Tritax Symmetry (Hinckley) Limited

HINCKLEY NATIONAL RAIL FREIGHT INTERCHANGE

The Hinckley National Rail Freight Interchange Development Consent Order

Project reference TR050007

M1 J21 Modelling Note

Document reference: 18.18

Revision: 01

9 February 2024

Planning Act 2008

The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009 Regulation 5(2)(q)

TRANSPORT TECHNICAL NOTE – M1 JUNCTION 21 MODELLING

Hinckley National Rail Freight Interchange

PROJECT NAME	**Hinckley National Rail Freight Interchange**		
DOCUMENT NUMBER	HNRFI-BWB-GEN-XX-RP-TR-0041	**BWB REF**	NTT2814
AUTHOR	Vibeeshan Devaharan	**STATUS**	S2
CHECKED	Malcolm Ash	**REVISION**	P01
APPROVED	Andy Passmore	**DATE**	02/02/2024

1. INTRODUCTION

1.1 This Technical Note has been produced to provide further modelling of M1 Junction 21 following comments raised during the Hinckley National Rail Freight Interchange Hearing that took place on 31 October 2023. This related to a need for further explanation of the results at M1 J21 as requested by the ExA. This note covers the following:

- Updated modelling of M1 Junction 21 with the approved Lutterworth East Sustainable Urban Extension (LUE) improvements in place.
- A comparison between the existing and LUE improvements at the junction and the effects on the development traffic.
- Testing of scenario removing blocking from the northbound on-slip to the M1.

2. BACKGROUND

2.1 Current capacity constraints at Junction 21 are longstanding and driven by the following key issues:

- The single lane on the M1 Southbound mainline causes slow moving traffic at the diverge on the M1 mainline. However, there are modest queues on the approach to J21 as it opens out into four lanes.
- Blocking back of the M1 Northbound onslip. Merge/diverge calculations in the Transport Assessment demonstrate this is due to constraints on mainline flow capacity.
- Southbound circulatory is already at its limit of 4 lanes under the M1 and this restricts level of traffic approaching from the A5460.

2.2 Improvement to address these constraints would be of a significant magnitude and require considerable Government investment. Whilst there is a clear aspiration from both Leicestershire County Council and National Highways to improve the junction, there is currently no scheme identified.

2.3 Micro-Simulation modelling (VISSIM) was discussed with the Highway Authorities, though no up-to-date validated model exists. Recent developments have not had to analyse J21 using a micro-simulation model. The only development to propose mitigation (Lutterworth East Urban Extension) had assessed M1 J21using a LinSig model in November 2019, three years after the construction of the Junction 21 Paramics model

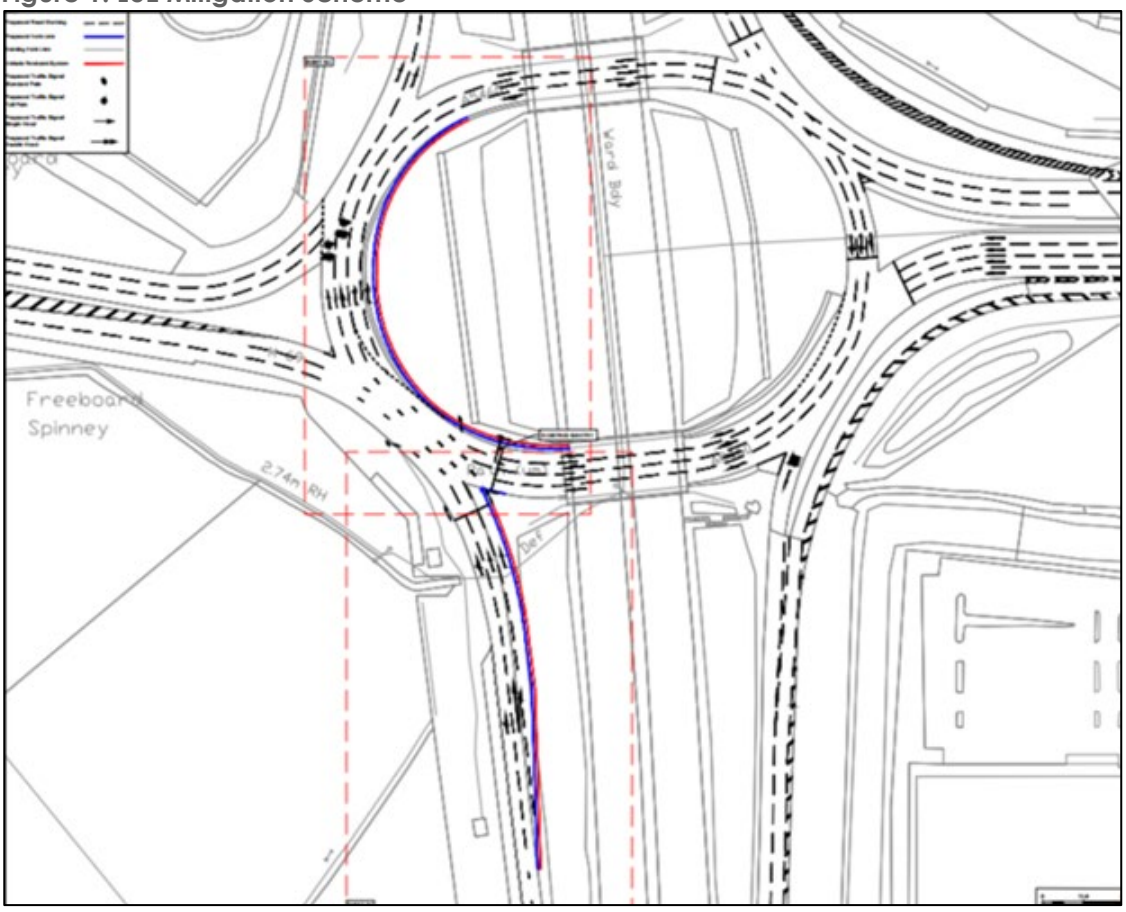
by LCC. The LUE was an application by Leicestershire County Council and is discussed further within this note.

