of the proposed town centre improvements, specifically where the reconfiguration from priority junctions to signals is suggested.

The substantial flow reductions achieved along Tiddington Road, illustrated within the earlier flow difference analysis demonstrates that there could potentially be additional capacity along Tiddington Road and Clopton Bridge for services between the SUE and Stratford town centre to be delivered. A Bus priority strategy could then be incorporated into the proposed signals at Tiddington Road/Bridgefoot, Bridgefoot/Bridgeway and Guild Street/Warwick Road junctions to create a loop for buses to travel between the SUE and the town centre.

6.6 Stage 4 – Implementation of HGV Restrictions along Clopton Bridge

6.6.1 Overview

One potential benefit that has been proposed through the delivery of the ERR Option 1 alignment is that it provides an alternative route for HGV's to travel from the North to the southeast of Stratford. At the moment there is a perception locally that the level of HGV movements across Clopton Bridge is particularly high and an option is sought whereby these movements can be reduced.

At the moment, Clopton Bridge represents one of only two major crossing points across the River Avon within the area of Stratford town centre. Restricting HGV movements across Clopton Bridge would result in HGV's which approach between Birmingham Road/Warwick Road and Banbury Road/Shipston Road suffering increases in journey distances of over a minimum of 0.5 miles. Tiddington Road to Warwick Road would increase from the current 0.5 mile journey distance to a 2.5 mile journey distance should it need to be travelled via a route which does not involve Clopton Bridge. Inclusion of the ERR and the new bridge between B4086 Main Street, Tiddington and A439 Warwick Road/Ingon Lane means that this increase in journey distance is at least partly mitigated and

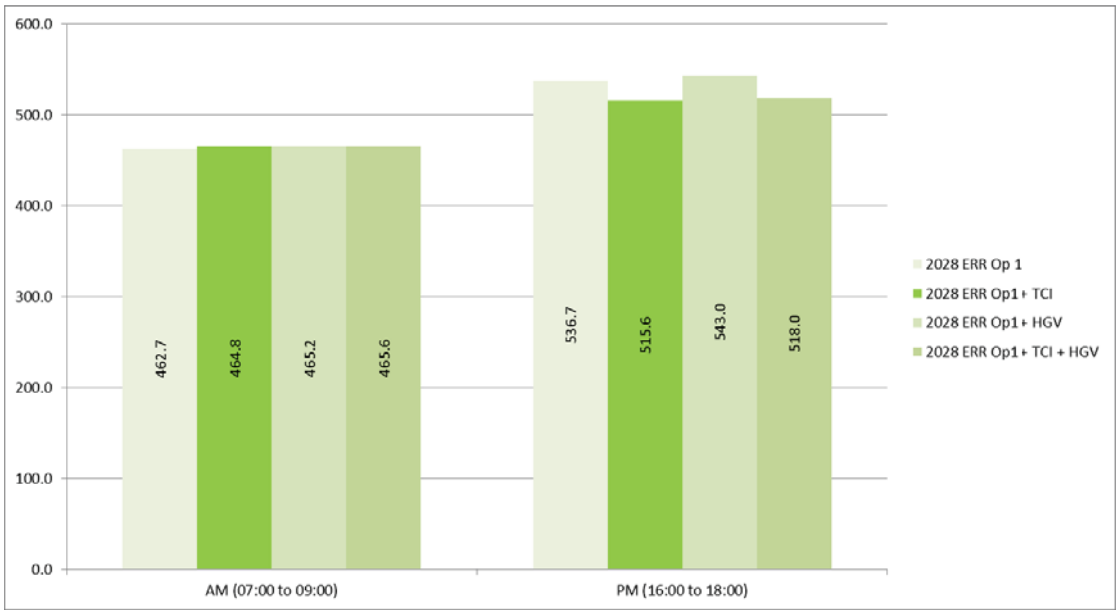
HGVs still have two options to cross the River Avon but neither involve Clopton Bridge.

The focus of this testing has been to ascertain the potential implications of delivering such a restriction alongside the ERR/SUE. As a result the restriction has been applied to both ERR Option 1 Scenarios and the models have been run and outputs assessed in line with earlier analysis. The focus of the assessment has been at a strategic level and has been undertaken both for all vehicles within the model network and is supported by analysis which has been processed specifically pertaining to the movements of HGV's across the network.

6.6.2 Network-wide Performance Measures – All Vehicles

Analysis of the difference in the average journey times (in seconds) between the four scenarios has been illustrated within the following **Figure 21**:

Figure 21 - Average Journey Time (Seconds), 2028 ERR Op 1 (with and without TCI) vs. 2028 ERR Op 1 (with and without TCI) plus HGV Restriction on Clopton Bridge



Analysis of the previous Figure reveals that, in general, the implementation of the HGV restriction has no discernible impact on journey times across the four scenarios. Journey times within the scenarios in which the HGV restrictions have been applied tend to mirror those experienced within the scenarios without the HGV restriction in place.

Analysis of the changes in average journey distance across the four scenarios has been presented within the **Table 58** on the following page.

Table 58 - Average Journey Distance (Km), 2028 ERR Op 1 (with and without TCI) vs. 2028 ERR Op 1 (with and without TCI) plus HGV Restriction on Clopton Bridge

	2028 ERR Op 1	2028 ERR Op1 + TCI	2028 ERR Op1 + HGV	2028 ERR Op1 + TCI + HGV
AM (07:00 to 09:00)	7.6	7.6	7.6	7.6
PM (16:00 to 18:00)	6.9	6.9	6.9	6.9

Analysis of the above Table reveals no difference between the four scenarios indicating that the HGV restrictions do not affect overall journey distances.

Analysis of the changes in average journey speed across the four scenarios has been presented within the following **Table 59**:

Table 59 - Average Journey Speed (Km/h), 2028 ERR Op 1 (with and without TCI) vs. 2028 ERR Op 1 (with and without TCI) plus HGV Restriction on Clopton Bridge

	2028 ERR Op 1	2028 ERR Op1 + TCI	2028 ERR Op1 + HGV	2028 ERR Op1 + TCI + HGV
AM (07:00 to 09:00)	58.8	58.6	58.5	58.5
PM (16:00 to 18:00)	46.2	48.4	45.8	48.2

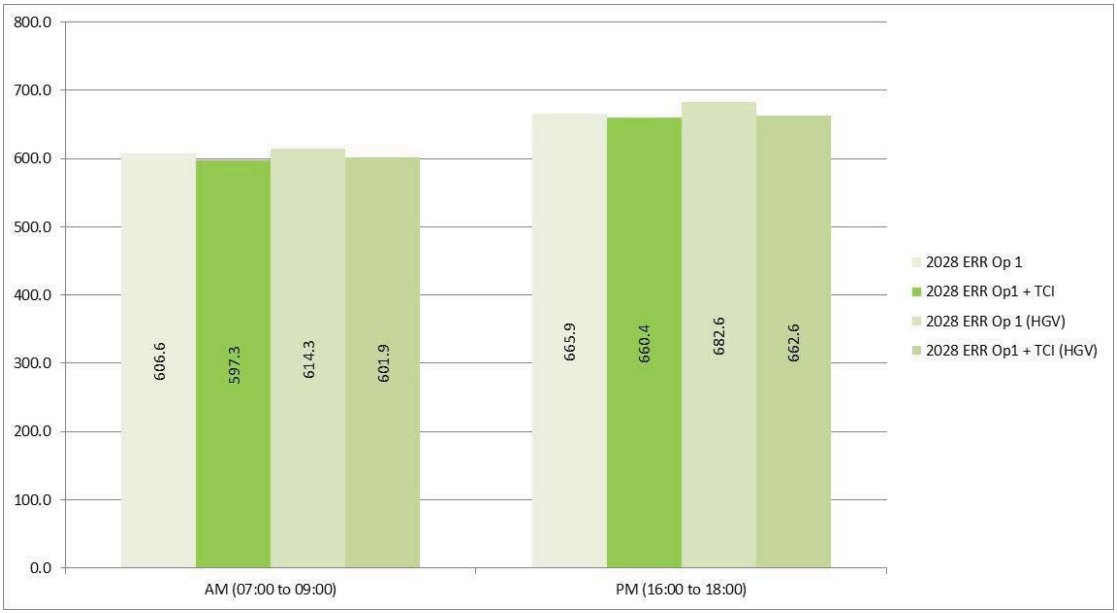
Analysis of the above Table reveals that the impacts on journey speeds tend to indicate very little difference between the scenarios. In the AM there is no discernible difference in the journey speeds across all scenarios. Within the PM, journey speeds are actually highest within the 2028 Stratford SRZ + SUE + ERR Op1 + TCI scenario prior to the implementation of the HGV restrictions. This does not, however, correlate with the reduction in average delay that is achieved by the implementation of the HGV restrictions. In both ERR Option scenarios, when you compare the scenarios with and without the HGV restriction, the difference in average speeds is less than 1% in the PM, this level is not considered a significant difference. Furthermore the results still demonstrate that speeds are quicker when the TCI measures are included than when they are not (circa 5% in both options).

6.6.3 Network-wide Performance Measures – HGV's

Similar to the previous analysis, analysis of the differences in the network wide performance indicators has been undertaken specifically for the HGV movements across the model network. This analysis has been presented within the following section of this note and focusses specifically on the differences in statistics specifically pertaining to the OGV1 and OGV2 vehicles types that have been assigned within the model network.

Analysis of the difference in the average journey times (in seconds) experienced by the OGV 1 and OGV 2 vehicle types, between the four scenarios has been illustrated within **Figure 22** on the following page:

Figure 22 – HGV Average Journey Time (Seconds), 2028 ERR Op 1 (with and without TCI) vs. 2028 ERR Op 1 (with and without TCI) plus HGV Restriction on Clopton Bridge



Analysis of the previous Figure indicates that the implementation of the HGV restriction does not materially impact upon the journey times experienced by the HGV vehicles types as they travel through the model network.

In addition to the impacts on HGV-specific journey times, analysis of the impacts on HGV specific journey distances and speeds has been undertaken and has been presented within the following **Table 60** and **Table 61**:

Table 60 – HGV Average Journey Distance (Km), 2028 ERR Op 1 (with and without TCI) vs. 2028 ERR Op 1 (with and without TCI) plus HGV Restriction on Clopton Bridge

	2028 ERR Op 1	2028 ERR Op1 + TCI	2028 ERR Op1 + HGV	2028 ERR Op1 + TCI + HGV
AM (07:00 to 09:00)	10.0	9.9	10.0	10.0
PM (16:00 to 18:00)	9.3	9.4	9.4	9.5

Table 61 – HGV Average Journey Speed (Km/h), 2028 ERR Op 1 (with and without TCI) vs. 2028 ERR Op 1 (with and without TCI) plus HGV Restriction on Clopton Bridge

	2028 ERR Op 1	2028 ERR Op1 + TCI	2028 ERR Op1 + HGV	2028 ERR Op1 + TCI + HGV
AM (07:00 to 09:00)	59.3	59.8	58.8	60.0
PM (16:00 to 18:00)	50.3	51.1	49.6	51.6

The previous tables demonstrate that the implementation of the HGV Restriction alongside the ERR and SUE, is unlikely to have an impact on the overall journey

times of HGV vehicle types through the model network with HGV;s travelling similar distances at similar speeds both with and without the restriction in place.

6.6.4 HGV Restriction Analysis - Conclusion

Based on this fifth stage of assessment it is reasonable to conclude that either option concerning the delivery of the ERR and SUE (with or without TCI measures) is likely to be able to accommodate the implementation of a HGV restriction on Clopton Bridge without any obvious impacts to either general vehicular movements across the network or HGV specific movements.

6.7 Summary, Conclusions and Further Considerations

6.7.1 Summary

The stages of assessment which have been completed, and are outlined previously within this section of the Report, are as follows:

- The existing 2021 Stratford-upon-Avon model has been extended to include the B4086 between Stratford-upon-Avon and the A429 to just south of Longbridge Island. This model has then been forecast to 2028 to provide the Reference Case conditions from which all other scenarios have been derived.
- The 2028 Reference Case has been amended, initially to include the assumptions pertaining to the Stratford Regeneration Zone, and then, subsequently, to include a Sustainable Urban Extension (SUE) to the South East of Stratford-upon-Avon, comprising 2,750 dwellings and 8 Hectares of B1 Employment. The SUE is intended to be delivered alongside a proposed Eastern Relief Road (ERR) which has also been included within the modelling on the basis of two possible alignments:
    - **ERR Option 1 -** Between B4086 Main Street, Tiddington and A439 Warwick Road/Ingon Lane including the elevated bridge section above the River Avon floodplain as suggested by the Environment Agency.
    - **ERR Option 2 -** Improving the alternative ERR route via the B4086 linking with the A429 at Wellesbourne.
- In addition to the assessment of the aforementioned scenarios a series of sensitivity tests have been undertaken to determine the potential impacts of a series of variations including:
    - A qualitative review of the potential for reallocation of road space to bus priority
    - An assessment of the potential impacts of HGV restrictions on Clopton Bridge

6.7.2 Conclusion

Based on the analysis set out previously within this section of the report, the following initial conclusions have been determined:

- That the ERR Option 2 alignment is unlikely to sufficiently mitigate the potential impacts of locating the SUE to the Southeast of Stratford-upon-Avon
- That there are impacts attributable to the adoption of the SRZ policy that would likely benefit from further investigation and, potentially, focussed mitigation.
- That both ERR Option 1 scenarios (with and without TCI measures) appear to be able to facilitate the additional demand assigned to the network as a result of the SUE.
- That the inclusion of the TCI measures, in addition to the ERR, results in the most improved network conditions when compared to those present within the 2028 Reference Case.

A more detailed review of the impacts on town centre 'through trips' and the impacts on key links within the town reveals the following:

- That, compared to the 2028 SRZ scenario, the introduction of the ERR results in a reduction in the number of through trips within the town centre.
- That, during the PM period, the introduction of the TCI measures, alongside the ERR, is likely to result in a level of 'through trips' which is not dissimilar to the level experienced within the 2028 Reference Case.
- The introduction of measures along Seven Meadows Road and Trinity Way has the potential to complement the ERR implementation by providing improved conditions for vehicles travelling East to West and vice versa between Evesham Road, the proposed ERR and the M40.
- The impacts are more noticeable within the PM than the AM because the network is much closer to capacity during the PM period and, as a result, vehicles are more likely to reassign away from major routes as result of existing congestion effects.
- It is likely that, in the AM, when the magnitude of demand approaches the levels observed during the PM period these effects would be replicated within the AM network.
- That, compared to the 2028 SRZ scenario, the introduction of the ERR is likely to result in a reduction in the number of vehicular movements on some key links within the town centre whilst the magnitude of vehicles on others will remain broadly static.
- Without the TCI measures in place, Guild Street suffers an increase in traffic flow in both AM and PM periods when the ERR and SUE are included whilst, in the PM, Birmingham Road and Bridge street also suffer increases.
- The inclusion of the ERR is likely to trigger substantial reductions in flow along Clopton Bridge and Grove Road during both AM and PM time periods and these reductions are increased further by the inclusion of the TCI measures.

It was concluded that both ERR Options (with and without TCI improvements) are likely to result in an increase in the level of flow across key links within the historic spine, i.e. Church Street, Chapel Street and High Street. This route appears to have become a preferential SW to NE route across the town centre and this displacement of traffic is likely to contribute to the reductions experienced along Grove Road. Analysis of the flow differences across the town centre

indicated that additional restrictions could potentially be added to Church Street, Chapel Street and High Street to reduce the magnitude of the predicted reassignment. Testing of such a scenario would require more certainty on the approach to allocating growth before it could be undertaken with a greater degree of certainty.

A review of the potential for reallocation of road space to bus priority indicated that the ability to deliver additional measures to improve the movement of buses across the town, and specifically between the SUE and Stratford town centre, relies heavily on the delivery of the proposed town centre improvements, specifically where the reconfiguration from priority junctions/roundabouts to signals is suggested.

The assessment of the impacts of introducing a HGV restriction along Clopton Bridge concluded that either option concerning the delivery of the ERR Op1 and SUE (with or without TCI measures) is likely to be able to accommodate the implementation of a HGV restriction on Clopton Bridge without any significant impacts to either general vehicular movements across the network or HGV specific movements.

6.7.3 Further Considerations and Recommendations

Further stages of this assessment should potentially consider the following:

An isolated assessment of the impacts of the SRZ policy application, specifically in terms of localised impacts on delay and queuing, should be undertaken with a view to determining a localised mitigation strategy to accompany the SRZ. There is a notable impact that is observed when assessing the difference in the levels of the key network performance indicators before and after the SRZ policy is assigned within the modelling. If the SRZ policy were assigned within the modelling alongside a targeted mitigation strategy it is likely that these impacts would be lessened prior to the inclusion of the SUE/ERR and TCI Measures.

It is apparent that implementation of the TCI measures, including the new schemes proposed between Clifford Lane and Trinity Way, result in an overall benefit, particularly when considering the performance of the network within the PM where introduction of the TCI, alongside the SUE/ERR measures results in levels of delay which are lower than in the SRZ scenario and, correspondingly, higher speeds. What has not been ascertained at this stage is the potential benefits that are unlocked by delivering the TCI measures irrespective of whether the SUE/ERR is progressed. The benefits of such an assessment would be to understand what the level of mitigation of the SRZ would likely require should it come forward without the SUE/ERR but with the TCI measures. Earlier STA work has identified that the TCI measures are likely to require delivery in some form irrespective of the proposed allocation strategy adopted by SDC. Therefore it is reasonable to conclude that these schemes may provide a level of mitigation of the SRZ policy application that is not yet recognised as the additional capacity provided by these measures is likely to be consumed by the additional demand created by the adoption of the SUE.

Sensitivity testing regarding the mode shift parameters may either identify the need for further mitigation measures or that impacts may be less than those currently predicted depending upon the strategy adopted. This analysis should be supported by some initial feasibility assessments regarding the provision of PT

measures. As has been outlined previously, it is unlikely that additional PT infrastructure could be delivered without the TCI measures but that the infrastructure is unlikely to be dependent upon the delivery of the SUE/ERR. An understanding of whether the principles of schemes outlined within the previous section of this report would be necessary to ensure the credibility of any assumptions included within the modelling which rely on certain mode shift percentages being achieved. If the impacts of delivering these schemes incurs unacceptable consequence regarding the wider network operation or results in very little benefit in terms of Bus journey times then it is unlikely that these schemes could be considered as being feasible and, thus, any mode shift assumptions would need to be revised accordingly.

7 Development South of Stratford – Sensitivity Testing

7.1 Overview

Following the completion of the initial SUE/ERR testing, a sensitivity test was required whereby the ability of the network, inclusive of the TCI & ERR improvements, to accommodate additional development could be ascertained.

The objective of this testing is to ascertain the likely impact of delivering additional development levels, above those which are contained within the SUE site, without triggering the need to deliver additional infrastructure measures beyond those already assumed in the form of the ERR and TCI measures.

7.1.1 Development Details

At this stage the delivery of additional development has assumed that the site would be located at some point to the west of the B4632 between Clifford Chambers to the North and Long Marston to the South.

Initial the development has been assumed to comprise 2,000 dwellings which, after applying the 15% mode shift reduction and the STA WCC dwelling trip rate, results in the following trip generation levels:

Table 62 - Development South of Stratford: Trip Generation Totals

	In	Out	Total
0700 to 0800	133	559	692
0800 to 0900	204	816	1020
1600 to 1700	592	197	789
1700 to 1800	816	204	1020

7.1.2 Scenarios

Analysis of the following scenarios has been undertaken as part of this sensitivity test:

- **2028 Reference Case**
- **2028 Stratford SRZ + SUE + ERR Op1 + TCI**
- **2028 + SOS Dev.** – The previous scenario inclusive of additional development south of Stratford
- **2028 + SOS Dev. W/ERR** – The previous scenario without the ERR.
- **2028 + SOS Dev. W/ERR/SUE** – The previous scenario without the ERR or the SUE.

The purpose of the three additional scenarios is firstly to ascertain whether the additional development to the south of Stratford (SOS) can be delivered without triggering the need for additional major infrastructure, how critical is the delivery of the ERR in facilitating these development levels, how effective the residual mitigation measures are at accommodating the additional SOS development demand should the SUE and ERR not be taken forward, this should help determine whether the ERR is necessary in delivering the additional development

and, whether it is reasonable for the additional development to be expected to contribute to the costs thereof.

