Technical Note

AECOM

Project:	**Milton Keynes Model Update**	Job No:	**60516496**
Subject:	**Plan:MK East of M1 Mitigation Testing**		
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Introduction

The primary purpose of this technical note is to assess the impact of proposed mitigation measures to mitigate the impact of the East of M1 development on the wider Milton Keynes road network and to provide supporting evidence for the Highway Infrastructure Funding (HIF) bid.

Milton Keynes Council (MKC) is looking into a number of growth options for Plan:MK which outlines development growth to 2031. The East of M1 site is considered as part of Scenario 2. The starting point to assess Plan:MK is by defining and assessing what is termed the Reference Case which incorporates currently committed growth across Milton Keynes to 2031. The Reference Case is described in detail in the MKMMM Traffic Forecasting Report while more recent updates to the Reference Case are described in Technical Note TN20.

The Milton Keynes Multi-Modal Model has been used to assess the proposed developments including those in the 'East of M1' area. This assessment has focussed on the 2031 AM (0800-0900) and PM (1700-1800) peaks but some output from the Inter-peak period (average hour of 1000-1600) model is also included.

As outlined in TN20 Revised Reference Case, a number of amendments have been made to the Reference case network, primarily the new layout for Kelly's Kitchen Roundabout and the removal of the left bypass lane for westbound traffic at the A421 roundabout adjacent to M1 junction 13. As such a revised Scenario2b has been produced incorporating these same amendments. Although there was reduced delay at Kelly's kitchen Roundabout and some redistribution of traffic in the vicinity accordingly, overall the modelled congestion issues highlighted in the original Reference Case (reported in the MKMMM Traffic Forecasting Report) remain unchanged.

This note provides a brief overview of the impacts of the Reference Case amendments when applied to Scenario 2b before assessing the mitigation measures.

Plan MK Scenario 2b Growth

The dwellings growth above the Reference Case is plotted in Figure 2 with the jobs growth above the Reference Case plotted in Figure 2. Scenario 2b includes all the Scenario 2 growth, which is an additional 10,674 dwellings and 11,502 jobs on top of the Reference Case. In addition a further 2,000 dwellings have been included in the East of M1 development taking the total to 5,000 dwellings for this site. Although planned after the Plan:MK 2031 horizon year these additional dwellings have been included to better measure the impacts on the road network and mitigation measures in this area.

As well as the 5,000 dwellings and 6,330 jobs east of M1, Scenario 2b includes:

- 918 jobs in Central Milton Keynes as part of the University Campus site;
- 1,500 dwellings of the Gallagher's development site near Bow Brickhill ;and
- A further 500 dwellings as part of the O&H site in South East MK.

This growth of 2,000 dwellings is split evenly across the two zones north of Bow Brickhill. Figure 1 shows this growth as well as the 2031 Scenario 1 growth above that for the Reference Case.

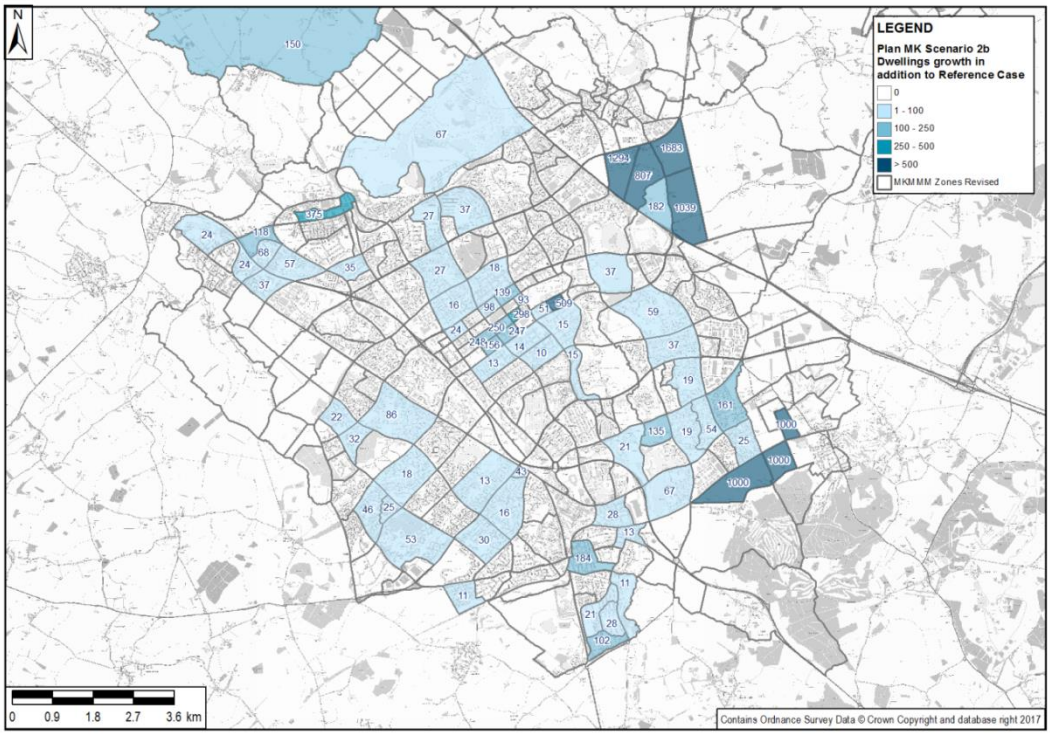

Figure 1. Plan:MK Scenario 1 and 2b Additional Dwellings Growth to 2031

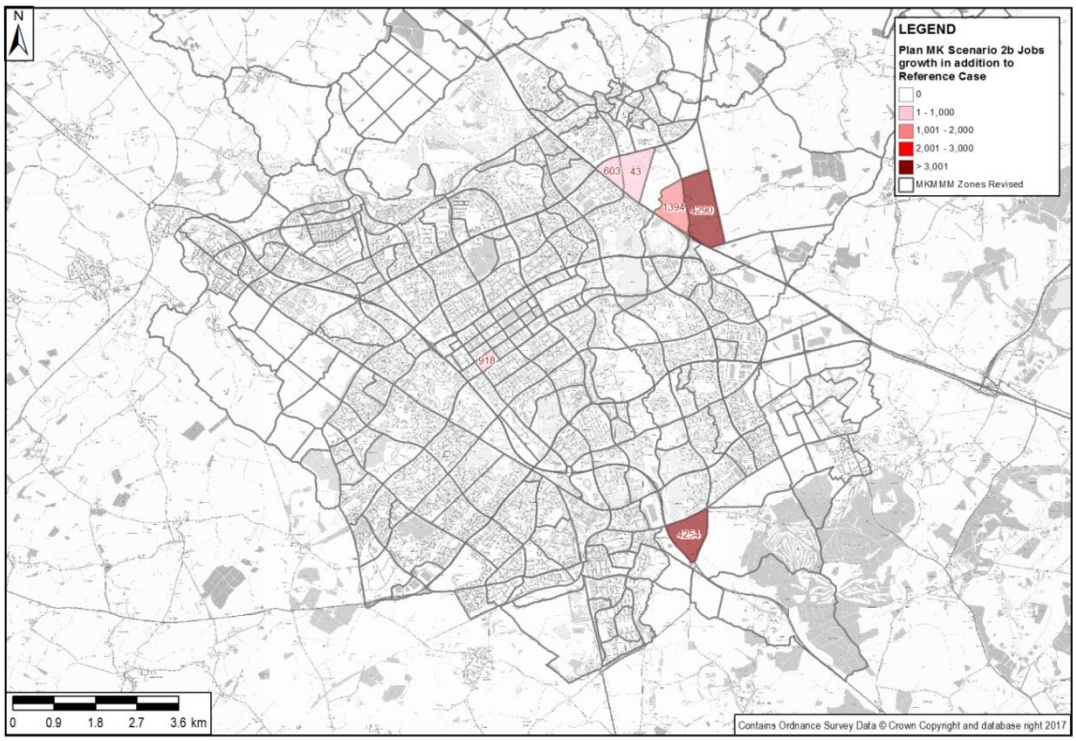

Figure 2. Plan:MK Scenario 1 and 2b Additional Jobs Growth to 2031

Scenario 2b Additional Highway Network

Additional road network is proposed to facilitate the two main development sites in Scenario 2b. Details of which are outlines in this section. For the purposes of the mitigation testing this additional network is assumed to be in place.

East of M1

To facilitate the East of M1 growth a revised road layout is proposed as shown in Figure 3. This includes a new primary route between the dualled A509 to the south of Interchange Park through to M1 J14. A new route from Renny Lodge roundabout bridging the motorway and connecting to Tongwell Street, with the existing A509 between these new routes remaining as access to the development. In addition there is an east-west link between the two routes to the north of the site with an east-west route linking Willen Road through to a re-aligned Newport Road. Signal timings have not been provided for the new signalised junctions and hence these have been estimated based on forecast flow ratios. It has been assumed the three entry lanes on the A509 southbound approach to M1 J14 will remain.

