Lutterworth East SDA Junctions Operational Assessment

Leicestershire County Council and Harborough District Council

Technical Note - Lutterworth East SDA Junctions

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Lutterworth East SDA Junctions

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1. Scope and Purpose of the Technical Note

1.1 Introduction

Jacobs was commissioned by Harborough District Council (HDC) and Leicestershire County Council (LCC) to undertake an operational assessment of the traffic impacts of the Lutterworth East Strategic Development Area (SDA) short listed Local Plan option for Harborough District.

This work builds upon the preliminary assessment carried out by Jacobs for the district, detailed in the 'Harborough District Local Plan Preliminary Traffic Impact Assessment' report, a final version of which was submitted to HDC and LCC on 1st November 2016. Following strategic SATURN traffic modelling of four short-listed Local Plan options, the Preliminary TIA report indicated that more detailed investigation was required of the underlying causes and potential for mitigation of modelled congestion at the M1 Junction 20 and new junctions on the A4303 and A4304 associated with the Lutterworth East SDA proposal, referred to as Option 6.

1.2 Scope of work

The work detailed in this technical note focussed on optimising the signal controlled junctions associated with the Lutterworth East SDA in relation to method of control and signal timings, and then inputting the results from the optimisation exercise into the SATURN model to determine if the predicted delays (summarised in the Preliminary TIA report) could be reduced. This refinement process was carried out twice to ensure we captured more robust delay results from the SATURN model.

All the analysis detailed in this note relates to 2031 AM peak hour (0800-0900) and PM peak hour (1700-1800) forecasts derived from the SATURN model for the 'Option 6A' scenario. This included road network changes and end-of-Plan housing and employment assumptions related to the Lutterworth East SDA (Option 6) in addition to traffic generation associated with proposed new developments around Magna Park to the west of Lutterworth. This scenario was selected as it represents a worst-case in terms of forecast traffic volumes along the key A4303/A4304 east-west corridor to the south of the SDA site. In each case, Option 6A road network performance was compared with a 2031 'do minimum' baseline referred to in this note as the Reference Case.

The following work was carried out as part of this junction operational assessment:

1) Extract relevant demand and actual flow data from the 2031 AM and PM peak "Option 6A" SATURN model runs
2) Obtain and review the junction models and AutoCAD plans developed by AECOM (who developed the traffic proposals on behalf of the SDA developer) for the following junctions:
    a) A4303 / Rugby Road Junction (Frank Whittle Junction)
    b) M1 / A4303 / A4304 Junction (M1 Junction 20)
    c) New A4304 / Eastern Link Road junction
    d) A426 / Bill Crane Way Junction
3) Optimise the performance of the above junctions, through an assessment of the signal staging & timings and highway layout (two iterations)
4) Review additional congestion mitigation measures
5) Re-run the "Option 6A" SATURN test with optimised settings and additional mitigation (two iterations)

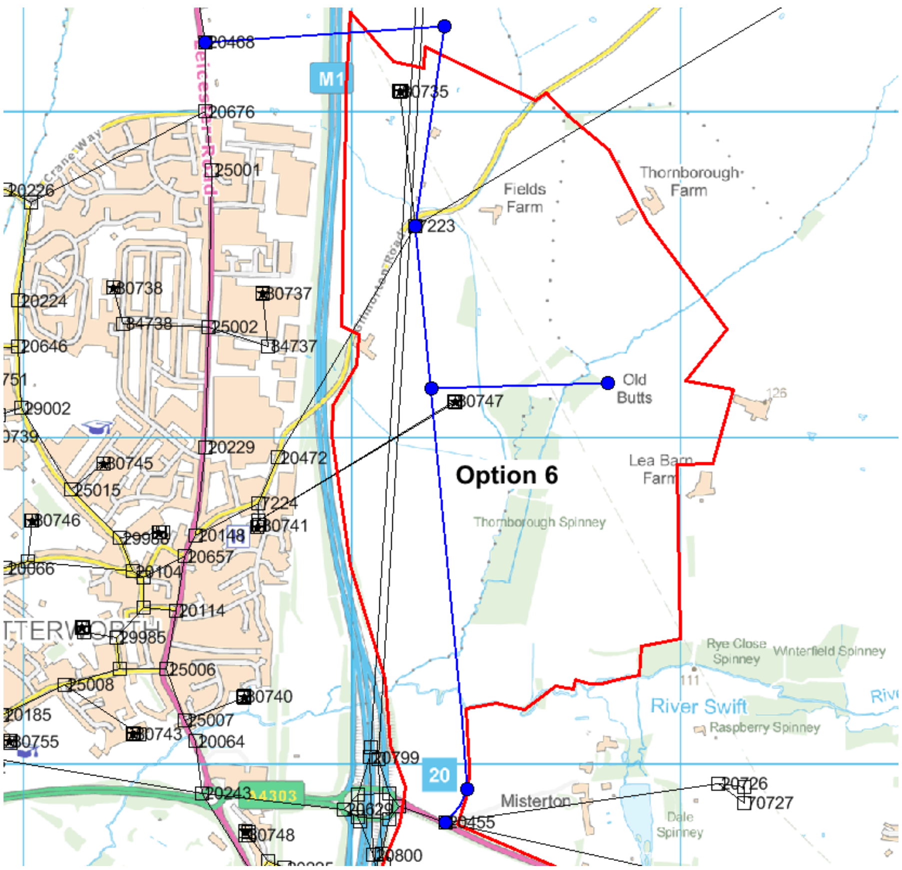
This Technical Note reports the results of the above list of activities and focuses on the traffic modelling undertaken in LinSig for the junction optimisation and junction designs developed in AutoCAD (CAD).

2. Previous work

2.1 Background

The assumed road network changes associated with the Lutterworth East SDA (Option 6) are summarised on the plan in Figure 2.1 below and include the provision of a new two-way single carriageway link road with a 30mph speed limit connecting the A4304 at its junction with Chapel Lane to a new uncontrolled roundabout on the A426 north of its existing junction with Bill Crane Way. The new link road runs to the east of the M1 and Lutterworth through the new SDA site for much of its length, crossing the M1 via a new bridge to the north of the existing settlement.

Figure 2.1 : Assumed Lutterworth SDA road network amendments



In addition, the A4303 / Rugby Road roundabout would be converted to a signalised four-arm junction, while a new signalised junction would be provided replacing the existing A4304 / Chapel Lane junction. The M1 Roundabout would also be signalised.

Some minor network changes were also made to allocate trips to and from the proposed new development sites around Magna Park to the west of Lutterworth in Option 6A, as shown in Figure 2.2. A new junction was coded to allocate expected demand from the sites on to the A5 and Mere Lane, with the latter providing a new connection to Hunter Boulevard.

Figure 2.2: Assumed 'Option 6A' road network amendments

Signal cycle times and junction geometry assumptions were sourced from the traffic team working for the SDA developers and were incorporated in the original SATURN model. The average change in delay at junctions from this original Option 6A SATURN run when compared with the Reference Case are shown below in Figure 2.3 and Figure 2.4 respectively.

Figure 2.3 : Original AM Average Delay Plot (change in delay: Option 6A v Reference Case)

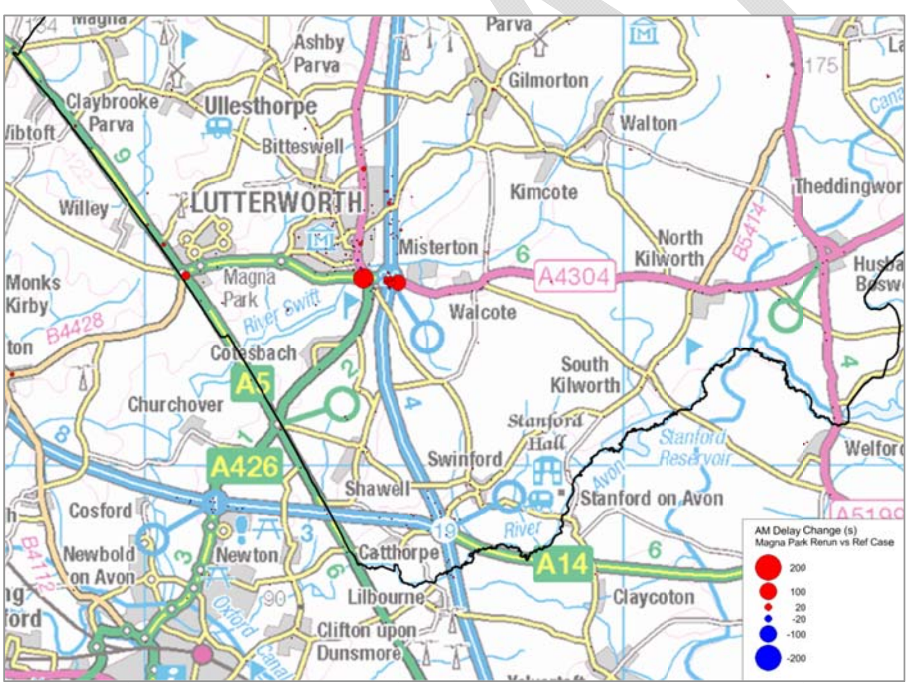
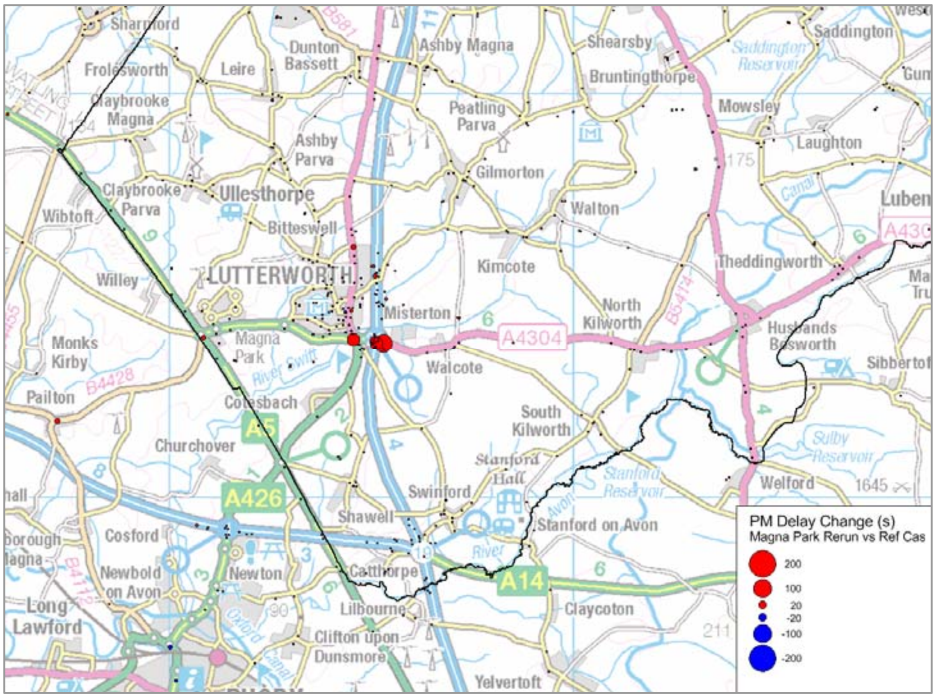


Figure 2.4 : Original PM Average Delay Plot (change in delay: Option 6A v Reference Case)



The original SATURN runs predicted that there would be some significant delay changes at the Frank Whittle and New Eastern Link Road junctions.

2.2 Review of AECOM local models

Local junction modelling for all of the four junctions had been undertaken by AECOM on behalf of the SDA developer using the LinSig modelling program.

All these LinSig models were reviewed by us and amendments were necessary for the following in some of the models:

- Link structure
- Saturation flows. These were measured from the CAD drawings provided by AECOM or if any changes were undertaken to the junction layout by us, then from the amended CAD drawings
- Intergreens. Likewise these were measured from the CAD drawings provided by AECOM or from the amended CAD drawings
- Give way parameters
- Phases and phases in stages
- Phase delays
- Stage sequence. The stage sequence was selected that had the lowest overall delay to traffic

3. Junction optimisation

Following the model review, the LinSig models were optimised for cycle time, splits and offsets. There were two iterations with the SATURN model (i.e. two sets of flows from the SATURN model runs tested in LinSig) and the results in this section are those from the second and last iteration. The results comparison from the original (or reference case) SATURN and the two iterations are illustrated in Section 4 Modelling Analysis Summary.

3.1 Frank Whittle Junction

3.1.1 Junction Layout Changes

In general the junction design provided by AECOM was found to be adequate. The only junction layout changes required from the original design were for the Rugby Road northbound left turn to be a left turn slip instead of being signalised, and lane designation for Rugby Road northbound and southbound. For southbound ahead and left turn traffic are allowed from the centre lane and for northbound ahead and right turn traffic are allowed from the centre lane.

3.1.2 Model Amendments

The following model amendments were undertaken in order for the model to match the latest CAD drawing:

- A three phase staggered pedestrian crossing across the Rugby Road northern arm was added to the model
- The Rugby Road northbound left turn was changed from being signalised to a give way left turn slip
- The lane designations were modelled as designed

3.1.3 Modelling Results

Table 3.1 below shows the modelling results using the LinSig traffic model received from the AECOM with the Initial Option 6A SATURN traffic flows as input.

Table 3.1 : AECOM model with Initial Option 6A SATURN flows

Movement	AM Peak		PM Peak	
	Degree of Saturation (%)	Mean Max Queue (PCU)	Degree of Saturation (%)	Mean Max Queue (PCU)
Rugby Road Southbound Left Turn	91.9	18.2	72.3	6.2
Rugby Road Southbound ahead and Right Turn	83.1	16.6	81.3	11.6
A4303 Westbound Left Turn	92.2	21.6	77.2	11.3
A4303 Westbound Ahead	87.5	18.4	61.5	8.1
A4303 Westbound Right Turn	91.1	14.9	79.5	6.9
Rugby Road Northbound Ahead and Left	79.8	10.3	81.0	9.3
Rugby Road Northbound Right Turn	93.7	15.9	82.2	10.0
A4303 Eastbound Ahead and Left Turn	76.7	14.9	81.8	12.4
A4303 Eastbound Ahead and Right Turn	72.6	15.3	76.0	13.1
Cycle Time (seconds)	120		120	
Practical Reserve Capacity (%)	-4.1		9.5	

Table 3.2 below shows the AM and PM peak Degree of Saturation and Mean Max Queue results for the Frank Whittle Junction after the junction layout changes and model amendments have been incorporated and the second iteration was completed.

Table 3.2 : Frank Whittle Junction: Option 6A LinSig modelling results (after second iteration)

Movement	AM Peak		PM Peak	
	Degree of Saturation (%)	Mean Max Queue (PCU)	Degree of Saturation (%)	Mean Max Queue (PCU)
Rugby Road NB Left Ahead	73.2	9.5	53.6	3.8
Rugby Road NB Ahead Right	73.3	9.6	54.7	4.0
Rugby Road NB Right	71.1	8.5	50.5	3.3
A4303 EB Left Ahead	66.9	8.4	55.9	5.0
A4303 EB Right Ahead	56.9	7.9	51.8	4.5
Rugby Road SB Ahead Left	60.5	5.1	71.0	5.7
Rugby Road SB Ahead Right	69.5	8.3	55.5	5.1
A4303 WB Left Ahead	83.6	13.2	55.1	4.7
A4303 WB Ahead	80.4	13.0	59.1	5.4
A4303 WB Right	74.0	4.5	51.3	2.6
Cycle Time (seconds)	96		72	
Practical Reserve Capacity (%)	7.7		26.7	

Comparing the results between the Initial Option 6A scenario with the results after the second iteration clearly demonstrate that the junction operates more efficiently at a lower cycle time and with an increase in junction capacity (Practical Reserve Capacity increases).

3.2 M1 Junction 20

3.2.1 Junction Layout Changes

The junction design provided by AECOM was found to be adequate for this junction and therefore no junction layout changes have been undertaken.

3.2.2 Model Amendments

No significant changes were made to the model for this junction aside from signal timing and staging adjustments.

3.2.3 Modelling Results

Table 3.3 below shows the modelling results using the LinSig traffic model received from AECOM with the Initial Option 6A SATURN traffic flows as input.

Table 3.3 : AECOM model with Initial Option 6A SATURN flows

Movement	AM Peak		PM Peak	
	Degree of Saturation (%)	Mean Max Queue (PCU)	Degree of Saturation (%)	Mean Max Queue (PCU)
M1 Southbound offslip nearside lane	82.8	9.7	68.9	6.9
M1 Southbound offslip offside lane	62.3	7.6	46.0	4.8
A4304 Westbound nearside lane	64.9	9.1	51.5	6.1
A4304 Westbound offside lane	64.3	8.8	49.2	6.3
M1 Northbound offslip nearside lane	62.1	3.6	40.0	2.1
M1 Northbound offslip offside lane	89.9	5.7	72.5	4.3
A4303 Eastbound nearside lane	78.8	9.5	74.0	8.6
A4303 Eastbound offside lane	62.5	8.6	50.4	6.4
Cycle Time (seconds)	60		60	
Practical Reserve Capacity (%)	0.8		21.7	

Table 3.4 below shows the AM and PM peak the Degree of Saturation and Mean Max Queue results for the M1 Junction 20 after the second modelling iteration.

Table 3.4 : M1 Junction 20 Option 6A LinSig modelling results (after second iteration)

Movement	AM Peak		PM Peak	
	Degree of Saturation (%)	Mean Max Queue (PCU)	Degree of Saturation (%)	Mean Max Queue (PCU)
M1 Southbound off slip nearside lane	67.6	5.9	42.5	3.1
M1 Southbound off slip offside lane	57.0	5.1	31.2	2.4
A4304 Westbound nearside lane	47.8	4.2	39.4	3.0
A4304 Westbound offside lane	44.7	3.9	32.1	2.4
M1 Northbound off slip nearside lane	47.6	2.4	26.6	1.3
M1 Northbound off slip offside lane	70.7	4.6	48.0	2.6
A4303 Eastbound nearside lane	76.6	8.7	64.6	6.4
A4303 Eastbound offside lane	40.3	3.5	20.0	1.5
Cycle Time (seconds)	44		44	
Practical Reserve Capacity (%)	17.5		39.3	

Comparing the results between the Initial Option 6A scenario with the results after the second iteration demonstrate that the junction operates more efficiently at a lower cycle time and with an increase in junction capacity (Practical Reserve Capacity increases).

