Technical Note

Project:	**Elstree Way Corridor**	Job No:	**60278138**
Subject:	**PM Peak and Sensitivity Testing Traffic Model Analysis**		
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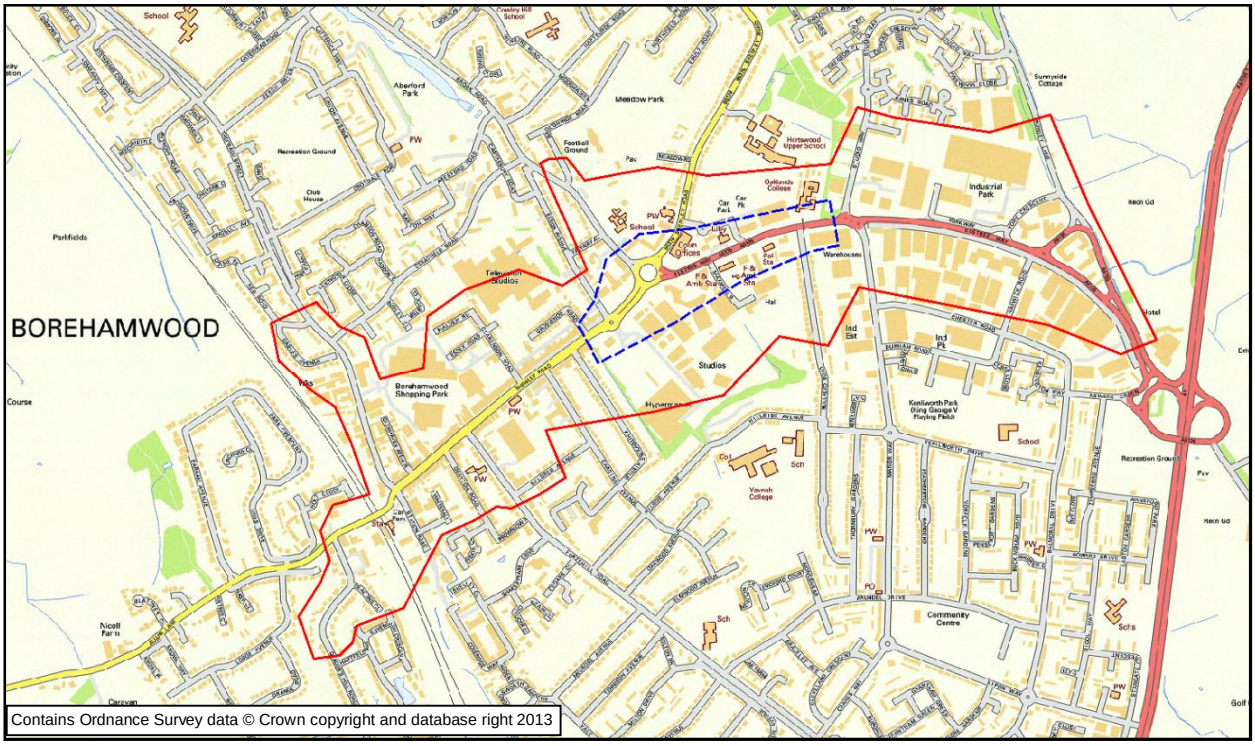
1: Introduction and Context

AECOM has been requested by Hertsmere Borough Council (HBC) to prepare robust scheme proposals with associated cost estimates for Elstree Way Corridor. HBC also require an understanding of how the scheme could be implemented over a series of phases dependent upon the scale of development and associated funding available.

The primary area of interest is highlighted with a red perimeter in **Figure 1**, with a blue perimeter highlighting the broad scheme area;

Figure 1: Scheme location and area of interest



In 2010 the Elstree and Borehamwood Transport Study tested a number of scenarios for the corridor and surrounding road network. Option 2B was the preferred scenario and the key principles of this have been taken forward in the Preliminary Design work for the corridor.

From 2B, two alternative options were proposed;

- Option 1) Focussing on the key junctions with minimal engineering interventions on the links; and
- Option 2) Increased interventions on links using a combination of medium and quality materials;

Following discussions with the HCC and HBC (meeting 29/01/13), it was agreed that further to Option 2 (referred to here as the Do-Something or DS), AM (morning) peak analysis would be conducted.

A strategic SATURN traffic model has been used to analyse the scheme's traffic impacts at a wider level and a localised Paramics model used to analyse the scheme at a corridor level.

The AM peak SATURN and Paramics model results were reported in the technical note entitled "Paramics Modelling Analysis". The outcome of the AM peak analysis was that, given the assumptions made within that piece of work, the Scheme appeared to perform satisfactorily. This led to the question of how a corresponding PM (evening) peak scenario would perform. Furthermore, the question has been asked as to what would be the implication if the assumed level of demand was altered, if 'worse case' scenario was considered.

The purpose of this note is to report on the corresponding PM peak model which has been developed, as well as the findings of demand sensitivity testing for the AM and PM models.

This note should be read in conjunction with the previous AM peak note, in particular with reference to assumptions made behind the modelling approach.

Sections

The following sections are included within this technical note:

1: Introduction and Context
2: High Level Review
3: Future Year 2026 PM Peak 'Do-Something' (DS) Scenario Testing
4: Future Year 2026 Sensitivity Testing
5: Summary & Conclusions

2: High Level Review

This section sets out the high level review of the corridor and wider area models for the area of interest.

The network related observations which have previously been made on the AM peak are also applicable to the PM peak and are not repeated here. The following analysis therefore focuses on the time period specific observations for the Base Model.

As has been stated before, it is not within the scope of this project to conduct a full model audit, nor was that expected to be required. It is understood that this has previously been undertaken by HCC and the model was viewed as being sufficiently robust.

Review of Calibration / Validation Report (LMVR), PM Peak

Local Model Validation Report (LMVR)

General issues identified for the AM peak are applicable for the PM peak. It would have been useful if the journey times were more disaggregate or/and queue data presented, to assist in the confirmation of base year congestion 'hotspots'.

Local Corridor Paramics Model Calibration/Validation Performance

Count Data

The base model calibration counts for the local corridor Paramics model are documented as performing to the required standard. It is not within the scope of this project to conduct an in-depth analysis of the accuracy of these figures and the data upon which they are based.

It is of importance though, to consider the performance of the model with respect to the observed count data, for the junctions of most relevance to the proposed scheme. This includes junctions which are proposed to be modified as part of the scheme, those in close proximity to the scheme and locations which act as particular network constraints (bottlenecks).

Figure 2 below shows the location of the turning counts which are reported on in the LMVR as having a GEH of 5 or greater for the Paramics model and/or don't meet the target flow criteria, i.e. locations where the model differs significantly from observed traffic flows.