2.4 As set out in Paragraph 49 of Circular 01/2022 'planned improvements to the SRN or local road network should be considered in any assessment where there is a high degree of certainty that this will be delivered'. Given there was no scheme committed or even foreseeable to address these existing issues at Junction 21, LCC's PRTM2.2 model reflects the current arrangement. This was agreed with the TWG as part of the Infrastructure Log for PRTM2.2 (Appendix 8.1: Transport Assessment PRTM 2.2 Forecast Modelling 6.2.8.1).

2.5 Since running the PRTM, the Lutterworth East Sustainable Urban Extension (LUE) (19/00250/OUT) has been granted planning permission with the S106 signed off in May 2022. The traffic associated with this development had been included within the PRTM2.2, but the mitigation had not been approved and was therefore not included in the Infrastructure Log. Consequently, it was not considered within the Transport Assessment.

2.6 **Figure 1** shows the approved Lutterworth East SUE mitigation scheme, which involves widening the M1 northbound off-slip to provide two lanes and a flare, as well as widening the western circulatory carriageway from three to four lanes. The resulting arrangement provides two dedicated lanes onto A5460, a single dedicated lane onto M1 northbound on-slip and a third offside lane shared between the two movements.

Figure 1: LUE Mitigation Scheme



Updated Traffic Surveys

2.7 The Hinckley National Rail Freight Interchange (HNRFI) ISH2 Hearing took place on 31 October 2023 during which time comments were raised about various parts of the Transport Assessment.

2.8 One comment concerns that the previous junction modelling was based on survey data that pre-dated the Covid pandemic. Therefore, new traffic surveys were commissioned on 29 November 2023. A comparison of the flows is included in Table 1

Table 1: Survey Flow Comparison

	2016 LUE Base		2019 Survey		2023 Survey	
	AM	PM	AM	PM	AM	PM
M1 SB	1877	1435	1714	1508	1254	1246
A5460	2774	3035	2692	2900	2756	2817
M69 EB	740	505	686	508	549	416
M1 NB	1274	603	1265	1036	1102	682
Total	6665	5578	6357	5952	5661	5161

3. JUNCTION MODEL VALIDATION

3.1 This section provides the results and validation of M1 Junction 21 which has been built using JCT's LinSig software (version V3.2.44). A copy of the approved LUE LinSig model has been replicated utilising the LinSig outputs presented in the LUE TA.

3.2 Further to manual turning counts, green time survey and Degree of Saturation (DoS) surveys were undertaken to validate the models.

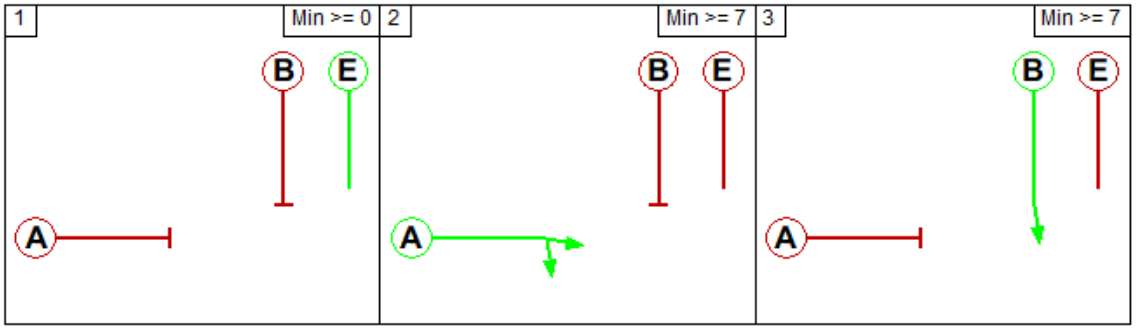
3.3 TfL modelling guidelines recommend that "A Degree of Saturation (DoS) survey should be conducted on all critical approaches for each modelled period. Critical approaches would include those close to saturation, those that determine stage length and those key to scheme proposals".

3.4 The validation criteria for LinSig models are presented in 'TfL modelling guidelines' which indicates that modelled DoS should be within 5% of observed values.

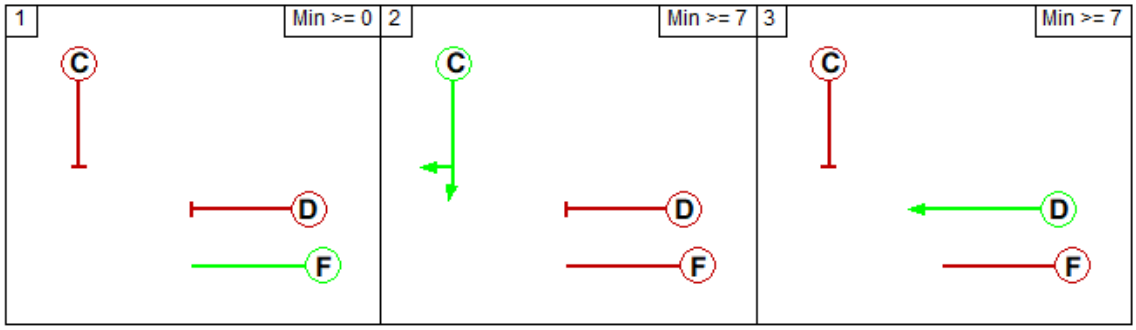
Signal Operation

3.5 M1 Junction 21 operates utilising two controllers. Details of the stage sequence for the respective Controllers/Streams are provided below.