3.3 A4304 / Eastern Link Road Junction

3.3.1 Junction Layout Changes

The junction design provided by AECOM was found to be adequate for this junction and therefore no junction layout changes have been undertaken.

3.3.2 Model Amendments

No significant changes were made to the model for this junction aside from signal timing and staging adjustments.

3.3.3 Modelling Results

Table 3.5 below shows the modelling results using the LinSig traffic model received from AECOM with the Initial Option 6A SATURN traffic flows as input.

Table 3.5 : AECOM model with Initial Option 6A SATURN flows

Movement	AM Peak		PM Peak	
	Degree of Saturation (%)	**Mean Max Queue (PCU)**	**Degree of Saturation (%)**	**Mean Max Queue (PCU)**
Eastern Link Road Southbound Ahead and Left Turn	90.2	16.0	73.4	13.6
Eastern Link Road Southbound Right Turn	89.6	15.1	72.3	12.8
A4304 Westbound Ahead and Left Turn	84.8	11.8	40.7	5.9
A4304 Westbound Ahead and Right Turn	88.5	14.1	50.2	7.8
Development Access Northbound Left Turn	31.1	3.1	38.6	4.9
Development Access Northbound Right Turn	83.6	6.0	75.1	9.3
A4304 Eastbound Ahead and Left Turn (nearside 2 lanes)	66.3	11.4	74.1	12.7
A4304 Eastbound Ahead (middle lane)	39.7	4.7	49.8	8.2
A4304 Eastbound Right Turn	87.5	16.1	72.4	8.9
Cycle Time (seconds)	120		120	
Practical Reserve Capacity (%)	-0.3		19.9	

Table 3.6 below shows the AM and PM peak Degree of Saturation and Mean Max Queue results for the A4304 / Eastern Link Road junction after the second modelling iteration.

Table 3.6 : A4304 / Eastern Link Road Junction Option 6A LinSig modelling results (after second iteration)

Movement	AM Peak		PM Peak	
	Degree of Saturation (%)	**Mean Max Queue (PCU)**	**Degree of Saturation (%)**	**Mean Max Queue (PCU)**
Eastern Link Road Southbound Ahead and Left Turn	13.3	6.1	11.5	0.6
Eastern Link Road Southbound Right Turn	69.5	5.6	61.7	4.8
A4304 Westbound Ahead and Left Turn	67.1	6.7	47.6	4.4
A4304 Westbound Ahead and Right Turn	70.3	7.7	55.1	5.8
Development Access Northbound Left Turn	73.1	5.5	31.0	1.3
Development Access Northbound Right Turn	14.5	0.7	12.4	0.6
A4304 Eastbound Ahead and Left Turn (nearside 2 lanes)	61.5	7.0	42.7	5.3
A4304 Eastbound Ahead (middle lane)	32.7	3.8	30.3	3.6
A4304 Eastbound Right Turn	2.9	0.3	38.3	4.0
Cycle Time (seconds)	88		88	
Practical Reserve Capacity (%)	23.2		46.0	

Comparing the results between the Initial Option 6A scenario with the results after the second iteration demonstrate that the junction operates more efficiently at a lower cycle time and with an increase in junction capacity (Practical Reserve Capacity increases).

3.4 A426 / Bill Crane Way Junction

3.4.1 Junction Layout Changes

The junction design provided by AECOM was found to result in degrees of saturation significantly over 100% for this junction. For degrees of saturation to be less than 100% in both peaks, the following amendments have been undertaken to the junction layout:

- Removal of the signalised pedestrian crossing across the A426 northern arm
- An additional 40 metre flared lane on the A426 northbound approach. This means there are three lanes on this approach. The nearside lane for ahead and left turning traffic, the middle lane for ahead traffic only and the offside lane for right turning traffic only
- A two to one lane merge on the A426 northbound exit to accommodate the merge from the two A426 northbound ahead lanes
- Extension of the Bill Crane Way flared lane from 50 metres to 80 metres

Analysing the OS mapping details it is assumed that all these changes can be accommodated within the existing highway boundary, however this needs to be confirmed by the highway authority. The changes are illustrated on a junction layout sketch provided in Appendix B.

3.4.2 Modelling Amendments

The model for this junction was updated to reflect the changes to the junction layout mentioned above.

3.4.3 Modelling Results

Table 3.7 below shows the modelling results using the LinSig traffic model received from AECOM with the Initial Option 6A SATURN traffic flows as input.

Table 3.7 : AECOM model with Initial Option 6A SATURN flows

Movement	AM Peak		PM Peak	
	Degree of Saturation (%)	Mean Max Queue (PCU)	Degree of Saturation (%)	Mean Max Queue (PCU)
Rugby Road Southbound	119.3	94.7	103.3	53.8
Development Access	34.8	1.7	11.6	0.5
Rugby Road Northbound Ahead and Left Turn	117.8	82.5	50.3	8.7
Rugby Road Northbound Right Turn	117.8	82.5	50.3	8.7
Bill Crane Way	115.7	64.1	103.5	46.1
Cycle Time (seconds)	120		120	
Practical Reserve Capacity (%)	-32.5		-14.9	

Table 3.8 below shows the Degree of Saturation and Mean Max Queue results for both the AM and PM peaks for the A426 / Bill Crane Way Junction after the junction layout changes and model amendments have been incorporated and the second iteration was completed.

Table 3.8 : Bill Crane Way Junction Option 6A LinSig modelling results (after second iteration)

Movement	**AM Peak**		**PM Peak**	
	Degree of Saturation (%)	**Mean Max Queue (PCU)**	**Degree of Saturation (%)**	**Mean Max Queue (PCU)**
Rugby Road Southbound	83.5	7.5	87.9	16.6
Development Access	13.2	0.8	4.8	0.3
Rugby Road Northbound Ahead and Left Turn	62.6	5.0	62.3	4.1
Rugby Road Northbound Right Turn	5.0	0.1	20.0	0.5
Bill Crane Way	72.6	6.5	86.9	11.4
Cycle Time (seconds)	72		80	
Practical Reserve Capacity (%)	7.8		2.4	

Comparing the results between the Initial Option 6A scenario with the results after the second iteration clearly demonstrates a significant improvement in junction operational capacity. The junction operates more efficiently at a lower cycle time and with an increase in junction capacity (Practical Reserve Capacity increases).

4. Modelling Analysis Summary

4.1 Junction Operational Assessments

Analysing the results from the LinSig modelling for the second iteration indicates that all the modelled junctions, incorporating the proposed junction layout and modelling amendments, operates with sufficient levels of capacity.

The junctions operate with spare capacity during the 2031 AM and PM peak hours respectively, with no approach arm operating with a Degree of Saturation above 90%, which is generally regarded within the industry and highway authorities as an acceptable level of operation.

The junction cycle times are also well below the maximum of 120 seconds, providing traffic signal control engineers with flexibility and resilience to implement various signal timing plans, enabling them to effectively control and manage traffic by changing signal timings within reasonable limits if required.

4.2 Road Network Impacts

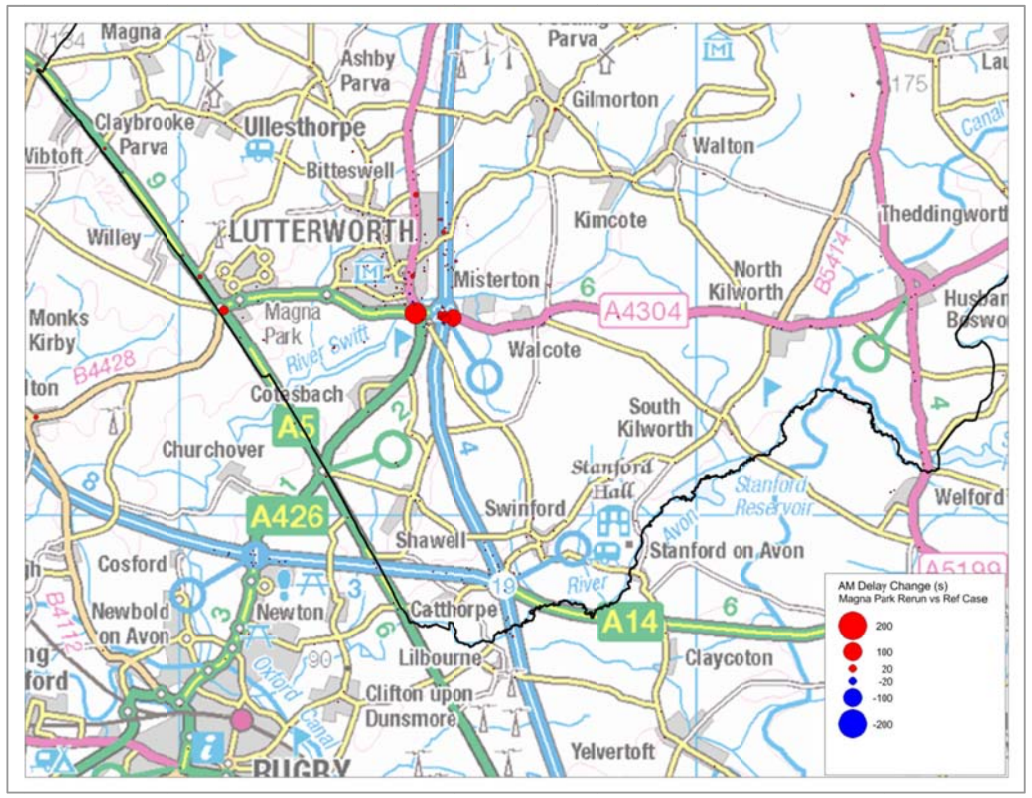
The model summary compares the impacts on the road network from the original modelling or Reference Case with a number of SATURN runs or scenarios for Option 6A, including the two iterations that were carried out as part of the junction optimisation process. The impacts (on the road network) comparison is between the following scenarios:

- Reference Case
- Initial Option 6A scenario (as reported in Preliminary TIA)
- Option 6A Iteration 1 (first junctions optimisation exercise)
- Option 6A Iteration 2 (second junctions optimisation exercise)

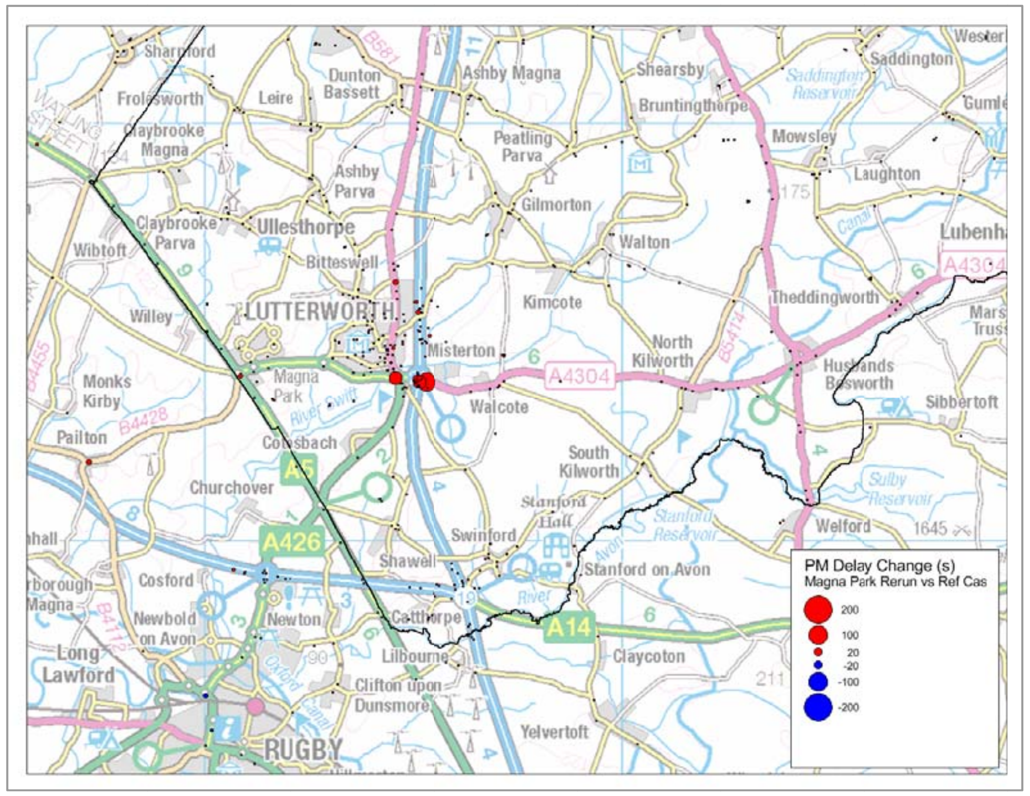
Figure 4.1 shows the average delay at junctions (measured in seconds per PCU) forecast during the 2031 peak hours (AM & PM) in the base scenario, after the first junction optimisation iteration and the second junction optimisation iteration respectively.

Figure 4.1 : Average Delay Plots

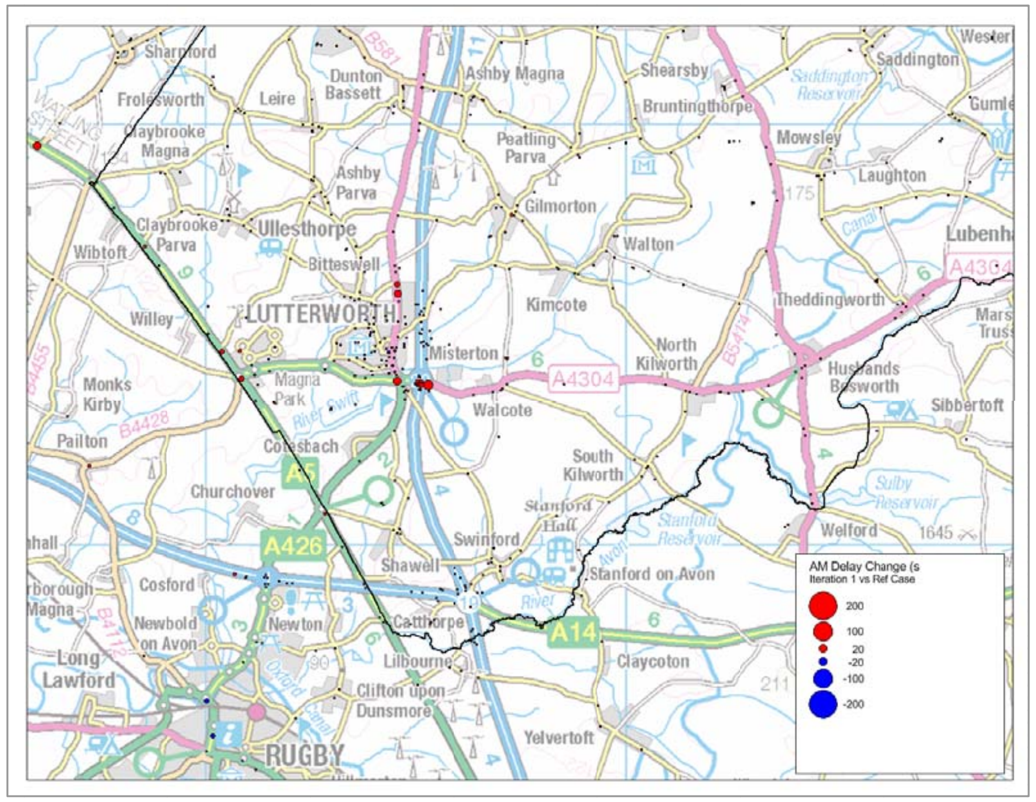
Change in delay (initial Option 6A v Reference Case, AM peak hour)



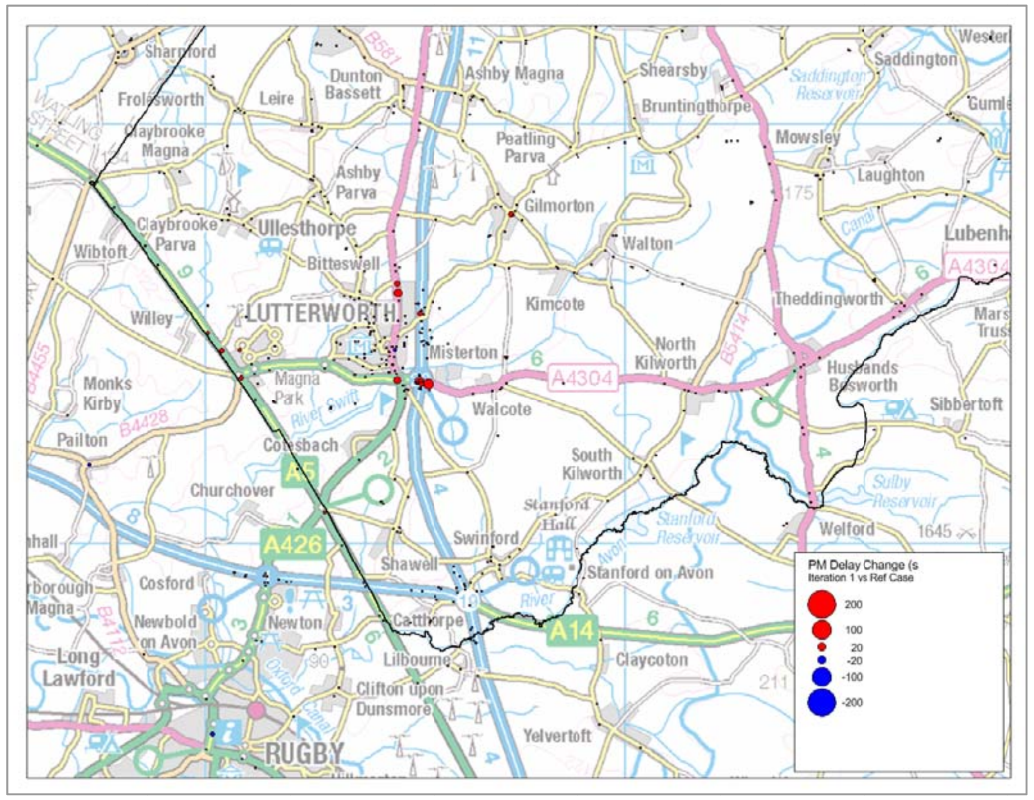
Change in delay (initial Option 6A v Reference Case, PM peak hour)



