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HS2

High Speed Rail (Crewe – Manchester) Environmental Statement

Volume 5: Appendix TR-005-00000_Report 2

Traffic and transport

Transport Assessment Annexes B - G - Report 2 of 2

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Department for Transport

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1 Introduction

1.1 Background information

1.1.1 This report provides documentation of a model performance review that has been carried out for the Greater Manchester Public Transport Model (GMPTM).

1.1.2 The local transport authority, Transport for Greater Manchester (TfGM), released to HS2 Ltd copies of the latest available model versions (as of March 2019).

1.1.3 The purpose of this report is to provide evidence that this public transport assignment model is suitable to support the Transport Assessment (TA) of the Proposed Scheme.

1.1.4 For the Proposed Scheme TA, the route is split into a number of geographical areas referred to as community areas (CA). The GMPTM will provide an evidence base for the Proposed Scheme TA covering the following CA:

- MA06 – Hulseheath to Manchester Airport;
- MA07 – Davenport Green to Ardwick; and
- MA08 – Manchester Piccadilly Station.

1.2 Model framework

1.2.1 TfGM's Greater Manchester suite of models is comprised of the following:

- exogenous forecasting model (EFM);
- variable demand model;
- highway assignment model; and
- public transport assignment model.

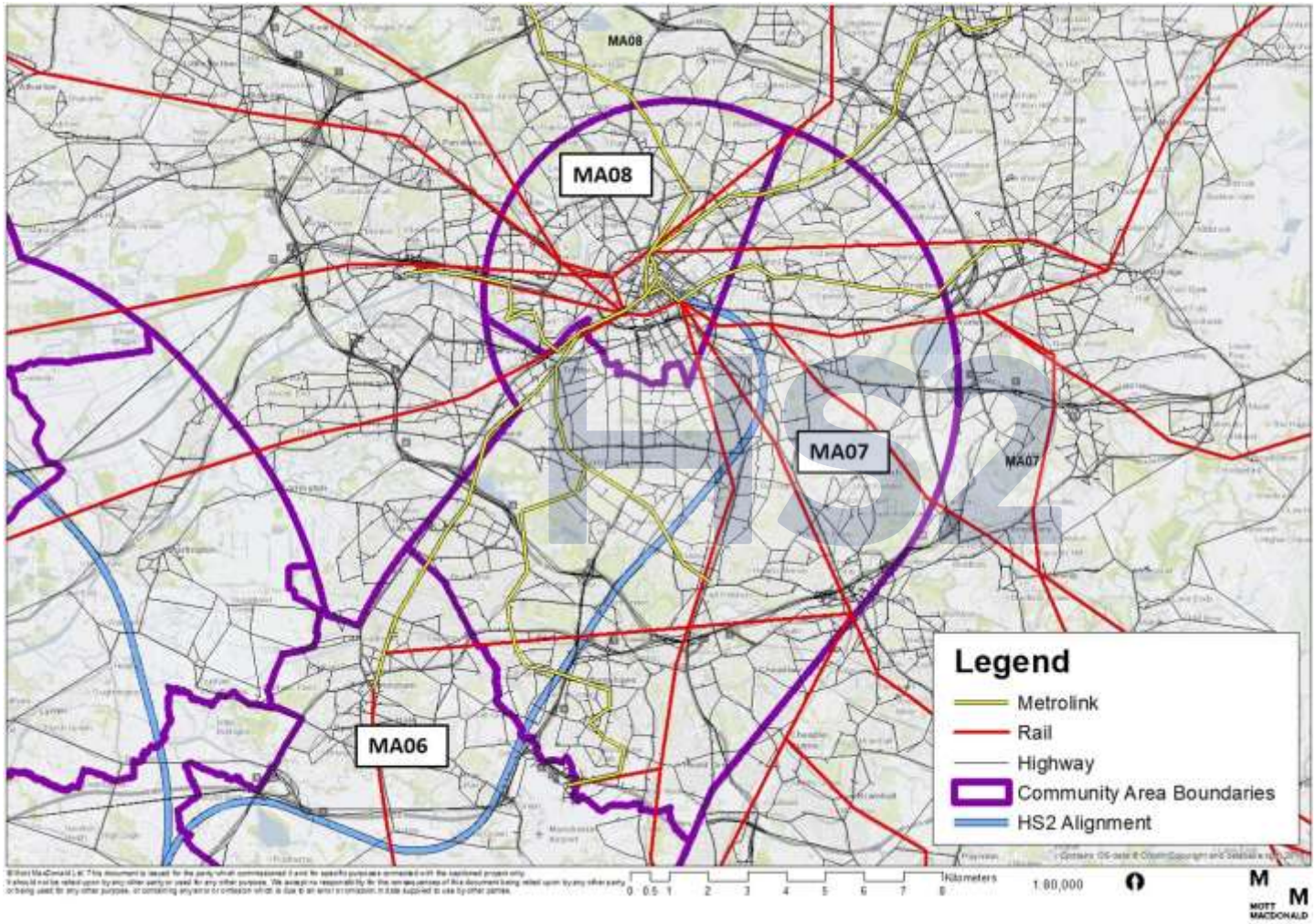
1.2.2 The Greater Manchester Variable Demand Model (GMVDM) has been developed within a Cube Voyager model software platform (version 6.4.3) and has a supporting EFM that supplies reference case projections of future year changes in land-use trips.

1.2.3 The GMPTM is a public transport assignment model and has also been developed within a Cube Voyager model software platform (version 6.4.3).

1.2.4 The Greater Manchester SATURN highway assignment Model (GMSM) is a strategic highway model that has been developed within a SATURN model software platform (version 11.3.12).

1.2.5 The detailed modelled study area for the above models covers the Greater Manchester district; and has supporting network and zone system detail to provide representation of external area supply and demand. Reference should be made to Figure 1.

Figure 1: Model study area



1.3 Model development

1.3.1 The TfGM suite of models were subject to a present year validation (PYV) exercise in 2017 to reflect 2017 base year spring transport conditions. This model has also been updated to account for changes to local and national planning datasets. This model update was completed by transport consultants working on behalf of TfGM.

1.3.2 The model updates have supported the following primary TfGM model applications:

- Manchester Airport Terminal 2 – Metrolink Extension – Strategic Outline Business Case (2017); and
- Greater Manchester Spatial Framework Strategy (GMSF – 2016 Dataset).

1.3.3 GMVDM04 (version DA_2017) was the latest demand model version available for release by TfGM and was developed to assess the GMSF (2016 Consultation Dataset).

1.3.4 TfGM is currently working on the development of GMSF forecasts based on the 2019 Consultation Dataset, although these models were not scheduled to be available for release until spring/summer 2020 at the earliest, which was too late for use in this assessment.

1.4 Model description

1.4.1 TfGM's public transport assignment model (GMPTM) has been developed for the following years:

- 2017 base year;
- 2025 first future year; and
- 2040 horizon future year.

1.4.2 The future years correspond with local plan assessment years.

1.4.3 The model is representative of the following time periods:

- AM peak hour – 08:00–09:00;
- average inter peak (IP) hour – 10:00–15:30; and
- PM peak hour – 17:00–18:00.

1.4.4 The model is comprised of the following sub transport modes:

- rail;
- metrolink;
- bus; and
- metroshuttle (free bus system).

1.4.5 Transport demand for model assignment is comprised of a single user class matrix representing demand for all public transport sub-modes and trip purpose types.

1.4.6 The base year model as received from TfGM has not been subject to any updates and enhancements for the Proposed Scheme application.

1.5 Model application objectives

1.5.1 The public transport assignment model will be used for the:

- provision of preliminary public transport usage data to inform scheme design;
- provision of data on operation of the public transport network including flow changes and crowding impacts; and
- provision of changes in public transport usage and network performance for the construction and operational phases of the Proposed Scheme to undertake the assessment of significant transport effects as part of the Environmental Statement.

1.5.2 The construction impacts of the Proposed Scheme will be mostly experienced on the highway network; although, there will be some impacts on public transport and active modes particularly during the closure of the Metrolink line between Manchester Piccadilly and Ashton-Under-Lyne. The operational assessment of the Proposed Scheme considers the likely impacts on station access and egress modes at Manchester Piccadilly and Manchester Airport rail stations (highway modes, public transport models and active modes).

1.5.3 The public transport assignment model will be used to assess the likely impacts of the Proposed Scheme operation on patronage forecasts for station access and egress modes (rail, bus and Metrolink). This will provide an evidence base for the Proposed Scheme TA. In addition, an assessment will also be carried out to consider the combined likely impacts of both the Proposed Scheme and Northern Powerhouse Rail (NPR) to inform scheme design.

2 Guidance used

2.1 Introduction

2.1.1 This public transport model performance review makes reference to the following Transport Analysis Guidance as published by the Department for Transport (DfT): TAG Unit M3.2 Public Transport Assignment (May 2020).

2.2 Public transport assignment model guidance

2.2.1 Provided below are extracts from DfT TAG Unit M3.2 in relation to the validation of public transport assignment models.

2.2.2 'The validation of a public transport passenger assignment model should involve three kinds of check:

- validation of the trip matrix;
- network and service validation; and
- assignment validation'.

2.2.3 'The DfTs recommendation is that across modelled screenlines, modelled flows should, in total, be within 15 percent of the observed values. On individual links in the network, modelled flows should be within 25 percent of the counts, except where observed hourly flows are particularly low (less than 150 passengers per hour)'.

3 Calibration and validation data

3.1 Overview

3.1.1 This section of the report presents an overview of public transport survey data that has been collected by TfGM for the purpose of assessing model calibration and validation performance.

3.1.2 The GMPTM is representative of an average weekday based on Monday to Thursday traffic conditions for a neutral period (Spring 2017).

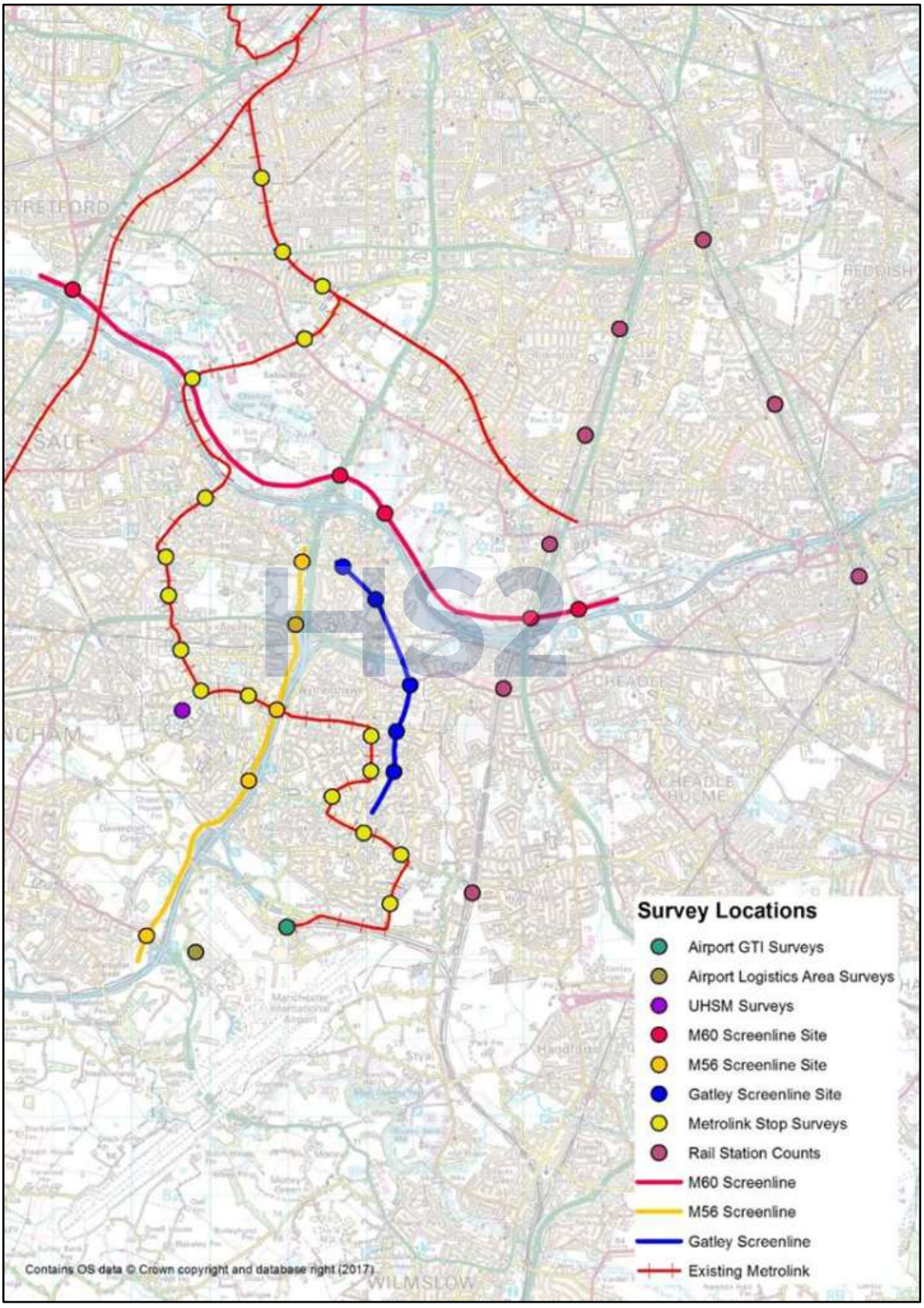
3.2 Review of TfGM survey data for model development

3.2.1 A programme of public transport origin and destination surveys and supporting passenger count surveys was commissioned in spring 2017, by TfGM. The collection of new survey data focussed on the South Manchester area, City Centre, and Regional Centres. This dataset was combined with survey data county wide. The dataset included new spring 2017 surveys, plus a rebasing of supplementary survey data that was within three years of the new model base year of 2017.

