Warwickshire County Council

A46 Strategic Link Road Assessment
Detailed Modelling Assessment

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Contents

1 EXECUTIVE SUMMARY

Overview

1.1 Vectos Microsim (VM) has been commissioned by Warwickshire County Council (WCC) to undertake detailed testing of the impact of delivering the A46 Strategic Link Road within the recently developed A46 Link Road Paramics model.

1.2 This report documents the detailed testing that has been undertaken within the microsimulation model, developed specifically, to aid the appraisal of options pertaining to both the delivery of the link road as well as any attendant proposals required to accompany the link road.

Objectives

1.3 The following objectives have been derived for this study:

- To assess the implications of delivering the link in phases including several options for delivery.
- To identify wider effects arising from the delivery of the link road including any impacts on the A45 as well as around Westwood Heath and the University.
- To consider the effects on network conditions that may be induced as a result of strategic reassignment (to be identified from the CASM model)
- To identify any additional highway interventions which may be able to complement the link road through improved flow of traffic.
- To identify opportunities to provide complementary measures such as the downgrading of Gibbet Hill to encourage active mode choice.
- To identify effects of delivery of wider growth aspirations including the reserve site at DS21, additional growth at the University of Warwick and further build out at Kings Hill.

Scenario Development

1.4 The assessment of the link road proposals have been considered with a Paramics Discovery model developed specifically for this study. A 2029 Reference Case model has been forecast via the inclusion of all known committed developments, along with the interrogation of the TEMPRO database (for external growth only).

1.5 Upon review of the model operation it was clear that the schemes around the Stivichall Interchange and A46/Stoneleigh Road junction were necessary in order to reduce the significant levels of queueing that were being observed.

1.6 The delivery of these committed schemes resulted in a network with a predictable pattern of congestion, without the model resulting in 'locking up'. Despite this, significant queues are observed within the models, particularly along the A45.

Stages of Assessment

1.7 In order to address the study objectives, this testing has been to split into three stages. The first stage considers the impact of delivering the link road in phases along with the analysis of variations in the delivery of the full link. This stage of the assessment seeks to identify the relative benefits of the phases of the link road building out from the A46.

1.8 The second stage of assessment builds on Stage 1, by undertaking a detailed review of the wider effects of the link road in terms of impact on queues and traffic flows on other parts of the network. This stage then identifies any additional mitigation required, in order to reduce any impacts arising as a result of delivering the link.

1.9 The final stage considers the impact of any traffic redistribution (as informed by the CASM). In addition to considering the redistribution effects, this stage also reviews the impact of additional development trips on the network, which may be unlocked by the delivery of the link road.

Stage 1 – Strategic Link Road Options

1.10 The first stage reports the strategic level impact of delivering variations of the link road. The impact of delivering the link road in phases has been assessed, along with the analysis of variations in accompanying measures delivered alongside the full link. Upon completion of this stage of the assessment, the following conclusions were drawn:

- The modelling outputs indicate that delivering only southern part of the link road (i.e. not providing a connection between the A429 and Westwood Heath Road) is unlikely to result in any notable benefit at a strategic level;

- The results demonstrate that delivering the full link achieves significant improvements in terms of strategic impacts over the Reference Case, and critically over the partial delivery of the link;
- It has been determined that the restriction to through traffic on Gibbet Hill Road, alongside the delivery of the link road in full, delivers the highest traffic flows along the link itself, whilst affording an additional objective of this assessment to be met, in regards to the downgrading of Gibbet Hill Road to all through trips, without having an adverse strategic level impact;
- This scenario has been taken forward for detailed analysis, presented within Stage 2 of the results analysis.

Stage 2 – Localised Highway Impact

1.11 The second stage outlines the modelled impact of the preferred Link Road option (inclusive of link restrictions on Gibbet Hill Road), on the local road network. Upon completion of this stage of the assessment, the following conclusions were drawn:

- The delivery of the link alone leads to a small number of instances of worsening queue conditions predominantly across the Tile Hill/Westwood Heath area of the model network;
- Accordingly, six concept mitigation schemes have been derived and included within the model to form the Do Something + Mitigation scenario;
- The resultant analysis of this scenario has highlighted that the inclusion of the link road, plus the mitigation, has the potential to deliver significant queue reductions across the network, with critical strategic benefits at the congested A45/Kenilworth Road junction.

Stage 3 – Sensitivity Testing

1.12 The final stage of the assessment outlines the sensitivity testing undertaken around the inclusion of reassignment effects within the model, along with an assessment of the impact of delivering additional growth alongside the link road. Upon completion of this stage of the assessment, the following conclusions were drawn:

- The reassignment effects test has been developed to capture any strategic re-routing predicted to occur as a result of delivering the link road, and consistently demonstrate

that there are no substantive issues predicted to arise as a result of the reassignment considered;

- The results of the additional growth test demonstrate that the Reference Case scenario does not have the capacity to accommodate the additional demands without significant congestion issues occurring;
- The results have however indicated that the additional demands could be accommodated alongside the delivery of the link;
- The analysis has highlighted that along with the link and the previously identified mitigation, it is likely further localised schemes would be required to further improve network conditions.

Conclusions

1.13 Based upon the assessment documented within this report, and the summary provided above, it is possible to draw the following conclusions from this study:

- The full connection between the A46 and Westwood Heath is required to unlock the strategic benefits of the link road.
- Delivery of the link road is likely to be the only option which will provide the opportunity to restrict Gibbet Hill to through trips and that, based on the modelling, if it is delivered with the link road, the restrictions would not undermine the strategic benefits of the link road.
- There are a series of mitigation measures which could be delivered alongside the link road, and would mitigate any problems arising from changes in traffic flows resulting from the inclusion of the link road.
- The impacts of strategic reassignment do not indicate a significant draw of additional traffic will occur as a result of the link road delivery.
- Although there will be some residual impacts remaining on the network the link road does provide an opportunity for significantly more development to come forward within the area than may otherwise occur if it is not delivers.

Recommendations for Future Assessment

1.14 The following outlines a series of recommendations that should be considered for any additional stages of assessment related to this study:

- Despite the inclusion of the proposed mini-roundabout scheme at the Cromwell Lane/Westwood Heath Road junction, queues continue to form at this junction, as the southbound traffic is now forced to give way to right turning traffic. Further work should be undertaken to understand the origin and destination of trips travelling through this junction, particularly those making the problematic right turn movement, whilst at the same time exploring alternative options for a larger mitigation scheme;
- One of the mitigation schemes identified, involved a re-configuration of the Kings Hill junction. It is recommended that further consideration is given to alternative strategies for Kings Hill traffic, and whether the currently proposed mitigation junction arrangement is the optimal solution;
- Alternatively, consideration should be given to an additional junction on the new link road, where it meets Stoneleigh Road, which may provide improved connectivity between the A46 and the Kings Hill site.
- Within the Stage 2 analysis a scenario in which a connection between the strategic link and the Westwood Heath Business Park was included. This test indicated that the inclusion of the connection to the business park had the potential to improve the model performance, however, this option was discarded at this stage due to uncertainty over the connection and its deliverability. It is suggested that should further details on this connection emerge then undertaking a further sensitivity test with the connection included would be beneficial;
- It is recommended that any additional modelling work undertaken begin to review the junction forms on the link itself, and an update to the modelled layout of junctions along the route following any detailed design work, which should be undertaken.
- A final recommendation relates to the CASM reassignment work undertaken. The reassignment considered in this assessment is based upon output matrices provided to VM from a 2026 assessment year CASM run. It is understood that a future year scenario of 2034 has been run, and accordingly, the reassignment should potentially be revisited in the form of an additional sensitivity test using these output matrices.

2 INTRODUCTION

2.1 Vectos Microsim (VM) has been commissioned by Warwickshire County Council (WCC) to undertake detailed testing of the impact of delivering the A46 Strategic Link Road within the recently developed A46 Link Road Paramics model.

2.2 The A46 Link Road proposals have been identified as a scheme of strategic benefit and a Business Case is in the process of being compiled for submission to the Department for Transport (DfT). The business case work is being completed within the Coventry Area Strategic Model (CASM) which is a VISUM model covering a significant area.

2.3 In addition to the VISUM modelling, supplementary modelling has also been undertaken using a microsimulation approach. The microsimulation approach brings with it the benefits of being able to more accurately reflect capacity constraint and traffic conditions at the local junction level. The counter to the increased level of detail is that the modelling can only consider a relatively small study area, relative to the VISUM modelling and, as such, the microsimulation modelling is being used in this instance to supplement the strategic modelling by supporting the identification of detailed localised impacts arising from the delivery of the link road proposals.

2.4 The microsimulation model was developed specifically for this purpose. It is envisaged that the localised schemes identified through this assessment can be fed back in to the CASM model during any subsequent iterations of the link road testing.

2.5 Additionally, the relative simplicity afforded to the assessment through the smaller study area also means that the microsimulation model can be used to assess a suite of design options more easily as the focus of impacts are smaller and easier to discern from smaller changes to the model as a result.

2.6 This report documents the detailed testing that has been undertaken within the microsimulation model, developed specifically, to aid the appraisal of options pertaining to both the delivery of the link road as well as any attendant proposals required to accompany the link road.

Background

2.7 Funding has recently been secured for the A46/Stoneleigh interchange scheme. The business case for this scheme was predominantly supported by the use of the CASM model but microsimulation modelling was used for some of the detailed analysis, particularly concerning the assessment of localised queueing and delay benefits arising from the delivery of the scheme proposals.

2.8 Work is currently been undertaken within the Coventry Area Strategic Model (CASM) to assess the implications of delivering s the proposed A46 link road which will tie in to the junction proposals and significantly improve the connectivity between the University of Warwick and the A46.

2.9 Detailed local level modelling is required to assess the impacts of different options for the link road on the surrounding local highway network as well as identifying any additional measures necessary to compliment the link road.

2019 A46 Link Road Base Model

2.10 VM previously developed the 2019 A46 Link Road Base Model for the assessment of the link road. The model extent covers the highway network between Kenilworth and south west Coventry and includes significant sections of the A45 and A46, together with the University of Warwick and a number of residential areas that form the suburbs of south west Coventry. The extent of the model is illustrated within **Figure 1**.

2.11 The development of this model was underpinned by a significant amount of observed data collected within the study area, based upon MCC turn count data, ATC link count data and ANPR journey time data. The coverage of this 2019 data is demonstrated within **Figures 2-4**.

2.12 This model was calibrated and validated in line with WebTAG guidance, and subsequently independently audited by Systra, whom issued a final audit report in February 2020.

Figure 1 Study Area

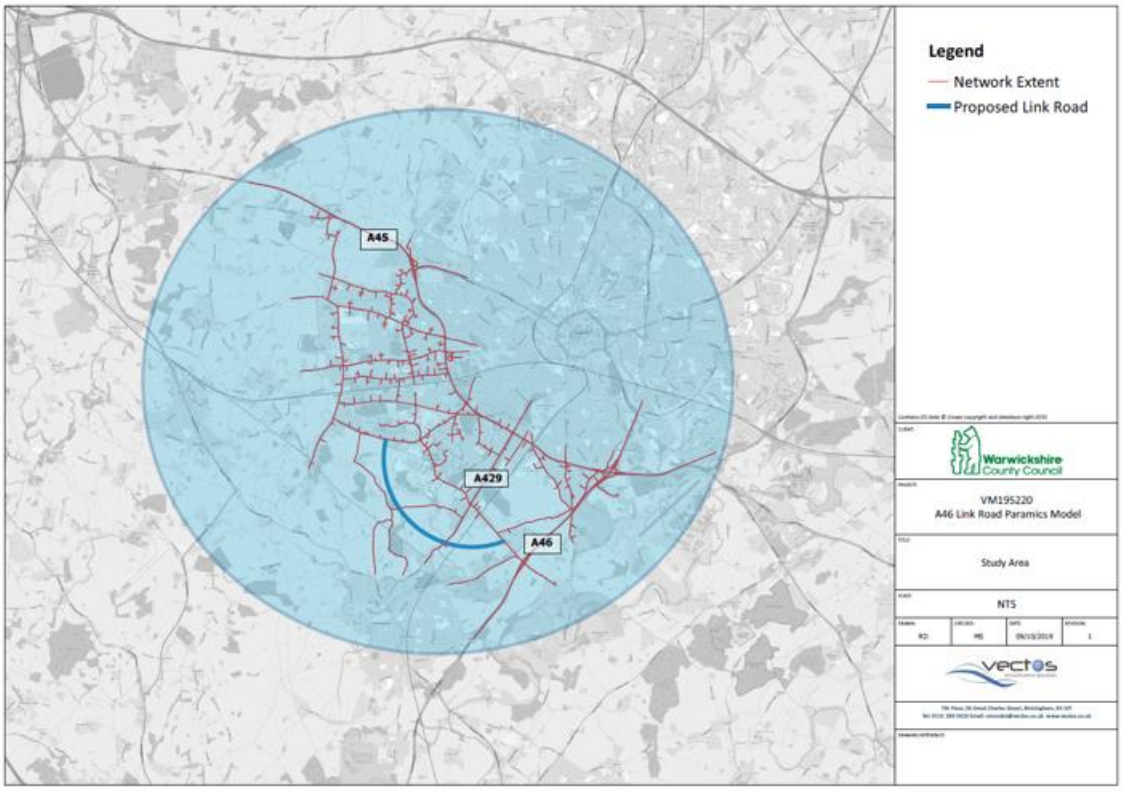


Figure 2 MCC Data Coverage

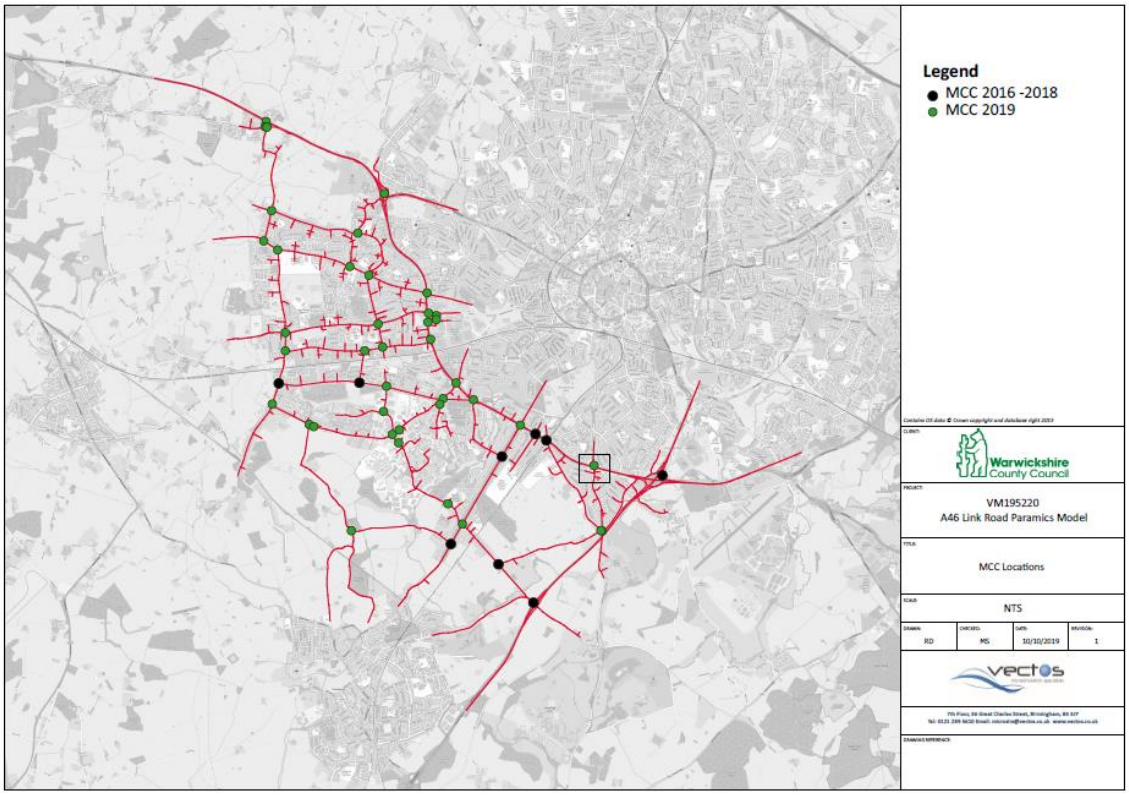


Figure 3 ATC Data Coverage

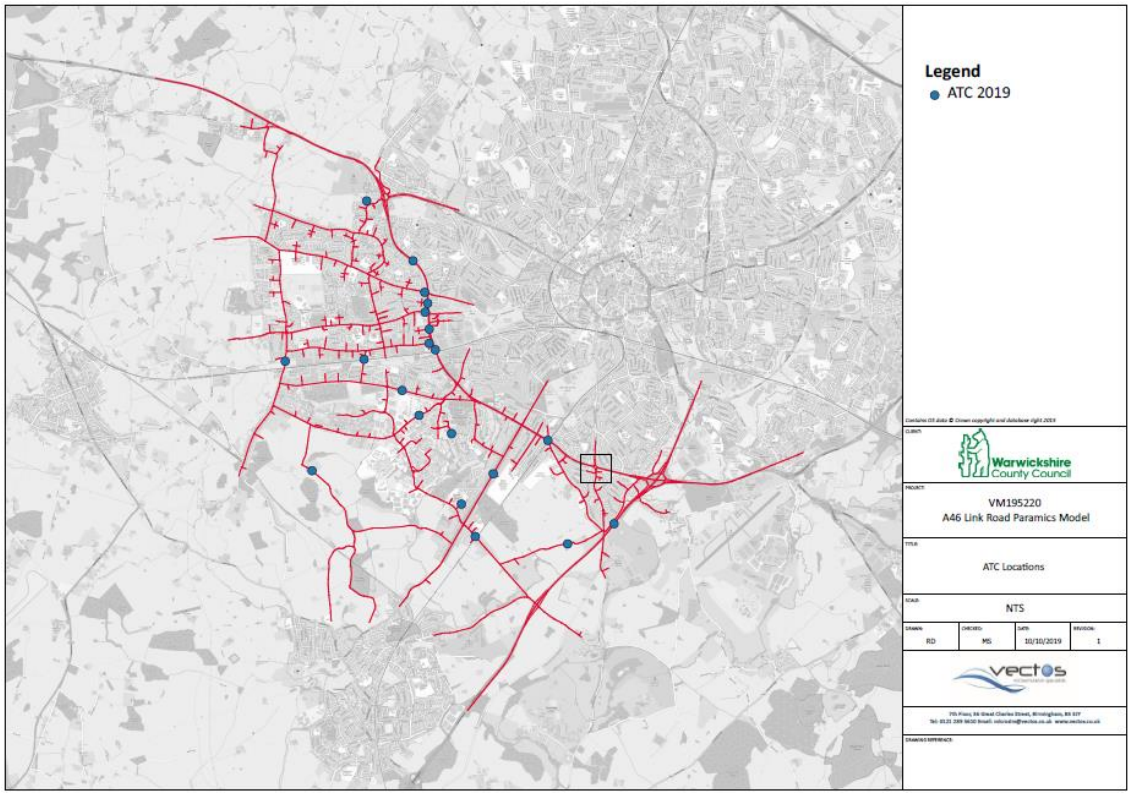
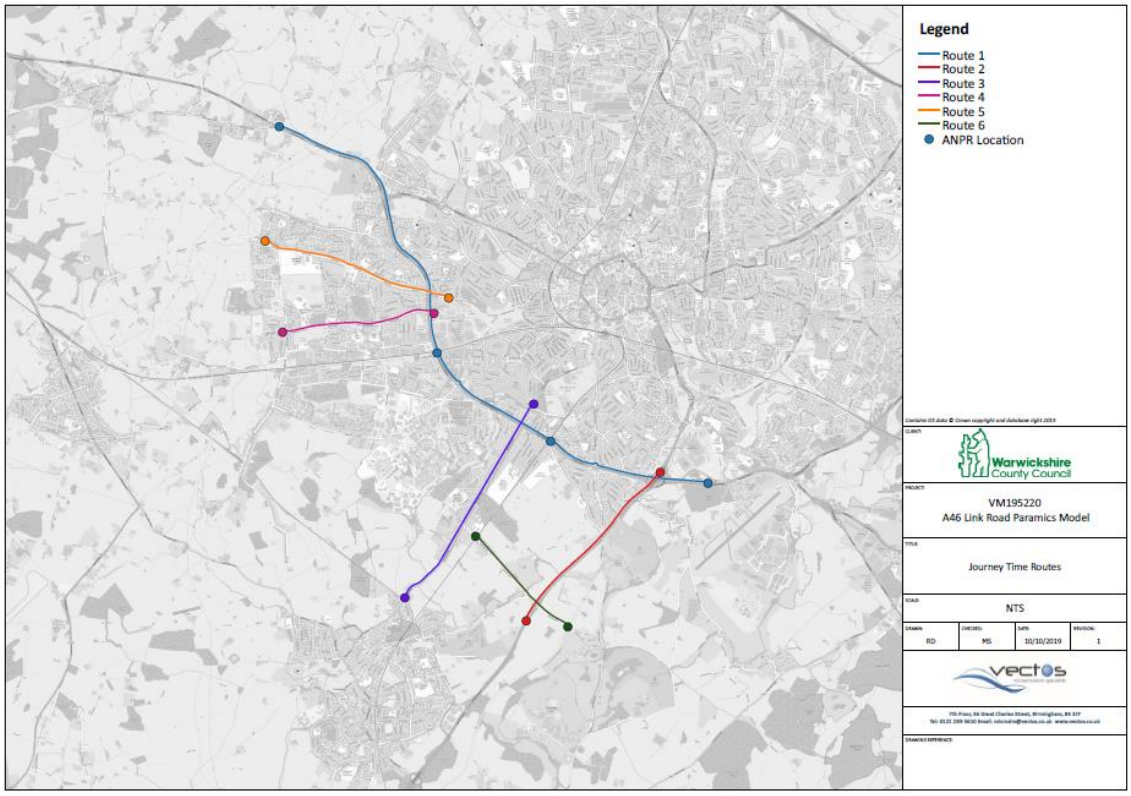


Figure 4 ANPR Journey Time Data Coverage



Link Road Initial Option Testing

2.13 Following the calibration and validation of the base model, VM have undertaken an initial stage of modelling related to the delivery of the link road. In this stage of modelling, a series of option tests were undertaken, which examined the impact that three link road configurations would potentially have on the local highway network.

2.14 This initial stage of testing was undertaken within a 2026 future year scenario, which was developed to ensure consistency with the CASM modelling, which has also been developed for the 2026 assessment year.

2.15 In order to develop a 2026 future year model for this testing, the Paramics base model demand matrices were modified to reflect future year traffic volumes by a combination of information extracted from the CASM model and factors calculated from TEMPRO.

2.16 This stage of testing assessed the impacts of the link road by examining the changes in journey time along a series of strategic corridors in the model. Following the identification of corridors where journey times were noted to increase, a number of junctions were classified as requiring further detailed analysis.

Detailed Modelling Assessment

2.17 The detailed testing documented within this report is intended to follow on from the identification of outputs from this initial testing as well as focusing on specific junctions in greater detail. This current round of testing considers the localised impacts of the link road delivery alongside detailed inclusions of committed developments within the study area.

2.18 This latest round of testing also considers the impact over a longer build out period, up to the end of Local Plan period of 2029, rather than the previously tested assessment year of 2026 allowing for the designs to be tested with higher traffic flows then previous predicted through the 2026 modelling to ensure that schemes are robustly considered.

Study Objectives

2.19 The testing documented within this report considers the localised implications of design options for the link road as well as identifying any additional highway measures necessary to minimise any traffic impacts arising from the link road proposals. In order to address this, the following objectives have been derived:

- To assess the implications of delivering the link in phases including several options for delivery.
- To identify wider effects arising from the delivery of the link road including any impacts on the A45 as well as around Westwood Heath and the University.
- To consider the effects on network conditions that may be induced as a result of strategic reassignment (to be identified from the CASM model)
- To identify any additional highway interventions which may be able to complement the link road through improved flow of traffic.
- To identify opportunities to provide complementary measures such as the downgrading of Gibbet Hill to encourage active mode choice.
- To identify effects of delivery of wider growth aspirations including the reserve site at DS21, additional growth at the University of Warwick and further build out at Kings Hill.

Report Structure

2.20 This report comprises the following chapters:

- **Chapter 3** – Reference Model Development; *a summary of the network and demand changes required to create the reference case model.*
- **Chapter 4** – Assessment Methodology; *a summary of the methodology behind the analysis undertaken within this study.*
- **Chapter 5** – Stage 1 Results Analysis; *assessment of the implications of delivering the link road in phases and identification of the wider effects arising from delivering the link*
- **Chapter 6** – Stage 2 Results Analysis; *identification of any additional highway interventions to complement the link road*
- **Chapter 7** – Stage 3 Results Analysis; *review of the impacts of strategic reassignment as a result of delivering the link, along with identification of the effects of delivering wider growth aspirations alongside the link*
- **Chapter 8** – Summary, conclusions and Recommendations for further consideration.

3 MODEL FORECASTING

Overview

3.1 As detailed within the previous section, whilst previous assessment work has made use of the 2026 traffic forecast, this round of modelling has been undertaken within a 2029 future year model. Accordingly, A set of 2029 traffic forecast were derived for this purpose.

3.2 It was determined that 2029 would be an appropriate test year for the detailed link road assessment, given that this reflected the end of WDC Local Plan period, and thus enable a higher growth scenario to be assessed than the CASM and previous Paramics link road tests. Furthermore, by including the development in a high level of detail it is possible to give further consideration to the effects of traffic growth within the area than can be achieved through the analysis of the strategic modelling outputs in isolation.

3.3 In order to develop the 2029 Reference Case model all committed development sites within or around the study area were explicitly included within the modelling, along with committed highway schemes.

3.4 Subsequently, TEMPRO forecasts were used to derive an appropriate level of external traffic growth within the model representing growth in traffic travelling through the study area (i.e. traffic that does not have a trip start or end within the study area).

3.5 Additionally, as a sensitivity test for this study, strategic reassignment effects were accounted for through analysis of the effects observed within CASM across the same study area.

Committed Development Details

3.6 As outlined above, it has been determined that all relevant committed development trips should be included within the model. Accordingly, the developments listed in **Tables 1-3** (and shown in **Figure 5**) have been included within the model.

Table 1 Committed Development Details – Residential Sites

Name	Number of Dwellings
A. Land at Cromwell Lane	240
B. Land at Westwood Heath Road	425
C. Eastern Green	2,250
D. Kings Hill Park	2,500
G. Burton Green	90
H. Crackley Triangle	93
K. Land at Woodside	700
Total	**6,298**

Table 2 Committed Development Details – Employment Sites

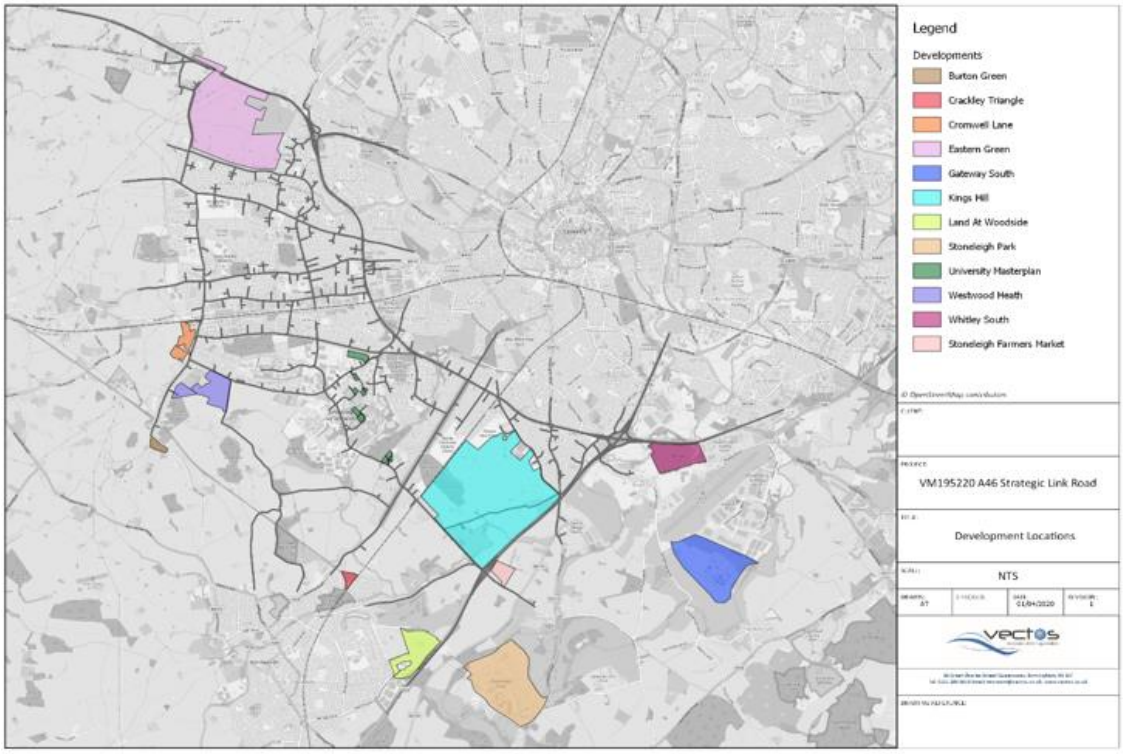
Name	Floor Space
F. Stoneleigh Farmers Market	7.6 hectares
I. Gateway South	181 hectares
J. Whitley South	24. 3 hectares
L. Stoneleigh Park	101.6 hectares

Table 3 Committed Development Details – Other Sites

Name	2029 Details
E. University Masterplan	4 car parks with increased capacity*

*Car park 1, 608 to 1300 spaces. Car park, 1631 spaces to 2069. Car park 3, 964 to 1500 spaces. Car park 4, 390 to 650 spaces.

Figure 5 Committed Development Locations



3.7 Further details on each of the developments identified in **Table 1**, **Table 2** and **Table 3** are provided below:

Site A – Land at Cromwell Lane

- Development Proposals – Residential development located to the west of Cromwell Lane, between Charter Avenue and Westwood Heath Road. The development consists of 240 dwellings.
- Access Proposals – two new accesses in the form of priority junctions off Cromwell Lane
- Trip Rates – the trip rates used to inform the model demands for this site have been derived from the associated Transport Assessment documents.

