Warwickshire County Council

Strategic Transport Assessment Phase 4

Stratford Road Development Testing

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1 Introduction

1.1 Scope

Arup have been commissioned by Warwickshire County Council (WCC) and Warwick District Council (WDC) to update development assumptions and appraise impacts in the latest testing of the WDC Strategic Transport Assessment. This report builds upon the evidence presented within the Phase 2, Phase 3 and Phase 4 Assessment reports[1], to the last of which outlined the impacts of a revised approach to the allocation of growth, herein referred to as the 'Revised Development Approach' (RDA). This report reviews those impacts in light of a number of changes to the network, namely:

- Improvements to the scenario networks now likely to be delivered through the early implementation of the A46/A425 'Stanks' improvements.
- The additional impacts likely to occur as a result of the application of a new, 11 Ha B1 Employment site on the Stratford road just to the northeast of M40 J15 'Longbridge Island'.

1.2 Study Objectives

This stand-alone assessment is intended to record the revised network conditions which are now within both the existing and 2028 scenario networks, as a result of the inclusion of the A46/A425 improvements. Furthermore, the study intends to ascertain the implications on the strategic infrastructure of the allocation of additional employment land to the south east of Warwick, off A429 Stratford Road. It has been deemed appropriate for the testing to be undertaken using the existing 2028 Warwick and Leamington Wide Area (WLWA) Reference and RDA Scenario networks as the starting point.

1.3 Background

The objectives set out in section 1.2 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.

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 assessment is based on the most up to date and current assumptions but should by no means be considered conclusive. The outputs from this assessment are intended to advise on the potential implications of the relevant allocation strategies and accompanying mitigation schedules.

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

An overview of the process that has been followed prior to the commencement of this additional 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 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.

WDC Strategic Transport Phase 4

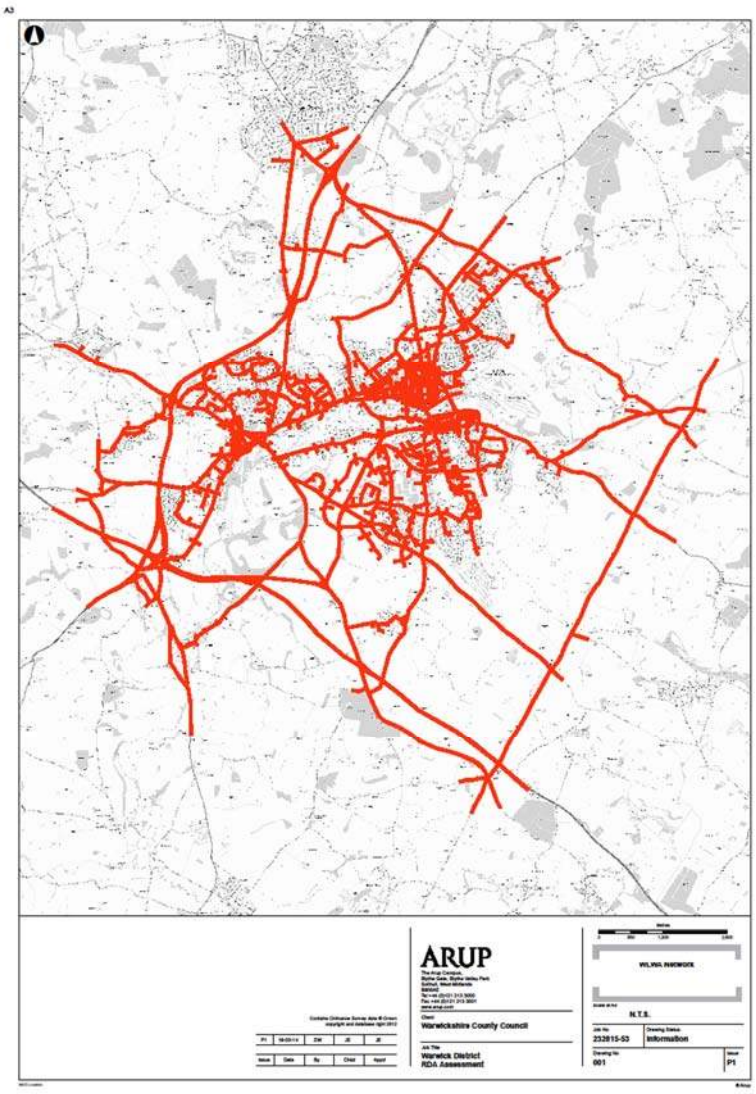
The fourth phase of the strategic transport assessment undertook a more detailed assessment of the potential impacts of the RDA on the Warwick and Leamington area road network. This stage of the work also refined the proposed Local Plan

transport scheme assumptions, in light of the impacts of the RDA, and identified, where appropriate, areas of change compared to the previously proposed phase 3 mitigation strategy. This study also involved an assessment of the potential impacts of adopting alternative layouts for some of the originally proposed schemes within the area of Warwick Town Centre. 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 to feasibility or deliverability have arisen.

1.4 Study Area

In line with previous stages of the STA the assessment has predominantly focused 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). The coverage of the WLWA model has been illustrated within Figure 1:

Figure 1 - Warwick and Leamington Model Coverage



2 Scenario Development

Prior to the commencement of the assessment it is important to ascertain that the Reference Case 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.

An update to the existing Reference Case was identified as necessary in order that the revised status of the A46/A425 scheme could be accounted for within the assessment. An overview of the scheme proposals is provided within the following section:

2.1 The A46/A425 'Stanks' Corridor Improvements

The 2028 Reference model has been adapted to reflect the proposed changes on A425 Birmingham Road as part of the "Stanks" corridor improvements scheme. The scheme focuses on the A46 Stanks grade separated junction, and the A425 corridor, to the west of Warwick town centre. The scheme comprises capacity improvements at the following junctions:

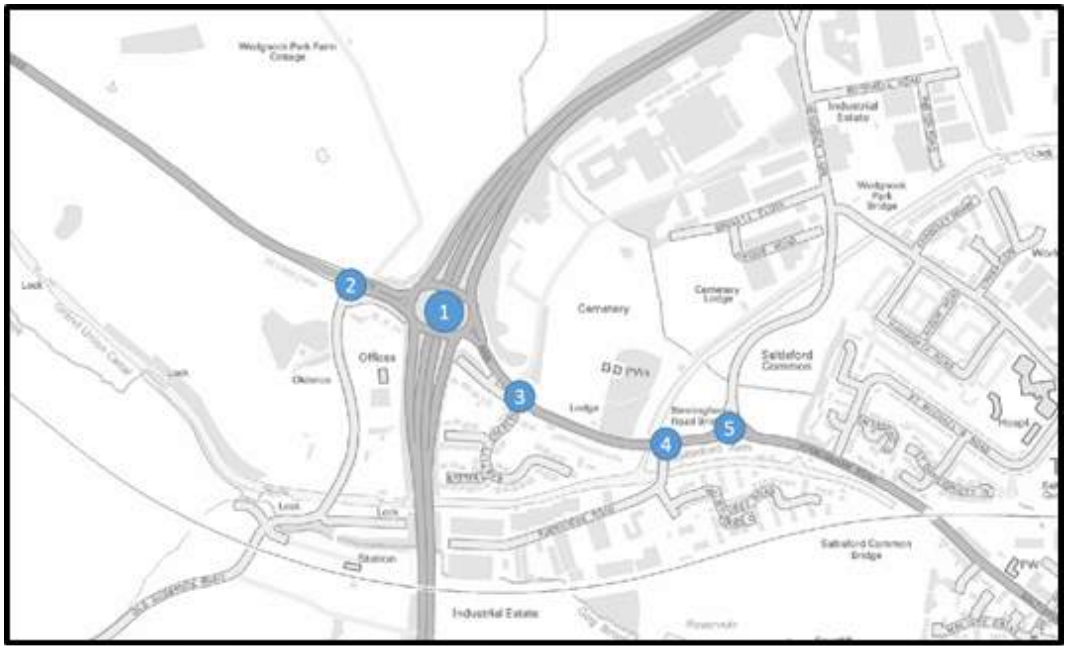
- A425/A46/A4177 roundabout;
- A4177 Budbrooke Signals;
- A425 IBM entrance;
- A425 Budbrooke Industrial Estate; and
- A425 Wedgenock Lane roundabout.

The proposed scheme involves the following improvements (see Figure 2):

1) Widen all approaches to A425/A46/A4177 roundabout to 3 lanes, widen circulatory to the west and east of circulatory and signalise;
2) Widen approach to A4177 Budbrooke signals to 2 lanes on Old Budbrooke Road;
3) Realign IBM entrance and residential access and signalise junction;
4) Signalise and physically restrict movements at Budbrooke industrial estate;

5) Originally proposals to widen Wedgenock lane roundabout were suggested, but the final scheme is now anticipated to include a signalised priority junction configuration instead.
6) The final scheme will also apply MOVA and SCOOT signal control to provide maximum capacity and minimum delay along corridor. Such changes however are not able to be accounted for within the modelling due to the increased complexity required and the extended run times. Thus, the current method of scheme inclusion within the assessment should be considered as being robust.

Figure 2 - The A46/A425 'Stanks' Corridor Improvements



2.2 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 4 STA work and, other than the inclusion of the revised scheme proposals outlined previously, no further amendments were considered necessary at this stage. Similarly, the demands were retained at the 2028 forecast levels rather than being uplifted to 2029 in order to maintain a consistency with the results and outputs presented during the previous stages of Strategic Transport Assessment work.

2.3 2028 WLWA Revised Development Allocation (RDA)

Similar to the 2028 Reference Case the 2028 WLWA RDA scenario network was adapted directly from the original STA phase 4 work. The network was updated to include the revised scheme proposals along the A46/A425 ‘Stanks’ corridor.

Aside from the Stanks improvements, the mitigation strategy contained within the 2028 WLWA RDA scenario network is consistent with that which was reported during the WDC STA Phase 4 Report.

2.4 2028 WLWA Revised Development Allocation + Stratford Road Development

The 2028 WLWA RDA scenario was adapted to include the proposed development on Stratford Road. The Stratford Road development consists of a new, 11 Ha B1 Employment site, off Stratford Road, to the northeast of M40 J15 'Longbridge Island'

2.4.1 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. In this assessment employment is assumed to be delivered within the allocated site as follows:

- 11Ha of Employment (100% B1)

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 peak period STA employment trip rates, for this land use classification, are presented within the following Table 1:

Table 1 – B1 Land Use Employment Trip Rates (0.01 Ha)

	In	Out	Total
0700-0800	0.72	0.15	0.87
0800-0900	1.30	0.24	1.54
0900-1000	0.75	0.21	0.96
1600-1700	0.21	0.96	1.18
1700-1800	0.18	1.11	1.29
1800-1900	0.09	0.39	0.48

The peak hour trip rates have been factored by the 40% coverage factor, to produce a single set of universal employment trip rates that have been assigned to the Stratford Road employment site. The factors used to profile the trips rates across the period are consistent with those which have been used throughout the STA work. These trip rates are summarised within the following Table 2:

Table 2 – B1 Employment Trip Rates (0.01 Ha)

	In	Out	Total
0700 to 0800	0.29	0.06	0.35
0800 to 0900	0.52	0.10	0.62
0900 to 1000	0.30	0.08	0.39
1600 to 1700	0.09	0.39	0.47
1700 to 1800	0.07	0.44	0.52
1800 to 1900	0.04	0.16	0.19

