TECHNICAL NOTE

DERBY HMA LOCAL PLAN

DERBY HMA LOCAL PLAN – MODEL CALIBRATION & VALIDATION

IDENTIFICATION TABLE	
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1. INTRODUCTION

1.1.1 SYSTRA has been commissioned by Derby City Council (DCC) to use the East Midlands Gateway Model (EMGM) to assess the strategic transport impacts of the updated Derby HMA Local Plan.

1.1.2 The EMGM is a multimodal transport model built in accordance with TAG guidance. The model is fully calibrated and validated for a base year of 2016. The purpose of the note is to provide information on the performance of the model within the Derby HMA area to ensure it is suitable to use for the assessment of the Derby HMA local plan.

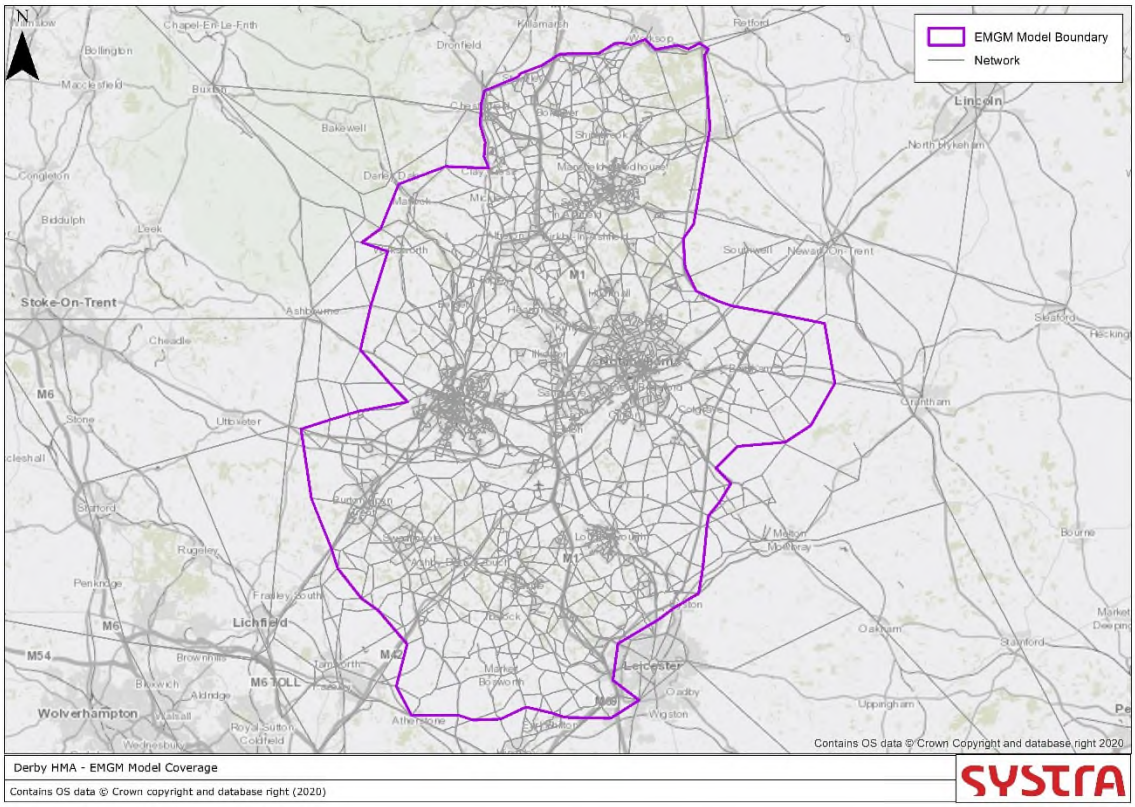
2. EAST MIDLANDS GATEWAY MODEL

2.1.1 The EMGM has been developed as a multimodal transport model built following guidance in the Department for Transport's (DfT) Transport Analysis Guidance (TAG). The modelling suite is comprised of the following elements:

- SATURN Highway Model.
- CUBE Voyager Public Transport Model.
- Cube Variable Demand Model including destination, mode choice, trip frequency and time of day responses.
- Park and Ride model.
- TRICS based Trip End Model.

2.1.2 The EMGM is fully simulated in an area covering Nottinghamshire, Derbyshire and North Leicestershire. The extent of the EMGM coverage is shown in Figure 1.

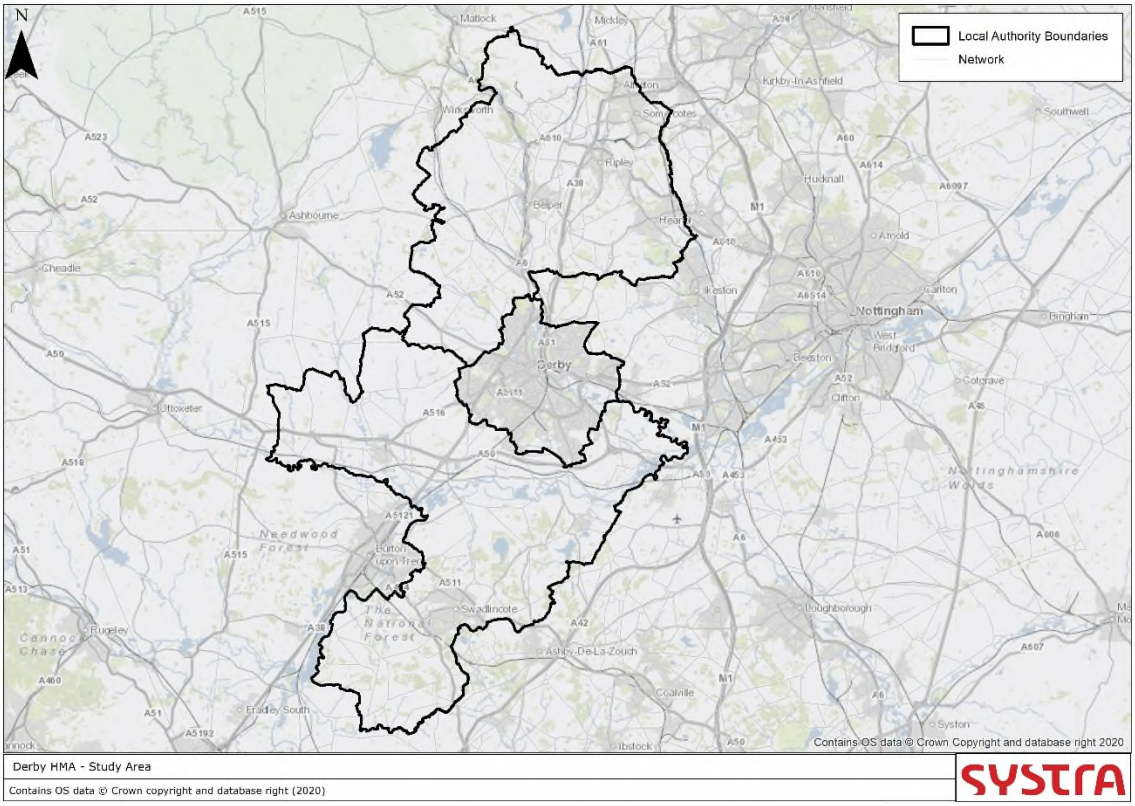
Figure 1. EMGM Model Extent



2.2 Study Area

2.2.1 The Derby HMA area is made up of the Local Authority (LA) boundaries of Derby City, South Derbyshire and Amber Valley. Figure 4 below shows the extent of the Derby HMA AOI.

Figure 2. Derby HMA AOI



2.3 Model Base Year

2.3.1 The EMGM has been calibrated and validated to a 2016 base year. Due to time and monetary constraints, it was not possible to rebase the model for the HMA study to reflect a post COVID base and the EMGM in its current form has recently been approved for use in other local plans in the area including Ashfield, Erewash, Amber Valley, the Nottingham Core Strategy and Mansfield.

2.3.2 The requirement for models to be no older than 5 years has been removed from TAG, however, it is still a requirement that models are not outdated and that there haven't been significant changes to the network and assignment routing.

2.3.3 To better understand the changes to flows across the modelled area as a result of COVID, we have contacted local councils within the model area and have been provided with traffic growth analysis based on average two-way traffic volumes across 51 permanent traffic counters for March 2020 (pre pandemic) and September 2023 (post pandemic). The data provided was for total vehicle volumes only and therefore does not distinguish between different vehicle types. It also does not show any change in trip purpose between the two years. The key output of this data for the peak hours is presented in Table 1 and 2 below.