Site B – Land at Westwood Heath Road

- Development Proposals – Residential development located approximately 5km south-west of Coventry city centre on the southern side of Westwood Heath Road. The development consists of 425 dwellings.
- Access Proposals –vehicular access is to be provided directly onto Westwood Heath Road via two new junctions on Westwood Heath Road.
- Trip Rates – the trip rates used to inform the model demands for this site have been derived from the associated Transport Assessment.

Site C – Eastern Green

- Development Proposals – Residential development site to the north of Upper Eastern Green Lane and south of the A45 Birmingham Road. The development consists of 2,250 dwellings.
- Access Proposals – Access to the Eastern Green development site is proposed via two access points to the north and west of the site. The main site access, to the north of the development, is to be provided via a grade separated junction with the A45. The access to the west of the development is via Pickford Green Lane, in the form of a traffic-controlled signal junction.
- Trip Rates – the trip rates used to inform the model demands for this site have been derived from the associated Eastern Green Transport Assessment

Site D – Kings Hill Park

- Development Proposals – This largely residential development site is located between Finham and Kenilworth, west of the A46. The development proposals consist of the the delivery of 2,500 dwellings.

- Access Proposals – There are three proposed accesses to the development. The main access points are via a roundabout junction of St. Martins Road/Green Lane/Howes Lane, and a signalised junction at the existing Kings Hill Lane/Stoneleigh Road junction. A third access is provided onto Green Lane, with this access is for buses only.
- Trip Rates – the trip rates used to inform the model demands for each land use element of the site have been derived from the associated Lioncourt Strategic Land Ltd Kings Hill Park Transport Assessment.

Site E – University Masterplan

- Development Proposals – The development proposals at this location consist of expanding existing car parks at the university site. Three of the car parks being expanded lie within the Central Campus, while the fourth lies within the Medical Campus to the south.
- Access Proposals – access to the university sites remain unchanged.
- Trip Rates – The trip rates for the university were taken from the Warwick University Capital Plan model demands.

Site F – Stoneleigh Farmers Market

- Development Proposals – This development consists of the relocation of the Rugby Farmer Market to the south-east of the A46 Birmingham Road between Whitley and Kenilworth and to the north of Stoneleigh Road. The development proposals amount to a 7.6 hectare site.
- Access Proposals – The access proposed consists of a four-arm roundabout on Stoneleigh Road.
- Trip Rates – the trip rates used to inform the model demands for this site have been derived from the HS2 Stoneleigh Road Compound Junction Assessment.

Site G – Land off Red Lane, Burton Green

- Development Proposals – This residential development is located 8km south-west of Coventry city centre and is bounded to the west by Hobb Lane and to the north-east by Red Lane. The development proposals consist of delivering 90 dwellings
- Access Proposals – as the development lies outside of the model extent, the access proposals have not been explicitly included within the model coding
- Trip Rates – the trip rates used to inform the model demands for this site have been derived from the Land off Red Lane, Burton Green Transport Assessment.

Site H– Crackley Triangle

- Development Proposals – This residential development at the Crackley Triangle site is located to the west of the A46 and to the east of Coventry Road. The development proposals consist of delivering 93 dwellings.
- Access Proposals – as the development lies outside of the model extent, the access proposals have not been explicitly included within the model coding
- Trip Rates – the trip rates used to inform the model demands for this site have been derived from the associated Transport Assessment.

Site I – Gateway South

- Development Proposals – This development is a 181 hectare employment site, which lies to the south of the A45 and east of Stivichall Interchange.
- Access Proposals – as the development lies outside of the model extent, the access proposals have not been explicitly included within the model coding
- Trip Rates – the trip rates used to inform the model demands for this site have been cordoned out of the KSWA Model.

Site J – Whitley South

- Development Proposals – This employment site, Whitley South, lies south of the Coventry Airport and the Middlemarch Industrial Estate. The development proposals consist of expanding the Jaguar Land Rover research and development facilities which will adjoin their existing Whitley Site.
- Access Proposals – as the development lies outside of the model extent, the access proposals have not been explicitly included within the model coding
- Trip Rates – the trip rates used to inform the model demands for each land use element of the site have been derived from The Coventry & Warwickshire Development Partnership (CWDP) Gateway South Transport Assessment.

Site K – Land at Woodside

- Development Proposals – This residential development at the Land at Woodside site is located to the west of the A46 and east of Glasshouse Lane. The development proposals consist of delivering 700 dwellings.
- Access Proposals – as the development lies outside of the model extent, the access proposals have not been explicitly included within the model coding

- Trip Rates – the trip rates used to inform the model demands for each land use element of the site have been derived from the Land at Woodside Training Centre & Crewe Lane Kenilworth Transport Assessment.

Site L – Stoneleigh Business Park

- Development Proposals – The Stoneleigh Park employment site is located to the east of the A46, south of Stoneleigh. The development proposals consist of delivering 101 hectares of employment land.
- Access Proposals – as the development lies outside of the model extent, the access proposals have not been explicitly included within the model coding.
- Trip Rates – the trip rates used to inform the model demands for each land use element of the site have been derived from associated Transport Assessment.

3.8 Each of these committed developments listed have been included in the 2029 Reference models, along with associated access strategies and mitigation infrastructure.

Committed Development Trip Generation

3.9 The trip generation figures associated with each of the committed developments are detailed in the following tables.

Table 4 - AM Committed Development Trip Generation

Development	0700-0800		0800-0900		0900-1000	
	In	Out	In	Out	In	Out
A. Land at Cromwell Lane	18	66	35	91	32	43
B. Land at Westwood Heath Road	34	140	51	204	51	94
C. Eastern Green	681	844	875	1199	1257	832
D. Kings Hill Park	269	587	857	1207	497	580
E. University Masterplan	40	384	71	607	81	211
F. Stoneleigh Farmers Market	29	0	15	0	9	14
G. Burton Green	7	30	11	43	11	20
H. Crackley Triangle	8	28	17	38	17	23
I. Gateway South	326	180	482	134	296	136
J. Whitley South	508	208	683	248	544	171
K. Land at Woodside	51	206	92	271	104	113
L. Stoneleigh Business Park	33	7	93	16	41	14

Table 5 PM Committed Development Trip Generation

Development	1600-1700		1700-1800		1800-1900	
	In	Out	In	Out	In	Out
A. Land at Cromwell Lane	68	43	80	46	52	37
B. Land at Westwood Heath Road	149	51	204	51	153	51
C. Eastern Green	818	1203	855	957	632	969
D. Kings Hill Park	787	623	874	576	608	501
E. University Masterplan	460	37	465	37	180	114
F. Stoneleigh Farmers Market	2	1	15	6	6	9
G. Burton Green	32	11	43	11	32	11
H. Crackley Triangle	32	19	35	24	28	22
I. Gateway South	204	514	194	468	382	340
J. Whitley South	141	496	186	597	146	406
K. Land at Woodside	181	113	230	112	199	118
L. Stoneleigh Business Park	18	53	17	83	11	24

3.10 The cumulative hourly trip generation for the 2029 Reference Case model based on the above committed development trips is summarised in **Table 6**.

Table 6 2029 Net Trip Generation

Hour	Total Trips	Periodic
0700-0800	4684	17215
0800-0900	7340	
0900-1000	5191	
1600-1700	6056	17253
1700-1800	6166	
1800-1900	5031	

Committed Development Trip Distribution

3.11 The committed development sites have been coded into the model in the form of new zones, or trips added to existing zones where applicable.

3.12 The distribution applied to the committed developments was based upon the WCC Mobile Network Database (MND) tool distributions. A specific MND distribution has been developed for each site.

Committed Development Release Profiles

3.13 As the microsimulation model covers the three-hour peak periods for both AM and PM it is necessary to control how traffic is released within those periods. Most often this is done in either 5 or 15 minute intervals with the hourly trip generation totals being used to control

how much traffic is assigned in each hour. In this instance, the release of committed development trips has been controlled via the same profiles assigned to the equivalent zones in the base model. Where new zones have been created, the profiles, which control the assignment of trips onto the same links as the new zones, (i.e. appropriate adjacent zones or zones which represent land uses similar to those represented by the new committed developments), have been selected.

Committed Development Matrix Level

3.14 The trip generation and distributions described above have been used to develop two new demand matrix levels for each modelled hour. These are listed below:

- Matrix Level 3 – Internal Committed Development (committed development sites which lie within the model extent)
- Matrix Level 4 – External Committed Development (committed development sites which lie outside of the model extent)

3.15 These new matrix levels reflects the committed development trip levels and Origin-Destination (O-D) patterns for internal and external developments.

3.16 These matrices have been included in the 2029 Reference Case model and assigned new vehicle types “Internal Com Dev” and “External Com Dev” which are car vehicle types with the same familiarity and perturbation settings as all cars assigned to matrix level 1 in the Base model.

Committed Development Growth Review

3.17 Upon inclusion of the committed development trips within the model it was appropriate to review the resultant internal traffic growth. For the purposes of this review, both the internal and external committed development trips were assumed to make up ‘internal growth’ within the model, on the basis that all demands for these matrix levels had a trip origin or destination within the model extent.

3.18 The 2029 Reference Case model demands and resultant impact on internal growth within the model are set out in **Table 7**.

Table 7 Internal Growth Review

	0700-0800	0800-0900	0900-1000	1600-1700	1700-1800	1800-1900
Background Demands (INT)	13332	19545	11617	17239	17781	14121
Internal Com Dev (Matrix 3)	3090	5207	3697	4243	4166	3312
External Com Dev (Matrix 4)	1058	1421	1029	1152	1217	1093
Com Dev Growth (%)	**31.12%**	**33.92%**	**40.38%**	**31.15%**	**30.13%**	**31.02%**
Periodic Growth (%)	**35.14%**			**30.77%**		

3.19 The inclusion of the committed development trips alone within the model resulted in a level of internal growth by 2029 of 35% in the AM period and 31% in the PM period.

3.20 At this stage it was determined that no further adjustments would be made to the background and committed development demands. The level of growth predicted by the assignment of trips associated with the committed developments exceeds that which is predicted through TEMPRO and, as such, was considered appropriate and suitably robust for the purposes of this link road assessment.

External Growth

3.21 Once the relevant committed development trips had been included within the model, it was determined that the demands travelling through the model network should also be adjusted to reflect predicted growth in trips on the strategic road network. Accordingly, it was necessary to forecast the growth in all 'external' trips within the network.

3.22 This external growth adjustment involves factoring all external-to-external zone movements across the network by an external growth factor, derived from TEMPRO.

3.23 The growth factor applied for the external trips was taken from an average of the 'Warwick' and 'Coventry' output areas within TEMPRO. This was undertaken on the basis that the two output areas would capture the growth in trips from the wider district/authorities. This would account for trips travelling through the model network, from the wider Warwickshire area, and beyond.

3.24 On this basis the external growth factors to be applied are as follow:

- External Growth Factor – 2029 AM Period - 9.1%
- External Growth Factor – 2029 PM Period - 9.2%

3.25 This predicted external growth has then been assigned into the model via a discrete matrix level (matrix level 5), which was assigned a separate vehicle type, 'external growth' with the same familiarity and perturbation settings at the car vehicle type assigned to matrix level 1.

University of Warwick Trips

3.26 Following the inclusion of all committed development and external growth trips within the model network, it was established that further consideration around the inclusion of the University of Warwick trips within the model was required.

3.27 As part of the detailed testing being undertaken within this assessment focuses on restrictions to traffic through the university itself, it was determined that in order to control these restrictions, all university trips should be assigned their own matrix level and vehicle type. Accordingly, University of Warwick trips from all matrix levels (background demands, internal committed development and external committed development) were removed from the model and re-added via a new matrix level (matrix level 6).

3.28 This matrix level was assigned a new vehicle type 'University of Warwick' which was a car with the same familiarity and perturbation settings at the car vehicle type assigned to matrix level 1 in the Base model.

Summary of Demands

3.29 Following the steps undertaken to develop the model demands as outlined above, the demand matrices for the 2029 Reference Case, and the resultant levels of overall growth in trips within the model are shown in **Table 8**.

Table 8 2029 Model Demands

Matrix Level	0700-0800	0800-0900	0900-1000	1600-1700	1700-1800	1800-1900
Background	24343	28663	17647	27294	27782	21543
HGV	1051	1231	1391	827	808	681
Internal Com Dev	2651	4498	3386	3646	3555	2937
External Com Dev	1022	1371	992	1080	1140	1011
External Growth	1321	1174	772	1266	1268	918
UoW	4134	4685	2929	4619	4720	3216
Total	34522	41622	27117	38732	39273	30306
Total Growth (%)	**24.01%**			**22.01%**		

3.30 As detailed within **Table 8**, following the inclusion of the committed development demands, plus the external growth, the overall level of growth within the model is around 24% in the AM period and 22% in the PM period.

Committed Highway Infrastructure

3.31 Following the inclusion of the demands outlined within **Table 8**, a review of the model operation was undertaken. It was observed that significant congestion issues were occurring, across both the AM and PM period. At this point, three committed schemes within the study area were included within the model network. These schemes are detailed below:

A46/Stoneleigh Junction

3.32 The A46/Stoneleigh Road junction is a committed scheme, which consists of a new grade separated roundabout as detailed within the following figure. The circulatory consists of two lanes, with two lane approaches on all arms, including signalisation of the A46 off-slips. The Stoneleigh Road eastbound approach includes a left turn filter to the A46 northbound.

3.33 Alignment changes with the existing roundabout at the Dalehouse Lane junction have also been made. The layout of the scheme is illustrated within **Figure 6.**

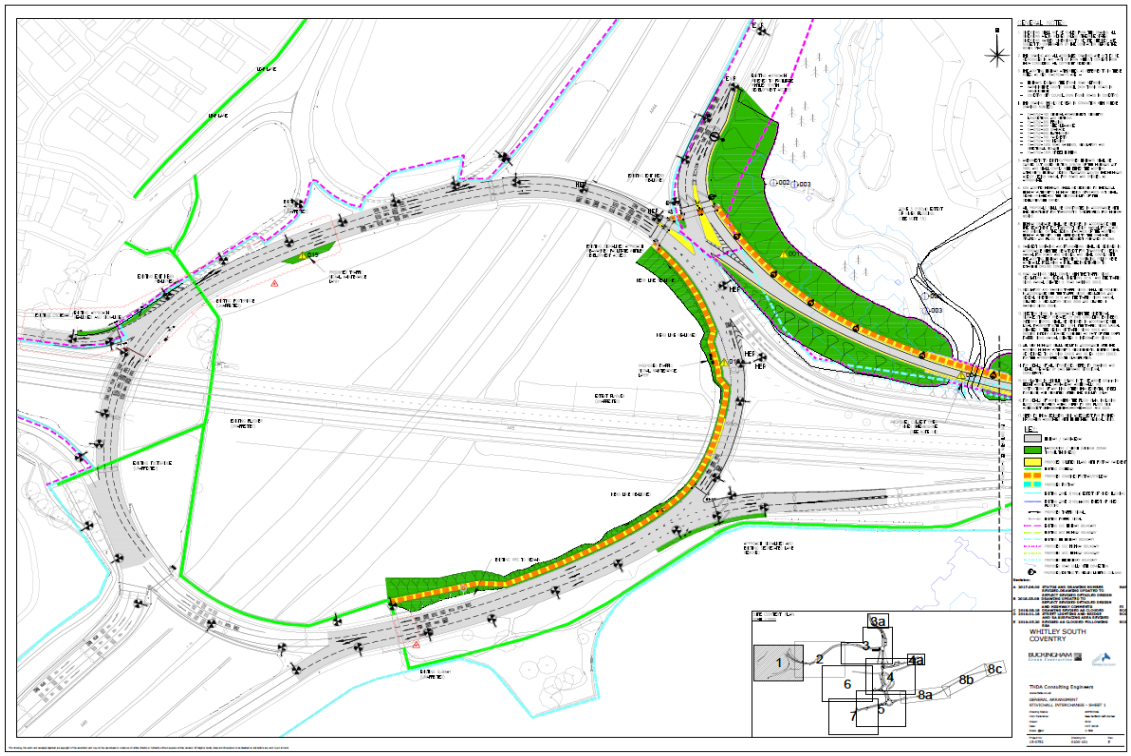
Figure 6 A46/Stoneleigh Road Junction Scheme

Stivichall Interchange

3.34 Committed improvements exist at the Stivichall Interchange, at the junction of the A45/A46/A444, in the form of widening of some of the circulatory and entry arms, along with signalisation of the A46/A444/A45 off-slip arms.

3.35 The layout of the scheme is illustrated within **Figure 7**.

Figure 7 Stivichall Interchange Scheme



Cromwell Lane/Westwood Heath Road

3.36 The scheme included at this location is associated with the delivery of the committed residential site off Cromwell Lane. The scheme itself consists of widening the Westwood Heath Road approach the junction to two lanes (see **Figure 8**).

Figure 8 Cromwell Lane/Westwood Heath Road Scheme

Model Stability

3.37 Upon inclusion of the above schemes in the 2029 Reference Case model, the model stability was assessed. In order to assess the stability and success rate, 20 AM and 20 PM runs have been collected. The outputs of the batch runs are summarised in the following **Table 9**.

3.38 The statistics focus on the number of vehicles present on the network at a certain point in time and are based on successful runs only.

3.39 A successful run has been deemed as such if the number of vehicles on the network is shown to increase from the start of the period, reach a peak level, and then fall as the period nears its end.

3.40 This has been supported by visual observations of the models to ensure that in cases where this pattern is not present, that it is indeed a result of an unrealistic locking up of the network.

Table 9 2029 Reference Model Stability

	2029 Reference Model	
	AM	**PM**
Runs	20	20
Successful Runs	18	20
Success Rate	90%	100%
Peak (veh): Max	8682	7305
Peak (veh) : Ave Max	8454	7144
Peak Range	08:53-09:00	17:23-17:45
End of Period (veh): Max	6426	6160
End of Period (veh):Ave	5531	5599

3.41 The model performance statistics for the 2029 Reference Case model indicate a high level of stability in both the AM and PM periods, albeit with 2 out of the 20 runs in the AM period being considered 'failed'. It is clear that the delivery of the mitigation schemes outlined have contributed to a network with a predictable pattern of congestion, without the model resulting in 'locking up' on a consistent basis.

3.42 Despite this, a visual review of the model performance has highlighted that significant congestion issues occur during both the AM and PM period within the model. The profile of traffic on the network, throughout all the AM and PM modelled periods is presented within the following **Figures 9-10**. It is apparent, when analysing these figures, that the congestion levels are predictable across the AM and PM period within the 2029 model.

Figure 9 Vehicles on the Network – 2029 Reference Case (AM Period)

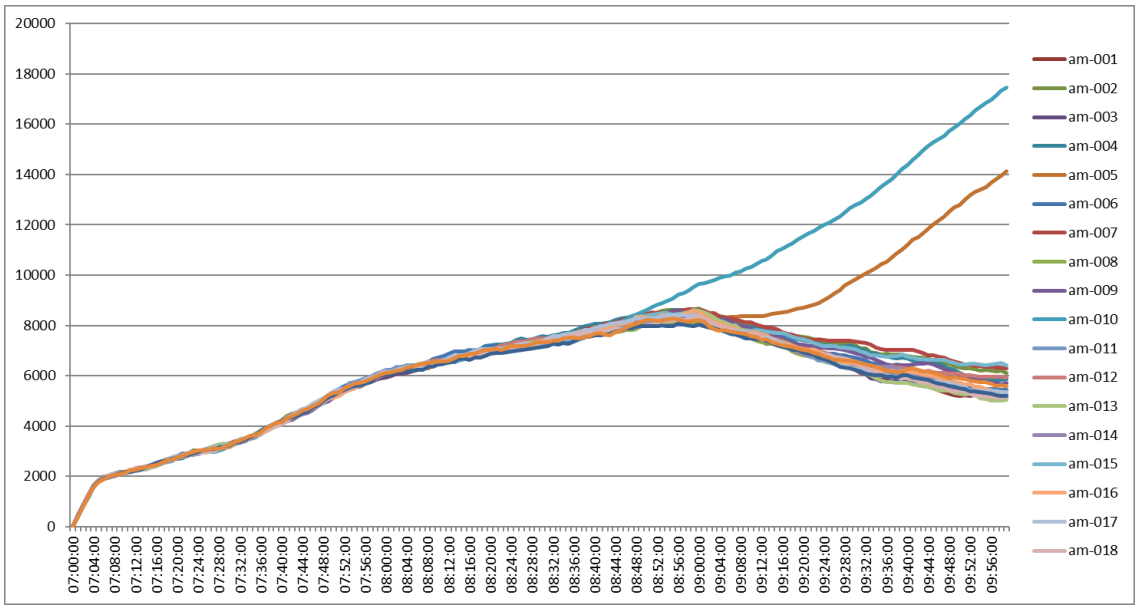
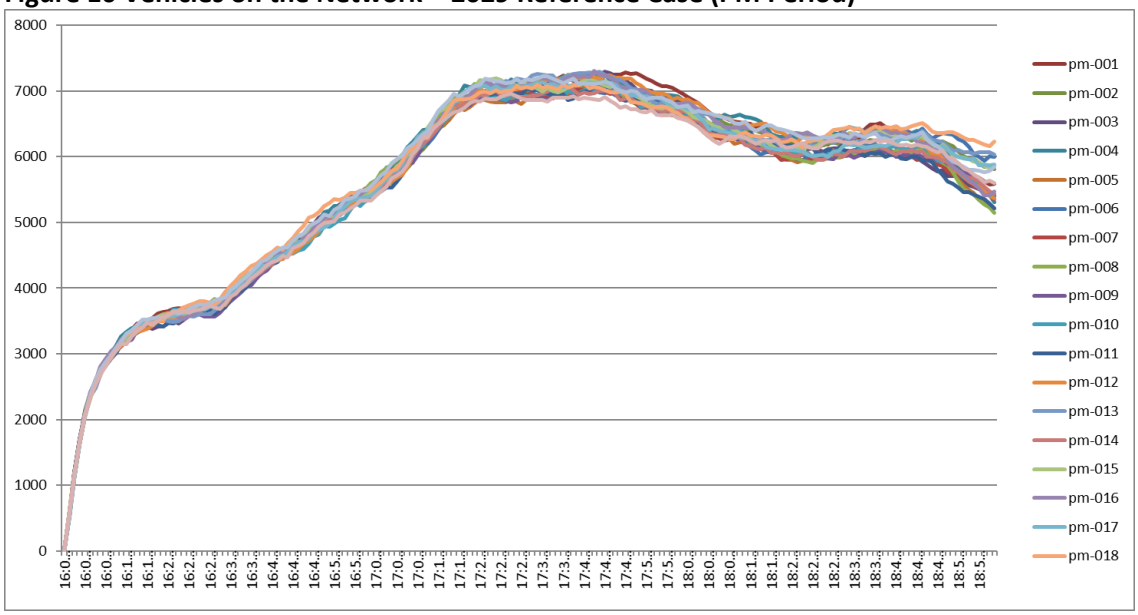


Figure 10 Vehicles on the Network – 2029 Reference Case (PM Period)



Forecasting Summary

3.43 The 2029 Reference Case model created through this exercise has been forecast via the inclusion of all known committed developments, along with the interrogation of the TEMPRO database (for external growth only).

3.44 Upon review of the model operation it was clear that the schemes around the Stivichall Interchange and A46/Stoneleigh Road junction were necessary in order to reduce the significant levels of queueing that were being observed.

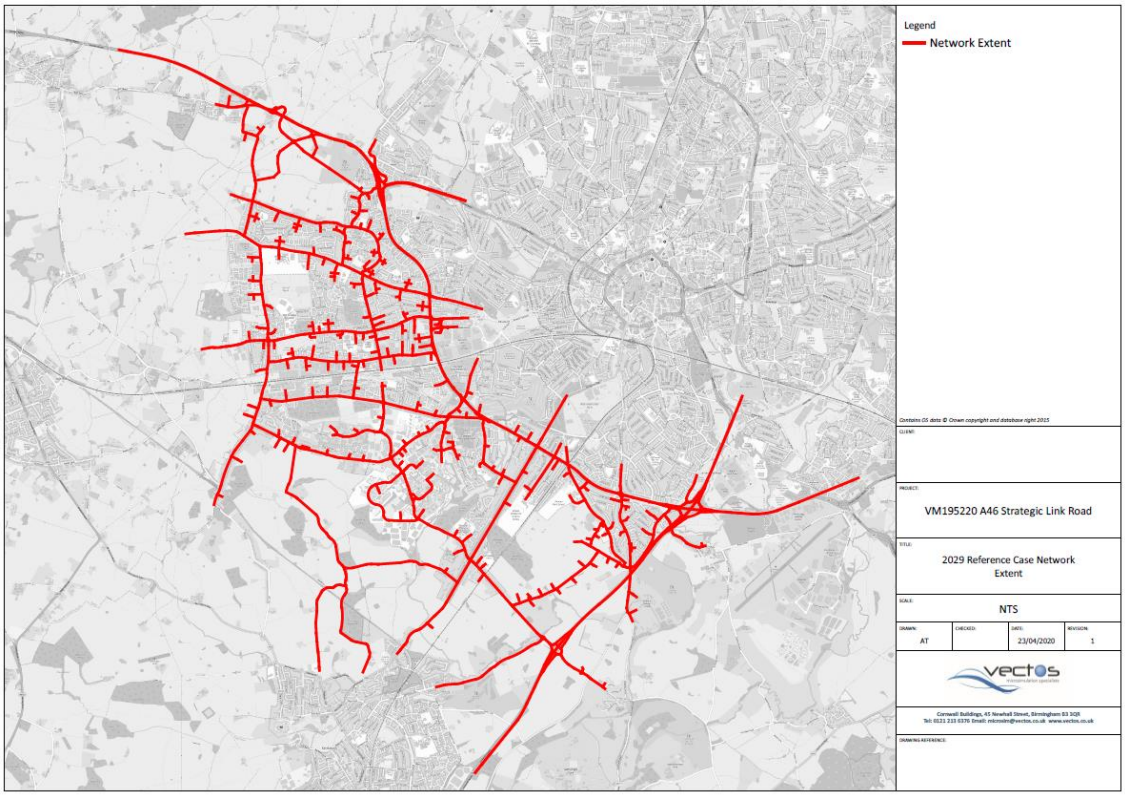
3.45 The delivery of these committed schemes resulted in a network with a predictable pattern of congestion, without the model resulting in 'locking up'. Despite this, significant queues are observed within the models, particularly along the A45. Although the queues are extensive, they do not cause the model to grid lock and so it is considered appropriate to utilise this modelling to inform the assessment of the link road proposals. Additionally, concerns regarding the prevalence of congestion being affected by the limited scope of the model (i.e. that traffic cannot reassign away from the study area) will in part be addressed via the interrogation of reassignment effects derived from the CASM cordon demands.

4 ASSESSMENT

Methodology

4.1 The focus of this assessment is to assess scenarios containing variations around the delivery of the A46 strategic link road. The assessment has been completed using the 2019 A46 SLR Base model, built in Paramics Discovery. The extent of this model is illustrated in **Figure 11.**

Figure 11 A46 SLR Base Model Extent



Paramics Microsimulation

4.2 Paramics is a micro-simulation traffic model that simulates the behaviour of each individual vehicle and presents its output as a real time visual display for traffic management and road network design.

4.3 Paramics allows a detailed representation of the highway network in the form of modelling a high level of detail, such as individual lanes, traffic signals, junctions, pedestrian crossings and bus stops as well as the events which occur on it. Each individual vehicle is separately represented and therefore the program can take an account of each individual driver's behaviour.

4.4 The output is a visual display which shows the changing position of individual vehicles and queues on the highway network in real time. The advantage of a visual display enables non-technical stakeholders to view the results of highway and development proposals in terms of traffic flows and congestion.

4.5 There are a number of advantages of using Paramics to inform the assessment as it allows a visual interrogation of the network to be completed alongside the empirical analysis. This, in turn, enables the identification of potential schemes to be completed within the same assessment and, unlike other approaches, does not require supplementary analysis to be completed using isolated junction modelling tools to support the overall analysis.

4.6 The A46 SLR Paramics model also operates under conditions of dynamic assignment which means that the reassignment of vehicles in response to congestion as a result of traffic growth or, alternatively, in response to the alleviation of congestion through schemes, can be considered within the assessment work.

4.7 As mentioned previously, the Paramics provides a more detailed representation of the immediate study area and also encompasses the full 3 hour AM and PM peak periods this allows a more refined assessment of the localised impacts to be completed. However, the Paramics model covers a significantly smaller study area than the CASM model, and as such, it is necessary to make use of the CASM model, to estimate the strategic reassignment effects of delivering the link road within the Paramics modelling.

Stage of Assessment

4.8 In order to address the study objectives, this testing has been to split into three stages which are described below:

Stage 1 – Strategic Link Road Options

4.9 The first stage considers the impact of delivering the link road in phases along with the analysis of variations in the delivery of the full link. This stage of the assessment seeks to identify the relative benefits of the phases of the link road building out from the A46. Initially by considering just the connection to the A429 before considering different strategies to connect in to the University of Warwick as well as to Westwood Heath Road.

Stage 2 – Localised Impact Assessment

4.10 The second stage of assessment builds on Stage 1, by undertaking a detailed review of the wider effects of the link road in terms of impact on queues and traffic flows on other parts of the network. This stage then identifies any additional mitigation required, in order to reduce any impacts arising as a result of delivering the link.

Stage 3 – Sensitivity Testing

4.11 The final stage considers the impact of any traffic redistribution (as informed by the CASM). In addition to considering the redistribution effects, this stage also reviews the impact of additional development trips on the network, which may be unlocked by the delivery of the link road.

5 STAGE 1 ANALYSIS - STRATEGIC LINK ROAD OPTIONS

5.1 As set out within the previous section of this report, the results analysis is broken down into three stages. The following section details the outputs from the Stage 1 testing.

Strategic Options

5.2 The first stage of assessment focuses on the various options around the link road delivery, both of delivering the link road in part and in full. The various options tested at this stage are set out within **Table 10** below, and detailed in the following.

Table 10 Scenario List

Scenario	A46 Link to A429 only	A46 Full Link	Stoneleigh Rd Closure	UoW Cost Factor 1.5	Uow Closure	UoW Cost Factor 1.2	Business Park Link
2029 Do Min	X						
2029 Do Min V1	X		X				
2029 Do Min V2	X		X				
2029 Do Something		X	X				
2029 Do Something V1		X	X	X			
2029 Do Something V2		X	X		X		
2029 Do Something V3		X	X			X	
2029 Do Something V4		X	X			X	X

A46 Link Road Coding

5.3 The A46 Link has been included in some form in all of the scenarios tested. The link road itself has been coded as 50mph along its entire length, with the section between the A46 and A429 included as a dual carriageway, whilst the section between the A429 and Westwood Heath Road is included as single carriageway.

