

Milton Keynes Multi Modal Transport Testing.

For the Proposed
Submission
(Regulation 19) Milton
Keynes City Plan 2050

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Introduction

The outputs from the Milton Keynes Multi Model Transport Model (MK MMTM) were used to identify the impacts of Milton Keynes City Plan (MKCP) in the forecasting year 2050, highlighting areas where future mitigation may be needed and including areas of concern on the Strategic Road Network.

The Reference Case (RC) transport forecast – described in the ‘Milton Keynes Multi-Modal Model 2019 Forecasting Report v3.1’ (11 Feb 2025) – formed the background against which the Milton Keynes City Plan (MKCP) impacts were tested.

The transport forecasts were prepared for the 2050 future year. The RC transport forecast included the impacts of known developments that are reasonably likely to be permitted and implemented.

Two test cases were prepared. Both tests started with the RC forecasts and then added the extra person trips associated the MKCP housing and employment sites. One of the tests (P1) included a mass rapid transport (MRT) system on five radial routes extending from Central Milton Keynes (CMK). The second test (P2) was identical t P1 but excluded the MRT system.

The MK MMTM is a suite of interlinked models. These are the demand model, the public transport model and the highway model.

Data Sources

Travel movement data collected in 2019 formed the initial basis for the transport model’s development. The Base Year model was validated against 2019 observed conditions. Subsequently, the post-COVID travel conditions in 2023 were compared against the earlier 2019 observed traffic flows. A set of procedures were then developed that were applied to the outputs of each transport forecast to adjust for the impacts of COVID. Although the version of the model is titled “MK MMTM 2019”, the transport forecasts were adjusted for the observed change in travel patterns between 2019 and 2023.

Data sources used to develop the transport model included:

- service information, which were used to define rail and bus routes in the public transport module.
- travel demand data collected for bus journeys.
- travel demand data collected for railways.
- travel demand data collected for users of the highway.
- traffic count surveys, journey time data used to calibrate the highway module.
- mobile network positioning data (MND) to inform travellers’ origins and destinations.
- The DfT’s National Travel Surveys.
- Modelling parameters published by the Department for Transport (DfT).

The MK MMTM Demand Model

The Demand model contained within the MK MMTM suite is an “absolute model applied incrementally” as defined in the DfT’s transport appraisal guidance (TAG). The demand model was developed in-line with the guidance set out in TAG Unit M2.1 and the associated data book. The performance of the model was assessed using the realism tests defined in TAG, which varied the modelled travel demand in response to changes in car fuel costs, car journey times, and public transport fares.

The Demand model used the outputs from the PT model and from the Highway model to monitor journey costs. The Demand model also included a sub model to represent car parking in Central Milton Keynes and a synthetic model of active travel modes. The person trip demands were combined with the outputs from the models and distributed to the most appropriate travel modes, by time of day.

Across the modelled area, the Demand model’s parameters were calibrated to reproduce: the trip-cost profile, the time-period proportions, and the mode shares proportions observed in the validated base year highway and public transport models.

The future year growth in person trips was based on the DfT’s travel projection models. Where greenfield zones are to be developed, the DfT’s rules for applying future year synthetic estimates were applied.

The Demand Model Development report documents the validation checks and the results from the TAG realism tests and concluded that the demand model was a robust basis for forecasting travel demand in Milton Keynes.

The MK MMTM Public Transport Model

The public transport model was built using industry standard software. Various sources of observed data were used to represent the public transport services, including bus and rail timetables, ticket sales data, passenger counts at bus stops, and passenger stops at railway station platforms.

A validation of the public transport model demonstrated that there was an acceptable match with the observed data. The conclusion was that the public transport model was suitable for developing future public transport demands and for determining a traveller’s mode choices. Suitable applications of the public transport model included:

- informing the MK Local plan.
- evaluating the mode share effects of policy making across a wide area.
- providing an evidence base for the assessment of transport interventions, including a Mass Rapid Transport business case.

The MK MMTM Highway Model

The highway model represented a typical weekday (Monday-Thursday) in the autumn months of 2019. The modelled periods were average hours in the AM, inter-peak, and PM. The trips were segmented by three vehicle types (cars, light goods, and heavy goods vehicles). The car and light goods vehicle trips were further segmented by trip purpose (home-based work, home-based other, and non-home-based movements).

The highway network contained a detailed simulation of the junctions in the Milton Keynes area. The level of detail in the highway network reduced with increasing distance from Milton Keynes, which is a standard method of keeping the computer processing time to manageable levels. The network was built using Ordnance Survey's mapping data, observed journey times, junction layout details, and typical stage times at traffic signal and level crossings. Heavy goods vehicle movements were restricted in speeds and were banned from using some links to simulate traffic regulation orders.

The highway trip demands were obtained from the demand model. These trip demands were assigned to the highway network along the lowest cost routes. The flows on each road and the modelled journey times were extracted from the assigned highway model.

A series of checks were then undertaken to compare the base year model's outputs with the observed data. This comparison demonstrated that the highway model performed satisfactorily and for most areas within Milton Keynes met the DfT's validation guidelines in all three modelled time periods.

The highway local model validation report (LMVR) concluded that the MK MMTM highway model could be used to:

- understand the existing provision and constraints on transport within Milton Keynes.
- forecast the impact of proposed growth on the highway and public transport networks.
- develop and assess multimodal transport schemes required to deliver the proposed level of growth.
- produce an evidence base for the Local Plan and the assessment of transport schemes proposed to facilitate the expected growth in person trips.

Reference Case Forecasts

The Reference Case forecasts were developed to be the baseline against which schemes and plans can be tested. This section summarises the assumptions made to build this Reference Case forecast and the model's outputs.

