stability levels of less than 50% in the PM, it should be recognised that every other model run experienced heavy congestion such that the impacts were of a severity such that they rendered the model outputs invalid. The results presented within the PM will be biased towards more favourable runs and, therefore, the results are to be considered as bias towards a more preferential set of network conditions than would be likely to occur in reality.

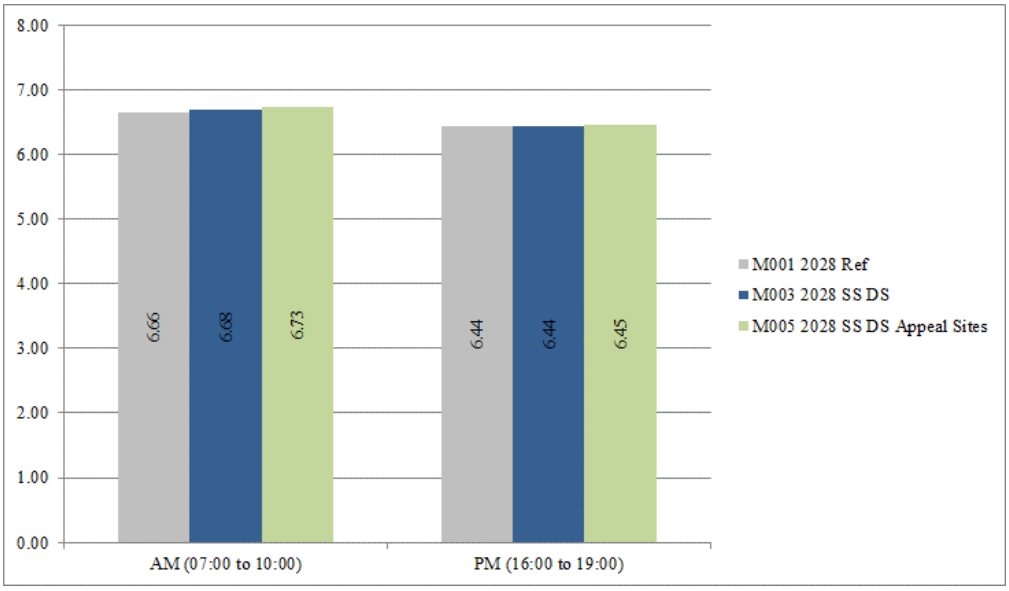
7.3 Network Wide Statistics

The following sets out the changes in network wide statistics between the 2028 Reference Case and the 2028 DS + Appeals scenario.

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 25. Analysis of this figure indicates very little difference between the three scenarios.

Figure 25 - Average Journey Distance (2028 Reference vs. 2028 SS Do Something vs. 2028 SS DS + Appeals), Km



The differences in journey distance across the three scenarios are therefore not considered to be significant in the PM, however, considering the limited number of runs that this is based on that can be concluded from this is that, when reviewing the PM model runs that have worked, redistribution is unlikely to occur. Within the AM it is apparent that the inclusion of the Appeals sites results in an increase in the distances vehicles have to travel which may, at least in part, occur due to the reassignment onto alternative routes in response to congestion effects.

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 26**:**

Figure 26 - Average Journey Speed (2028 Reference vs. 2028 SS Do Something vs. 2028 SS DS + Appeals), Km/h

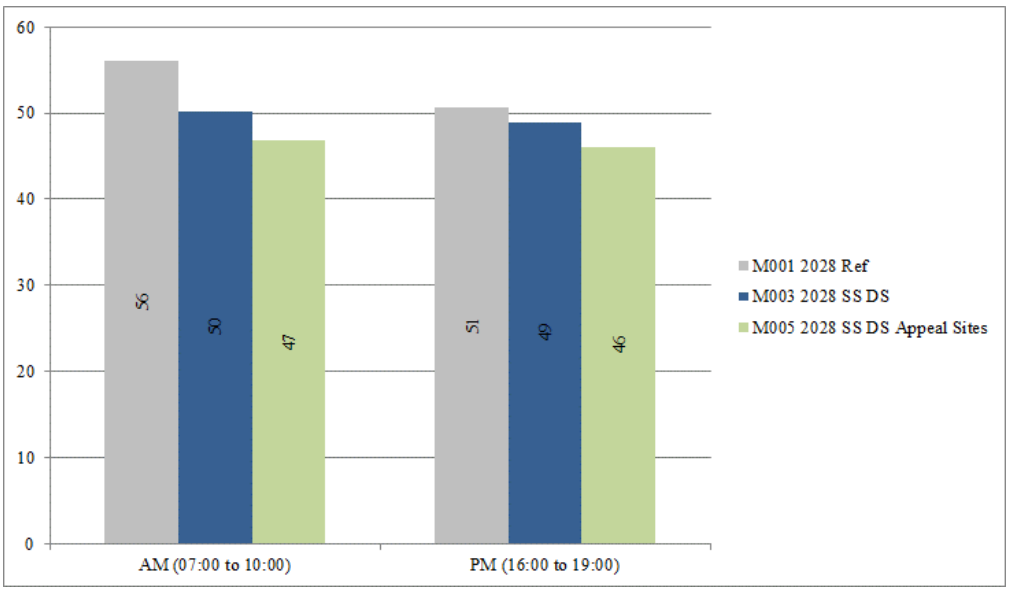


Figure 26 demonstrates that the allocation of the Appeal demands is likely to result in a 17% and 9% reduction in journey speeds for the AM and PM peak periods respectively between the Reference Case network and the DS + Appeals scenario. This reduction is also greater than that experienced by the Do Something scenario when compared to the Reference case.

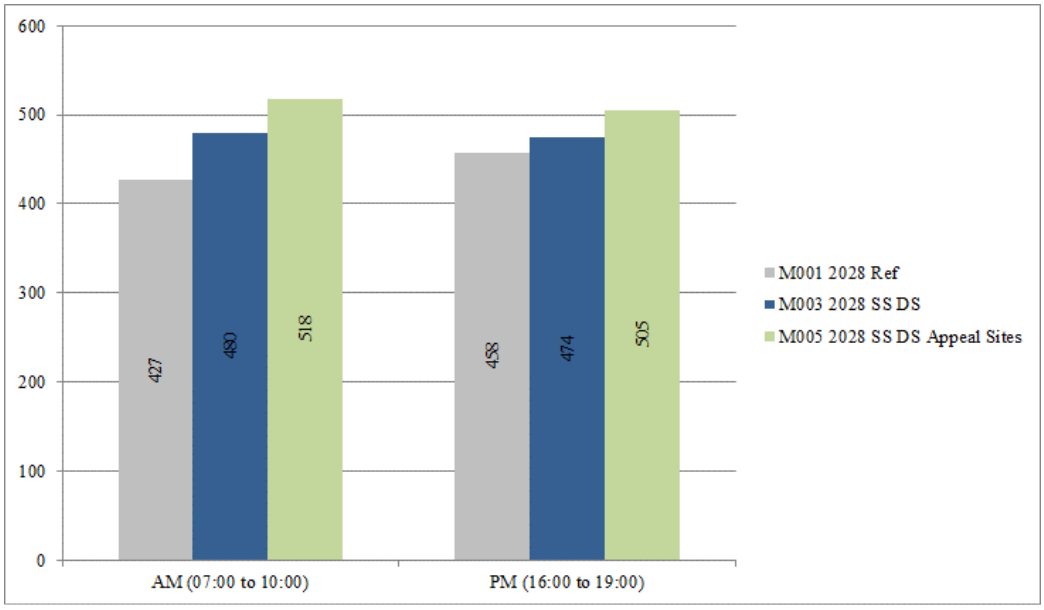
This is likely to occur as a result of the additional Appeals demand on the network and indicates that whilst the mitigation measures introduced within the SS DS scenario appear to mitigate the demands associated with the Southern Sites, they are less able to mitigate the effects of the demands associated with the Appeal sites in conjunction with the allocated sites.

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 27

Figure 27 on the following page. Analysis of Figure 27 reveals that journey times within the 2028 SS DS + Appeal scenario network are 21% and 10% higher within the AM and PM time periods respectively when compared to the 2028 Reference Case journey times. Again, this increase is also greater than that experienced by the Do Something scenario when compared to the Reference case. Furthermore it should be acknowledged that the analysis of the PM impacts is based on a disproportionately low number of successful runs and therefore the analysis will be bias towards the more favourable model runs as a result.

Figure 27 - Average Journey Time (2028 Reference vs. 2028 SS Do Something vs. 2028 SS DS + Appeals) Seconds



7.4 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 SS DS + Appeals scenario.

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

7.4.1 AM Analysis (MQ007)

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

- There are two instances of a severe increase in the queue levels. One of these instances occurs at the A445 Leicester Lane/ Westhill Road/ Kenilworth Road junction, which correlates with the queueing increase in the 2028 DS model, the second increase occurs at Bericote roundabout.
- There are still a number of instances where a queue reduction is expected (9) but this is lower than that expected for the SS DS scenario (12)
- The majority of junctions assessed experience a negligible change in queue level (greater than -5 vehicles and less than 30 vehicles change)
- There are a greater number of junctions where a moderate increase in the queue length is expected for the SS DS + Appeals scenario than expected for the SS DS scenario

7.4.2 PM Analysis (MQ008)

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

- There is one instance of a severe queue length increase at A46 Warwick By-Pass/ A425 Birmingham Road/ A4177 Birmingham Road. This increase in queuing in this area does not occur in any other scenario and so is considered to be an indication that the additional developments in the south may result in an increase in trips accessing the sites via the Birmingham Road rather than being retained on the A46 and M40.
- There are still a number of instances where a queue reduction is expected (9) but this is lower than that expected for the SS DS scenario (16).
- The majority of junctions assessed experience a negligible change in queue level (greater than -5 vehicles and less than 30 vehicles change)
- There are a greater number of junctions where a moderate increase in the queue length is expected for the SS DS + Appeals scenario than expected for the SS DS scenario

7.4.3 Queue Analysis Summary

A summary of the findings obtained through comparing the changes in queuing between the 2028 WLWA Reference and 2028 WLWA DS + Appeals 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 30 vehicles change) in both the AM and PM periods
- Inclusion of the demands associated with the Appeal Sites has a negative effect on the queues expected compared the SS DS scenario. The number of junction where a queue reduction is expected to decrease and the number of junction where a severe queue length change is expected increases
- The negative effects on queues compared to the SS DS scenario is notably greater during the PM peak period.

Analysis of the difference in queuing levels should be treated with caution, especially when considering the fact that over half of the results were excluded from the analysis on the basis that the model runs failed.

7.5 Journey Time Analysis

The following sets out some initial observations of the mean speed plots for the two key model scenarios; 2028 Reference and 2028 SS DS + Appeals 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.

7.5.1 AM Analysis (MD007)

Analysis of the difference in queuing between the 2028 Reference and 2028 SS DS + Appeals scenarios, during the AM period, reveals the following:

- From the outset, the inclusion of the Appeal Site demands has a negative effect on the journey times expected on the network
- There are ten instances where a very severe increase in the delay is expected for the SS DS + Appeals site when compared to the Reference Case. This is opposed to only three instances where a severe increase is expected for the SS DS scenario

- The majority of the routes in the vicinity of the proposed sites experience severe or very severe increases in journey times when compared to the Reference Case
- In a number of occasions the increases in journey times experienced within the 2028 SS DS + Appeals is actually greater than the increase recorded within the 2028 SS Do Nothing model network.

7.5.2 PM Analysis (MD008)

Analysis of the difference in delay between the 2028 Reference and 2028 SS DS + Appeals scenario, during the PM period, reveals the following:

- There are some instances where increases in journey times are predicted to be higher than within the 2028 Do Something model but the number of increases is less prevalent than when considering the performance of the various networks within the AM period.
- There is a general increase in journey times on routes travelling SB through the model network, most likely due to the increased draw of trips towards the south as a result of the new developments located to the southwest of the model network
- However there are instances where a slight improvement is expected for journey times compared to the results of the SS DS scenario. One instance where this occurs is on the south east arm approach to Grey's Mallory where a severe delay increase was expected for the SS DS scenario but now a moderate increase is expected for the SS DS + Appeals scenario. Given that a worsening of the delays expected occurs at other locations in the model this likely indicates this improvement is due to a reallocation of demand over the network

7.5.3 Delay Analysis Summary

The inclusion of the Appeal Site demands has a detrimental effect on the delays expected within the network. This effect is notably greater during the AM peak period where a number of routes are expected to experience a severe delay increase which were not expected to do so for the SS DS scenario. This indicates that the mitigation schemes are not able to fully mitigate the effects of the additional demand on the network and further optimisation or additional schemes are likely to be required to reduce these impacts.

7.6 Conclusion

The initial comparisons between the 2028 Reference and 2028 SS DS + Appeals scenarios reveal the following conclusions:

- Inclusion of the Appeal 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 in comparison to the 2028 Reference Case conditions and compared to the SS DS scenario
- The high levels of instability within the 2028 SS DS + Appeals scenario, during the PM model period, indicate that there are likely to be one or more issues which have the potential to cause flow breakdown and potentially network wide failure. Detailed investigation of these impacts are considered to

be essential if the additional developments are assigned to the network without further mitigation and additional optimisation of those measures identified within the 2028 SS + DS scenario network

- The reductions in network statistics for the DS + Appeals scenario are larger than those which occur within the Do Something scenario
- The Do Something scenario is better able to cope with the increased demands on the network compared to the DS + Appeals scenario as reflected in the improved network conditions
- The analysis of the changes in journey times reveals that there are a significant number of very severe increases in journey times that occur within the 2028 SS DS Appeals scenario when comparing the increases that occur when comparing the 2028 SS Do Something network against the reference case.

Notwithstanding the above, it should also be acknowledged that the analysis set out within the remainder of this report, specifically concerning the PM network performance, should be viewed as an indication of the network conditions based on a disproportionate set of model runs. When considering stability levels of less than 50% in the PM, it should be recognised that every other model run experienced heavy congestion such that the impacts were of a severity such that they rendered the model outputs invalid. The results presented within the PM will be biased towards more favourable runs and, therefore, the results are to be considered as bias towards a more preferential set of network conditions than would be likely to occur in reality.

8 Summary and Conclusions

8.1 Summary

Arup have been commissioned by Warwickshire County Council (WCC) and Warwick District Council (WDC) to undertake additional, more detailed analysis of the WDC Strategic Transport Assessment (STA) scenarios. This report serves as an addendum to the previous Phase 4 Strategic Transport Assessment (STA) and builds upon the evidence presented within that and previous STA Assessment reports.

This addendum is intended to outline the impacts of the southern Warwick sites that have been identified through the Local Plan to ascertain the level of mitigation that is envisaged as being necessary to deliver only those sites and to establish costs of the cumulative mitigation measures identified through this study.

The objectives of this phase of work were as follows:

- To understand the level of mitigation that is envisaged as being necessary to deliver only those sites in the south of the study area and to establish costs of the cumulative mitigation measures identified as a result of this process.
- To assess, once an appropriate mitigation strategy has been identified, the impacts of two potential additional scenarios on the overall level of network operation, specifically:
    - Inclusion of a link through the Europa Way consortium land which connects Europa Way to Myton Road
    - Inclusion of additional sites to the South of Warwick not previously included within the earlier assessment or the original Phase 4 STA work.

The study has been split into three phases of analysis:

- The first phase reviewed the impacts of allocating the sites to the south without any supporting mitigation measures (2028 SS Do Nothing) and then, subsequently, reviewed the changes to the network performance once a development specific mitigation strategy was assigned to the network in conjunction with the proposed sites.
- The second phase looked at the strategic implications of including a link through the Europa Way Consortium land, between Europa Way and Myton Road.
- The final phase assessed the additional impacts that were predicted to occur as a result of allocating additional demand on the network through the ‘appeal’ sites.

These phases have been completed through the development and application of the following model scenarios:

- M001 WLWA STA 2028 Reference Case – The 2028 WLWA Reference Case inclusive of the updated proposals at A46 Stanks junction and corridor improvements as identified within the Coventry and Warwickshire Strategic Economic Plan
- M002 WLWA STA 2028 Southern Sites Do Nothing – the 2028 Reference Case inclusive of the proposed sites to the South of Warwick but without any

additional mitigation measures over and above the necessary access arrangements
- M003 WLWA STA 2028 Southern Sites Do Something – the 2028 Do Nothing inclusive of the mitigation measures identified within Section 4 of this Report
- M004 WLWA STA 2028 Southern sites Do Something + Link road – the previous scenario inclusive of a link between Europa Way and Myton Road
- M005 WLWA STA 2028 Southern Sites Do Something + Appeals Sites – the 2028 SS Do Something scenario inclusive of the additional sites identified within section 2.7 of this Report.

The mitigation measures which have been identified thus far correlate to schemes identified within the previous Phase 4 Strategic Transport Work. Further analysis of the specific impacts on the M40 mainline and junctions is still to be completed by the HA.