Table 1. Average weekday AM Peak (0800-0900) traffic flows.

WEEK COMMENCING (MON)	URBAN	RURAL	AVERAGE	URBAN	RURAL	AVERAGE
02-Mar-20	1165	871	975	100%	100%	100%
18-Sep-23	1124	846	944	97%	95%	96%

Table 2. Average weekday PM Peak (0800-0900) traffic flows.

WEEK COMMENCING (MON)	URBAN	RURAL	AVERAGE	URBAN	RURAL	AVERAGE
02-Mar-20	1215	910	1017	100%	100%	100%
18-Sep-23	1183	864	976	96%	97%	97%

2.3.4 Tables 1 and 2 suggest that traffic levels in 2023 were, in general, around 3% lower than pre-pandemic levels in the AM Peak and 4% in the PM peak. For the longer term for future forecasting, 2044 in this case, this is a relatively insignificant drop in flows and is unlikely to have a significant impact on the Derby HMA appraisal.

2.1 Matrix Estimation

2.1.1 Matrix Estimation was used in the development of the full model and was undertaken in line with TAG guidance. Details are provided in the full EMGM Model Validation Report[1] which has been extensively reviewed by National Highways in the past.

[1] 106770 EMGM Highway LMVR v2.0.pdf

3. FLOW CALIBRATION AND VALIDATION CHECKS

3.1 Introduction

3.1.1 A review of the calibration/validation of the EMGM 2016 highway model has been undertaken for the Derby HMA area. The model performance within the Derby HMA area has been assessed in line with guidance provided in TAG unit 3.1.

3.2 Guidelines

3.2.1 DfT guidelines for the calibration and validation of highway models stipulate that there are two separate sets of criteria against which the counts and modelled flow comparison should be measured:

- GEH Statistic: links should have a GEH value of less than 5, and
- Vehicle flow comparison:
  - where observed flow is less than 700 vehicles per hour, the modelled flow should be within 100 vehicles of the observed flow.
  - where observed flow is between 700 and 2700 vehicles per hour, the modelled flow should be within 15% of observed flow; and
  - where observed flow is greater than 2700 vehicles per hour, the modelled flow should be within 400 vehicles of the observed flow.

3.2.2 DfT guidelines on the acceptability of validation statistics, TAG Unit 3.1 section 3.2.7 discusses validation statistics for counts meeting GEH and flow criteria, stating that:

> *"These two measures are broadly consistent and link flows that meet either criterion should be regarded as satisfactory."*

3.2.3 The calibration and validation review of the EMGM has been conducted in line with these guidelines and criteria.

3.3 Derby HMA Calibration and Validation

3.3.1 Table 1 provides the headline calibration and validation statistics for the highway network within the Derby HMA area.

3.3.2 In all three peak hours the model achieves a high level of calibration, with over 95% of counts meeting the criteria, with particular strong performance of LGV and HGV counts. These statistics exceed the recommended target of 85% stated in TAG guidance.

3.3.3 In the AM and PM peaks over 80% of the validation counts match either the GEH or flow criteria. This is slightly lower than the recommended 85% target specified by TAG, however, it still demonstrates a strong level of model validation given the size of the model, the number of counts within the data set and the complexities of route choice available within the model.

Table 3. Calibration and Validation Statistics – Derby HMA

	CALIBRATION				VALIDATION			
	counts	GEH < 5	% flow	GEH < 5 or flow	counts	GEH < 5	% flow	GEH < 5 or flow
Morning Peak								
Cars	268	95%	98%	**98%**	175	67%	74%	**75%**
LGV	268	89%	98%	**98%**	175	75%	94%	**94%**
HGV	268	89%	100%	**100%**	175	82%	97%	**97%**
Total	268	95%	97%	**97%**	175	72%	79%	**81%**
Inter Peak								
Cars	222	93%	96%	**96%**	168	68%	76%	**77%**
LGV	222	86%	98%	**98%**	168	79%	93%	**93%**
HGV	222	88%	98%	**98%**	168	82%	95%	**95%**
Total	222	91%	94%	**95%**	168	68%	77%	**78%**
Evening Peak								
Cars	268	95%	96%	**96%**	148	68%	80%	**81%**
LGV	268	89%	99%	**99%**	148	78%	97%	**97%**
HGV	268	94%	100%	**100%**	148	85%	100%	**100%**
Total	268	94%	95%	**96%**	148	70%	76%	**80%**

3.4 Strategic Road Network

3.4.1 Table 3 provides the headline calibration statistics for the Strategic Road Network within the Derby HMA area. All model calibration counts meet either the GEH or flow criteria in each peak hour.

3.4.2 In all three peaks over 85% of the validation counts meet either the GEH or flow criteria indicating that the model demonstrates a good level of model validation along the SRN within the HMA area. In the AM peak, the model meets the expected % flow criteria for all user classes but the percentage of counts meeting GEH < 5 criteria is slightly lower than the recommended 85% threshold. Most of these affected counts have a GEH narrowly above 5 and still match the % flow criteria. The remaining counts are located on the edges of the HMA area and are not considered to be important due to their location.

Table 4. Calibration and Validation Statistics – National Highways

	CALIBRATION				VALIDATION			
	counts	GEH < 5	% flow	GEH < 5 or flow	counts	GEH < 5	% flow	GEH < 5 or flow
Morning Peak								
Cars	36	97%	100%	**100%**	34	82%	85%	**85%**
LGV	36	94%	97%	**97%**	34	82%	91%	**91%**
HGV	36	100%	100%	**100%**	34	65%	88%	**88%**
Total	36	97%	100%	**100%**	34	79%	94%	**94%**
Inter Peak								
Cars	35	97%	100%	**100%**	36	81%	78%	**81%**
LGV	35	97%	97%	**97%**	36	81%	81%	**81%**
HGV	35	89%	94%	**94%**	36	64%	78%	**78%**
Total	35	100%	100%	**100%**	36	86%	83%	**86%**
Evening Peak								
Cars	36	100%	100%	**100%**	21	76%	90%	**90%**
LGV	36	97%	97%	**97%**	21	67%	76%	**76%**
HGV	36	97%	100%	**100%**	21	71%	100%	**100%**
Total	36	100%	100%	**100%**	21	86%	95%	**95%**

3.5 Full Modelled Area

3.5.1 Table 4 provides the headline calibration statistics for the full model area.

3.5.2 In all three peak hours at least 90% of the model calibration counts meet either the GEH or flow criteria with particular strong performance of LGV and HGV counts. These statistics meet the recommended target of 85% stated in TAG guidance.

3.5.3 For validation, over 80% of the counts match either the GEH or flow criteria within the AM, IP and PM peak. This is slightly lower than the recommended 85% target specified by TAG, however, it still demonstrates a strong level of model validation given the size of the model, the number of counts within the data set and the complexities of route choice available within the model.

Table 5. Calibration and Validation Statistics – Full Model

	CALIBRATION				VALIDATION			
	counts	GEH < 5	% flow	GEH < 5 or flow	counts	GEH < 5	% flow	GEH < 5 or flow
Morning Peak								
Cars	1214	90%	93%	**94%**	1003	78%	85%	**87%**
LGV	1214	88%	97%	**97%**	1003	82%	95%	**95%**
HGV	1459	87%	98%	**99%**	1047	85%	98%	**98%**
Total	1459	87%	89%	**91%**	1047	76%	82%	**84%**
Inter Peak								
Cars	783	88%	92%	**93%**	563	71%	81%	**83%**
LGV	783	87%	98%	**99%**	563	81%	96%	**96%**
HGV	1009	86%	97%	**97%**	609	80%	94%	**94%**
Total	1009	83%	89%	**90%**	609	70%	79%	**80%**
Evening Peak								
Cars	1183	91%	93%	**94%**	794	75%	83%	**85%**
LGV	1183	92%	99%	**99%**	794	85%	98%	**98%**
HGV	1498	93%	99%	**99%**	985	91%	98%	**99%**
Total	1498	88%	90%	**92%**	985	75%	81%	**83%**

3.6 Performance of Counts – Spatial Analysis

3.6.1 Figures 3 to 5 show the distribution and performance of counts across the model in the AM, IP and PM Peaks. Detailed plots showing the SRN count performance are provided in Appendix A. The locations where TAG Guidance is met are denoted by green lines and where counts have not met TAG guidance, the flow is shown as high (red) or low (blue). There are no clusters of counts which fail to meet the criteria, providing reassurance that the model is stable and there is no particular area of weakness or concern.