7.2 SOS Scenario Assessment

7.2.1 Model Stability

As with previous stages of the analysis, a review was firstly undertaken to compare the level of model stability exhibited across each scenario, during the AM and PM time periods. This has been presented within the following **Table 63**:

Table 63 - Model Stability Analysis

Time Period	2028 Ref Case	2028 Err Op1 + TCI	2028 Err Op1 + SOS	2028 SOS – W/ERR	2028 SOS – W/ERR/SUE
AM (07:00 to 09:00)	100%	100%	90%	**50%**	100%
PM (16:00 to 18:00)	100%	70%	100%	**0%**	**0%**

Analysis of the previous Table reveals that the level of stability contained within the scenario in which all development has been included but the ERR has been removed is at a level which is not considered acceptable. Similarly, analysis of the network performance when both the ERR and SUE are removed reveals that, during the PM, again the level of model stability is not considered acceptable. Additional analysis to understand the pattern of vehicles on the network has also been undertaken to ascertain the relative levels of demand on each network at any one time. These outputs have been presented for the AM and PM periods respectively within the **Figure 23** and **Figure 24** on the following page.

Analysis of both Figures reveals that the option in which the development is progressed without the ERR does not perform to an acceptable level during either the AM or PM periods. This is to be expected as, given the nature of traffic patterns within the southeast of Stratford-upon-Avon there is an intrinsic need for the SUE and ERR to be delivered in unison.

Furthermore, the figures also reveal that a similar pattern occurs when both the ERR & SUE are removed from the network in so far as the number of vehicle on the network increases considerably within the AM peak hour, whilst, within the PM peak hour, it is evident that the model is not able to accommodate the additional demand generated by the additional development located to the South.

Figure 23 - AM Peak Hour (08:00 to 09:00), Vehicles on the Network

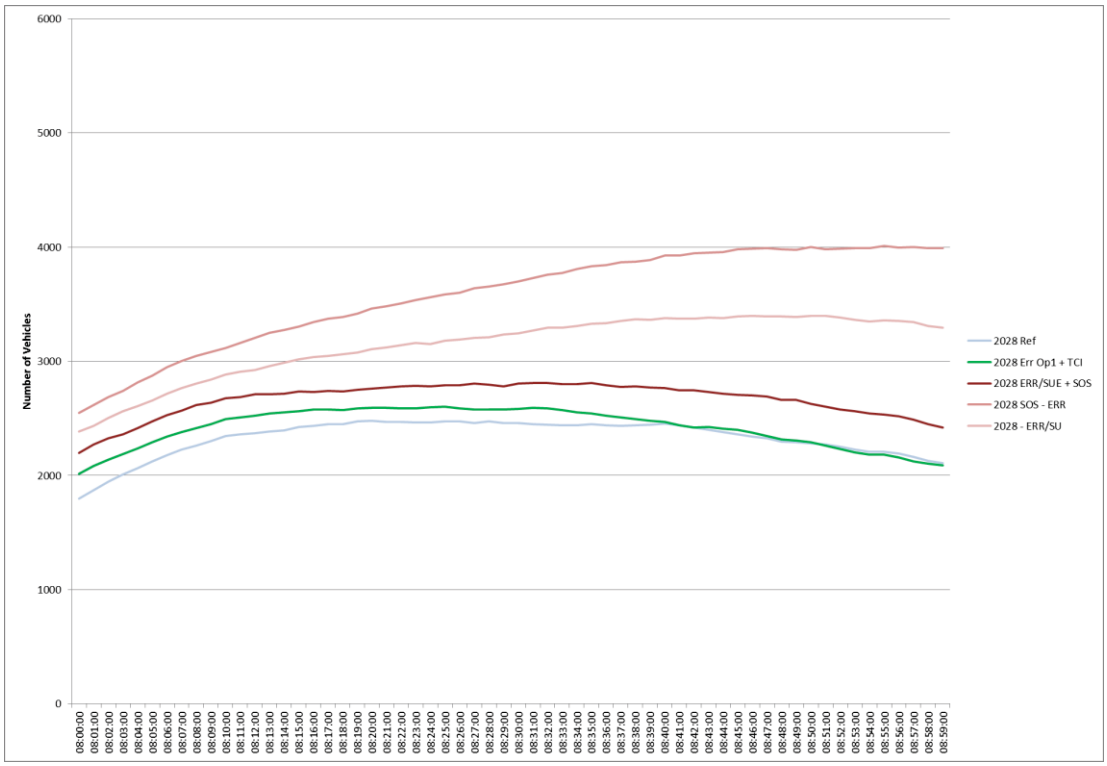
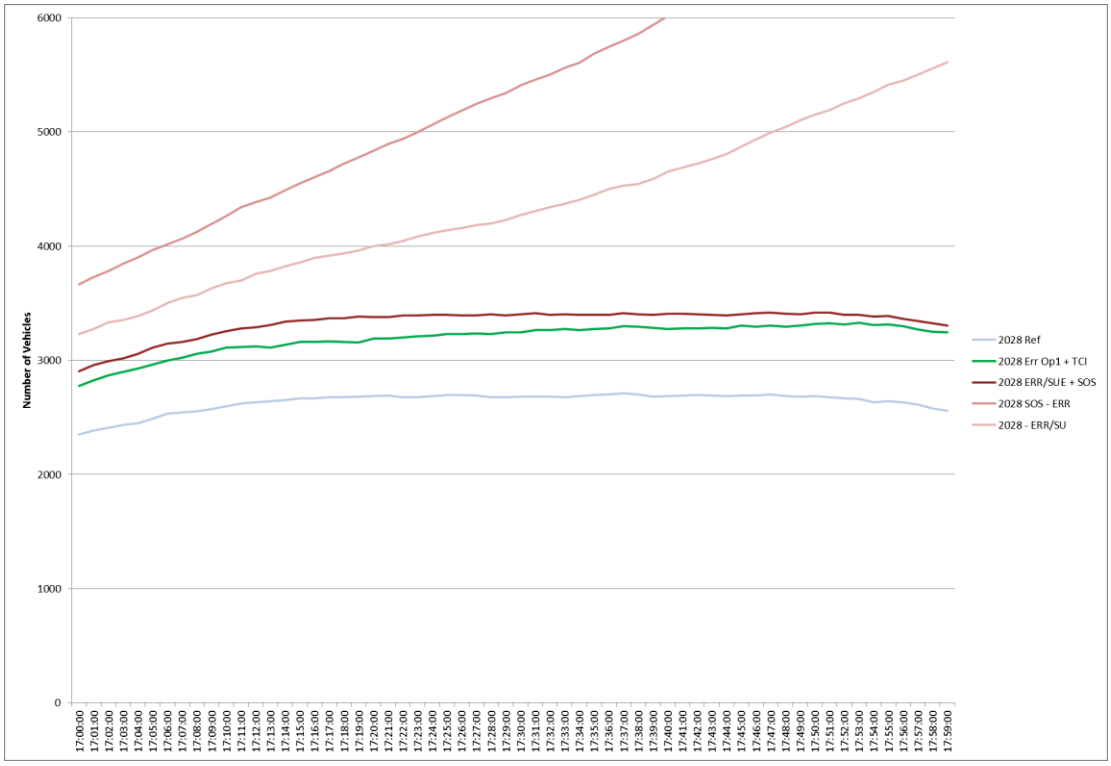


Figure 24 - PM Peak Hour (17:00 to 18:00), Vehicles on the Network



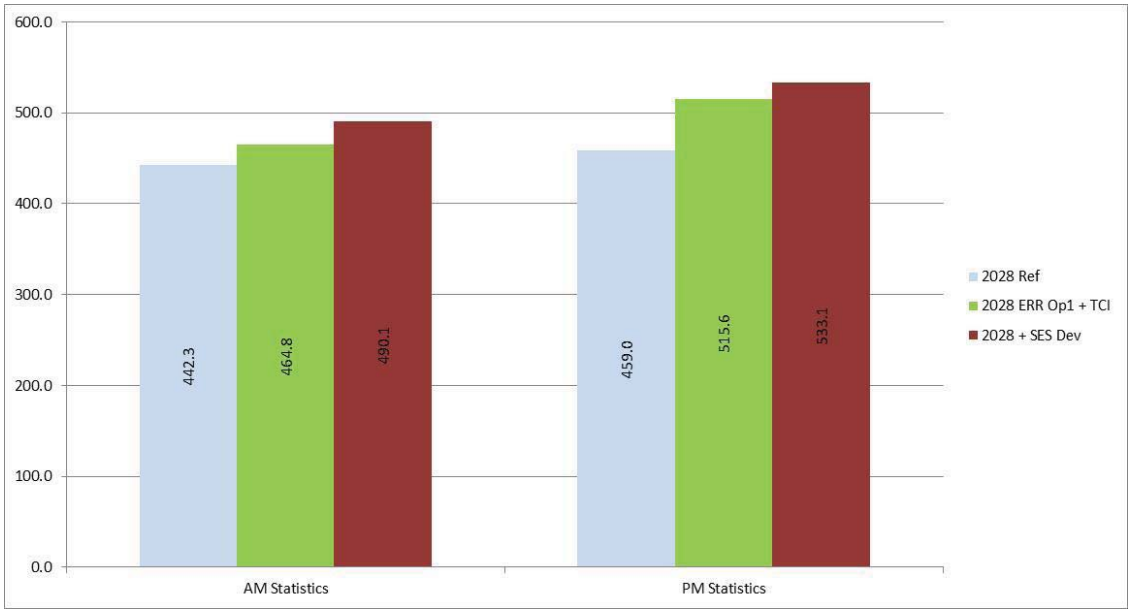
7.2.2 Network Wide Performance Measures

The analysis outlined previously demonstrated that the delivery of the additional development without the ERR is not a scenario that can be delivered and so has been removed from the following stages of analysis. Similarly it is evident that, within the PM, the development to the south cannot be included without a step change in the level of mitigation proposed as part of the TCI measures.

Thus the impact analysis of locating the additional development to the south of Stratford assumed that the development will be delivered in unison with the SUE and ERR since results extracted from the other scenarios are unlikely to be appropriate given the inability of the networks to accommodate the demand levels that have been assigned.

Analysis of the difference in the average journey times (in seconds) between the three remaining scenarios has been illustrated within the following **Figure 25**:

Figure 25 - Average Journey Time (Seconds), 2028 Ref vs. 2028 SUE/ERR vs. 2028 plus SOS



Analysis of the previous Figure reveals that there is an increase in the average journey times experienced by all vehicles travelling through the network as a result of the inclusion of the SOS development.

Similarly the analysis of the impacts on average journey distance and average journey speeds also seems to indicate that the SOS scenario does not perform as well as the SUE/ERR scenario in isolation.

The impacts on journey distances and speeds across the three key scenarios have been presented within the **Table 64** and **Table 65** on the following page.

Table 64 - Average Journey Distance (Kilometres), 2028 Ref vs. 2028 SUE/ERR vs. 2028 plus SOS (with and without SUE/ERR)

	2028 Ref Case	2028 Err Op1 + TCI	2028 Err Op1 + SOS
AM (07:00 to 10:00)	7.37	7.57	7.75
PM (16:00 to 19:00)	6.68	6.93	7.09

Table 65 - Average Journey Speed (Km/h), 2028 Ref vs. 2028 SUE/ERR vs. 2028 plus SOS (with and without SUE/ERR)

	2028 Ref Case	2028 Err Op1 + TCI	2028 Err Op1 + SOS
AM (07:00 to 10:00)	60.0	58.6	56.9
PM (16:00 to 19:00)	52.4	48.4	47.9

The results presented previously indicate that the SUE+ERR scenario performs most favourably when considering the two development scenarios.

7.3 Summary, Conclusions and Further Considerations

7.3.1 Summary

A sensitivity test has been undertaken within the modelling whereby the model has been amended to accommodate an additional 2000 dwellings which are to be located to the south of Stratford-upon-Avon and to the west of the B4632. In all, five scenarios have been assessed initially, namely:

- **2028 Reference Case**
- **2028 Stratford SRZ + SUE + ERR Op1 + TCI**
- **2028 + SOS Dev.** – The previous scenario inclusive of additional development south of Stratford
- **2028 + SOS Dev. W/ERR** – The previous scenario without the ERR removed completely
- **2028 + SOS Dev. W/ERR/SUE** – The previous scenario without the ERR or SUE.

7.3.2 Conclusions

Based on the outcome of this initial stage of testing the following conclusions have been drawn:

- The additional development can be delivered to the South of Stratford without the need for a substantial increase in the level of mitigation over and above that which is proposed through the ERR and TCI measures.
- That the delivery of the ERR or mitigation of a similar scale is likely to be required irrespective of whether the SUE is included within the network or not.

7.3.3 Further Considerations and Recommendations

It is recommended that further analysis of the potential for delivering development to the south of Stratford is undertaken inclusive of a review of the potential network impacts to enable a more refined mitigation strategy to be developed.

8 New Settlement: M40 Localised Testing

8.1 Introduction

The initial objective concerning the assessment of the NS at G/LH was to ascertain whether the initial requirements concerning the need for localised mitigation measures were feasible.

The first stage of the assessment was undertaken qualitatively. The peak CITEware outputs for the NS trip generation, within the M40 model area, were extracted and transposed into hourly trip generation matrices for assignment within the M40 model.

The purpose of this initial assessment was to identify whether such an approach to the allocation of the NS was feasible and what the necessary mitigation requirements would be.

8.2 Process

The initial methodology was intended to review the localised impacts of the NS with a view to determining an appropriate mitigation strategy. Following on from that, outputs from the M40 corridor model, specifically relating to the movement of development trips across the WLWA model network, were fed into the WLWA model.

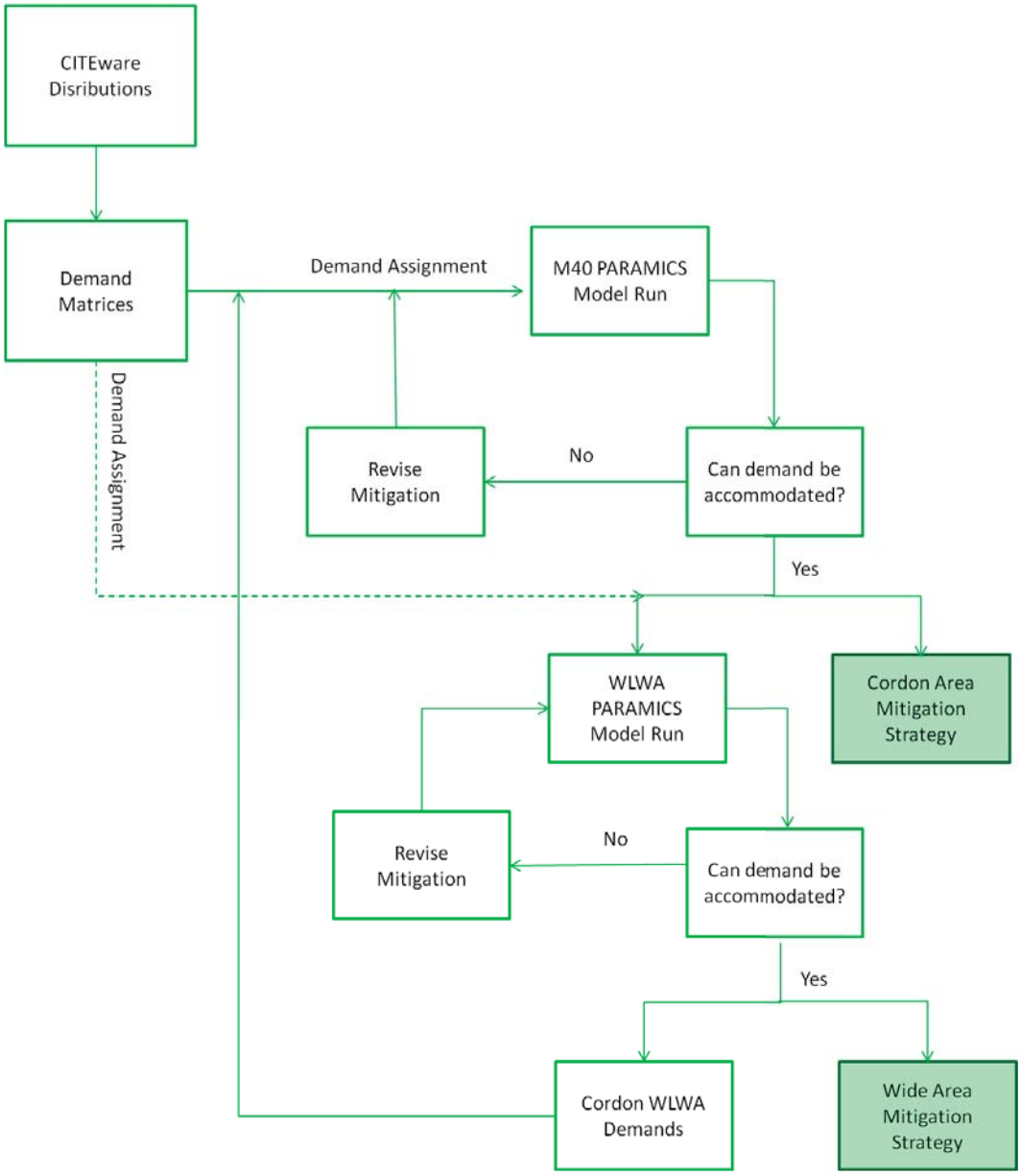
As mentioned previously, the current methodology does not allow for any reassignment of routes away from the M40 area in response to increased congestion, nor does it account for an increased draw of traffic in response to the implementation of a successful mitigation strategy.

The approach to undertaking the assessment was completed in an iterative manner whereby mitigation would be included within the M40 model and the network run to assess the level of network performance. Additional mitigation measures where then incorporated until a point was reached where the model operation was perceived to be at an acceptable level.

As has been noted previously within this report, the focus of this assessment extended to just north of the M40 J13, beyond that point the network was left relatively unconstrained to ensure the maximum levels of demand possible were able to interact with the NS and, importantly, the schemes proposed within the vicinity of the NS where subjected to largest levels of demand possible to ensure that the testing was based on a robust set of modelled flows.

An overview of the process that has been followed is provided within **Figure 26** on the following page.

Figure 26 - Threshold Testing Methodology



8.3 Outline Scenario Assessment

A number of iterations of the M40 assessment have been completed, since the Europa Way area of the model has been left largely unconstrained within the M40 NS scenario assessment the use of network-wide performance measures to inform the analysis of the impacts is inappropriate as the measures are not strictly comparable. Particularly as analysis from the 2011 Baseline scenario has also been included for information purposes as well.

As a result, the analysis has focussed initially on some key local, performance measures and is intended only to provide an overview on the potential conditions

that may result from the delivery of the NS and associated mitigation measures. It should be recognised that a more robust stage of modelling to underpin the impact analysis, undertaken within an extended M40 PARAMICS network, should be completed before any conclusions can be determined.

The outputs presented within the subsequent stages of analysis have been derived from the following scenarios:

- 2011 Base – 2011 Calibrated and validated base model
- 2028 Reference Case – 2011 Base model forecast to 2028 inclusive of major committed developments (JLR/AML)
- 2028 New Settlement – The previous scenario inclusive of the New settlement and localised mitigation measures.

The 2011 base model has been included within the analysis due to the fact that it is considered to be an accurate reflection of current on-street conditions.

Furthermore, the inclusion of the proposals at J12 are intended to mitigate existing issues as well as facilitate the additional demand likely to be generated as a result of the existing, outstanding, extant planning permission associated with the JLR site which is adjacent to the land outlined for the NS. Including outputs from both the 2011 Base model and the 2028 Reference Case is intended to demonstrate the impact of the development and proposed mitigation measures against both current and forecast conditions.

8.3.1 Maximum Queue Length Analysis

One of the critical aspects of the J12 proposals concerns the delivery of a scheme which will ensure that the existing situation, whereby vehicles are frequently observed to queue back onto the M40 mainline, occupying the hard shoulder, during every morning, is mitigated.

Since these impacts occur during the AM period, analysis of the impact of the NS and associated mitigation measures, on queuing levels on both the SB and NB M40/B4451 slip roads.

Analysis of the AM (06:00 to 10:00) average maximum queue lengths, in metres, across all three scenarios has been presented within **Figure 27** and **Figure 28** on the following page. The average maximum queue length analysis is accompanied by the indicative slip road lengths in order that the propensity for the queue length to extend back onto the M40 mainline can be established.