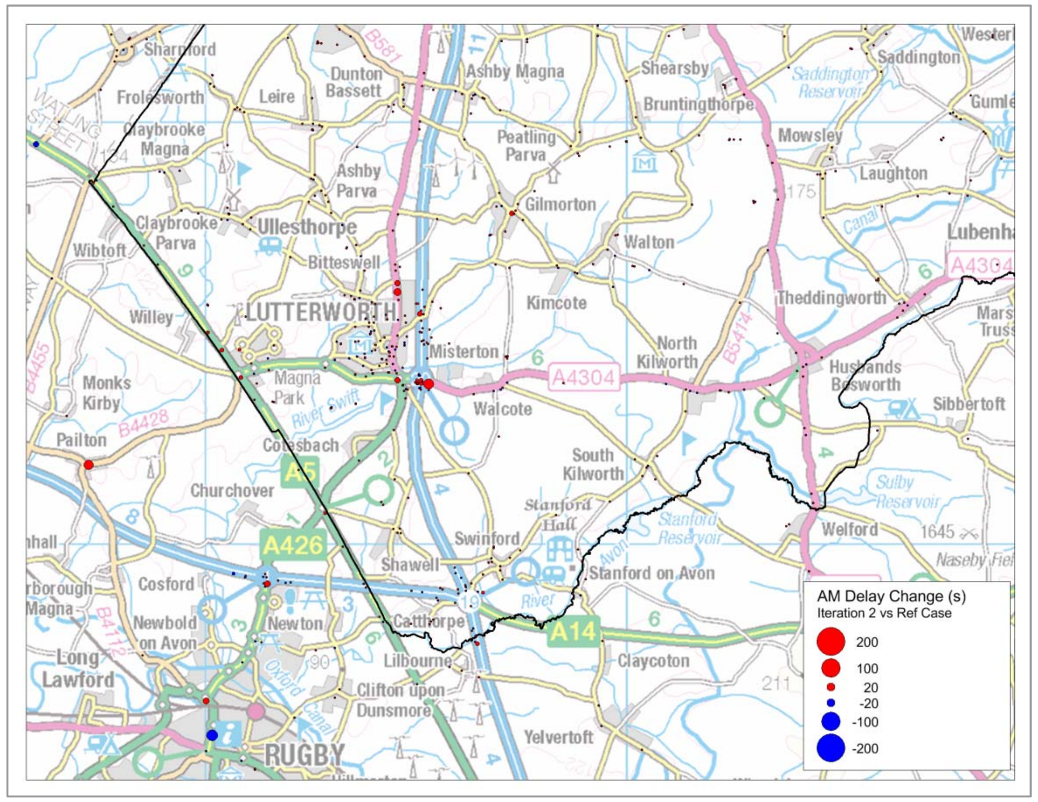
First Iteration AM



First Iteration PM



Second Iteration AM



Second Iteration PM

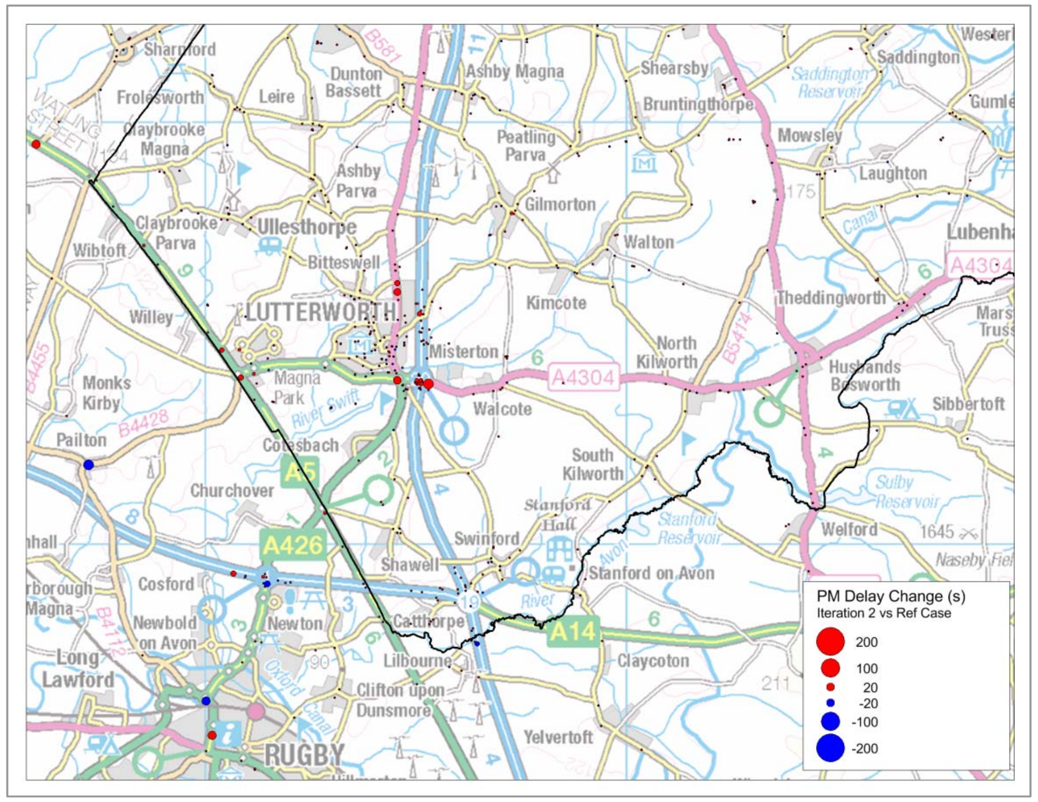


Table 4.1 below shows the average delay per PCU in the peak hour in seconds at each of the four junctions optimised.

Table 4.1 : Average Delay per PCU in peak hour in seconds

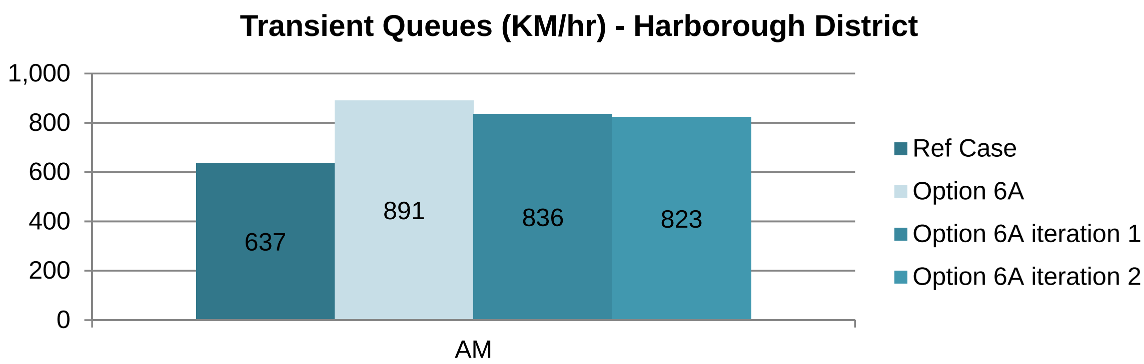
Run / Scenario	A426 / Bill Crane Way Junction	Frank Whittle Junction	M1 Junction 20 (combined)	A4304 / Eastern Link Road Junction
Initial Option 6A, AM peak hour	10	122	96	75
Iteration 1 AM	23	44	44	33
Iteration 2 AM	20	29	42	34
Initial Option 6A, PM peak hour	11	84	94	102
Iteration 1 PM	20	34	41	36
Iteration 2 PM	21	33	36	33

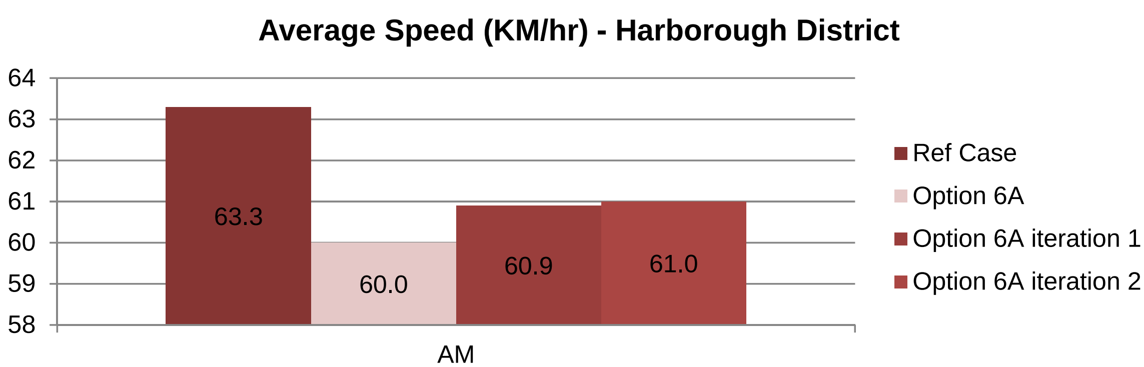
The results (referring to Figure 4.1 and Table 4.1) indicate that as the junction operational optimisation was carried out and progressing from one iteration to the next in the SATURN model, the average delay per PCU at the junctions tend to reduce. There are minor increases in delay at the A426/Bill Crane Way junction due to the introduction of signals in the iterations which introduces a small amount of stopping time for vehicles associated with the signal staging, but these increases are significantly off-set by the savings at the three junctions on the A4303/A4304 corridor to the south.

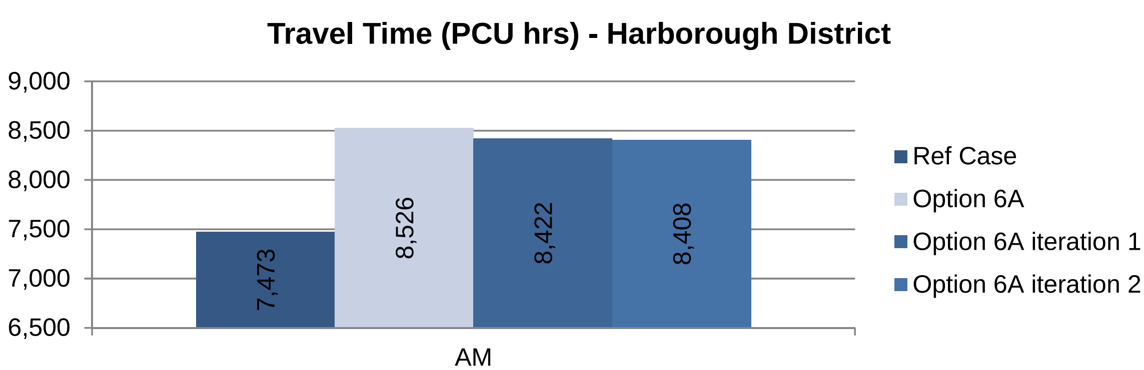
Figure 4.2 below summarises the impacts on the road network within Harborough District in the AM peak hour in 2031, reported in terms of overall travel time (measured in PCU-hours), average speed (kph), overall travel distance (PCU-kms) and transient queues (measured in PCUs). The latter metric represents the forecast number of vehicles left in queues on the road network at the end of the modelled hour due to network congestion, which would consequently have to complete their journeys in the subsequent hour.

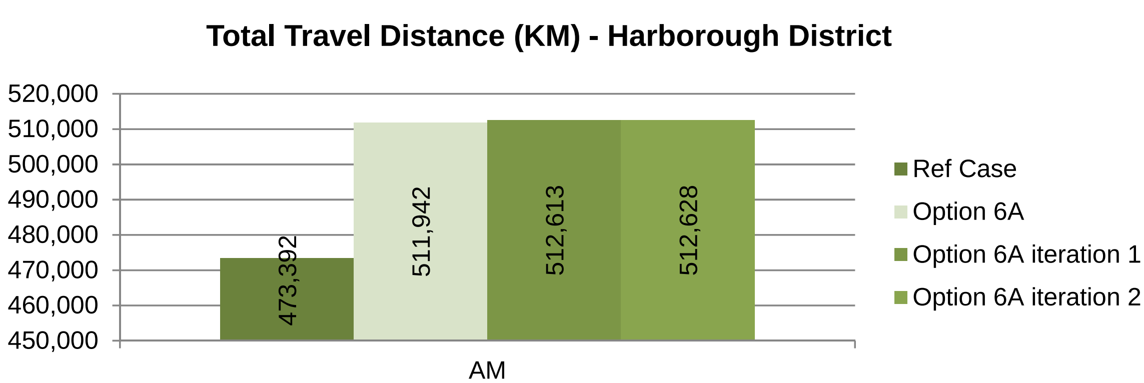
The graphs indicate that by optimising the junction operation and iterating it twice in the SATURN model, it results in reduced transient queueing, higher average speeds and reduced overall travel time in the AM peak hour for Option 6A.

Figure 4.2 : Comparison of impacts on road network in Harborough District









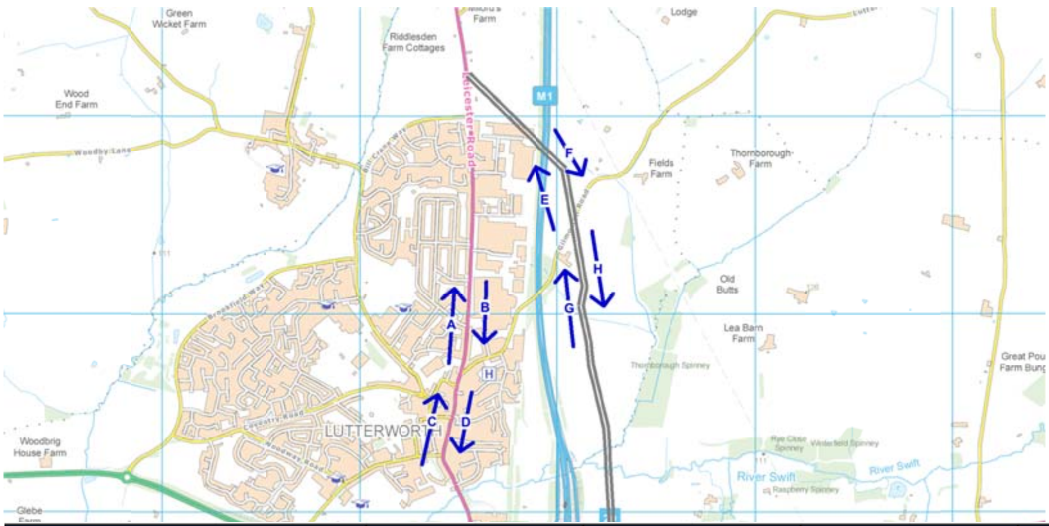
4.3 Heavy Goods Vehicle (HGV) routing

Further analysis of the strategic model was undertaken to determine how HGVs are forecast to respond to road network and demand changes associated with Option 6A both before and after the junction optimisation work described earlier in this note. The principle aim of this analysis was to understand the likely scope for reducing the level of HGV traffic on the A426 High Street in Lutterworth town centre, and the potential implications of different approaches that could be adopted to manage HGV demand in the town centre.

It should be noted that the analysis summarised in this section was based on outputs from the strategic model runs that supported the junction optimisation work, and no further model tests have been undertaken to-date to determine the impacts of any of the measures discussed. In addition, all model outputs are reported as Passenger Car Units (PCUs) – in modelling terms a single HGV has an approximate value of two PCUs.

Figure 4.3 shows the forecast change in HGV and general traffic on the A426 High Street and the new Eastern Link Road during the AM peak hour in 2031.

Figure 4.3 : AM peak hour actual flow in PCUs by direction (Reference Case and Option 6A)



Actual Flow PCU/HR			Ref Case AM		Option 6 + Magna Park AM		Iteration 1 AM		Iteration 2 AM	
Link	Ref	Direction	HGV	All	HGV	All	HGV	All	HGV	All
A426 North of Gilmorton Rd	A	NB	137	712	119	616	90	485	90	476
	B	SB	94	712	125	556	111	593	113	621
A426 South of Gilmorton Rd	C	NB	144	845	118	799	90	746	90	729
	D	SB	111	990	125	1028	111	932	113	968
Dev't Rd N of Gilmorton Rd	E	NB	0	0	31	76	47	250	48	255
	F	SB	0	0	63	229	64	265	64	254
Dev't Rd S of Gilmorton Rd	G	NB	0	0	113	235	146	404	146	406
	H	SB	0	0	139	359	155	444	154	422

The plan shows that northbound HGV traffic on the A426 High Street (link C) reduces from 144 PCUs (72 vehicles) in the Reference Case in this time period to 59 vehicles in the initial Option 6A test, and then further to 90 PCUs (45 vehicles) in the modelling iterations as congestion at the A4304/Eastern Link Road reduces. This represents an overall reduction of 38%. Correspondingly, northbound HGV traffic on the new Eastern Link Road (link G) increases from 113 PCUs in the initial Option 6A test to 146 PCUs in the modelling iterations as congestion eases and attracts traffic to the new route.