5.4 In all instances junctions on the link road have been coded as indicative schemes, with sufficient capacity provided as not to cause unnecessary levels of congestion with the model.

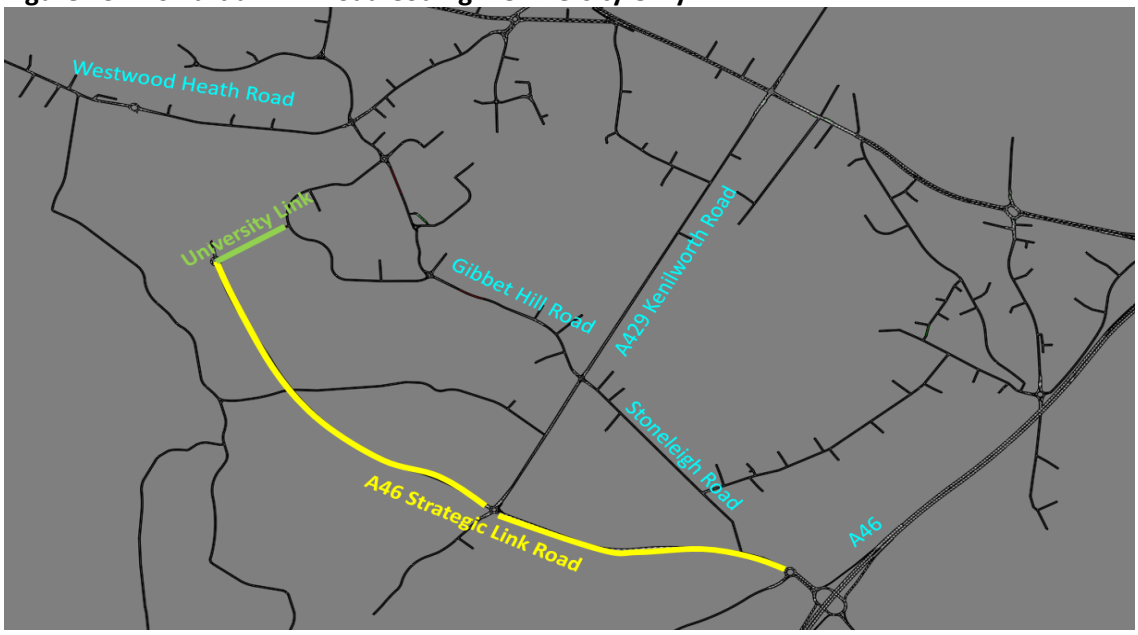
5.5 As part of the link road coding, the junction of the link road/Stoneleigh Road has been included as a left in/left out junction.

5.6 The Do Minimum and Do Minimum V1 scenarios consist of the partial delivery of the link, between the A46 and Kenilworth Road, as demonstrated within **Figure 12**.

Figure 12 A46 Partial Link Road Coding

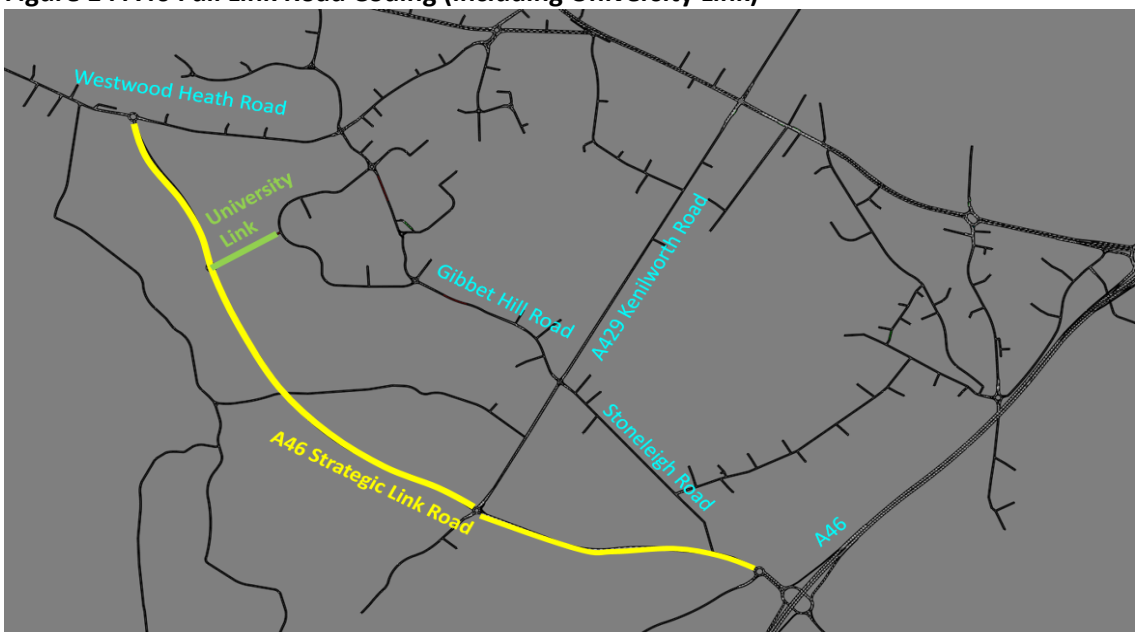
5.7 The Do Minimum V2 scenario consists of the link road as above, plus a connection from the A429 into the University at Scarman Lane. The layout of this scenario is demonstrated within **Figure 13**.

Figure 13 A46 Partial Link Road Coding + University Only Link



5.8 The Do Something scenarios all consist of the full delivery of the link, whereby the link continues from the A429 to Westwood Heath Road. The Do Something scenarios also consist of a connection into the University, between the A46 Link Road and Scarman Lane. The layout of these scenarios are demonstrated within **Figure 14**.

Figure 14 A46 Full Link Road Coding (including University Link)

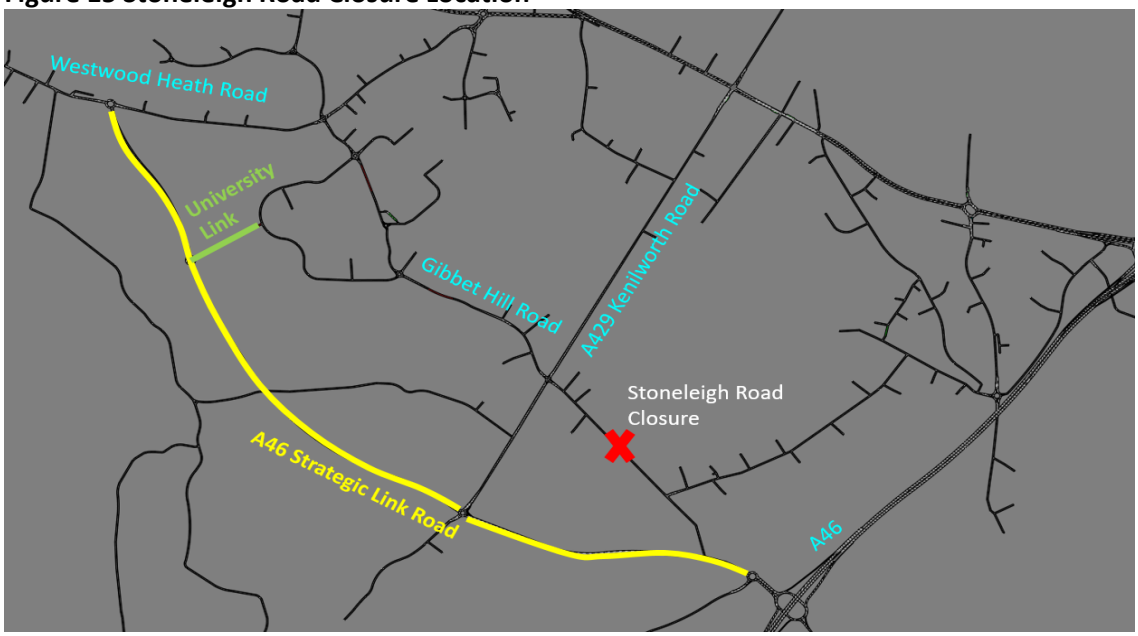


Stoneleigh Road Closure

5.9 In the majority of scenarios (see **Table 10**), a closure has been applied to Stoneleigh Road, alongside the delivery of the link road. The location of the closure is demonstrated in **Figure 15**. The closure has been applied just to the north of Kings Hill Lane to ensure to the residential areas to the north of this is still possible from the A429.

5.10 Given the presence of the link road now running in parallel to Stoneleigh Road between the A46 and A429, the opportunity is afforded to close Stoneleigh Road to through trips, by enforcing a link closure between the A429 and Kings Hill site access.

Figure 15 Stoneleigh Road Closure Location



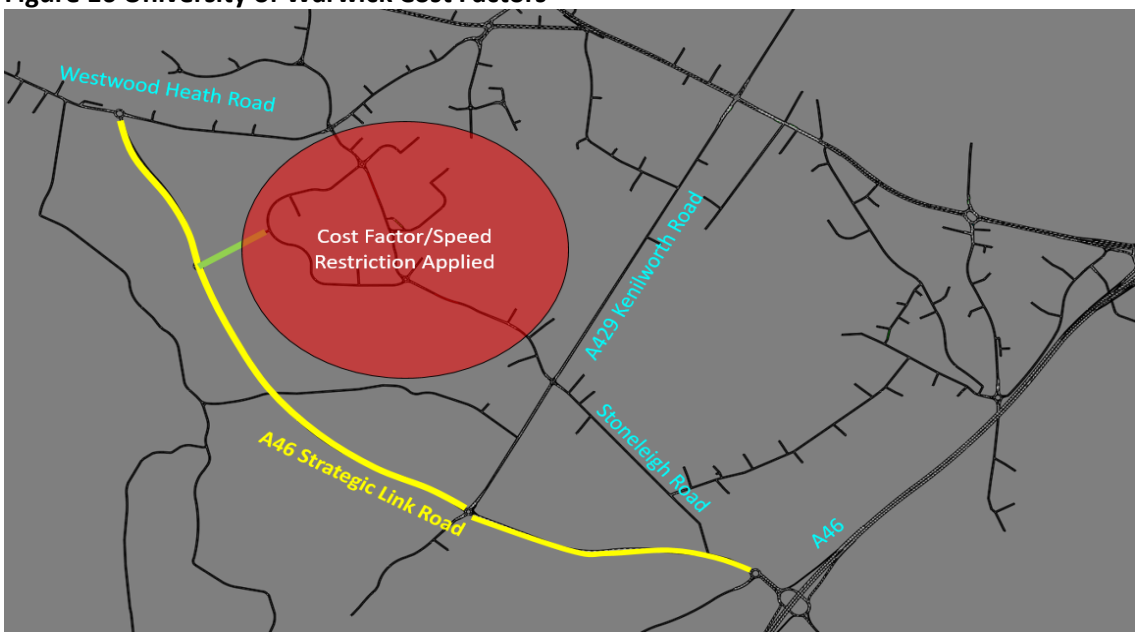
University of Warwick Cost Factors

5.11 Within the 2029 Do Something V1, V3 and V4 scenarios further measures have been included, alongside the link road, in the form of the application of cost factors and speed restrictions on links within the University of Warwick. This test represents the introduction of measures to further discourage the use of Gibbett Hill and roads within the university. These measures are only possible if an alternative route is provided for these trips (i.e. the link between Westwood Heath Road and the A429).

5.12 The cost factors are intended to represent traffic calming measures (speed bumps, give way to oncoming traffic etc).

5.13 The area highlighted by **Figure 16** demonstrate the links on which costs factors and speed restrictions have been applied. In the Do Something V1 scenario, more severe restrictions in the form of a 1.5 cost factor and 15 mph speed limit have been applied on these links, whilst in the Do Something V3 and V4 scenarios, a 1.2 cost factor and 20mph speed limit has been applied. Two scenarios have been designed to allow an understanding of the sensitivities of traffic behaviours to these measures and thus establish how critical achieving certain conditions in this area (i.e. through speed reductions and other measures) is to achieving the desired reassignment effects.

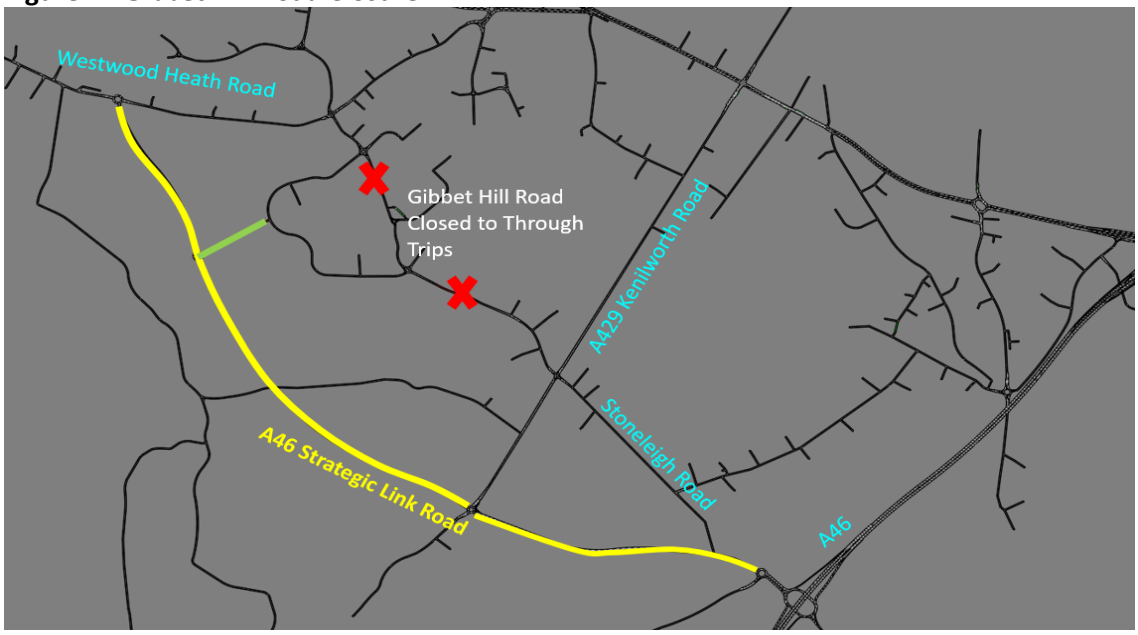
Figure 16 University of Warwick Cost Factors



Gibbet Hill Road (University) Road Closure

5.14 Further to the general deterrence test, a test has been undertaken related to traffic restrictions within the University. This involves the closure of Gibbet Hill Road to all non-university trips and was applied in the Do Something V2 scenario. **Figure 17** demonstrates the indicative locations at which the closure to through trips has been enforced. As a result of this closure, only trips with an origin or destination within the University, and bus services, are permitted to route through the University campus.

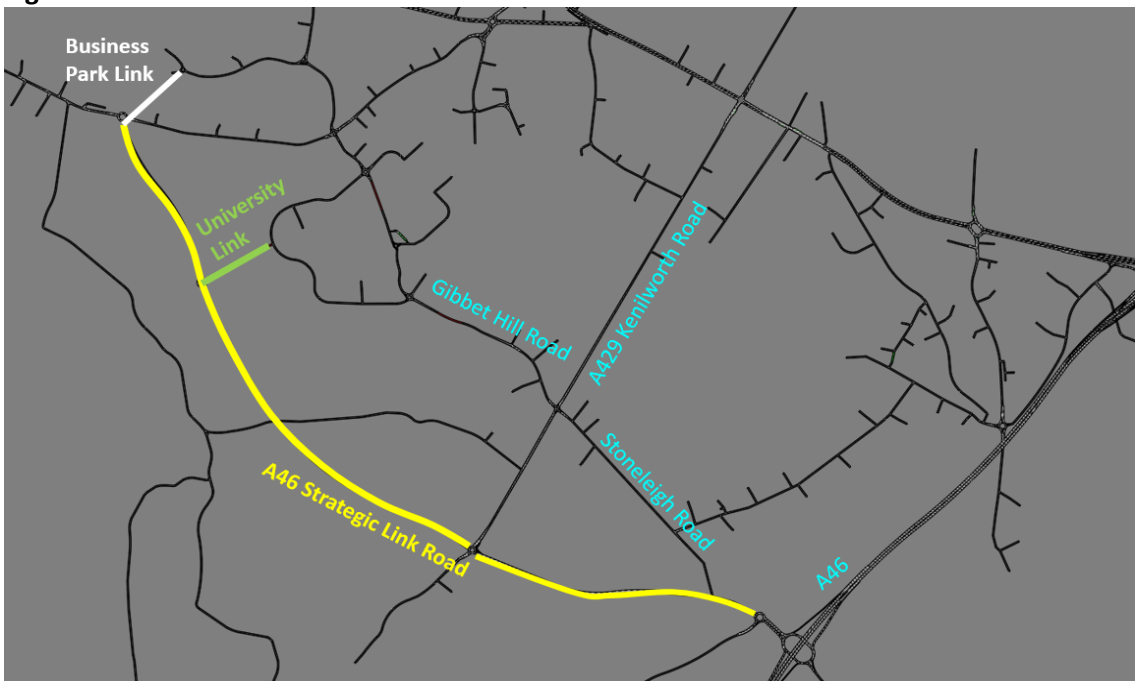
Figure 17 Gibbet Hill Road Closure



Westwood Heath Business Park Link

5.15 The final test undertaken at this stage, Do Something V4, includes a link from the northern end of the link connecting through to the Westwood Heath Business Park. At this stage, the inclusion of the link through to the business park has been included as an indicative scheme, given the uncertainty around this part of the link. The link was included as per **Figure 18**, which enabled an assessment of the performance of this scheme.

Figure 18 Business Park Link



Do Minimum Scenario Assessment

Strategic Impact

5.16 As per the scenarios outlined in **Table 10**, three Do Minimum scenarios have been run, each of which contain only part of the link road. In order to assess the performance of each of the Do Minimum scenarios, an initial high level review of the network wide statistics been undertaken.

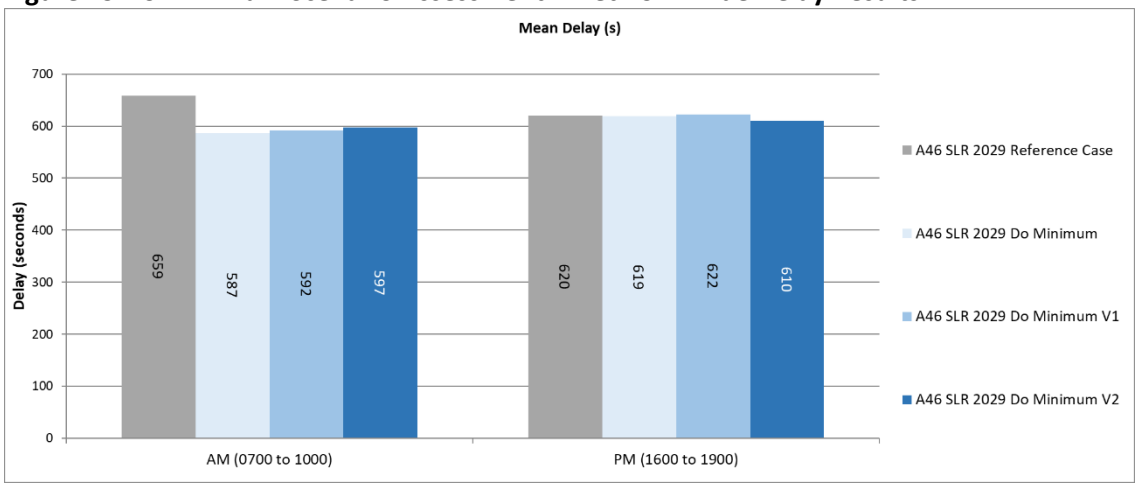
5.17 The following comparative statistics have been extracted from each Do Minimum scenario, and compared with 2029 Reference Case conditions:

- **Average Delay (seconds)** – The average journey time of a completed trip during the model simulation period

- **Completed Trips (vehicles)** – The number of completed trips recorded during the model simulation.

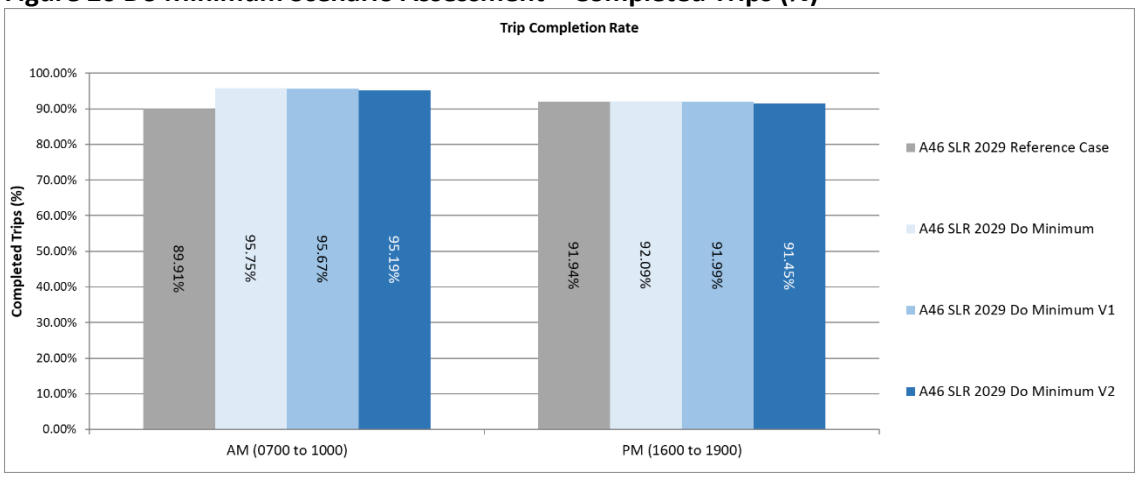
5.18 A summary of the network wide statistics for the Do Minimum scenarios is presented within the following.

Figure 19 Do Minimum Scenario Assessment – Network Wide Delay Results



5.19 **Figure 19** illustrates the impact on network wide delay in each of the Do Minimum scenarios tested, compared with the 2029 Reference Case. The results indicate that the inclusion of the partial link improves average journey times during the AM period, however, the PM period results suggest that the inclusion of the partial link does not deliver any changes to the network wide performance of the model.

Figure 20 Do Minimum Scenario Assessment – Completed Trips (%)



5.20 Further to the network wide delay analysis, the completed trips analysis for the Do Minimum scenarios is presented within **Figure 20**. In a similar pattern, the Do Minimum scenarios

demonstrate a betterment to the network performance during the AM period, on the basis that more trips are able to complete, i.e. there is less congestion preventing trips from completing.

5.21 The results for the PM period however demonstrate that there is no change in the level of completed trips, further indicating that the inclusion of the partial link road is not having an impact on the network wide performance.

5.22 Notably, there is also little difference in the performance of the Do Minimum V2 scenario, which contains the link through to the university, and the remaining Do Minimum scenarios.

5.23 Strategically, therefore, the benefits to the network are limited within the PM. Most likely this is because the partial link serves to improve access for trips heading from the A46 to the University of Warwick and on to the Businesses in Westwood Heath but in the PM the reverse trips do not see the same level of benefit as they are constrained by the need to travel along Westwood Heath road and, in particular, the congestion along Gibbet Hill Lane towards the A46.

A45 Journey Time Impacts

5.24 One of the potential strategic advantages of delivering the link road is the potential to relieve congestion on the A45. Accordingly, additional analysis has been undertaken which reviews the impact on journey times along the A45 in each Do Minimum scenario and compared with the 2029 Reference Case journey times.

5.25 The section of A45 analysed is shown in **Figure 21**, with the resultant AM and PM peak hour journey times modelled demonstrated within **Figure 22** and **Figure 23**.

Figure 21 Section of A45 Analysed

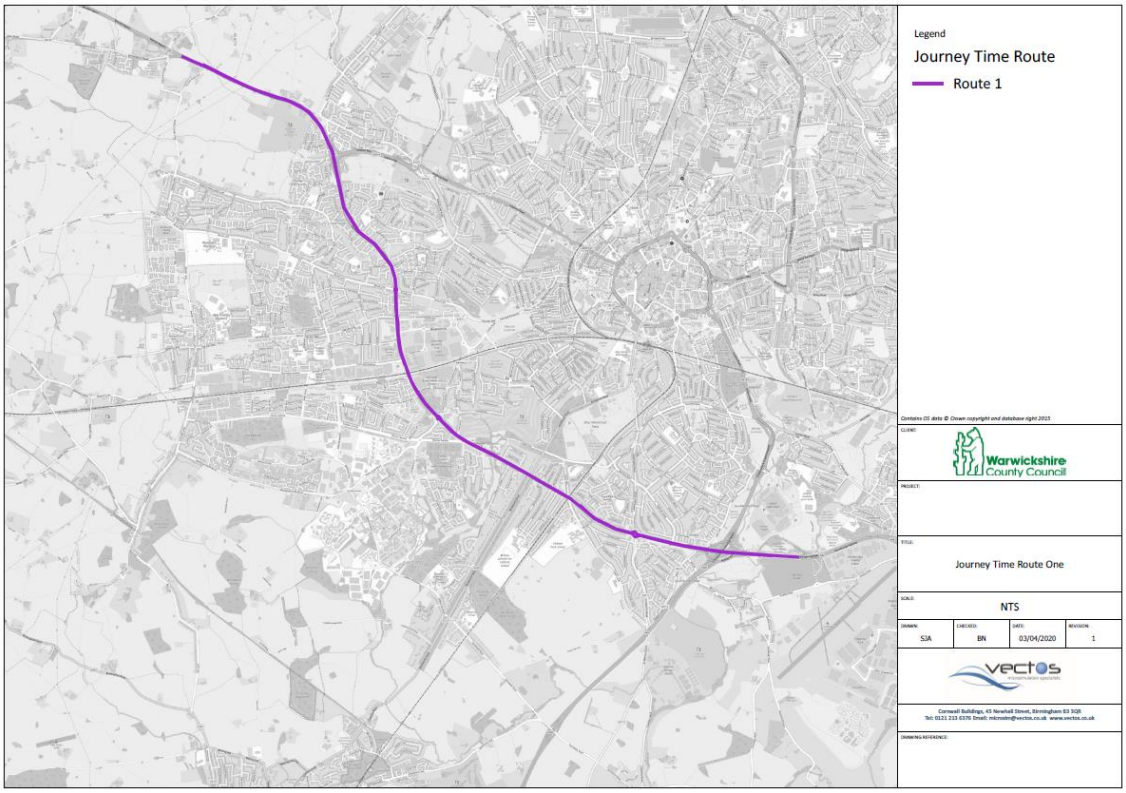
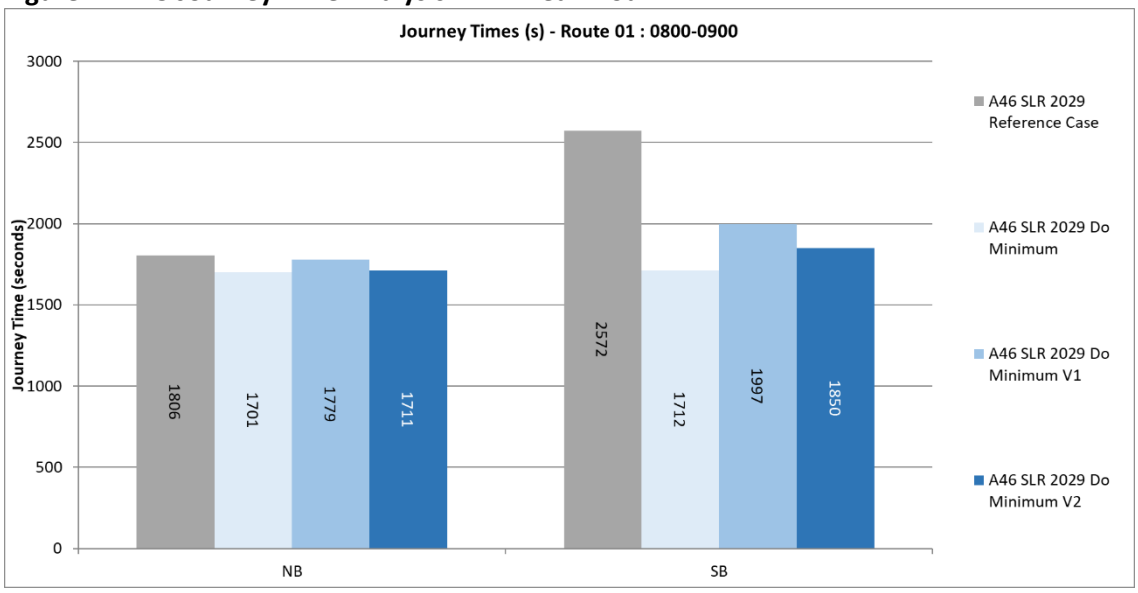


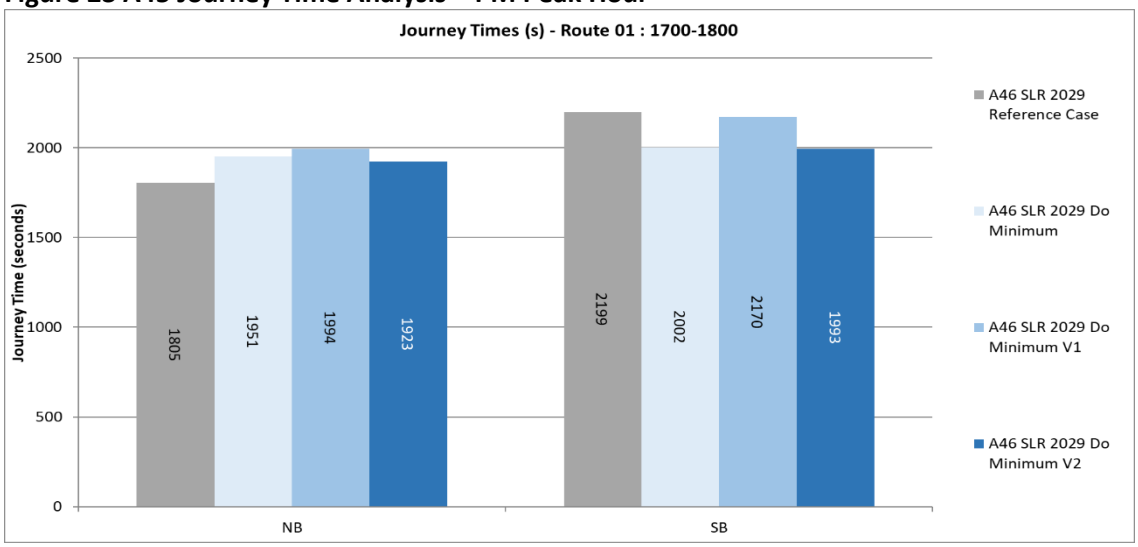
Figure 22 A45 Journey Time Analysis – AM Peak Hour



5.26 **Figure 22** presents the impact on journey times on the A45 in the AM peak hour, in each of the Do Minimum scenarios. The results demonstrate that the introduction of the partial link between the A46 and A429 has the potential to reduce southbound journey times during the AM peak.