The Demand model, the PT model and the Highway model were use in combination to forecast the number of trip ends, the travel patterns and the travel conditions in the specified future years 2031, 2041 and 2050.

Standard sources were used to generate the future year trip projections. These sources included the DfT's National Trip End Model (NTEM) version 8.0, which was used to produce the background growth for cars. The growth of light and heavy goods vehicles was obtained from the National Road Transport Projections (NRTP) published in 2022.

The key data inputs to the person trip end model were:

- Population
- Employment
- Households
- Car ownership

The outputs from the trip end model were forecasts of:

<u>Travel Mode</u>	<u>Trip Purpose</u>
Highway	Commuting
Rail	Education
Bus	Home-based business
Active	Home-based other
	Non-home-based business
	Non-home-based other

The inputs to the 2019 base year model were the readily available demographic statistics.

In the specified future years, adjustments were made to the traffic model at a zone level to allow for known development sites through an examination of planning applications and ongoing discussions. Sites that were assessed in the model's uncertainty log as more than likely to proceed were included in the input data. Some of the know development sites will be Milton Keynes urban area extensions and will be determined by adjacent planning authorities. These sites were also included in the Reference Case inputs.

The total dwellings and jobs generated by the planned sites are presented in Tables 1 and 2 below:

Table 1: Number of dwellings included in the Reference Case

Area	2019 to 2031	2032 to 2040	2041 to 2050	Total
Milton Keynes	25,264	2,935	2,050	30,249
Bedford	7,144	2,115	0	9,259
Buckinghamshire	2,430	690	0	3,120
Central Bedfordshire	19,665	6,305	0	25,970
Northampton	13,239	2,624	0	15,863
Wellingborough	5,415	0	0	5,415
Total	73,157	14,669	2,050	89,876

Table 2: Number of jobs included in the Reference Case

Area	2019 to 2031	2031 to 2050	Total
Milton Keynes	25,116	3,282	28,398
Bedford	5,463	94	5,557
Buckinghamshire	895	0	895
Central Bedfordshire	17,068	1,354	18,422
Northampton	2,500	0	2,500
Wellingborough	5,304	0	5,304
Total	56,346	4,730	61,076

The future infrastructure interventions that were known to be reasonably certain were included in the Highway and the PT models as appropriate. The types of intervention included were highway schemes, changes to parking facilities (including park and ride), and public transport improvements.

The planning inputs were used to produce forecasts of the travel conditions in Milton Keynes for each of the three modelled future years. The model produced various outputs, which are summarised in the next section.

Reference Case Forecasts

The Reference Case forecasts were developed to be the baseline against which schemes and plans can be tested. These outputs and findings were provided in the MK MMTM Transport Forecasting Report (version 3.1; dated 11 Feb 2025). This section summarises the forecast travel conditions.

Mode Shift

The forecast changes in travel mode, compared to the 2019 base year, are summarised in Table 3. The acronyms HB and NHB are short for 'home-based' and 'non-home-based' trip types.

Table 3: Mode Split Percentages by Trip Purpose – Change in 2050 compared to the 2019 Base Year

Travel Mode	Commuting	Education	HB-Business	HB-Other	NHB-Business	NHB-Other
Active	-1%	-8%	0%	4%	-9%	-4%
Bus	1%	3%	3%	12%	-2%	-5%
Highway	22%	12%	32%	33%	26%	16%
Rail	-1%	-19%	-4%	13%	-6%	-19%

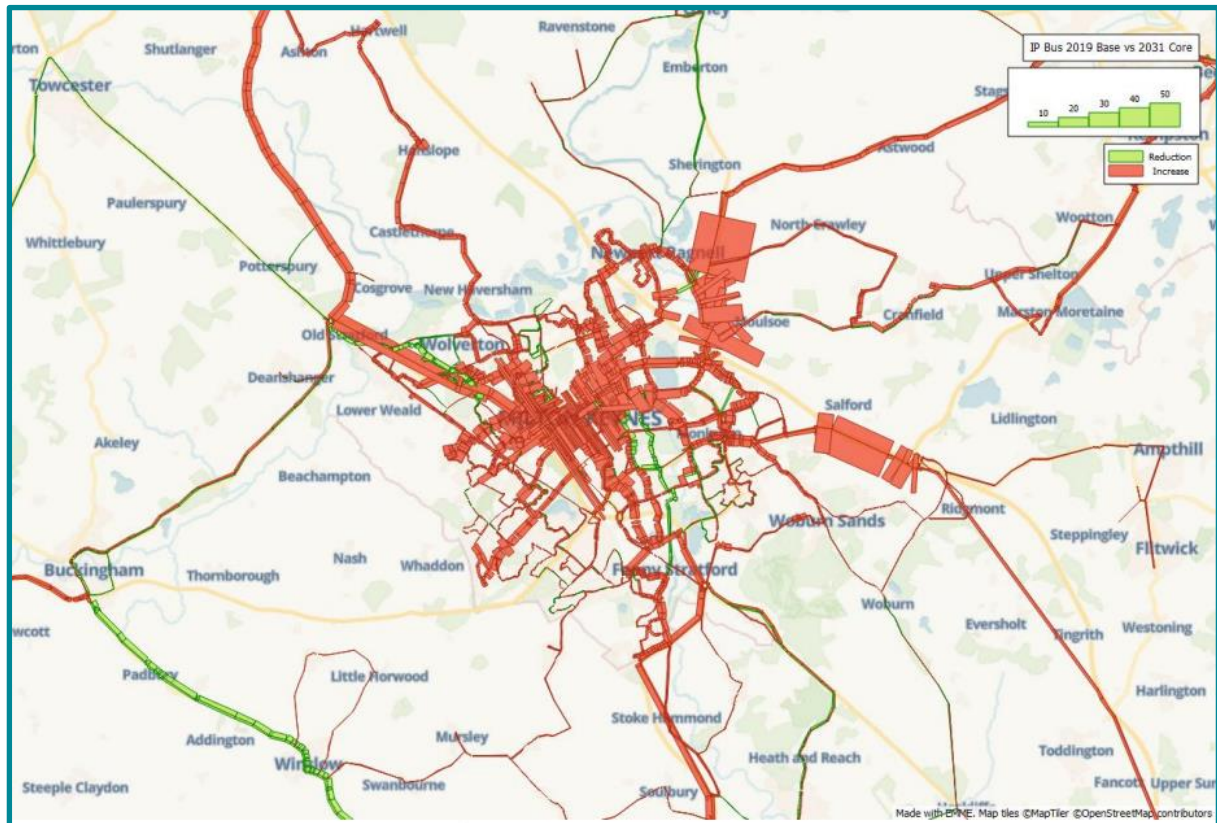
The trip length distribution plots for the forecast years in the modelled hours showed a similar pattern to the base year. However, overall trip lengths increased. The cost of travel, in real terms, will be cheaper in 2050 than in 2019, which is reflected in longer journeys.