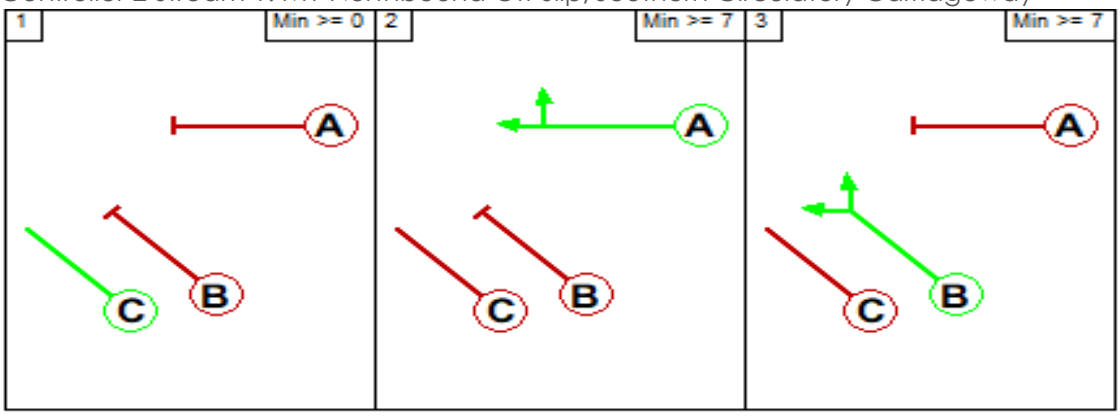
Controller 1 Stream 1: M1 Southbound Off Slip/Northern Circulatory Carriageway



Controller 1 Stream 2: A5460/Eastern Circulatory Carriageway



Controller 2 Stream 1: M1 Northbound Off Slip/Southern Circulatory Carriageway



Signal Timing Analysis

3.6 The junction operates on Microprocessor Optimised Vehicle Actuation (MOVA) with varying stage lengths per cycle. A summary of number of times each Controller/Stream was activated is presented in **Table 2** below.

Table 2: No. Stage Activation

	M1 SB	A5460	M1 NB
AM	47	48	49
PM	48	47	48

3.7 Based on Table 2 above, it is understood that the junction operates approximately on an average cycle time of 75 seconds (3600s/48) therefore this has been utilised in the 2023 Base modelling scenarios.

3.8 Further to the above, a green time survey was undertaken at M1 Junction 21 to identify the average, minimum and maximum green times recorded at the junction. Subsequently the average green times have been input into the base model on all approaches except M1 NB off-slip PM peak hour. It should be noted that as the junction operates on MOVA, the DoS recorded would vary cycle to cycle therefore it has been ensured that all green times input the model are between the minimum and maximum green times.

3.9 A summary of the green times for the approach arms to the junction are provided in **Table 3** below.

Table 3: Signal Timing Analysis

	Average			Minimum			Maximum			Modelled		
	M1 SB	A5460	M1 NB	M1 SB	A5460	M1 NB	M1 SB	A5460	M1 NB	M1 SB	A5460	M1 NB
AM	22	33	12	19	8	11	24	43	16	22	33	11
PM	21	36	11	21	35	9	24	42	14	21	36	9

Base Model Validation

3.10 A summary of the base model validation has been presented in **Table 3**.

Table 4: DoS Validation Summary

		AM			PM		
		Observed	Modelled	Difference	Observed	Modelled	Difference
M1 SB	Lane 1	80.4%	79.1%	-1.3%	79.4%	80.3%	0.9%
	Lane 2	77.0%	73.7%	-3.3%	79.5%	75.0%	-4.5%
	Lane 3	81.1%	79.7%	-1.4%	76.3%	80.9%	4.6%
A5460	Lane 1	68.0%	63.2%	-4.8%	64.2%	61.7%	-2.5%
	Lane 2	67.7%	63.2%	-4.5%	64.1%	61.7%	-2.4%
	Lane 3	92.6%	93.2%	0.6%	84.7%	82.5%	-2.2%
	Lane 4	96.2%	99.8%	3.6%	86.3%	88.3%	2.0%
M1 NB	Lane 1	96.7%	93.6%	-3.1%	86.9%	85.8%	-1.1%
	Lane 2	88.9%	86.9%	-2.0%	83.4%	79.9%	-3.5%

3.11 **Table 4** above illustrates that the modelled DoS are within 5% of the observed data therefore it is considered the signalised approaches of the junction meet the validation criteria and therefore is 'fit for purpose' for future year assessment.