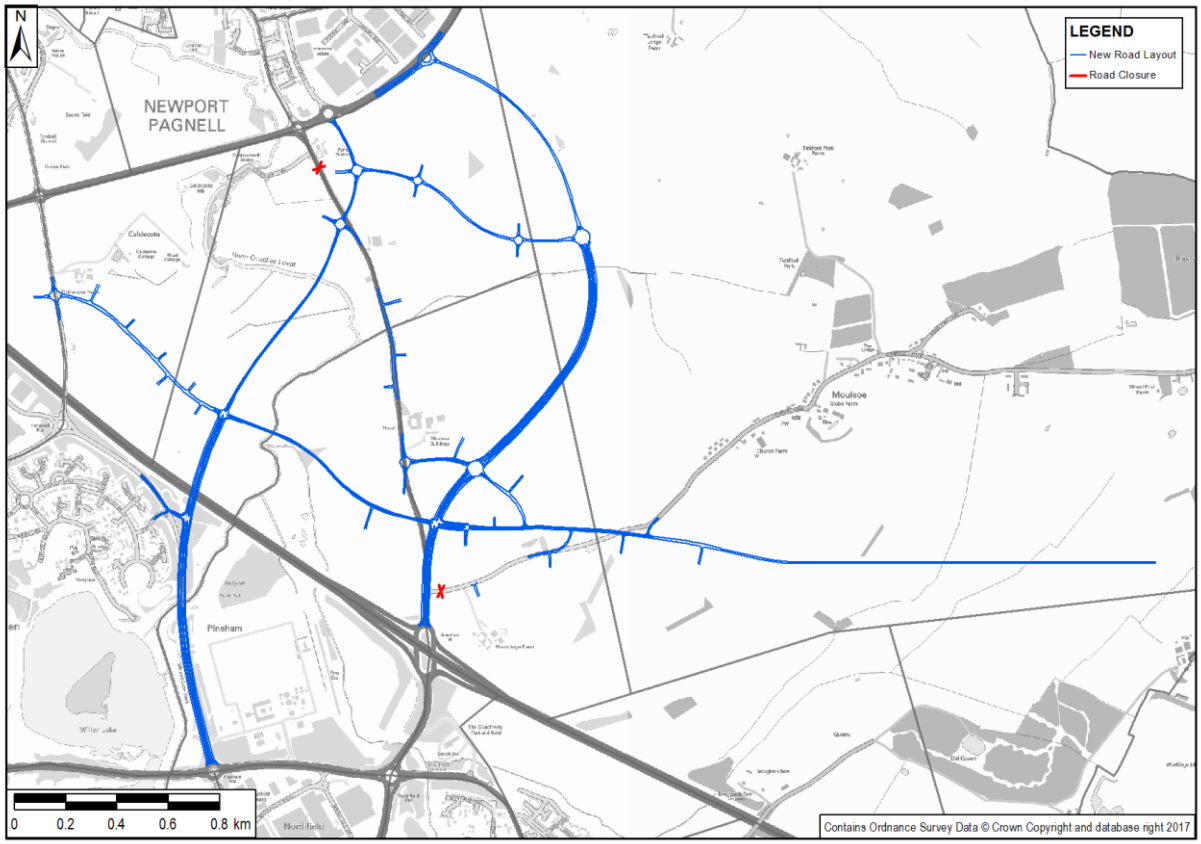

Figure 3. Indicative Additional Road Network – East of M1

South East Milton Keynes

Within Scenario 2b, in addition to the new road network east of M1, it is proposed that the South East Milton Keynes Site 2 (SEMK2) north of Bow Brickhill is served by additional road network as shown in Figure 4. This includes extending H10 as a single carriageway across to the A5130 Newport Road. There is also a connection included between the A5130 Newport Road and Bow Brickhill Road, which intersects the H10 extension and bridges the railway line. In addition there is a development spine road to the south of the railway line through SEMK2.

Following further discussion the junction arrangement on Brickhill Street north of the railway crossing was modified such that the only revision was the addition of a fourth arm at the Caldecotte Lake Drive roundabout.

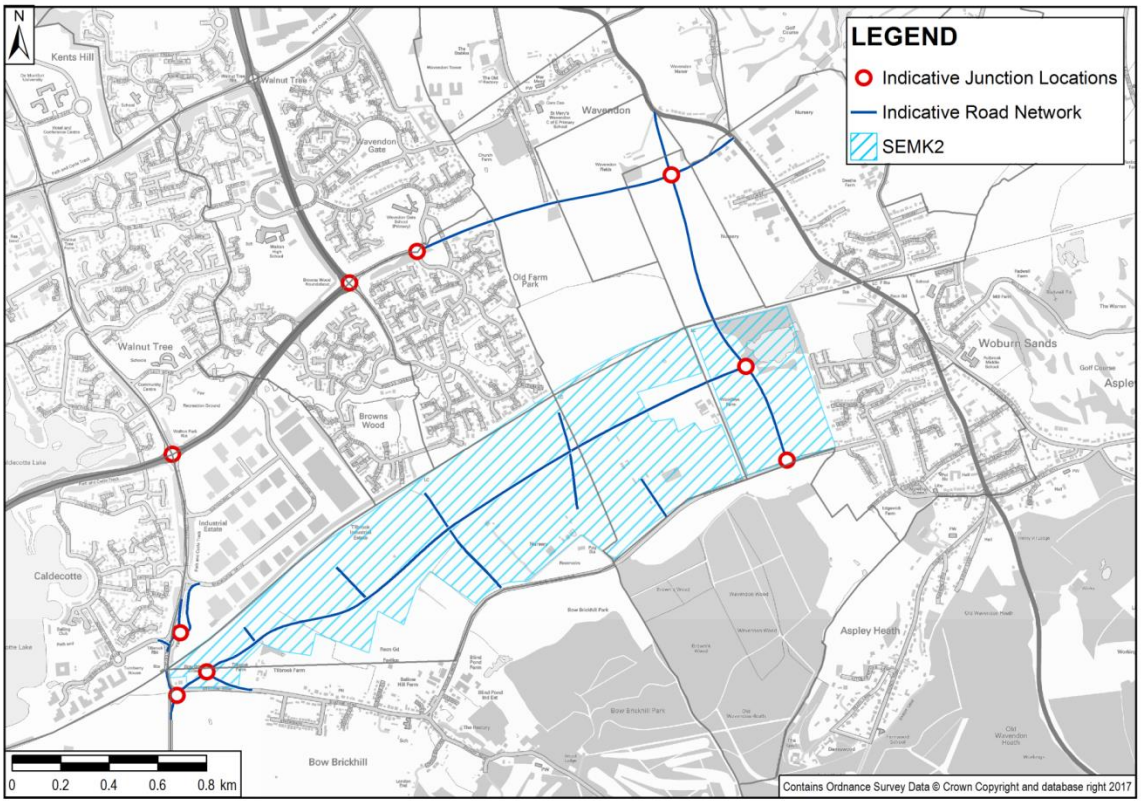

Figure 4. Indicative Additional Road Network

Public Transport

A park and ride site has been proposed as part of the East of M1 development. However in its current form it is not possible to model park and ride explicitly within the MKMMM. Due to time constraints and to give a worse case highways impact no changes to public transport have been made compared to the Reference Case. No amendments have been made to the public transport model as part of the mitigation testing.

Impacts of the Reference Case amendments to Scenario 2b

The amendments made in the Revised Reference Case have been applied to Plan:MK Scenario 2b to create Plan:MK Scenario 2bv2. This section compares the Plan:MK Scenario 2bv2 flows with Plan:MK 2b. The flow difference is plotted as bandwidths to the left side of each link by direction, with an increase in actual flow between the Reference Case and Scenario 2b shown in green and a decrease in blue. It is also important to note that where new links have been added no comparison is shown.

The flow comparisons are presented in Figure 5 to Figure 7. The modelled impact to the roads through the East of M1 development is minimal. In the PM peak there is an increase in flow along the Newport Road / Cranfield between Cranfield and the A509 immediately north of Junction 14. This is due to the release traffic from Cranfield University. The impact of this additional traffic appears minimal west of the M1.

The most notable changes are in the AM peak with a large increase in traffic northbound along the A5. There is also some reassignment of westbound traffic from Childs Way to alternative parallel routes to the south.