The various model outputs included the number of passenger movements on public transport services and the traffic flows on Milton Keynes's highways. The modelled flows were extracted from the Reference Case forecasting models in the AM, PM and inter-peak periods.

Public Transport Changes

Public transport (PT) passenger plots are provided in the Transport Forecasting Report. An example is shown in Figure 1. The scale of the change in bus passenger volumes is shown by the width of the line. An increase in passenger volumes is shown in red, and a reduction is shown in green.

Figure 1: Change In Public Transport Use From 2019 To 2031 – inter-peak in passengers per hour



The impact of a future mass rapid transport scheme is not reflected in the 2031 forecasts because it is unlikely to be operational by 2031.

In all future years, there was an increase in bus passenger volumes from the 2019 base year. This increase was smaller in the later forecast years. The increase in the inter-peak period was primarily around CMK. Along Whaddon Way, Standing Way and V8 Marlborough Street, reductions in passenger volumes were northbound in the AM Peak and southbound in the PM Peak.

The V8 Marlborough Street was operating near to capacity in the 2031 forecast year. Bus congestion feedback was implemented in the MK MMTM models and therefore modelled highway congestion would cause bus speeds to reduce, resulting in lower bus patronage.

There was an overall increase in rail flows across the forecast years in the AM and PM Peaks. The largest growth was on the East-West Rail corridor. The rail flows in the forecast inter-peak period had smaller increases compared to the AM and PM peaks and in some cases had a slight reduction in passenger volumes.

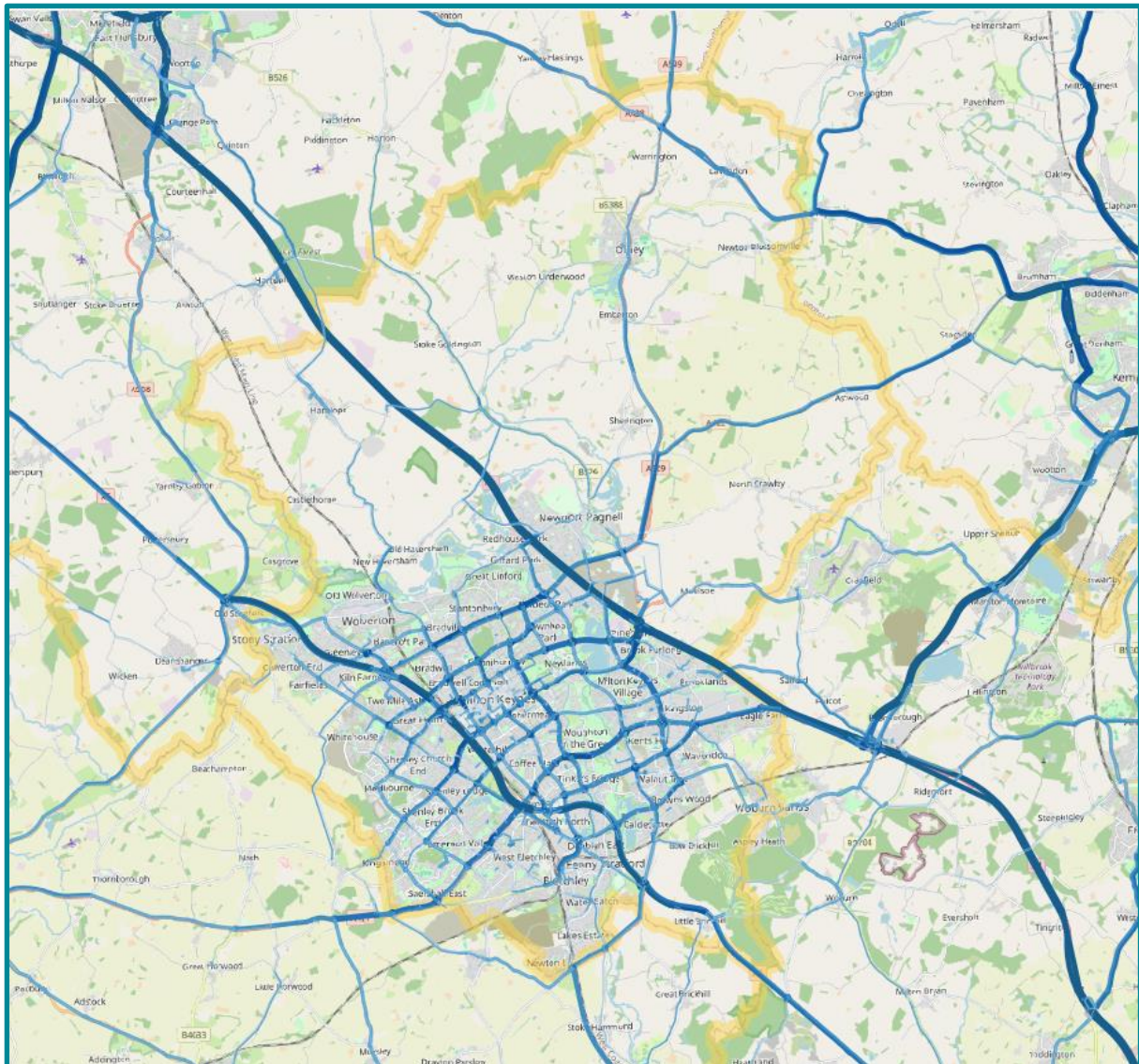
Bus boarding and alighting data, extracted from the public transport model, showed that the total volume of boarding and alighting increased between 2019 and 2031, and decreased in 2040 and 2050, although the volume of boarding and alighting remained above the 2019 volumes.