M69 West Validation

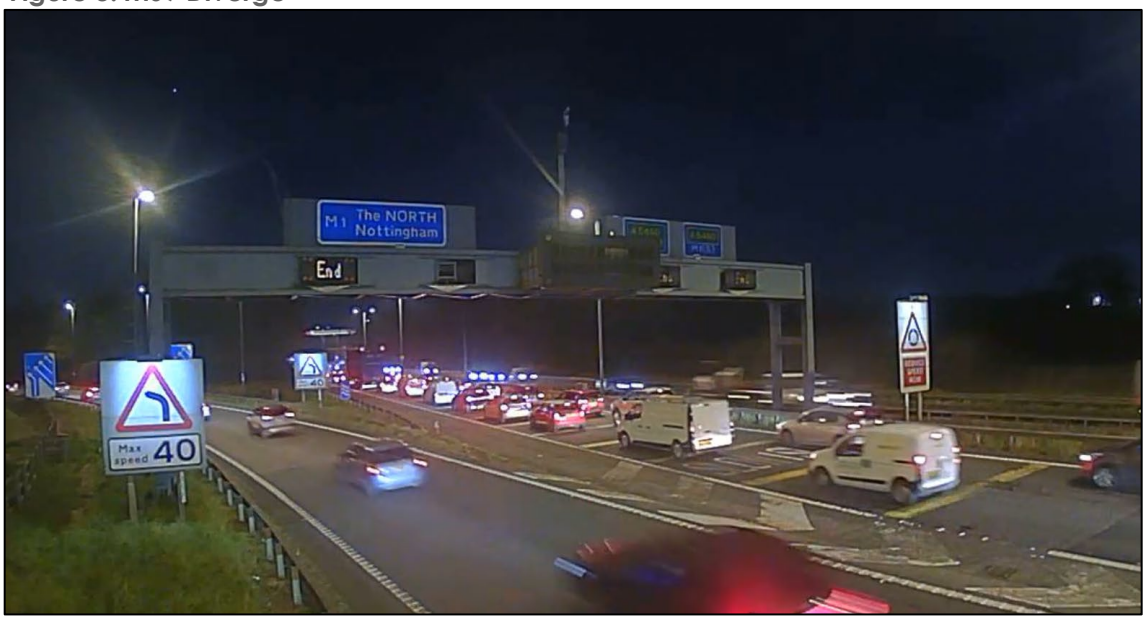
3.12 M69 western approach of the junction is currently a priority-controlled junction. A review of the video footage was undertaken whilst validating the approach arm to modelled queues. It was noted that the queues from M1 northbound on-slip was blocking back onto M1 Junction 21 and thereby impacting the capacity of M69 western approach. It was noted that this occurred in both AM and PM peak hour periods however at varying frequencies and duration.

3.13 **Figure 2** illustrates the blocking back of vehicles observed in the evening peak hour.

Figure 2: M1 NB block back

3.14 Further examination of the video footage was undertaken to understand whether the segregated left turn movement was affected by the queues on M1 northbound. However, it was noted that the segregated left turn from M69 West was free flowing in both AM and PM peak hours. **Figure 3** provides a snapshot of the operation of M69 West diverge in the PM peak hour.

Figure 3: M69 Diverge



3.15 To replicate the blocking back of queues across the M69 Western approach, saturation flows have been altered. These have been input separately for AM and PM peak hour scenario to reflect observed queues. The saturation flows utilised in the base model will be maintained for forecast AM and PM peak hour assessments respectively.

3.16 A summary of the queue validation on M69 West is provided below.

Table 5: M69 EB Queue Validation

	AM			PM		
	Observed	Modelled	Difference	Observed	Modelled	Difference
Lane 1	19	16.7	-2.3	19	20.5	2.1
Lane 2	19	20.3	1.3	16	16.1	0.1

3.17 **Table 5** illustrates that the modelled queues are reflective of the observed queues. It is concluded that the base LinSig model is reflective of existing operation of M1 J21 and therefore it is 'fit for purpose' for future year assessment.

LUE Base Model Comparison

3.18 It is understood that LUE base LinSig model was built utilising 2016 observed data. A comparison of DoS and MMQ between LUE model and BWB's validated 2023 modelling results are provided in the table below.

Table 6: Base Model Comparison

		2016 LUE Base				2023 BWB Base				BWB Minus LUE Output			
		AM		PM		AM		PM		AM		PM	
	Lane	DoS (%)	Queue	DoS (%)	Queue	DoS (%)	Queue	DoS (%)	Queue	DoS (%)	Queue	DoS (%)	Queue
M1 SB	1	115.7	58.5	56.3	7.6	79.1	10.9	80.3	10.9	-36.6	-47.6	24.0	3.3
	2+3	118.2	113.8	58.3	8.4	73.7	10.7	75.0	10.6	-44.5	-103.1	16.7	2.2
A5460	1	79.4	11.2	59.0	8.9	65.1	9.9	61.7	9.7	-14.3	-1.3	2.7	0.8
	2	79.6	11.8	59.0	9.5	65.1	9.9	61.7	9.7	-14.5	-1.9	2.7	0.2
	3	115.0	77.1	91.1	22.1	96.1	26	82.5	17.4	-18.9	-51.1	-8.6	-4.7
	4	115.1	72.4	91.3	21	102.8	40.9	88.3	19.3	-12.3	-31.5	-3.0	-1.7
M69 EB	1	86.1	9.4	61.2	4.5	99.2	10.8	85.8	20.5	13.1	1.4	24.6	16
	2+3	118.1	96.3	93.2	11.8	99.5	8.8	79.9	16.1	-18.6	-87.5	-13.3	4.3
M1 NB	1	113.5	33	90.4	8.4	93.6	16.7	100.3	7.1	-19.9	-16.3	9.9	-1.3
	2	113.6	35.3	90.1	8.7	86.9	20.3	100.9	6.3	-26.7	-15	10.8	-2.4

3.19 **Table 6** illustrates that in general the junction operates better than the 2016 model. A further review of the traffic flows has been undertaken to understand the difference between the modelled years.