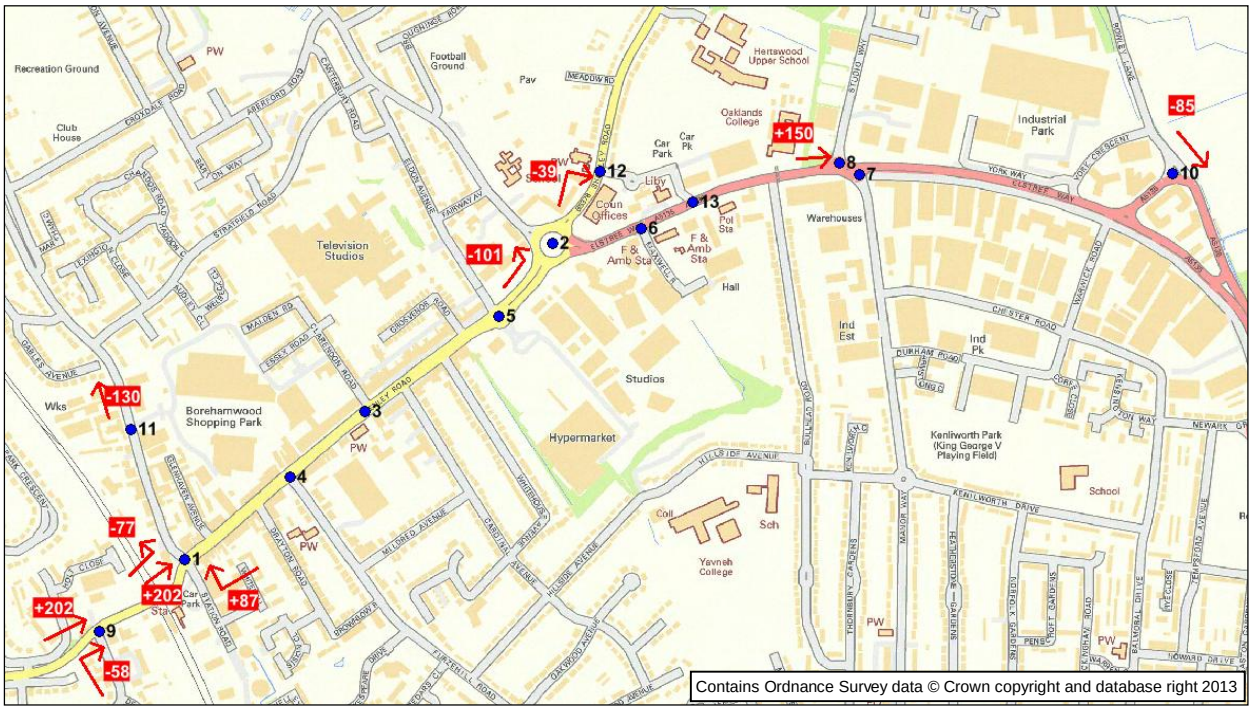
There are two movements around the scheme though which may be of concern.

- The underestimation of 101 vehicles turning left at the Shenley Road / Elstree Way roundabout northwards up Brook Road, could result in an underestimation of vehicles using the junction in the future year 'base' (do-nothing) scenario also.
- There is also an inconsistency of 150 vehicles eastbound on Elstree Way, so perhaps some of the 101 vehicles should be heading straight on rather than turning left at the Shenley Road / Elstree Way roundabout.

There are a number of poor performing turning movement flows around the train station area of the model. That part of the network is further away from the scheme though and is of lower concern.

Some turning counts were set aside for independent validation results for the Paramics model. Those results do not appear in the LMVR, so the performance of the model for those locations is unknown.

Figure 2: Paramics model – underperforming calibration count movements

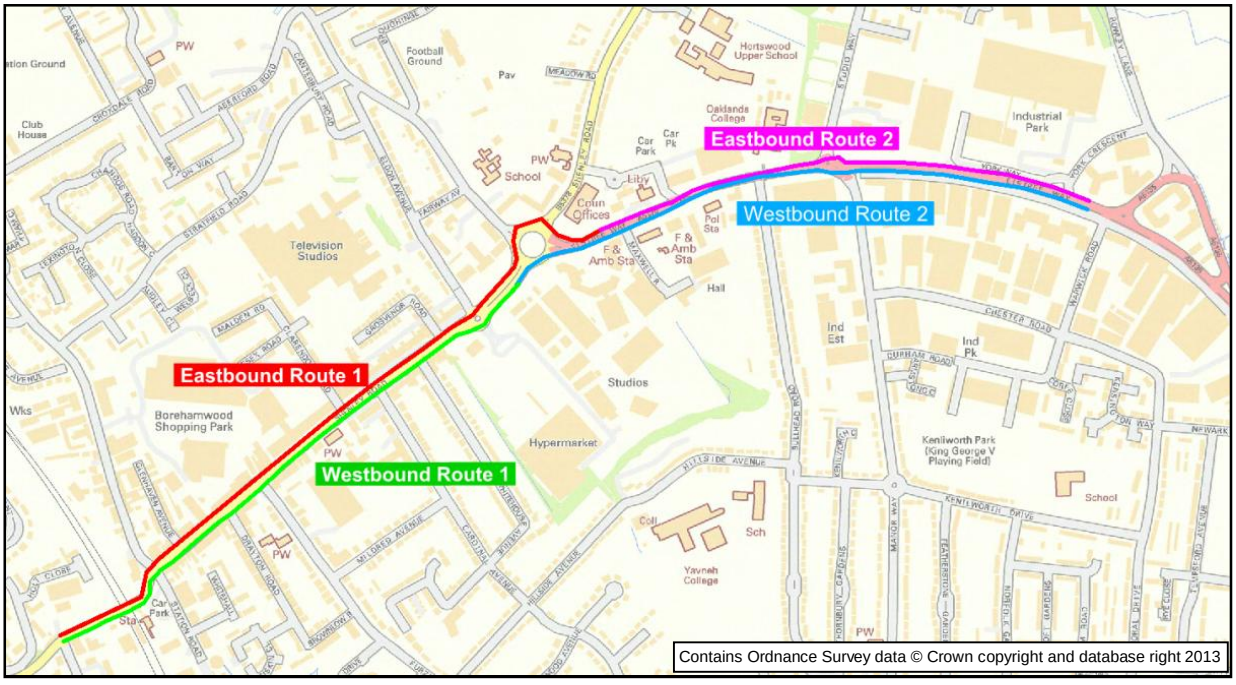


Journey Times

The PM peak modelled journey times pass the targets set within the LMVR. However, as with the AM peak analysis, they pass on the '60-second' target rather than the 15% target, which is easier for relatively short journey times.