Analysis of the interventions that have been identified reveals total scheme costs of £22.7 million which comprise:

- £17,500,000 capacity enhancements on local road network
- £1,480,000 Contribution towards sustainable transport provision
- £3,720,000 contribution to works on the M40

As it is not possible at present to identify the actual scale, cost and timing of capacity enhancements along the M40 corridor resulting from Local Plan proposals, Warwick District Council will continue to work with Warwickshire County Council, the Highways Agency and Stratford District Council to determine appropriate and timely capacity enhancements on the M40 and how such enhancements can be funded.

8.2 Conclusions

Conclusions have been drawn from each key phase of analysis and these have been set out in the following section of the Report.

The first phase of testing involving the 2028 SS Do Nothing and 2028 SS Do Something Sites revealed the following conclusions:

- Inclusion of the Southern Sites 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 in comparison to the 2028 Reference Case conditions
- These negative impacts are reduced by markedly with the introduction of the mitigation measures associated with the Do Something scenario during both peak periods
- The most severe impacts within the 2028 SS scenarios occur on routes around the area of the developments and to the north of the sites
- Some areas experience improvements in delay and queuing despite no mitigation measures being proposed within the immediate area, this is indicative of wider benefits that could potentially be unlocked by the inclusion of the full set of mitigation measures identified in STA4.

The allocation of the mitigation measures does not appear to fully mitigate the impacts of the development and further optimisation would likely reveal further mitigation above that which has been identified within this report.

However, it is clear from the analysis that the additional mitigation measures do deliver benefits as the journey times reduce substantially as a result of their inclusion. Furthermore, it should also be recognised that there will be a natural increase in journey times which will occur as a result of the inclusion of the proposed sites and the associated mitigation measures. For example introducing signal control in areas that were previously free flow will induce additional delays that will increase journey times slightly but this is offset by maintaining a safe level of junction operation and enabling a better level of control regarding traffic movements and queue management.

The initial comparisons between the 2028 Reference and 2028 SS DS + Link scenarios revealed that, strategically, inclusion of the link road will not have a material impact on the overall network performance, especially when compared to the 2028 SS Do Something scenario network.

Locally, the changes in flows were also not significant between the two Do Something scenarios, analysis did also reveal that, despite being coded within the model using relatively unattractive calibration parameters, vehicle demands of up to 250 two way flows per hour were predicted which indicates that careful consideration will need to be given to the design of the link road, if it is to be delivered, in order that it does not present a viable and attractive route for strategic level trips to move between Europa Way and Myton Road.

The initial comparisons between the 2028 Reference and 2028 SS DS + Appeals scenarios reveal the following conclusions:

- Inclusion of the Appeal 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 in comparison to the 2028 Reference Case conditions and compared to the SS DS scenario
- The high levels of instability within the 2028 SS DS + Appeals scenario, during the PM model period, indicate that there are likely to be one or more issues which have the potential to cause flow breakdown and potentially network wide failure. Detailed investigation of these impacts are considered to be essential if the additional developments are assigned to the network without further mitigation and additional optimisation of those measures identified within the 2028 SS + DS scenario network
- The reductions in network statistics for the DS + Appeals scenario are larger than those which occur within the Do Something scenario
- The Do Something scenario is better able to cope with the increased demands on the network compared to the DS + Appeals scenario as reflected in the improved network conditions
- The analysis of the changes in journey times reveals that there are a significant number of very severe increases in journey times that occur within the 2028 SS DS Appeals scenario when comparing the increases that occur when comparing the 2028 SS Do Something network against the reference case. This is particularly pertinent when considering the fact that over 50% of the model runs, collected during the PM, where discounted on account of unrealistic congestion levels and unacceptable model stability.

It is therefore recommended that, should additional sites be proposed to within the area to the South of Warwick, additional mitigation measures are considered essential over and above those identified within this assessment. Particular attention should be drawn to the stability levels exhibited within the PM period as

the levels of stability indicate further mitigation measures are essential in order that the additional impacts that have occurred within the scenario network can be overcome.

Appendix A

Scheme Plots

A3

NOTE:
This plot was produced from a S-Paramics Model output. It is considered representative of what has been included within the modelling.
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Scheme 01

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Scheme 02

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Scheme 03

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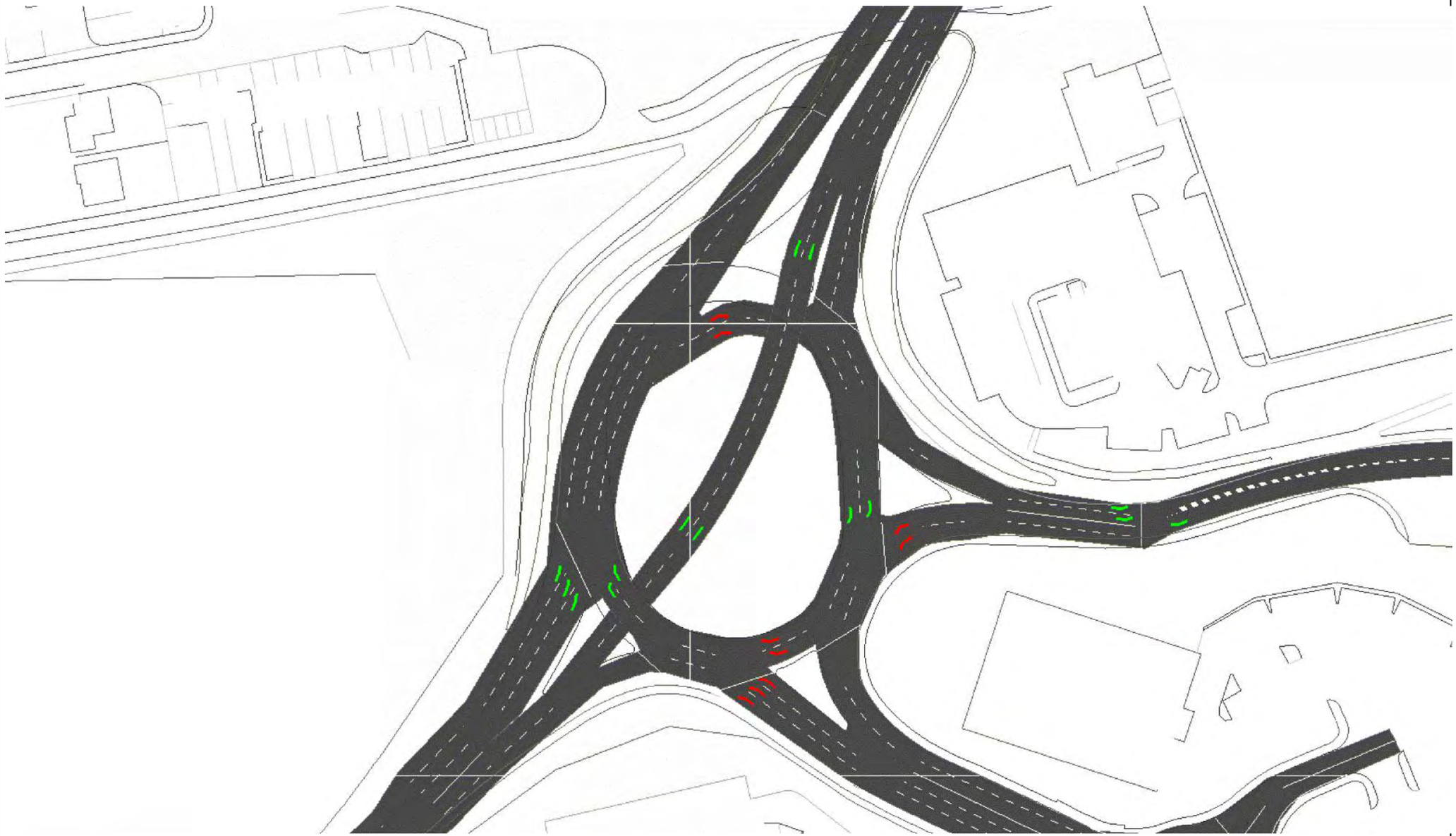

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Scheme 04

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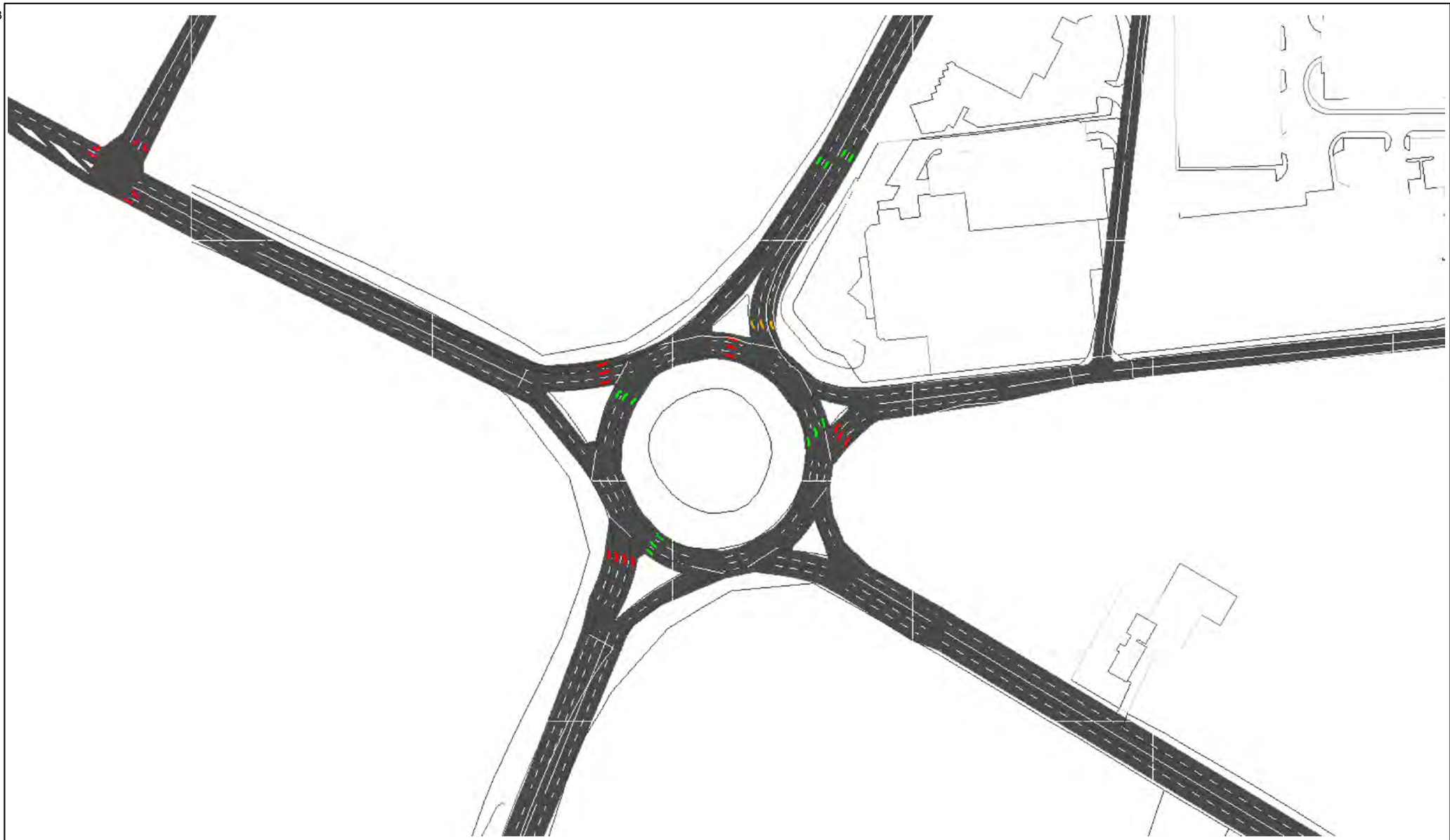

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Scheme 05

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Scheme 06

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Scheme 07

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Scheme 08

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Scheme 09

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Scheme 10

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Scheme 11

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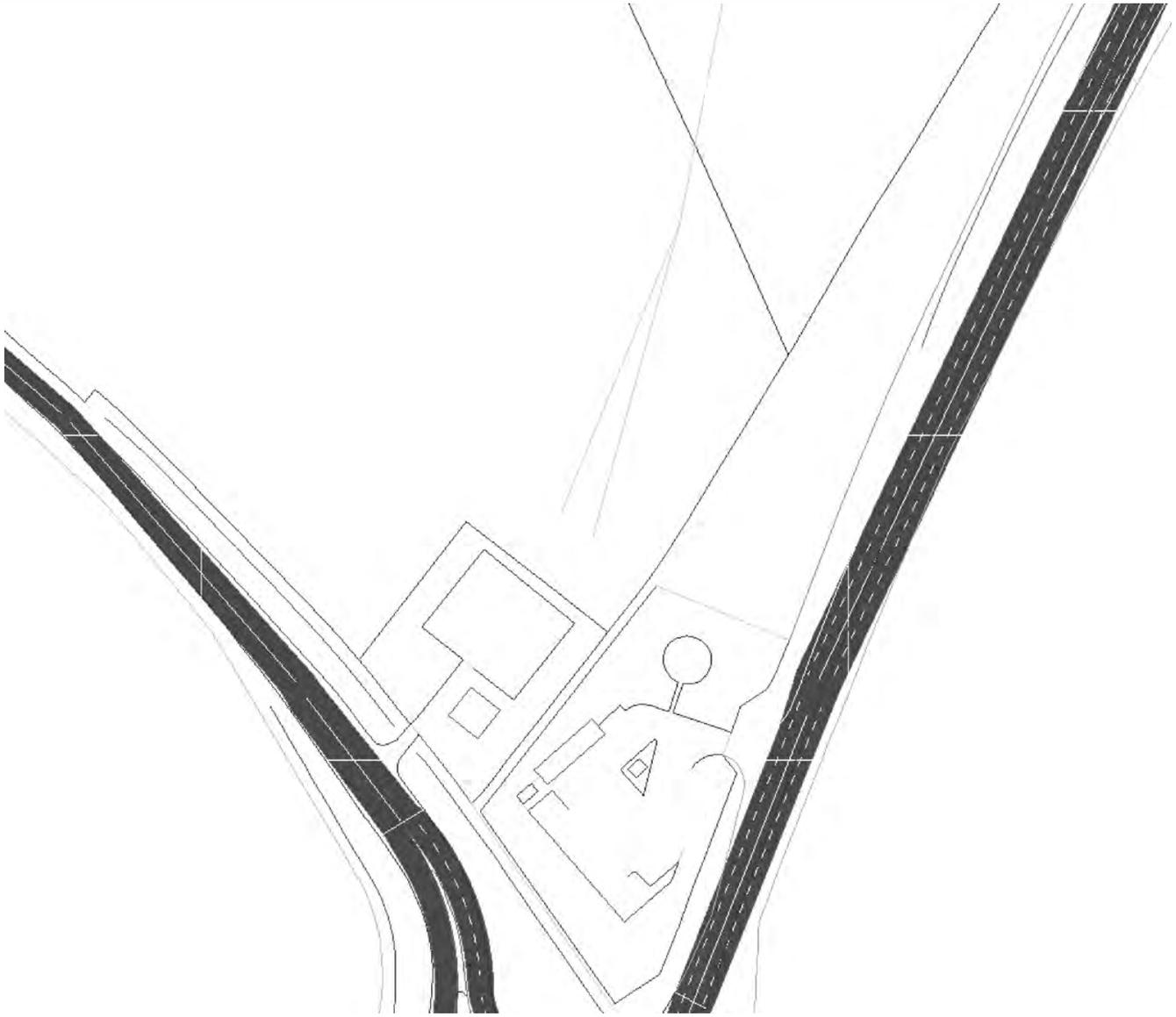
N.T.S.

Job No	Drawing Status
232815-60	For Information

Drawing No	Issue
MS 011	**P1**

MXD Location \\global.arup.com\europe\Midlands\jobs\232000\232815-60\4 Internal Project Data\4-04 Calculations\GIS\Southern Sites Final\MXD\MS 011.mxd

A3



NOTE:
This plot was produced from a S-Paramics Model output. It is considered representative of what has been included within the modelling.
This should not be considered a final design nor should it be assumed to be at true scale. It's the recipient's responsibility to confirm its accuracy.