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

Table 3 - Allocated Demand Levels

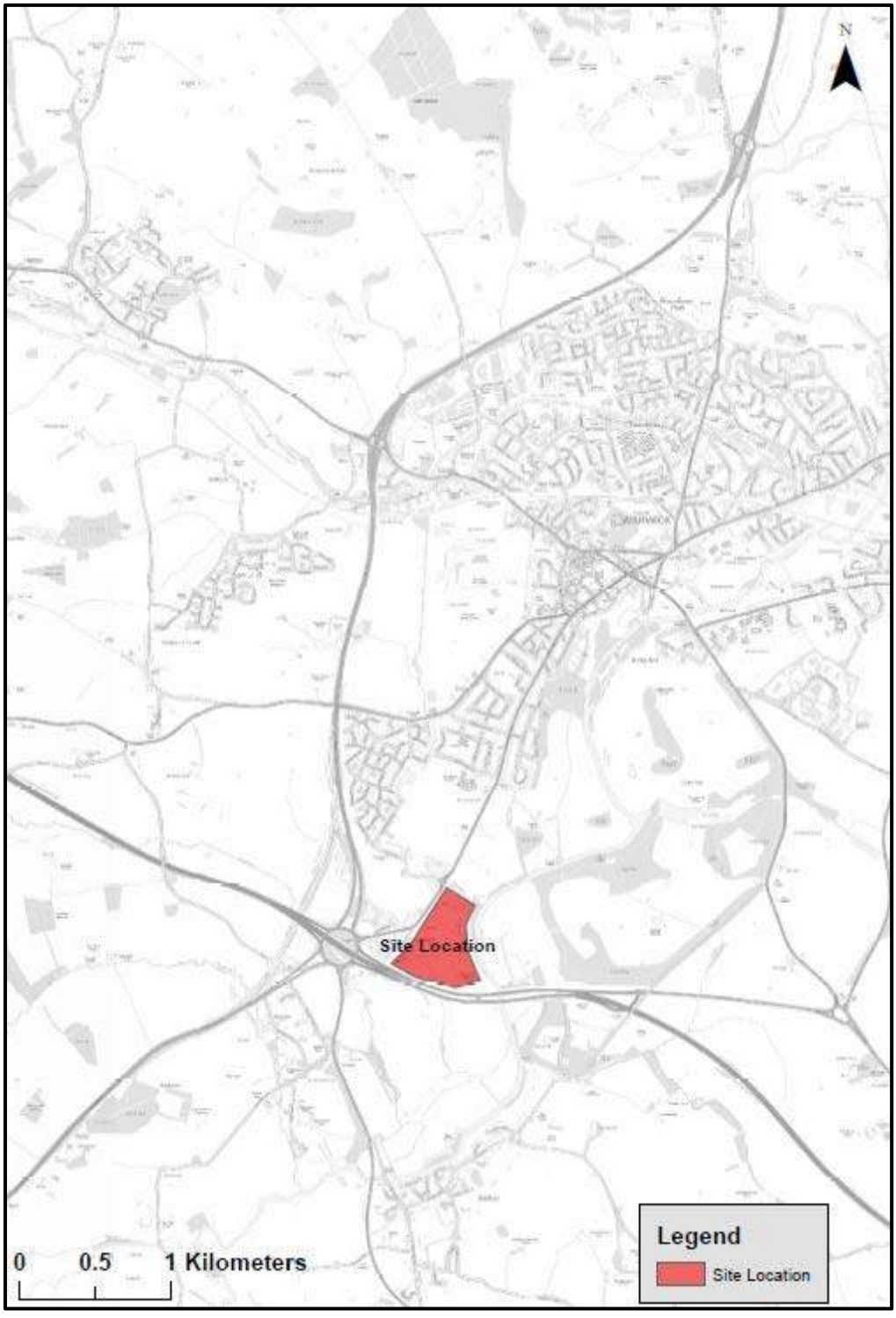
Model	0700 to 0800	0800 to 0900	0900 to 1000	1600 to 1700	1700 to 1800	1800 to 1900
WLWA	386	678	425	522	568	214

Assignment of the demands as outlined in the table above across the WLWA network provided the starting point for the assessment of the impacts of the proposed development.

2.4.2 Development Location

The proposed development is located off the A429 Stratford Road, to the north east of the M40 Junction 15 'Longbridge Island, approximately 2.5km south of Warwick town centre. The figure below outlines the location of the proposed site.

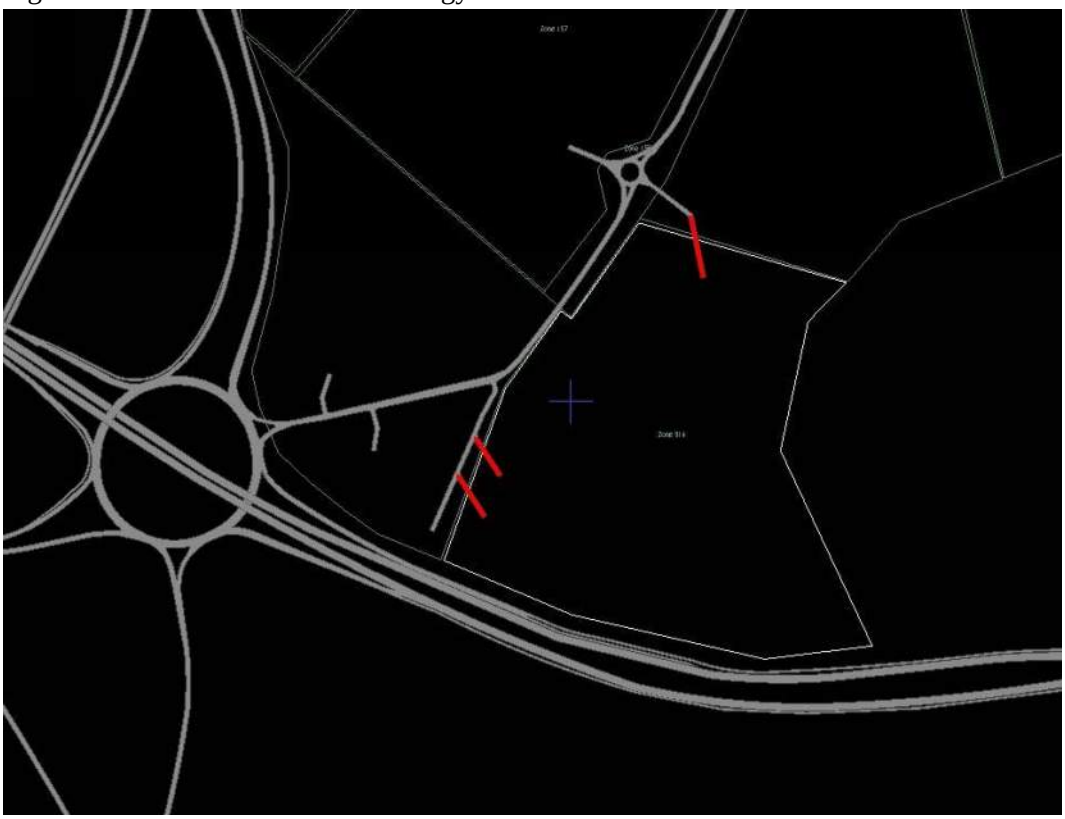
Figure 3 Site Location



2.4.3 Site Access Strategy

The proposed site access strategy consists of three entry points from the existing road network. The primary access point will be located at the A429 Stratford Road/Edgehill Drive roundabout. The site will be accessed via the existing westbound link to this roundabout. The second access point will be via the existing link off the A429 Stratford Road, located to the south of the A429 Stratford Road/Edgehill Drive roundabout but north of the 'Longbridge Island' junction. At the entry point to this link a ghost island right turn is provided on the A429. It is proposed that there will be two access points into the site off this link. Figure 4 shows how the access strategy has been coded into the modelled network.

Figure 4 Modelled Site Access Strategy



3 Results Analysis

3.1 Overview

The following sections of the report are intended to present the results obtained from the detailed testing undertaken in WLWA model.

A tiered assessment has been adopted; results analysis is focused on a strategic level assessment at this stage. All of the measures used to inform the assessment are outlined as follows:

3.2 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.

Model stability is indicative of the ability of the mitigation identified to accommodate additional demands. If it is model error causing instability 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 a model 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 detailed transport assessments. This level of detail cannot be achieved during a high level strategic assessment. All mitigation identified within the STA 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.

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.

3.3 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.

3.4 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.

3.5 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 A 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 5 on the following pages for the WLWA model network.

3.6 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 different options when compared to the Reference Case.

In total 9 key routes were defined within the model network and these routes have been illustrated within Figure 6 for the WLWA model network.

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 5 WLWA Queue Assessment Junction Locations

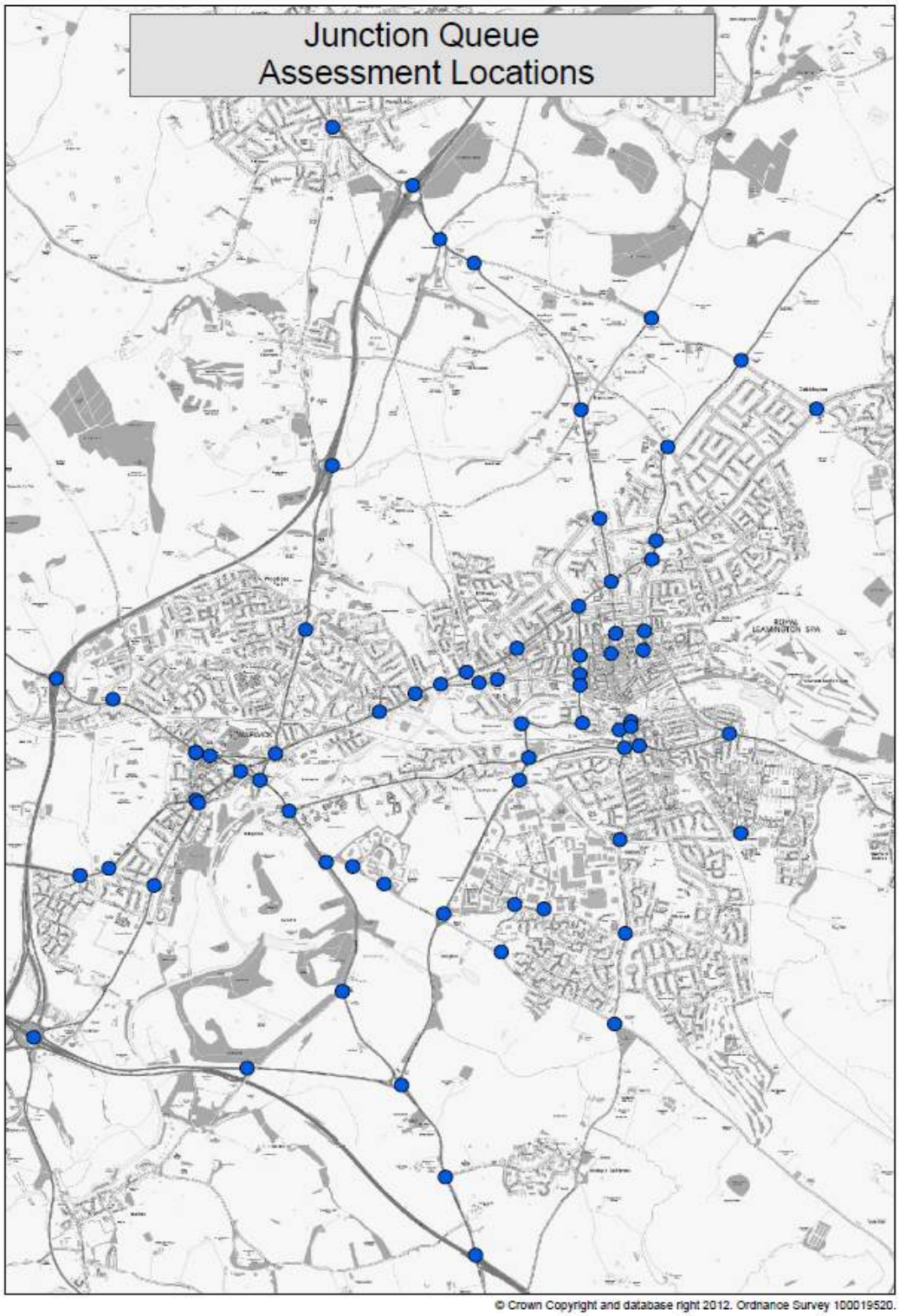
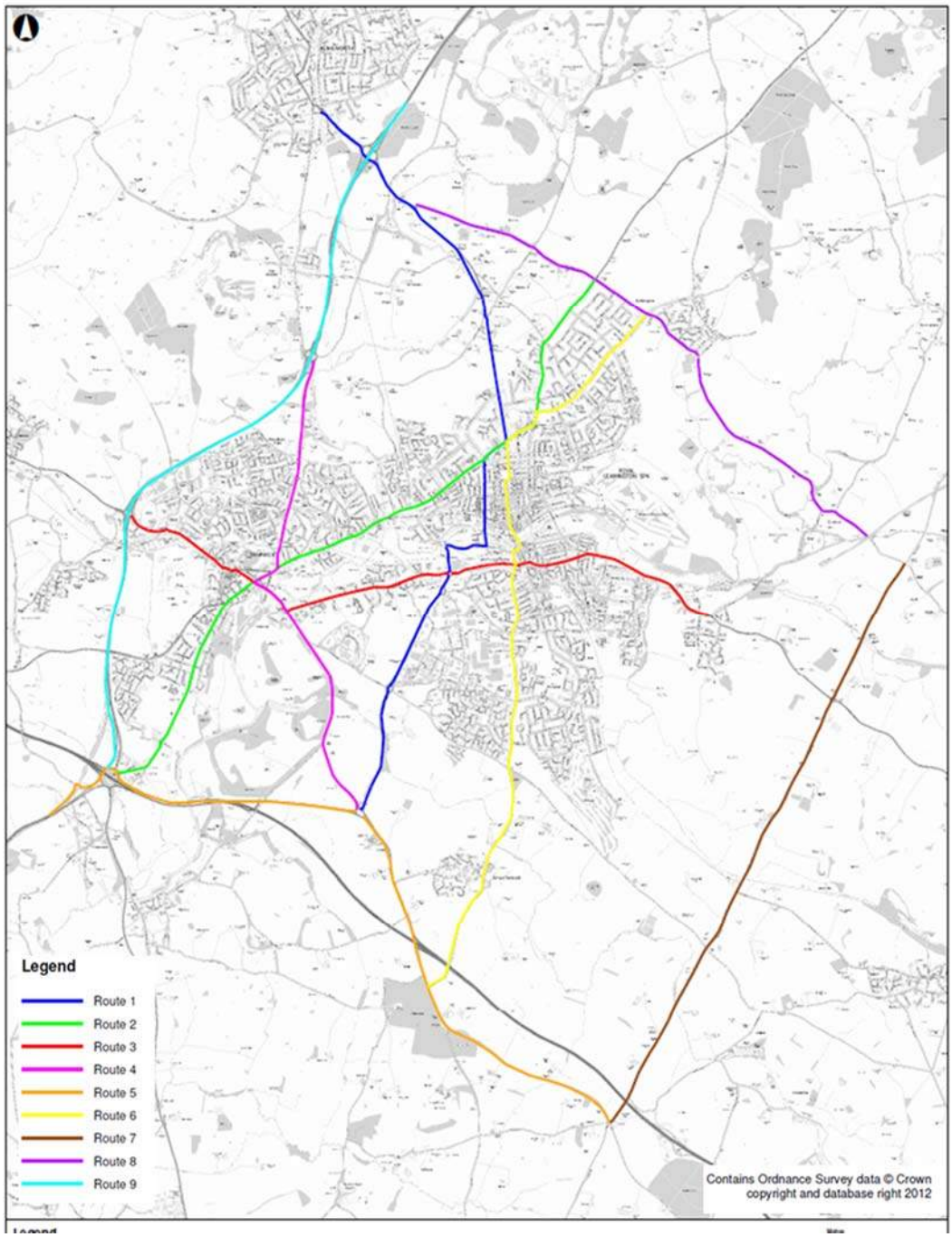


