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Subject:	<b>South Caldecotte, Audit of forecast VISSIM model</b>	
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## Executive Summary

This technical note describes the modelling audit of the South Caldecote forecast Vissim models of the A5/A4146 Kelly's Kitchen Roundabout, provided by BWB to support the planning application of the proposed South Caldecotte development in Milton Keynes. The audit was carried out based on WebTAG guidance and best practices recommended in Transport for London (TfL) Traffic Modelling Guidance.

AECOM has previously undertaken three reviews of the base models (reference 'South Caldecotte VISSIM Model Review\_v10' – dated 2<sup>nd</sup> November 2018, 'Revised South Caldecotte VISSIM review\_v8' – dated 26<sup>th</sup> April 2019, and 'South Caldecotte Revised VISSIM Review\_v7' – dated 1<sup>st</sup> August 2019), in the last of which, the base models were signed off (subject to minor amendments) and agreed to be taken forward for forecast modelling.

Consequently, AECOM carried out a review of the proposed models ('TN07 South Caldecotte Revised Forecast VISSIM review\_v13' – dated 24<sup>th</sup> January 2020) and recommended that concerns raised during the review were addressed and the models and forecast report were resubmitted for review.

This audit focuses on the updated models and forecast report submitted by BWB on 11<sup>th</sup> February 2020.

The note draws attention to the elements described in BWB's TN 'SCD-BWB-GEN-XX-RP-TR-005\_Forecast Model TN-S2-P1':

- Changes to the model from previous submission;
- Modelling results;
- Outstanding comments from previous review; and
- Analysis and interpretation of modelling results.

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

- **MINOR** – The issues found are likely to produce minimal 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.

Table 0-1 summarises the status of the issues identified during the previous audits:

**Table 0-1. Summary of outstanding issues with Base models from previous audits.**

Issue Identified in Previous Audit	Level of Issue	Resolved?	Comments
General Coding Errors (Overlapping vehicles)	Medium	No	Changes have been introduced to reduce this error, but it is not fully solved.
Incomplete definition of scenarios	Minor	No	The new report does not contain a description of the modelled scenarios
Analysis of latent demand	Medium	Yes	Latent demand analysis has been carried out in the updated report
Incorrect lane allocation on the A5 southbound	Medium	Yes	The updated model correctly reflects the lane allocation for the committed scheme at Kelly's Kitchen roundabout.
Lane changes on the approaches to the junction	Medium	Yes	Lane changes over hatched areas have correctly been banned.
Use of both priority rules and conflict areas	Minor	No	The model still contains priority rules and conflict areas controlling the same conflict points
Signal operation	Medium	No	The roundabout continues to operate with unrealistic levels of congestion
Inability of the model to replicate the reported results	Significant	Yes	The updated models successfully replicate the reported results
Analysis of network performance for all scenarios	Medium	Yes	The new report includes an analysis of network performance results for all scenarios.
Validation of journey times	Medium	Yes	The base models were considered appropriate in the previous audit review.

Two **SIGNIFICANT** issues in the forecast scenarios has been identified during the model review:

- Excessive queuing has been observed inside the roundabout, resulting in an unrealistic operation.
- The Do Something scenarios use signal controllers different to those of the Do Minimum scenarios, preventing a like for like comparison of the mitigation proposals.

This issue has been further investigated and the results are significantly affected by it.

Modelling results indicate that, while journey times on Brickhill Street northbound and the A5 southbound improve significantly with the proposed mitigations, the impact of the development on journey times along Watling St and the A5 northbound is not mitigated.

However, overall network performance results show that delays across the junction remain at similar levels in the AM, and are significantly reduced in the PM i.e. in terms of overall delay through the junction, the proposed mitigation offsets most of the impact in the AM and significantly reduces the impact in the PM.

A better signal optimisation could allow a more even distribution of the benefits observed on the A5 southbound among other arms of the junction.

It is recommended that the issues highlighted in this report are addressed so that a reliable assessment of the impact of the development and the suitability of the proposed mitigation can be made.

## 1 Introduction

This Technical Note (TN08) provides a summary of the audit work conducted on the revised Forecast Vissim model (dated 11<sup>th</sup> February 2020) developed for the A5 Kelly's Kitchen Roundabout by BWB. The Vissim model has been prepared to support the planning application of an employment development at South Caldecotte in Milton Keynes.

This Technical Note should be read alongside AECOM's Technical Note 03 ('South Caldecotte VISSIM Model Review\_v10'), Technical Note 04 ('Revised South Caldecotte VISSIM review\_v8'), Technical Note 05 ('Revised South Caldecotte VISSIM review\_v7'), and Technical Note 07 ('TN07 South Caldecotte Revised Forecast VISSIM review\_v13') which documents the review of the previous base and forecast models and AECOM's Technical Note 06 ('TN06\_Review of South Caldecotte TA\_v7'), which documents the review of the revised Transport Assessment (TA) associated with the proposed development.

The audit of the most recently submitted base model (Technical Note 07 – 24<sup>th</sup> January 2020) recommended that the modelling issues highlighted in the report were addressed, and the models and forecast report were resubmitted for review.

The models/information received by AECOM for this audit include:

- The VISSIM model; and
- Updated Forecast Model Report (*SCD-BWB-GEN-XX-RP-TR-005\_Forecast Model TN-S2-P1*).

## 2 Forecast model review

### 2.1 Changes from previous model submission

#### 2.1.1 Modelling approach

The composition of the modelled scenarios is detailed in Table 2-1. It should be noted that the Do Something Scenarios now include mitigation at the southbound approach on the A5.

The mitigations being modelled in the Do Something scenarios consists of:

- An additional merging lane northbound leaving Tilbrook Roundabout; and
- A change in lane allocation on the A5 southbound approach to allow the straight-ahead movement from the nearside lane (it is currently left turn only in the committed scheme drawings associate with development at Eaton Leys).

It should be noted that the scenario labelled 'Do Minimum' does not represent 'Do Minimum' in traditional modelling sense as this scenario includes the proposed development. To evaluate the impact of the proposed development on the network, comparison should be made against the 'Reference Case – without proposed development but with committed Kelly's Kitchen Hamburger Scheme (by others)' and 'Do Minimum - with development' and the 'Do Something – with development, plus lane designation alterations to A5 SB approach'.

A drawing illustrating the proposed mitigation at the A5/A4146 junction has not been provided by BWB. It is recommended that once the mitigation scheme has been agreed in principle, that a drawing illustrating the proposed mitigation measures is provided such that the proposed modifications can be subjected to Highways England's Road Safety Audit procedures and to allow the drawing to be referenced in planning conditions, as appropriate, such that may it be attached to the potential planning permission in the event planning permission is granted.

Table 2-1. Composition of modelled scenarios.

	Flows	Schemes
Reference Case 2023	Base + Committed Developments	Kelly's Kitchen Roundabout Scheme
Do Min 2023	Base + Committed developments + Proposed development	Kelly's Kitchen Roundabout Scheme
Do Something 2023	Base + Committed developments + Proposed development	Kelly's Kitchen Roundabout Scheme + Tilbrook Roundabout Scheme + change in lane allocation on A5 SB
Reference Case 2031	Base + Committed Developments	Kelly's Kitchen Roundabout Scheme
Do Min 2031	Base + Committed developments + Proposed development	Kelly's Kitchen Roundabout Scheme
Do Something 2031	Base + Committed developments + Proposed development	Kelly's Kitchen Roundabout Scheme + Tilbrook Roundabout Scheme + change in lane allocation on A5 SB

### 2.1.2 Network Changes

The updated model has been checked for consistency with the previously audited forecast model. The changes in the models described in BWB's updated Forecast Model Technical Note (*SCD-BWB-GEN-XX-RP-TR-005\_Forecast Model TN-S2-P1*), consist of:

- Changes in signal controllers to modify minimum and maximum green times;
- Changes in links, connectors and routing decisions to correctly model lane utilisation; and
- Changes to priority rules and reduced speed areas to prevent overlapping vehicles.
- Changes in connector from the A5 southbound approach to the junction to allow the two-lane straight-ahead movement in the Do Something scenarios.

The above changes from the previously submitted model are considered appropriate and resolve the following concerns raised in the previous model audit (TN07):

- Issues regarding lane allocation have been resolved; and
- Issues regarding lane changes on the approaches to the junction have been resolved;

Whilst additional priority rules have been coded in the model to prevent overlapping vehicles on the southern stream of the roundabout, these have not been coded in all the necessary connectors, and overlapping vehicles still occur (shown in Figure 1). The frequency with which these occur is significantly lower compared to the previous model and will have a lower impact on modelling results. This issue is considered **MINOR**, however, it is recommended that appropriate priority rules are coded in all required connectors to avoid overlapping vehicles.

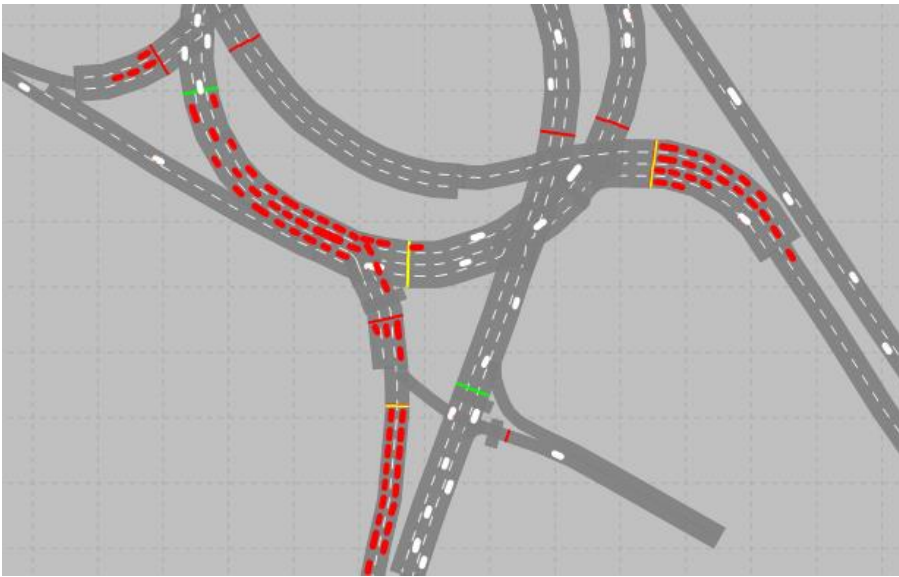


Figure 1. Vehicles overlap unrealistically at the southern stream of the roundabout.

The changes made to signal controllers in this submission did not solve the issue regarding excessive queuing inside the roundabout. Figure 2 shows two snapshots of the model where excessively long queues form at the northern and southern circulatory links (refer to §2.1.3). This issue is considered **SIGNIFICANT** as this is not how the signal timings realistically would operate for safety reasons, with the additional risk the junction could lock up, hence the model does not reflect the likely operation and underestimates the queue lengths on arms approaching the roundabout.

It is recommended that this issue is addressed before a conclusive assessment of modelling results is made and conclusions about the suitability of the proposed mitigations are drawn. It is recommended that the average queues inside the roundabout should remain under approximately two thirds of the link lengths, to avoid safety issues.

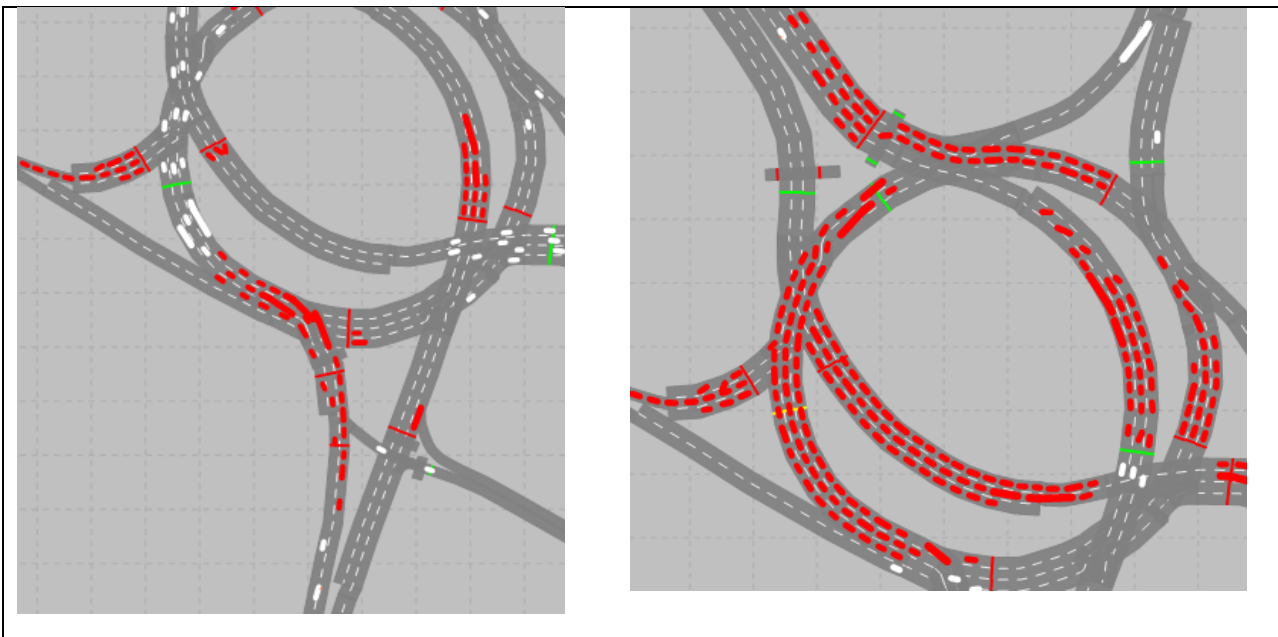


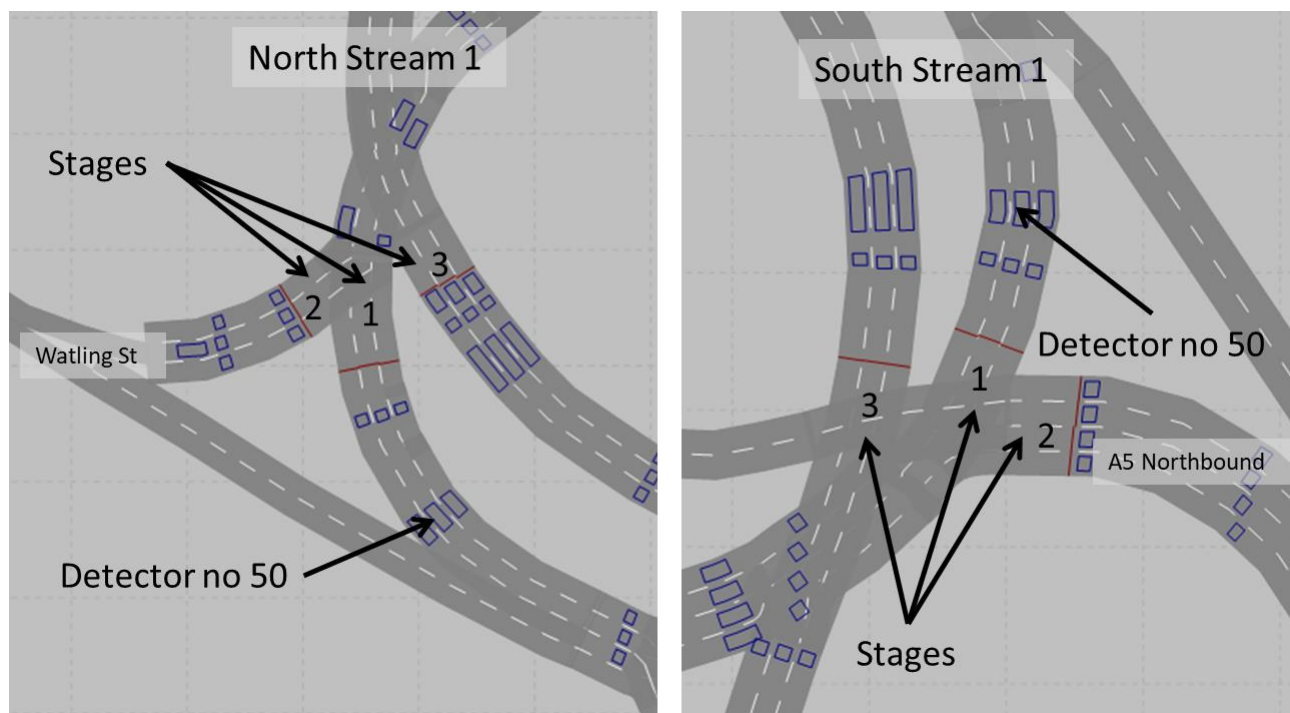
Figure 2. Excessive queuing inside the junction (Left – Do Something 2031, PM Right - Do Something 2031 AM)

### 2.1.3 Changes to signal controllers

A change in the operation of signal controllers 'North Stream 1' and South Stream 1' (Watling St and A5 northbound approaches to the junction respectively) has been introduced in the Do Something Scenarios.

With the new signal controller configuration, the Do Something scenarios allow for an increased level of congestion inside the roundabout before the access on Watling St and the A5 northbound is stopped to allow vehicles inside the roundabout to leave through the conflicting arms.