Issue	Date	By	Chkd	Appd
P1	23/10/2014	ZW	JE	JE

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www.arup.com

Client

Warwickshire County Council

Job Title

Strategic Transport Assessment 4 Addendum

Scheme 12

Scale at A3

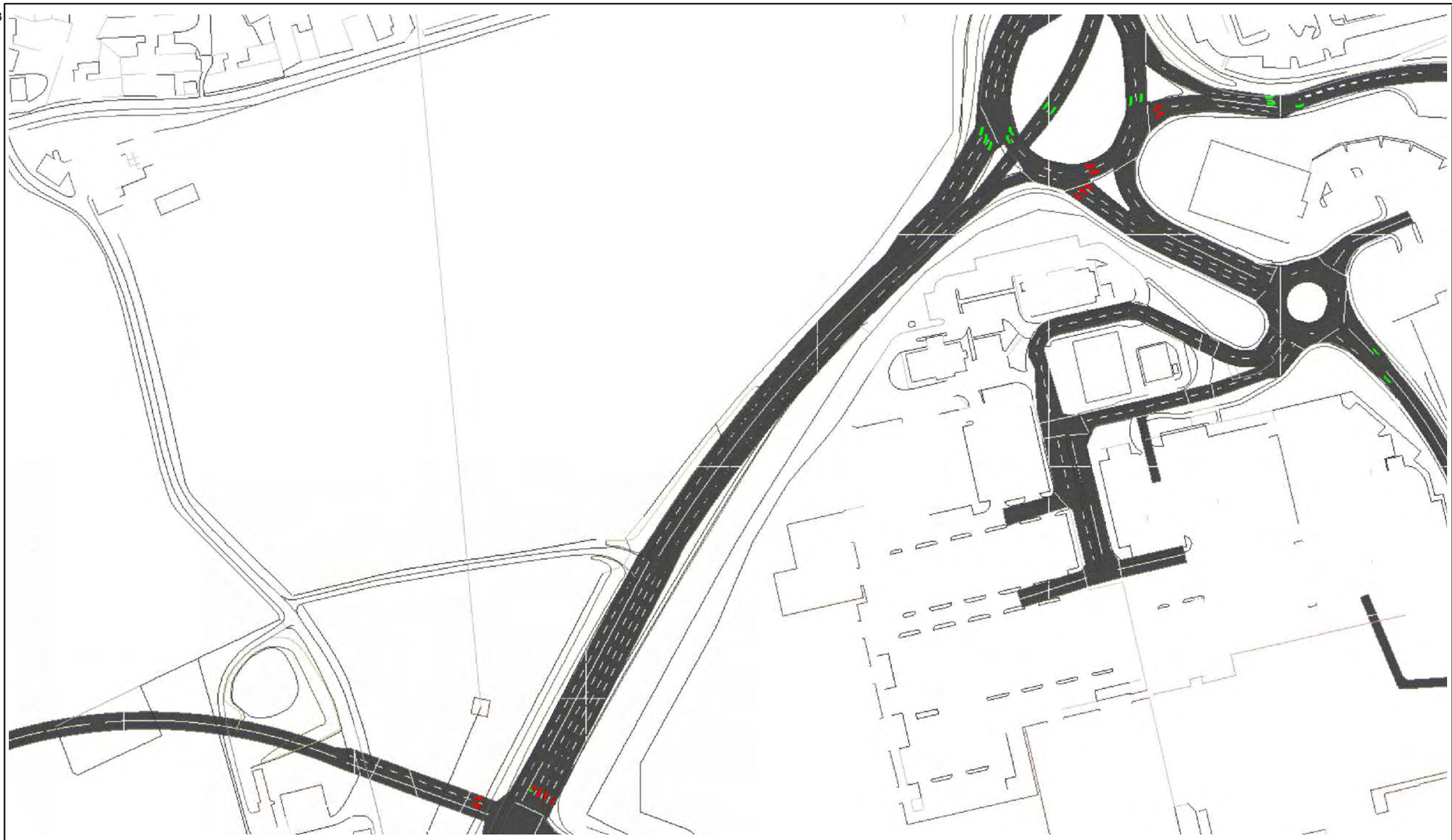
N.T.S.

Job No	Drawing Status
232815-60	For Information

Drawing No	Issue
MS 012	**P1**

MXD Location J:\232000\232815-60\4 Internal Project Data\4-04 Calculations\GIS\Southern Sites Final\MXD\MS 012.mxd

A3



NOTE:
This plot was produced from a S-Paramics Model output. It is considered representative of what has been included within the modelling.
This should not be considered a final design nor should it be assumed to be at true scale. It's the recipient's responsibility to confirm its accuracy.

Issue	Date	By	Chkd	Appd
P1	23/10/2014	ZW	JE	JE

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Client

Warwickshire County Council

Job Title

Strategic Transport Assessment 4 Addendum

Scheme 13

Scale at A3

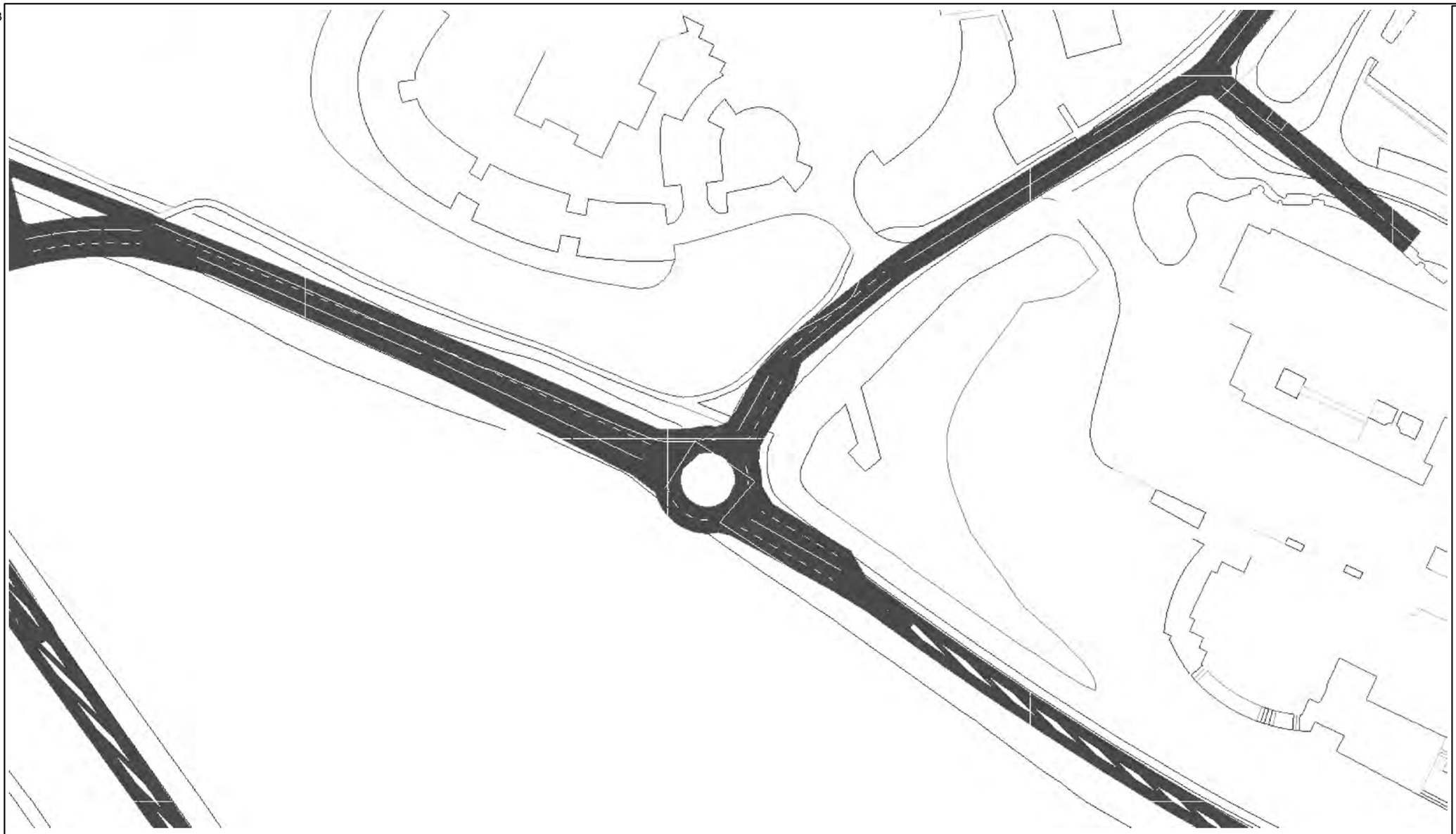
N.T.S.

Job No	Drawing Status
232815-60	For Information

Drawing No	Issue
MS 013	**P1**

MXD Location J:\232000\232815-60\4 Internal Project Data\4-04 Calculations\GIS\Southern Sites Final\MXD\MS 013.mxd

A3



NOTE:
This plot was produced from a S-Paramics Model output. It is considered representative of what has been included within the modelling.
This should not be considered a final design nor should it be assumed to be at true scale. It's the recipient's responsibility to confirm its accuracy.

Issue	Date	By	Chkd	Appd
P1	23/10/2014	ZW	JE	JE

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Client

Warwickshire County Council

Job Title

Strategic Transport Assessment 4 Addendum

Scheme 14

Scale at A3

N.T.S.

Job No	Drawing Status
232815-60	For Information

Drawing No	Issue
MS 014	**P1**

MXD Location J:\232000\232815-60\4 Internal Project Data\4-04 Calculations\GIS\Southern Sites Final\MXD\MS 014.mxd

A3

NOTE:
This plot was produced from a S-Paramics Model output. It is considered representative of what has been included within the modelling.
This should not be considered a final design nor should it be assumed to be at true scale. It's the recipient's responsibility to confirm its accuracy.

Issue	Date	By	Chkd	Appd
P1	23/10/2014	ZW	JE	JE

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Client

Warwickshire County Council

Job Title

Strategic Transport Assessment 4 Addendum

Scheme 15

Scale at A3

N.T.S.

Job No	Drawing Status
232815-60	For Information

Drawing No	Issue
MS 015	**P1**

MXD Location J:\232000\232815-60\4 Internal Project Data\4-04 Calculations\GIS\Southern Sites Final\MXD\MS 015.mxd

A3

NOTE:
This plot was produced from a S-Paramics Model output. It is considered representative of what has been included within the modelling.
This should not be considered a final design nor should it be assumed to be at true scale. It's the recipient's responsibility to confirm its accuracy.

Issue	Date	By	Chkd	Appd
P1	23/10/2014	ZW	JE	JE

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Client

Warwickshire County Council

Job Title

Strategic Transport Assessment 4 Addendum

Scheme 16

Scale at A3

N.T.S.

Job No	Drawing Status
232815-60	For Information

Drawing No	Issue
MS 016	**P1**

MXD Location J:\232000\232815-60\4 Internal Project Data\4-04 Calculations\GIS\Southern Sites Final\MXD\MS 016.mxd

Appendix B

WDC STA Phase 4 - Queue Analysis Plots

B1 Contents

- **MQ001** – 2028 Reference V 2028 SS DN AM (07:00 to 10:00)
- **MQ002** – 2028 Reference V 2028 SS DN PM (16:00 to 19:00)
- **MQ003** – 2028 Reference V 2028 SS DS AM (07:00 to 10:00)
- **MQ004** – 2028 Reference V 2028 SS DS AM (16:00 to 19:00)
- **MQ005** – 2028 Reference V 2028 SS DS + Link AM (07:00 to 10:00)
- **MQ006** - 2028 Reference V 2028 SS DS + Link PM (16:00 to 19:00)
- **MQ005** – 2028 Reference V 2028 SS DS + Appeals AM (07:00 to 10:00)
- **MQ006** - 2028 Reference V 2028 SS DS + Appeals PM (16:00 to 19:00)

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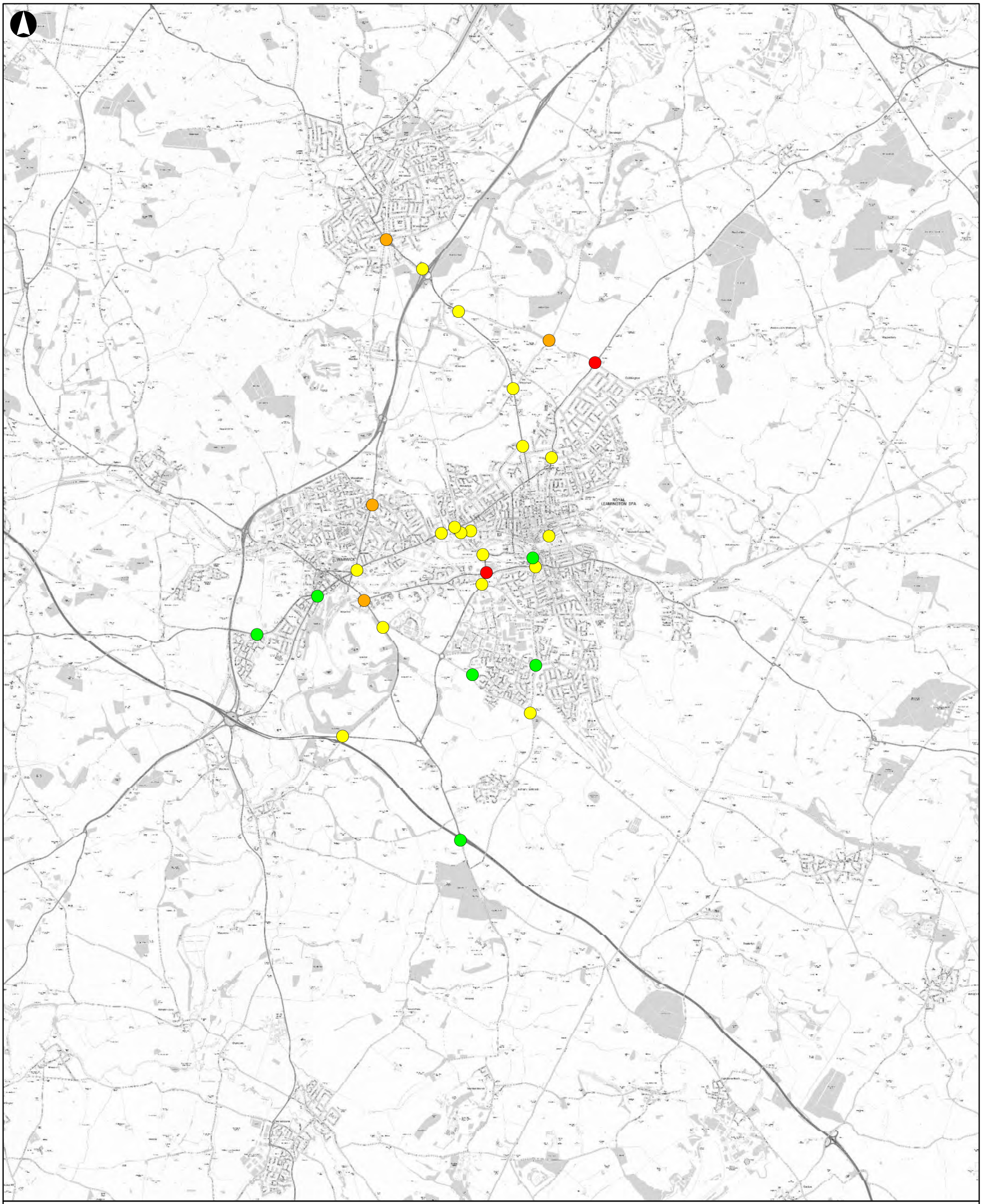

Legend

AM peak period

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

Issue	Date	By	Chkd	Appd
P1	23/10/2014	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 SS Do Nothing
2028 AM Peak Period
Average Maximum Queue

Scale at A3
N.T.S.