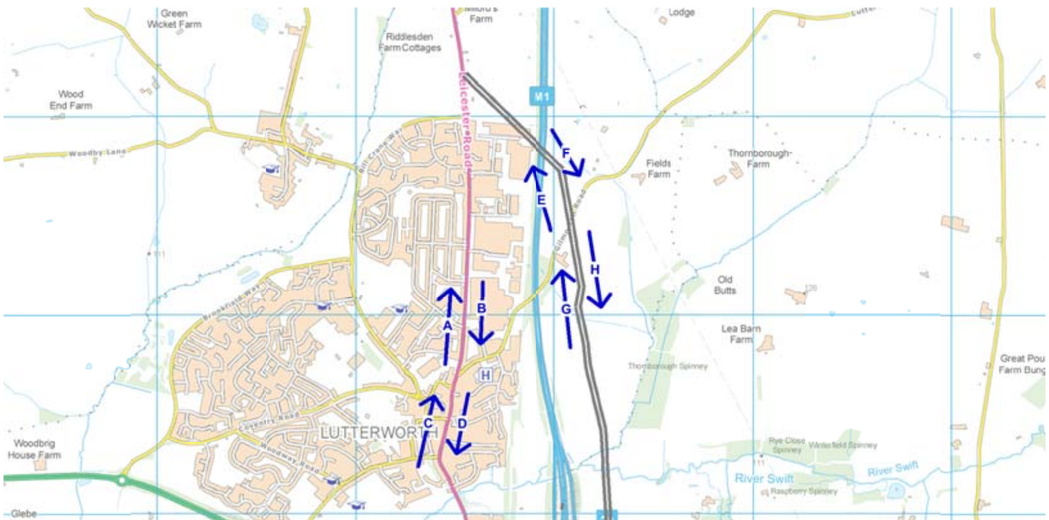
In the southbound direction however, HGVs on the A426 High Street (link D) increase from 111 PCUs (56 vehicles) in the Reference Case to 125 (63 vehicles) in the initial Option 6A. The modelling iterations then reduce this flow to a similar level observed in the Reference Case but there is no overall reduction from Reference Case levels.

Broadly similar patterns are evident when general traffic flows are considered. For example in the northbound direction on link C, overall traffic reduces from 845 PCUs in the Reference Case to 799 in the initial Option 6A and then to 729 in the modelling iterations. Southbound traffic on link D however increases from 990 PCUs in the Reference Case to 1,028 in the initial Option 6A test before reducing in the iterations.

There are also significant differences in total flow on the new Eastern Link Road either side of the junction with Gilmorton Road. For example in the final modelling iteration, southbound flows (link F) increase from 254 PCUs north of the junction to 422 PCUs south of the junction (link H). The same pattern is evident northbound, with significantly higher flows recorded south of the junction. This suggests that a significant proportion of traffic on the new Eastern Link Road is using it to access Gilmorton Road.

Figure 4.4 shows the forecast change in HGV and general traffic on the A426 High Street and the new Eastern Link Road during the PM peak hour in 2031.

Figure 4.4 : PM peak actual flow by direction (Reference Case and Option 6A iteration 2)



Actual Flow PCU/HR			Ref Case PM		Option 6 + Magna Park PM		Iteration 1 PM		Iteration 2 PM	
Link	Ref	Direction	HGV	All	HGV	All	HGV	All	HGV	All
A426 North of Gilmorton Rd	A	NB	33	678	48	494	35	574	35	568
	B	SB	45	894	26	806	26	780	26	830
A426 South of Gilmorton Rd	C	NB	43	995	48	989	35	1049	35	1030
	D	SB	50	1066	26	902	26	933	26	969
Dev't Rd N of Gilmorton Rd	E	NB	0	0	22	63	34	111	34	106
	F	SB	0	0	27	246	26	261	24	263
Dev't Rd S of Gilmorton Rd	G	NB	0	0	56	136	69	216	68	214
	H	SB	0	0	73	363	73	373	73	362

The plan shows that northbound HGV traffic on the A426 High Street (link C) increases from 43 PCUs in the Reference Case to 48 PCUs in the initial Option 6A run before reducing to 35 PCUs in the modelling iterations. In the southbound direction (link D), HGV traffic reduces from 50 PCUs in the Reference Case to 26 in the initial Option 6A test, with similar figures reported following the modelling iterations. General northbound traffic on the A426 High Street increases from 995 PCUs in the Reference Case to 1,030 in the modelling iterations, while southbound traffic decreases from 1,066 in the Reference Case to 969 in the modelling iterations.

In terms of the new Eastern Link Road in the PM peak hour, the modelling iterations generally attract more traffic to the road as congestion at key junctions eases, and the same change in flows either side of the junction with Gilmorton Road evident in the AM peak hour is also evident in the PM peak.

4.3.1 HGV Select Link Analysis

To further understand HGV routing around Lutterworth with the new Eastern Link Road in place, Select Link Analysis (SLA) was undertaken on three sections of the road network approaching the town: the A4304 Lutterworth Road to the east; the A426 Leicester Road to the north; and the A426 Rugby Road to the south of the Frank Whittle roundabout.

Figure 4.5 summarises the analysis of HGV traffic on the A4304 in both time periods in the Reference Case and the second iteration of Option 6A. The figure shows that very little HGV traffic on the A4304 travels to or from the High Street or Lutterworth in general in either time period. In the AM peak hour Reference Case for example, 125 HGV PCUs were recorded travelling westbound on the A4304. Of those, 53 headed northbound along the M1 while 72 headed west along the A4303, with 55 heading further west through Frank Whittle towards Magna Park and 12 heading south along the A426 Rugby Road. In the eastbound direction, the HGV traffic on the A4304 originated either from the A4303 to the west or from the A426 Rugby Road to the south.

In both time periods the route choices of HGVs remains broadly similar with the new Eastern Link Road in place, with the exception that the new road appears to encourage a small number of HGVs to access the A4304 via Gilmorton Road in the AM peak. The Option 6A iteration 2 AM peak hour plot for example indicates that 21 HGV PCUs (11 vehicles) use Gilmorton Road and the new Eastern Link Road southbound to turn left onto the A4304 at the new A4304/Eastern Link Road junction.

Figure 4.6 summarises the analysis of HGV traffic on the A426 Leicester Road to the north of Lutterworth in both time periods in the Reference Case and the second iteration of Option 6A. The analysis for this link indicates that there is a significant degree of interaction with the High Street, with the Reference Case plots in both time periods indicating that virtually all of the HGV traffic on the link in both directions passes along the High Street. In the Option 6A iteration 2 plots, a significant proportion of traffic on the A426 Leicester Road switches from the High Street to the new Eastern Link Road, primarily traffic travelling between the A426 and the M1 via Junction 20. This change reduces the number of HGVs on the A426 Leicester Road that travel up and down the High Street by around 50%.

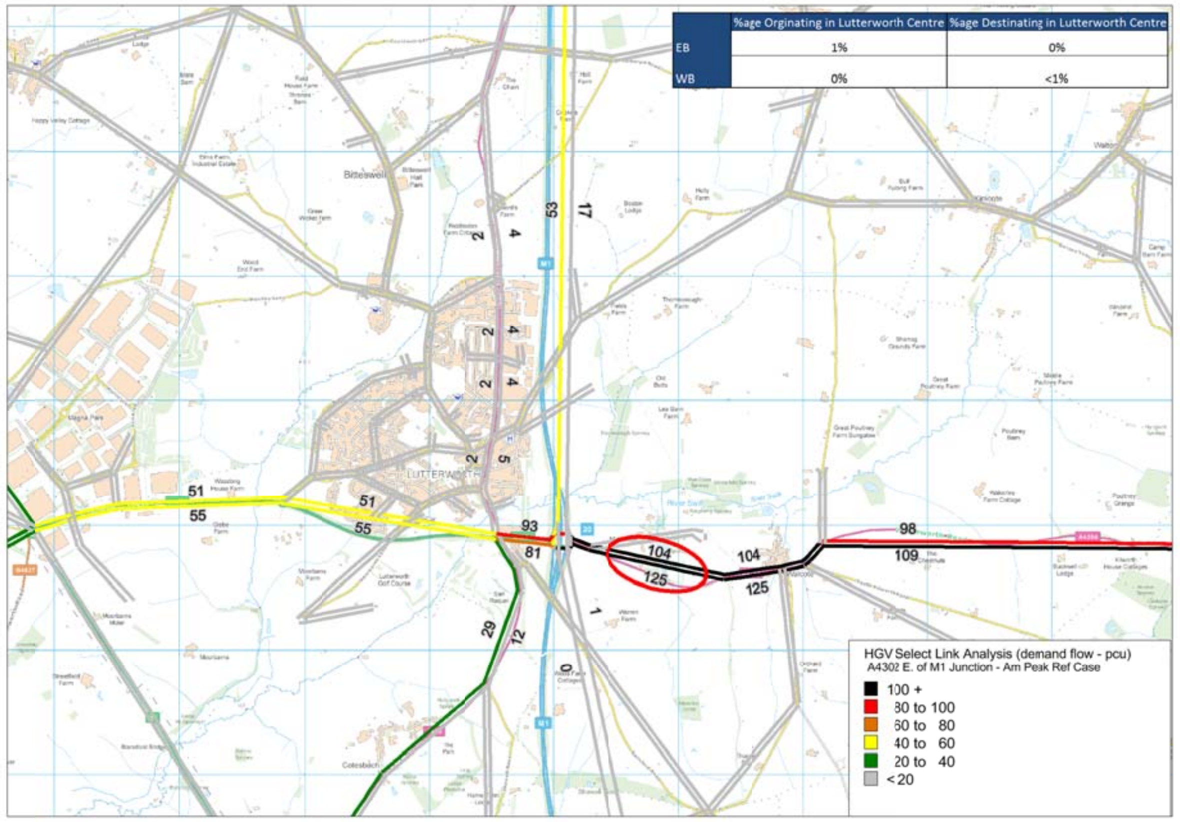
It is also evident from the tables included with the plots that unlike HGV traffic on the A4304, a significant proportion of HGVs using the A426 Leicester Road have trip origins or destinations within Lutterworth. In the Option 6A iteration 2 tests for example, 21% of southbound traffic in the AM peak hour and 30% in the PM peak hour has a destination in Lutterworth.

Figure 4.7 summarises the analysis of HGV traffic on the A426 Rugby Road in both time periods in the Reference Case and the second iteration of Option 6A. The impact of the new Eastern Link Road on HGV traffic on this link is less significant than it is on traffic on the Leicester Road to the north: in general, HGV flows on the High Street reduce in both time periods but by lower proportions. The proportion of traffic on the network with an origin or destination in Lutterworth is also much lower on this link that it is on the Leicester Road.

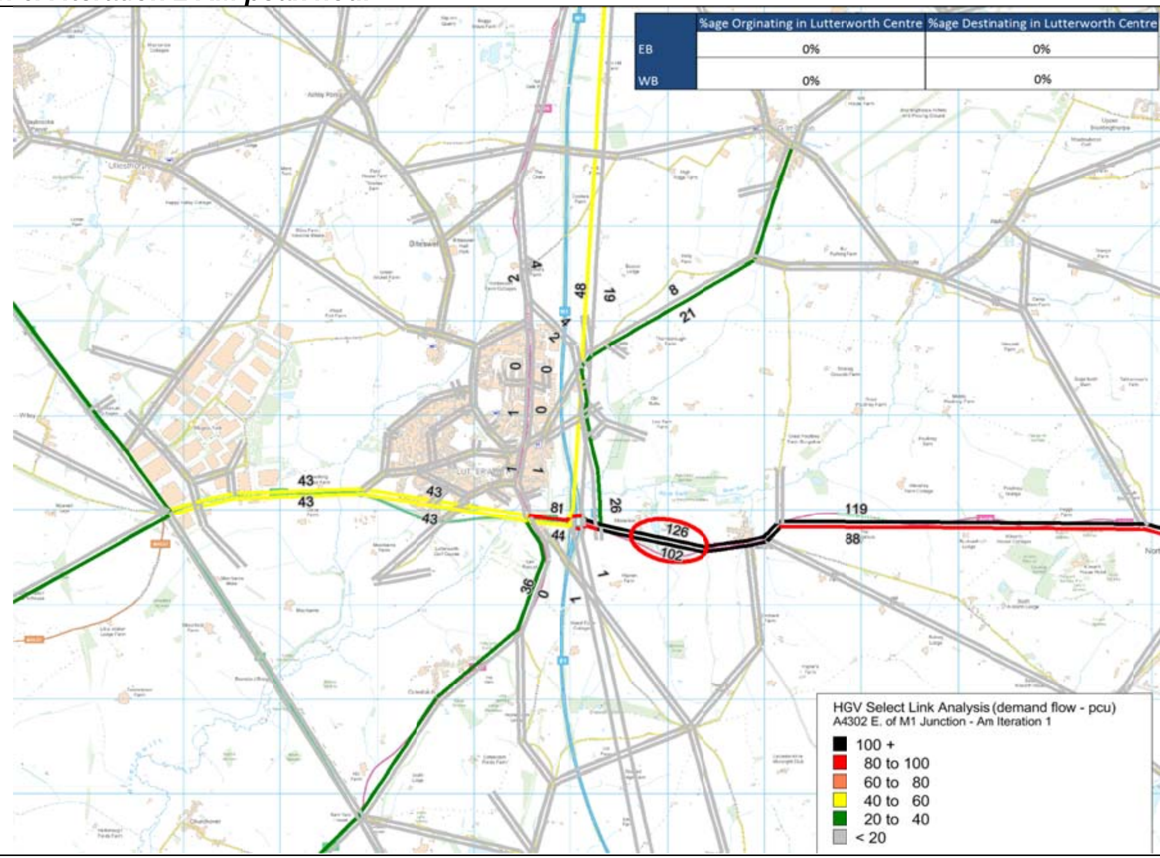
The impact of the Eastern Link Road encouraging more traffic to use Gilmorton Road is also evident from this figure: in the AM peak hour, 183 HGV PCUs (92 vehicles) are modelled travelling north on the A426 Rugby Road, of which 43 (22 vehicles) route through to Gilmorton Road via the new Eastern Link Road.

