Warwickshire County Council

Strategic Transport Assessment Phase 4

Revised Development Allocation Testing

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Ove Arup & Partners Ltd
The Arup Campus
Blythe Gate
Blythe Valley Park
Solihull B90 8AE
United Kingdom
www.arup.com

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1 Executive Summary

1.1 Overview

Arup have been commissioned by Warwickshire County Council (WCC) and Warwick District Council (WDC) to undertake additional testing of the proposed Warwick Core Strategy (CS) allocations. This report is intended to outline the impacts of a revised approach to the allocation of growth, referred to as the 'WDC Revised Development Approach' (WDC RDA), on the Warwick and Leamington area road network.

1.2 Objectives

The objectives of this fourth phase of work were as follows:

- To assess the potential impacts of the RDA on the Warwick and Leamington area road network.
- To refine the proposed Local Plan transport scheme assumptions in light of the impacts of the RDA and identify, where appropriate, areas of change compared to the previously proposed phase 3 mitigation strategy.
- To undertake a focussed assessment within the Kenilworth and Stoneleigh Wide Area PARAMICS model to assess whether the RDA is likely to trigger further mitigation within that area.
- To assess the potential impacts of adopting alternative layouts for some of the originally proposed schemes within the area of Warwick Town Centre.

1.3 Scenario Development

The demand allocation that has been tested within the model is one which has been amended slightly when compared to previous tests. The sites selected within the RDA strategy represent a combination of the sites allocated across previous allocation strategies which were tested during the previous phase of this assessment. The revised demands produced as a result of the RDA scenario strategy have been subjected to mode shift, internalisation and peak spreading procedures. Growth within both scenarios has been capped so as not to exceed the levels of growth predicted by the TEMPRO database, after adjustments for national trends (NTEM Adjusted TEMPRO).

It was considered that the housing projections represented by the adoption of the factors outlined within TEMPRO/NTEM are representative of the total houses currently being considered for allocation within the study area.

Testing has been undertaken within both the Warwick and Leamington Wide Area (WLWA) and Kenilworth and Stoneleigh Wide Area models.

1.4 Mitigation Delivery Schedule

As part of this fourth phase of the STA, the network interventions in some areas have been reviewed and, where possible, refined in response to the conditions that

have been observed to occur as a result of the assignment of the RDA Demands within the model networks and the impacts thereof. In addition further amendments to the schemes have been made where concerns with regards feasibility or deliverability have arisen.

There have been some amendments to the mitigation strategy which have resulted in some schemes being removed or reduced whilst others have been added. As a result the costs associated with the majority of the mitigation measures is consistent with the previous phase of STA work whilst the costs associated with the overall mitigation strategy are also broadly consistent with those costs identified during the previous phase of STA work.

Excluding the costs associated with the Portobello Bridge capacity enhancements the following provides a breakdown of the indicative costs, by grade, of the proposed mitigation schedule:

- Grade 1 – £32,550,000
- Grade 2 – £3,950,000
- Grade 3 – £1,300,000

1.5 Stages of Assessment

The approach to undertaking the assessment has been adopted in line with previous phases of the STA, demands have been forecast for the RDA and these have been assigned onto the model network inclusive of the proposed mitigation measures.

The first stage of the assessment involved a review of the WLWA network performance and associated mitigation measures whilst the second phase reviewed the performance of the KSWA network performance.

1.6 WLWA Assessment Findings

The first stage of the assessment was undertaken within the WLWA model. Once the RDA demands had been assigned, and the mitigation measures refined, the following conclusions were drawn:

- Inclusion of the Revised Allocation strategy demands will likely result in an increase in the average network journey times and a reduction in average speeds that vehicles are able to achieve within the 2028 Revised Allocation network in comparison to the 2028 Reference Case conditions. These impacts occur in spite of the adoption of a proposed mitigation strategy.
- Similar impacts are observed within the 2028 WLWA RDA + RTC scenario albeit there is a further increase in the journey times experienced on the network as a result of these proposals.
- Analysis of the queuing outputs indicates that the 2028 WLWA + RDA network suffers less overall increases in queue lengths than the 2028 WLWA RDA + RTC network.
- The 2028 WLWARDA model network still suffers a number of instances of queuing levels increasing by 30 to 50 vehicles indicating that the network would benefit from further optimisation of mitigation measures and, potentially, additional schemes being included.

- Queue impacts identified within the 2028 WLWA RDA + RTC network indicates that there may be strategic impacts incurred in areas which provide alternative routes to the routes through the town centre, such as the A46 towards Longbridge Island, A452 between M40 and Leamington and Emscote Road Corridor.
- Analysis of the impacts on journey times reveals that within the AM there are some areas that experience reductions in delay and others which experience increases but those areas where the most severe increases occur appear to be in regions where there is the potential to further optimise the proposed mitigation measures to overcome the issues.
- There are further impacts accrued within the AM network as a result of the allocation of the RTC measures. This indicates that further refinement of the proposed measures is likely to be required before an optimum solution can be identified.

The impacts within the PM both with and without the RTC measures appear to indicate little difference in performance of the two networks

1.7 KSWA Assessment Findings

The second stage of the assessment was undertaken within the KSWA model. Once the RDA demands had been assigned, and the mitigation measures incorporated, the following conclusions were drawn:

- Inclusion of the RDA demands will likely result in a relatively small increase in the average network journey times and a reduction in average speeds that vehicles are able to achieve in comparison to the 2028 Reference Case conditions
- Analysis of the trip completion ratio within both Reference Case and RDA scenarios indicates that, the network is able to accommodate the assigned demands. The mitigation measures simply act to minimise the impacts rather than enabling more trips to be completed, there is no trip suppression caused by congestion preventing traffic entering the network.
- The Do Something scenario is better able to cope with the increased demands on the network compared to the Do nothing scenario as reflected in the improved network conditions
- Without mitigation, adoption of the RDA strategy will potentially lead to a worsening of traffic conditions within the Kenilworth and Stoneleigh town areas however the proposed mitigation measures have the potential to deliver improved conditions for road users in the form of reduced queuing and, in some cases improved journey times.

1.8 Sustainable Transport

This document has focussed on the highway network mitigation required in order to achieve an acceptable level of network performance when considering WDC Core Strategy allocation. The exercise has been based around modelling outcomes which primarily focus on car based trips. However, there are wider ranging sustainable transport issues which need to be considered in conjunction with this report

It is critical that sustainable transport improvements form part of the mitigation package to support the housing and employment growth proposals within the District. Such improvements will:

- Contribute towards the delivery of sustainable development within the District;
- Maximise the number of journeys made by sustainable transport modes from trips generated as a result of new development;
- Reduce the impact of car based travel on the local and strategic highway network;
- Deliver an integrated approach to transport provision to serve new development; and
- Contribute towards the aims and objectives of the District Council's Garden Towns, Villages and Suburbs Prospectus.

1.9 Conclusions

Overall, the findings of this Report indicate that the potential impacts of the proposed RDA strategy will be, in part, mitigated by the proposed transport strategy but some residual impacts will still occur. Such impacts may occur through the allocation of natural growth within the network although, without the mitigation measures, the impacts may reach comparable levels at an earlier point in time.

The Report considers the impacts likely to occur at the end of the plan period based on robust trip generation assumptions and including schemes which should be considered as being relatively high level in terms of design and feasibility. Detailed work on measures which may reduce the car based trip generation, through alternative, sustainable, modes, as well as further refinement of the proposed measures, would likely reduce the impacts that have been documented within this report.

1.10 Recommendations

The following outlines a series of recommendations that should be considered during any additional stages of the Strategic Transport assessment.

- Further work on calculating the costs of delivering the Highways Agency network safety and capacity improvements (for the purposes of this study have been assumed to take the form of Smart Motorways) and identifying an acceptable level of developer contribution toward the overall mitigation strategy is recommended to be undertaken at the earliest opportunity.
- That, once the preferred allocation strategy has been determined, consideration should be given to undertaking an assessment to confirm that the proposed mitigation will still operate within acceptable levels.
- That the potential impacts of any strategic reserve sites that come forward as part of the preferred allocation strategy are not likely to fundamentally change the nature of the mitigation that is proposed
- More detailed work is undertaken on sustainable transport requirements and the assumptions on mode share and mode shift are based on the outcome of these studies. Once the preferred allocation

strategy has been identified, a sensitivity test should be undertaken to determine the importance of achieving the targets for mode share/shift and internalisation and to establish areas where further mitigation may be required should the targets, associated with the proposed sites not be realised.

- As more certainty emerges on the provision of Education facilities alongside the allocation strategy, further testing should be undertaken which includes more detailed assumptions regarding the access strategy including any additional pedestrian facilities, trip generation and the distribution thereof.
- Testing of a phased approach to the implementation of the mitigation strategy should be undertaken to determine which schemes are likely to be required at an early stage of the plan period and, conversely, which can be delivered towards the end of the plan period.

2 Introduction

2.1 Scope

Arup have been commissioned by Warwickshire County Council (WCC) and Warwick District Council (WDC) to undertake additional testing of the proposed Warwick Core Strategy (CS) allocations. This report builds upon the evidence presented within the Phase 2 and Phase 3 Assessment reports[1], and is intended to outline the impacts of a revised approach to the allocation of growth, herein referred to as the 'WDC Revised Development Approach' (WDC RDA), on the Warwick and Leamington area road network.

2.2 Study Objectives

The objectives of this fourth phase of work are as follows:

- To assess the potential impacts of the RDA on the Warwick and Leamington area road network.
- To refine the proposed Local Plan transport scheme assumptions in light of the impacts of the RDA and identify, where appropriate, areas of change compared to the previously proposed phase 3 mitigation strategy.
- To undertake a focussed assessment within the Kenilworth and Stoneleigh Wide Area PARAMICS model to assess whether the RDA is likely to trigger further mitigation within that area.
- To assess the potential impacts of adopting alternative layouts for some of the originally proposed schemes within the area of Warwick Town Centre.

In addition to the above objectives, some further refinements to the proposed mitigation measures within the Warwick and Leamington areas have been incorporated within the assessment.

The impact analysis that is presented within this report is intended to inform an assessment on the traffic impacts of the RDA strategy alongside the proposed mitigation measures. At this stage, the level of assessment does not include detailed information and analysis of each of the proposed schemes in detail. Rather it is intended to confirm what strategic elements of infrastructure are likely to be required to ensure that the allocated growth can be accommodated upon the existing network.

It is anticipated that the planning process associated with the individual sites will continue throughout the development of the Core Strategy and that each development will be supported by a separate planning application that will, in turn, be accompanied by a Transport Assessment (TA). The planning process associated with the individual sites will be expected to deal in more detail with issues such as the associated access strategies and the mitigation of localised impacts.

[1] 211439-19.R006 Warwick STA - Phase 2 Assessment, Arup, February 2013 & 211439-19.R012 Warwick STA – Phase 3 Assessment, Arup, May 2013

At this stage it should also be recognised that the purpose of this assessment is to determine an appropriate mitigation strategy necessary to accommodate all of the growth that is envisaged to occur across the duration of the plan period. Thus the mitigation proposed through this work reflects that which will be anticipated across the entire 2011 to 2029 plan period.

Whilst it is recognised that there may be a requirement to determine an appropriate phasing strategy to accompany the delivery of the allocated sites throughout the plan period it should also be recognised that such work cannot be completed until the allocation strategy is adopted and the accompanying full mitigation schedule determined.

2.3 Background

The objectives set out in section 2.2 are intended to build upon transport work previously undertaken. It is intended that this report should be considered alongside these independent but, but complimentary, reports[2].

The nature of the strategic transport assessments completed to date mirrors the emergent nature of the development of the Core Strategy itself. As is mentioned throughout the remainder of this report, there are a number of assumptions pertaining to the Core Strategy that have yet to be fully determined, as such, this work and the preceding stages represent assessments are based on the most up to date and current assumptions but should by no means be considered conclusive. Rather they are intended to advise on the potential implications of the relevant allocation strategies and accompanying mitigation schedules.

An overview of the process that has been followed prior to the commencement of this fourth phase of testing has been summarised as follows:

WDC Strategic Transport Assessment – Phase 1

The first phase of the strategic transport assessment comprised three separate elements. Firstly, a strategic transport assessment was undertaken using Strategic modelling techniques. This formed a high level/low detail assessment which was intended to begin to inform WCC, WDC and the HA on the potential implications of a number of different allocation options. This work was then supplemented by an additional, more detailed, series of tests undertaken using the existing PARAMICS models of both Warwick & Leamington and Kenilworth and Stoneleigh. At this stage the assessments were based on four potential options and compared the differences between the Reference Case, Do Nothing (i.e. growth but no mitigation measures) and Do Something scenarios.

Finally, complementary technical assessments and key findings thereof were presented alongside a detailed review of additional mitigation measures that could be delivered alongside the proposed approach to the allocation of housing across the District. The principles regarding the implementation of sustainable modes set out within these assessments are still applicable today as they are valid irrespective of the allocation strategy adopted. However they cannot be

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http://www.warwickdc.gov.uk/wdc/planning/planning+policy/local+development+framework/evidence+base/

determined further until a preferred option is identified as there is a need to tailor these measures specific to the sites proposed.

WDC Strategic Transport Phase 2

The second phase of the strategic transport assessment undertook a more detailed comparison of the potential impacts of two specific allocation strategies namely the Preferred Option and the Southern Focus. At this stage a more detailed review of the potential mitigation measures was undertaken and additional mitigation measures where included within the assessment dependent upon the option being tested. A number of additional sensitivity tests were completed which focussed on a variety of issues such as the impact of the Coventry and Warwickshire Gateway development and the strategic significance of the Northern Relief Road.

WDC Strategic Transport Phase 3

The third phase of the strategic transport assessment undertook a more detailed comparison of the potential impacts of one specific approach to the allocation of development, namely the Revised Allocation. At this stage a more detailed review of the potential mitigation measures was undertaken and additional mitigation measures were included within the assessment dependent upon the option being tested. A number of additional sensitivity tests were completed which focussed on a variety of issues such as the potential impacts of education provision, the impacts of revising certain mitigation measures and the potential feasibility of amending the mitigation strategy in order that it can better accommodate public transport movements and, specifically, those associated with a Park and Ride site located south of Warwick and Leamington.

2.4 Study Area

In line with previous stages of the STA the assessment has predominantly focussed on the impacts within and performance of the Warwick and Leamington transport network as informed by the Warwick and Leamington Wide Area PARAMICS model (WLWA).

In addition to the WLWA model testing, testing has also been undertaken within the Kenilworth and Stoneleigh Wide Area PARAMICS model (KSWA). This assessment was necessary to determine the likely impacts on the Kenilworth and Stoneleigh network and identify whether any further mitigation measures were required in addition to those already proposed within the area of Thickthorn and the A452. The coverage of the WLWA and KSWA models has been illustrated within the following figures:

Figure 1 - Warwick and Leamington Model Coverage

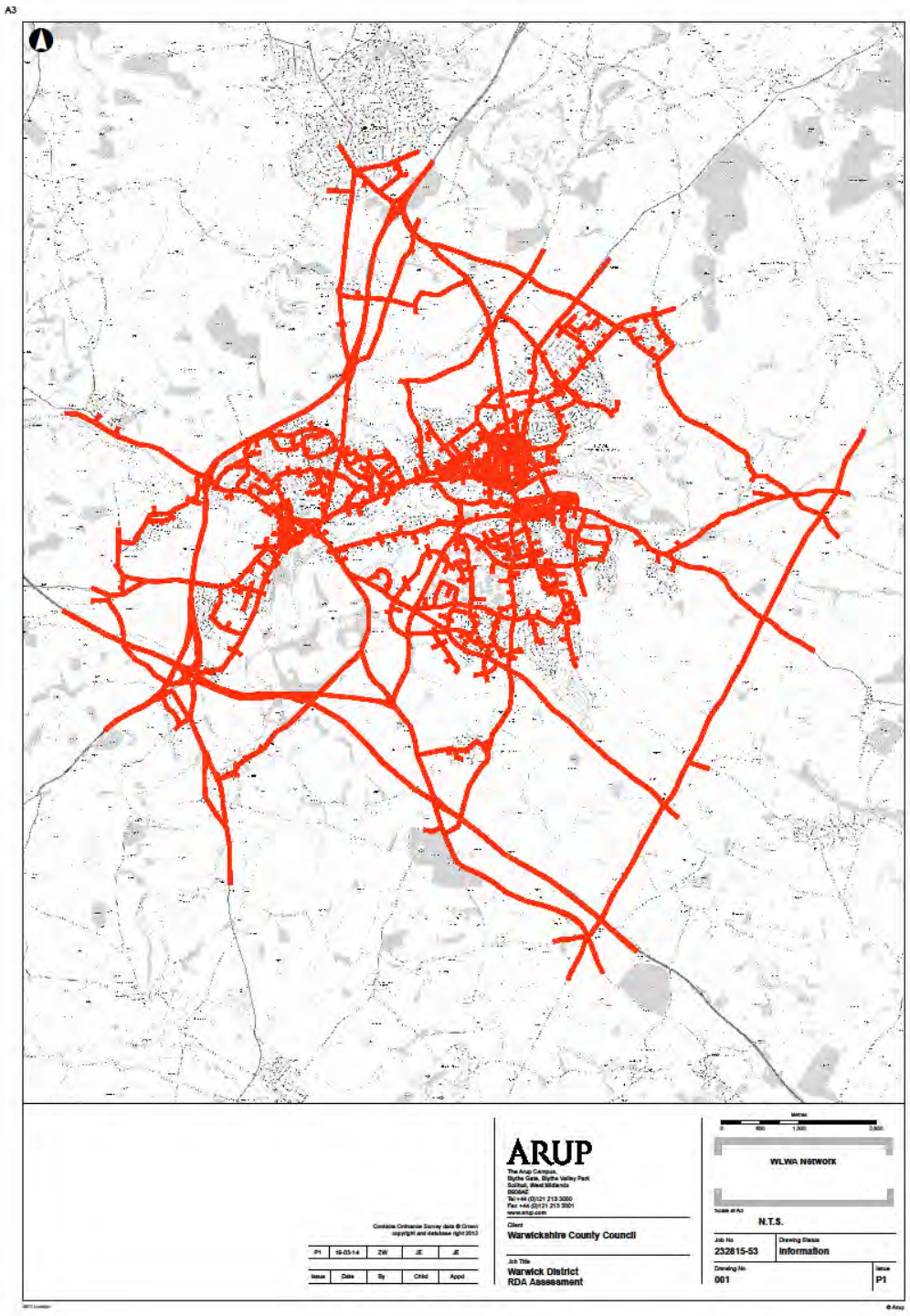
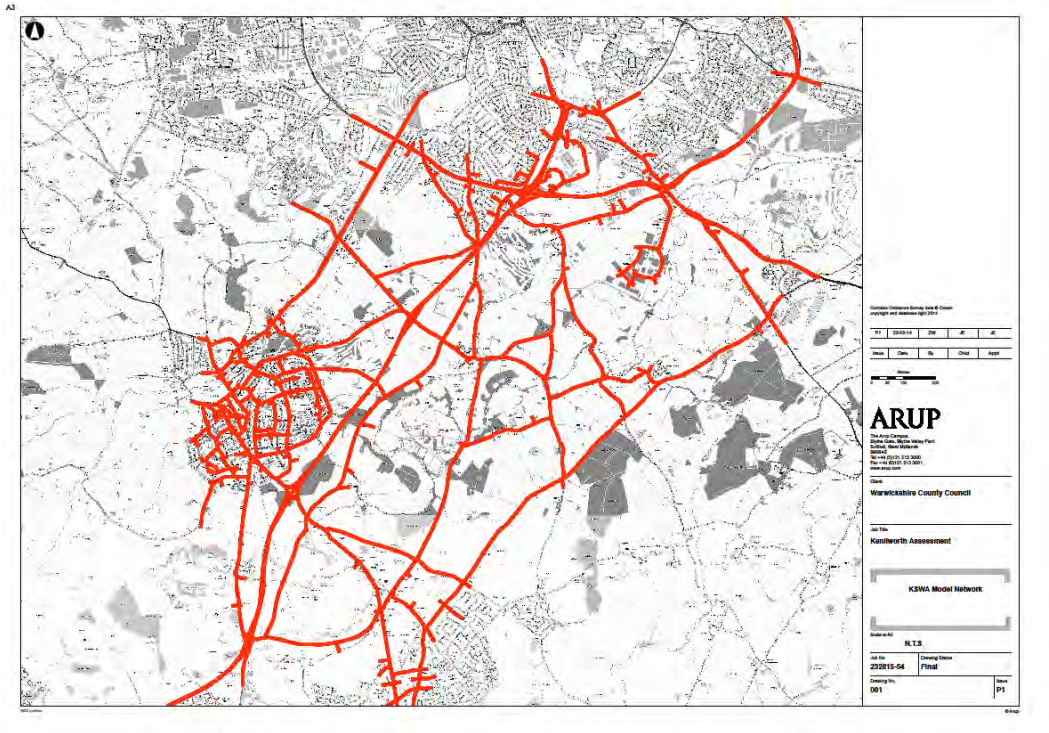


Figure 2 - Kenilworth and Stoneleigh Model Coverage



2.5 Report Structure

The remainder of this report is set out as follows:

- **Section 3** – Outlines the development of the respective model scenarios
- **Section 4** – Presents an overview of the mitigation assumptions and amendments.
- **Section 5** – Describes the measures used to inform the assessment and analysis of impacts.
- **Section 6** – Presents the outcome of the testing completed within the WLWA model.
- **Section 7** – Documents the impacts within the KSWA model identified during the course of the assessment.
- **Section 8** – Outlines the Summary and Conclusions

3 Scenario Development

3.1 Overview

Prior to the commencement of the assessment it is important to ascertain that the Reference Case that has been adopted to inform the assessment is appropriate and fit for purpose.

The term Reference Case refers to the scenario against which all other scenarios are compared. In assessing the implications of any development allocation strategy it is important to ensure all variables are kept to a minimum, thus the Reference Case is used to identify the likely network conditions prior to the application of any of the core strategy assumptions.

In this case the differences between scenarios should relate specifically to the development strategy (i.e. growth & mitigation thereof), other considerations, such as committed developments and network interventions, should be consistent throughout the assessment.

3.2 Core Strategy Plan Period – 2028 to 2029 Comparisons

WDC advised that the testing should consider the implications of the plan period extending beyond 2028 and into 2029. Currently, the majority of forecast models and redistribution calculations have been based on growth factors which have been derived from the TEMPRO database.

TEMPRO stands for The National Trip End Model (NTEM) forecasts and the TEMPro (Trip End Model Presentation Program) software are used for transport planning purposes. The forecasts include population, employment, households by car ownership, trip ends and simple traffic growth factors based on data from the National Transport Model (NTM).

The Warwick District TEMPRO factor for the 2011 to 2028 period is 10.2 % whilst the factor for the 2011 to 2029 period is 10.6%. This indicates that the TEMPRO predictions vary by less than 0.5% across the period. Therefore it was not considered necessary to reforecast the existing 2028 Reference Case to 2029 levels at this stage. It is unlikely that a variation of less than 5% in the overall growth forecasts would impact upon the results that are being presented as the majority of growth is related to the CS sites that are included in addition to the reference case demands rather than any additional forecasting of background trips.

As such the modelling has been assessed with the original 2028 Forecast demands included within the assessment. Should the plan period deviate by more than 3 or 4 years it may be necessary to update the forecasting processes but, until that time, it is reasonable to conclude that the incremental growth in demand between 2028 and 2029 is unlikely to affect the outcome of the assessment.

3.3 WLWA 2028 Reference Case

WCC have already developed a forecast PARAMICS model for the Warwick and Leamington area which was considered to be reflective of likely 2028 conditions. This model was adopted during the previous Phase 3 STA work and it was not

considered necessary to amend this model for the purposes of this assessment. Since the assumption is that all additional growth that is likely to be delivered within the area between 2011 and the end of the plan period, which currently stands at 2029, is associated with the Core Strategy sites, then it was not considered necessary to make any further amendments to the model at this stage. Full details on the assumptions contained within the 2028 Reference Case are available within the accompanying model forecast report[3].

3.4 KSWA 2028 Reference Case

An update to the KSWA model was required to ensure the 2028 Reference case model fit for purpose.

The update to the Reference Case required the following steps to be undertaken:

1) The existing 2021 KSWA Reference Case which was derived for the purposes of assessing the proposed impacts of the C&W Gateway development was interrogated to determine appropriate assumptions for committed developments within the area of south Coventry.

2) Development specific model scenarios were provided by WCC, inclusive of the relevant development specific assumptions, for interrogation and, where possible, extraction of key development information for use within the assessment. This included the Kenilworth Station and Stoneleigh Business Park planning application models.

3) Demands were forecast based on NTEM/TEMPRO factors and then adjusted using the information collated during stages 1) and 2) to account for committed developments.

An overview of the update to the KSWA 2028 forecast model is provided within the following section:

3.5 2028 KSWA Forecasting Overview

KSWA Committed Developments

Following discussions with WCC it became apparent that the existing KSWA future year model needed to be updated to ensure it reflected known committed development assumptions as well as to ensure that it was representative of the 2028 end of plan year.

The committed developments and the methodology for inclusion within the revised KSWA forecast model are documented as follows:

Jaguar Land Rover Whitley

Expansion of the JLR Whitley site to include B1 (Office) uses and improved/new site accesses. These proposals were included within the model by identifying the increases in demand, associated with the zones that represent the site, within the

[3] MID2535 LMVR Final 001 120710, JMP Consultants, July 2010

existing 2011 KSWA Base model and the 2021 C&W Gateway Reference Case model. Specifically KSWA zones 252, 253, 254 and 290.

Warwick University

Expansion of the university site according to the Warwick University Masterplan, as with the JLR Whitley proposals, the demands associated with the Warwick University development were included within the model by identifying the increases in demand, associated with the zones that represent the site, within the existing 2011 KSWA Base model and the 2021 C&W Gateway Reference Case model. Specifically KSWA zone 224.

Ryton

Development of the former Peugeot factory at Ryton to include a mix of B2 (General Industrial) and B8 (Distribution) land uses. A new roundabout access point is planned on Oxford Road.

WCC provided trip generation figures associated specifically to the Ryton development so that the development could be included within the modelling based on the latest and most up to date assumptions. These trips rates where then distributed across the model network using the same distribution as was assigned to this development site within the original KSWA 2021 Reference Case as adopted during the C&W Gateway testing.

Stoneleigh Park

Development proposals according to the Stoneleigh Park Masterplan, to include 11,590m2 of B1 (Office) space, retail, visitor centres, hotel extensions, National Equine Centre and some on site residential uses. The development includes of a new main entrance roundabout on the B4113 and a new entrance for traffic leaving the A46 on the B4115, south of Stoneleigh Road.

WCC provided the final planning application model pertaining to this particular development. Because of this it was possible to include the trip assumptions relating to this particular site by extracting the O-D matrix directly out of the Stoneleigh Park planning application model and reassigning it within the updated 2028 KSWA model network.

Kenilworth Station

The new station will include a ticket office, a 90 space car park and cycle parking. The Station will be served by a new local train service between Leamington Spa and Coventry which has been developed by the County Council in partnership with train operator London Midland who will also manage the new station. The new station is forecast to attract 446 return passenger journeys per day of which 58% would be ‘new to rail’.

WCC provided the final planning application model pertaining to this particular development. Because of this it was possible to include the trip assumptions relating to this particular site by extracting the O-D matrix directly out of the Kenilworth Station planning application model and reassigning it within the updated 2028 KSWA model network.

KSWA Committed Development Demands

Based on the outcome of this first stage of data extraction the following demand totals were identified as representative of the committed developments during the respective AM (07:00 to 10:00) and PM (16:00 to 19:00) periods:

Table 1 - 2028 KSWA Committed Development Totals

	AM	PM
Demand (veh.)	6705	5787

KSWA Forecasting Overview

Once the appropriate committed development demands had been identified, the next stage was to forecast the KSWA model based on 2012 to 2028 Factors and to make adjustments to account for the committed developments.

The approach adopted to inform the forecasting was consistent with the approach to forecasting all other WCC PARAMICS models. A summary of this process is provided as follows:

- Each Zone within the KSWA model was categorised as being either internal or external (i.e. a cordon or loading zone).
- Each zone was then assigned a relative TEMPRO factor based on its location within the model area.
- Each of the external zones was also assigned suitable NTEM factors based on the road type, flow and understanding of the local area. In some cases, although the zone may lie on the edge of the model network it may still be assumed to be an internal zone, and so factored by TEMPRO only, on the basis that it is unlikely to generate any strategic level trips.
- Trips between external zones were factored by the external NTEM factors.
- Trips associated with internal zones were factored by the relative internal TEMPRO factors.

The NTEM table used to derive factors for the external growth is provided within **Appendix A** of this report. In line with current guidance, the TEMPRO factors adopted in this process have been summarised within the following **Table 2**:

Table 2 - 2012 to 2028 TEMPRO Factors

Level	Name	AM		PM	
		Origin	Destination	Origin	Destination
County	Warwickshire	1.0691	1.1165	1.1136	1.0844
Authority	Warwick	1.0808	1.1055	1.1012	1.085
44UF0	rural (Warwick)	1.0902	1.108	1.1062	1.0947
44UF4	Kenilworth	1.0784	1.1063	1.1008	1.0844
Authority	Coventry	1.2012	1.1309	1.1473	1.1911

The resultant growth levels predicted following the application of the TEMPRO factors have been identified for all of the model demands. A comparison of the internal growth levels against the growth levels predicted as a result of the

application of the aforementioned committed development demand levels has then also been undertaken. Any adjustments to the TEMPRO growth levels undertaken in response to the presence of the committed developments have been restricted to the internal demands. Growth in the strategic or 'through trips' as well as growth in HGV movements has remained unconstrained.

A summary of the original 2012 Base model demands and the resultant 2028 Reference Case Demands is provided within the following **Table 3:**

Table 3 - 2012 to 2028 KSWA Forecast Demands

2012 Demands Levels		**AM**	**PM**
M1	Background	73394	78532
M2	HGV	4270	3345
Total		**77664**	**81877**
2028 Reference Case Demand Levels		**AM**	**PM**
M1	Background	73394	78532
M2	HGV	5143	4029
M3	Committed	5077	4471
M4	Growth	3693	4619
Total		**87308**	**91652**
Growth		12.42%	11.94%

The previous table demonstrates that the levels of growth contained within the 2028 Reference Case network are around 12% higher than the levels contained within the 2012 Base model.

3.6 KSWA Network Interventions

In addition to the allocation of the Committed Development demands it was also necessary to include a number of committed network interventions. In some cases these interventions were included as part of the committed development schedule whilst in other cases the amendments were made to reflect known or aspirational network schemes that are anticipated to be delivered through finance secured by means other than Core Strategy developments. The schemes incorporated within all KSWA model scenarios are therefore outlined as follows:

- A45/Leamington Road - Optimisation of the junction arrangement.
- A46/Brandon Road Junction – signal optimisation
- A46/Stoneleigh Road – Signalisation
- Kenilworth Road/Stoneleigh Road – amended in response to pinch point scheme proposals.

3.7 KSWA - Coventry & Warwickshire Gateway

The KSWA network has not, at this stage, been amended to reflect the proposals for the Coventry and Warwickshire Gateway. The testing for the Coventry and Warwickshire Gateway did originally include the proposals and sites as identified within the Phase 2 STA Assessment. Through the course of the assessment relating to that work there were no additional impacts identified through the C&W

Gateway testing that were likely to result in a revision to the schemes identified during the STA itself.

The analysis that has been completed to date is therefore considered sufficiently robust, given the overall strategic nature of all of the testing being undertaken thus far, to prevent the need for further consideration of the C&W Gateway at this stage.

Any detailed assessment pertaining to the delivery of one or more of the Core Strategy sites, which is likely to be undertaken as part of a broader environmental impact assessment, will potentially need to consider this issue in more detail but, for the time being, it is considered reasonable to conclude that the C&W Gateway development will be unlikely to impact on the network interventions proposed to accommodate the Core Strategy Allocations.

3.8 Core Strategy Scenario Development

Core Strategy development site assumptions were provided to Arup by WDC/WCC. Whereas previous stages of the assessment have focussed on the assignment of demands associated with the allocated sites into the WLWA model network this stage of assessment has considered the demand levels within both the KSWA and WLWA model areas.

The core site assumptions pertaining to the delivery of housing, the site location and the primary model environment for the impact assessment are summarised within the following **Table 4** and **Table 5** for the KSWA and WLWA sites respectively.