Job No	Drawing Status
232815-60	For Information

Drawing No	Issue
MQ 001	**P1**

MXD Location Document Path: J:\232000\232815-60\4 Internal Project Data\4-04 Calculations\GIS\Southern Sites Final\MXD\MQ 001.mxd

A3

Legend

PM peak period

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

Issue	Date	By	Chkd	Appd
P1	23/10/2014	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 SS Do Nothing
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 002	**P1**

MXD Location Document Path: \\global.arup.com\europe\Midlands\jobs\232000\232815-60\4 Internal Project Data\4-04 Calculations\GIS\Southern Sites Final\MXD\MQ 002.mxd

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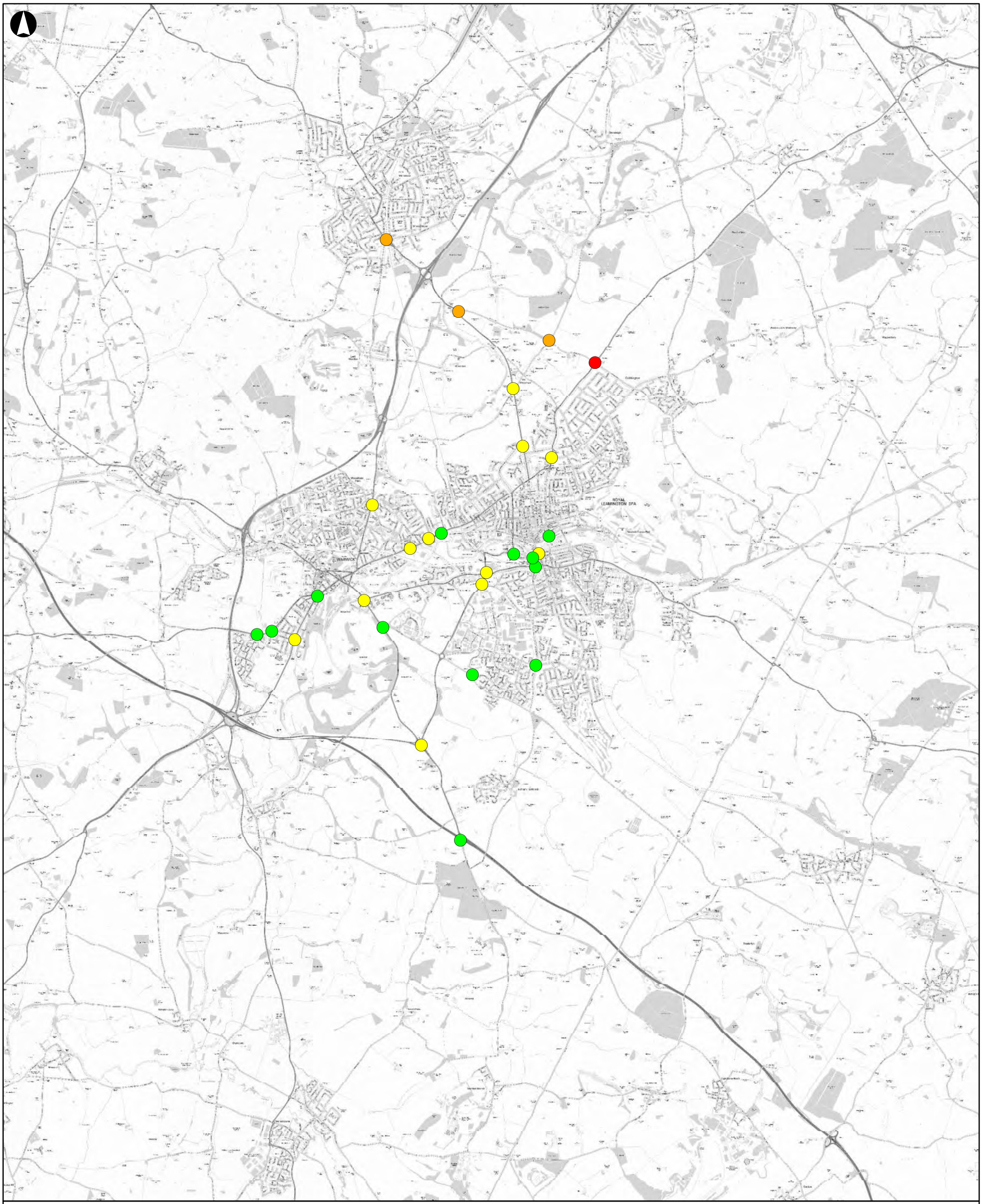

Legend

AM peak period

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

Issue	Date	By	Chkd	Appd
P1	23/10/2014	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 SS Do Something
2028 AM Peak Period
Average Maximum Queue

Scale at A3
N.T.S.

Job No	Drawing Status
232815-60	For Information

Drawing No	Issue
MQ 003	P1

MXD Location Document Path: \\global.arup.com\europe\Midlands\jobs\232000\232815-60\4 Internal Project Data\4-04 Calculations\GIS\Southern Sites Final\MXD\MQ 003.mxd

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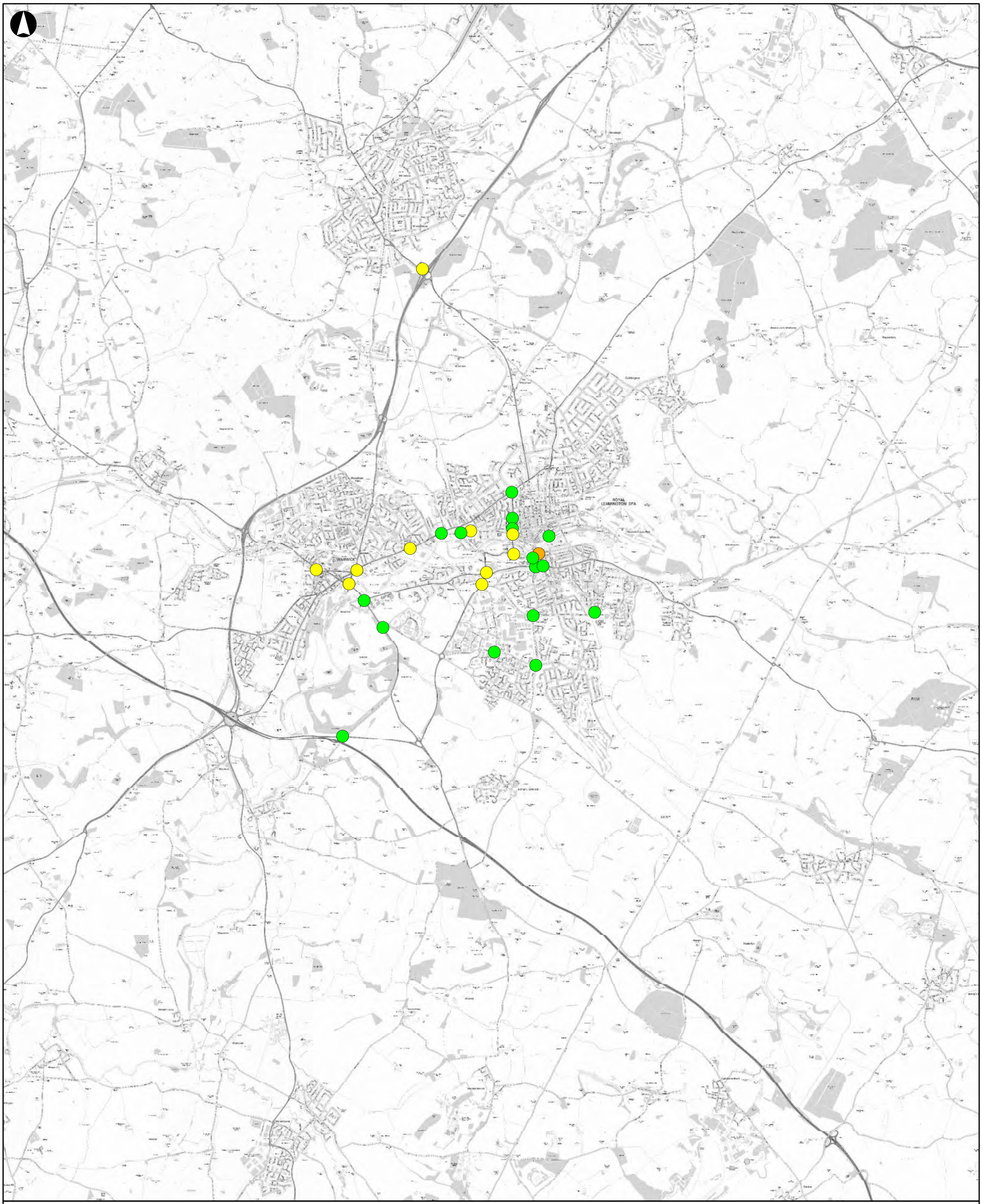

Legend

PM peak period

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

Issue	Date	By	Chkd	Appd
P1	23/10/2014	ZW	JE	JE

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Job Title
Strategic Transport Assessment 4 Addendum

Metres
0 750 1,500 3,000

Reference V SS Do Something
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

MXD Location Document Path: \\global.arup.com\europe\Midlands\jobs\232000\232815-60\4 Internal Project Data\4-04 Calculations\GIS\Southern Sites Final\MXD\MQ 004.mxd

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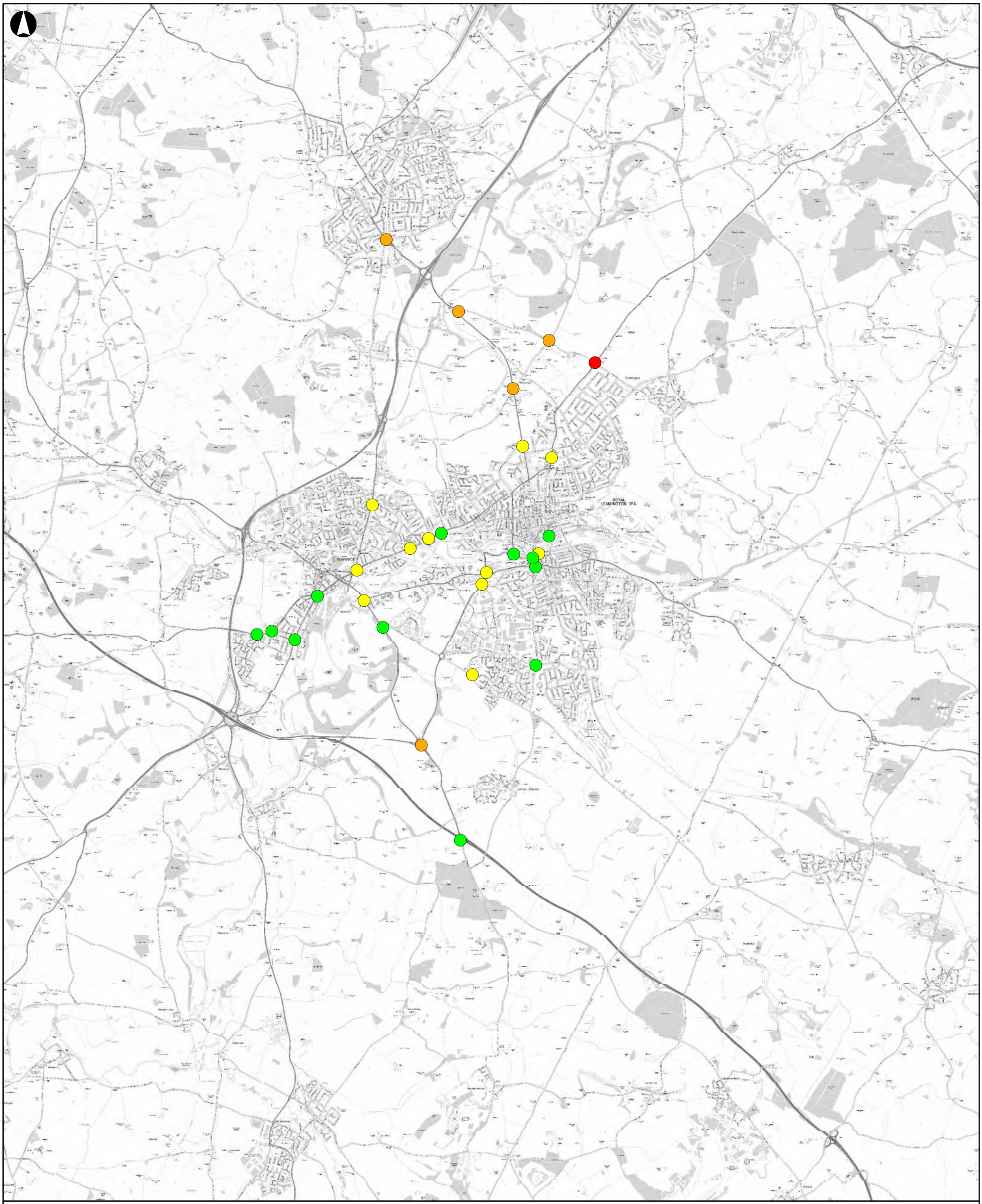

Legend

AM peak period

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

Issue	Date	By	Chkd	Appd
P1	23/10/2014	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 SS DS + Link
2028 AM Peak Period
Average Maximum Queue

Scale at A3
N.T.S.

Job No	Drawing Status
232815-60	For Information

Drawing No	Issue
MQ 005	P1

MXD Location Document Path: \\global.arup.com\europe\Midlands\jobs\232000\232815-60\4 Internal Project Data\4-04 Calculations\GIS\Southern Sites Final\MXD\MQ 005.mxd

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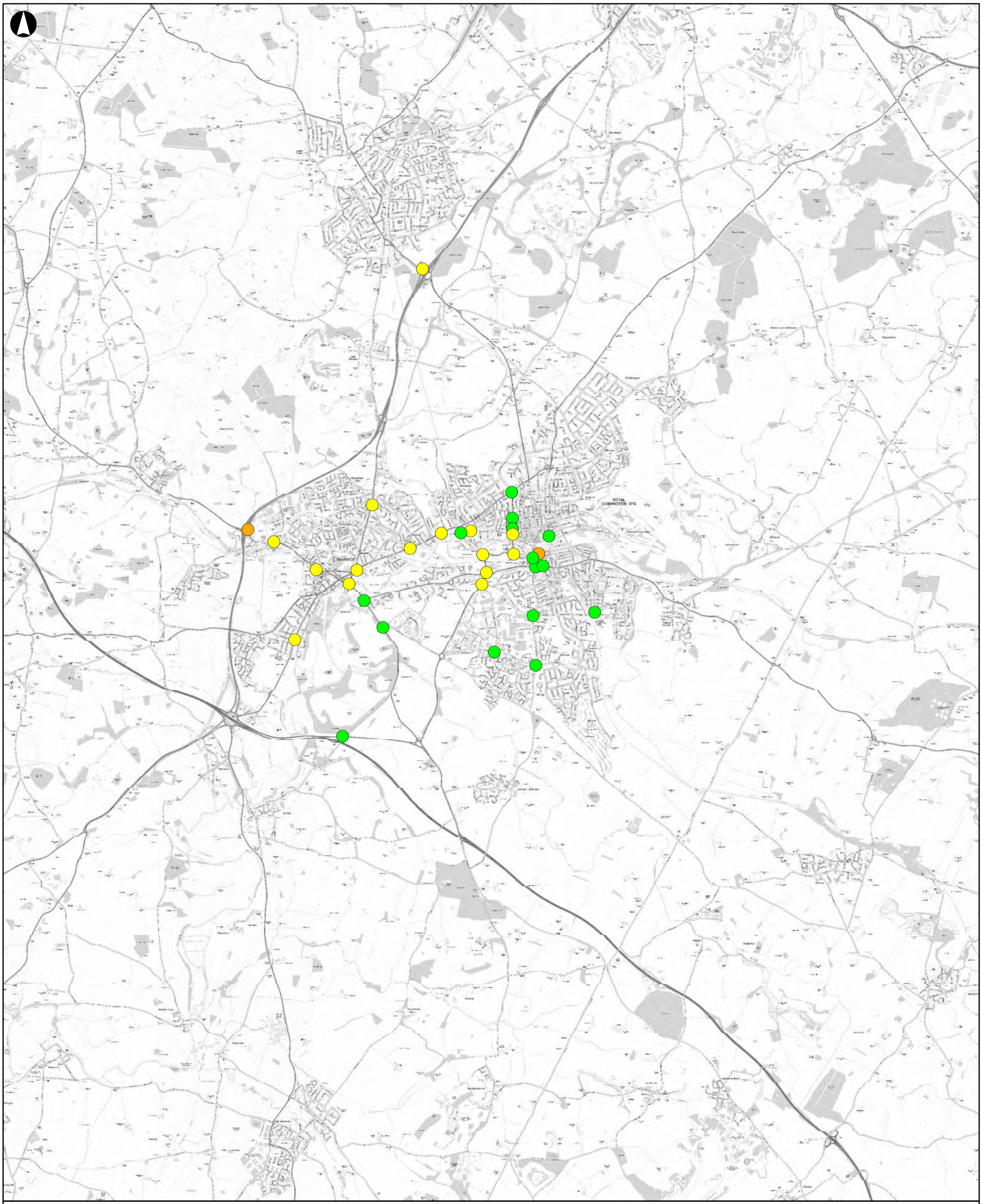

Legend

PM peak period

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

Issue	Date	By	Chkd	Appd
P1	23/10/2014	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 SS DS + Link
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 006	**P1**

MXD Location Document Path: \\global.arup.com\europe\Midlands\jobs\232000\232815-60\4 Internal Project Data\4-04 Calculations\GIS\Southern Sites Final\MXD\MQ 006.mxd