As discussed in the AM analysis, there are no north-south observations or queue data analysis, nor do we see a disaggregated breakdown of the journey times on a junction-to-junction basis, so we are only seeing a partial analysis of the corridor performance in terms of congestion 'hotspots'.

Figure 3: Paramics model journey time validation routes

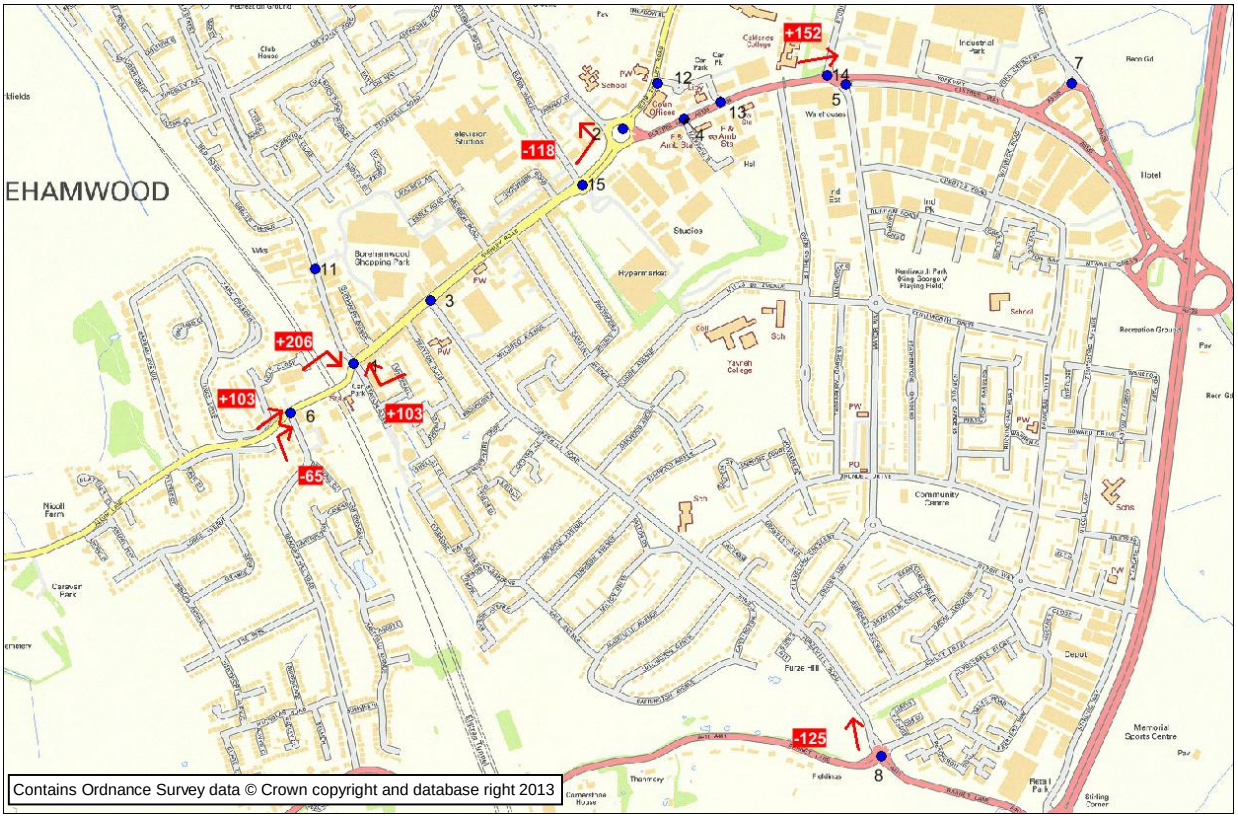


Wider Area SATURN Model Calibration – Modelled Against Observed Traffic Flows (GEH)

The SATURN model calibration results are similar to the Paramics results, which is to be expected given that the Paramics demand is derived from a cordon of the SATURN model. Overall, most of the model movements meet the GEH target of 5 compared to the observed flows.

One particular location of concern though is Brook Road northbound. In 'Table A 21' of the LMVR, the observed flow in the PM peak is recorded as 73, whereas the modelled flow is recorded as 395. First, this looks like a large difference on a key link. However, the A Node and B Node are not that of Brook Road N/B, they are actually Shenley Road S/B and this is the modelled flow that is entered. The real Brook Road N/B modelled flow in the SATURN model is 637, so the difference is significantly greater. The 'observed' value of 73 looks somewhat suspicious though, as it is very different from the AM peak equivalent value of 520. This apparent problem *may* therefore be a simple reporting error.

Figure 4: SATURN model – underperforming calibration count movements



Additional calibration counts are used for the wider SATURN model are reported within the LMVR. These are reported in the form of count 'screenlines' - lines of counts designed to assess how well the overall demand of traffic movements from for example north to south within an area. The screenlines are not watertight though - some junctions are included along the screenline but others not and within the count sites which are included, there are some locations which perform poorly when comparing modelled and observed flows. There is also a lack of an east-west screenline through the centre of Borehamwood.

Therefore, we have unknown accuracy of information on links which might be used as parallel routes or 'rat-runs' if the Elstree Way corridor becomes congested.

3: Future Year 2026 PM Peak 'Do-Something' (DS) Scenario Testing

This section of the technical note reports on the Corridor model results, comparing the proposed Elstree Way Corridor scheme against the current (Base) scenario, for the PM peak time period.

Future Year (2026) Scheme Network Assumptions

Modelled road network characteristics, traffic demand inputs and driver behaviour assumptions are the same as described in the AM peak model analysis note, which should be referred to for additional information.

Operational Corridor (Paramics model) Assessment

The future year (2026) Paramics model uses a cordon extract from the wider SATURN model for its traffic demand. It uses the base year (2010) time period profile to fine traffic flows on a five-minute basis. The base year profile was based on base year count data. The future year model includes traffic signal timings originating from Linsig (specific traffic signal junction software) analysis.

Demand

The wider routing of traffic following the implementation of the scheme results in traffic re-routing away in a similar way as the AM peak, but to a greater extent as there is greater congestion modelled around the Elstree Way / Shenley Road roundabout in the PM peak.

Table 1 and **Table 2** below compare the Core hour demand cordoned and transferred into Paramics for the respective scenarios for the AM and PM peaks. The results show that both the AM and PM scheme scenarios contain more traffic than the base year model and the PM peak contains slightly more traffic than the AM peak. Overall there is a 9% growth in traffic in the AM peak and 8% growth in the PM peak.