Of the sites listed previously WDC/WCC advised that two of these sites would also be expected to deliver 8Ha of employment. The assumptions pertaining to the employment delivery were incorporated within the model as follows:

- 8Ha of Employment (100% B1) use has been assumed to be delivered within the Thickthorn Site (WLWA01/KSWA06) – WDC have advised that some B" may be delivered in this area but B1 trip rates were adopted as they are considered robust an a shift from this assumption would reduce the trip generation values and so negate the need for further modelling on account of the original assumptions being more robust.
- 8 Ha of Employment use (50% B1 & 50% B2) has been assumed for delivery at the Lower Heathcote Farm Site (WLWA22)

Table 4 - KSWA CS Housing Sites

Site Name	Ref	Model Zone	Housing	Distribution Area
Kenilworth School	KSWA1	110	220	Kenilworth
Kenilworth 6th Form	KSWA2	111	110	Kenilworth
Crackley Triangle	KSWA3	31	75	Kenilworth
Baginton	KSWA4	277	35	Kenilworth
Burton Green	KSWA5	224	75	Kenilworth
Thickthorn	KSWA6	23	700	Leamington

Table 5 - WLWA Housing Sites

Site Name	Ref	Model Zone	Housing	Distribution Area
Thickthorn	WLWA01	900	700	Leamington
St Fremunds Way	WLWA02	910	209	Leamington
North of Harbury Lane	WLWA03	105	220	Leamington
Filedgate Lane/Golf Lane	WLWA04	909	94	Leamington
Earl Rivers Ave Care Home	WLWA05	105	118	Leamington
Woodside Farm	WLWA06	901	250	Leamington
Station Approach	WLWA07	64	220	Leamington
Leamington Fire Station	WLWA08	41	60	Leamington
Former Ridgeway School	WLWA09	362	50	Warwick
Riverside House	WLWA10	326	130	Leamington
Theatre Street Warwick	WLWA12	132	40	Warwick
Court Street Area	WLWA13	308	50	Leamington
Soans Site, Sydenham Drive	WLWA14	78	140	Leamington
Opus 40 Site	WLWA15	160	107	Warwick
Former Sewage Works, South of Harbury Lane	WLWA16	907	235	Leamington
East of Whitnash (excl St. Frem Way)	WLWA17	910	300	Warwick
Red House Farm	WLWA18	76	250	Leamington
Europa Way (Myton Garden Suburb)**	WLWA19	902	1060	Leamington
Myton School (adj to Myton Road)	WLWA20	356	300	Leamington
South of Gallows Hill	WLWA21	903	0	Leamington
Lower Heathcote Farm	WLWA22	904	720	Leamington
Grove Farm	WLWA23	104	525	Leamington
Featherstone Court	WLWA24	83	45	Leamington
Bishops Tachbrook	WLWA25	206	150	Combined
Cubbington	WLWA26	532	75	Leamington
Hampton Magna	WLWA27	209	100	Warwick
Kingswood	WLWA28	515	62	Warwick
Radford Semele	WLWA29	533	100	Leamington
Barford	WLWA30	208	80	Warwick
Hatton Park	WLWA31	520	90	Warwick
Leek Wootton	WLWA32	201	80	Warwick
Other rural sites	WLWA33	534	90	Combined
Consolidated Employment areas and canalside regeneration	n/a	165	150	Warwick
		146	150	Warwick
Small Urban SHLAA Sites	n/a	78	150	Leamington
		75	150	Leamington
		327	150	Warwick

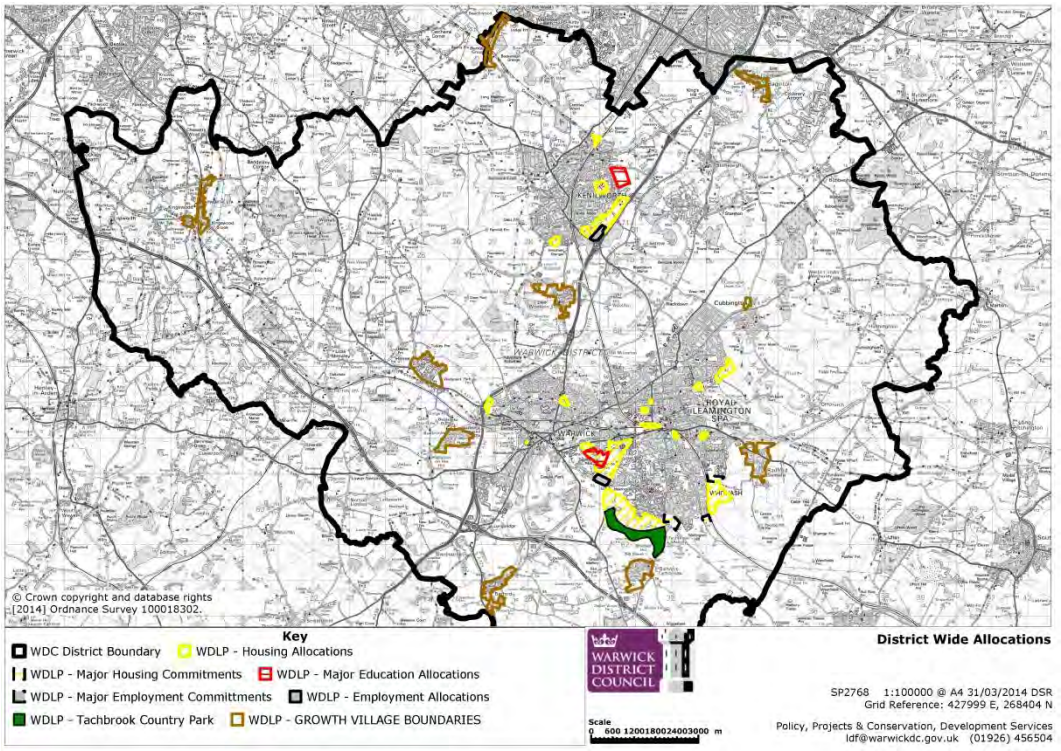
As has been mentioned previously, earlier phases of the STA work sought to allocate and test the impacts of all of the sites within the WLWA test environment. This stage of the assessment has been refined so as to distinguish between sites allocated within the WLWA study area and sites allocated within the KSWA study area.

In all but one case this has led to the allocation of each of the sites outlined above in either the WLWA or KSWA models. The Thickthorn site has been allocated within both models due to the magnitude of the site.

These sites are included within the relevant models in addition to the committed developments that are already included. Furthermore, the forecasting process which underpins each of the Reference Case models has been subject to unconstrained external growth forecasts, the application of which is assumed to be sufficient to account for the delivery of housing levels not identified within the previous **Table 4** and **Table 5** Further information regarding these principles is provided within the TEMPRO forecasting section of this report (**Section 3.16.1**)

An overview of the site locations is provided within the following **Figure 3**:

Figure 3 - RDA Site Locations



3.9 Core Strategy Demand Forecasting

The following outlines the trip forecasting process associated with the RDA sites for inclusion within the modelling.

3.9.1 Residential Trip Generation

Trip generation for each of the sites has been derived for the peak hours based on strategic residential trip rates provided by Warwickshire County Council and

factored to encompass shoulder hours as per the methodology applied during the first phase of the PARAMICS STA modelling. This is based on the application of WCC's standard residential trip rates. The WCC standard, peak hour residential trip rate, per dwelling, is summarised within the following **Table 6:**

Table 6 - WCC Standard Residential Trip Rate (per dwelling)

	In	Out	Total
0800 to 0900	0.12	0.48	0.6
1700 to 1800	0.48	0.12	0.6

These trip rates have then been factored to provide trip generation values for the shoulder hours of both AM and PM model periods. The methodology adopted is in line with that which was adopted previously. The following **Table 7** provides the factors used to extrapolate peak hour trip rates to encompass the entire AM (07:00 to 10:00) and PM (16:00 to 19:00) time periods:

Table 7 - Residential Trip Profiling Factors

	0700 to 0800	0800 to 0900	0900 to 1000	1600 to 1700	1700 to 1800	1800 to 1900
In	65.10%	100.00%	101.90%	72.60%	100.00%	76.00%
Out	68.50%	100.00%	46.10%	96.40%	100.00%	97.90%
Average	66.80%	100.00%	74.00%	84.50%	100.00%	87.00%

The resultant, hourly trips rates, adopted to produce the development specific matrices are summarised within the following **Table 8**:

Table 8 - Residential Trip Rates

STA Trip Generation Rates	In	Out	Total
0700 to 0800	0.078	0.33	0.42
0800 to 0900	0.12	0.48	0.6
0900 to 1000	0.12	0.22	0.34
1600 to 1700	0.35	0.11	0.46
1700 to 1800	0.48	0.12	0.6
1800 to 1900	0.36	0.11	0.48

3.9.2 Employment Trip Generation

During previous iterations of the STA work, assumptions have been made regarding the likely composition of employment delivered through the allocation strategy. WDC/WCC have advised that employment is assumed to be delivered within two of the allocated sites as follows:

- 8Ha of Employment (100% B1) use has been assumed to be delivered within the Thickthorn Site (WLWA01/KSWA06)
- 8 Ha of Employment use (50% B1 & 50% B2) has been assumed for delivery at the Lower Heathcote Farm Site (WLWA22)

The above figures are gross floor area GFA which were converted into net coverage by the application of a 40% coverage factor. This is in line with previous stages of the STA. The historic STA employment trip rates, by classification, are presented within the following **Table 9**:

Table 9 - Employment Trip Rates

	0800 to 0900		1700 to 1800	
	In	Out	In	Out
B1:	1.3	0.24	0.18	1.11
B2:	0.36	0.14	0.07	0.27
B8:	0.11	0.07	0.06	0.11

As with the residential trip generation, these peak hour trip rates have been profiled to encompass the shoulder hours within the AM and PM periods. The factors used to profile the trips rates across the period are consistent with those which have been used throughout the STA work and are summarised as follows:

Table 10 - Employment Trip Profiling Factors

	0700 to 0800	0800 to 0900	0900 to 1000	1600 to 1700	1700 to 1800	1800 to 1900
In	55.60%	100.00%	58.00%	120.30%	100.00%	51.10%
Out	64.70%	100.00%	88.20%	87.30%	100.00%	35.60%
Average	60.20%	100.00%	73.10%	103.80%	100.00%	43.40%

The peak hour trip rates have been factored by the above shoulder hour factors, as well as the relative proportions of each classification, to produce a single set of universal employment trip rates that have been assigned to all employment sites assumed within the allocation. These trip rates are summarised within the following **Table 11** and **Table 12** for the B1 and B2 employment uses.

Table 11 – B1 Employment Trip Rates (0.01 Ha)

	In	Out
0700 to 0800	0.29	0.06
0800 to 0900	0.52	0.10
0900 to 1000	0.30	0.08
1600 to 1700	0.09	0.39
1700 to 1800	0.07	0.44
1800 to 1900	0.04	0.16

Table 12 – B2 Employment Trip Rates (0.01 Ha)

	In	Out
0700 to 0800	0.08	0.04
0800 to 0900	0.14	0.06
0900 to 1000	0.08	0.05
1600 to 1700	0.03	0.09
1700 to 1800	0.03	0.11
1800 to 1900	0.01	0.04

Since there is no allocation of B8 employment use identified within the latest set of sites there has not been any further adjustments to the B8 employment trip rates.

3.10 Trip Discounting

In line with the earlier assessments, adjustments have been made to trip generation to account for internalisation and mode shift.

A modal shift allowance was made for all sites of 15% whilst sites which contained an element of Residential and Employment were subject to a further 7.5% reduction to allow for internalisation.

The resultant trip generation levels, post application of the internalisation and modal shift factors were assigned to each of the developments as outlined within the following **Table 13**.

Table 13 - Net Trip Generation

Site Name	Site Ref	Adj.		AM		PM	
		Int.	MS	Arrs	Dep	Arrs	Dep
St Fremunds Way	WLWA02	×	✓	21	85	85	21
North of Harbury Lane	WLWA03	×	✓	22	90	90	22
Filedgate Lane/Golf Lane	WLWA04	×	✓	10	38	38	10
Earl Rivers Ave Care Home	WLWA05	×	✓	12	48	48	12
Woodside Farm	WLWA06	×	✓	26	102	102	26
Station Approach	WLWA07	×	✓	22	90	90	22
Leamington Fire Station	WLWA08	×	✓	6	24	24	6
Former Ridgeway School	WLWA09	×	✓	5	20	20	5
Riverside House	WLWA10	×	✓	13	53	53	13
Theatre Street Warwick	WLWA12	×	✓	4	16	16	4
Court Street Area	WLWA13	×	✓	5	20	20	5
Soans Site, Sydenham Drive	WLWA14	×	✓	14	57	57	14
Opus 40 Site	WLWA15	×	✓	11	44	44	11
Former Sewage Works, South of Harbury Lane	WLWA16	×	✓	24	96	96	24
East of Whitnash (excl St. Frem Way)	WLWA17	×	✓	31	122	122	31
Red House Farm	WLWA18	×	✓	26	102	102	26
Thickthorn	KSWA6	✓	✓	393	325	309	345
Kenilworth School	KSWA1	×	✓	22	90	90	22
Kenilworth 6th Form	KSWA2	×	✓	11	45	45	11
Crackley Triangle	KSWA3	×	✓	8	31	31	8
Europa Way (Myton Garden Suburb)**	WLWA19	×	✓	108	432	432	108
Myton School (adj to Myton Road)	WLWA20	×	✓	31	122	122	31
Lower Heathcote Farm	WLWA22	✓	✓	277	320	303	242
Grove Farm	WLWA23	×	✓	54	214	214	54

Featherstone Court	WLWA24	×	✓	5	18	18	5
Bishops Tachbrook	WLWA25	×	✓	15	61	61	15
Cubbington	WLWA26	×	✓	8	31	31	8
Hampton Magna	WLWA27	×	✓	10	41	41	10
Kingswood	WLWA28	×	✓	6	25	25	6
Radford Semele	WLWA29	×	✓	10	41	41	10
Barford	WLWA30	×	✓	8	33	33	8
Baginton	KSWA4	×	✓	4	14	14	4
Burton Green	KSWA5	×	✓	8	31	31	8
Hatton Park	WLWA31	×	✓	9	37	37	9
Leek Wootton	WLWA32	×	✓	8	33	33	8
Other rural sites	WLWA33	×	✓	9	37	37	9
Consolidated Employment areas and canalside regeneration	n/a	×	✓	31	31	122	31
Small Urban SHLAA Sites	n/a	×	✓	31	31	122	31
Total				4443		4512	

During previous stages of the STA the majority of the demands outlined above would have been allocated within the WLWA model network either via internal zones or through the assignment of the trip generation to the nearest WLWA external zone.

However, for this assessment it was possible to disaggregate the allocation across both the WLWA and KSWA model networks.

Initially this resulted in the following hourly, allocated demand levels, being identified for assignment within the WLWA and KSWA model networks:

Table 14 - Allocated Demand Levels

Model	0700 to 0800	0800 to 0900	0900 to 1000	1600 to 1700	1700 to 1800	1800 to 1900
WLWA	2714	4099	2372	3155	3987	2980
KSWA	622	980	582	756	917	599

Assignment of the demands as outlined within the previous table across both the WLWA and KSWA provided the starting point for the assessment of the impacts of the proposed CS demand levels.

3.11 WLWA/KSWA CS Interaction

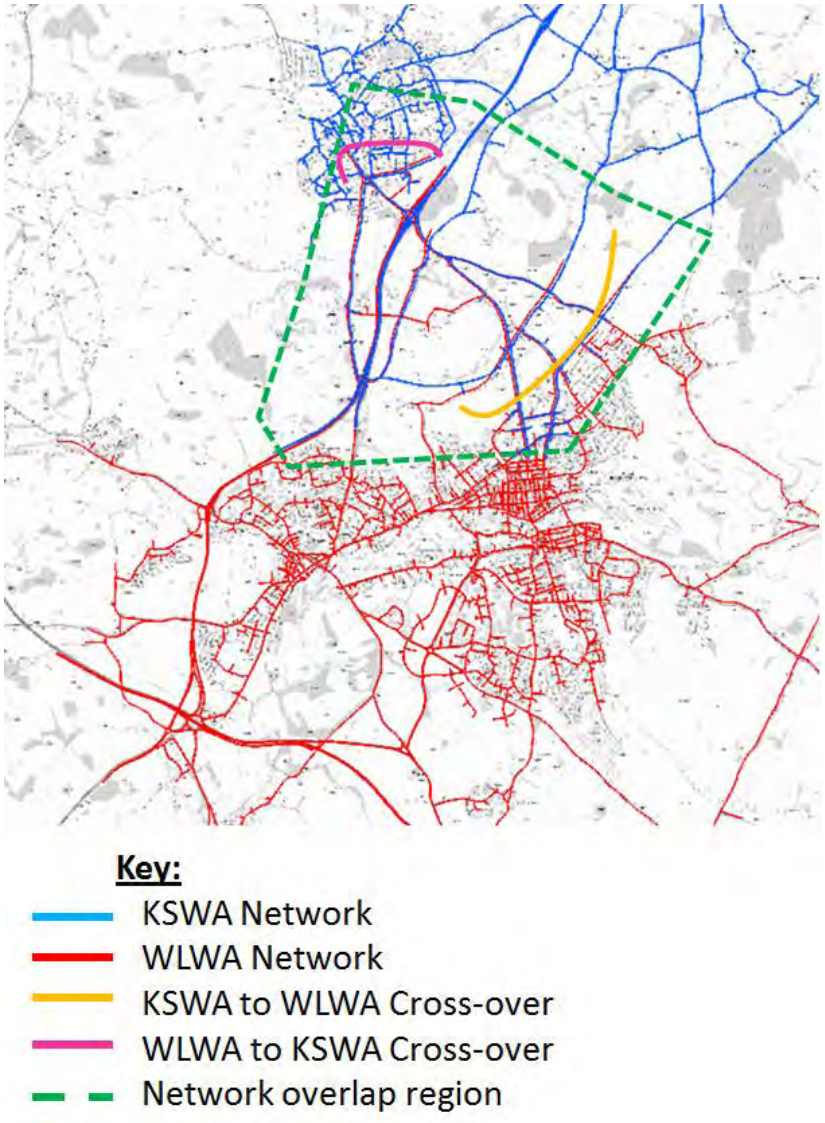
However, since most sites have been allocated to either one or other of the wide area PARAMICS models the potential interaction between trips created in one study area to affect the network performance within another study area is not accounted for by the aforementioned methodology.

In order that a value could be determined for the trips traversing the two study areas a further assessment of the CS matrices was undertaken. This assessment was intended to review the number of trips entering and exiting the peripheral

zones within both WLWA and KSWA model networks. These trip totals were then converted from exit counts for one model into entry counts in the other model and vice versa. Whilst the underlying assumptions used to calculate the level of traversing trips is relatively simplistic it was felt that this was the most appropriate methodology to adopt in the short term as the level of detail concerning the site allocations is not yet fully defined.

There is a significant level of overlap between the WLWA and KSWA models as identified in Figure 4. The outer extent of the overlap between the two models was defined as the WLWA or KSWA cordon points. These areas are highlighted within **Figure 4**.

Figure 4 - WLWA & KSWA Model Cross-over



The routing and assignment of trips originating at the CS sites with a trip end assigned to either the WLWA or KSWA cross-over region, depending upon the CS site location, was calculated by tracing the trips between the relevant CS sites and the entry/exit points.

Once these totals were identified they were then reassigned to the origin/destination zones of the model in which they were assumed to enter. The

level of traversing trips identified as a result of this assessment is summarised within the following **Table 15**:

Table 15 – Traversing Demand Levels

Model	0700 to 0800	0800 to 0900	0900 to 1000	1600 to 1700	1700 to 1800	1800 to 1900
KSWA to WLWA	73	115	69	89	109	71
WLWA to KSWA	19	29	17	22	28	21

3.12 KSWA CS Demand Forecasting

Following the completion of the demand forecasting and identification of the traversing trips a further step was undertaken whereby all of the remaining general internal growth that had previously been assigned within the Reference Case network was removed, the purpose of this is to ensure that the internal growth assigned within the model network relates specifically to the CS sites which is consistent with the assumptions that underpin the WLWA forecasting process.

Table 16 - KSWA 2028 CS Model Demands

Demand Levels		AM	PM
M1	Background	73394	78532
M2	HGV	5143	4034
M3	Committed	5077	4469
M4	Growth	3693	4589
M5	LDF	2249	2344
Total		**89557**	**93967**
Growth		*15.31%*	*14.77%*

The previous table demonstrates that the levels of growth within the 2028 KSWA CS model demand levels are around 15% higher than the 2012 base levels.

Since these growth levels are below the regional 2012 to 2028 NTEM adjusted TEMPRO forecast levels for Warwickshire, which currently stand at **19.19%** and **19.92%** for the AM and PM period respectively, there was no need to apply the redistribution procedure identified during previous phases of the STA work, to these demands. As a result the demands were assigned to the KSWA model in line with those identified within **Table 16**.

3.13 WLWA CS Demand Forecasting

A summary of the WLWA model CS demand levels output as a result of the stages outlined within Section 3.8 and 3.9 of this report is provided within **Table 17.**

Table 17 – WLWA Initial 2028 CS Model Demands

	07 to 08	08 to 09	09 to 10	16 to 17	17 to 18	18 to 19
RDA Demands	2785	4212	2439	3243	4094	3050
2028 + RDA Demands	40669	44117	35454	46424	50912	42272
Internal Growth	20.1%			20.8%		

An assessment of the levels of growth predicted to occur as a result of the assignment of these demands revealed that internal growth levels for the 2011 to 2028 forecast period was in the region of **20.1%** and **20.8%** for the AM and PM period respectively.

The NTEM adjusted TEMPRO predictions for the same period currently stand at **19.19%** and **19.92%** for the AM and PM period respectively.

3.14 CS Redistribution and Peak Spreading

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. The approach to the adoption of this procedure is outlined as follows:

3.14.1 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 respective CS growth options.

The need to apply a capping procedure is further demonstrated by the fact that, during the initial modelling exercise, it was not possible to undertake an assessment of the impacts of each option within the PM model period on account of the inherent model instability. By applying a cap the impacts of model instability are minimised.

3.14.2 Redistribution Methodology

The application of the cap to the levels of growth within the model was based on NTEM Adjusted TEMPRO factor for Warwickshire County. The AM and PM NTEM adjusted factors currently stand at **19.19%** and **19.92%** respectively.

Due to the relatively fixed nature of Education and HGV trips across the network it was decided that these should be excluded from the calculations as the existing trips of this nature would be unlikely to redistribute in response to the inclusion of the allocated sites. Particularly as the CS site compositions provided by WDC focus on housing and employment rather than education and so those demands should not be considered within the calculations. It should be noted that HGV and education trip shave still be subject to forecasting through the development of the Reference Case model.

Furthermore, the original 2028 Reference Demands were interrogated for instances were internal growth was retained and this was removed. This is on the presumption that all growth that occurs in addition to committed developments is associated with the allocated sites. This approach is valid as analysis of the demands determined that the growth within the models, before redistribution, exceeded TEMPRO predictions and, therefore, the internal element of the growth could be removed to reduce the potential for double counting to occur.

The methodology for applying the capping procedure was as follows:

- Education and HGV trips were excluded from the capping calculations;
- External growth was allocated via the standard TEMPRO/NTEM factoring methodology.
- The level of demand within the 2011 model, less education and HGV, was calculated
- 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 RDA sites was calculated.
- If the level of demand assigned within the model as a result of the RDA sites was in excess of the 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 CS developments.
- The redistribution of trips in response to the inclusion of the RD developments was calculated by subtracting the growth levels forecast within the RDA matrices from the TEMPRO/NTEM predicted forecasts and the applying the aforementioned reduction proportionally across the background matrices. This was done by comparing the demand within the revised allocation 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 revised allocation sites.
- The reduction was calculated firstly by O-D (Origin – Destination) 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 RDA sites.

Redistributing trips means that background trips are diverted based on the level of interaction between existing zones and sites within the RDA. This means that zones which had a high level of trip interaction with RDA zones were likely to experience greater reductions in the background traffic generation totals than those with limited or no interaction with RDA zones. This limits the potential for reductions in background trips to materialise in areas where there is little or no interaction with RDA sites.

The impact of the redistribution procedure is outlined within the **Table 18.**

Table 18- TEMPRO Capping Overview

	07 to 08	08 to 09	09 to 10	16 to 17	17 to 18	18 to 19
Base Model Demand (excluding HGV & Education)	32174	38778	29127	38790	44134	32609
Periodic	100078			115532		
2028 Reference Demands (Less HGV& Education & External Growth)	38731	39905	33468	43222	46833	39306
Periodic	112104			129360		
2009 to 2028 Ref	***12.02%***			***11.97%***		
RDA Demands:	2785	4212	2439	3243	4094	3050
2028 + RDA	40669	44117	35454	46424	50912	42272
Periodic	120240			139609		
2009 to 2028 + RDA Original	***20.15%***			***20.84%***		
TEMPRO NTEM Target	119285	19.19%		138549	19.92%	
Reduction	-955			-1059		

Proportion of CD Demand	-282	-426	-247	-331	-417	-311
RDA Revised Demand Totals	40387	43691	35207	46093	50495	41961
Periodic	119285			138549		
2009 to 2028 + RDA Adjusted	***19.19%***			***19.92%***		
Total Demand (Including HGV & Growth)	42707	53135	38590	49595	52540	43722
Periodic	134431			145856		
Net Growth	**17.97%**			**19.39%**		

3.15 Peak Spreading Methodology

As with earlier stages of the STA, peak spreading assumptions were applied after the redistribution since redistribution deals with demand across the entire period whilst peak spreading deals with hourly changes.

Once the revised CS demand totals had been derived peak spreading assumptions were applied. Since peak spreading assumptions had already been applied to the 2028 Reference Demands[4] then the application of further peak spreading assumptions has been applied only to the growth that could be considered as occurring in addition to the original 2028 Reference Case.

The peak spreading assumptions applied were initially consistent with those outlined within the 2028 Future Year model development report and are summarised, for the AM and PM model periods, within **Table 19** and **Table 20**.

Table 19 – AM Peak Spreading Proportions

0700 to 0800	0800 to 0900	0900 to 1000
68%	6%	26%

Table 20 – PM Peak Spreading Proportions

1600 to 1700	1700 to 1800	1800 to 1900
54%	26%	20%

Peak spreading evidence and the derived trend data was based on observed Automatic Traffic Count (ATC) data collected annually at WCC cordon monitoring locations around the modelled area. After application of the above proportions it was apparent that there was a substantial shift in demand within the PM model period. The shift occurred to such an extent that the 16:00 to 17:00 demand levels exceeded those within the 17:00 to 18:00. Whilst there is potential for this situation to occur, the principle of peak spreading is such that vehicles are redistributed away from the most congested peak hour in response to congestion. As a result the PM peak spreading proportions were readjusted within the PM period to ensure that demand in the 1600 to 1700 hour did not substantially exceed the level of demand within the 17:00 to 18:00 peak hour.

Whilst testing without any application of peak spreading assumptions is not likely to yield acceptable results due to the general bias towards the peak hour, it is recommended that, once the final option for the allocation of growth is

[4] Warwick District Council Strategic Transport Assessment Modelling, - PARAMICS Testing and Results, JMP Consultants, 17 April 2012

determined, testing is undertaken both with and without the revised PM spreading assumptions attributed to the model demands.

In order that this principle could be achieved 30% of the 16:00 to 17:00 increase was redistributed, proportionally, back across the 17:00 to 18:00 and 18:00 to 19:00 hours. By redistributing 30% the goal of ensuring that demand within the 16:00 to 17:00 and 17:00 to 18:00 hours was retained at comparable levels.

The resultant peak spreading proportions assigned to the PM period are summarised within the following **Table 21**:

Table 21 – Revised PM Peak Spreading Proportions

1600 to 1700	1700 to 1800	1800 to 1900
24%	43%	33%

The peak spreading proportions were applied to only those levels of growth that occur in excess of the levels contained within the 2028 Reference Case since the Reference Case had already been subject to some element of peak spreading.

The specific differences between the two scenarios relates primarily to the inclusion of the demand associated with the RDA strategy. If, however, peak spreading assumptions were applied only to those demands then it would result in a disproportionate shift in CS demand away from the traditional peak hour.

As a result, a more refined methodology was adopted whereby the assumption was that only 50% of the total traffic growth would be subjected to peak spreading. Furthermore 50% of the growth that was subjected to peak spreading would be associated with the RDA demands whilst the remaining 50% would be associated with the background matrices. This approach is reasonable given that Committed Developments and Forecast growth have already been subjected to peak spreading during the development of the Reference Case whilst the Education and HGV trips are unlikely to be affected by peak spreading.

An overview of changes resulting from the application of the peak spreading procedure to is illustrated within the following **Table 22**.

Table 22- Peak Spreading Overview

	07 to 08	08 to 09	09 to 10	16 to 17	17 to 18	18 to 19
2028 Reference Demands	41050	49349	36850	46723	48878	41066
2028 RDA Demands	42707	53135	38590	49595	52540	43722
Growth from 2028 Ref	1656	3786	1739	2871	3662	2656
Periodic Growth	7181			9189		
50% Peak Spread Total	3591			4595		
Peak Spreading Proportions	68%	6%	26%	24%	43%	33%
LDF Adjustments	1221	108	467	551	987	759
Background Adjustments	1299	-1795	497	967	-2297	1331
Assigned Hourly Demands	44645	50662	39078	50391	50328	45119
Difference	1939	-2473	488	796	-2212	1397

3.16 WLWA RDA Demand Summary

The resultant Hourly demands assigned within the two key modelling scenarios are summarised within the following **Table 23**:

Table 23 - Scenario Demand Summary

	07 to 08	08 to 09	09 to 10	16 to 17	17 to 18	18 to 19
2028 Reference Demands	41050	49349	36850	46723	48878	41066
2028 RDA Demands	44645	50662	39078	50391	50328	45119
Growth	4.9%			5.9%		

3.16.1 TEMPRO Factors

The demands outlined within the previous **Table 23** have been derived through interrogation of the TEMPRO database and have been informed partially by a review of the planning assumptions therein.

When reviewing the TEMPRO[5] database factors the database predicts growth in housing within Warwick, between 2011 and 2028 of almost 5200 houses. The average growth rate for this period is around 10.2%.

The data provided by WDC and WCC indicated housing projections of just over 12,800 households including 2011 to 2013 completions, existing permissions and windfalls allowances.

The NTEM adjusted TEMPRO factor for the region stands at 19.2 and 19.9% for the AM and PM periods respectively which represents almost double the housing projections of the current authority levels. Since the allocations which are the focus of this testing had not been accounted for during the previous update to the TEMPRO database it is unrealistic to expect them to have all been accounted for.

Comparisons between the local and NTEM adjusted factors revealed that by adjusting the housing numbers by the same differential as the growth factors, Warwick Authority to NTEWM Adjusted Warwickshire, the NTEM adjusted factors would account for around 10,000 houses.

There are 2200 households that have been completed between the 2011 to 2013 period or were committed during the previous update to the 2028 WLWA model[6].

Therefore it was considered that the housing projections represented by the adoption of these factors are representative of the total houses currently being considered for allocation within the study area.

[5] Version 6.2 dataset 62 April 2010
[6] MID2535 LMVR Final 001 120710, JMP Consultants, July 2010

4 Mitigation Overview

4.1 Introduction

During each of the preceding stages of the Strategic Transport Assessment, a series of network interventions have been derived and tested alongside the various housing and employment land allocation strategies.

4.2 Outline Mitigation Schemes

During the previous phases of STA testing the mitigation packages were categorised into broad locations. These broad locations do not imply that the mitigation within each of the areas has to be implemented in entirety for benefits to be accrued but it should be considered that, where appropriate, the cumulative impact of implementing the mitigation within the areas outlined is likely to be substantial when compared to the benefits of implementing schemes in isolation.

The broad locations have been presented within **Figure 5** on the following page.

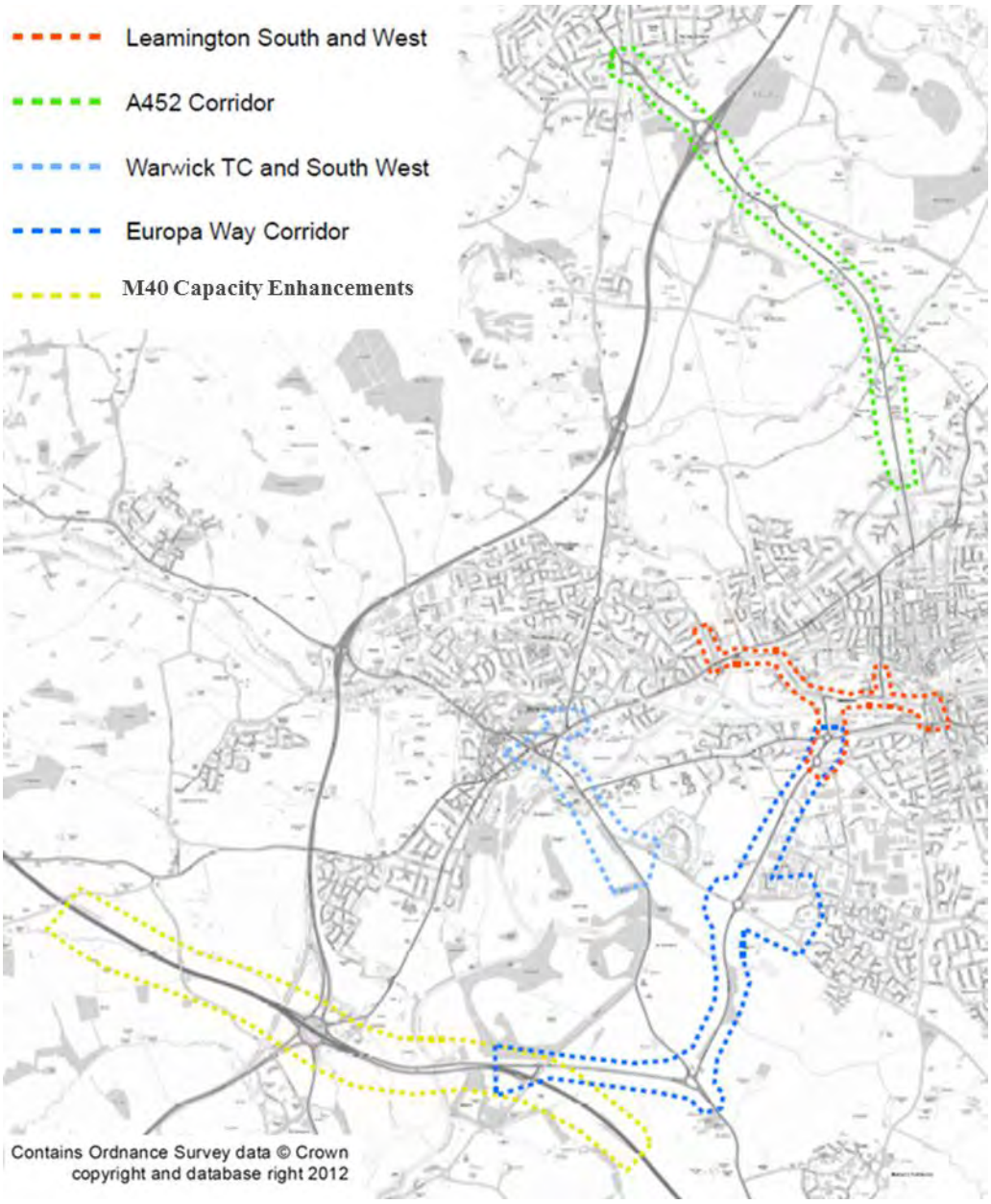
4.3 Network Review & Optimisation

As part of this fourth phase of the STA, the network interventions in some areas have been reviewed and, where possible, refined in response to the conditions that have been observed to occur as a result of the assignment of the RDA Demands within the model networks and the impacts thereof. In addition further amendments to the schemes have been made where concerns with regards feasibility or deliverability have arisen.