Figure 4.5 : HGV routing on A4304 Lutterworth Road

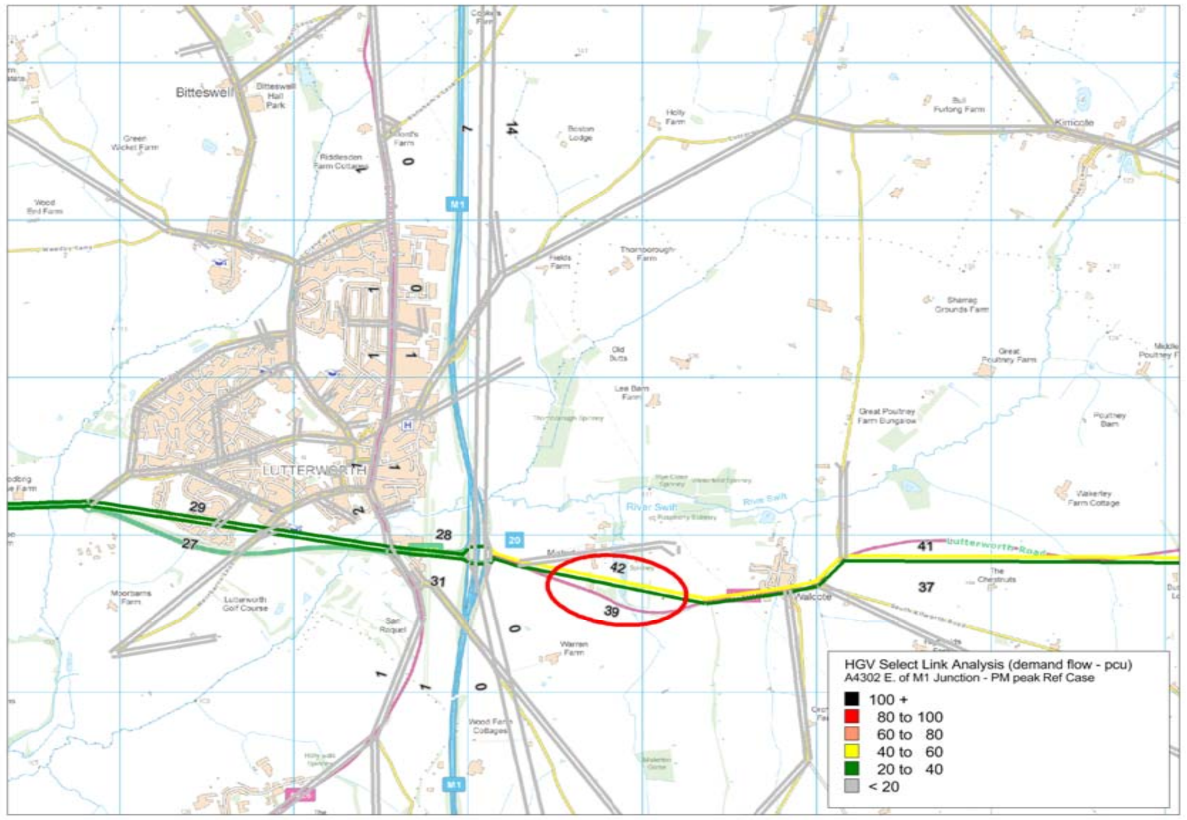
2031 Reference Case AM peak hour



2031 Option 6A iteration 2 AM peak hour



2031 Reference Case PM peak hour



2031 Option 6A iteration 2 PM peak hour

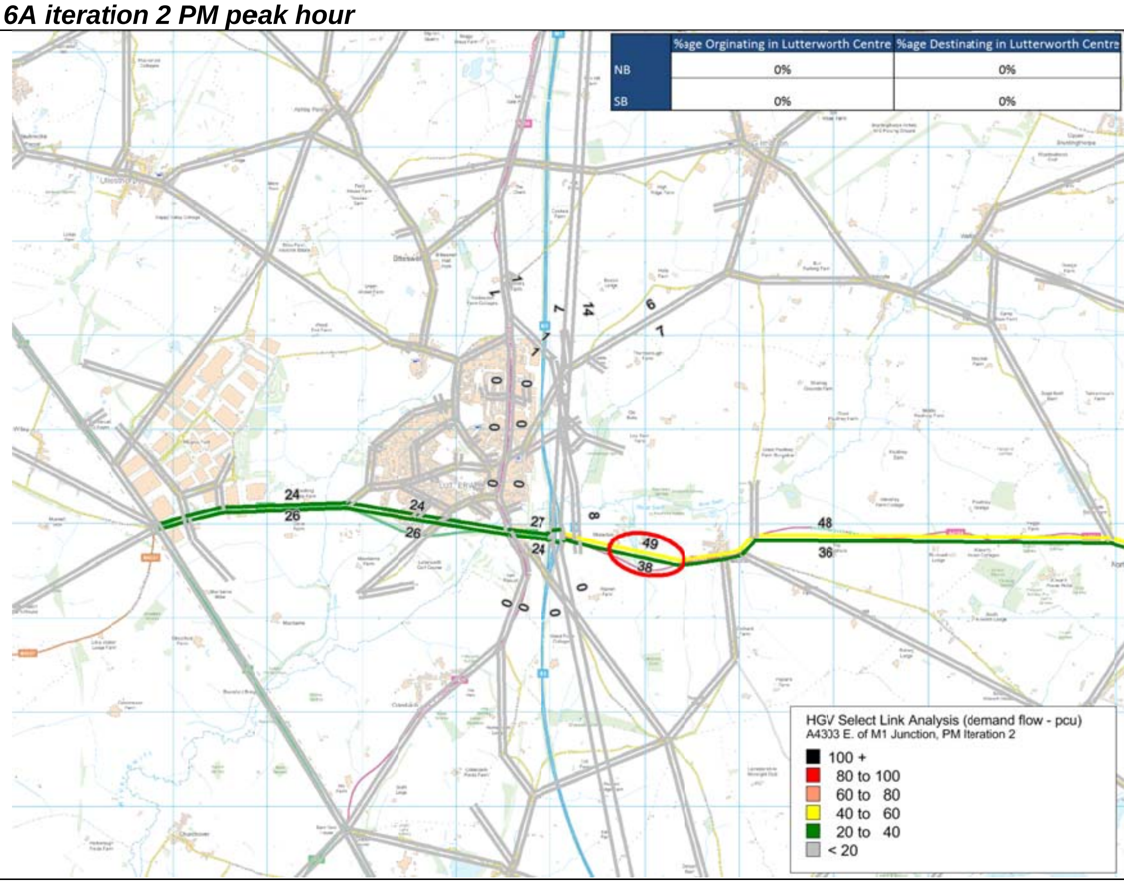
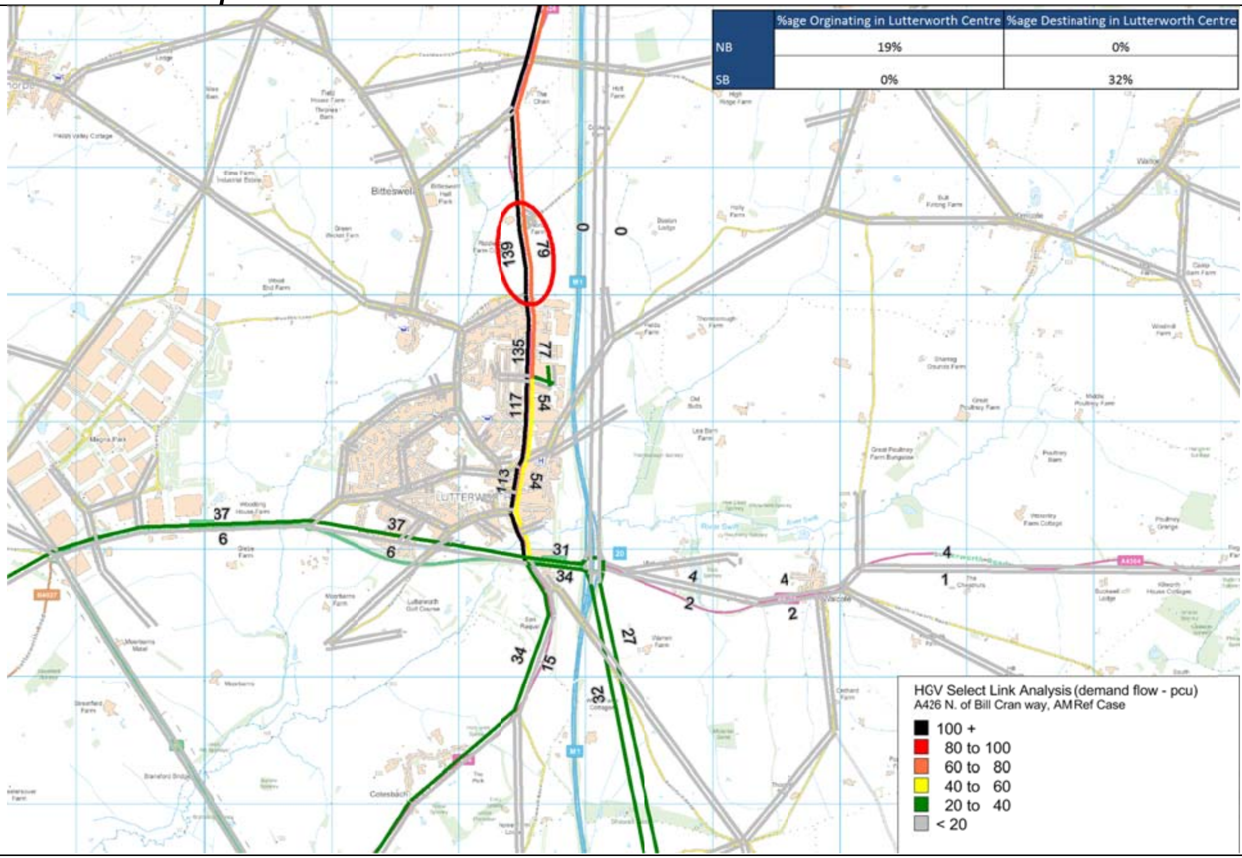
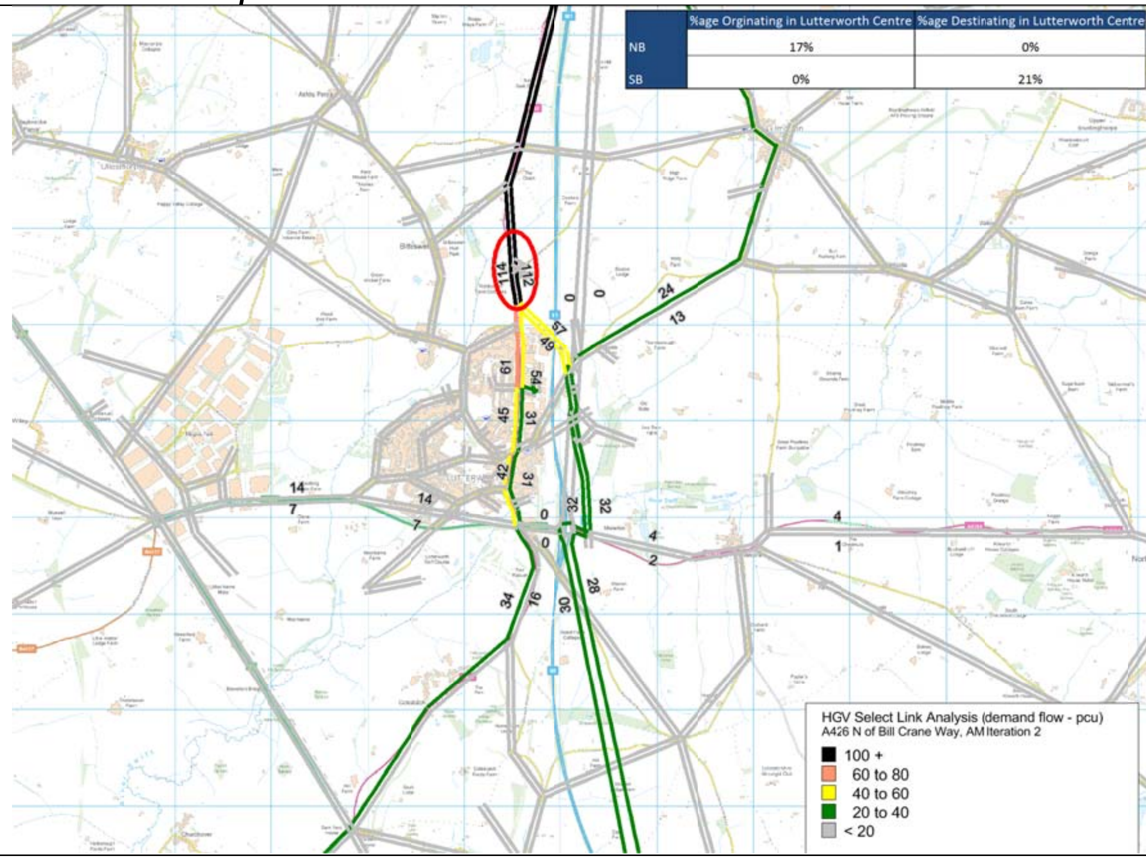


Figure 4.6 : HGV routing on A426 Leicester Road (north of Lutterworth)

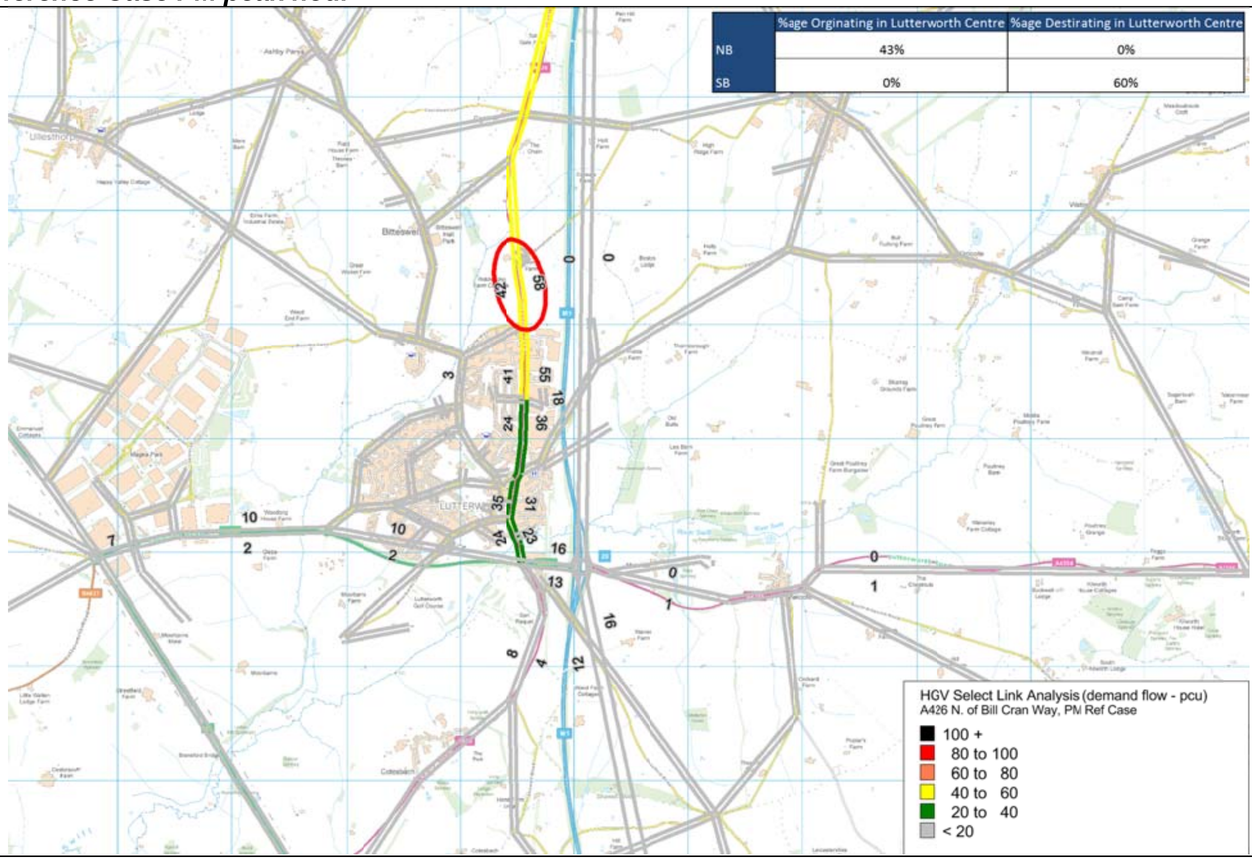
2031 Reference Case AM peak hour



2031 Option 6A iteration 2 AM peak hour



2031 Reference Case PM peak hour



2031 Option 6A iteration 2 PM peak hour

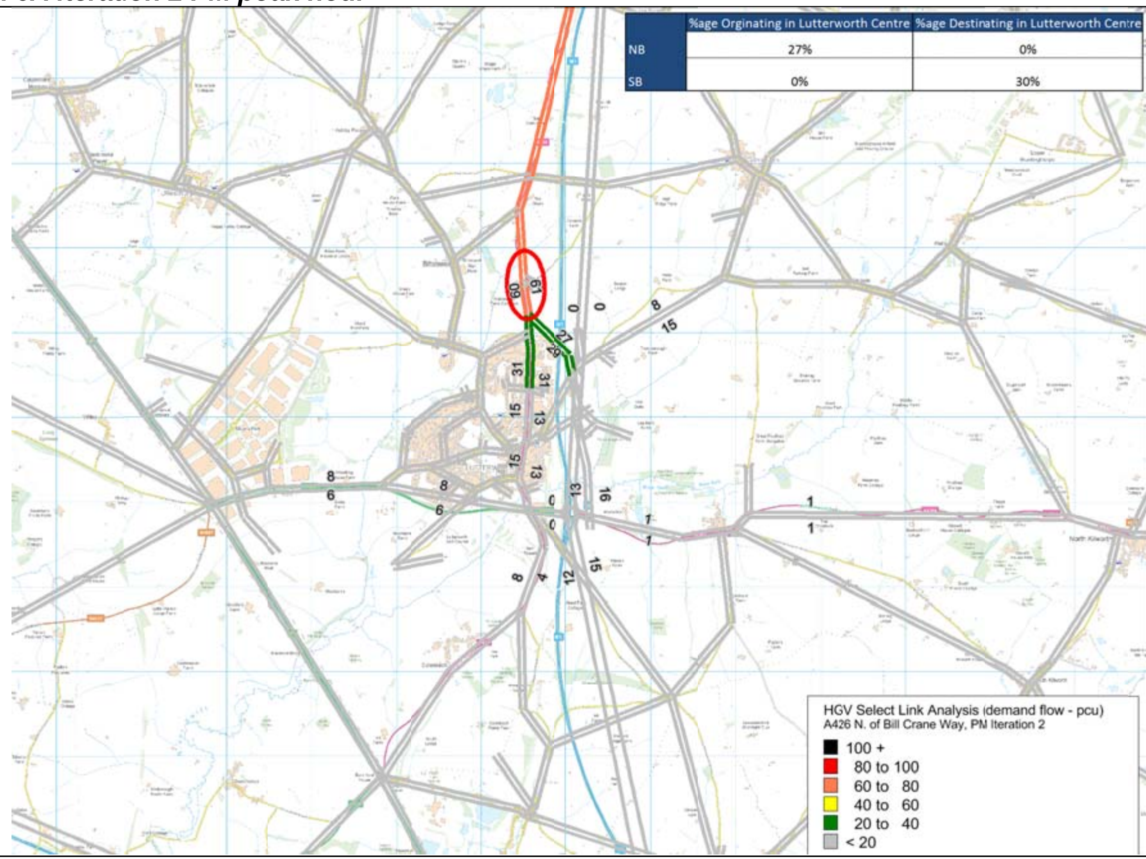
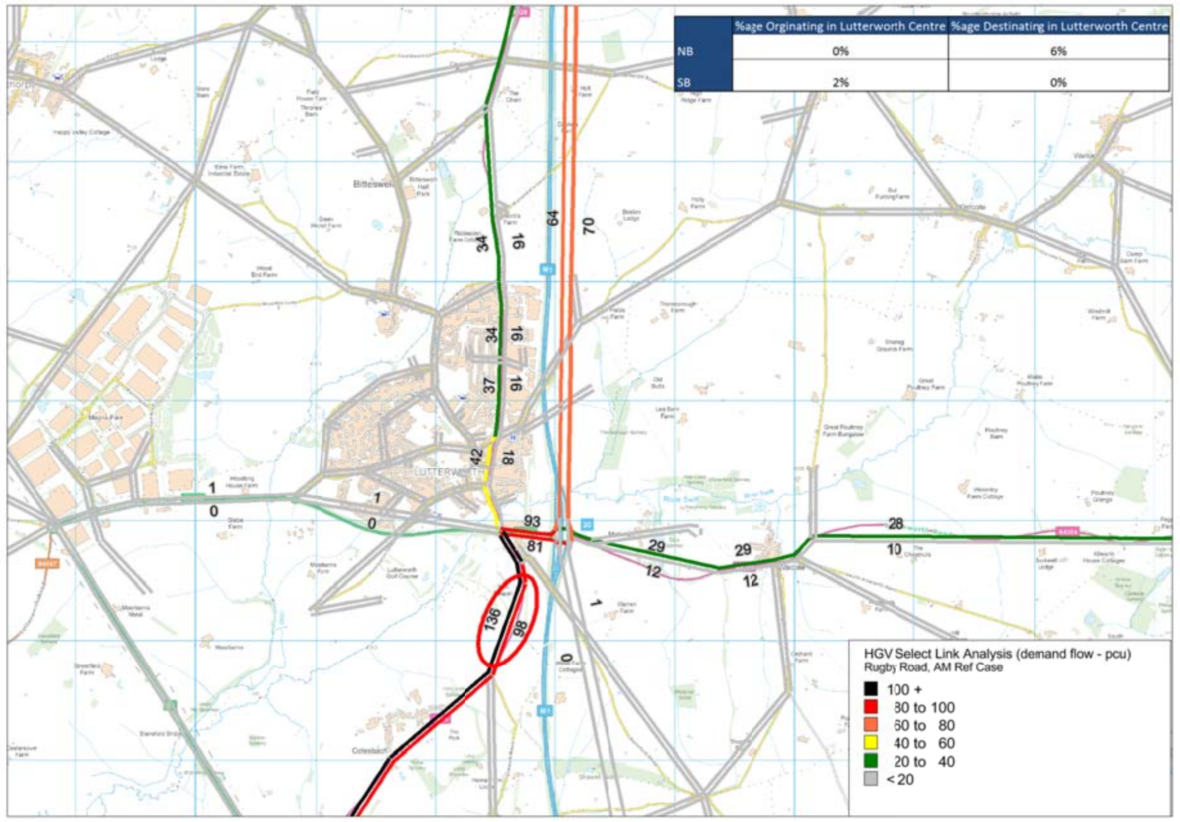
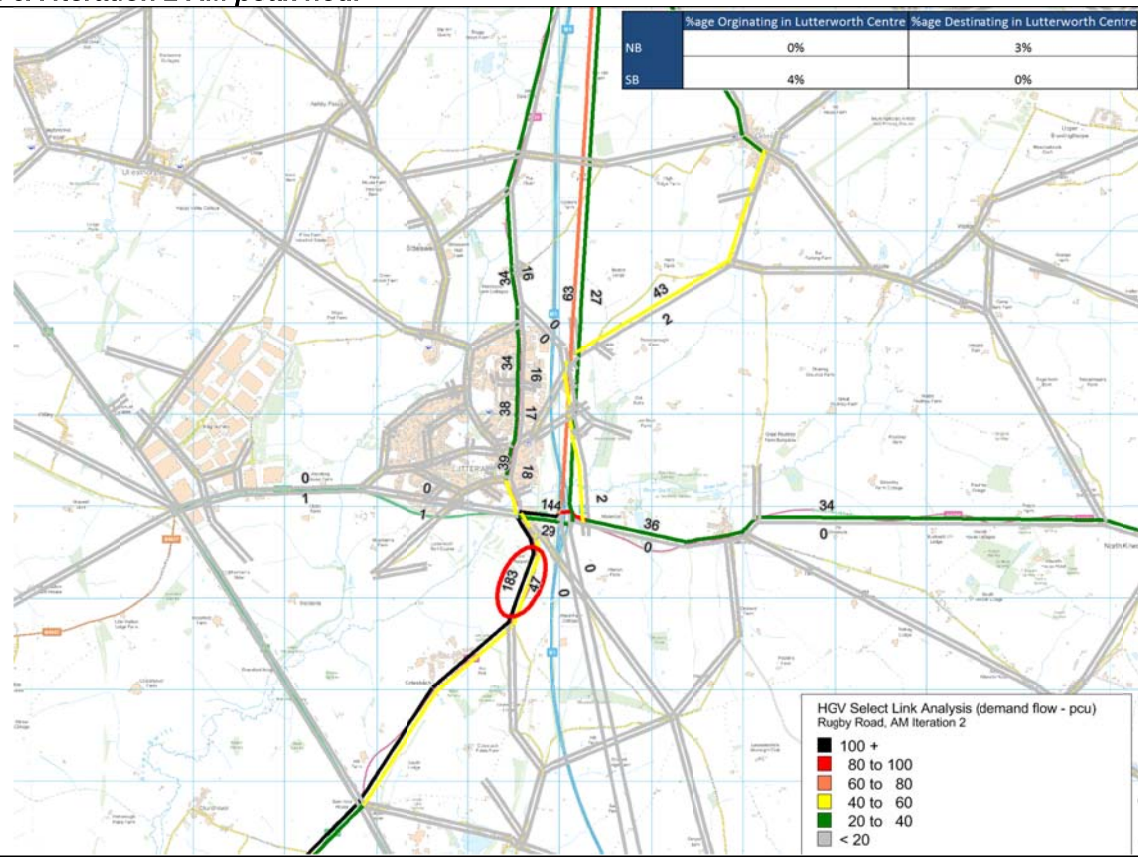