Analysis of the results presented within **Figure 27** reveals that the queue levels on the approach to the SB off-slip are largely consistent in both the 2028 Ref case and New Settlement Scenarios and at no point do the queuing levels indicate a propensity to extend back onto the mainline.

Analysis of the results presented within **Figure 28** reveals that queuing levels within the 2028 Ref Case and the 2028 NS Scenarios remain fairly consistent, albeit queuing levels in both scenarios are slightly higher than those present within the 2011 scenario. Despite the increase in queuing levels it is clear that neither the Ref Case nor NS queuing levels are likely to impact on the M40 mainline.

Figure 27 - J12 SB Off-Slip Average Maximum Queue Length (metres), 2011 Base vs. 2028 Ref vs. 2028 New Settlement, AM (06:00 to 10:00)

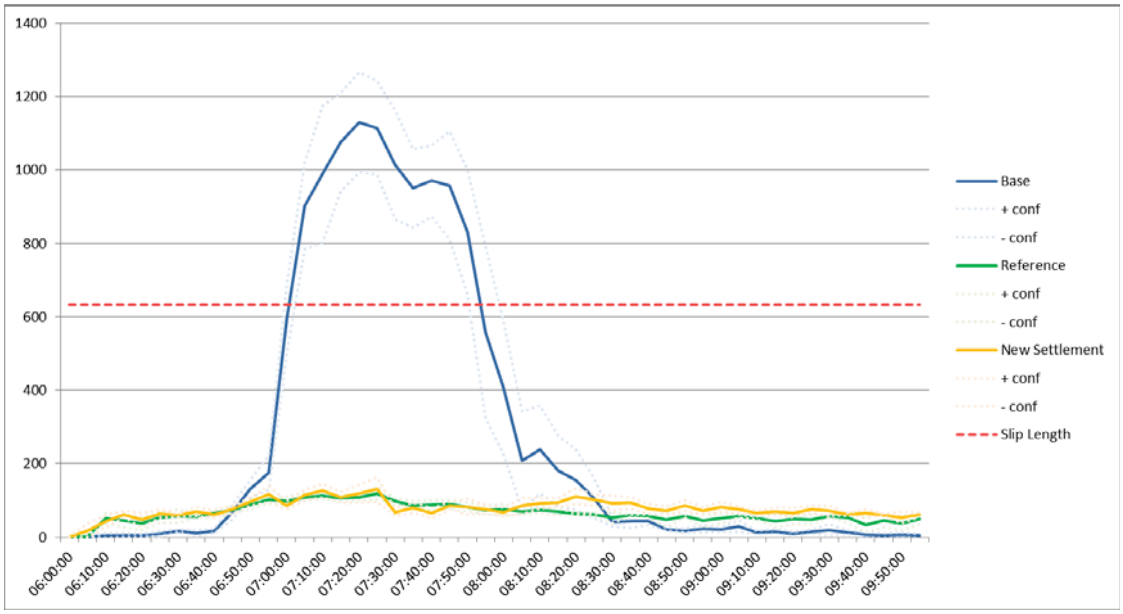
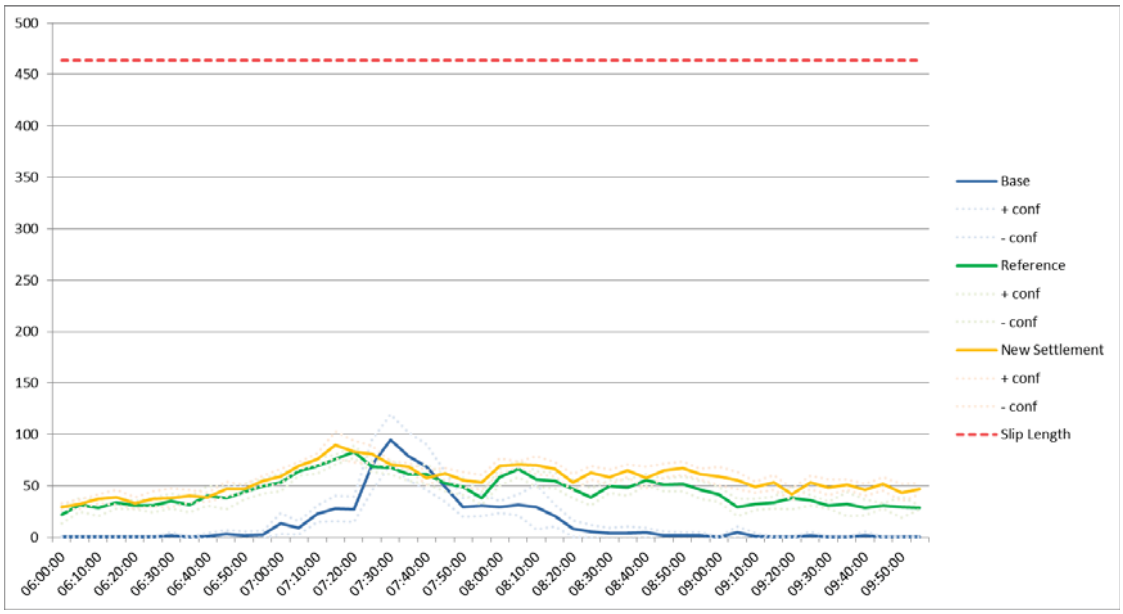


Figure 28 - J12 NB Off-Slip Average Maximum Queue Length (metres), 2011 Base vs. 2028 Ref vs. 2028 New Settlement, AM (06:00 to 10:00)

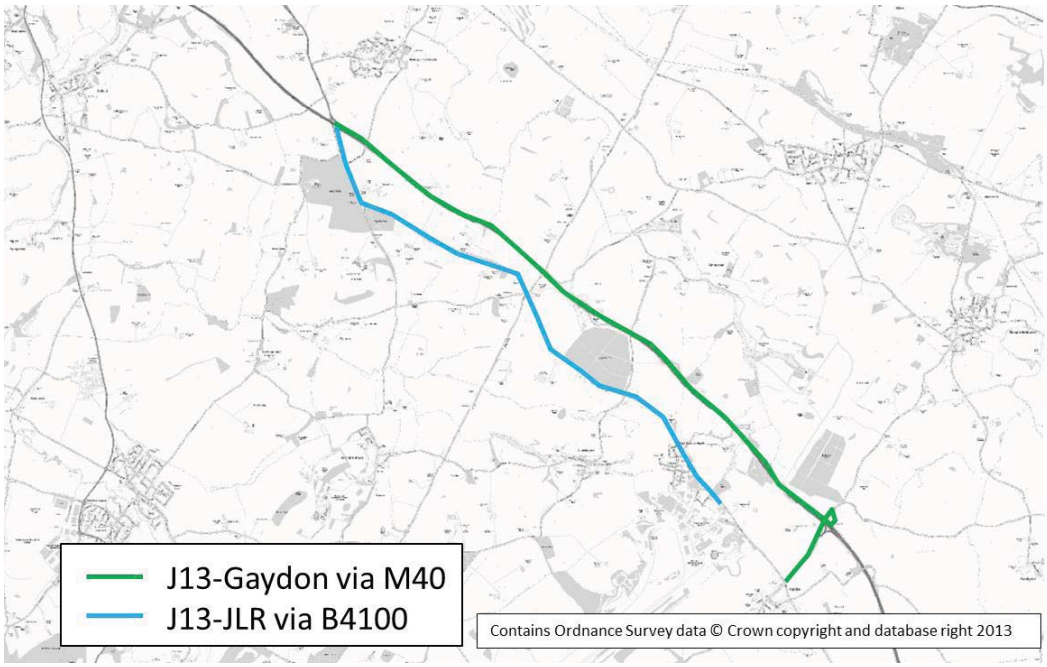


8.3.2 Average Journey Time Analysis

In addition to the impact on queuing at junction 12 analysis of the difference in the levels of delay experienced on a number of key routes within the model network has also been undertaken.

Two routes have been defined within the model network and the average time it takes all vehicles to traverse the length of these routes has been calculated across both the AM and PM model periods, for all three scenarios. The routes that have been defined within the model are illustrated within **Figure 29** on the following page.

Figure 29 - M40 Journey Time Analysis Routes



The complete outputs extracted from this assessment have been presented within **Appendix B**. Analysis of the outputs presented within Appendix B reveals the following:

- Within the AM, the journey times from J13 to Gaydon via the M40 are lower in the NS scenario than the 2011 Base for the majority of the period and consistent with the 2028 Ref Case in all but the final hour. Journey times in the NS scenario are higher in the final AM hour of the NS scenario but it is likely that the signals could be further optimised to reduce this impact. Within the PM, journey times along the same route are lower within the NS scenario than the 2028 Ref Case.
- When reviewing the impacts on journey times for vehicles travelling from Gaydon to J13 via the M40, during the AM, journey times are lowest within the 2028 NS scenario whilst the journey times within the PM are consistent across all three scenarios.
- Journey times between J13 and JLR via the B4100 are fairly consistent across all three scenarios outside of the peak hour. Within the Peak hour journey times are lowest within the NS scenario and significantly higher within the 2011 Baseline. Within the PM journey times appear to be consistently higher within the NS scenario with the exception of one 30 minute period where there is a distinct peak in journey times within the 2028 Ref Case. The magnitude of difference between all three scenarios outside of this 30 minute period is however, relatively small.
- Analysis of the impact on journey times between JLR and J13 via the B4100 reveals that, during both AM and PM periods, journey times are highest within the NS scenario. Within the PM the journey times within the NS scenario are consistently higher when the NS is included within the model.

The initial analysis of the impacts on delay reveals that the only discernible impacts that are incurred within the model network occur when analysing the

route NB from the JLR entrance to M40 J13 and, thus, it is likely that further mitigation measures may be required along this corridor. The potential for the need to signalise the B4100/Fosse Way roundabout should be investigated when more refined impact analysis is undertaken.

At this stage the results presented are based on a high level review of the network and it is highly likely that detailed impact analysis will reveal additional impacts that have not yet been identified.

8.4 Initial Findings

The access strategy associated with the development, at this stage, assumes the delivery of a new signalised cross roads to provide two new development access points along the B4100 to the north of Lighthorne Heath, retention of the priority junction just north of Winyates Road, two new access arms which tie into proposed junctions just outside the Heritage Motor Centre and the new junction proposed to bypass Gaydon roundabout. A link through the site, running parallel to the B4100, configured to discourage 'rat-running' (speeds set to 20mph, no signposting) to act as a distributor link for development trips.

After some initial runs of the model were completed, in addition to the aforementioned access strategy, the following local and strategic interventions were included within the modelling:

- Introduction of a new NB slip onto the M40 from the B4451 which omits the need for vehicles to turn right from the B4451 NB to access the M40. The left turn from the B4451 SB is still currently maintained and vehicles merge prior to merging onto the M40. Further review of this configuration is required and such an arrangement may potentially be replaced by an arrangement which involves signalisation of the right turn from the B4451 SB towards the M40 NB on-slip.
- Introduction of signals at the NB off-slip of J13, queue detectors have been used to ensure that queuing does not propagate back onto the mainline.
- Introduction of Managed Motorway (MM) All Lanes Running (ALR) between J13 and J14.

Implementation of the aforementioned schemes appeared sufficient to ensure that network operation was maintained and the trip generation outputs where acceptable for translation into the WLWA model to inform the outline cumulative impact assessment.

A further review of the model has also indicated that there may be further benefits in investigating the implementation of ramp metering at the J13 SB on-slip as speeds on the mainline carriageway appear to drop, in spite of the implementation of MM ALR, due to the high level of demand predicted to use this junction to travel southwards to M40 J12 and the proximate developments including but not limited to the proposed NS. Similarly there is a potential need for signalisation, or similar improvements, when considering the operation of the B4100/Fosse Way roundabout but further investigation is required before such assumptions can be fully determined.

8.5 Summary, Conclusions and Further Considerations

8.5.1 Summary

Testing has been undertaken within the M40 PARAMICS model to understand the potential impact, of locating a New Settlement in the Gaydon/Lighthorne Heath area, on the nearby transport infrastructure.

The stages of assessment which have been completed, and are outlined within the previous sections of this report, are as follows:

- The assumptions pertaining to the trip generation associated with the development at Lighthorne have been included within the existing M40 PARAMICS model. The M40 PARAMICS model used to inform this analysis was inclusive of the proposed scheme at M40 J12 as well as the accompanying B4100 capacity enhancements and JLR/AML extant planning permission.
- The WDC STA measures were included within the network but the inability of the model to accommodate the fluctuation in route choice between Europa Way and Banbury Road (via Myton Road) meant that the network did not perform satisfactorily. This is contrary to the analysis that has been extracted from earlier WDC STA tests but indicates that further testing, at least within the model that has been extended to include the section of Myton Road between Europa Way and Banbury Road, should be considered at a later stage.

8.5.2 Conclusions

Based on the aforementioned stages of assessment the following conclusions have been drawn:

- That the access strategy delivered alongside the development should include at least 4 junctions between the site and the B4100, two of these junctions could tie into junctions that are anticipated to be delivered through the existing J12/B4100 proposals, whilst the existing priority junction just north of Winyates Rd could also be retained (albeit with a likely need for standards to be upgraded), meaning only one entirely new junctions is likely to be required just north of Lighthorne Heath. Delivery of a signalised junction in this area is likely to create artificial gaps downstream which enable traffic to enter and exit from the aforementioned priority junction as well as the priority junctions that serve the existing Lighthorne Heath area.
- That the following localised mitigation measures are likely to be required, as a minimum, to minimise impacts on the B4100 and M40 as a result of the inclusion of the development:
    - Introduction of a new NB slip onto the M40 from the B4451 which omits the need for vehicles to turn right from the B4451 NB to access the M40. The left turn from the B4451 SB is still currently maintained and vehicles merge prior to merging onto the M40. Further review of this configuration is required and such an arrangement may potentially be replaced by an

arrangement which involves signalisation of the right turn from the B4451 SB towards the M40 NB on-slip.

- Introduction of signals at the NB off-slip of J13, queue detectors have been used to ensure that queuing does not propagate back onto the mainline.
- Introduction of Managed Motorway (MM) All Lanes Running (ALR) between J13 and J14.

8.5.3 Further Considerations and Recommendations

Future testing within the M40 model should be undertaken on an extended model which, as a minimum, included the Chesterton Road/Harbury Lane route from the proposed development site as this route runs parallel to the M40 and B4100 and, given the perceived issues at Grey's Mallory that have become apparent through this stage of testing, it is likely that more Warwick-bound traffic, will reassign along this route. Thus the model would benefit from an extension in this area as it would allow the potential impacts of such routing decisions to be better understood.

Similarly, additional impact analysis is likely to be required to establish the wider impacts of the NS on areas such as Bishops Itchington, Southam and Kineton. At this stage the traffic movements between the NS and these areas are predicted to be relatively small in comparison to the M40 and Warwick/Leamington facing trips which comprise approximately 85% to 95% of the total NS traffic movements across the model network. Detailed analysis of the potential impacts in these areas will need to be considered during any future stage of assessment.

9 New Settlement + WDC Local Plan – Cumulative Assessment

9.1 Introduction

The primary purpose of this stage of testing is to inform the feasibility and indicate the likely impacts of allocating the proposed housing and employment at G/LH on the Warwick District Road network. These impacts have been assessed alongside the impacts of delivering the current assumed Warwick District Local Plan sites and the associated mitigation measures identified within the WDC Local Plan. At this stage the WDC Local Plan is not adopted and, as such, the sites contained within the modelling do not have status within the Local Plan. Rather they represent what is currently perceived to be the most likely approach to the allocation of growth within the WDC Local Plan.

Should the complexion or proposals within the WDC local plan change substantially it is recommended that these changes should be carried forward into any cumulative WDC/SDC testing.

9.2 Scenarios

Initially, demands associated with the development have been assigned within the modelling, the model has been run and the outputs reviewed to understand where the potential, additional impacts are likely to occur, an initial set of mitigation measures have been determined and the impacts of the development, inclusive of an accompanying mitigation strategy have then been determined.

At this stage, due to the time constraints, the mitigation measures included within the modelling are based on a single iteration of this feedback process. In reality it is likely that 10 or more iterations would be required to fully define an appropriate mitigation strategy.

The initial assessment of outputs has then been based on the following scenarios:

- **2028 Reference Case –** the existing Warwick and Leamington 2028 Reference Case, inclusive of all known committed developments and network interventions within the study area as well as the forecasting of external trips, in line with NTEM/TEMPRO,.
- **2028 WDC STA Case –** the model which best represents the Warwick and Leamington road network inclusive of Warwick District Local Plan Sites and associated infrastructure. (This model contains all sites outlined within the WDC Revised Allocation strategy and all mitigation outlined within the latest version of the WDC STA with the exception of the capacity enhancements at Portobello Bridge).
- **2028 WDC STA + NS –** The 2028 WDC STA model scenario with the additional demand associated with the NS.
- **2028 WDC STE + NS + Mitigation –** The previous model inclusive of additional mitigation measures as outlined within the **Section 4** of this report.

9.3 NS Scenario Assessment

The following section presents the results analysis based on the aforementioned test scenarios:

9.3.1 Model Stability

Each scenario was initially run 10 times per time period and then the number of vehicles on the network was assessed to determine whether the model run could be considered as having 'locked-up'. Two distinct indicators of a model lock-up are too many vehicles left on the network at the end of the simulation period or a constant build-up of vehicles on the model network with no apparent dissipation. The initial outputs from the model stability analysis have been summarised as follows:

Table 66 - Model Stability Analysis

Time Period	2028 Reference	2028 WDC STA	2028 WDC STA + NS.	2028 WDC STA + NS. & Mit
AM (07:00 to 09:00)	85%	80%	45%	55%
PM (16:00 to 18:00)	75%	70%	**30%**	65%

A review of the model stability reveals that the inclusion of the NS does result in a drop in model stability. Although the stability analysis does not necessarily indicate a problem as it is based on a series of 20 random runs, a significant drop in the percentage of runs which are successfully completed can be assumed to be indicative of wider issues on the model network. Analysis of the outputs presented within the previous Table indicates that there is a drop in overall model stability across both scenarios which contain demand associated with the NS. The most severe drop in model stability is observed within the PM period of the scenario in which mitigation measures have not been applied and is indicative of significant impacts occurring on the network as a result of the inclusion of the development.

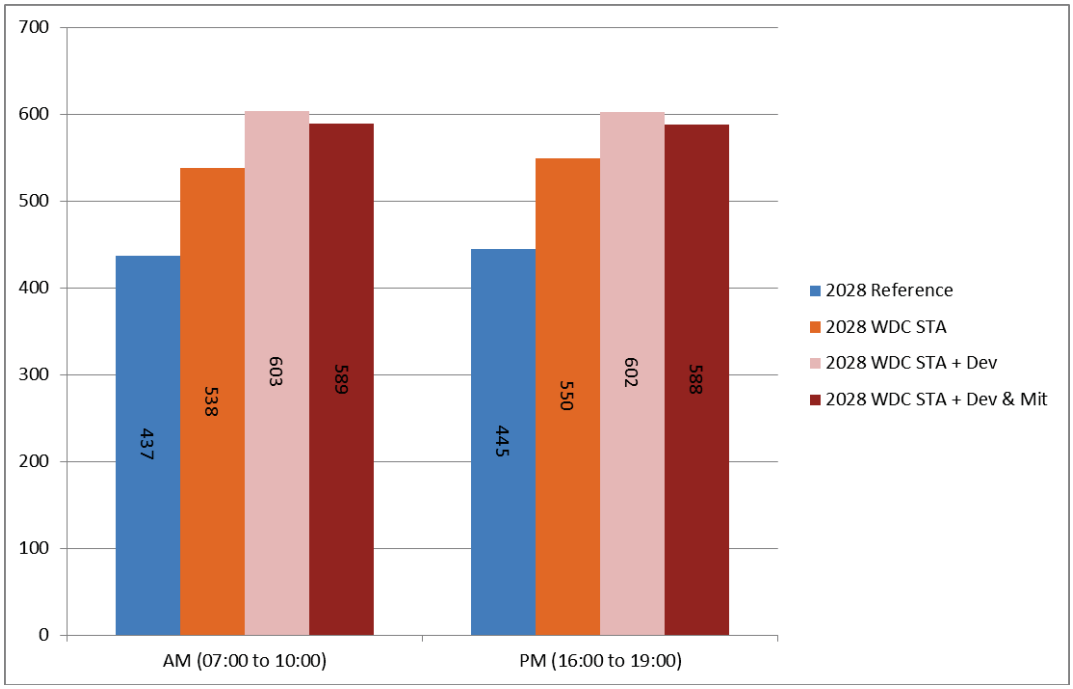
Unsuccessful runs are discounted form the further stages of analysis on the basis that the levels of delay contained within them are unrealistically high and as a result, the impacts on journey times and queuing levels within the model runs that have been perceived to have 'locked up' are not considered to be reliable.