Table 6. AM Peak Count Performance

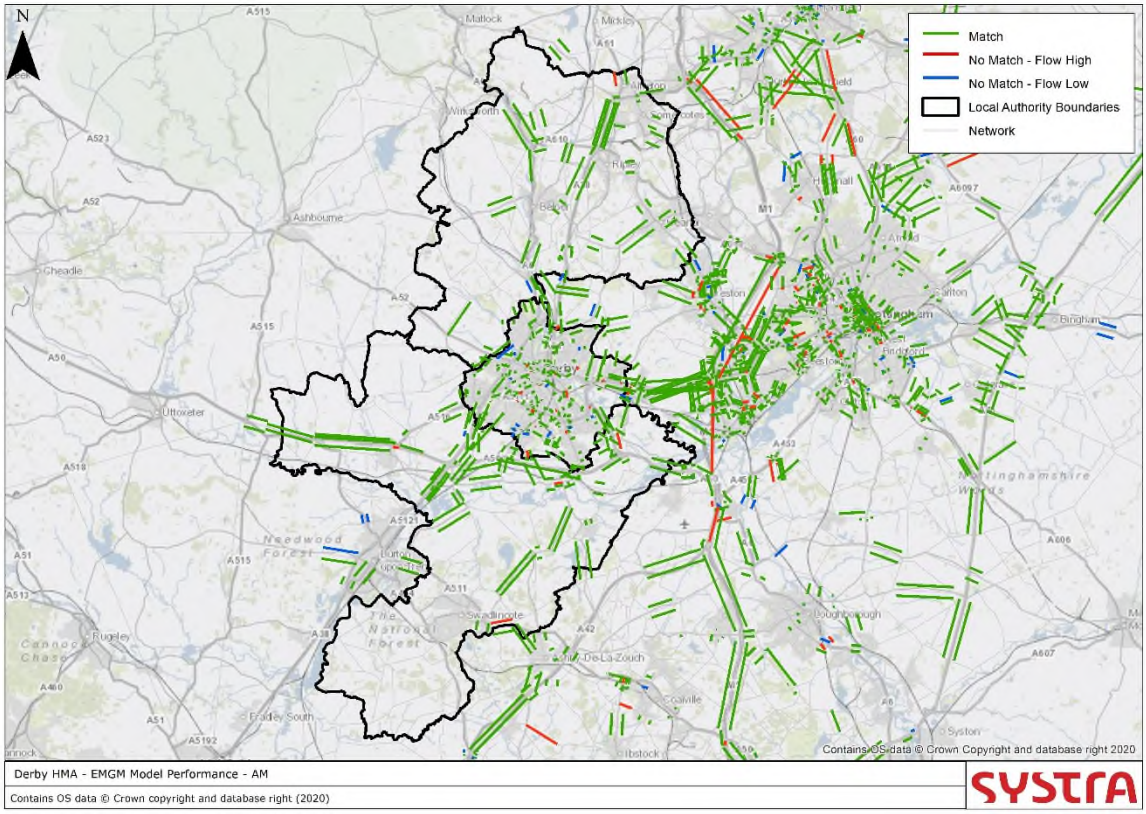


Figure 3. IP Peak Count Performance

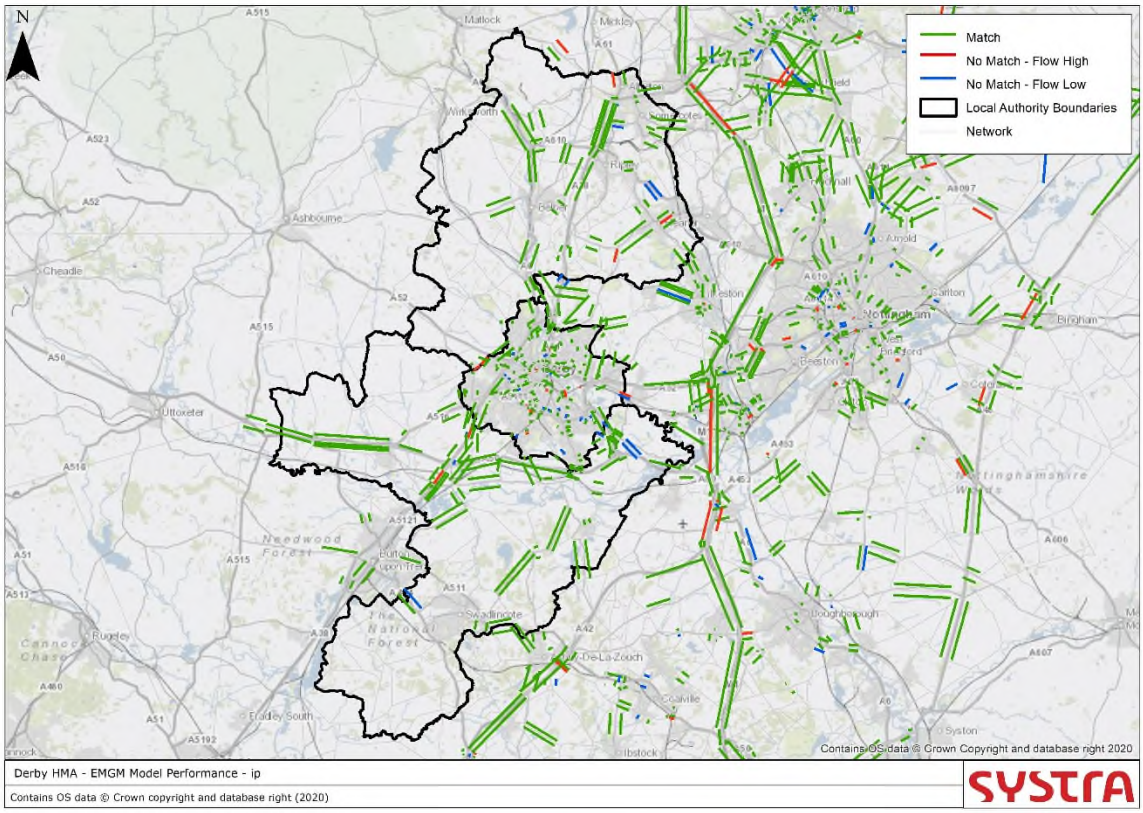
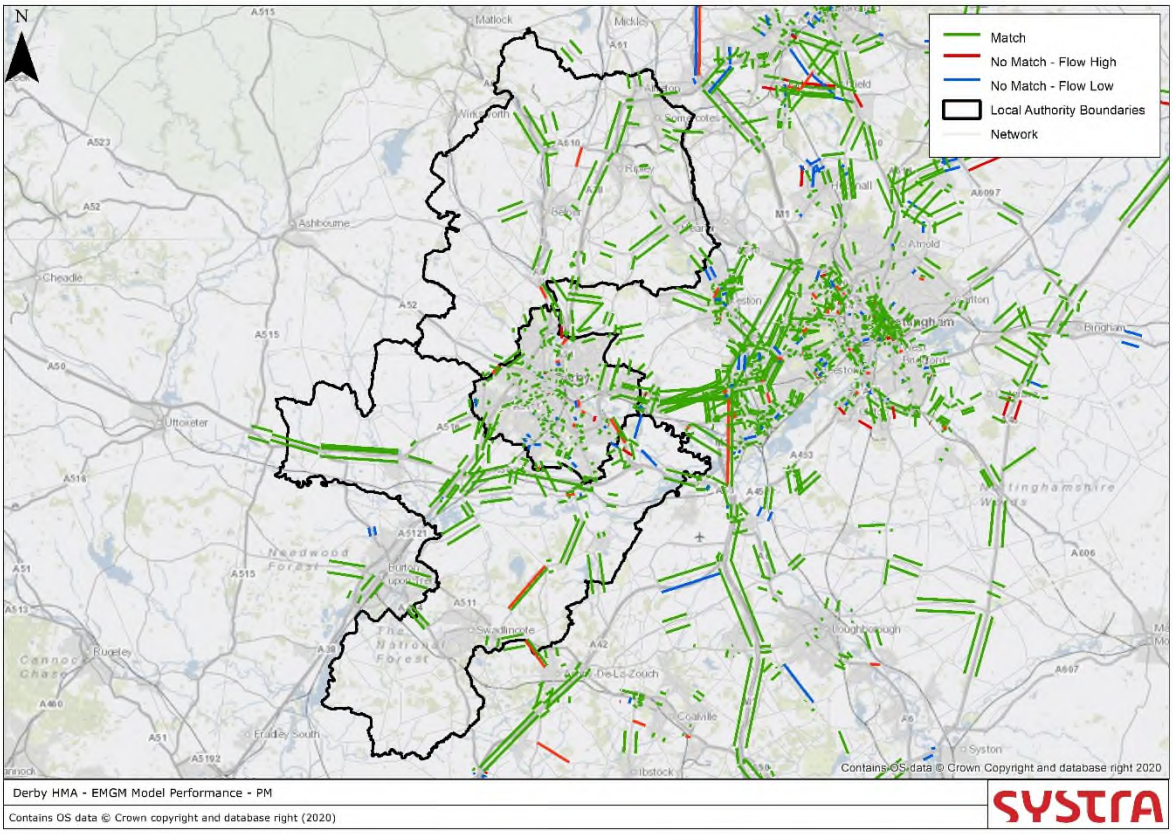