Similarly, the volume of boarding and alighting increased between 2019 and 2031, and then decreased from 2031 onwards, although these volumes remained above the 2019 values.

Highway Traffic Flows

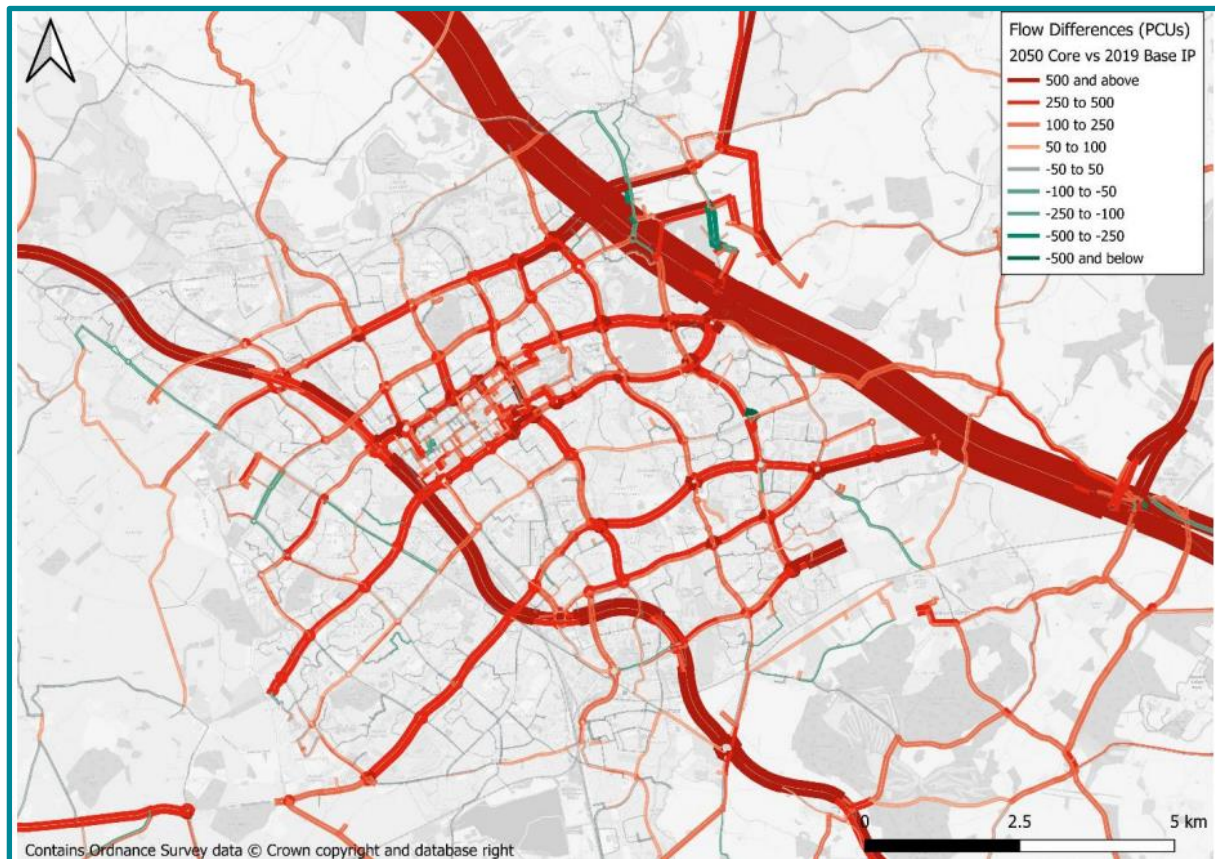
The 2050 forecast traffic flows are shown in Figure 2. The roads with the larger traffic flows are plotted with a wider and darker line. Roads that form part of the strategic road network, which are maintained by National Highways, have the highest flows.

Figure 2: Reference Case forecasts in 2050 – traffic flow bandwidths



The forecast Reference Case flow changes, from 2019 to 2050 (in the inter-peak), are indicated in Figure 3. Note that the flow differences are plotted with larger widths per vehicle than shown in Figure 2.

Figure 3: Change in traffic flows between 2019 and the 2050 Reference Case (inter-peak)



The flow difference plots showed an overall forecast increase in the flows on those highways within Milton Keynes. These increased flows were expected given the scale of the projected growth in houses and jobs.

The largest traffic growth was on the M1 and A5 across all the three time periods, which are strategic routes maintained by National Highways. Flow reductions were forecast along V4 Watling Street in all three time periods and across all forecast years. In contrast, there were large traffic flow increases on the roads surrounding Central Milton Keynes such as on the A509 and H6 Childs Way.