3.2.2 Figure 2 shows the location of passenger survey data collected in spring 2017 for the South Manchester area.

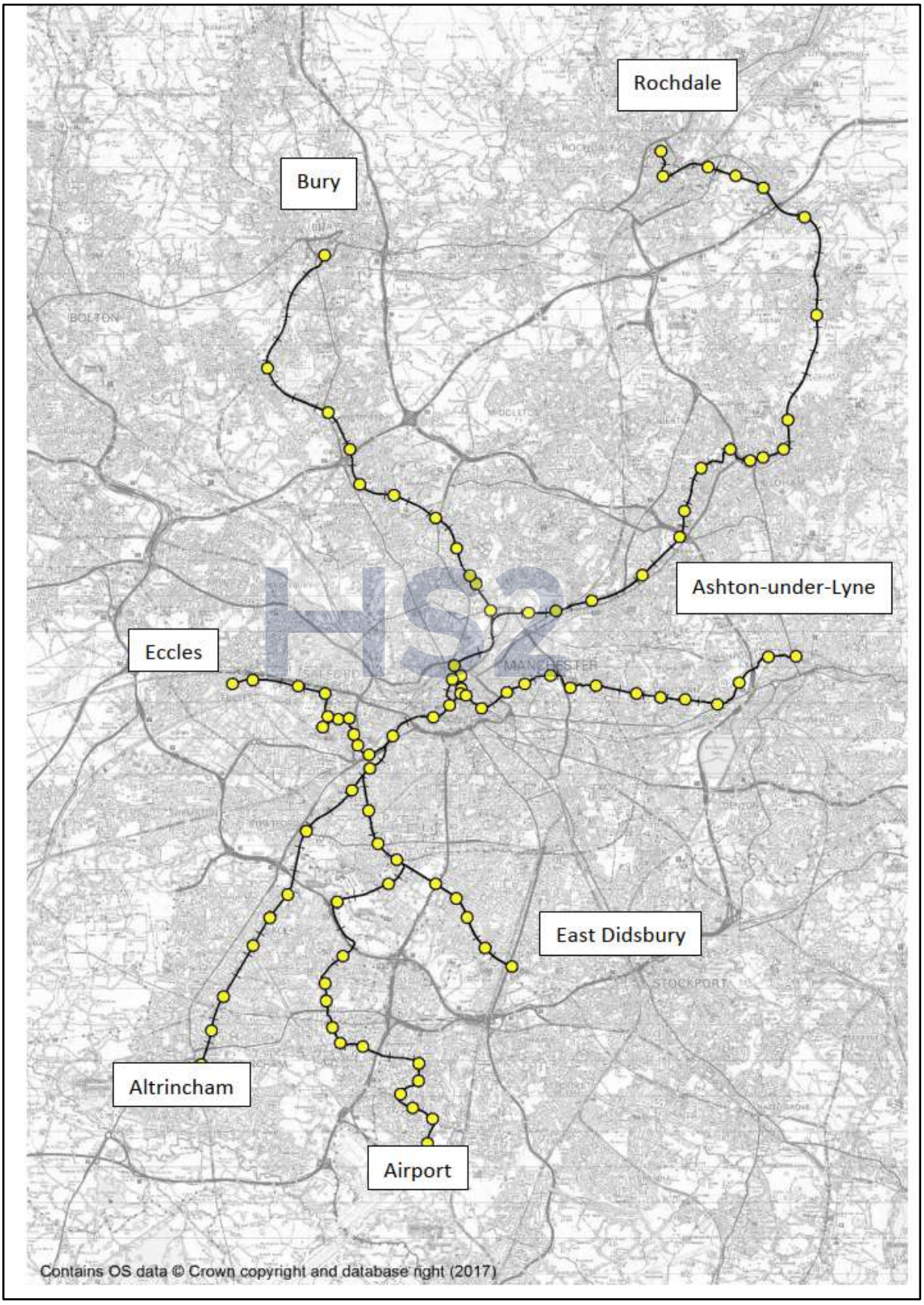
3.2.3 Figure 3, Figure 4 and Figure 5 show the location of passenger survey data collected for Metrolink, bus and rail respectively.

Figure 2: Location of 2017 South Manchester origin and destination surveys and count data



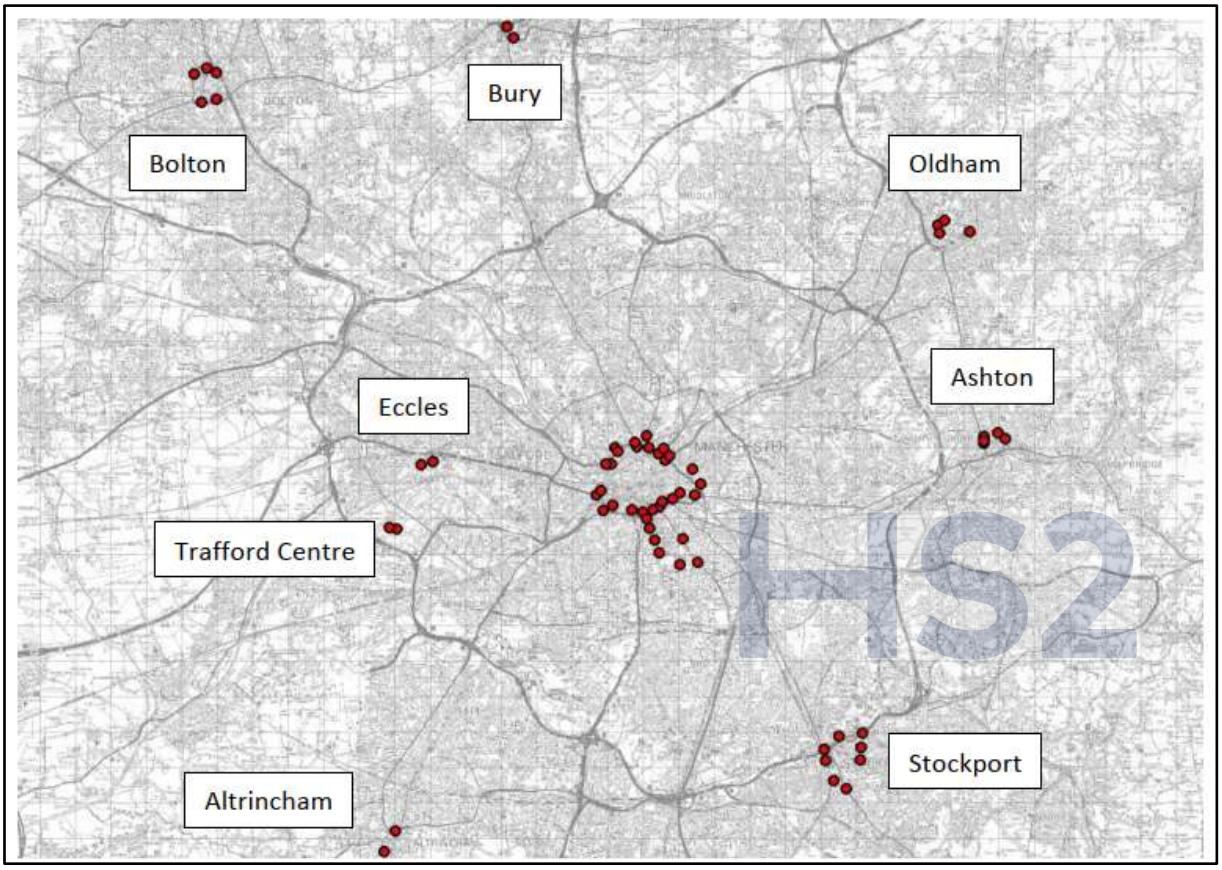
Source: TfGM – GMPTM Local Model Validation Report

Figure 3: Location of Metrolink passenger count surveys



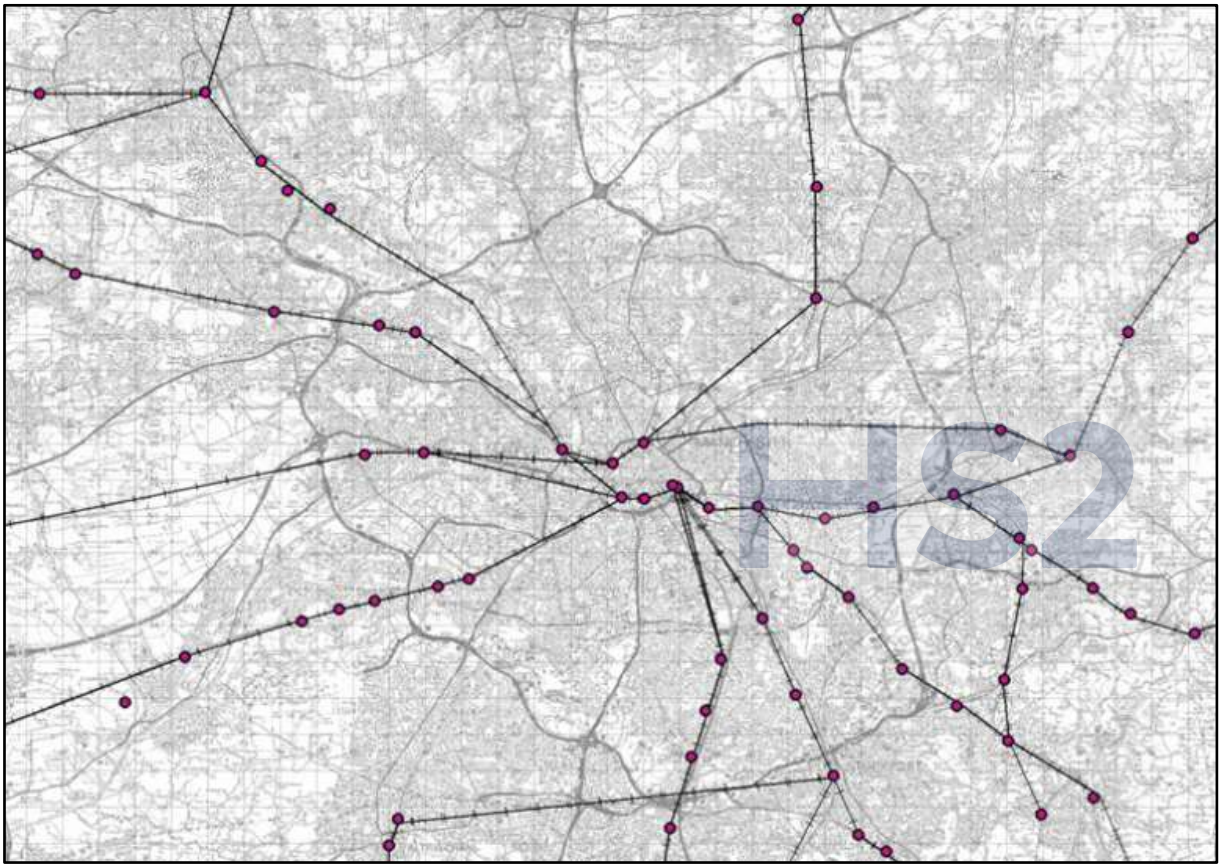
Source: TfGM – GMPTM Local Model Validation Report

Figure 4: Location of bus passenger count surveys



Source: TfGM – GMPTM Local Model Validation Report

Figure 5: Location of rail passenger count surveys



Source: TfGM – GMPTM Local Model Validation Report

4 Model calibration

4.1 Overview

4.1.1 This section of the report presents a review of the GMPTM (TfGM version) calibration performance in relation to transport supply and demand.

4.2 Transport supply – network and service checks

4.2.1 A high-level summary of service departures by mode and time period is presented in Table 1, and Table 2 presents a high-level summary of travel distance and speeds by mode.

4.2.2 As part of the review for the assessment of the Proposed Scheme, a detailed analysis of transport supply has been carried out within the local study areas of interest: Manchester Piccadilly and Manchester Airport, to verify that modelled transport modes provide an accurate representation of accessibility and journey time.

4.2.3 The modelled network and transit line files for Metrolink and local and national rail services connecting to Manchester Piccadilly rail station have been cross referenced to observed time-table information, frequencies, and capacities of rolling stock to check that the levels of service are representative of base year conditions. A similar exercise has also been carried out for local bus services to check that the levels of provision on routes adjacent to Manchester Piccadilly rail station are representative of base year conditions.

4.2.4 A verification exercise has also been carried out for the Manchester Airport area to check that the model is representative of base year transport supply conditions for Metrolink, rail and local bus services. The provision of modelled bus services and routing along the A538 Hale Road corridor to Altrincham and along Runger Lane to Manchester Airport have been cross-referenced to observed timetable information and calling patterns to check that the model provides a realistic representation of observed conditions.

4.2.5 The walk network has also been reviewed for Manchester Piccadilly and the Manchester Airport area to check that modelled walk links and the connectivity between zones and transit stops is representative of the catchment area serving these local study areas.

Table 1: Summary of service departures by mode and time period

Time period	Bus	Metrolink	Rail	Metroshuttle	Total
AM peak hour	1,439	80	212	18	1,749
Average IP hour	1,517	80	209	29	1,834
PM peak hour	1,370	80	217	19	1,687
Total	**4,325**	**240**	**639**	**66**	**5,270**

Source: TfGM – GMPTM Local Model Validation Report

Table 2: Summary of travel distance and speeds by mode

Time period	Vehicle distance (km)			Vehicle speeds (kph)		
	Bus	Metrolink	Rail	Bus	Metrolink	Rail
AM peak hour	22,096	1,757	12,510	17	27	61
Average IP hour	23,507	1,757	12,570	18	27	61
PM peak hour	20,732	1,757	12,863	17	27	61

Source: TfGM – GMPTM Local Model Validation Report

4.3 Model assignment parameters

4.3.1 The model assignment algorithm takes account of the following parameters:

- value of time;
- in-vehicle time factors;
- walk and wait time factors;
- boarding and interchange penalties;
- wait curves; and
- crowding curves.

4.3.2 Reference should be made to Table 3 which presents model assignment parameter values.

4.3.3 The model assignment also includes wait curves and crowding curves and these are applied to all public transport modes (rail, bus and Metrolink).

4.3.4 The calculated parameter values follow guidance as defined in DfT, TAG Unit M3.2 Public Transport Assignment guidance.

Table 3: Model assignment parameters

Model assignment parameter		Applied value/cost
Value of time	AM peak hour	£6.18
	Average IP hour	£5.30
	PM peak hour	£6.18
Vehicle time factor	Bus	1.00
	Metrolink	0.79
	Rail	0.71
Weight values	Walk time	1.90
	Wait time	1.90
Boarding penalty	Bus	5 minutes
	Metroshuttle	12 minutes
	All other public transport sub-modes	0 minutes
Interchange penalty	Between the same public transport sub-mode	2.5 minutes
	Between different public transport sub-modes	5.0 minutes

Source: TfGM

4.4 Transport demand

4.4.1 The public transport demand prior matrix was rebased to 2017 by TfGM using data from the following data-sources to develop matrices by sub mode and by trip purpose:

- metrolink ticket vending machine data county-wide;
- annual station-to-station matrices developed by the Office for Road and Rail from rail ticket sales data, county-wide;
- continuous passenger sampling survey data for bus;
- 2017 OD surveys at Manchester Airport, freight terminal and University Hospital South Manchester (UHSM);
- 2017 OD surveys on two bus screenlines again capturing movements relevant to the Manchester Airport; and
- 2017 OD surveys at Metrolink stations along the Manchester Airport line.