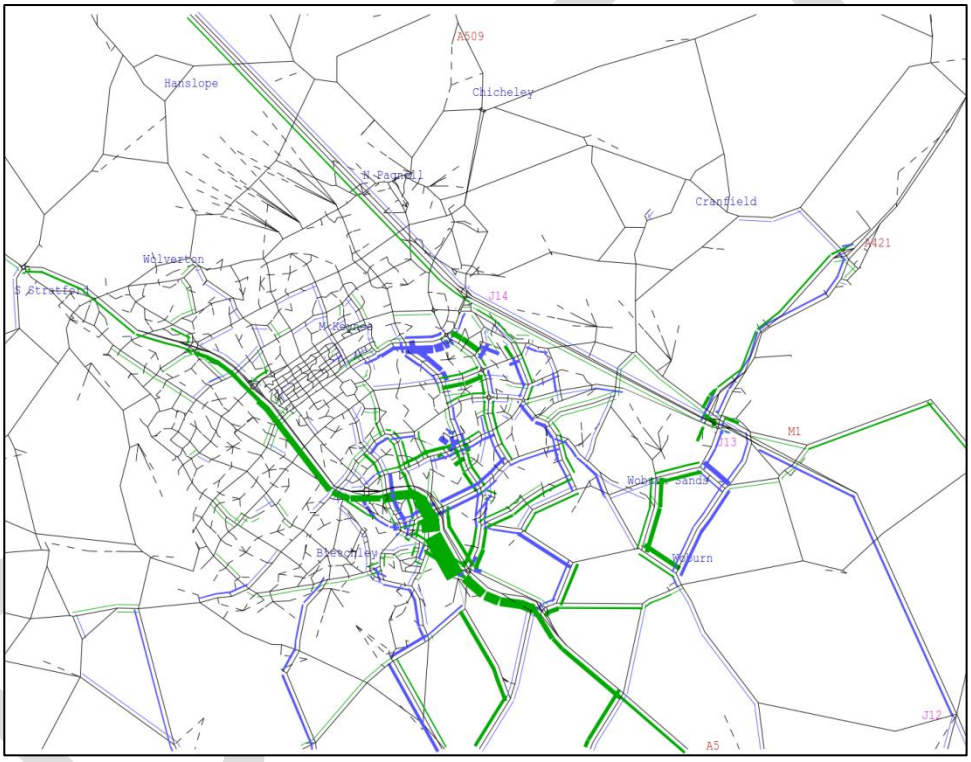

Figure 5. Change in modelled flow MK, Scenario 2b v2 less Scenario 2b AM

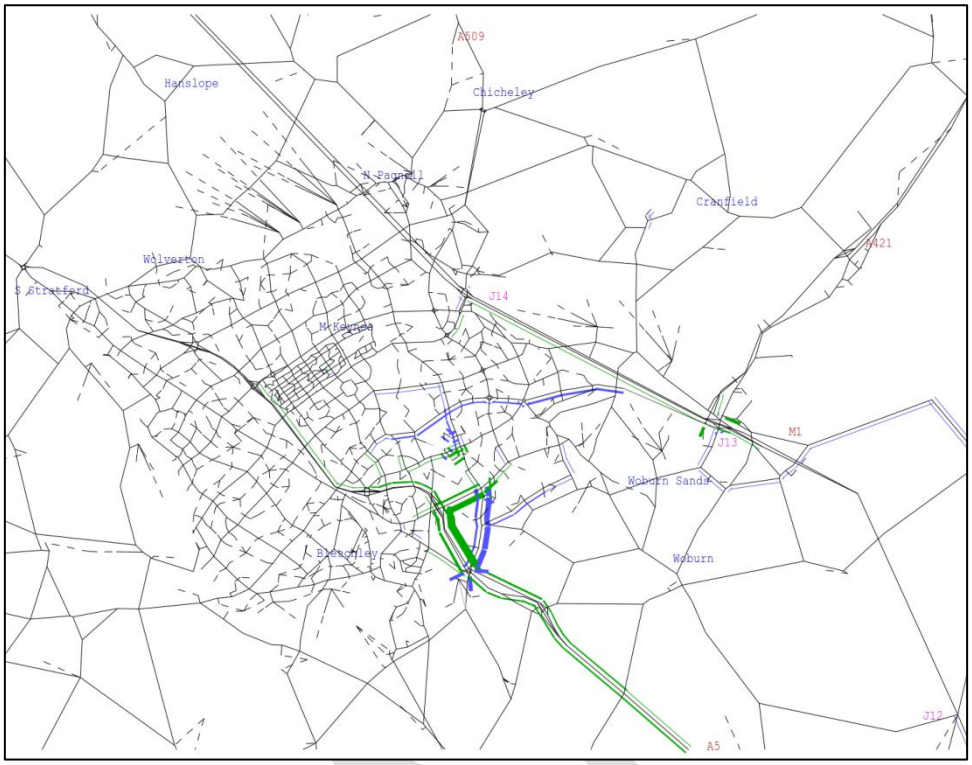

Figure 6. Change in modelled flow MK, Scenario 2b v2 less Scenario 2b Inter-peak

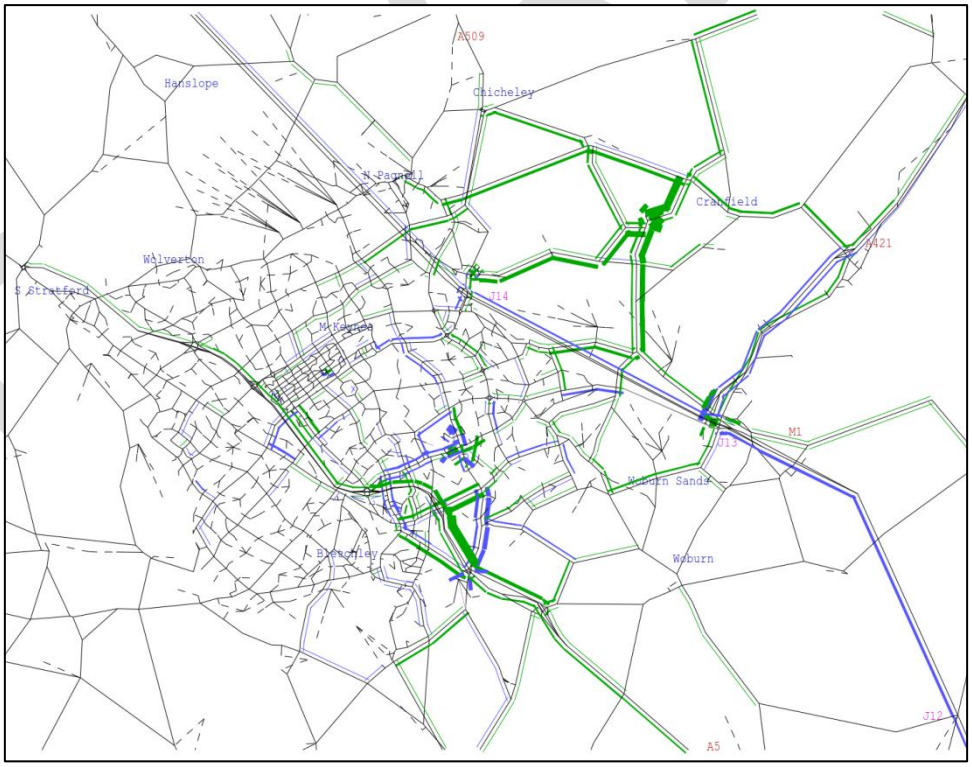

Figure 7. Change in modelled flow MK, Scenario 2b v2 less Scenario 2b PM

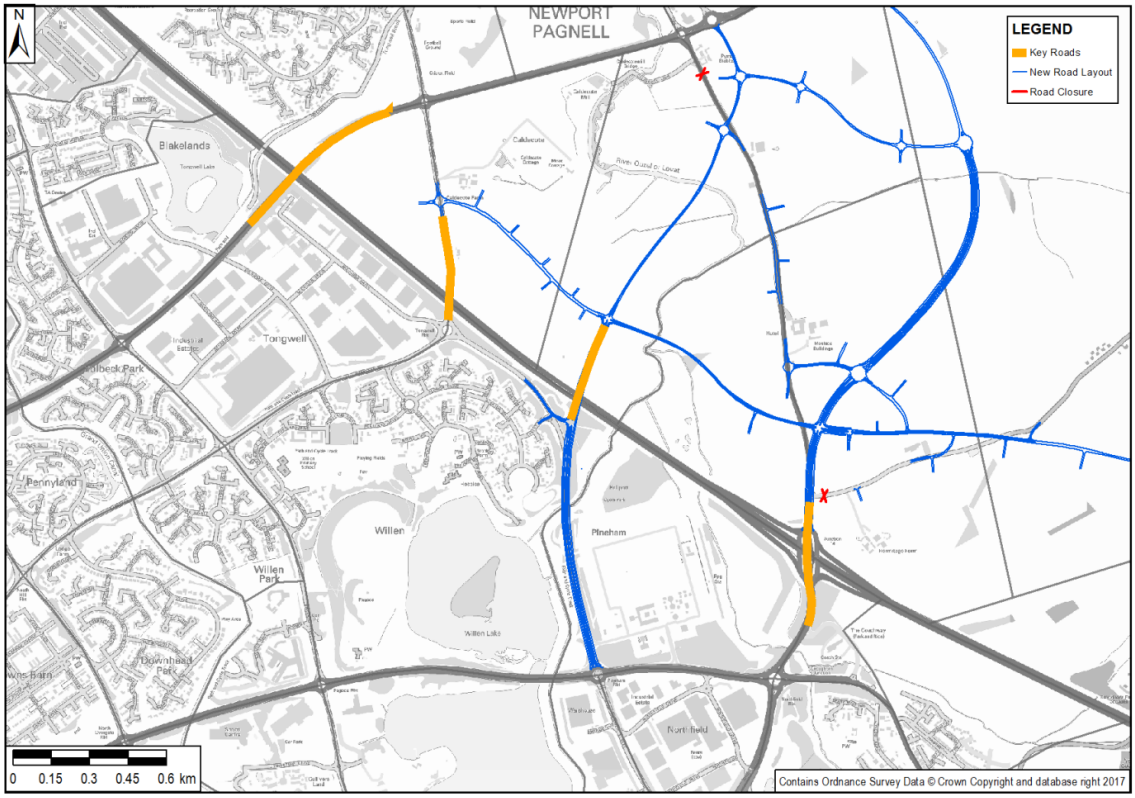

Figure 8. Motorway crossings between East of M1 and Milton Keynes

Comparing traffic flows across the M1 using the roads highlighted in Figure 17 shows little change between version 2 and the original Scenario 2b models. There is little change in the AM in total traffic crossing the M1. In the PM there is a more notable change. , In the PM peak towards Milton Keynes, there is an increase of 124PCU crossing the M1, an increase of just 4%. Conversely towards the east of M1, there is a reduction of 121 PCU, predominantly on the A422.