Table 7: Base Flow Comparison

	2016 LUE Base		2023 Survey		Percentage Increase/decrease	
	AM	PM	AM	PM	AM	PM
M1 SB	1877	1435	1254	1246	-33.2%	-13.2%

A5460	2774	3035	2756	2817	-0.6%	-7.2%
M69 EB	740	505	549	416	-25.8%	-17.6%
M1 NB	1274	603	1102	682	-13.5%	+13.1%
Total	6665	5578	5661	5161	--15.1%	-7.5

3.20 **Table 6** shows that the traffic flows have generally decreased at M1 Junction 21 particularly on M1 SB approach towards M69 W.

3.21 Therefore the BWB base model works better than the LUE base model, which is to be expected as the 2023 observed flow data is lower.

4. PRTM TRAFFIC FLOWS

Traffic flows

4.1 Development traffic flows have been assigned to M1 J21 and are included in Table 8. These flows have displaced background forecast vehicles which are primarily using short distance routes. This means that the net impact at the junction is minor as demonstrated in Table 9. This contains the forecast flows from the PRTM for both '2036 with development' (WD) and '2036 without development' (WoD) and the net differences. These were reported in Section 8 of the original Transport Assessment.

4.2 The modelling of this route choice was the main purpose of using the PRTM model, ie to understand how traffic re-routes around the existing and forecast congestion. This is consistent with the approach the Applicant has taken on all other junctions.

4.3 It is the existing problems at M1 J21 identified in paragraph 2.1 that have caused the diversions of background traffic and the residual impact of the flows on the M69 and M1 north are due to this diversion.

4.4 Table 8 demonstrates that in the AM peak hour, 22% of development light vehicles and 23% of HGVs are predicted to route through M1 Junction 21. In the PM peak hour, 26% of development light vehicles and 23% of HGVs are predicted to route through M1 the junction.

Table 8: Development Traffic through M1 Junction 21

From	To	AM			PM		
		LGV	HGV	Total	LGV	HGV	Total
M69 W	M1 N	24	50	74	119	50	169
M69 W	A5460	2	3	5	109	11	120
M1 N	M69 W	36	33	69	29	40	69
A5460	M69 W	159	14	173	69	16	85
Total		**221**	**100**	**321**	**326**	**114**	**443**

Table 9: 2036 PRTM flows at M1 Junction 21- Net Traffic Change.

Road	2036 AM Peak						2036 PM Peak					
	Total Vehicles			HGVs			Total Vehicles			HGVs		
	WoD	WD	Diff.	WoD	WD	Diff.	WoD	WD	Diff.	WoD	WD	Diff.
M69 W	963	958	-5	50	43	-6	1027	1043	15	52	61	9
M1 N	1801	1744	-56	205	228	23	1799	1774	-25	177	212	36
A5460	3282	3331	49	234	245	10	3082	3189	107	139	149	10
M1 S	566	568	2	96	96	0	573	589	16	57	58	1
Total	**6612**	**6602**	**-10**	**585**	**611**	**26**	**6481**	**6595**	**114**	**425**	**481**	**56**

4.5 **Table 1** shows that the PRTM is predicting there to be a reduction of 10 vehicles in the morning peak hour and an increase of 114 vehicles in the evening peak hour at M1 Junction 21 between the WoD and WD scenarios.

4.6 The traffic flows extracted from PRTM have been furnessed for M1 Junction 21 in accordance with the agreed methodology outlined in HNRFI-BWB-GEN-XX-RP-TR-0022 Furnessing Methodology. Subsequently the derived forecast matrices have been utilised in the modelling assessment of M1 Junction 21.

5. FORECAST MODELLING

LUE Forecast Base Model Comparison

5.1 It is understood that PRTM 2.2 model includes for LUE development traffic however does not account for mitigation proposed by the LUE scheme. Therefore, a comparison of LUE 2036 WD scenario has been undertaken against PRTM 2.2 PRTM 2036 WoD scenario. These are presented in **Table 10** below.

Table 10: LUE WD vs PRTM WoD Model Output Comparison

		2036 LUE WD				2036 PRTM WoD				PRTM Minus LUE Output			
		AM		PM		AM		PM		AM		PM	
	Lane	DoS	Queue	DoS	Queue	DoS	Queue	DoS	Queue	DoS	Queue	DoS	Queue
M1 SB	1	88.6%	14.8	62%	8.5	86.0%	13	80%	11.6	-2.6%	-1.8	18.9%	3.1
	2+3	96.9%	19.7	66%	9.9	86.7%	12.6	81%	11.3	-10.2%	-7.1	15.2%	1.4
A5460	1	121.6%	84.2	87%	15.9	81.7%	14.8	72%	12.7	-39.9%	-69.4	-15.5%	-3.2
	2	121.4%	89.2	86%	16.3	81.8%	14.9	72%	12.7	-39.6%	-74.3	-14.1%	-3.6
	3	121.6%	89.9	99%	30.5	101.2%	37.8	77%	15.3	-20.4%	-52.1	-22.3%	-15.2
	4	122.7%	87.6	108%	56.2	108.3%	62	83%	16.6	-14.4%	-25.6	-25.0%	-39.6
M6 EB	1	99.7%	21	69%	5.8	109.3%	18.8	91%	8.7	9.6%	-2.2	22.2%	2.9
	2+3	107.2%	51.8	83%	8.4	100.7%	12.6	84%	7.1	-6.5%	-39.2	1.3%	-1.3
M1	1	121.5%	48.3	86%	8.2	106.7%	42.3	103%	23.8	-14.8%	-6	17.0%	15.6

		2036 LUE WD				2036 PRTM WoD				PRTM Minus LUE Output			
		AM		PM		AM		PM		AM		PM	
	Lane	DoS	Queue	DoS	Queue	DoS	Queue	DoS	Queue	DoS	Queue	DoS	Queue
	2	120.5%	49.7	87%	8.8	106.9%	57.9	108%	56.6	-13.6%	8.2	21.6%	47.8

5.2 Table 10 illustrates that the 2036 PRTM LinSig model furnessed based on 2023 observed data operates better than LUE 2036 with development scenario. It should be noted that the LinSig model has been validated against observed data and therefore should form a robust basis for forecast modelling assessment.