Vehicle	AM 2010 Base	AM 2026 DS	% Growth
Car	5752	6238	8%
LGV	580	620	7%
HGV	132	160	21%
Taxi	41	46	12%
TOTAL	**6505**	**7064**	**9%**

Table 1: Corridor traffic demand for 2010 to 2026, AM peak

Vehicle	PM 2010 Base	PM 2026 DS	% Growth
Car	6219	6598	6%
LGV	485	515	6%
HGV	77	106	38%
Taxi	45	55	22%
TOTAL	**6825**	**7379**	**8%**

Table 2: Corridor traffic demand for 2010 to 2026, PM peak

Congestion – Comparison of Base and DS

The figures below show screenshots of the corridor (Paramics) model, comparing the Base (2010) model against the future year (2026) scenario with the scheme in place (Do-Something).

The results suggest that the network-wide impact of the scheme is minimal in terms of creating additional congestion. It would have been expected to see an increase in congestion and delay between

the Base 2012 and Scheme 2026 with the increase in traffic over time and decrease in overall network capacity.

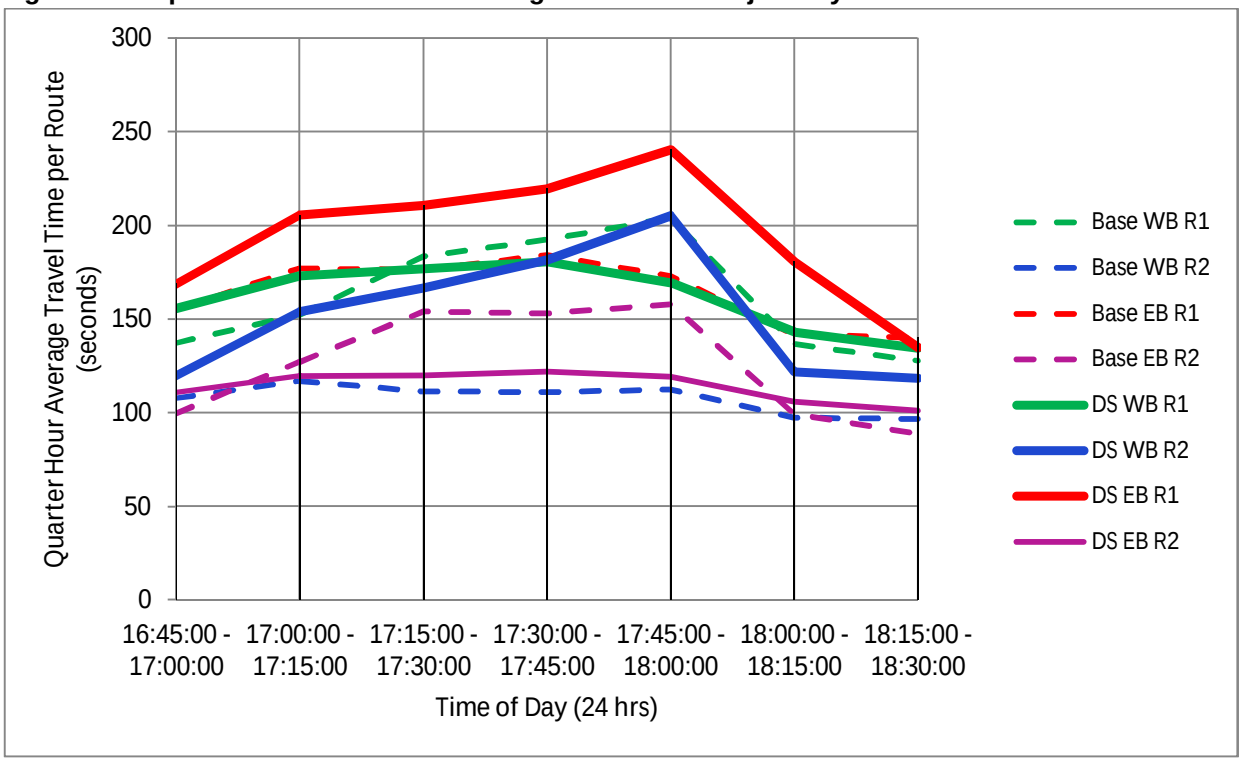
Journey Times – Comparison of Base and DS

Figure 5 below compares the journey times in the local corridor model for the Base (2010) and Do-Something (2026) scenarios, for the PM peak. The routes are identified in Figure 3 above; Route 1 covers the Elstree Way corridor between Deacons Hill Road and the Elstree Way / Shenley Road / Brook Road junction.
Route 2 covers the Elstree Way corridor between Rowley Lane and the Elstree Way / Shenley Road / Brook Road junction.

The figure shows that the modelled scheme performs at level somewhat 'worse' than the current according to the journey times through the corridor, which reflects the same outcome from the corresponding AM peak analysis. Although there is an increase in journey times however, this additional delay will include delay associated with the traffic signal cycles as well as any associated with network congestion.

Subsequent analysis will assess whether this outcome remains positive under alternative demand assumptions. For transparency and ease of comparison, each of the journey time analyses will compare the future year scenario journey times for the two routes against the current base levels.

Figure 5: PM peak Base and Do-Something corridor model journey times



Wider Network (SATURN Model) Assessment

The Paramics traffic inputs originate from an extract (cordon) of the wider network SATURN model. Therefore it is relevant to look at how the traffic within that model varies under the different scenarios and importantly, to what extant traffic re-routes away from the corridor if it becomes congested.

Strategic Model (SATURN) Traffic Flows (Actual Flows, PCUs)

Figure 6 shows how the network with the scheme in place would compare to the network without the scheme, assuming the same overall level of traffic in 2026. The scheme has a lower capacity than the current arrangement for the Elstree Way / Shenley Road junction. As a result of this, traffic is re-routing away from the corridor, making use of parallel roads. The strategic model suggests traffic will make increased use of the following routes as alternatives;

