Project:	**Highways England Spatial Planning Arrangement**	Job No: **60600479 DM014.005**
Subject:	**South Caldecotte, Audit of Revised VISSIM model**	
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Executive Summary

This technical note consists of a modelling audit of the revised Kelly's Kitchen Roundabout (A5) base VISSIM models, provided by BWB to support the planning application of the proposed South Caldecotte development at Milton Keynes. The audit was carried out based on WebTAG guidance and best practices based on the VISSIM Model Audit Process (VMAP) from Transport for London.

AECOM has previously undertaken a review of the original base and forecast models (reference 'South Caldecotte VISSIM Model Review_v10') and AECOM's comments on the previous base model have been considered within this review. It is understood that revised forecast models will be built once the base models are agreed.

The note draws attention to the elements coded and the vehicle data used in the model. Elements that have been audited are:

- Vehicle Inputs and routes;
- Turning Count data and Journey times;
- Signal Operation;
- Priority Rules & Conflict areas;
- Reduced Speed Areas & Speed Distributions;
- Network Operation & Routing;
- Driving Behaviour; and
- Calibration Results.

Issues/Errors that were found in the model have been classified into three levels:

- **MINOR –** The issues found are likely to produce minimum changes in the results.
- **MEDIUM –** The issues found could have a medium impact on the results.
- **SIGNIFICANT –** The issues are considered as an error and are likely to have a large/ significant impact on the results.

The following table shows a summary of assessment on the status of the issues identified during the previous audit:

Issue Identified in Previous Audit	Level of Issue	Resolved?	Comments
Traffic Composition not including LGVs	Minor	No	
Network Coding errors of Overlapping Connectors	Minor	Yes.	It has been addressed to a great extent. However, there are

Issue Identified in Previous Audit	Level of Issue	Resolved?	Comments
			minor vehicles clashing issues observed which could be addressed.
Network Coding error of 2 lane Roundabout	Minor	Yes	
Vehicle Inputs	Minor	Yes	Few more inconsistencies have been observed in the model inputs when compared with the survey data
Signal Coding and Detector errors	Significant	Yes	
Priority Rules and Conflicting Areas	Minor	Yes	
Reduced Speed Areas inconsistency between AM and PM	Medium	Yes	
Speed Distribution – Speeds used in the model	Significant	Yes	
Driving Behaviours	Minor	-	Changed for a certain Driving Behaviour but justification should be provided for the new driving behaviours included in the model.
Model Calibration and Latent Demand reporting issues	Significant	No	Latent Demand reporting is missing
Reduced Speed Areas not coded on the Roundabout	Significant	Yes	
Saturation Flow Calibration not provided	Medium	Yes	
Journey Time Validation criteria Misinterpretation	Significant	Yes	
Evidence supporting calibration of MOVA	Medium	No	
Consistency issues between AM and PM Peak models	Significant	Yes	Few issues are still unresolved as detailed within this report

*The modelling issues that are considered to be **SIGNIFICANT** are listed below*

- The audit reveals that there are inconsistencies observed between the vehicle inputs and survey data.
- The survey flows used in the calibration tables do not show consistency with the vehicle inputs or the survey data provided. To be resolved or appropriate justification provided.
- The LMVR misses out on the reporting of Latent Demand for each run in the model. It would be ideal to document this in an updated LMVR.

*The following lists modelling issues that are considered to be **MEDIUM***

- There are some errors identified with the Desired Speed Decision coding and correcting those might have some impact on the Journey Time results.

In addition to the SIGNIFICANT and MEDIUM issues highlighted above, there are a number of MINOR issues raised which are highlighted within green throughout this technical note, which are expected to have a minimal impact on the operation of the models. However, it is recommended that these are considered further by the modellers and addressed where necessary – as the cumulative impact may be more significant and addressing these is likely to assist with calibration/ validation.

Based on the overall findings from the model audit, although there is a significant improvement from the previous submission, there are a few areas of the model which need addressing before the models are fit for purpose. It is advisable to make those corrections and provide justification on the concerns raised regarding the Vehicle Inputs. If by addressing those issues, the models calibrate and validate within the acceptable guidelines, the revised models should be presented to review along with the Future Year Models which could then be based upon these acceptable base models.