Figure 4.7 : HGV routeing on A426 Rugby Road (south of Lutterworth)

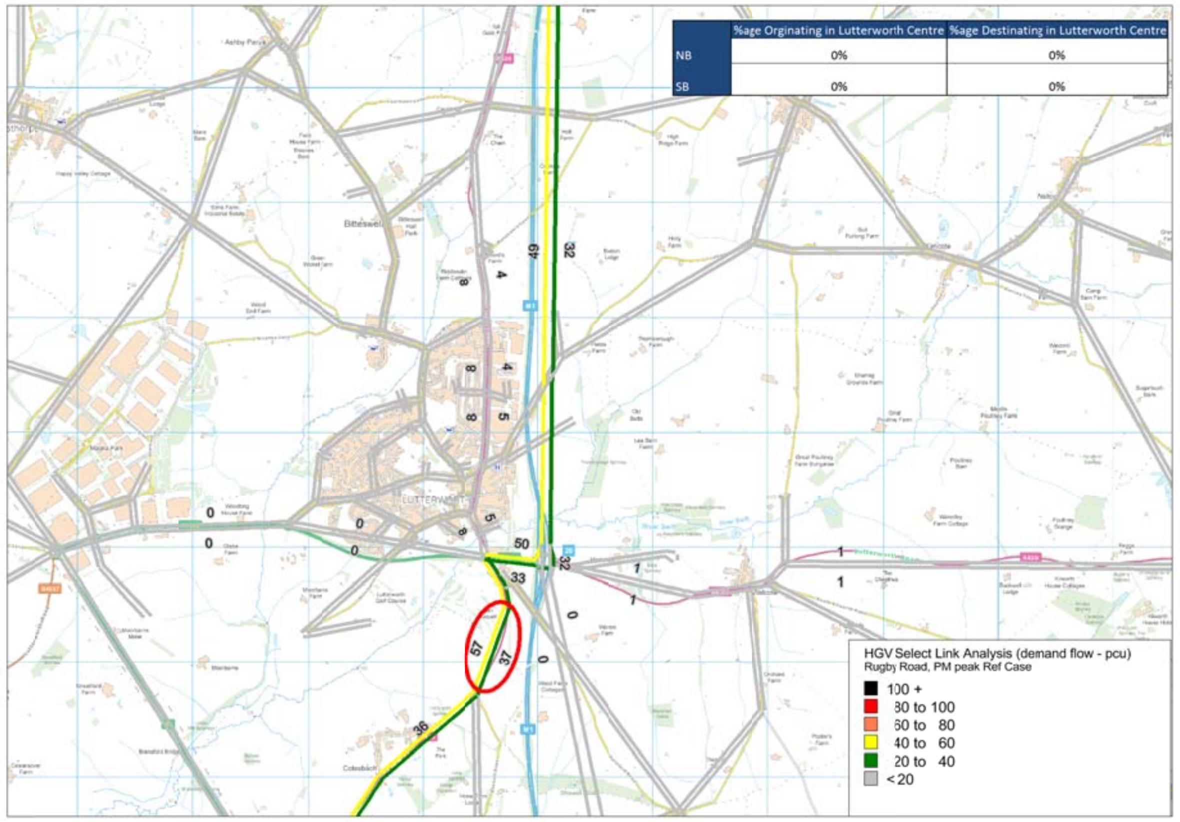
2031 Reference Case AM peak hour



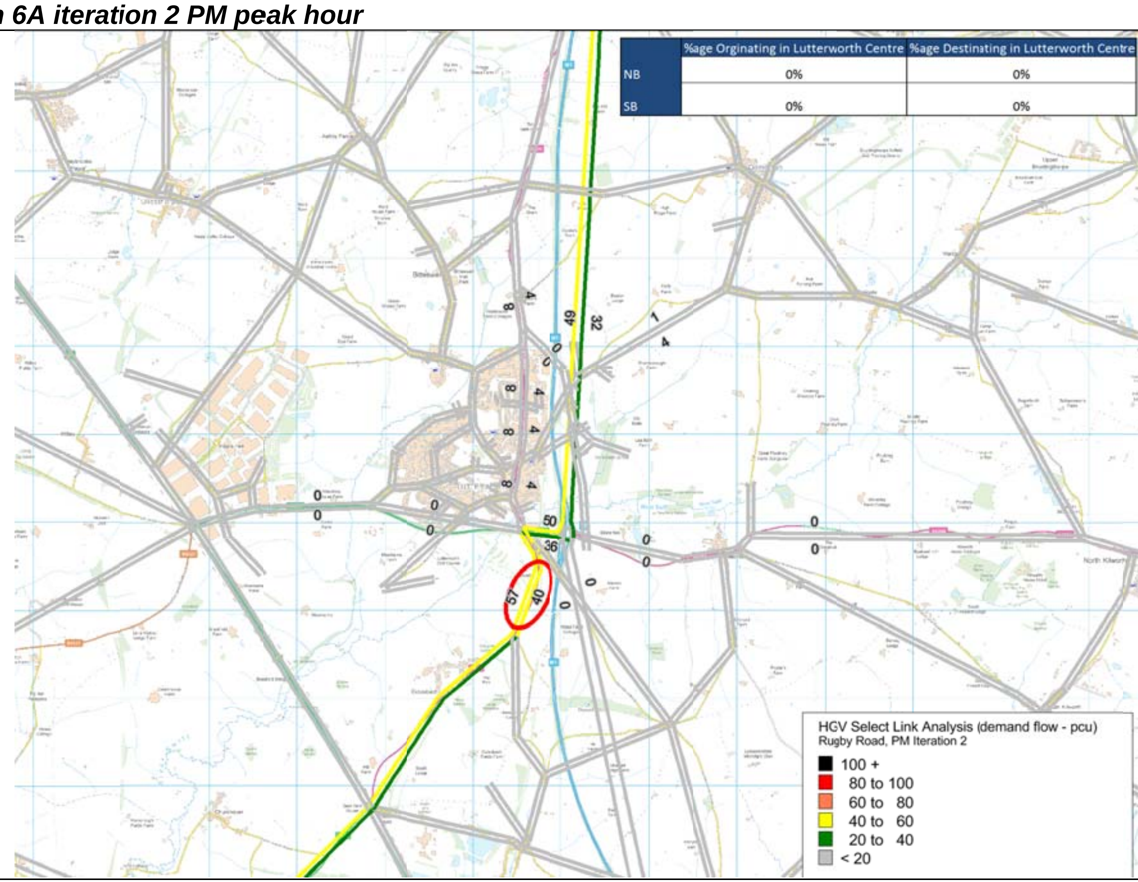
2031 Option 6A iteration 2 AM peak hour



2031 Reference Case PM peak hour



2031 Option 6A iteration 2 PM peak hour



4.3.2 Managing HGV traffic in Lutterworth town centre

Several measures can be adopted to reduce the level of HGV traffic on the A426 High Street in Lutterworth Town Centre and to manage HGV demand in the town centre.

As part of effective town centre traffic management, it may be appropriate to control access to the High Street for HGVs (or selected types of vehicle) at certain times of the day - managing the delivery times in the town centre. This usually requires a Traffic Regulation Order (TRO). It is important that access restrictions on freight vehicles are undertaken with consideration of their likely effects on the economic performance of the town centre. Consider, if not already in place, Freight Quality Partnerships. These are partnerships between a range of interested stakeholders that may include local authorities, freight operators and community representatives and are designed to:

- Resolve conflicts of interest;
- Ensure that freight is moved in an efficient and effective manner; and
- Minimise the impact of freight operations on the environment and communities.

Where a TRO is considered insufficient, access control could be provided through the introduction of environmental weight and/or width restrictions (signs only) at strategic locations, with appropriate advance warning signing that enables HGV drivers to select an alternative route early. Access can be monitored using Closed Circuit Television (CCTV) and automatic enforcement systems such as number plate recognition can be employed to ensure compliance.

Making the High Street less attractive through physical measures such as width restriction bollards and introducing low speed zones (20 mph zones) could also be considered and could deter HGV drivers selecting the route through the High Street.

5. Conclusion

5.1 Summary

The LinSig modelling shows that all four junctions are able to accommodate the predicted 2031 Option 6A traffic flows for both the AM and PM peaks.

The M1 Junction 20 and A4304 / Eastern link roads will operate with considerable spare capacity for both peaks, with fairly low cycle times.

The Frank Whittle and A426 / Bill Crane Junctions operate closer to capacity; however still operate with some spare capacity.

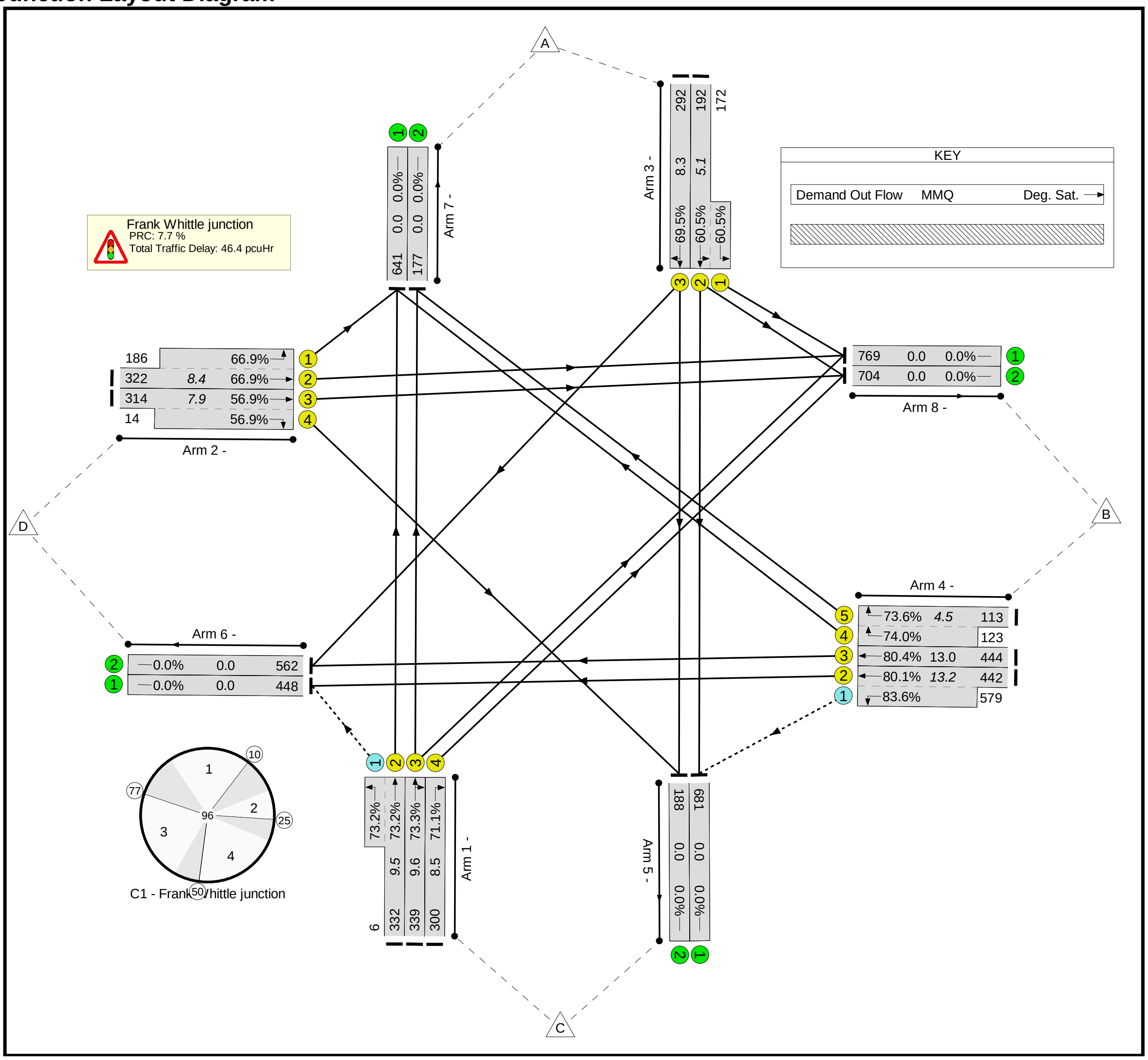
The iteration process in combination with the junction operational optimisation resulted in reduced transient queueing, higher average speeds and reduced overall travel time in the AM peak hour for Option 6A.

Various measures are available to consider for the reduction of HGV traffic through the A426 High Street in Lutterworth. This includes height and width restriction signing supported by appropriate enforcement, and physical measures such as width restriction bollards and low speed zones.