Table 1. Comparison of flows from East of M1 towards MK (PCU)

Time Period	Scenario	A422	Willen Road	New Bridge	J14 through Traffic	Total
AM	Scenario 2b	1110	1576	1666	1445	**5797**
	Scenario 2b v2	1102	1567	1665	1433	**5767**
	Difference	-8	-9	-1	-12	**-30**
PM	Scenario 2b	1210	467	856	802	**3335**
	Scenario 2b v2	1226	469	924	840	**3459**
	Difference	16	2	68	38	**124**

Table 2, Comparison of flows from MK towards East of M1 (PCU)

Time Period	Scenario	A422	Willen Road	New Bridge	J14 through Traffic	Total
AM	Scenario 2b	977	343	593	323	**2236**
	Scenario 2b v2	978	345	602	320	**2245**
	Difference	1	2	9	-3	**9**
PM	Scenario 2b	1790	985	1545	62	**4382**
	Scenario 2b v2	1694	958	1555	54	**4261**
	Difference	-96	-27	10	-8	**-121**

Comparisons showing the difference in delay between Scenario 2b v2 and Scenario 2 are presented in Figure 9 to Figure 11. In the AM peak there is an increase in delay at the H6 Childs Way / Brickhill Street junction and on the westbound approach to the signalised cross roads to the north of the new M1 crossing. Optimising the signal timings based on the revised flows could reduce this delay. The impacts in the IP and PM are to a lesser degree. There is little change in the inter-peak and in the PM the change is focussed around Cranfield University.

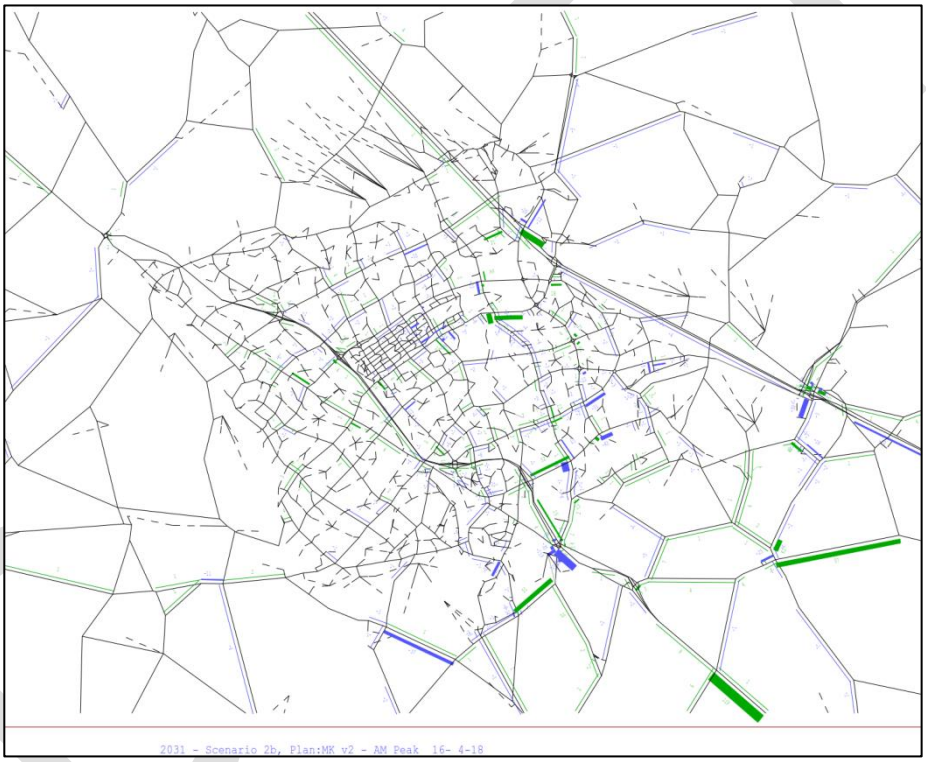

Figure 9. Change in modelled delay MK, Scenario 2b v2 less Scenario 2b AM

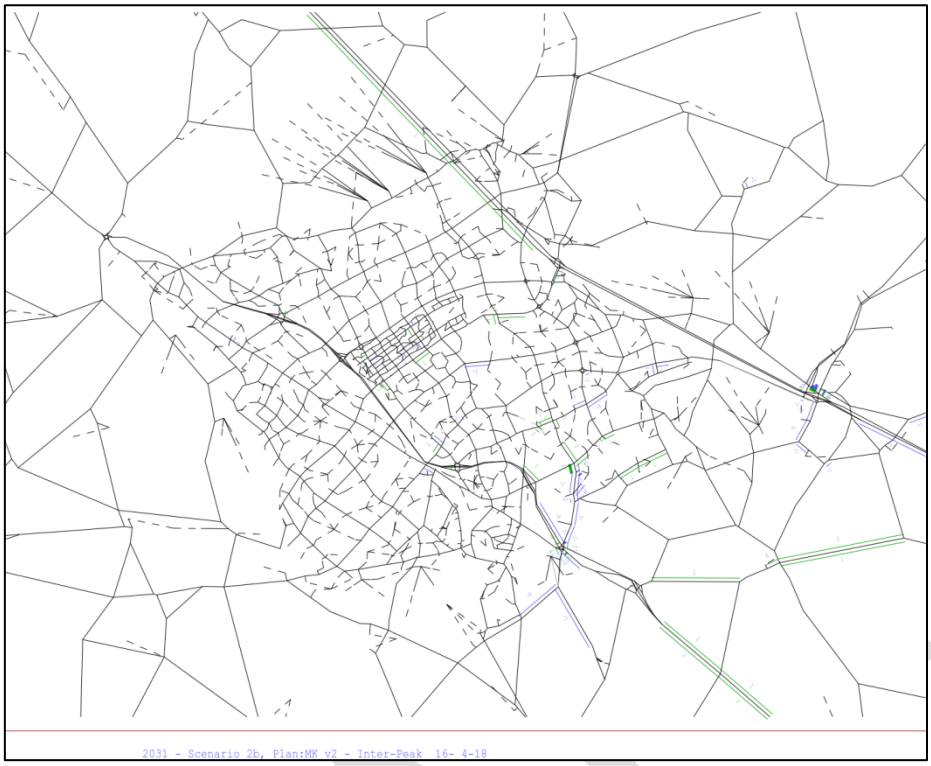

Figure 10. Change in modelled delay MK, Scenario 2b v2 less Scenario 2b Inter-peak