Figure 4. PM Peak Count Performance

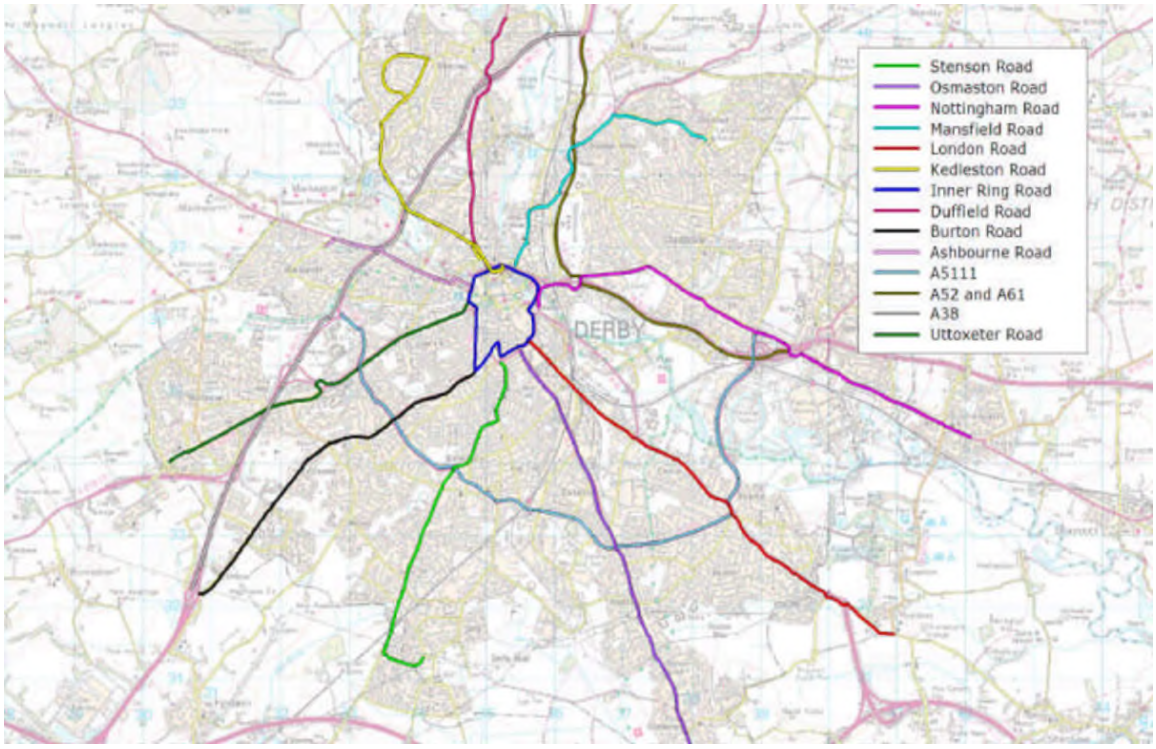


4. JOURNEY TIME VALIDATION CHECKS

4.1.1 Modelled and observed journey times have been compared on 9 routes within Derby. The Derby journey time data was provided by Derby City and was collected and processed by AECOM in 2015 for the purpose of the A38 model development. Journey time data for the morning peak (08:00 – 09:00) and evening peak (17:00 – 18:00) was provided.

4.1.2 Figures 5 below illustrates the journey time routes for Derby.

Figure 5. Journey Time Validation Routes – Derby

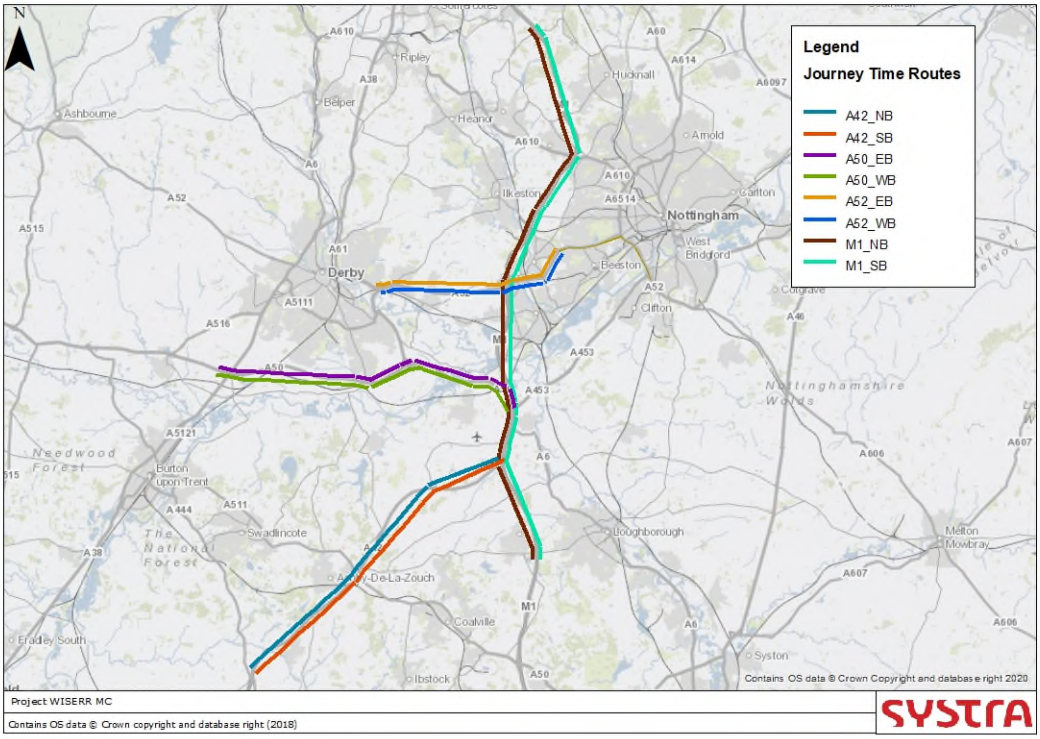


4.1.3 In addition to local routes, an assessment of journey times along the SRN has been undertaken using data from National Highways; Journey Time Database. Four routes along the SRN were selected for analysis, including:

- M1 – Between Junctions 23 and 27.
- A52 - Between Derby and Nottingham (SRN sections only).
- A50 – Between the A38 and the M1.
- A42 – Between the M42 Junction 11 and the M1.

4.1.4 Selected route extents are presented in Figure 6.

Figure 6. SRN Journey Time Route Extents



4.1.5 Given the presence of roadworks on the M1 during the early half of 2016, data has been extracted for the month of November 2016, unless data was unavailable. This month is a neutral month due to the lack of significant bank holidays or School holidays.

4.2 Journey Time Validation Guidelines

4.2.1 The TAG requirement (as set out in TAG Unit M3.1 Table 3) for journey time validation is that modelled times along the route should be within 15% of the observed time on more than 85% of routes.

4.2.2 The modelled times that are referred to in this section represent the time taken to travel from the start of the route to the routes end point and have been calculated using the Saturn 'Joy Ride' facility. This includes the turning delays for the specific set of turns made in the course of the journey.