Appendix A. LinSig Outputs after the second iteration

Junction Results Summary - Frank Whittle Junction

Scenario 1: 'AM ' (FG1: 'AM Peak', Plan 1: 'Network Control Plan 1')
Junction Layout Diagram

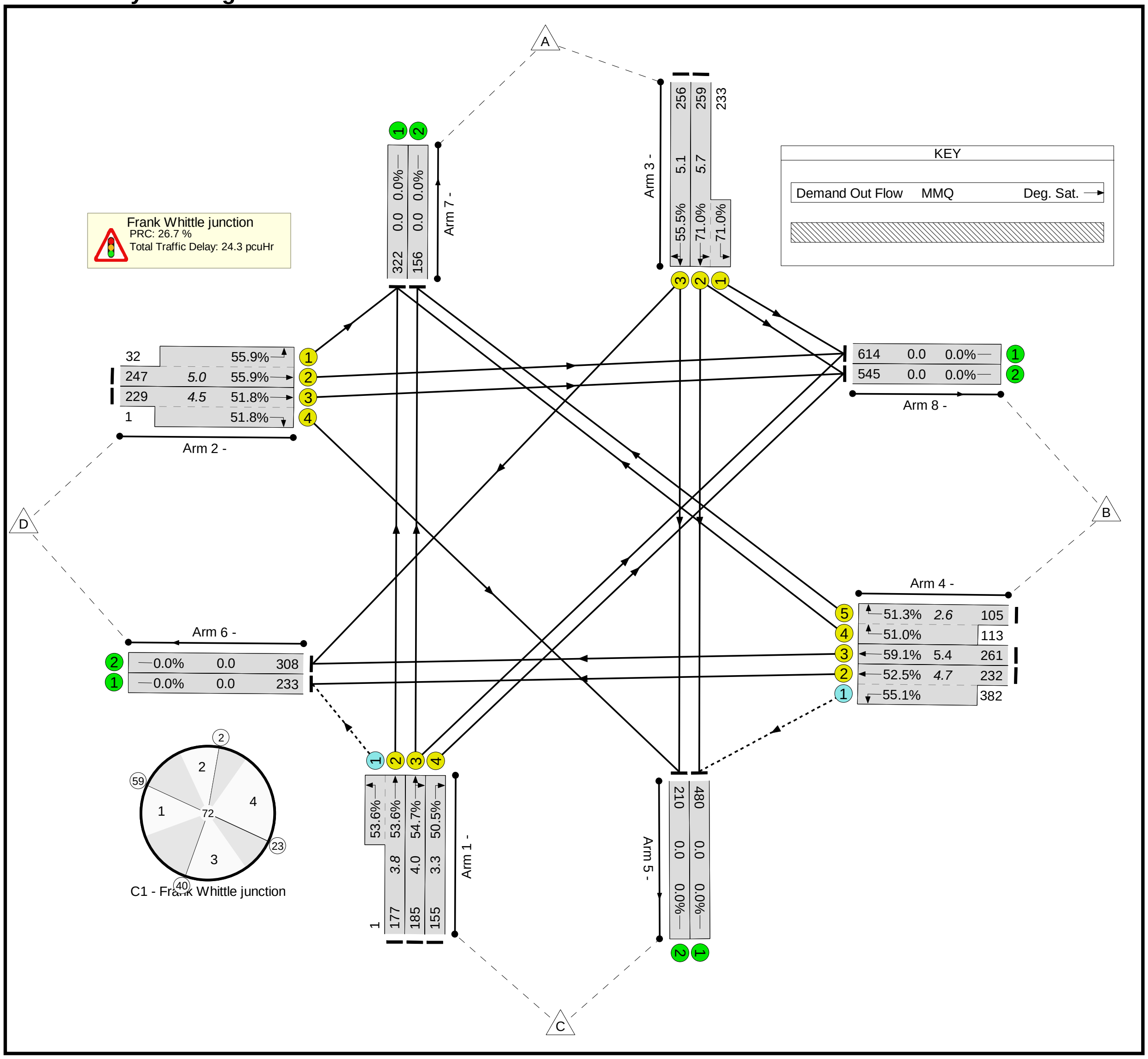


Link Results

Item	Lane Description	Full Phase	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Deg Sat (%)	Total Delay (pcuHr)	Mean Max Queue (pcu)
Network	-	-	-	-	**83.6%**	**46.4**	-
Frank Whittle junction	-	-	-	-	**83.6%**	**46.4**	-
1/2+1/1	Left Ahead	B -	338	1980:1805	73.2 : 73.2%	4.5	9.5
1/3	Ahead Right	B	339	2018	73.3%	4.6	9.6
1/4	Right	A	300	1842	71.1%	4.0	8.5
2/2+2/1	Left Ahead	D	508	2120:1842	66.9 : 66.9%	5.3	8.4
2/3+2/4	Right Ahead	D C	328	2120:1842	56.9 : 56.9%	3.5	7.9
3/2+3/1	Ahead Left	E	364	2079:1853	60.5 : 60.5%	4.0	5.1
3/3	Ahead Right	E	292	1922	69.5%	3.9	8.3
4/2+4/1	Left Ahead	G -	1021	2120:1842	80.1 : 83.6%	6.3	13.2
4/3	Ahead	G	444	2120	80.4%	6.1	13.0
4/5+4/4	Right	F	236	1842:1995	73.6 : 74.0%	4.2	4.5

C1 - Frank Whittle junction PRC for Signalled Lanes (%): 7.7 Total Delay for Signalled Lanes (pcuHr): 4
PRC Over All Lanes (%): 7.7 Total Delay Over All Lanes(pcuHr): 4

Scenario 2: 'PM (FG2: 'PM Peak', Plan 1: 'Network Control Plan 1')
Junction Layout Diagram



Link Results

Item	Lane Description	Full Phase	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Deg Sat (%)	Total Delay (pcuHr)	Mean Max Queue (pcu)
Network	**-**	**-**	**-**	**-**	**71.0%**	**24.3**	**-**
Frank Whittle junction	**-**	**-**	**-**	**-**	**71.0%**	**24.3**	**-**
1/2+1/1	Left Ahead	B -	178	1980:1805	53.6 : 53.6%	1.9	3.8
1/3	Ahead Right	B	185	2028	54.7%	2.0	4.0
1/4	Right	A	155	1842	50.5%	1.7	3.3
2/2+2/1	Left Ahead	D	279	2120:1842	55.9 : 55.9%	2.6	5.0
2/3+2/4	Right Ahead	D C	230	2120:1842	51.8 : 51.8%	2.2	4.5
3/2+3/1	Ahead Left	E	492	2066:1853	71.0 : 71.0%	4.5	5.7
3/3	Ahead Right	E	256	1953	55.5%	2.3	5.1
4/2+4/1	Left Ahead	G -	614	2120:1842	52.5 : 55.1%	2.2	4.7
4/3	Ahead	G	261	2120	59.1%	2.6	5.4
4/5+4/4	Right	F	218	1842:1995	51.3 : 51.0%	2.3	2.6

C1 - Frank Whittle junction

PRC for Signalled Lanes (%): 26.7

PRC Over All Lanes (%): 26.7

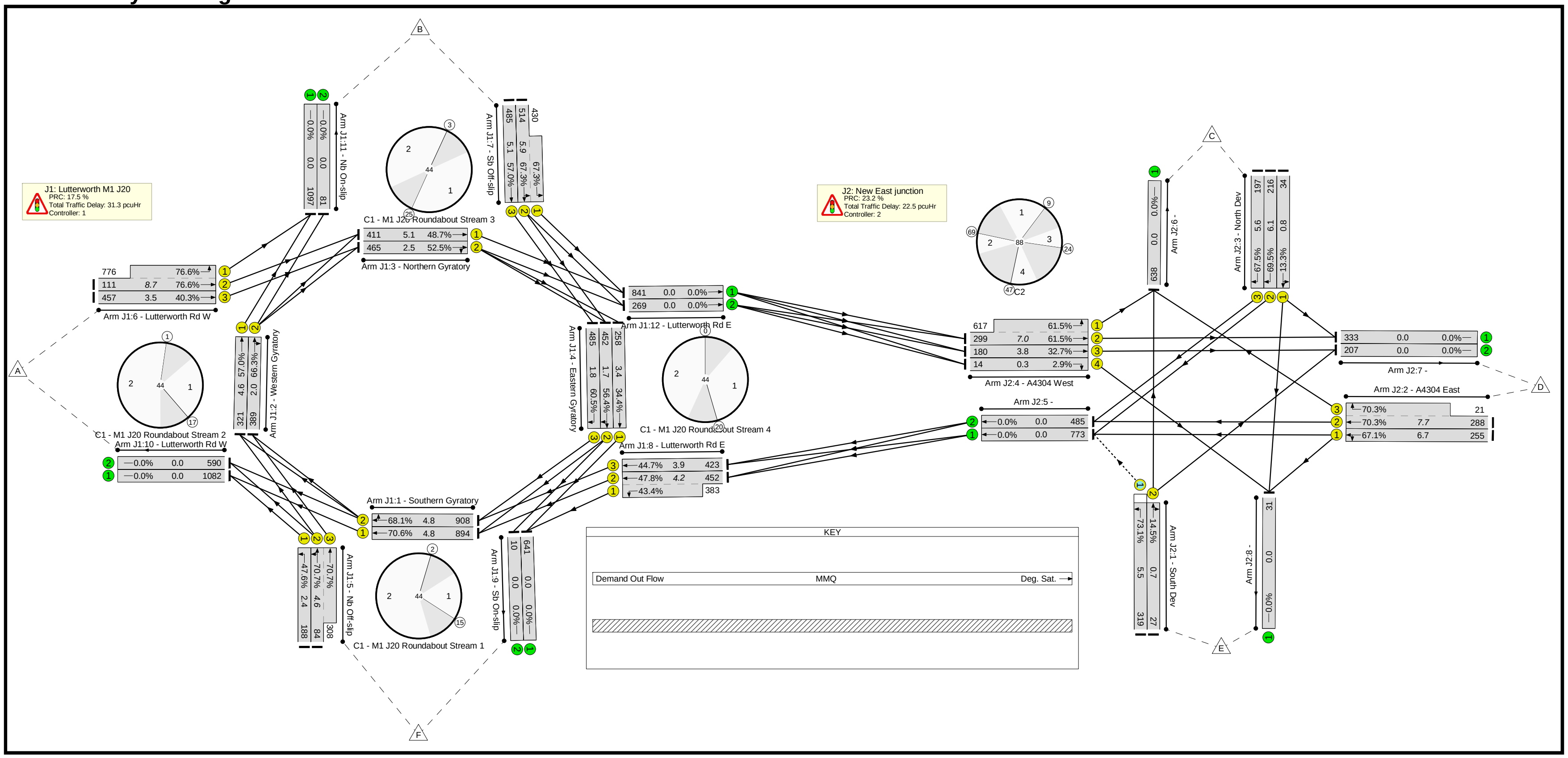
Total Delay for Signalled Lanes (pcuHr):

Total Delay Over All Lanes(pcuHr):

Junction Results Summary - M1 Junction 20 & A4304 / Eastern Link Road Junction

Scenario 1: 'AM' (FG1: 'AM', Plan 1: 'Lutterworth')

Junction Layout Diagram

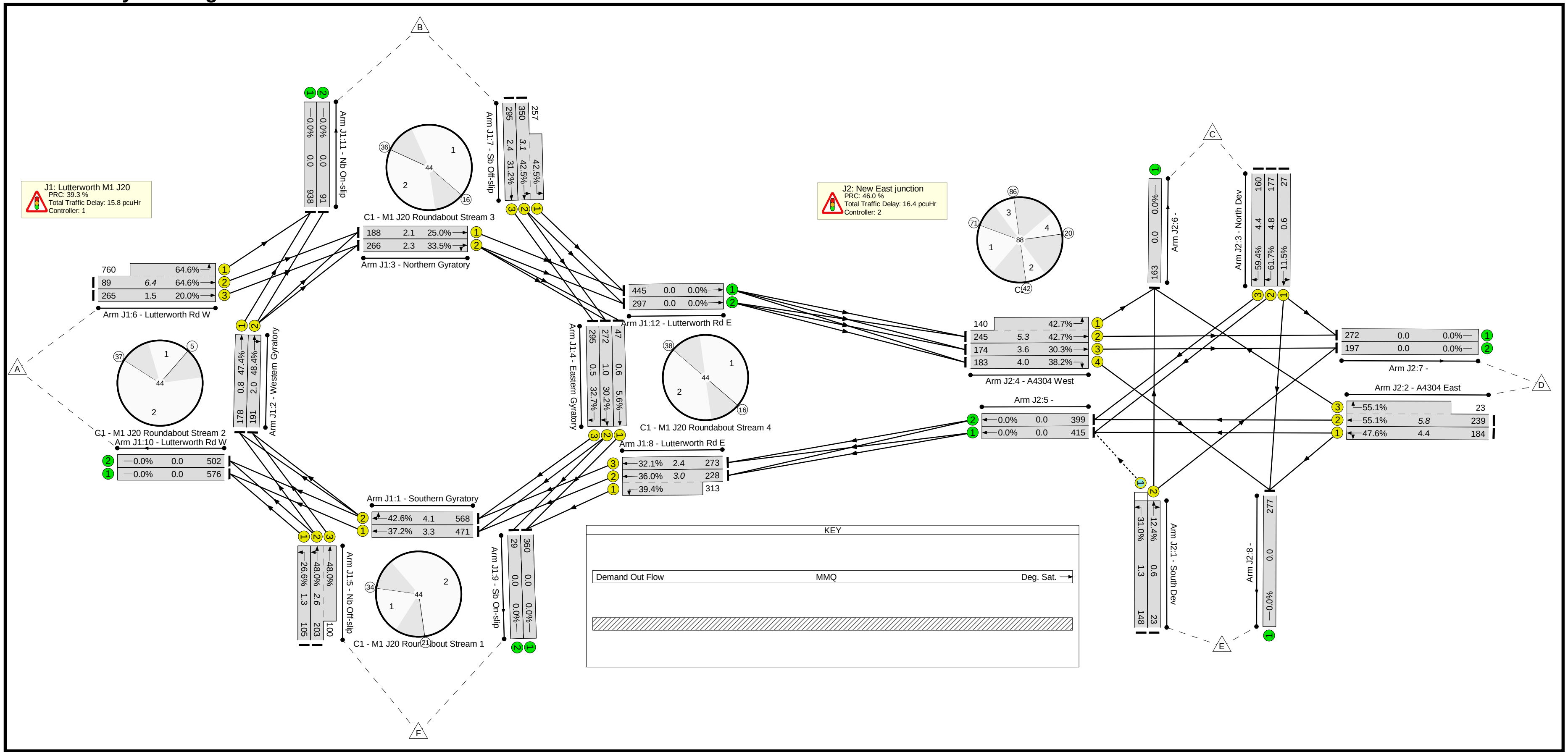


Link Results

Item	Lane Description	Full Phase	Num Greens	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Deg Sat (%)	Total Delay (pcuHr)	Mean Max Queue (pcu)
Network	-	-	-	-	-	**76.6%**	**53.8**	-
J1: Lutterworth M1 J20	-	-	-	-	-	**76.6%**	**31.3**	-
1/1	Southern Gyratory Ahead	C1:B	1	894	2065	70.6%	1.8	4.8
1/2	Southern Gyratory Right Ahead	C1:B	1	908	2174	68.1%	1.6	4.8
2/1	Western Gyratory Ahead	C1:D	1	321	2065	57.0%	2.1	4.6
2/2	Western Gyratory Right Ahead	C1:D	1	389	2151	66.3%	1.3	2.0
3/1	Northern Gyratory Ahead	C1:F	1	411	2065	48.7%	1.4	5.1
3/2	Northern Gyratory Right Ahead	C1:F	1	465	2165	52.5%	1.2	2.5
4/1	Eastern Gyratory Ahead	C1:H	1	258	2065	34.4%	1.2	3.4
4/2	Eastern Gyratory Right Ahead	C1:H	1	452	2205	56.4%	1.2	1.7
4/3	Eastern Gyratory Right	C1:H	1	485	2205	60.5%	1.4	1.8
5/1	Nb Off-slip Left	C1:A	1	188	1932	47.6%	1.3	2.4
5/2+5/3	Nb Off-slip Ahead Left	C1:A	1	392	2068:2130	70.7 : 70.7%	2.9	4.6
6/2+6/1	Lutterworth Rd W Ahead Left	C1:C	1	887	2080:1940	76.6 : 76.6%	3.4	8.7
6/3	Lutterworth Rd W Ahead	C1:C	1	457	2080	40.3%	1.1	3.5
7/2+7/1	Sb Off-slip Ahead Left	C1:E	1	944	2080:1879	67.3 : 67.3%	3.7	5.9
7/3	Sb Off-slip Ahead	C1:E	1	485	2080	57.0%	2.0	5.1
8/2+8/1	Lutterworth Rd E Ahead Left	C1:G	1	835	2080:1940	47.8 : 43.4%	2.3	4.2
8/3	Lutterworth Rd E Ahead	C1:G	1	423	2080	44.7%	1.4	3.9
J2: New East junction	-	-	-	-	-	**73.1%**	**22.5**	-
1/1	South Dev Left	C2:Q	1	319	1852	73.1%	2.2	5.5
1/2	South Dev Ahead Right	C2:G	1	27	2042	14.5%	0.4	0.7
2/1	A4304 East Ahead Left	C2:F	1	255	1967	67.1%	3.3	6.7
2/2+2/3	A4304 East Ahead Right	C2:F C2:E	1	309	2120:1972	70.3 : 70.3%	4.0	7.7
3/1	North Dev Left Ahead	C2:D	1	34	1729	13.3%	0.4	0.8
3/2	North Dev Right	C2:D	1	216	2105	69.5%	3.2	6.1
3/3	North Dev Right	C2:D	1	197	1976	67.5%	3.0	5.6

Item	Lane Description	Full Phase	Num Greens	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Deg Sat (%)	Total Delay (pcuHr)	Mean Max Queue (pcu)
4/2+4/1	A4304 West Left Ahead	C2:B C2:C	1:2	916	2105:1879	61.5 : 61.5%	4.3	7.0
4/3	A4304 West Ahead	C2:B	1	180	2105	32.7%	1.6	3.8
4/4	A4304 West Right	C2:A	1	14	1914	2.9%	0.1	0.3