9.3.2 Network-Wide Performance Indicators

Average Delay

Analysis of the difference in the average journey times (in seconds) between the four scenarios has been illustrated within **Figure 30** on the following page.

Figure 30 - Average Journey Time (Seconds), 2028 Ref vs. 2028 WDC STA vs. 2028 plus NS (with and without mitigation)



Analysis of the previous Figure reveals that there is an increase in the average journey times experienced by all vehicles travelling through the network as a result of the inclusion of the NS. In general, the increases appear most substantial when considering the impacts within the PM period when compared to the AM period which correlates to the results extracted from the model stability analysis.

Introduction of the mitigation measures results in a substantial improvement in journey times within the AM, although levels are still considerably higher than those present within the 2028 WDC STA model scenario. Within the PM, however, the impact of incorporating the mitigation measures is relatively limited, at this stage.

The average journey times across both time periods indicate that further mitigation is likely to be required before the impacts could be considered as being acceptable. However, the first iteration of mitigation measures resulted in a reduction in journey times of approximately 3% within the AM and it is reasonable to assume that further reductions could be achieved through the adoption of a more refined mitigation strategy.

In general, once the development and mitigation measures have been assigned within the model network, levels of delay are observed to increase by approximately 8.5% in the AM and 6.5% in the PM when compared to the 2028 WDC STA scenario.

These delays are in addition to those which are incurred by the application of the growth and mitigation strategy outlined within the WDC Local plan. When compared to the levels of delay contained within the 2028 Reference case, journey times are predicted to increase by just over 25% in both time periods as a result of the allocation of the NS.

Average Journey Distance

Analysis of the average journey distance is sometimes used to indicate whether a model scenario, when compared to another, indicates a high propensity for vehicles to reassign in response to congestion on the more direct routes.

It is, however, highly likely that journey distances will increase marginally as a result of the additional demand associated with the NS. This increase is attributable to the fact that the development is located on the periphery of the network. In this case, the development is actually located beyond the current extent of the model network and vehicles load in via external zones along the B4100 and M40. This means that it is inevitable that the additional demand, associated with the developments, will be travelling relatively longer distances when compared to the existing, average journey distances.

Analysis of the difference in the average journey distance (in kilometres) between the four scenarios has been illustrated within the following **Table 67**:

Table 67 - Average Journey Distance (Kilometres), 2028 Ref vs. 2028 WDC STA vs. 2028 plus NS (with and without mitigation)

	2028 Reference	2028 WDC STA	2028 WDC STA + NS	2028 WDC STA + NS & Mit
AM (07:00 to 10:00)	6.7	6.9	7.0	7.0
PM (16:00 to 19:00)	6.4	6.6	6.8	6.8

Analysis of the average journey distances between each of the scenarios, presented within the previous tables, reveals that journey distances do increase when the NS trips are included within the modelling. The increase in journey distances between the 2028 WDC STA and 2028 WDC STA + NS, with mitigation, are consistent across the AM and PM time periods with both experiencing an increase of around 2.3% and, compared to the Reference Case, journey distances have increased by just over 5%.

It is interesting to note that the implementation of mitigation does not have an impact on the journey distances when the outputs from the two WDC + NS Scenarios (with and without mitigation) are compared

Average Speeds

Analysis of the average speeds that vehicles achieve within each scenario time period has been presented within **Table 68** on the following page.

Analysis of **Table 68** reveals that average journey speeds are likely to drop as a result of the inclusion of the NS. This correlates with the outputs extracted during the analysis of the average journey times within the model networks. Journey speeds are between 5 and 7% lower when the NS, alongside the proposed mitigation measures, is included when compared to the performance of the WDC STA model network.

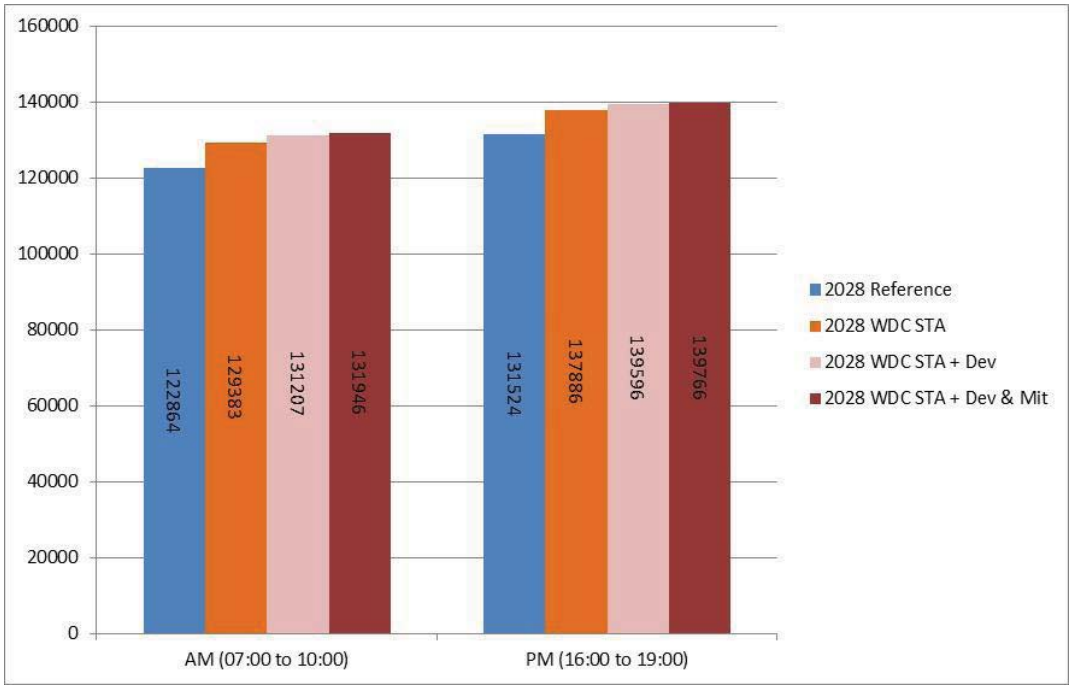
Table 68 - Average Journey Speed (Km/h), 2028 Ref vs. 2028 WDC STA vs. 2028 plus NS (with and without mitigation)

	2028 Reference	2028 WDC STA	2028 WDC STA + NS	2028 WDC STA + NS & Mit
AM (07:00 to 10:00)	54.98	46.02	42.10	43.02
PM (16:00 to 19:00)	52.12	43.49	40.66	41.59

9.3.3 Completed Trips

Analysis of the total number of completed trips within each scenario, across the entire AM and PM model periods, is presented within the following **Figure 31**:

Figure 31 – Completed Trips (Vehicles), 2028 Ref vs. 2028 WDC STA vs. 2028 plus NS (with and without mitigation)



Analysis of the previous Figure reveals that there is an increase in the completed trips of around 1.5 to 2% higher across the AM and PM time periods when comparing the 2028 WDC STA and 2028 WDC STA + NS plus mitigation scenarios. Demand within the 2028 STA + NS model scenarios is around 3.5% higher than the levels contained within the 2028 WDC STA scenario. This indicates that around half of the additionally assigned demand is accommodated within the existing model network.

Because of the need for a cut off period it is never possible that 100% of the demand assigned within the model network will complete the entire journey by the end of the model period. Some trips will have only just started when the model ends whilst some may be released onto the network later due to congestion effects.

To understand how much demand is either unreleased or left on the network at the end of the simulation period the number of completed trips has been compared against the total demand levels assigned within the model. This information has been presented within the following **Table 69**:

Table 69 Completed Trips Analysis 2028 Ref vs. 2028 WDC STA vs. 2028 plus NS (with mitigation)

	AM (07:00 to 10:00)			PM (16:00 to 19:00)		
	Demand	Completed Trips	Completed %	Demand	Completed Trips	Completed %
2028 Ref	127250	122864	96.55%	136667	131524	96.24%
2028 WDC STA	134412	129383	96.26%	145864	137886	94.53%
2028 WDC + NS + Mit	138500	131946	95.27%	150464	139766	92.89%

The previous Table illustrates that, as a proportion of the assigned demand, the number of trips that are completed during both AM and PM model periods reduces when the NS is included. Previously, during the AM, the WDC allocations and mitigation measures appeared to result in a level of completed trips that was comparable to the 2028 Reference Case. This has now dropped as a result of the inclusion of the development at Lighthorne. Similarly, the rate of trip completion within the PM has also dropped although the magnitude of difference between the 2028 WDC STA and 2028 WDC STA + NS plus mitigation scenarios is lower in the PM than the AM.

Historically, the PM period has always been more congested and, as such, it is more difficult to maintain network conditions at levels that are similar to the Reference Case as the incremental addition of developments within the PM can have a disproportionate impact on the level of performance observed within the model scenario.

9.3.4 Summary

Analysis of the network wide performance measures, across the four key scenarios, reveals the following:

- Average Delay across the network increases as a result of the inclusion of the NS, correspondingly, this is accompanied by a reduction in average speeds.
- Average journey distance is relatively unaffected by the inclusion of the NS. A small increase in journey distance is observed when the NS is included within the modelling but this is likely to be attributable to the location of the NS as, since it is on the periphery of the network there will be a natural increase in distances.
- Analysis of the completed trips reveals that there is a small drop in the percentage of completed trips that occurs in the AM, as a proportion of the total assigned demand, and a slightly larger drop in the rate of trip completion that occurs in the PM.
- Generally, the introduction of mitigation appears to have a bigger impact on the AM network performance than the PM network performance indicating that the focus of any future phases of

mitigation assessment should firstly concentrate on the PM network performance.

In general it is clear that the implementation of the NS will have an impact on the WLWA model network. The incremental impact, when compared to the performance of the WDC STA model network, does not appear substantial when considering the strategic impacts. Furthermore, the analysis also indicates that benefits have already been unlocked from a single iteration of the mitigation assessment, further optimisation and the derivation of additional mitigation measures, as identified as being necessary would be likely to further reduce the gap in network performance between the WDC STA model and the New Settlement scenario.

9.3.5 Average Maximum Queue Length Analysis

Outputs from this queue analysis have been presented within **Appendix C** of this report. The following outlines the scenario comparisons that have been presented within outputs presented within Appendix B alongside the drawing reference numbers, unless stated otherwise the queue difference is calculated based on a comparison of the queuing levels within the fore mentioned scenarios versus those which have been calculated within the 2028 Reference Case:

- **MQ001** – 2028 WDC STA AM
- **MQ002 -** 2028 WDC STA PM
- **MQ003** – 2028 WDC STA + NS AM
- **MQ004 -** 2028 WDC STA + NS PM
- **MQ005** – 2028 WDC STA + NS & Mitigation AM
- **MQ006 -** 2028 WDC STA + NS & Mitigation PM
- **MQ007** – 2028 WDC STA + NS & Mitigation vs. 2028 WDC STA AM
- **MQ008 -** 2028 WDC STA + NS & Mitigation vs. 2028 WDC STA PM

The following sets out some initial observations on the queuing levels experienced within each of the model scenarios.

AM Queue Analysis

When assessing the differences in queuing conditions between the various scenarios and the 2028 Reference Case it is apparent that, when the NS is included without mitigation, there is an increase in the number of instances where the increase in queuing levels has been categorised as very severe. Without the mitigation in place, 2 junctions suffer very severe increases in queuing levels and 8 suffer severe increases in queuing levels, previously, within the WDC STA model, these values were 0 and 5 respectively. Once the mitigation is included the number of instances where very severe increases in queue lengths occurs actually increases to 4. The queue increases occur at Longbridge Island and the adjacent roundabout to the south, the Parade/Spencer Street corner of the proposed Bath St/Lower Ave/Spencer Street gyratory within Leamington and the Europa Way/Old Warwick Road junction just north of Shires Retail Park.

Conditions at the Shires Retail park roundabout have worsened within the 2028 WDC STA + NS plus Mitigation scenario. Similarly, conditions to the southwest of Warwick appear to have worsened slightly with junctions that previously had

not experienced increases in queuing now demonstrating increases of between 15 and 50 vehicles. These queue increases occur at the Purser Dr/Hampton Rd and Stratford Rd/Shakespeare Ave junctions. Previous work in this area has indicated that these are some of the first junctions to suffer when conditions at Longbridge worsen and this is likely partly to be as a result of queue propagation back from the junction and partly in response to the reassignment of traffic away from the junction in response to the effects of congestion in the area.

Conditions also appear to worsen around the area of the A46/Birmingham Road junction and it is likely that this is because more traffic elects to travel between the A46 and the allocated sites to the south via Warwick as conditions around Longbridge have got worse and so make that route less attractive.

Further optimisation of the signal times at Longbridge Island, as well further optimisation of the proposed signal timings at Grey's Mallory could potentially reduce the impacts on the A46.

In order to gain a better understanding of some of these impacts, a comparison of the queue levels within the 2028 WDC STA + NS plus Mitigation scenario has been compared to the queue levels within the 2028 WDC STA and this is presented, for the AM period, within MQ007.

Analysis of MQ007 reveals that there are only a small number of differences between the two scenarios which are of a sufficient magnitude that they appear within the plot. There is an improvement in queuing levels around the Oakley Wood/Harbury Lane junction which is delivered by the proposed mitigation measures in this area.

The increase at Longbridge Island has been acknowledged through the previous analysis and this, in turn leads to the increases in and around the area to the southwest of Warwick.

PM Queue Analysis

Analysis of the impacts on queuing levels between the various scenarios reveals that, during the PM period, when the NS is included without mitigation, the number of instances where queue increases are categorised as very severe increases from 0 to 5 whilst there is also a substantial increase in the number of instances where the impact in queuing is considered severe from 5 to 14.

Assessing the performance of the scenario in which the mitigation has been assigned reveals that the number of very severe impacts drops down to 4 and the locations of these increases correspond to the same areas where very severe increases have been noted within the AM analysis, namely Longbridge Island and the Parade/Spencer Street corner of the proposed Bath St/Lower Ave/Spencer Street gyratory within Leamington Spa.

Similarly the number of instances where queue increases have been categorised as severe reduces from 14 to 4.

Also, in line with the AM analysis, there appears to be a worsening of conditions to the West and Southwest of Warwick as a result of the development inclusion and this is likely to be linked to the worsening of conditions at Longbridge Island. Furthermore, again, corresponding with the results extracted for the AM period, there appears to be a worsening of queuing conditions in the area of Shires Retail Park.

As per the AM analysis, a direct comparison of the queue levels within the 2028 WDC STA + NS plus Mitigation scenario has been compared to the queue levels within the 2028 WDC STA and this is presented, for the PM period, within MQ008.

Analysis of MQ008 reveals that there are only a few instances where queue increases between the two scenarios are of a sufficient magnitude to appear on the map. Within the PM the instances of queue increases appears to be less concentrated in a particular area with small increase being visible in a number of areas to the South including Longbridge, Greys Mallory and Tachbrook Road.

9.3.6 Queue Analysis Summary

Based on the analysis set out in the previous section of this note the following conclusions have been drawn:

- That queue levels at a number of locations are likely to increase as a result of the NS.
- That the mitigation that has been proposed does alleviate some of these queue increases.
- That there are significant implications to the network performance as a whole regarding the increase in queue lengths at Longbridge Island.
- Comparisons between the 2028 WDC STA + NS plus Mitigation scenario and the 2028 WDC STA scenario do not reveal a significant number of instances where moderate or severe increases in queue lengths occur. Thus, it can be concluded that there is a general worsening of conditions across the network as a result of the NS and, in some cases, this worsening is sufficient to result in the re-categorisation of queue increases at certain junctions, when compared to the reference case levels, from moderate to severe and in the case of Longbridge Island, from severe to very severe. As a result;
- It is reasonable to conclude that there are a limited number of locations where specific intervention or additional mitigation measures would provide a reduction in queuing levels since impacts are likely to be smaller and widespread. However, it is likely that further optimisation of the signals at Longbridge Island, accompanied by improvements along the Europa Way and, potentially, Tachbrook Road corridors, would further reduce the perceived impacts that occur on the network as a result of the NS.

9.3.7 Detailed Journey Time Impact Analysis

In total, 9 key journey time routes have been defined within the modelling and the time it takes vehicles to traverse these routes has been collected and compared between scenarios.

The outcome of these comparisons has been output in GIS format and these have been provided within **Appendix D** of this report. Unless specified otherwise, comparisons have been against the 2028 Reference Case. The following outlines the comparisons that have been made alongside the drawing reference:

- **MD001 –** 2028 WDC STA AM

- **MD002 -** 2028 WDC STA PM
- **MD003 –** 2028 WDC STA + NS AM
- **MD004 -** 2028 WDC STA + NS PM
- **MD005 –** 2028 WDC STA + NS & Mitigation AM
- **MD006 -** 2028 WDC STA + NS & Mitigation PM
- **MD007 –** 2028 WDC STA + NS & Mitigation vs. 2028 WDC STA AM
- **MD008 -** 2028 WDC STA + NS & Mitigation vs. 2028 WDC STA PM

AM Journey Time Analysis

Analysis of the impact on journey times, within the AM period, reveals that when the NS is included within the model network there are substantial increases in the level of delays experienced along certain sections of the network. The impacts on delay between the two NS scenarios, when compared to the 2028 WDC STA scenario outputs, reveal that the impacts between the two scenarios are comparable. The mitigation results in slightly lower increases in delay along the following routes:

- Stratford Rd NB from Long Bridge Island
- Europa Way SB towards Grey's Mallory
- Oakley Wood Rd NB
- Tachbrook Rd NB

Whilst the inclusion of mitigation reduces the delay in these areas, when compared to the scenario which does not contain mitigation, in all but 1 case the increase in delay is still higher than that which is experienced within the 2028 WDC STA network. Furthermore, the increases in delay further indicates the impacts of congestion at Longbridge, the routes which approach Grey's Mallory all appear to suffer substantial increases in the levels of delay experienced when the NS is included. A lot of the increases in delay are concentrated within the southern area of the network. Unlike the queuing analysis, the delay appears to indicate that further attention should be given to the performance of Longbridge Island, Grey's Mallory and the Junctions along Tachbrook Road and Oakley Wood Road.

When comparisons are drawn between the levels of delay within the 2028 WDC STA + NS plus Mitigation scenario and the levels within the 2028 WDC STA and this is presented within MD007, this appears to broadly correlate with the aforementioned results analysis. Delays on a number of approaches to Grey's Mallory and the Stratford Rd SB approach to Longbridge Island can be observed to suffer very sever increases in delay levels. Tachbrook Road/Oakley Wood Road and Myton Road also appear to suffer increases at the same time.

PM Journey Time Analysis

Analysis of the impact on journey times, within the PM period, reveals that when the NS is included within the model network there are a number of areas where the increases in the level of delays experienced along certain sections of the network within the scenario inclusive of the NS is greater than the increases within the 2028 WDC STA scenario network.

When considering the performance of the Lighthorne scenario inclusive of the mitigation measures, a number of areas where delay levels increase mirrors those which have been identified within the analysis of the AM impacts, namely:

- Stratford Rd NB from Long Bridge Island
- Warwick by-pass NB towards Grey's Mallory
- B4100 NB towards Grey's Mallory
- Tachbrook Rd NB towards Leamington Spa

The correlation of the analysis of PM impacts, alongside AM impacts, indicates that the areas outlined above should form the starting point of the focus of further mitigation measures.

9.3.8 Journey Time Analysis Summary

The journey time analysis outline previously indicates that there are a large number of areas, primarily located to the south of Warwick and Leamington, where the levels of delay are likely to increase as a result of the inclusion of the NS.

Analysis of the differences in the levels of delay experienced along key routes indicates that further optimisation or additional mitigation measures should initially focus on the following areas:

- Longbridge Island
- Greys Mallory
- Oakley Wood Road and Tachbrook Road

It is likely that improvements in these areas will result in wider reductions in delay as the reassignment of vehicles in response to the congested conditions will be reduced.

In general, the delay analysis appears to indicate a number of areas where very severe increases in delay are likely, when compared to the impacts within the 2028 WDC STA model scenario. It should be noted that the analysis of the differences in delay focusses on the peak hours rather than the entire model period and, as a result, represents a worst case. This is likely to be further exacerbated by the fact that the trip generation associated with the NS has not been subject to peak spreading as such assumptions are not considered appropriate at this stage.