4.3 Journey Time Validation

4.3.1 Tables 7 and 8 summarise the journey time validation for each route in Derby including those along the SRN. In the morning peak 14 out of 26 (or 54%) of journey time routes are within +/- 15% of the observed data. In the evening peak, 15 out of 26 (or 58%) of routes are within +/- 15% of the observed data. Several of the routes narrowly miss out on the +/-15% criteria with 19 routes (73%) being within +/-20% in the AM peak and 17 routes (65%) in the PM peak.

4.3.2 Appendix B provides journey time graphs for the SRN routes. The majority of the SRN routes meet the TAG calibration criteria of +/- 15%. The exceptions to this are the A52 and the A38. The A52 WB in the AM Peak is slightly fast and the A52 EB in the PM Peak is slightly slow. The A38 is marginally fast in the AM peak but slow in both directions in the

PM peak. The A52 and A38 are both very congested routes and as a result journey time can fluctuate significantly. The journey times along the A38 are of more importance for the HMA strategy due to the nearby location of several local plan sites. The AM journey time is narrowly outside the recommended threshold, and we do not feel this will have a fundamental impact on routings through the area. The slow journey times in the PM is along the entire route and not at a specific location. The model shows a good level of flow validation on the A38, on adjacent nearby local routes and on other SRN alternatives, suggesting that the slower journey times do not cause a significant movement away from the A38.

4.3.3 Overall, 88% of the SRN routes meet the TAG journey time calibration criteria and therefore the model represents the journey times on the SRN network.

4.3.4 The emphasis of this EMGM model validation process has been on flow validation. To rectify some of these journey time would affect the flow validation and as a result we have prioritised the flow validation over the journey time validation.

Table 7. Derby Journey Time Validation – Morning Peak

ROUTE	DIRECTION	OBSERVED	MODELLED	% CHANGE	TAG
Stenson Road	Inbound	854	880	3%	OK
Stenson Road	Outbound	699	906	30%	SLOW
Osmaston Road	Inbound	1235	1135	-8%	OK
Osmaston Road	Outbound	964	1058	10%	OK
London Road	Inbound	1001	916	-9%	OK
London Road	Outbound	769	1023	33%	SLOW
Inner Ring Road	Clockwise	540	726	34%	SLOW
Inner Ring Road	AntiClockwise	567	622	10%	OK
Burton Road	Inbound	1142	780	-32%	FAST
Burton Road	Outbound	717	799	11%	OK
A5111	Clockwise	1379	1650	20%	SLOW
A5111	AntiClockwise	1263	1485	18%	SLOW
A52 A61	Inbound	932	782	-16%	FAST
A52 A61	Outbound	839	600	-29%	FAST
A38	NB	907	795	-12%	OK
A38	SB	1143	934	-18%	FAST
Uttoxeter Road	Inbound	986	790	-20%	FAST

ROUTE	DIRECTION	OBSERVED	MODELLED	% CHANGE	TAG
Uttoxeter Road	Outbound	598	823	38%	SLOW
M1	Northbound	1343	1387	3%	OK
M1	Southbound	1447	1425	-2%	OK
A52	Eastbound	580	614	6%	OK
A52	Westbound	679	539	-21%	FAST
A50	Eastbound	1113	964	-13%	OK
A50	Westbound	761	788	4%	OK
A42	Southbound	816	845	4%	OK
A42	Northbound	794	901	14%	OK

Table 8. Derby Journey Time Validation – Evening Peak

ROUTE	DIRECTION	OBSERVED	MODELLED	% CHANGE	TAG
Stenson Road	Inbound	952	815	-14%	OK
Stenson Road	Outbound	926	1116	21%	SLOW
Osmaston Road	Inbound	1024	1105	8%	OK
Osmaston Road	Outbound	1074	1263	18%	SLOW
London Road	Inbound	757	920	22%	SLOW
London Road	Outbound	884	1212	37%	SLOW
Inner Ring Road	Clockwise	760	750	-1%	OK
Inner Ring Road	AntiClockwise	742	625	-16%	FAST
Burton Road	Inbound	694	774	12%	OK
Burton Road	Outbound	772	829	7%	OK
A5111	Clockwise	1744	1780	2%	OK
A5111	AntiClockwise	1390	1232	-11%	OK
A52 A61	Inbound	1020	729	-29%	FAST
A52 A61	Outbound	499	646	30%	SLOW
A38	NB	648	844	30%	SLOW

ROUTE	DIRECTION	OBSERVED	MODELLED	% CHANGE	TAG
A38	SB	670	947	41%	SLOW
Uttoxeter Road	Inbound	684	678	-1%	OK
Uttoxeter Road	Outbound	925	733	-21%	FAST
M1	Northbound	1546	1415	-8%	OK
M1	Southbound	1477	1397	-5%	OK
A52	Eastbound	646	799	24%	SLOW
A52	Westbound	560	558	0%	OK
A50	Eastbound	843	948	13%	OK
A50	Westbound	753	798	6%	OK
A42	Southbound	828	839	1%	OK
A42	Northbound	800	890	11%	OK

4.4 Model convergence

The convergence statistics are provided below. The model is considered stable, with the change in flows between the final four loops being limited, and Delta and %GAP values within acceptable values. A series of high-level sense checks on routes across the modelled area has also been carried out to ensure logical routings. These are provided in Appendix C.

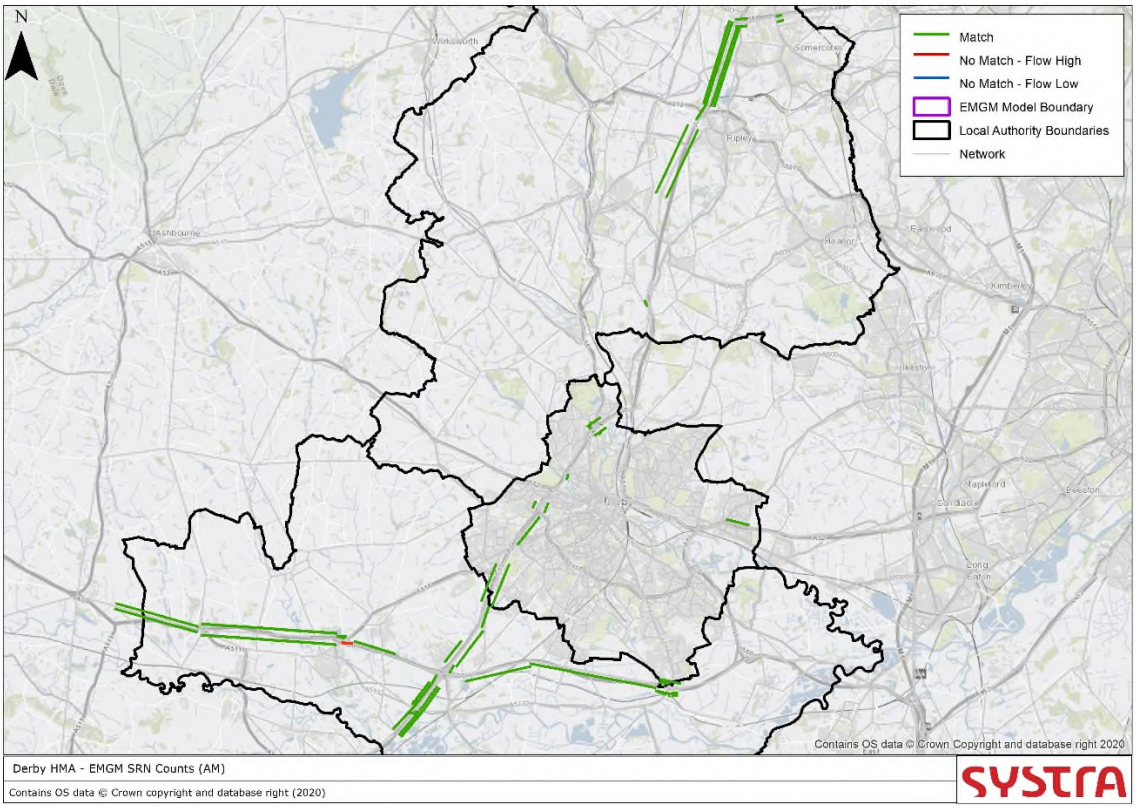
CRITERION	TARGET	AM PEAK	PM PEAK
Delta	< 0.1%	0.0355	0.0264
%GAP	< 0.1%	0.035	0.017
Number of Loops	150	55	46
% of links with < 1% flow change on final iteration	98%	98.0	98.2
Final iteration one		98.0	98.2
Final iteration two		98.1	98.1
Final iteration three		98.1	98.3