Because the road layout in Milton Keynes is laid out as a grid, vehicles can easily take multiple alternative routes from an origin to a destination. To review the overall levels of traffic flow across the area, the traffic flows crossing defined screen-lines and cordons were summed. The findings were:

- The largest percentage increase in forecast flows was in the Inter-peak period.
- The largest proportional increase in flows that crossed the outer cordon around the whole Milton Keynes urban area was in the inter peak period; the largest was 58%. (The largest proportional increase in a peak period was 41%).
- Examining the Central Milton Keynes (CMK) cordon, the largest proportional increase in the inter peak period was 55%. (The largest proportion increase in a peak period was 43%).

- For the cordon around the CMK in the peak hours, the largest directional increase in the percentage flows were outbound in the AM Peak and inbound in the PM Peak in all the forecast years.
- In terms of absolute flow differences, the inbound flows to CMK were similar in 2050 compared to 2019 in all the modelled time periods. (The absolute flow increase in the PM peak was slightly higher than in the other two periods.)
- The outbound flows from CMK showed a different pattern. The AM Peak flow differences were substantially higher than in the PM peak.
- The inbound and outbound flows to CMK in the inter-peak periods were less than in the peak hours.
- In the later forecast years (2041 & 2050) there was an indication of demand suppression occurring. Where congestion on a road network increases, the travel costs become higher and some of the demand to travel might be suppressed. This effect is represented by the MK MMTM Demand model.

For the 2031 Core scenario, the origins and destinations of trips into the CMK in the AM Peak, and from the CMK in the PM Peak was examined. The results of this analysis showed that, in the AM Peak, several trips travel along the A5, H5 Portway, and from the M1 south to Central Milton Keynes. Trips from the CMK in the PM Peak mostly travel along the A5 and H5 Portway, plus along the A509 to the M1 southbound.

An examination of V/C plots showed that the capacity of the highway network decreased in the forecast years. The reduction in capacity was highest in the peak hours.

Overall, journey times increased in the forecast years, with the largest increases in the AM and PM Peaks. There was a reduction in journey times for Route 7, which routes along the M1, due to the motorway widening scheme. The largest increase in journey times was noted on Route 9 (V10 Brickhill Road) southbound and on Route 10 (Newport Road) southbound towards Woburn Sands.

The Milton Keynes City Plan

The Milton Keynes Multi Model Transport Model was used to test the impacts of the proposed Milton Keynes City Plan (MKCP). The test was based upon the Reference Case forecasts described in the previous section. Comparisons between the Test forecast outputs against the Reference Case outputs provided an indication of the impacts and benefits of the MKCP.

The tests were initially undertaken using a 2050 forecasting year, which is the horizon year for the MKCP.

The Tests were undertaken both with and without the proposed mass rapid transport (MRT) scheme provided along five radial corridors. It is expected that the MRT would be operational before the 2050 forecast year.

The additional dwellings and jobs generated by the MKCP sites are presented in Tables 3 and 4 below:

Table 3: Number of additional dwellings in the MKCP

Dwellings	2019 to 2050	Post-2050	Total
Housing	31,721	8,400	40,121
Remove changes	2,516	0	2,516
MRT Dependent	-491	0	-491
Total dwellings	33,746	8,400	42,146

Table 4: Number of additional jobs in the MKCP

Jobs	2019 to 2031	2031 to 2050	Post-2050	Total
Total jobs	58,273	4,730	0	63,003

The additional planning data was input to the MK MMTM as a test, and compared to a counterfactual scenario represented by the Reference Case forecasts.

Around the proposed east sustainable city extension (ESCE) development, connections were added to load the generated highway trips onto the Newport Road and onto the A509 to the east of the M1 motorway and its junction 14. The Broughton Grounds Lane single track road was assumed to be closed to private vehicles by the ESCE. Instead, a new bridge over the M1 motorway is likely to be provided off Tongwell Street. This combination of highway interventions would reduce the use of the A509 and M1 junction 14.

Figure 4: Assumed internal road layout for the ESCE development



Milton Keynes City Plan - Transport Impacts

The resulting changes in traffic flows on the highway network are presented in Figures 5 and 6 below.

Those junctions where there would be the greatest change to their capacity are indicated on the heat maps plotted in Figure 7 below.

Adjacent stakeholders have expressed concern that the M1 junction 13 could become overloaded by the combination of Local Plans and prospective planning applications that are emerging. The MKCP's contribution to flow increases at M1 junction 13 were shown to be minimal.

The traffic flow increases were highest on the A5, which is part of the strategic road network. Within Milton Keynes there were flow increases across the Milton Keynes highway grid. However, the increases were a small uplift compared to the 2019 to 2050 growth predicted in the Reference Case forecasts.

The largest flow increases in the urban area were on H5 Portway (A509) radial between Shenley and Central Milton Keynes. This increase appeared to be caused by a rerouting of trips away from the H6 Childs Way radial route. As noted below, there were large junction capacity reductions shown on the H6 Childs Way route that could have caused this rerouting.

There were also notable flow increases on H3 Monks Way and on V5 Great Monks Street where vehicles were travelling to access the A5 at the Abbey Hill roundabout. Other notable flow increases were shown on the V6 Grafton Street and around the Central Milton Keynes car parks.