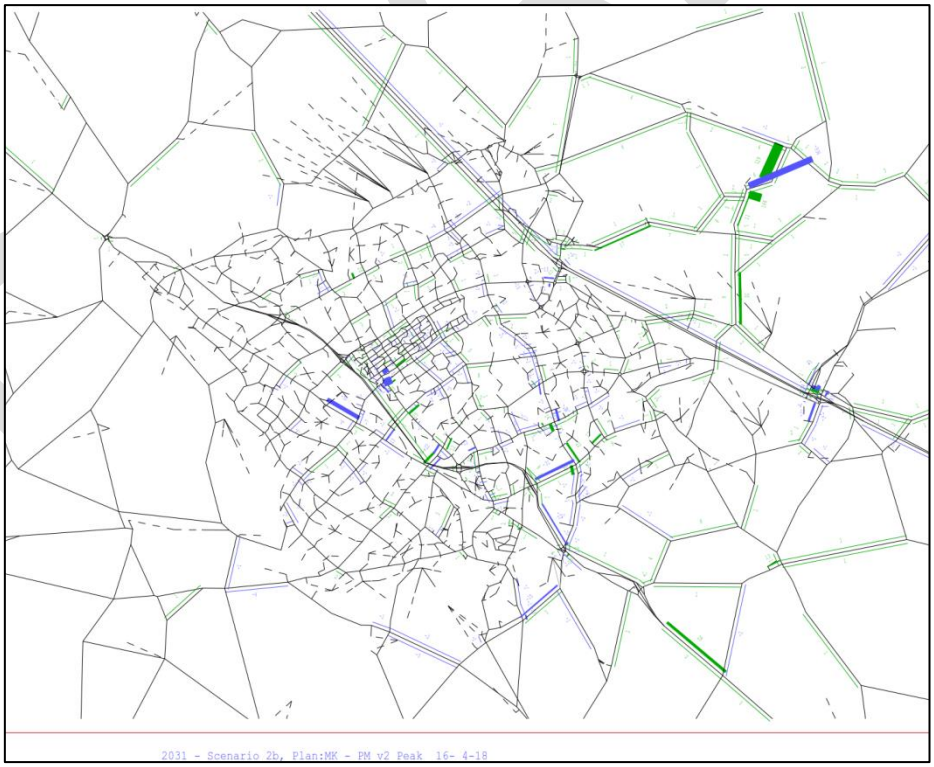

Figure 11. Change in modelled delay MK, Scenario 2b v2 less Scenario 2b PM

Propose Mitigation Measures

Following on from TN16 Impacts of Plan:MK Scenario 2b_v2 the transport consultants working for the East of M1 site developers have proposed mitigation measures for junctions in the vicinity of the development as shown in Figure 12. Flow, queue and delay data for the Reference Case Scenario and Scenario 2b+1 was provided to the consultants.

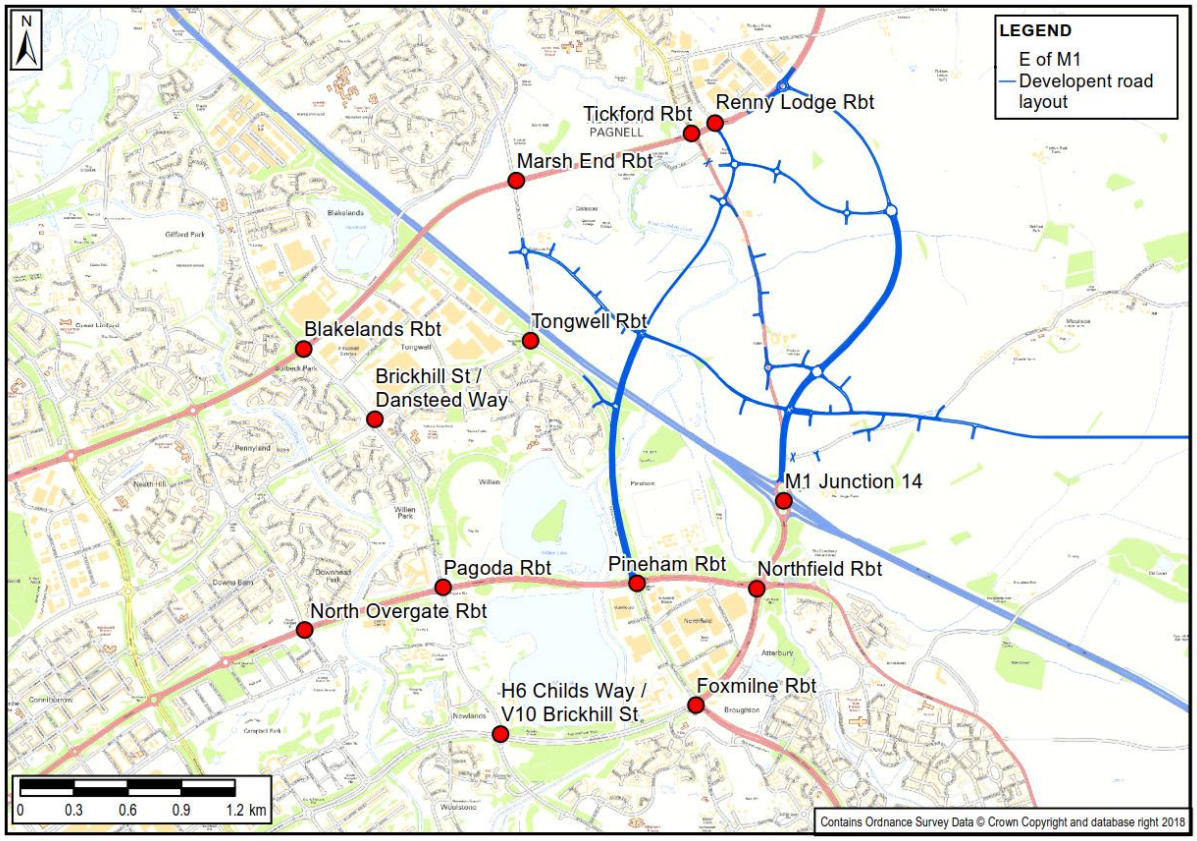

Figure 12. Junctions assessed for mitigation

The measures proposed are summarised in Table 3. These measures are in addition to the proposed improvements at M1 J14 which have also been included in this test. Layouts have been provided for non-signalised junction improvements. At this stage in the process, plans have not been drawn up for signal schemes. For these the LINSIG models have been provided and used to code up the lane markings.

[1] Scenario 2b+ was an interim scenario which is as Scenario 2b but includes the proposed M1 J14 scheme. The demand from Scenario 2b was assigned to the Scenario 2+ network without re-running the demand model, to allow the impacts of this junction improvement to be accounted for in the design of the mitigation schemes.

Table 3

Junction	Identified Impact	Mitigation	Comments
H6 Childs Way / V10 Brickhill St. Woodstone Roundabout)	Impact on all approaches	Provision of extended flares and entry widths to roundabout	Changes can be modelled
Blakelands	Impact upon southern, western and northern approach	Provision of increased flares on Brickhill St (S) and Monks Way (W) and change of road markings on Brickhill (N)	Changes too minor to model in SATURN
Fox Milne	Impact on western and northern approach	Propose full signalisation of the existing junction	Changes can be modelled
Marsh End	No negative impact	-	-
Northfield	Impact upon northern approach and internal queueing	Additional exit lane provided on Childs Way (S) and Portway (W) alongside change of road markings	Changes can be modelled
Pagoda	Impact upon all approaches to the junction	Increased flares to improve arms affected by development	Northbound approach changes can be modelled, Changes on eastbound approach too minor to model in SATURN
Pineham	Impact on northern and western approaches	Partial signalisation (Partial signalisation provided on Tongwell Road (N).	Changes can be modelled
Tongwell	No negative impact	-	-
Willen	Impact on western and eastern approaches	Flare increased on western approach. Two lane exit provided on western exit.	Changes too minor to model in SATURN
Renny Lodge	No negative impact	-	-
Tickford	No negative impact	-	-
North Overgate Roundabout	No negative impact	-	-

Where possible the mitigation measures have been coded into SATURN to create a 'Do Something' (DS) network. This Do Something scenario was then run through the demand model pivoting off the costs of the Scenario 2b v2 Do Minimum model.

Traffic Flow Changes

This section compares the Plan:MK Scenario 2b v2 Do Something flows with those of the Do Minimum. The flow difference is plotted as bandwidths to the left side of each link by direction, with an increase in actual flow between the Reference Case and Scenario 2b shown in green and a decrease in blue. It is also important to note that where new links have been added no comparison is shown.

As shown by Figure 13 to Figure 16, there is a large increase in flow on Childs Way between Childs Way / Tongwell St roundabout and the Childs Way / Brickhill Street Roundabout. This is mirrored to a lesser extent in the PM peak in the opposite direction. In the PM peak the main flow increase is parallel on A509.

There is also an increase in northbound flow on the M1 between J13 and J14 in both AM and PM peaks, with an increase of over 200PCU modelled in the PM peak north of J14 also.

In both peaks there is a reduction in flow along V11, Tongwell Street between Childs Way and A421.