9.4 Summary, Conclusions and Further Considerations

9.4.1 Summary

Testing has been undertaken to understand the potential impact on the Warwick and Leamington road network, of locating a New Settlement in the Gaydon/Lighthorne Heath area.

The stages of assessment which have been completed, and are outlined within the previous sections of this report, are as follows:

- The initial testing undertaken within the M40 model was sufficient to determine a localised mitigation strategy that would accommodate the additional trip generation created by the development, at least between J12 and J14. Flows along the M40 and B4100 where then extracted from the M40 model and fed into the WLWA model. Trips were subject to enable distribution across the wider WLWA model network.
- The trip generation associated with the development, predicted to impact on the WDC road network, was assigned to the WDC road network already inclusive of the WDC Local Plan considerations. The impacts of the assignment of these demands was assessed and a second iteration of the modelling was run inclusive of some proposed interventions intended to mitigate the impacts of the development trip generation.
- Outputs from the following four scenarios were then assessed:
    - **2028 Reference Case –** the existing Warwick and Leamington 2028 Reference Case, inclusive of all known committed developments and network interventions within the study area as well as the forecasting of external trips, in line with NTEM/TEMPRO,.
    - **2028 WDC STA Case –** the model which best represents the Warwick and Leamington road network inclusive of Warwick District Local Plan Sites and associated infrastructure. (This model contains all sites outlined within the WDC Revised Allocation strategy and all mitigation outlined within the latest version of the WDC STA with the exception of the capacity enhancements at Portobello Bridge).
    - **2028 WDC STA + NS –** The 2028 WDC STA model scenario with the additional demand associated with the NS.
    - **2028 WDC STE + NS + Mitigation –** The previous model inclusive of additional mitigation measures as outlined previously within this note.

9.4.2 Conclusions

Based on the aforementioned stages of assessment the following conclusions have been drawn:

- That, as a minimum, the following, strategic, mitigation measures, should be considered for delivery alongside the development at Lighthorne:
    - Implementation of MM ALR south of M40 J13
    - Signalisation of the J13 NB off-slip
    - Widening of the circulating carriageway and all approaches to the Fosse Way/A452 roundabout, provision of two lane exit flares on the Fosse Way in both directions.
    - Further enhancements to Grey's Mallory, including revision of the lane markings between the B4100 WB and Europa Way NB, and addition of a third lane to accommodate more traffic movements from Europa Way SB to the B4100 EB.
    - Addition of a left turn slip from Oakely Wood Rd NB to Harbury Lane WB

- In addition to the aforementioned schemes it is likely that provision for Ramp Metering at the J13 SB on-slip is likely to be required, this is partly attributable to the proposed development trips but is also likely to be triggered by the improvements at J12 and the fact that this scheme will encourage existing and future traffic to travel between J13 and J12 via the M40 rather than the B4100 as is currently the case.
- Initial findings from the assessment undertaken within the WLWA model, inclusive of WDC Local Plan considerations; indicate that inclusion of the development at Lighthorne is likely to have an adverse effect on the road network within Warwick and Leamington.
- Despite the implementation of the mitigation measures, journey times are observed to increase, as are queues and delays at key locations within the model network.
- When considering the network conditions, post-implementation of the proposed WDC STA mitigation measures, it is likely that further attention is required, at least, in the following areas:
    - Longbridge Island
    - Europa Way Corridor, and potentially;
    - Oakley Wood Road/Tachbrook Road corridors.
- It is likely that improvements in these areas will result in wider network improvements as the reassignment of vehicles in response to the congested conditions will be reduced.

The analysis that has been completed to date has adopted robust assumptions with regards the level of trip generation associated with the NS and, specifically, how those trip generation figures have been distributed across the Warwick and Leamington Road network. As a result it is reasonable to conclude that the results presented thus far represent a worst case.

Furthermore, the distribution does not account for the potential draw between WDC allocated sites and the NS; it is likely that there will be a draw between the housing sites to the South of Warwick and the proposed employment within the NS.

At the moment, the modelling within the WLWA model assumes all employment trips are new whereas, in reality, some of the trips associated with the employment will come from the proposed WDC allocated sites to the south. At the moment these represent 2 trips in the current modelling that would likely be reduced to 1 trip in future, more refined assessments. Furthermore, these trips will be travelling against the primary flow of traffic (i.e. Southbound away from Warwick/Leamington in the AM and northbound towards Warwick/Leamington in the PM) which may further reduce the potential impacts across the network as a whole. Albeit the localised impacts at the Grey's Mallory junction will be likely to require further attention.

Based on the results that have been extracted it is apparent that allocating the housing and employment within the NS will have an adverse effect on the WDC transport network despite the inclusion of mitigation measures designed to accommodate WDC's Local Plan Allocations.

The results indicate that the development is likely to result in an increase in journey times across the network whilst specific queuing and delay analysis indicates that a substantial amount of the impacts are likely to be experienced

within the southern areas of Warwick and Leamington. This is to be expected due to the fact that this is the main area of interaction between existing demand and the proposed trip generation associated with the NS.

Whilst some of the impacts that are predicted appear to be very severe it is likely that further optimisation of existing schemes and, potentially, the introduction of additional mitigation measures, will further reduce the impacts incurred by the allocation of the NS but are unlikely to completely mitigate the potential impacts.

9.4.3 Further Considerations and Recommendations

Further stages of this assessment should consider the following:

- Further iterations of the mitigation measures to understand the level of mitigation that can be achieved under the current conditions which are considered to be likely to reflect a 'worst case'
- More detailed refinement of the distribution, potentially with sensitivity testing, would be beneficial to understand what the potential range of impacts may be depending upon the level of interaction of NS trips and the local Warwick and Leamington road network.
- More detailed refinement of the mitigation assumptions as well as a review of the potential for draw between the proposed housing in WDC and the proposed employment delivered as part of the NS should be considered as it would potentially reduce the trip generation figures that are being assigned to the WLWA model by minimising the risk of double counting in this area.
- Consideration should potentially be given to the assumptions that have been applied pertaining to the level of mode shift and internalisation levels. Currently these account for 20% in total.

The recommendations outlined previously provide some, additional, indications as to why the results that are being presented thus far are reflective of likely 'worst case' conditions.

Further optimisation of the proposed mitigation measures, as a well as an assessment of whether additional mitigation measures can be proposed, would be likely to reduce further the current impacts that are being presented. Critical to this appears to be the need to improve the level of operation of Longbridge Island. At the moment this operates on fixed time signals within the PARAMICS modelling and it is highly unlikely that these present the best case in operational terms due to the fluctuating nature of the flow on each of the approaches. Longbridge currently operates with MOVA control and a separate study undertaken to determine the level of performance of the junction under MOVA operation, when compared to the fixed times adopted within the PARAMICS modelling, has revealed that inclusion of a MOVA control strategy significantly improves junction performance beyond that which is presented within the current wide area modelling[6].

Refinement of the distributions that have been adopted would also be likely to result in more refined outputs being extracted from the modelling for a number of reasons:

[6] MID3543.R001 – M40 J15 MOVA Study 220413, JMP Consultants, April 2013.

- The level of interaction between the NS and the WLWA internal road network appears very high with almost 50% of all new trips feeding directly onto the WLWA internal road network; a review as to how reasonable this is would be unlikely to increase this value and may result in a reduction, furthermore, testing of the potential range of distributions may offer a solution in so far as it allows the level of impact across a range of scenarios (from high to low level NS ~ WLWA interaction) to be identified.
- The distribution does not account for the potential draw between the NS and the sites allocated as part of the WDC Local Plan. A significant proportion of the employment anticipated to serve the allocated housing sites is located to the North of Warwick and Leamington whilst a large proportion of the houses are located to the south of Warwick. Therefore it is reasonable to assume that some of the trips that would otherwise travel northwards along the Europa Way Corridor and through Leamington, would elect to travel southwards in response to the employment provision afforded by the NS. Whilst the net trip generation effect of the NS is always likely to generate more WLWA inbound trips than it is attract outbound trips, the incremental benefits of drawing traffic away from the Europa Way corridor would at least be likely to reduce the level of impact compared with that which has been presented currently.

Additional work on the mode shift assumptions would undoubtedly be of benefit. Currently a flat 20% reduction has been applied to cover internalisation and mode shift. It is possible that this figure represents an underestimation of both the level of internalisation that could be achieved as well as the potential for mode shift. It is up to the site promoters to demonstrate what level of internalisation/mode shift will be achievable by the proposed NS but at the same time ***it is recommended that sensitivity testing of these parameters is undertaken to understand the potential implications and severity of impacts that may be reliant upon certain targets being achieved.***

Furthermore, the recent WDC STA Phase 3 Report outlines the possibility of a Park & Ride site being delivered towards the south of Warwick and Leamington. The potential for this site to lead to early termination of Warwick/Leamington bound trips could lead to further reductions in the level of interaction between the WLWA network and the NS. There is also potential for showcase or rapid bus transit services to be delivered which link the NS directly to the P&R which would then provide services onwards to Warwick and Leamington. Understanding how these factors could be incorporated within the modelling would likely reduce the level of overall impact exerted as a result of the allocation of the NS whilst, at the same time, the sustainability credentials of the NS could also be enhanced.

10 Summary and Conclusions

10.1 Summary

Arup have been commissioned by Warwickshire County Council (WCC) and Stratford on Avon District Council (SDC) to undertake testing of two different

approaches to the allocation of housing and employment as part of the emerging Core Strategy (CS), specifically:

- Allocation of 2,750 dwellings and 8Ha of employment within a Sustainable Urban Extension (SUE) to the south east of Stratford-upon-Avon as well as redevelopment of land to the north west of Stratford town centre, known as the Stratford Regeneration Zone (SRZ) for approx. 700 dwellings and 25 Ha of land on the northern edge of the town for employment across two additional sites.
- Allocation of 5,000 dwellings and 18Ha of employment in a New Settlement (NS) at Gaydon/Lighthorne Heath (G/LH).

10.2 Stages of Assessment

A divergent approach to the testing of the various scenarios has been adopted whereby the two core options for the allocation of housing and employment have been tested within either the Stratford-upon-Avon PARAMICS model (SUE/ERR) or the M40 and Warwick and Leamington Wide Area (WLWA) PARAMICS Models.

Stratford-upon-Avon Testing Overview

Testing of SUE has been undertaken through the completion of the following steps:

- The 2021 model has been forecast to 2028 and extended to include the route to the M40 from the southeast of Stratford via the B4086 and the A429 to create a new Reference Case
- The 2028 Reference Case model has been amended to reflect the proposals contained within the Stratford Regeneration Zone (SRZ) and associated employment sites.
- The 2028 SRZ model has been amended to include provision for the SUE to the southeast within the modelling. Two potential alignments for the ERR have been included within the modelling, both involve delivery of a new section of road between the A422 and the B4086 then diverge as follows:
    - **ERR Option 1 -** B4086 Main Street, Tiddington and A439 Warwick Road/Ingon Lane including the elevated bridge section above the River Avon floodplain.
    - **ERR Option 2 -** Improving the alternative ERR route via the B4086 linking with the A429 at Wellesbourne.
- The aforementioned 2028 SUE models, inclusive of the ERR alignments, have been amended further to include the Town Centre Improvements (TCI) which consist primarily of the schemes proposed during the earlier STA analysis undertaken within the PARAMICS model.
- After an initial assessment was undertaken to understand the potential implication of delivering the two potential ERR alignment scenarios, as well as more detailed impact analysis of the preferred options, sensitivity testing was undertaken to understand:
    - The potential for delivering an HGV restriction across Clopton Bridge and the potential impacts thereof;

- The potential implications of delivering additional development to the south of Stratford (SOS) with and without the ERR and SUE.

New Settlement Testing Overview

Testing of the impacts of the allocation of a New Settlement (NS) within the Gaydon and Lighthorne Heath (G/LH) areas has been undertaken via a phased approach. Having determined an appropriate level of trip generation and identified some initial distributions, the following stages were completed:

- The trip generation and distribution assumptions were first included within the M40 corridor model, inclusive of Junction 12 proposals, and a review of the network performance was undertaken.
- Proximate and localised mitigation measures were then proposed and tested within the M40 PARAMICS model.
- Following the M40 corridor testing, outputs from the corridor model, pertaining to the movement of development trips across the M40 and B4100, were fed into the Warwick and Leamington Wide Area (WLWA) model.
- The WLWA model testing was undertaken inclusive of the sites and mitigation measures that had been identified during the recent stages of the Warwick District Council Strategic Transport Assessment.
- An initial review of the network performance, once the development demand had been included within the model network, was undertaken and some initial mitigation measures were proposed.
- The WLWA model inclusive of the NS and mitigation measures was then also run and the outputs from all scenarios were assessed.

10.3 Scenario Overview

10.3.1 Stratford SUE

The purpose of the testing undertaken within the Stratford-upon-Avon model was to understand the impacts of the allocation of the Stratford Regeneration Zone (SRZ) Policy as well as the delivery of a Sustainable Urban Extension (SUE) to the southeast of Stratford-upon-Avon.

The SRZ policy comprises the redevelopment of land within Stratford-upon-Avon to facilitate the delivery of 700 dwellings as well as the allocation of 25Ha proposed employment across two areas on the periphery of the Stratford-upon-Avon network, partly to relocate businesses from the SRZ.

The SUE proposals adopted within the modelling assume the delivery of 2,750 dwellings alongside 8 Ha B1 Employment.

Demands have been forecast for three key scenarios involved in the testing of the SUE/ERR impacts namely:

- The 2028 Reference Case
- The previous scenario inclusive of the Stratford Regeneration Zone Policy
- The previous scenario inclusive of the SRZ and SUE allocations

A secondary set of scenarios have been tested whereby an additional 2,000 houses have been allocated on land to the south of Stratford. A cumulative assessment has been undertaken where demand associated with this development has been assigned to the network alongside the SUE and ERR. Subsequent testing was then undertaken to understand the impacts of the removal of the ERR and then the SUE iteratively.

10.3.2 New Settlement At Gaydon Lighthorne Heath

Testing of the impacts associated with the delivery of a new settlement at Gaydon/Lighthorne Heath has been undertaken using both the M40 and WLWA PARAMICS model. Both of which have been amended to include some account of proposals that have been put forward as part of the WDC Core Strategy.

The assumptions pertaining to the delivery of the NS at G/LH include the delivery of 5,000 dwellings alongside 18Ha of B1 employment.

The impact analysis concerning this scenario has firstly been undertaken using the M40 Corridor model to assess the localised impacts and enable proximate mitigation measures to be determined. Following on from that initial testing, more detailed testing has been undertaken to determine the cumulative impacts on the WDC transport network of delivering the NS alongside the development and mitigation proposed through the WDC Core Strategy.

10.4 Mitigation Measures

Throughout the course of the testing iterative reviews of the network performance have been undertaken and, where appropriate, additional mitigation has been included or existing schemes have been optimised.

10.4.1 SUE Mitigation

The mitigation measures included within the SUE testing include:

- Delivery of an Eastern Relief Road
- Delivery of the majority of the measure proposed within the earlier STA work which form the Town Centre Improvements (TCI), namely:
    - Signalisation/reconfiguration of the Evesham Road/Evesham Place roundabout
    - Signalisation of the Bridgeway Gyratory
    - Signalisation/reconfiguration of the Banbury Road/Shipston Road roundabout
    - Signalisation/reconfiguration of the Tiddington Road/Swan's Nest Lane/Banbury Road junction
    - High Street and Grove Road to become northbound (NB) only
    - Rother Street to become southbound (SB) only
- In addition to the schemes proposed as part of the initial TCI Works, schemes have also been proposed at the Shipston Road/Trinity Way and the Shipston Road/Clifford Road roundabouts involving substantial widening of both roundabouts and the delivery of two lanes NB and SB between the two junctions.

10.4.2 New Settlement Mitigation

The mitigation measures proposed through the NS testing include:

- Introduction of a new NB slip onto the M40 from the B4451 which omits the need for vehicles to turn right from the B4451 NB to access the M40. The left turn from the B4451 SB is still currently maintained and vehicles merge prior to joining the M40. Further review of this configuration is required and such an arrangement may potentially be replaced by an arrangement which involves signalisation of the right turn from the B4451 SB towards the M40 NB on-slip.
- Introduction of signals at the NB off-slip of J13, queue detectors have been used to ensure that queuing does not propagate back onto the mainline.
- Introduction of Managed Motorway (MM) All Lanes Running (ALR) between J13 and J14.
- Introduction of Ramp Metering on the J13 NB on-slip.
- Widening of the circulating carriageway and all approaches to the Fosse Way/A452 roundabout, provision of two lane exit flares on the Fosse Way in both directions.
- Further enhancements to Grey's Mallory, including revision of the lane markings between the B4100 WB and Europa Way NB, and addition of a third lane to accommodate more traffic movements from Europa Way SB to the B4100 EB.
- Addition of a left turn slip from Oakley Wood Rd NB to Harbury Lane WB

10.4.3 Further Mitigation

Despite the identification of the schemes outlined previously, most of the outputs that have been assessed thus far are based on a small number of iterations as far as the identification and optimisation of the proposed mitigation measures is concerned. It is highly likely that, during future stages of the assessment, additional mitigation measures will be identified which will further reduce the proposed impacts and improve the overall level of network operation.

10.5 Conclusions

Based on the stages of the assessment that have been completed to date, the following conclusions have been drawn:

10.5.1 Stage 1 – SUE Testing

The conclusions drawn from this first stage of testing have been summarised as follows:

- That the ERR Option 2 alignment is unlikely to sufficiently mitigate the potential impacts of locating the SUE to the Southeast of Stratford-upon-Avon
- That there are impacts attributable to the adoption of the SRZ policy that would likely benefit from further investigation and, potentially, focussed mitigation.

- That both ERR Option 1 scenarios (with and without TCI measures) appear to be able to facilitate the additional demand assigned to the network as a result of the SUE.
- That the inclusion of the TCI measures, in addition to the ERR, results in the most improved network conditions when compared to those present within the 2028 Reference Case.

A more detailed review of the impacts on town centre 'through trips' and the impacts on key links within the town revealed the following initial conclusions:

- That, compared to the 2028 SRZ scenario, the introduction of the ERR is likely to result in a reduction in the number of through trips within the town centre.
- That, during the PM period, the introduction of the TCI measures alongside the ERR is likely to result in a level of 'through trips' which is not dissimilar to the level experienced within the 2028 Reference Case.
- The introduction of measures along Seven Meadows Road and Trinity Way has the potential to complement the ERR implementation in providing improved conditions for vehicles travelling East to West and vice versa between Evesham Road, the proposed ERR and onwards to the M40.
- The impacts are more noticeable within the PM than the AM because the network is much closer to capacity during the PM period and, as a result, vehicles are more likely to reassign away from major routes as result of existing congestion effects.
- It is likely that, in the AM, when the magnitude of demand approaches the levels observed during the PM period these effects would be replicated within the AM network.
- That, compared to the 2028 SRZ scenario, the introduction of the ERR is likely to result in a reduction in the number of vehicular movements on some key links within the town centre whilst the magnitude of vehicles on others will remain broadly static.
- Without the TCI measures in place, Guild Street suffers an increase in traffic flow in both AM and PM periods when the ERR and SUE are included whilst, in the PM, Birmingham Road and Bridge street also suffer increases.
- The inclusion of the ERR is likely to trigger substantial reductions in flow along Clopton Bridge and Grove Road during both AM and PM time periods and these reductions are increased further by the inclusion of the TCI measures.
- The inclusion of ERR Op1 delivers the possibility of delivering an HGV restriction on Clopton Bridge with minimal impact likely to be experienced by HGV or other user-classes as a result of the restriction.

Furthermore, analysis of the flow differences across the town centre indicated that additional restrictions could potentially be added to Church Street, Chapel Street and High Street to reduce the magnitude of the predicted reassignment. Testing of such a scenario would require more certainty on the approach to allocating growth before it could be undertaken with a greater degree of confidence.

10.5.2 Stage 2 – South of Stratford Sensitivity Test

Based on the outcome of the SOS sensitivity testing the following conclusions have been drawn:

- The additional development can be delivered to the South of Stratford without the need for a substantial increase in the level of mitigation over and above that which is proposed through the ERR and TCI measures.
- That the delivery of the ERR or mitigation of a similar scale is likely to be required irrespective of whether the SUE is included within the network or not.