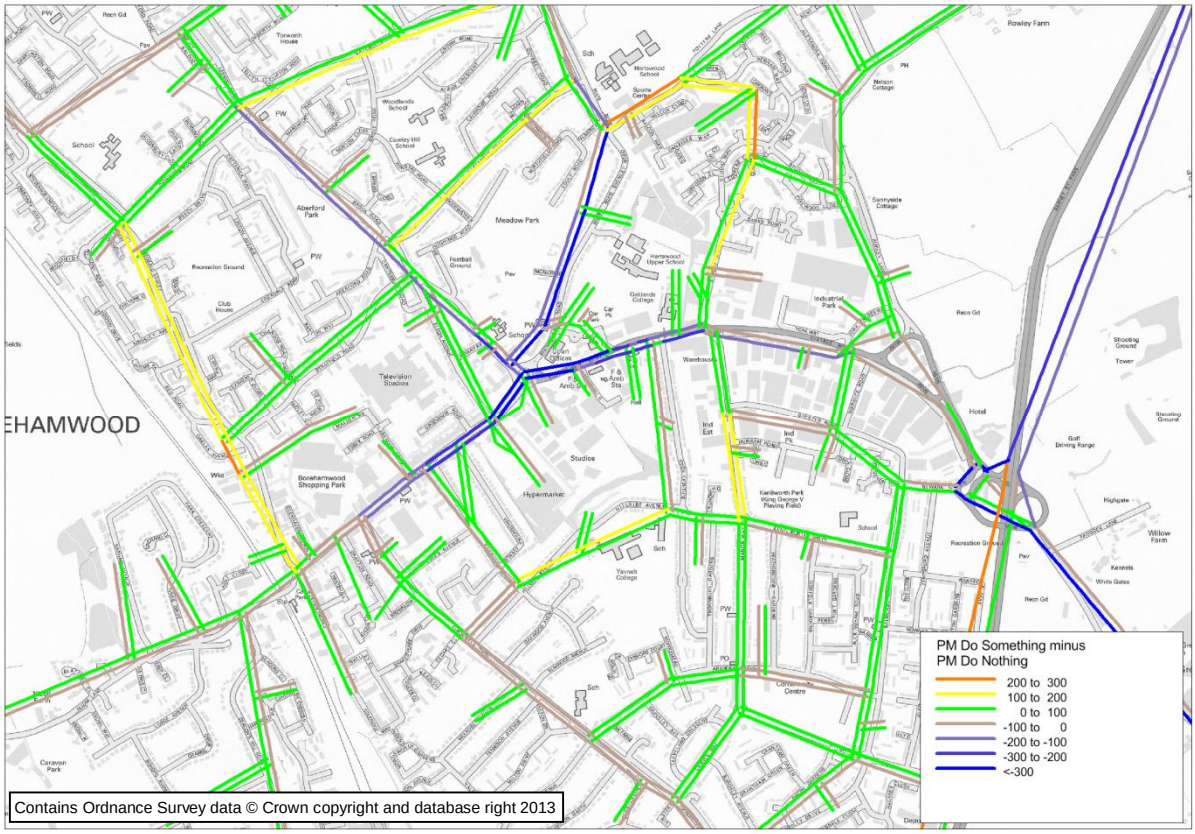
- Rowley Lane
- Studio Way
- Denham Way
- Gateshead Road
- Theobald Street
- Hartford Road
- Manor Way
- Hillside Avenue
- Furzehill Road

If this re-routing does not (can not) take place, then the flows in the local corridor model would be higher and there would be an increase in congestion and delays within the model.

Limited information has been presented and applied within the wider model for these adjacent corridors. Therefore it may be the case that the capacity of the roads are either under or over estimated, along with the base year demand.

Confidence in the model replicating observed base year conditions needs to be understood prior to forecasting future year demand and responses to the proposed internal network changes. This is discussed further in the conclusions section.

Figure 6: PM peak 2026 With Scheme minus PM peak 2026 No Scheme



4: Future Year 2026 Sensitivity Testing

Traffic Growth

Within traffic models there exists an element of uncertainty. In order to reduce the risk of this uncertainty sensitivity testing is conducted, to assess the potential impact of which this range of uncertainty might have. In this case the sensitivity test is an alteration of future year traffic levels, as there is some uncertainty over the level of traffic growth between 2010 and 2026.

Traffic growth currently assumed in the wider SATURN model area and the more localised Paramics corridor model, from 2010 to 2026 has been calculated by comparing the traffic levels in these model scenarios. The growth factors from that have been compared with an independent source – 'Tempro'. "*Tempro is a modelling tool designed to allow users to look at the growth in trip ends, using actual and forecast data supplied by the Department for Transport*".

Comparing the modelled growth against Tempro (**Table 3** below), shows a distinct difference between the growth applied in the wider (SATURN) model and the corresponding 'Tempo – Hertfordshire' growth value, with the latter being significantly greater. The lower growth in the model could potentially underestimate background traffic. This lower level of background traffic could make it easier for traffic to re-route at a wider level if the town centre was congested.

In the context of EWC, the more important comparison is probably between the local model and 'Tempro – Borehamwood'. Here the difference is not as great, though the Tempro figures suggest that the modelled growth in traffic at this local level might also be a conservative estimate overall.

Based on this analysis for the local and wider area it appears traffic growth applied is likely to be underestimated.

Time Period	Model Wider	Model Local	Tempro - Hertfordshire	Tempro - Borehamwood
AM	4.8%	8.6%	13.8%	12.2%
PM	4.4%	8.4%	12.8%	12.2%

Table 3: 'Core' modelled and Tempro growth comparison for traffic levels between 2010 and 2026

Corridor (Paramics model) Sensitivity Testing Output Analysis

The following analysis compares the output of the local corridor model under the 'Core' traffic growth scenario, against re-run versions of the model with the same scheme network, but with higher traffic growth - based on the Tempro estimated growth factors.

This test makes the assumption that traffic growth is under estimated and there is no available capacity on adjacent corridors.

Journey time route comparison

Figure 7 and **Figure 8** below show journey time route outputs for the local corridor model, comparing the Base model against the Do-Something (with-scheme) under the higher (Tempro - Borehamwood) traffic growth assumption, as taken from **Table 2**. The outputs can be compared to the previous PM (**Figure 6** above) and AM (see previous technical note) figures.

The impact of the higher assumed traffic growth from 2010 to 2026 is shown by a marked increase in journey times for the sensitivity scheme test (DS+) and the Base model journey times. Most notable is the Westbound route, section 2 (see **Figure 3** above for identification of the routes), where there is a significant amount of additional delay. This could potentially be mitigated partially on site by using

demand dependent traffic signals, but such is the increase in delay, it is unlikely that this would remove all of the additional delay which is suggested in the outputs.

The implication from this is that if traffic cannot re-route from the corridor and traffic levels are forecast to grow in line with Tempro, then there could be a significant increase in journey times through the corridor.

Figure 7: AM peak Base (Base) and Scheme sensitivity test (DS+) journey time comparison