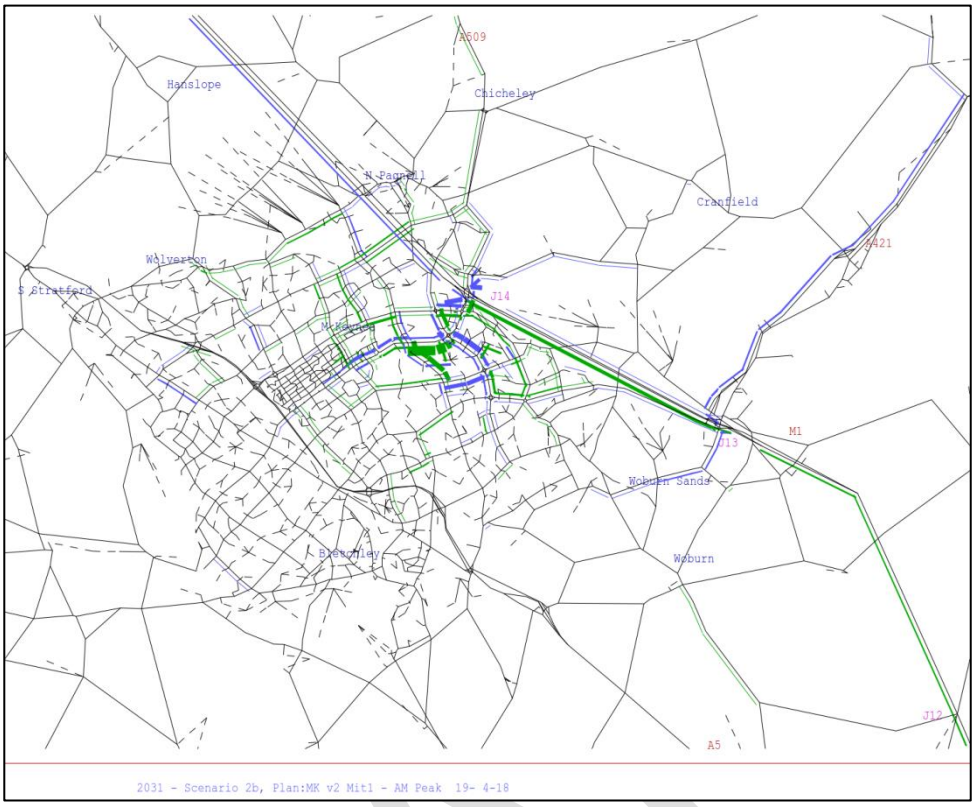

Figure 13. Change in modelled flow, Scenario 2b DS less DM AM

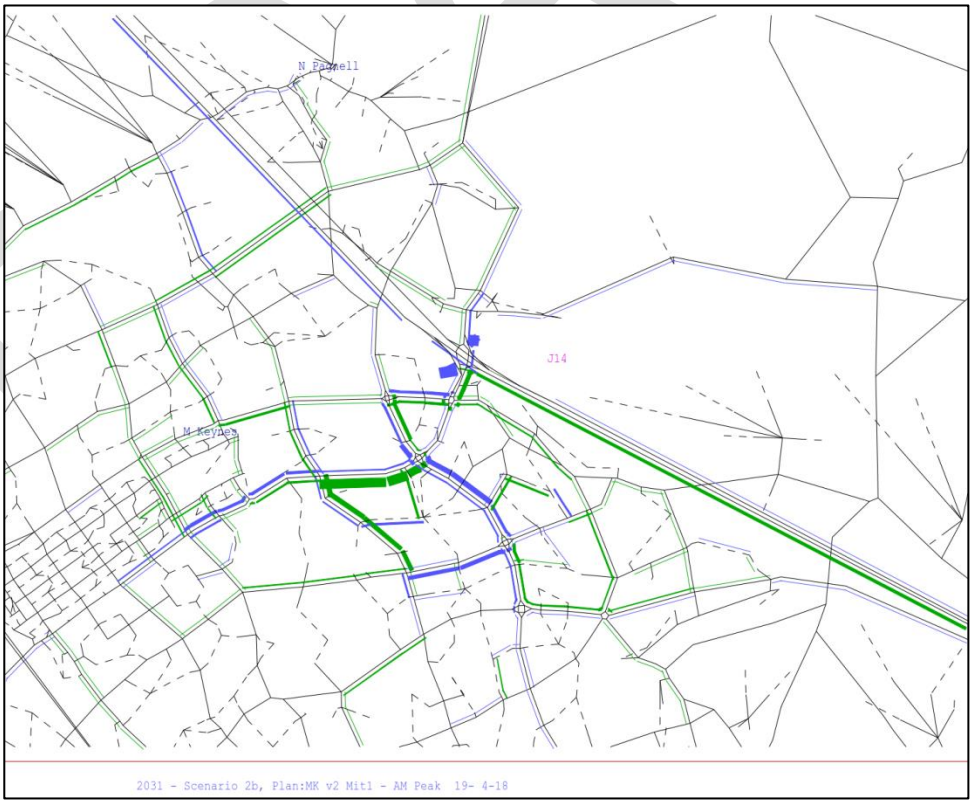

Figure 14. Change in modelled flow East of M1, DS less DM AM

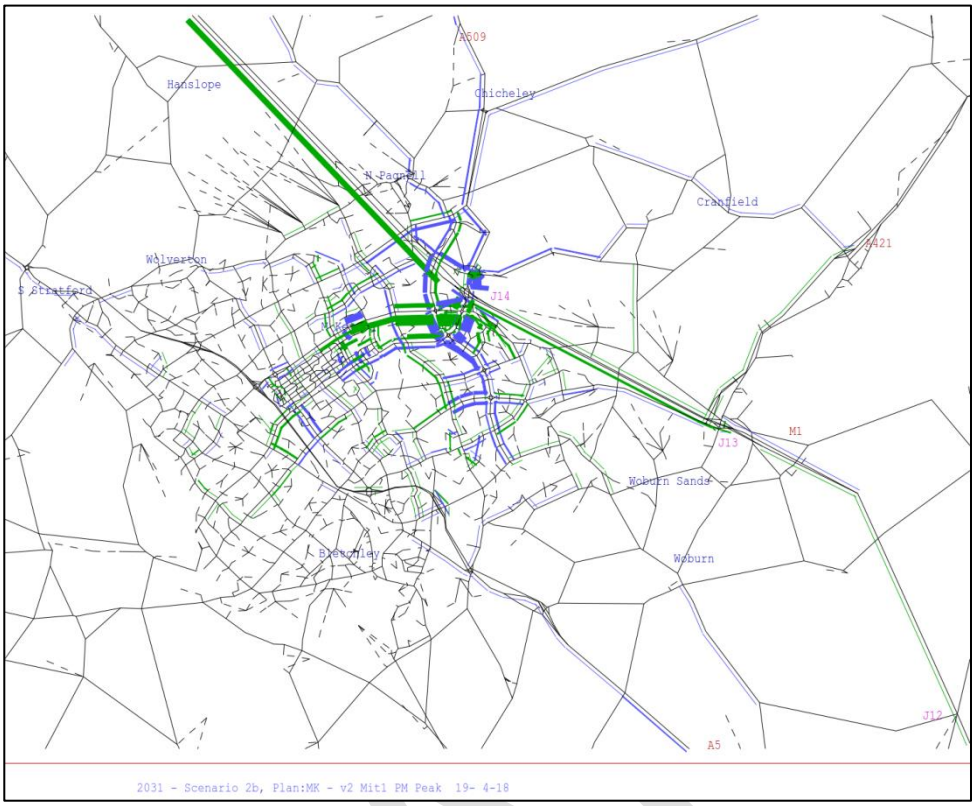

Figure 15. Change in modelled flow, Scenario 2b DS less DM PM

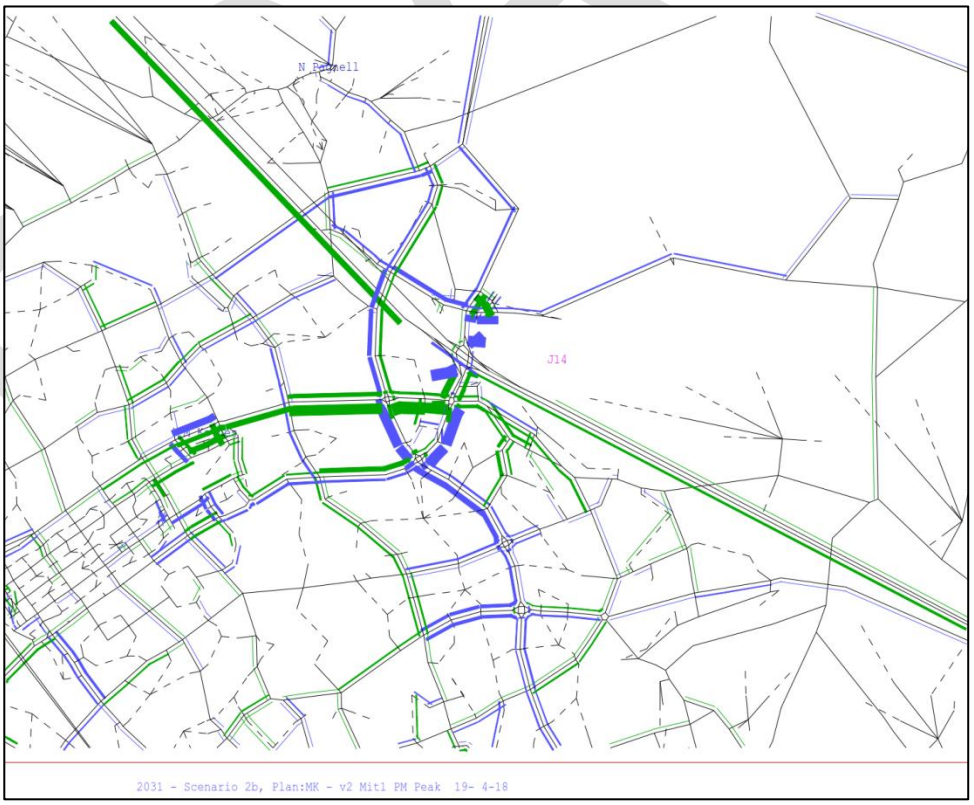

Figure 16. Change in modelled flow East of M1, DS less DM PM

A comparison of flows on the roads which cross the M1 motorway between the A422 and M1 J14 inclusive, as shown in Figure 17, are presented in Table 4 and Table 5.