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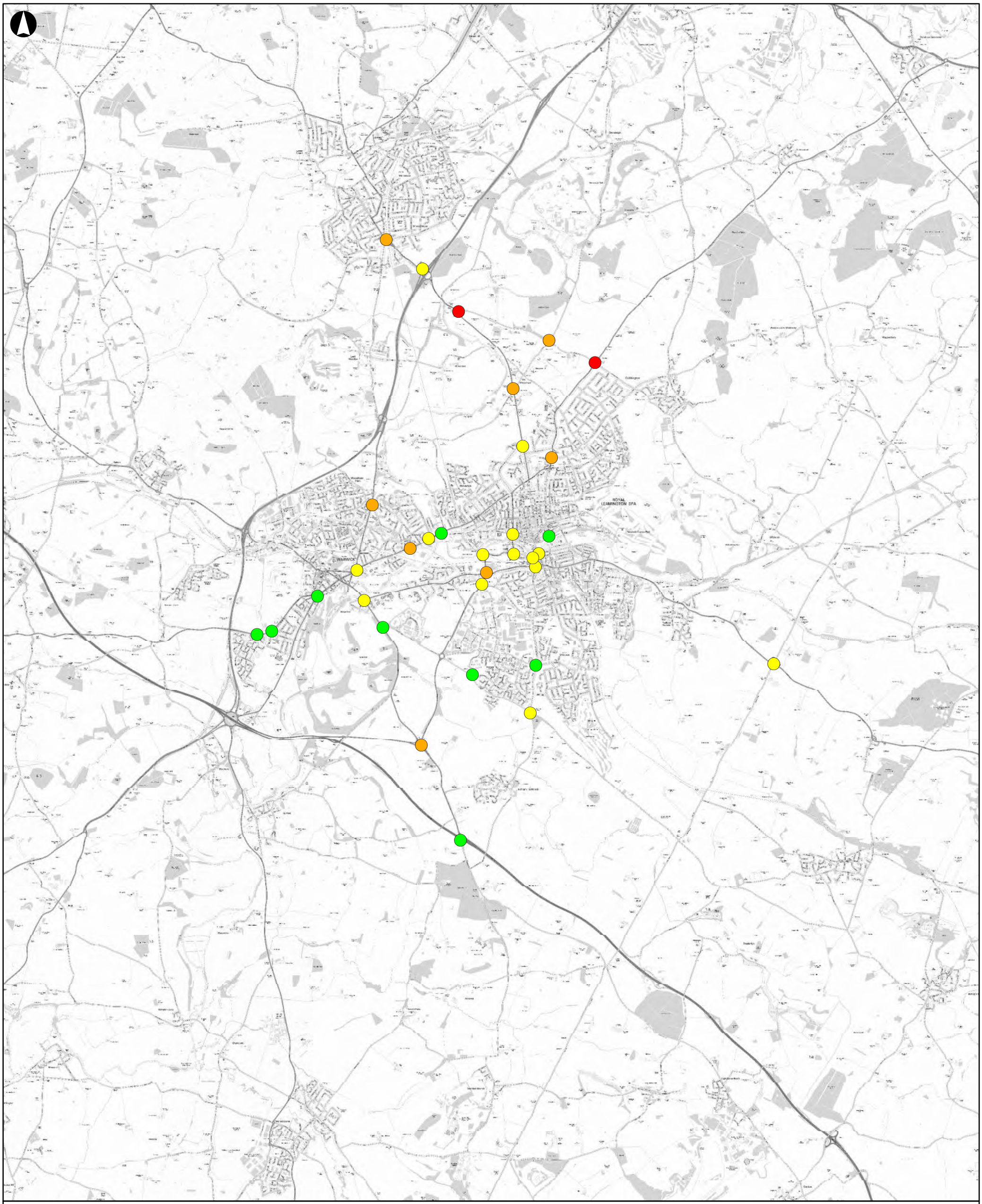

Legend

AM peak period

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

Issue	Date	By	Chkd	Appd
P1	23/10/2014	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

Reference V SS DS + Appeal Sites
2028 AM Peak Period
Average Maximum Queue

Scale at A3
N.T.S.

Job No	Drawing Status
232815-60	For Information

Drawing No	Issue
MQ 007	**P1**

MXD Location Document Path: \\global.arup.com\europe\Midlands\jobs\232000\232815-60\4 Internal Project Data\4-04 Calculations\GIS\Southern Sites Final\MXD\MQ 007.mxd

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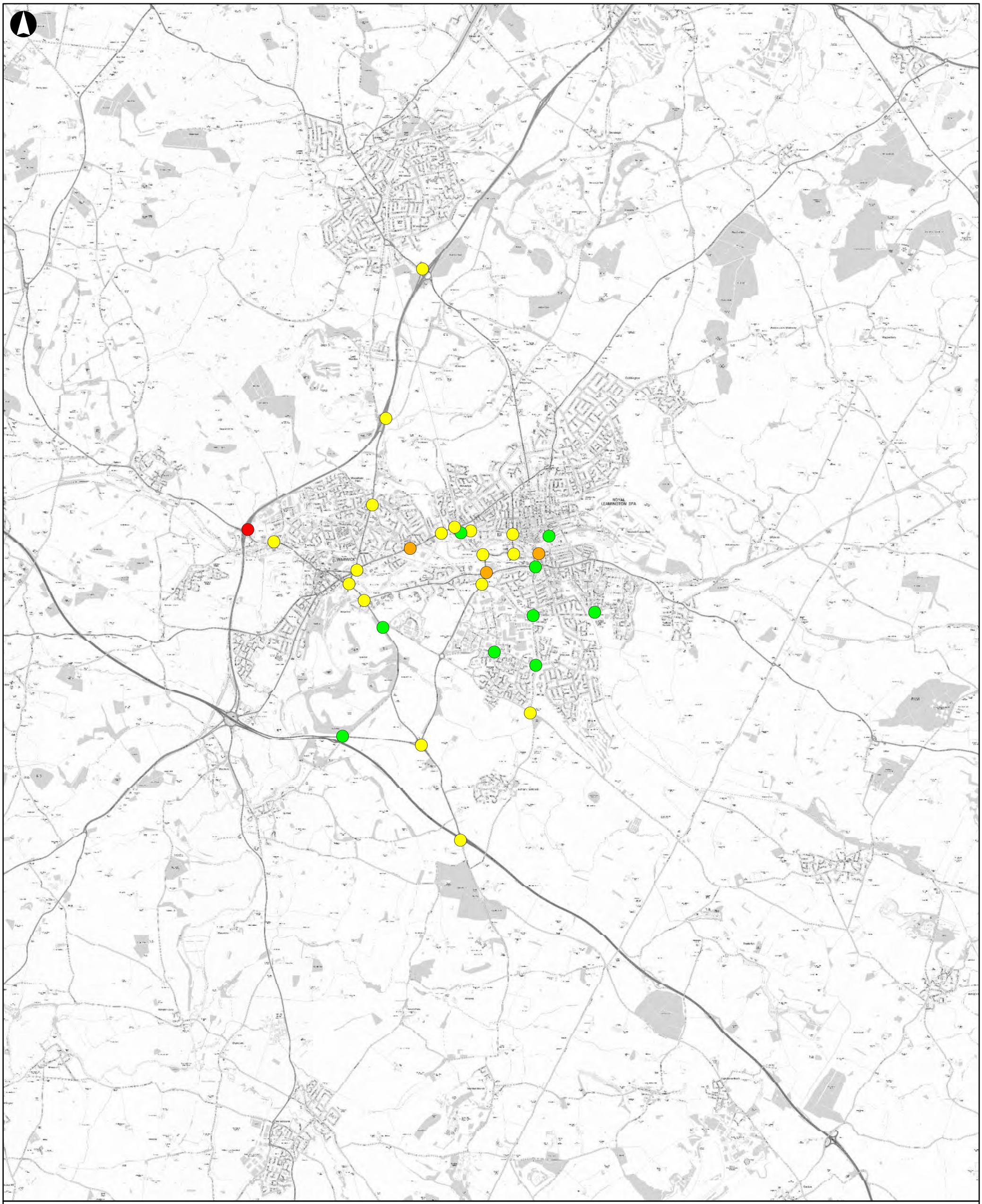

Legend

PM peak period

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

Issue	Date	By	Chkd	Appd
P1	23/10/2014	ZW	JE	JE

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Job Title
Strategic Transport Assessment 4 Addendum

Metres
0 750 1,500 3,000

Reference V SS DS + Appeal Sites
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 008	**P1**

MXD Location Document Path: \\global.arup.com\europe\Midlands\jobs\232000\232815-60\4 Internal Project Data\4-04 Calculations\GIS\Southern Sites Final\MXD\MQ 008.mxd

Appendix C

WDC STA Phase 4 - Journey Time Analysis Plots

C1 Contents

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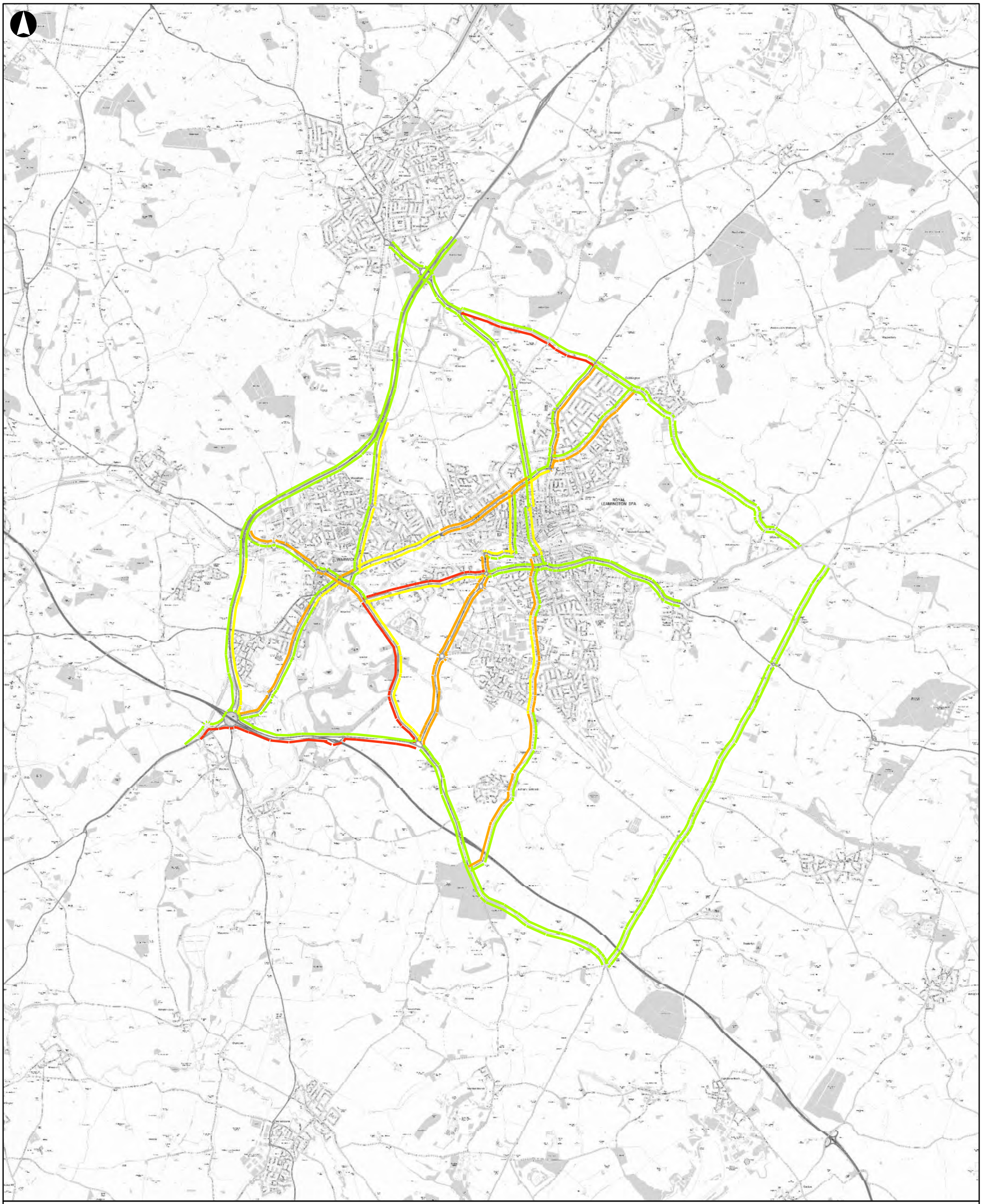

Legend

Peak Hour

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

Issue	Date	By	Chkd	Appd
P1	23/10/2014	ZW	JE	JE

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Job Title
Strategic Transport Assessment 4 Addendum

Metres
0 750 1,500 3,000

Reference V SS Do Nothing
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 001	**P1**

MXD Location Document Path: \\global.arup.com\europe\Midlands\jobs\232000\232815-60\4 Internal Project Data\4-04 Calculations\GIS\Southern Sites Final\MXD\MD 001.mxd

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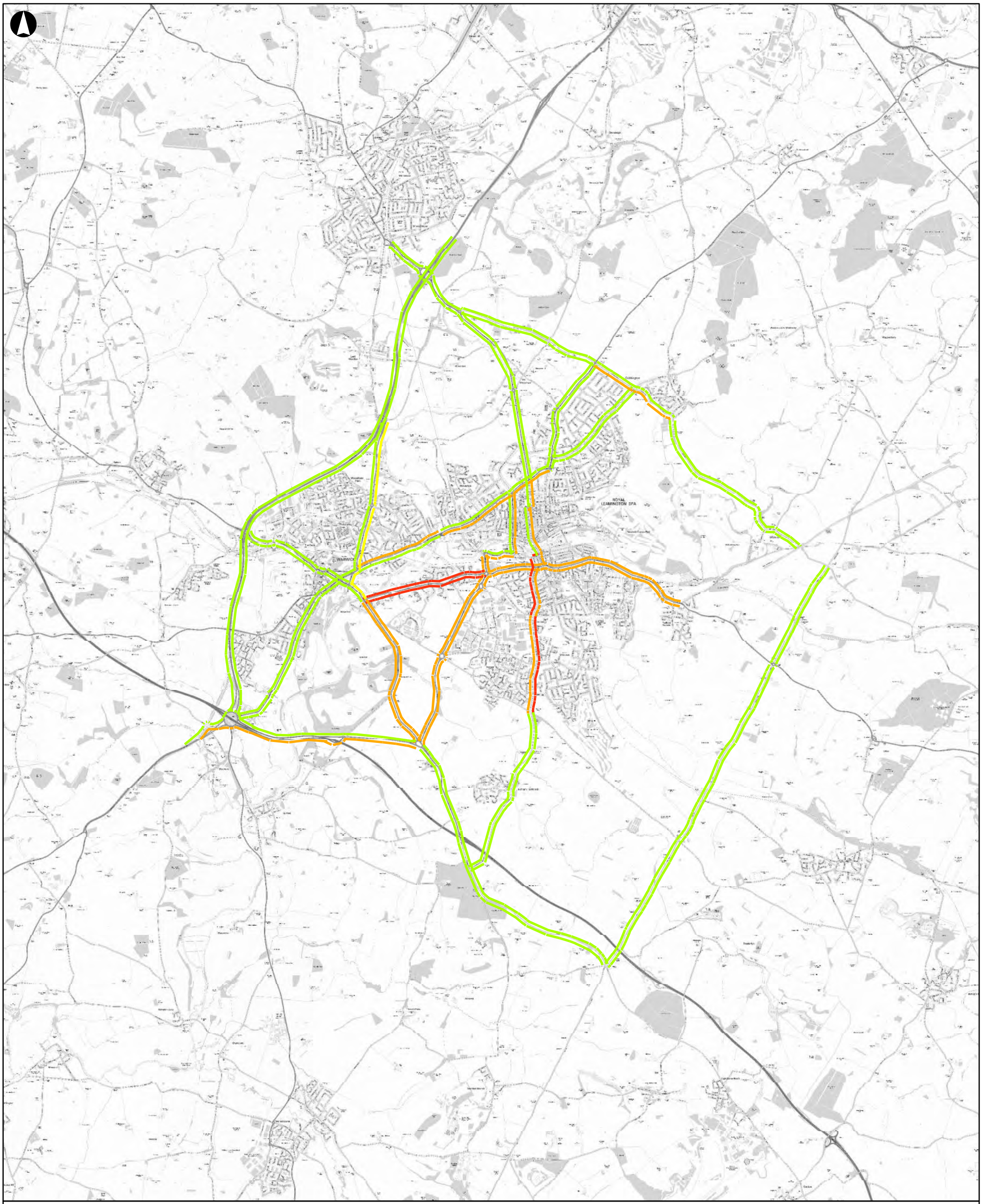

Legend

Peak Hour

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

Issue	Date	By	Chkd	Appd
P1	23/10/2014	ZW	JE	JE

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Warwickshire County Council

Job Title
Strategic Transport Assessment 4 Addendum

Metres
0 750 1,500 3,000

Reference V SS Do Nothing
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 002	P1

MXD Location Document Path: \\global.arup.com\europe\Midlands\jobs\232000\232815-60\4 Internal Project Data\4-04 Calculations\GIS\Southern Sites Final\MXD\MD 002.mxd