5.27 The results also suggest that the introduction of the link has no notable benefit for northbound journey times along the route.

Figure 23 A45 Journey Time Analysis – PM Peak Hour



5.28 **Figure 23** presents the impact on journey times on the A45 in the PM peak hour in each of the Do Minimum scenarios. The results demonstrate that the introduction of the partial link does not deliver any journey time savings on the A45 during this period. A visual review of the modelling to support this analysis reveals that the lack of the second half of the link leads to additional pressure of the A45/Kenilworth Road junction (see **Figure 24**), resulting in the need to allow more green time for the movement out of Kenilworth Road, and thus reducing the flow of traffic on the A45.

Figure 24 A45/Kenilworth Road Queue Extent

Do Minimum Scenario Summary

5.29 The results presented for the Do Minimum scenario demonstrate that although the delivery of the partial link road has the potential to improve network conditions during the AM period, the PM period show little change in terms of modelled outputs.

5.30 The Do Minimum V2 test, which includes the link from the A429 to the University, also delivers no betterment over the remaining Do Minimum scenarios.

5.31 These modelling outputs indicate that delivering only southern part of the link road (i.e. not providing a connection between the A429 and Westwood Heath Road) is unlikely to result in any notable benefit at a strategic level. The impact on the A45 has also been presented within this section, which again demonstrates the potential for some benefits being delivered during the AM period, but the PM period shows little improvement with the partial delivery of the link road.

Do Something Scenario Assessment

Strategic Impact

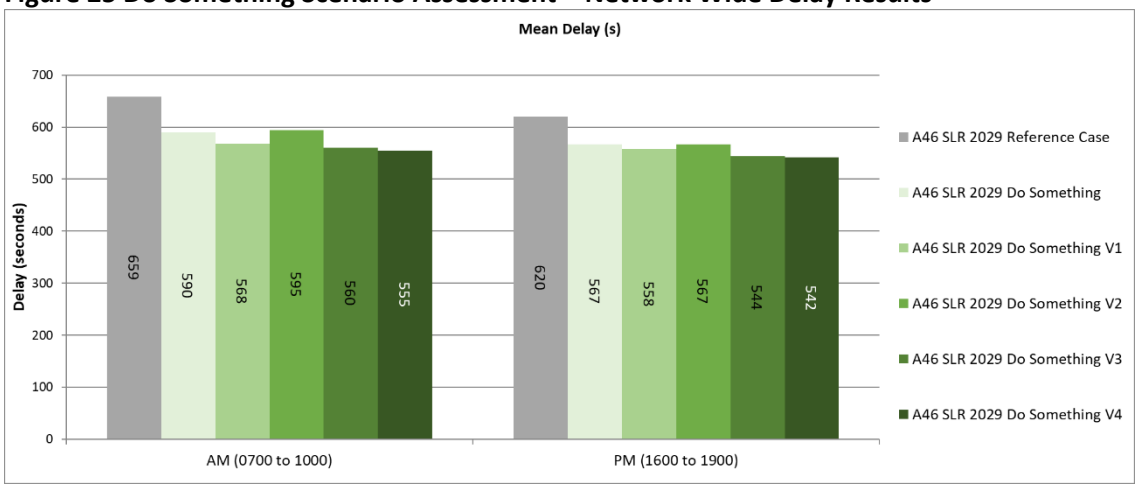
5.32 Following on from the Do Minimum scenario assessment, a number of Do Something scenarios have been assessed, each of which deliver the full link between the A46 and Westwood Heath Road.

5.33 The variations in coding applied to each Do Something scenario are summarised below:

- **Do Something** – delivery of the full link (between A46 and Westwood Heath Road) plus Stoneleigh Road closure
- **Do Something V1** - delivery of the full link + Stoneleigh Road closure + University of Warwick Cost Factors (1.5/15mph)
- **Do Something V2** - delivery of the full link + Stoneleigh Road closure + Restrictions to through traffic on Gibbet Hill Road
- **Do Something V3** - delivery of the full link + Stoneleigh Road closure + University of Warwick Cost Factors (1.2/20mph)
- **Do Something V4** - delivery of the full link + Stoneleigh Road closure + University of Warwick Cost Factors (1.2/20mph) + connection to Westwood Heath Business Parl

5.34 The network wide statistics have initially been reviewed for each scenario, as presented within the following figures.

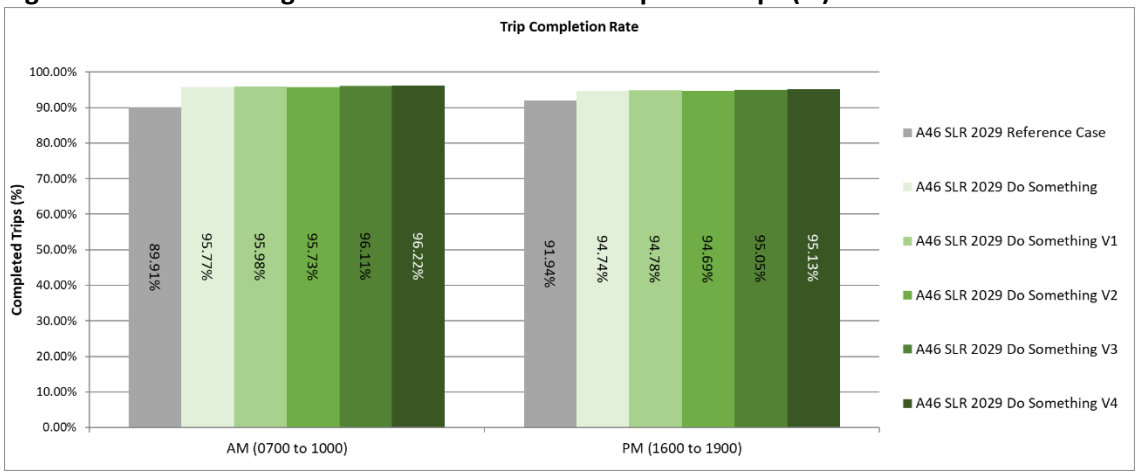
Figure 25 Do Something Scenario Assessment – Network Wide Delay Results



5.35 The network wide delay statistics presented within **Figure 25** demonstrate substantial reductions in journey times across the network, during the AM and PM periods, in each of the Do Something scenarios assessed. The AM reductions are at or below the levels observed within the Do Minimum testing whilst, in the PM, the reductions are significantly greater than those observed within the Do Minimum testing.

5.36 The results suggest marginal differences between each of the Do Something scenarios, with the V4 scenario (inclusive of the Westwood Heath Business Park and cost factors at the University) the best performing option in terms of the strategic level impact on journey times.

Figure 26 Do Something Scenario Assessment – Completed Trips (%)



5.37 In line with the network wide delay results, the completed trips analysis also suggests significant improvements in the model performance across each scenario in both the AM and PM periods.

5.38 The AM period results suggest that in each of the Do Something scenarios around 6% more trips are able to complete compared with the 2029 Reference Case scenario, whilst this figure is around 3% in the PM period. These means that, in addition to the reduced travel times within both model periods of around 100 and 80 seconds respectively there are also 6000 (AM) and 3000 (PM) more trips which are completed within the same period. Thus travel times reduce across the network to an extent that significantly more trips can get through the network within the same 3 hour period.

5.39 These results indicate that the introduction of the full link is serving a clear strategic benefit, in terms of simply reducing congestion on the network and thereby enabling a higher number of vehicles to reach their destination during the modelled period.

Link Road Flows

5.40 Further to the analysis of the network wide model performance, modelled flows across the AM and PM period on the link road itself have also been considered for each Do Something scenario. Flows have been considered on the southern section of the link (between the A46 and A429) and the northern section of the link (between the A429 and Westwood Heath Road), at the locations demonstrated by **Figure 27**.

Figure 27 Strategic Link Road - Link Flow Analysis Locations

Figure 28 A46 Link Flows (Southern Section) – AM Period

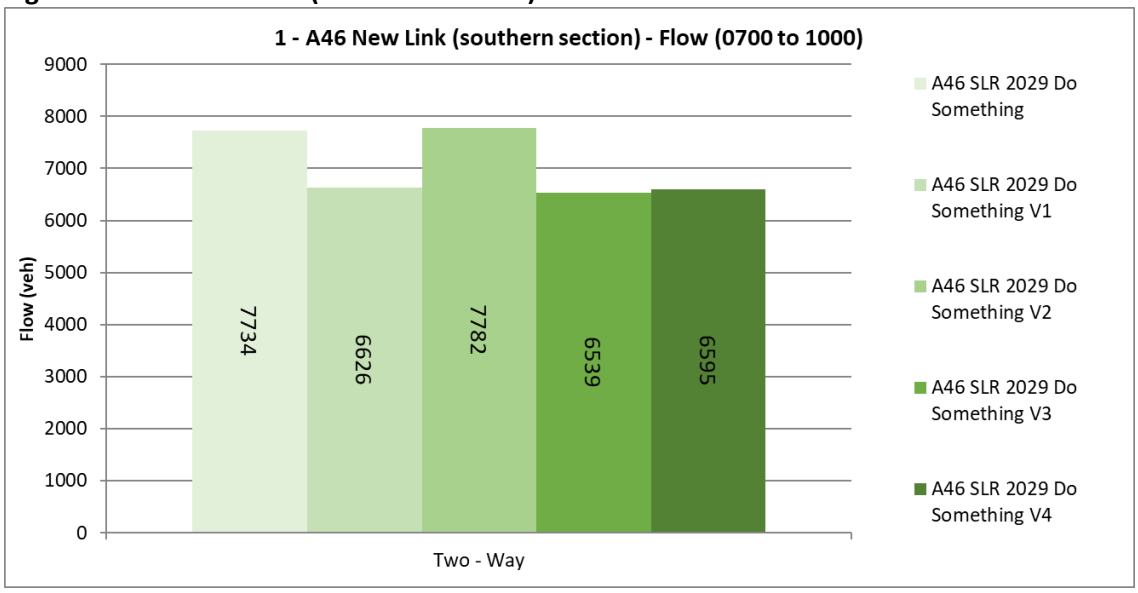
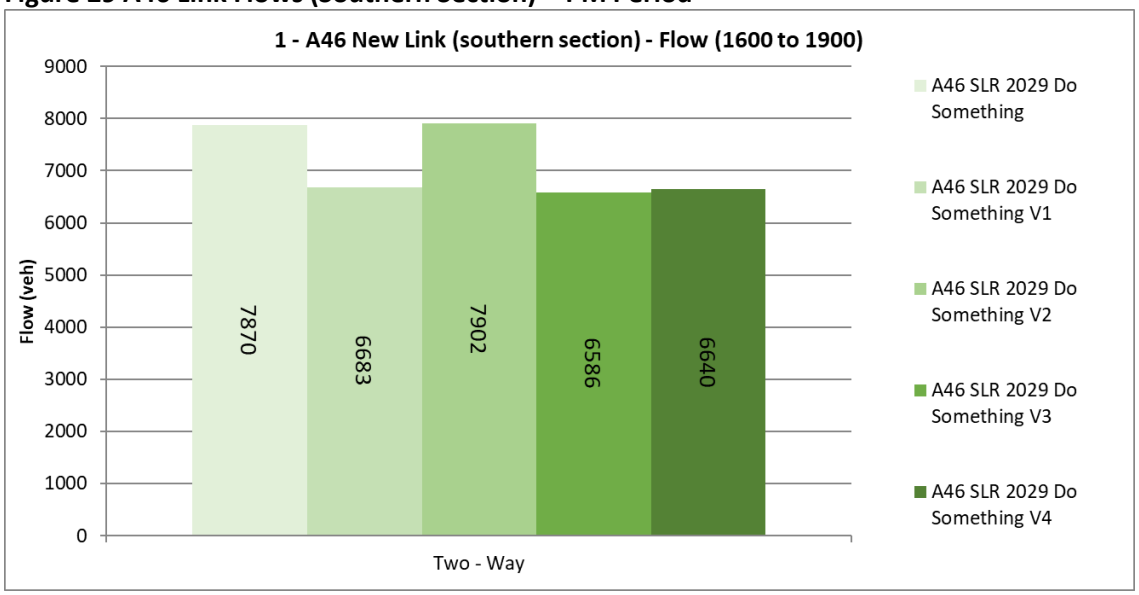


Figure 29 A46 Link Flows (Southern Section) – PM Period



5.41 The link flows presented for the southern section of the A46 link across the AM and PM period demonstrate that the Do Something V2 scenario results in the highest two way traffic flows on the link itself. These results suggests that the complete closure of Gibbet Hill Road to through trips has the most noticeable impact in terms of drawing trips onto the new link road.

Figure 30 A46 Link Flows (Northern Section) – PM Period

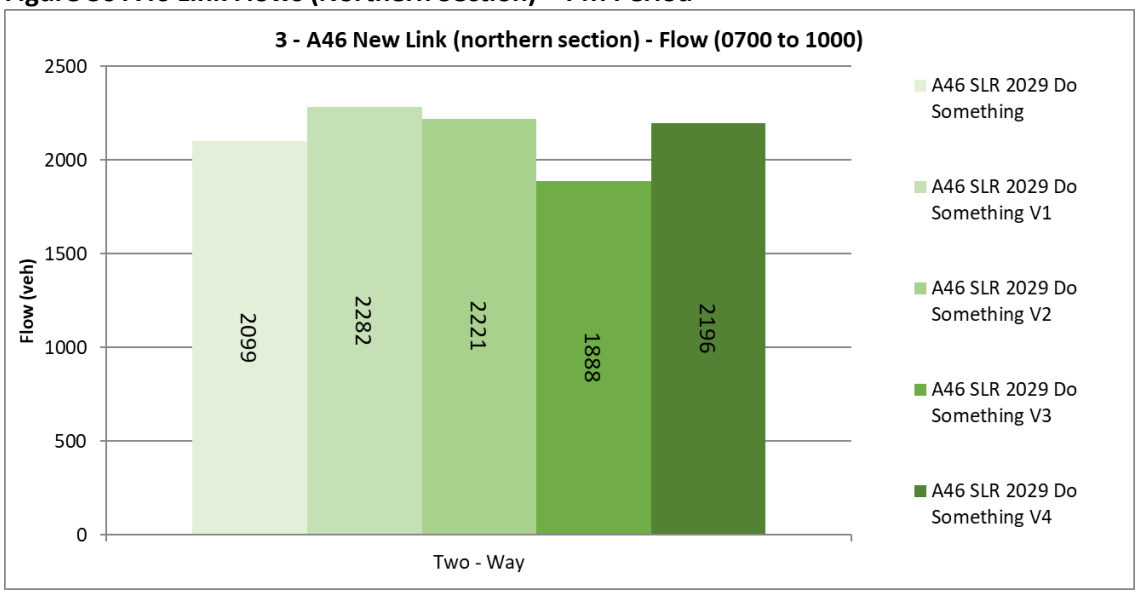
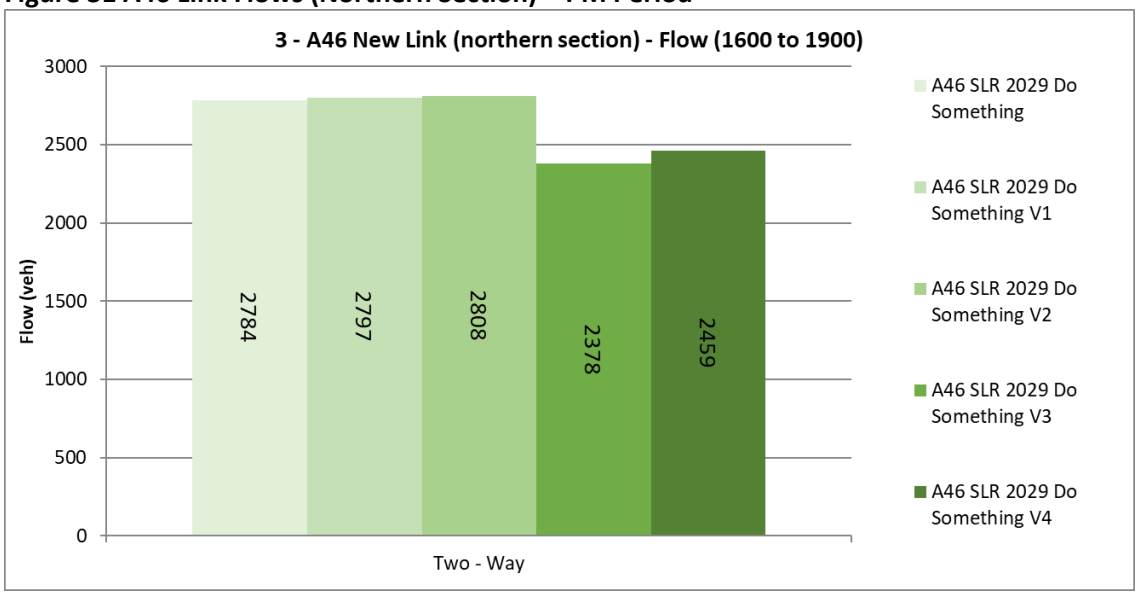


Figure 31 A46 Link Flows (Northern Section) – PM Period



5.42 The link flows presented for the northern section of the link road suggest fewer trips will use this section of the link compared with the southern section. This is to be expected however as some traffic which is destined for the University will still make use of the A429 and Gibbet Hill. However, a similar pattern emerges, whereby the closure of Gibbet Hill Road in the Do Something V2 scenario only leads to the greatest increase in traffic flows on the link itself as all non-university traffic is now utilising the new link.

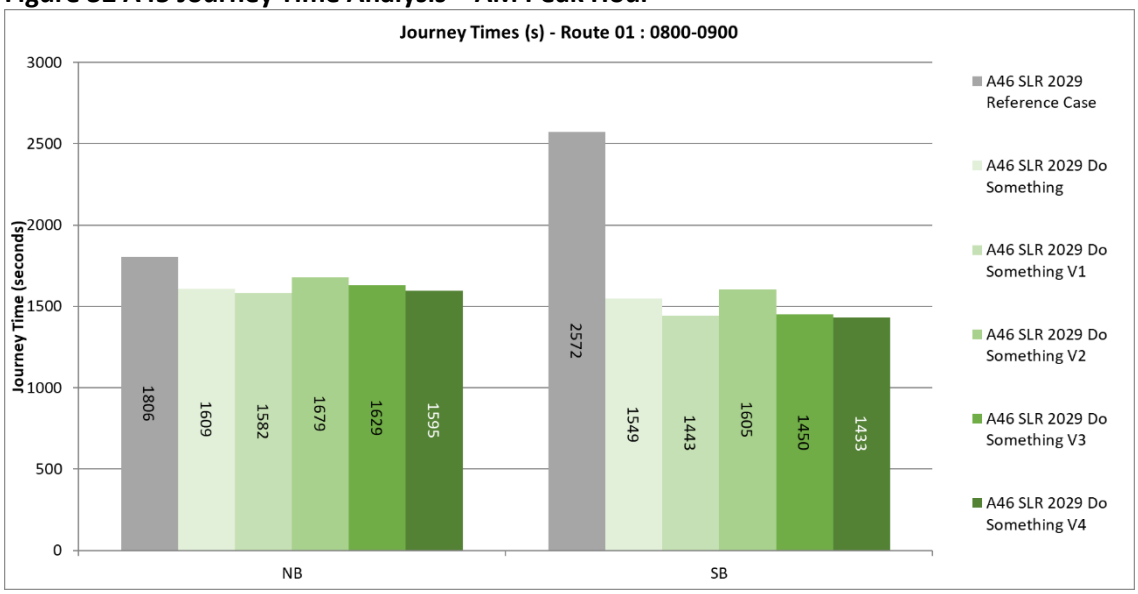
5.43 These link flow results suggest that the Gibbet Hill Road closure results in increased use of the link road, noticeably more so that simply applying speed and cost factor restrictions.

5.44 It is also noticeable the opening up the link through to the Westwood Heath Business Park results in an increase in flows on the northern section of the link but even then the level of demand for the link road does not exceed that observed as a result of the closure to through trips.

A45 Journey Time Impacts

5.45 As per the analysis of the Do Minimum scenarios, journey time impacts along the A45 have been reviewed for all Do Something scenarios. The resultant modelled journey times are presented within **Figure 32** and **Figure 33**.

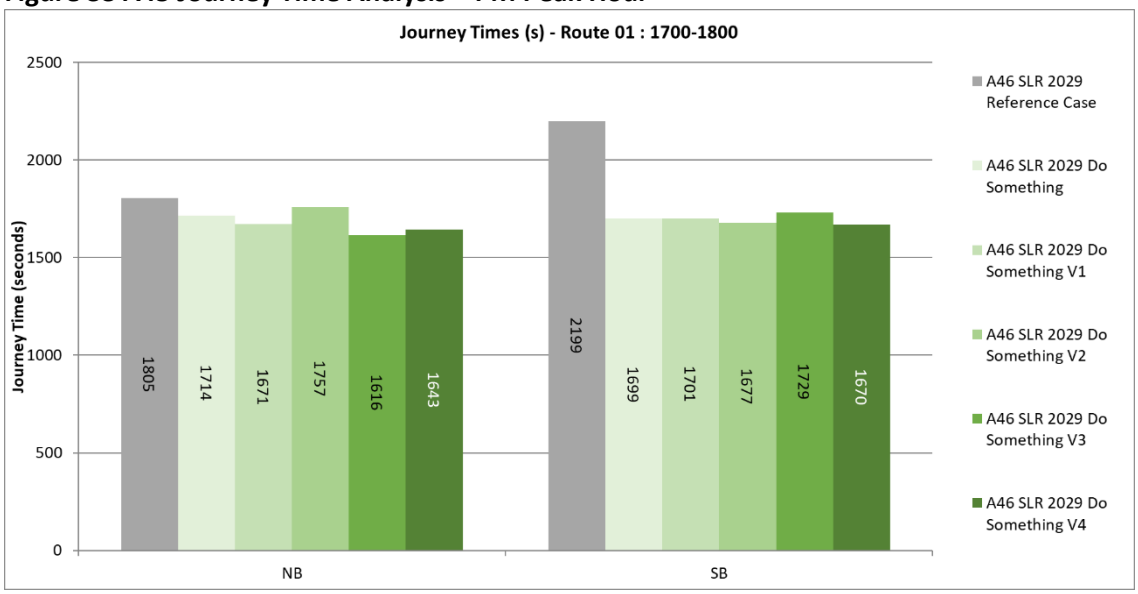
Figure 32 A45 Journey Time Analysis – AM Peak Hour



5.46 The AM peak hour journey times on the A45 are presented within **Figure 32**. As with the Do Minimum scenario analysis, the inclusion of the link results in significantly reduced journey times on the A45 southbound in each of the Do Something scenarios when compared with 2029 Reference Case conditions and that these reductions are also significantly greater than any reductions achieved through the implementation of the options identified within the Do Minimum testing

5.47 The journey times on the northbound route also reduce in each of the Do Something scenarios, however, to a much smaller extent that those on the southbound route.

Figure 33 A45 Journey Time Analysis – PM Peak Hour



5.48 The PM peak hour journey times on the A45 are presented within **Figure 33.** Within each of the Do Something scenarios, significant reductions in journey times on the southbound route are recorded when compared with the Reference Case conditions, unlike the Do Minimum scenario analysis, which demonstrated no improvement.

5.49 Due to the delivery of the full link, opportunity is afforded to optimise the A45/Kenilworth Road signal timings to improve throughput on the A45, which contributes to the reduced journey times on the A45.

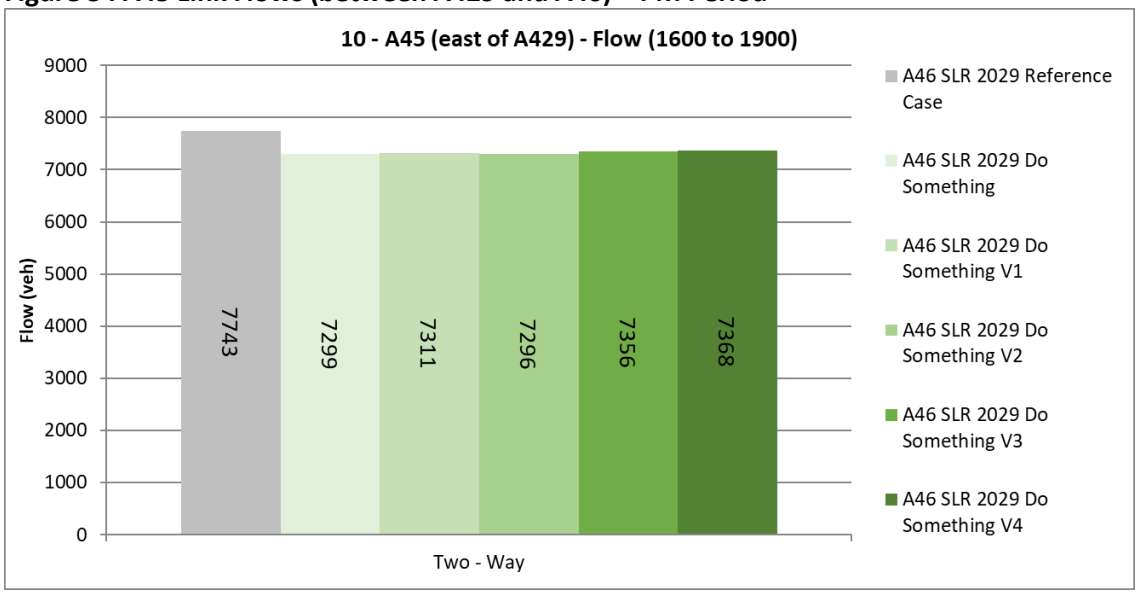
5.50 This reduction in A45 journey times within each of the Do Something scenarios, compared with Reference Case conditions is significant, in the context of the additional number of completed trips now occurring on the network as a result of delivering the link.

5.51 Additionally, with the full link delivered, traffic appears to be using the link road, before joining the A45 to the north of the A45/Kenilworth Road junction, rather than previously routing via either of the following:

- A46 and A45
- A429 and A45

5.52 The result is lower traffic flows on the A45 (between the A429 and A46), demonstrated by the PM period link flows on the A45 shown in **Figure 34**.

Figure 34 A45 Link Flows (between A429 and A46) – PM Period



Do Something Scenario Summary

5.53 The analysis presented within this section has compared each of the Do Something scenarios tested against the Reference Case conditions.

5.54 The results demonstrate that the Do Something scenarios deliver significant improvements in terms of strategic impacts over the Reference Case, and critically over the partial delivery of the link presented within the Do Minimum scenarios.

5.55 In terms of delivering the greatest network wide journey time savings the Do Something V4 (with connection through to Westwood Heath Business Park) appears to be the most effective, however, in terms of simply the highest level of flows on the link itself, the Do Something V2 (Gibbet Hill closure) is the most effective scenario. Furthermore, this is also the scenario most likely to achieve the aim of enabling the road network within the university to be downgraded making it more attractive to active mode users.

5.56 The analysis has also presented impacts on the A45, which again reports modelled journey times in all Do Something scenarios reducing, both northbound and southbound, in the AM and PM period.

5.57 In the context of the above analysis, it is possible to conclude that the delivery of the full link results in network wide benefits, along with more localised benefits in critical parts of the network, such as the A45.

5.58 In terms of determining a preferred Do Something scenario to take forward for further analysis, each option is clearly delivers strategic level benefits. However, the Do Something V2 option delivers the highest traffic flows along the link itself, whilst affording an additional objective of this assessment to be met, downgrading of Gibbet Hill Road to all through trips, without having an adverse strategic level impact.

5.59 The Do Something V4 does result in the lowest level of network wide delay, however, this link is considered complex to deliver, and this option is not as effective as the Do Something V2 in terms of flows on the link road, and reducing traffic on Gibbet Hill Road.

5.60 On this basis, the Do Something V2 scenario has been taken forward for further detailed analysis, presented within Stage 2 of the assessment.

6 STAGE 2 ANALYSIS – LOCALISED IMPACT ASSESSMENT

6.1 Following on from Stage 1, Stage 2 of the assessment involved a review the impact on the local highway network of the preferred Do Something scenario and the identification of highway interventions that could be delivered alongside the link road, to further optimise the network performance.

6.2 As detailed in Stage 1, the preferred option for the link at this stage is assumed to be the Do Something V2 scenario (henceforth referred to as the Do Something scenario). This scenario contains the following link road features:

- Delivery of the full link between the A46 and Westwood Heath Road
- Closure of Stoneleigh Road to through trips
- Restrictions on Gibbet Hill Road to allow only university traffic and public transport to travel along this corridor

6.3 The resultant impact on the network is identified in the following, before the mitigation required outlined.

Do Something Scenario Impact

6.4 **Figure 35** and **Figure 36** presents the strategic level impacts of the preferred Do Something scenario compared within the 2029 Reference Case conditions.