It should be acknowledged that the schemes proposed within the modelling have not been subject to any detailed design or safety review at this stage. Furthermore, it should not be assumed that the schemes recommended through this study are fixed and will be delivered in the form described within this report. Rather it is intended that the schemes proposed are outline schemes which may change through further optimisation and detailed design that will precede the final delivery.

The proposed mitigation schemes have been documented extensively within previous phases of the STA work, therefore the following section of this report is intended only to summarise new assumptions or substantial refinements to those proposed schemes. Throughout the modelling exercise signals times have been refined and optimised, in some cases through the use of signal plans. It is expected that specific requirements to optimise signalised junctions will be identified during the detailed planning phase associated with one or more of the proposed site allocations.

Figure 5 - Broad Mitigation Areas



4.4 Schemes

Following the assignment of the revised demands to the updated model network the mitigation measures were reviewed and, if appropriate, amended in response to either the changes in conditions or as an outcome of the initial feasibility review. A summary of the mitigation measures or changes thereto is provided as follows:

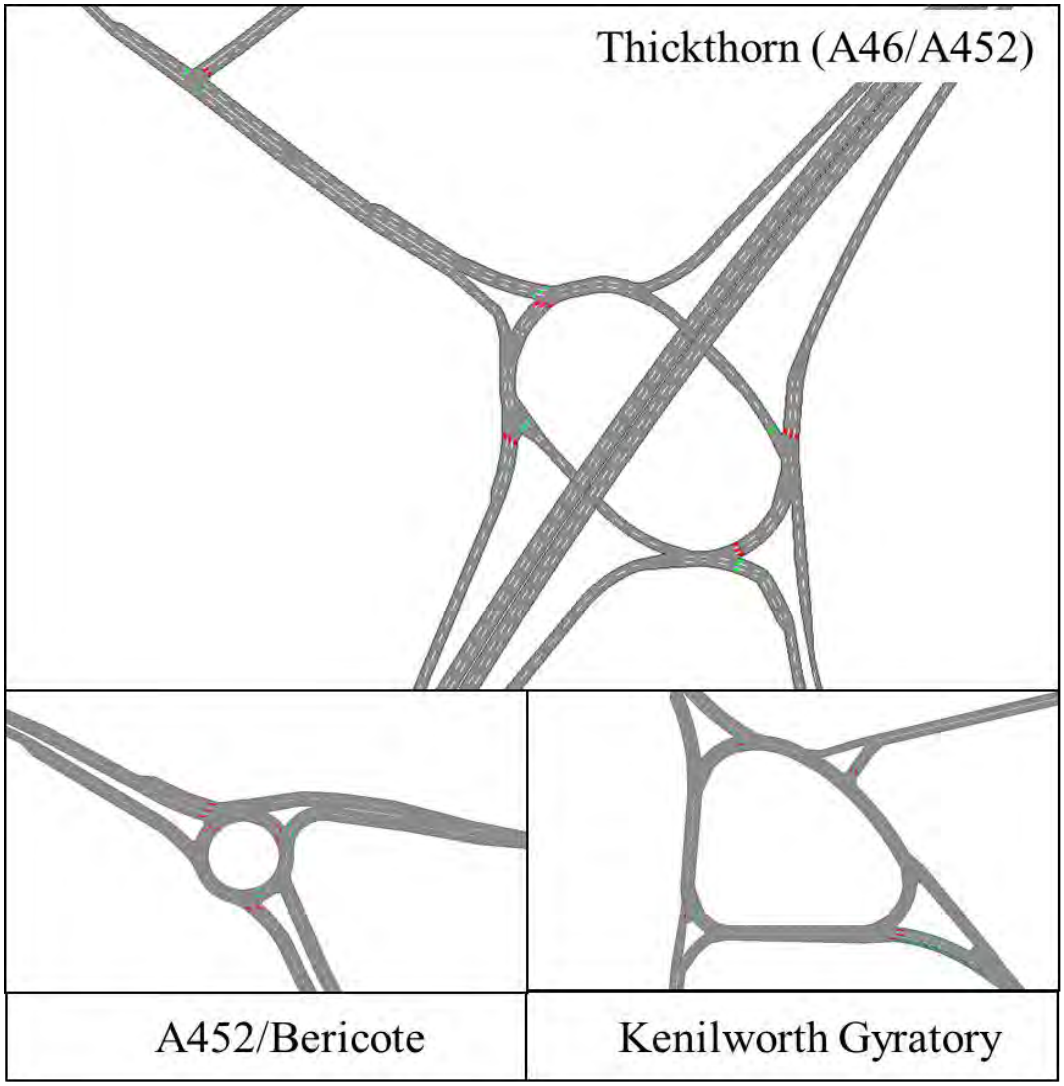
4.4.1 WLWA/KSWA Combined Mitigation

Previous phases of the STA have identified proposals at Thickthorn and the Kenilworth gyratory whilst further refinement of the proposals in this area have also identified a signalised roundabout scheme for the A452/Bericote Rd

roundabout which had previously been modelled as a signalised crossroads. At the same time a recommendation was also made by WCC that the proposed site access for the Thickthorn development should be removed from the A452/A46 junction and repositioned to the North-West of the junction.

A brief overview of these scheme proposals is provided as follows:

Figure 6 - Thickthorn, A452/Bericote & Kenilworth Gyratory Proposals



The schemes illustrated previously were included within both the WLWA and KSWA model networks.

In addition to the revisions to the schemes in and around the Thickthorn junction a series of additional scheme amendments where incorporated within the WLWA model network. An overview of these amendments is provided within the following section:

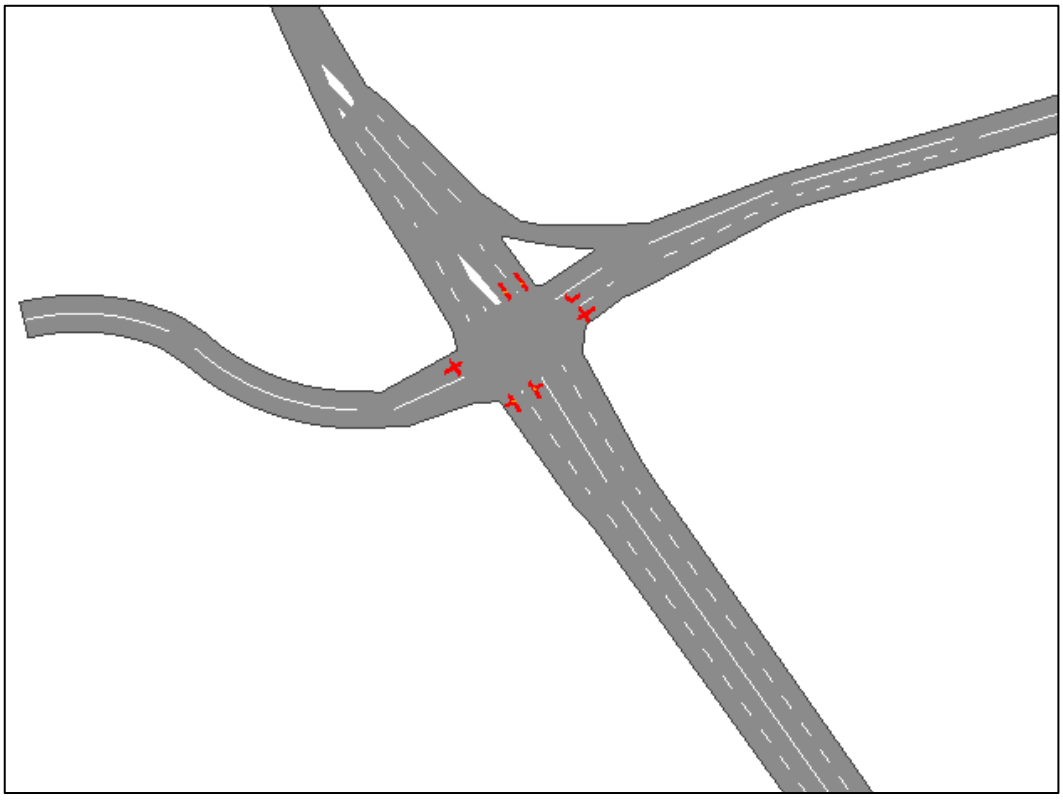
4.4.2 WLWA Mitigation Amendments

Myton Road/Banbury Road Roundabout

The footprint of this scheme has been reduced by banning the right turn from Banbury Rd SB into Bridge End, similarly the right turn bay from Banbury Rd NB into Myton Rd has also been removed and the outside lane remarked for straight on and right turn combined.

The dedicated left turn slip from Banbury Rd SB into Myton road has been reduced in scale and was also reconfigured to a priority junction rather than being controlled by a down-stream merge in turn configuration. **Figure 7** provides an overview of the revised proposals for the Myton Road that have been included within the model network.

Figure 7 - Revised Myton Road Proposals



Gallows Hill/Banbury Road

Due to the reduced scale of development within the Gallows Hill/Banbury Road area the amendments that have been to the mitigation measures that were initially proposed within the Banbury Road/Gallows Hill area.

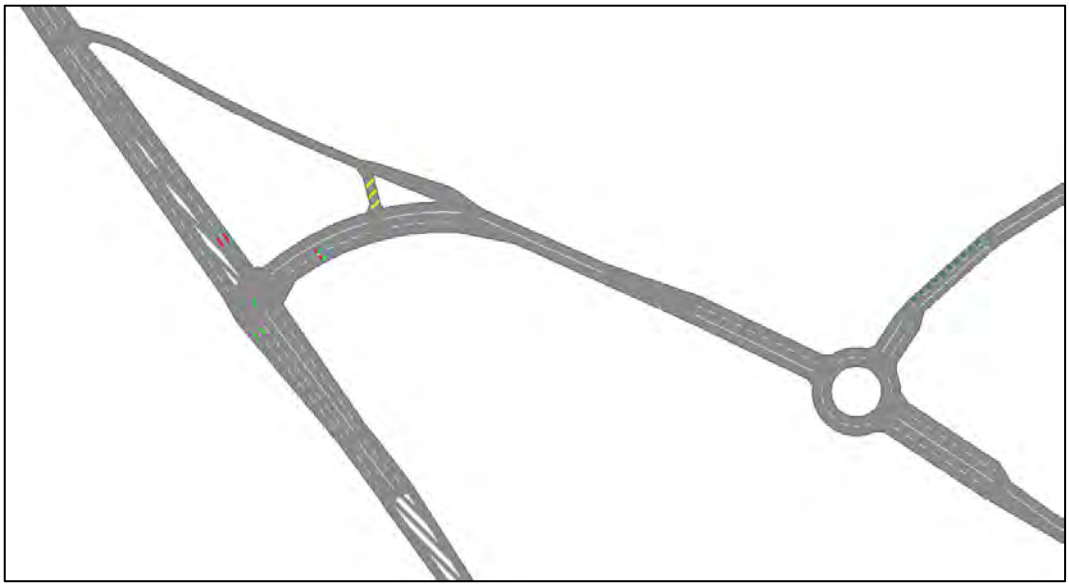
The previous assessment assumed that Gallows Hill would be dualled from Europa Way to Banbury Road in both directions. In addition there was originally proposed to be a signalised junction between the eastern Warwick Tech Park entrance and the Banbury Road/Gallows Hill junction. This has now been removed.

In order to maintain good access to the Tech Park however the model has been amended to include a new roundabout at the Western Entrance which improves

accessibility to the site and reduces the propensity for vehicles waiting to turn into the Tech Park to exacerbate queuing and delay levels along the Gallows Hill corridor. The extent of the two lane sections of the Banbury Road both around the Gallows Hill junction and south of the Gallows Hill/Myton Road junction has also been reduced in comparison to the previous phase of the STA.

An overview of the revised proposals that have been included within the model is provided within the following **Figure 8**.

Figure 8 - Revised Gallows Hill Proposals



4.5 Mitigation Schedule Cost Adjustments

A high level cost estimate of the aforementioned changes results in the following adjustments to the overall mitigation cost schedule:

Table 24 - RDA Mitigation Schedule Cost Adjustments

Amendment	Cost Adjustment
Reduced Banbury Rd 2 Lane Section	-£400,000
Removed Gallows Hill 2 Lane Section	-£1.5 Million
Reduced Myton Rd Junction footprint	-£50,000
New Tech Park Roundabout	+£600,000
Total	-£1.35 Million

4.6 Mitigation Grading & Updated Cost Estimate

Aside from the changes outlined previously there have been no other amendments to the mitigation measures proposed throughout the course of the assessment. As a result the costs associated with the mitigation strategy are broadly consistent with those costs identified during the previous phase of STA work. The existing schemes are subject to the same grading system as has been previously adopted. The following provides an overview of the grading system applied to the current mitigation measures.

- **GRADE 1 - Strategically Essential** – A scheme identified at an early stage of the assessment that has been included within the modelling and is likely to be essential in maintaining network operation and conditions. Delivery of these schemes will serve a role of strategic importance in the context of maintaining overall network operation levels.
- **GRADE 2 - Strategically Desirable -** A scheme identified during the assessment that has been included within the modelling, implementation of the scheme is desirable to ensure maintenance of network operation and conditions. Further investigation may be required to determine whether the scheme is essential. Delivery of these schemes is likely serve a role of strategic importance in the context of maintaining overall network operation levels.
- **GRADE 3 –Locally Desirable -** A scheme identified during the assessment that has been included within the modelling, implementation of the scheme is desirable to ensure maintenance of network operation and conditions. Further investigation may be required to determine whether the scheme is essential. Delivery of these schemes is will serve a role of local importance in the context of maintaining the operational levels in the areas of close proximity to the scheme.

At this stage it is believed that no unnecessary schemes are contained within the model network. Furthermore, the schemes that have been categorised as desirable rather than essential tend to indicate schemes that are more likely to be triggered by proximate development. In some cases, the impacts that are addressed are likely to be of strategic importance to maintaining overall levels of network operation whilst in others the benefits of implementation are more likely to be focussed in the immediate area of the proposed mitigation measures. The grading and costs attributed to each of the schemes is summarised within the following **Table 25.**

27 schemes are proposed within the study area, 19 schemes have been classified as Grade 1, and 6 schemes have been classified as Grade 2 whilst the remaining 2 schemes have been classified as Grade 3. This amounts to an approximate 60:40 split in classification between essential and desirable schemes.

It should be acknowledged that implementation of all of the schemes results in improved network performance when compared to the situation where any one of the mitigation schemes is not adopted. Furthermore, the results analysis in the following sections of this report demonstrate that, in spite of the application of all proposed mitigation measures, the impacts of the development allocation strategy are not fully mitigated. Should any of the mitigation measures be removed completely these impacts would inevitably be further exacerbated.

4.7 Outline Cost Estimate

Excluding the costs associated with the Portobello Bridge capacity enhancements the following provides a breakdown of the indicative costs, by grade, of the proposed mitigation schedule:

- Grade 1 – £32,550,000
- Grade 2 – £3,950,000
- Grade 3 – £1,300,000

Table 25 - Outline Mitigation Schedule

Scheme	Grade	Cost
Thickthorn Roundabout	Grade 1	£1,250,000
Kenilworth Gyratory	Grade 1	£300,000
A452/Bericote Roundabout	Grade 1	£1,250,000
A452/Blackdown Roundabout	Grade 1	£650,000
A429 Spinney Hill Roundabout	Grade 2	£450,000
Emscote Road/Greville Road	Grade 1	£750,000
Princes Drive/Warwick New Road	Grade 1	£350,000
Bath Street/High Street	Grade 1	£500,000
Adelaide Road/Avenue Road	Grade 2	£350,000
Dormer Place/Adelaide Road	Grade 2	£300,000
Myton Road Roundabout	*Grade 1*	*£450,000*
Priory Road/Smith Street/St Nicholas	Grade 1	£300,000
Castle Hill Gyratory Signals	Grade 1	£650,000
Europa Way/Myton Road Roundabout	Grade 1	£1,600,000
Shires Retail Park Roundabout	Grade 1	£1,250,000
Europa Way Roundabout	Grade 1	£900,000
Grey's Mallory Roundabout	Grade 2	£500,000
A46/Birmingham Road 'Stanks Island'	Grade 1	£1,400,000
Bericote Road Stoneleigh Road	Grade 3	£500,000
Kenilworth Road/Westhill Road	Grade 3	£500,000
Europa Way Corridor – Part 1	Grade 1	£5,550,000
Europa Way Corridor – Part 2	Grade 1	£2,950,000
Tech Park Roundabout	*Grade 2*	*£600,000*
Banbury Road – 2 Lanes	*Grade 2*	*£500,000*
HA network safety and capacity improvements e.g ATM "Smart Motorways", lane gains, All Lanes Running (ALR)	Grade 1	£10,000,000
Sustainable Travel Infrastructure	Grade 1	£2,000,000
Virtual P&Rs	Grade 1	£2,000,000
Total		£37,800,000
Grade 1		£34,100,000
Grade 2		£2,700,000
Grade 3		£1,000,000

Costs have been calculated based on a high level review of the proposed mitigation measures completed by WCC. Included in the costs is an element attributable to highway works including utilities, an element attributable to the cost of implementing signals where necessary, the latter of which contains at least some account of any likely commuted sums, as well as an element attributed to the design and delivery costs. Design and delivery costs have been calculated at 48% of the costs of highway and signal works attributable to each scheme. The

costs are based on average costs from a number of historical schemes within the urban Warwick District area. At this stage these costs are still high level estimates but they have been informed by WCC through an overarching review of the proposed schemes and so represent the most accurate costing that is available at this time given the current, strategic level of the assessment.

4.7.1 M40 Motorway Enhancements

The previously outlined costs attribute almost 25% of the required revenue to the delivery of capacity enhancements on the section of the M40 between Junction 15 and Junction 13. Thus far the assessment has included an additional lane on the M40 between J15 and J14, one of these lanes has been segregated so that traffic travelling to Warwick via the A46 and M40 does not need to enter into the M40 mainline.

Since the issue of the Phase 3 STA work there has been a dialogue with the Highways Agency regarding Managed Motorways. This form of mitigation is now termed 'Smart Motorways'. Whilst the assessment work has indicated that Smart Motorways may not be required until towards the end of the plan period, the Agency has indicated that due to technology advances other interventions may be more appropriate at that time. Therefore at this stage we refer to Motorway Enhancements rather than Smart Motorways.

The final form of the capacity enhancements on the M40 will be dependent up on the level of demand and requirements at the time. It is not possible at this early stage to precisely define proposals for the M40 due to the high level of detailed design work likely to be required. As such an appropriate level of funding contribution is only likely to be fully determinable once the complete costs for delivering the scheme have been ascertained.

The identification of an acceptable level of contribution also requires further work as there are likely to be a number of contributing factors which trigger the need for additional capacity in this area, the most significant of which is likely to constitute existing demand alongside forecast growth in strategic trips. Thus, any cost apportionment should be undertaken in consideration of the demand which will benefit from the implementation of the scheme. Such an exercise has not yet been completed but work is on-going to understand the level of significance associated with the delivery of M40 capacity enhancements. This work is important as it is important to understand whether there is a strong reliance on the delivery of additional capacity when considering the life of the plan period and also to understand whether it is reasonable to conclude that the delivery of additional capacity would be likely to be required towards the end of the plan period rather than the beginning as this is likely to have a bearing on the overall viability of the proposed sites.

Following the completion of the previous phase 3 STA work a separate study was undertaken whereby the additional lanes, and the capacity that they deliver, have been removed from the model network. This was undertaken to assess the level of significance attributed to the delivery of the extra capacity, which was originally assumed to take the form of Managed Motorways (the HA have recently developed this concept into Smart Motorways), and how critical these safety and capacity improvements were to the delivery of the Core Strategy. A copy of this

report has been provided within **Appendix E** of this report. The conclusions from this work have been summarised as follows:

- That the delivery of extra capacity in this area of the M40 results in substantial, network wide benefits but, that there is potential for the allocation strategy that has been tested to be adopted without SM measures should the need arise.
- That it is reasonable to conclude that the delivery of the additional capacity could be scheduled towards the end of the plan period which would allow alternative funding means to be identified
- That the need for the delivery of extra capacity on the M40 is more discernible when considering the impact on the network performance during the PM period than the AM period.
- That the primary contributing factors to the need for the delivery of additional M40 capacity are the existing levels of traffic coupled with the forecast external growth levels. Traffic levels associated with the Allocated Sites comprise the third/fourth highest traffic type when considering the levels of flow on the M40 between J14 and J15. This indicates that there is likely to be a need for the delivery of additional capacity at some point within the medium term (25 to 40 years +) irrespective of the proposed demand levels likely to be produced as a result of the proposed WDC Core Strategy developments.

For the purposes of this study the additional capacity provided through utilising the hard shoulder has been assumed to take the form of Smart Motorways. However, the application of other safety and capacity improvements which achieve similar results may provide an acceptable level of mitigation for Local Plan related growth. The requirement for such mitigation is likely to occur towards the end of the plan period, by which time, advances in technology, changes to highway standards and adjustments to national traffic growth forecasts may enable alternative mitigation solutions. As discussed, the primary contributing factors to the need for the delivery of additional M40 capacity are the existing levels of traffic coupled with the forecast external growth levels. Local Plan related growth is only one element of the M40 traffic profile. The Highways Agency will ultimately determine the infrastructure requirements for the M40 corridor and will be required to give full consideration all emerging growth proposals.

4.8 Revised Town Centre Approach

In addition to the measures proposed previously a second refined model network has been established which includes a series of further refinements to the schemes proposed in and around the Warwick Town Centre Area. The purpose of these refinements was to address concerns regarding the foot print of some of the schemes proposed through the assessment and also to reduce the need for signals to be delivered.

An overview of the changes proposed through this sensitivity test is as follows:

- The Butts has been reverted to one-way WB
- The signals at the Priory Road/Smith Street junction have been removed and the junction configuration is in line with the current layout. The only

exception to this is the Priory Rd to St Nicolas Church Street movement has been restricted.

- The signals proposed within the Castle Hill/St Nicholas Church Street/Banbury Road junction have been removed and the original junction layout re-instated.
- Further reduction to the extent of the Myton Road/Banbury Rd proposals have been included, this has been achieved by reducing the Banbury Rd SB to a single Lane. A series of measures were tested for this area including reinstatement of the roundabout and also reduction of the NB movement to a single lane but the proposals included within the sensitivity test network where identified as the least likely of the three schemes to incur additional impacts when compared to the original proposals for this area.

There has not been any detailed cost estimates produced for these schemes as they have been included within the model network at this stage to enable a better understanding of the potential alternative options that exist to manage the flow of traffic throughout the town.

The purpose of testing these revised schemes is to understand what the implications may be of delivering junctions of a different form to those currently proposed within the STA work. The assessment is intended to be indicative as neither configuration is considered to have been fully optimised at this stage. However, it should be acknowledged that the previous phase of STA work identified that:

> *"…delivery of the proposed Warwick Town Centre improvements, or schemes which conform in principle to those proposed within the modelling, has both local and strategic level benefits, particularly when considering the AM network performance. Without the schemes in place it appears impossible to ensure an acceptable level of network operation can be delivered, particularly when considering the areas around Warwick town."*(Warwick Strategic Transport Assessment – Phase 3 Assessment, May2013, p4)

As a result it was not considered appropriate to test an option without any town centre schemes in places. Furthermore, It is not proposed to make any further refinements within the STA. A strategic assessment of the impacts and mitigation requirements within the town centre has been undertaken and strategies for managing the traffic impacts relating to Local Plan growth have been identified. Within this latest stage of assessment, a number of revisions have been identified which reduce the environmental impact of the Warwick town centre mitigation strategy. It has been demonstrated that with moderate, targeted improvements, the town centre network can cope with the increase in demand for road space. However, the need for a comprehensive local town centre transport strategy which manages traffic demands and improves the town centre environment for all users is recognised. Developing this strategy is beyond the scope of this assessment. As with all schemes identified within the STA, further detailed work will be required to define the optimum mitigation schemes.

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 both the WLWA and KSWA models.

A tiered assessment has been adopted; results analysis is focussed on a strategic level assessment at this stage similar to that adopted during earlier stages of the assessment.

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 issue 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 stability within the models frequently improves as development plans evolve and mitigation schemes are refined. This is also partly due to developments within the plan proceeding with applications prior to adoption, this allows the more localised impacts to be identified and mitigated through the developments detailed transport assessments. This level of detail cannot be achieved during a high level strategic assessment. All mitigation proposals will be subject to further detailed assessments, refinements and optimisation through the planning process and it is expected that improved network results and stability will be realised.

Twenty 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 a minimum of twelve runs per time period.

Based on an initial review of the model performance it was decided that an AM model run could be considered as having locked up whenever more than 8,500

vehicles are observed to remain on the model network at the end of the AM simulation period and 9,500 vehicles are observed to remain on the model network at the end of the PM simulation period. A greater level of latent demand is deemed acceptable during the PM than the AM due to the inherently higher level of variability contained within the PM scenario between each of the individual runs which is largely related to the higher demand levels within the WLWA model.

5.3 Number of Runs

Network statistics analysis has been based, consistently, on 10 runs per scenario due to the method of production, however, unless stated otherwise, all other statistics are based on a minimum of 10 runs and a maximum of 20 depending upon the number of successful runs collected.

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 Distance (Km)** – The average distance travelled by a vehicle that completed their journey during the model simulation period.
- **Average Time (seconds)** – The average travel time of a completed trip 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.

The first three measurements are averages so can be used to compare between the various scenarios. The final measurement is an absolute and is dependent on congestion on the network (as this will prevent trips from completing) and the demand within the model (i.e. the number of trips actually trying to complete). As demand differs between scenarios, as well as small variations between runs of the same scenario, we cannot expect the number of completed trips to be the same. However, as the demands do not differ significantly it can still provide an indication of the relative congestion on each network.

The use of these statistics is in line with the methodology adopted during the previous Strategic Transport Assessment work.

5.5 Queue Lengths

A second, more detailed, level of analysis has been undertaken in the form of queue length analysis. Queue length analysis is intended to accompany the mean speed analysis as it provides a more detailed picture of the impacts at specific junctions within the model network.

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 maximum of these values, across all hours, is reported as the maximum periodic average maximum queue length. All queues are reported in numbers of vehicles.

The junctions for which average hourly maximum queue lengths have been calculated and compared are illustrated within Figure 14 on the following page. 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.

Queue difference plots have been produced for all model scenarios and have been presented within **Appendix B** of this report.

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 classifications for the queue length analysis are 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)

The locations of the junctions that have been included within the assessment are outlined within **Figure 9** and **Figure 10** on the following pages for the WLWA and KSWA model networks respectively.

5.6 Journey Time Analysis

During the first phase of STA analysis some journey time routes were defined within the modelling and the time it takes vehicles to traverse these routes was collected and presented within the analysis. At that stage the purpose of analysis was simply to ascertain which routes experienced the lowest and greatest levels of delay across a number of different allocation options. Building upon that analysis, the purpose of the comparisons during this stage of work is to identify which areas of the network, when compared to the Reference Conditions, are likely to suffer the greatest changes in levels of delay when the allocated demand is assigned to the network.

In total 9 key routes were defined within the model network and these routes have been illustrated within **Figure 11** and **Figure 12** on the following pages for the WLWA and KSWA model networks respectively.

In order that the impact on delay across various routes can be better understood the routes have been filtered by direction and have been split into sections. The purpose of this disaggregation is to ensure that a sufficient sample size is collected from the analysis as the number of vehicles travelling across the entire length of a number of the routes is likely to be substantially smaller than the number of vehicles travelling along each of the component parts of the route.

The average time it takes for vehicles to travel across each section of the route has been collected and aggregated for each scenario and then the level of deviation from the Reference Case conditions has been summarised using the following classification bands:

- **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, when compared to the Reference Case, of more than 50%

At this stage it was decided to classify journey time differences of between -15% and +15% as not significant. The intention is to highlight those areas which suffer the greatest impacts as these impacts are more pertinent to this stage of the assessment. The classifications adopted are in line with those that have been recommended by WCC and are such that they reflect the DMRB acceptability standards for comparisons between observed and modelled journey times. It should be noted that although the current methodology does not consider an increase in delay of less than 15%, on a single section of a route, as significant, during assessment of planning applications a lower threshold maybe considered as it would be expected that the mitigation schemes are optimised

The benefit of undertaking delay analysis on key routes, compared to simply reviewing the network wide average journey time alongside the mean speed outputs, is that it begins to allow a more detailed picture of where the additional delays or journey time improvements are likely to occur.

Figure 9 – WLWA Queue Assessment, Junction Locations

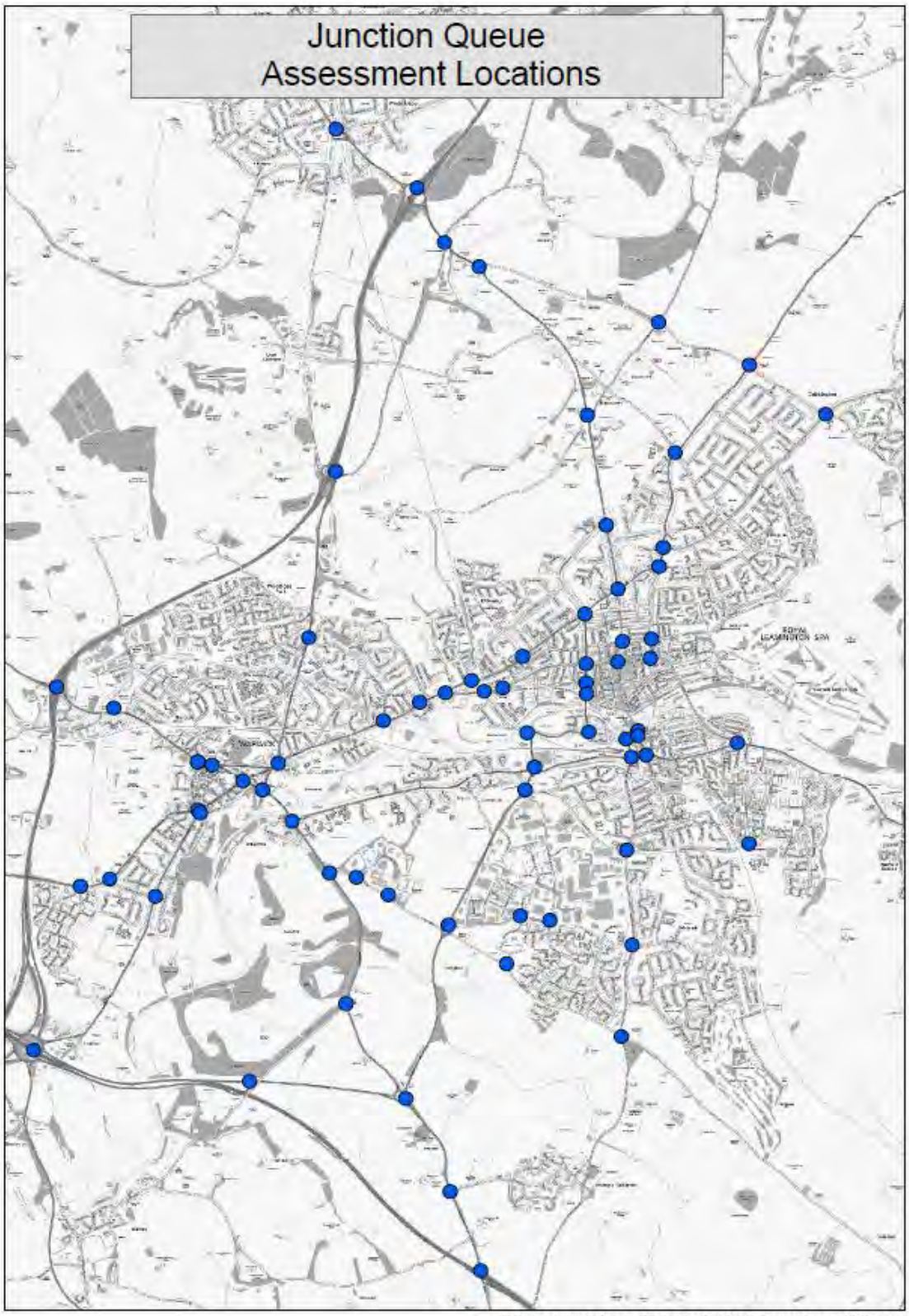


Figure 10 – KSWA Queue Assessment, Junction Locations

Figure 11 – WLWA Journey Time Analysis Routes

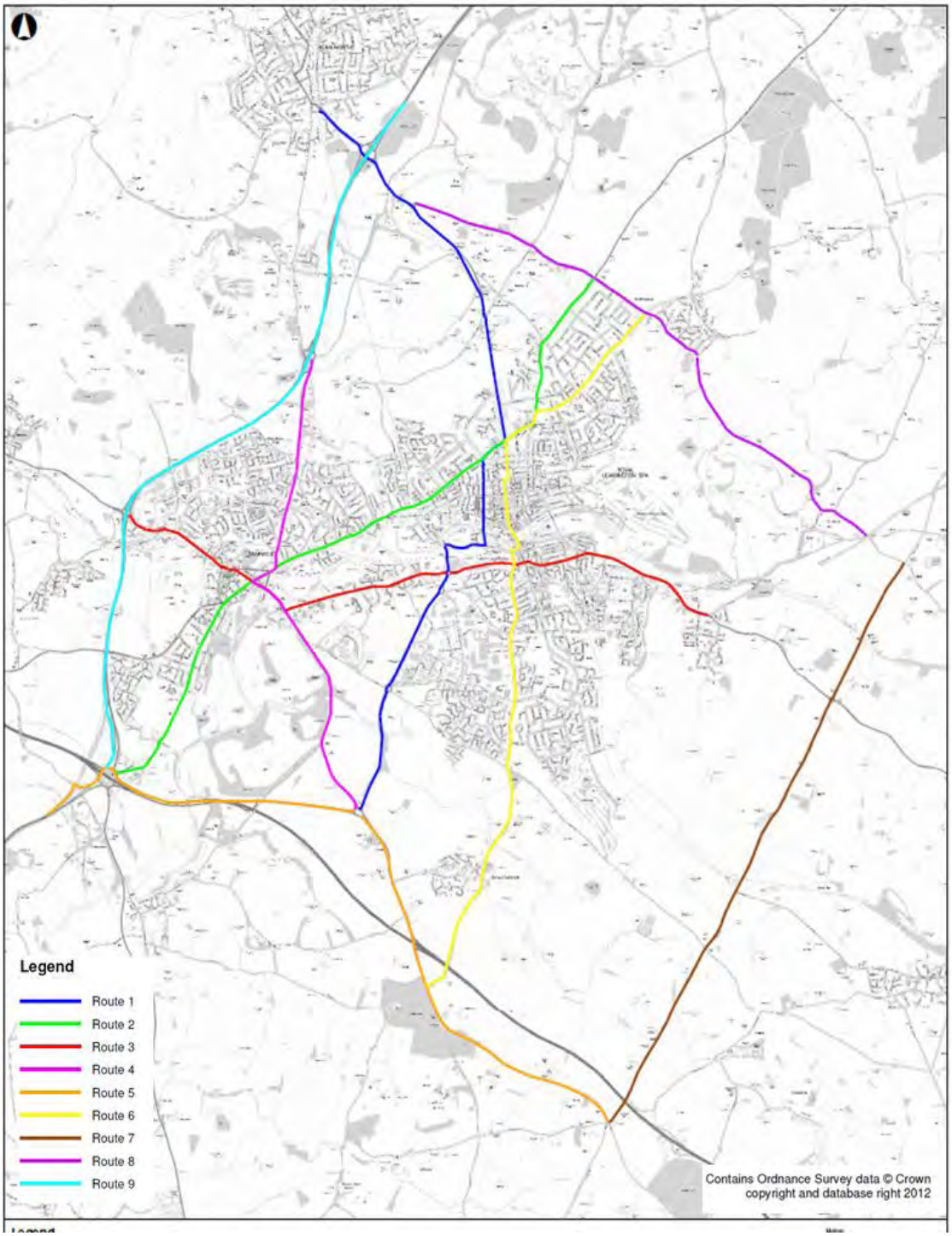
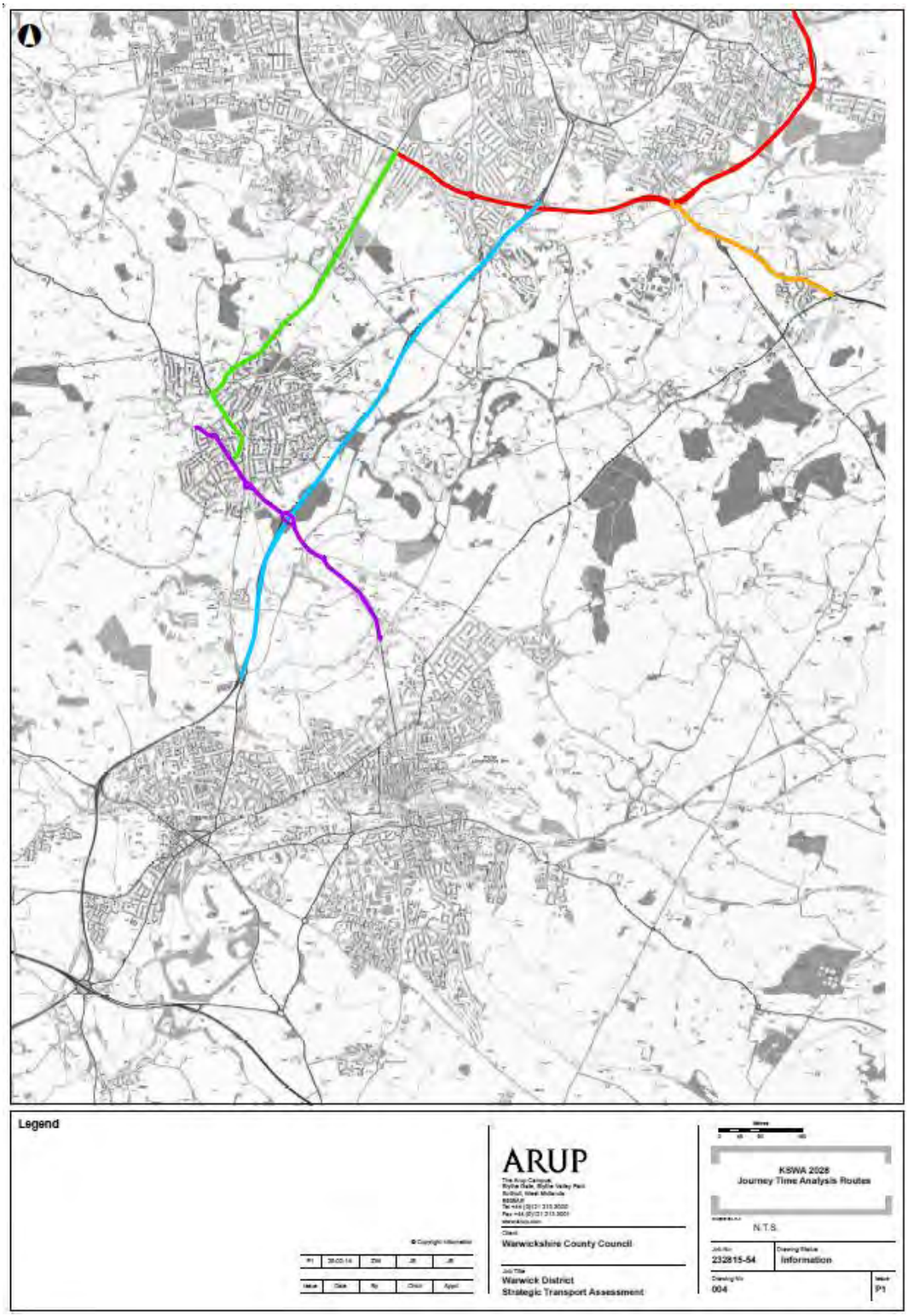


Figure 12 – KSWA Journey Time Analysis Routes



5.7 Results overview

The results analysis that has been set out within the remaining sections of this report has been divided by area, with WLWA model outputs being analysed first and the KSWA model outputs have been presented subsequently.

6 WLWA Results Analysis

6.1 Overview

The following sections of the report are intended to present the results obtained from the detailed testing undertaken for M40 model for the following three scenarios within the Warwick and Leamington Areas:

- 2028 Reference Demands
- 2028 WLWA Revised Development Approach (WLWA RDA)
- 2028 WLWA Revised Development Approach plus Revised Town Centre Measures (WLWA RDA + RTC)

6.2 2028 RDA - Results Analysis

The first stage of this assessment was to review the performance of the model network following the allocation of the revised demand levels and network optimisation.

6.3 Model Stability

An initial assessment of the level of model stability was undertaken by comparing the number of completed runs against the number of runs assumed to have failed, as outlined earlier within **Section 5.2** of this report.

The apparent network stability exhibited within the AM and PM simulation runs across the two scenarios is illustrated within the following Table 26:

Table 26 - Model Stability Assessment 2028 Reference vs. 2028 RDA

	Reference Case	WLWA RDA	WLWA RDA + RTC
AM	75%	75%	70%
PM	80%	80%	70%

Given the size of 20 runs it is reasonable to conclude, from the previous table, that there are no notable differences between the Reference Case and WLWA RDA scenarios when considering network stability. The inclusion of the revised town centre measures appears to result in a small reduction in model stability levels in the AM and a slightly larger reduction in network stability levels within the PM. In the AM this is unlikely to be considered significant, within the PM this could be indicative of potential additional issues although more runs would be necessary to confirm this.

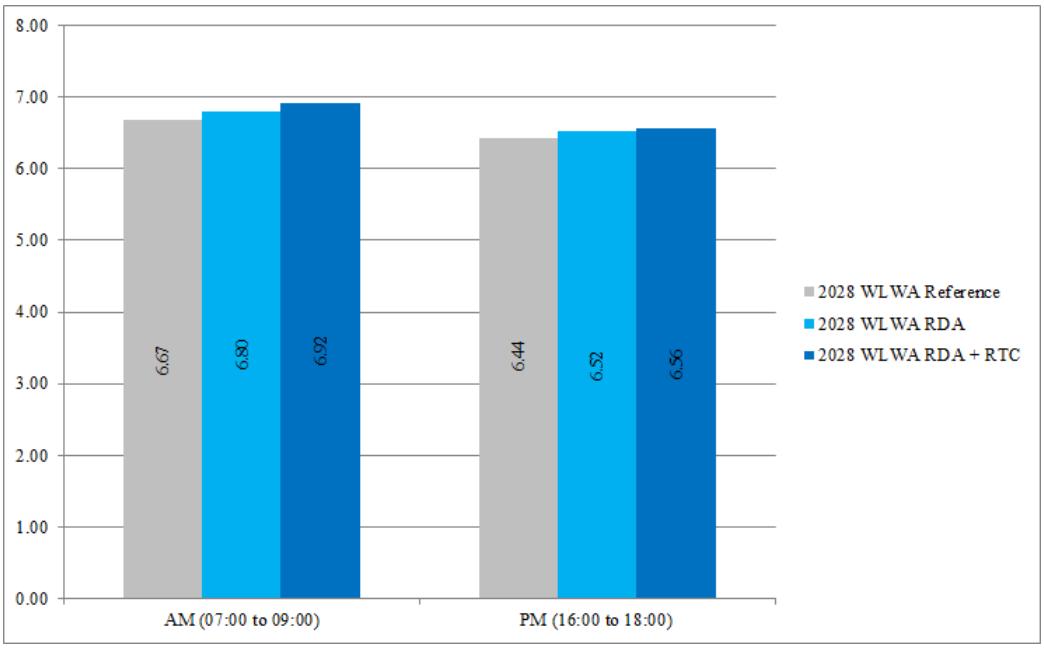
6.4 Network Wide Statistics

The following sets out the changes in network wide statistics between the 2028 Reference Case and the 2028 RDA scenarios.

6.4.1 Average Journey Distance

Analysis of the average journey distance within each scenario, across the entire AM and PM model periods is presented within the following **Figure 13.**

Figure 13 - Average Journey Distance (2028 Ref vs WLWA RDA and WLWA RDA +RTC), Km



Analysis of the figure indicates very little difference between the three scenarios. An increase in the distance travelled may indicate an increase in the number of longer distance trips occurring within an option, or it may indicate an increased propensity for vehicles to reassign along longer routes in response to congestion.

A small increase in the distance travelled is always going to be likely due to the need to locate development on the periphery of the existing town network since that is where the available land is located.

The increase in journey distances that is experienced between the WDC RDA and the RTC scenarios can be attributed to the effects of vehicles reassigning to longer distance routes. Since demand levels within the two scenarios are consistent then this increase in journey distances must be attributable to reassignment in response to congestion effects.

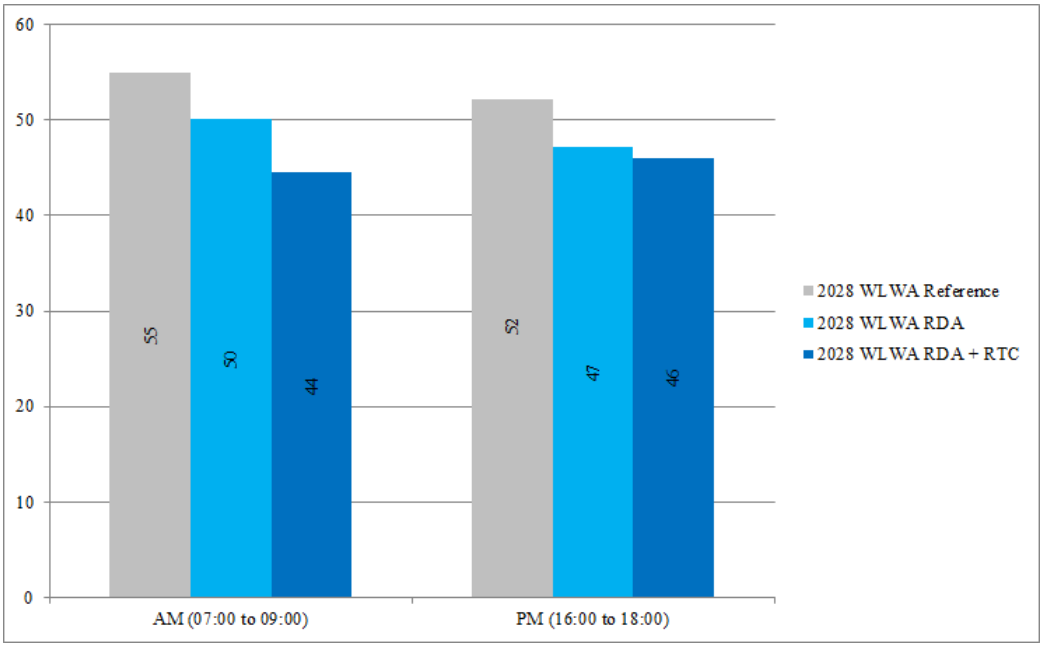
6.4.2 Average Journey Speed

Analysis of the average journey speed (km/h) within the three scenarios, across the entire AM and PM model periods, is presented within the **Figure 14** on the following page.

Figure 14 demonstrates that the allocation of the RDA strategy results in a drop in the average speed of vehicles, on the network, of approximately 10% and 11% in the AM and PM peak periods respectively for the WLWA RDA scenario. When compared to the reference scenario, the WLWA RDA + RTC scenario results in a respective 19% and 12% drop in average speeds.

The drop in average speeds is likely to be indicative of the general effects of the assignment of the additional demand and the congestion effects thereof. The substantial drop in speeds that is revealed within the 2028 WLWA RDA + RTC scenario indicates that the network configuration within this scenario is less effective at accommodating the demand levels than that which has been adopted within the 2028 WLWA RDA model network.

Figure 14 - Average Journey Speed (2028 Ref vs WLWA RDA and WLWA RDA +RTC), Km/h



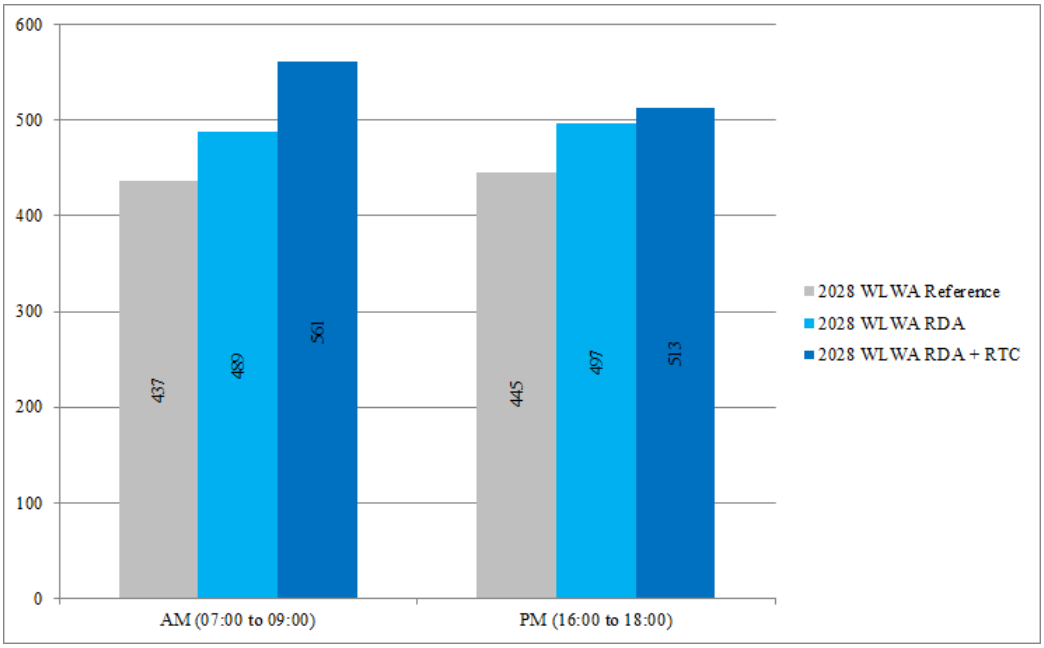
6.4.3 Average Journey Time (Seconds)

Analysis of the average journey time, in seconds, within each scenario, across the entire AM and PM model periods, is presented within **Figure 15** on the following page.

Analysis of the difference in average journey times indicates an increase in the time it takes to complete a journey when compared to the 2028 Reference Case conditions of around 15% during both AM and PM periods for the WLWA RDA scenario.

When comparing the Reference Case to the WLWA RDA + RTC scenario, the increase in 28% and 15% is expected during the AM and PM periods respectively.

Figure 15 - Average Journey Time (2028 Ref vs WLWA RDA and WLWA RDA +RTC), Seconds



An incremental increase in delay is likely to be experienced as a result of these vehicles being added on to an already congested network. In some areas mitigation has been introduced to minimise these impacts and it is entirely possible that conditions in some areas will improve as a result of the schemes which accompany the allocated growth. However, overall, it can be assumed that there will be a general increase in the average time spent travelling on the network once the allocated demand has been assigned to the network. Furthermore it is reasonable to conclude that these journey times are likely to increase further, especially within the AM period, should the revised town centre network proposals be adopted.

6.5 Completed Trips

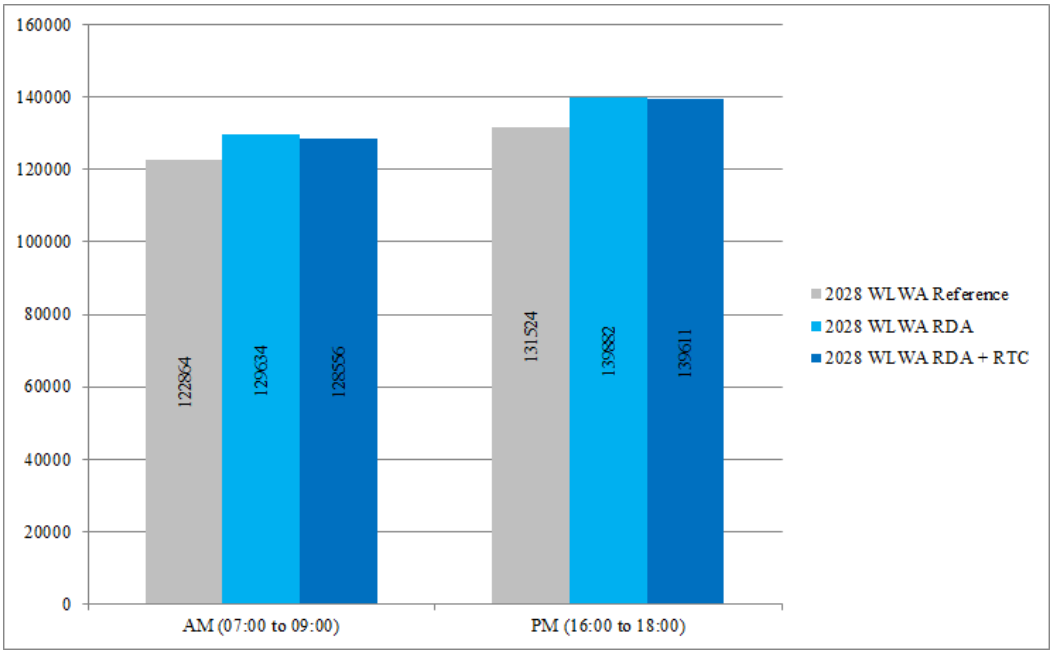
Analysis of the total number of completed trips within each scenario, across the entire AM and PM model periods, is presented within **Figure 16** on the following page.

Analysis of the figure indicates that there is an increase in completed trips of around 5%, for both scenarios in both the AM and PM periods respectively, when compared to the 2028 Reference Case.

Notably, the level of demand assigned within the RDA scenario network is around 4.9% higher in the AM and 5.9% higher in the PM. It is worth noting that the increase in completed trips is higher than the increase in assigned demand between the two scenarios.

The requirement for a cut off time period within the model means that it is never possible for 100% of the demand assigned within the model network to 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.

Figure 16 - Completed Trips (2028 Ref vs WLWA RDA and WLWA RDA + RTC), Vehicles



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 27:

Table 27 Completed Trips Analysis (2028 Ref vs WLWA RDA and WLWA RDA +RTC)

	AM (07:00 to 10:00)			PM (16:00 to 19:00)		
	Demand	Completed Trips	Completed %	Demand	Completed Trips	Completed %
2028 Reference Demands	127811	122864	96.13%	137249	131524	95.83%
2028 WLWA RDA	134385	129364	96.26%	145838	139882	95.92%
2028 WLWA RDA + RTC	134385	128556	95.66%	145838	139611	95.73%

The previous Table illustrates that, as a proportion of the demand assigned, the number of trips that are completed during the AM and PM model periods, is comparable between both Reference Case and 2028 WLWA RDA scenarios. The numbers are slightly lower within the 2028 WLWA RDA + RTC model network.

This indicates that, in general, the mitigation measures within the 2028 WLWA RDA model network are able to accommodate the additional demand levels assigned during the AM and PM periods but that this is diminished by the revision to the network that is assumed within the 2028 WLWA + RDA + RTC model network.

6.6 Maximum Queue Length Analysis

The following sets out some initial observations based on the differences in queue lengths between the 2028 Reference Case and 2028 Revised Development Allocation scenarios.

The maps which are referred to within the following analysis are presented within **Appendix B** of this report.

6.6.1 AM Analysis (MQ001 and MQ003)

Analysis of the difference in queuing between the 2028 Reference and 2028 WLWA RDA scenario, during the AM peak hour, reveals the following:

- There are no instances of severe increases in queue lengths.
- The majority of junctions assessed that trigger the criteria experience a level between a reduction in queuing levels and a maximum increase of 30 vehicles.

Analysis of the difference in queuing between the 2028 Reference and 2028 WLWA RDA + RTC scenario, during the AM peak hour, reveals the following:

- There are a number of instances (four) of severe increases in queue lengths exceeding 50 vehicles on the network when compared to the reference case. These impacts occur around the Shires Retail Park/Europa Way junctions as well as one along Emscote Road and an increase in the impacts on Longbridge Island. This is likely to be caused by the reassignment of traffic in response to the inclusion of the revised measures within the model network.
- The majority of junctions assessed that trigger the criteria experience something between a reduction in queuing levels and a maximum increase of 30 vehicles.

6.6.2 PM Analysis (MQ002 and MQ004)

Analysis of the difference in queuing between the 2028 Reference and 2028 WLWA RDA scenario, during the PM peak hour, reveals the following:

- The majority of junctions assessed that trigger the criteria experience a queue length increase of 15 to 30 vehicles
- There are less instances of queue length decreases across the network when compared to the AM period (MQ001)

Analysis of the difference in queuing between the 2028 Reference and 2028 WLWA RDA + RTC scenario, during the PM peak hour, reveals the following:

- There are no severe increases experienced within the PM network which is an improvement in comparison to the AM.
- The majority of junctions assessed that trigger the criteria experience a queue length increase of 15 to 30 vehicles

6.6.3 Queue Analysis Summary

A summary of the findings obtained through comparing the changes in queuing between the 2028 Reference Case and 2028 RDA Scenario is provided as follows:

- The 2028 WLWA RDA junction performance is comparable to the 2028 Reference Case network with the majority of impacts ranging from a decrease in queuing to an increase of 30 vehicles.
- The 2028 WLWA RDA network impacts are similar in magnitude during both AM and PM periods.
- When reviewing the performance of the 2028 WLWA RDA + RTC network performance it is apparent that the PM network performs better than the AM network.
- The most severe impacts within the 2028 WLWA RDA + RTC network occur on routes outside of Warwick town indicating that the displacement of traffic away from the town centre as a result of the schemes may impact alternative routes which may be required to accommodate greater levels of demand in response to the changes.

6.7 Journey Time Analysis

The following sets out some initial observations of journey time analysis plots for the three key scenarios; 2028 Reference Case and 2028 WLWA RDA and 2028 WLWA RDA +RTC. The comments in the remainder of this section are based on observations of the predicted journey times across pre-defined routes within the model area during both AM (08:00 to 09:00) and PM (17:00 to 18:00) peak hours.

The maps which are referred to within the following analysis are presented within **Appendix C** of this report whilst the specific drawing number pertaining to each element of the analysis has been provided within the accompanying title brackets.

6.7.1 AM Analysis (MD001 and MD003)

Analysis of the difference in queuing between the 2028 Reference and 2028 WDC RDA scenario, during the AM peak hour, reveals the following:

- The routes into Warwick experience limited changes in journey times compared to the Reference Case, notably the Banbury Road, Birmingham Road and Coventry Road all experience reductions.
- Increases in journey times are evident on three of the four approaches to Grey's Mallory. This indicates that further optimisation of the scheme proposed in this area is desirable.
- There are still increases in delay along the A452 in both directions which indicates that further optimisation of the schemes in this area may also be desirable. Particularly when considering the substantial increases experienced on the approach from the south.
- There are two other instances of severe increases in journey times. One occurs on the approach to the Emscote Road Greville Road junction which is likely to be as a result of the introduction of signals at the junction where previously traffic flowing from this direction was unopposed. The

second instance is the Myton Road approach to the Princes Drive/Europa Way roundabout which indicates that further optimisation of the signal scheme in this area is also desirable.

- Notably, there are no negative impacts accrued on the approaches to the Banbury Rd/Myton Rd junction proposals which indicate that the reduced scheme for this area is effective.

Analysis of the difference in queuing between the 2028 Reference and 2028 WDC RDA + RTC scenario, during the AM period, reveals the following:

- Severe increases in delay are experienced by vehicles approaching from the south east, the predominant increases occur on all routes within this area. Whilst it is apparent from the previous analysis that delays on the approaches to Grey's Mallory have increases irrespective of the proposals for the Town Centre, delays have now manifest in the opposite direction.
- Delay on routes along the A452 as well as on routes across Leamington have also further increased when compared to the 2028 WLWA + RDA scenarios.

6.7.2 PM Analysis (MD002 and MD004)

Analysis of the difference in queuing between the 2028 Reference and 2028 WDC RDA scenario, during the PM peak hour, reveals the following:

- There are a large number of instances where journey times have reduced around the Myton Road/Europa Way area which indicates that the mitigation in these areas is operating effectively.
- There are still increases in delay on the approaches to Grey's Mallory which would likely benefit from further optimisation of the Grey's Mallory Scheme proposals.
- There is an increase in delay along the A452 which indicates further optimisation of the proposed measures during the PM period is also desirable. There is an historic issue associated with vehicles wishing to turn right from the A452 into Northumberland Road which will also contribute to the increases in delay, there may be scope to extend the right turn bay to minimise these impacts but it is also undesirable to increase the levels of demand along Northumberland Road and so further investigation would be required before such proposals were adopted.
- Delays on the Stratford Rd approach to Longbridge Island have also increased but further optimisation of the signals in this location may further mitigate these impacts. This has been demonstrated through previous work undertaken by the Highways Agency Consultants[7] in 2013 albeit with slightly different demand assumptions included for the LDF sites.
- Further increases in delay occur on the Birmingham Road and Coventry Road routes into Warwick which may require attention.

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

Analysis of the difference in queuing between the 2028 Reference and 2028 WDC RDA + RTC scenario, during the PM peak hour, reveals the following very few differences in the journey time impacts either with or without the Revised Town Centre measures.

6.7.3 Delay Analysis Summary

Analysis of the difference in journey times between the two 2028 WLWA RDA scenarios and the Reference Case reveals that within the AM period the 2028 WDC + RDA network performs well with a limited number of instances of severe increases in delay. These instances all occur on the approach to proposed signalised junctions and, coupled with the fact that there are reductions in delay on other approaches to the same junctions, or at least scope to further enhance the junction proposals, these impacts would likely be further mitigated through additional scheme optimisation.

When considering the AM the difference in journey times between the 2028 WLWA RDA + RTC network and Reference Case it is apparent that the reconfiguration, as it currently stands, accrues additional impacts. Notably there are improvements in journey times from the North but routes into Warwick from the South are negatively affected by the proposals as they currently stand.

When reviewing the PM impacts it is apparent that further review of proposals along the A452 and consideration towards further optimisation of Longbridge Island (M40 J15) are desirable.

Notably the difference in journey times within the PM period when comparing both RDA scenarios to the 2028 Reference Case is limited.

6.8 Conclusion

The initial comparisons between the 2028 Reference Case and the 2028 WLWA RDA scenarios reveal the following conclusions:

- Inclusion of the Revised Allocation strategy demands will likely result in an increase in the average network journey times and a reduction in average speeds that vehicles are able to achieve within the 2028 Revised Allocation network in comparison to the 2028 Reference Case conditions. These impacts occur in spite of the adoption of a proposed mitigation strategy.
- Similar impacts are observed within the 2028 WLWA RDA + RTC scenario albeit there is a further increase in the journey times experienced on the network as a result of these proposals.
- Analysis of the queuing outputs indicates that the 2028 WLWA + RDA network suffers less overall increases in queue lengths than the 2028 WLWA RDA + RTC network.
- The 2028 WLWARDA model network still suffers a number of instances of queuing levels increasing by 30 to 50 vehicles indicating that the network would benefit from further optimisation of mitigation measures and, potentially, additional schemes being included.
- Queue impacts identified within the 2028 WLWA RDA + RTC network indicates that there may be strategic impacts incurred in areas which provide alternative routes to the routes through the town centre,

such as the A46 towards Longbridge Island, A452 between M40 and Leamington and Emscote Road Corridor.

- Analysis of the impacts on journey times reveals that within the AM there are some areas that experience reductions in delay and others which experience increases but those areas where the most severe increases occur appear to be in regions where there is the potential to further optimise the proposed mitigation measures to overcome the issues.
- There are further impacts accrued within the AM network as a result of the allocation of the RTC measures. This indicates that further refinement of the proposed measures is likely to be required before an optimum solution can be identified.
- The impacts within the PM both with and without the RTC measures appear to indicate little difference in performance of the two networks.

6.9 Further Considerations

The initial analysis indicates that the proposals considered as part of the Revised Town Centre measures may not successfully accommodate the required level of demand with the same magnitude of impact as the schemes proposed within the RDA network.

It is apparent, however, that the performance of the two scenario networks when reviewing the network wide performance measures and also the queuing and delay analysis is much closer aligned in the PM than the AM.

The issue in the AM appears to relate to the performance of the St Nicholas Church Street/Castle Hill junction and the balance of movements across the junction. It should be acknowledged that by introducing a means of controlling the flows across this junction better than currently exists within the RTC model but avoiding full signalisation would likely lead to an overall improvement in the model performance in this area.

7 KSWA Results Analysis

7.1 Overview

The following sections of the report are intended to present the results obtained from the detailed testing undertaken within the Kenilworth and Stoneleigh Area Model for the following three scenarios:

- 2028 KSWA Reference Demands
- 2028 KSWA Revised Development Approach Do Nothing (KSWA RDA DN) – The 2028 Reference Case network plus the 2028 RDA Demands
- 2028 KSWA Revised Development Approach Do Something (KSWA RDA DS) – The 2028 KSWA DN inclusive of the proposals at Thickthorn, Kenilworth Gyratory and the A452.

7.2 Model Stability

An initial assessment of the level of model stability was undertaken by comparing the number of completed runs against the number of runs which failed.

The network stability exhibited within the AM and PM simulation runs across the two scenarios is illustrated within the following Table 28:

Table 28 - Model Stability Assessment 2028 Reference vs. 2028 RDA

	Reference Case	KSWA RDA DN	SKWA RDA DS
AM	100%	100%	100%
PM	100%	100%	100%

Given the sample size of 20 runs it is reasonable to conclude, that there are no differences in network stability between the three scenarios. All scenarios demonstrate the same level of stability to within one run.

7.3 Network Wide Statistics

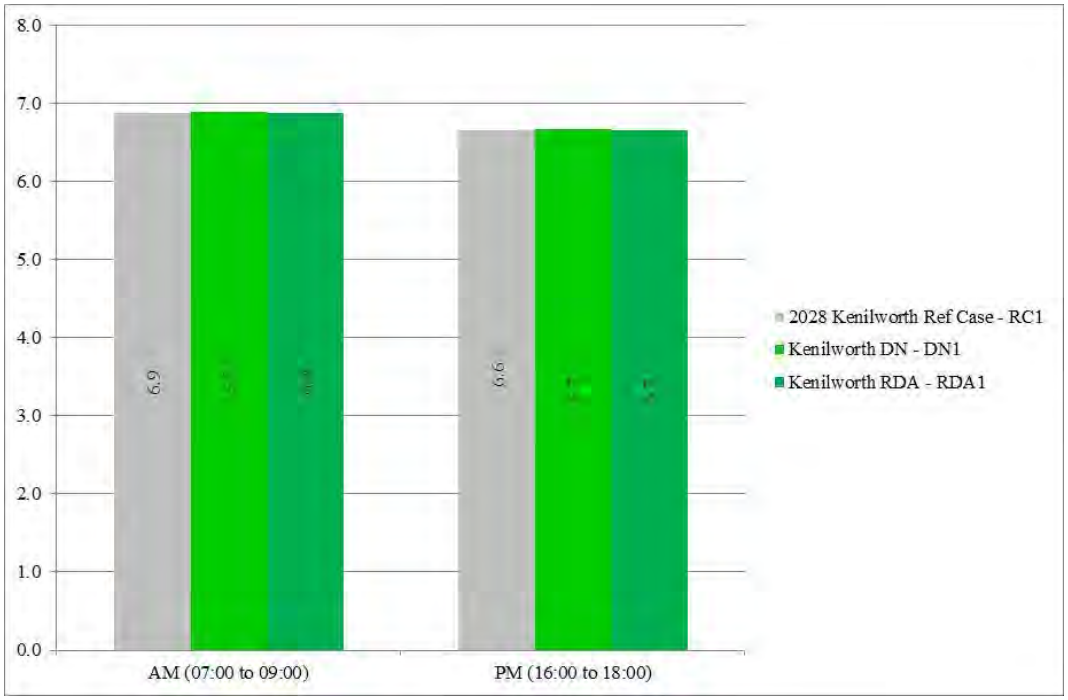
The following sets out the changes in network wide statistics between the 2028 Reference Case and the RDA scenarios.

7.3.1 Average Journey Distance

Analysis of the average journey distance within each scenario, across the entire AM and PM model periods is presented within **Figure 17** on the following page. Analysis of the figure indicates very little difference between the three scenarios.

An increase in the distance travelled may indicate an increase in the number of longer distance trips occurring within an option, or it may indicate an increased propensity for vehicles to reassign along longer routes in response to congestion. A small increase in the distance travelled will always be likely due to the need to locate most development on the periphery of the town, where land is available.

Figure 17 - Average Journey Distance (2028 Ref vs. KSWA RDA DN vs. KSWA RDA DS), Km



The differences in journey distance across the three scenarios are not considered to be significant.

7.3.2 Average Journey Speed

Analysis of the average journey speed (km/h) within the three scenarios, across the entire AM and PM model periods, is presented within **Figure 18** on the following page.

Figure 18 demonstrates that the allocation of the RDA demands is likely to result in a reduction in journey speeds between the Reference Case network and the KSWA RDA DN scenario. This reduction in journey speeds is mitigated within the 2028 KSWA RDA DS model network, as the speeds return to the 2028 Reference Case levels.

7.3.3 Average Journey Time (Seconds)

Analysis of the average journey time, in seconds, within each scenario, across the entire AM and PM model periods, is presented within **Figure 19** on the following page.

Analysis of **Figure 19** reveals that journey times within the 2028 KSWA RDA DN scenario network are between 3 and 5% higher within both AM and PM time periods when compared to the 2028 Reference Case journey times. The mitigation measures within the 2028 KSWA RDA DS network appear to mitigate some of the increases in delay and the increase in journey times within the 2028 KSWA RDA DS scenario network are less than 2% for both AM and PM model periods.

Figure 18 - Average Journey Speed (2028 Ref vs KSWA RDA DN and KSWA RDA DS Km/h

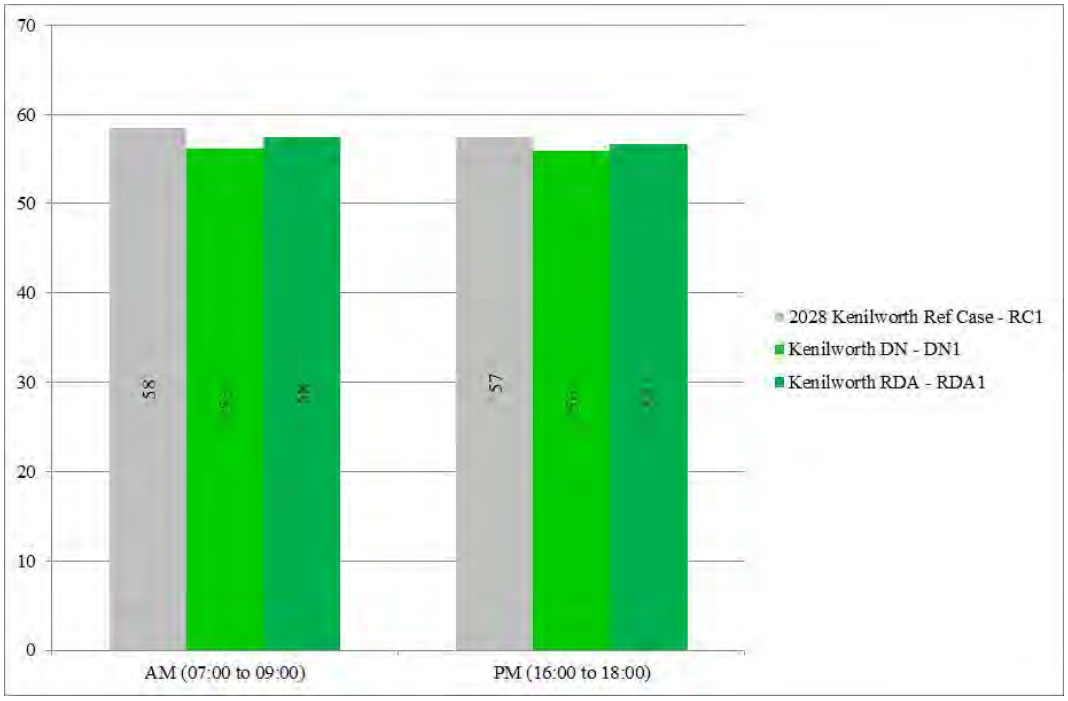
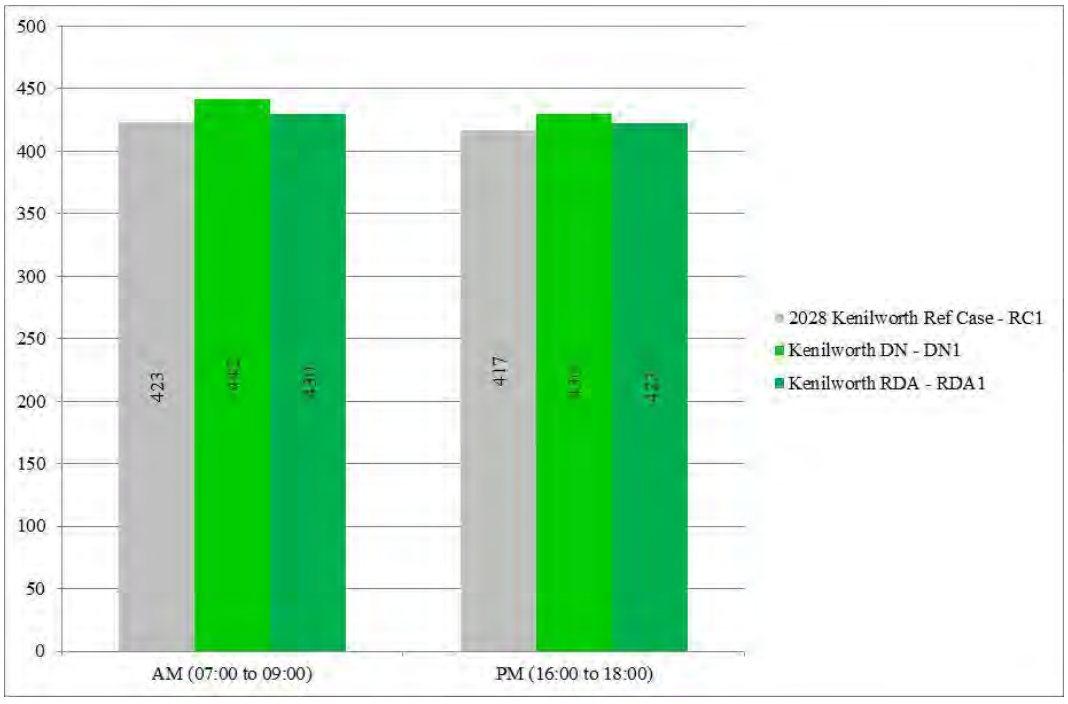


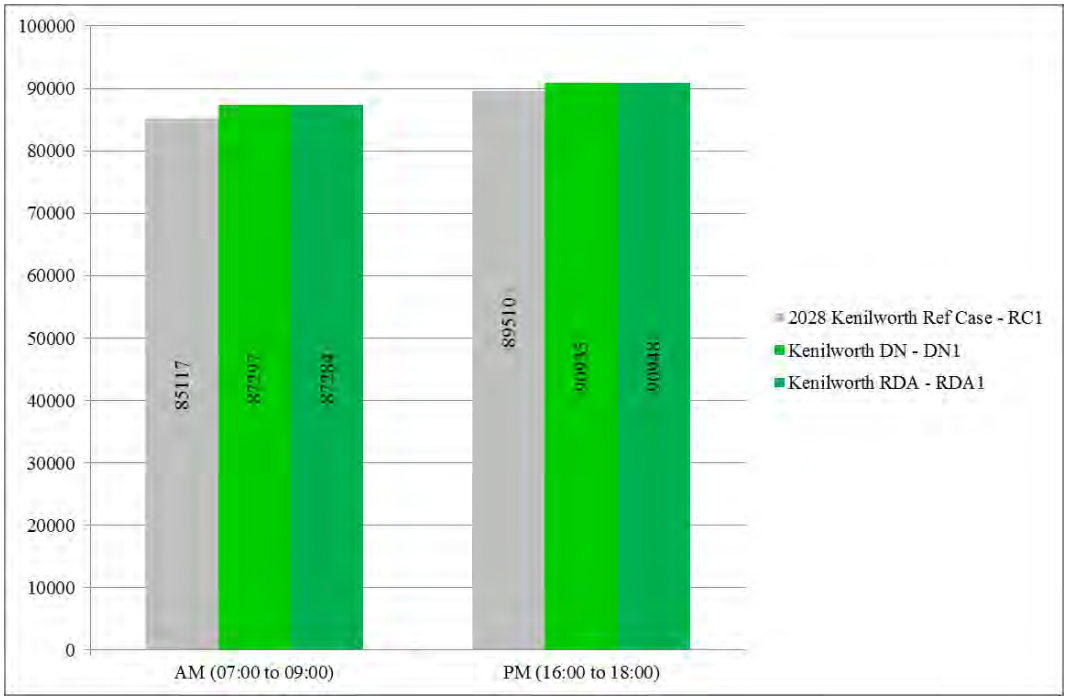
Figure 19 - Average Journey Time (2028 Ref vs KSWA RDA DN and KSWA RDA DS), Seconds



7.4 Completed Trips

Analysis of the total number of completed trips within each scenario, across the entire AM and PM model periods, is presented within **Figure 20**.

Figure 20 - Completed Trips (2028 Ref vs KSWA RDA DS and KSWA RDA DN), Vehicles



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 29**:**

Table 29 - Completed Trips Analysis (2028 Ref vs WLWA RDA and WLWA RDA +RTC)

	AM (07:00 to 10:00)			PM (16:00 to 19:00)		
	Demand	**Completed Trips**	**Completed %**	**Demand**	**Completed Trips**	**Completed %**
2028 KSWA Reference	87277	85117	97.53%	91651	89510	97.66%
2028 KSWA RDA DN	89526	87297	97.51%	93163	90935	97.61%
2028 KSWA RDA DS	89526	87284	97.50%	93163	90948	97.62%

The previous Table illustrates that, as a proportion of the demand assigned, the number of trips that are completed during the AM and PM model periods, is very similar between the three scenarios.

This indicates that, in general, the RDA demands can be accommodated within the existing network, the addition of the mitigation measures doesn't actually increase the number of trips that are completed within the simulation period but it does reduce the time it takes for these trips to be completed when compared to the 2028 KSWA RDA DN scenario network.

7.5 Maximum Queue Length Analysis

The following sets out some initial observations based on the differences in queue lengths between the 2028 KSWA Reference Case and 2028 KSWA RDA Do Something scenario.

The maps which are referred to within the following analysis are presented within **Appendix B** of this report.

7.5.1 AM Analysis (MQ005)

Analysis of the difference in queuing between the 2028 KSWA Reference and 2028 KSWA RDA DS scenario, during the AM peak hour, reveals the following:

- There is one instance of a severe increase in the queue levels at the A429 Kenilworth Road/ Gibbert Hill Road/ Stoneleigh Road junction. There is, however, a pinch point scheme proposed for this area already and, therefore, further analysis of this would be required once the proposed scheme has been delivered before any additional amendments to the junction are proposed.
- There are three instances of a queue reduction
- The majority of junctions assessed experience a negligible change in queue level (greater than -5 vehicles and less than 15 vehicles change)

7.5.2 PM Analysis (MQ006)

Analysis of the difference in queuing between the 2028 Reference and 2028 RDA DS scenario, during the PM peak hour, reveals the following:

- There are two instances of a moderate queue length increase at the junctions of Stoneleigh Road/ Dalehouse Lane and A425 Leamington Road/ Warwick Road. It is likely that the C&WG proposlas in these areas will serve to further mitigate these impacts.
- The majority of junctions assessed experience a negligible change in queue level (greater than -5 vehicles and less than 15 vehicles change)
- There are two instances of a queue reduction which includes the Thickthorn junction where a mitigation scenario has been proposed under the RDA DS scenario

7.5.3 Queue Analysis Summary

A summary of the findings obtained through comparing the changes in queuing between the 2028 Reference Case and 2028 RDA Scenario is provided as follows:

- Generally the majority of junctions assessed experience a negligible change in queue level (greater than -5 vehicles and less than 15 vehicles change) in both the AM and PM periods
- There are no instances of severe queue length increase expected in either period

- Where a queue length reduction is expected, a mitigation measure was proposed indicating the scheme is expected to perform favourably

7.6 Journey Time Analysis

The following sets out some initial observations of the mean speed plots for the two key model scenarios; 2028 Reference Case and 2028 KSWA RDA DS scenario. The comments in the remainder of this section are based on observations of the predicted changes in peak hour mean speed across links within the model area during both AM (08:00 to 09:00) and PM (17:00 to 18:00) peak hours.

The maps which are referred to within the following analysis are presented within **Appendix C** of this report whilst the specific drawing number pertaining to each element of the analysis has been provided within the accompanying title brackets.

7.6.1 AM Analysis (MD005)

Analysis of the difference in queuing between the 2028 Reference and 2028 KSWA RDA DS scenarios, during the AM period, reveals the following:

- A reduction in delay is expected along the A452 eastbound and westbound and the A45 eastbound/westbound during the AM peak period
- A greater than 50% increase in delay is expected along the A429 Kenilworth Road northbound route, similar to the queuing at the A429 Kenilworth Road/ Gibbert Hill Road/ Stoneleigh Road junction it is likely that some of these impacts may be further mitigated by the inclusion of the proposed pinch point scheme and, therefore, further analysis is would be required once the proposed scheme has been delivered before any additional amendments to the junction are proposed.
- Generally a -15 to 15% change in delay is expected along the examined routes in the AM peak period with respect to the 2028 reference scenario

7.6.2 PM Analysis (MD006

Analysis of the difference in queuing between the 2028 Reference and 2028 KLWA RDA DS scenarios, during the PM period, reveals the following:

- A reduction in delay is expected A45 northbound/ southbound during the PM peak period as well as along the A46 southbound and other sections along the east/west A45/A46 routes
- There are no instances where a greater than a 25% delay is expected
- Generally a -15 to 15% change in delay is expected along the examined routes in the AM peak period with respect to the 2028 reference scenario

7.6.3 Delay Analysis Summary

In general, the results indicate that changes in delay levels, between scenarios are likely to be variable with some areas suffering increases in delay levels whilst reductions may be achievable in other areas. It should be remembered that any

reduction in delay is achieved in spite of the general increase in demand levels across the entire network.

7.7 Conclusion

The initial comparisons between the 2028 Reference Case and the 2028 Revised Development Allocation scenarios reveal the following conclusions:

- Inclusion of the RDA demands will likely result in a relatively small increase in the average network journey times and a reduction in average speeds that vehicles are able to achieve in comparison to the 2028 Reference Case conditions
- Analysis of the trip completion ratio within both Reference Case and RDA scenarios indicates that, the network is able to accommodate the assigned demands. The mitigation measures simply act to minimise the impacts rather than enabling more trips to be completed, there is no trip suppression caused by congestion preventing traffic entering the network.
- The Do Something scenario is better able to cope with the increased demands on the network compared to the Do nothing scenario as reflected in the improved network conditions
- Without mitigation, adoption of the RDA strategy will potentially lead to a worsening of traffic conditions within the Kenilworth and Stoneleigh town areas however the proposed mitigation measures have the potential to deliver improved conditions for road users in the form of reduced queuing and, in some cases improved journey times.

8 Summary and Conclusions

8.1 Summary

Arup have been commissioned by Warwickshire County Council (WCC) and Warwick District Council (WDC) to undertake additional testing of the proposed Warwick Core Strategy (CS) allocations. This report is intended to outline the impacts of a revised approach to the allocation of growth, referred to as the 'WDC Revised Development Approach' (WDC RDA), on the Warwick and Leamington area road network.

The objectives of this fourth phase of work were as follows:

- To assess the potential impacts of the RDA on the Warwick and Leamington area road network.
- To refine the proposed Local Plan transport scheme assumptions in light of the impacts of the RDA and identify, where appropriate, areas of change compared to the previously proposed phase 3 mitigation strategy.
- To undertake a focussed assessment within the Kenilworth and Stoneleigh Wide Area PARAMICS model to assess whether the RDA is likely to trigger further mitigation within that area.
- To assess the potential impacts of adopting alternative layouts for some of the originally proposed schemes within the area of Warwick Town Centre.

In addition to the above objectives, some further refinements to the proposed mitigation measures within the Warwick and Leamington areas have been incorporated within the assessment.

The impact analysis that is presented within this report is intended to inform an assessment on the traffic impacts of the RDA strategy alongside the proposed mitigation measures. At this stage, the level of assessment does not include detailed information and analysis of each of the proposed schemes in detail. Rather it is intended to confirm what strategic elements of infrastructure are likely to be required to ensure that the allocated growth can be accommodated upon the existing network.

It is anticipated that the planning process associated with the individual sites will continue throughout the development of the Core Strategy and that each development will be supported by a separate planning application that will, in turn, be accompanied by a Transport Assessment (TA). The planning process associated with the individual sites will be expected to deal in more detail with issues such as the associated access strategies and the mitigation of localised impacts.

At this stage it should also be recognised that the purpose of this assessment is to determine an appropriate mitigation strategy necessary to accommodate all of the growth that is envisaged to occur across the duration of the plan period. Thus the mitigation proposed through this work reflects that which will be anticipated across the entire 2011 to 2029 plan period.

The modelling has been undertaken using the existing Warwick and Leamington Wide Area PARAMICS model. This has a reference year of 2028. Analysis of the

TEMPRO database identified that the difference in growth projections between 2011 to 2028 and 2011 to 2029 were minimal. The differences in the TEMPRO Warwick factors (Authority) were less than 1%. Thus, the use of the 2028 demands, in line with previous phase of the STA work, was considered appropriate.

As part of this fourth phase of the STA, the network interventions in some areas have been reviewed and, where possible, refined in response to the conditions that have been observed to occur as a result of the assignment of the RDA Demands within the model networks and the impacts thereof. In addition further amendments to the schemes have been made where concerns with regards feasibility or deliverability have arisen.

There have been some amendments to the mitigation strategy which have resulted in some schemes being removed or reduced whilst others have been added. As a result the costs associated with the majority of the mitigation measures is consistent with the previous phase of STA work whilst the costs associated with the overall mitigation strategy are also broadly consistent with those costs identified during the previous phase of STA work.

Excluding the costs associated with the Portobello Bridge capacity enhancements the following provides a breakdown of the indicative costs, by grade, of the proposed mitigation schedule:

- Grade 1 – £32,550,000
- Grade 2 – £3,950,000
- Grade 3 – £1,300,000

8.2 Conclusions

The initial comparisons between the 2028 Reference Case and the 2028 WLWA RDA scenarios reveal the following conclusions:

- Inclusion of the Revised Allocation strategy demands will likely result in an increase in the average network journey times and a reduction in average speeds that vehicles are able to achieve within the 2028 Revised Allocation network in comparison to the 2028 Reference Case conditions. These impacts occur in spite of the adoption of a proposed mitigation strategy.
- Similar impacts are observed within the 2028 WLWA RDA + RTC scenario albeit there is a further increase in the journey times experienced on the network as a result of these proposals.
- Analysis of the queuing outputs indicates that the 2028 WLWA + RDA network suffers less overall increases in queue lengths than the 2028 WLWA RDA + RTC network.
- The 2028 WLWARDA model network still suffers a number of instances of queuing levels increasing by 30 to 50 vehicles indicating that the network would benefit from further optimisation of mitigation measures and, potentially, additional schemes being included.
- Queue impacts identified within the 2028 WLWA RDA + RTC network indicates that there may be strategic impacts incurred in areas which provide alternative routes to the routes through the town centre, such as the A46 towards Longbridge Island, A452 between M40 and Leamington and Emscote Road Corridor.

- Analysis of the impacts on journey times reveals that within the AM there are some areas that experience reductions in delay and others which experience increases but those areas where the most severe increases occur appear to be in regions where there is the potential to further optimise the proposed mitigation measures to overcome the issues.
- There are further impacts accrued within the AM network as a result of the allocation of the RTC measures. This indicates that further refinement of the proposed measures is likely to be required before an optimum solution can be identified.
- The impacts within the PM both with and without the RTC measures appear to indicate little difference in performance of the two networks.

Testing undertaken within the KSWA model, between the 2028 Reference Case and the 2028 Revised Development Allocation scenarios reveal the following conclusions:

- Inclusion of the RDA demands will likely result in a relatively small increase in the average network journey times and a reduction in average speeds that vehicles are able to achieve in comparison to the 2028 Reference Case conditions
- Analysis of the trip completion ratio within both Reference Case and RDA scenarios indicates that, the network is able to accommodate the assigned demands. The mitigation measures simply act to minimise the impacts rather than enabling more trips to be completed, there is no trip suppression caused by congestion preventing traffic entering the network.
- The Do Something scenario is better able to cope with the increased demands on the network compared to the Do nothing scenario as reflected in the improved network conditions
- Without mitigation, adoption of the RDA strategy will potentially lead to a worsening of traffic conditions within the Kenilworth and Stoneleigh town areas however the proposed mitigation measures have the potential to deliver improved conditions for road users in the form of reduced queuing and, in some cases improved journey times.

Overall, the findings of this Report indicate that the potential impacts of the proposed RDA strategy will be, in part, mitigated by the proposed transport strategy but some residual impacts will still occur. Such impacts may occur through the allocation of natural growth within the network although, without the mitigation measures, the impacts may reach comparable levels at an earlier point in time.

The Report considers the impacts likely to occur at the end of the plan period based on robust trip generation assumptions and including schemes which should be considered as being relatively high level in terms of design and feasibility. Detailed work on measures which may reduce the car based trip generation, through alternative, sustainable, modes, as well as further refinement of the proposed measures, would likely reduce the impacts that have been documented within this report.

9 Further Considerations and Recommendations

9.1 Overview

The following section of this Report outlines some additional points for consideration during any future stages of assessment. Further work is only recommended once the certainty regarding the proposed sites for allocation has been established.

9.2 Mitigation Scheme Proposals

The mitigation measures presented within this work are still considered to be inception designs. The timescales and costs likely to be incurred through the detailed design process that would be required for each of these schemes, inclusion of sketches and completion of safety audits, would be both prohibitive and disproportionate to the current level of assessment as a whole. Before schemes are subject to further refinements or detailed design it is recommended that the priority for delivery of the schemes is identified in order that those schemes which are likely to be triggered during the early stages of the plan period have been fully established.

9.3 Sustainable Transport

This document has focussed on the highway network mitigation required in order to achieve an acceptable level of network performance when considering WDC Core Strategy allocation. The exercise has been based around modelling outcomes which primarily focus on car based trips. However, there are wider ranging sustainable transport issues which need to be considered in conjunction with this report

It is critical that sustainable transport improvements form part of the mitigation package to support the housing and employment growth proposals within the District. Such improvements will:

- Contribute towards the delivery of sustainable development within the District;
- Maximise the number of journeys made by sustainable transport modes from trips generated as a result of new development;
- Reduce the impact of car based travel on the local and strategic highway network;
- Deliver an integrated approach to transport provision to serve new development; and
- Contribute towards the aims and objectives of the District Council's Garden Towns, Villages and Suburbs Prospectus.

Sustainable transport is an umbrella term which includes provision of bus services, bus infrastructure, park and ride, access to rail services, walking, cycling and behavioural measures (Smarter Choices). **Appendix D** sets out what sustainable transport improvements will be sought through the planning process to support development generally within the District. Specific measures to mitigate

major development in South Warwick/Leamington Spa are also described in more detail.

9.4 Recommendations

The following outlines a series of recommendations that should be considered during any additional stages of the Strategic Transport assessment.

- Further work on calculating the costs of delivering HA network safety and capacity improvement works and an acceptable level of apportionment is recommended to be undertaken at the earliest opportunity as this represents a significant factor in the determination of the costs of delivering the associated mitigation infrastructure.
- That, once the preferred allocation strategy has been determined, consideration should be given to undertaking an assessment to confirm that the proposed mitigation will still operate within acceptable levels.
- That the potential impacts of any strategic reserve sites that come forward as part of the preferred allocation strategy are not likely to fundamentally change the nature of the mitigation that is proposed
- More detailed work is undertaken on sustainable transport requirements and the assumptions on mode share and mode shift are based on the outcome of these studies. Once the preferred allocation strategy has been identified, a sensitivity test should be undertaken to determine the importance of achieving the targets for mode share/shift and internalisation and to establish areas where further mitigation may be required should the targets, associated with the proposed sites not be realised.
- As more certainty emerges on the provision of Education facilities alongside the allocation strategy, further testing should be undertaken which includes more detailed assumptions regarding the access strategy including any additional pedestrian facilities, trip generation and the distribution thereof.
- Testing of a phased approach to the implementation of the mitigation strategy should be undertaken to determine which schemes are likely to be required at an early stage of the plan period and, conversely, which can be delivered towards the end of the plan period.

Appendix A

NTEM Table

A1 NTEM West Midlands Factors

Region: West Midlands	Urban				All Urban Roads	Rural				All	All Roads
	Urban Mway	Urban Trunk	Urban Principal	Urban Minor		Rural Mway	Rural Trunk	Rural Principal	Rural Minor	Rural Roads	All Roads
2003	1	1	1	1	1	1	1	1	1	1	1
2004	1.00565	1.00407	1.00327	1.00407	1.00407	1.00565	1.00487	1.00407	1.00487	1.00487	1.00487
2005	1.01134	1.00816	1.00656	1.00816	1.00816	1.01134	1.00976	1.00816	1.00976	1.00976	1.00976
2006	1.01706	1.01227	1.00985	1.01227	1.01227	1.01706	1.01467	1.01227	1.01467	1.01467	1.01467
2007	1.02281	1.01640	1.01316	1.01640	1.01640	1.02281	1.01961	1.01640	1.01961	1.01961	1.01961
2008	1.02859	1.02054	1.01648	1.02054	1.02054	1.02859	1.02458	1.02054	1.02458	1.02458	1.02458
2009	1.03441	1.02470	1.01980	1.02470	1.02470	1.03441	1.02956	1.02470	1.02956	1.02956	1.02956
2010	1.04026	1.02887	1.02314	1.02887	1.02887	1.04026	1.03457	1.02887	1.03457	1.03457	1.03457
2011	1.04614	1.03306	1.02649	1.03306	1.03306	1.04614	1.03961	1.03306	1.03961	1.03961	1.03961
2012	1.05205	1.03727	1.02985	1.03727	1.03727	1.05205	1.04467	1.03727	1.04467	1.04467	1.04467
2013	1.05800	1.04150	1.03322	1.04150	1.04150	1.05800	1.04976	1.04150	1.04976	1.04976	1.04976
2014	1.06398	1.04574	1.03661	1.04574	1.04574	1.06398	1.05487	1.04574	1.05487	1.05487	1.05487
2015	1.07000	1.05000	1.04000	1.05000	1.05000	1.07000	1.06000	1.05000	1.06000	1.06000	1.06000
2016	1.09020	1.06322	1.05499	1.06500	1.06588	1.08849	1.07501	1.06233	1.07323	1.07501	1.07501
2017	1.11077	1.07662	1.07019	1.08021	1.08199	1.10731	1.09023	1.07480	1.08663	1.09023	1.09023
2018	1.13174	1.09018	1.08562	1.09564	1.09835	1.12644	1.10566	1.08742	1.10019	1.10566	1.10566
2019	1.15310	1.10391	1.10127	1.11129	1.11496	1.14591	1.12131	1.10019	1.11393	1.12131	1.12131
2020	1.17486	1.11781	1.11714	1.12716	1.13181	1.16572	1.13719	1.11310	1.12783	1.13719	1.13719
2021	1.19704	1.13189	1.13324	1.14327	1.14892	1.18587	1.15329	1.12617	1.14191	1.15329	1.15329
2022	1.21963	1.14615	1.14957	1.15960	1.16630	1.20636	1.16962	1.13939	1.15616	1.16962	1.16962
2023	1.24265	1.16058	1.16614	1.17616	1.18393	1.22721	1.18618	1.15277	1.17059	1.18618	1.18618
2024	1.26610	1.17520	1.18295	1.19296	1.20183	1.24842	1.20297	1.16631	1.18521	1.20297	1.20297
2025	1.29000	1.19000	1.20000	1.21000	1.22000	1.27000	1.22000	1.18000	1.20000	1.22000	1.22000
2026	1.30785	1.20511	1.21422	1.22601	1.23513	1.28695	1.23513	1.19510	1.21600	1.23602	1.23602
2027	1.32594	1.22041	1.22860	1.24224	1.25044	1.30412	1.25044	1.21039	1.23222	1.25225	1.25225
2028	1.34428	1.23590	1.24316	1.25867	1.26595	1.32152	1.26595	1.22588	1.24866	1.26869	1.26869
2029	1.36288	1.25159	1.25789	1.27533	1.28164	1.33915	1.28164	1.24157	1.26531	1.28535	1.28535
2030	1.38174	1.26748	1.27279	1.29221	1.29754	1.35702	1.29754	1.25746	1.28219	1.30223	1.30223
2031	1.40085	1.28357	1.28787	1.30931	1.31362	1.37513	1.31362	1.27355	1.29929	1.31933	1.31933
2032	1.42023	1.29986	1.30313	1.32663	1.32991	1.39347	1.32991	1.28985	1.31661	1.33665	1.33665
2033	1.43988	1.31637	1.31857	1.34419	1.34640	1.41207	1.34640	1.30635	1.33417	1.35420	1.35420
2034	1.45980	1.33308	1.33419	1.36198	1.36310	1.43091	1.36310	1.32307	1.35197	1.37198	1.37198
2035	1.48000	1.35000	1.35000	1.38000	1.38000	1.45000	1.38000	1.34000	1.37000	1.39000	1.39000

Appendix B

WDC STA Phase 4 - Queue Analysis Plots

B1 Contents

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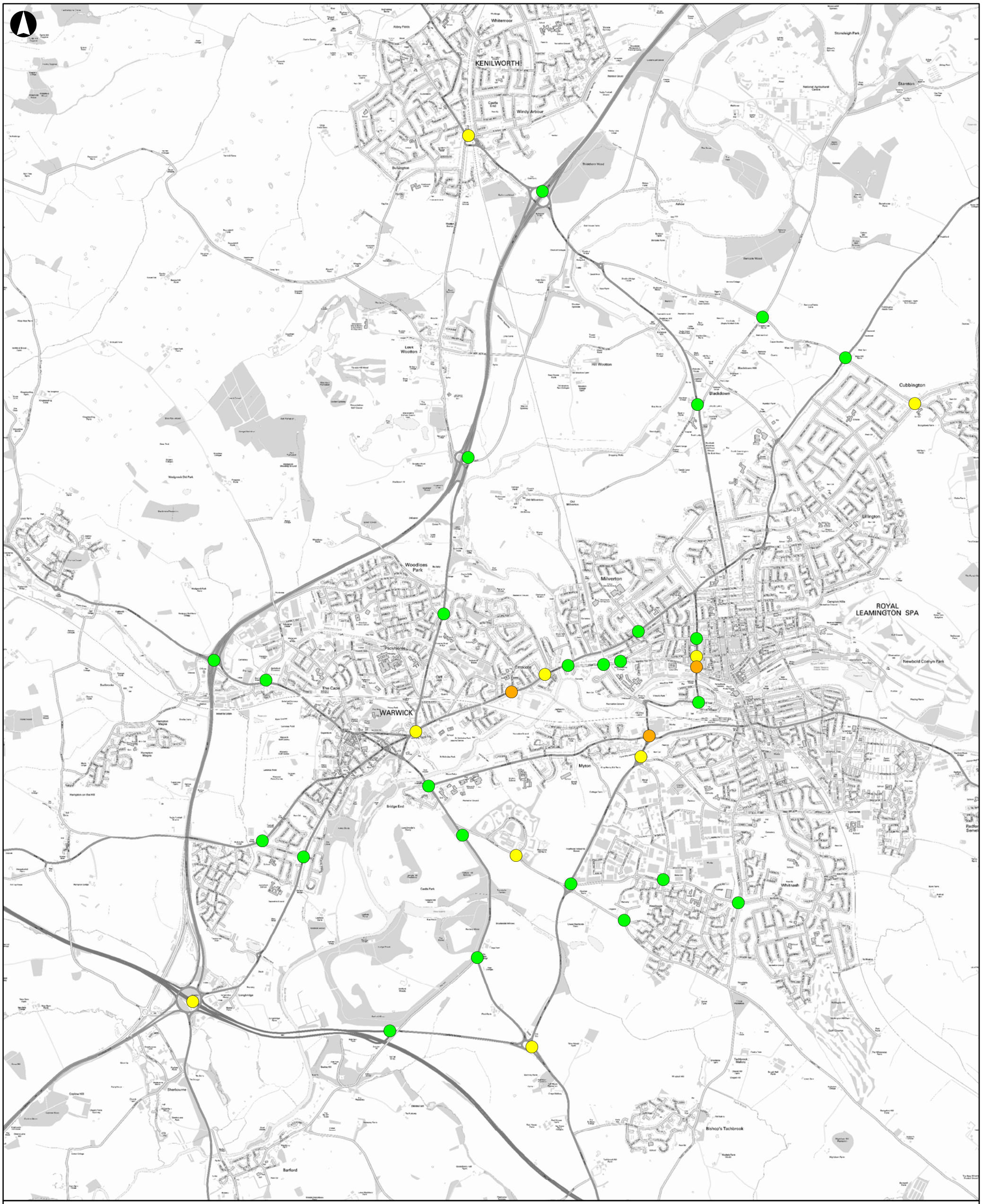

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- between + 15 and +30
- between +30 and +50
- greater than +50

Issue	Date	By	Chkd	Appd
P1	13-03-14	ZW	JE	JE

ARUP
The Arup Campus,
Blythe Gate, Blythe Valley Park
Solihull, West Midlands
B908AE
Tel +44 (0)121 213 3000
Fax +44 (0)121 213 3001
www.arup.com

Client
Warwickshire County Council

Job Title
Warwick District
Strategic Transport Assessment

Metres
0 425 850 1,700

WLWA RDA
2028 AM Peak Period
Average Maximum Queue

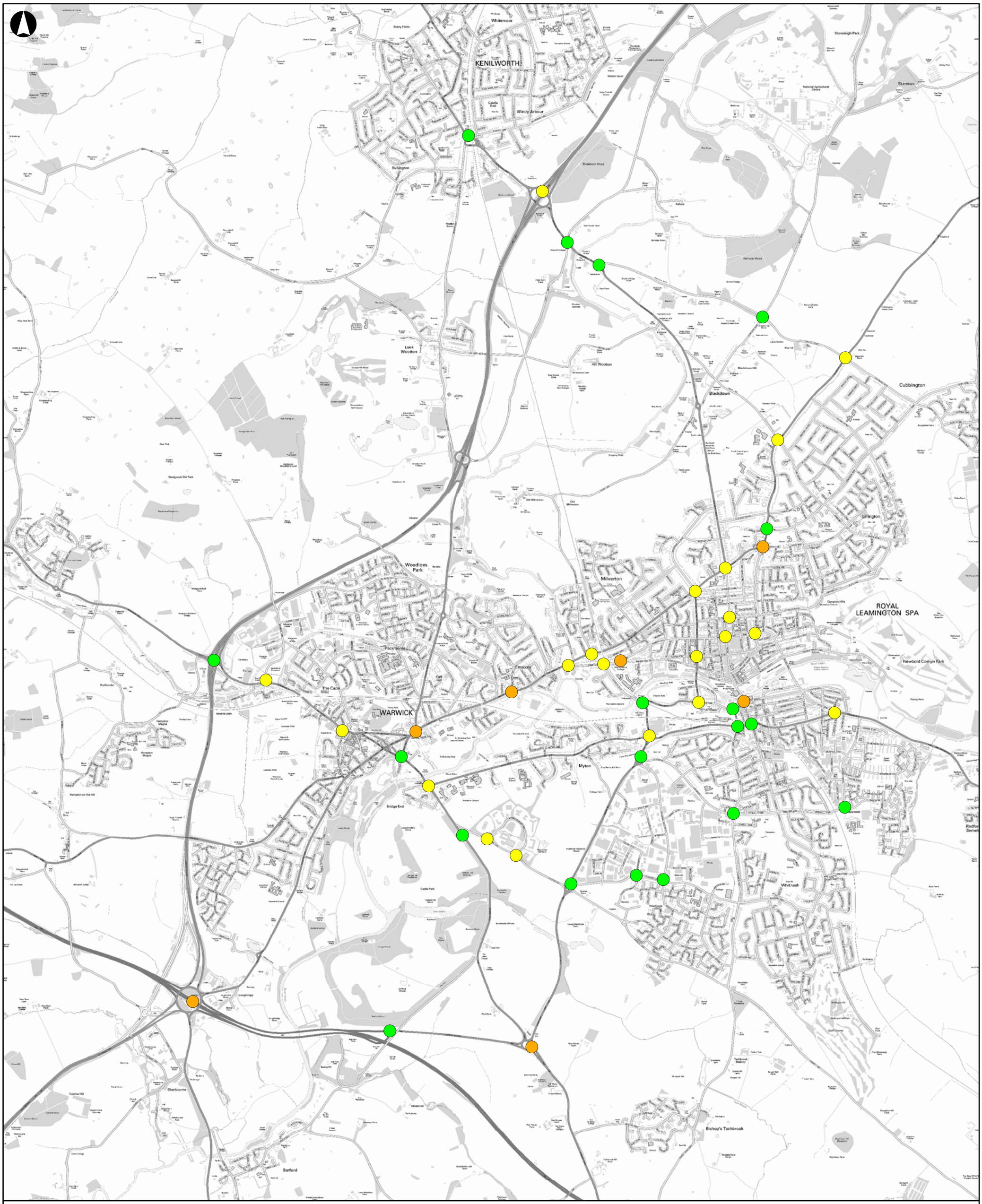
Scale at A3
N.T.S.

Job No	Drawing Status
232815-53	**Information**

Drawing No	Issue
MQ 001	**P1**

MXD Location

A3



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- greater than +50

Issue	Date	By	Chkd	Appd
P1	13-03-14	ZW	JE	JE

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Job Title
Warwick District
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Metres
0 425 850 1,700

WLWA RDA
2028 PM Peak Period
Average Maximum Queue

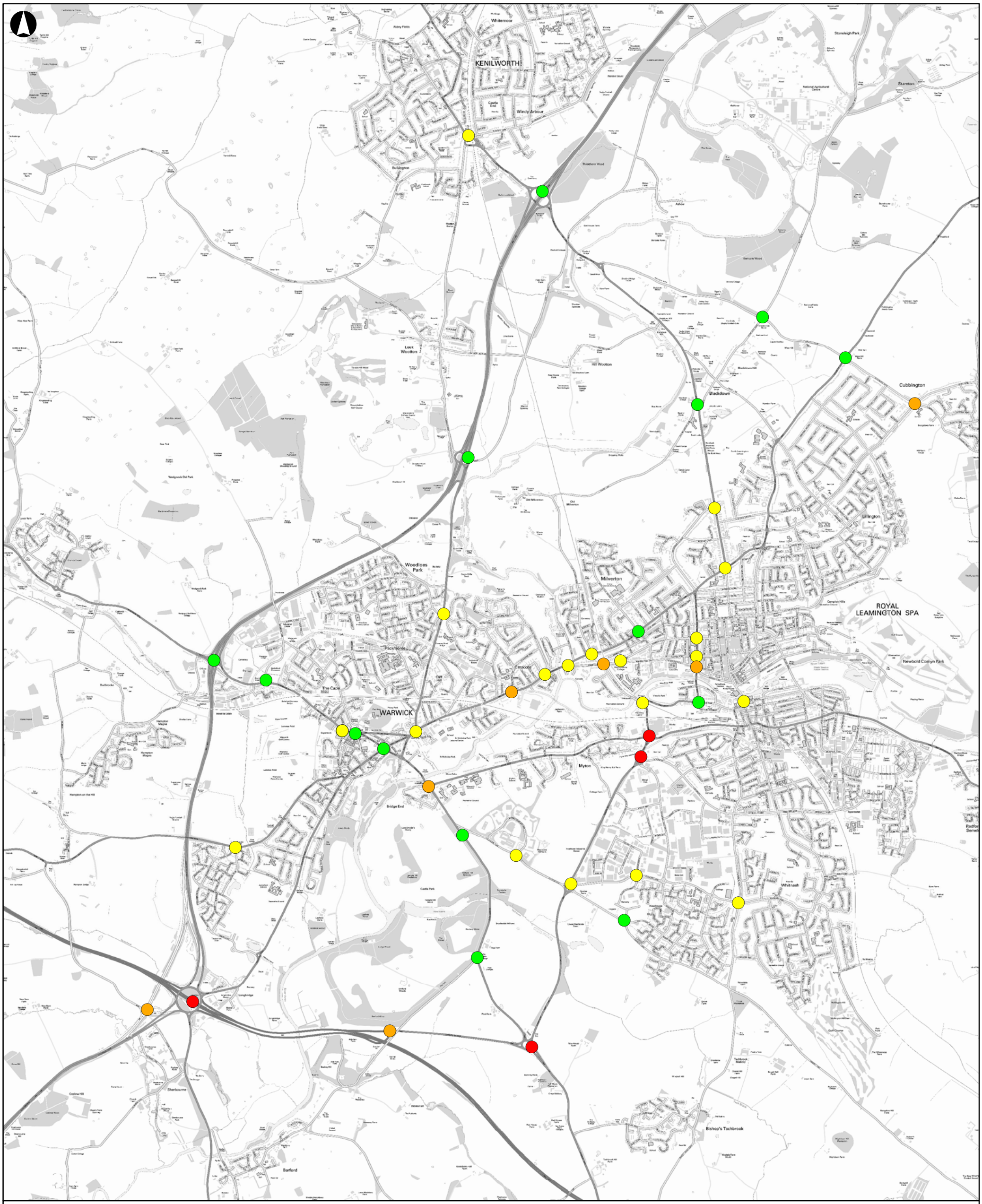
Scale at A3
N.T.S.

Job No	Drawing Status
232815-53	**Information**

Drawing No	Issue
MQ 002	**P1**

MXD Location

A3



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- between + 15 and +30
- between +30 and +50
- greater than +50

Issue	Date	By	Chkd	Appd
P1	13-03-14	ZW	JE	JE

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The Arup Campus,
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B908AE
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Client
Warwickshire County Council

Job Title
Warwick District
Strategic Transport Assessment

Metres
0 425 850 1,700

WLWA RDA + RTC
2028 AM Peak Period
Average Maximum Queue

Scale at A3
N.T.S.

Job No	Drawing Status
232815-53	**Information**

Drawing No	Issue
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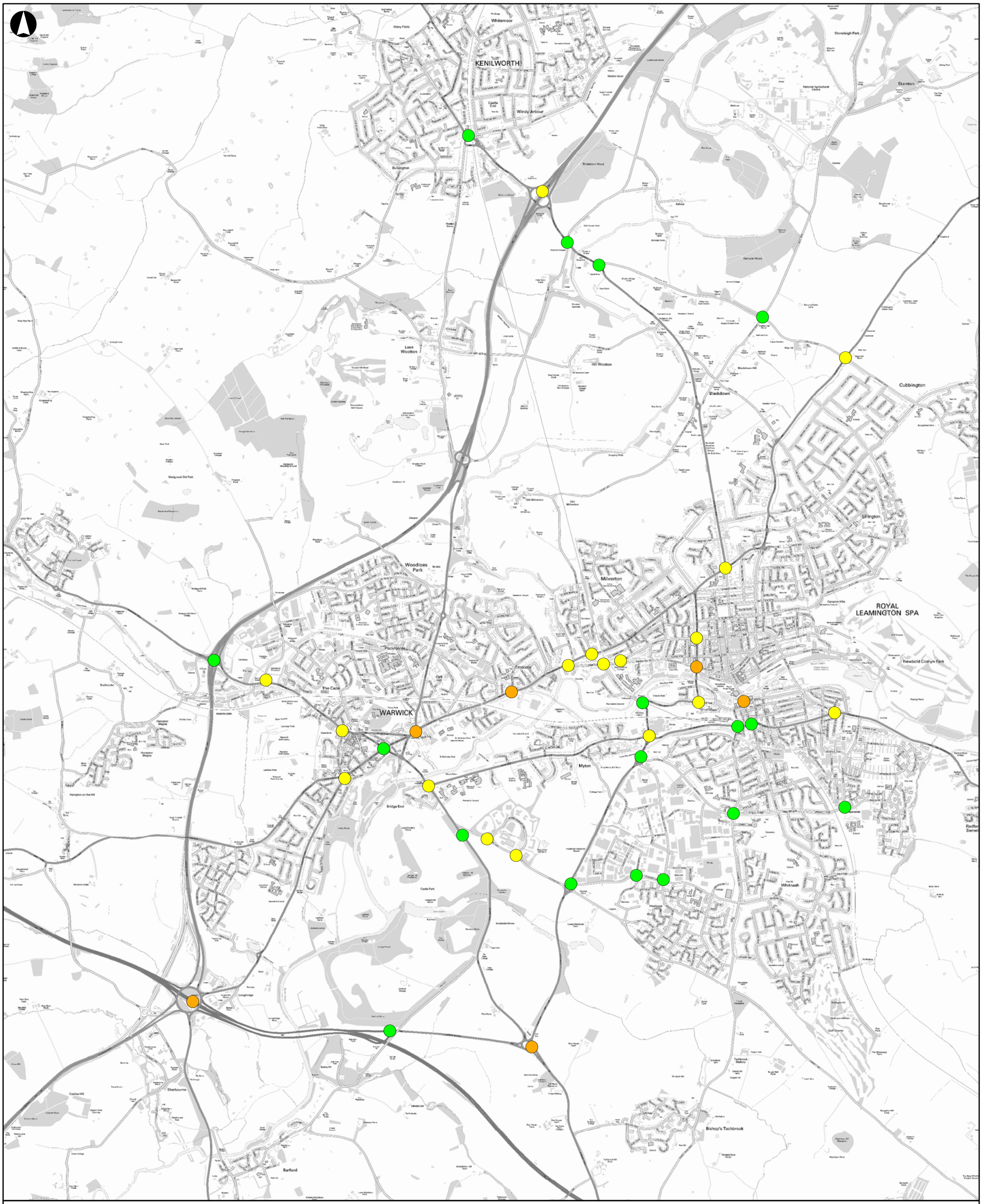
MXD Location

A3



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

Issue	Date	By	Chkd	Appd
P1	13-03-14	ZW	JE	JE

ARUP
The Arup Campus,
Blythe Gate, Blythe Valley Park
Solihull, West Midlands
B908AE
Tel +44 (0)121 213 3000
Fax +44 (0)121 213 3001
www.arup.com

Client
Warwickshire County Council

Job Title
Warwick District
Strategic Transport Assessment

Metres
0 425 850 1,700

WLWA RDA + RTC
2028 PM Peak Period
Average Maximum Queue

Scale at A3
N.T.S.

Job No	Drawing Status
232815-53	**Information**

Drawing No	Issue
MQ 004	**P1**

MXD Location

A3

Legend

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- between + 15 and +30
- between +30 and +50
- greater than +50

Issue	Date	By	Chkd	Appd
P1	13-03-14	ZW	JE	JE

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The Arup Campus,
Blythe Gate, Blythe Valley Park
Solihull, West Midlands
B908AE
Tel +44 (0)121 213 3000
Fax +44 (0)121 213 3001
www.arup.com

Client
Warwickshire County Council

Job Title
Warwick District
Strategic Transport Assessment

Metres
0 425 850 1,700

WLWA RDA + RTC Alternative
2028 AM Peak Period
Average Maximum Queue

Scale at A3
N.T.S.

Job No	Drawing Status
232815-53	**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	13-03-14	ZW	JE	JE

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The Arup Campus,
Blythe Gate, Blythe Valley Park
Solihull, West Midlands
B908AE
Tel +44 (0)121 213 3000
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Client
Warwickshire County Council

Job Title
Warwick District
Strategic Transport Assessment

Metres
0 425 850 1,700

WLWA RDA + RTC Alternative
2028 PM Peak Period
Average Maximum Queue

Scale at A3
N.T.S.

Job No	Drawing Status
232815-53	**Information**

Drawing No	Issue
MQ 006	**P1**

MXD Location

Appendix C

WDC STA Phase 4 - Journey Time Analysis Plots

C1 Contents

- **MD001** – 2028 WLWA RDA AM (08:00 to 09:00)
- **MD002** – 2028 WLWA RDA PM (17:00 to 18:00)
- **MD003** – 2028 WLWA RDA + RTC AM (08:00 to 09:00)
- **MD004** – 2028 WLWA RDA + RTC PM (17:00 to 18:00)
- **MD005** – 2028 KSWA RDA AM (07:00 to 10:00)
- **MD006** - 2028 KSWA RDA PM (16:00 to 19:00)

A3

Legend

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

Issue	Date	By	Chkd	Appd
P1	17-03-14	ZW	JE	JE

ARUP
The Arup Campus,
Blythe Gate, Blythe Valley Park
Solihull, West Midlands
B908AE
Tel +44 (0)121 213 3000
Fax +44 (0)121 213 3001
www.arup.com

Client
Warwickshire County Council

Job Title
Warwick District
Strategic Transport Assessment

Metres
0 550 1,100 2,200

WLWA RDA
2028 AM 0800-0900
Percentage Difference Mean Delay

Scale at A3
N.T.S.

Job No	Drawing Status
232815-53	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	17-03-14	ZW	JE	JE

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The Arup Campus,
Blythe Gate, Blythe Valley Park
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Fax +44 (0)121 213 3001
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Client
Warwickshire County Council

Job Title
Warwick District
Strategic Transport Assessment

Metres
0 550 1,100 2,200

WLWA RDA
2028 PM 1700-1800
Percentage Difference Mean Delay

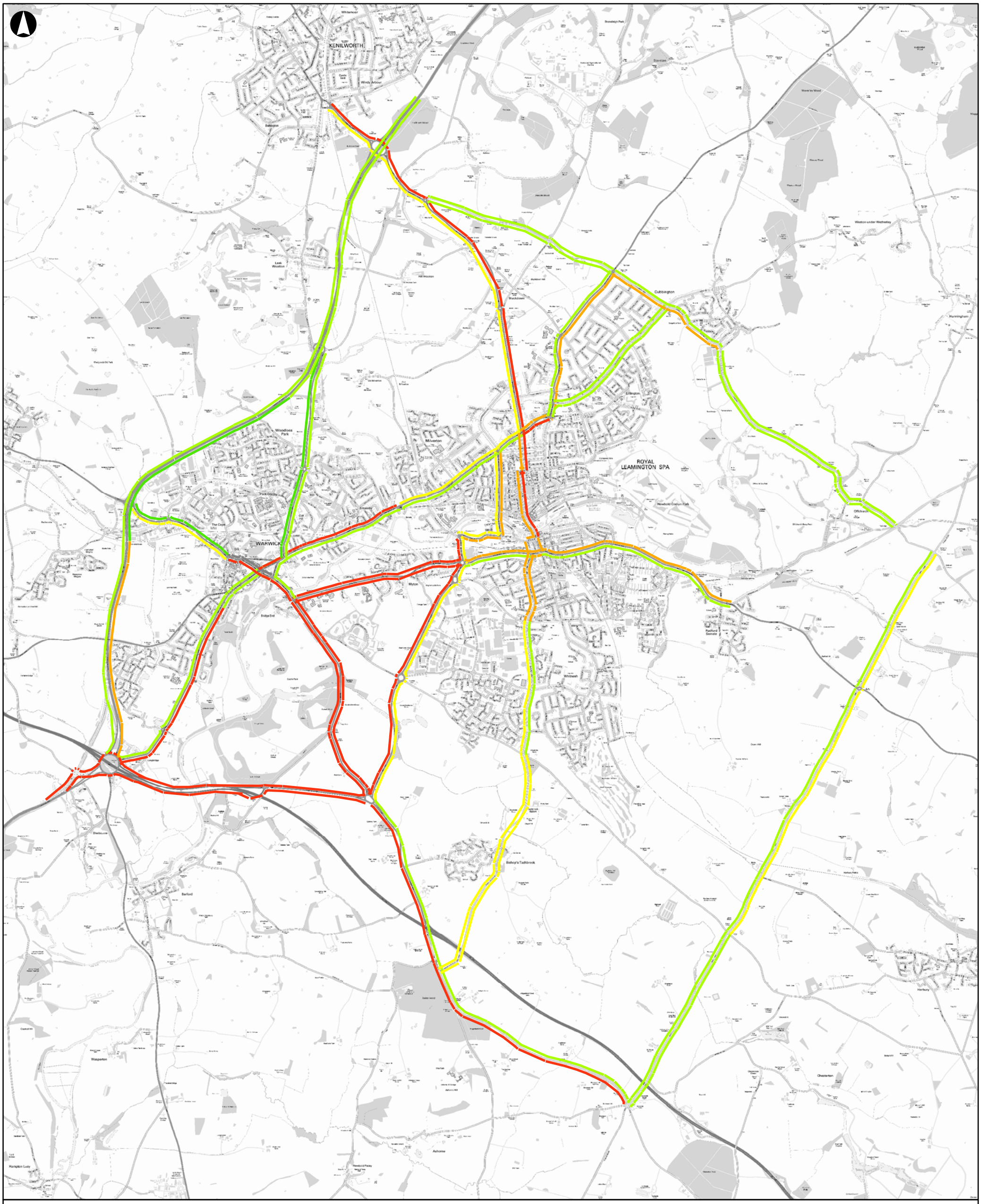
Scale at A3
N.T.S.

Job No	Drawing Status
232815-53	Information

Drawing No	Issue
MD 002	P1

MXD Location

A3



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- +50%

Issue	Date	By	Chkd	Appd
P1	17-03-14	ZW	JE	JE

ARUP
The Arup Campus,
Blythe Gate, Blythe Valley Park
Solihull, West Midlands
B908AE
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Fax +44 (0)121 213 3001
www.arup.com

Client
Warwickshire County Council

Job Title
Warwick District
Strategic Transport Assessment

Metres
0 550 1,100 2,200

WLWA RDA + RTC
2028 AM 0800-0900
Percentage Difference Mean Delay

Scale at A3
N.T.S.

Job No	Drawing Status
232815-53	Information

Drawing No	Issue
MD 003	P1

MXD Location

A3

Legend

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

Issue	Date	By	Chkd	Appd
P1	17-03-14	ZW	JE	JE

ARUP
The Arup Campus,
Blythe Gate, Blythe Valley Park
Solihull, West Midlands
B908AE
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Fax +44 (0)121 213 3001
www.arup.com

Client
Warwickshire County Council

Job Title
Warwick District
Strategic Transport Assessment

Metres
0 550 1,100 2,200

WLWA RDA + RTC
2028 PM 1700-1800
Percentage Difference Mean Delay

Scale at A3
N.T.S.

Job No	Drawing Status
232815-53	Information

Drawing No	Issue
MD 004	P1

MXD Location

A3

Legend

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

Issue	Date	By	Chkd	Appd
P1	17-03-14	ZW	JE	JE

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The Arup Campus,
Blythe Gate, Blythe Valley Park
Solihull, West Midlands
B908AE
Tel +44 (0)121 213 3000
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Client
Warwickshire County Council

Job Title
Warwick District
Strategic Transport Assessment

Metres
0 550 1,100 2,200

WLWA RDA + RTC Alternative
2028 AM 0800-0900
Percentage Difference Mean Delay

Scale at A3
N.T.S.

Job No	Drawing Status
232815-53	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	17-03-14	ZW	JE	JE

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Client
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Job Title
Warwick District
Strategic Transport Assessment

Metres
0 550 1,100 2,200

WLWA RDA + RTC Alternative
2028 PM 1700-1800
Percentage Difference Mean Delay

Scale at A3
N.T.S.

Job No	Drawing Status
232815-53	Information

Drawing No	Issue
MD 006	P1

MXD Location

Appendix D

Sustainable Transport Technical Note

Technical Note

Project title	WDC Strategic Transport Assessment Phase 4
Prepared by	Adrian Hart
Date	07th April 2014
Subject	WDC Core Strategy – Sustainable Transport Overview

Introduction

It is critical that sustainable transport improvements form part of the overall mitigation package to support the housing and employment growth proposals within the District. Such improvements will:

- Contribute towards the delivery of sustainable development across the District;
- Maximise the number of journeys made by sustainable transport modes from trips generated as a result of new development;
- Reduce the impact of car based travel on the local and strategic highway network;
- Deliver an integrated approach to transport provision to serve new development; and
- Contribute towards the aims and objectives of the District Council's Garden Towns, Villages and Suburbs Prospectus.

Sustainable transport is an umbrella term which includes provision of bus services, bus infrastructure, park and ride, access to rail services, walking, cycling and behavioural measures (Smarter Choices). This note sets out what sustainable transport improvements will be sought through the planning process to support development generally within the District. Specific measures to mitigate the proposed major development to the south of Warwick and Leamington Spa are also described in more detail.

Public Transport

Introduction

Public transport has an important role to play in supporting new development by providing genuine travel choice to residents and employees. This in turn can help mitigate the overall impact of development on the highway network by reducing the number of car trips generated as a result of growth.

Improvements to public transport can include service enhancements and investment in infrastructure. Further details of these are set out below.

Improvements to Bus Services – General

The County Council may require financial contributions towards the provision of improvements to bus services as part of all significant new development. This will generally take the form of either enhancements to existing bus services which fall within 400m walking distance of the site, or for larger sites the provision of new standalone bus services which deliver direct access to the development in question. Contributions will be sought for a minimum of five year period, net of fare box revenue. Alternatively, developers may wish to contract new or enhanced bus services directly with an operator rather than pay a contribution. Such requirements will be agreed as part of the planning process and conditioned accordingly.

New or enhanced bus services should ideally provide a minimum of a 15 minute frequency serving the development between 0630 – 1900 from Monday to Saturday, with a 30 minute frequency in evenings and on Sundays.

Improvements to Bus Services – South Warwick/Leamington Spa

As has been raised in previous submissions by the County Council, the concentration of large scale development to the south of Warwick and Leamington Spa area should facilitate the conditions required to support the introduction of a network of new and/or enhanced services that stand a reasonable chance of becoming commercially viable over time.

As such, the County Council has developed an outline specification and costing for enhancing the existing Service 68 (Cubbington to Hatton Park via Leamington Spa and Warwick) and providing a new 20 minute frequency bus service serving the proposed major development in this area. These will deliver improved links between the new development and Warwick/Leamington Spa town centres, as well as other key trip attractors such as nearby employment areas and Leamington Spa rail station. **Figure 1** provides a plan showing the proposed routes of these bus services.

Extension of Service 68 and ensuring a consistent and reliable 30 minute frequency will require the provision of an additional vehicle, at a cost of around £130,000 per year for five years. The proposed new 20 minute frequency service linking the area with Leamington Spa town centre will require three buses, at a cost of around £130,000 per bus per year for five years.

The following breakdown provides a broad indication of the level of contributions towards the delivery of these new/enhanced bus services:

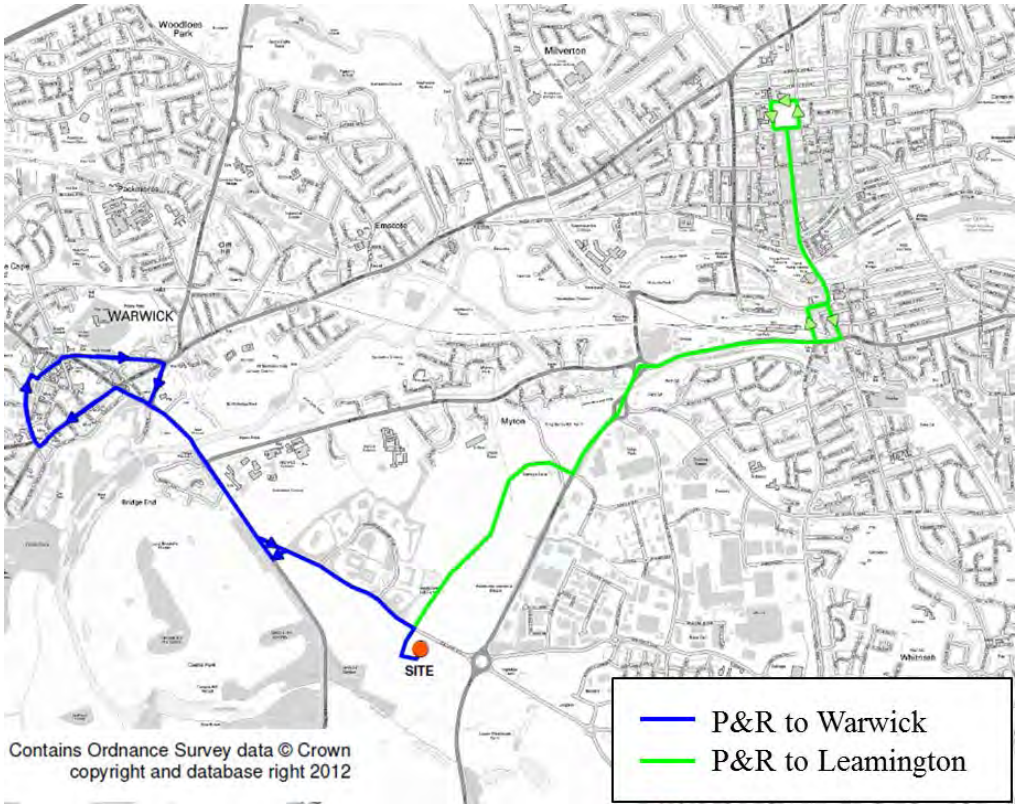
Year 1 - £416,000 (80% of total contribution)
Year 2 - £374,400 (assuming 10% reduction due to increased revenue)
Year 3 - £336,960 (assuming a further 10% increase in revenue)
Year 4 - £303,264 (assuming a further 10% increase in revenue)
Year 5 - £272,938 (assuming a further 10% increase in revenue)

This gives a total contribution of £1,703,562.

This figure will be divided by the total number of dwellings and possibly the quantum of employment delivered in the area, giving a per dwelling/per m² of residential/ employment contribution.

For example if the final housing allocation for the area was 3000 dwellings, with no allowance for employment floor space, this calculation would give a, per dwelling, contribution of £568.

Figure 1 - Park & Ride Route Assumptions



Bus Infrastructure

The principal infrastructure associated with bus service improvements are bus stops, shelters, laybys, information and priority measures.

In relation to bus stops, we would expect these to be well located in relation to the surrounding development (for example in terms of local service centres and schools), with a maximum walk distance of no more than 400m from any point within the development. In most cases bus stop poles with flags and timetable cases should be sufficient. At key stops, consideration should be given to providing a bus shelter. A commuted sum will be required for a period of five years to cover the maintenance costs of each shelter provided. Bus stop laybys are generally not required unless it is necessary for a vehicle to wait for some time at a particular point in its journey due to an operational issue (for example at the beginning or end of a route).

The County Council does not generally require Real Time Information (RTI) to be provided at bus stops and within bus shelters. However, liaison with site promoters will be undertaken to discuss the possible provision of supporting underground infrastructure, should RTI be pursued at some point in the future.

A considerable amount of work has been undertaken by the County Council to identify and test a number of potential bus priority measures to assist the operational reliability and attractiveness of bus services to/from the proposed major development area to the South of Warwick and Leamington Spa.

From the proposed southern Park and Ride facility (see below for further details) towards Leamington Spa rail station and town centre, the following bus priority measures have been identified and tested within the traffic modelling assessment:

- Bus loop detectors at the exit of the Park and Ride site and at the junction onto the Heathcote Farm development site distributor road;
- Bus lane northbound along the Heathcote Farm development site distributor road as far as the junction of Gallows Hill/Heathcote Lane;
- Bus gate at the junction of the Heathcote Farm development site distributor road with Gallows Hill/Heathcote Lane (to facilitate left and straight on bus movements);
- Bus lane on the exit from the Land west of Europa Way development site northbound, with a bus gate to provide access onto the A452 Europa Way. Bus loop detectors for the reciprocal movement from the A452 Europa Way south into the Land west of Europa Way development;
- Bus lane northbound around the western edge of the Shires Retail Park roundabout, with corresponding southbound bus lane provided as part of the hamburger design through the centre of the roundabout;
- Bus detector loops on each approach to the main access to the Ford Foundry development (Morrisons);
- Queue detector loops on all approaches to the proposed Old Warwick Road/ Lower Avenue/Spencer Street/Bath Street gyratory system; and
- Bus detector loops on the approaches to all three main junctions on the Parade (Regent Street, Warwick Street and Clarendon Avenue).

From the proposed southern Park and Ride facility towards Warwick town centre, the following bus priority measures have been identified and tested within the traffic modelling work:

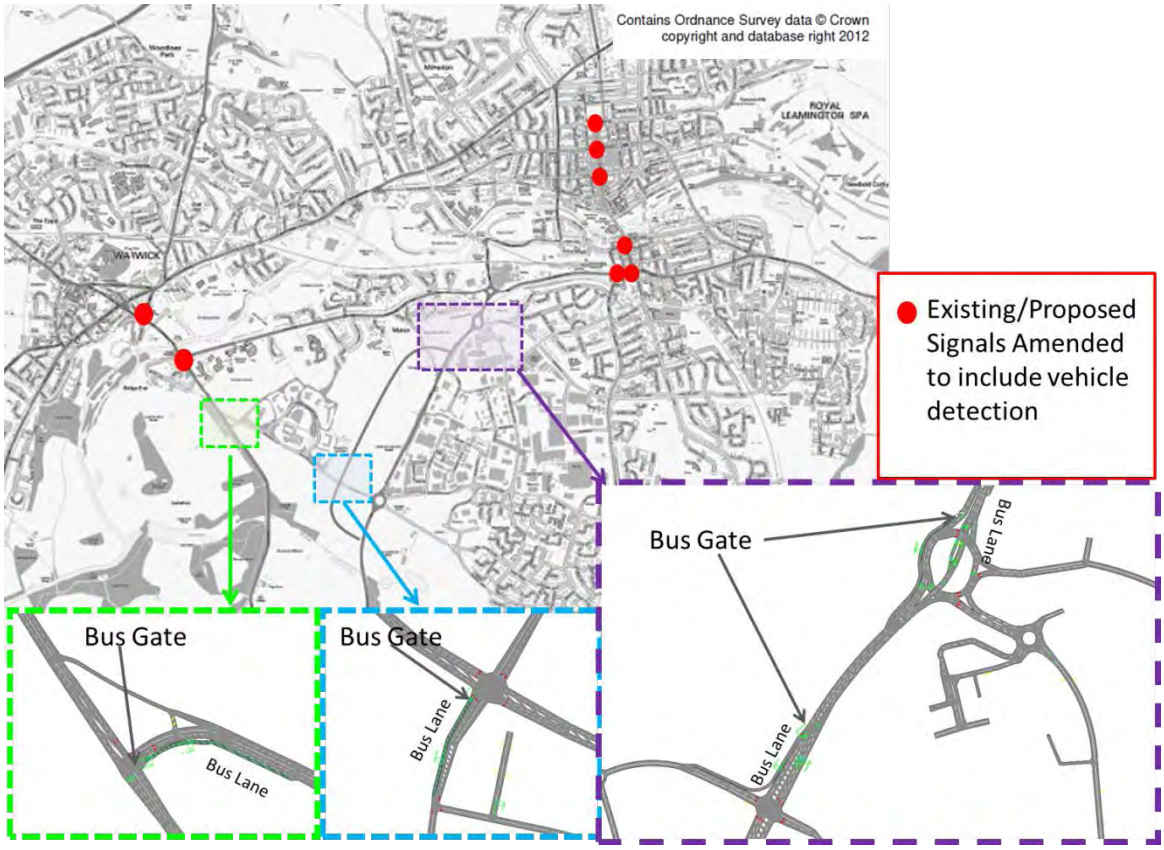
- Bus loop detector on the approach to Banbury Road from Gallows Hill/Heathcote Lane with associated bus lane;
- Bus loop detectors on all approaches to the Banbury Road/Myton Road junction; and
- Bus loop detectors at the junction of St Nicholas Church Street/Castle Hill.

There are limited further opportunities for bus priority in Warwick due to the constrained nature of the other principal junctions within the town centre.

Figure 2 provides further details regarding the location of the bus priority measures set out above. An initial assessment has been carried out regarding the impact of the bus priority measures on vehicle journey times and network performance. The findings of this work are detailed in the main report.

Further opportunities for bus priority provision elsewhere within the District will be sought as a result of new development.

Figure 2 - P&R Proposed Network Interventions



Park and Ride

The County Council has previously highlighted the opportunity for some form of Park and Ride in the vicinity of the A452 Heathcote roundabout to be delivered as a result of development to the south of Warwick and Leamington Spa. This would be served by the enhanced Service 68 and new bus services to/from Leamington town centre described above. Discussions are ongoing with a number of developers in the area regarding a specific location for the Park and Ride facility.

An opportunity exists for a complimentary northern Park and Ride facility to be provided to further mitigate the impact of development planned within the District. Even with growth focussed to the south of Warwick/Leamington Spa, the modelling work undertaken by the County Council indicates that the A452 corridor (which already carries significant volumes of traffic throughout the day and particularly at peak times) will come under further pressure as a result of growth. Work undertaken previously by the County Council as part of the SPARK Major Public Transport scheme suggested that an optimum location for a northern Park and Ride site would be between the A46/A452 Thickthorn roundabout and the A452/B4113 Blackdown roundabout. It is anticipated that the facility would be served by some or all of the existing bus services which currently use this corridor, thus delivering a highly attractive frequency of service for users. This would ideally be accompanied by bus priority measures along the route, particularly at key pinch points.

It is anticipated that any Park and Ride facility provided within the District would be constructed, owned and operated in perpetuity by the District Council as an off-street car park, given that as an Authority it controls a significant proportion of the off-street car parks in both Warwick and Leamington Spa town centres and sets the parking charges therein. Any costs associated with the subsidy and operation above and beyond the

funding provided by developers towards the bus services associated with the Park and Ride facility would also fall on the District Council.

The County Council has recently commissioned a piece of work which will review the case for Park and Ride provision as part of an overall package of measures to deliver growth and provide a wider contribution to the two town centres of Warwick and Leamington Spa.

Access to Rail Services

The principal access points to the rail network for those living or working in the District are Warwick, Warwick Parkway, Leamington Spa and Coventry. The smaller station facilities at Hatton, Lapworth and Claverdon provide important secondary facilities for local residents and the surrounding rural areas. The County Council is currently in the process of securing the necessary funding to deliver a new station at Kenilworth as part of the NUCKLE Phase 2 proposals. These will build on the Phase 1 improvements that are about to be delivered between Nuneaton and Coventry, which include new stations at Bermuda and Coventry Arena and platform extensions at Bedworth.

The principal rail head which will serve the majority of the development proposed in the Core Strategy will be Leamington Spa, which currently benefits from direct rail services to London Marylebone, Banbury, Oxford, the South Coast, Solihull, Birmingham New Street, the North West and the North East. High frequency, rapid access from the proposed growth sites in south Warwick and Leamington Spa to the rail station would be provided via the new bus services described earlier in this note, linking the proposed southern Park and Ride facility with the town centre.

Walking and Cycling

General

It is essential that high quality pedestrian and cycle routes are provided to and within all new development sites that come forward in the District.

Internal provision for pedestrians and cyclists should deliver good access to local service centres, schools and open spaces/play areas. The County Council's preference is that pedestrians and cyclists should generally be accommodated on streets rather than routes segregated from traffic. Short pedestrian and cycle only links are acceptable if well-designed where they provide short cuts or opportunities for leisure cycling or walking. Routes should also be provided as part of new 'green' corridors, with suitable links to them from within the development. Good connections to the external pedestrian and cycle network should also be provided.

In terms of other pedestrian and cycle infrastructure, crossing facilities should be considered where flows justify such provision. Toucan crossings may be required on key cycle routes. New or enhanced pedestrian/cycle signage should also be considered, particularly in terms of links to the National Cycle Network and important local facilities such as rail stations. We would expect to see good quality cycle parking provided at local service centres, schools and open spaces/play areas within development sites.

The cycle network within the Warwick/Leamington Spa area is reasonably well developed, although there are a number of missing links which would help to reinforce the overall network. Whilst some progress has been made recently to expand the cycle network within Kenilworth (including the Connect2 scheme), further investment is required to deliver a number of important routes. The most important inter-urban cycle route which is currently missing within the District is a dedicated facility between Kenilworth and Leamington Spa (often referred to as K2L). The traffic modelling work which has been undertaken has demonstrated that

there will be further pressure on the A452 as a result of growth, which reinforces the need for investment in sustainable transport measures such as this within the corridor. Completion of the cycle route between Warwick and Leamington Spa (which currently ends near Tesco on the A445 Emscote Road) is also a priority.

The County Council will seek contributions towards these cycle improvements through the proposed CIL Charging Schedule and from other sources such as the Single Local Growth Fund.

Improvements for Pedestrians and Cyclists – South Warwick/Leamington Spa

In a similar way to public transport provision, a critical mass of development in the south Warwick and Leamington Spa area should provide the circumstances whereby a meaningful internal and external network of pedestrian and cycle routes can be delivered as a result of growth.

In terms of external access, links to the following will be required:

- The schools on Myton Road;
- Warwick Town Centre;
- Warwick Technology Park;
- The employment areas to the east of Europa Way (Tachbrook Business Park, Queensway Trading Estate and Heathcote Industrial Estate);
- Shires Retail Park;
- Ford Foundry site (Morrisons);
- Leamington Spa Town Centre;
- Leamington Spa Rail Station; and
- Warwick Gates and Whitnash.

Where possible, these links should maximise use of the existing pedestrian/cycle network, in particular the facilities on Myton Road, Old Warwick Road, Queensway the Grand Union Canal towpath and the Banbury Road/Heathcote Lane/Gallows Hill route which serves Warwick Technology Park and Warwick Gates.

Demand Management

The County Council has commissioned consultants to consider a number of options regarding an 'Alternative Approach' to dealing with the forecast transport impacts within Warwick and Leamington Spa town centres. The study will draw upon the measures highlighted in this technical note and take account of the identified Local Plan highway infrastructure mitigation measures. The study will consider the likely reductions in traffic movements between origins and destinations as a response to improved mode choice opportunities and rerouting of traffic.

The Local Plan highway infrastructure measures identified in the STA are considered fit for purpose, in that they achieve the objective of mitigating the impacts of Local Plan growth within the Warwick and Leamington Spa area. As such, the transport strategy to be adopted to mitigate the Local Plan is in no way dependent on the outcomes of this study. Rather, it may prove possible to further reduce the levels of congestion demonstrated within the STA through considered targeting of initiatives to reduce the demand for vehicular road space within the two town centres.

The study will draw on a number of measures and policy interventions, including:

- Park and Ride
- Bus priority
- Improved facilities for pedestrians and cyclists
- Smarter Choices initiatives
- Changes to parking charges, supply and designation (long/short stay)
- Low Emission Zones
- Worplace Parking Levy

Smarter Choices

In order to reinforce the investment in public transport, walking and cycling described in this section of the report, the County Council would expect to see the parallel deployment of a range of behavioural measures (also known as Smarter Choices) as part of the growth proposals across the District.

Examples of such measures include:

- Workplace Travel Plans (in respect of sites generating in excess of 100 jobs);
- Sustainable Travel Packs for new residents;
- Personalised travel planning;
- Travel awareness campaigns;
- Public transport information and marketing;
- Car clubs;
- Car sharing schemes; and
- Teleworking, teleconferencing and home shopping.

Adrian Hart

Appendix E

Warwick STA Phase 3
Addendum 1 – M40 Assessment

Warwickshire County Council

Warwick Strategic Assessment

Warwick STA Phase 3 Addendum 1 - Managed Motorways

211439-19.R013

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Ove Arup & Partners Ltd
The Arup Campus
Blythe Gate
Blythe Valley Park
Solihull B90 8AE
United Kingdom
www.arup.com

Warwickshire County Council

ARUP

Contents

Appendices

1 Introduction

1.1 Overview

Arup have been commissioned by Warwickshire County Council (WCC) and Warwick District Council (WDC) to undertake a sensitivity test pertaining to the current core strategy assumptions with a view to understanding the strategic implication of the delivery of Managed Motorways alongside WDC's Local Plan Allocations.

1.2 Background

This report is part of series of reports that have been compiled as part of the Strategic Transport Assessment work which is intended to outline the potential implications of the delivery of WDC's Local Plan allocations.

This report is intended to serve as an addendum to the Warwick District STA Phase 3 modelling report. The allocation of growth and the assumptions contained within the modelling thus far have all been documented within the main STA Phase 3 modelling report.

The Phase 3 Report outlines the allocation strategy assumed within the modelling alongside 27 proposed transport interventions, inclusive of an assumption regarding the implementation of Managed Motorways (MM) Between M40 J15 and J12.

The need for the delivery of MM was first identified within the WDC Phase 2 STA. This work looked at two potential allocations of growth namely:

- The Preferred Option
- The Southern Focus

The second phase STA indicated that there was a likely need to deliver MM irrespective of the allocation strategy that was adopted.

This assumption appears to have been reaffirmed within the third phase of STA testing.

It should be recognised that the assumptions regarding the inclusion of MM measures within the modelling are, at this stage, fairly simplistic. It is likely that a detailed assessment of the impacts of delivering MM measures may, at a later stage, be required but the accurate coding of speed and flow related changes in modelling parameters, during the simulation period, is likely to require the adoption of the S-PARAMICS ATM controller. It is highly unlikely that such a detailed approach would be conducive to the strategic level modelling that is currently being used to inform the analysis and, as a result, no changes to the method of coding have been incorporated at this stage of analysis.

1.3 Objectives

The purpose of this assessment is as follows:

- To determine the likely severity of impacts that could be incurred should MM not be delivered.
- To begin to understand which elements of growth are likely to trigger the need for the implementation of MM
- To assess the predicted traffic types utilising the M40 at upon delivery and completion of the local plan (2028)

1.4 Methodology

In order that the objectives of this stage of the STA can be addressed, a phased approach to the assessment has been undertaken as follows:

- **Stage 1 –** The first stage of the assessment involved the removal of MM measures within the current WDC Revised Allocation model, the purpose of this was to understand the implications of removing MM on the wider level of network performance.
- **Stage 2 –** The second stage of the assessment was to remove the external growth in demand that had been allocated to both M40 and A46 'through trips' alongside the removal of the MM measures.
- **Stage 3 –** The third phase of the assessment reviewed the flow levels predicted along sections of the M40 to understand the contributing factors to the need for delivery of mitigation measures within this area

The purpose of the first stage of the assessment is to understand the implications on the WDC Transport Network should MM not be delivered within the local plan period. The rationale behind this is to understand the potential impacts associated with the delivery of the allocated sites without MM.

If removing MM results in severe impacts in certain areas then, depending upon the severity of these impacts, this may indicate areas where additional mitigation may be required in lieu of the MM measures. If the impacts are perceived to be severe but manageable then this may indicate that delivery of MM measures are necessary but can be considered towards the end of the local plan period.

The purpose of the second stage of this assessment is to begin to understand how much of the need for MM is related to the growth allocated through the local plan. It is reasonable to conclude that one of the primary triggers for the delivery of MM is existing traffic levels on the network. In addition to existing traffic levels, various traffic types have been forecast to increase on the MM and these include:

- Committed developments
- HGV's
- Growth in Background demand

The methodology for forecasting demand with the models has been documented, in detailed, within the 2018/2028 Model development report[1] as well as the STA Phase 3 modelling Report[2]. The growth in background demand that has been included within the modelling relates only to the growth in external trips. These

[1] R115196.R002 WarLeam Future Year Development Report, JMP Consultants, May 2012
[2] 211439-19.R012, Warwick STA – Phase 3 Assessment, Arup, 22 May 2013

are trips from which both the origin zone and the destination zone are considered to be external zones, these external zones are zones that lie on the periphery of the model network and are responsible for loading trips onto the model network. Most often these zones represent the Strategic Road Network whilst some represent the more rural road network on the edges of towns.

The second stage of the assessment aims to determine the level of impact on the Strategic Road Network (SRN) that is attributable to growth associated with the Local Plan and it aims to do this by removing the growth in external trips between the A46 and M40 zones. SRN routes represent routes of significance, either trunk or motorway roads, that are used to facilitate trips across longer distances than rural and local roads. The growth in demand levels between the A46 and the M40 have been removed from the model, alongside the MM measures and the scenarios have been rerun to understand the potential impacts thereof. The purpose of targeting the removal of external growth in this way, rather than simply removing all external growth from the model, is that the assessment will still contain some element of growth on the SRN, not related to the Local Plan. This residual growth is likely to displace at least some of the local plan demand onto the local road network rather than being retained on the SRN. The SRN growth that is being removed however is that which WDC has no control over and, as such, it is reasonable to understand what the impacts are without such growth being accounted for within the model network, irrespective of the fact that such a scenario would never materialise.

The purpose of the third stage of the assessment is simply to quantify some of the demand assumptions that have been assigned to the M40 within the modelling in order to further understand the traffic levels on the M40 which are perceived as contributing to the need for MM in the area.

1.5 Model Scenarios

The following model scenarios have either been derived or interrogated as part of this analysis:

- **2028 Reference Case –** The WDC 2028 PARAMICS Reference case model which includes background forecasts to 2028 but no account of either local plan growth or the associated infrastructure amendments.
- **2028 WDC STA RA –** The above scenario with the WDC Core Strategy Allocated Sites and 27 key infrastructure measures incorporated within the model network
- **2028 WDC STA RA WMM –** The previous model scenario with the MM scheme removed from the model network (Without Managed Motorways)
- **2028 WDC STA RA WSRN –** The 2028 WDC STA RA MM model scenario with the forecast growth in trips between the M40 and A46 SRN zones removed from the assessment (Without SRN Growth)

1.6 Report Structure

The remainder of this report is set out as follows:

- **Section 2** – provides an overview of the results extracted from stages 1 and 2 of the assessment.

- **Section 3** – presents the findings from the third stage of the assessment.
- **Section 4** – outlines the summary and any conclusions.

2 Managed Motorway Testing

2.1 Scenario Overview

The first phase of testing involved the removal of the assumptions pertaining to the adoption of MM from the existing WDC STA PARAMICS model network. The network between J15 and J14 was reverted back to reflect the layout and calibration assumptions adopted within the 2028 Reference Case. The 26 remaining infrastructure schemes identified through earlier stages of the STA have, however, all been retained.

Once the 2028 WDC STA RA WMM (Without Managed Motorways) model network had successfully been produced, the next stage was to isolate out the growth in vehicle trips specifically attributable to journeys between the A46 and M40.

External growth has been retained within the modelling within a separate matrix level (level 5). To derive the sensitivity test, the external growth between the following zones has been removed from the model matrices:

- M40 West of J14 – Zone 512
- M40 East of J15 – Zone 517
- A46 South of J15 – Zone 516
- A46 North of Thickthorn – Zone 504

The growth in vehicular trips between these zones was reduced to zero. The resultant changes in external growth levels are summarised within the following **Table 1**:

Table 1 - External Growth Totals Pre/Post SRN Adjustment

Period	Pre – Adjustment Totals	Post- Adjustment Totals	Difference	
			Veh.	%
AM (07:00 to 10:00)	7246	1478	-5768	-79.6%
PM (16:00 to 19:00)	7257	1628	-5629	-77.6%

Analysis of the previous table reveals that the trips between the M40 and A46 constitute a significant proportion of the overall, external growth levels, assigned within the model. The impact on demand levels across all matrix levels, as a result of this reduction, is summarised for both AM and PM periods, within the following **Table 2:**

Table 2 - Model Demand Totals Pre/Post SRN Adjustment

Period	Pre – Adjustment Totals	Post- Adjustment Totals	Difference	
			Veh.	%
AM (07:00 to 10:00)	134412	129944	-4469	-3.3%
PM (16:00 to 19:00)	145864	141059	-4805	-3.3%

The previous table demonstrates that net demand within the 2028 WDC STA WSRN (Without SRN Growth) model reduces by around 3% across both time periods when the through trips have been removed.

2.2 Results Analysis

The following sets out the initial results analysis based on extracts form the aforementioned scenarios. With the exception of the average delay analysis, which is based on AM and PM peak hour data, results are based on the entire AM and PM modelled periods (07:00 to 10:00 and 16:00 to 19:00).

2.3 Network Wide Performance Measures

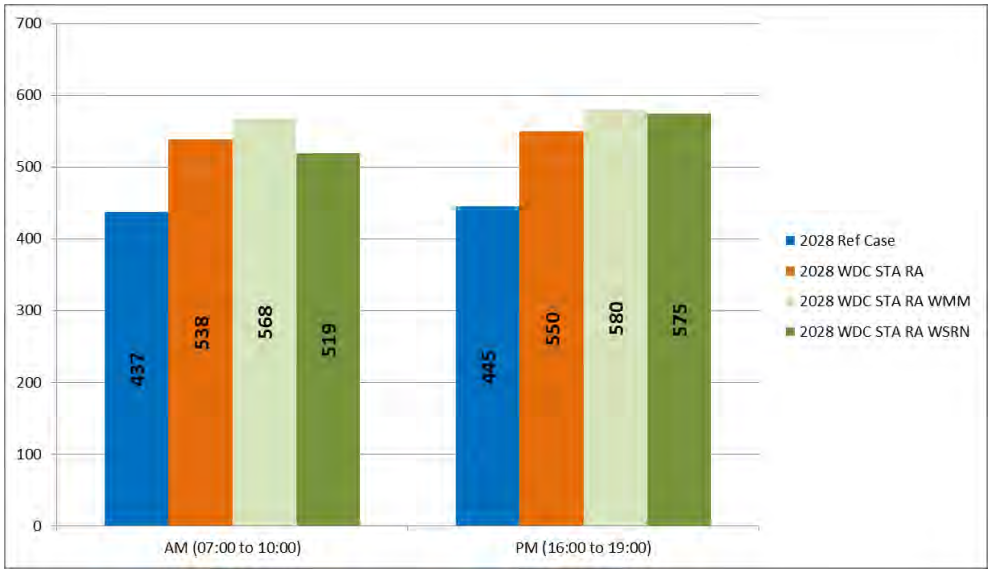
Once each of the scenarios had been fully derived some initial strategic analysis was undertaken to understand the network wide performance levels within each scenario. These strategic measures focussed on the following:

- **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.

2.3.1 Average Journey Time

Analysis of the difference in the average journey times (in seconds) between the four scenarios has been illustrated within the following **Figure 1**:

Figure 1 - Average Journey Time (Seconds), 2028 Ref vs. 2028 STA vs. 2028 STA WMM vs. 2028 STA WSRN



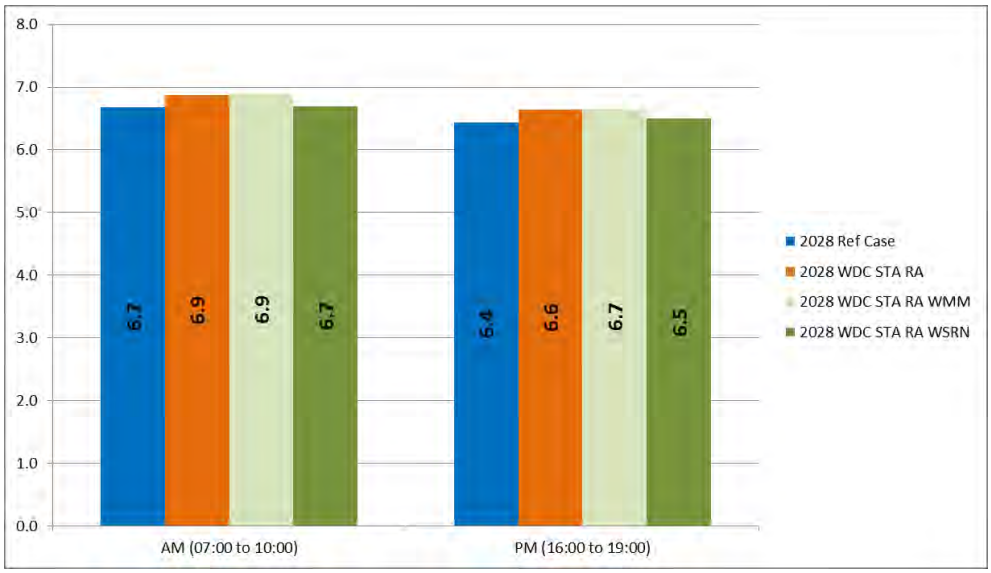
Analysis of the previous figure demonstrates that the average delay experienced by vehicles travelling through the model network increases when the MM measures are removed. When the SRN growth is removed from the model scenario there is a reduction in delay levels contained within the AM and the PM albeit the PM reduction is of a much smaller magnitude.

The increase in delay when the MM measures are removed represents an increase of around 30% when compared to the Reference Case conditions. When considering the scenario in which external growth has been reduced, this increase drops to around 20% in the AM but is retained at around 30% within the PM.

Average Journey Distance

Analysis of the difference in the average journey distance (in kilometres) between the four scenarios has been illustrated within the following **Figure 2**:

Figure 2 - Average Journey Distance (Kilometres), 2028 Ref vs. 2028 STA vs. 2028 STA MM vs. 2028 STA SRN



Analysis of the previous figure indicates that there is little impact on journey distances when the MM measures are removed within the AM. Within the PM the removal of MM measures results in a minor increase in the average journey distance. Within the scenario in which external growth has been reduced the average journey distances reduces. This is likely to be reflective of the fact that the trips that have been removed from the model network tend to travel longer distances in the first place rather than indicating a reduction in the level of reassignment that occurs when the growth is removed.

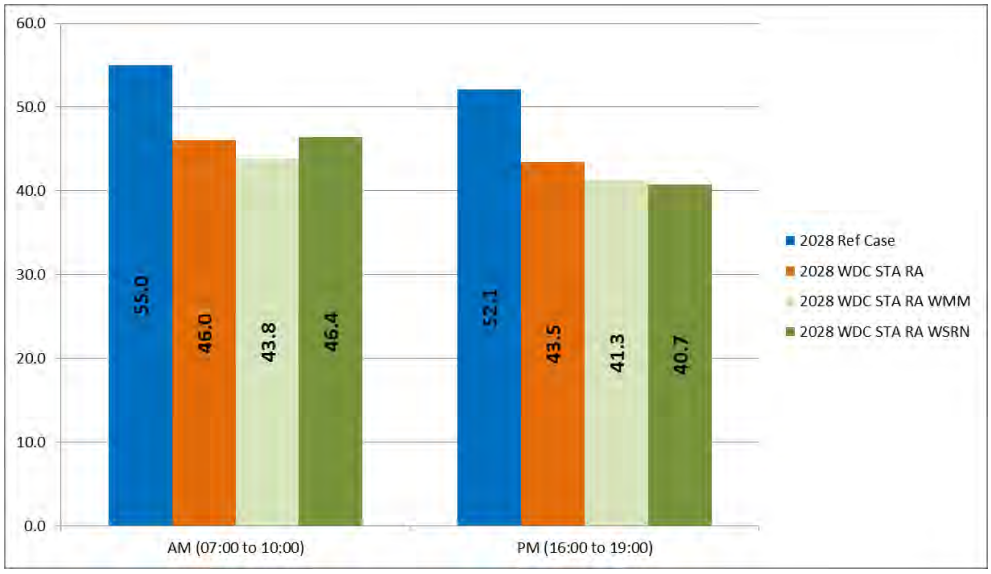
2.3.2 Average Vehicle Speeds

Analysis of the difference in the average vehicle speeds (in kilometres per hour) between the four scenarios has been illustrated within **Figure 3** on the following page.

Analysis of **Figure 3** reveals that in the AM the average speeds drops when the MM measures are removed but then the average speeds increase again when the growth is removed. Within the PM average speeds again drop, although by a

smaller magnitude, when the MM measures are removed. When growth is removed there is a further, small, drop in average speeds.

Figure 3 - Average Journey Speed (Kph), 2028 Ref vs. 2028 STA vs. 2028 STA MM vs. 2028 STA SRN



2.3.3 Completed Trips

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 3**:

Table 3 Completed Trips Analysis (2028 Ref vs. 2028 RA)

	AM (07:00 to 10:00)			PM (16:00 to 19:00)		
	Demand	**Completed Trips**	**Completed %**	**Demand**	**Completed Trips**	**Completed %**
2028 Ref	127250	122864	96.6%	136667	131524	96.2%
2028 RA	134412	129383	96.3%	145864	137886	94.5%
2028 RA - WMM	134412	129021	96.0%	145864	135143	92.7%
2028 - MM -WSRN	129944	125130	96.3%	141059	132760	94.1%

Analysis of the previous Table reveals that there is a reduction in the number of trips that are completed within the model network as a result of the removal of the MM measures. The most substantial drop in the rate of trip completion, as a result of removing MM measures, occurs within the PM period.

When the growth is removed from the network the number of trips that are completed increases again compared to the 2028 WDC STA RA WMM scenario. Within the AM the proportion of completed trips is directly comparable to the situation within the WDC STA RA model scenario whilst, within the PM, the proportion of trips which are completed is only marginally lower.

2.3.4 Network Wide Performance Measures – Summary

Analysis of the difference in network wide performance indicators between the four key scenarios reveals the following:

- That average delay increases across the network when MM is removed. When the SRN growth is removed as well however, levels of delay within the AM period reduce substantially and are, in fact lower than those observed within the 2028 WDC RA scenario network. Whilst a reduction in delay occurs within the PM as well it is of a relatively small magnitude.
- That the average journey distance increases when MM measures are removed and reduces when the SRN growth is removed. The former increase is likely to indicate that including the MM measures encourages vehicles to travel more direct routes between origin and destination zones (less direct routes occur as a result of vehicles reassigning in response to downstream congestion). The latter increase is considered to be more indicative of the removal of some 'longer distance' trips rather than being related to congestion effects on the model network.
- Furthermore, average speeds are also observed to drop when MM measures are removed and, correspondingly, speeds increase within the AM when SRN growth is also removed. Within the PM however, there is a further reduction in speeds that occurs when the SRN growth is removed. Initially this is considered to be reflective of the fact that the levels of demand within the town centres of Warwick and Leamington are at such levels that there are a large number of slow moving platoons of vehicles which traverse wide areas of the network. The average speeds in these areas are substantially lower than the average speeds that vehicles achieve on the M40 either with or without MM in place. By removing the additional demand that travels along the M40 these average speeds are discounted from this analysis. Furthermore, if, in the PM removing the SRN growth does not significantly increase speeds on the M40 then this will simply mean that more vehicles with higher than average speeds will have been removed from the model network which, in turn will bring down the cumulative average speeds.
- The analysis of the completed trips reveals that the removal of managed motorways results in a drop in the number of trips that are completed within both AM and PM time period. Whilst the number of vehicles released onto the model network remains consistent between the WDC STA RA and WDC STA RA WMM scenarios the number of vehicles that complete the entire journey reduces by 0.3% and 1,5% respectively. When the SRN growth is removed the trip completion rate reverts to the levels experienced within the WDC STA RA scenario. This is particularly important when considering that the network wide performance measures seem to indicate that there is little difference between either WDC STA RA WMM **or** WDC STA RA WSRN scenarios when considering average journey times or average vehicle speeds, thus it would be reasonable to assume that the level of performance across the two scenarios is broadly similar, however an increase in the rate of trip completions when the SRN growth is removed is indicative of improved conditions as vehicles are able to traverse the network at a higher rate.

2.4 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 AM and PM model periods (07:00 to 10:00 and 16:00 to 19:00)

At this stage the analysis of queue lengths has been based on the average of the 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 **Figure 4** on the following page.

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:

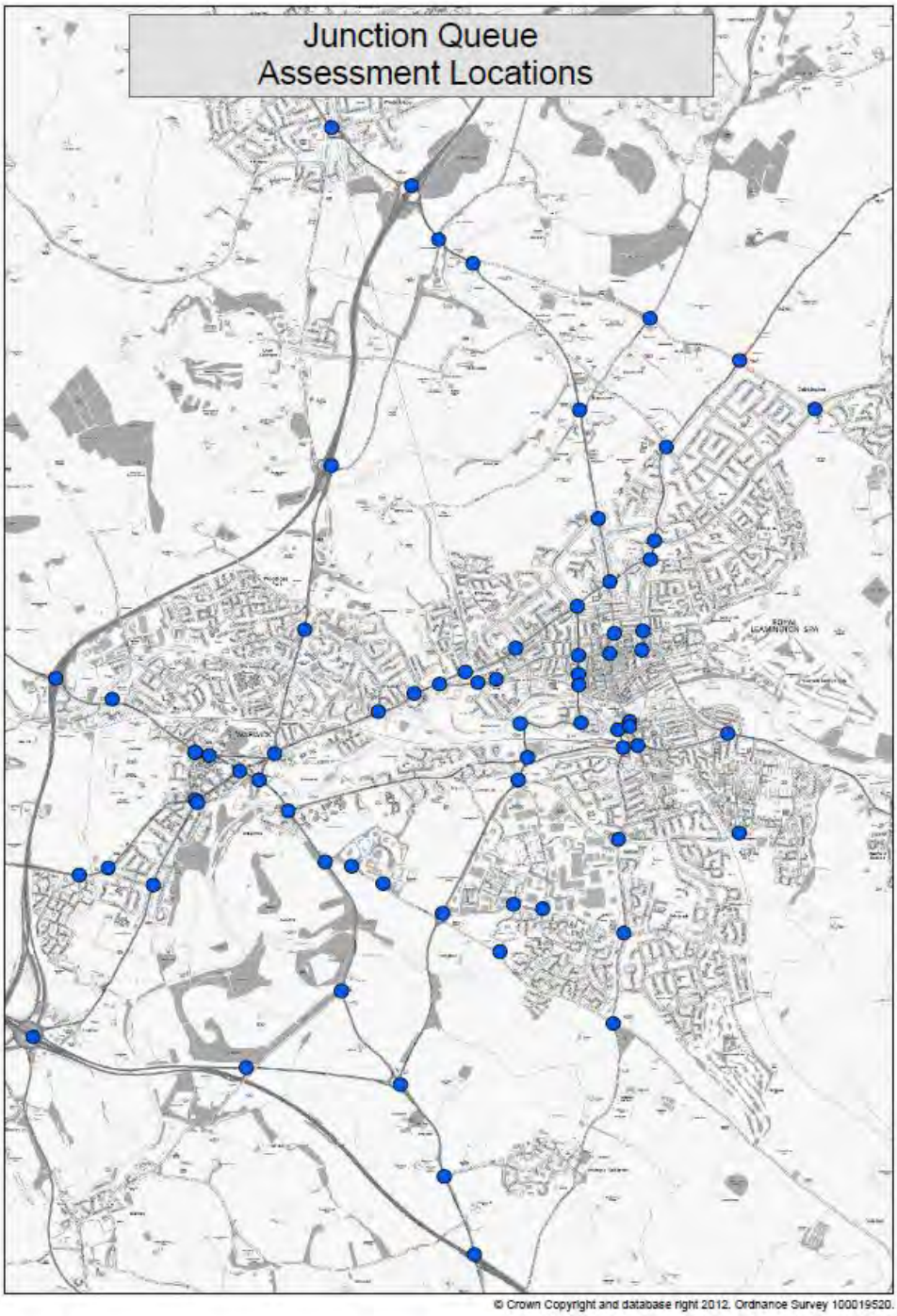
- **Queue Reduction** (a reduction in queue lengths of greater than 5 vehicles)
- **Moderate Increase** (an increase in queue lengths of between 15 and 30 vehicles)
- **Severe Increase** (an increase in queue lengths of between 30 and 50 vehicles)
- **Very Severe Increase** (an increase in queue length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

Outputs from this queue analysis have been presented within a series of plots that have been provided within **Appendix A** of this report. The following outlines the scenario comparisons that have been presented within the accompanying drawings 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 RA AM
- **MQ002 -** 2028 WDC STA RA PM
- **MQ003 –** 2028 WDC STA RA W/MM AM
- **MQ004 -** 2028 WDC STA RA W/MM PM
- **MQ005 –** 2028 WDC STA RA W/SRN AM
- **MQ006 -** 2028 WDC STA RA W/SRN PM

MQ001 and MQ002 correlate to MQ004 and MQ005 presented within the third phase STA report[3] and have been included within this report for information purposes.

Figure 4 - Queue Assessment, Junction Locations



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

[3] 211439-19.R012, Warwick STA – Phase 3 Assessment, Arup, 22 May 2013, APPENDIX F

2.4.1 AM Queuing Analysis

Analysis of the impacts, on junction queuing levels, of the various scenarios reveals that, within the AM, the removal of Managed motorways does not result in any particular junction suffering an increase in queuing that could be categorised as very severe. Impacts on junctions to the south of Warwick and Leamington, when the MM measures are removed, are broadly similar to those that occur within the 2028 WDC STA RA scenario. The only exception appears to be Longbridge Island which experiences a reduction in queuing levels from very severe to severe. Most other areas appear relatively unchanged, however, the junction to the East of the A46/Birmingham Road 'Stanks Island' as well as the A46/A452 Thickthorn Island both junctions cease to experience reductions in queuing and, instead, suffer moderate increases. This is likely to indicate impacts of additional pressure on these routes caused by some traffic reassigning away from the A46/M40 route to the south of Warwick and Leamington and electing to travel via these alternate routes instead. This would also correlate with the reduction that occurs at Longbridge Island which may be indicative of a reduction in vehicular demand at this junction since the M40 is now a less attractive route. Analysis of the AM impacts, when SRN growth is removed from the model network, alongside the MM measures, reveals that there is a significant reduction in the number of junctions which experience moderate increases in queue lengths. Every junction within the Southwest quadrant of the study area now experiences a reduction in queue lengths. Furthermore, there are even a number of occasions where junctions to the north of Leamington, around Northumberland Avenue, cease to experience increases in queue lengths when SRN growth is removed.