10.5.3 Stage 3 – New Settlement Localised Testing

Based on the aforementioned stages of assessment the following conclusions have been drawn:

- That the access strategy delivered alongside the development should include at least 4 junctions between the site and the B4100, two of these junctions could tie into junctions that are anticipated to be delivered through the existing J12/B4100 proposals, whilst the existing priority junction just north of Winyates Rd could also be retained (albeit with a likely need for standards to be upgraded), meaning only one entirely new junction is likely to be required just north of Lighthorne Heath. Delivery of a signalised junction in this area is likely to create artificial gaps downstream which enable traffic to enter and exit from the aforementioned priority junction as well as the priority junctions that serve the existing Lighthorne Heath area.
- That the following localised mitigation measures are likely to be required, as a minimum, to minimise impacts on the B4100 and M40 as a result of the inclusion of the development:
    - Introduction of a new NB slip onto the M40 from the B4451 which omits the need for vehicles to turn right from the B4451 NB to access the M40. The left turn from the B4451 SB is still currently maintained and vehicles merge prior to merging onto the M40. Further review of this configuration is required and such an arrangement may potentially be replaced by an arrangement which involves signalisation of the right turn from the B4451 SB towards the M40 NB on-slip.
    - Introduction of signals at the NB off-slip of J13, queue detectors have been used to ensure that queuing does not propagate back onto the mainline.
    - Introduction of Managed Motorway (MM) All Lanes Running (ALR) between J13 and J14.

10.5.4 Stage 4 – New Settlement Strategic Testing

Based on the outcome of the first phase of the strategic cumulative assessment the following conclusions have been drawn:

- That, as a minimum, the following, strategic, mitigation measures, should be considered for delivery alongside the development at Lighthorne:
    - Implementation of MM ALR south of M40 J13
    - Signalisation of the J13 NB off-slip
    - Widening of the circulating carriageway and all approaches to the Fosse Way/A452 roundabout, provision of two lane exit flares on the Fosse Way in both directions.
    - Further enhancements to Grey's Mallory, including revision of the lane markings between the B4100 WB and Europa Way NB, and addition of a third lane to accommodate more traffic movements from Europa Way SB to the B4100 EB.
    - Addition of a left turn slip from Oakely Wood Rd NB to Harbury Lane WB
- In addition to the aforementioned schemes it is likely that provision for Ramp Metering at the J13 SB on-slip is likely to be required, this is partly attributable to the proposed development trips but is also likely to be triggered by the improvements at J12 and the fact that this scheme will encourage existing and future traffic to travel between J13 and J12 via the M40 rather than the B4100 as is currently the case.
- Initial findings from the assessment undertaken within the WLWA model, inclusive of WDC Local Plan considerations; indicate that inclusion of the development at Lighthorne is likely to have an adverse effect on the road network within Warwick and Leamington.
- Despite the implementation of the mitigation measures, journey times are observed to increase, as are queues and delays at key locations within the model network.
- When considering the network conditions, post-implementation of the proposed WDC STA mitigation measures, it is likely that further attention is likely to be required, at least, in the following areas:
    - Longbridge Island
    - Europa Way Corridor, and potentially;
    - Oakley Wood Road/Tachbrook Road corridors.
- It is likely that improvements in these areas will result in wider network improvements as the reassignment of vehicles in response to the congested conditions will be reduced.

The analysis that has been completed to date has adopted robust assumptions with regards the level of trip generation associated with the development at Lighthorne and, specifically, how those trip generation figures have been distributed across the Warwick and Leamington Road network. As a result it is reasonable to conclude that the results presented thus far represent a worst case.

11 Further Recommendations and Considerations

At the conclusion of each of the key stages of the assessment a number of additional recommendations have been suggested for consideration during any future stages of assessment pertaining to any of the development allocations that has been tested thus far.

These recommendations have been summarised separately for each stage of the testing as follows:

11.1 Stage 1 – SUE Testing

An isolated assessment of the impacts of the SRZ policy application, specifically in terms of localised impacts on delay and queuing, should be undertaken with a view to determining a localised mitigation strategy to accompany the SRZ in order that the impacts of the SRZ can be lessened prior to any inclusion of the SUE/ERR and TCI Measures.

Further analysis to ascertain the benefits of the delivery of the TCI measures, at least to some extent, alongside the SRZ policy but without including the SUE or ERR would assist in identifying the potential benefits that are unlocked by delivering the TCI measures irrespective of whether the SUE/ERR is progressed.

Sensitivity testing regarding the mode shift parameters may either identify the need for further mitigation measures or that impacts may be less than those currently predicted depending upon the strategy adopted. This analysis should be supported by some initial feasibility assessments regarding the provision of PT measures.

It is unlikely that additional PT infrastructure could be delivered without the TCI measures, however, that infrastructure is unlikely to be dependent upon the delivery of the SUE/ERR. An understanding of whether the principles of schemes outlined within the previous section of this report would be necessary to ensure the credibility of any assumptions included within the modelling, which rely on certain mode shift percentages being achieved, would also enhance the understanding of the range and magnitude of any potential impacts with respect to a potential shift to public transport measures.

11.2 Stage 2 – South of Stratford Sensitivity Testing

It is recommended that further analysis of the potential for delivering development to the south of Stratford is undertaken inclusive of a complete review of the potential network impacts to enable a more refined mitigation strategy to be developed that complements the development proposals since, at this stage, testing has involved including the development alongside a series of largely pre-determined mitigation measures.

11.3 Stage 3 – Localised NS Impact Assessment

It is recommended that any future, more detailed testing within the M40 model should be undertaken on an extended model which includes the Chesterton

Road/Harbury Lane route from the proposed development site as this route runs parallel to the M40 and B4100 and, given the perceived issues at Grey's Mallory that have become apparent through this stage of testing, it is likely that more Warwick-bound traffic will reassign along this route than can be accommodated within the current extent of the model.

11.4 Stage 4 – NS Strategic Impact Assessment

Further stages of the cumulative impact assessment of the NS and WDC Core Strategy Allocations combined should potentially consider the following:

- Further iterations of the mitigation measures to understand the level of mitigation that can be achieved under the current conditions which are considered to be likely to reflect a 'worst case'
- More detailed refinement of the distribution, potentially with sensitivity testing, would be beneficial to understand what the potential range of impacts may be depending upon the level of interaction of NS trips and the local Warwick and Leamington road network.
- More detailed refinement of the mitigation assumptions as well as a review of the potential for draw between the proposed housing in the WDC area and the proposed employment delivered as part of the NS should be considered as it would potentially reduce the trip generation figures that are being assigned to the WLWA model by minimising the risk of double counting in this area.
- Consideration should potentially be given to the assumptions that have been applied pertaining to the level of mode shift and internalisation levels. Currently these account for 20% in total.

It is likely that further optimisation of the proposed mitigation measures, as well as an assessment of whether additional mitigation measures can be proposed, would be likely to reduce further the current impacts that are being presented. Critical to this appears to be the need to improve the level of operation of Longbridge Island which is likely to be reflecting a worse level of impact than would occur in reality due to the inability of the model network to replicate the operation of MOVA signals.

Refinement of the distributions that have been adopted would also be likely to result in more refined outputs being extracted from the modelling for a number of reasons:

- The level of interaction between the NS and the WLWA internal road network appears very high with almost 50% of all new trips feeding directly onto the WLWA internal road network; a review as to how reasonable this is would be unlikely to increase this value and may result in a reduction. Furthermore, testing of the potential range of distributions may offer a solution in so far as it allows the level of impact across a range of scenarios (from high to low level NS ~ WLWA interaction) to be identified.
- The distribution does not account for the potential draw between the NS and the sites allocated as part of the WDC Local Plan. A significant proportion of the employment anticipated to serve the allocated housing sites is located to the north of Warwick and Leamington whilst a large proportion of the houses are located to the south of Warwick.

> Therefore it is reasonable to assume that some of the trips that would otherwise travel northwards along the Europa Way Corridor and through Leamington, would elect to travel southwards in response to the employment provision afforded by the NS. Whilst the net trip generation effect of the NS is always likely to generate more WLWA inbound trips than it is attract outbound trips, the incremental benefits of drawing traffic away from the Europa Way corridor would at least be likely to reduce the level of impact compared with that which has been presented within the current round of testing.

Additional work on the mode shift assumptions would undoubtedly be of benefit. Currently a flat 20% reduction has been applied to cover internalisation and mode shift. It is possible that this figure represents an underestimation of both the level of internalisation that could be achieved as well as the potential for mode share. It is up to the site promoters to demonstrate what level of internalisation/mode shift will be achievable by the proposed NS but at the same time it is recommended that sensitivity testing of these parameters is undertaken to understand the potential implications and severity of impacts that may be reliant upon certain targets being achieved.

Furthermore, the recent WDC STA Phase 3 Report outlines the possibility of a Park & Ride site being delivered towards the south of Warwick and Leamington. The potential for this facility to lead to early termination of Warwick/Leamington bound trips could lead to further reductions in the level of interaction between the WLWA network and the NS. There is also potential for showcase or rapid bus transit services to be delivered which link the NS directly to the P&R which would then provide services onwards to Warwick and Leamington. Understanding how these factors could be incorporated within the modelling would likely reduce the level of overall impact exerted as a result of the allocation of the NS whilst, at the same time, the sustainability credentials of the NS could also be enhanced.

Appendix A

Stratford-upon-Avon Model Extension - GEH Comparison Tables

			Cost Factor 1.0									
				AM		Diff			PM		Diff	
			Ref	Extend	GEH	ABS	%	Ref	Extend	GEH	ABS	%
1	NEB	A46 Warwick Road (North of A439/A46 Roundabout)	2912	2797	2.2	-115	-4%	3051	3028	0.4	-22	-1%
1	SWB	A46 Warwick Road (North of A439/A46 Roundabout)	2656	2381	5.5	-275	-10%	3051	2738	5.8	-313	-10%
2	NEB	A46 (South of Sand Barn Lane)	2093	1992	2.2	-101	-5%	1967	1985	0.4	17	1%
2	SWB	A46 (South of Sand Barn Lane)	1578	1395	4.7	-182	-12%	1874	1692	4.3	-182	-10%
3	NB	A439 Warwick Road (North of Stratford Road)	870	856	0.5	-14	-2%	1136	1100	1.1	-36	-3%
3	SB	A439 Warwick Road (North of Stratford Road)	1062	974	2.8	-88	-8%	1149	1021	3.9	-128	-11%
4	NEB	A439 Warwick Road (South of Ingon Lane)	1189	1167	0.6	-22	-2%	1540	1501	1.0	-38	-2%
4	SWB	A439 Warwick Road (South of Ingon Lane)	1315	1236	2.2	-79	-6%	1408	1279	3.5	-129	-9%
5	NEB	B4086 Tiddington Road (South of Knights Lane)	952	933	0.6	-20	-2%	902	888	0.5	-15	-2%
5	SWB	B4086 Tiddington Road (South of Knights Lane)	923	1174	7.7	250	27%	1127	1394	7.5	268	24%
6	NB	Pimlico Lane (South of Wellesbourne Road)	115	120	0.4	5	4%	84	92	0.8	8	9%
6	SB	Pimlico Lane (South of Wellesbourne Road)	72	80	0.9	8	11%	78	88	1.1	10	12%
7	EB	Loxley Road (East of Pimlico Lane)	196	184	0.9	-12	-6%	197	182	1.1	-15	-8%
7	WB	Loxley Road (East of Pimlico Lane)	204	205	0.0	0	0%	187	186	0.1	-1	0%
8	NB	Knights Lane (South of Pimlico Lane)	104	112	0.7	7	7%	77	95	2.0	19	24%
8	SB	Knights Lane (South of Pimlico Lane)	133	144	0.9	10	8%	75	100	2.7	25	33%
9	EB	Loxley Road (West of Knights Lane)	214	202	0.8	-12	-6%	208	204	0.2	-3	-2%
9	WB	Loxley Road (West of Knights Lane)	145	142	0.2	-3	-2%	189	195	0.5	6	3%
10	NB	A422 Banbury Road (North of Trinity Way)	523	495	1.2	-28	-5%	533	448	3.8	-84	-16%
10	SB	A422 Banbury Road (North of Trinity Way)	357	320	2.0	-37	-10%	471	448	1.0	-22	-5%
11	NB	A422 Banbury Road (South of Trinity Way)	574	578	0.2	4	1%	618	623	0.2	5	1%
11	SB	A422 Banbury Road (South of Trinity Way)	674	638	1.4	-36	-5%	643	620	0.9	-23	-4%
12	EB	A4390 Trinity Way	727	730	0.1	4	0%	852	835	0.6	-17	-2%
12	WB	A4390 Trinity Way	681	709	1.1	29	4%	675	712	1.4	37	6%
13	NB	A3400 Shipston Road	922	910	0.4	-11	-1%	1057	1102	1.4	45	4%
13	SB	A3400 Shipston Road	586	605	0.8	19	3%	1078	1064	0.4	-14	-1%
14	EB	A4390 Seven Meadows Road	1233	1212	0.6	-21	-2%	1759	1693	1.6	-66	-4%
14	WB	A4390 Seven Meadows Road	1287	1322	0.9	34	3%	1452	1401	1.3	-51	-3%
15	EB	A422 Banbury Road (North of Bridgetown Road)	477	467	0.5	-10	-2%	872	874	0.1	2	0%
15	WB	A422 Banbury Road (North of Bridgetown Road)	561	461	4.4	-100	-18%	344	226	7.0	-118	-34%
16	NB	B4086 Tiddington Road (South of Loxley Road)	1038	1009	0.9	-29	-3%	979	979	0.0	0	0%
16	SB	B4086 Tiddington Road (South of Loxley Road)	1153	1355	5.7	202	18%	1495	1717	5.5	222	15%
17	NWB	A3400 Bridge Foot (South of Bridgeway)	2123	2211	1.9	88	4%	2073	2210	2.9	136	7%
17	SEB	A3400 Bridge Foot (South of Bridgeway)	1600	1591	0.2	-9	-1%	2041	2021	0.5	-20	-1%
18	SB	A3400 Bridgeway	2369	2332	0.8	-38	-2%	3400	3334	1.1	-66	-2%
19	NB	A439 Warwick Road (South of Bridgeway)	2832	2809	0.4	-23	-1%	3337	3339	0.0	2	0%
20	EB	A3400 Guild Street	964	954	0.3	-10	-1%	1215	1209	0.2	-6	-1%
20	WB	A3400 Guild Street	1233	1287	1.5	54	4%	1575	1608	0.8	34	2%
				38					38			
				35					34			
				92.11%					**89.47%**			

			Cost Factor 1.5									
				AM		Diff			PM		Diff	
			Ref	Extend	GEH	ABS	%	Ref	Extend	GEH	ABS	%
1	NEB	A46 Warwick Road (North of A439/A46 Roundabout)	2912	2882	0.6	-31	-1%	3051	3029	0.4	-21	-1%
1	SWB	A46 Warwick Road (North of A439/A46 Roundabout)	2656	2378	5.5	-278	-10%	3051	2741	5.8	-310	-10%
2	NEB	A46 (South of Sand Barn Lane)	2093	2080	0.3	-13	-1%	1967	1982	0.3	15	1%
2	SWB	A46 (South of Sand Barn Lane)	1578	1395	4.7	-183	-12%	1874	1690	4.4	-184	-10%
3	NB	A439 Warwick Road (North of Stratford Road)	870	862	0.3	-8	-1%	1136	1102	1.0	-34	-3%
3	SB	A439 Warwick Road (North of Stratford Road)	1062	970	2.9	-92	-9%	1149	1026	3.7	-123	-11%
4	NEB	A439 Warwick Road (South of Ingon Lane)	1189	1164	0.7	-25	-2%	1540	1498	1.1	-41	-3%
4	SWB	A439 Warwick Road (South of Ingon Lane)	1315	1232	2.3	-83	-6%	1408	1283	3.4	-125	-9%
5	NEB	B4086 Tiddington Road (South of Knights Lane)	952	935	0.6	-17	-2%	902	886	0.6	-17	-2%
5	SWB	B4086 Tiddington Road (South of Knights Lane)	923	1175	7.8	251	27%	1127	1393	7.5	267	24%
6	NB	Pimlico Lane (South of Wellesbourne Road)	115	117	0.1	1	1%	84	93	0.9	9	10%
6	SB	Pimlico Lane (South of Wellesbourne Road)	72	76	0.4	4	5%	78	85	0.8	7	9%
7	EB	Loxley Road (East of Pimlico Lane)	196	180	1.2	-16	-8%	197	184	0.9	-13	-7%
7	WB	Loxley Road (East of Pimlico Lane)	204	207	0.2	3	1%	187	187	0.0	0	0%
8	NB	Knights Lane (South of Pimlico Lane)	104	114	0.9	10	9%	77	96	2.1	20	26%
8	SB	Knights Lane (South of Pimlico Lane)	133	143	0.9	10	8%	75	96	2.2	21	28%
9	EB	Loxley Road (West of Knights Lane)	214	195	1.3	-19	-9%	208	206	0.1	-2	-1%
9	WB	Loxley Road (West of Knights Lane)	145	149	0.3	4	3%	189	197	0.6	8	4%
10	NB	A422 Banbury Road (North of Trinity Way)	523	485	1.7	-38	-7%	533	444	4.0	-88	-17%
10	SB	A422 Banbury Road (North of Trinity Way)	357	324	1.8	-34	-9%	471	450	1.0	-20	-4%
11	NB	A422 Banbury Road (South of Trinity Way)	574	583	0.4	9	2%	618	620	0.1	2	0%
11	SB	A422 Banbury Road (South of Trinity Way)	674	643	1.2	-31	-5%	643	623	0.8	-20	-3%
12	EB	A4390 Trinity Way	727	729	0.1	2	0%	852	840	0.4	-12	-1%
12	WB	A4390 Trinity Way	681	705	0.9	24	4%	675	720	1.7	45	7%
13	NB	A3400 Shipston Road	922	902	0.7	-20	-2%	1057	1090	1.0	33	3%
13	SB	A3400 Shipston Road	586	605	0.8	19	3%	1078	1063	0.5	-15	-1%
14	EB	A4390 Seven Meadows Road	1233	1223	0.3	-10	-1%	1759	1711	1.2	-48	-3%
14	WB	A4390 Seven Meadows Road	1287	1321	0.9	34	3%	1452	1418	0.9	-34	-2%
15	EB	A422 Banbury Road (North of Bridgetown Road)	477	475	0.1	-2	0%	872	872	0.0	1	0%
15	WB	A422 Banbury Road (North of Bridgetown Road)	561	466	4.2	-95	-17%	344	233	6.5	-111	-32%
16	NB	B4086 Tiddington Road (South of Loxley Road)	1038	1012	0.8	-27	-3%	979	978	0.0	-1	0%
16	SB	B4086 Tiddington Road (South of Loxley Road)	1153	1355	5.7	202	18%	1495	1713	5.4	218	15%
17	NWB	A3400 Bridge Foot (South of Bridgeway)	2123	2216	2.0	93	4%	2073	2195	2.6	122	6%
17	SEB	A3400 Bridge Foot (South of Bridgeway)	1600	1591	0.2	-9	-1%	2041	2013	0.6	-29	-1%
18	SB	A3400 Bridgeway	2369	2329	0.8	-40	-2%	3400	3325	1.3	-75	-2%
19	NB	A439 Warwick Road (South of Bridgeway)	2832	2813	0.4	-19	-1%	3337	3331	0.1	-6	0%
20	EB	A3400 Guild Street	964	961	0.1	-3	0%	1215	1212	0.1	-3	0%
20	WB	A3400 Guild Street	1233	1281	1.4	49	4%	1575	1596	0.5	21	1%
				38					38			
				35					34			
				92.11%					**89.47%**			