1 Introduction

This Technical Note (TN04) provides a summary of the auditing work conducted of the VISSIM models developed for the A5 Kelly's Kitchen Roundabout by BWB. The VISSIM models have been prepared to support the planning application of a proposed employment development at South Caldecotte in Milton Keynes. This Technical Note should be read alongside Technical Note 03 ('South Caldecotte VISSIM Model Review_v10'), which documents the review of the previous base and forecast models and Technical Note 02 ('TN02_Review of South Caldecotte TA_v7'), which documents the review of the Transport Assessment (TA) associated with the proposed development, which the VISSIM model has been used to inform.

The models/information received by AECOM include:

- The Base year 2017 AM/PM peak models; and
- Local Model Validation Report (LMVR), file reference 'SCD-BWB-GEN-XX-RP-TR-003_LMVR-S2-P3'.

2 2017 Base Model Review

2.1 Traffic Data

The vehicle traffic data model inputs when compared with survey data provided has revealed a number of inconsistencies.

Table 1: Inconsistencies between surveyed and modelled data – AM Peak

Time	Arm	Reference	Cars	LGVs	Total Lights	Total HGVs (OGV1 + OGV2)
AM Peak (08:00-09:00)	A4146 Road	Survey Data	1219	115	1334	81
		VISSIM Inputs			1259	73
		Difference			75	8

Table 2: Inconsistencies between surveyed and modelled data – PM Peak

Time	Arm	Reference	Cars	LGVs	Total Lights	Total HGVs (OGV1 + OGV2)
PM Peak (17:00-18:00)	A4146 Road	Survey Data	1080	151	1231	45
		VISSIM Inputs			835	47
		Difference			396	2

Section 3.1 of the LMVR indicates that the turning count surveys were used to derive the matrix containing each movement categorised in Lights, MGV and HGVs. It is therefore interpreted that the Vehicle Inputs coding in the models were based on the MCTC data. There is no evidence provided in the LMVR to support the difference observed in the table above. This difference should be justified, as it might have an impact on the overall model validation and calibration results. The impact would be **SIGNIFICANT**.

It is recommended that the inputs and corresponding Static Routes be justified by reference to supporting survey data for both AM and PM peak hour time periods.

2.2 Traffic Composition

It has been mentioned in the LMVR that LGVs and Cars have been modelled as Lights. HGV includes MGV (58%) and HGV (42%) which is in line with the DfT split, while Lights composition only include Cars – which is not likely to represent actual proportions of LGVs/ Cars. LGVs are not included in the model and these could

have been defined in the traffic composition, as they have different model characteristics which may have some impact. This was pointed out in the previous audit.