5.3 Due to the existing constraints at M1 Junction 21, the PRTM demonstrates that the proposed development traffic results in background traffic re-routing onto alternative routes. However, Leicestershire County Council (LCC) has requested a theoretical sensitivity test if re-routing does not occur. Consequently, the following scenarios have been assessed:

- Scenario 1: 2036 WD v WoD with the LUE as committed scheme AM/PM
- Scenario 2: 2036 WD v WoD without LUE Layout (Existing) AM/PM
- Sensitivity Test: 2036 WoD AM/PM + Development Traffic

5.4 Scenarios 1 & 2 have been modelled using both the M1 Junction 21 existing layout and the committed mitigation scheme for the LUE. The sensitivity test was undertaken only on the LUE committed mitigation scheme.

Modelling Output

5.5 A summary of the LinSig output is presented in **Table 11** for the morning peak hour period for scenarios 1 and 2. **Appendix 1** incudes the output data. The modelling files have been shared with the TWG on 12 Jan 2023.

Table 11: M1 Junction 21 Modelling Results (AM peak hour)

PRC Max Per Approach							
		LUE Committed Layout Scenario 1			Existing Layout Scenario 2		
		2036WoD	2036 WD	Diff	2036WoD	2036 WD	Diff
M1 SB Off-Slip	Lane 1	76%	79%	3%	86%	86%	0%
	Lane 2	77%	74%	-3%	87%	87%	0%
A5460	Lane 1	77%	81%	4%	82%	86%	4%
	Lane 2	77%	81%	4%	82%	86%	4%
	Lane 3	95%	95%	0%	101%	100%	-1%
	Lane 4	102%	102%	0%	108%	108%	0%
M1 NB Off-Slip	Lane 1	73%	73%	0%	109%	109%	0%
	Lane 2	73%	73%	0%	101%	102%	1%
M69 EB	Lane 1	102%	103%	1%	107%	109%	2%
	Lane 2	102%	103%	1%	107%	109%	2%

PRC Max Per Approach							
		LUE Committed Layout Scenario 1			Existing Layout Scenario 2		
		2036WoD	2036 WD	Diff	2036WoD	2036 WD	Diff
AM Average Delay							
M1 SB Off-Slip	Lane 1	32.5	35.4	2.9	44.4	44.4	0
	Lane 2	26.3	28.0	1.7	32.7	32.7	0
A5460	Lane 1	25.1	27.3	2.2	29.5	33.2	3.7
	Lane 2	25.2	27.3	2.1	29.6	33.2	3.6
	Lane 3	49.1	46.4	-2.7	92.8	84.6	-8.2
	Lane 4	102.8	96.3	-6.5	189.2	181	-8.2
M1 NB Off-Slip	Lane 1	63.3	63.3	0	264.1	265.2	1.1
	Lane 2	47.8	47.7	-0.1	161.4	170.8	9.4
M69 EB	Lane 1	123.1	136.6	13.5	182.1	213	30.9
	Lane 2	101.5	116.3	14.8	165.8	199.1	33.3
AM MMQ							
M1 SB Off-Slip	Lane 1	11.1	11.5	0.4	13	13	0
	Lane 2	10.9	11.5	0.6	12.6	12.6	0
A5460	Lane 1	13.7	15.2	1.5	14.8	16.7	1.9
	Lane 2	13.7	15.2	1.5	14.9	16.7	1.8
	Lane 3	26.3	25.2	-1.1	37.8	35.5	-2.3
	Lane 4	40.5	38.6	-1.9	62	59.6	-2.4
M1 NB Off-Slip	Lane 1	4.3	4.3	0	18.8	18.9	0.1
	Lane 2	4.3	4.3	0	12.6	13.3	0.7
M69 EB	Lane 1	36.7	39	2.3	42.3	46.5	4.2
	Lane 2	44	48.3	4.3	57.9	66.2	8.3

5.6 **Table 11** illustrates that in the morning peak hour period A5460 Lane 3 and 4, M1 Nb off slips and M69 EB approach all operate over capacity in the WoD scenario. A comparison against the WD scenario indicates that there are minimal changes in PRC, with approximately a 1% increase on M1 NB offslip and a 2% increase in PRC on M69 EB. This results in a queue increase of 1 and 12 PCUs on M1 NB slip road and M69 EB, respectively.

5.7 The introduction of the proposed LUE mitigation enhances the junction's operation, particularly benefiting A5460 and M1 NB off slip. A comparison between the WoD and WD scenarios indicates a negligible impact.

5.8 **Table 12** provides a summary of the evening peak hour modelling results, and illustrates that the junction would operate close to capacity on all approach arms of the junction except for M69 EB. However, it should be noted that the base model was calibrated to restrict vehicles egressing from M69 EB to replicate on site observation of M1 NB blocking back onto the junction. Consequently, an additional assessment was undertaken to analyse the junction's operation in the scenario where the M1 NB on slip is not obstructed. Further details are outlined in Table 14 and paragraph 5.11.