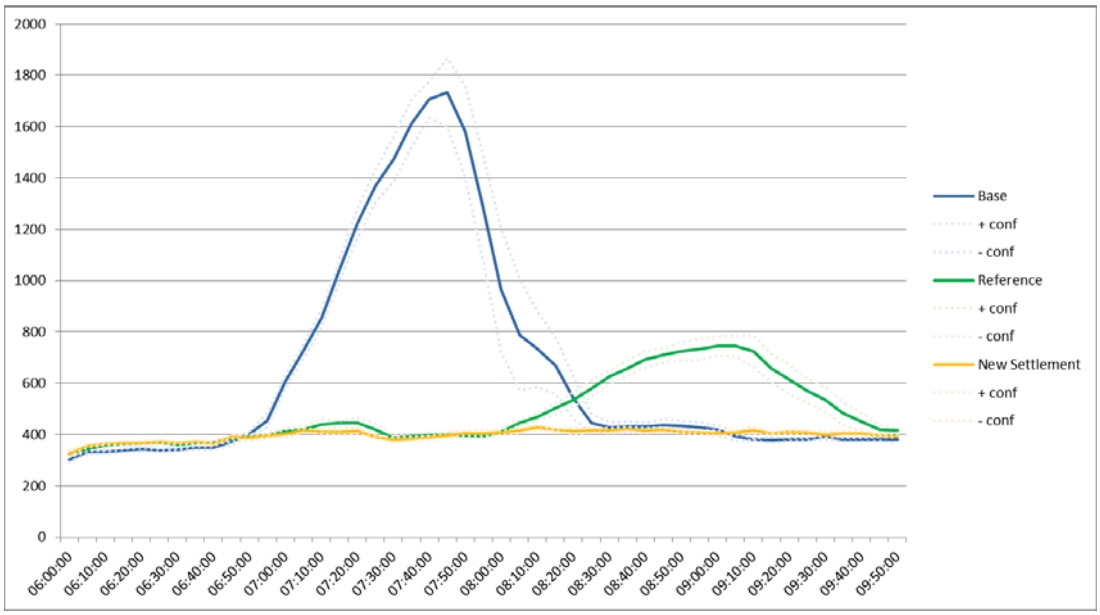
			Cost Factor 2.0									
				AM		Diff			PM		Diff	
			Ref	Extend	GEH	ABS	%	Ref	Extend	GEH	ABS	%
1	NEB	A46 Warwick Road (North of A439/A46 Roundabout)	2912	2884	0.5	-28	-1%	3051	3036	0.3	-14	0%
1	SWB	A46 Warwick Road (North of A439/A46 Roundabout)	2656	2388	5.3	-268	-10%	3051	2734	5.9	-317	-10%
2	NEB	A46 (South of Sand Barn Lane)	2093	2079	0.3	-15	-1%	1967	1976	0.2	9	0%
2	SWB	A46 (South of Sand Barn Lane)	1578	1400	4.6	-178	-11%	1874	1699	4.2	-176	-9%
3	NB	A439 Warwick Road (North of Stratford Road)	870	860	0.3	-9	-1%	1136	1111	0.7	-25	-2%
3	SB	A439 Warwick Road (North of Stratford Road)	1062	975	2.7	-87	-8%	1149	1015	4.1	-134	-12%
4	NEB	A439 Warwick Road (South of Ingon Lane)	1189	1159	0.9	-29	-2%	1540	1507	0.8	-32	-2%
4	SWB	A439 Warwick Road (South of Ingon Lane)	1315	1238	2.2	-78	-6%	1408	1271	3.7	-137	-10%
5	NEB	B4086 Tiddington Road (South of Knights Lane)	952	939	0.4	-14	-1%	902	890	0.4	-12	-1%
5	SWB	B4086 Tiddington Road (South of Knights Lane)	923	1163	7.4	240	26%	1127	1413	8.0	287	25%
6	NB	Pimlico Lane (South of Wellesbourne Road)	115	119	0.3	3	3%	84	107	2.3	23	27%
6	SB	Pimlico Lane (South of Wellesbourne Road)	72	84	1.3	12	16%	78	87	1.0	9	11%
7	EB	Loxley Road (East of Pimlico Lane)	196	182	1.0	-14	-7%	197	188	0.6	-9	-4%
7	WB	Loxley Road (East of Pimlico Lane)	204	204	0.0	0	0%	187	188	0.1	1	1%
8	NB	Knights Lane (South of Pimlico Lane)	104	114	0.9	10	9%	77	100	2.5	24	31%
8	SB	Knights Lane (South of Pimlico Lane)	133	144	0.9	11	8%	75	99	2.5	23	31%
9	EB	Loxley Road (West of Knights Lane)	214	199	1.0	-15	-7%	208	218	0.7	10	5%
9	WB	Loxley Road (West of Knights Lane)	145	151	0.5	6	4%	189	196	0.5	7	4%
10	NB	A422 Banbury Road (North of Trinity Way)	523	499	1.1	-24	-5%	533	444	4.0	-89	-17%
10	SB	A422 Banbury Road (North of Trinity Way)	357	334	1.2	-23	-6%	471	438	1.5	-33	-7%
11	NB	A422 Banbury Road (South of Trinity Way)	574	582	0.3	8	1%	618	610	0.3	-7	-1%
11	SB	A422 Banbury Road (South of Trinity Way)	674	648	1.0	-26	-4%	643	628	0.6	-14	-2%
12	EB	A4390 Trinity Way	727	733	0.2	6	1%	852	844	0.3	-8	-1%
12	WB	A4390 Trinity Way	681	713	1.2	33	5%	675	723	1.8	48	7%
13	NB	A3400 Shipston Road	922	888	1.1	-34	-4%	1057	1095	1.1	38	4%
13	SB	A3400 Shipston Road	586	613	1.1	27	5%	1078	1076	0.1	-2	0%
14	EB	A4390 Seven Meadows Road	1233	1204	0.8	-29	-2%	1759	1728	0.7	-31	-2%
14	WB	A4390 Seven Meadows Road	1287	1342	1.5	55	4%	1452	1461	0.2	9	1%
15	EB	A422 Banbury Road (North of Bridgetown Road)	477	469	0.4	-8	-2%	872	861	0.3	-10	-1%
15	WB	A422 Banbury Road (North of Bridgetown Road)	561	468	4.1	-93	-17%	344	229	6.8	-115	-33%
16	NB	B4086 Tiddington Road (South of Loxley Road)	1038	1015	0.7	-24	-2%	979	979	0.0	0	0%
16	SB	B4086 Tiddington Road (South of Loxley Road)	1153	1348	5.5	195	17%	1495	1709	5.4	214	14%
17	NWB	A3400 Bridge Foot (South of Bridgeway)	2123	2187	1.4	63	3%	2073	2160	1.9	86	4%
17	SEB	A3400 Bridge Foot (South of Bridgeway)	1600	1595	0.1	-5	0%	2041	1995	1.0	-46	-2%
18	SB	A3400 Bridgeway	2369	2334	0.7	-35	-1%	3400	3322	1.4	-79	-2%
19	NB	A439 Warwick Road (South of Bridgeway)	2832	2807	0.5	-25	-1%	3337	3322	0.3	-15	0%
20	EB	A3400 Guild Street	964	966	0.1	2	0%	1215	1219	0.1	3	0%
20	WB	A3400 Guild Street	1233	1267	1.0	34	3%	1575	1607	0.8	32	2%
				38					38			
				35					34			
				92.11%					**89.47%**			

Appendix B

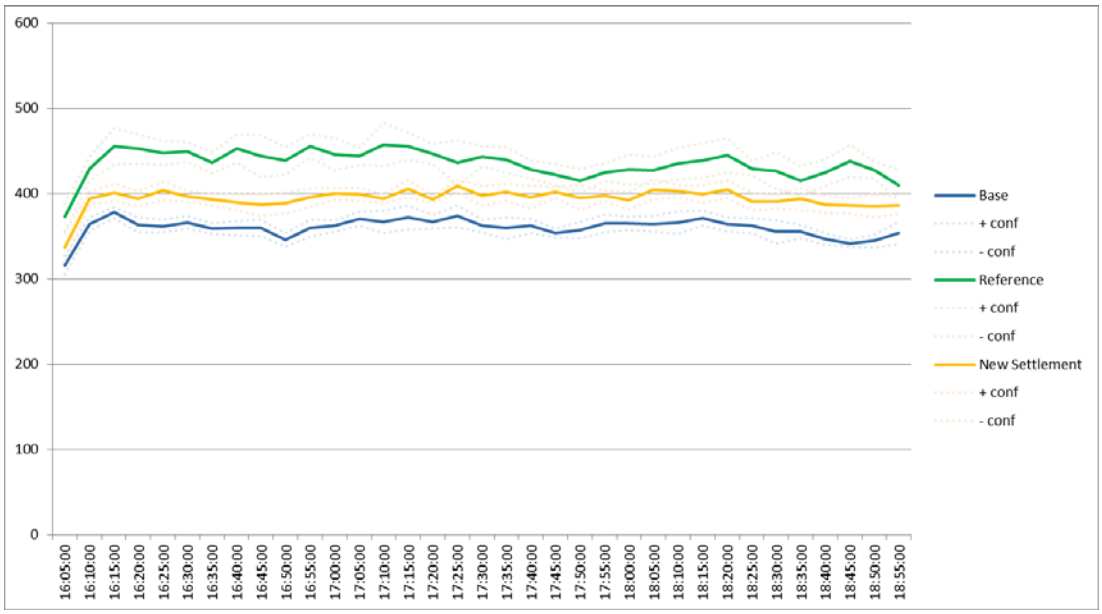
M40 Journey Time Analysis Outputs

B1 J13 to Gaydon RB via M40

AM Average Journey Time Analysis (Seconds)

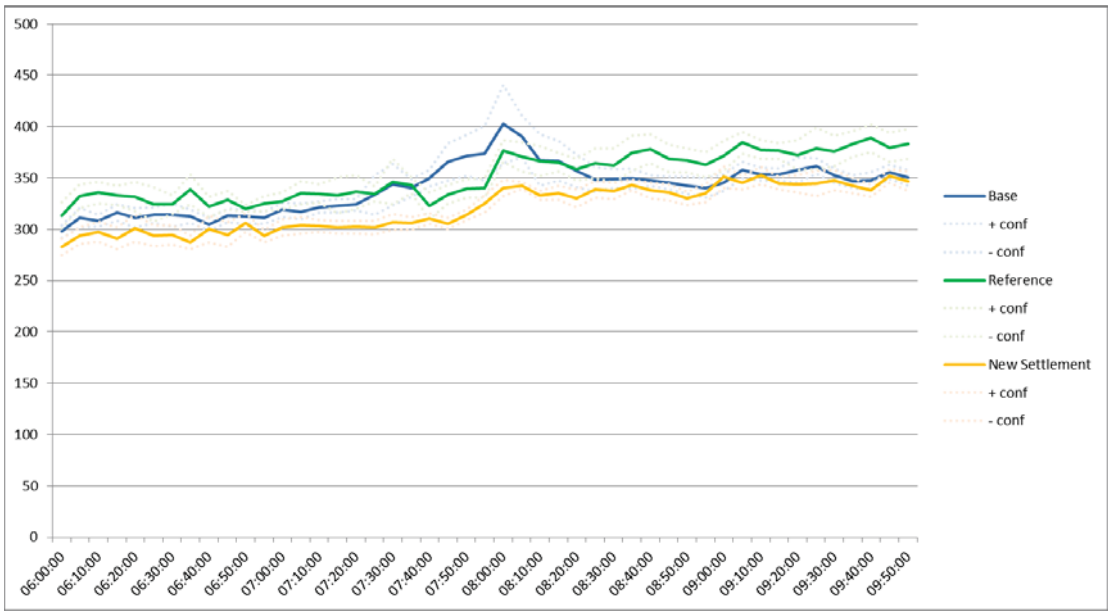


PM Journey Time Analysis (Seconds)

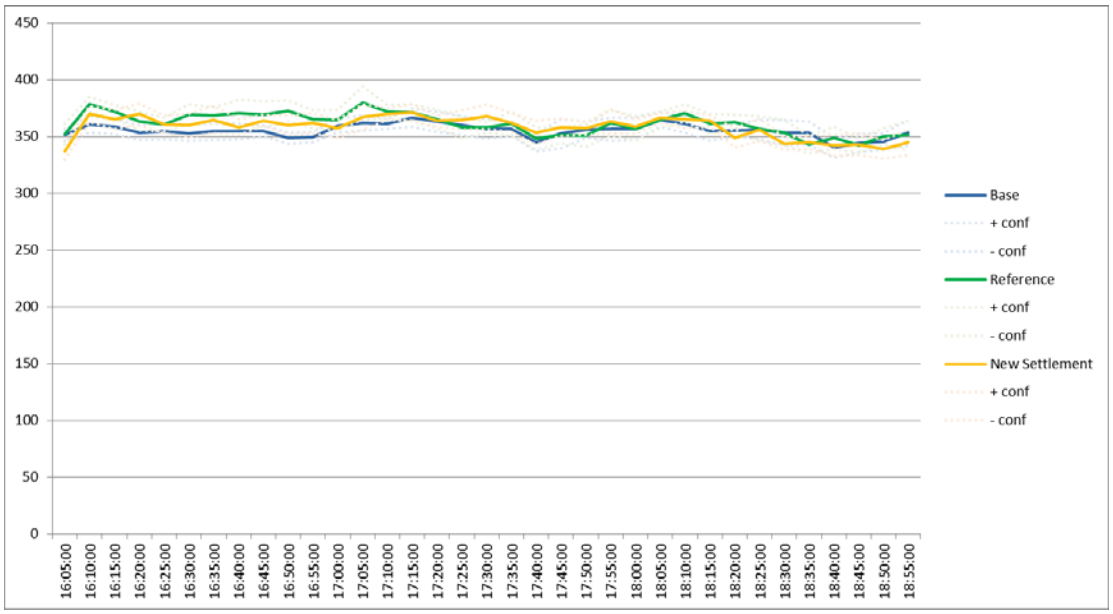


B2 Gaydon RB to J13 via M40

AM Average Journey Time Analysis (Seconds)

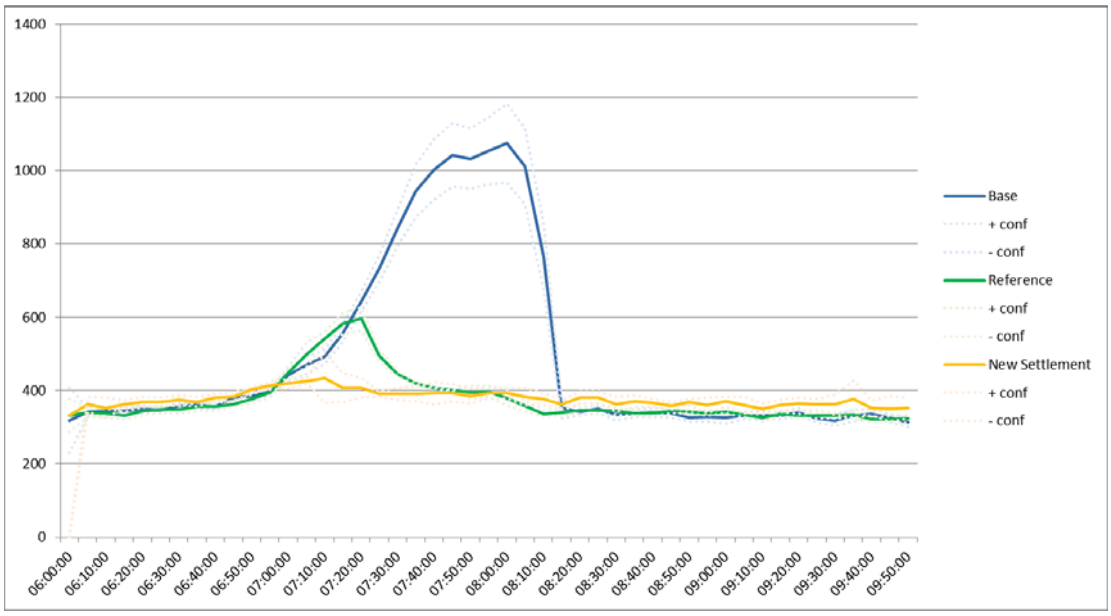


PM Journey Time Analysis (Seconds)

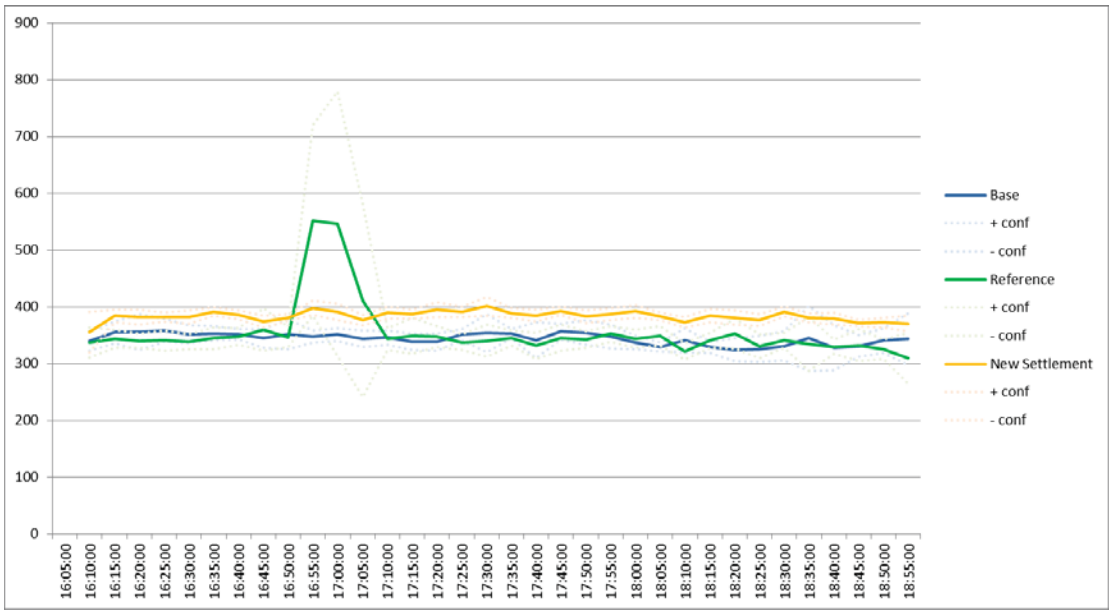


B3 J13 to JLR via B4100

AM Average Journey Time Analysis (Seconds)

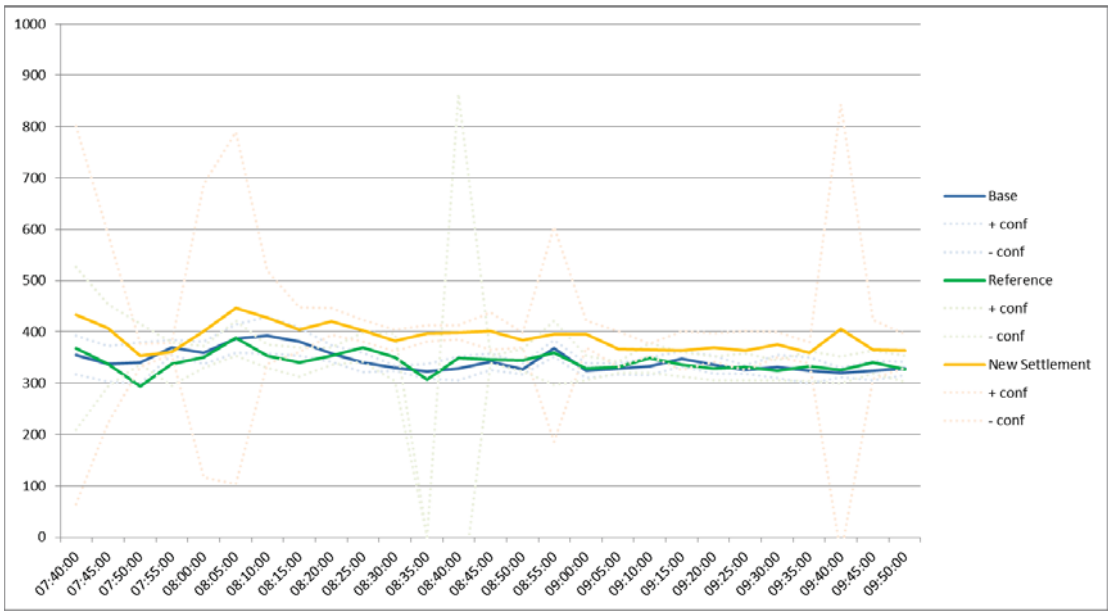


PM Journey Time Analysis (Seconds)

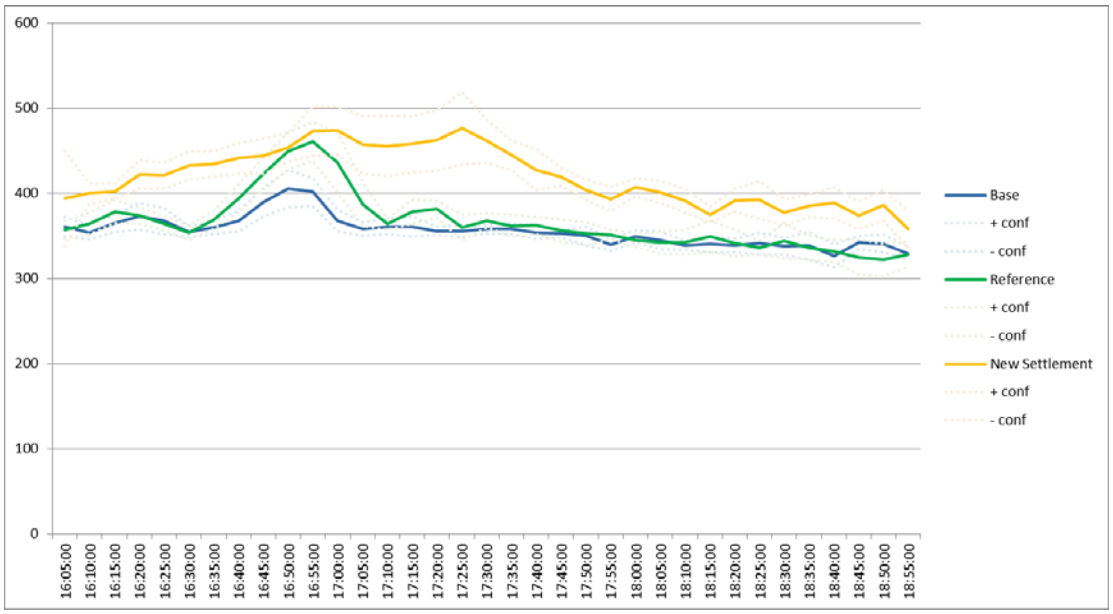


B4 JLR to J13 via B4100

AM Average Journey Time Analysis (Seconds)



PM Journey Time Analysis (Seconds)



Appendix C

New Settlement - WLWA Queue Analysis Plots

A3

Legend

- less than -5 vehicles
- between + 15 and +30
- between +30 and +50
- greater than +50

Issue	Date	By	Chkd	Appd
P1	30-05-13	MG	JE	JE

ARUP
The Arup Campus,
Blythe Gate, Blythe Valley Park
Solihull, West Midlands
B90 8AE
Tel +44 (0)121 213 3000
Fax +44 (0)121 213 3001
www.arup.com

Client
Warwickshire County Council

Job Title
Stratford
Strategic Transport Assessment Phase 2

Metres
0 430 860 1,720

2028 WDC STA AM
0800-0900
Average Maximum Queue

Scale at A3
N.T.S.