Count: 3	No	Name
1	1	Default
2	2	Lights
3	3	Heavies

Count: 1	VehType	DesSpeedDistr	RelFlow
1	100: Car	1053: 60mph C	1.000

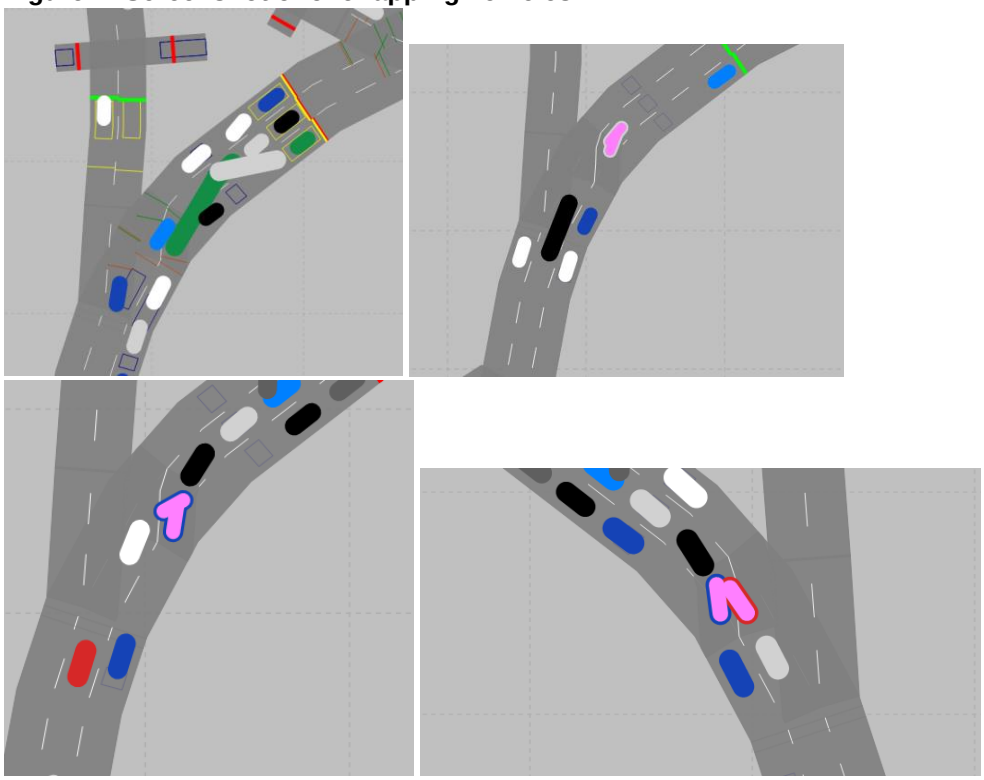
The likely impact would be **MINOR.**

2.3 Network Coding

General Coding Errors

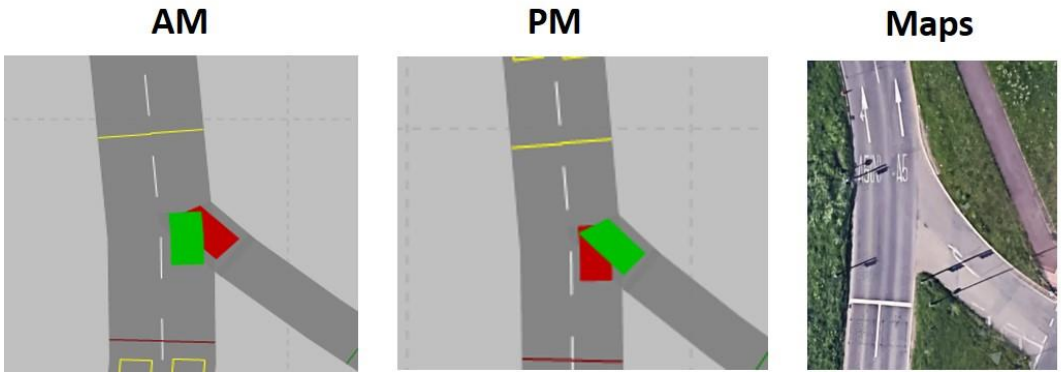
There are occasions when the vehicles overlap each other on the roundabout. The pictures below shows a few instances of the occurrences. This problem has been improved when compared to the previously submitted models, but addressing further improvements to avoid these overlaps would be ideal. The likely impact would be **MINOR.**

Figure 1: Screenshot of overlapping vehicles



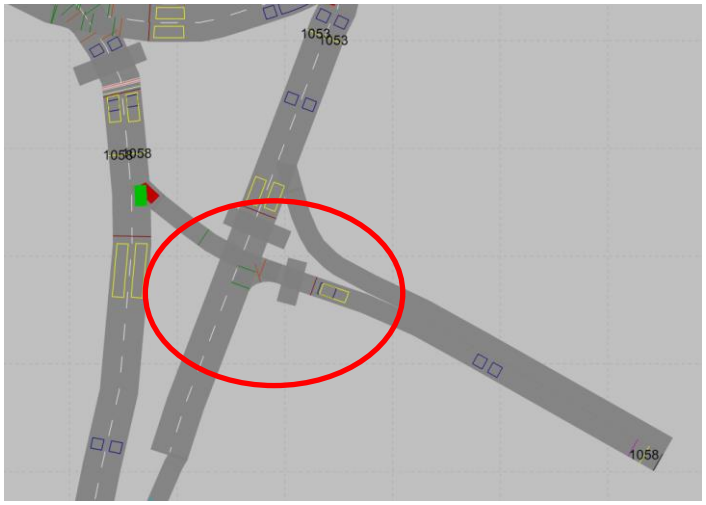
The conflict area coding of merge of Link 28 (Northbound link) and Link 39 (Side arm link) in the PM Peak model is inconsistent with AM Peak model. This might cause unnecessary waiting of vehicles on Link 28 whenever there is a congestion or queue on north of the merge towards the signals at Roundabout. It is ideal to have consistency between AM and PM models. This inconsistency is not justified in the LMVR. This might have an impact on the Validation and Calibration.
The impact would be **MINOR.**

Figure 2: Conflict Area error.