5. CONCLUSION

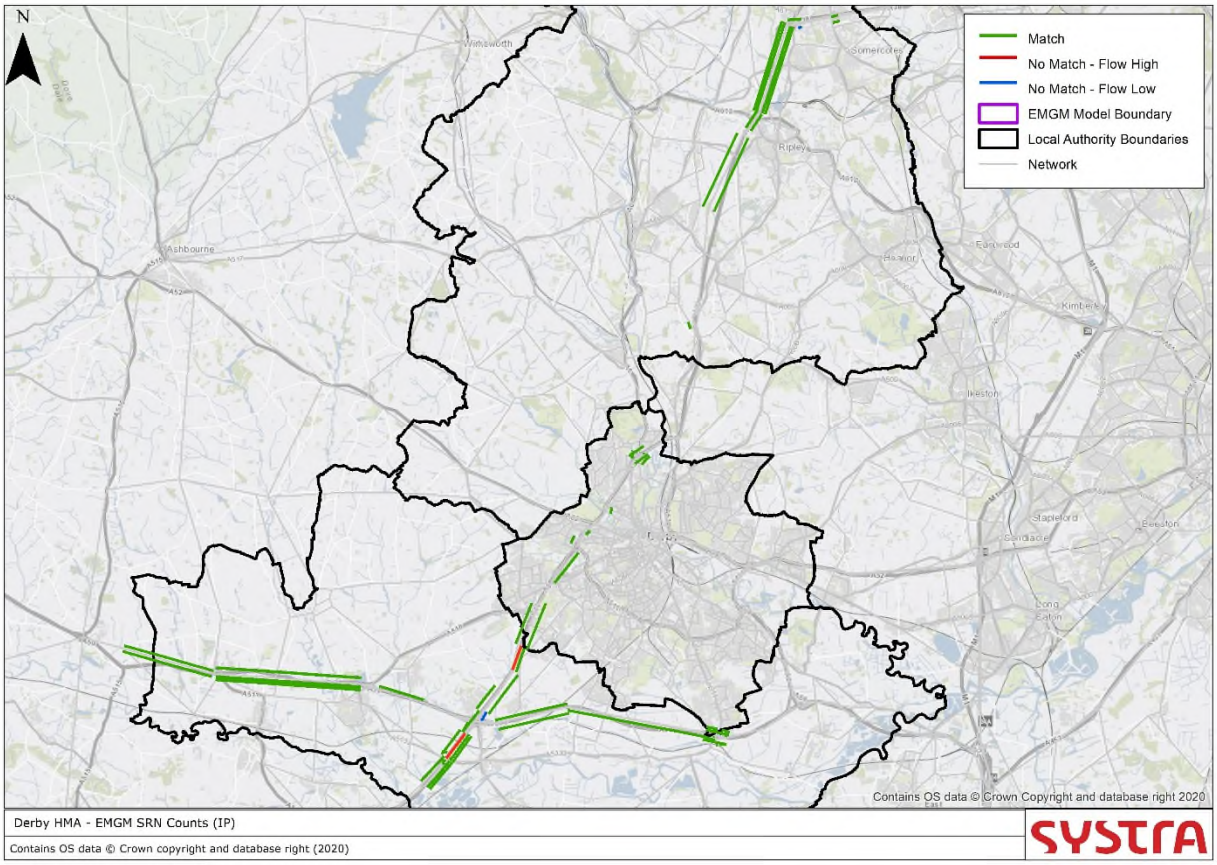
5.1.1 The EMGM achieves good levels of calibration and validation across the Derby HMA area, the local SRN network and the wider model. It is therefore recommended as 'fit for purpose' to inform on the impact of the developments and infrastructure of the Derby HMA Local Plan.