Figure 6 WLWA Journey Time Analysis Routes



4 Impact Assessment

4.1 Overview

The following section of the report presents the results obtained from the testing undertaken for the following three scenarios:

- 2028 Reference Case;
- 2028 WLWA Revised Development Allocation (WLWA RDA); and
- 2028 WLWA Revised Development Allocation + Stratford Road Development (WLWA RDA + SR)

4.2 Results Analysis

This assessment involves the review of the performance of the model network following the allocation of the revised demand levels, network optimisation, and the inclusion of development on Stratford Road.

4.3 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 within Section 3.2 of this report.

The network stability within the AM and PM simulation runs across the three scenarios is illustrated within Table 4**.**

Table 4 Model Stability Assessment 2028 Reference vs 2028 WLWA RDA

	Reference Case	WLWA RDA	WLWA RDA + SR
AM	70%	80%	50%
PM	80%	70%	60%

Given the sample size of 20 runs it is reasonable to conclude, from the table above, that there are no notable differences between the Reference Case and WLWA RDA scenario when considering network stability. The inclusion of the RDA demands and associated mitigation appears to result in an increase in network stability levels in the AM and a reduction in network stability levels in the PM. In both time periods this is unlikely to be considered a significant change.

The addition of the Stratford Road development appears to impact on the model stability, most notably during the AM period. This could be indicative of potential additional issues, although more runs would be necessary to confirm this, or mitigation within the model may be required. There is also a reduction in stability levels in this scenario during the PM period when compared to the Reference Case.

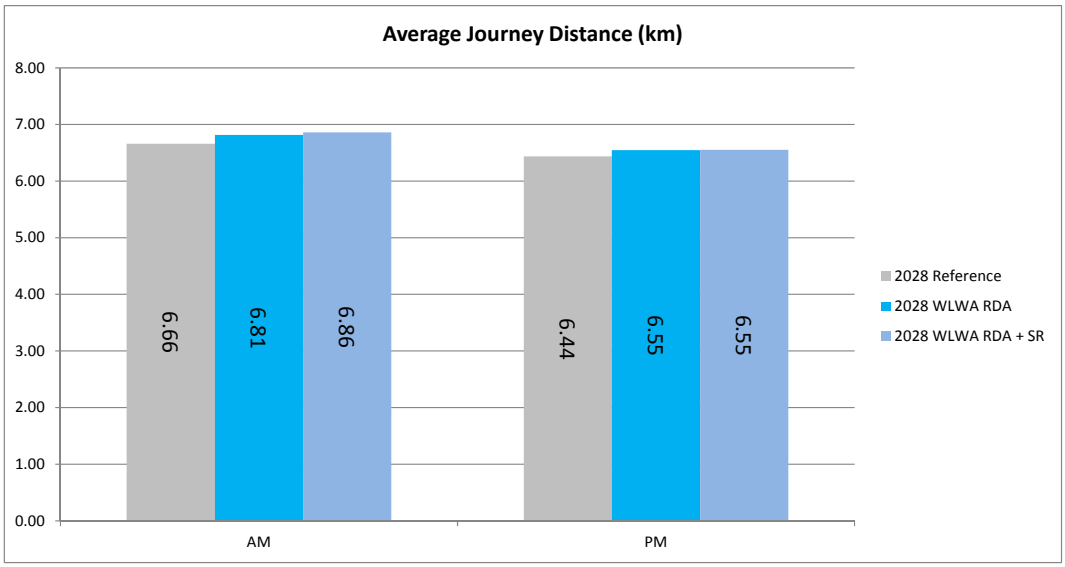
4.4 Network Wide Statistics

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

4.4.1 Average Journey Distance

Analysis of the average journey distance within each scenario, across the AM and PM model periods is presented in Figure 7.

Figure 7 Average Journey Distance (2028 Ref vs WLWA RDA and WLWA RDA + SR)



Analysis of the Figure 7 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 small increase in trip distance in the AM period of the WLWA RDA + SR scenario, when compared to the WLWA RDA model could suggest that congestion is occurring on the network in this scenario. This is further supported by the lack of increase in trip distance during the PM period, suggesting that the problem is likely to be confined to the AM.

4.4.2 Average Journey Speed

Analysis of the average journey speed within the three scenarios, across the AM and PM model periods, is presented in Figure 8.

Figure 8 Average Journey Speed (2028 Ref vs WLWA RDA and WLWA RDA + SR)

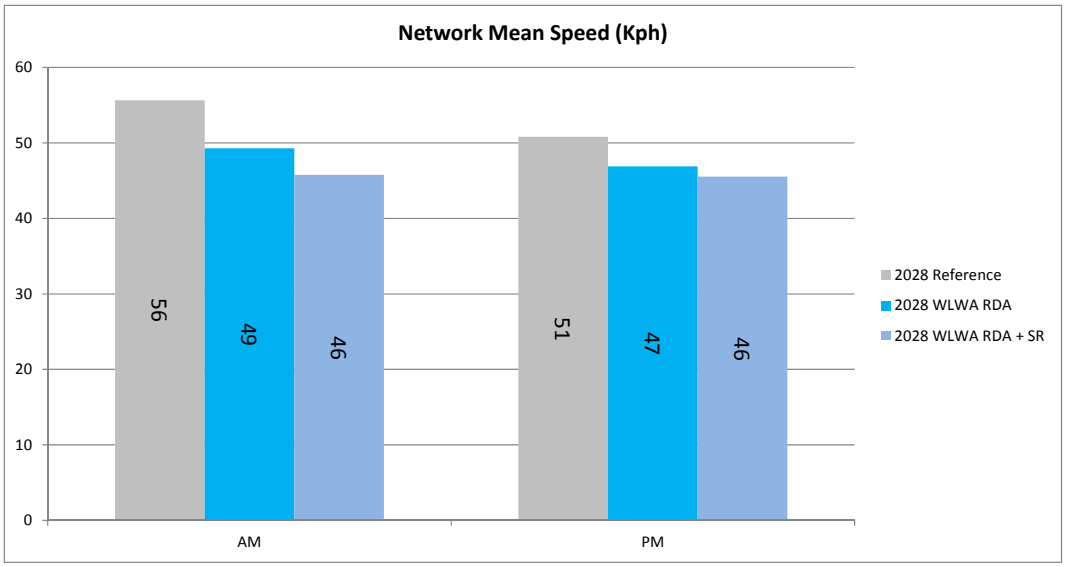


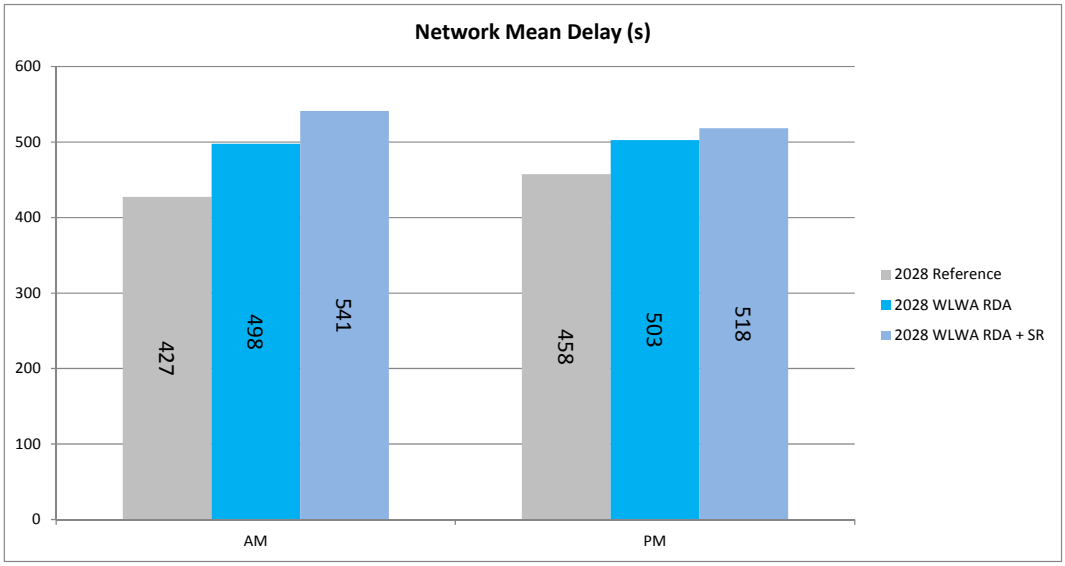
Figure 8 demonstrates that the allocation of the RDA strategy results in a drop in the average speed of vehicles, on the network, of approximately 14% and 9% in the AM and PM peak periods respectively. When compared to the Reference Case, the WLWA RDA + SR scenario results in a respective 27% and 10% drop in average speeds in the AM and PM periods.

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 + SR scenario, particularly during the AM, indicates that the network configuration within this scenario is less effective at accommodating the demands than that which has been adopted within the 2028 WLWA RDA model network. This reduction in speeds is likely to be directly attributable to the inclusion of the additional development and its associated demands along the Stratford Road.