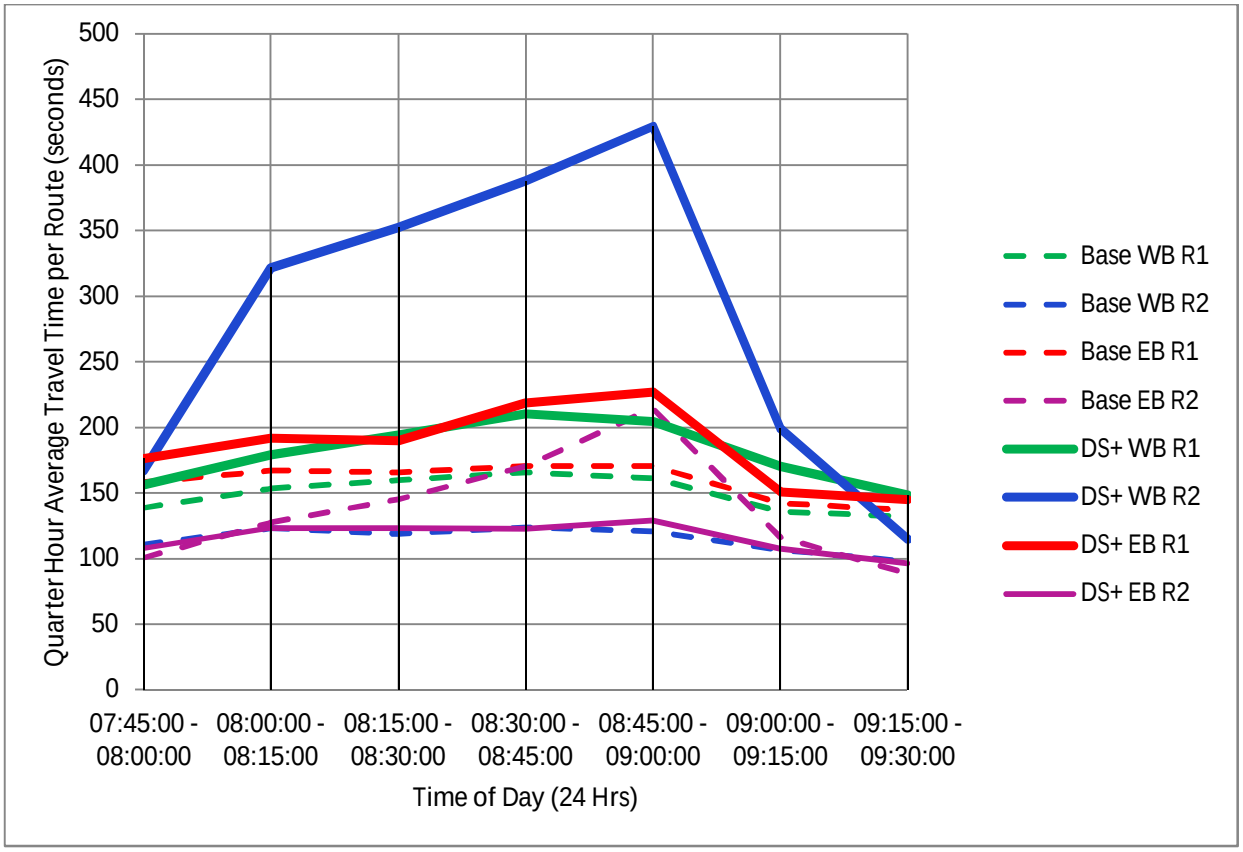


Figure 8: PM peak Base (Base) and Scheme sensitivity test (DS+) journey time comparison

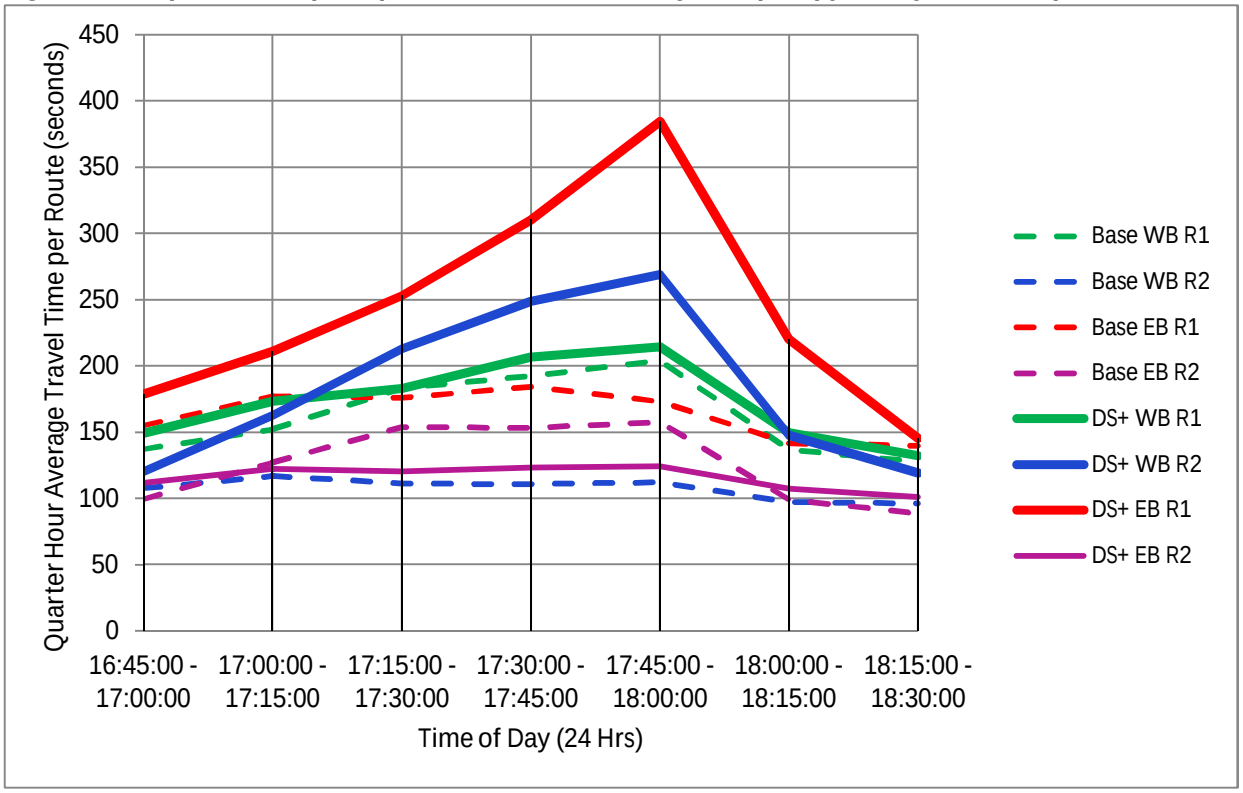


Table 4 below shows the network-wide impact of increasing the level of traffic within the Paramics model. With the 'Core' level of traffic there is only a relatively small increase in delay when the 2026 DS scenario is compared to the 2010 Base scenario. However, increase traffic beyond this Core level and parts of the network pass over capacity levels and some parts of the network experience large increases in delay.

This translates to increases in average travel time of up to 30% when the traffic growth is 12% as in the AM peak.

	Future year (2026) growth in vehicles compared to Base (2010)	Future year (2026) growth in average travel time compared to Base (2010)
AM peak 'Core'	9%	4%
AM peak Sensitivity Test	12%	30%
PM peak 'Core'	8%	4%
PM peak Sensitivity Test	12%	21%

Table 4: Growth in network-wide vehicles and delay comparing Base (2010) and future year (2026) Do-Something scenarios

Wider network (SATURN model) sensitivity testing output analysis

Figures 9 and **10** below show the impact on the wider network if the higher 'Tempro – Hertfordshire' 2010 to 2026 traffic growth factors of around 13% were assumed instead of the current 'Core' growth factors of 4 to 5%. The comparison uses the same scheme network, but with the different traffic levels.