Table 12: M1 Junction 21 Modelling Results (PM peak hour)

PRC Max Per Approach			
		LUE Committed Layout Scenario 1	Existing Layout Scenario 2

		2036WoD	2036 WD	Diff	2036WoD	2036 WD	Diff
M1 SB Off-Slip	Lane 1	51%	68%	17%	80%	85%	5%
	Lane 2	56%	68%	12%	81%	80%	-1%
A5460	Lane 1	78%	67%	-11%	72%	74%	2%
	Lane 2	78%	67%	-11%	72%	74%	2%
	Lane 3	84%	76%	-8%	77%	84%	7%
	Lane 4	90%	81%	-9%	83%	90%	7%
M1 NB Off-Slip	Lane 1	76%	79%	3%	91%	94%	3%
	Lane 2	75%	78%	3%	84%	88%	4%
M69 EB	Lane 1	102%	100%	-2%	103%	117%	14%
	Lane 2	114%	110%	-4%	108%	111%	3%
PM Average Delay							
M1 SB Off-Slip	Lane 1	15.9	26.3	10.4	37.4	43.3	5.9
	Lane 2	14.4	22.6	8.2	29.3	32.3	3.0
A5460	Lane 1	25.5	17.3	-8.2	20.7	22.4	1.7
	Lane 2	25.5	17.3	-8.2	20.7	22.4	1.7
	Lane 3	28.5	19.6	-8.9	22.3	27	4.7
	Lane 4	36.2	22.6	-13.6	26	34.4	8.4
M1 NB Off-Slip	Lane 1	66.5	70.6	4.1	91.6	103.9	12.3
	Lane 2	47.3	51.8	4.5	68.6	76.8	8.2
M69 EB	Lane 1	145.5	125.9	-19.6	160.4	334.8	174.4
	Lane 2	261.4	215	-46.4	193.2	230.9	37.7
PM MMQ							
M1 SB Off-Slip	Lane 1	7.4	9.9	2.5	11.6	12.7	1.1
	Lane 2	7.5	9.9	2.4	11.3	12.4	1.1
A5460	Lane 1	13.9	11.5	-2.4	12.7	13.1	0.4
	Lane 2	13.9	11.5	-2.4	12.7	13.1	0.4
	Lane 3	17.2	15.5	-1.7	15.3	17.9	2.6
	Lane 4	19.5	16.8	-2.7	16.6	20.4	3.8
M1 NB Off-Slip	Lane 1	4.6	5	0.4	8.7	9.8	1.1
	Lane 2	4.4	5	0.6	7.1	8	0.9
M69 EB	Lane 1	23.2	22	-1.2	23.8	35.3	11.5
	Lane 2	66.3	60.2	-6.1	56.6	62.1	5.5

5.9 **Table 13** provides a theoretical assessment to assess the operation of the junction to exclude the rerouting of background traffic. This illustrates that the impact of the proposed development on M1 J21 remains negligible, though this scenario is not valid as it does not accord with the accepted methodology based on diversions of traffic as forecast through the PRTM outputs.

Table 13: M1 Junction 21 Sensitivity Test Result

PRC Max Per Approach							
		LUE Committed Layout AM			LUE Committed Layout PM		
		2036WoD	2036 WD	2036 WoD +Dev	2036WoD	2036 WD	2036 WoD +Dev
M1 SB Off-Slip	Lane 1	76%	79%	68%	51%	68%	67%
	Lane 2	77%	74%	68%	56%	68%	68%
A5460	Lane 1	77%	81%	87%	78%	67%	72%
	Lane 2	77%	81%	87%	78%	67%	72%
	Lane 3	95%	95%	95%	84%	76%	73%
	Lane 4	102%	102%	102%	90%	81%	79%

PRC Max Per Approach							
		LUE Committed Layout AM			LUE Committed Layout PM		
		2036WoD	2036 WD	2036 WoD +Dev	2036WoD	2036 WD	2036 WoD +Dev
M1 NB Off-Slip	Lane 1	73%	73%	73%	76%	79%	76%
	Lane 2	73%	73%	73%	75%	78%	75%
M69 EB	Lane 1	102%	103%	104%	102%	100%	108%
	Lane 2	102%	103%	104%	114%	110%	126%
Average Delay							
M1 SB Off-Slip	Lane 1	32.5	35.4	24.7	15.9	26.3	25.4
	Lane 2	26.3	28.0	21.1	14.4	22.6	21.8
A5460	Lane 1	25.1	27.3	31.9	25.5	17.3	19.4
	Lane 2	25.2	27.3	31.9	25.5	17.3	19.4
	Lane 3	49.1	46.4	48.7	28.5	19.6	19.4
	Lane 4	102.8	96.3	104.4	36.2	22.6	22
M1 NB Off-Slip	Lane 1	63.3	63.3	63.3	66.5	70.6	66.5
	Lane 2	47.8	47.7	47.8	47.3	51.8	49.5
M69 EB	Lane 1	123.1	136.6	153.3	145.5	125.9	213.9
	Lane 2	101.5	116.3	132.8	261.4	215	413.6
MMQ							
M1 SB Off-Slip	Lane 1	11.1	11.5	10.4	7.4	9.9	10
	Lane 2	10.9	11.5	10.6	7.5	9.9	10
A5460	Lane 1	13.7	15.2	17.7	13.9	11.5	13
	Lane 2	13.7	15.2	17.7	13.9	11.5	12.9
	Lane 3	26.3	25.2	26.2	17.2	15.5	14.3
	Lane 4	40.5	38.6	40.8	19.5	16.8	15.4
M1 NB Off-Slip	Lane 1	4.3	4.3	4.3	4.6	5	4.6
	Lane 2	4.3	4.3	4.3	4.4	5	4.6
M69 EB	Lane 1	36.7	39	41.9	23.2	22	31.6
	Lane 2	44	48.3	53.1	66.3	60.2	98

5.10 As mentioned in Paragraph 5.8 an additional assessment was undertaken to analyse the junction's operation in the scenario where the M1 NB on slip is not obstructed. A summary of the results is presented in **Table 14** below.