4.4.2 These matrices were subsequently combined to create a single public transport prior matrix for assignment. The prior matrix was then subject to factoring at a sector level before proceeding to matrix estimation.

4.4.3 The impact of matrix estimation has been reviewed at the following levels: matrix total level; zonal cell trip level; trip end level; and trip length distributions which have also been compared between the prior and post matrices.

4.4.4 Table 4 shows a comparison between prior and post matrix estimation totals, and Figure 6 to Figure 8 present a comparison of trip length distributions by time period.

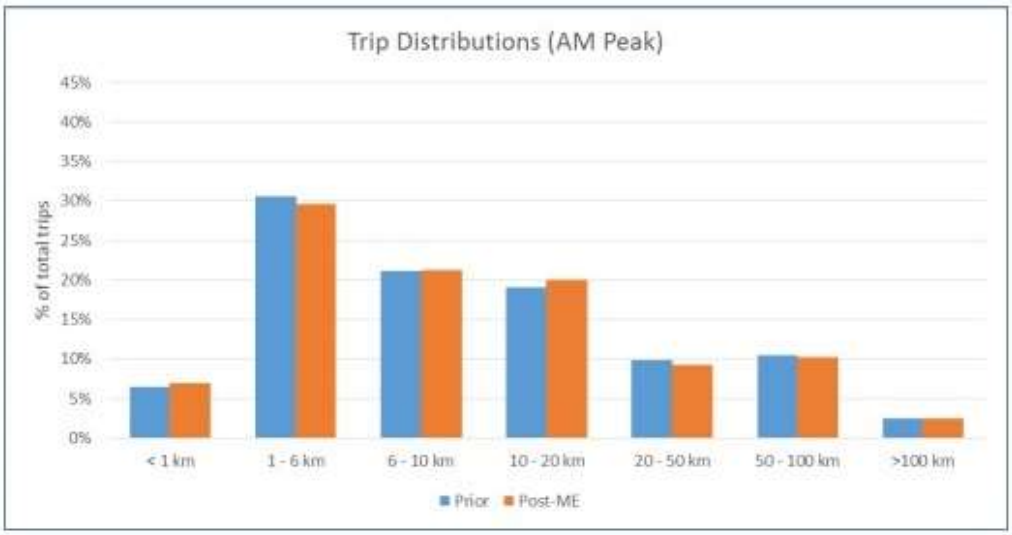
4.4.5 The comparisons show that matrix estimation has had a very small (less than 0.5 percent at the matrix total level) impact on the shape of matrices for all modelled time periods.

Table 4: Impact of matrix estimation – comparison of matrix totals

Matrix totals	AM peak value	Average IP hour	PM peak value
Prior matrix	90,455	55,711	70,367
Post matrix	90,807	55,809	70,527
Difference	352	98	160
Percentage difference	0.39%	0.18%	0.23%

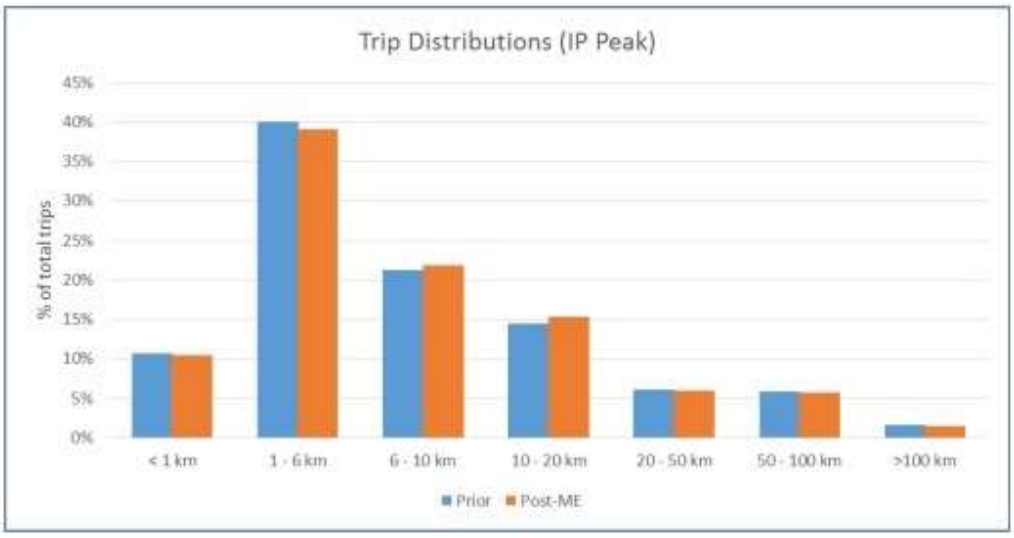
Source: TfGM – GMPTM Local Model Validation Report

Figure 6: Impact of matrix estimation – trip length distribution – AM peak hour



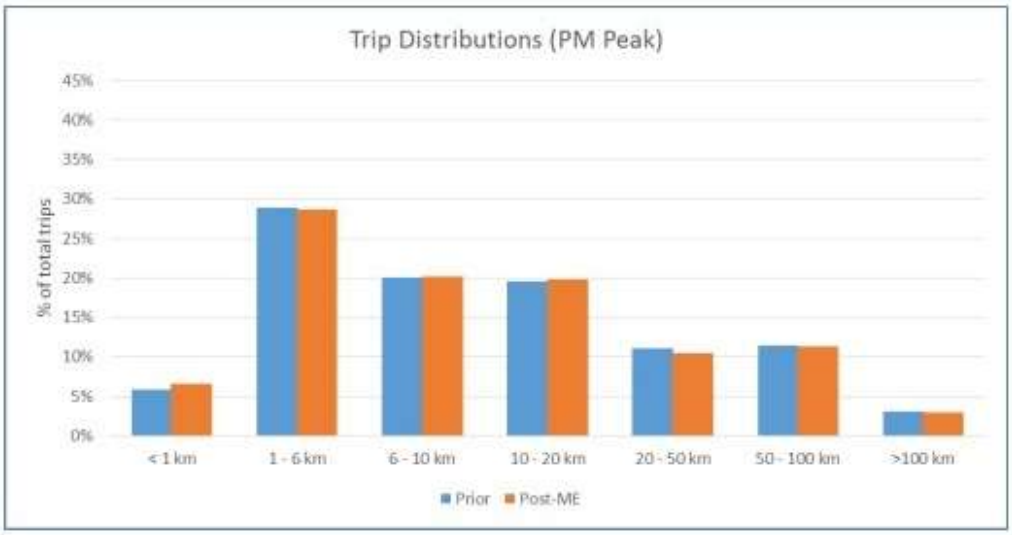
Source: TfGM – GMPTM Local Model Validation Report

Figure 7: Impact of matrix estimation – trip length distribution – average IP hour



Source: TfGM – GMPTM Local Model Validation Report

Figure 8: Impact of matrix estimation – trip length distribution – PM peak hour



Source: TfGM – GMPTM Local Model Validation Report

5 Model validation

5.1 Overview

5.1.1 This section of the report presents a discussion of the GMPTM (TfGM version) validation performance.

5.1.2 Mott MacDonald WSP Joint Venture (MWJV) has carried out a replication base year model run to check and confirm that the model achieves the same level of DfT TAG validation performance as reported in the GMPTM local Model validation report. The replication run demonstrated that the same model results were achieved, and that the model compares well against DfT TAG validation guidance criteria.

5.1.3 Presented below is a discussion of assignment model validation with reference to the following:

- Greater Manchester – area wide validation;
- local study area – rail validation;
- local study area – Metrolink validation; and
- local study area – bus validation.

5.2 Greater Manchester – area wide screenline validation

5.2.1 Public transport passenger flows by mode for boarding and alighting at stops have been compared across multiple screenlines covering Greater Manchester.

5.2.2 The validation of screenline passenger flows has been carried out by TfGM using passenger boarding and alighting count data at stops for rail and Metrolink. For bus, a comparison of observed and modelled link passenger count data has been carried out across screenlines for the inbound direction of travel.

5.2.3 The rail and Metrolink validation does not conform to the conventional DfT TAG comparison of comparing observed and modelled link passenger count data across screenlines. The same DfT TAG guidance criteria has been applied by TfGM to this alternative observed dataset.

5.2.4 Table 5 to Table 7 present an area wide validation summary for rail, Metrolink and bus. The rail validation summary shows that flows have been compared across 38 screenlines, and that all screenlines by time period achieve the DfT TAG criteria of modelled flows being within a flow difference range of less than 15 percent of observed flows. Reference should also be made to Appendix A, Section 1.

5.2.5 Table A 1 to Table A 3 which presents supporting information showing the validation of screenline flows for rail.

5.2.6 The Metrolink validation summary also shows that all screenlines by time period achieve the DfT TAG criteria of modelled flows being within a flow difference range of less than 15 percent of observed flows. Metrolink flows have been compared across 16 screenlines by direction. Reference should also be made to Appendix A, Section 2, Table A 4 to Table A 6 which presents supporting information showing the validation of screenline flows for Metrolink.

5.2.7 The bus validation summary shows that passenger link flows have been compared across nine screenlines for the inbound direction of travel, with exception to the PM peak hour time period which only provides a comparison for eight screenlines. The Manchester City Centre screenline has been omitted from the PM peak hour time period due to no observed data being available for validation.

5.2.8 The results show that only a partial validation of bus screenline flows is achieved across all time periods. The AM and IP time periods achieve six and seven out of nine respectively, and the PM achieves three out of nine screenlines within a flow difference range of less than 15 percent. From looking more closely at the PM screenline validation results, it is evident that there are a further three screenlines that lie within 25 percent range of observed flows.

5.2.9 Reference should also be made to Appendix A, Section 3, Table A 7 to Table A 9 which presents supporting information showing the validation of screenline flows for bus.

5.2.10 In summary, at an area wide level, a good validation of rail and Metrolink flows is achieved across Greater Manchester. It is also evident that the validation of bus flows achieves a lower level of performance. This is generally the case with the validation of bus elements of public transport assignment models.

Table 5: Rail – area wide screenline validation summary

DfT TAG screenline criteria – flow difference less than 15 percent			
Time period	**Total number of screenlines**	**Number of screenlines passing criteria**	**Percentage**
AM peak hour	38	38	100%
Average IP hour	38	38	100%
PM peak hour	38	38	100%

Table 6: Metrolink – area wide screenline validation summary

DfT TAG screenline criteria – flow difference less than 15 percent			
Time period	**Total number of screenlines**	**Number of screenlines passing criteria**	**Percentage**
AM peak hour	16	16	100%
Average IP hour	16	16	100%
PM peak hour	16	16	100%

Table 7: Bus – area wide screenline validation summary

DfT TAG screenline criteria – flow difference less than 15 percent			
Time period	**Total number of screenlines**	**Number of screenlines passing criteria**	**Percentage**
AM peak hour	9	6	67%
Average IP hour	9	7	78%
PM peak hour	8	3	38%

5.3 Local study area – rail validation

5.3.1 A validation of rail passenger flows has been carried out for a selection of key screenlines to provide evidence that there is a good correspondence between observed and modelled transport conditions within the local study areas of interest.

5.3.2 Reference should be made to Appendix B, Section 1, Table B 1 to B3 which present a validation of Manchester City Centre screenline flows for rail passenger boarding and alighting by time period.

5.3.3 The results show that the validation of all individual modelled flows by time period are within a 25 percent range of observed flows; and that the validation of all screenline modelled total flow is within a 15 percent range of observed flows. These results are in accordance with DfT TAG flow difference range acceptance criteria.

5.3.4 The validation of individual modelled flows for Manchester Piccadilly show a good correlation with observed flows and that flow differences meet DfT TAG criteria range for all time periods.

5.3.5 Reference should be made to Appendix B, Section 2, Table B 4 to Table B 6 which present a validation of Manchester Airport rail line screenline flows for rail passenger boarding and alighting by time period. The results show that the Manchester Airport rail stop meets individual flow difference criteria for all time periods. The overall Manchester Airport screenline meets flow difference criteria for all time periods.

5.3.6 In addition, reference should also be made to Appendix B, Section 3, Table B 7 to Table B 9, which present a validation of Stockport rail line screenline flows for rail passenger boarding and alighting by time period. The results show that the Stockport rail stop meets individual flow difference criteria for all time periods. The overall Stockport line screenline meets flow difference criteria for all time periods.

5.4 Local study area – Metrolink validation

5.4.1 A validation of Metrolink passenger flows has been carried out for a selection of key screenlines to provide evidence that there is a good correspondence between observed and modelled transport conditions within the local study areas of interest.

5.4.2 Reference should be made to Appendix C, Section 1, Table C 1 to Table C 3 which present a validation of Manchester City Centre screenline flows for Metrolink passenger boarding and alighting by time period.

5.4.3 The results show that the validation of screenline modelled total flow is within a 15 percent range of observed flows for all time periods. These results are in accordance with DfT TAG flow difference range acceptance criteria.

5.4.4 The validation of individual modelled flows for Manchester Piccadilly show a good correlation with observed flows for all time periods with exception to PM alighting whereby the validation shows an overestimation of modelled flows. The differential between observed and modelled PM peak hour alighting flows is 28 percent (265 passengers), which is just outside of the 25 percent guidance range.

5.4.5 Overall, the validation of individual modelled flows by time period shows a good level of performance with exception of a couple of sites that lie outside of the 25 percent flow criteria range.

5.4.6 Reference should be made to Appendix C, Section 2, Table C 4 to Table C 6 which present a validation of East Manchester screenline flows for Metrolink passenger boarding and alighting by time period. The results show that the screenline meets flow difference criteria for all time periods.

5.4.7 In addition, reference should also be made to Appendix C, Section 3, Table C 7 to Table C 9, which present a validation of Manchester Airport screenline flows for Metrolink passenger boarding and alighting by time period. The results show that the Manchester Airport Metrolink stop meets individual flow difference criteria for all time periods. The overall Manchester Airport screenline meets flow difference criteria for all time periods.

5.5 Local study area – bus validation

5.5.1 A validation of bus passenger flows has been carried out for the Manchester City Centre screenline for the AM and IP time periods to provide evidence that there is a good correspondence between observed and modelled transport conditions within the local study areas of interest.

5.5.2 The Manchester City Centre screenline has been omitted from the PM peak hour time period due to no observed data being available for validation.

5.5.3 Reference should be made to Appendix D, Section 1, Table D 1 to Table D 2 which present a validation of Manchester City Centre screenline flows for bus passenger inbound flows (passenger link counts) by time period. The results show that the screenline validation is within a 15 percent range of observed flows for all time periods. These results are in accordance with DfT TAG flow difference range acceptance criteria.

5.5.4 The AM validation of individual flows shows that 11 out of 14 sites (79 percent) validate, and that the IP shows that 9 out of 14 sites (64 percent) validate within the 25 percent guidance range.

5.5.5 The two key locations with reference to Manchester Piccadilly are A6 London Road and B6469 Fairfield Street. It is evident that A6 London Road validates for both AM and IP time periods; and that B6469 Fairfield Street only validates for the AM peak hour.

5.5.6 In general, the bus assignment validation is weaker than for Metrolink and rail modes. This is generally the case with the validation of bus elements of public transport assignment models, and this is influenced by relatively low flow volumes compared to other modes, multiple competing bus routes, and the impact of highway network delays.

6 Model convergence

6.1.1 Achieving a suitable level of model convergence is necessary to provide stable, consistent, and robust model results and to differentiate between real changes and those associated with differing degrees of convergence.

6.1.2 The public transport assignment model includes crowding on all modes (rail, bus and Metrolink), and therefore, the model is subjected to an iterative based assignment as opposed to a single iteration.

6.1.3 The crowding curves implemented in the model assignment have been calibrated for all modes (rail, bus and Metrolink).

6.1.4 The base year public transport assignment model for all time periods is subjected to eight iterative assignment loops before model convergence with crowding is stabilised. Table 8 presents an iterative measure of public transport model assignment convergence. The measure is based on the root mean square error (RMS) statistic as reported by the Cube Voyager software. The statistic provides a measure of the percentage change to link times for all links. The results show that the level of percentage of change is 0.28 for AM peak hour, 0.01 for average inter-peak hour, and 1.07 for PM peak hour. These values represent a low margin of error between datasets and are relatively close to the perfect fit of zero.

Table 8: Public transport model convergence – root mean square error

Root mean square error value (percentage change to link times based on all links)			
Iteration	**AM peak hour**	**Average IP hour**	**PM peak hour**
1	5.16	1.03	5.38
2	2.34	0.20	2.12
3	1.43	0.43	1.86
4	0.67	0.15	0.80
5	0.62	0.09	1.39
6	0.70	0.03	0.80
7	0.39	0.02	0.74
8	0.28	0.01	1.07

7 Summary and conclusions

7.1.1 The GMPTM 2017 base year public transport assignment model as supplied by TfGM provides a good representation of public transport passenger flows and conditions for Metrolink and rail modes for all model time periods.

7.1.2 The validation of screenline passenger flows for rail and Metrolink has been carried out by TfGM using passenger boarding and alighting count data at stops. This does not conform to the conventional DfT TAG comparison of comparing observed and modelled link passenger count data across screenlines, however, it does provide a good measure of model performance.

7.1.3 The area wide screenline validation summary results show that there is a good correspondence of modelled and observed flows for rail and Metrolink modes. The screenline validation of bus flows falls short of DfT TAG flow difference acceptance criteria; although, it is noted that bus validation is generally weaker in public transport models.

7.1.4 Further detailed analysis has been carried out for screenlines within the local study areas of interest of Manchester Piccadilly and Manchester Airport by mode. The analysis shows that there is a good correlation between observed and modelled flows for Manchester City Centre screenlines for rail and Metrolink.

7.1.5 The validation of individual rail passenger flows for Manchester Piccadilly shows that there is a good correlation between observed and modelled flows for all time periods. This is also true for the validation of Metrolink flows at Manchester Piccadilly except for PM peak hour alighting which shows an overestimation of modelled flows. The validation of PM peak hour Metrolink alighting flows is at 28 percent and exceeds the 25 percent target range for individual flows.

7.1.6 The validation of individual bus flows at locations adjacent to Manchester Piccadilly – A6 London Road and B6469 Fairfield Street show a good correspondence to observed flows for the AM peak hour.

7.1.7 In relation to Manchester Airport local study area, a validation of flows has been carried out for the existing rail and Metrolink lines. The validation shows that there is a good correspondence between observed and modelled flows for rail and Metrolink for all time periods.

7.1.8 In summary, the GMPTM 2017 base year model provides a good representation of local public transport assignment conditions for rail and Metrolink based on a comparison with observed passenger boarding and alighting count data. The bus flow validation also shows a good comparison between observed and modelled passenger link counts at a screenline level. The validation of individual link flows for bus is much more difficult to achieve due to relatively low flows compared to other modes, multiple competing bus routes, and the influence of highway network delays.

8 Acronyms

Table 9: Acronyms

Acronym	
GMSM	Greater Manchester SATURN Model
GMPTM	Greater Manchester Public Transport Model
GMVDM	Greater Manchester Variable Demand Model
LMVR	Local model validation report
MPR	Model performance report
TA	Transport Assessment
ES	Environmental Statement
DfT	Department for Transport
DMRB	Design Manual for Roads and Bridges
ATC	Automatic traffic count
MCC	Manual classified count
JTC	Junction turning count
GEH	Geoffrey Havers (statistic)
CDES	Civil Design and Environmental Services (Consultant)

9 References

Department for Transport (2020), *TAG unit M3.2 Public Transport Assignment*. Available online at: https://www.gov.uk/government/publications/webtag-tag-unit-m3-2-public-transport-assignment-modelling.

Appendix A: Area wide model validation

Rail – passenger boarding and alighting screenline summary

Table A 1: Rail – boarding and alighting passenger screenline summary – AM peak hour

Alighting – AM peak hour					
Screenline	**Modelled**	**Observed**	**Difference**	**Percentage difference**	**GEH**
City Centre	16,564	16,838	-274	-2%	2.12
East (Bredbury - Belle Vue)	45	44	2	4%	0.24
East (Glossop - Flowery Field)	143	143	0	0%	0.04
East (Guide Bridge - Ardwick)	141	142	0	0%	0.01
East (Marple and Romiley)	75	72	2	3%	0.26
East (via Stalybridge)	115	107	8	7%	0.76
East (Woodley - Hyde North)	23	22	1	5%	0.25
North (Bolton - Salford Crescent)	994	975	20	2%	0.62
North (Daisy Hill - Swinton)	75	74	1	1%	0.09
North (via Bolton)	288	293	-5	-2%	0.31
North East (via Rochdale)	185	181	3	2%	0.26
South (Airport line)	771	763	9	1%	0.31
South (Stockport - Levenshulme)	600	583	17	3%	0.69
South (via Altrincham)	231	210	21	10%	1.45
South (via Cheadle Hulme)	170	169	2	1%	0.13
South (via Hazel Grove)	136	141	-5	-4%	0.44
West (via Eccles)	80	84	-4	-4%	0.40
West (via Urmston)	171	169	2	1%	0.15

Alighting – AM peak hour					
Wigan	517	497	20	4%	0.89
Total	**21,325**	**21,507**	**-183**	**-1%**	**1.25**
Boarding – AM peak hour					
Screenline	**Modelled**	**Observed**	**Difference**	**Percentage difference**	**GEH**
City Centre	2,350	2,361	-11	0%	0.23
East (Bredbury - Belle Vue)	274	264	10	4%	0.64
East (Glossop - Flowery Field)	295	297	-3	-1%	0.15
East (Guide Bridge - Ardwick)	204	203	1	0%	0.06
East (Marple and Romiley)	388	389	-1	0%	0.05
East (via Stalybridge)	827	848	-21	-3%	0.73
East (Woodley - Hyde North)	52	46	6	14%	0.91
North (Bolton - Salford Crescent)	893	902	-9	-1%	0.31
North (Daisy Hill - Swinton)	510	537	-27	-5%	1.19
North (via Bolton)	451	470	-19	-4%	0.88
North East (via Rochdale)	731	808	-77	-9%	2.77
South (Airport line)	1,214	1,216	-3	0%	0.08
South (Stockport - Levenshulme)	1,359	1,404	-45	-3%	1.21
South (via Altrincham)	179	164	15	9%	1.18
South (via Cheadle Hulme)	449	444	5	1%	0.22
South (via Hazel Grove)	535	566	-31	-6%	1.34
West (via Eccles)	79	90	-11	-12%	1.19
West (via Urmston)	404	419	-15	-4%	0.72
Wigan	934	927	7	1%	0.24
Total	**12,128**	**12,359**	**-232**	**-2%**	**2.09**

Table A 2: Rail – boarding and alighting passenger screenline summary – average IP hour

Alighting – average IP hour					
Screenline	**Modelled**	**Observed**	**Difference**	**Percentage difference**	**GEH**
City Centre	3,174	3,190	-16	-1%	0.29
East (Bredbury - Belle Vue)	24	24	0	0%	0.00
East (Glossop - Flowery Field)	77	77	-1	-1%	0.08
East (Guide Bridge - Ardwick)	31	31	0	1%	0.03
East (Marple and Romiley)	36	34	1	4%	0.24
East (via Stalybridge)	85	82	3	4%	0.36
East (Woodley - Hyde North)	14	12	2	13%	0.46
North (Bolton - Salford Crescent)	336	328	9	3%	0.47
North (Daisy Hill - Swinton)	60	59	1	2%	0.13
North (via Bolton)	60	60	0	0%	0.01
North East (via Rochdale)	130	130	0	0%	0.04
South (Airport line)	510	503	7	1%	0.32
South (Stockport - Levenshulme)	275	275	0	0%	0.01
South (via Altrincham)	38	34	4	13%	0.72
South (via Cheadle Hulme)	42	42	0	0%	0.01
South (via Hazel Grove)	43	45	-2	-4%	0.29
West (via Eccles)	6	6	0	-5%	0.12
West (via Urmston)	46	46	0	-1%	0.06
Wigan	355	351	4	1%	0.22
Total	**5,343**	**5,331**	**12**	**0%**	**0.16**

Boarding – average IP hour					
Screenline	**Modelled**	**Observed**	**Difference**	**Percentage difference**	**GEH**
City Centre	3,021	3,074	-53	-2%	0.96
East (Bredbury - Belle Vue)	53	53	0	1%	0.06
East (Glossop - Flowery Field)	64	65	-1	-1%	0.08
East (Guide Bridge - Ardwick)	36	37	-1	-3%	0.21
East (Marple and Romiley)	60	59	0	0%	0.02
East (via Stalybridge)	194	195	-1	-1%	0.10
East (Woodley - Hyde North)	27	27	0	0%	0.00
North (Bolton - Salford Crescent)	380	380	0	0%	0.01
North (Daisy Hill - Swinton)	93	94	-1	-1%	0.14
North (via Bolton)	88	92	-4	-5%	0.46
North East (via Rochdale)	226	230	-3	-1%	0.23
South (Airport line)	622	621	2	0%	0.06
South (Stockport - Levenshulme)	343	342	1	0%	0.05
South (via Altrincham)	37	32	4	14%	0.75
South (via Cheadle Hulme)	61	61	1	1%	0.08
South (via Hazel Grove)	75	76	-2	-2%	0.19
West (via Eccles)	15	15	0	-1%	0.03
West (via Urmston)	81	83	-3	-3%	0.28
Wigan	484	485	-1	0%	0.05
Total	**5,960**	**6,023**	**-63**	**-1%**	**0.81**

Table A 3: Rail – boarding and alighting passenger screenline summary – PM peak hour

Alighting – PM peak hour					
Screenline	**Modelled**	**Observed**	**Difference**	**Percentage difference**	**GEH**
City Centre	3,423	3,433	-10	0%	0.17
East (Bredbury - Belle Vue)	184	191	-7	-4%	0.52
East (Glossop - Flowery Field)	545	569	-24	-4%	1.01
East (Guide Bridge - Ardwick)	152	154	-1	-1%	0.10
East (Marple and Romiley)	283	281	2	1%	0.11
East (via Stalybridge)	597	609	-12	-2%	0.50
East (Woodley - Hyde North)	39	36	2	6%	0.37
North (Bolton - Salford Crescent)	777	753	24	3%	0.87
North (Daisy Hill - Swinton)	375	389	-14	-4%	0.71
North (via Bolton)	361	381	-20	-5%	1.03
North East (via Rochdale)	545	584	-39	-7%	1.65
South (Airport line)	907	901	5	1%	0.17
South (Stockport - Levenshulme)	1,211	1,193	19	2%	0.53
South (via Altrincham)	158	159	-1	0%	0.05
South (via Cheadle Hulme)	321	320	0	0%	0.02
South (via Hazel Grove)	381	410	-29	-7%	1.44
West (via Eccles)	94	100	-6	-6%	0.61
West (via Urmston)	302	316	-14	-4%	0.81
Wigan	785	778	7	1%	0.25
Total	**11,440**	**11,561**	**-121**	**-1%**	**1.13**

Boarding – PM peak hour					
Screenline	**Modelled**	**Observed**	**Difference**	**Percentage difference**	**GEH**
City Centre	12,985	13,251	-266	-2%	2.32
East (Bredbury - Belle Vue)	62	61	1	2%	0.15
East (Glossop - Flowery Field)	126	127	-1	-1%	0.08
East (Guide Bridge - Ardwick)	140	150	-10	-7%	0.85
East (Marple and Romiley)	111	111	0	0%	0.03
East (via Stalybridge)	180	179	1	1%	0.07
East (Woodley - Hyde North)	28	28	0	1%	0.06
North (Bolton - Salford Crescent)	1,055	1,044	10	1%	0.32
North (Daisy Hill - Swinton)	106	109	-3	-2%	0.26
North (via Bolton)	309	326	-17	-5%	0.95
North East (via Rochdale)	265	267	-2	-1%	0.11
South (Airport line)	819	823	-4	0%	0.13
South (Stockport - Levenshulme)	584	578	6	1%	0.24
South (via Altrincham)	198	183	15	8%	1.08
South (via Cheadle Hulme)	249	249	0	0%	0.03
South (via Hazel Grove)	206	207	-1	0%	0.05
West (via Eccles)	68	71	-3	-5%	0.40
West (via Urmston)	212	230	-18	-8%	1.22
Wigan	596	572	23	4%	0.96
Total	**18,298**	**18,568**	**-270**	**-1%**	**1.99**

Metrolink – passenger boarding and alighting screenline summary

Table A 4: Metrolink – boarding and alighting passenger screenline summary – AM peak hour

Alighting – AM peak hour					
Screenline	**Modelled**	**Observed**	**Difference**	**Percentage difference**	**GEH**
City Centre	8,635	8,380	255	3%	2.76
Altrincham	3,027	3,068	-41	-1%	0.74
Bury	1,800	1,790	10	1%	0.23
Eccles	1,500	1,466	34	2%	0.89
Oldham	1,473	1,433	40	3%	1.04
South Manchester	624	622	2	0%	0.09
East Manchester	565	590	-25	-4%	1.02
Airport	841	827	14	2%	0.50
Total	**18,466**	**18,176**	**290**	**2%**	**2.14**
Boarding – AM peak hour					
Screenline	**Modelled**	**Observed**	**Difference**	**Percentage difference**	**GEH**
City Centre	4,576	4,290	286	7%	4.29
Altrincham	3,597	3,598	-2	0%	0.03
Bury	2,997	3,111	-114	-4%	2.06
Eccles	1,147	1,158	-11	-1%	0.32
Oldham	2,084	1,936	149	8%	3.31
South Manchester	2,112	2,127	-15	-1%	0.32
East Manchester	986	992	-6	-1%	0.19
Airport	966	964	3	0%	0.09
Total	**18,465**	**18,176**	**290**	**2%**	**2.14**

Table A 5: Metrolink – boarding and alighting passenger screenline summary – average IP hour

Alighting – average IP hour					
Screenline	**Modelled**	**Observed**	**Difference**	**Percentage difference**	**GEH**
City Centre	2,498	2,544	-46	-2%	0.92
Altrincham	1,060	1,065	-4	0%	0.13
Bury	1,383	1,400	-17	-1%	0.45
Eccles	599	556	42	8%	1.76
Oldham	1,174	1,179	-5	0%	0.13
South Manchester	414	414	0	0%	0.02
East Manchester	523	542	-19	-4%	0.83
Airport	518	544	-26	-5%	1.14
Total	**8,170**	**8,244**	**-74**	**-1%**	**0.82**
Boarding – average IP hour					
Screenline	**Modelled**	**Observed**	**Difference**	**Percentage difference**	**GEH**
City Centre	2,331	2,355	-23	-1%	0.48
Altrincham	1,086	1,084	3	0%	0.08
Bury	1,378	1,386	-8	-1%	0.23
Eccles	568	561	7	1%	0.29
Oldham	1,223	1,233	-10	-1%	0.28
South Manchester	451	456	-5	-1%	0.22
East Manchester	564	596	-33	-6%	1.36
Airport	568	573	-5	-1%	0.20
Total	**8,170**	**8,244**	**-74**	**-1%**	**0.82**

Table A 6: Metrolink – boarding and alighting passenger screenline summary – PM peak hour

Alighting – PM peak hour					
Screenline	**Modelled**	**Observed**	**Difference**	**Percentage difference**	**GEH**
City Centre	3,710	3,314	396	12%	6.69
Altrincham	2,502	2,481	21	1%	0.42
Bury	2,604	2,653	-48	-2%	0.94
Eccles	1,020	1,077	-58	-5%	1.78
Oldham	2,255	2,129	126	6%	2.69
South Manchester	1,543	1,499	44	3%	1.13
East Manchester	853	840	13	2%	0.45
Airport	819	778	41	5%	1.45
Total	**15,306**	**14,770**	**535**	**4%**	**4.37**
Boarding – PM peak hour					
Screenline	**Modelled**	**Observed**	**Difference**	**Percentage difference**	**GEH**
City Centre	7,141	6,699	441	7%	5.31
Altrincham	2,056	2,046	10	0%	0.23
Bury	1,136	1,129	7	1%	0.22
Eccles	1,654	1,581	72	5%	1.80
Oldham	1,352	1,328	24	2%	0.66
South Manchester	681	676	5	1%	0.18
East Manchester	646	648	-2	0%	0.06
Airport	640	663	-23	-3%	0.91
Total	**15,305**	**14,770**	**535**	**4%**	**4.36**

Bus – passenger link count – screenline summary

Table A 7: Bus – passenger link count (inbound) – screenline summary – AM peak hour

AM peak hour					
Screenline	**Modelled**	**Observed**	**Difference**	**Percentage difference**	**GEH**
Manchester	11,544	12,657	-1,113	-9%	10.12
Altrincham	354	436	-82	-19%	4.12
Ashton	359	498	-139	-28%	6.72
Bolton	1,598	1,568	30	2%	0.75
Bury	-	-	-	-	-
Eccles	457	582	-125	-21%	5.49
Oldham	1,051	1,114	-63	-6%	1.91
Rochdale	68	64	4	7%	0.53
Stockport	1,805	1,885	-80	-4%	1.86
Wigan	880	1,025	-145	-14%	4.70
Total	**18,116**	**19,828**	**-1,712**	**-9%**	**12.43**

Table A 8: Bus – passenger link count (inbound) – screenline summary – average IP hour

Average IP hour					
Screenline	**Modelled**	**Observed**	**Difference**	**Percentage difference**	**GEH**
Manchester	5,830	6,521	-691	-11%	8.79
Altrincham	205	227	-22	-10%	1.50
Ashton	303	478	-175	-37%	8.88
Bolton	1,465	1,593	-127	-8%	3.26
Bury	-	-	-	-	-
Eccles	488	551	-62	-11%	2.72

Average IP hour					
Oldham	785	885	-99	-11%	3.44
Rochdale	49	80	-30	-38%	3.75
Stockport	1,445	1,495	-50	-3%	1.30
Wigan	820	953	-133	-14%	4.46
Total	**11,390**	**12,780**	**-1,390**	**-11%**	**12.64**

Table A 9: Bus – passenger link count (inbound) – screenline summary – PM peak hour

PM peak hour					
Screenline	**Modelled**	**Observed**	**Difference**	**Percentage difference**	**GEH**
Manchester	-	-	-	-	-
Altrincham	96	141	-45	-32%	4.09
Ashton	214	271	-57	-21%	3.68
Bolton	753	933	-180	-19%	6.21
Bury	-	-	-	-	-
Eccles	561	512	49	10%	2.10
Oldham	749	815	-66	-8%	2.37
Rochdale	44	64	-20	-31%	2.73
Stockport	1141	1184	-44	-4%	1.28
Wigan	371	464	-93	-20%	4.57
Total	**3,928**	**4,384**	**-457**	**-10%**	**7.08**

Appendix B: Local study area – rail validation

City centre screenline validation – rail

Table B 1: City centre screenline – rail boarding and alighting passengers – AM peak hour

Alighting – AM peak hour						
Rail station	**Modelled**	**Observed**	**Difference**	**Percentage difference**	**GEH**	**Within percentage difference range**
Deansgate	807	797	10	1%	0.35	✓
Manchester Oxford Road	2,905	2,780	125	4%	2.34	✓
Manchester Piccadilly	8,438	8,407	31	0%	0.34	✓
Salford Central	1,340	1,445	-105	-7%	2.81	✓
Manchester Victoria	3,074	3,409	-335	-10%	5.88	✓
Total	**16,564**	**16,838**	**-274**	**-2%**	**2.12**	✓
Boarding – AM peak hour						
Rail station	**Modelled**	**Observed**	**Difference**	**Percentage difference**	**GEH**	**Within percentage difference range**
Deansgate	143	143	0	0%	0.04	-
Manchester Oxford Road	214	199	15	8%	1.05	✓
Manchester Piccadilly	1,563	1,593	-30	-2%	0.76	✓
Salford Central	36	36	0	1%	0.04	-
Manchester Victoria	393	390	3	1%	0.16	✓
Total	**2,350**	**2,361**	**-11**	**0%**	**0.23**	✓

Table B 2: City centre screenline – rail boarding and alighting passengers – average IP hour

Alighting – average IP hour						
Rail station	**Modelled**	**Observed**	**Difference**	**Percentage difference**	**GEH**	**Within percentage difference range**
Deansgate	109	108	1	1%	0.14	-
Manchester Oxford Road	406	390	16	4%	0.81	✓
Manchester Piccadilly	2,016	2,050	-34	-2%	0.75	✓
Salford Central	70	68	2	3%	0.24	-
Manchester Victoria	572	574	-2	0%	0.10	✓
Total	**3,174**	**3,190**	**-16**	**-1%**	**0.29**	✓
Boarding – average IP hour						
Rail station	**Modelled**	**Observed**	**Difference**	**Percentage difference**	**GEH**	**Within percentage difference range**
Deansgate	77	77	-1	-1%	0.08	-
Manchester Oxford Road	406	388	18	5%	0.89	✓
Manchester Piccadilly	1,983	2,048	-65	-3%	1.45	✓
Salford Central	70	70	0	0%	0.03	-
Manchester Victoria	485	491	-5	-1%	0.23	✓
Total	**3,021**	**3,074**	**-53**	**-2%**	**0.96**	✓

Table B 3: City centre screenline – rail boarding and alighting passengers – PM peak hour

Alighting – PM peak hour						
Rail station	**Modelled**	**Observed**	**Difference**	**Percentage difference**	**GEH**	**Within percentage difference range**
Deansgate	174	171	3	2%	0.24	✓
Manchester Oxford Road	377	354	23	7%	1.22	✓
Manchester Piccadilly	2,203	2,247	-44	-2%	0.94	✓
Salford Central	61	60	1	2%	0.12	-
Manchester Victoria	608	601	7	1%	0.28	✓
Total	**3,423**	**3,433**	**-10**	**0%**	**0.17**	✓
Boarding – PM peak hour						
Rail station	**Modelled**	**Observed**	**Difference**	**Percentage difference**	**GEH**	**Within percentage difference range**
Deansgate	545	569	-24	-4%	1.01	✓
Manchester Oxford Road	2,191	2,168	23	1%	0.49	✓
Manchester Piccadilly	7,036	6,989	47	1%	0.56	✓
Salford Central	827	896	-69	-8%	2.36	✓
Manchester Victoria	2,387	2,629	-242	-9%	4.84	✓
Total	**12,985**	**13,251**	**-266**	**-2%**	**2.32**	✓

Airport line screenline validation – rail

Table B 4: Airport line screenline – rail boarding and alighting passengers – AM peak hour

Alighting – AM peak hour						
Rail station	**Modelled**	**Observed**	**Difference**	**Percentage difference**	**GEH**	**Within percentage difference range**
Mauldeth Road	19	18	1	4%	0.15	-
Burnage	8	8	0	-6%	0.17	-
East Didsbury	85	84	1	1%	0.07	-
Gatley	36	36	0	1%	0.04	-
Heald Green	100	117	-18	-15%	1.69	-
Airport	525	499	25	5%	1.11	✓
Total	**771**	**763**	**9**	**1%**	**0.31**	✓
Boarding – AM peak hour						
Rail station	**Modelled**	**Observed**	**Difference**	**Percentage difference**	**GEH**	**Within percentage difference range**
Mauldeth Road	168	170	-1	-1%	0.11	✓
Burnage	130	132	-2	-2%	0.19	-
East Didsbury	113	113	0	0%	0.03	-
Gatley	178	175	3	2%	0.22	✓
Heald Green	157	162	-5	-3%	0.39	✓
Airport	468	465	3	1%	0.15	✓
Total	**1,214**	**1,216**	**-3**	**0%**	**0.08**	✓

Table B 5: Airport line screenline – rail boarding and alighting passengers – average IP hour

Alighting – average IP hour						
Rail station	**Modelled**	**Observed**	**Difference**	**Percentage difference**	**GEH**	**Within percentage difference range**
Mauldeth Road	21	22	-1	-3%	0.16	-
Burnage	17	18	-1	-3%	0.15	-
East Didsbury	17	17	1	4%	0.14	-
Gatley	20	19	1	5%	0.20	-
Heald Green	25	25	0	-2%	0.09	-
Airport	409	402	8	2%	0.38	✓
Total	**510**	**503**	**7**	**1%**	**0.32**	✓
Boarding – average IP hour						
Rail station	**Modelled**	**Observed**	**Difference**	**Percentage difference**	**GEH**	**Within percentage difference range**
Mauldeth Road	29	29	-1	-3%	0.14	-
Burnage	22	22	0	-2%	0.08	-
East Didsbury	30	30	0	0%	0.03	-
Gatley	27	27	1	3%	0.16	-
Heald Green	30	30	0	0%	0.01	-
Airport	485	483	2	0%	0.09	✓
Total	**622**	**621**	**2**	**0%**	**0.06**	✓

Table B 6: Airport line screenline – rail boarding and alighting passengers – PM peak hour

Alighting – PM peak hour						
Rail station	**Modelled**	**Observed**	**Difference**	**Percentage difference**	**GEH**	**Within percentage difference range**
Mauldeth Road	105	101	4	4%	0.37	-
Burnage	87	88	-1	-1%	0.13	-
East Didsbury	78	79	0	0%	0.02	-
Gatley	76	72	3	5%	0.38	-
Heald Green	120	145	-25	-17%	2.15	-
Airport	441	417	24	6%	1.17	✓
Total	**907**	**901**	**5**	**1%**	**0.17**	✓
Boarding – PM peak hour						
Rail station	**Modelled**	**Observed**	**Difference**	**Percentage difference**	**GEH**	**Within percentage difference range**
Mauldeth Road	46	47	-1	-2%	0.13	-
Burnage	23	23	0	0%	0.01	-
East Didsbury	54	53	1	2%	0.17	-
Gatley	35	35	0	1%	0.08	-
Heald Green	121	126	-6	-4%	0.50	-
Airport	540	539	1	0%	0.03	✓
Total	**819**	**823**	**-4**	**0%**	**0.13**	✓

Stockport line – screenline validation – rail

Table B 7: Stockport screenline – rail boarding and alighting passengers – AM peak hour

Alighting – AM peak hour						
Rail station	**Modelled**	**Observed**	**Difference**	**Percentage difference**	**GEH**	**Within percentage difference range**
Levenshulme	32	29	3	9%	0.50	-
Heaton Chapel	35	33	2	7%	0.39	-
Stockport	533	521	12	2%	0.51	✓
Total	**600**	**583**	**17**	**3%**	**0.69**	✓
Boarding – AM peak hour						
Rail station	**Modelled**	**Observed**	**Difference**	**Percentage difference**	**GEH**	**Within percentage difference range**
Levenshulme	237	249	-13	-5%	0.80	✓
Heaton Chapel	411	445	-34	-8%	1.65	✓
Stockport	711	710	2	0%	0.06	✓
Total	**1,359**	**1,404**	**-45**	**-3%**	**1.21**	✓

Table B 8: Stockport screenline – rail boarding and alighting passengers – average IP hour

Alighting – average IP hour						
Rail station	**Modelled**	**Observed**	**Difference**	**Percentage difference**	**GEH**	**Within percentage difference range**
Levenshulme	33	34	-1	-2%	0.14	-
Heaton Chapel	33	33	0	1%	0.03	-
Stockport	209	208	1	0%	0.06	✓
Total	**275**	**275**	**0**	**0%**	**0.01**	✓
Boarding – average IP hour						
Rail station	**Modelled**	**Observed**	**Difference**	**Percentage difference**	**GEH**	**Within percentage difference range**
Levenshulme	42	43	-1	-1%	0.09	-
Heaton Chapel	41	41	0	0%	0.01	-
Stockport	260	259	2	1%	0.09	✓
Total	**343**	**342**	**1**	**0%**	**0.05**	✓

Table B 9: Stockport screenline – rail boarding and alighting passengers – PM peak hour

Alighting – PM peak hour						
Rail station	**Modelled**	**Observed**	**Difference**	**Percentage difference**	**GEH**	**Within percentage difference range**
Levenshulme	202	202	-1	0%	0.04	✓
Heaton Chapel	352	368	-17	-5%	0.88	✓
Stockport	658	622	36	6%	1.41	✓
Total	**1,211**	**1,193**	**19**	**2%**	**0.53**	✓
Boarding – PM peak hour						
Rail station	**Modelled**	**Observed**	**Difference**	**Percentage difference**	**GEH**	**Within percentage difference range**
Levenshulme	35	34	2	5%	0.28	-
Heaton Chapel	52	51	1	2%	0.14	-
Stockport	497	494	3	1%	0.14	✓
Total	**584**	**578**	**6**	**1%**	**0.24**	✓

Appendix C: Local study area – Metrolink validation

City centre screenline validation – Metrolink

Table C 1: City centre screenline – Metrolink boarding and alighting passengers – AM peak hour

Alighting – AM peak hour						
Metrolink stop	**Modelled**	**Observed**	**Difference**	**Percentage difference**	**GEH**	**Within percentage difference range**
Deansgate-Castlefield	1,521	1,488	33	2%	0.84	✓
Exchange Square	447	248	199	80%	10.68	×
Market Street	1,506	1,697	-192	-11%	4.79	✓
Piccadilly	656	690	-33	-5%	1.29	✓
Piccadilly Gardens	1,235	1,217	17	1%	0.49	✓
Shudehill	533	588	-54	-9%	2.29	✓
St Peter's Square	2,025	1,827	197	11%	4.49	✓
Victoria	713	625	88	14%	3.39	✓
Total	**8,635**	**8,380**	**255**	**3%**	**2.76**	✓
Boarding – AM peak hour						
Metrolink stop	**Modelled**	**Observed**	**Difference**	**Percentage difference**	**GEH**	**Within percentage difference range**
Deansgate-Castlefield	804	791	13	2%	0.45	✓
Exchange Square	48	21	27	127%	4.54	-
Market Street	429	440	-11	-2%	0.51	✓
Piccadilly	2,159	1,912	247	13%	5.47	✓
Piccadilly Gardens	409	434	-25	-6%	1.21	✓
Shudehill	128	132	-4	-3%	0.34	-

Boarding – AM peak hour						
Metrolink stop	**Modelled**	**Observed**	**Difference**	**Percentage difference**	**GEH**	**Within percentage difference range**
St Peter's Square	287	244	43	17%	2.62	✓
Victoria	312	316	-4	-1%	0.21	✓
Total	**4,576**	**4,290**	**286**	**7%**	**4.29**	✓

Table C 2: City centre screenline – Metrolink boarding and alighting passengers – average IP hour

Alighting – average IP hour						
Metrolink stop	**Modelled**	**Observed**	**Difference**	**Percentage difference**	**GEH**	**Within percentage difference range**
Deansgate-Castlefield	299	301	-2	-1%	0.13	✓
Exchange Square	139	124	15	12%	1.34	-
Market Street	501	517	-16	-3%	0.71	✓
Piccadilly	364	390	-26	-7%	1.32	✓
Piccadilly Gardens	478	500	-23	-5%	1.02	✓
Shudehill	133	139	-6	-4%	0.51	-
St Peter's Square	375	366	9	2%	0.47	✓
Victoria	210	208	2	1%	0.13	✓
Total	**2,498**	**2,544**	**-46**	**-2%**	**0.92**	✓
Boarding – average IP hour						
Metrolink stop	**Modelled**	**Observed**	**Difference**	**Percentage difference**	**GEH**	**Within percentage difference range**
Deansgate-Castlefield	243	243	1	0%	0.04	✓
Exchange Square	98	83	15	19%	1.61	-
Market Street	453	465	-12	-3%	0.57	✓
Piccadilly	535	522	12	2%	0.54	✓
Piccadilly Gardens	379	407	-28	-7%	1.39	✓
Shudehill	114	122	-8	-6%	0.71	-
St Peter's Square	329	333	-4	-1%	0.23	✓
Victoria	180	180	0	0%	0.01	✓
Total	**2,331**	**2,355**	**-23**	**-1%**	**0.48**	✓

Table C 3: City centre screenline – Metrolink boarding and alighting passengers – PM peak hour

Alighting – PM peak hour						
Metrolink stop	**Modelled**	**Observed**	**Difference**	**Percentage difference**	**GEH**	**Within percentage difference range**
Deansgate-Castlefield	697	673	24	4%	0.92	✓
Exchange Square	116	74	42	56%	4.28	-
Market Street	366	389	-23	-6%	1.16	✓
Piccadilly	1,219	953	265	28%	8.05	×
Piccadilly Gardens	491	456	36	8%	1.64	✓
Shudehill	143	155	-12	-8%	0.96	✓
St Peter's Square	416	373	43	12%	2.17	✓
Victoria	261	241	21	9%	1.31	✓
Total	**3,710**	**3,314**	**396**	**12%**	**6.69**	✓
Boarding – PM peak hour						
Metrolink stop	**Modelled**	**Observed**	**Difference**	**Percentage difference**	**GEH**	**Within percentage difference range**
Deansgate-Castlefield	1,137	1,080	57	5%	1.72	✓
Exchange Square	489	326	163	50%	8.07	×
Market Street	1,115	1,257	-142	-11%	4.12	✓
Piccadilly	591	538	54	10%	2.27	✓
Piccadilly Gardens	775	774	1	0%	0.05	✓
Shudehill	523	574	-51	-9%	2.19	✓
St Peter's Square	1,973	1,661	311	19%	7.31	✓
Victoria	538	490	48	10%	2.12	✓
Total	**7,141**	**6,699**	**441**	**7%**	**5.31**	✓

East Manchester screenline validation – Metrolink

Table C 4: East Manchester screenline – Metrolink boarding and alighting passengers – AM peak hour

Alighting – AM peak hour						
Metrolink stop	**Modelled**	**Observed**	**Difference**	**Percentage difference**	**GEH**	**Within percentage difference range**
Ashton-under-Lyne	126	123	2	2%	0.20	-
Ashton West	15	14	1	8%	0.29	-
Ashton Moss	9	8	0	5%	0.15	-
Audenshaw	8	8	-1	-7%	0.20	-
Droylsden	36	36	0	0%	0.02	-
Cemetery Road	27	27	0	0%	0.00	-
Edge Lane	60	63	-4	-6%	0.47	-
Clayton Hall	23	18	5	26%	1.04	-
Velopark	68	113	-45	-40%	4.69	-
Etihad Campus	115	99	15	16%	1.49	-
Holt Town	26	22	4	19%	0.86	-
New Islington	53	57	-4	-6%	0.48	-
Total	**565**	**590**	**-25**	**-4%**	**1.02**	✓
Boarding – AM peak hour						
Metrolink stop	**Modelled**	**Observed**	**Difference**	**Percentage difference**	**GEH**	**Within percentage difference range**
Ashton-under-Lyne	122	112	10	9%	0.97	-
Ashton West	27	24	3	12%	0.59	-
Ashton Moss	34	40	-6	-14%	0.91	-
Audenshaw	48	45	3	6%	0.41	-
Droylsden	100	94	6	7%	0.62	-

Boarding – AM peak hour						
Metrolink stop	**Modelled**	**Observed**	**Difference**	**Percentage difference**	**GEH**	**Within percentage difference range**
Cemetery Road	63	50	13	27%	1.78	-
Edge Lane	116	114	2	2%	0.18	-
Clayton Hall	137	129	8	6%	0.69	-
Velopark	50	53	-3	-6%	0.43	-
Etihad Campus	73	70	3	5%	0.37	-
Holt Town	60	39	21	53%	2.94	-
New Islington	155	222	-67	-30%	4.86	×
Total	**986**	**992**	**-6**	**-1%**	**0.19**	✓

Table C 5: East Manchester screenline – Metrolink boarding and alighting passengers – average IP hour

Alighting – average IP hour						
Metrolink stop	**Modelled**	**Observed**	**Difference**	**Percentage difference**	**GEH**	**Within percentage difference range**
Ashton-under-Lyne	122	123	-1	-1%	0.07	-
Ashton West	19	19	-1	-3%	0.13	-
Ashton Moss	23	27	-3	-13%	0.68	-
Audenshaw	23	24	-1	-5%	0.25	-
Droylsden	50	51	-1	-2%	0.15	-
Cemetery Road	22	22	0	-2%	0.08	-
Edge Lane	47	50	-4	-8%	0.55	-
Clayton Hall	32	27	4	16%	0.83	-
Velopark	31	37	-5	-14%	0.87	-
Etihad Campus	90	93	-3	-3%	0.28	-
Holt Town	25	24	1	5%	0.23	-
New Islington	39	45	-6	-13%	0.88	-
Total	**523**	**542**	**-19**	**-4%**	**0.83**	✓
Boarding – average IP hour						
Metrolink stop	**Modelled**	**Observed**	**Difference**	**Percentage difference**	**GEH**	**Within percentage difference range**
Ashton-under-Lyne	111	111	1	1%	0.08	-
Ashton West	16	16	0	-2%	0.08	-
Ashton Moss	25	38	-13	-34%	2.29	-
Audenshaw	32	32	-1	-3%	0.15	-
Droylsden	61	61	0	0%	0.04	-
Cemetery Road	26	25	1	4%	0.18	-
Edge Lane	50	52	-2	-3%	0.25	-

Boarding – average IP hour						
Metrolink stop	**Modelled**	**Observed**	**Difference**	**Percentage difference**	**GEH**	**Within percentage difference range**
Clayton Hall	30	29	1	2%	0.10	-
Velopark	43	56	-13	-23%	1.82	-
Etihad Campus	97	94	3	4%	0.34	-
Holt Town	22	17	4	26%	1.01	-
New Islington	51	65	-14	-21%	1.82	-
Total	**564**	**596**	**-33**	**-6%**	**1.36**	✓

Table C 6: East Manchester screenline – Metrolink boarding and alighting passengers – PM peak hour

Alighting – PM peak hour						
Metrolink stop	**Modelled**	**Observed**	**Difference**	**Percentage difference**	**GEH**	**Within percentage difference range**
Ashton-under-Lyne	118	103	15	14%	1.42	-
Ashton West	52	48	4	9%	0.63	-
Ashton Moss	54	61	-7	-12%	0.94	-
Audenshaw	42	41	2	4%	0.27	-
Droylsden	69	63	6	10%	0.78	-
Cemetery Road	54	48	6	13%	0.88	-
Edge Lane	98	89	9	11%	0.97	-
Clayton Hall	65	56	9	15%	1.11	-
Velopark	57	72	-16	-22%	1.96	-
Etihad Campus	91	87	5	5%	0.49	-
Holt Town	48	31	18	58%	2.81	-
New Islington	104	143	-38	-27%	3.42	-
Total	**853**	**840**	**13**	**2%**	**0.45**	✓
Boarding – PM peak hour						
Metrolink stop	**Modelled**	**Observed**	**Difference**	**Percentage difference**	**GEH**	**Within percentage difference range**
Ashton-under-Lyne	120	118	2	2%	0.17	-
Ashton West	27	27	0	1%	0.04	-
Ashton Moss	37	41	-4	-9%	0.57	-
Audenshaw	33	34	-1	-2%	0.14	-
Droylsden	38	36	2	5%	0.27	-
Cemetery Road	21	20	1	4%	0.16	-
Edge Lane	53	51	2	4%	0.29	-

Boarding – PM peak hour						
Metrolink stop	**Modelled**	**Observed**	**Difference**	**Percentage difference**	**GEH**	**Within percentage difference range**
Clayton Hall	31	27	4	15%	0.75	-
Velopark	60	74	-14	-19%	1.74	-
Etihad Campus	100	95	5	5%	0.53	-
Holt Town	43	32	11	35%	1.81	-
New Islington	83	93	-10	-11%	1.05	-
Total	**646**	**648**	**-2**	**0%**	**0.06**	✓

Airport line – screenline validation – Metrolink

Table C 7: Airport – screenline – Metrolink boarding and alighting passengers – AM peak hour

Alighting – AM peak hour						
Metrolink stop	**Modelled**	**Observed**	**Difference**	**Percentage difference**	**GEH**	**Within percentage difference range**
Barlow Moor Rd	71	72	-1	-1%	0.09	-
Sale Water Park	7	7	0	0%	0.01	-
Northern Moor	49	48	1	3%	0.21	-
Wythenshawe Park	23	22	2	7%	0.32	-
Moor Rd	129	126	3	2%	0.27	-
Baguley	27	25	2	9%	0.44	-
Roundthorn	140	144	-4	-3%	0.36	-
Martinscroft	69	69	0	0%	0.03	-
Benchill	39	40	-1	-2%	0.11	-
Crossacres	39	7	32	451%	6.63	-
Wythenshawe Town Centre	132	115	17	15%	1.53	-
Robinswood Rd	0	16	-16	-100%	5.68	-
Peel Hall	17	43	-26	-60%	4.68	-
Shadowmoss	27	23	4	16%	0.75	-
Airport	72	71	1	1%	0.10	-
Total	**841**	**827**	**14**	**2%**	**0.50**	✓
Boarding – AM peak hour						
Metrolink stop	**Modelled**	**Observed**	**Difference**	**Percentage difference**	**GEH**	**Within percentage difference range**
Barlow Moor Rd	103	103	-1	-1%	0.07	-
Sale Water Park	40	41	-2	-4%	0.26	-

Boarding – AM peak hour						
Metrolink stop	**Modelled**	**Observed**	**Difference**	**Percentage difference**	**GEH**	**Within percentage difference range**
Northern Moor	148	162	-14	-8%	1.09	✓
Wythenshawe Park	107	103	4	4%	0.43	-
Moor Rd	61	59	2	3%	0.24	-
Baguley	33	31	2	7%	0.39	-
Roundthorn	42	48	-6	-13%	0.92	-
Martinscroft	69	67	2	3%	0.26	-
Benchill	119	108	11	10%	1.04	-
Crossacres	73	40	33	83%	4.42	-
Wythenshawe Town Centre	67	67	0	0%	0.02	-
Robinswood Rd	0	17	-17	-100%	5.80	-
Peel Hall	25	42	-18	-42%	3.08	-
Shadowmoss	39	34	5	16%	0.88	-
Airport	41	42	0	-1%	0.07	-
Total	**966**	**964**	**3**	**0%**	**0.09**	✓

Table C 8: Airport – screenline – Metrolink boarding and alighting passengers – average IP hour

Alighting – average IP hour						
Metrolink stop	**Modelled**	**Observed**	**Difference**	**Percentage difference**	**GEH**	**Within percentage difference range**
Barlow Moor Rd	30	30	0	-1%	0.04	-
Sale Water Park	24	24	0	0%	0.01	-
Northern Moor	43	43	0	1%	0.07	-
Wythenshawe Park	31	30	1	4%	0.19	-
Moor Rd	28	28	0	0%	0.01	-
Baguley	21	21	0	1%	0.03	-
Roundthorn	50	53	-3	-6%	0.42	-
Martinscroft	38	37	1	3%	0.18	-
Benchill	43	44	-2	-4%	0.26	-
Crossacres	13	14	-1	-5%	0.20	-
Wythenshawe Town Centre	97	104	-7	-7%	0.73	-
Robinswood Rd	0	15	-14	-97%	5.18	-
Peel Hali	13	13	0	2%	0.07	-
Shadowmoss	24	27	-3	-12%	0.62	-
Airport	64	63	1	2%	0.14	-
Total	**518**	**544**	**-26**	**-5%**	**1.14**	✓
Boarding – average IP hour						
Metrolink stop	**Modelled**	**Observed**	**Difference**	**Percentage difference**	**GEH**	**Within percentage difference range**
Barlow Moor Rd	40	41	-1	-3%	0.19	-
Sale Water Park	17	17	0	-2%	0.07	-
Northern Moor	40	40	0	1%	0.04	-
Wythenshawe Park	37	37	1	2%	0.14	-

Boarding – average IP hour						
Metrolink stop	**Modelled**	**Observed**	**Difference**	**Percentage difference**	**GEH**	**Within percentage difference range**
Moor Rd	47	48	0	-1%	0.04	-
Baguley	17	17	0	0%	0.00	-
Roundthorn	43	45	-2	-4%	0.29	-
Martinscroft	31	31	0	0%	0.00	-
Benchill	39	37	2	7%	0.40	-
Crossacres	13	12	1	10%	0.33	-
Wythenshawe Town Centre	101	100	1	1%	0.05	-
Robinswood Rd	0	7	-7	-100%	3.71	-
Peel Hall	50	48	2	4%	0.30	-
Shadowmoss	21	20	1	5%	0.23	-
Airport	71	74	-3	-3%	0.30	-
Total	**568**	**573**	**-5**	**-1%**	**0.20**	✓

Table C 9: Airport – screenline – Metrolink boarding and alighting passengers – PM peak hour

Alighting – PM peak hour						
Metrolink stop	**Modelled**	**Observed**	**Difference**	**Percentage difference**	**GEH**	**Within percentage difference range**
Barlow Moor Rd	83	83	-1	-1%	0.07	-
Sale Water Park	43	44	-1	-3%	0.18	-
Northern Moor	93	92	0	0%	0.03	-
Wythenshawe Park	73	72	1	1%	0.08	-
Moor Rd	110	58	52	90%	5.68	-
Baguley	28	29	0	-2%	0.09	-
Roundthorn	41	47	-6	-12%	0.84	-
Martinscroft	63	60	4	6%	0.46	-
Benchill	65	64	1	1%	0.09	-
Crossacres	29	32	-3	-8%	0.47	-
Wythenshawe Town Centre	74	74	0	0%	0.03	-
Robinswood Rd	2	19	-17	-89%	5.19	-
Peel Hall	24	17	8	45%	1.67	-
Shadowmoss	28	27	1	4%	0.18	-
Airport	62	60	3	4%	0.34	-
Total	**819**	**778**	**41**	**5%**	**1.45**	✓
Boarding – PM peak hour						
Metrolink stop	**Modelled**	**Observed**	**Difference**	**Percentage difference**	**GEH**	**Within percentage difference range**
Barlow Moor Rd	34	34	0	-1%	0.08	-
Sale Water Park	23	23	0	0%	0.00	-
Northern Moor	51	51	0	0%	0.03	-
Wythenshawe Park	32	31	1	2%	0.13	-

Boarding – PM peak hour						
Metrolink stop	**Modelled**	**Observed**	**Difference**	**Percentage difference**	**GEH**	**Within percentage difference range**
Moor Rd	31	29	2	6%	0.32	-
Baguley	28	28	0	1%	0.08	-
Roundthorn	106	110	-4	-4%	0.43	-
Martinscroft	23	22	1	3%	0.16	-
Benchill	35	34	1	4%	0.25	-
Crossacres	16	16	0	2%	0.08	-
Wythenshawe Town Centre	100	104	-3	-3%	0.32	-
Robinswood Rd	0	10	-10	-99%	4.43	-
Peel Hall	60	61	-1	-2%	0.19	-
Shadowmoss	23	23	0	1%	0.06	-
Airport	78	88	-10	-11%	1.06	-
Total	**640**	**663**	**-23**	**-3%**	**0.91**	✓

Appendix D: Local study area – bus validation

City centre screenline validation – bus

Table D 1: City centre – screenline – bus - passenger link count (inbound) – AM peak hour

Inbound – AM peak hour						
Road name	**Modelled**	**Observed**	**Difference**	**Percentage difference**	**GEH**	**Within percentage difference range**
A34 Oxford Rd	2,343	2,466	-123	-5%	2.52	✓
A5103 Medlock St	142	231	-89	-39%	6.52	×
A56 Chester Rd	100	119	-19	-16%	1.80	-
A56 Gt Ducie St	285	286	-1	0%	0.03	✓
A6 Chapel St	1,884	1,938	-54	-3%	1.24	✓
A6 London Rd	1,846	1,952	-106	-5%	2.42	✓
A6041 Blackfriars Rd	391	388	3	1%	0.13	✓
A6042 Corporation St	674	665	9	1%	0.35	✓
A6143 Water St	0	129	-129	-100%	16.06	-
A664 Shudehill	1,284	1,366	-82	-6%	2.24	✓
B6469 Fairfield St	316	405	-89	-22%	4.70	✓
C Cambridge St	259	264	-5	-2%	0.32	✓
U Oldham St	1,628	1,971	-343	-17%	8.09	✓
Upper Brook Street	392	477	-85	-18%	4.07	✓
Total	**11,544**	**12,657**	**-1,113**	**-9%**	**10.12**	✓

Table D 2: City centre – screenline – bus – passenger link count (inbound) – average IP hour

Inbound – average IP hour						
Road name	**Modelled**	**Observed**	**Difference**	**Percentage difference**	**GEH**	**Within percentage difference range**
A34 Oxford Rd	1,390	1,508	-118	-8%	3.10	✓
A5103 Medlock St	80	123	-43	-35%	4.28	-
A56 Chester Rd	66	90	-23	-26%	2.62	-
A56 Gt Ducie St	234	274	-40	-15%	2.54	✓
A6 Chapel St	875	893	-18	-2%	0.59	✓
A6 London Rd	833	855	-22	-3%	0.74	✓
A6041 Blackfriars Rd	217	220	-2	-1%	0.16	✓
A6042 Corporation St	243	239	4	2%	0.27	✓
A6143 Water St	0	68	-68	-100%	11.62	-
A664 Shudehill	663	711	-48	-7%	1.82	✓
B6469 Fairfield St	163	232	-69	-30%	4.88	×
C Cambridge St	250	253	-3	-1%	0.20	✓
U Oldham St	736	847	-110	-13%	3.92	✓
Upper Brook Street	79	211	-132	-62%	10.95	×
Total	**5,830**	**6,521**	**-691**	**-11%**	**8.79**	✓

Annex C: Model performance report – Greater Manchester SATURN Model (GMSM)

Contents

Tables

Figures

1 Introduction

1.1 Background information

1.1.1 This report provides documentation of the model performance review that has been carried out for the Greater Manchester SATURN highway assignment Model (GMSM).

1.1.2 The local transport authority, Transport for Greater Manchester (TfGM), released to HS2 Ltd copies of the latest available model versions (as of March 2019).

1.1.3 The GMSM has subsequently been updated by HS2 Ltd transport consultants, Mott MacDonald WSP Joint Venture (MWJV), to include additional network and spatial detail within the local study areas around Manchester Piccadilly High Speed Station and Manchester Airport High Speed Station.

1.1.4 The purpose of this report is to provide evidence that this highway assignment model is suitable to support the Transport Assessment (TA) of the Proposed Scheme.

1.1.5 For the Proposed Scheme TA, the route is split into a number of geographical areas referred to as community areas (CA). The GMSM will provide an evidence base for the Proposed Scheme TA covering the following CA:

- MA06 – Hulseheath to Manchester Airport;
- MA07 – Davenport Green to Ardwick; and
- MA08 – Manchester Piccadilly Station.

1.2 Model framework

1.2.1 TfGM's Greater Manchester suite of models is comprised of the following:

- exogenous forecasting model (EFM);
- variable demand model;
- highway assignment model; and
- public transport assignment model.

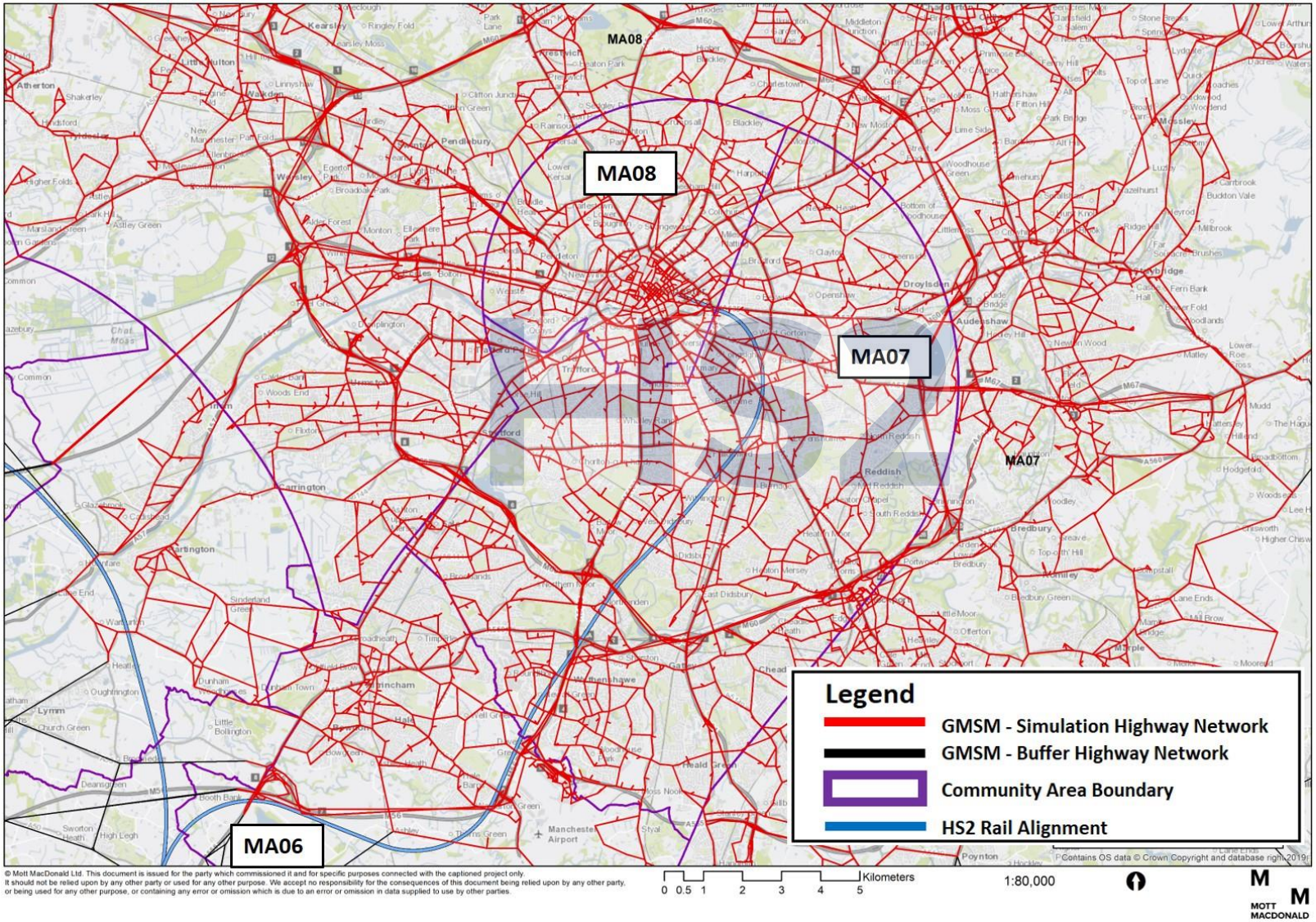
1.2.2 The Greater Manchester Variable Demand Model (GMVDM) has been developed within a Cube Voyager model software platform (version 6.4.3) and has a supporting EFM that supplies reference case projections of future year changes in land-use trips.

1.2.3 The Greater Manchester Public Transport Model (GMPTM) is a public transport assignment model and has also been developed within a Cube Voyager model software platform (version 6.4.3).

1.2.4 The GMSM is a strategic highway model that has been developed within a SATURN model software platform (version 11.3.12).

1.2.5 The detailed modelled study area for the above models covers the Greater Manchester district; and has supporting network and zone system detail to provide representation of external area supply and demand. Reference should be made to Figure 1.

Figure 1: Model study area



1.3 Model development

1.3.1 The TfGM suite of models were subject to a present year validation (PYV) exercise in 2017 to reflect 2017 base year spring transport conditions. This model has also been updated to account for changes to local and national planning datasets. This model update was completed by transport consultants working on behalf of TfGM.

1.3.2 The model updates have supported the following primary TfGM model applications:

- Manchester Airport Terminal 2 – Metrolink Extension – Strategic Outline Business Case (2017); and
- Greater Manchester Spatial Framework Strategy (GMSF – 2016 Dataset).

1.3.3 GMVDM04A (version DA_2017) was the latest demand model version available for release by TfGM and was developed to assess the GMSF (2016 Consultation Dataset).

1.3.4 TfGM is currently working on the development of GMSF forecasts based on the 2019 Consultation Dataset, although these models were not scheduled to be available for release until spring/summer 2020 at the earliest, which was too late for use in this assessment.

1.4 Model description

1.4.1 TfGM's GMSM strategic highway assignment model has been developed for the following years:

- 2017 base year;
- 2025 first future year; and
- 2040 horizon future year.

1.4.2 These future years correspond with Local Plan assessment years.

1.4.3 The strategic highway assignment model is representative of the following time periods:

- AM peak hour – 08:00–09:00;
- average inter peak (IP) hour – 10:00–15:30; and
- PM peak hour – 17:00–18:00.

1.4.4 The local highway assignment model is comprised of the following demand user-classes:

- car commute;
- car employers business;
- car other;
- light goods vehicles (LGV); and
- other goods vehicles (OGV).