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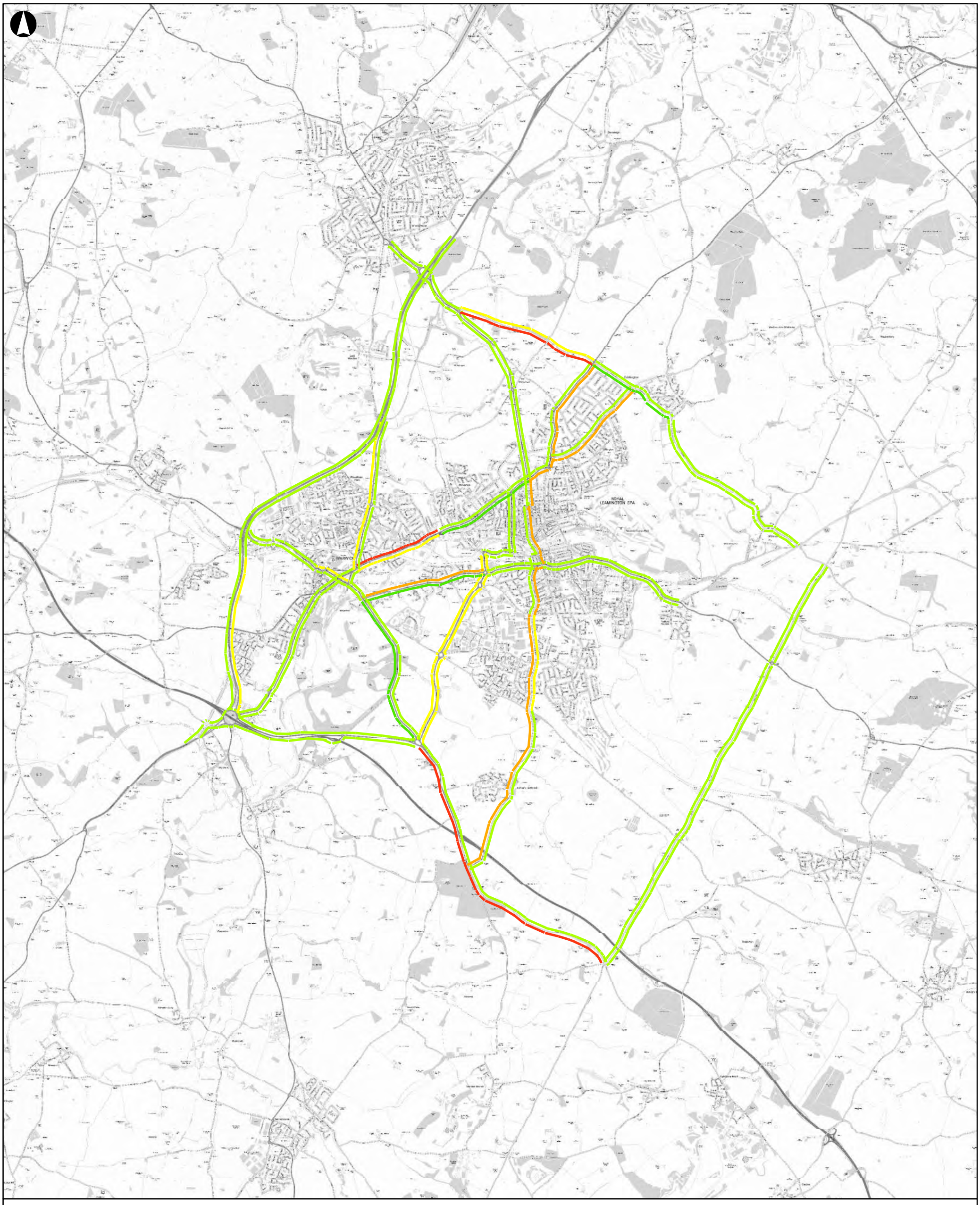

Legend

Peak Hour

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

Issue	Date	By	Chkd	Appd
P1	23/10/2014	ZW	JE	JE

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Job Title
Strategic Transport Assessment 4 Addendum

Metres
0 750 1,500 3,000

Reference V SS Do Something
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**

MXD Location Document Path: \\global.arup.com\europe\Midlands\jobs\232000\232815-60\4 Internal Project Data\4-04 Calculations\GIS\Southern Sites Final\MXD\MD 003.mxd

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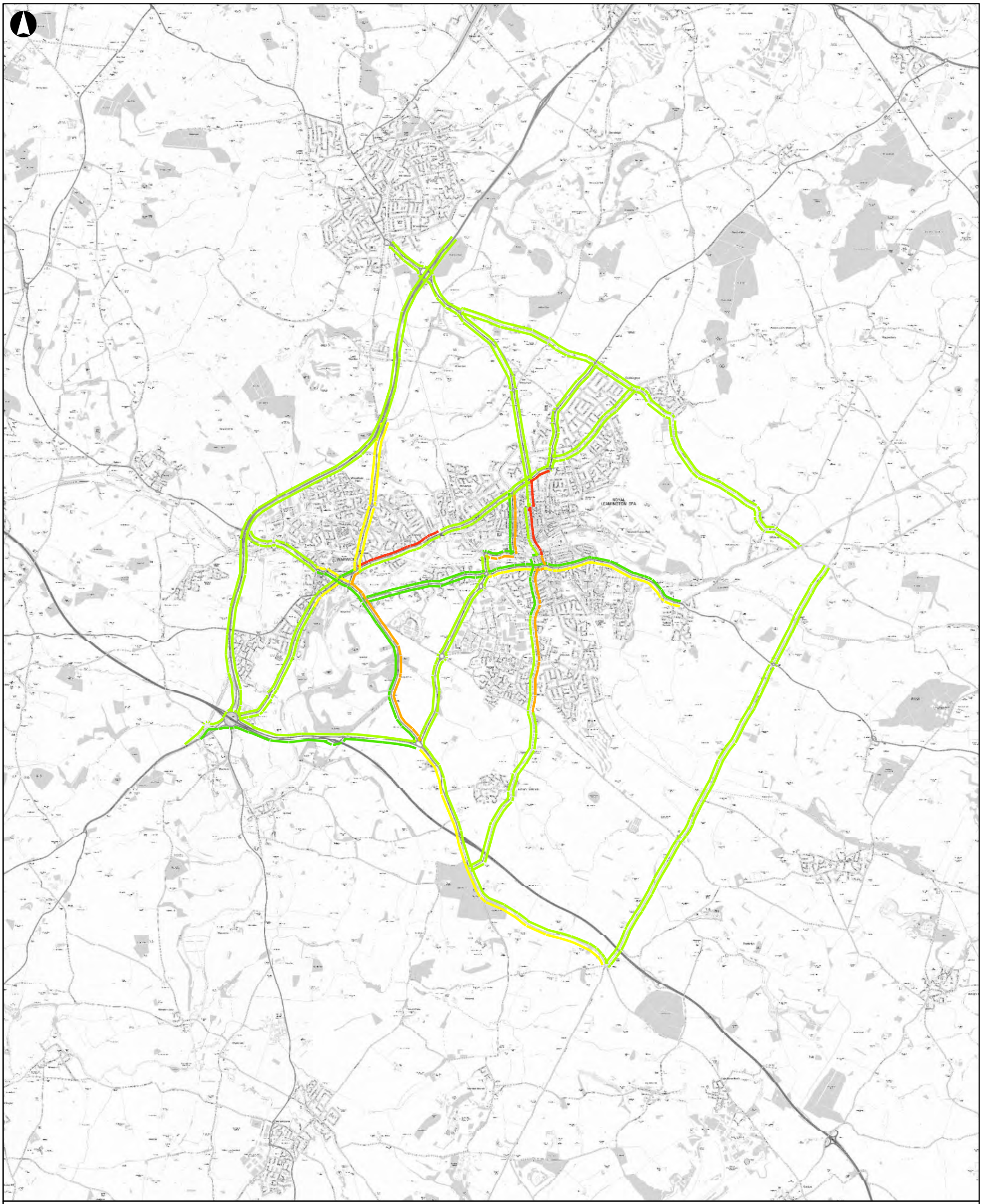

Legend

Peak Hour

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

Issue	Date	By	Chkd	Appd
P1	23/10/2014	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 SS Do Something
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\Southern Sites Final\MXD\MD 004.mxd

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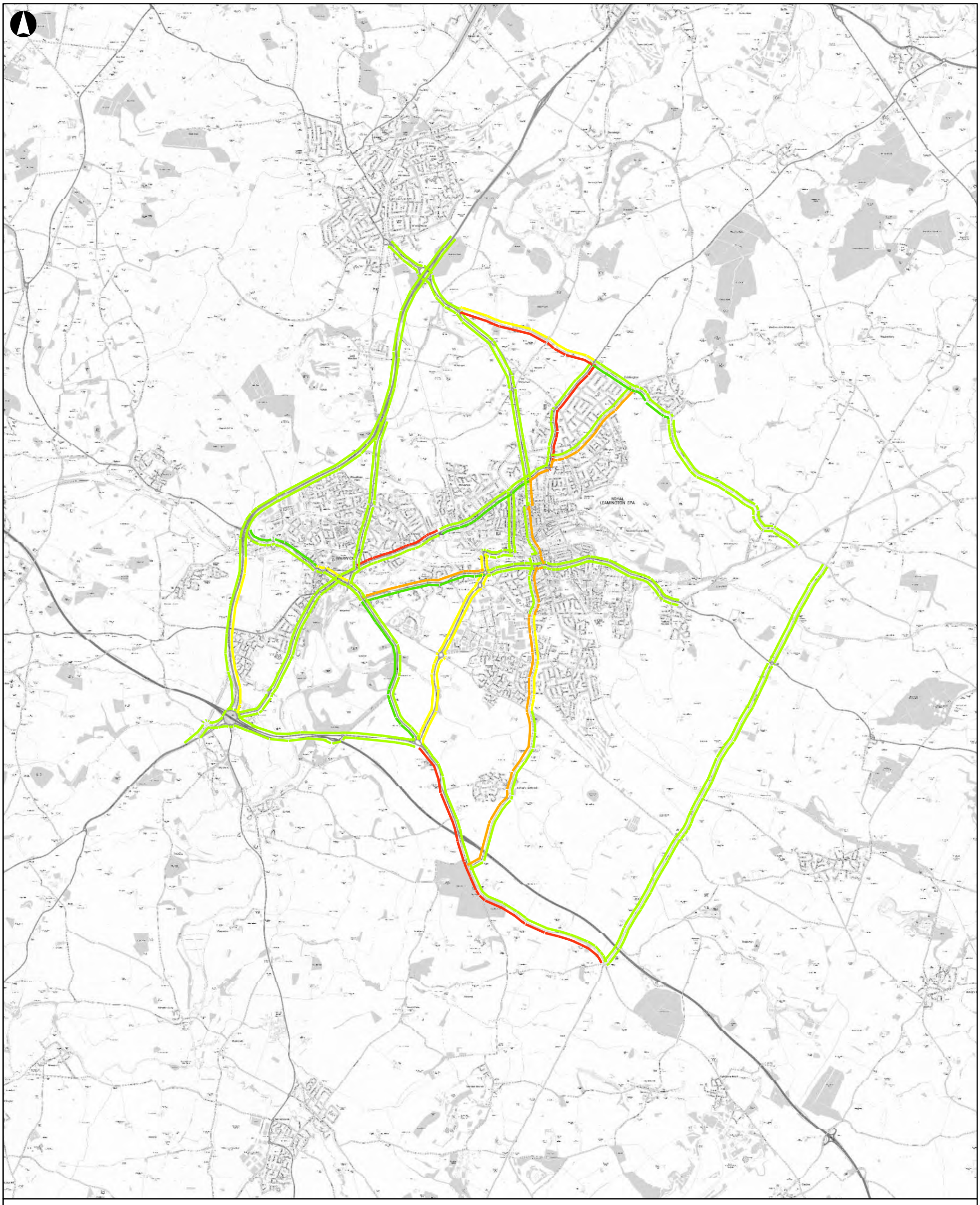

Legend

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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Job Title
Strategic Transport Assessment 4 Addendum

Metres
0 750 1,500 3,000

Reference V SS DS + Link
2028 AM Peak Hour 0800-0900
Percentage Difference Mean Delay

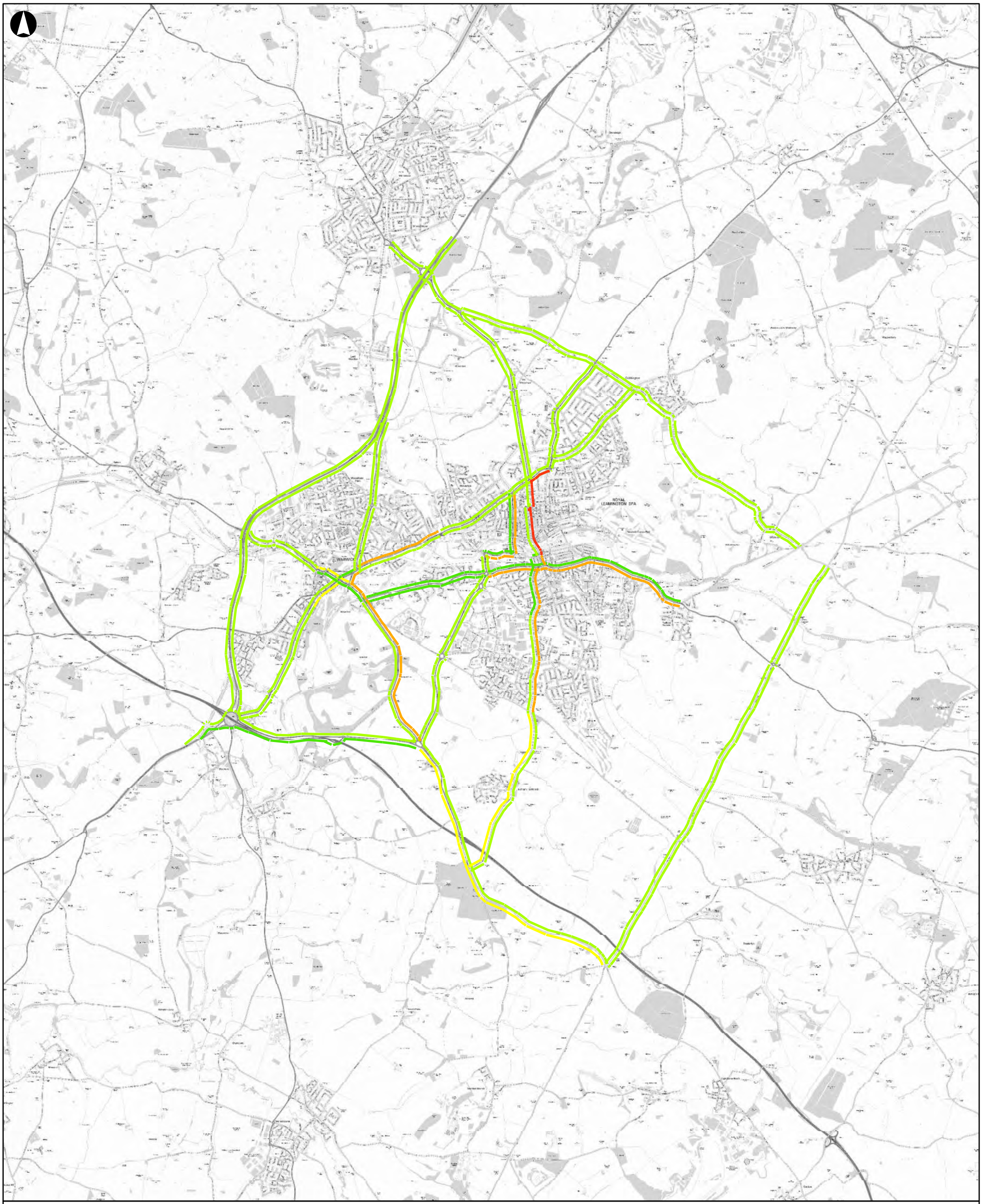
Scale at A3
N.T.S.