4.4.3 Average Journey Time (Seconds)

Analysis of the average journey time, within each scenario, across the AM and PM model periods, is presented in Figure 9.

Figure 9 Average Delay (2028 Ref vs WLWA RDA and WLWA RDA + SR)



Analysis of the difference in average journey times between the 2028 Reference Case and the WLWA RDA scenario indicates an increase in the time it takes to complete a journey when comparing to the 2028 Reference Case, of around 16% during the AM and 10% during the PM periods for the WLWA RDA scenario.

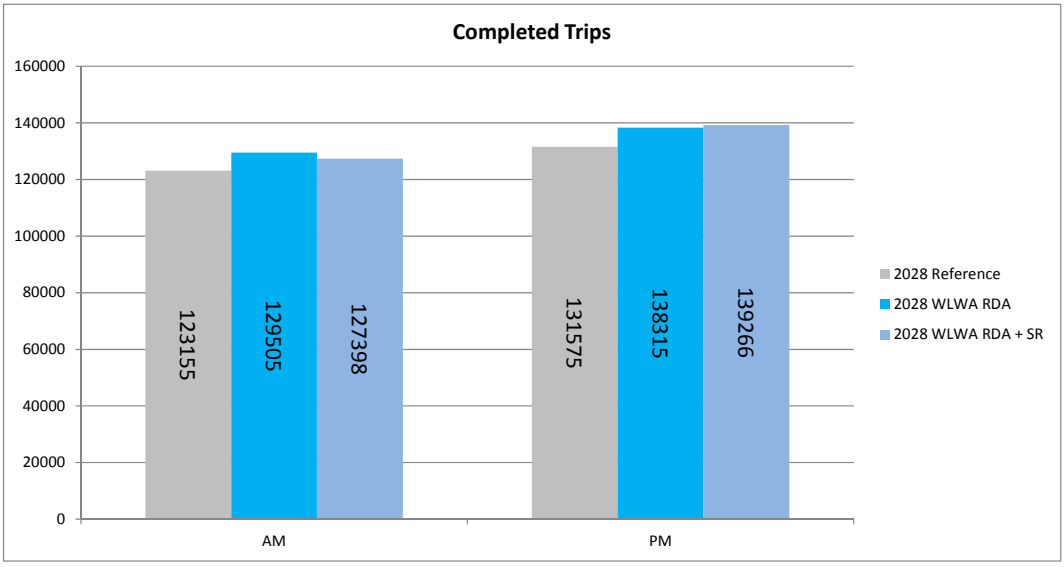
When comparing the Reference Case to the WLWA RDA + SR scenario, an increase of 25% and 13% in journey times is expected during the AM and PM periods respectively. An incremental increase in delay is likely to be experienced as a result of these vehicles being added on to an already congested network. 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.

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 development on Stratford Road be adopted. Notably the development does not appear to have a significant impact on journey times in the PM peak period, again suggesting the congestion issues are confined to the AM.

4.4.4 Completed Trips

Analysis of the total number of completed trips within each scenario, during the AM and PM model periods, is presented in Figure 10 on the following page.

Figure 10 Completed Trips (2028 Ref vs WLWA RDA and WLWA RDA + SR)



Analysis of the figure indicates that there is an increase in completed trips of around 5%, for the WLWA RDA scenario in both the AM and PM periods, when compared to the 2028 Reference Case. The number of completed trips increases by 3% in the WLWA RDA + SR scenario during the AM period and 6% in the PM period, suggesting the network provides capacity for the additional demand created at the Stratford Road development.

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.

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 Table 5.

Table 5 Completed Trips Analysis (2028 Ref vs WLWA RDA and WLWA RDA + SR)

	AM (07:00 to 10:00)			PM (16:00 to 19:00)		
	Demand	Completed Trips	Completed %	Demand	Completed Trips	Completed %
2028 Reference	127249	123155	96.78	136667	131575	96.27
2028 WLWA RDA	134372	129505	96.37	145826	138315	94.84
2028 WLWA RDA + SR	134405	127398	94.79	145846	139266	95.49

Table 5 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 + SR 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 addition to the network of development on Stratford Road in the WLWA RDA + SR model network particularly during the AM peak.

4.5 Maximum Queue Length Analysis

The following sets out observations based on the differences in queue lengths between the 2028 Reference Case and 2028 WLWA RDA scenarios.

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

4.5.1 AM Analysis (MQ001 and MQ003)

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

- In the majority of instances the propensity for queues to increase beyond 30 vehicles is limited.
- There are three junctions in the modelled network which trigger the criteria, whereby maximum queue lengths increase by 30-50 vehicles. These impacts occur on the A445/All Saints Road junction between Warwick and Leamington, at the A425/Europa Way roundabout in Leamington and the B4087 in the centre of Leamington. This is likely to be caused by the reassignment of traffic in response to the inclusion of the revised measures within the model network.

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

- In the majority of instances the propensity for queues to increase beyond 30 vehicles is limited.
- There are two instances of increases in queue lengths exceeding 50 vehicles on the network when compared to the reference case. This occurs at the A46/Birmingham Road roundabout and the M40 Junction 15 ‘Longbridge Island’. This increase in queuing is likely to be caused by the reassignment of traffic in response to the inclusion of the development within the model network, along with traffic arriving at the development on Stratford Road via the M40. Further optimisation of the traffic signals at the M40 Junction 15, in local proximity to the development site, may reduce these impacts.
- There are also increases in queue lengths at the A46/B4463 roundabout, adjacent to the M40 Junction 15, and the A425/Banbury Road junction.

4.5.2 PM Analysis (MQ002 and MQ004)

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

- The majority of junctions assessed that trigger the criteria experience a queue length increase less than 30 vehicles
- There are some instances of increases in queue lengths of greater than 30 vehicles. This occurs at M40 Junction 15, junctions along the A425 between Warwick and Leamington, and at the Greys Mallory Junction (where the A425 meets the A452). Again this is likely to be caused by the reassignment of traffic in response to the inclusion of the revised measures within the model network.

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

- The majority of junctions assessed that trigger the criteria experience a queue length of less than 30 vehicles.
- There are severe increases in queuing experienced within the PM network, evident at M40 Junction 15, the Greys Mallory Roundabout and along the A429 Stratford Road towards Warwick. This is likely to be a result of development traffic routing through these junctions, or traffic reassigning on the network as a result of congestion near the development site.

4.5.3 Queue Analysis Summary

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

- The 2028 WLWA RDA junction performance is largely 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 + SR network performance it is apparent that the PM network performs better than the AM network. It is also notable that the PM network performs very similarly to the 2028 WLWA RDA network, other than at two junctions nearby the development site, suggesting the impact of the Stratford Road development strategically in the PM is minimal; and
- The most severe impacts within the 2028 WLWA RDA + SR network occur on junctions close to the Stratford Road development. Queues increase significantly on the M40 Junction 15, A46/Birmingham Road, and the Greys Mallory junction, which suggests that this junction is being used by a large amount of traffic arriving at the development site and that traffic on the network may be re-assigning to avoid this congested junction. This impact is localised to this part of the network, without wider strategic impacts on the model. As such options for mitigating the queuing

occurring at M40 Junction15 are likely to improve the performance of the surrounding network. These options are discussed in Section 4.8.

4.6 Journey Time Analysis

The following sets out observations from the journey time analysis plots for the three key scenarios; 2028 Reference Case and 2028 WLWA RDA and 2028 WLWA RDA +SR. 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 B of this report, whilst the specific drawing number relating to each element of the analysis has been provided.

4.6.1 AM Analysis (MD001, MD003 and MD005)

Analysis of the difference in delay between the 2028 Reference and 2028 WLWA 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 Banbury Road and Birmingham Road all experience reductions.
- Increases in journey times are evident on the four approaches to Grey's Mallory. This indicates that further optimisation of the scheme proposed in this area is desirable.
- There are increases in delay along the A452 in both directions which indicates that further optimisation of the schemes in this area may also be desirable.
- There are 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.

Analysis of the difference in delay between the 2028 Reference and 2028 WLWA RDA + SR scenario, during the AM period, reveals the following:

- Severe increases in delay are experienced by vehicles approaching the M40 Junction 15, with increased delay occurring on all approaches to this junction.
- Whilst it is apparent from the previous analysis that delays on the approaches to Grey's Mallory have increased, it appears that these delays have worsened in this scenario, particularly on the A425 and Warwick Bypass approaches. This suggests that development traffic may route to the proposed site via this junction, or that existing traffic may be re-routing to avoid the congested M40 Junction 15

- Delay on Myton Road is now being experienced in both directions, compared to just the Leamington bound approach in the 2028 WLWA RDA network. The Coventry Road and Emscote Road approach to Warwick also experiences increased delay when compared to the 2028 Reference scenario.

Analysis of the difference in queuing between the 2028 WLWA RDA and 2028 WLWA RDA + SR scenario, during the AM period, (plot MD005), reveals the following:

- Aside from the increase in delay observed around M40 Junction 15 and approaches to the Greys Mallory junction, delay across the remaining parts of the network is consistent between the 2028 WLWA RDA and 2028 WLWA RDA + SR scenario. This suggests that the impacts of the development will be localised, with little strategic impact on the wider network.

4.6.2 PM Analysis (MD002, MD004 and MD006)

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

- There are a large number of instances where journey times have reduced around the network, notably in 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 Kenilworth Road 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 the M40 Junction 15 have also increased but further optimisation of the signals in this location may further mitigate these impacts.
- Increases in delay occur on the Coventry Road route into Warwick which may require attention.

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

- There are negligible differences in the journey time impacts as a result of the development proposals on Stratford, with the exception of increases in delay on Stratford Road, between the M40 Junction 15 and Warwick town centre. There are increases in delay along this route, particularly in a southbound direction. The Warwick Bypass between Grey's Mallory and M40 Junction 15 also experiences increases in delay.

Analysis of the difference in queuing between the 2028 WLWA RDA and 2028 WLWA RDA + SR scenario, during the AM period, (plot MD006), reveals the following:

- Aside from the increase in delay observed along Stratford Road, between the M40 Junction 15 and Warwick town centre, and Warwick Bypass, delay across the remaining parts of the network is consistent between the 2028 WLWA RDA and 2028 WLWA RDA + SR scenarios. This suggests that the impacts of the development will be localised, with little strategic impact on the wider network.

4.6.3 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 WLWA + 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 + SR network and Reference Case it is apparent that the inclusion of the proposed development on Stratford road has notable localised impacts on network delay. Routes around M40 Junction 15 are negatively affected by the proposals as they currently stand.

When reviewing the PM impacts it is apparent that impact of the development on the network is reduced compared to the AM. The difference in journey times within the PM period when comparing both RDA scenarios to the 2028 Reference Case are limited to Stratford Road only.

4.7 Conclusions

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

- Inclusion of the RDA 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 network in comparison to the 2028 Reference Case conditions. These impacts occur in spite of the adoption of a proposed mitigation strategy.
- With the inclusion of the proposed development on Stratford Road, impacts are observed locally. Queue impacts identified within the 2028 WLWA RDA + SR network indicate that there may be significant impacts occurring on localised parts of the network (M40 J15) which would require mitigation.
- There are also impacts accrued on nearby parts of the network as a result of the Stratford Road development, namely at the Greys Mallory junction, and A46/Birmingham Road junction. This indicates that the additional queuing at M40 Junction 15, is having an impact on the operation of the local network.

- Despite this there appears to be no strategic impact of the developments inclusion on the network.

This analysis indicates that the proposals considered for the Stratford Road development may not be successfully accommodated on the network, with increases in queue lengths and delay in the AM and PM peak. It is likely that additional mitigation measures will need to be considered to accommodate this.

The issue in both peaks appears to relate to the performance of the M40 Junction 15 and the balance of movements across the junction. It should be acknowledged that introducing a means of controlling the flows across this junction better than currently exists within the model, would likely lead to an overall improvement in the model performance at this junction, and across the nearby parts of the network.

Should further investigation of the development impacts on Junction 15 be required then it is recommended that consideration be given to the adoption and application of the testing within the M40 J15 isolated junction model. Testing the proposals to optimise the signal times for M40 J15 within the WLAW strategic level Paramics model would likely be very difficult and time consuming because of the strategic level nature of the model coupled with the relatively long model run times.