Figure 5: Milton Keynes City Plan (with MRT) in 2050 – Traffic flow changes

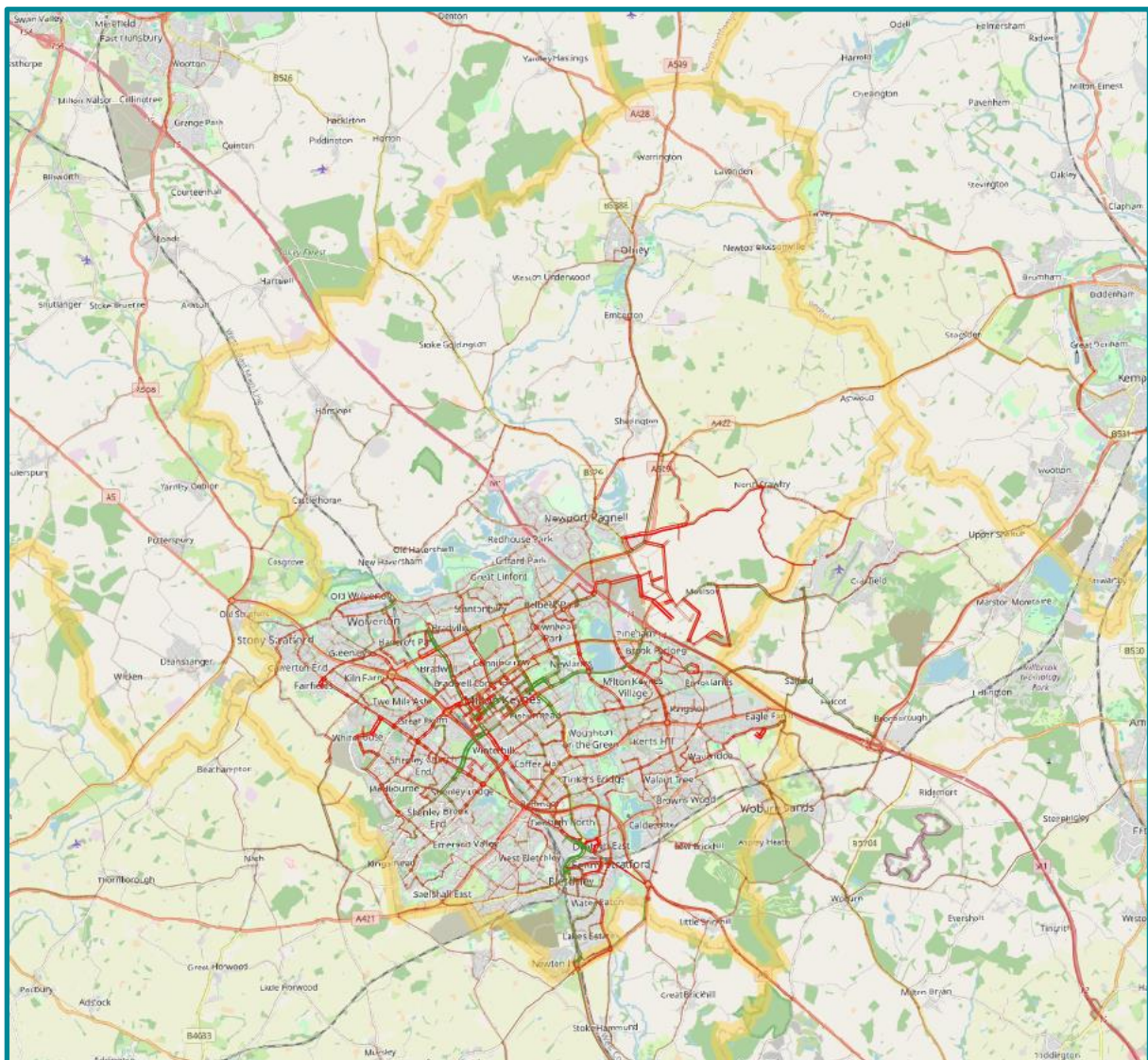


Figure 6: Milton Keynes City Plan (with MRT) in 2050 – Traffic flow changes (INSET of Figure 5)