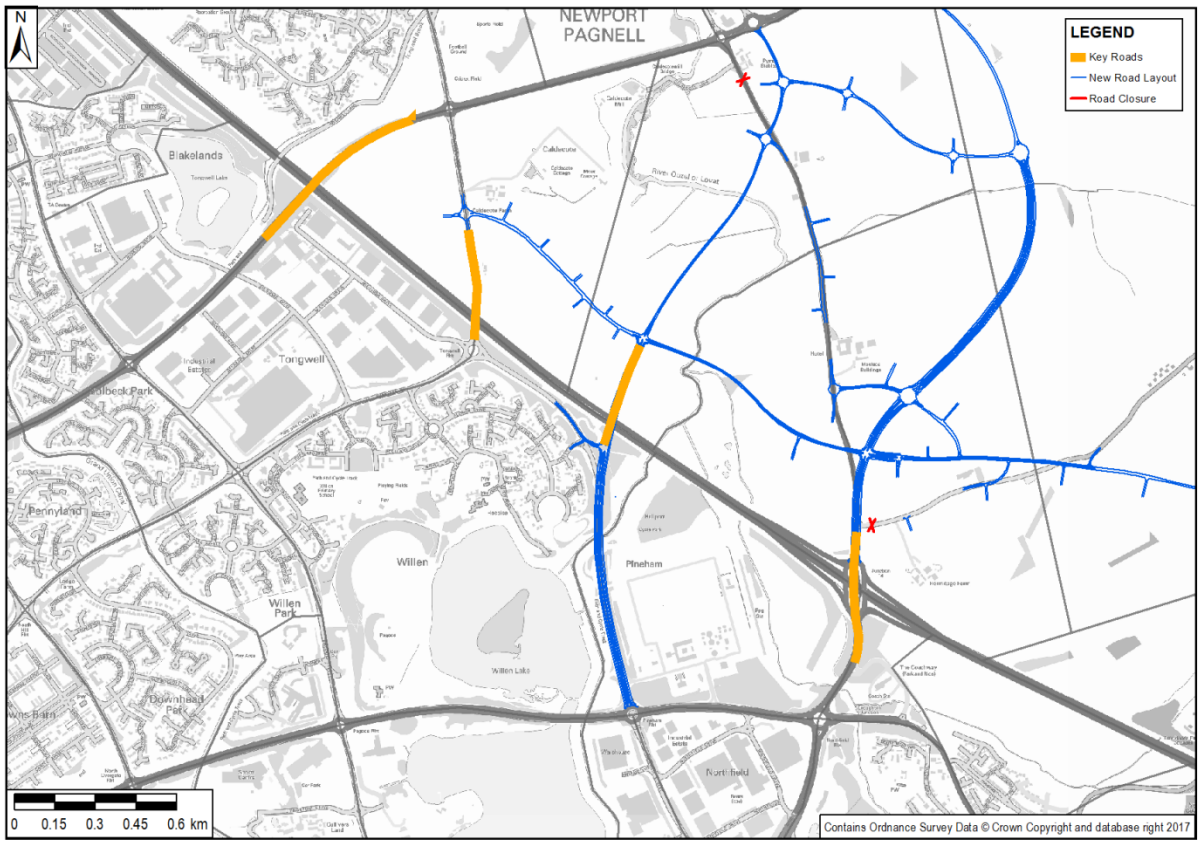

Figure 17. Motorway crossings between East of M1 and Milton Keynes

The mitigation measures have minimal impact on modelled traffic crossing the M1 motorway. Overall there is slightly less traffic crossing the M1, the largest reduction is towards to the East of M1 from Milton Keynes in the PM peak, but the reduction is only 70 PCUs (Passenger Car Units).

Table 4. Comparison of flows with and without mitigation from East of M1 towards MK (PCU)

Time Period	Scenario	A422	Willen Road	New Bridge	J14 through Traffic	Total
AM	Scenario 2b DM	1102	1567	1665	1433	**5767**
	Scenario 2b DS	1145	1551	1652	1359	**5707**
	Difference	43	-16	-13	-74	**-60**
PM	Scenario 2b DM	1226	469	924	840	**3459**
	Scenario 2b DS	1194	481	985	788	**3448**
	Difference	-32	12	61	-52	**-11**

Table 5, Comparison of flows with and without mitigation from MK towards East of M1 (PCU)

Time Period	Scenario	A422	Willen Road	New Bridge	J14 through Traffic	Total
AM	Scenario 2b DM	978	345	602	320	**2245**
	Scenario 2b DS	1025	338	585	317	**2265**
	Difference	47	-7	-17	-3	**20**
PM	Scenario 2b DM	1694	958	1555	54	**4261**
	Scenario 2b DS	1785	967	1350	89	**4191**
	Difference	91	9	-205	35	**-70**

Delays

The difference in delay between the DS (with the mitigation) and DM (without the mitigation) in the AM and PM peaks is presented in Figure 18 and Figure 19 respectively, with the total delay in Scenario 2b presented in Figure 20 and Figure 21 to add some context.

In the AM there is a large reduction in delay on the M1 northbound off slip at junction 14. There is also reduction in delay at the H6 / V10 roundabout going towards central Milton Keynes. There has also been a reduction in delay at Brinklow and Monkston with traffic routing away from the parallel west east routes through them to Childs Way.

However there is a noticeable increase in delay at the westbound approaches to the junctions with V9 Overstreet as the traffic is no longer held back upstream.

In the PM peak there is a reduction in delay on the northbound A509 approach to junction 14. However delays at other junctions have increased,

In both AM and PM peaks the northbound approach to Pagoda roundabout has a notable increase in delay

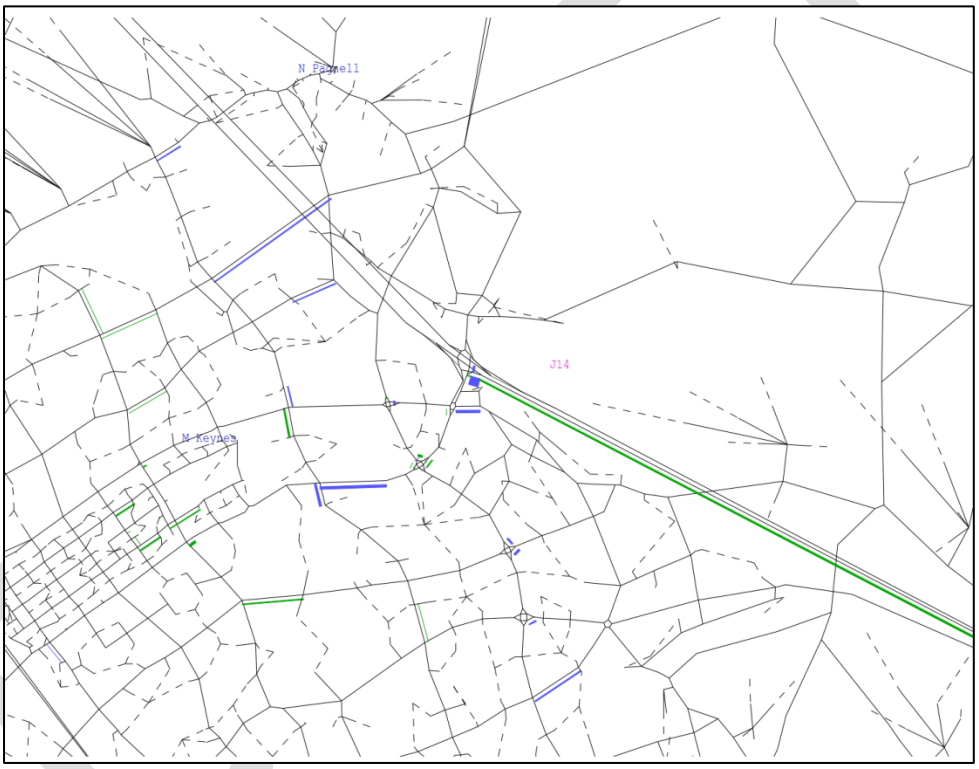

Figure 18. Change in Average Delay (seconds), Scenario 2, DS less DM, AM

Figure 19. Average Delay (seconds), Scenario 2b DS AM

In the PM peak there is a notable reduction in delay on the A422 and also on the eastbound approach to Northfield roundabout. However this delay has moved downstream to the southwest part of the J14 circulatory. There is also a 17 second increase in delay on the southbound off slip approach to the junction, and a 28 second increase in delay at the end of the southbound on-slip the latter due to additional traffic joining the motorway.