Scenario 2: 'PM' (FG2: 'PM', Plan 1: 'Lutterworth')
Junction Layout Diagram



Link Results

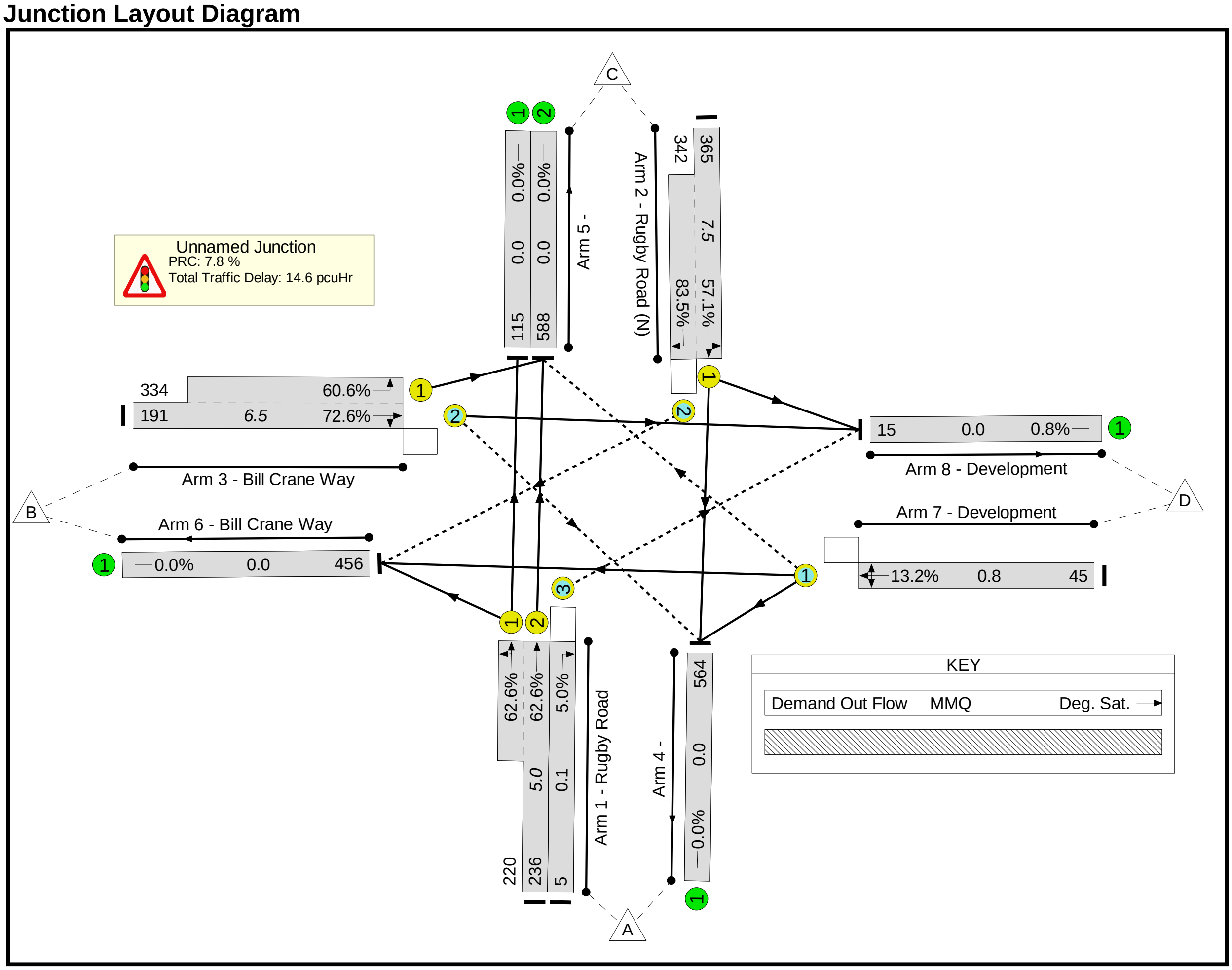
Item	Lane Description	Full Phase	Num Greens	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Deg Sat (%)	Total Delay (pcuHr)	Mean Max Queue (pcu)
Network	-	-	-	-	-	**64.6%**	**32.1**	-
J1: Lutterworth M1 J20	-	-	-	-	-	**64.6%**	**15.8**	-
1/1	Southern Gyratory Ahead	C1:B	1	471	2065	37.2%	0.8	3.3
1/2	Southern Gyratory Right Ahead	C1:B	1	568	2172	42.6%	1.0	4.1
2/1	Western Gyratory Ahead	C1:D	1	178	2065	47.4%	0.7	0.8
2/2	Western Gyratory Right Ahead	C1:D	1	191	2169	48.4%	0.9	2.0
3/1	Northern Gyratory Ahead	C1:F	1	188	2065	25.0%	0.7	2.1
3/2	Northern Gyratory Right Ahead	C1:F	1	266	2185	33.5%	0.8	2.3
4/1	Eastern Gyratory Ahead	C1:H	1	47	2065	5.6%	0.2	0.6
4/2	Eastern Gyratory Right Ahead	C1:H	1	272	2205	30.2%	0.4	1.0
4/3	Eastern Gyratory Right	C1:H	1	295	2205	32.7%	0.4	0.5
5/1	Nb Off-slip Left	C1:A	1	105	1932	26.6%	0.6	1.3
5/2+5/3	Nb Off-slip Ahead Left	C1:A	1	303	2068:2130	48.0 : 48.0%	1.7	2.6
6/2+6/1	Lutterworth Rd W Ahead Left	C1:C	1	849	2080:1940	64.6 : 64.6%	2.0	6.4
6/3	Lutterworth Rd W Ahead	C1:C	1	265	2080	20.0%	0.4	1.5
7/2+7/1	Sb Off-slip Ahead Left	C1:E	1	607	2080:1879	42.5 : 42.5%	1.7	3.1
7/3	Sb Off-slip Ahead	C1:E	1	295	2080	31.2%	0.9	2.4
8/2+8/1	Lutterworth Rd E Ahead Left	C1:G	1	541	2080:1940	36.0 : 39.4%	1.6	3.0
8/3	Lutterworth Rd E Ahead	C1:G	1	273	2080	32.1%	0.9	2.4
J2: New East junction	-	-	-	-	-	**61.7%**	**16.4**	-
1/1	South Dev Left	C2:Q	1	148	1852	31.0%	0.4	1.3
1/2	South Dev Ahead Right	C2:G	1	23	2042	12.4%	0.3	0.6
2/1	A4304 East Ahead Left	C2:F	1	184	1888	47.6%	2.0	4.4
2/2+2/3	A4304 East Ahead Right	C2:F C2:E	1	262	2120:1972	55.1 : 55.1%	2.9	5.8
3/1	North Dev Left Ahead	C2:D	1	27	1729	11.5%	0.3	0.6
3/2	North Dev Right	C2:D	1	177	2105	61.7%	2.6	4.8
3/3	North Dev Right	C2:D	1	160	1976	59.4%	2.3	4.4

Item	Lane Description	Full Phase	Num Greens	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Deg Sat (%)	Total Delay (pcuHr)	Mean Max Queue (pcu)
4/2+4/1	A4304 West Left Ahead	C2:B C2:C	1:2	385	2105:1879	42.7 : 42.7%	2.4	5.3
4/3	A4304 West Ahead	C2:B	1	174	2105	30.3%	1.4	3.6
4/4	A4304 West Right	C2:A	1	183	1914	38.2%	1.7	4.0

Junction Results Summary - Bill Crane Way Junction

Scenario 1: 'AM - with Link' (FG3: 'Design - with Link AM', Plan 1: 'Network Control Plan 1')

Junction Layout Diagram

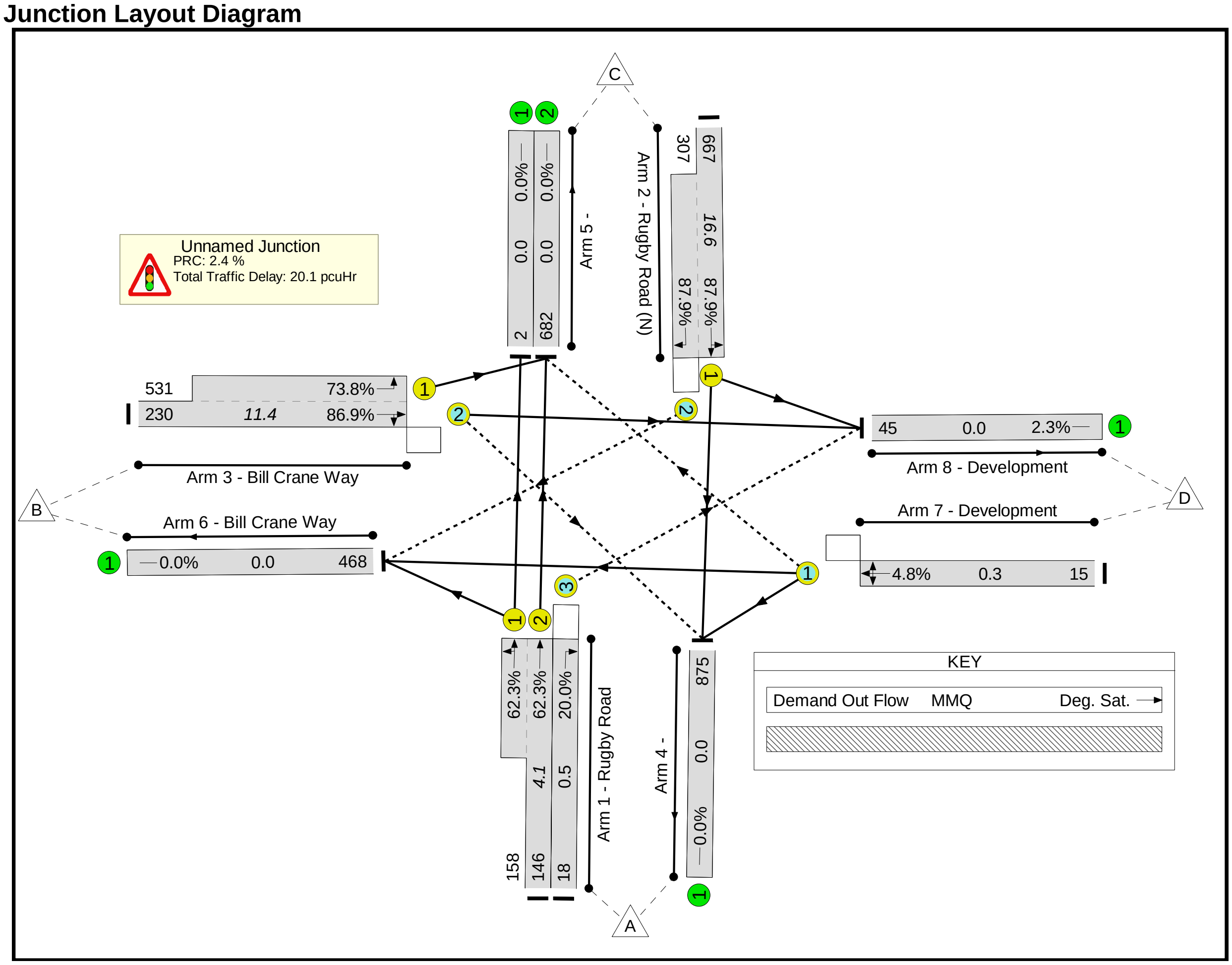


Link Results

Item	Lane Description	Full Phase	Num Greens	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Deg Sat (%)	Total Delay (pcuHr)	Mean Max Queue (pcu)
Network	-	-	-	-	-	**83.5%**	**14.6**	-
Unnamed Junction	-	-	-	-	-	**83.5%**	**14.6**	-
1/2+1/1	Rugby Road Ahead Left	C	1	456	1940:1810	62.6 : 62.6%	4.1	5.0
1/3	Rugby Road Right	C	1	5	1764	5.0%	0.1	0.1
2/1+2/2	Rugby Road (N) Ahead Right Left	A	1	707	1936:1962	57.1 : 83.5%	5.6	7.5
3/2+3/1	Bill Crane Way Right Left Ahead	B	1	525	1815:1724	72.6 : 60.6%	4.4	6.5
7/1	Development Left Right Ahead	E	1	45	1940	13.2%	0.4	0.8
8/1	Development	-	-	15	1940	0.8%	0.0	0.0

C1 PRC for Signalled Lanes (%): 7.8 Total Delay for Signalled Lanes (pcuHr): 1
PRC Over All Lanes (%): 7.8 Total Delay Over All Lanes(pcuHr): 1

Scenario 2: 'PM - with Link' (FG4: 'Design - with Link PM', Plan 1: 'Network Control Plan 1')
Junction Layout Diagram

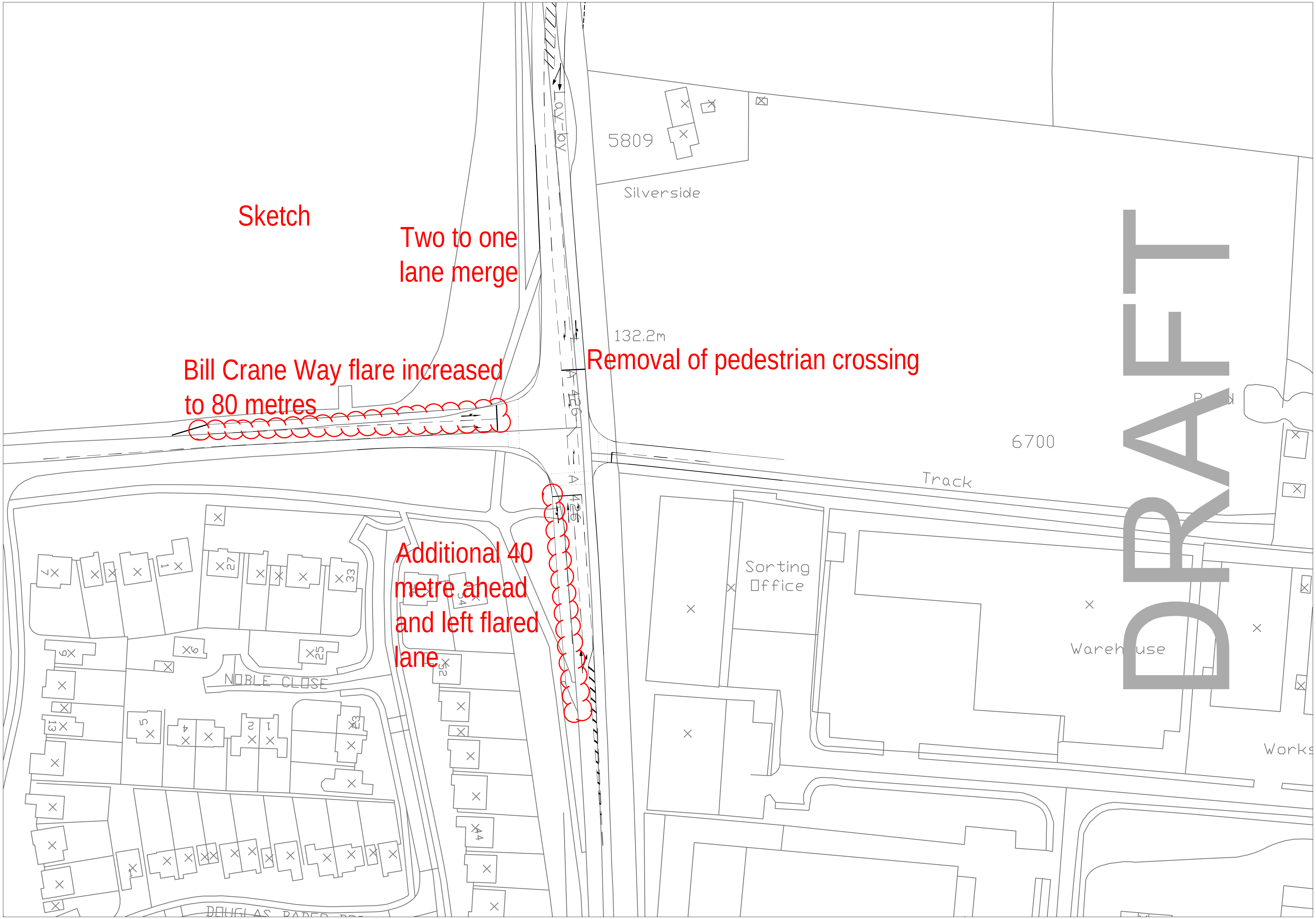


Link Results

Item	Lane Description	Full Phase	Num Greens	Demand Flow (pcu)	Sat Flow (pcu/Hr)	Deg Sat (%)	Total Delay (pcuHr)	Mean Max Queue (pcu)
Network	**-**	**-**	**-**	**-**	**-**	**87.9%**	**20.1**	**-**
Unnamed Junction	**-**	**-**	**-**	**-**	**-**	**87.9%**	**20.1**	**-**
1/2+1/1	Rugby Road Ahead Left	C	1	304	1940:1690	62.3 : 62.3%	3.5	4.1
1/3	Rugby Road Right	C	1	18	1764	20.0%	0.4	0.5
2/1+2/2	Rugby Road (N) Ahead Right Left	A	1	974	1932:1962	87.9 : 87.9%	9.3	16.6
3/2+3/1	Bill Crane Way Right Left Ahead	B	1	761	1818:1724	86.9 : 73.8%	6.7	11.4
7/1	Development Left Right Ahead	E	1	15	1940	4.8%	0.1	0.3
8/1	Development	-	-	45	1940	2.3%	0.0	0.0

C1 PRC for Signalled Lanes (%): 2.4 Total Delay for Signalled Lanes (pcuHr): 2
PRC Over All Lanes (%): 2.4 Total Delay Over All Lanes(pcuHr): 2

Appendix B. Bill Crane Way junction improvement sketch


Sketch
Two to one lane merge
Bill Crane Way flare increased to 80 metres
Removal of pedestrian crossing
Additional 40 metre ahead and left flared lane
DRAFT
5809
Silverside
Lay-by
132.2m
A 426
6700
Track
Sorting Office
Wareh use
Works
NOBLE CLOSE