5 Summary & Conclusions

5.1 Summary

Arup have been commissioned by Warwickshire County Council (WCC) and Warwick District Council (WDC) to undertake additional testing as part of the latest testing of the WDC Strategic Transport Assessment. This report reviews thoe performance of the current WLWA Paramics model networks, inclusive of Local Plan allocations and mitigation measures, in light of a number of changes to the network, namely:

- Improvements to the scenario networks now likely to be delivered through the early implementation of the A46/A425 'Stanks' improvements
- The additional impacts likely to occur as a result of the application of a new, 11 Ha B1 Employment site on the Stratford road just to the northeast of M40 J15 'Longbridge Island'

This stand-alone assessment is intended to record the revised network conditions which are now within both the existing and 2028 scenario networks, as a result of the inclusion of the A46/A425 improvements as well as an additional sensitivity test which assesses the allocation of additional employment land to the south east of Warwick, off Stratford Road. Testing was undertaken using the existing 2028 Warwick and Leamington Wide Area (WLWA) Reference and RDA Scenario networks as the starting point.

5.2 Conclusions

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

- Inclusion of the RDA 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 network in comparison to the 2028 Reference Case conditions. These impacts occur in spite of the adoption of a proposed mitigation strategy.
- With the inclusion of the proposed development on Stratford Road, impacts are observed locally. Queue impacts identified within the 2028 WLWA RDA + SR network indicate that there may be significant impacts occurring on localised parts of the network (M40 J15) which would require mitigation.
- There are also impacts accrued on nearby parts of the network as a result of the Stratford Road development, namely at the Greys Mallory junction, and A46/Birmingham Road junction. This indicates that the additional queuing at M40 Junction 15, is having an impact on the operation of the local network.
- Despite this there appears to be no strategic impact of the developments inclusion on the network.

This analysis indicates that the proposals considered for the Stratford Road development may not be successfully accommodated on the network, with increases in queue lengths and delay in the AM and PM peak. It is likely that additional mitigation measures will need to be considered to accommodate this.

The issue in both peaks appears to relate to the performance of the M40 Junction 15 and the balance of movements across the junction. It should be acknowledged that introducing a means of controlling the flows across this junction better than currently exists within the model, would likely lead to an overall improvement in the model performance at this junction, and across the nearby parts of the network.

5.3 Further Considerations

The results analysis detailed in this chapter has highlighted that with the addition of the development proposed on Stratford Road, there is likely to be a localised impact on the network. Queue lengths increase on approach arms to the M40 Junction 15 signalised roundabout in the AM and PM peak period.

Should further investigation of the development impacts on Junction 15 be required then it is recommended that consideration be given to the adoption and application of the testing within the M40 J15 isolated junction model. Testing the proposals to optimise the signal times for M40 J15 within the WLWA strategic level Paramics model would likely be very difficult and time consuming because of the strategic level nature of the model coupled with the relatively long model run times.

Given that the junction is currently controlled by MOVA configuration, in reality it is likely that any significant increases in queuing could be balanced out by MOVA. This would spread the impacts across the junction. A limitation to this modelling exercise is that MOVA cannot be accurately modelled in a network of this size. The ability to model MOVA accurately within PARAMICS is time consuming, and impractical for a large model. A modelling exercise has however been undertaken by JMP Consultants Ltd (JMP) to assess the potential benefits that arise from modelling MOVA control at the M40 Junction 15. This was undertaken by developing a cordon model of the junction from the larger 2028 WLWA model[2]. This modelling exercise concluded that the junction operates with significant improvements in delay and queue lengths with the inclusion of MOVA, and that the inclusion of MOVA increases capacity at the junction.

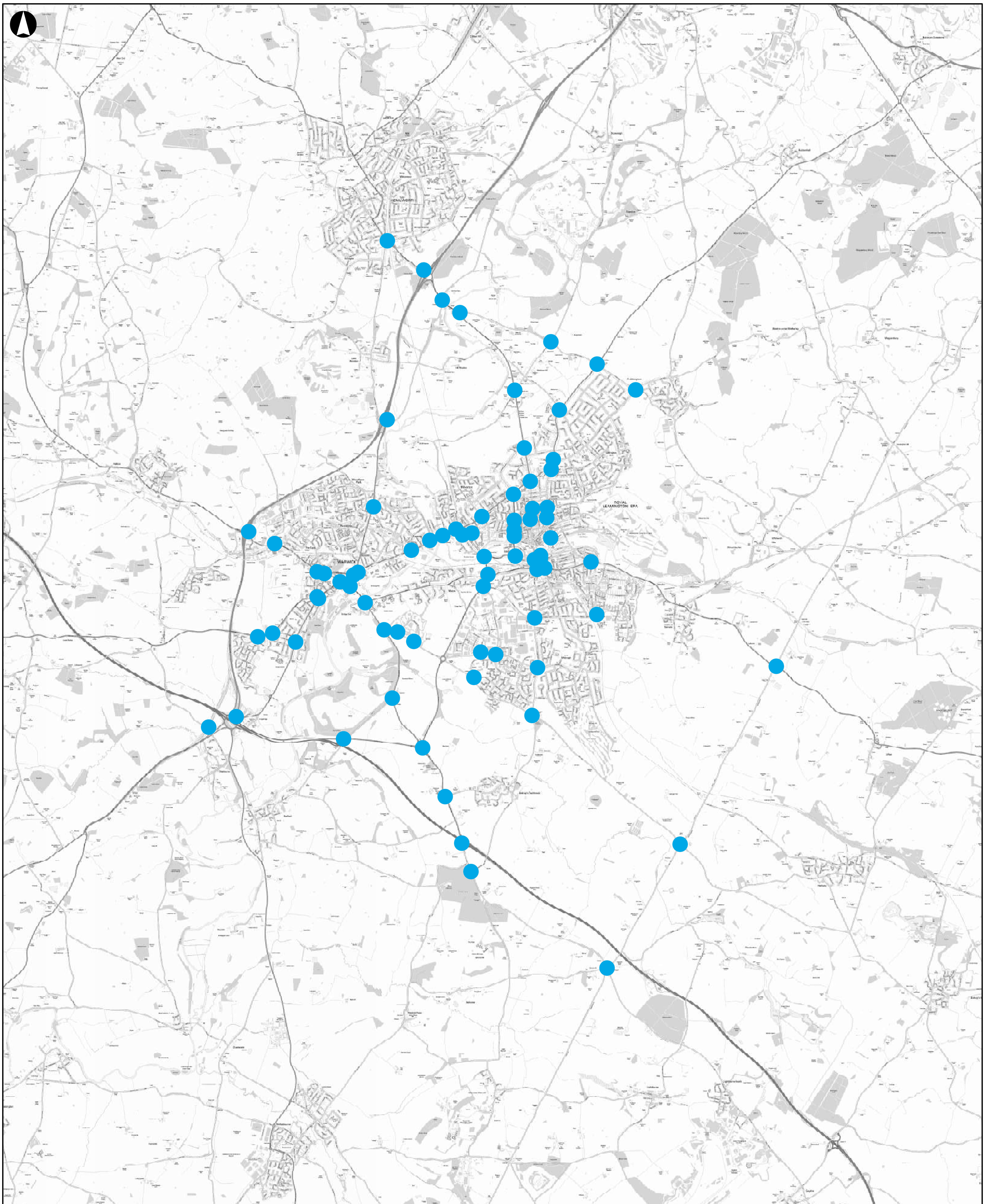
Given the findings of the JMP study, it is considered likely that the increases in queuing observed in the WLWA RDA + SR model at the M40 Junction 15 would be reduced in a scenario which modelled the use of MOVA controlled signalling at this junction. It is suggested that a localised detailed assessment of this junction performance, inclusive of MOVA, be undertaken. This will enable a more reliable assessment of the impacts of the Stratford Road development on this junction, and an appropriate mitigation strategy, should it be needed, to be identified.

[2] M40 Junction 15 MOVA Study, JMP Consultants Ltd, April 2013

Appendix A

Maximum Queue Length Analysis Plots

A3



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Junction Locations

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Issue	Date	By	Chkd	Appd
P1	14/10/2014	ZW	JE	JE

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www.arup.com

Client
Warwickshire County Council

Job Title
Strategic Transport Assessment 4 Addendum

Metres
0 750 1,500 3,000

WLWA Queue Assessment
Junction locations

Scale at A3
N.T.S.

Job No
232815-60

Drawing Status
For Information

Drawing No
MQ 000

Issue
P1

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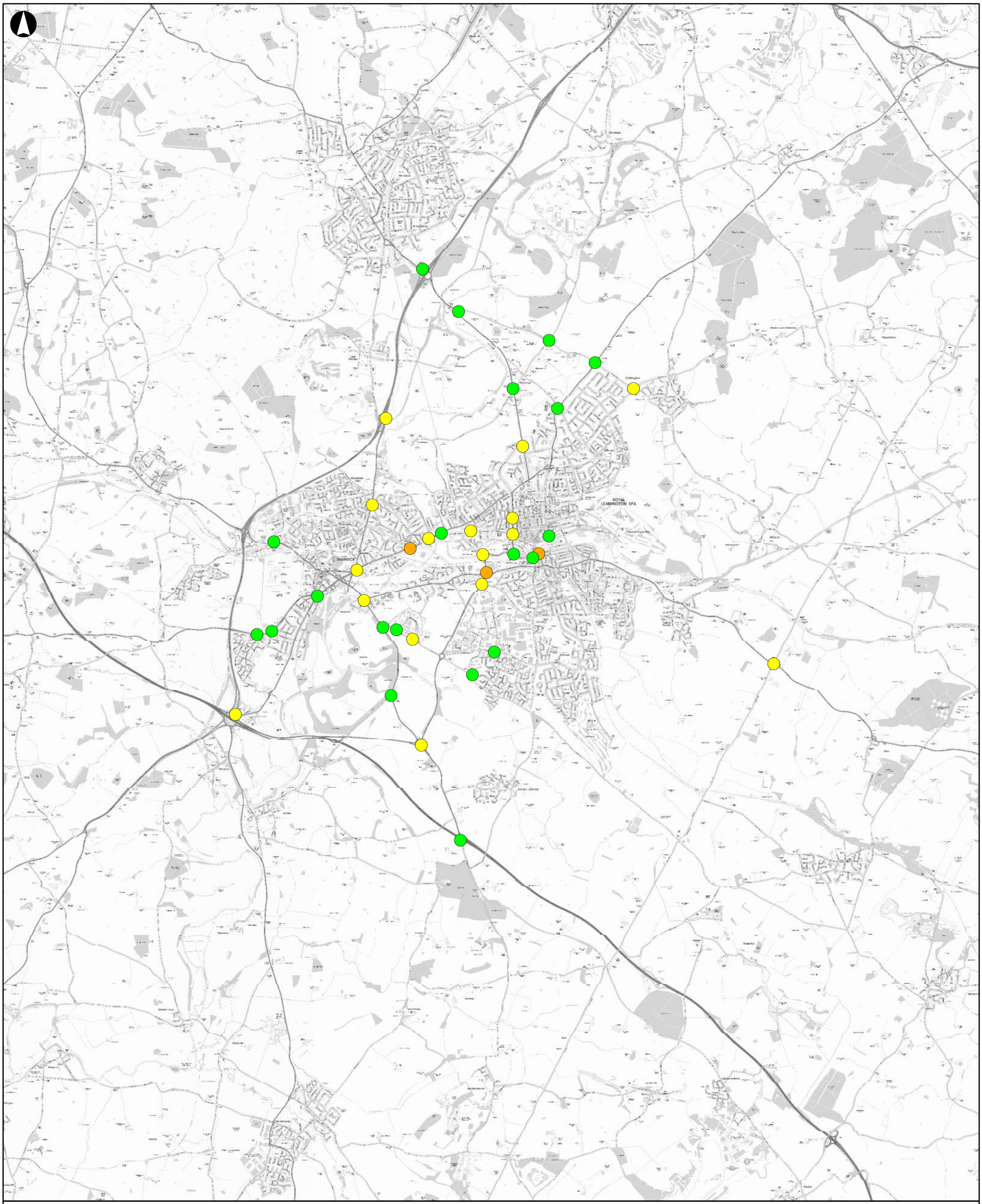

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AM peak period

- < -5 vehicles
- 15 - 30 vehicles
- 30 - 50 vehicles
- > 50 vehicles

Issue	Date	By	Chkd	Appd
P1	22/10/2014	ZW	JE	JE

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Job Title
Strategic Transport Assessment 4 Addendum

Metres
0 750 1,500 3,000

Reference V WDC RDA
2028 AM Peak Period
Average Maximum Queue

Scale at A3
N.T.S.