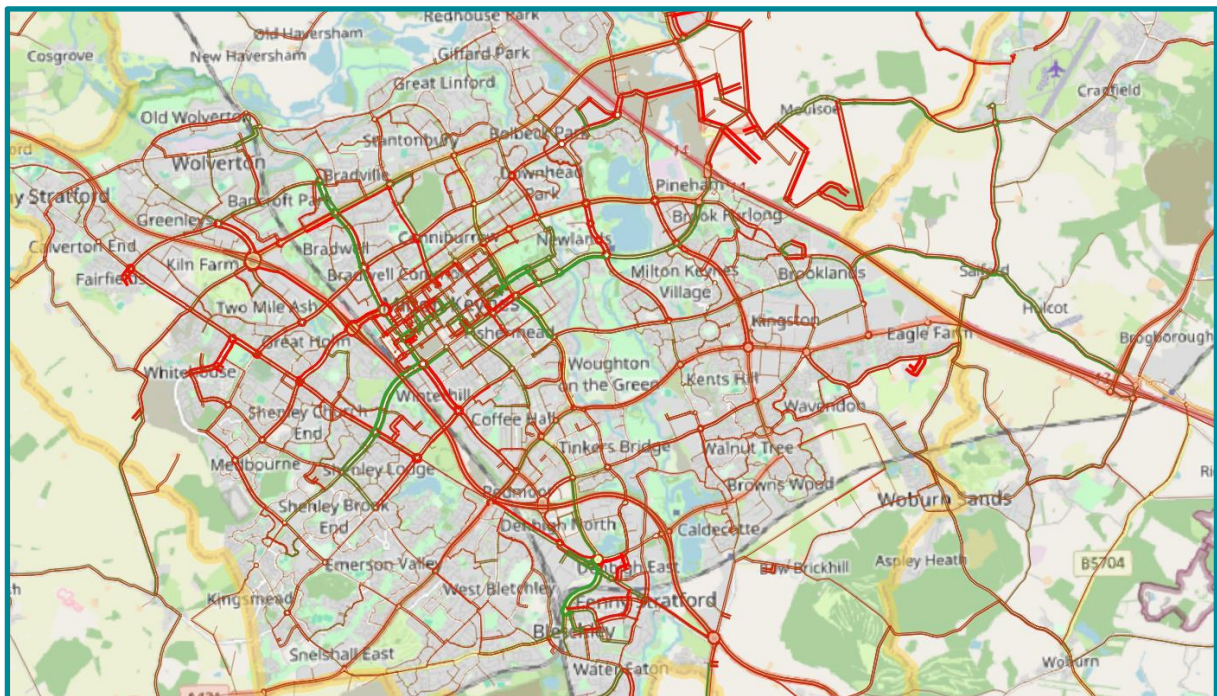
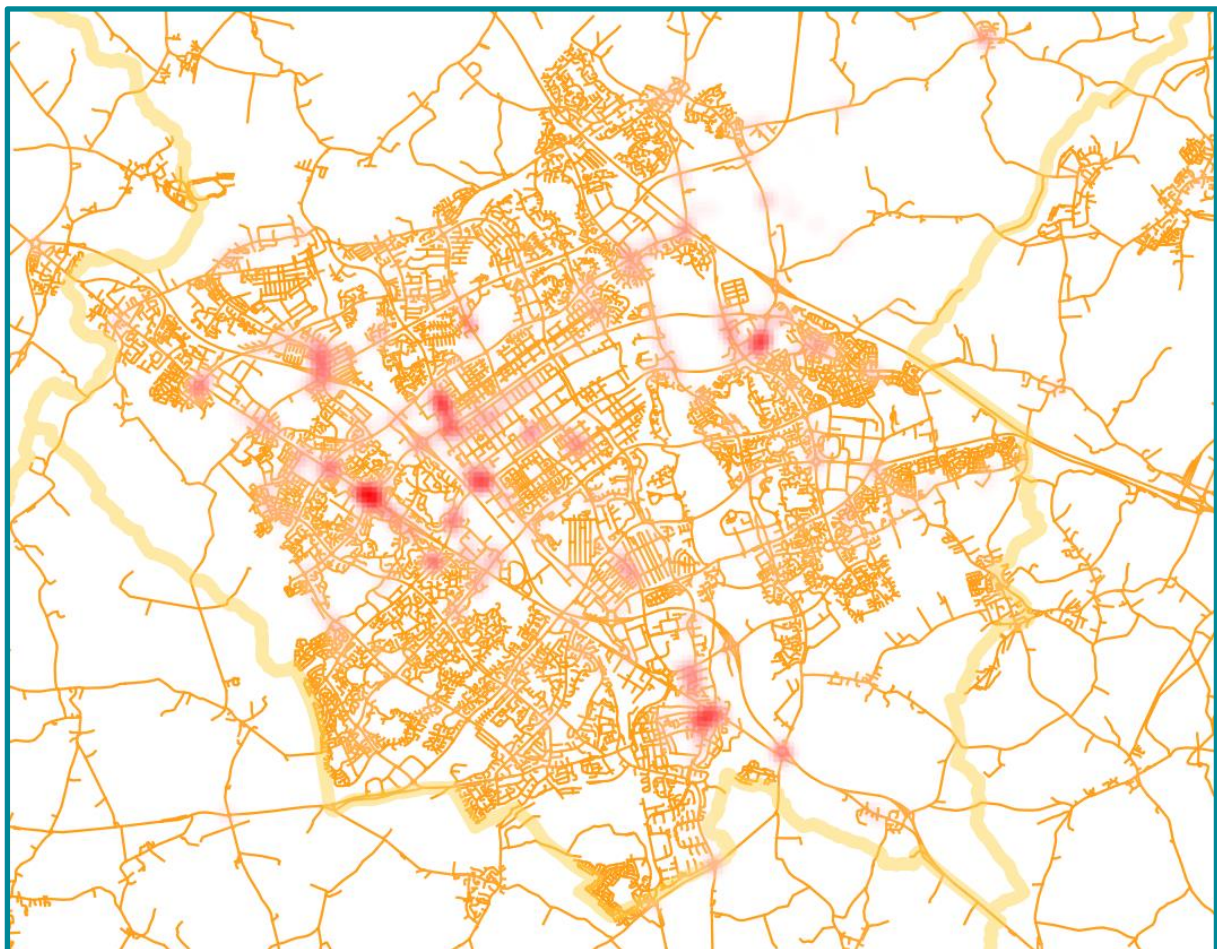


Figure 7: Milton Keynes City Plan in 2050 (with MRT) – junctions where flows increased



The headroom in the capacity of a junction is a measure of the extra traffic that can be added to a junction before that junction exceeds its capacity. The headroom capacity varies by time-period. In the MK MMTM, the headroom was determined by dividing the flow volume (V) on a link by the capacity (C) on each road approaching a junction. The junction capacity heat map in Figure 7 above shows the areas with larger reductions in headroom capacity. Note that a reduced headroom capacity in a future year does not necessarily mean that a junction will be overcapacity. A more detailed junction capacity analysis, using a local model, would be required to understand the impacts of the MKCP upon individual junctions.

The MK MMTM test forecasts identified where the vehicle delays on at least one of the approaches to a junction increased by more than 90 seconds. These junctions were:

- Calverton Road / Whitehouse (Upper Weald)
- H4 Danstead Way / Randall Avenue
- H6 Childs Way / V4 Watling Street
- V4 Watling Street / V7 Saxon Street
- A5 / A4146 / V4 Watling Street / Brickhill Road (Kelly's Kitchen)
- Multiple junctions in Central Milton Keynes and car parks.
- H5 Portway / V11 Tongwell Street (Pineham Roundabout)
- M1 J13 / A421 west approach
- M1 J14 / A509 Langley Street east approach
- A509 / A422 (Tickford Roundabout)
- B526 Tickford Street / North Crawley Road (Newport Pagnell)

Local area junction models will be required to investigate the cumulative impacts of the proposed developments on the highway network's operational efficiency. It appears to be the case that junction capacity improvements could be delivered, either through mitigation measures attached to each development or by contributions towards a Council managed improvement scheme.