The analysis suggests that there would be some increase in traffic through the Elstree Way corridor, but as with the comparison between the Base and Core Do-Something, much of the additional traffic would re-route around the corridor. The outputs suggest there is actually a decrease in traffic westbound on Elstree Way approach the central junction in the AM peak, as vehicles start to avoid the increased delay there. There is a similar finding for the PM eastbound traffic, also notable in the PM peak is the extent of suggested increase in traffic along parallel routes, such as Hillside Avenue. Whether this re-routing onto parallel routes and 'rat-runs' is realistic and acceptable should be confirmed.

Figure 9: AM peak 2026 With Scheme 'Tempro' growth minus AM peak 2026 with Scheme 'Core' growth

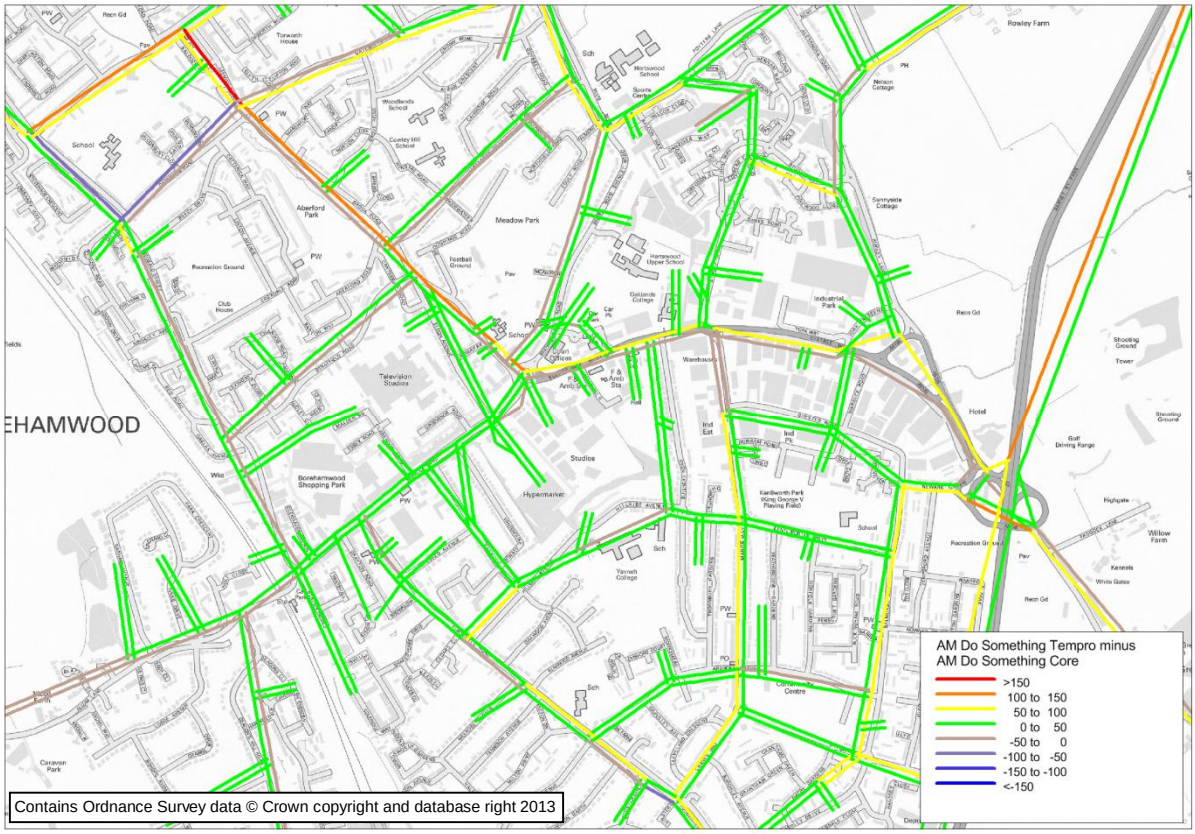
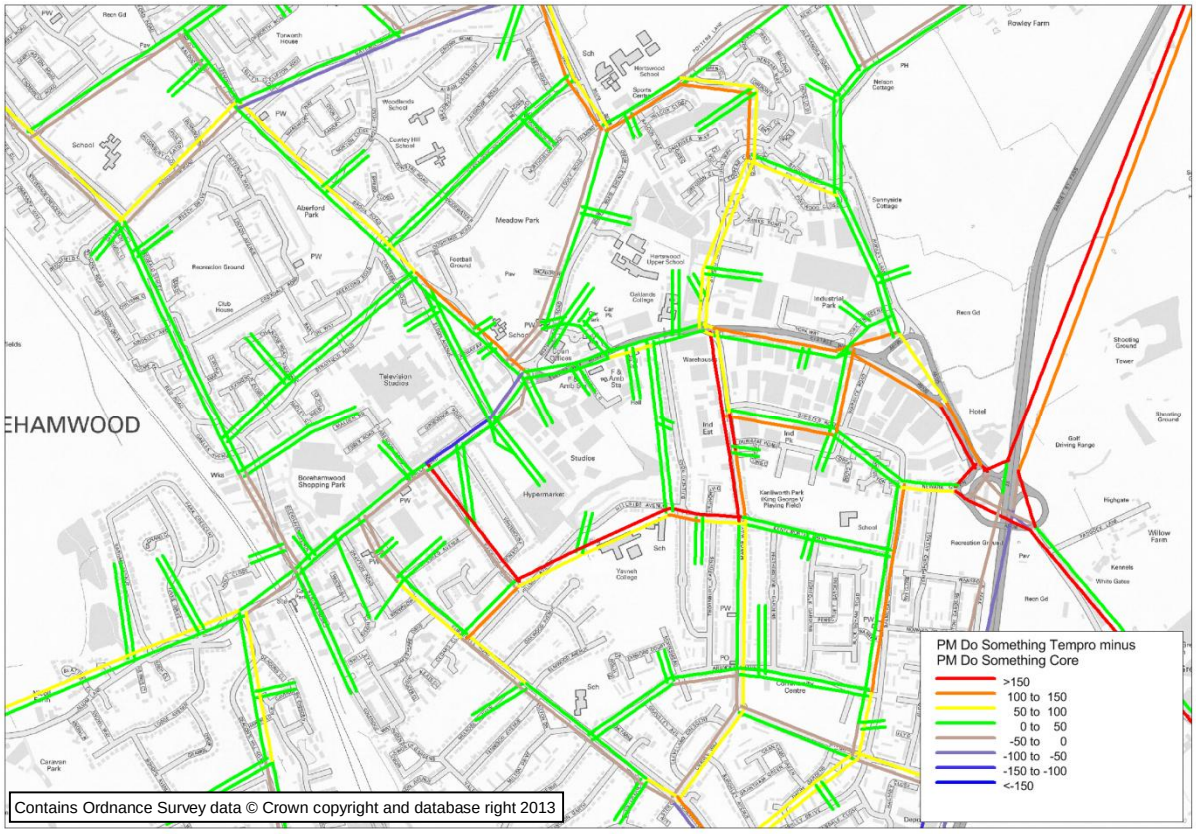


Figure 10: PM peak 2026 With Scheme 'Tempro' growth minus PM peak 2026 with Scheme 'Core' growth



5: Summary & Conclusions

This technical note has presented the findings from the PM peak 2026 scheme scenario testing and AM and PM peak sensitivity testing. The latter maintains the same scheme network, but tests a higher growth in traffic between 2010 and 2026.

This section of the note summarises key findings from the conducted analysis and suggests how the project can be taken forward.

PM Peak Scheme Assessment

The scheme impact on the corridor can be summarised as follows;

- Under the with-scheme (Do-Something) 2026 scenario, compared to the Base 2010 situation traffic across the local model increases overall in the PM peak. However, a significant amount of traffic diverts away from the central junction of Brook Road and Elstree Way.

- Overall traffic queuing extents are not very different from existing under the with-scheme (Do-Something) scenario, compared to the Base situation. There is a redistribution of location of queuing though, with an increase around the new signals.

- Higher flows on particular movements result in slightly higher levels of congestion in the PM peak compared to the AM peak. The primary example of this is right turn movements from Brook Road southbound and Elstree Way westbound at the new crossroads.

- The performance of the scheme is quite sensitive to signal timings and relies on them being optimised.

The scheme impact on the corridor can be summarised as follows;

- The average AM and PM peak hour traffic growth is approximately 4.5% across the wider network (SATURN model) as a whole.

- Comparing the 2026 traffic demand results with the existing network (DN scenario) and proposed scheme network (DS scenario), there is forecast to be a substantial drop in traffic along Elstree Way, potentially around 40%. There is forecast to be an associated drop in traffic along Brook Road northbound and Shenley Road southbound in particular. This decrease in traffic is associated with the reduced capacity of the Elstree Way / Brook Road crossroads, which increases delay for traffic users overall.

- Traffic will re-route around this central Elstree Way / Brook Road junction, making increased use of the following routes as alternatives;
    - Rowley Lane
    - Studio Way
    - Denham Way
    - Gateshead Road
    - Theobald Street
    - Hartford Road
    - Manor Way
    - Hillside Avenue
    - Furzehill Road

- The ease and appropriateness at which traffic re-routes onto minor roads or rat-runs should be considered both in terms of its realistic capacity and also the appropriateness.

AM and PM Peak Sensitivity Testing Assessment

- Sensitivity testing has been conducted on the level of traffic growth forecast between 2010 (Base) and 2026 (Do-Something). The sensitivity test increases the overall amount of traffic further upwards from 'Core' growth levels from 2010 to 2026. When higher growth in traffic is assumed it either re-routes around the corridor to an extent (as analysed using the wider model) or if assuming no traffic re-routes (assuming higher growth in the local corridor model) then there is a notable increase in central congestion.

- Sensitivity tests suggests that if traffic growth is higher than is assumed in the strategic model 'Core' scenario, then some of that additional traffic would route through the Brook Road / Elstree Way junction, but some of this additional traffic would also seek to use alternative routes.

Conclusion

The conclusion of the above analysis at both the local and wider network are, is that the proposed new Elstree Way Corridor scheme will decrease capacity for traffic and resulting re-routing may occur. This assumes possibly lower traffic growth applied than which might be the case.

If however, traffic growth is higher in the town centre, as shown in the Paramics model sensitivity tests, then areas within the network will reach capacity with increased congestion and delays. Therefore, there is a reliance on traffic re-routing around the congested central area or/and people altering their trip patterns, if the scheme is implemented.

There are therefore uncertainty and risks in the modelling analyses and conclusions from these, on that basis we are unable to confirm that the proposed scheme works to an acceptable level.

Additional sensitivity testing has been proposed, which investigates the potential impact of an additional housing development on land within the corridor model area. If these additional development trips are added onto the current scheme model scenario for the wider network, it is likely that the impact will be similar to the demand sensitivity testing conducted above. The likely model impact would be some increase in demand through the corridor, but with part of the traffic re-routing away. If however, these additional trips were added directly onto the local corridor model, assuming no re-routing away from the corridor, then the impact would be more pronounced and congestion would increase, so both of these methods should be considered.

Assumptions

A number of assumptions have been necessary to undertake the modelling work and associated analysis. These need to be borne in mind when interpreting the results and determining the performance and adequacy of the proposed scheme. The assumptions have included:

- There are known errors in the coding of the Base SATURN model, carried through to future year modelling, which will impact on the re-routing of traffic. The impact of it should be sense checked in terms of realistic capacity and acceptability and altered if appropriate.

- Similarly there are known errors in the Base Paramics model. These relate more to zoning of traffic, which would ideally be corrected. Driver behaviour at junctions in terms of their gap acceptability and mid-junction queuing is also a query. At present it is assumed that there is no 'yellow boxing', but also that traffic does not creep mid-junction when turning right.

- Likewise some caution towards the results should be considered in light of potential inconsistent counts, the lack of queue data and potential unreliability of journey times, which may have an impact on the degree of modelled rat-running.

- Fixed traffic signal timings have been assumed.

- Levels and distribution of development are fluid, those provided during the model development were used.

- Trips arising from the developments have been based on the size of the development (supplied by HCC) and the average trip rate for different types of development. The average trip rates were taken from the previous modelling work for consistency with that work. Those trip rates were based on TRICS data – a database of trip rates for developments, categorised by development type and geographic location.

- A comparison of the Base Year (2010) demand model and the Forecast Year (2026) strategic model, suggests that growth in traffic demand across the area is lower than might be expected, according to comparison statistics (Tempro). This may be due to the growth expectations at the time of the model development, or related to the basis of the model development. Therefore, the level of traffic in the model may be an underestimation.

- Growth in the town centre (Paramics) model is also lower than comparison with Tempro.

Way Forward

Given the analysis of re-routing, it is recommended that sense checking of the network capacity and traffic demand is conducted for adjacent corridors to Elstree Way. It should be confirmed whether the amount of traffic transferring onto alternative routes is realistic and acceptable.

From this, improvements to the model network to aid confidence and understanding of the scheme impact can be made.

Once a suitable level of confidence in the model network is reached, traffic growth should be confirmed and adjusted as may be required.