The Desired Speed Decisions are missing on Link 5 (2-lane segment in southbound direction) for the Left turning vehicles from Link 37 (Side arm). The vehicles on Link 37 drive at a desired speed of 30 mph as coded. Link 5 should have a speed of 60 mph coded. This will reduce the overall driving speed on this Arm in Southbound direction and have an impact on the Journey Time Results for the Journey Time sections, especially those which end on Link 27 (1-lane segment in southbound direction). While this might or might not result in a significant change to the results of the Base Year models, it could impact the Forecast Year models where there could be a vehicular growth on this Link. The likely impact of this issue is considered to be **MEDIUM**.

Figure 3: Desired Speed Decision coding error.

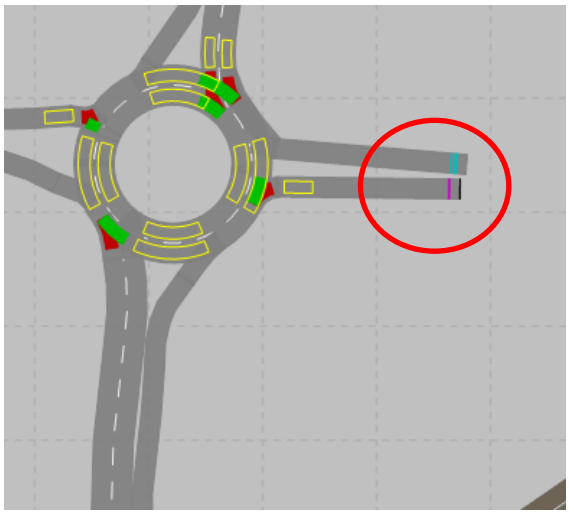


The Desired Speed Decisions on Link 33 are inconsistent between different lanes. Lane 2 and Lane 4 have Speeds of 20 mph compared to Lane 1 and Lane 3 which are coded as 30 mph. This will mean that the vehicles using Lane 2 and Lane 4 will drive on the roundabout at a speed less than the desired speed and might impact the overall capacity of the Roundabout. The likely impact would be **MINOR.**

Figure 4: Desired Speed Decision coding error.

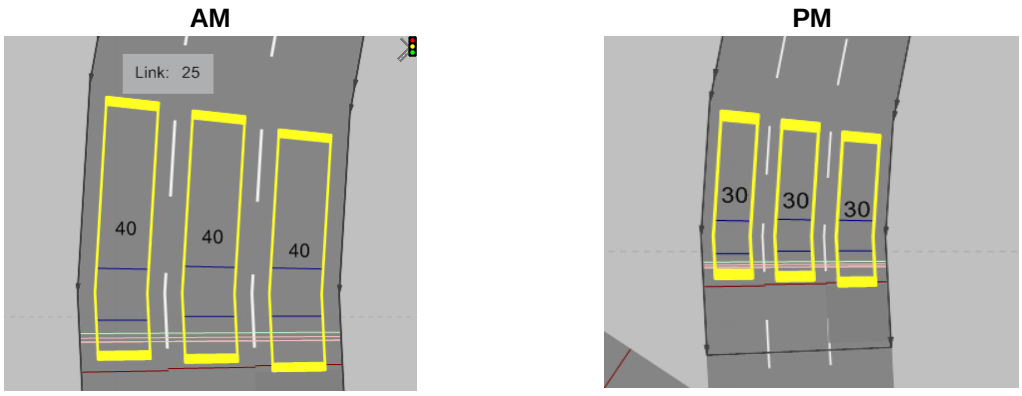
The Figure 5 shows that there is no Desired Speed Coded on Link 32 which would mean that the Vehicles originating from Link 32 will drive on the Default Speed of 60 mph which is higher than the desired speed of the roundabout (40 mph) as coded on other approach arms to this roundabout. The flow from this link is negligible but it is advisable to correct this with a Desired Speed Decision coding. The likely impact would be **MINOR.**

Figure 5: Desired Speed Decision coding error.