One area for further study is on the A509 (to northeast of the M1) and the nearby local roads within the areas of Newport Pagnell and North Crawley. In the MK MMTM Tests, the internal road layout was at an outline design stage and therefore assumptions were made – see Figure 4 above. There were also large increases in delays on the roads crossing the M1 motorway that are maintained by the local highway authority. The initial model outputs suggest that substantial transport interventions could be required. However, the proposed East of Milton Keynes developments are large and therefore contributions towards large transport interventions are likely to be viable.

Impacts Of Omitting The MRT

The second test using the MK MMTM used the same MKCP planning data but omitted the proposed mass rapid transit (MRT) scheme. The resulting change in flows is presented in Figure 8. A junction headroom heat map is presented in Figure 9.

The figures show:

- The MRT schemes will reduce (red) the highway traffic across Milton Keynes thereby mitigating some of the impacts of the MKCP.
- The detrimental impacts of private vehicles rerouting to parallel routes (green) had a smaller magnitude than the benefits of the MRT, which supports the policy to reduce private vehicle trips. i.e. there is visibly more red than green in Figure 7.
- An MRT route is proposed along a length of H6 Childs Way. The associated reduction in highway capacity will reroute private vehicles to H7 Chaffron Way.
- An MRT route is proposed along V6 Grafton Street. The associated reduction in highway capacity will reroute private vehicle along V7 Saxon Street north of Central Milton Keynes.
- An MRT route is proposed along V7 Saxon Street in Bletchley. There would be a large reduction in highway capacity, which would lead to private vehicles rerouting to multiple parallel routes.
- All the MRT routes are proposed to intersect in Central Milton Keynes. Reconfiguring the highway grid around the Central Milton Keynes area will lead to many changes to local traffic patterns.

Figure 8: Impact of omitting the MRT scheme from the MKCP – Traffic flow changes

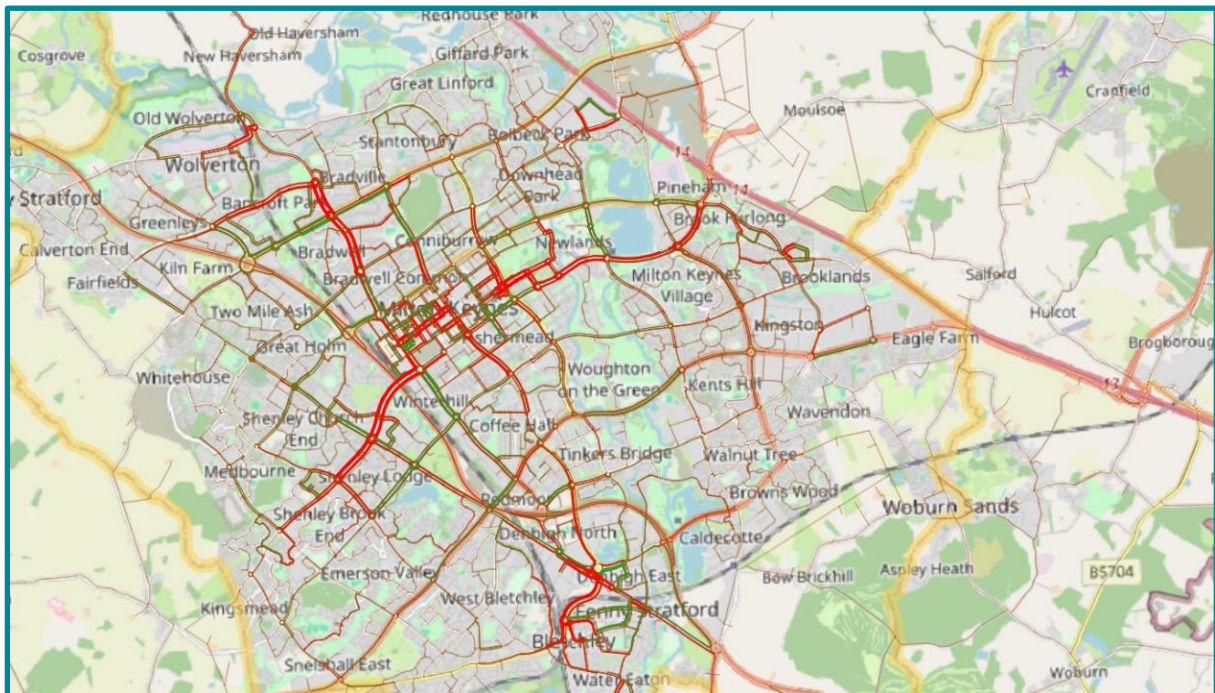


Figure 9: Impact of omitting the MRT scheme from the MKCP – junction capacity heat map



Conclusions

It appears that junction capacity improvements could be delivered, either through mitigation measures attached to each development, or by contributions towards packages of Council managed improvement schemes.

An area of uncertainty is on the A509 (to northeast of the M1) and those nearby local highways within the areas of Newport Pagnell and North Crawley. In the MK MMTM Tests, the internal highway layout was at an outline design stage, which introduced some uncertainty and hindered a definitive conclusion. The initial model outputs suggest that substantial transport interventions could be required. However, the proposed ESCE developments would be large and therefore contributions towards large transport interventions are likely to be viable. Further studies will be required to identify the proportionate mitigation measures.

The provision of mass rapid transport on radial routes will assist with mitigating the transport impacts of the MKCP.