Appendix A

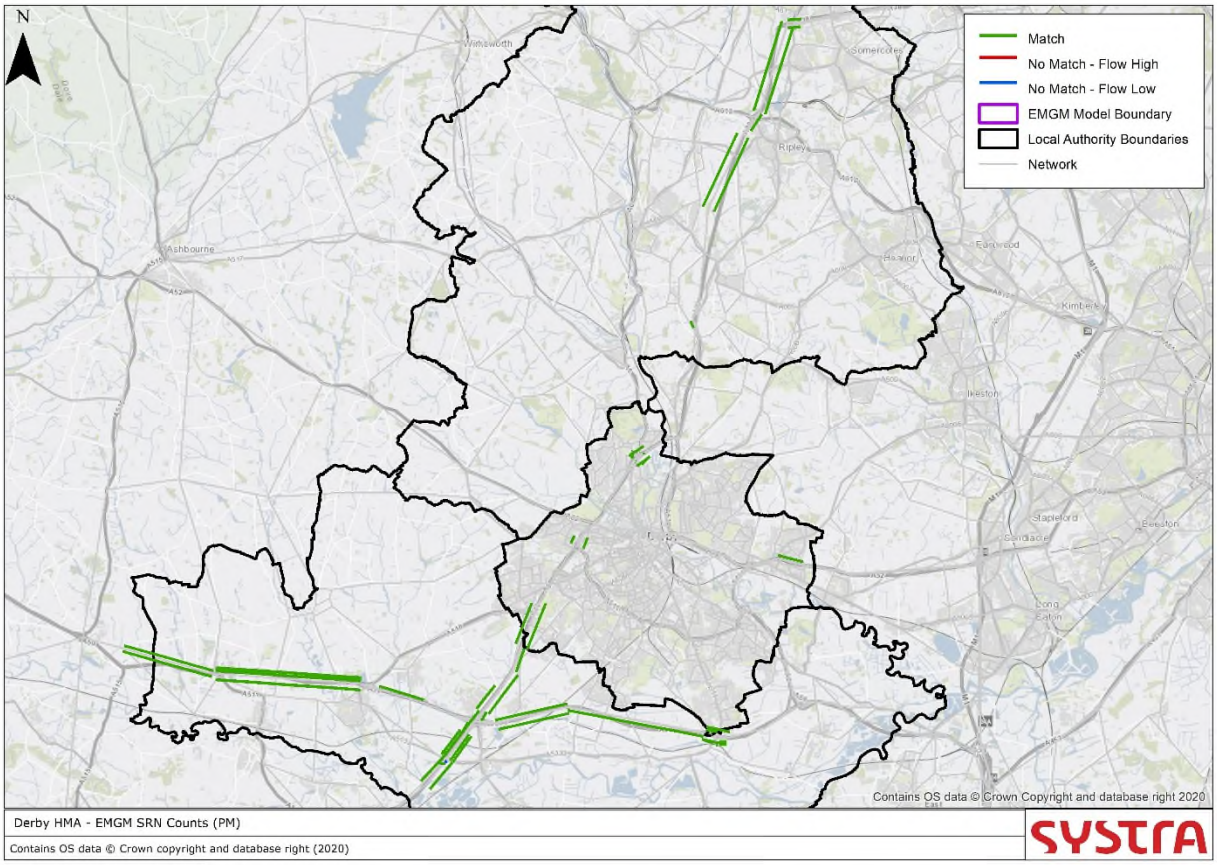
AM SRN Count Performance



IP SRN Count Performance

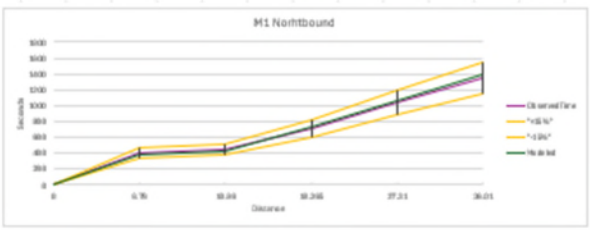


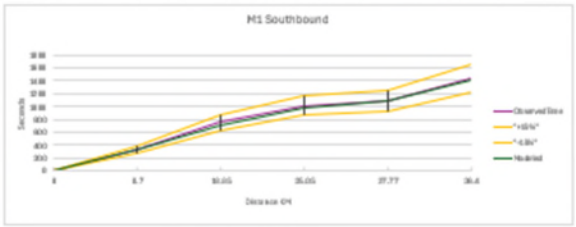
PM SRN Count Performance

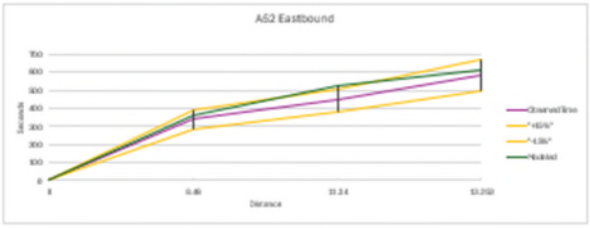


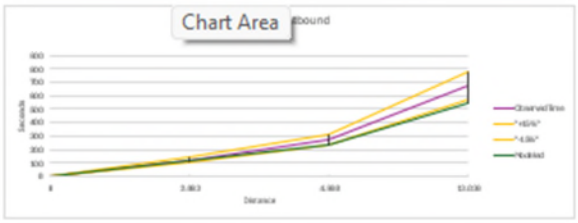
Appendix B

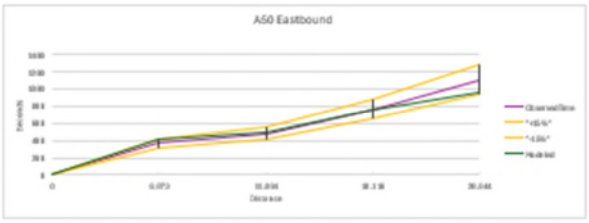
AM SRN Journey Time Graphs

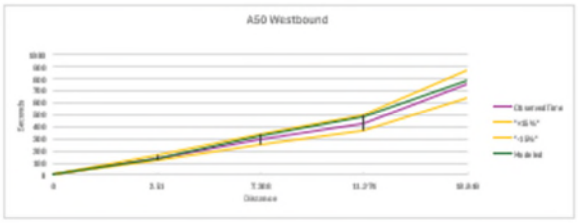


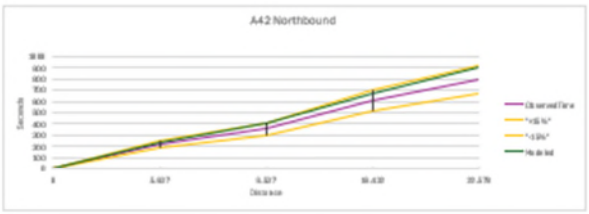


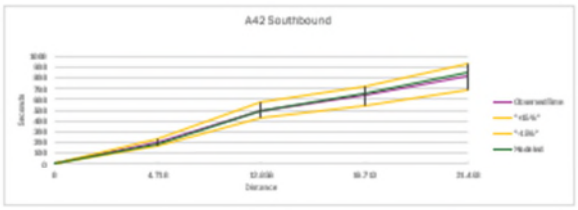


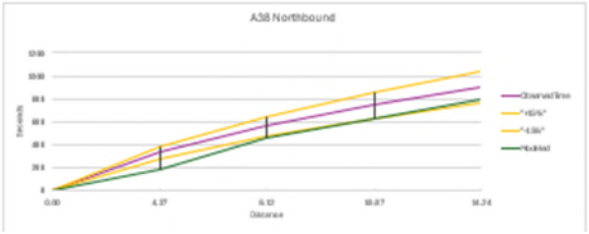


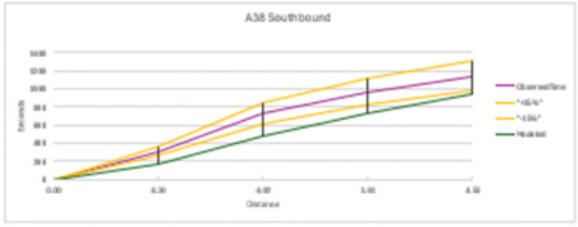




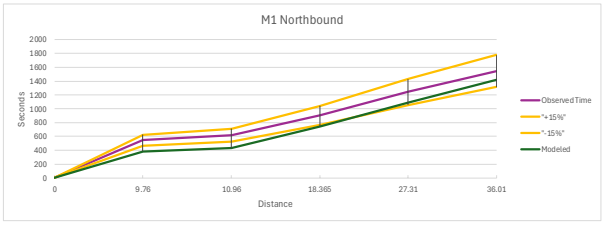


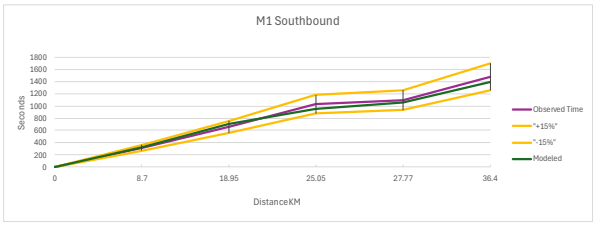


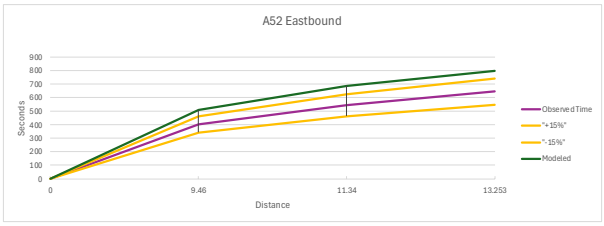


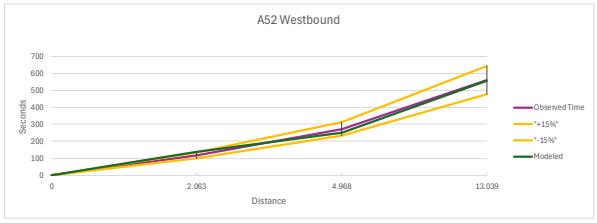


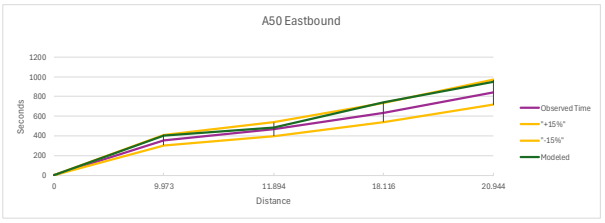
PM SRN Journey Time Graphs

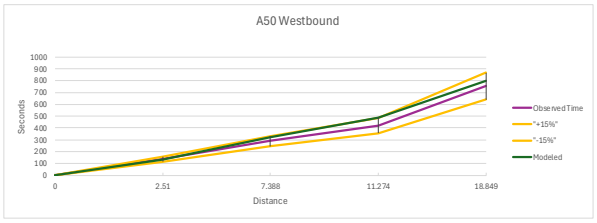


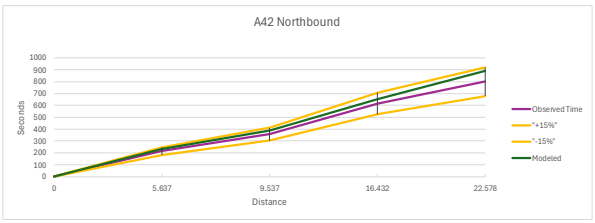