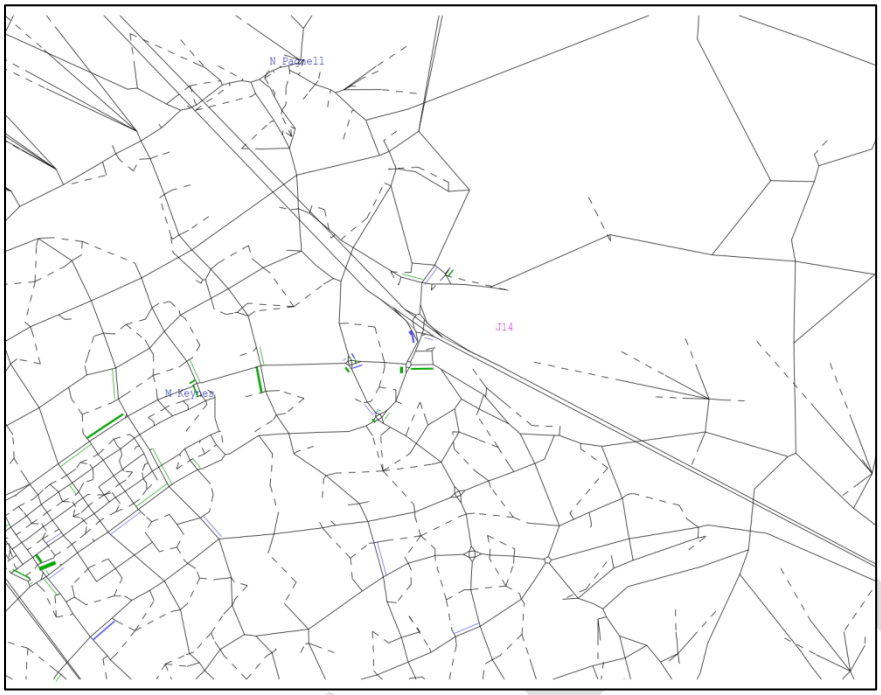

Figure 20 Change in Average Delay (seconds), Scenario 2, DS less DM, PM

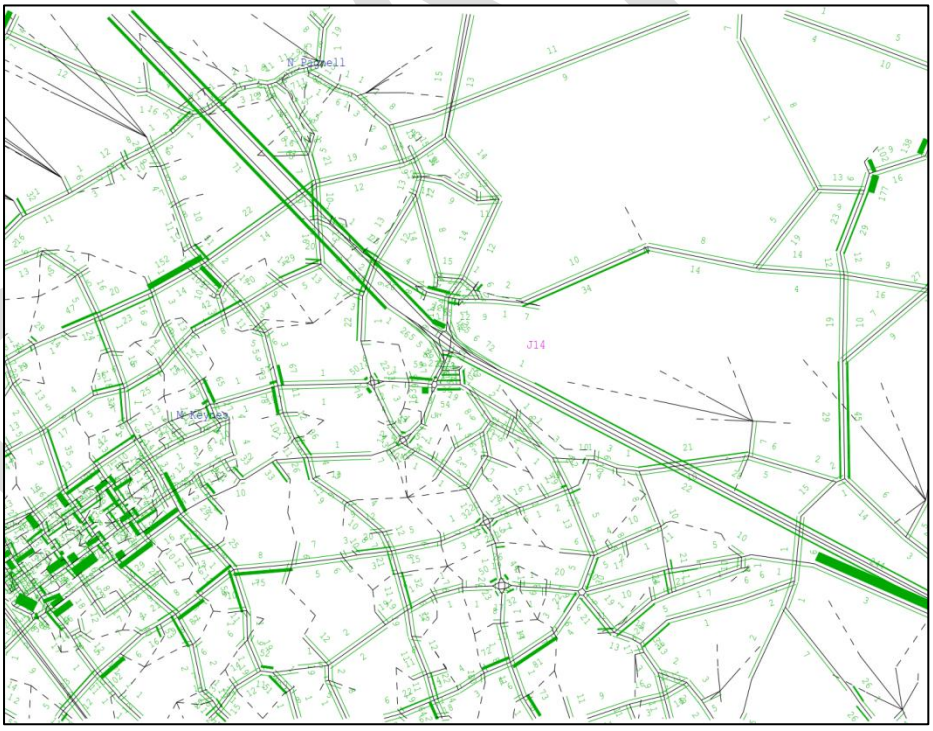

Figure 21. Average Delay (seconds), Scenario 2b DS, PM

Mitigation Scheme Assessment

Junction	Max Ref Case Delay	issue in Reference Case	Max Scenario 2 delay	Issue in Sc2	Source of Delay	Performance of mitigation	Notes
J14	AM peak, 3.5 minutes both northbound and southbound off-slips PM peak 1.min 47s circulatory to northbound on-slip	High	AM Peak, northbound off slip 1min 42s delay, 1min 42s delay on circulatory PM Peak 1min 21s delay circulatory to NB on slip	High	Primarily Reference Case issue but increased delay on sb on and off slips and A509 nb approach to junction and circulatory on approach to nb on-slip	Delays for A509 sb traffic are reduced on the circulatory and the delays on the nb off slip PM Peak, delays from A509 northbound to the northbound on slip are greatly reduced, whilst facilitating an increase of nearly 300PCU to join M1 northbound.	There is still a notable amount of delay at the northbound diverge on M1 which could be mitigated with a tiger tail diverge. This however may not be feasible using the land available.
H6 Childs Way / V10 Brickhill St. (Woodstone Roundabout)	AM Peak, Westbound approach 40s delay Northbound approach 30s delay	Moderate	AM Peak, Westbound approach 1m 58s delay Northbound approach 1min 40s delay	High	Delays primarily caused by Scenario 2b	delays reduced in both AM by 1min 12s on westbound approach in AM, and 53s on northbound approach	Delay reduction on westbound approach despite increase in traffic of 482PCU
Fox Milne	15-25s delay on both approach and circulatory and Tongwell street approach signals	Low	PM Peak 17- 27s delay on circulatory at SB Tongwell St approach	Low	Primarily Reference Case Issue	Reduced delays on north and south parts circulatory, increased on east and west circulatory	The mitigation measures at Northfield and Pineham roundabouts has reduced the flow through this junction notably.
Northfield	PM Peak, 3min 26s delay on eastbound approach, 2 minutes 42 second delay northbound approach	High	PM Peak, 49s on eastbound approach, 1min 34s delay on northbound approach	Moderate	Primarily Reference Case issue	Increased delay of 1min 29s on nb approach in PM, delay reduced on sb approach by 8s,	The junction is handling more traffic, particularly in the PM, but further optimisation of signal timings required to reduce delay on northbound approach

Pagoda	AM Peak, 1 min 16s delay eastbound approach, 58s delay northbound approach	Moderate	AM Peak, 3min 10s eastbound approach, 51s nb approach and 69 s sb approach	High	Primarily East of M1 development on Eastbound approach but Impact on all approaches,	negligible impact in terms of delay, though northbound approach now increase in delay of 45s	westbound approach traffic in PM 526 PCU higher with mitigation, reassignment of traffic from Childs Way to A509
Pineham	AM Peak, 29s delay on east circulatory PM peak, 1 min 3s delay eastbound approach	Moderate	AM Peak, 61s delay on east circulatory PM Peak 1min 9s eastbound approach	Moderate	Scenario 2b impact on northbound and southbound approaches and east circulatory	AM Peak, east circulatory delay reduced by 45s but increase of 23s on north circulatory. But delays are more balanced around the junction PM Peak, reduced delays on all approaches except northbound approach in PM	PM mitigation works well in prioritising east-west traffic, despite large flow increases westbound through the junction. This increase does cause more delay on the northbound approach to the junction in PM. The junction may perform better in the AM peak with adjusted signal timings, with greater green time for the eastbound traffic through the junction.

Conclusions

The mitigation measures cannot be looked at solely on a junction by junction basis. The grid structure of Milton Keynes road network widens the impact of the mitigation measures. Increased capacity at one junction attracts traffic off parallel routes, with the additional traffic reducing the benefit at that particular junction in terms of delay although the benefits are gained on the parallel routes.

In the AM peak the mitigation at the H6 Childs Way / Brickhill St. roundabout has the most notable impact in terms of re-assignment. This measure is forecast to attract traffic from parallel routes, such as the A421, which has also helped reduce congestion at Brinklow and Monkston roundabouts. In the PM peak the combination of measures has caused traffic to re-assign to the A509 from Childs Way.

There is also a relationship between increasing east-west flows causing delays on north-south routes. In both peaks there is a reduction in traffic on Tongwell Street (V11) as a result of the increase in traffic volume of the conflicting east west flows. With exception of the northbound approach to Pagoda roundabout this does not appear to cause notable additional modelled delays on alternative north-south routes.

The measures generally help reduce the delays for traffic travelling between the M1 and central Milton Keynes, particularly in the AM Peak. However the increased capacity at the mitigated junctions has, in the AM peak, caused an uplift in delay on the approaches to Over Street (V9) as the traffic is no longer blocked upstream of this junction. Further signal optimisation in the PM Peak could help reduce delays further.

Although there is an increase in traffic travelling to and from the M1, there is little impact in flow crossing the motorway between A422 and J14.