Job No	Drawing Status
211439-19	**Information**

Drawing No	Issue
MQ 001	**P1**

MXD Location

A3

Legend

- less than -5 vehicles
- between + 15 and +30
- between +30 and +50
- greater than +50

Issue	Date	By	Chkd	Appd
P1	30-05-13	MG	JE	JE

ARUP
The Arup Campus,
Blythe Gate, Blythe Valley Park
Solihull, West Midlands
B90 8AE
Tel +44 (0)121 213 3000
Fax +44 (0)121 213 3001
www.arup.com

Client
Warwickshire County Council

Job Title
Stratford
Strategic Transport Assessment Phase 2

Metres
0 430 860 1,720

2028 WDC STA PM
1700-1800
Average Maximum Queue

Scale at A3
N.T.S.

Job No	Drawing Status
211439-19	Information

Drawing No	Issue
MQ 002	P1

MXD Location

A3

Legend

- less than -5 vehicles
- between + 15 and +30
- between +30 and +50
- greater than +50

Issue	Date	By	Chkd	Appd
P1	18-06-13	MG	JE	JE

ARUP
The Arup Campus,
Blythe Gate, Blythe Valley Park
Solihull, West Midlands
B90 8AE
Tel +44 (0)121 213 3000
Fax +44 (0)121 213 3001
www.arup.com

Client
Warwickshire County Council

Job Title
Stratford
Strategic Transport Assessment Phase 2

Metres
0 430 860 1,720

2028 WDC STA + NS AM
0800-0900
Average Maximum Queue

Scale at A3
N.T.S.

Job No	Drawing Status
211439-19	**Information**

Drawing No	Issue
MQ 003	**P1**

MXD Location

A3

Legend

- less than -5 vehicles
- between + 15 and +30
- between +30 and +50
- greater than +50

Issue	Date	By	Chkd	Appd
P1	16-06-13	MG	JE	JE

ARUP
The Arup Campus,
Blythe Gate, Blythe Valley Park
Solihull, West Midlands
B90 8AE
Tel +44 (0)121 213 3000
Fax +44 (0)121 213 3001
www.arup.com

Client
Warwickshire County Council

Job Title
Stratford
Strategic Transport Assessment Phase 2

Metres
0 430 860 1,720

2028 WDC STA + NS PM
1700-1800
Average Maximum Queue

Scale at A3
N.T.S.

Job No	Drawing Status
211439-19	**Information**

Drawing No	Issue
MQ 004	**P1**

MXD Location

A3

Legend

- less than -5 vehicles
- between + 15 and +30
- between +30 and +50
- greater than +50

Issue	Date	By	Chkd	Appd
P1	16-06-13	MG	JE	JE

ARUP
The Arup Campus,
Blythe Gate, Blythe Valley Park
Solihull, West Midlands
B90 8AE
Tel +44 (0)121 213 3000
Fax +44 (0)121 213 3001
www.arup.com

Client
Warwickshire County Council

Job Title
Stratford
Strategic Transport Assessment Phase 2

Metres
0 430 860 1,720

2028 WDC STA + NS & Mitigation AM
0800-0900
Average Maximum Queue

Scale at A3
N.T.S.

Job No	Drawing Status
211439-19	Information

Drawing No	Issue
MQ 005	P1

MXD Location

A3

Legend

- less than -5 vehicles
- between + 15 and +30
- between +30 and +50
- greater than +50

Issue	Date	By	Chkd	Appd
P1	30-05-13	MG	JE	JE

ARUP
The Arup Campus,
Blythe Gate, Blythe Valley Park
Solihull, West Midlands
B90 8AE
Tel +44 (0)121 213 3000
Fax +44 (0)121 213 3001
www.arup.com

Client
Warwickshire County Council

Job Title
Stratford
Strategic Transport Assessment Phase 2

Metres
0 430 860 1,720

2028 WDC STA + NS & Mitigation PM 1700-1800 Average Maximum Queue

Scale at A3
N.T.S.

Job No	Drawing Status
211439-19	Information

Drawing No	Issue
MQ 006	P1

MXD Location

A3

Legend

- less than -5 vehicles
- between + 15 and +30
- between +30 and +50
- greater than +50

Issue	Date	By	Chkd	Appd
P1	16-06-13	MG	JE	JE

ARUP
The Arup Campus,
Blythe Gate, Blythe Valley Park
Solihull, West Midlands
B90 8AE
Tel +44 (0)121 213 3000
Fax +44 (0)121 213 3001
www.arup.com

Client
Warwickshire County Council

Job Title
Stratford
Strategic Transport Assessment Phase 2

Metres
0 430 860 1,720

2028 WDC STA + NS & Mitigation vs. 2028 WDC STA AM Average Maximum Queue

Scale at A3
N.T.S.

Job No	Drawing Status
211439-19	**Information**

Drawing No	Issue
MQ 007	**P1**

MXD Location

A3

Legend

- less than -5 vehicles
- between + 15 and +30
- between +30 and +50
- greater than +50

Issue	Date	By	Chkd	Appd
P1	16-06-13	MG	JE	JE

ARUP
The Arup Campus,
Blythe Gate, Blythe Valley Park
Solihull, West Midlands
B90 8AE
Tel +44 (0)121 213 3000
Fax +44 (0)121 213 3001
www.arup.com

Client
Warwickshire County Council

Job Title
Stratford
Strategic Transport Assessment Phase 2

Metres
0 430 860 1,720

2028 WDC STA + NS & Mitigation vs. 2028 WDC STA PM Average Maximum Queue

Scale at A3
N.T.S.

Job No	Drawing Status
211439-19	**Information**

Drawing No	Issue
MQ 008	**P1**

MXD Location

Appendix D

New Settlement - WLWA Delay Analysis Plots

A3

Legend

- No Data
- -15%
- > -15% < +15%
- +15%
- +25%
- +50%

Issue	Date	By	Chkd	Appd
P1	30-05-13	MG	JE	JE

ARUP
The Arup Campus,
Blythe Gate, Blythe Valley Park
Solihull, West Midlands
B90 8AE
Tel +44 (0)121 213 3000
Fax +44 (0)121 213 3001
www.arup.com

Client
Warwickshire County Council

Job Title
Stratford
Strategic Transport Assessment Phase 2

Metres
0 550 1,100 2,200

2028 WDC STA AM
Percentage Difference Mean Delay

Scale at A3
N.T.S.

Job No	Drawing Status
211439-19	**Information**

Drawing No	Issue
MD 001	**P1**

MXD Location

A3

Legend

- No Data
- -15%
- > -15% < +15%
- +15%
- +25%
- +50%

Issue	Date	By	Chkd	Appd
P1	30-05-13	MG	JE	JE

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Client
Warwickshire County Council

Job Title
Stratford
Strategic Transport Assessment Phase 2

Metres
0 550 1,100 2,200

2028 WDC STA PM
Percentage Difference Mean Delay

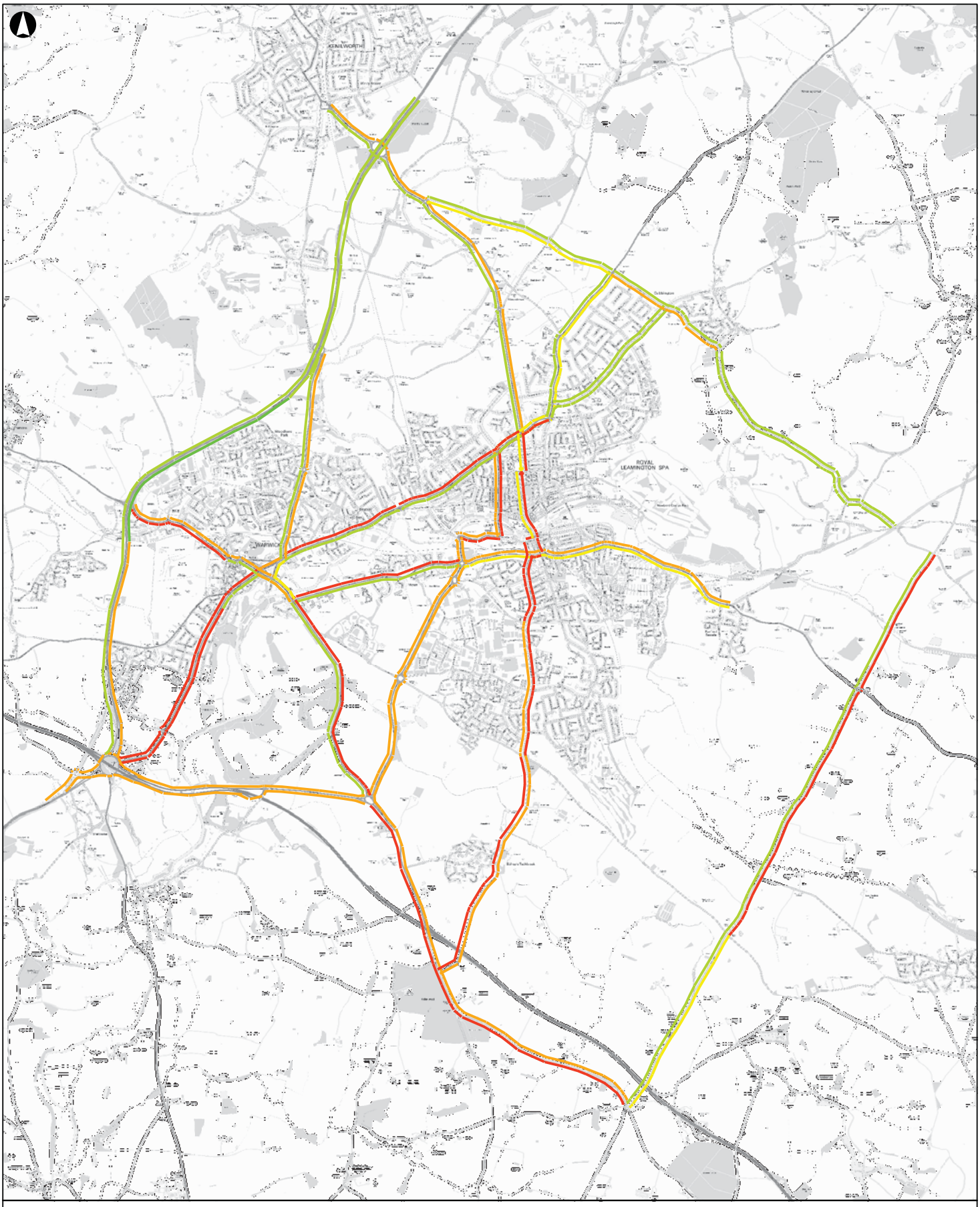
Scale at A3
N.T.S.

Job No	Drawing Status
211439-19	**Information**

Drawing No	Issue
MD 002	**P1**

MXD Location

A3



Legend

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- -15%
- > -15% < +15%
- +15%
- +25%
- +50%

Issue	Date	By	Chkd	Appd
P1	18-06-13	MG	JE	JE

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Client
Warwickshire County Council

Job Title
Stratford
Strategic Transport Assessment Phase 2

Metres
0 550 1,100 2,200

2028 WDC STA + NS
AM 0800-0900
Percentage Difference Mean Delay

Scale at A3
N.T.S.

Job No	Drawing Status
211439-19	Information

Drawing No	Issue
MD 003	P1

MXD Location

A3

Legend

- No Data
- -15%
- > -15% < +15%
- +15%
- +25%
- +50%

Issue	Date	By	Chkd	Appd
P1	16-06-13	MG	JE	JE

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Client
Warwickshire County Council

Job Title
Stratford
Strategic Transport Assessment Phase 2

Metres
0 550 1,100 2,200

2028 WDC STA + NS
PM 1700-1800
Percentage Difference Mean Delay

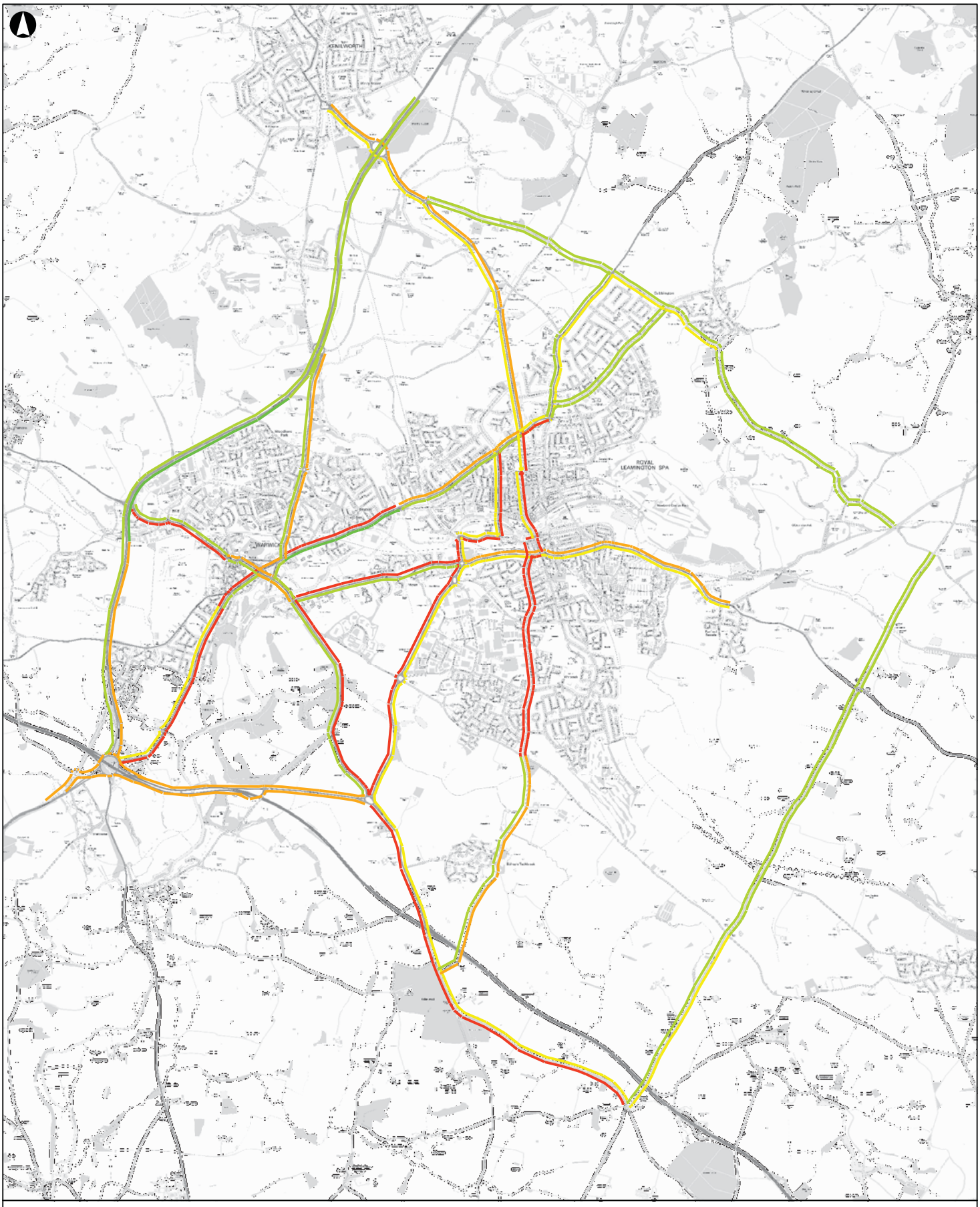
Scale at A3
N.T.S.

Job No	Drawing Status
211439-19	Information

Drawing No	Issue
MD 004	P1

MXD Location

A3



Legend

- No Data
- -15%
- > -15% < +15%
- +15%
- +25%
- +50%

Issue	Date	By	Chkd	Appd
P1	18-06-13	MG	JE	JE

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Client
Warwickshire County Council

Job Title
Stratford
Strategic Transport Assessment Phase 2

Metres
0 550 1,100 2,200

2028 WDC STA + NS & Mitigation
AM 0800-0900
Percentage Difference Mean Delay

Scale at A3
N.T.S.

Job No	Drawing Status
211439-19	Information

Drawing No	Issue
MD 005	P1

MXD Location

A3

Legend

- No Data
- -15%
- > -15% < +15%
- +15%
- +25%
- +50%

Issue	Date	By	Chkd	Appd
P1	18-06-13	MG	JE	JE

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Client
Warwickshire County Council

Job Title
Stratford
Strategic Transport Assessment Phase 2

Metres
0 550 1,100 2,200

2028 WDC STA + NS & Mitigation
PM 1700-1800
Percentage Difference Mean Delay

Scale at A3
N.T.S.

Job No	Drawing Status
211439-19	Information

Drawing No	Issue
MD 006	P1

MXD Location

A3

Legend

- No Data
- -15%
- > -15% < +15%
- +15%
- +25%
- +50%

Issue	Date	By	Chkd	Appd
P1	18-06-13	MG	JE	JE

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Client
Warwickshire County Council

Job Title
Stratford
Strategic Transport Assessment Phase 2

Metres
0 550 1,100 2,200

2028 WDC STA + NS & Mitigation vs. 2028 WDC STA AM Percentage Difference Mean Delay

Scale at A3
N.T.S.

Job No	Drawing Status
211439-19	Information

Drawing No	Issue
MD 007	P1

MXD Location

A3

Legend

- No Data
- -15%
- > -15% < +15%
- +15%
- +25%
- +50%

Issue	Date	By	Chkd	Appd
P1	18-06-13	MG	JE	JE

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Client
Warwickshire County Council

Job Title
Stratford
Strategic Transport Assessment Phase 2

Metres
0 550 1,100 2,200

2028 WDC STA + NS & Mitigation vs. 2028 WDC STA PM Percentage Difference Meam Delay

Scale at A3
N.T.S.

Job No	Drawing Status
211439-19	**Information**

Drawing No	Issue
MD 008	**P1**

MXD Location