Job No	Drawing Status
232815-60	For Information

Drawing No	Issue
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A3

Legend

PM peak period

- < -5 vehicles
- 15 - 30 vehicles
- 30 - 50 vehicles
- > 50 vehicles

Issue	Date	By	Chkd	Appd
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Metres
0 750 1,500 3,000

Reference V WDC RDA
2028 PM Peak Period
Average Maximum Queue

Scale at A3
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Job No	Drawing Status
232815-60	For Information

Drawing No	Issue
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A3

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AM peak period

- < -5 vehicles
- 15 - 30 vehicles
- 30 - 50 vehicles
- > 50 vehicles

Issue	Date	By	Chkd	Appd
P1	22/10/2014	ZW	JE	JE

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Job Title
Strategic Transport Assessment 4 Addendum

Metres
0 750 1,500 3,000

Reference V WDC RDA + SR
2028 AM Peak Period
Average Maximum Queue

Scale at A3
N.T.S.

Job No	Drawing Status
232815-60	For Information

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MQ 003	**P1**

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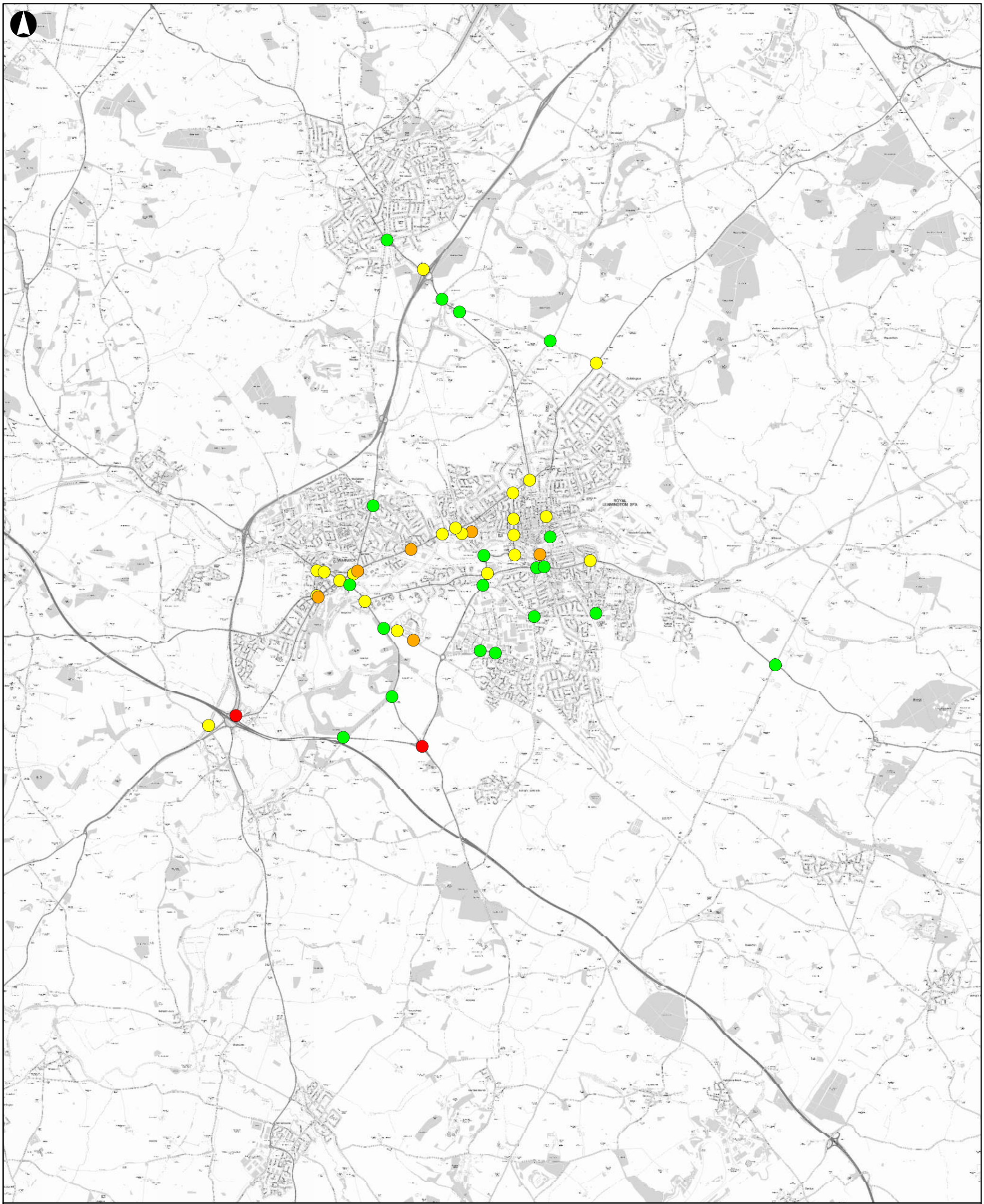

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PM peak period

- < -5 vehicles
- 15 - 30 vehicles
- 30 - 50 vehicles
- > 50 vehicles

Issue	Date	By	Chkd	Appd
P1	22/10/2014	ZW	JE	JE

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Job Title
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Metres
0 750 1,500 3,000

Reference V WDC RDA + SR
2028 PM Peak Period
Average Maximum Queue

Scale at A3
N.T.S.

Job No	Drawing Status
232815-60	For Information

Drawing No	Issue
MQ 004	**P1**

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Appendix B

Journey Time Analysis Plots

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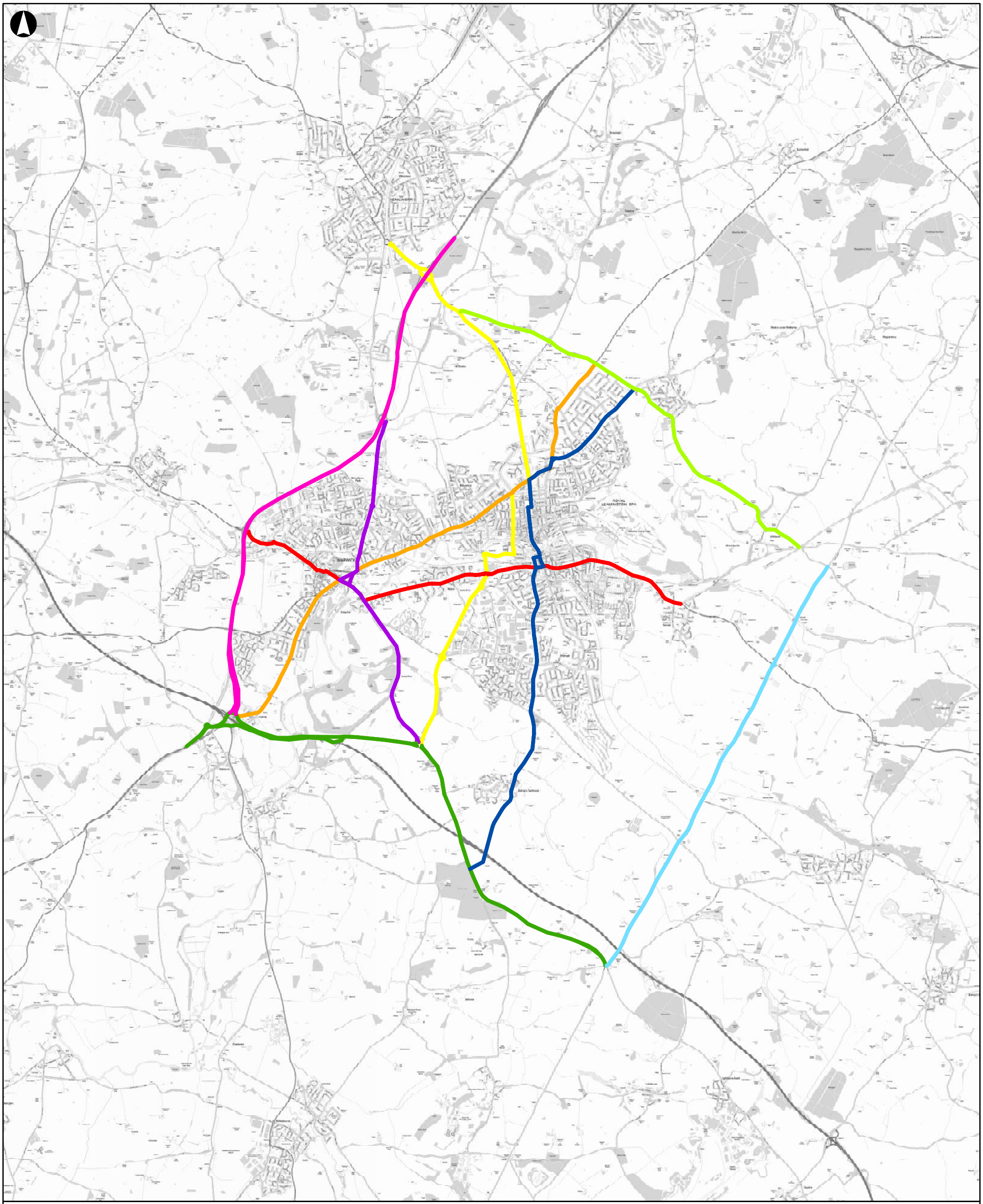

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- 3
- 4
- 5
- 6
- 7
- 8
- 9

Issue	Date	By	Chkd	Appd
P1	14/10/2014	MM	JE	JE

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Job Title
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Metres
0 750 1,500 3,000

Journey Time Analysis Routes

Scale at A3
N.T.S.

Job No	Drawing Status
232815-60	For Information

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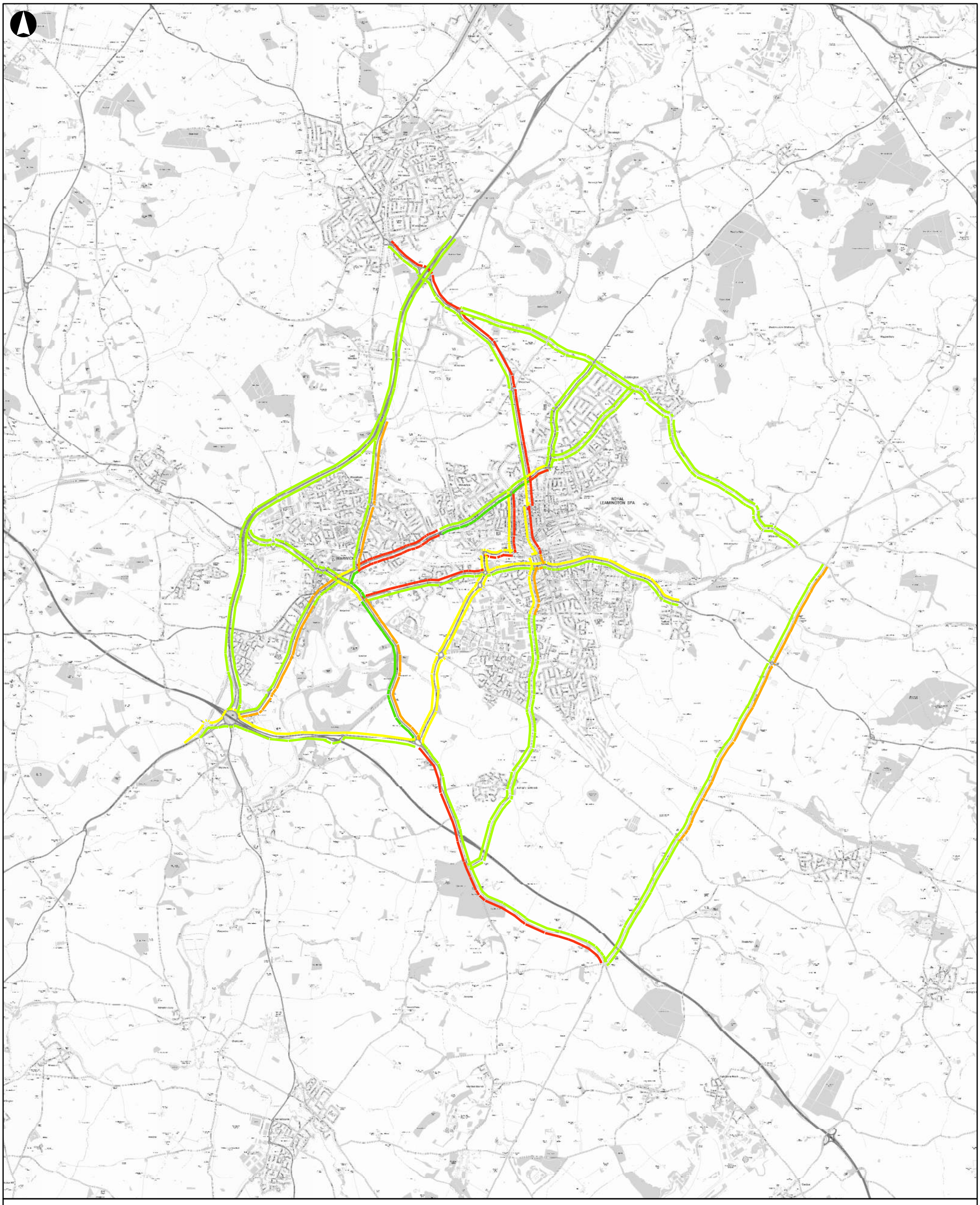