Table 14: M1 Junction 21 Modelling Results (PM peak hour no block back)

PRC Max Per Approach							
		Existing Layout			LUE Committed Layout		
		2036WoD	2036 WD	2036 WoD +Dev	2036WoD	2036 WD	2036 WoD +Dev
M1 SB Off-Slip	Lane 1	88%	85%	84%	50%	54%	67%
	Lane 2	88%	80%	88%	55%	58%	68%
A5460	Lane 1	72%	72%	83%	80%	76%	85%
	Lane 2	72%	72%	82%	80%	76%	85%
	Lane 3	77%	81%	84%	86%	86%	86%
	Lane 4	83%	89%	90%	92%	92%	92%
M1 NB Off-Slip	Lane 1	83%	85%	83%	76%	79%	76%
	Lane 2	77%	80%	77%	75%	78%	75%
M69 EB	Lane 1	59%	63%	67%	52%	56%	60%
	Lane 2	58%	63%	67%	51%	56%	60%
PM Average Delay							
M1 SB Off-Slip	Lane 1	48.3	45.6	42.4	15.1	17.9	25.4

PRC Max Per Approach							
		Existing Layout			LUE Committed Layout		
		2036WoD	2036 WD	2036 WoD +Dev	2036WoD	2036 WD	2036 WoD +Dev
	Lane 2	34.8	31.8	35	13.7	16	21.8
A5460	Lane 1	20.7	20.9	28.3	27.6	24	31.2
	Lane 2	20.7	20.9	28.2	27.6	24	31.1
	Lane 3	22.3	24.1	28.5	31.5	29.8	31.5
	Lane 4	26	31.5	36.2	42.5	40.3	42.5
M1 NB Off-Slip	Lane 1	65.3	70	65.3	66.5	70.6	66.5
	Lane 2	54.8	58.4	54.8	49.5	51.8	49.5
M69 EB	Lane 1	18.2	22.1	23	15.5	18.9	18.4
	Lane 2	13.1	16.2	17.1	11.7	14.4	13.8
PM MMQ							
M1 SB Off-Slip	Lane 1	13.3	12.7	12.5	7.3	8	10
	Lane 2	12.8	12.4	13.9	7.4	8.2	10
A5460	Lane 1	12.7	12.8	15.8	14.5	13.7	16.5
	Lane 2	12.7	12.8	15.6	14.5	13.7	16.4
	Lane 3	15.3	16.8	17.2	18.2	18.9	18.2
	Lane 4	16.6	19.9	19.5	21.2	22.1	21.2
M1 NB Off-Slip	Lane 1	6.9	7.5	6.9	4.6	5	4.6
	Lane 2	6.2	6.7	6.2	4.6	5	4.6
M69 EB	Lane 1	4.2	4.8	5.6	3.3	4.2	5
	Lane 2	4.2	4.8	5.6	3.3	4.2	5.1

5.11 **Table 14** demonstrates that, should the M1 NB slip not block back onto the junction, M69 EB would not have any capacity issues. Therefore, it is considered that this is because of the existing issue on the M1 mainline.

6. SUMMARY

6.1 The purpose of this Technical Note is to provide additional information on the modelling of M1 Junction 21.

- 2023 observed data has been utilised to calibrate and validate the M1 J21 LinSig model to represent existing operation of the junction.
- A review of the traffic surveys indicated that there is a reduction in traffic flows between 2016 and 2023 at M1 J21.
- The model has been utilised to assess forecast modelling scenarios.
- A comparison of the 2023 validated model and LUE 2016 base model illustrates that the 2023 model operates better on most approach arms of the junction.
- Forecast modelling was undertaken and it was concluded that there is a residual impact from the development, but it is negligible when compared with the wider junction capacity.
- An impact on M69 EB was noted in the evening peak hour however this was attributed to M1 NB mainline flows blocking back onto the junction which is an existing issue.
- In accordance with National Government Policy, the development would seek to limit future traffic growth at the junction through the reduction of single occupancy

car trips as secured through the Sustainable Transport Strategy. It is also important to highlight via its contribution to transferring freight from road to rail aims to reduce long distance trips on sections of the SRN like M69 and M1, an effect that has not been accounted for within the assessment work.

- Based on the analysis included within this note, it is concluded that there is a small residual impact due to the HNRFI traffic at M1 J21, but the cumulative impact is not severe nor causes a highway safety issue. Therefore, the Development should not be prevented or refused on this basis, as per NPPF Paragraph 115. The development accords with NPPS Policy, specifically paragraph 5.214 which states:
    - *'Provided that the applicant is willing to commit to transport planning obligations and, to mitigate transport impacts identified in the WebTAG transport assessment (including environment and social impacts), with attribution of costs calculated in accordance with the Department's guidance, then development consent should not be withheld.* ***Appropriately limited weight should be applied to residual effects on the surrounding transport infrastructure.'***

APPENDICES

APPENDIX 1: