
Update to the M1J22 modelling in response to observations from National Highways

1.1 Background

- 1.1.1 A Transport Assessment (TA) and Framework Travel Plan (FTP) were submitted in support of Planning Application 23/01090/OUT on 31/05/2024. The Local Highway Authority (LHA) and National Highways (NH) provided their consultation responses dated 18/07/2024 and 17/07/2024 respectively to the Local Planning Authority (LPA), Hinckley & Bosworth Borough Council.
- 1.1.2 In their consultation responses, NH and the LHA detailed further information, and the revisions required regarding certain aspects of the proposal.
- 1.1.3 A TA addendum was produced to address all the outstanding issues raised and to provide additional information requested by the LHA and NH in their consultation responses. This addendum needs to be read in conjunction with the TA that was submitted on 31/05/2024.
- 1.1.4 On the 4/10/24, in response to this addendum, NH confirmed that they were satisfied with the updated assumptions related to the trip generation and trip distribution. However, they noted a few concerns related to parameters within the model and requested information on the model validation.
- 1.1.5 We note that both highway authorities have agreed on the assumptions to be used when assessing the development and this note addresses the outstanding NH concerns related to the model structure, details of the model validation and the updated results using a revised model.

1.2 Revision to the model

- 1.2.1 The M1J22 model was purchased from the LHA and in response to NH observations the LHA have provided an updated model that addresses the concerns related to Lane set-up, Saturation flow and the Give Way on Cliffe Lane. These changes are described below.
 - **Lane Setup.** The lane lengths on the circulating roundabout were measured between the stop lines where in some instance they should have been measured back to where queueing traffic would then impede another movement. Arm 7 (Lane 1) could be 46m, however Lane 2 can queue back to 75m without blocking another movement. Arm 2 (Lane 1) has been changed to 97m.
 - **Saturation Flow:** Saturation flows of 1900 were used for all arms as a lower end realistic SAT flow. When designing improvement schemes, it can be beneficial to slightly underestimate future capacity than overestimate. RR67 SAT flows can be a little high in cases where there are wide lanes. It is understood that using RR67 sat flows makes it more impartial and factual. Accordingly, all SAT flows have been adjusted based on measurements taken from the topographical drawing. This has increased all SAT flows and thus improved the capacity of the roundabout.
 - **Give Way:** The give-way coefficient was wrong, and the values have been changed to what NH have stated. The max flow of 1000 could be higher on the basis that traffic could queue next to each other as it's a very wide single lane. This would again slightly improve the results
 - 1.2.2 The LHA also advised that the controller was built to their specification and that they should be contacted directly by NH if they require further information.
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1.3 Results from re-running the model

- 1.3.1 The model was checked and updated in the following 3 stages (Note: the details are reported in Appendix A using the observed 2023 volumes and queue data included as Appendix J of the original Transport Assessment):
1. Check the validation of original model using 2023 observed queue data
 2. Check the validation of updated model using 2023 observed queue data
 3. Calibrate the updated model to improve the validation of queue lengths
- 1.3.2 This resulted in an updated model that has addressed the issues identified by NH and is validated such that it is fit-for-purpose for undertaking an assessment of the potential highways impact from the development on Cliffe Lane
- 1.3.3 The updated model was then rerun using the assumptions agreed with the LHA and NH and which are set out in section 1.4 of the Transport Assessment Addendum.
- 1.3.4 In summary, the junction was assessed in 2024 and 2029 with background traffic flows and the two scenarios of trip volumes from the proposed site:
- Baseline – no development traffic
 - Scenario 1 – preferred development trip volumes as set out in the original TA
 - Scenario 2 – sensitivity test with revised development trip generation assumptions as set out in the Addendum TA
- 1.3.5 Details of the model runs are included in the model report in Appendix A
- 1.3.6 Practical Reserve Capacity and Traffic Delay were used to determine the performance and operation of the junction and a summary of the results are shown in Table 1 below.

Table 1: Junction Summary Modelling Results

M1 J22		AM Peak		PM Peak	
		PRC %	Delay (PCUhr)	PRC %	Delay (PCUhr)
2024	Baseline	11.2%	44.39	18.8%	38.89
	Scenario 1	11.1%	41.75	18.6%	39.56
	Scenario 2	9.9%	42.71	18.4%	40.40
2029	Baseline	9.9%	48.60	13.3%	43.63
	Scenario 1	9.5%	46.63	13.1%	44.56
	Scenario 2	9.1%	47.80	13.1%	45.17

- 1.3.7 The results show that whilst traffic from the development will result in a small reduction in Practical Reserve Capacity and a small increase in delay the junction will continue to operate well within reserve capacity in 2024 and 2029 in all scenarios tested
- 1.3.8 The Degree of Saturation on the Cliffe Lane entry to the motorway junction increased from 36.6% in the 2024 'No development' baseline to 65.2% in the 2029 scenario 2 sensitivity test showing that the Cliffe Lane approach to the junction has a significant amount of spare capacity.
- 1.3.9 In conclusion, the modelling shows that the junction will continue to operate with spare capacity. On this basis, it is respectfully suggested that the junction does not require any mitigation and that there should be no objections, in principle, to the proposed development.

Appendix A. Modelling Report



INTRODUCTION

Tetra Tech has been commissioned by Edwards & Edwards Ltd. to undertake local junction modelling for M1 Junction 22 in support of a Transport Assessment. This note summarises the agreed scope of work including:

- Task 1 – Compare the outputs of the 2024 Base Year LinSig model that was submitted to National Highways against the 2023 queue lengths for both the AM & PM Peaks.
- Task 2 – Re-run the 2023 base year model for both the AM & PM Peaks using an updated model (provided by Leicestershire County Council [LCC]), addressing several errors identified in the previous model. The outputs of this model are to be compared against the 2023 queue lengths for both the AM & PM Peaks.
- Task 3 – Undertake Model Queue Length Validation of the 2023 base year model in both the AM & PM Peaks.
- Task 4 – Produce new forecast year models to assess the impact of the proposed development.

The above tasks are required following comments raised by National Highways regarding the original LinSig V3 model supplied by Leicestershire County Council. The main area of concern was the lack of any information relating to base year junction validation. It is considered that the tasks listed above in relation to the supplied model and the additional validation tasks will be sufficient to demonstrate to National Highways that a proportionate assessment of the impacts of the proposed development has been undertaken.

1.0 – TASK 1: 2024 MODEL VALIDATION SUMMARY

Traffic Surveys were undertaken on Tuesday 31st January 2023, these comprised Manually Classified Counts (MCCs) and Queue Length data. The survey data was provided to Tetra Tech in the form of Passenger Car Unit (PCU) matrices and queue length tables.

The queue survey data was tabulated by Peak Hour and Arm / Lane, to enable a comparison against the queue lengths forecast by the LinSig model previously submitted to National Highways. A summary of the comparison is shown in **Table 1-1** & **Table 1-2** for the AM & PM Peaks respectively.

Table 1-1 - 2024 Model Validation (AM Peak)

Arm	Lane	AM Peak (08:00 - 09:00)		
		Modelled Queue Length (PCU)	Surveyed Queue Length (PCU)	Diff (PCU)
M1 Southbound Off-Slip	1	7	11	4
	2	8	11	3
	3	8	12	5
A50 Westbound	1	8	10	2
	2	7	12	5
	3	9	15	6
M1 Northbound Off-Slip	1	5	9	4
	2	7	11	4
	3	1	2	1
Cliffe Lane	1	1	2	1
A511 Eastbound	1	4	5	1
	2	10	8	-2
	3	8	9	0
Northern Circulatory	1	9	5	-4
	2	8	4	-4
Eastern Circulatory	1	6	8	2
	2	4	3	-1
	3	4	0	-3
Southern Circulatory	1	4	4	0
	2	4	3	-1
	3	0	1	1
Western Circulatory	1	0	4	4
	2	1	4	3
	3	0	1	1
Totals		121	154	32

Table 1-2 - 2024 Model Validation (PM Peak)

Arm	Lane	PM Peak (17:00 - 18:00)		
		Modelled Queue Length (PCU)	Surveyed Queue Length (PCU)	Diff (PCU)
M1 Southbound Off-Slip	1	6	9	3
	2	6	9	3
	3	6	11	5
A50 Westbound	1	10	7	-2
	2	7	9	2
	3	8	7	0
M1 Northbound Off-Slip	1	5	8	3
	2	7	7	1
	3	1	1	1
Cliffe Lane	1	1	2	1
A511 Eastbound	1	4	5	1
	2	11	8	-3
	3	9	10	0
Northern Circulatory	1	10	2	-8
	2	9	2	-7
Eastern Circulatory	1	7	6	-1
	2	3	4	0
	3	3	0	-3
Southern Circulatory	1	4	4	1
	2	3	3	0
	3	0	1	1
Western Circulatory	1	0	3	2
	2	1	4	2
	3	0	1	1
Totals		121	123	3

Overall, across the whole junction there is a difference of 32 PCU in the AM peak and 3 PCU in the PM peak, with the surveyed queues being greater than the modelled queues in both peaks. On key junction approaches such as the A50 and the M1 Southbound / Northbound Off-Slip(s) the maximum difference on any arm is 13 PCU across all lanes, which is observed in the AM peak on the A50 Westbound arm.

2.0 – TASK 2: 2023 BASE MODEL & VALIDATION SUMMARY

LCC provided Edwards & Edwards with a corrected 2023 Base Model for M1 Junction 22. This model included the following changes:

- Updates to lane types and flare lengths.
- Updates to Saturation Flows.
- Updates to Custom Cruise Lengths Times / Speeds.
- Updates to Platoon Dispersion and Random Delay Settings.

As per the exercise undertaken in Task 1, a comparison of the modelled results has been undertaken and is shown in **Table 2-1** & **Table 2-2** for the AM & PM Peaks respectively.

Table 2-1 - 2023 Model Unvalidated (AM Peak)

Arm	Lane	AM Peak (08:00 - 09:00)		
		Modelled Queue Length (PCU)	Survey Queue Length (PCU)	Diff (PCU)
M1 Southbound Off-Slip	1	7	11	4
	2	8	11	4
	3	7	12	5
A50 Westbound	1	9	10	1
	2	6	12	6
	3	7	15	8
M1 Northbound Off-Slip	1	6	9	3
	2	7	11	4
	3	1	2	1
Cliffe Lane	1	1	2	1
A511 Eastbound	1	4	5	1
	2	10	8	-2
	3	7	9	2
Northern Circulatory	1	9	5	-4
	2	7	4	-3
Eastern Circulatory	1	6	8	2
	2	4	3	-1
	3	4	0	-4
Southern Circulatory	1	4	4	0
	2	4	3	-1
	3	0	1	1
Western Circulatory	1	1	4	3
	2	1	4	4
	3	0	1	1
Totals		120	154	36

Table 2-2 - 2023 Model Unvalidated (PM Peak)

Arm	Lane	PM Peak (17:00 - 18:00)		
		Modelled Queue Length (PCU)	Survey Queue Length (PCU)	Diff (PCU)
M1 Southbound Off-Slip	1	6	9	3
	2	6	9	3
	3	6	11	5
A50 Westbound	1	9	7	-2
	2	6	9	3
	3	8	7	-1
M1 Northbound Off-Slip	1	6	8	2
	2	6	7	1
	3	1	1	0
Cliffe Lane	1	1	2	1
A511 Eastbound	1	4	5	1
	2	11	8	-3
	3	9	10	1
Northern Circulatory	1	10	2	-8
	2	9	2	-7
Eastern Circulatory	1	7	6	-1
	2	4	4	0
	3	3	0	-3
Southern Circulatory	1	3	4	1
	2	3	3	0
	3	0	1	1
Western Circulatory	1	0	3	3
	2	1	4	3
	3	0	1	1
Totals		119	123	4

Overall the comparison is similar to the previous summary with the overall differences being 36 PCU in the AM peak and 4 PCU in the PM peak across the whole junction, with the surveyed queues being greater than the modelled queues in both peaks. Looking at individual arms some big differences in the AM & PM Peak(s) highlight that the signal timings and strategy adopted in the model differs to the one operating on the ground.

A summary of the key differences include:

- In the AM Peak, the queue survey records the M1 Southbound off-slip to have queue lengths across all lanes at 11-12 PCUs, where the model records queue lengths of 7-8 PCUs.
- Additionally in the AM Peak, the queue survey records the A50 Westbound to have a queue of 12 PCUs in Lane 2 and 15 PCUs in Lane 3, where the model records 6 & 7 PCUs respectively.
- In the PM Peak, the queue survey records the northern circulatory to have a queue length of 10 PCUs in lane 1 and 9 PCUs in lane 2. The model records queue lengths of 2 PCUs across both lanes of the northern circulatory

Further modelling is required to achieve better levels of validation in the 2023 scenarios across the AM & PM Peaks.

3.0 – TASK 3: TETRA TECH MODEL VALIDATION

We have undertaken Queue Length Validation of the latest models provided by LCC, to improve the queue length validation to the traffic surveys collected by LCC and provided to Edwards & Edwards.

From a review of the queue data provided, it was highlighted that, particularly in the AM Peak, queue lengths for some approaches were longer at the end of the peak hour than they were at the start. As such the difference in queue length was added to the Actual Traffic Survey flows to create a demand matrix.

This resulted in the following increases in demand:

- AM Peak (increase of 27 PCUs) –
 - 3 PCU increase from M1 North to the A50 East.
 - 1 PCU increase from M1 South to the A50 East.
 - 23 PCU increase from the M1 South to the A50 East.
- PM Peak – No increase in traffic demand.

In addition to the increases in demand for some approaches the traffic signal timings were assessed to see if they could be updated to operate in the form of a roundabout but help to better reflect the queueing that occurs at the junction.

Once the signal timings were representative of queues on each approach it was identified from the queue survey that vehicles did not use the lanes equally and that some routes required manual adjustment. A summary of the amendments made to the base model is below.

- AM Peak Routing adjustments:
 - M1 North to the A50 East showed a slight favouring to the use of Lane 1 over Lane 2 to make the left turn. As such 52% of this traffic flow was allocated to use Lane 1.
 - The A50 Westbound recorded larger queue lengths in Lane 3 for this approach. As Lane 3 only accommodates one movement, approximately 70% of the A50 to M1 North Traffic was manually routed through Lane 3 on the A50 approach.
 - The M1 Northbound off-slip received a manual adjustment in traffic flows to ensure a 50/50 split of vehicles travelling to the A511 used both Lanes 1 & 2.
 - The A511 approach demonstrated a slight imbalance in traffic flow despite the queue survey showing approximately equal queueing. Due to Lane 3 being dominated by traffic flow travelling to the M1 South. The A511 to A50 traffic was adjusted so that approximately 80% use Lane 2.
- PM Peak Routing adjustments:
 - Differing to the AM Peak, the M1 North to A50 East showed a favouring to Lane 2 over Lane 1 demonstrated through longer queues in Lane 2. To replicate in the model, a manual adjustment was made to make 49% of left turning traffic use Lane 1.
 - The A511 approach continues to show an imbalance in queueing in the PM Peak like the AM Peak. However, recorded survey queue lengths highlight that larger queues should exist in Lane 3. As such 66% of traffic travelling to the A50 was manually adjusted to use Lane 2.

The outcomes of the validation exercise and comparison to the survey results can be found below in **Table 3-1** & **Table 3-2**.

Table 3-1 - 2023 Model Validation (AM Peak)

Arm	Lane	2023 AM Peak (08:00 - 09:00)		
		Modelled Queue Length (PCU)	Surveyed Queue Length (PCU)	Diff (PCU)
M1 Southbound Off Slip	1	<u>7.6</u>	<u>11.0</u>	<u>3.4</u>
	2	12.1	11.2	-0.9
	3	12.6	12.3	-0.3
A50 Westbound	1	<u>6.6</u>	<u>9.6</u>	<u>3.0</u>
	2	11.5	11.9	0.4
	3	14.4	15.1	0.7
M1 Northbound Off Slip	1	<u>6.2</u>	<u>9.1</u>	<u>2.9</u>
	2	10.8	11.0	0.2
	3	<u>0.6</u>	<u>1.7</u>	<u>1.1</u>
Cliffe Lane	1	0.8	2.2	1.4
A511 Eastbound	1	<u>3.9</u>	<u>5.3</u>	<u>1.4</u>
	2	8.0	8.0	0.0
	3	8.5	8.6	0.1
Northern Circulatory	1	4.6	5.2	0.6
	2	4.8	3.7	-1.1
Eastern Circulatory	1	5.4	8.5	3.1
	2	0.4	2.5	2.1
	3	1.3	0.4	-0.9
Southern Circulatory	1	3.6	4.0	0.4
	2	4.0	2.9	-1.1
	3	0.3	1.1	0.8
Western Circulatory	1	<u>0.6</u>	<u>4.0</u>	<u>3.4</u>
	2	<u>8.0</u>	<u>4.5</u>	<u>-3.5</u>
	3	0.5	1.1	0.6
Totals		137	155	18

In the AM Peak all external & internal approaches validate well to within 1 PCU of the observed queue length except for the following situations:

- Where flared links are used, the profiling of traffic in local junction modelling software means that they are often “under utilised” within the red period of the cycle. Manually increasing the number of trips through the flared section would reduce the throughput (saturation flow) through the green elements of the cycle. It is therefore considered that providing the queue in its associated long lane is accurate then the model is representative. Where differences in queue length exceed 1 PCU and this link is a flare the difference is denoted in a **red** font.
- M1 Northbound Off-slip presents a queue length average of 1.7 PCUs. With only 40 PCUs passing through the lane in the modelled peak hour this is not able to be replicated. This difference is denoted in **blue** font.
- The circulatory carriageway shows variation in queue lengths, particularly on the shorter Western and Eastern circulatory. The differences relate to weaving traffic. This can be observed on the western circulatory carriageway where the model shows an 8 PCU queue in a single lane, whereas the data shows this equally shared as 4 PCUs across both Lanes 1 & 2. This difference is denoted in **green** font.

It is considered that as the external approaches validate well and that the queuing would be difficult to replicate on circulatory links without a significant number of manual routing adjustments therefore the margin for which circulatory validation varies is acceptable.

Table 3-2 - 2023 Model Validation (PM Peak)

Arm	Lane	PM Peak (17:00 - 18:00)		
		Modelled Queue Length (PCU)	Surveyed Queue Length (PCU)	Diff (PCU)
M1 Southbound Off-Slip	1	<u>6.7</u>	<u>8.9</u>	<u>2.2</u>
	2	9.7	8.8	-0.9
	3	10.3	11.1	0.8
A50 Westbound	1	6.6	7.2	0.6
	2	9.2	9.0	-0.2
	3	7.6	7.3	-0.3
M1 Northbound Off-Slip	1	<u>6.3</u>	<u>7.6</u>	<u>1.4</u>
	2	7.3	7.3	0.0
	3	0.5	1.0	0.5
Cliffe Lane	1	0.9	2.2	1.3
A511 Eastbound	1	<u>3.3</u>	<u>4.9</u>	<u>1.6</u>
	2	7.8	8.5	0.7
	3	9.9	9.9	0.0
Northern Circulatory	1	2.4	2.2	-0.2
	2	1.9	1.7	-0.2
Eastern Circulatory	1	5.0	6.3	1.3
	2	2.7	3.7	1.0
	3	1.1	0.1	-1.0
Southern Circulatory	1	3.5	4.5	1.0
	2	3.7	3.3	-0.4
	3	0.4	1.2	0.8
Western Circulatory	1	1.0	2.8	1.8
	2	3.0	3.6	0.6
	3	0.5	1.3	0.8
Totals		111	124	13

In the PM Peak, like the AM Peak all external & Internal approach validate well to within 1 PCU except for the following situations:

- Flared links consistent with the AM Peak showed comparison discrepancies for the reasons set out above. These differences are denoted in a red font.
- Circulatory carriageway links record differences greater than 1 PCU, particularly on the western and eastern links. These are considered to be similar constraints to the AM Peak but are within 2 PCUs.

On this basis and looking at the overall model results it is considered that these validate to an acceptable standard and is representative of the junction performance on the ground.

4.0 – TASK 4: FORECAST MODEL OUTPUTS

Following on from Task 3 the revised and validated M1 Junction 22 LinSig V3 model has been used to undertake accurate forecasting and assessment of junction performance at future years with and without proposed development traffic.

All traffic volume information including that of the proposed development has been provided by Edwards & Edwards Consultancy. The new validated model received increased traffic volumes to create demand matrices from actual traffic flow surveys. These traffic flows revised demand flows have been processed back through the matrix development process with factors being applied to these matrices, rather than the previous actual traffic volume matrices. Proposed traffic development (which was previously identified and used), has then been added to the revised matrices.

The following scenarios have been tested within the forecast model:

- 2024 Do Minimum (background traffic levels including NTEM growth).
- 2024 Scenario 1 (plus scenario 1 development traffic).
- 2024 Scenario 2 (plus scenario 2 development traffic).
- 2029 Do Minimum (background traffic levels including NTEM growth).
- 2029 Scenario 1 (plus scenario 1 development traffic).
- 2029 Scenario 2 (plus scenario 2 development traffic).

Outputs from these model runs can be found below in **Table 4-1 & Table 4-2**.



Table 4-1 2024 Forecast Model Results

Approach	Lane	2024 - Do Minimum				2024 - Scenario 1				2024 - Scenario 2			
		AM Peak		PM Peak		AM Peak		PM Peak		AM Peak		PM Peak	
		DoS (%)	MMQ (PCU)	DoS (%)	MMQ (PCU)	DoS (%)	MMQ (PCU)	DoS (%)	MMQ (PCU)	DoS (%)	MMQ (PCU)	DoS (%)	MMQ (PCU)
M1 Southbound Off-Slip	Lane 1	68.3%	6.52	57.4%	5.48	68.3%	6.52	57.4%	5.48	68.3%	6.52	57.4%	5.48
	Lane 2	68.4%	7.8	57.3%	6.1	68.4%	7.8	57.3%	6.1	68.4%	7.8	57.3%	6.1
	Lane 3	70.8%	7.7	59.7%	5.9	72.0%	7.8	60.2%	6	72.8%	8	60.2%	6
A50 Westbound	Lane 1	78.1%	6.43	75.8%	6.28	76.6%	6.3	75.9%	6.26	76.6%	6.31	76.0%	6.28
	Lane 2	78.1%	9.5	75.8%	8.9	76.6%	9.2	75.9%	8.9	76.6%	9.2	76.0%	8.9
	Lane 3	63.3%	7.7	60.7%	7.3	61.1%	7.5	61.0%	7.4	61.3%	7.5	60.7%	7.3
M1 Northbound Off-Slip	Lane 1	79.5%	5.97	71.9%	5.95	80.9%	6.07	72.5%	5.99	81.8%	6.13	72.5%	5.99
	Lane 2	79.5%	7.5	72.0%	6.8	81.0%	7.8	72.4%	6.9	81.9%	7.9	72.5%	6.9
	Lane 3	9.1%	0.6	7.4%	0.5	9.1%	0.6	7.4%	0.5	9.1%	0.6	7.4%	0.5
Cliffe Lane	Lane 1	36.6%	1	32.5%	0.9	47.9%	1.7	45.0%	1.4	59.4%	2.3	51.8%	2
A511 Eastbound	Lane 1	80.9%	4.21	73.8%	3.82	75.4%	4.04	74.3%	3.82	75.8%	4.04	74.5%	3.82
	Lane 2	80.9%	10.7	73.8%	9.9	75.4%	10	74.3%	10	75.8%	10.1	74.5%	10.1
	Lane 3	72.8%	8.3	66.8%	8.4	66.6%	7.7	66.8%	8.4	66.6%	7.7	66.9%	8.4

Approach	Lane	2024 - Do Minimum				2024 - Scenario 1				2024 - Scenario 2			
		AM Peak		PM Peak		AM Peak		PM Peak		AM Peak		PM Peak	
		DoS (%)	MMQ (PCU)	DoS (%)	MMQ (PCU)	DoS (%)	MMQ (PCU)	DoS (%)	MMQ (PCU)	DoS (%)	MMQ (PCU)	DoS (%)	MMQ (PCU)
Northern Circulatory	Lane 1	57.5%	9.7	63.1%	10.7	62.0%	9.7	63.4%	10.7	62.6%	9.8	64.2%	10.8
	Lane 2	52.4%	8.8	59.2%	9.9	50.5%	7.6	61.0%	10.1	51.8%	7.8	62.0%	10.3
Eastern Circulatory	Lane 1	43.5%	0.1	46.4%	0.1	48.8%	6.3	47.7%	0.1	50.3%	6.4	48.9%	0.2
	Lane 2	43.6%	3.8	41.6%	3.2	45.3%	4.3	42.5%	3.3	46.1%	4.4	43.2%	3.3
	Lane 3	43.6%	3.82	41.6%	3.22	45.3%	3.89	42.5%	3.25	46.1%	3.94	43.2%	3.25
Southern Circulatory	Lane 1	63.6%	3.9	60.9%	3.2	65.6%	4.2	61.3%	3.3	66.1%	4.3	61.6%	3.4
	Lane 2	67.2%	3.8	66.5%	3.2	67.6%	3.9	66.8%	3.3	68.0%	4	66.9%	3.3
	Lane 3	47.0%	0	47.8%	0	47.1%	0	48.0%	0	47.2%	0	47.8%	0
Western Circulatory	Lane 1	49.9%	0.5	52.1%	2.4	56.2%	0.5	51.6%	2.4	56.5%	0.5	54.3%	2.5
	Lane 2	41.4%	0.7	38.0%	0.8	44.3%	0.6	39.8%	0.8	45.8%	0.7	39.5%	0.9
	Lane 3	41.4%	0.69	38.0%	0.65	44.3%	0.26	39.8%	0.82	45.8%	0.34	39.5%	0.87
Junction PRC (%)		11.2%		18.8%		11.1%		18.6%		9.9%		18.4%	
Total Delay (PCU-hr)		44.39		38.89		41.75		39.56		42.71		40.4	

Table 4-2 2029 Forecast Model Results

Approach	Lane	2029 - Do Minimum				2029 - Scenario 1				2029 - Scenario 2			
		AM Peak		PM Peak		AM Peak		PM Peak		AM Peak		PM Peak	
		DoS (%)	MMQ (PCU)	DoS (%)	MMQ (PCU)	DoS (%)	MMQ (PCU)	DoS (%)	MMQ (PCU)	DoS (%)	MMQ (PCU)	DoS (%)	MMQ (PCU)
M1 Southbound Off-Slip	Lane 1	73.7%	7.04	62.0%	5.92	73.7%	7.04	62.0%	5.92	73.7%	7.04	62.0%	5.92
	Lane 2	73.8%	8.9	62.0%	6.8	73.8%	8.9	62.0%	6.8	73.8%	8.9	62.0%	6.8
	Lane 3	78.5%	8.7	64.4%	6.6	77.7%	8.9	64.9%	6.7	78.5%	9.2	64.9%	6.7
A50 Westbound	Lane 1	81.9%	6.76	79.4%	6.56	82.2%	6.59	79.6%	6.57	82.5%	6.56	79.6%	6.57
	Lane 2	81.9%	10.5	79.4%	9.8	82.2%	10.6	79.6%	9.8	82.5%	10.7	79.6%	9.8
	Lane 3	68.7%	8.8	66.2%	8.3	70.4%	9.1	66.2%	8.3	70.8%	9.4	66.2%	8.3
M1 Northbound Off-Slip	Lane 1	80.0%	6.33	77.7%	6.43	76.4%	6.33	78.3%	6.48	77.3%	6.4	78.4%	6.48
	Lane 2	80.2%	8	77.9%	7.9	76.3%	7.6	78.3%	7.9	77.1%	7.7	78.5%	8.0
	Lane 3	9.1%	0.6	8.0%	0.5	8.5%	0.6	8.0%	0.5	8.5%	0.6	8.0%	0.5
Cliffe Lane	Lane 1	45.2%	1.5	39.1%	1.1	52.9%	1.9	53.6%	2.0	65.2%	2.6	61.4%	2.4
A511 Eastbound	Lane 1	78.0%	4.36	77.9%	4.13	71.4%	4.09	78.4%	4.13	71.7%	4.09	78.6%	4.13
	Lane 2	78.0%	10.7	77.9%	10.9	71.4%	9.3	78.4%	11.2	71.7%	9.5	78.6%	11.3
	Lane 3	69.6%	8.3	70.7%	9.1	63.4%	7.7	70.8%	9.2	63.4%	7.7	70.8%	9.2

Approach	Lane	2029 - Do Minimum				2029 - Scenario 1				2029 - Scenario 2			
		AM Peak		PM Peak		AM Peak		PM Peak		AM Peak		PM Peak	
		DoS (%)	MMQ (PCU)	DoS (%)	MMQ (PCU)	DoS (%)	MMQ (PCU)	DoS (%)	MMQ (PCU)	DoS (%)	MMQ (PCU)	DoS (%)	MMQ (PCU)
Northern Circulatory	Lane 1	60.3%	10.2	66.3%	11.2	61.7%	10.4	67.2%	11.4	62.6%	10.6	67.5%	11.4
	Lane 2	55.9%	9.4	63.1%	10.6	57.2%	9.6	64.3%	10.8	58.1%	9.8	65.9%	11
Eastern Circulatory	Lane 1	48.3%	0.0	49.8%	0.1	48.8%	0.0	49.2%	0.2	50.0%	0.1	50.5%	0.3
	Lane 2	45.7%	4.1	45.4%	3.5	48.8%	4.2	48.2%	3.5	49.9%	4.2	48.8%	3.5
	Lane 3	45.7%	4.12	45.4%	3.47	48.8%	4.2	48.2%	3.5	49.9%	4.23	48.8%	3.5
Southern Circulatory	Lane 1	69.3%	4.2	64.0%	3.5	72.0%	6.5	64.6%	3.6	72.3%	7.6	64.8%	3.6
	Lane 2	73.2%	4.1	70.3%	3.5	76.2%	4.8	70.5%	3.5	76.6%	4.8	70.5%	3.5
	Lane 3	52.4%	0.0	52.1%	0.0	55.4%	0.0	52.1%	0.0	55.7%	0.0	52.1%	0.0
Western Circulatory	Lane 1	56.2%	0.7	57.6%	2.5	54.8%	2.6	78.4%	2.5	64.6%	3	57.4%	2.5
	Lane 2	48.9%	0.9	39.5%	0.8	54.5%	1.4	78.4%	0.8	56.9%	2.0	43.4%	0.9
	Lane 3	48.9%	0.86	39.5%	0.76	54.5%	0.69	70.8%	0.81	56.9%	0.73	43.4%	0.93
Junction PRC (%)		9.9%		13.3%		9.5%		13.1%		9.1%		13.1%	
Total Delay (PCU-hr)		48.6		43.63		46.63		44.56		47.8		45.17	

Please note, the assessment of signal-controlled junctions has been undertaken using the LinSig computer programme which is the 'industry standard' traffic modelling software package used for assessing the capacity of signal-controlled junctions. At traffic signal-controlled junctions Practical Reserve Capacity (PRC) is used to indicate the available spare capacity at a junction. PRC calculations are influenced by traffic delay and Degree of Saturation (DoS) on all approaches to a junction. It is noted that a junction is stable when the maximum DoS is below 85% and above this level traffic delay begins to increase exponentially. Where junctions operate close to zero PRC, corresponding to approximately 90% DoS, small reductions in capacity could result in a significant increase in delay.