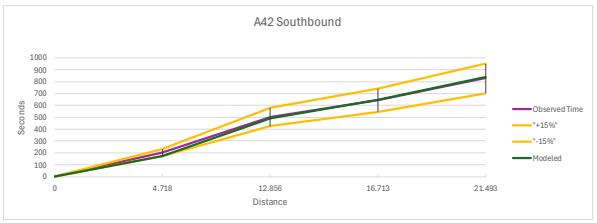


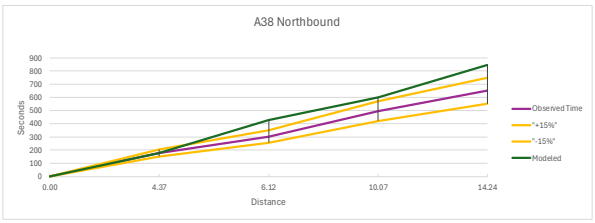


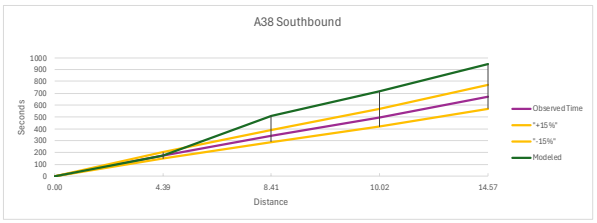




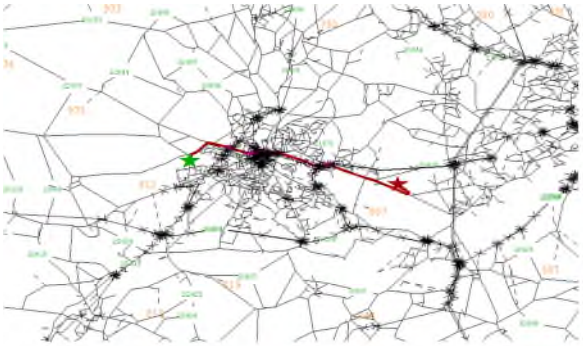


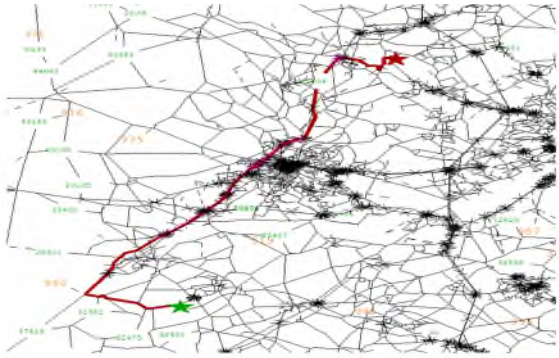


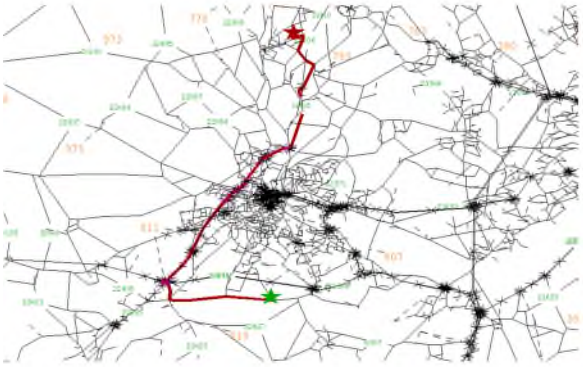


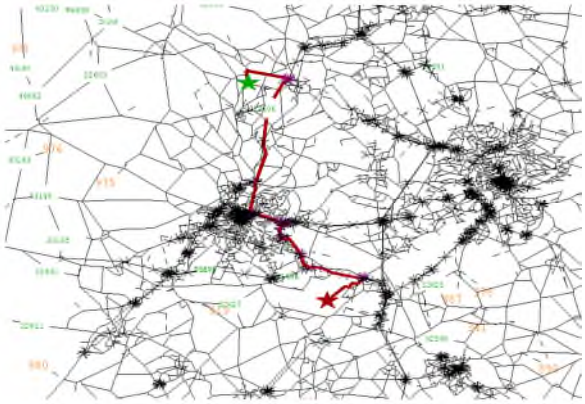


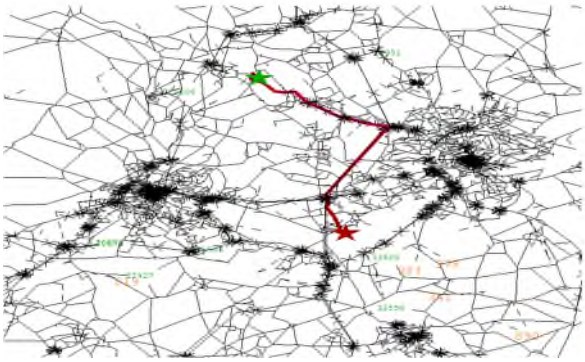
AM Routes Checks

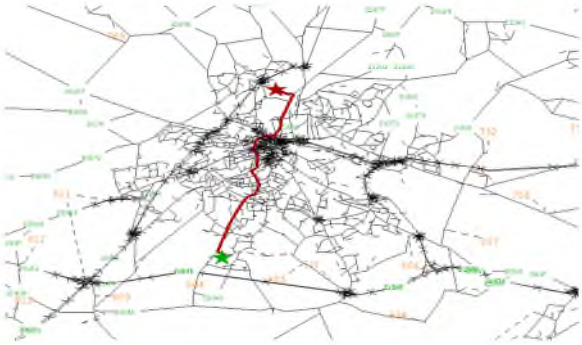




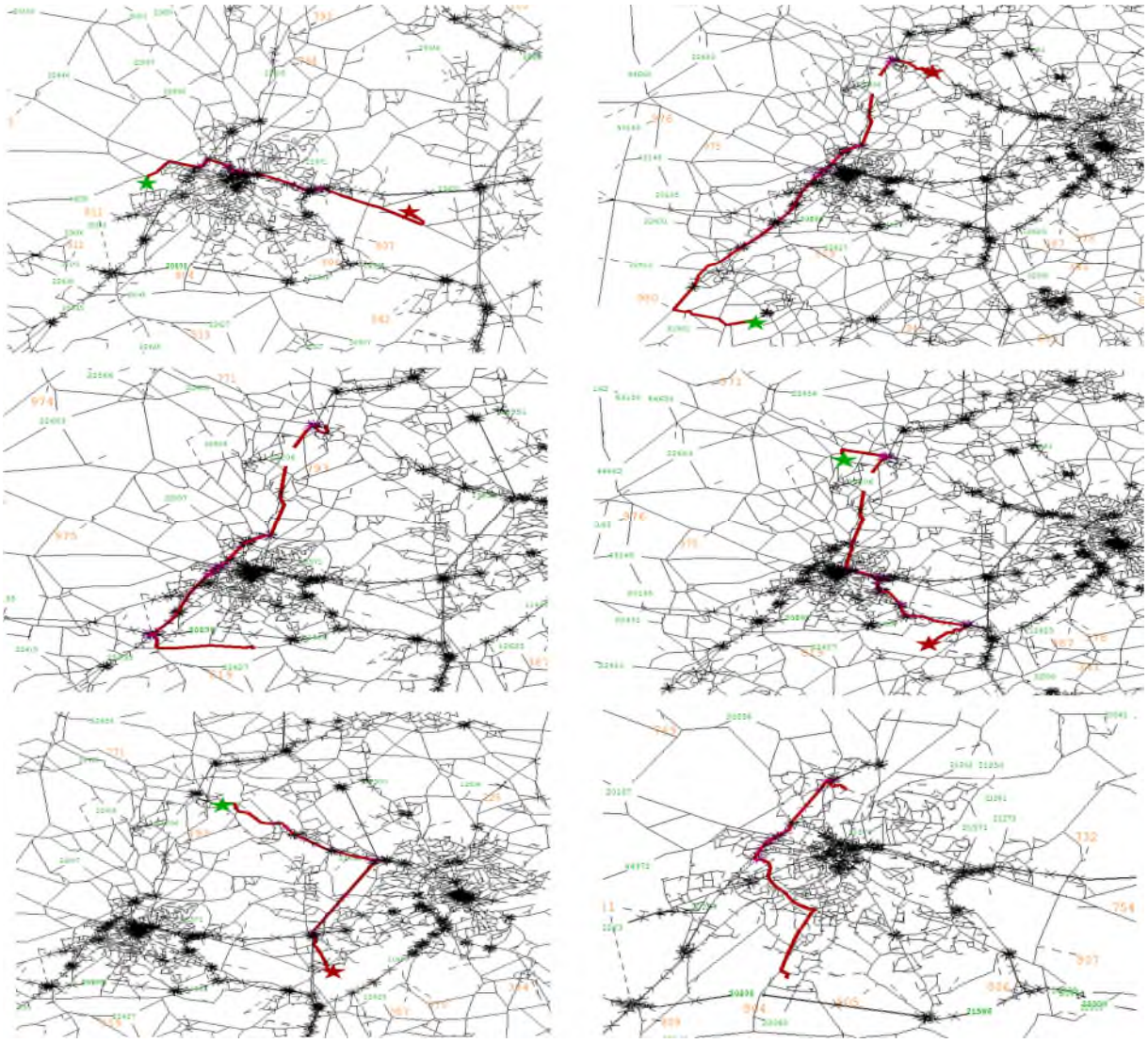








PM Route Checks



APPROVAL

Version	Name		Position	Date	Modifications
1	Author	James Homer	Principal Consultant	06/06/2025	Initial Draft
	Checked by	Rhian Collier	Associate Director	18/06/2025	
	Approved by	Duncan Irons	Director	19/06/2025	
2	Author	James Homer	Principal Consultant	04/11/2025	Final version including resolved comments
	Checked by	Rhian Collier	Associate Director	04/11/2025	
	Approved by	Duncan Irons	Director	04/11/2025	