In more detail (refer to Figure 3), when Stage 2 is running, queues will build up inside the roundabout: once vehicles are at a standstill over detector 50 for a set period of time, the controller triggers a change from Stage 2 to Stage 1 or 3. The set time period over detector 50 has been increased from 3 seconds (in Reference Case and Do Minimum) to 6 seconds in the Do Something scenarios, increasing the length of the queue allowed within the roundabout. A 6 seconds gap between the queue reaching the limit of available queuing capacity and the beginning of the stage change is excessive and this contributes to the issue of excessive queuing inside the roundabout described in §2.1.2.



**Figure 3. Stages and detectors on north and south stream 1 controllers.**

Changes in signal controllers are expected between scenarios to allow a better optimisation when the scenarios contain different flows. However, the changes relate to the amount of queuing allowed within the roundabout and there is no logical reason for this to increase in the Do Something scenario.

To understand the impact that these changes in signal controllers have in modelling results, the Do Something scenarios have been run by AECOM with the same congestion triggers as the Do Minimum scenarios (refer to §2.2.2) below.

This issue is considered **SIGNIFICANT**. It is recommended that a consistent signal operation is used across all scenarios. Although signal timings can be optimised to different flow patterns, the model should reflect the same level of realistic queuing inside the roundabout in all scenarios.

## 2.2 Modelling results

### 2.2.1 Replication of modelling results

The model has been rerun by AECOM to check that it replicates the results contained in the forecast report for all scenarios. The following issues highlighted in the previous model review are resolved:

- The model replicates the results contained in the Forecast Report;
- The results include latent demand figures for all scenarios; and
- The analysis of network performance results includes all scenarios.

### 2.2.2 Analysis of modelling results

As the changes adopted in signal controllers for the Do Something scenarios (detailed in §2.1.3), prevent a like for like comparison with the Do Minimum scenarios, the Do Something Scenarios have been run with the same signal controllers as the Do Minimum, and the results compared to the results reported by BWB in 'SCD-BWB-GEN-XX-RP-TR-005\_Forecast Model TN-S2-P1'.

A comparison between the reported Journey Times results and those modelled with consistent signal controllers in the Do Something Scenario has been carried out and the approaches on Watling St and on the A5 northbound showed to have significantly longer journey times. This issue is considered **SIGNIFICANT**.

It should be noted that, whilst the results of the Do Something scenarios are different for Watling St and the A5 northbound, the overall conclusions shown below are unlikely to change and particularly the network performance results showed to not be impacted by this issue.

Figure 4 shows the location of the journey time sections across the model.

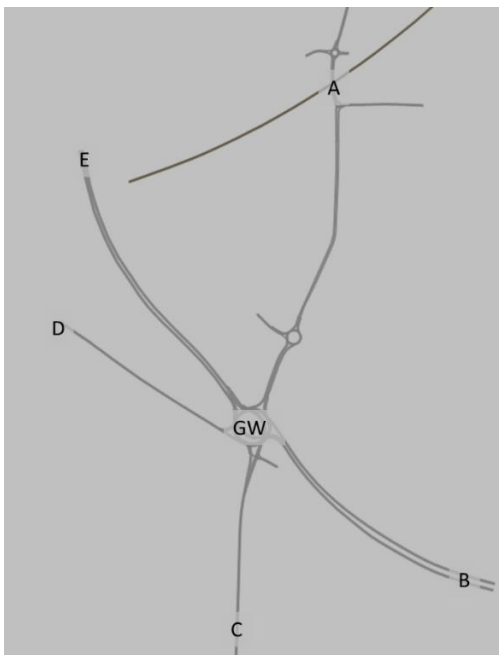
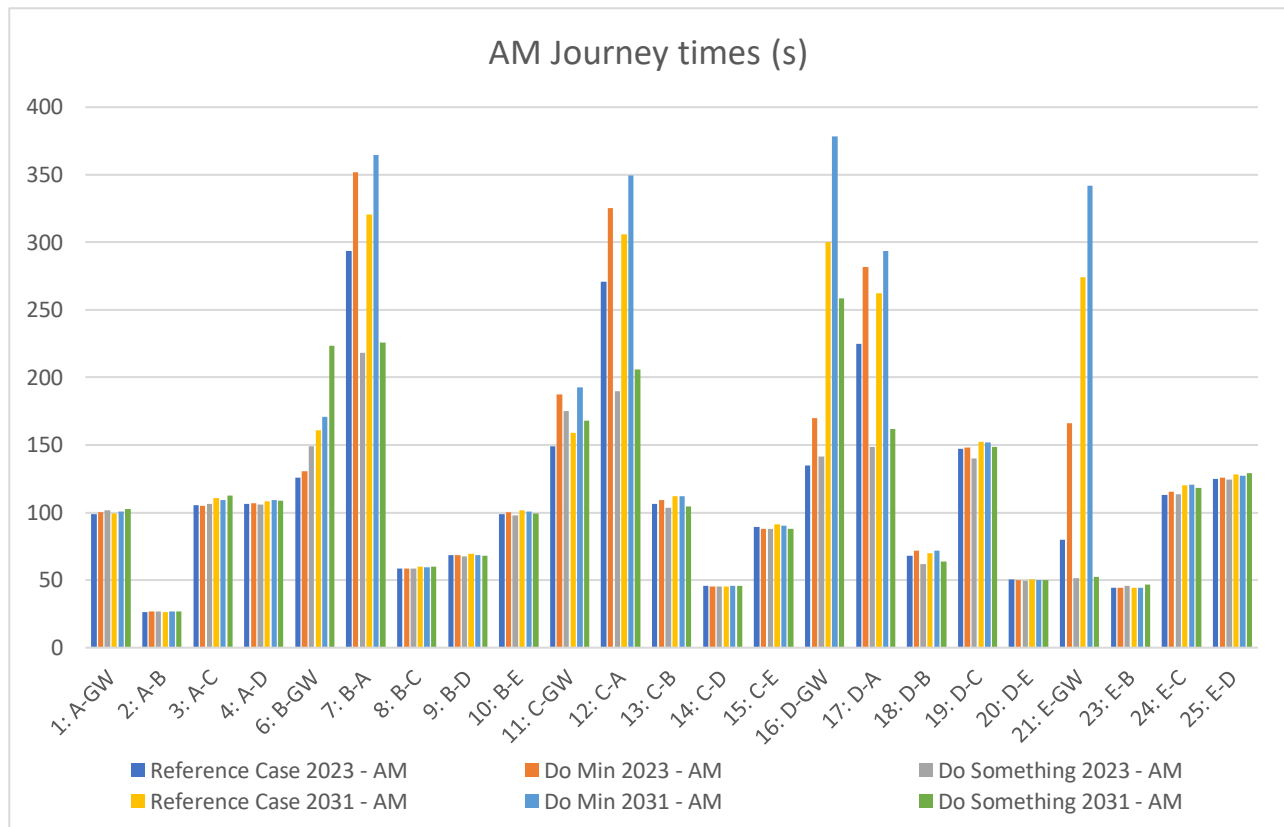


Figure 4. Journey time sections through the model.



Figure 5 and Figure 66 show the journey time results for AM and PM produced by the model submitted by BWB.



**Figure 5. Modelled AM journey times.**

Notwithstanding the remaining issues from the previous review, and the new concerns raised in this review, The AM journey time results show that:

- The mitigations in the Do Something effectively offset the increase in journey times seen from the Reference Case to Do Minimum on all approaches to the junction except the A5 northbound (B-GW) and the A4146 (C-GW);
- The approach on the A5 northbound (B-GW) suffers a sharp increase in journey time in the Do Something scenarios;
- The mitigation at Tilbrook Roundabout results in a significant reduction in northbound journey times along Brickhill St (B-A, C-A and D-A); and
- The change in lane allocation at the southbound approach on the A5 (E-GW) in the Do Something scenarios result in a significant reduction of journey times, such that it is an improvement to those in the Reference Case.



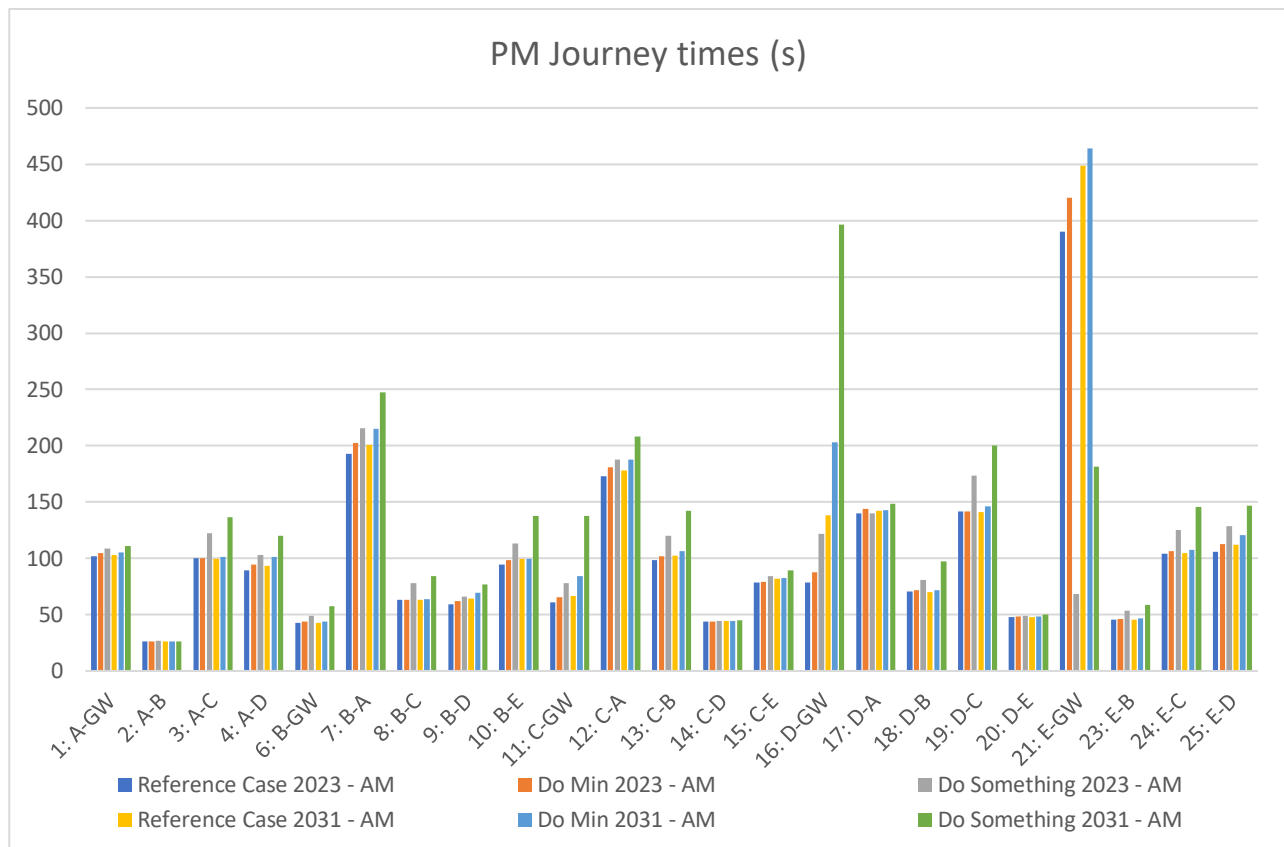


Figure 6. Modelled PM journey times.

Again, setting aside the issues highlighted in the model review, the PM journey time results shows that:

- The Do Something scenario journey times are slower than the Reference Case for all approaches and movements across the model except for the southbound approach on the A5 (E-GW);
- The approach on Watling St (D-GW) suffers an increase of over 250s in journey time from the Reference Case to the Do Something 2031 scenarios; and
- The southbound approach on the A5 (E-GW) in the Do Something scenarios is significantly faster than the Reference Case.

Table 2.2 and Figure 7 show the network performance results, as produced by the models submitted by BWB.

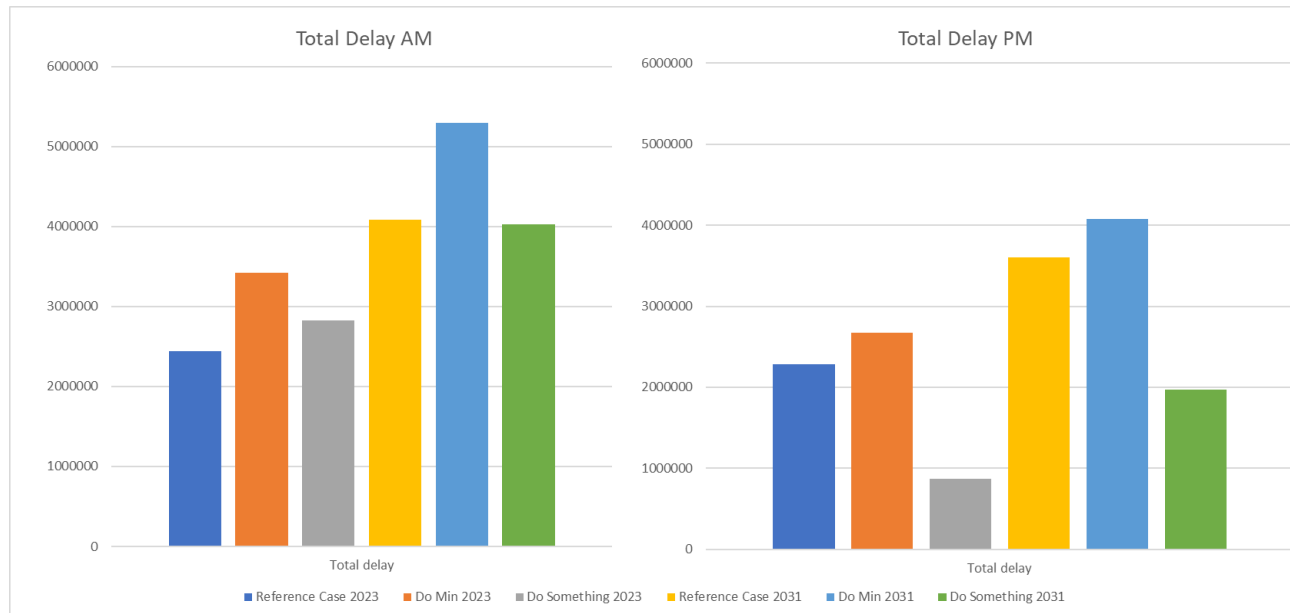
There is predicted to be a significant reduction in average delay and latent demand with the implementation of the proposed mitigations (Comparison between Reference Do Minimum and Do Something).