Figure 35 Network Wide Delay Comparison

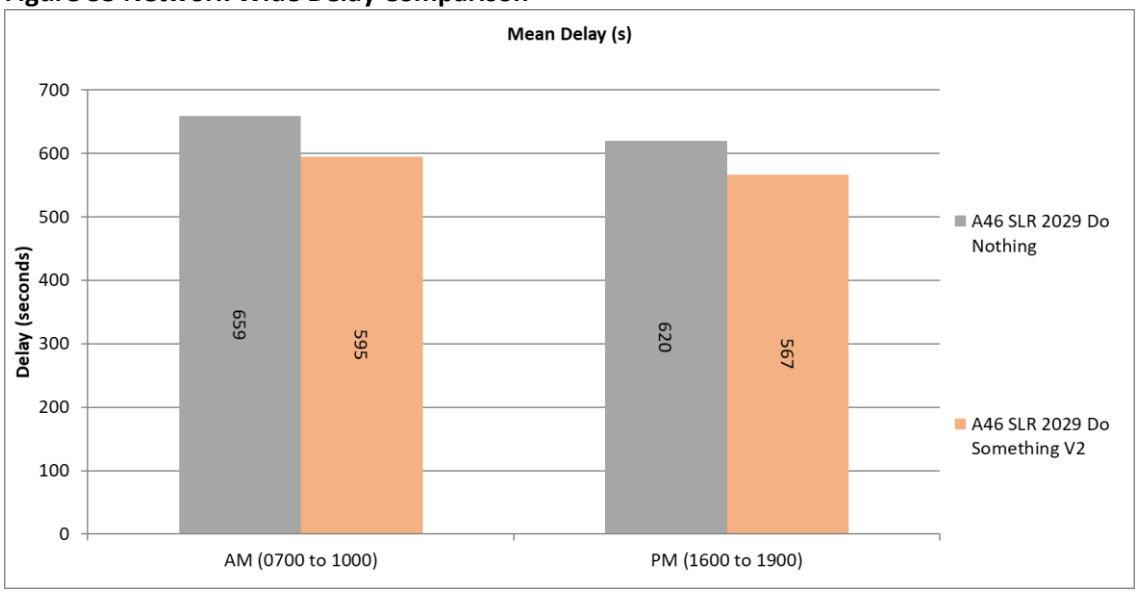
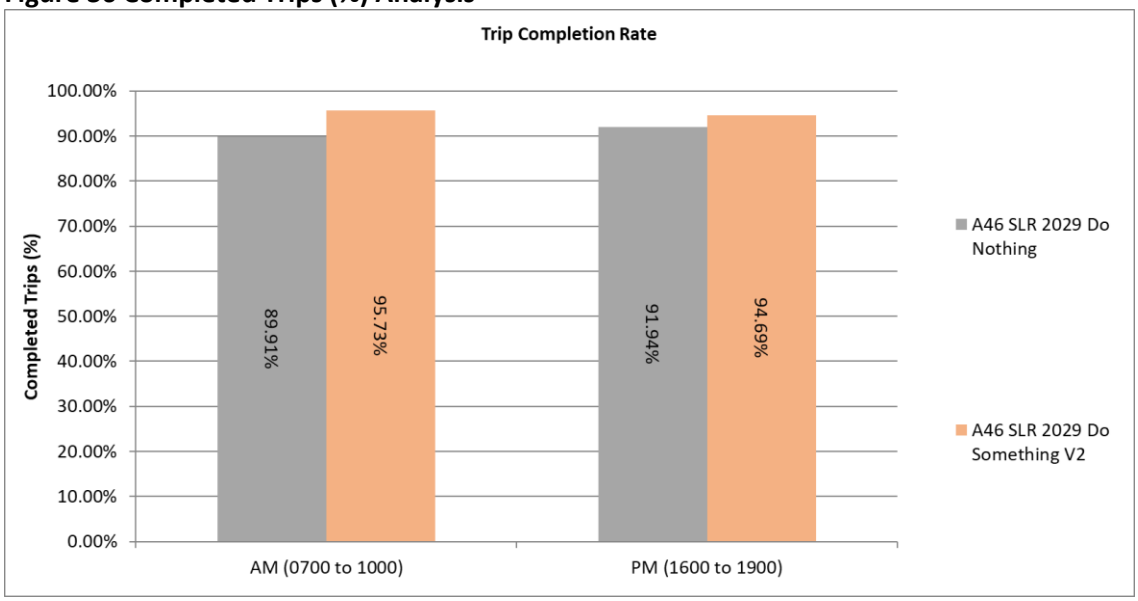


Figure 36 Completed Trips (%) Analysis



6.5 The results presented within **Figure 35** and **Figure 36** demonstrate the strategic benefits of the Do Something scenario compared within the 2029 Reference Case conditions. The delivery of the full link and closure to through traffic on Gibbet Hill Road in the Do Something scenario results in around a 10% reduction in average journey times across the network in the AM period, and 9% reduction in journey times during the PM period.

6.6 This is combined with a 6% increase in trips able to complete their journey in the AM peak, and 3% increase in trip completion rate during the PM period.

6.7 The results suggest, that at a strategic level, the Do Something scenario has considerable benefits to the network performance. Average AM and PM journey times are reduced by around 60 seconds and 55 seconds respectively, whilst around 6,000 additional trips are completed during the AM period, and 3,000 additional trips during the PM period.

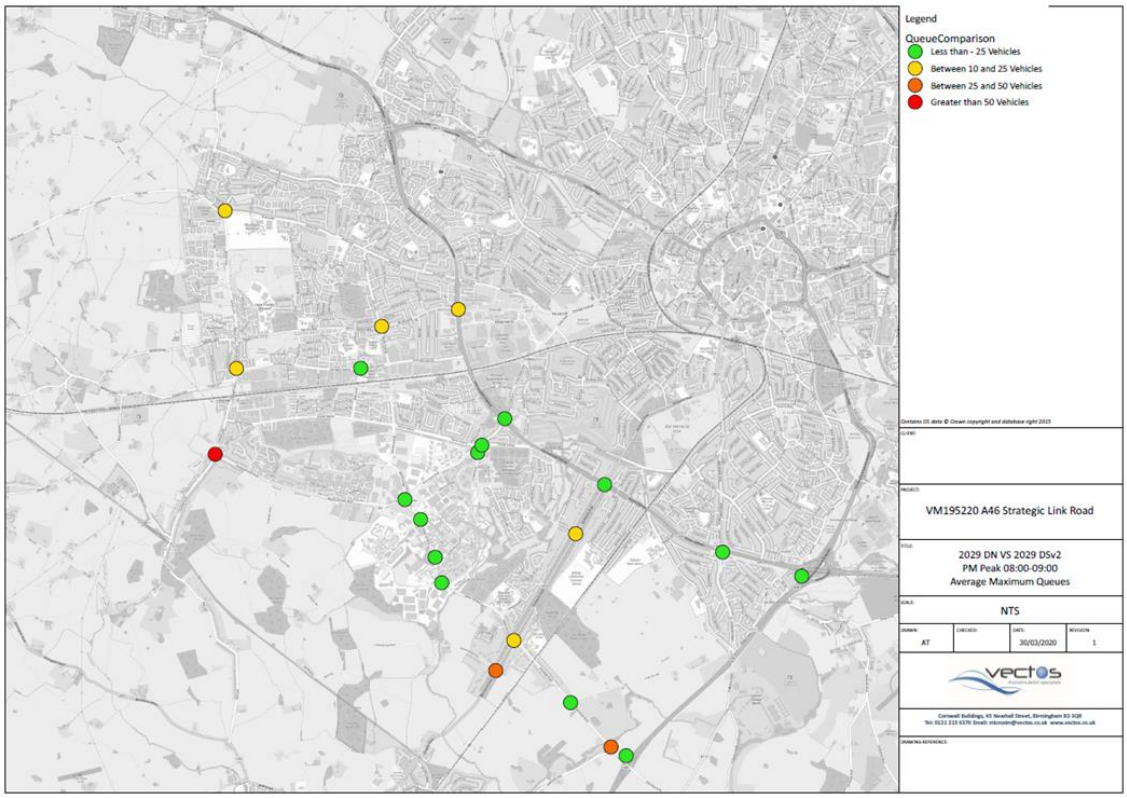
6.8 In addition to the network wide performance, consideration has also been given to the more localised impacts of the Do Something scenario. In order to understand these impacts, a queue length analysis has been undertaken. The analysis has been undertaken for every junction within the model network, and the results based on the modelled average hourly maximum queue length. Results presented for each junction are based on the worst performing single approach (e.g. if a four arm junction experiences three reductions in queueing and one increase then the increase will be reported) and only instances where the criteria are met results in junctions being reported through the analysis.

6.9 The classifications for the queue length analysis are outlined as follows, and are based on best practice adopted elsewhere within the county:

- **Queue Reduction** (a reduction in queue lengths of greater than 10 vehicles)
- **Moderate Increase** (an increase in queue lengths of between 10 and 25 vehicles)
- **Significant Increase** (an increase in queue lengths of between 25 and 50 vehicles)
- **Very Significant Increase** (an increase in queue length of over 50 vehicles)

6.10 Junctions where queue differences have not been presented on the plots simply represent locations which did not trigger any of the assessment criteria across any one approach.

Figure 37 Reference Case vs Do Something Queue Impacts – AM Peak Hour

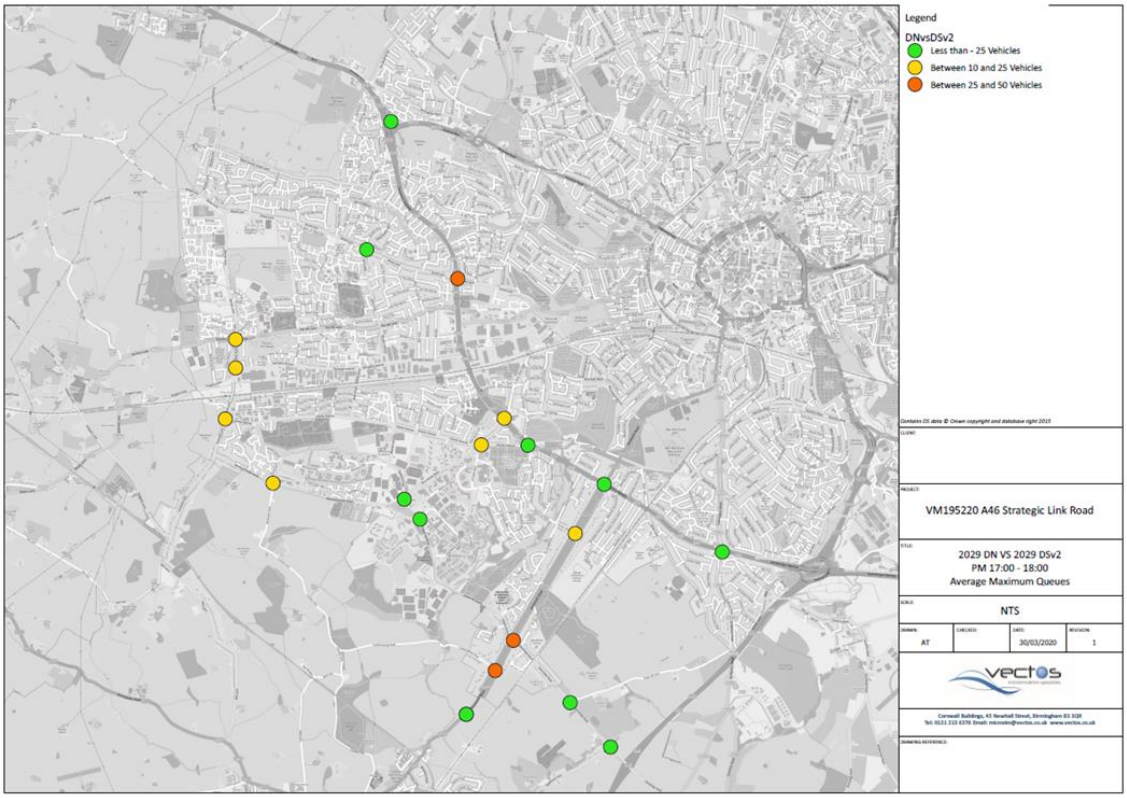


6.11 The AM peak hour queue length analysis, presented within **Figure 37,** reveals that the Do Something scenario results in significant number of queue length reductions across the network when compared with 2029 Reference Case conditions, notably along the A45 and Gibbet Hill Road.

6.12 There are however, several instances of minor increases in queues across the Charter Avenue/Tile Hill areas of the model, with three instances of significant increases in queues

most notably at the Dalehouse Lane junction, and Cromwell Lane/Westwood Heath Road junction.

Figure 38 Reference Case vs Do Something Queue Impacts – PM Peak Hour



6.13 The PM peak hour queue length analysis, presented within **Figure 38,** reports a similar pattern to the AM results, with a significant number of junctions at which queue lengths reduce, notably along the A45 and Gibbet Hill Road.

6.14 There are again, a number of instances of minor increases in queues across the Charter Avenue/Tile Hill areas of the model, with three instances of more significant increases in queues most notably at junctions on the A429.

Do Something Impact Summary

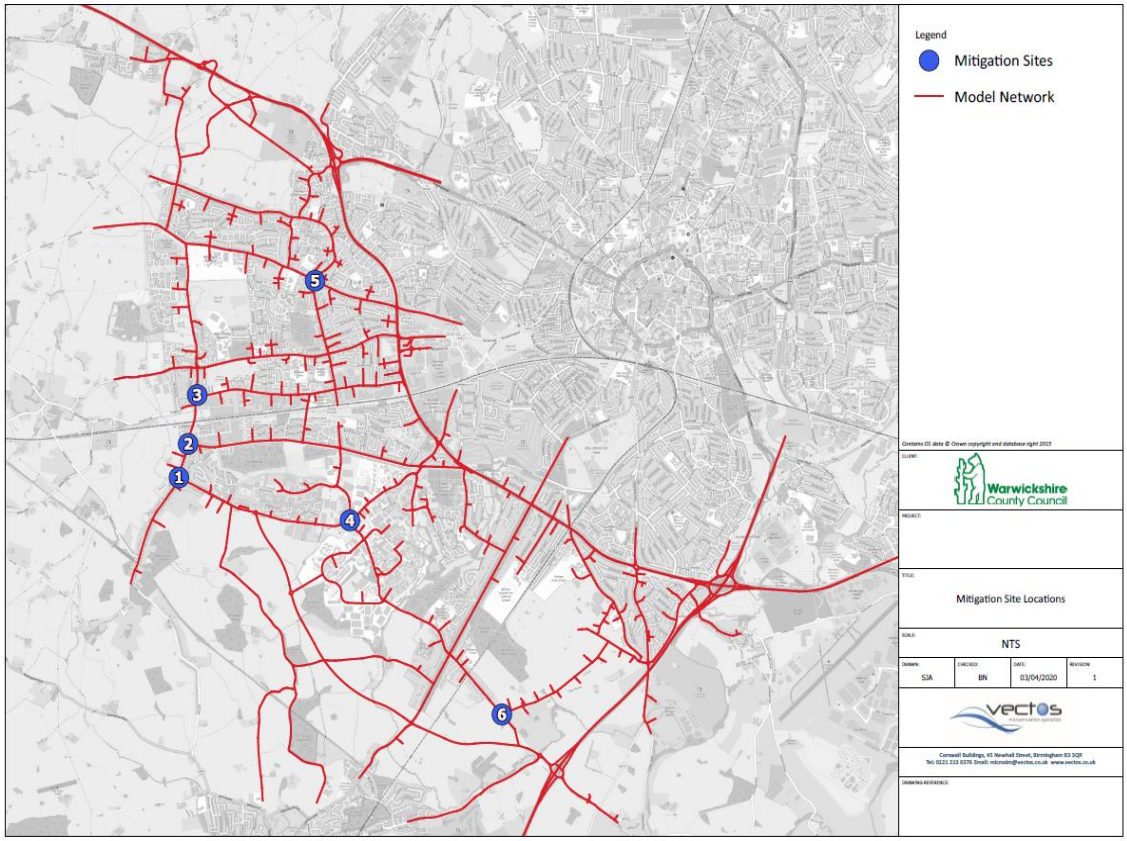
6.15 Based upon the above results presented, the preferred Do Something scenario results in a general improvement in the network wide performance of the network compared with the Reference Case queueing conditions. However, there are some localised impacts on queueing, which require further attention, most notably on Cromwell Lane, but generally around the Tile Hill/Charter Avenue area of the network.

Mitigation Inclusions

6.16 In an attempt to improve any identified localised impacts on the network, mitigation schemes have been included at the following junctions.

6.17 Each of the mitigation schemes included at this stage are 'concept' schemes only, and have in every instance, been included within the existing highway boundary.

Figure 39 Mitigation Scheme Locations

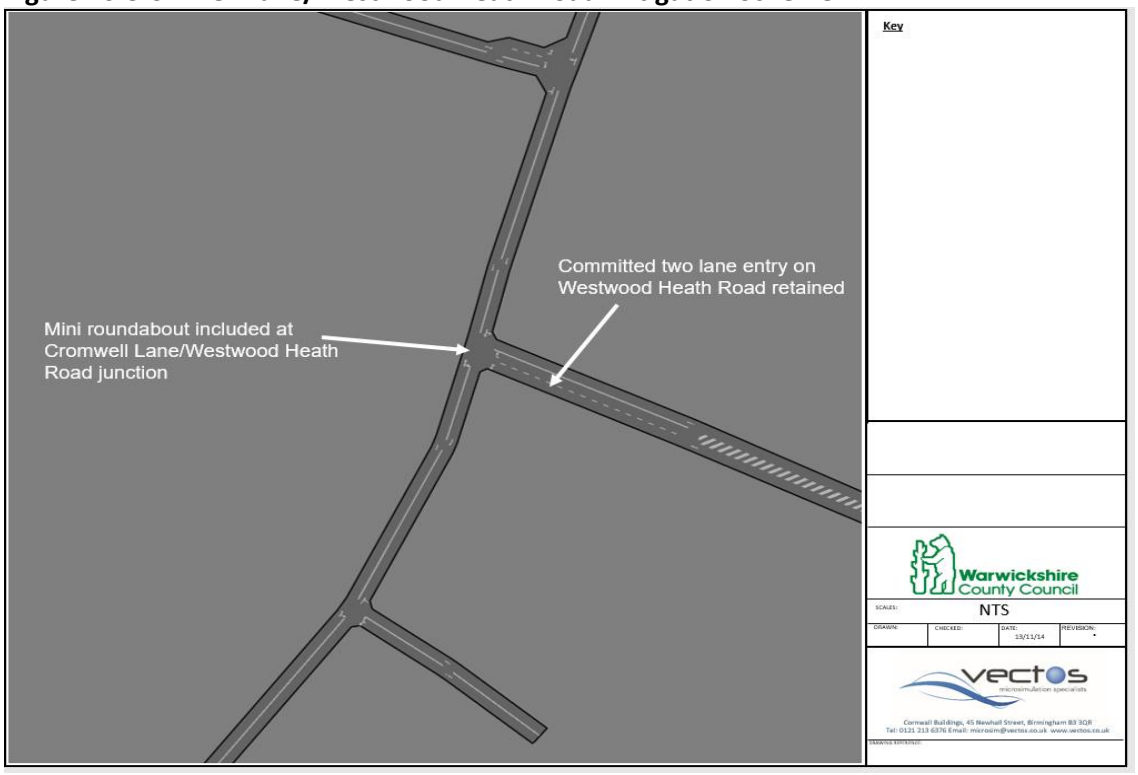


6.18 The schemes included are detailed in the following:

Scheme 1 - Cromwell Lane/Westwood Heath Road Junction

6.19 The scheme at this location involves adjusting the junction to form a mini-roundabout. The scheme maintains the two-lane entry on the Westwood Heath Road approach, delivered as part of the committed scheme identified at this junction. The layout of this scheme is illustrated within **Figure 40**.

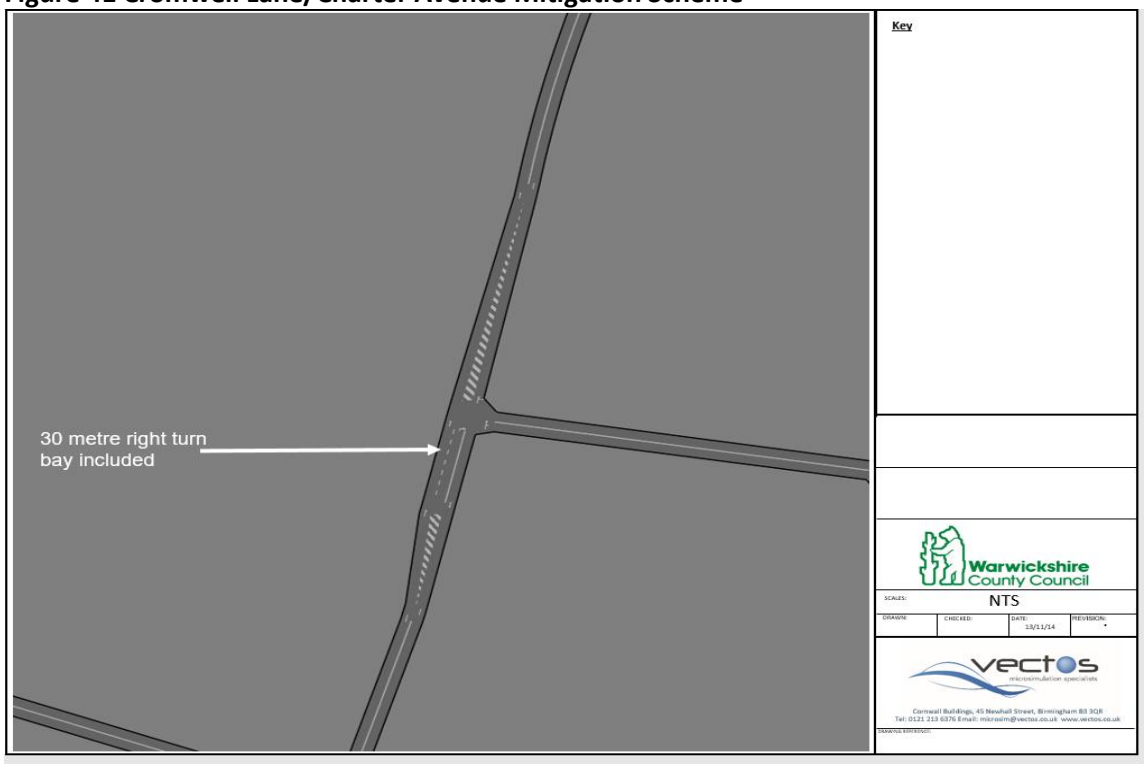
Figure 40 Cromwell Lane/Westwood Heath Road Mitigation Scheme



Scheme 2 – Cromwell Lane/Charter Avenue

6.20 The scheme at this location involves the provision of a 30 metre right turn bay on the Cromwell Lane northbound approach to the junction, illustrated within **Figure 41**.

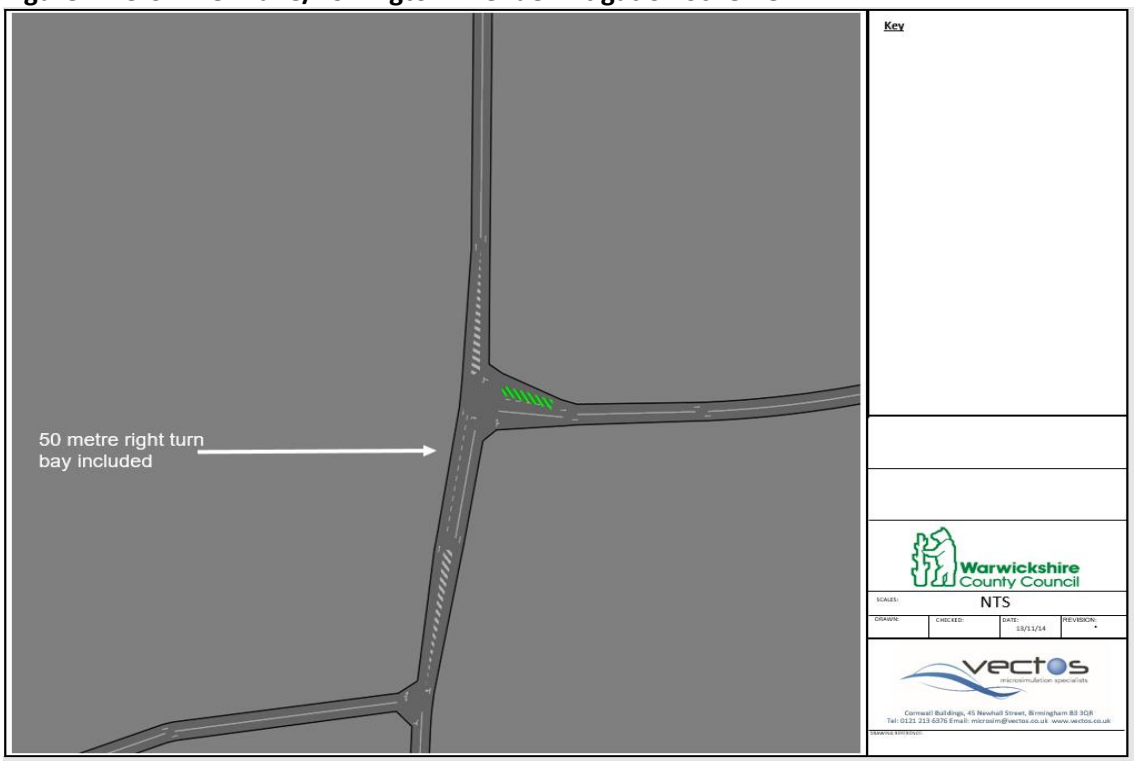
Figure 41 Cromwell Lane/Charter Avenue Mitigation Scheme



Scheme 3 – Cromwell Lane/Torrington Avenue

6.21 The scheme at this location involves the provision of a 50 metre right turn bay on the Cromwell Lane northbound approach to the junction, illustrated within **Figure 42**.

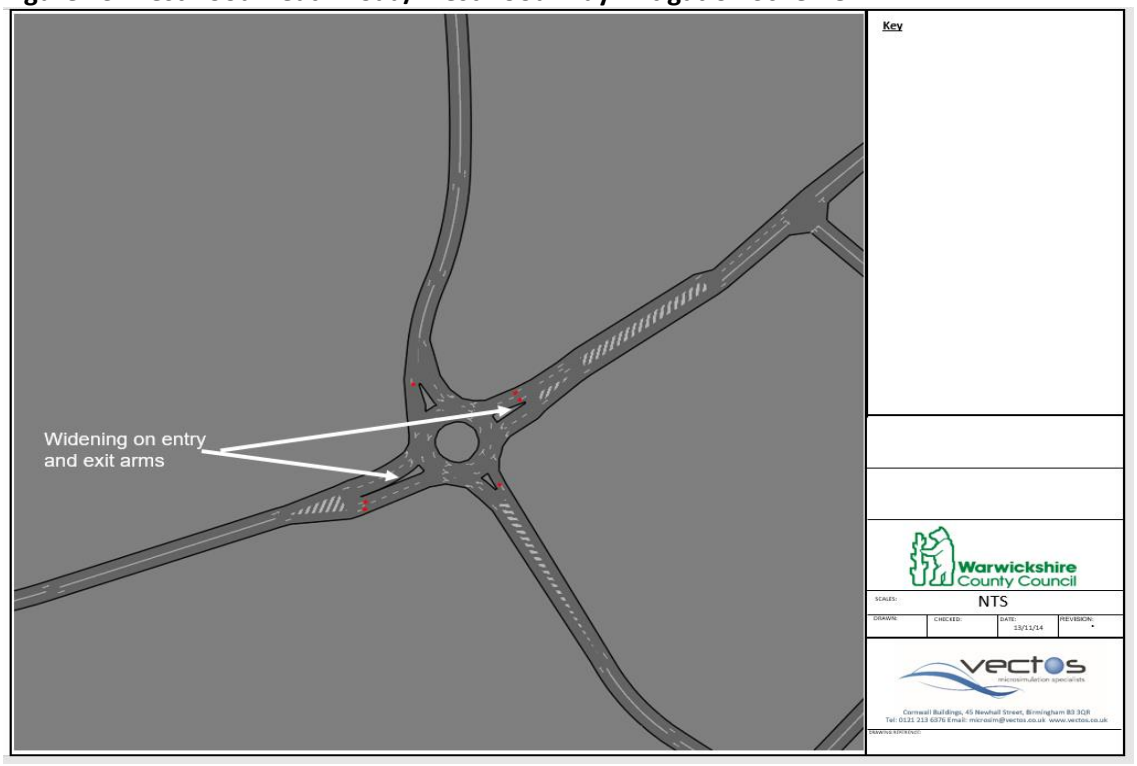
Figure 42 Cromwell Lane/Torrington Avenue Mitigation Scheme



Scheme 4 – Westwood Heath Road/Westwood Way

6.22 The scheme at this location involves the provision two-lane entry and exits on the Westwood Heath Road arms to the roundabout, to enable the east to west and west to east movement to be made in two lanes, illustrated within **Figure 43**.

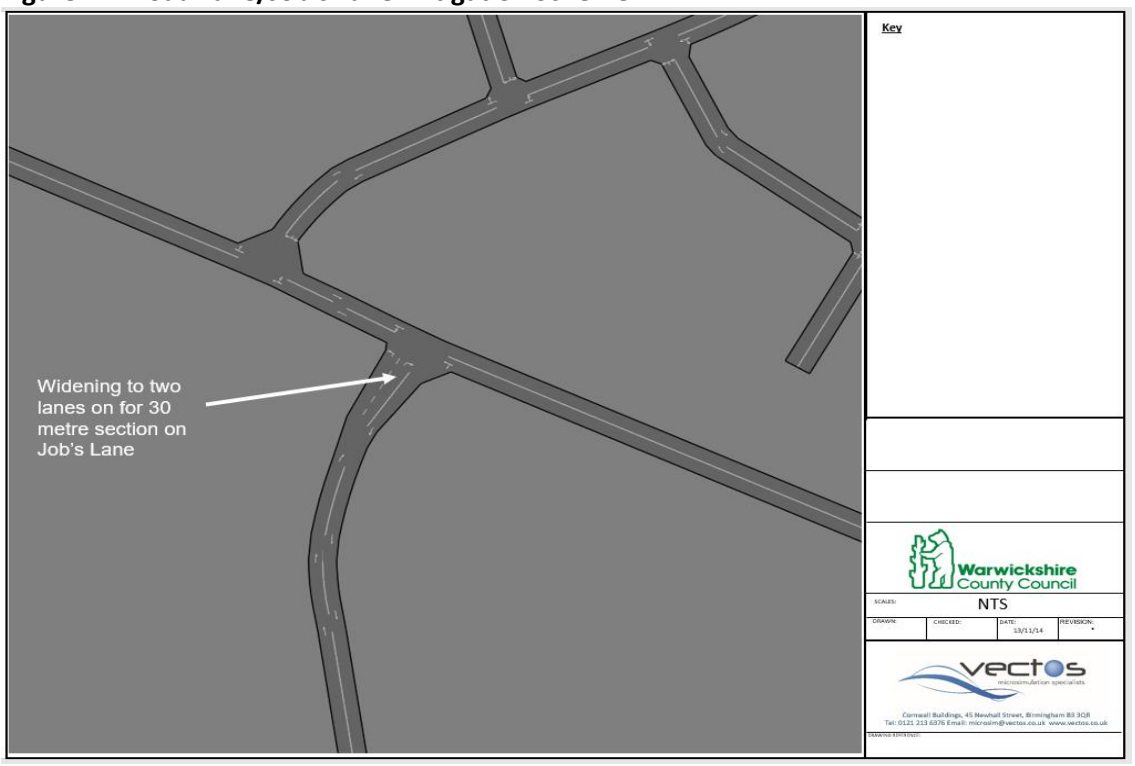
Figure 43 Westwood Heath Road/Westwood Way Mitigation Scheme



Scheme 5 – Broad Lane/Job's Lane

6.23 The scheme at this location involves the provision of a 30 metre two lane section on the Job's Lane approach to the junction, as illustrated within **Figure 44**.