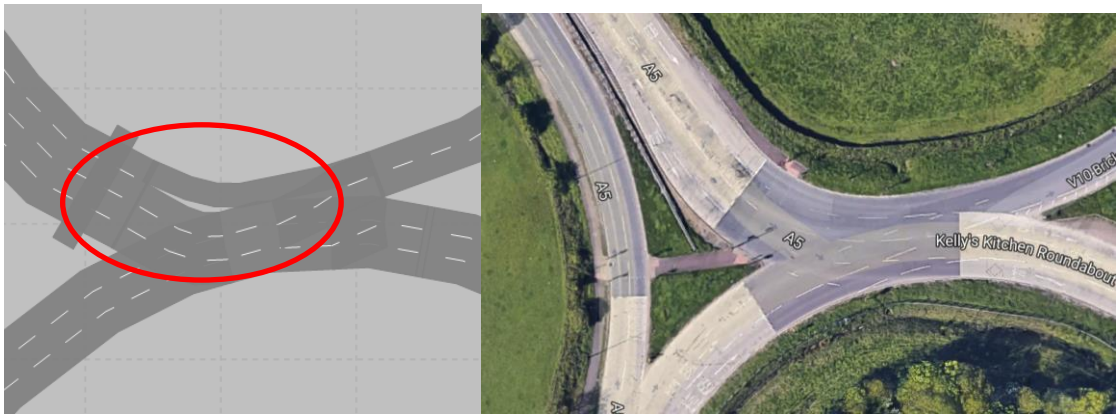
The Reduced Speed Areas should have consistency between the AM and PM peak models. Link 25 (Approach arm to the roundabout from North – V10 Brickhill Street) shows some inconsistency with the coded speeds in the Reduced Speed Areas. There is no reason given for this within the LMVR.
The likely impact would be **MINOR.**

Figure 6: Reduced Speed coding error.



There is an inconsistency between the layouts when compared to the Google Maps. There is no kerb or hatched area on the Roundabout approach arm of A5 North. The links and connectors need to be adjusted to match the on-ground conditions accurately. Figure 7 below shows the inconsistency. There would be no impact with this adjustment.

Figure 7: Link-Connector coding error.



2.4 Vehicle Inputs

The inconsistencies found when comparing vehicle model inputs with the traffic survey data has been reported in Section 2.1 of this report. The Inputs and Routings need to be verified to show consistency with the Survey data.

2.5 Signal Coding

Section 2.11 of the LMVR mentions that the video surveys were analysed to provide actual minimum and maximum green times to model the junction using Vis-VAP. There is no tabulated information on the results of the video survey which could be used to check the VAP coded signals in the models.

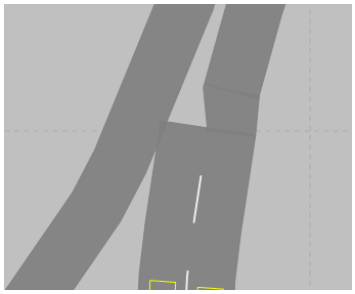
2.6 Priority Rules and Conflicting Areas

The priority rules and conflict areas issues in the model have been reported in Section 2.3 of this report. The priority rules and conflict areas need addressing where there is overlapping of vehicles.

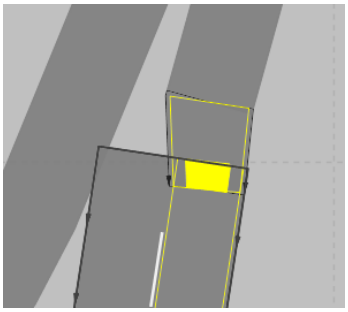
Conflict Area No. 46 is coded as Passive for Link 10062 and Link 46 and is present in the PM Model but not found in the AM Model. This correction will have no impact but it is ideal to have consistency between the AM and PM models.

Figure 8: Conflict Area Inconsistency.

AM Model - Missing



PM Model - Present



2.7 Reduced Speed Areas

The Reduced Speed Areas inconsistency between the AM and PM peak models has been reported in Section 2.3 of the report. The speed distribution used in Reduced Speed Areas 13, 14 and 15 are different between the AM and PM peak models.

The impact of this issue is considered to be **MINOR.**

2.8 Driving Behaviours

Different driving behaviours are used within the model on different links. Driving Behaviour 1 and Driving Behaviour 7 are both labelled as Urban (motorised) but have different characteristics when compared. The use of different or more aggressive driving behaviour in some sections of the model area should be reported and justified in the LMVR.

The impact of this issue is considered to be **MINOR.**

3 Calibration and Validation Results

No issues have been found when replicating calibration results for the AM or PM peaks. No issues have been found with turning count calibration, although the results are likely to change if all the issues identified above are resolved.

3.1 Turning Count Calibration

As mentioned earlier, the traffic input data used in the model does not match with the survey data provided.

Turning count calibration results on the report show close correlation between modelled outputs and surveyed data, however, the results are likely to change if all the issues identified in this report are resolved.

The survey traffic flows populated in the table of Flows Calibration in the LMVR Appendices for the AM Peak does not show consistency with the VISSIM inputs or survey data. Ideally, these need to be consistent. The table below shows some examples of inconsistency.

Table 3: Examples of flow inconsistency

AM Peak (8 AM to 9 AM)		VISSIM Inputs	Survey Data	Calibration Table (Survey Flows)	Matching with Survey Data/VISSIM Input
A	Brickhill Street	-	629	622 (-7)	No
B	A5 South	1292	1292	1259 (-33)	No
C	A4146	1332	1415	1391 (-24)	No (Inconsistency between VISSIM and Survey data as highlighted before)
D	Watling	535	535	526 (-9)	No
E	A5 North	1576	1576	1482 (-96)	No

The error logs show latent demand and remaining vehicles for Vehicle Input 5 on Link 6 (A4146 Road). As a best practice, it is advisable to report the latent demand results from the error logs in the LMVR and Forecasting reports for both AM and PM Peak models.

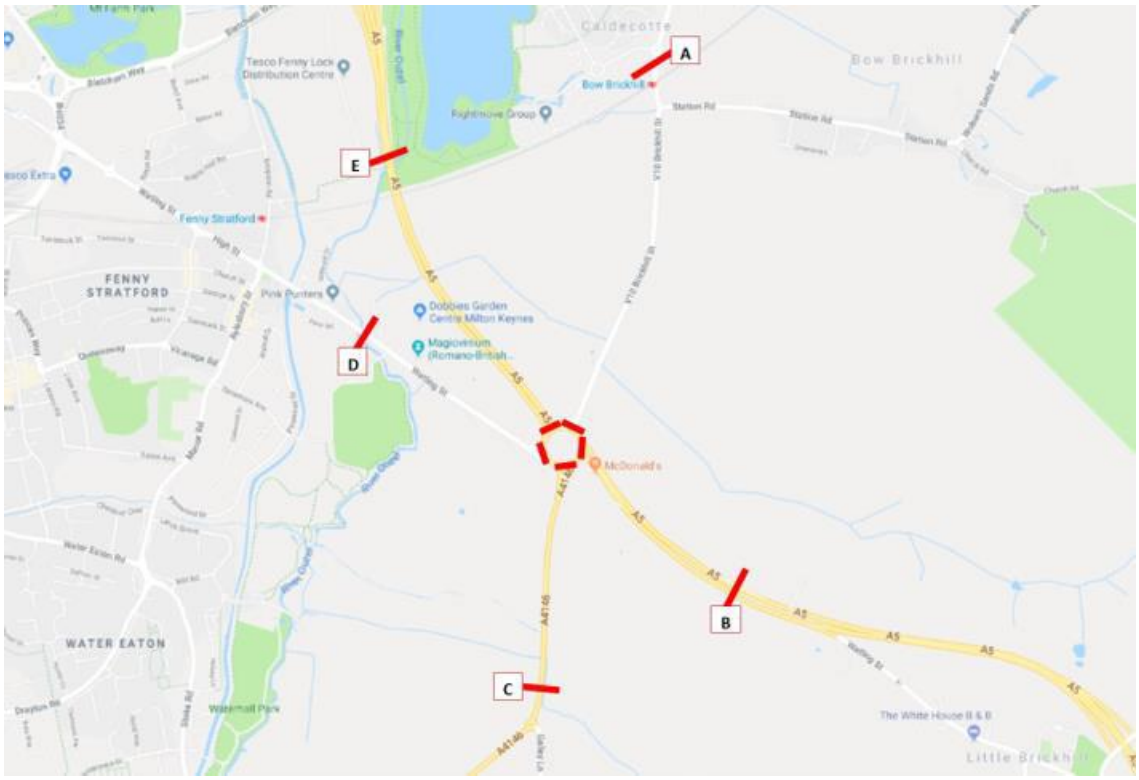
As also mentioned in the previous audit, the impact of the latent demand should be included in the LMVR and forecasting report, the impact is considered as **SIGNIFICANT**.