The total delay figures (calculated as the delay experienced by all vehicles loaded in the network, plus the delay experienced by vehicles that could not be loaded on to the network on time) indicates much of the delay caused by the development in AM is mitigated for, and there is less delay in the Do Something scenarios compared to the Reference Case scenarios in PM. It should be noted however that this assessment includes the mitigation at the Tilbrook Roundabout. Taken in isolation based upon the Journey Time results the A5 Northbound approach is worse off with the proposed development. In addition it is unclear how representative this is of a true comparison, results could vary significantly if the internal queue detectors/signal operation were consistent across all scenarios. It should also be noted that there is considerable variation in journey

times suggesting the A5/A4146 will be overloaded with significant delays on some approaches. The latent demand indicates, that due to congestion, not all vehicles are able to enter the model network.

**Table 2-2. Modelled network performance results.**

		Delay Avg	Speed Avg	Veh arrived	Latent demand	Total delay <sup>1</sup>
AM	Reference Case 2023	131	19	6346	699	2436151
	Do Min 2023	169	16	6369	1046	3423833
	Do Something 2023	128	19	6651	806	2821219
	Reference Case 2031	221	13	6451	1119	4088003
	Do Min 2031	255	12	6471	1562	5289665
	Do Something 2031	168	16	6893	1194	4028797
PM	Reference Case 2023	160	17	6070	581	2284033
	Do Min 2023	166	17	6216	765	2675364
	Do Something 2023	90	25	6839	67	873775
	Reference Case 2031	175	16	6263	1141	3603918
	Do Min 2031	185	15	6391	1303	4073888
	Do Something 2031	171	17	6932	337	1974672



**Figure 7. Network Performance results for total delay<sup>1</sup> including latent delay.**

<sup>1</sup> Total delay calculated as the sum of the total delay experienced by all vehicles that have been loaded onto the model at the end of the simulation plus the latent delay experienced by all vehicles that could not be loaded onto the network on time.

### 3 Conclusions

AECOM has undertaken an audit of the South Caldecotte Vissim Base and Forecast models, as part of a wider review of the potential impact of the proposed South Caldecotte development on the strategic and local road network.

Whilst some of the coding concerns raised during the previous audits of the base models have been addressed, other significant issues remain outstanding which should be addressed before the models are considered an accurate reflection of likely operation of the future network.

An additional coding issue has been found in this review – there is an inconsistency between signal controllers in the Do Something and Do Minimum scenarios. This issue significantly affects modelling results, it is unknown how this would affect the overall conclusions if revised. The comparison is not considered reliable and the inconsistencies should be addressed.

The modelling results as presented indicate that, while the journey times on Brickhill Street northbound and the A5 southbound improve significantly with the proposed mitigations, the development increases the journey times along the A4146 and the A5 northbound, despite the mitigations.

However, as presented, the network performance results show that due to the mitigations, delays across the network remain similar in the AM Do Something compared to the AM Reference Case, and there is a significant reduction in delays in the PM peak. It is observed that further signal optimisation may provide reduce delay more evenly for all arms of the junction, whereas the A5 southbound approach currently benefits most from the mitigation.

It is recommended that the issues of excessive queuing inside the roundabout and inconsistent signal operation between scenarios are addressed. A reliable assessment can then be made regarding the impact of the development and the suitability of the proposed mitigation.