Figure 44 Broad Lane/Job's Lane Mitigation Scheme



Scheme 6 – Kings Hill Access Restrictions

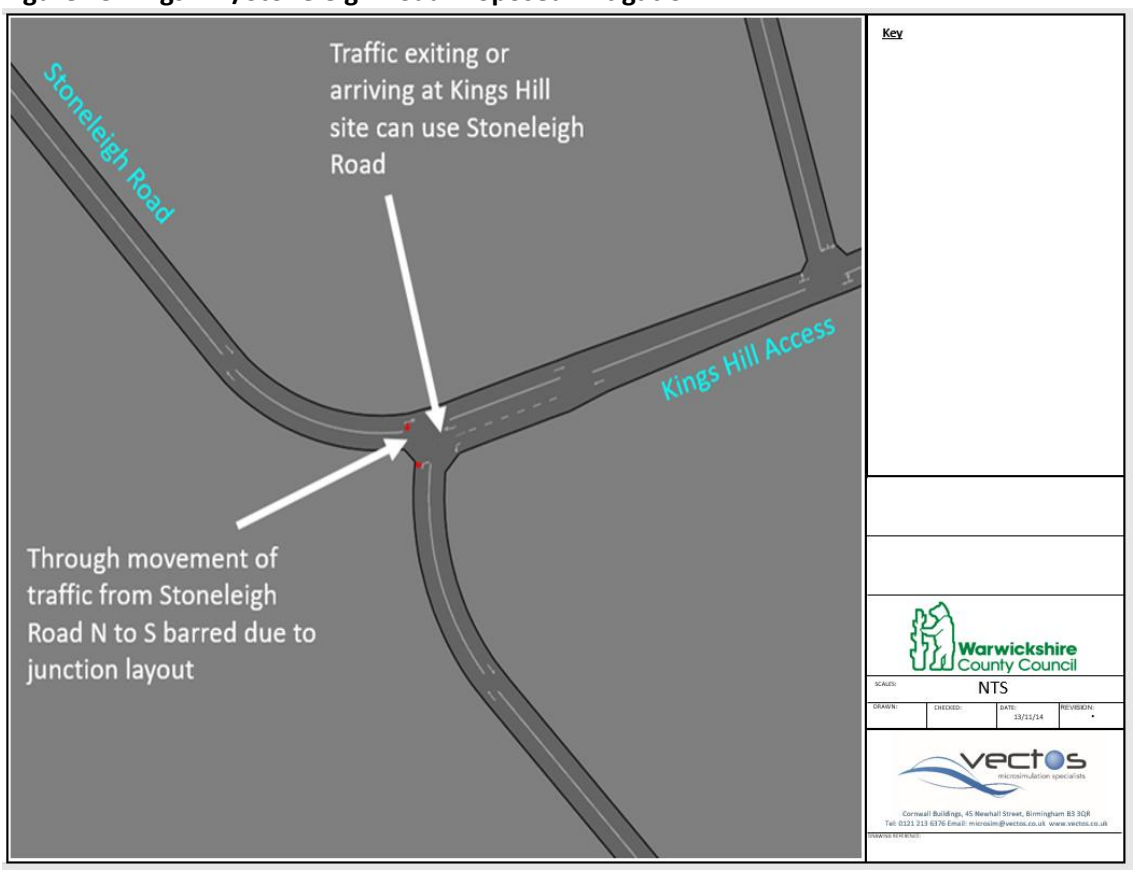
6.24 The scheme at this location involves re-configuring the Kings Hill access junction, and re-opening Stoneleigh Road. This scheme was required in response to a high volume of traffic travelling towards the Kings Hill site from the A46.

6.25 Due to the left in left out restriction at the Link Road/Stoneleigh Road junction, Kings Hill traffic returning to the site is forced to travel along the link road as far as the A429, before u-turning at the A429/Link Road roundabout and coming back along the link road.

6.26 Initially consideration was given to making the Link Road/Stoneleigh Road junction an all movement junction; however, this resulted in a blocking back of traffic on the link road to the A46.

6.27 Accordingly, modifications to the Kings Hill access junction have been made, as shown in **Figure 45**, which allows Kings Hill traffic to travel to /from the site via Stoneleigh Road, however through trips on Stoneleigh Road remain barred.

Figure 45 Kings Hill/Stoneleigh Road Proposed Mitigation

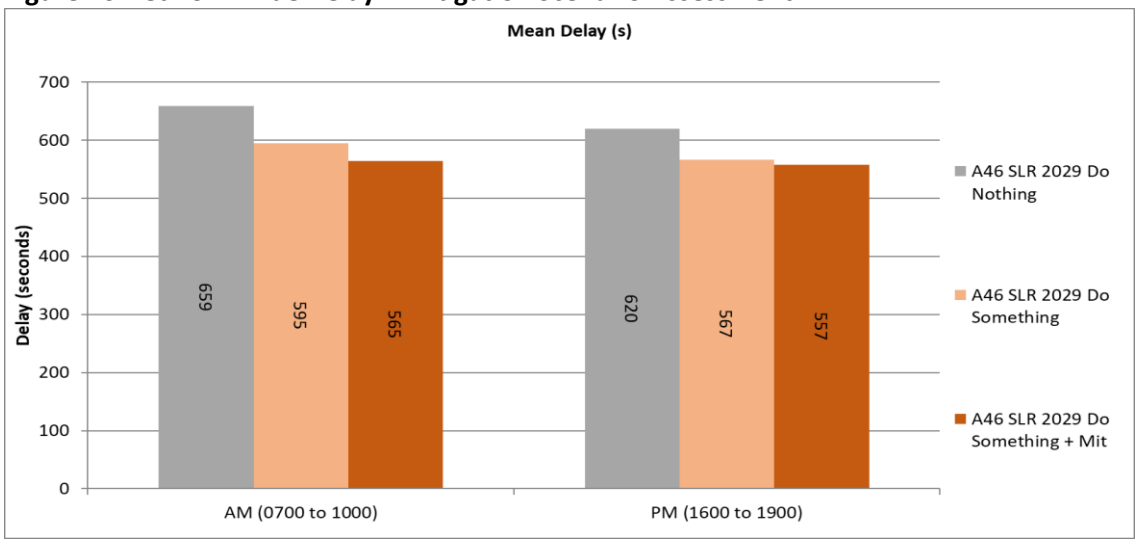


6.28 The schemes detailed above have been included within a version of the 2029 Do Something scenario, to form the 2029 Do Something + Mitigation scenario. The resultant impact on the model performance is detailed in the following section.

Mitigation Impact Assessment

6.29 As outlined above the schemes identified have been included within the 2029 Do Something + Mitigation scenario. In order to assess the impact of delivering these schemes alongside the proposed link and Gibbet Hill Road closure, network wide delay and queue impacts have been modelled.

Figure 46 Network Wide Delay – Mitigation Scenario Assessment



6.30 **Figure 46** demonstrates the impact on network wide delay once the mitigation identified is included within the network. The AM period results suggest that average journey times are reduced by a further 30 seconds over the Do Something scenario, once the mitigation is included.

6.31 The PM period experiences a 10 second reduction in journey times compared with the Do Something scenario. In both periods, significant journey time savings are modelled compared with the 2029 Reference Case conditions.

Figure 47 Reference Case vs Do Something + Mitigation Queue Impacts – AM Peak Hour

6.32 **Figure 47** demonstrates the AM peak hour queue length analysis of the 2029 Reference Case against the 2029 Do Something + Mitigation conditions.

6.33 Compared with the previous queue analysis presented, it is clear that the inclusion of the mitigation identified has largely removed all notable queue length increases, with the exception of the Cromwell Lane/Westwood Heath Road junction, which continues to experience queues during the AM and so further consideration may need to be given to the configuration of this junction at a later stage.

Figure 48 Reference Case vs Do Something + Mitigation Queue Impacts – PM Peak Hour

6.34 **Figure 48** illustrates the PM peak hour queue length analysis of the 2029 Reference Case against the 2029 Do Something + Mitigation conditions.

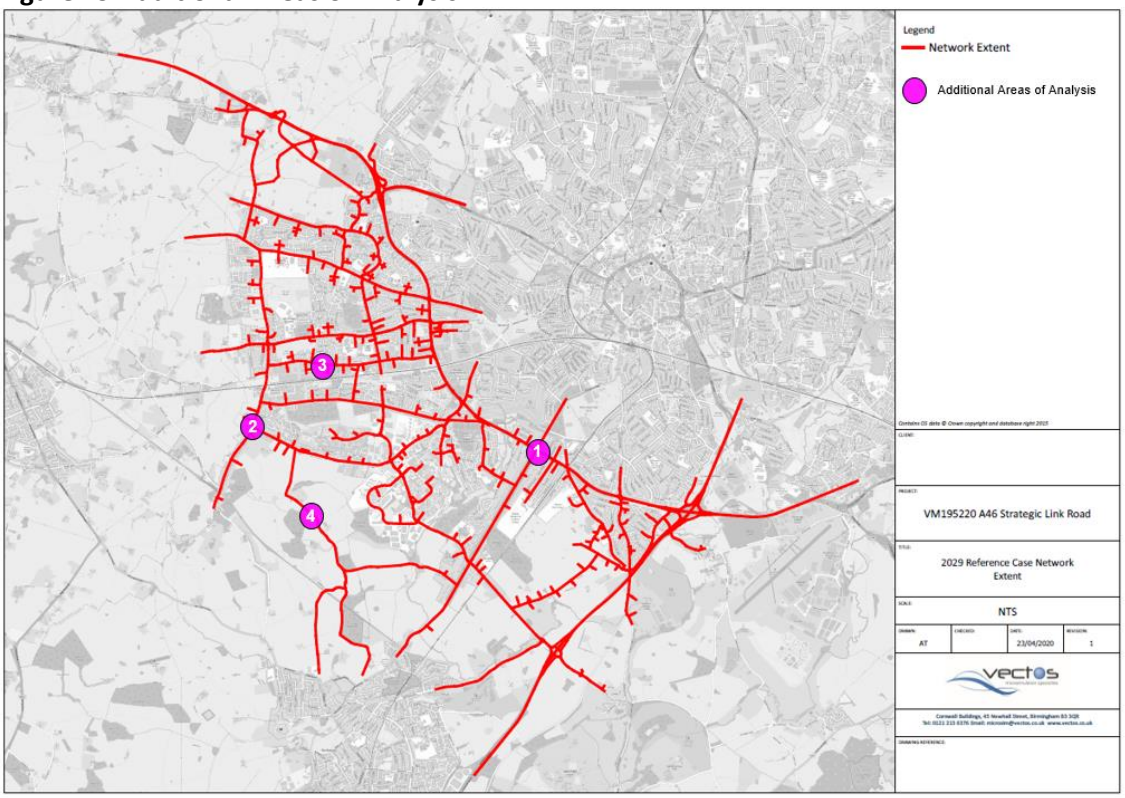
6.35 Again, compared with the previous queue analysis presented, it is clear that the inclusion of the mitigation identified has largely removed all notable queue lengths across the modelled network throughout the PM peak hour.

Detailed Mitigation Analysis

6.36 In order to support the network wide delay and queue length analysis presented above, further, more detailed, analysis of the performance of the mitigated network is provided within the following sections, by investigating and presenting the impact at critical parts of the network. This stage of the analysis has focused on the impact within the following areas:

1. A45/Kenilworth Road junction
2. Cromwell Lane/Westwood Heath Road junction
3. Rat running in Tile Hill Road/Westwood Heath Road/Charter Avenue area
4. Reassignment on other rural routes

Figure 49 Additional Areas of Analysis



A45/Kenilworth Road Junction

6.37 The A45/Kenilworth Road junction forms a critical part of the modelled network. As part of the delivery of the link road, the modelling has demonstrated a clear opportunity for an improvement in forecast conditions at this junction.

6.38 The queue lengths reported on all arms to the junction are presented for the AM and PM peak periods in the following figures.

Figure 50 A45/Kenilworth Road Queue Impacts – AM Peak Hour

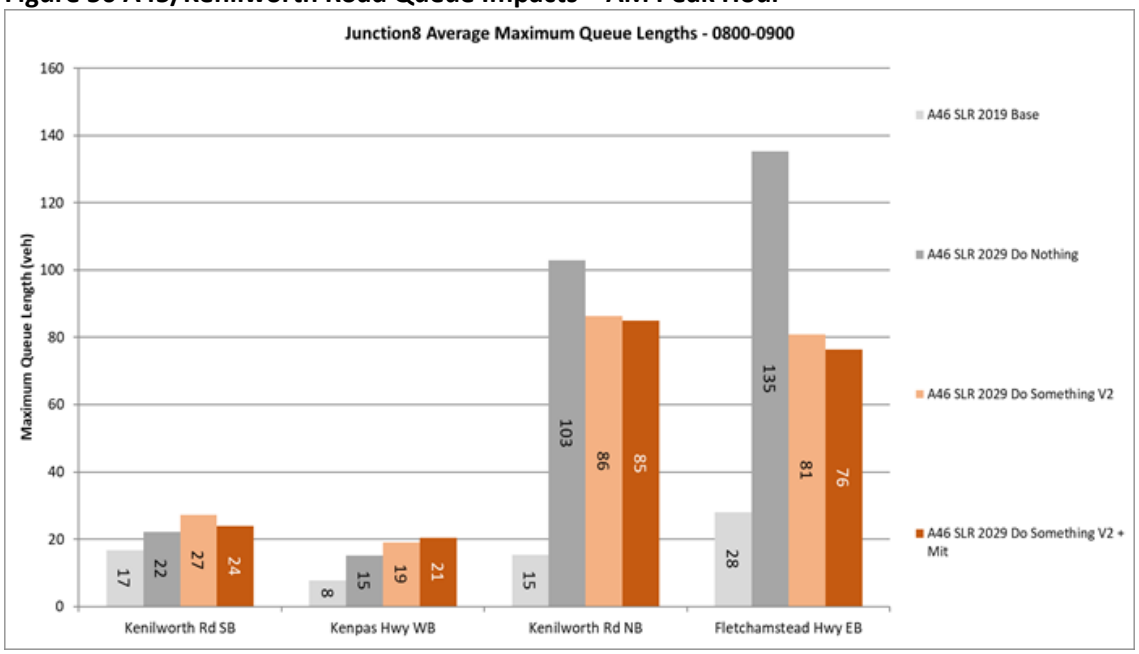
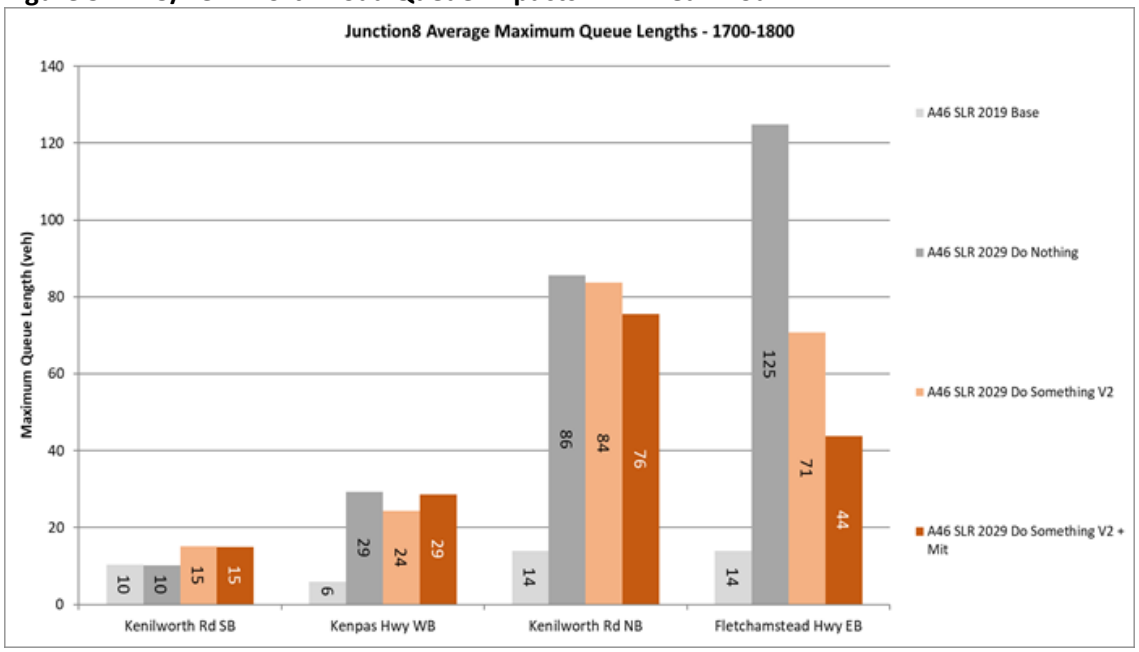


Figure 51 A45/Kenilworth Road Queue Impacts – PM Peak Hour



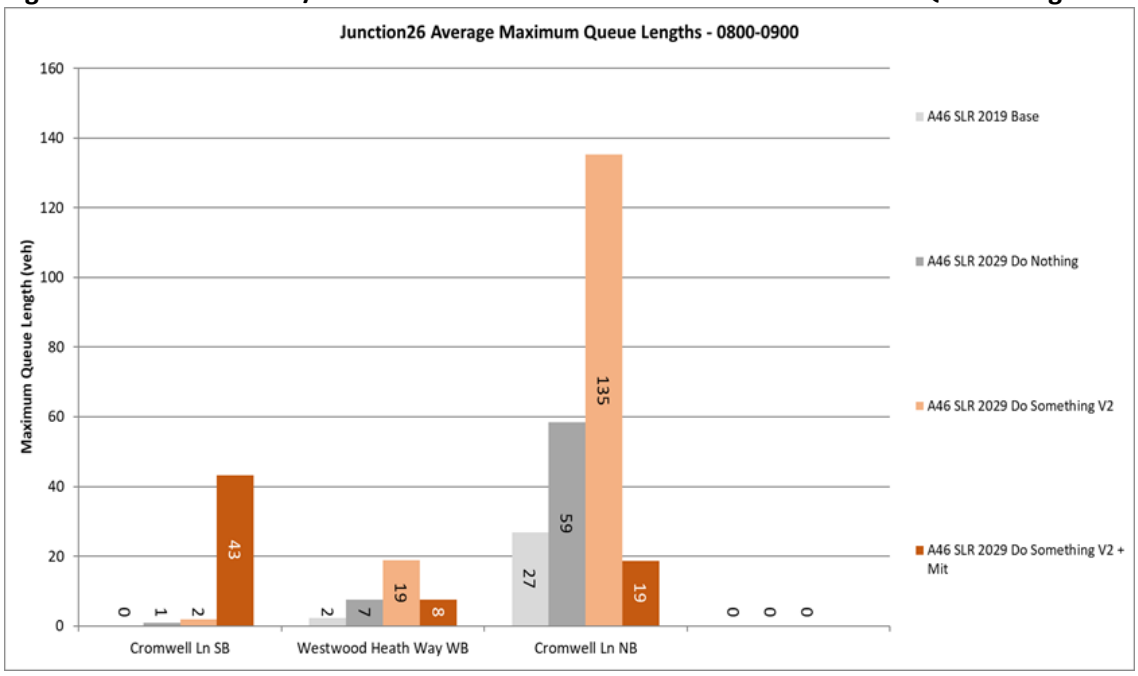
6.39 The queues reported in **Figure 50** and **Figure 51** demonstrate that across the AM and PM period, the Do Something scenarios enable significant improvements in queue lengths to be delivered at this junction, notably on the A45 eastbound approach. The addition of the mitigation further improves this junction performance over the Do Something scenario.

6.40 The presence of the link road results in lower flows on the Kenilworth Road northbound approach to the junction, which in turn allows for an optimisation of the signal timings at the junction, to reduce queues on the A45 approaches. The presence of the link road clearly allows for optimisation and improvement of this junction.

Cromwell Lane/Westwood Heath Junction

6.41 The analysis of the Do Something scenario highlighted significant queueing impacts at the Cromwell Lane/Westwood Heath Road junction during the AM period. Accordingly, mitigation has been included in the form of a mini roundabout. The resultant impact on queue lengths during the AM period only is demonstrated below.

Figure 52 Cromwell Lane/Westwood Heath Road Junction – AM Peak Hour Queue Lengths



6.42 The queue results demonstrate that within the Do Something scenario, once the link road is included within the network, queue lengths increase significantly on the Cromwell Lane northbound approach to the junction. This is a result of the number of vehicles waiting for a gap in the oncoming traffic to make a right turn movement from Cromwell Lane towards Westwood Heath Road. The volumes of these right turn movements are presented within **Table 11**, which demonstrate this increase in vehicles making the right turn movement once the link road is delivered.

Table 11 Cromwell Lane NB Right Turning Traffic (AM Peak Hour)

Scenario	Right Turn Movement (vehicles)
2029 Reference Case	264 trips
2029 Do Something	483 trips
2029 Do Something + Mitigation	490 trips

6.43 In an attempt to relieve the impact of the right turning vehicles at this junction, which block back through the junction resulting in significant queues on Cromwell Lane during the AM, a mini roundabout has been tested.

6.44 The queue results suggest that the mini roundabout is successful at reducing the queues on the Cromwell Lane northbound arm, however, queues on the southbound arm subsequently increase, as this traffic is now giving way to right turning northbound traffic.

6.45 The results suggest that although this may not be the ideal solution, the mini roundabout significantly reduces northbound queues at the junction, albeit worsening queues on the southbound are as a consequence as these vehicles now have to give way to other movements when they were previously unopposed.

Rat running in Tile Hill Road/Westwood Heath Road/Charter Avenue area

6.46 As part of the localised impact analysis of delivering the link road, a review of the impact on routes surrounding the northern end of the Link Road has been undertaken. This is to highlight areas on the network that trips using the new link road route through, when travelling between the end of the new link and the A45.

6.47 Accordingly, changes in link flows have been reviewed at the locations highlighted within **Figure 53**.

6.48 In order to assess the magnitude of any link flow changes, the GEH statistic has been used as a means of comparison. The GEH statistic is a measure that includes both the absolute and the relative difference. In this instance it is appropriate as a simple increase or decrease in flows on any link needs to be considered in the context of the volume of traffic predicted to be on the link in the Reference Case conditions.

6.49 In this instance, any change in the volume of traffic of above a GEH value of 5 is considered to represent a significant change.

Figure 53 Traffic Flow Analysis Locations

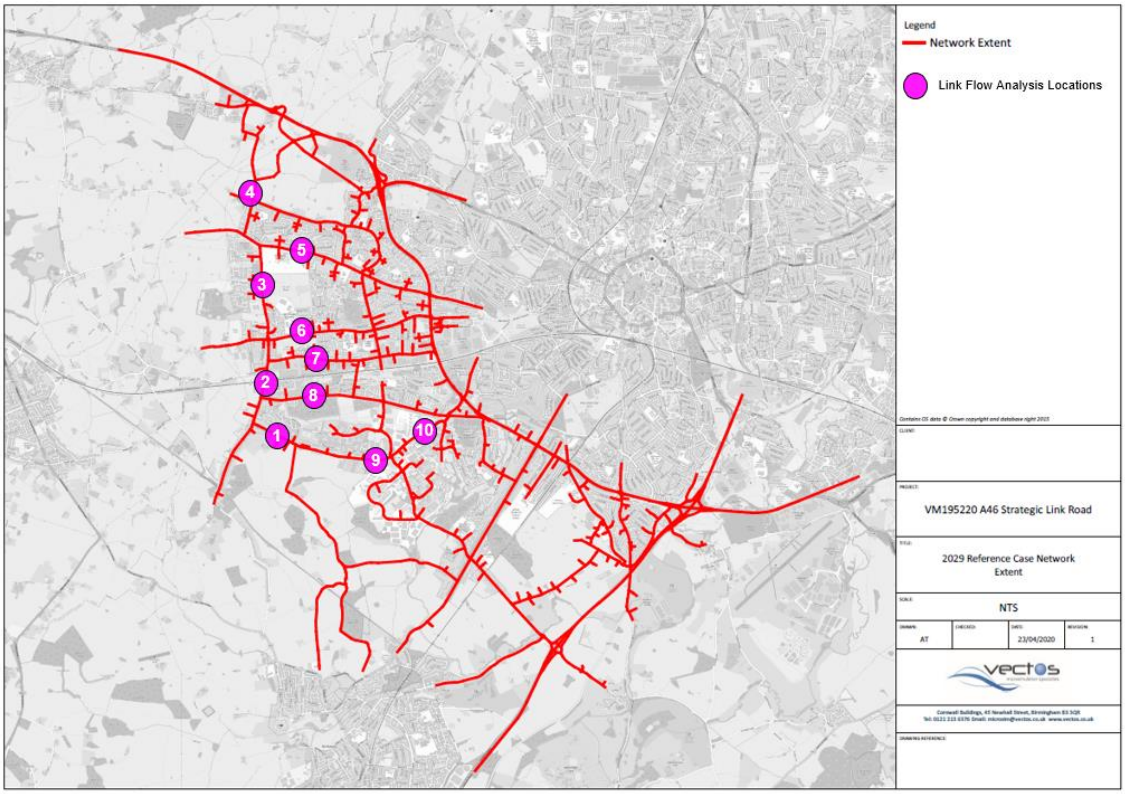
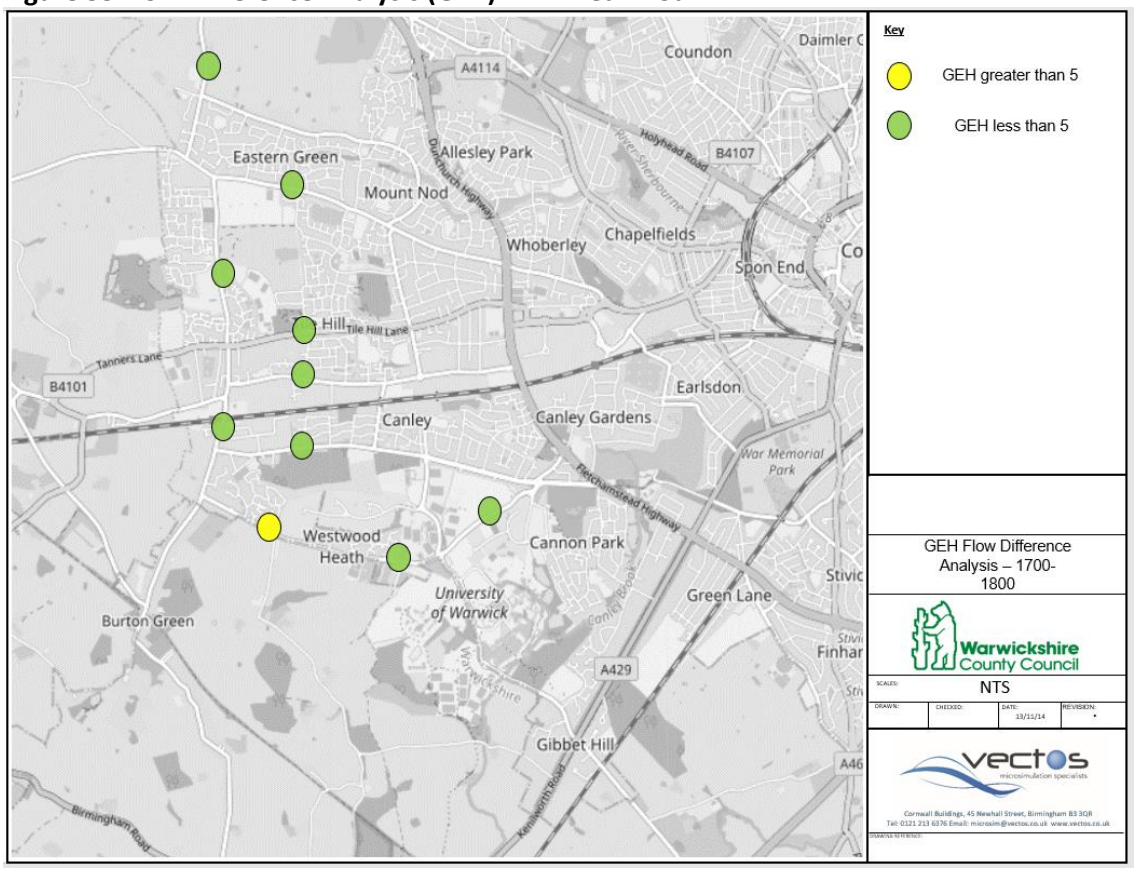


Table 12 Link Flow Changes between Link Road and A45

Link	AM Peak Hour			PM Peak Hour		
	Ref	DS + Mit	GEH	Ref	DS + Mit	GEH
1 – Westwood Heath Road	1131	1312	5.2	1140	1372	6.5
2 – Cromwell Lane	1507	1720	5.3	1452	1639	4.8
3 – Station Avenue	1371	1467	2.5	1308	1389	2.2
4 – Pickford Green Lane	874	978	3.4	880	938	1.9
5 – Broad Lane	981	991	0.3	987	1005	0.6
6 –Tile Hill Lane	841	847	0.2	756	752	0.1
7 – Torrington Avenue	533	552	0.8	589	621	1.3
8 – Charter Avenue	627	641	0.6	466	438	1.3
9 – Westwood Heath Road	1161	1033	3.9	1277	1204	2.1
10 – Kirkby Corner Road	1567	1484	2.1	1235	1385	4.1

Figure 54 Flow Difference Analysis (GEH) – AM Peak Hour

Figure 55 Flow Difference Analysis (GEH) – PM Peak Hour



6.50 The analysis presented within **Table 12, Figure 54** and **Figure 55,** highlights that with the inclusion of the Link Road, the areas of the network predicted to result in notable increases in traffic to the north of the Link Road itself are Westwood Heath Road (to the west of the Link Road), Cromwell Lane, Station Avenue and Pickford Green Lane. This would suggest that trips are routing along these links when travelling between the Link Road and A45, across the AM and PM period.

6.51 The analysis suggests that east to west routes, such as Tile Hill Lane, Torrington Avenue and Charter Avenue will not experience any notable changes in traffic flows with the link included. Furthermore the reductions in traffic on Westwood Heath Road, combined with the very small changes on Charter Avenue, suggest that there will not be a significant amount of induced demand occurring as a result of the link road.

6.52 The analysis has suggested that link flows may increase on Kirby Corner Road, particularly in the PM period, however this is likely to be constrained by congested conditions at the A45/Sir Henry Parkes Road junction, which would limit the propensity of traffic to use this route.

Reassignment on other Rural Routes

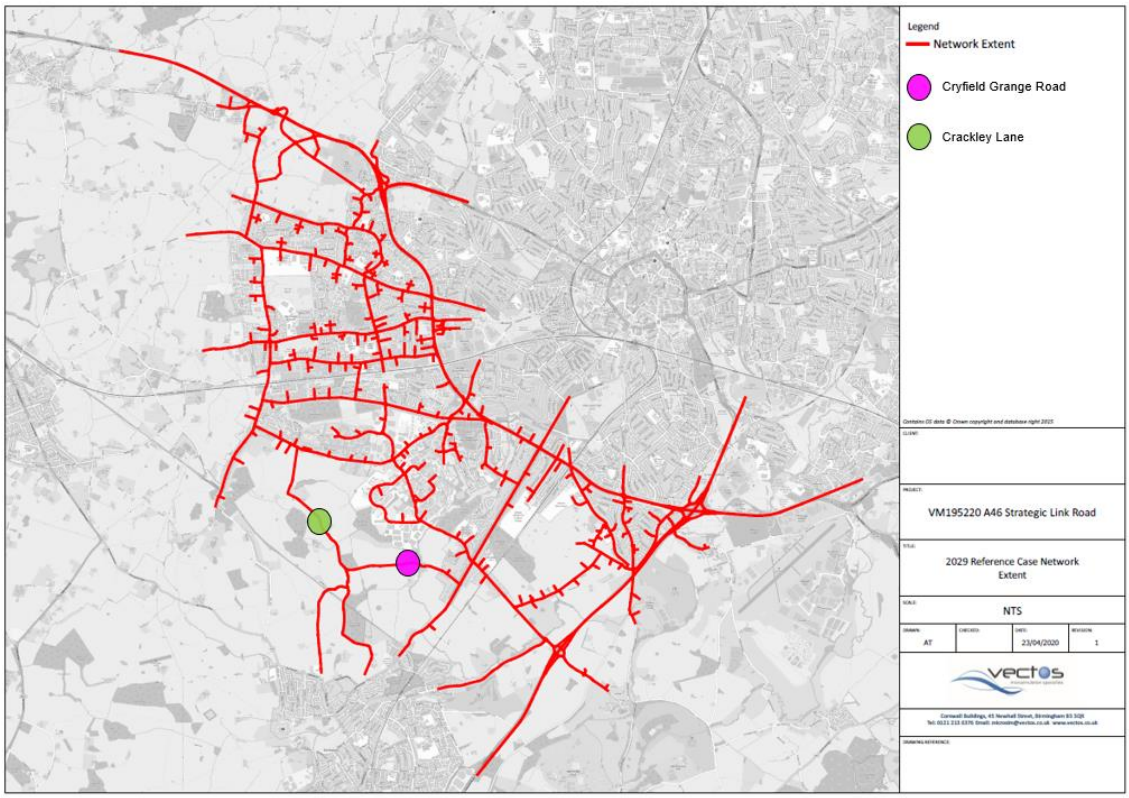
6.53 A further potential benefit that the Link Road is intended to deliver is to reduce the volume of traffic rat-running on rural routes within the study area. Given the coverage of the Paramics model, it is not possible to review all rural routes within the study area, however it has been possible to review changes in link flows on Crackley Lane and Cryfield Grange Road, two rural roads adjacent to the link road (see **Figure 56** which illustrates the location of these links).

6.54 The resulting changes in peak hour flows on these roads are presented within **Table 13**.

Table 13 Rural Routes Change in Vehicle Flows (Two Way Flows)

Link	AM Peak Hour			PM Peak Hour		
	Ref	DS + Mit	% Diff	Ref	DS + Mit	% Diff
Crackley Lane	440	320	-27%	399	289	-28%
Cryfield Grange	130	18	-86%	188	59	-68%

Figure 56 Rural Routes Analysis Locations



6.55 The traffic flows presented within **Table 13** suggest that the delivery of the link (along with the mitigation) has the potential to significantly reduce flows on both Crackley Lane and Cryfield Grange Road.

6.56 It is clear that the link road has the potential to reduce flows on rural roads in close proximity, such as the two links reviewed in this section.

Stage 2 Results Analysis Summary

6.57 The results presented within this stage of the note outline the performance of the preferred Link Road option (inclusive of link restrictions on Gibbet Hill Road), on the local road network.

6.58 The results demonstrate that the delivery of the link alone leads to a small number of instances of worsening queue conditions, predominantly across the Tile Hill/Westwood Heath area of the model network. Accordingly, six concept mitigation schemes have been derived and included within the model, to form the Do Something + Mitigation scenario.

6.59 The resultant analysis, inclusive of mitigation, highlights that the delivery of the link road, plus the mitigation, has the potential to deliver significant queue reductions across the network, with critical strategic benefits at the congested A45/Kenilworth Road junction.

6.60 The analysis also indicates that inclusion of the link has the potential to reduce rat running on surrounding rural routes, whilst not having a detrimental impact on flows in the Tile Hill area of the model. The only notable increase in modelled flows are reported between the Link Road and A45, occurring in the Cromwell Lane/Station Avenue areas of the model.

6.61 In summary, the link itself when delivered alongside the mitigation measures identified, has the potential to deliver significant strategic and localised benefits to the network and the current modelling does not indicate a significant prevalence of induced traffic in and around the Westwood Heath area beyond improved flows between Kenilworth Road, University of Warwick and Westwood Heath (including the business park).

7 STAGE 3 ANALYSIS – SENSITIVITY TESTING

7.1 Following the identification of the preferred link road option, and supporting highway mitigation, outlined within Stage 2, a final stage of testing was undertaken comprising two Sensitivity Tests.

7.2 The Sensitivity Test considered the effects of any strategic reassignment effects, occurring as a result of delivering the link road, which informed via analysis of the CASM cordon matrices for the study area.

7.3 The second Sensitivity Test assessed the impact on the network of a higher level of development being delivered at the Kings Hill site and the expansion of the University of Warwick alongside provision for the reserve housing site DS21 to come forward through the local plan.

CASM Reassignment

7.4 The first sensitivity test undertaken relates to the consideration of the likely reassignment effects, at a strategic level, of delivering the link road. In order to inform this reassignment, the matrices from the following CASM model runs have been received and reviewed:

- 2026 CASM Do Minimum (No Link Road)
- 2026 CASM Do Something (With Link Road)

7.5 VM have reviewed these CASM matrices for the AM and PM period, with a particular focus on any reassignment effects on the following loading points into the model (see also **Figure 57**):

- A46
- Dalehouse Lane
- A429 Kenilworth Road

7.6 The average of the AM and PM changes in demands at these locations is outlined in **Table 14**.

Figure 57 CASM Reassignment Assessment Locations

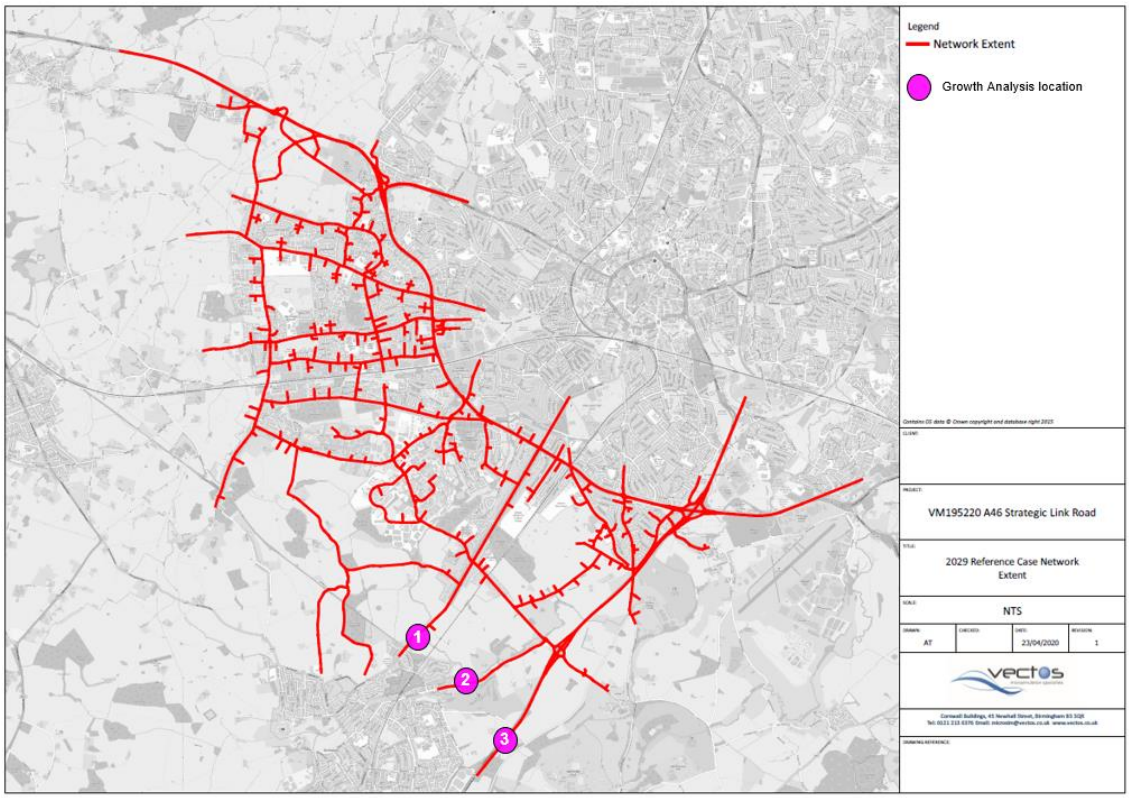


Table 14 Reassignment Impacts with Link Road Included (CASM Matrices Review)

Loading Point	AM Growth Change	PM Growth Change
1 - A429	-6.01%	-4.05%
2 – Dalehouse Lane	+0.89%	+1.68%
3 – A46	+0.35%	+1.02%

7.7 The growth analysis presented within **Table 14** suggests that, with the inclusion of the link road, there is a reduction in traffic loading into the model from the A429, and a minor increase in traffic loading from Dalehouse Lane and the A46.

7.8 It is likely that this is a result of vehicles travelling from the Warwick/Leamington direction now choosing to route on the A46 and new link road, rather than through Kenilworth and onto the A429 when travelling in the direction of the University of Warwick.

7.9 Accordingly, the Paramics demands in the 2029 Do Something + Mitigation scenario have been adjusted, by the percentages derived from CASM, for the zones representing the A429/Dalehouse Lane and A46 entry and exit points.

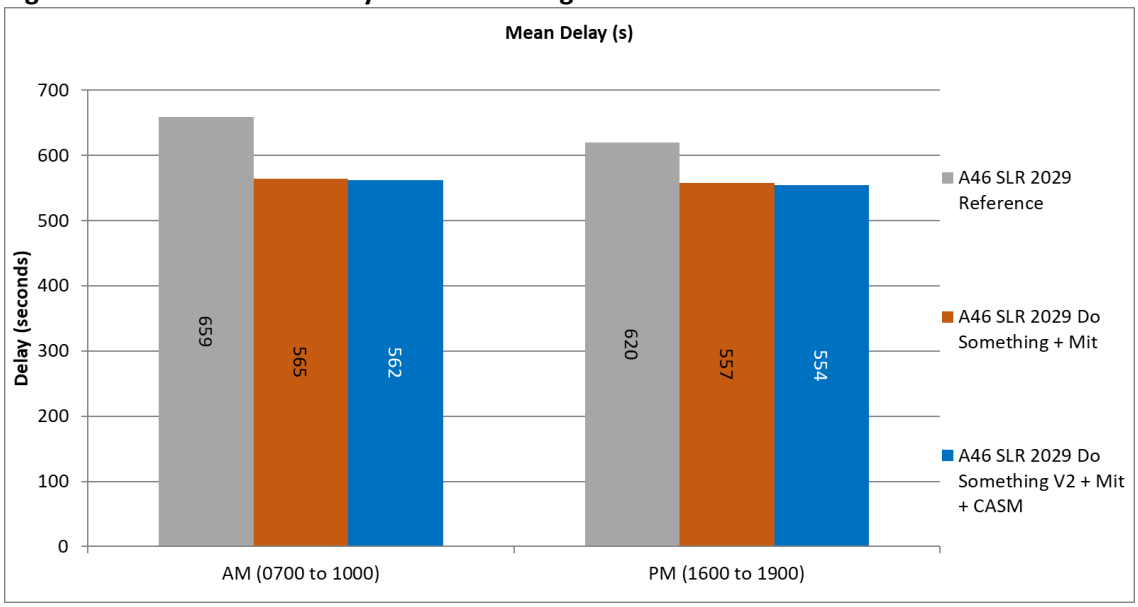
7.10 Further to this, the CASM cordoned demands have also been interrogated to establish any differences in the external to external zone movements as a result of delivering the link road

in CASM. This analysis revealed that with the link road included, the external growth within the model increases by around only 1% in the AM and PM periods. Accordingly, all external growth within the Paramics model has been uplifted by this amount within this sensitivity test.

7.11 The resultant model scenario has been named 2029 Do Something + Mitigation + CASM and has been run in order to compare outputs with the equivalent scenario not containing any reassignment effects.

7.12 The impact on network wide delay, along with the impact on queue lengths at the previously identified critical parts of the network is presented in the following analysis.

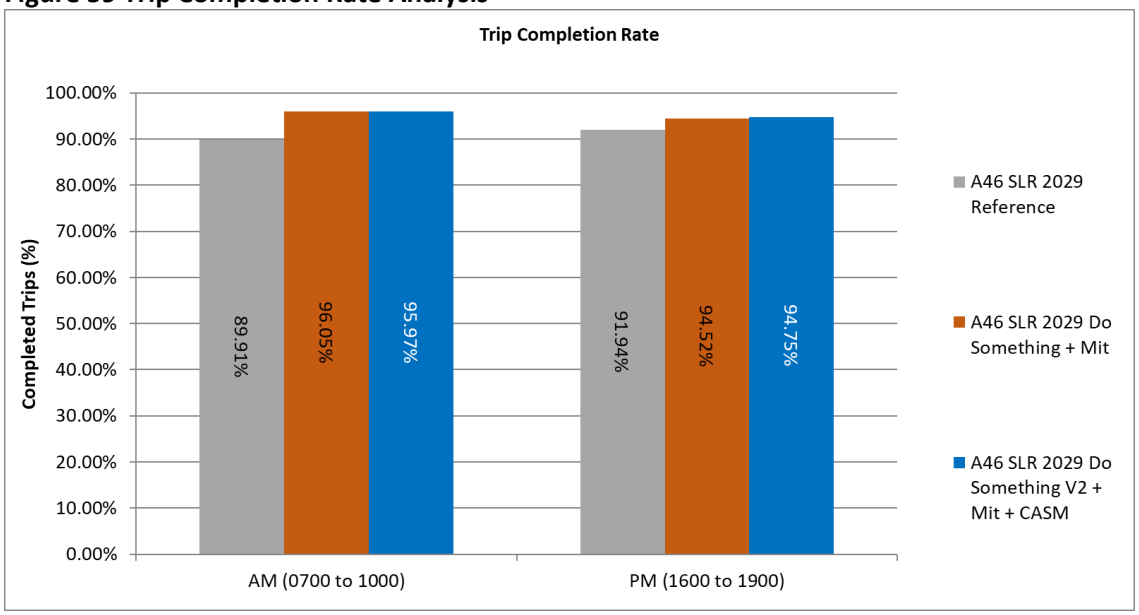
Figure 58 Network Wide Delay – CASM Reassignment Assessment



7.13 The network wide statistics analysis demonstrates that once the re-assignment is applied to the modelling, there is a small reduction in network wide delay across the AM and PM peak. In both periods, there is a three second reduction in average journey times, compared with the Do Something + Mitigation scenario. The modelling suggest that this is a result of the link road now drawing trips onto more direct routes (link road itself) and away from more minor routes.

7.14 This is combined with the fact that the adjustment for the CASM reassignment predicts an overall increase in demands within the model, which is demonstrated within **Figure 59.**

Figure 59 Trip Completion Rate Analysis



7.15 In order to review the impact of the reassignment in more detail, the critical junctions outlined within the Stage 2 analysis have been reviewed further, specifically the A45/Kenilworth Road junction, and Cromwell Lane/Westwood Heath Road junction.

Queue Length Analysis

7.16 The previous analysis has demonstrated that the inclusion of the Link Road plus mitigation has significant benefits for the A45/Kenilworth Road junction across the AM and PM period, whilst issues at the Cromwell Lane/Westwood Heath Road junction are improved.

7.17 It has been determined that the operation of these junctions should be reviewed following the inclusion of the reassignment effects informed via CASM. The following figures present this queue length analysis.

Figure 60 A45/Kenilworth Road Queue Analysis – AM Peak Hour

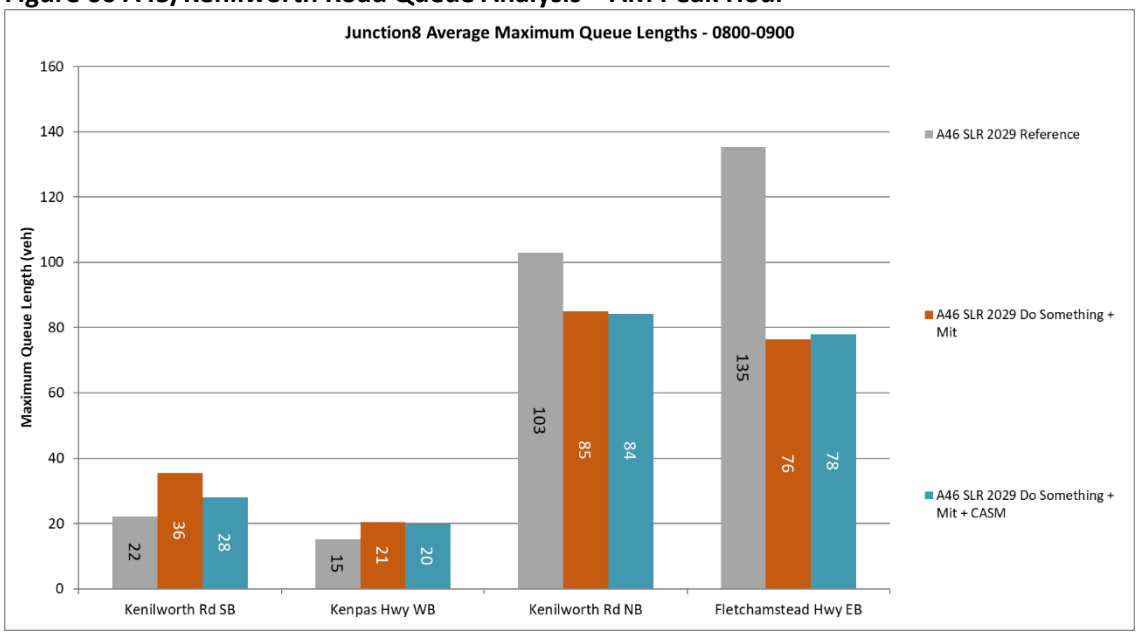
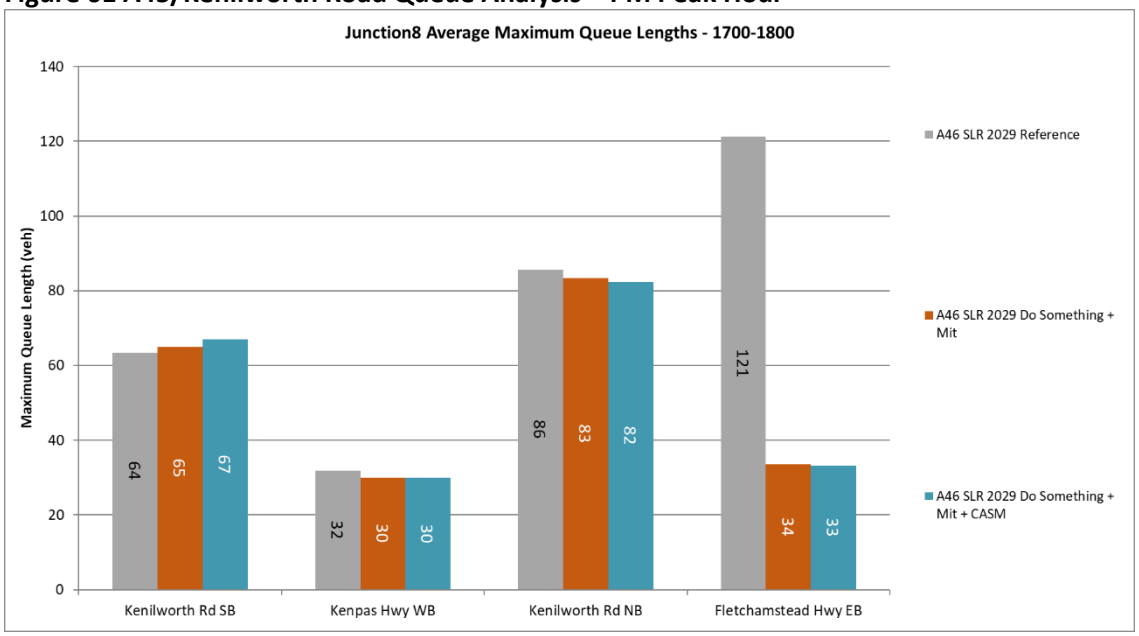


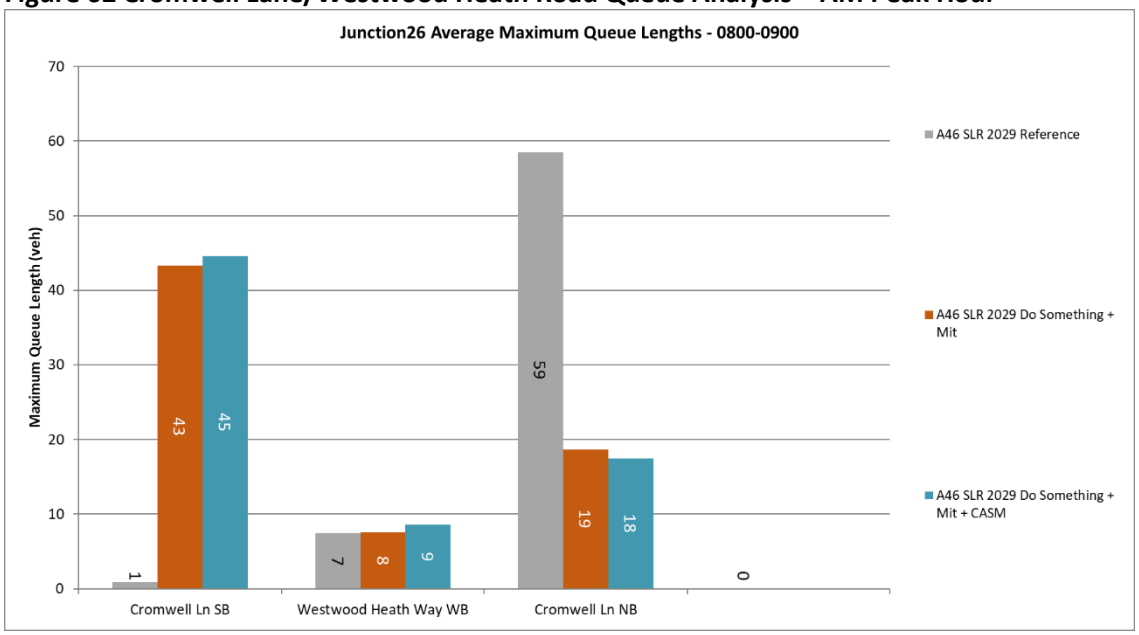
Figure 61 A45/Kenilworth Road Queue Analysis – PM Peak Hour



7.18 The queue analysis graphs presented within **Figure 60** and **Figure 61** demonstrate that across the AM and PM period there are no notable changes in queue lengths across the junction as a result of factoring into the modelling the reassignment effects.

7.19 Further to the above analysis, the Cromwell Lane/Westwood Heath Road junction has been considered below. On the basis that this junction only experienced issues during the AM period in the previous analysis, results for the AM peak hour only have been presented.

Figure 62 Cromwell Lane/Westwood Heath Road Queue Analysis – AM Peak Hour



7.20 In a similar pattern to the analysis of the A45/Kenilworth Road junction, the queue results during the AM peak hour presented within **Figure 62** demonstrates no change when comparing the scenarios with and without the reassignment effects included.

Link Flow Changes

7.21 A final stage of the analysis of the CASM reassignment effects reviews link flow changes previously analysed in the Tile Hill area of the model, along with on the Link Road itself. A comparison of the link flows in the 'with' and 'without' reassignment scenarios has been undertaken, with the results presented within **Table 15**.

Table 15 Reassignment Effect – Two Way Link Flow Changes between Link Road and A45

Link	AM Peak Hour			PM Peak Hour		
	DS + Mit	DS + CASM	% Diff	DS + Mit	DS + CASM	% Diff
1 – Westwood Heath Road	1312	1317	+0.3%	1372	1364	-0.8%
2 – Cromwell Lane	1720	1721	0.0%	1639	1650	+0.7%
3 – Station Avenue	1467	1467	0.0%	1389	1397	+0.5%
4 – Pickford Green Lane	978	977	0.0%	938	922	-1.7%
5 – Broad Lane	991	997	+0.6%	1005	999	-0.6%
6 –Tile Hill Lane	847	840	-0.8%	752	761	+1.1%
7 – Torrington Avenue	552	544	-1.4%	621	620	0.0%
8 – Charter Avenue	641	643	+0.3%	438	443	+1.1%
9 – Westwood Heath Road	1033	1021	-1.1%	1204	1185	-1.5%
10 – Kirkby Corner Road	1484	1466	-1.2%	1385	1383	-0.1%

7.22 The link flows presented within **Table 15** again demonstrate negligible change in the model outputs once the reassignment effects are considered, with no instances of more than 1.5% difference in the link flows presented.

Table 16 Reassignment Effect – Two Way Link Flow Changes on A46 Strategic Link

Link	AM Peak Hour			PM Peak Hour		
	DS + Mit	DS + CASM	GEH	DS + Mit	DS + CASM	GEH
Link Road (btwn A46 & A429)	3047	3021	0.5	2725	2714	0.2
Link Road (btwn A429 & Westwood Heath	761	752	0.3	801	785	0.6

7.23 The link flows presented within **Table 16** present changes to two-way flows on the link road itself, once the reassignment effects are considered. These flows extracted again demonstrate negligible differences between the scenarios with and without reassignment effects considered.

Reassignment Effect Summary

7.24 The results presented within this section have outlined the sensitivity testing undertaken around the inclusion of reassignment effects within the model. The reassignment effects are intended to capture any strategic re-routing predicted to occur as a result of delivering the link road, and have been extracted from the 2026 CASM model matrices provided to VM.

7.25 The focus of this reassignment has been on the loading points at the southern extent of the Paramics model network, and the resultant changes in demands between the CASM Do Minimum and CASM Do Something scenarios have been reflected within the Paramics model. In addition to this the all external to external zone movements within the Paramics modelling have been adjusted by the level of predicted demand changes interpreted from the CASM matrices.

7.26 The analysis has reviewed the impact network wide delay, queue lengths at critical junctions, and link flows at the northern end of the link, along with on the link itself.

7.27 The results have consistently demonstrated that there are no substantive issues predicted to arise as a result of the reassignment considered.

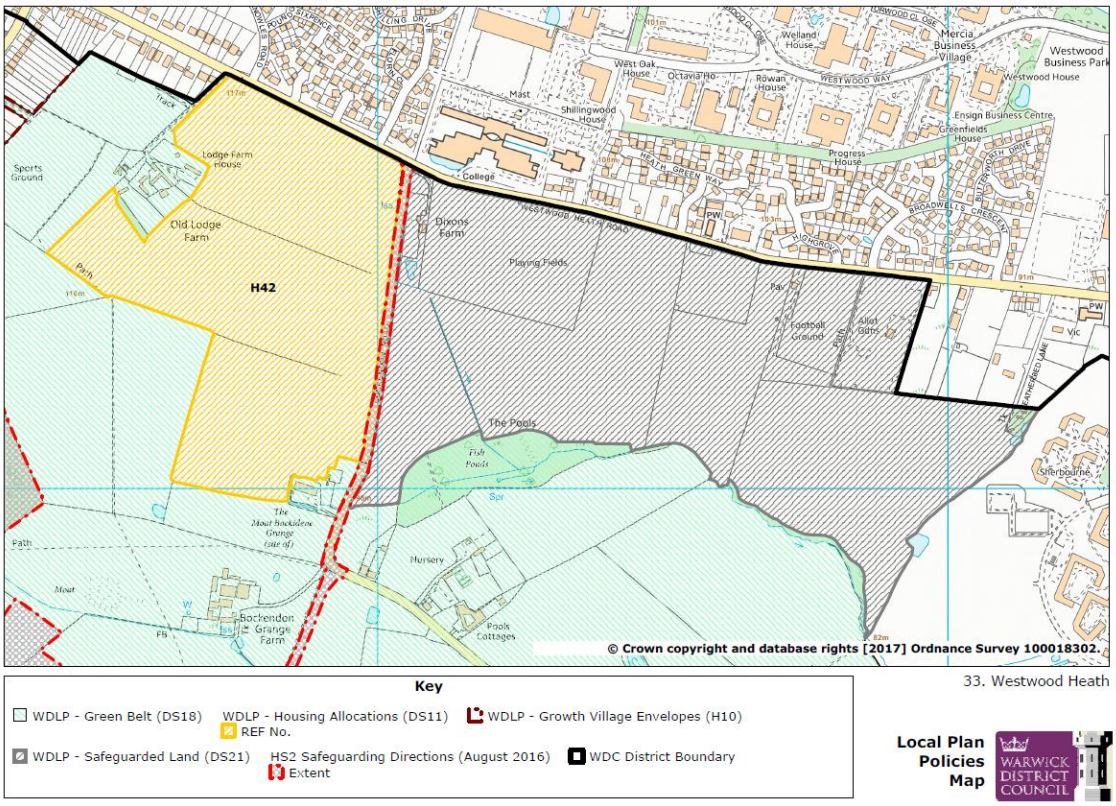
Additional Growth Assessment

7.28 The second sensitivity test undertaken relates to the inclusion of additional growth at specific locations within the model. VM understand that the delivery of the link road is likely to unlock the potential for additional growth to be delivered at the Kings Hill site, University of Warwick and the reserve site at Westwood Heath (DS21).