2.4.2 PM Queuing Analysis

Analysis of the impacts, on junction queuing levels within the AM, suggests that the removal of Managed motorways results in the increase in queue lengths at the Tachbrook Road/Heathcote Lane junction classified as very severe. There are further instances of severe queue increases along Tachbrook Road and Emscote Road as a result of the MM measures being removed, this is likely to be indicative of vehicles electing to take routes through Warwick and Leamington rather than via the SRN. Furthermore, the very severe increase in queue lengths at Thickthorn and the severe increases in queue lengths at the A46 Gaveston and Stanks Island junctions, where previously reductions in queue lengths had been achieved, indicate that more traffic must be using these junctions rather than travelling between the A46, Longbridge Island and the M40. Removing the SRN growth from the model network does not substantially alter the impacts as far as queuing levels within the model network are concerned. Aside from the reduction in queuing at the Tachbrook Road/Heathcote Lane junction from very severe back to severe there are no other obvious differences between the 2028 WDC STA RA WMM and 2028 WDC STA RA WSRN scenarios.

2.4.3 Queuing Analysis Summary

Analysis of the impact on queue lengths, between the four key scenarios, reveals that during the AM the removal of the MM measures does not result in a substantial change in queuing conditions between the two scenarios. There are indicators that alternate routes into Warwick and Leamington, specifically the A452 and Birmingham Road, come under more pressure as a result of the

removal of the MM measures which is indicative of vehicles reassigning most likely as a result of adverse conditions on the M40 since MM has been removed. Removal of the external SRN growth results in a substantial improvement in overall network conditions. All junctions within the southeast quadrant of the Study area experience a reduction in queue lengths when the SRN growth is removed.

Within the PM there are a number of instances where queuing increases when the MM measures are removed from the network. The majority of additional impacts occur either on or near the A46 or along the Emscote Road and Tachbrook Road corridors. It is likely that Tachbrook Road suffers a greater level of increase than Europa Way because Europa way is already approaching capacity meaning Tachrbook Road begins to become a viable, alternative, north to south route across Leamington. Unlike the impacts observed during the AM, removal of the SRN growth within the model network, during the PM, does not result in a substantial improvement in conditions.

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 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 outcomes of these comparisons have been output in GIS format and are provided within **APPENDIX B** of this report. Comparisons have been against the 2028 Reference Case. The following outlines the comparisons that have been made alongside the drawing reference:

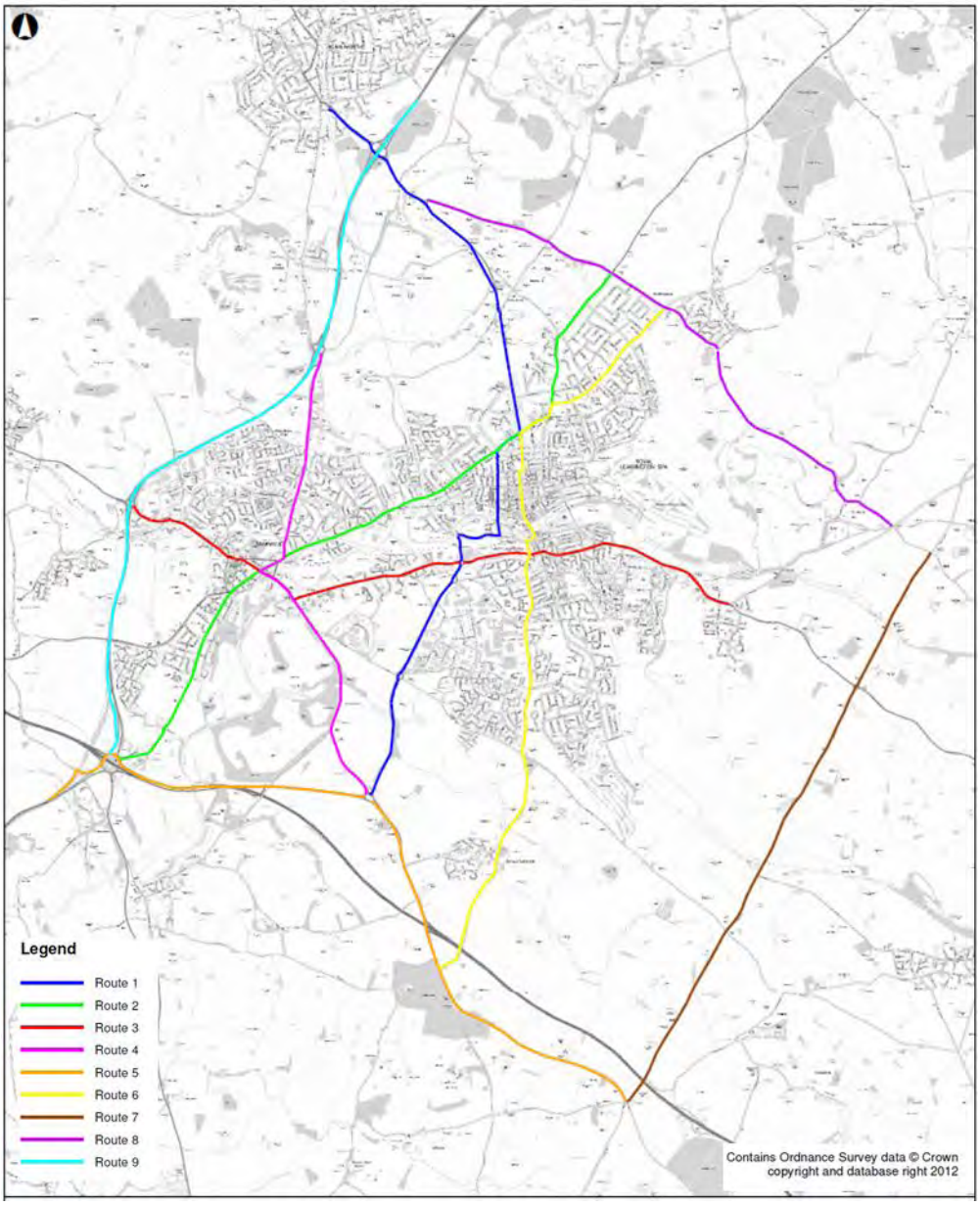
- **MD001 –** 2028 WDC STA RA AM
- **MD002 -** 2028 WDC STA RA PM
- **MD003 –** 2028 WDC STA RA WMM AM
- **MD004 -** 2028 WDC STA RA WMM PM
- **MD005 –** 2028 WDC STA RA WSRN AM
- **MD006 -** 2028 WDC STA RA WSRN PM

MD001 and MD002 correlate to MD004 and MD005 presented within the third phase STA report[4] and have been included within this report for information purposes.

The routes for which journey time data has been collected are illustrated within **Figure 5** on the following page.

[4] 211439-19.R012, Warwick STA – Phase 3 Assessment, Arup, 22 May 2013, APPENDIX G

Figure 5 - Journey Time Analysis Routes



2.4.4 AM Journey Time Analysis

Analysis of the impact on journey times, within the AM, indicates that there are a number of occasions where the levels of delay increase on key routes as a result of the removal of the MM measures. The majority of impacts appear to be focussed to the south of Warwick and Leamington. The delay increase on the Warwick by-pass approach to Grey's Mallory has increased from severe to very severe. Similarly, very severe increases in delay have also materialised on the following routes:

- B4100 WB towards Grey's Mallory
- Stratford Rd NB towards Warwick town centre
- Birmingham Rd EB towards Warwick town centre
- Coventry Road SB towards Warwick town centre

- A452 NB towards A46

The additional increase in the levels of delay experienced along these routes, which occurs as a result of the removal of the MM measures, indicates that additional pressures is exerted on a number of key corridors that are likely to act as alternative routes to the SRN and, specifically, the M40.
Analysis of the impacts on the levels of delay along the routes, during the AM, when the SRN growth is removed, reveals that there is a general reduction in the levels of delay along a number of key routes when compared to either the WDC STA RA or WDC STA RA WMM scenarios. This corresponds with the previous queuing analysis as well as the analysis of the network wide performance indicators.

2.4.5 PM Journey Time Analysis

Analysis of the impact on the levels of delay experienced across key routes, during the PM, when the MM measures are removed, indicates that there are a number of areas where the levels of delay appear to increase. The pattern of increase seems to be concentrated towards the southwest of the study area and the increases mainly occur on routes out of Warwick and Leamington. Specifically, increases occur on:

- Warwick by-pass SB and M40 towards Stratford-upon-Avon
- Stratford Road SB toward Longbridge Island
- Birmingham Rd WB towards the A46

In addition to the increases on the aforementioned routes, increases are also observed on the B4100 WB towards Greys Mallory and the B4100 northbound towards Warwick Town Centre. Levels of delay on routes within the two towns remain relatively unchanged between the two scenarios when compared to the 2028 Reference Case. When the SRN growth is removed from the model network it is apparent that these increases in delay are reduced back to levels that are consistent with the increases observed within the 2028 WDC STA RA network.

2.4.6 Journey Time Analysis Summary

Analysis of the differences in the level of delay experienced on key routes within the model network, when compared to the 2028 Reference Case, reveals that in both AM and PM time periods the impacts are largely focussed to the Southwest of Warwick. This is to be expected given the proximity to the area where MM was proposed.

Within the AM it is apparent that removing the MM measures results in an increase in the levels of delay experienced along a number of routes into Warwick and Leamington approaching from the West and South (Birmingham Road, Stratford Rd and the M40). Within the PM the opposite effect appears to occur and the levels of delay increase on key routes out of Warwick and Leamington. Again routes within the southwest quadrant of the study area are most affected (Warwick By-Pass, Stratford Rd SB, Birmingham Rd WB).

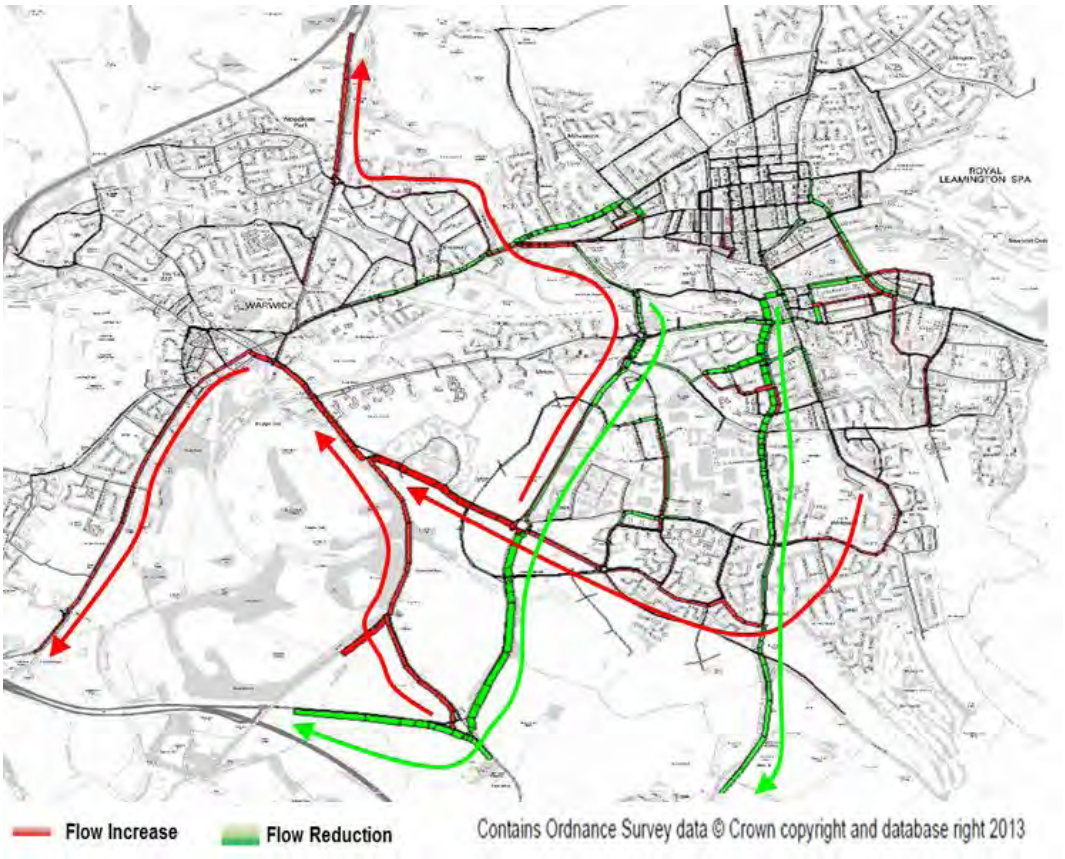
Removal of the SRN growth within the AM results in a substantial improvement in the levels of delay experienced along a number of key routes. In some cases the magnitude of increase, when compared to the reference case, is less in the

scenario with SRN growth removed than the original 2028 WDC STA RA scenario. Within the PM the removal of the SRN growth does not result in an improvement in conditions along key routes when compared to the results extracted following the removal of the MM measures.

2.5 Flow Difference Analysis

In order to better understand the impacts that occur within the network, during the PM period, when the MM measures are removed, analysis of the difference in periodic flow levels between the 2028 WDC STA RA scenario and the 2028 WDC STA WMM scenario has been assessed and is presented within the following **Figure 6**:

Figure 6 - WDC STA RA minus WDC STA RA WMM Flow Differences (16:00 to 19:00)



Within the previous Figure, areas which suffer an increase in flow as a result of the removal of the MM measures are illustrated by red links whilst reductions in flow are illustrated by green links. The arrows have been included to illustrate some of the changes which appear to occur consistently across directional corridors.

Analysis of **Figure 6** reveals that the removal of MM measures results in a decrease in southbound vehicular movements along both Tachbrook Road and Europa Way. There is also a substantial increase in west to east movements across the network, the flow increases along Gallows Hill appear to extend back to the Heathcote and Whitnash areas. Similarly there is an increase in movements northbound along Europa Way, towards Princes Drive and onwards, via Emscote

Road and Greville Road, to the Coventry Rd NB route out to the A46. It is interesting to note that there is an increase in vehicular movements southbound along Stratford Road which may indicate that some traffic now heads into Warwick and south along Stratford Road as a route towards Stratford and the A46 SB as opposed to heading southbound along Europa Way and then via the M40

3 Detailed Flow Analysis

3.1 Overview

In addition to the detailed results analysis that has been undertaken and presented within the previous section of this report, detailed analysis of the composition of flow that has been modelled on the M40 has been undertaken.

This analysis has been completed in order that the magnitude and composition of the traffic levels that are using the M40, specifically between J14 and J15, which is perceived to be the most problematic section of the motorway, can be better understood. The purpose of this analysis is to understand the levels of flow already contained upon the section of the SRN which appears most problematic, prior to the inclusion of MM and then how these change under the various scenario circumstances.

3.2 Analysis

The analysis has focussed on the difference and composition of flows between J14 and J15 on the M40. The location from which the various flows have been extracted is presented within the following **Figure7**:

Figure 7 - M40 Flow Analysis Location

The flow analysis has been disaggregated using the following traffic types:

- Background – All 2011 baseline car and LGV trips, inclusive of education based trip types.

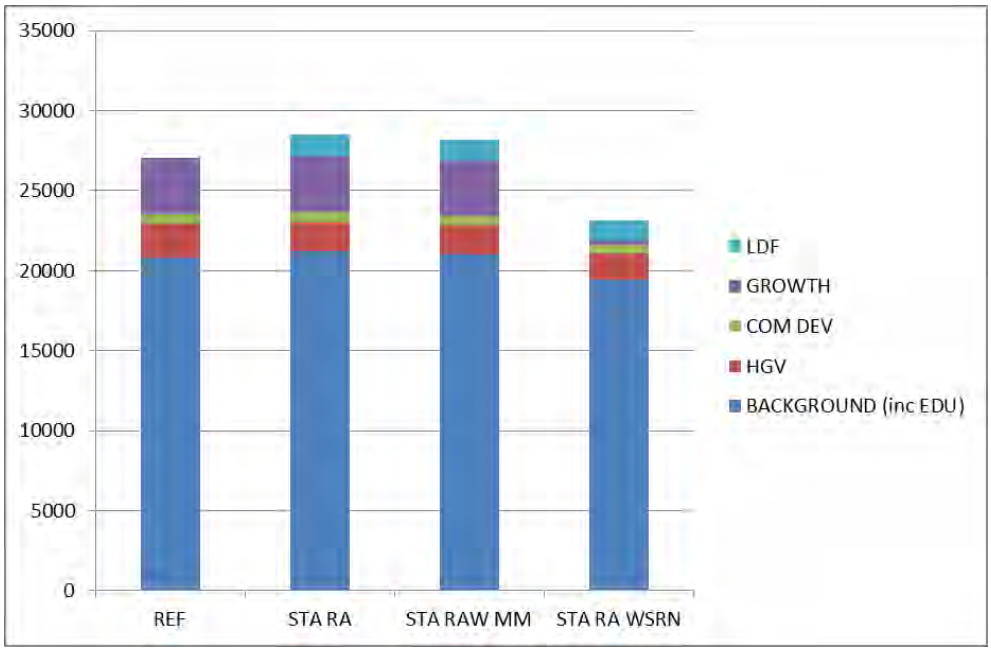
- HGV – All HGV movements within the model (base and forecast years combined)
- Committed Developments – All trips contained within the model that are associated with the committed developments that have been incorporated into the modelling during the forecast year development stages.
- Growth – 2011 to 2028 Forecast Growth levels – External Growth for the period 2011 to 2028
- Core Strategy – Demand associated with the sites identified during the previous Phase of STA testing.

Two-way flow analysis of the traffic composition crossing the aforementioned point of the M40 has been undertaken for both AM and PM model periods. The output extracted from the analysis of flows levels present within the AM model period is presented within the following **Table 4** and accompanying **Figure 8**.

Table 4 - M40 AM (07:00 to 10:00) Two-way Flow Analysis

	REF		**STA RA**		**STA RA WMM**		**STA RA WSRN**	
	Flow	*%*	Flow	*%*	Flow	*%*	Flow	*%*
ALL	**27052**	**-**	**28486**	**-**	**28167**	**-**	**23109**	**-**
BACKGROUND (inc. EDU)	20797	*76.9%*	21207	*74.4%*	21023	*74.6%*	19453	*84.2%*
HGV	2120	*7.8%*	1794	*6.3%*	1758	*6.2%*	1621	*7.0%*
COM DEV	628	*2.3%*	636	*2.2%*	611	*2.2%*	556	*2.4%*
GROWTH	3507	*13.0%*	3453	*12.1%*	3450	*12.3%*	263	*1.1%*
LDF	0	*0.0%*	1395	*4.9%*	1324	*4.7%*	1216	*5.3%*

Figure 8 - M40 AM (07:00 to 10:00) Two-way Flow Analysis



The results presented within the previous **Table 4** and corresponding **Figure 8** demonstrate that the majority of traffic that is present on the M40, between J14 and J15, comprises background traffic.

The proportion of traffic associated with allocated sites is 0% in the Ref Case since the developments have not been included. Within the both the STA scenarios (with and without MM) the proportion does not exceed 5%. Once SRN growth has been removed the proportion of traffic on the M40 that is associated with the allocated sites increases to 5.3%. However, there is actually a reduction, in absolute terms, in the level of flow that is associated with the allocated developments using the M40.

In most scenarios it is growth associated with Committed Developments that represents the smallest percentage of traffic type using this particular section of the M40. Demand associated with the allocated sites represents the second smallest proportion of traffic type observed to travel on this section of the M40.

It is interesting to note that the removal of the MM measures does not result in a substantial drop in the levels of traffic recorded on that section of the M40. Removal of the MM results in a diversion of 1.2% of traffic onto alternative routes during the AM period.

The output extracted from the analysis of flows levels present within the PM model period is presented within the following **Table 5** and accompanying **Figure 9**.

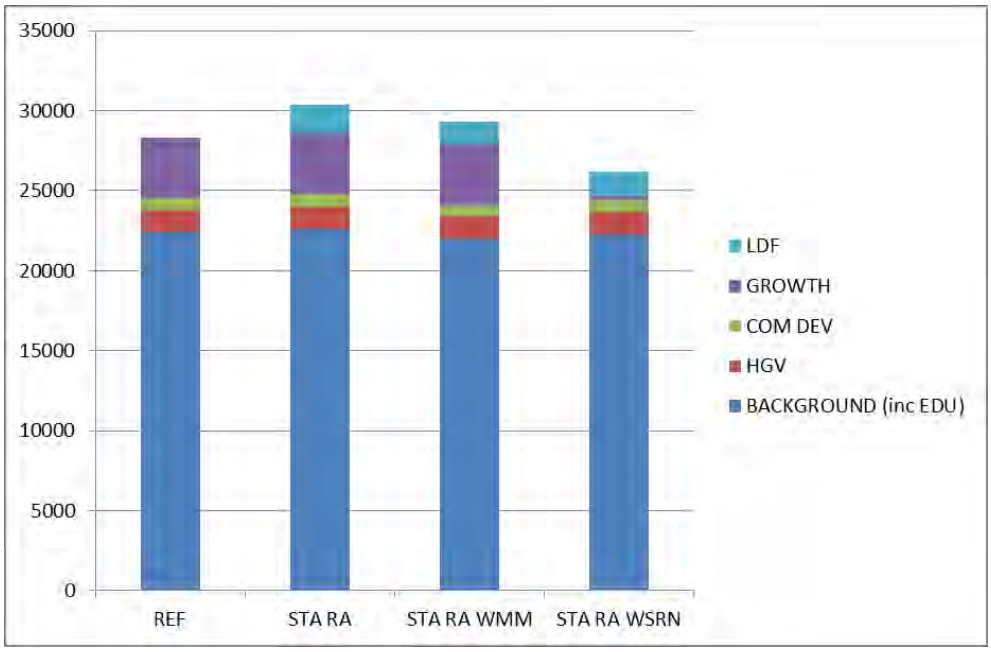
Table 5 - M40 PM (16:00 to 19:00) Two-way Flow Analysis

	REF		**STA RA**		**STA RA WMM**		**STA RA WSRN**	
	Flow	*%*	Flow	*%*	Flow	*%*	Flow	*%*
ALL	**28338**	**-**	**30358**	**-**	**29280**	**-**	**26199**	**-**
BACKGROUND (inc. EDU)	22430	*79.2%*	22627	*74.5%*	22026	*75.2%*	22280	*85.0%*
HGV	1370	*4.8%*	1370	*4.5%*	1365	*4.7%*	1369	*5.2%*
COM DEV	715	*2.5%*	827	*2.7%*	702	*2.4%*	737	*2.8%*
GROWTH	3823	*13.5%*	3821	*12.6%*	3796	*13.0%*	309	*1.2%*
LDF	0	*0.0%*	1714	*5.6%*	1391	*4.8%*	1505	*5.7%*

The results presented within the previous **Table 5** and corresponding **Figure 9** demonstrate again that the majority of traffic that is present on the M40, between J14 and J15, comprises background traffic.

The proportion of traffic associated with allocated sites is 0% in the Ref Case since the developments have not been included. Within the both the STA scenarios with and without MM measures included, the proportion of demand associated with the allocated sites is 5.6% and 4.8% respectively. Once SRN growth has been removed the proportion of traffic on the M40 that is associated with the allocated sites increases to 5.7%. However, as with the AM observations, there is actually a reduction in the level of flow, in absolute terms, that is associated with the allocated developments using the M40.

Figure 9 - M40 PM (16:00 to 19:00) Two-way Flow Analysis



Unlike the outputs extracted from the AM analysis, analysis of the PM traffic type proportions reveals that the demand associated with the allocated sites represents the third largest traffic type as there are more vehicles associated with the allocated sites using the M40 than the numbers associated with HGV or committed development movements.

Removal of the MM measures results in a more substantial drop in overall flow levels during the PM than was observed during the AM. Overall there is a reduction in demand of over 3.5% as a result of the removal of the scheme. This demand must divert onto the local road network as a result of the removal of MM. of the 1000+ vehicles that divert away from the motorway when the scheme is removed, 55% of the vehicles that elect to divert comprise background trips and 30% comprise demand associated with allocated sites. This analysis is interesting in so far as it demonstrates that the assignment of routes associated with background trips and allocated demand trips is more sensitive to the presences of the MM measures than other trip types.

Across the 3 scenarios in which SRN growth has been retained in full it is clear to see that the trip numbers associated with this traffic type remain fairly static at around 3800 vehicles across all three scenarios. Background and Allocated sites traffic drops by 600 and 300 trips respectively when the MM measures are removed. Notably the reduction in allocate site traffic of 300+ vehicles represents almost 20% of the total allocated site traffic levels using the M40 but only 2.5% of the total number of background trips.

Both trips types demonstrate a recovery in flow levels when the SRN growth is removed from the model network although neither background nor allocated site traffic levels exceed the levels present within the initial WDC STA scenario outputs.

3.3 Summary

Based on the results presented within the previous section of this report, the following points have been identified:

- That including the MM measures has a greater impact in the level of usage of the M40 within the PM period than the AM period.
- During the AM period removing the MM measures results in a drop in total flow of less than 1.5% and the majority of this reduction is influenced by the diversion of background traffic.
- Within the AM period, removing the SRN growth allocation does not result in the recovery of traffic levels associated with any of the traffic types back to the levels observed within the other scenarios. This indicates that the wider impacts of the SRN growth, within the AM period, are such that they actually displace other vehicle types and make the M40 more attractive. Were it simply a case that MM measures make the M40 a more attractive route it would be expected that background traffic levels (other than the demand associated with SRN growth) would recover back to the levels within the WDC RA scenario when SRN growth is removed.
- Within the PM the removal of MM measures results in a drop in traffic flow of over 3.5%.
- During the PM background and allocated site traffic levels appear more sensitive to the presences of MM measures as it is the diversion of these traffic types that accounts for the majority of the 3.5% reduction.
- As with the AM analysis, PM analysis of the effects on the network of removing the SRN growth reveals that traffic levels, associated with other traffic types, on the M40 recover but do not reach the levels observed during the WDC STA RA scenario runs.

The impacts of delivering the MM measures appear to be more discernible during the PM period than the AM. In general it is clear that the majority of traffic using the M40 comprise Background traffic and SRN Growth. Introduction of the MM measures, during the PM period results in an increase in background and committed traffic levels which occurs on top of the additional traffic now associated with the allocated sites.

4 Summary and Conclusion

4.1 Summary

Arup have been commissioned by Warwickshire County Council (WCC) and Warwick District Council (WDC) to undertake a sensitivity test pertaining to the current core strategy assumptions with a view to understanding the strategic implication of the delivery of Managed Motorways alongside WDC's Local Plan Allocations.

The purpose of this assessment is as follows:

- To determine the likely severity of impacts that could be incurred should MM not be delivered.
- To begin to understand which elements of growth are likely to trigger the need for the implementation of MM
- To assess the predicted traffic types utilising the M40 at upon delivery and completion of the local plan (2028)

The following model scenarios have either been derived or interrogated as part of this analysis:

- **2028 Reference Case –** The WDC 2028 PARAMICS Reference case model which includes background forecasts to 2028 but no account of either local plan growth or the associated infrastructure amendments.
- **2028 WDC STA RA –** The above scenario with the WDC Core Strategy Allocated Sites and 27 key infrastructure measures incorporated within the model network
- **2028 WDC STA RA WMM –** The previous model scenario with the MM scheme removed from the model network (Without Managed Motorways)
- **2028 WDC STA RA WSRN –** The 2028 WDC STA RA MM model scenario with the forecast growth in trips between the M40 and A46 SRN zones removed from the assessment (Without SRN Growth)

4.2 MM Impact Analysis

Analysis of the difference in network performance between the foure key scenarios has revealed the following:

- That average delay increases across the network when MM is removed. When the SRN growth is removed as well however, levels of delay within the AM period reduce substantially and are, in fact lower than those observed within the 2028 WDC RA scenario network. Whilst a reduction in delay occurs within the PM as well it is of a relatively small magnitude.
- That the average journey distance increases when MM measures are removed and reduces when the SRN growth is removed indicating that including the MM measures encourages vehicles to travel more direct routes between origin and destination zones whilst removal of SRN growth results in the removal of some 'longer distance' trips which, in turn reduces the overall average journey distance.

- Average speeds are also observed to drop when MM measures are removed and, correspondingly, speeds increase within the AM when SRN growth is also removed. Within the PM however, there is a further reduction in speeds that occurs when the SRN growth is removed.
- The analysis of the completed trips reveals that the removal of managed motorways results in a drop in the number of trips that are completed within both AM and PM time period. Whilst the number of vehicles released onto the model network remains consistent between the WDC STA RA and WDC STA RA WMM scenarios the number of vehicles that complete the entire journey reduces by 0.3% and 1,5% respectively.
- When the SRN growth is removed the trip completion rate reverts to the levels experienced within the WDC STA RA scenario. This is particularly important when considering that the network wide performance measures seem to indicate that there is little difference between either WDC STA RA WMM or WDC STA RA WSRN scenarios when considering average journey times or average vehicle speeds, thus it would be reasonable to assume that the level of performance across the two scenarios is broadly similar, however an increase in the rate of trip completions when the SRN growth is removed is indicative of improved conditions as vehicles are able to traverse the network at a higher rate.

Analysis of the impact on queue lengths, between the four key scenarios, reveals that:

- During the AM the removal of the MM measures does not result in a substantial change in queuing conditions between the two scenarios aside from minor indications alternate routes into Warwick and Leamington, specifically the A452 and Birmingham Road, come under more pressure as a result of the removal of the MM measures.
- Removal of the external SRN growth results in a substantial improvement in overall network conditions. All junctions within the southeast quadrant of the Study area experience a reduction in queue lengths when the SRN growth is removed
- Within the PM there are a number of instances where queuing increases when the MM measures are removed from the network. The majority of additional impacts occur either on or near the A46 or along the Emscote Road and Tachbrook Road corridors. It is likely that Tachbrook Road suffers a greater level of increase than Europa Way because Europa way is already approaching capacity meaning Tachbook Road begins to become a viable, alternative, north to south route across Leamington.
- Unlike the impacts observed during the AM, removal of the SRN growth within the model network, during the PM, does not result in a substantial improvement in conditions.

Analysis of the differences in the level of delay experienced on key routes within the model network, when compared to the 2028 Reference Case, reveals that:

- Across both AM and PM time periods the impacts are largely focussed to the Southwest of Warwick.

- Within the AM removing the MM measures results in an increase in the levels of delay experienced along a number of routes into Warwick and Leamington approaching from the West and South (Birmingham Road, Stratford Rd and the M40).
- Within the PM the opposite effect appears to occur and the levels of delay increase on key routes out of Warwick and Leamington. Again routes within the southwest quadrant of the study area are most affected (Warwick By-Pass, Stratford Rd SB, Birmingham Rd WB).
- Removal of the SRN growth within the AM results in a substantial improvement in the levels of delay experienced along a number of key routes.
- Within the PM the removal of the SRN growth does not result in an improvement in conditions along key routes when compared to the results extracted following the removal of the MM measures.

Analysis of the changes in the volumes of traffic which travel across the model network which occur as a result of the removal of the MM measures revealed that increases in northbound traffic levels were likely and that, correspondingly, southbound traffic movements, particularly across the Europa Way and Tachbrook Road corridors, would drop.

4.3 Flow Differences

In addition to the detailed results analysis that has been undertaken and presented within the previous section of this report, detailed analysis of the composition of flow that has been modelled on the M40 has been undertaken.

This analysis has been completed in order that the magnitude and composition of the traffic levels that are using the M40, specifically between J14 and J15, which is perceived to be the most problematic section of the motorway, can be better understood. The purpose of this analysis is to understand the levels of flow already contained upon the section of the SRN which appears most problematic, prior to the inclusion of MM and then how these change under the various scenario circumstances.

4.4 Analysis

The analysis has focussed on the difference and composition of flows between J14 and J15 on the M40. The flow analysis has been disaggregated using the following traffic types:

- Background – All 2011 baseline car and LGV trips, inclusive of education based trip types.
- HGV – All HGV movements within the model (base and forecast years combined)
- Committed Developments – All trips contained within the model that are associated with the committed developments that have been incorporated into the modelling during the forecast year development stages.
- Growth – 2011 to 2028 Forecast Growth levels – External Growth for the period 2011 to 2028
- Core Strategy – Demand associated with the sites identified during the previous Phase of STA testing.

Based on the results presented within the previous section of this report, the following points have been identified:

- That including the MM measures has a greater impact in the level of usage of the M40 within the PM period than the AM period.
- During the AM period removing the MM measures results in a drop in total flow of less than 1.5% and the majority of this reduction is influenced by the diversion of background traffic.
- Within the AM period, removing the SRN growth allocation does not result in the recovery of traffic levels associated with any of the traffic types indicating that the wider impacts of the SRN growth, within the AM period, are such that they actually displace other vehicle types and make the M40 more attractive. Were it simply a case that MM measures make the M40 a more attractive route it would be expected that background traffic levels would recover back to the levels within the WDC RA scenario when SRN growth is removed.
- Within the PM the removal of MM measures results in a drop in traffic flow of over 3.5%.
- During the PM background and allocated site traffic levels appear more sensitive to the presences of MM measures as it is the diversion of these traffic types that accounts for the majority of the 3.5% reduction.
- As with the AM analysis, PM analysis of the effects on the network of removing the SRN growth reveals that traffic levels, associated with other traffic types, on the M40 recover but do not reach the levels observed during the WDC STA RA scenario runs.

The impacts of delivering the MM measures appear to be more discernible during the PM period than the AM. In general it is clear that the majority of traffic using the M40 comprise Background traffic and SRN Growth. Introduction of the MM measures, during the PM period results in an increase in background and committed traffic levels which occurs on top of the additional traffic now associated with the allocated sites.

4.5 Conclusions

Based on the analysis set out within this report it is reasonable to conclude the following:

- That the delivery of MM results in substantial, network wide benefits but, that there is potential for the allocation strategy that has been tested to be adopted without MM measures should the need arise.
- That it is reasonable to conclude that the delivery of MM measures could be scheduled towards the end of the plan period which would allow alternative funding means to be identified
- That the need for the delivery of MM measures is more discernible when considering the impact on the network performance during the PM period than the AM period.
- That the primary contributing factors to the need for the delivery of MM are the existing levels of traffic coupled with the forecast external growth levels. Traffic levels associated with the Allocated Sites

comprise the third/fourth highest traffic type when considering the levels of flow on the M40 between J14 and J15. This indicates that there is likely to be a need for the delivery of MM measures at some point within the medium term (25 to 40 years +) irrespective of the proposed demand levels likely to be produced as a result of the proposed WDC Core Strategy developments.