Job No	Drawing Status
232815-60	For Information

Drawing No	Issue
MD 005	**P1**

MXD Location Document Path: \\global.arup.com\europe\Midlands\jobs\232000\232815-60\4 Internal Project Data\4-04 Calculations\GIS\Southern Sites Final\MXD\MD 005.mxd

A3



Legend

Peak Hour

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

Issue	Date	By	Chkd	Appd
P1	23/10/2014	ZW	JE	JE

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Warwickshire County Council

Job Title
Strategic Transport Assessment 4 Addendum

Metres
0 750 1,500 3,000

Reference V SS DS + Link
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 006	P1

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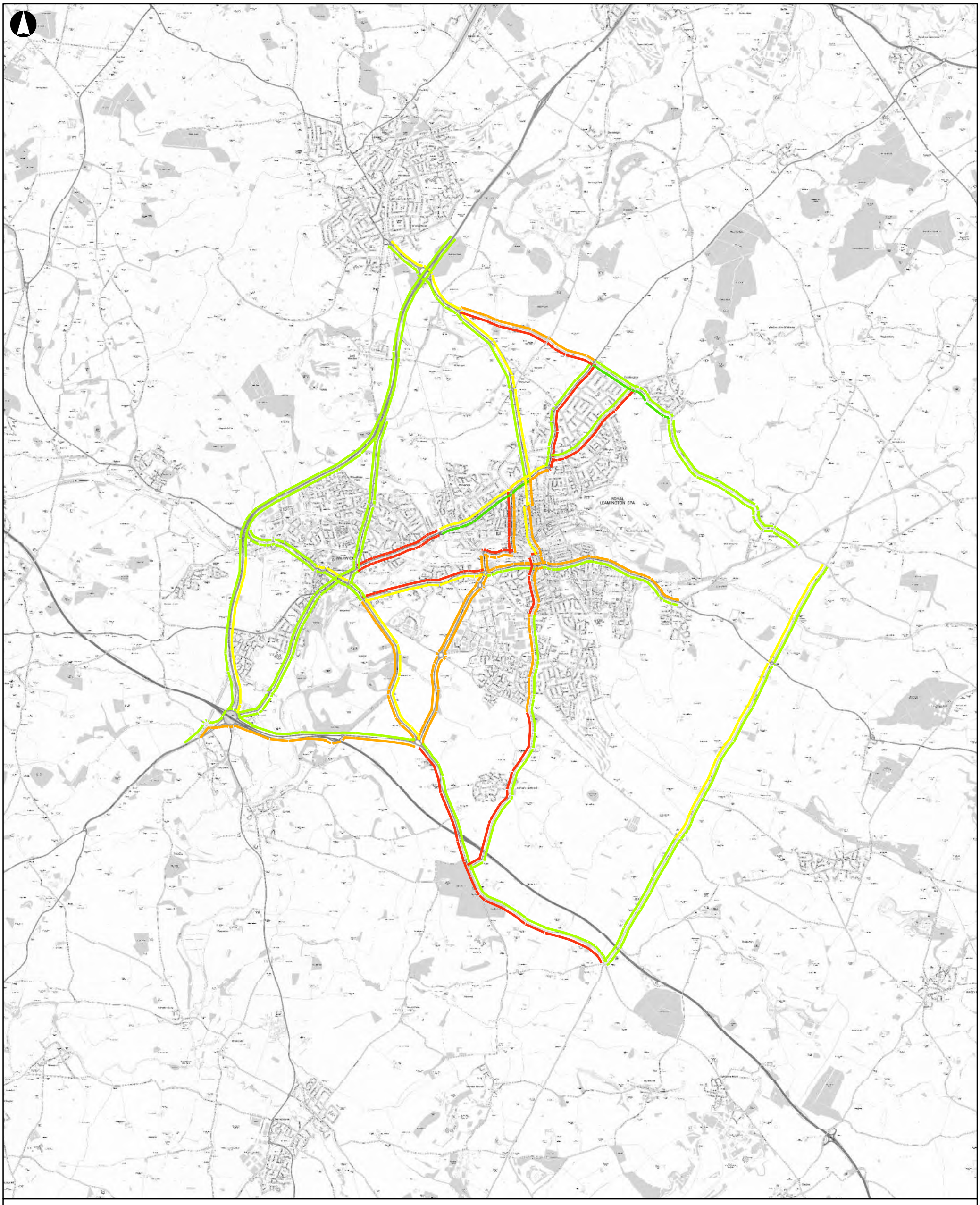
A3



Legend

Peak Hour

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

Issue	Date	By	Chkd	Appd
P1	23/10/2014	ZW	JE	JE

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Job Title
Strategic Transport Assessment 4 Addendum

Metres
0 750 1,500 3,000

Reference V SS DS + Appeal Sites
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**

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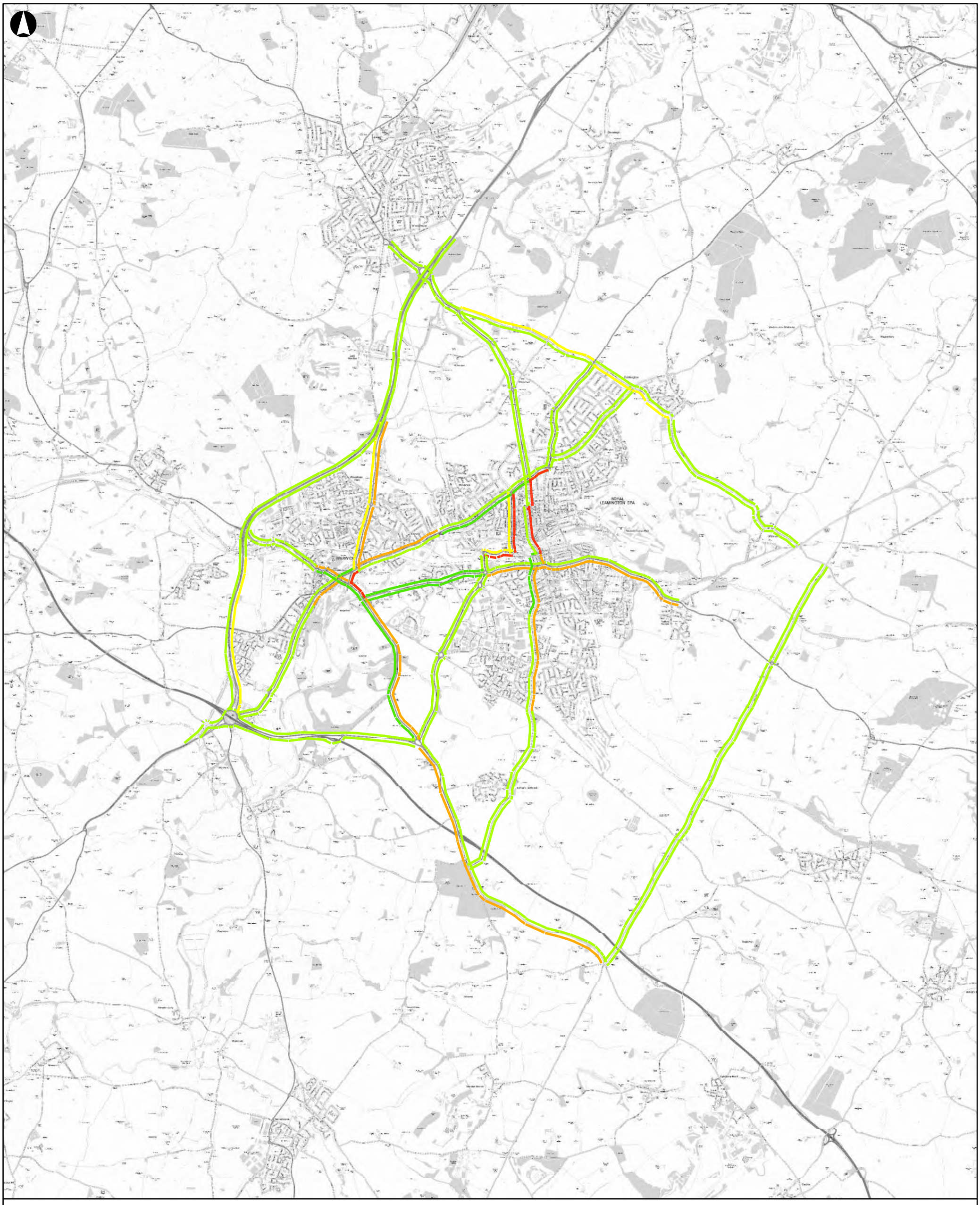

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Peak Hour

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Issue	Date	By	Chkd	Appd
P1	23/10/2014	ZW	JE	JE

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Metres
0 750 1,500 3,000

Reference V SS DS + Appeal Sites
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**

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Appendix D

2011 Southern Sites Distribution Analysis

TECHNICAL NOTE

Job Name: Warwickshire Citeware work

Job No: 32172/5501

Note No: 001

Date: 9 October 2014

Prepared By: Neil Bateman

Subject: **Warwick and Leamington STA CITEware distribution**

Item	Subject
1.	**Introduction** Peter Brett Associates LLP (PBA) was appointed by Warwickshire County Council (the Council) to provide traffic flow matrices to inform S-Paramics modelling in Warwick and Leamington to inform their Strategic Transport Assessment (STA). This Technical Note informs the Council of the methodology used to produce distribution matrices for use in S-Paramics. PBA undertook CITEware modelling using the updated 2011 Middle Layer Super Output Area (MSOA) -based model to extract distribution data and production of matrices for use in S-Paramics for sites in Warwick District. These were based on 2011 MSOA journey-to-work Census data, and assumed the delivery of the Coventry and Warwickshire Gateway site in full. The matrices were also prepared with and without 2,500 extra jobs at the Jaguar Land Rover (JLR)/ Aston Martin Lagonda (AML) Gaydon Facilities. The contents of this Technical Note is as follows: 1. Introduction 2. Background to CITEware 3. Update of CITEware to 2011 census 4. Methodology undertaken and outputs 5. Comparison of trip distributions 6. Presentation of strategic trip analysis showing tabulated district-to-district movements 7. Documentation of any amendments to results. The distribution matrices are appended in MS Excel format.

DOCUMENT ISSUE RECORD

Technical Note No	Rev	Date	Prepared	Checked	Reviewed (Discipline Lead)	Approved (Project Director)
32172/5501/TN001	-	09.10.14	NB	DG	DG	MP

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Item	Subject
2.	**Background to CITEware** The conceptual basis of the strategic modelling technique used in CITEware was developed for the Council and the Highways Agency, to provide the Council with a robust strategic modelling tool to measure the impact of planned developments on the strategic and major local road network. The approach used a similar methodology to a traditional spreadsheet gravity model. This was further developed using publicly available Geographic Information Systems (GIS) mapping data to produce a gravity type model which contains data covering the British mainland down to 'minor' road level (typically roads below B-road level linking other roads together, sometimes termed C-roads). The concept of a gravity model utilising journey time and distance to predict strategic journey routeing has evolved to incorporate a number of routeing behaviour rules, and a finer grade of initial distribution has been achieved: However, the outputs remain comparable, as distribution of likely trips to and from a destination using census data, and route choice derived by a combination of travel time and distance is provided. The current model is based in Microsoft Access, and runs using data taken from GIS and other sources. For displaying the results, a GIS is used to match up the output results (in spreadsheet format) with a GIS representation of the road network. The GIS network used is based on the Ordnance Survey's Strategi layer, licensed under the OpenData system. The network has slight differences from a truly geographically accurate map, due to its focus on clarity and legibility as a schematic mapping layer. However, the most important factors for the modelling is the length and accurate joining points for the modelling links. The marginal differences from a more accurate layer are outweighed by the benefits of its consistency and accurate bridge data, and that it includes the minor road level which is appropriate for a strategic model. Trip distribution is based on Census journey-to-work data . Any given site has its trip generation allocated to MSOAs in the proportions found in the Census data, and is allocated to the road network. All roads, where it is determined by the model from the road profile that trips may access the network, are given a volume of vehicle trips which will then be routed to their destination (in the case of inbound trips – for outbound trips the packet travels in the opposite direction). The trip packets are of equal size for each road within a MSOA,. The road network thereby serves as an intermediate aggregate layer between the S-Paramics zones and the census MSOAs. Once travel patterns are calculated using this methodology, the data is compared to a zonal system from S-Paramics and converted to a compatible matrix though the aggregation of roads to the nearest zone. As the distribution data is taken from the Census and thus reflects existing travel patterns, it is important that the MSOA used for a site is representative of likely future travel patterns. Sites are modelled initially to obtain a default distribution. Cases where this does not correspond to likely travel patterns, such as a site lying within a larger MSOA which distributes more heavily towards areas remote from the site than nearby employment opportunities are flagged. In such cases, the nearest MSOA which is likely to be more representative of the potential sites travel pattern is substituted to produce a revised distribution. **Calibration of Cost factors** Based on analysis of the journey-to-work information, an approximate cost factor is calculated based on number of jobs available versus the distance that each job lies from the residence. This is not a straightforward relationship as factors such as cost of travel, education vs available job types and staff turnover rates might be a stronger determinant of employment location than strictly the distance involved. However, empirical analysis of Census distribution data in the West Midlands indicates that

Item	Subject
	the attraction/ cost factor Census origin-destination data is approximately represented by Distance$^{-1.35}$ and therefore this is the standard cost factor used regarding route choice and gravity distribution attraction. **Outputs** CITEware can produce a number of outputs including: ▪ distribution and assignment data for GIS plots ▪ matrix information for zone-based microsimulation modelling ▪ tabulated strategic district-to-district travel information ▪ mode share information for the MSOA the site is located within ▪ data to produce spider diagrams in GIS plots **Datasets used** ▪ the datasets that were used in the model development are as follows: ▪ Strategi road network (Ordnance survey) ▪ Journey-to-Work dataset from 2011 Census ▪ MSOA ward boundaries ▪ DfT Congestion Indicator data to inform road speeds where available. **Scenario Building** When required to reflect future changes to housing and employment, the number of jobs/ residences in each MSOA can be varied to reflect different development scenarios and growth strategies, thereby enabling CITEware to be used as a strategic modelling tool to assess future traffic distribution patterns. This can include: ▪ locating all employment within an MSOA at a single large site, where the default census distribution is not representative ▪ permitting interaction between future developments ▪ removal of jobs where relocation or departure of employers is expected in a future scenario ▪ modelling a selection of growth scenarios in sensitivity testing to establish estimates of trip linkage between future developments.
3.	**Update of CITEware to 2011 Census data** On 25 July 2014 origin-destination data at MSOA level was released through NOMIS, and was revised on 11 August due to an error in reporting. This data is not directly comparable to data from the 2001 Census ward data due to the different geographic areas used and how the data is anonymised. However, it can be used in the same manner as ward data to provide origin to destination matrices as it provides an origin to destination matrix which can be applied to the roads within the MSOA, in the same way the ward data was originally applied. CITEware has been updated to use this dataset to inform distribution of traffic, following the Census release. Checks were undertaken during modelling of each site to ensure the appropriate MSOA is used, as Rural MSOAs can be large, and in some cases cover areas which would be expected to have quite different distributions of traffic. In some cases, this can be accommodated by splitting the MSOA areas into constituent Lower Super Output Areas (LSOAs) proportionally on the basis of number of residences or jobs recorded as appropriate. However, as the distribution data relies on the MSOA in which the site is located, in most cases using an appropriate proxy of a neighbouring area with similar land use to a proposed development overcomes issues of large rural MSOAs producing unexpected distributions.

Item	Subject
4.	**Methodology undertaken** The S-Paramics zone file, as supplied by the Council, was imported into CITEware and converted into a GIS-compatible format. The zones were then examined in a GIS, and where a zone represented an exit from the modelled area, these zones were reshaped to cover those areas which would enter the modelled area via the original exit zone. The resultant shapefile was then imported back into CITEware and used for the distribution modelling. The sites as supplied in the "site schedule" were modelled using CITEware, giving the distribution of traffic as derived from the MSOA level 2011 Census data. The resultant outputs give zone-to-zone movements. Tabulated results are appended to this document and indicative GIS plots are provided in Section 6. As requested by WCC, a comparison has been undertaken between the distribution calculated from the 2011 census data and the scenario as modelled in CITEware. This is shown in **Figure 1** and **Figure 2** and indicates that the distribution patterns calculated for the modelled scenario are similar to the distribution patterns seen in the 2011 census data. There are some additional attractors in the modelled scenario, with employment and residential trips permitted to interact between proposed developments, therefore the patterns are not expected to be absolutely identical. As specified in the brief, Zone 541 was modelled both with and without attraction from the AML/ JLR employment sites, results are shown in **Figure 3** and **Figure 4** and the tabulated results are also appended to this document.