7.29 The delivery of additional growth at these sites is intrinsically linked to the delivery of the link road, however, this test focuses on the impact of including this additional growth alongside the link road itself, and the predicted network wide impacts that may occur.

7.30 The additional growth considered for this test relates to the increase in the number of dwellings delivered at Kings Hill from the previously modelled 2,500 units to 4,000, delivering a further 20% growth in traffic from the University of Warwick, and 800 dwellings at the DS21 site off Westwood Heath Road (as per the grey shaded area in **Figure 63**).

Figure 63 Westwood Heath Reserve Site Location



Key

WDLP - Green Belt (DS18) WDLP - Housing Allocations (DS11) WDLP - Growth Village Envelopes (H10) REF No.

WDLP - Safeguarded Land (DS21) HS2 Safeguarding Directions (August 2016) WDC District Boundary Extent

33. Westwood Heath

Local Plan Policies Map

7.31 These demand adjustments have been assigned to the model to form the 2029 Do Something + Mitigation + Growth scenario. The additional growth demands have also been assigned to the 2029 Reference Case, in order to enable an assessment of the opportunity for including additional housing growth afforded by the delivery of the link. As such model

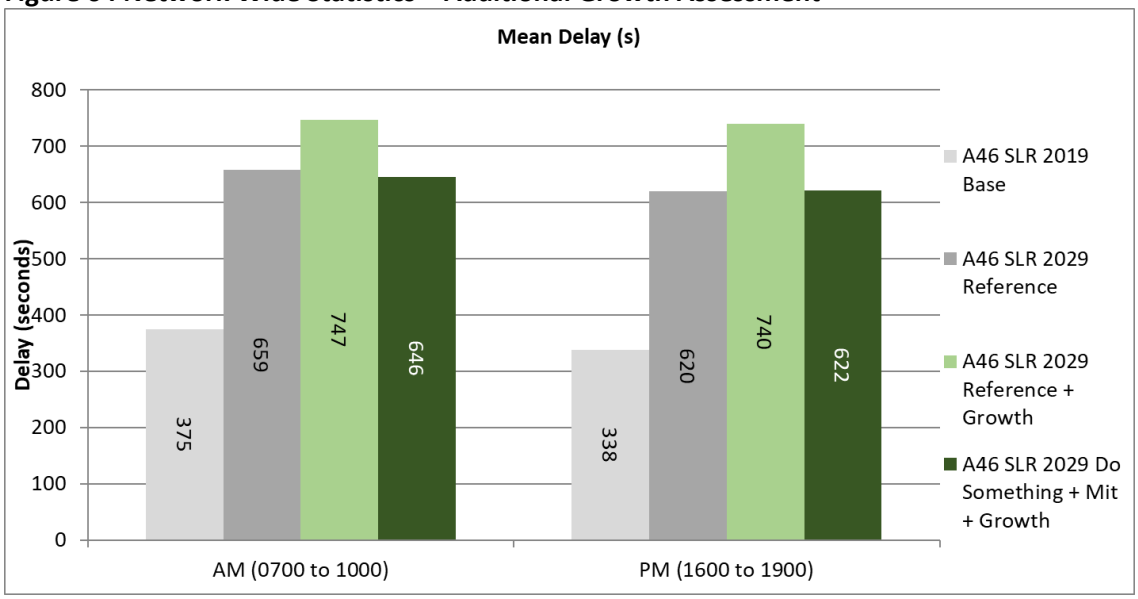
results have been extracted and presented for the following two scenarios (alongside 2029 Reference Case conditions):

- 2029 Reference Case + Additional Growth
- 2029 Do Something + Mitigation + Additional Growth

Additional Growth Impact Assessment

7.32 The impact on network wide delay, along with the trip completion rate are presented within the following figures.

Figure 64 Network Wide Statistics – Additional Growth Assessment



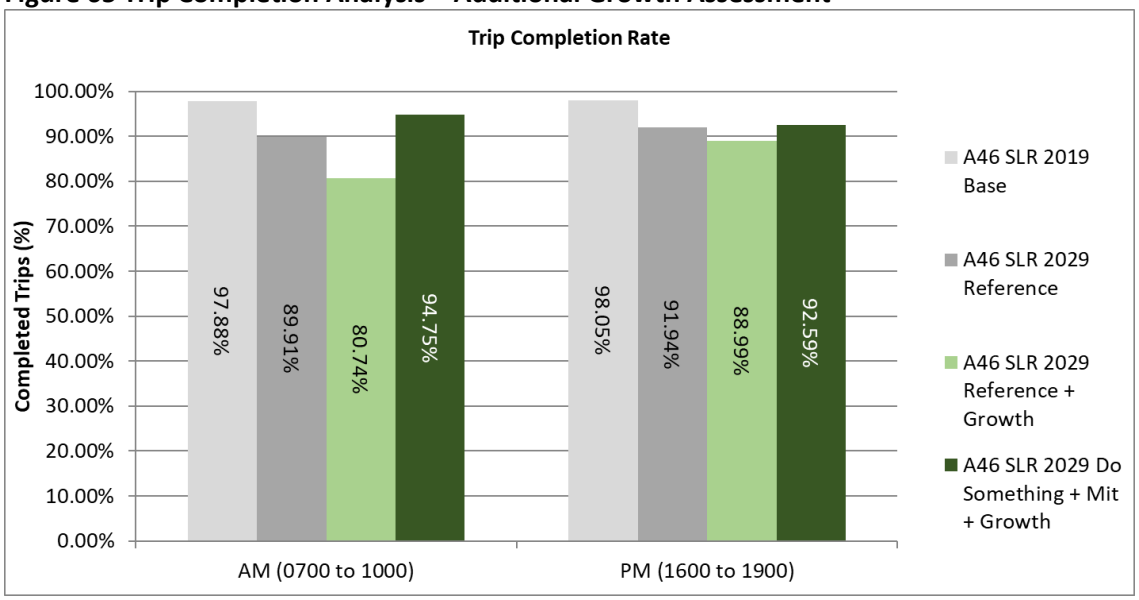
7.33 The network wide statistics presented within **Figure 64** demonstrate that following the inclusion of the additional growth assumptions within both model scenarios, the strategic impact reported within the Reference Case + Growth is significant, with average journey time increases over the Reference Case of around 50 seconds during the AM period, and 80 seconds in the PM period.

7.34 The results for the additional growth in the Do Something + Mitigation scenario demonstrate that average journey times remain lower than Reference Case conditions during the AM peak, and broadly similar in the PM peak.

7.35 This analysis is further supported by the trip completion analysis presented within **Figure 65**, which demonstrates a significant drop in the trip completion rate during the AM and PM period in the Reference + Growth scenario, whilst the trip completion rate within the Do

Something + Mitigation + Growth scenario demonstrates a higher rate than the Reference Case suggesting that this scenario is accommodating the additional traffic growth.

Figure 65 Trip Completion Analysis – Additional Growth Assessment



7.36 The network wide statistics analysis presented within the previous two figures has suggested that with the additional growth included within the 2029 Reference Case, the model begins to struggle to provide capacity for the additional demands, with significant increases in average journey times, and reductions in the proportion of completed trips relative to the demand totals.

7.37 The analysis of the Do Something + Mitigation + Growth scenario suggests that the additional trips can be accommodated within the network, albeit with an increases in delay over previous Do Something conditions.

7.38 In order to review the additional delay occurring as a result of including this growth in trips, further analysis has been undertaken in the form of queue length analysis. This has been undertaken to compare both the 2029 Reference + Growth and 2029 Do Something + Mitigation + Growth scenarios, against 2029 Reference Case conditions, and is presented within the following figures:

Figure 66 Queue Impact Analysis – AM Peak Hour – 2029 Ref vs 2029 Ref + Growth

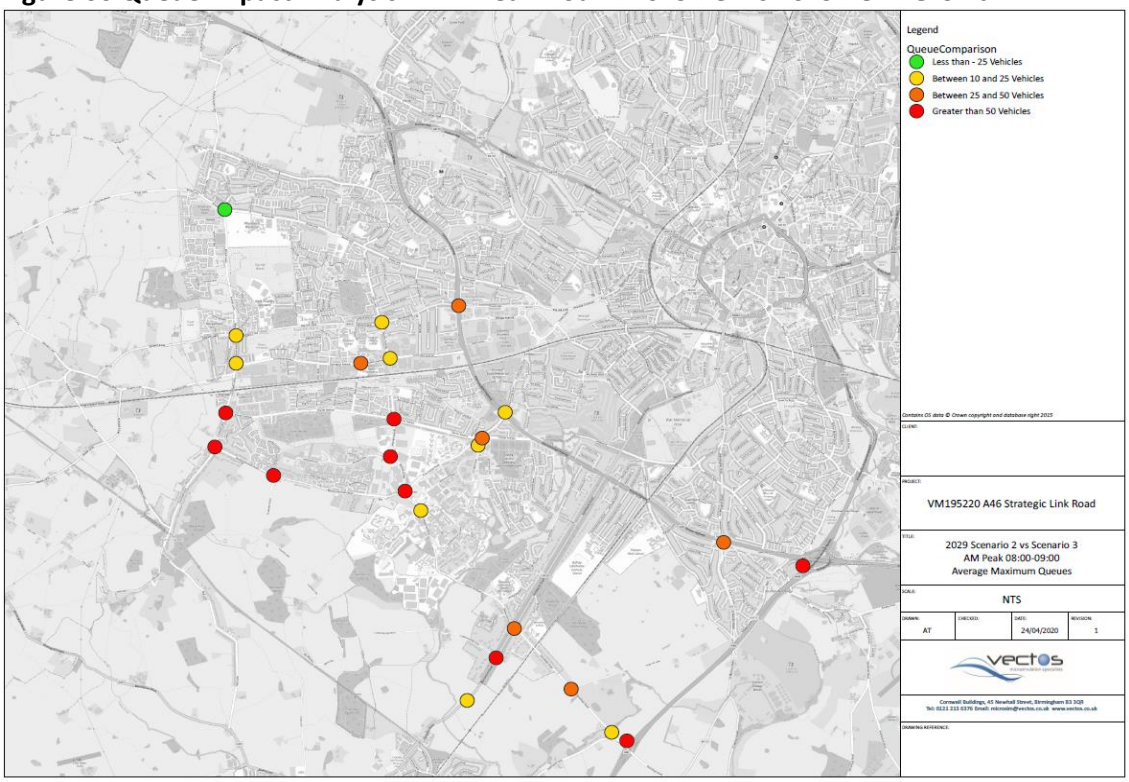
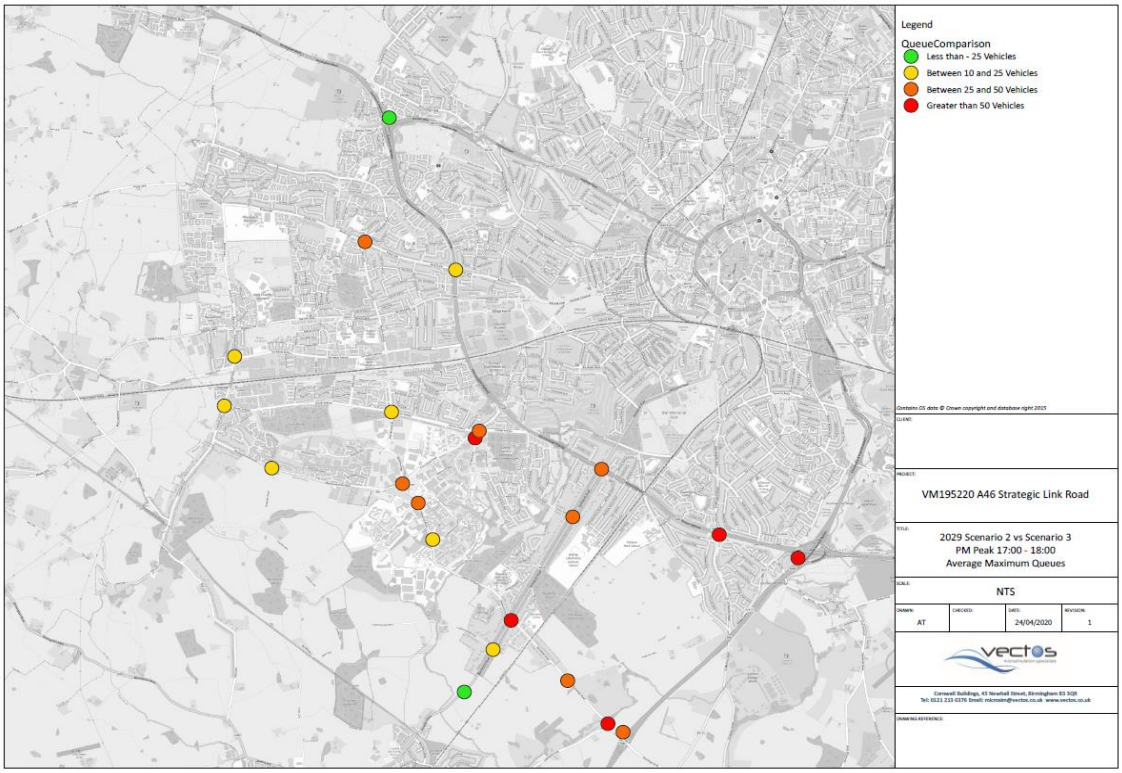


Figure 67 Queue Impact Analysis – PM Peak Hour – 2029 Ref vs 2029 Ref + Growth



7.39 The analysis presented within **Figure 66** and **Figure 67** illustrates the queue impact between the 2029 Reference and 2029 Do Something + Mitigation + Growth scenarios. In line with the network wide statistics results presented, this analysis suggests that the network is

beginning to operate over capacity, with a severe worsening of queue lengths at a number of junctions across the AM and PM period, when compared against 2029 Reference Case conditions.

Figure 68 Queue Impact Analysis – AM Peak Hour – 2029 Ref vs 2029 DS + Mit + Growth

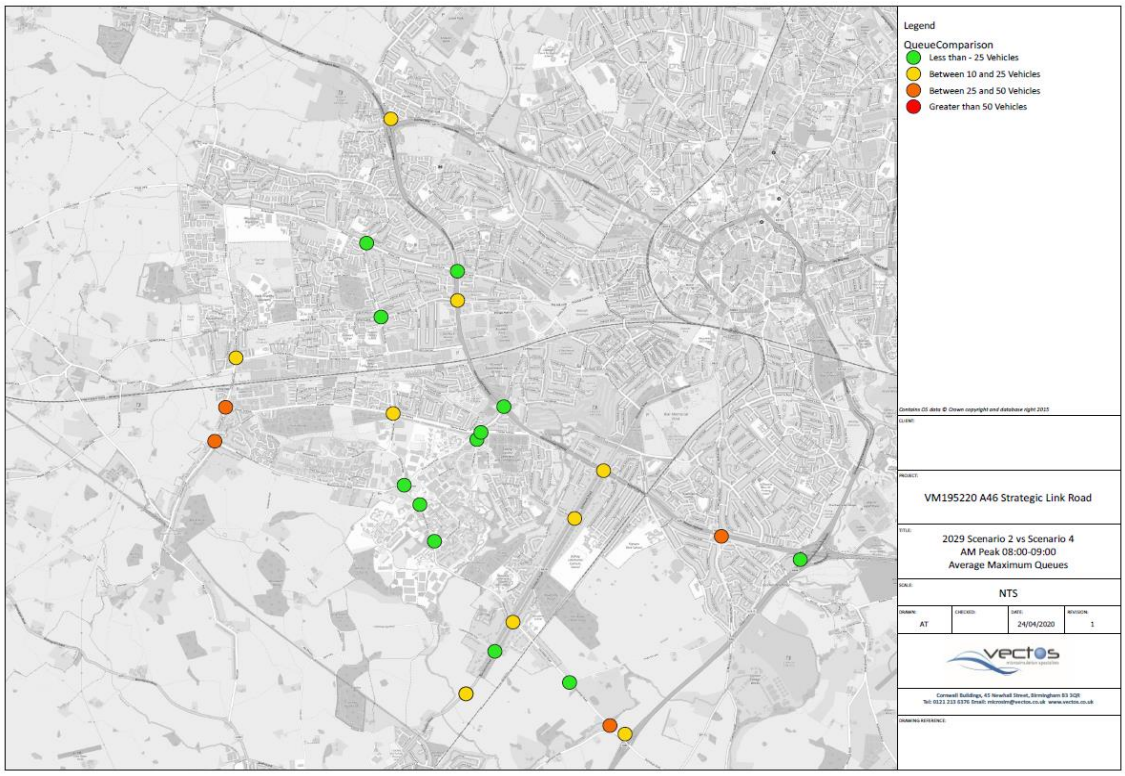
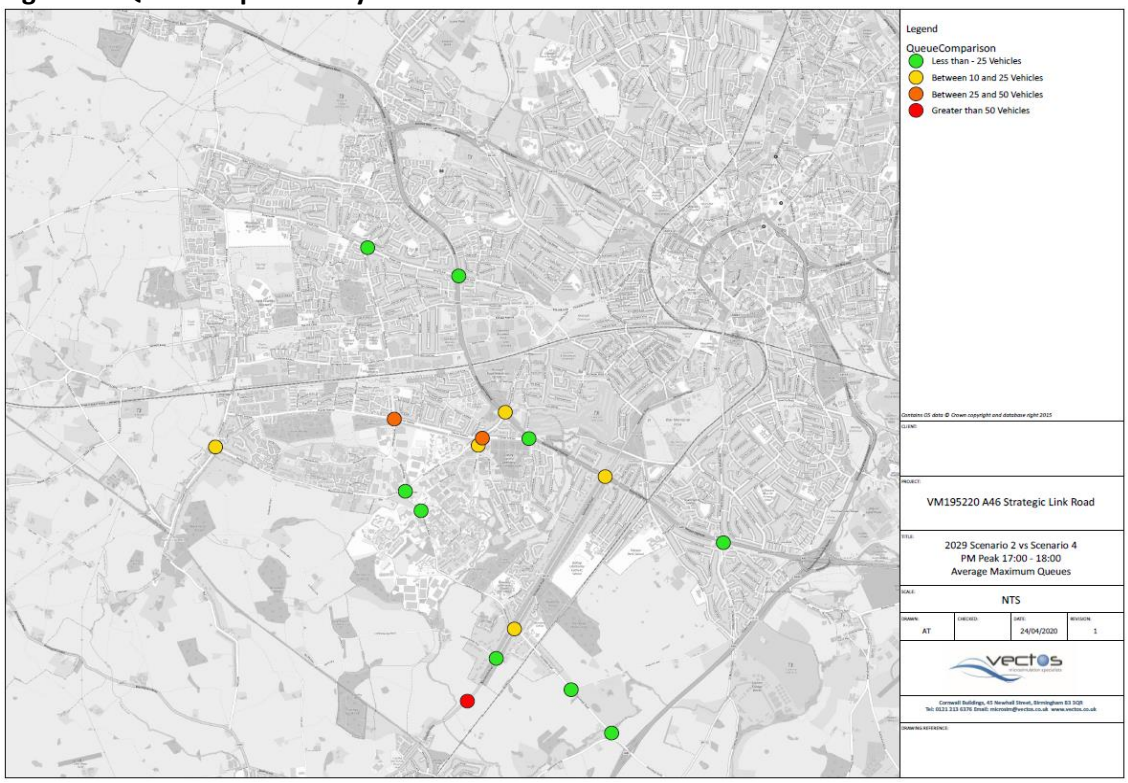


Figure 69 Queue Impact Analysis – PM Peak Hour – 2029 Ref vs 2029 DS + Mit + Growth



7.40 The analysis presented within **Figure 68** and **Figure 69** illustrates the queue impact between the 2029 Reference and 2029 Do Something + Mitigation + Growth scenarios.

7.41 These queue results suggest that despite the inclusion of additional growth within the model, the delivery of the link road, and mitigation schemes previously identified, lead to a number of instances of improvements in queue conditions across the AM and PM peak.

7.42 The results do however suggest that there is predicted to be a small number of localised impacts, which are likely to require additional mitigation to reduce the impact.

Additional Growth Summary

7.43 The analysis of the additional growth scenarios presented within this stage of the report has highlighted that the Reference Case clearly does not have available capacity to accommodate the additional growth alongside the already committed development trips, without significant congestion issues occurring.

7.44 The Do Something scenario results however have demonstrated that the inclusion of the additional growth alongside the link road results in a network performance which continues to deliver betterment over the 2029 Reference Case conditions, however, it is likely that further localised mitigation schemes will need to be required should the additional sites come forward.

Stage 3 Results Analysis Summary

7.45 The results presented within this section have outlined the sensitivity testing undertaken around the inclusion of reassignment effects within the model, along with an assessment of the impact of delivering additional growth alongside the link road.

7.46 The reassignment effects test has been developed to capture any strategic re-routing predicted to occur as a result of delivering the link road, and have been extracted from the 2026 CASM model matrices provided to VM. The results of this test have consistently demonstrated that there are no substantive issues predicted to arise as a result of the reassignment considered.

7.47 The results of the additional growth test demonstrate that the Reference Case scenario does not have the capacity to accommodate the additional demands without significant congestion issues occurring.

7.48 The results have however indicated that the additional demands could be accommodated alongside the delivery of the link. The analysis has highlighted that along with the link and the previously identified mitigation, it is likely further localised schemes would be required to further improve network conditions.

8 SUMMARY AND RECOMMENDATIONS

Summary

8.1 Vectos Microsim (VM) has been commissioned by Warwickshire County Council (WCC) to undertake testing related to the impact of delivering the A46 Strategic Link Road within the recently developed A46 Link Road Paramics model.

8.2 This report documents the detailed testing that has been undertaken within the microsimulation model developed specifically for this assessment, with a view to outlining the preferred link road option, along with supporting highway interventions.

8.3 The report specifically focuses on addressing the following objectives:

- To assess the implications of delivering the link in phases including several options for delivery.
- To identify wider effects arising from the delivery of the link road including any impacts on the A45 as well as around Westwood Heath and the University.
- To consider the effects on network conditions that may be induced as a result of strategic reassignment (to be identified from the CASM model)
- To identify any additional highway interventions which may be able to complement the link road through improved flow of traffic.
- To identify opportunities to provide complementary measures such as the downgrading of Gibbet Hill to encourage active mode choice.
- To identify effects of delivery of wider growth aspirations including the reserve site at DS21, additional growth at the University of Warwick and further build out at Kings Hill.

8.4 In order to address the objectives, the study has been broken down into three stages. The conclusions drawn from each stage are summarised below.

Stage 1 – Strategic Link Road Options

8.5 The first stage reports the strategic level impact of delivering variations of the link road. The impact of delivering the link road in phases has been assessed, along with the analysis of variations in accompanying measures delivered alongside the full link.

8.6 The results have initially been presented for the 'Do Minimum' scenarios, which deliver only part of the link road between the A46 and A429. These modelling outputs indicate that delivering only southern part of the link road (i.e. not providing a connection between the A429 and Westwood Heath Road) is unlikely to result in any notable benefit at a strategic level.

8.7 The Do Minimum V2 test, which includes the link from the A429 to the University, also delivers no betterment over the remaining Do Minimum scenarios.

8.8 Subsequently this stage of the report has then presented the analysis of the Do Something scenarios (which deliver the full link road). The results demonstrate that each of the Do Something scenarios deliver significant improvements in terms of strategic impacts over the Reference Case, and critically over the partial delivery of the link presented within the Do Minimum scenarios.

8.9 The analysis has also presented impacts on the A45, which again reports modelled journey times in all Do Something scenarios reducing, both northbound and southbound, in the AM and PM period.

8.10 In terms of determining a preferred Do Something scenario to take forward for further analysis, each option tested delivers strategic level benefits. However, the Do Something scenario which also contains a restriction to through traffic on Gibbet Hill Road, delivers the highest traffic flows along the link itself, whilst affording an additional objective of this assessment to be met, in regards to the downgrading of Gibbet Hill Road to all through trips, without having an adverse strategic level impact.

This scenario has been taken forward for detailed analysis, presented within Stage 2 of the results analysis.

Stage 2 – Localised Highway Impact

8.11 The results presented within Stage 2 outline the modelled impact of the preferred Link Road option (inclusive of link restrictions on Gibbet Hill Road), on the local road network.

8.12 The results demonstrate that the delivery of the link alone leads to a small number of instances of worsening queue conditions predominantly across the Tile Hill/Westwood Heath area of the model network. Accordingly, six concept mitigation schemes have been derived

and included within the model to form the Do Something + Mitigation scenario, as set out below:

- Cromwell Lane/Westwood Heath Road mini-roundabout
- Cromwell Lane/Charter Avenue right turn bay
- Cromwell Lane/Torrington Avenue right turn bay
- Westwood Heath Road/Westwood Way widening
- Broad Lane/Job's Lane widening
- Kings Hill Access/Stoneleigh Road reconfigured access and adjusted restrictions

8.13 The resultant analysis of this scenario has highlighted that the inclusion of the link road, plus the mitigation, has the potential to deliver significant queue reductions across the network, with critical strategic benefits at the congested A45/Kenilworth Road junction.

8.14 The analysis has also indicated that inclusion of the link has the potential to reduce rat running on surrounding rural routes, whilst not having a detrimental impact on flows in the Tile Hill area of the model. The only notable increase in modelled flows are reported between the Link Road and A45, occurring in the Cromwell Lane/Station Avenue areas of the model.

8.15 In summary, the link itself when delivered alongside the mitigation measures identified, has the potential to deliver significant strategic and localised benefits to the network, at the locations set out below:

- A45/Kenilworth Road – reduced queues
- A45 – reduced journey times
- Cromwell Lane/Westwood Heath Road – reduced queues
- Reduced rat running on rural roads
- Reduced traffic on Gibbet Hill Road/through the University of Warwick

Stage 3 – Sensitivity Testing

8.16 The results presented within this section have outlined the sensitivity testing undertaken around the inclusion of reassignment effects within the model, along with an assessment of the impact of delivering additional growth alongside the link road.

8.17 The reassignment effects test has been developed to capture any strategic re-routing predicted to occur as a result of delivering the link road, and have been extracted from the 2026 CASM model matrices provided to VM. The results of this test have consistently demonstrated that there are no substantive issues predicted to arise as a result of the reassignment considered.

8.18 The results of the additional growth test demonstrate that the Reference Case scenario does not have the capacity to accommodate the additional demands without significant congestion issues occurring.

8.19 The results have however indicated that the additional demands could be accommodated alongside the delivery of the link. The analysis has highlighted that along with the link and the previously identified mitigation, it is likely further localised schemes would be required to further improve network conditions.

Conclusions

8.20 Based upon the assessment documented within this report, and the summary provided above, it is possible to draw the following conclusions from this study:

- The full connection between the A46 and Westwood Heath is required to unlock the strategic benefits of the link road.
- Delivery of the link road is likely to be the only option which will provide the opportunity to restrict Gibbet Hill to through trips and that, based on the modelling, if it is delivered with the link road, the restrictions would not undermine the strategic benefits of the link road.
- There are a series of mitigation measures which could be delivered alongside the link road, and would mitigate any problems arising from changes in traffic flows resulting from the inclusion of the link road.
- The impacts of strategic reassignment do not indicate a significant draw of additional traffic will occur as a result of the link road delivery.
- Although there will be some residual impacts remaining on the network the link road does provide an opportunity for significantly more development to come forward within the area than may otherwise occur if it is not delivers.

Recommendations for Future Assessment

8.21 This study has reviewed the delivery of the link road at a strategic level, along with reviewing the predicted impact on the local highway network.

8.22 Within the study, a number of conclusions have been drawn regarding the need for mitigation schemes across the network, alongside the delivery of the link. These mitigation schemes, at this stage, are concept schemes, which in all instances are modelled within the existing highway boundary.

8.23 Despite the inclusion of the proposed mini-roundabout scheme at the Cromwell Lane/Westwood Heath Road junction, queues continue to form at this junction, as the southbound traffic is now forced to give way to right turning traffic.

8.24 Having discussed the issues at this junction, and the mitigation included, with Coventry CC officers, it has been determined that further work should be undertaken to understand the origin and destination of trips travelling through this junction, particularly those making the problematic right turn movement, whilst at the same time exploring alternative options for a larger mitigation scheme.

8.25 Additionally, one of the mitigation schemes identified, involved a re-configuration of the Kings Hill junction. This scheme was included to alleviate pressure on the A429/Link Road junction and reduce the need for Kings Hill traffic returning to the site via the link road to be forced to make a u-turn movement at this roundabout before travelling back along the link road turn left into Stoneleigh Road.

8.26 It is recommended that further consideration is given to alternative strategies for Kings Hill traffic, and whether the currently proposed mitigation junction arrangement is the optimal solution. Alternatively, consideration should be given to an additional junction on the new link road, where it meets Stoneleigh Road, which may provide improved connectivity between the A46 and the Kings Hill site.

8.27 Further to this, the Stage 2 analysis involved a scenario in which a connection between the strategic link and the Westwood Heath Business Park was included. This test indicated that the inclusion of the connection to the business park had the potential to improve the model performance, however, this option was discarded at this stage due to uncertainty over the connection and its deliverability. It is suggested that should further details on this connection

emerge then undertaking a further sensitivity test with the connection included would be beneficial.

8.28 As detailed within this report, the junctions included along the link road itself have all been included as indicative schemes, with a specific focus on enabling the required throughput of traffic without causing undue congestion and delay.

8.29 It is recommended that any additional modelling work undertaken begin to review the junction forms modelled, and perhaps update the layout of junctions along the route following any detailed design work, which should be undertaken.

8.30 A final recommendation relates to the CASM reassignment work undertaken. The reassignment considered in this assessment is based upon output matrices provided to VM from a 2026 assessment year CASM run. It is understood that a future year scenario of 2034 has been run, and accordingly, the reassignment should potentially be revisited in the form of an additional sensitivity test using these output matrices, to ascertain whether any more significant reassignment effects are predicted in this higher growth future year. This would make use of an updated set of CASM runs which include an account of the proposals identified within this study.