3.2 Journey Time Validation

The Journey Time Validation results show that three routes fail the validation criteria in both the AM and PM peaks. The results might change if the issues identified above are resolved.

Considering the volume of vehicles from survey data on the A4146 arm in the AM and PM peaks, the volume which is higher than the current vehicle input volumes in VISSIM, the modelled journey times might get slightly higher than current journey time results on sections originating from Point C in the following figure. This might also help the Journey Time validation result of Route C-B in the AM peak to fall within the acceptable criteria. However in the PM peak model, the journey time validation on Route C-A, Route C-D and Route C-E might be affected and result in those routes falling outside the acceptable validation criteria. These could be looked at by addressing the discharge record on these lanes without failing the saturation flow threshold of 10%.

Figure 9: Start and End points of journey time routes



There are issues with Desired Speed Decisions in the model which might or might not have an impact on the overall results of journey times in the model. The Journey Time results in the section ending on Point C in the Figure 9 above could be a little faster after addressing the issues with Desired Speed Decisions. These might or might not affect the validation results, with the journey times in the models still potentially falling within the acceptable validation criteria.

The impact of this issue is considered to be **MEDIUM.**

3.3 Saturation Flow

The Saturation Flow Calibration Summary shows a good match between the model and measured saturation flow. However, a few changes in the model need to be carried out to resolve the issues discussed above. These revisions might change the model Saturation Flow results but potentially might just remain within the acceptable criteria. It is advisable to generate the Saturation Flow Calibration results after all the coding issues have been amended.

The impact of these issues is likely to be **MINOR.**

3.4 Signal Control

MOVA has been replicated with VisVAP coding and PC MOVA software has not been used. Although it is generally known that PC MOVA can replicate MOVA controllers in the closest way, VisVAP coding can also give a reasonable representation of the signal operation. However, the modelled average stage length should be compared to MOVA logs to prove that the MOVA controller is closely represented. In this case, where the MOVA logs were not available for the day of the surveys, the modelled stage length could be compared against green times estimated from the video footage and included in the LMVR.

Although, no evidence has been provided to show that the calibration of MOVA is correct compared to on site operation, the signals have been coded as demand dependent to replicate MOVA operation dynamically and the model operation is considered correct compared with the MOVA setting files provided.

It is advisable to have a table showing the survey analysis from the videos for the Min and Max times used in the VAP coding. **AECOM consider that there is a need to provide further details regarding the calibration and validation of the base signal operation**.

The likely impact of this is cannot be estimated without the information provided.

3.5 Summary

The audit of the base year model shows that there are a few fundamental coding errors and that the model lacks consistency with the survey data. It is, therefore, advised to get these issues addressed before taking the model forward for modelling the impact of proposed developments and assessing future year models. The base model should be suitable for carrying out the future year modelling work once the issues highlighted are rectified and/or justified wherever necessary.

4 Conclusions

AECOM has undertaken an audit of the South Caldecotte VISSIM base models, as part of a wider review of the potential impact of the proposed South Caldecotte development on the strategic road network. A few concerns have been raised regarding the base models throughout the note regarding the build and consistency of the models. It is recommended that these are addressed to more accurately represent the existing network operation and understand the future operation of the junction following the construction of the proposed development.

These concerns have been split into three categories, **SIGNIFICANT**, **MEDIUM** and **MINOR**, which provide an indication as to how notable the concerns are, however it is recommended that all of the concerns are addressed by the modellers and these categories are only indicative.

Based on the overall findings from the model audit, it is concluded that the base year models provided do not accurately replicate the existing network operation and therefore are unlikely to provide the basis for accurate forecast year models. It is recommended to make the corrections wherever applicable and make the changes to the models to provide consistency with the data.

Based on the evidence provided in this note it is not recommended to use the provided modelling results to assess the impact of the proposed development on the A5 Kelly's Kitchen roundabout operation. It is recommended that the concerns raised within this technical note are addressed (alongside any relevant concerns raised within TN02 – the review of the associated Transport Assessment) and that revised base and forecast models are presented for review to support the development going forward.