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- < -15%
- -15% - 15%
- 15% - 25%
- 15% - 50%
- >50%

Issue	Date	By	Chkd	Appd
P1	22/10/2014	ZW	JE	JE

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Job Title
Strategic Transport Assessment 4 Addendum

Metres
0 750 1,500 3,000

Reference V WDC RDA
2028 AM Peak Hour 0800-0900
Percentage Difference Mean Delay

Scale at A3
N.T.S.

Job No	Drawing Status
232815-60	For Information

Drawing No	Issue
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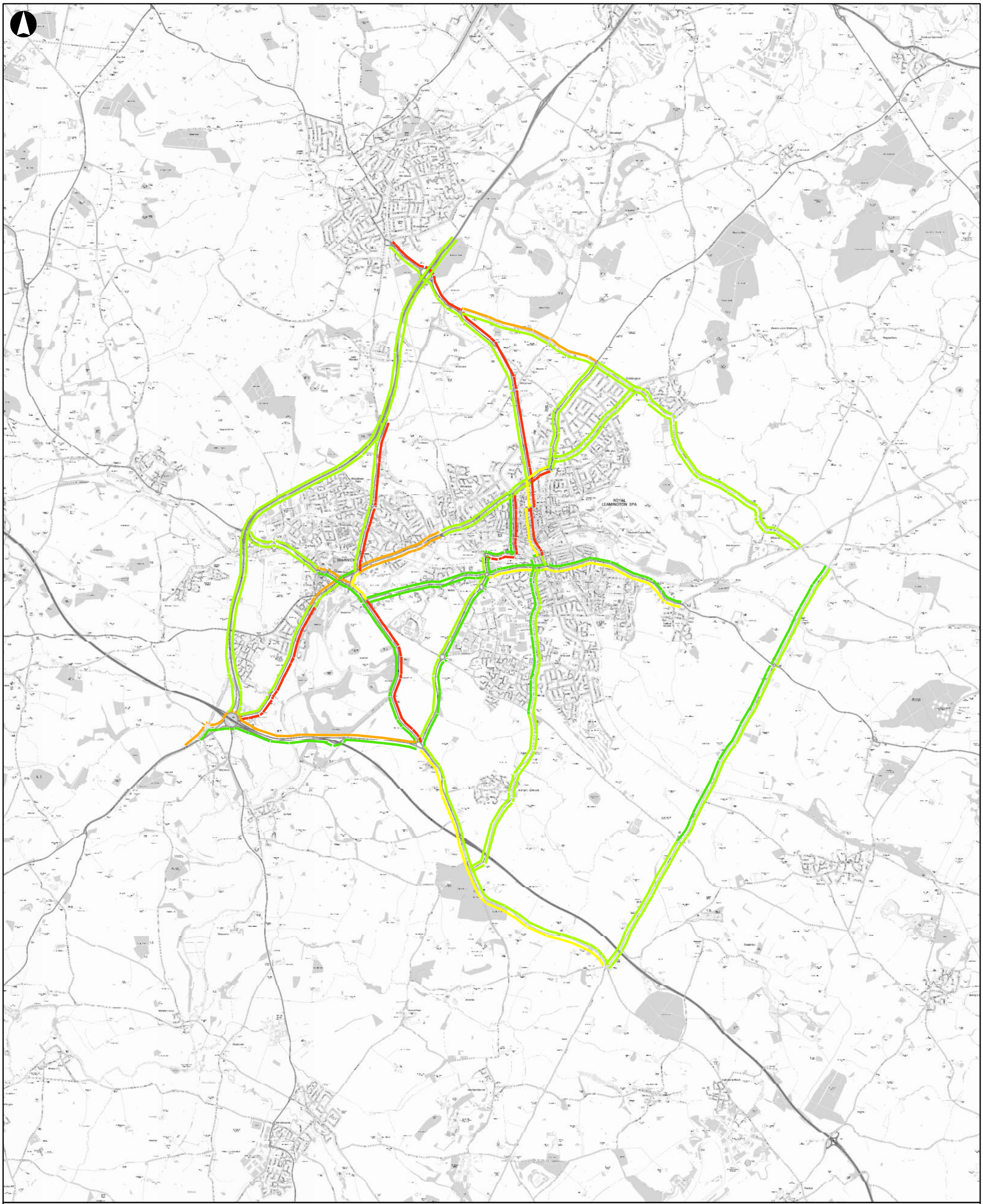

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Peak Hour

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

Issue	Date	By	Chkd	Appd
P1	22/10/2014	ZW	JE	JE

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Client
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Job Title
Strategic Transport Assessment 4 Addendum

Metres
0 750 1,500 3,000

Reference V WDC RDA
2028 PM Peak Hour 1700-1800
Percentage Difference Mean Delay

Scale at A3
N.T.S.

Job No	Drawing Status
232815-60	For Information

Drawing No	Issue
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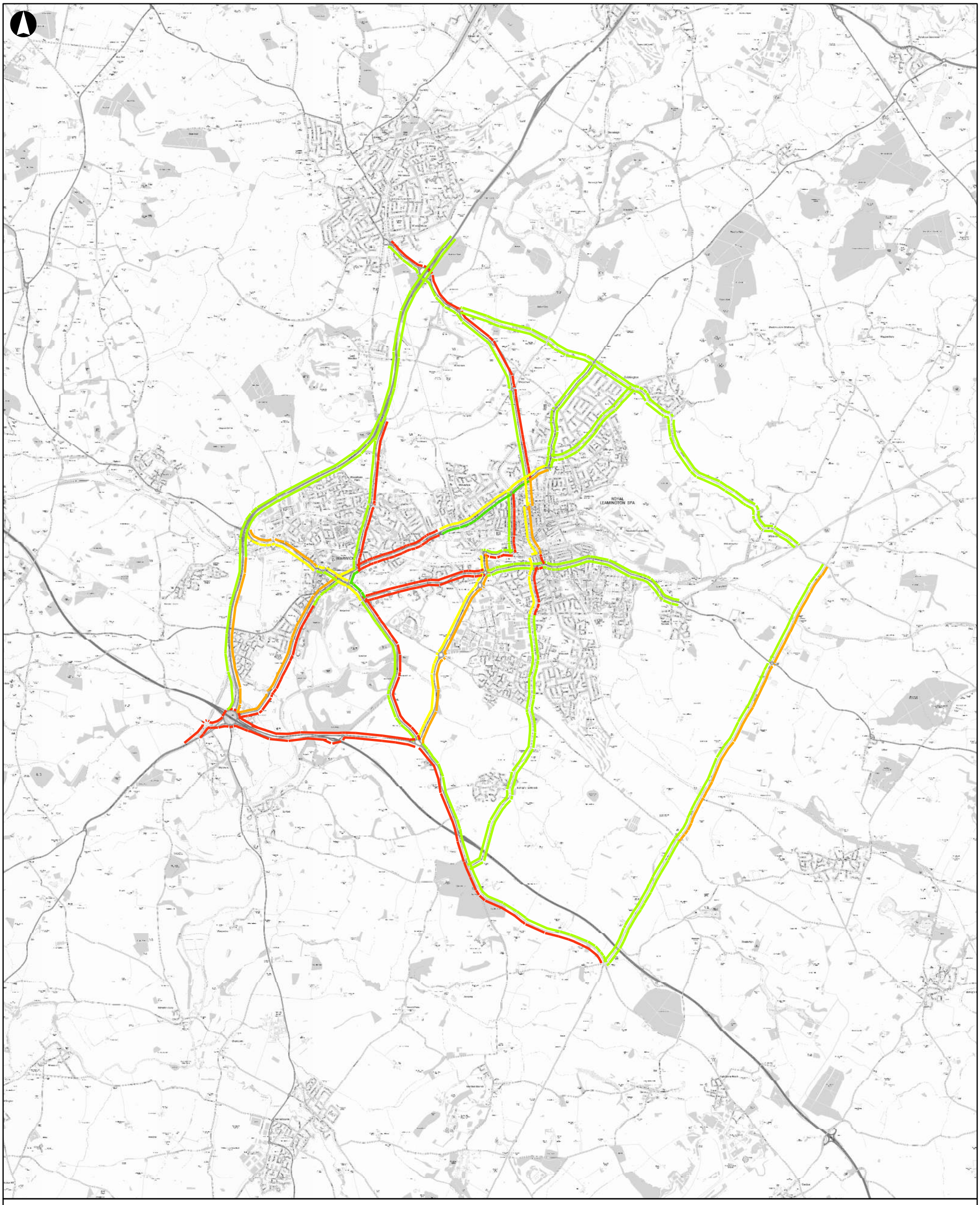

Legend

Peak Hour

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

Issue	Date	By	Chkd	Appd
P1	22/10/2014	ZW	JE	JE

ARUP

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Blythe Gate, Blythe Valley Park
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www.arup.com

Client
Warwickshire County Council

Job Title
Strategic Transport Assessment 4 Addendum

Metres
0 750 1,500 3,000

Reference V WDC RDA + SR
2028 AM Peak Hour 0800-0900
Percentage Difference Mean Delay

Scale at A3
N.T.S.