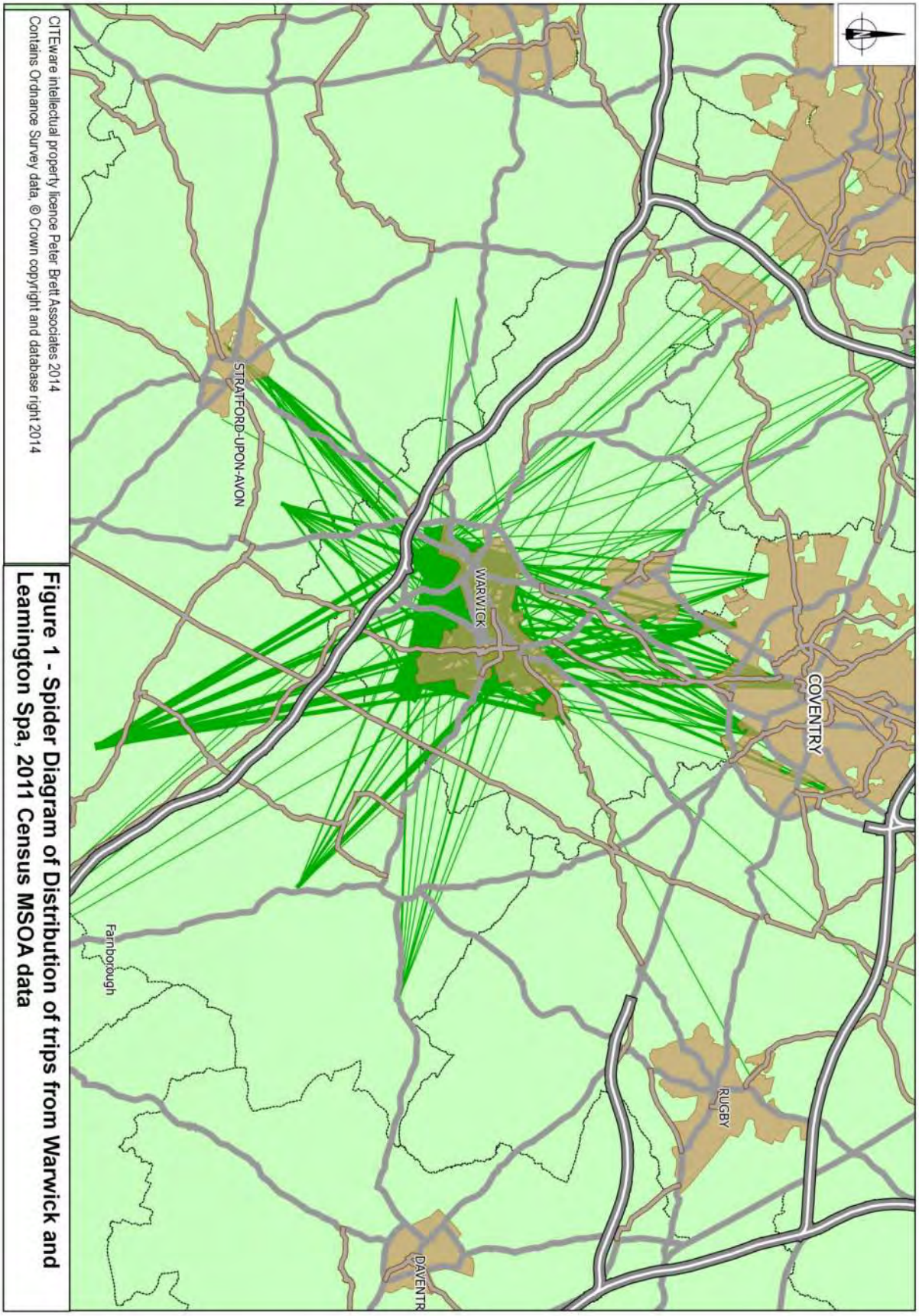

Figure 1 - Spider Diagram of Distribution of trips from Warwick and Leamington Spa, 2011 Census MSOA data

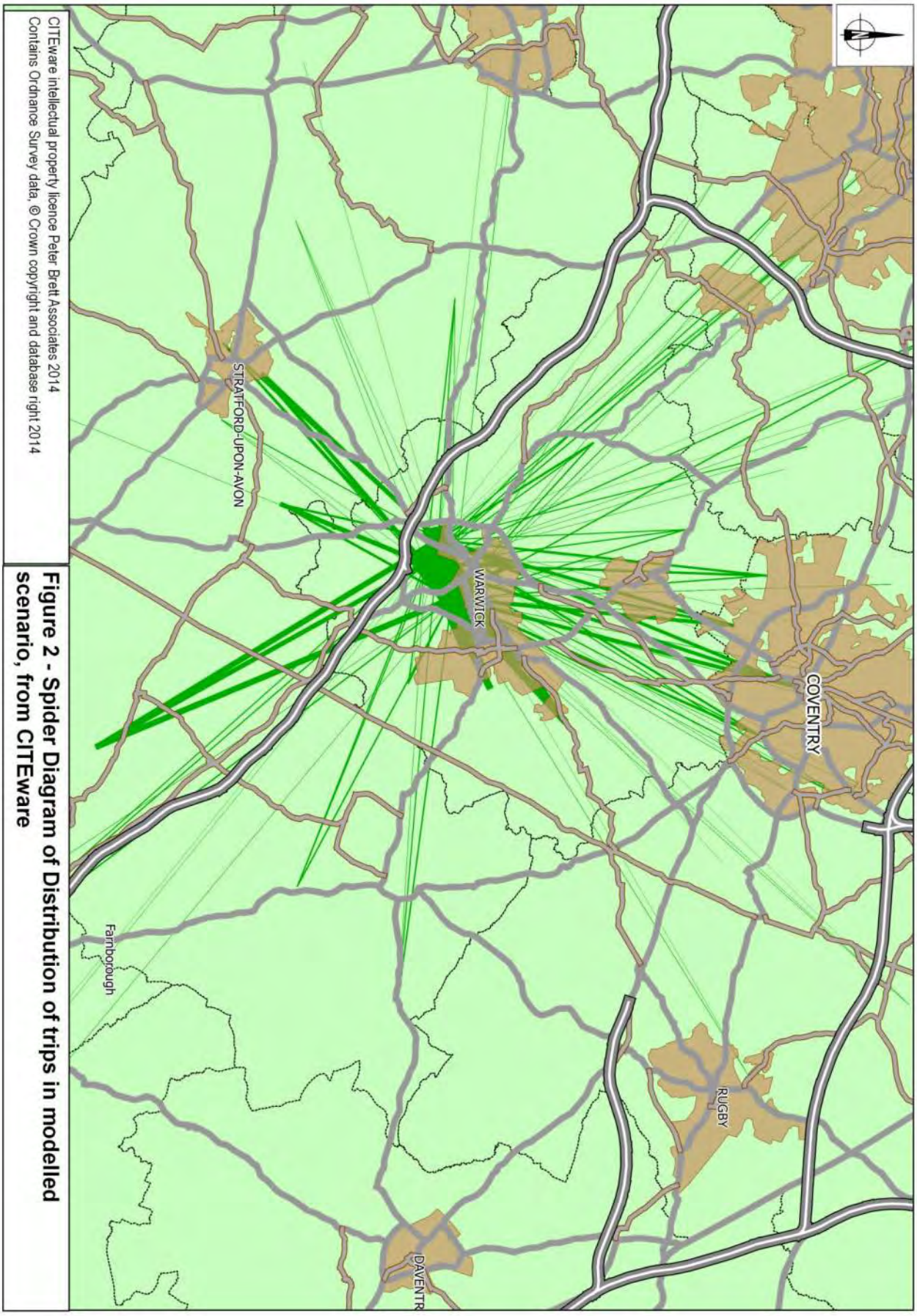

Figure 2 - Spider Diagram of Distribution of trips in modelled scenario, from CITEware

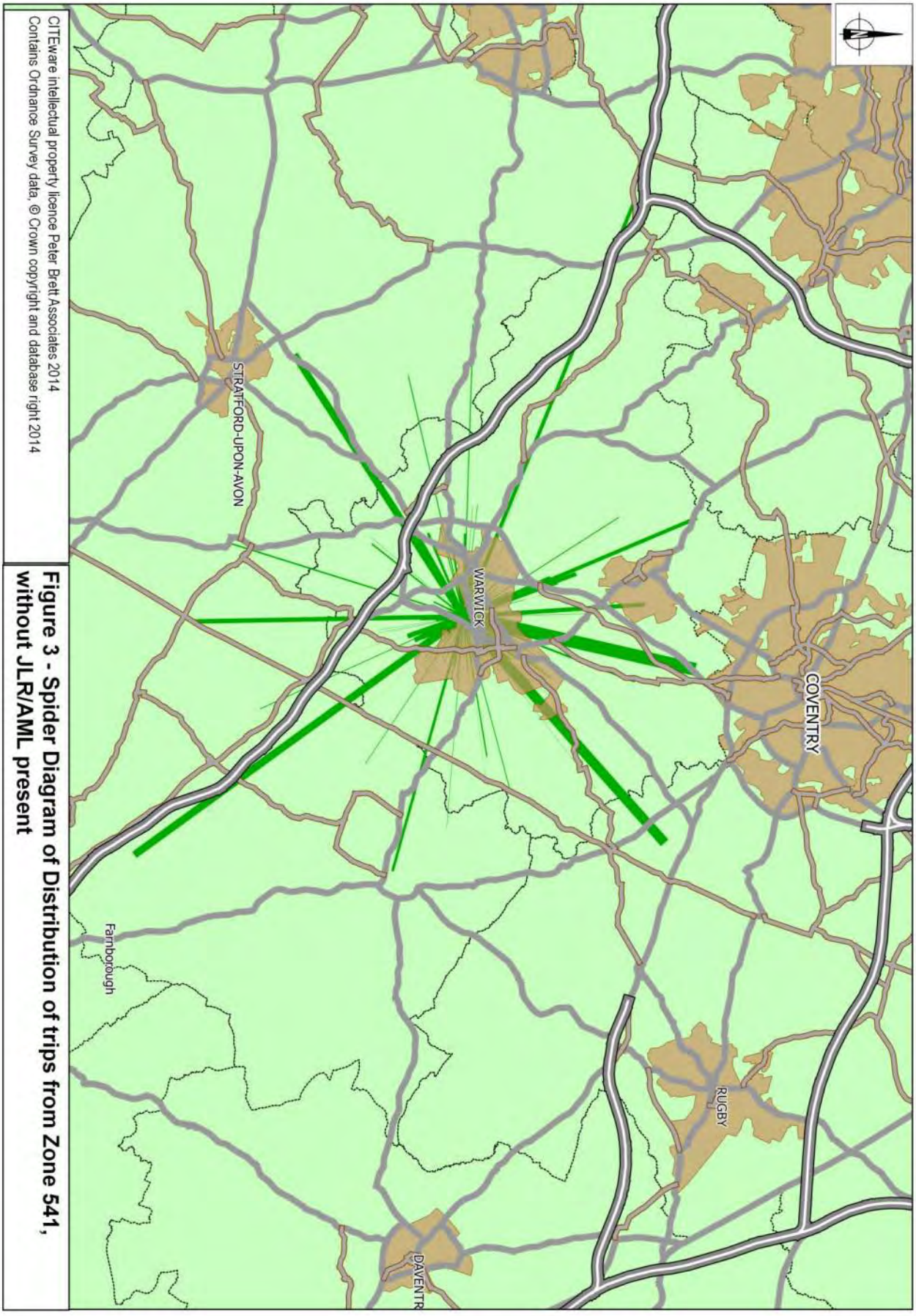

Figure 3 - Spider Diagram of Distribution of trips from Zone 541, without JLR/AML present

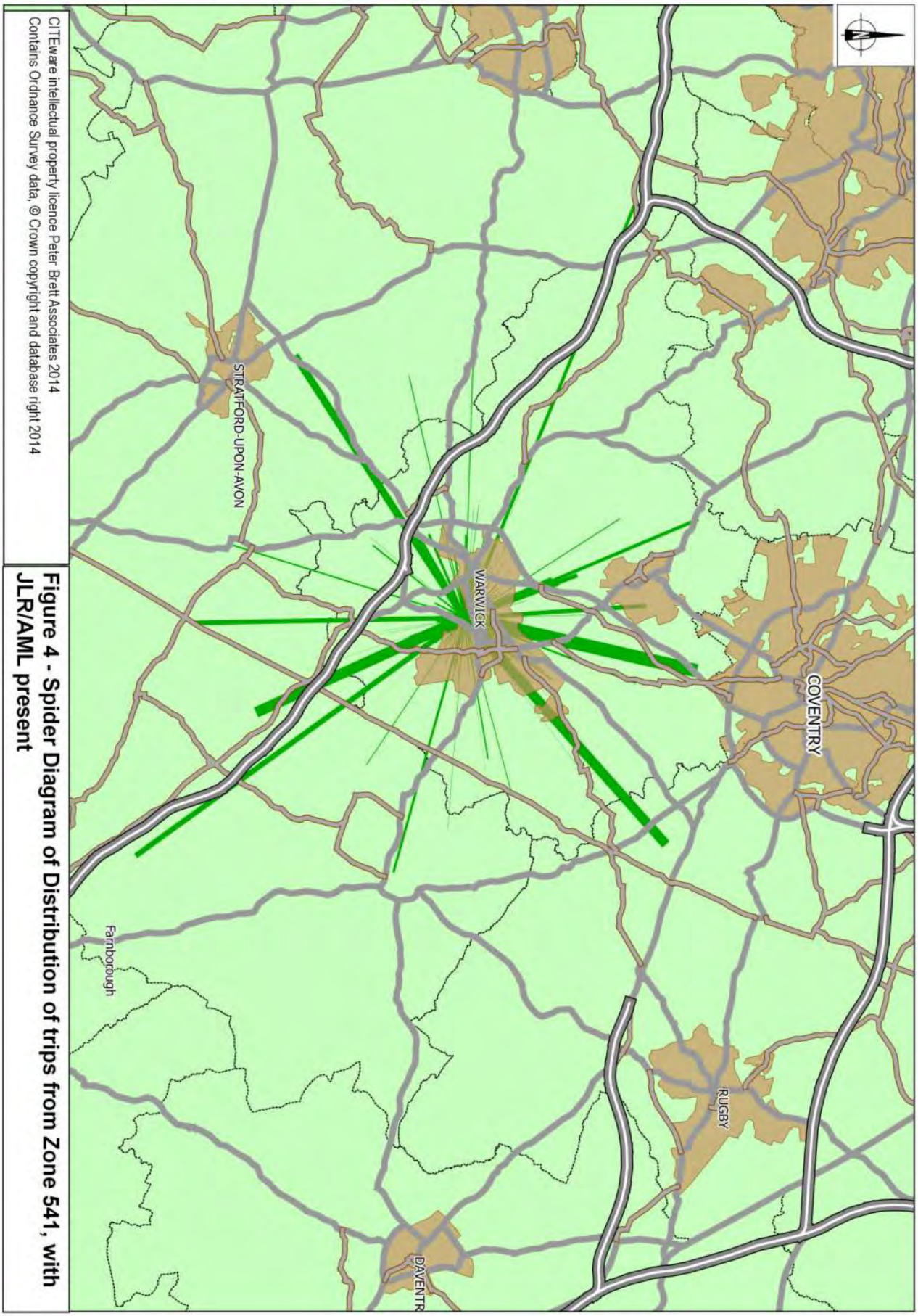

Figure 4 - Spider Diagram of Distribution of trips from Zone 541, with JLR/AML present

5 Comparison of Travel Patterns

As can be seen in **Figure 1** and **Figure 2**, the main destinations of the traffic from Warwick and Leamington broadly conforms with the travel patterns from the 2011 Census. As the sites tested within this scenario are focussed to the south of Warwick and Leamington Spa, the scenario distribution has slightly higher proportions of trips travelling towards Southam, Stratford-upon-Avon and Banbury than the District average. This provides the assurance sought by the Council that although the distribution will reflect new attractors, it remains broadly in line with the 2011 Census distribution.

As can be seen in **Figure 3** and **Figure 4** below, the presence of 2,500 jobs at the JLR/ AML facilities would comprise a significant attractor and be expected to influence travel patterns. This testing indicated that the presence of the JLR/ AML facilities causes approximately five percent of total trips to transfer from other destinations to these additional jobs.

6 Strategic Movements

The proportion of traffic distributed to strategic destinations is given below in **Table 5.1**, which shows that the distribution calculated using CITEware for the scenario provided is very similar to that in the 2011 Census data.

Table 5.1 – Destination of strategic trips

District	2011 Census	CITEware distribution of scenario with AML/JLR
Birmingham	4%	4%
Cherwell	2%	2%
Coventry	13%	13%
North Warwickshire	1%	1%
Nuneaton And Bedworth	1%	1%
Redditch	1%	1%
Rugby	2%	2%
Solihull	3%	4%
Stratford-on-Avon	12%	12%

7 Amendments to distribution assumptions

As specified during the project briefing with the Council, traffic movements which contradict the known land uses within a Zone or those that seem obviously anomalous have been amended following discussion with the Council's modelling staff to ensure the proposed modification is acceptable. The amendments which have been made are as follows:

- As specified in the project brief, no traffic was permitted to travel to Zone 543 as this represents an education facility for which a separate distribution exercise will be undertaken
- By default, Zone 548 sent the largest proportions of traffic to Zones 201, 202, and to Zone 542. This appears to be due to MSOA Warwick 014 that lies south of Warwick being a larger rural MSOA which has a northern boundary close to zones 201 and 202. As Zone 548 is remote from Zones 201 and 202 this was considered anomalous, therefore the site access point was realigned in order that it snap to the MSOA to the north (the zone overlaps both, so this is reasonable, and is likely to be more representative of future residents)

- Zone 541 sent a large proportion of trips to 542, presumably because 542 is close and it's picking up the nearby employment uses that in reality are in Zones 107, 106, 87 and 86. This was adjusted down to an attraction reflective of small-scale employment within a residential development and other Zones received a proportional increase in distributed traffic equal in total to the adjustment, and
- Zones 105 and 549 had a similar issue to zone 541, for which the same solution was applied

As an additional check, the approximate draw of the JMR/ AML developments was tested in an unconstrained attractor scenario (normally draw to one site is capped to prevent close planning assumptions causing overestimated draw). The results indicate that the presence of these employment destinations results in a total diversion of approximately 5 per cent of outbound residential traffic from other destinations to these sites.

8 Conclusion

The distributions supplied with this document are produced according to the principles agreed with the Council, and following review by the Council, should be presented to the Council's modelling staff to inform the distributions used in the S-Paramics modelling of STA scenarios.

Appendix A – Distribution of trips