Job No	Drawing Status
232815-60	For Information

Drawing No	Issue
MD 003	**P1**

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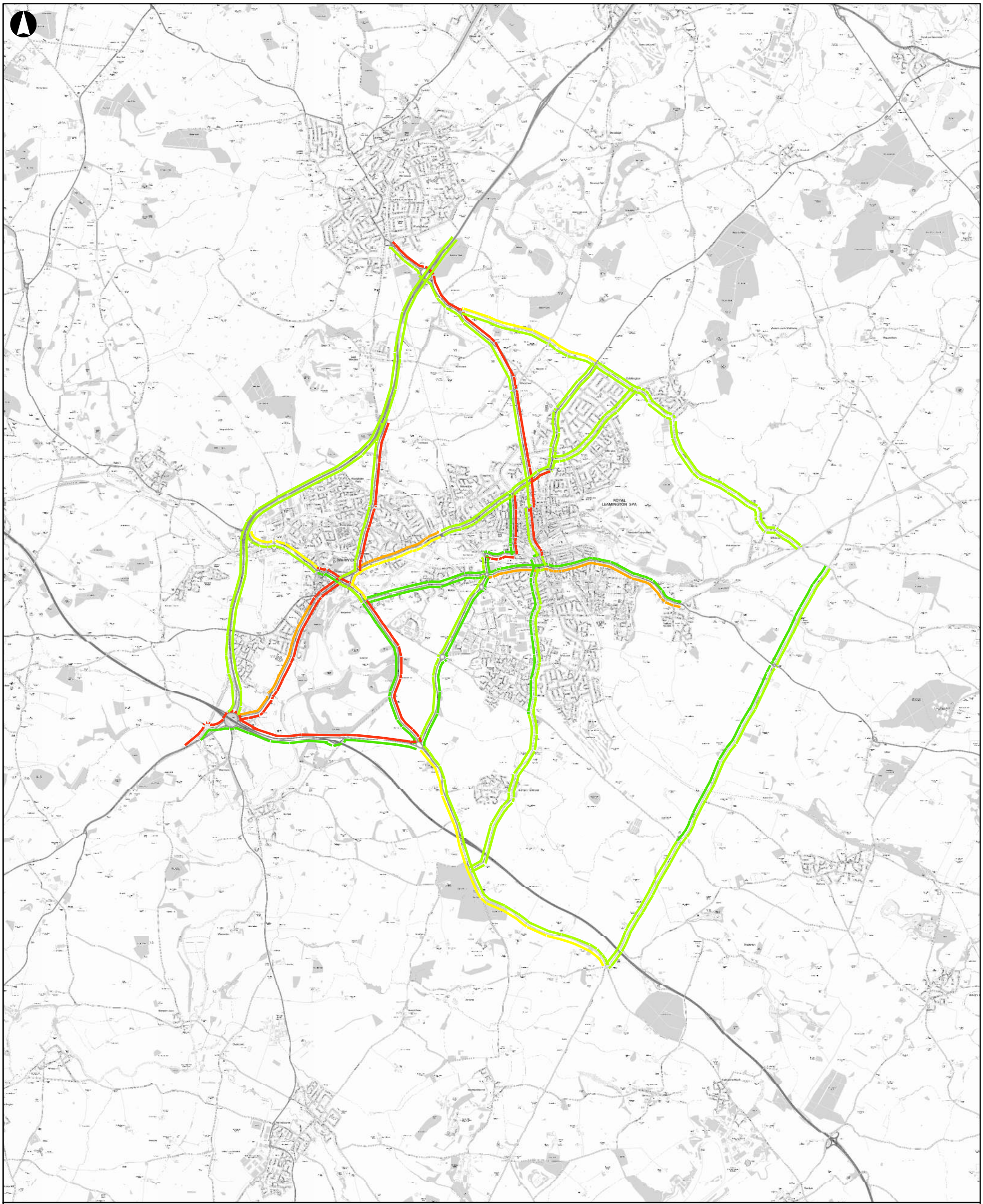

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Peak Hour

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

Issue	Date	By	Chkd	Appd
P1	22/10/2014	ZW	JE	JE

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Client
Warwickshire County Council

Job Title
Strategic Transport Assessment 4 Addendum

Metres
0 750 1,500 3,000

Reference V WDC RDA + SR
2028 PM Peak Hour 1700-1800
Percentage Difference Mean Delay

Scale at A3
N.T.S.

Job No	Drawing Status
232815-60	For Information

Drawing No	Issue
MD 004	P1

MXD Location Document Path: \\global.arup.com\europe\Midlands\jobs\232000\232815-60\4 Internal Project Data\4-04 Calculations\GIS\Stratford Road Testing\MXD\MD 004.mxd

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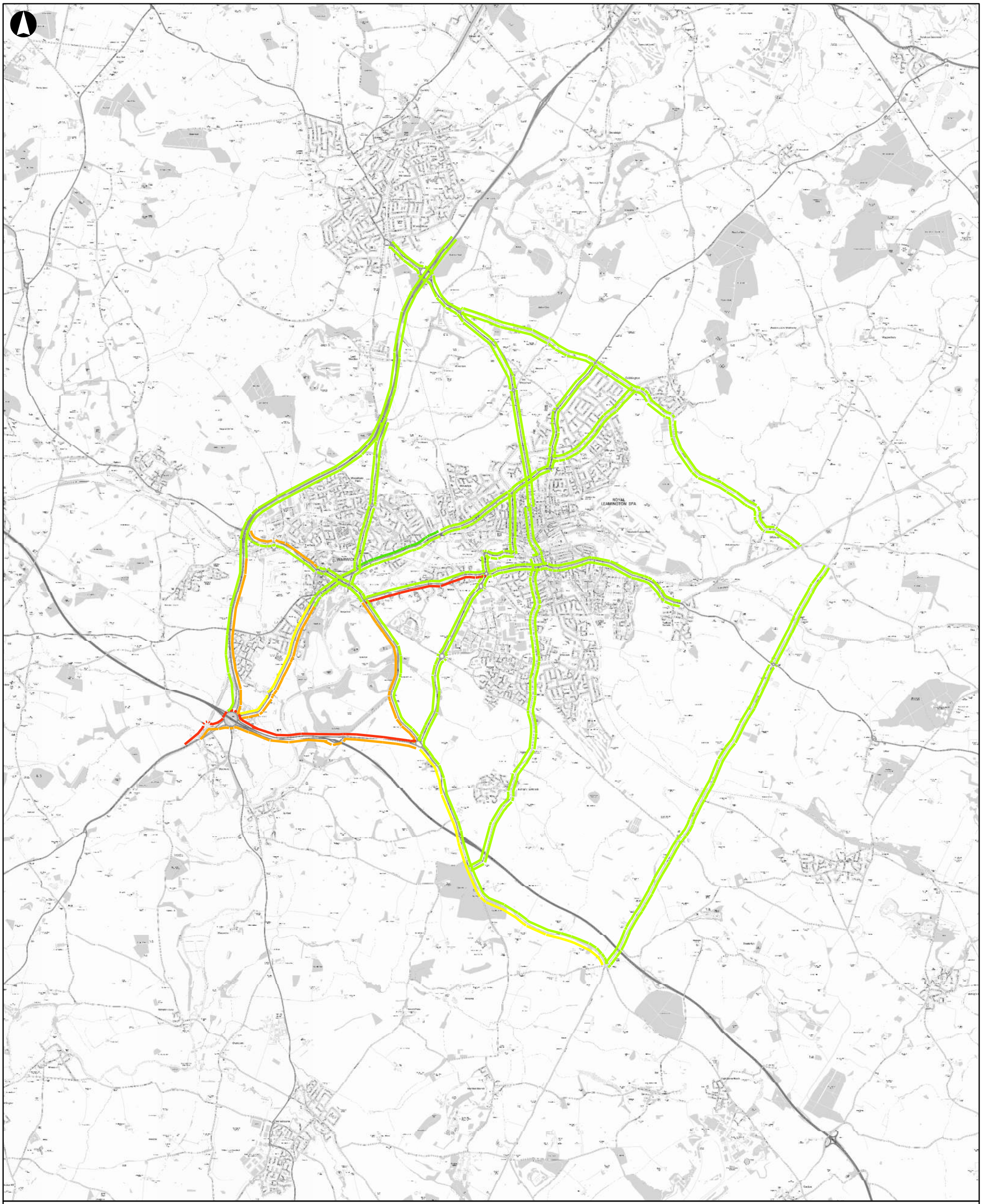

Legend

Peak Hour

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

Issue	Date	By	Chkd	Appd
P1	21/10/2014	ZW	JE	JE

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Client
Warwickshire County Council

Job Title
Strategic Transport Assessment 4 Addendum

Metres
0 750 1,500 3,000

WDC RDA V WDC RDA + SR
2028 AM Peak Hour 0800-0900
Percentage Difference Mean Delay

Scale at A3
N.T.S.

Job No	Drawing Status
232815-60	For Information

Drawing No	Issue
MD 007	P1

MXD Location Document Path: J:\232000\232815-60\4 Internal Project Data\4-04 Calculations\GIS\Stratford Road Testing\MXD\MD 007.mxd

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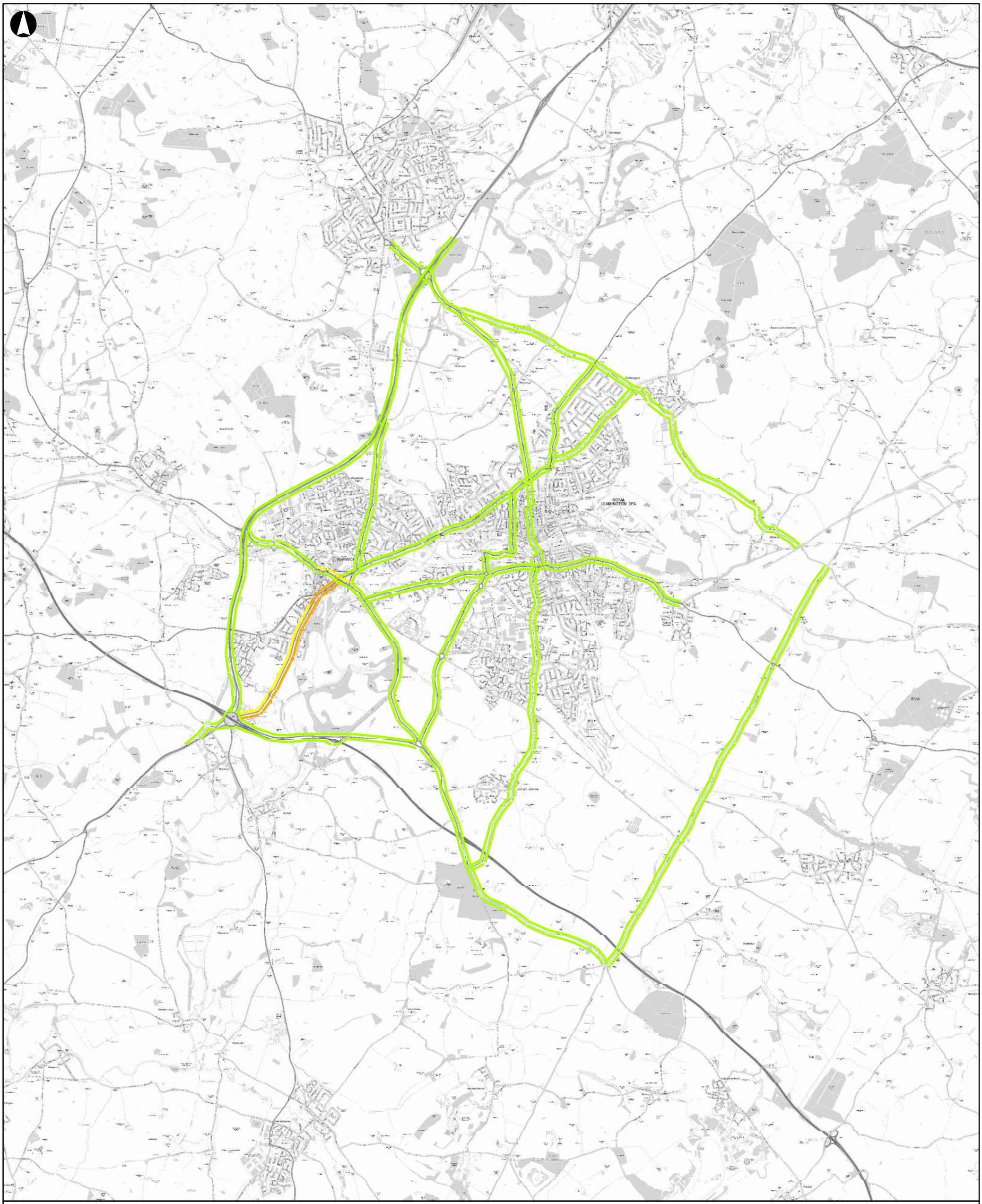

Legend

Peak Hour

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

Issue	Date	By	Chkd	Appd
P1	21/10/2014	ZW	JE	JE

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Warwickshire County Council

Client
Warwickshire County Council

Job Title
Strategic Transport Assessment 4 Addendum

Metres
0 750 1,500 3,000

WDC RDA V WDC RDA + SR
2028 PM Peak Hour 1700-1800
Percentage Difference Mean Delay

Scale at A3
N.T.S.

Job No	Drawing Status
232815-60	For Information

Drawing No	Issue
MD 008	P1

MXD Location Document Path: J:\232000\232815-60\4 Internal Project Data\4-04 Calculations\GIS\Stratford Road Testing\MXD\MD 008.mxd