1.4.5 For the assessment of the Proposed Scheme, there is a requirement to add additional local highway network and spatial detail within the local study areas of Manchester Piccadilly and

Manchester Airport to enhance representation of base year traffic conditions; and to capture the potential effects of both the Proposal Scheme and Northern Powerhouse Rail (NPR).

1.5 Model application objectives

1.5.1 For the assessment of the Proposed Scheme, the Greater Manchester local highway assignment model will:

- provide preliminary traffic data to inform scheme design;
- provide traffic data for the construction and operational phases of the Proposed Scheme on which to base the assessment of significant effects for the Environmental Statement;
- provide changes in traffic flows, congestion and journey times to inform the TA for the Proposed Scheme; and
- provide changes in traffic flows between the base year and forecast scenarios for application to local models.

1.5.2 The model will be used primarily to assess the likely impacts of the Proposed Scheme's construction and operational traffic in order to provide an evidence base for the Proposed Scheme TA; although, the model will also be used to consider the likely combined impacts of both the Proposed Scheme and NPR to inform scheme design.

2 Guidance used

2.1 Introduction

2.1.1 This local highway model performance review makes reference to the following Transport Analysis Guidance as published by the Department for Transport (DfT): TAG Unit M3.1 Highway Assignment Modelling (January 2014).

2.2 Public transport assignment model guidance

2.2.1 In relation to providing an assessment of model calibration and validation performance, reference has been made to Section 3.2 of TAG Unit M3.1 (Table 1, Table 2, and Table 3).

2.2.2 The criteria for the assessment of model calibration and validation of traffic flows and journey time performance is presented in Table 1.

Table 1: DfT – TAG validation criteria

Criteria	Acceptability guideline
Assigned hourly flows	
Individual flows within +/-15% for flows 700–2,700 vph	>85% of cases
Individual flows within +/-100 vph for flows <700 vph	>85% of cases
Individual flows within +/-400 vph for flows >2,700 vph	>85% of cases
Screenline flows (normally >5 links) to be within 5%	All or nearly all screenlines
GEH statistic	
Individual flows GEH <5	>85% of cases
Screenline totals GEH <4	All or nearly all screenlines
Journey times	
Modelled journey times within 15% (or 1 minute if higher)	>85% of cases

Source: Table 1, Table 2, Table 3, DfT TAG Unit M3.1 Highway Assignment Modelling (January 2014)

2.2.3 The criteria for the assessment of highway model assignment convergence is presented in Table 2.

Table 2: Summary of convergence measures and base model acceptable values

Measures of convergence	Acceptability guidelines
Delta and %GAP	Less than 0.1% or at least stable with convergence fully documented and all other criteria met
Percentage of links with flow change (P) <1%	Four consecutive iterations greater than 98%
Percentage of links with cost change (P2) <1%	Four consecutive iterations greater than 98%
Percentage change in total user costs of links with flow change (V) <1%	Four consecutive iterations less than 0.1% (SUE only)

Source: Table 4, DfT TAG Unit M3.1 Highway Assignment Modelling (January 2014)

3 Calibration and validation data

3.1 Overview

3.1.1 This section of the report presents details of traffic survey data that has been collected for the purpose of assessing model calibration and validation performance within the defined local study areas of interest for the Manchester Piccadilly and Manchester Airport areas.

3.2 Dates of survey data collection

3.2.1 The traffic data used in the MWJV calibration and validation process is from the following data sources and has been collected on behalf of HS2 Ltd:

- MWJV – June 2017 traffic counts (Automatic Traffic Counts, Manual Classified Counts);
- TfGM – May/June 2017 traffic counts (Automatic Traffic Counts); and
- Webtris data (Highways England database).

3.2.2 Traffic counts are representative of an average weekday based on Monday to Thursday traffic conditions for a neutral period (Spring 2017). This is consistent with the development of the GMSM base year model (GMVDM04 version).

3.3 Traffic flow screenlines

3.3.1 The location of traffic counts and definition of additional and new MWJV screenlines for the purpose of the Proposed Scheme TA is discussed below with reference to the local study area.

Manchester Piccadilly

3.3.2 The calibration of traffic flows covering the Piccadilly area has been carried out across one cordon (two by direction) incorporating a total of 30 link counts. Reference should be made to Figure 2 which shows the location of the cordon used to calibrate traffic flows.

3.3.3 In addition to the cordon traffic counts, there are also 45 number of 2017 traffic counts within the Piccadilly area that have also been included in model calibration as individual link counts.

Manchester Airport

3.3.4 The calibration of traffic flows for the Manchester Airport area was carried out across five screenlines (ten by direction) incorporating a total of 23 counts (46 by direction).

3.3.5 The definition of screenlines is listed below, and reference should be made to Figure 3 which shows their location.

- screenline 1 – East Airport Screenline (five count sites);
- screenline 2 – East of M56 Screenline (six count sites);
- screenline 3 – West of M56 (five count sites);
- screenline 4 – North of A538 Wilmslow Road (three count sites); and
- screenline 5 – Airport Screenline (four count sites).

3.3.6 There are also an additional ~20 traffic counts (40 by direction) from 2017 traffic surveys within the Manchester Airport area included in model calibration.

Figure 2: Manchester Piccadilly local study area – location of traffic counts and cordon

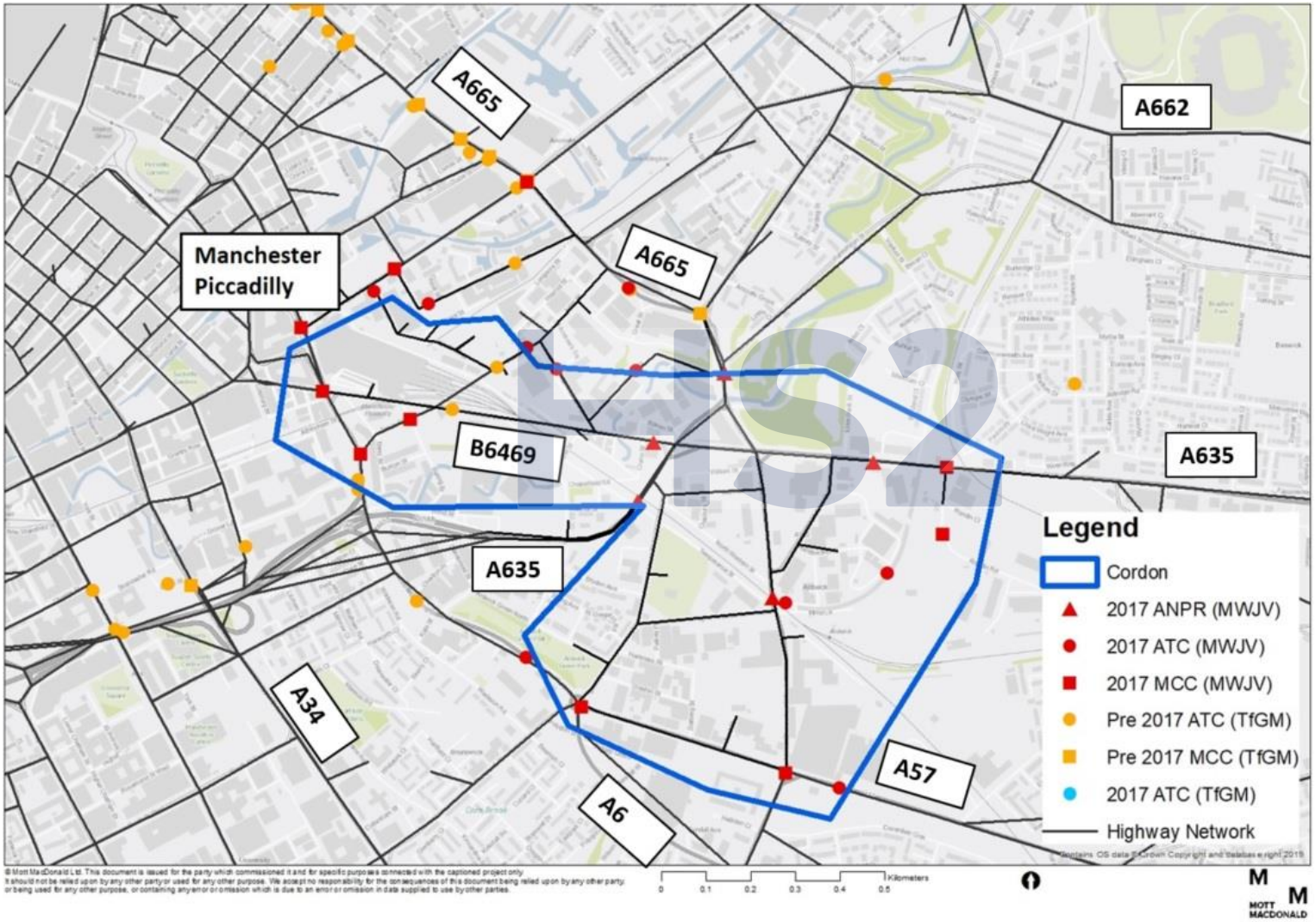
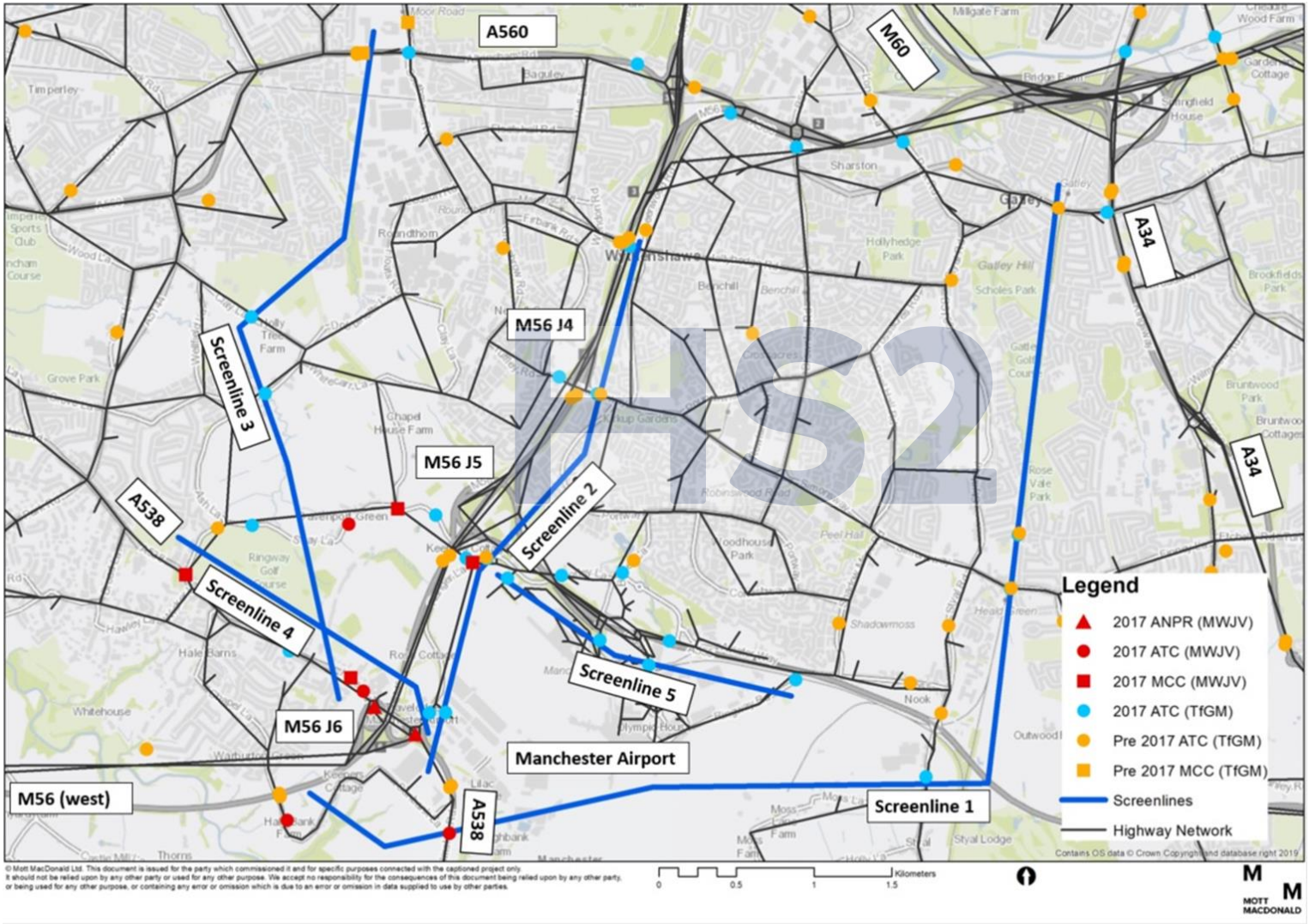


Figure 3: Manchester Airport local study area – location of traffic counts and screenlines



Journey time data source

3.3.7 Model validation of journey times within the defined local study areas of interest makes best use of existing Trafficmaster data available within the parent model validation dataset. In addition, there was also the requirement to source supplementary Trafficmaster data from TfGM for defined routes in the Manchester Piccadilly area.

Journey time data processing

3.3.8 Observed journey times are representative of an average 2017 neutral weekday based on Monday to Thursday traffic conditions.

3.3.9 Observed and modelled journey times were compared along three defined routes (six by direction) for the Manchester Airport area. The defined routes are as follows:

- route 1 – M56 junction 5 to junction 7 (~7.1 km);
- route 2 – M56 Airport Spur/Ringway Road (~3.7 km); and
- route 3 – A538 Wilmslow Road (between Mill Lane and Shay Lane) (~3.2 km).

3.3.10 Figure 4 shows the definition of journey time routes for the Manchester Airport local study area.

3.3.11 Observed journey times were taken from the existing 2017 GMSM model validation dataset for route 2 and route 3. For route 1, observed journey times for the M56 were extracted from Trafficmaster data (the journey time route extends to M56 junction 7).

3.3.12 For the Piccadilly local study area four journey time routes (eight by direction) were identified:

- route 4 – B6469 Fairfield Street/A635 Ashton Old Road (between A6 and A6010 ~2.5 km);
- route 5 – A665 (between Pin Mill Brow and A57 Hyde Road ~2.2 km);
- route 6 – A6/A57 (between Store Street and Devonshire Street North ~1.6 km); and
- route 7 – A635/A665 (between A34 Brook Street and Store Street ~2.1 km).

3.3.13 Figure 5 shows the definition of journey time routes for the Piccadilly local study area.

Figure 4: Manchester Airport local study area – journey time routes for validation (routes 1–3)

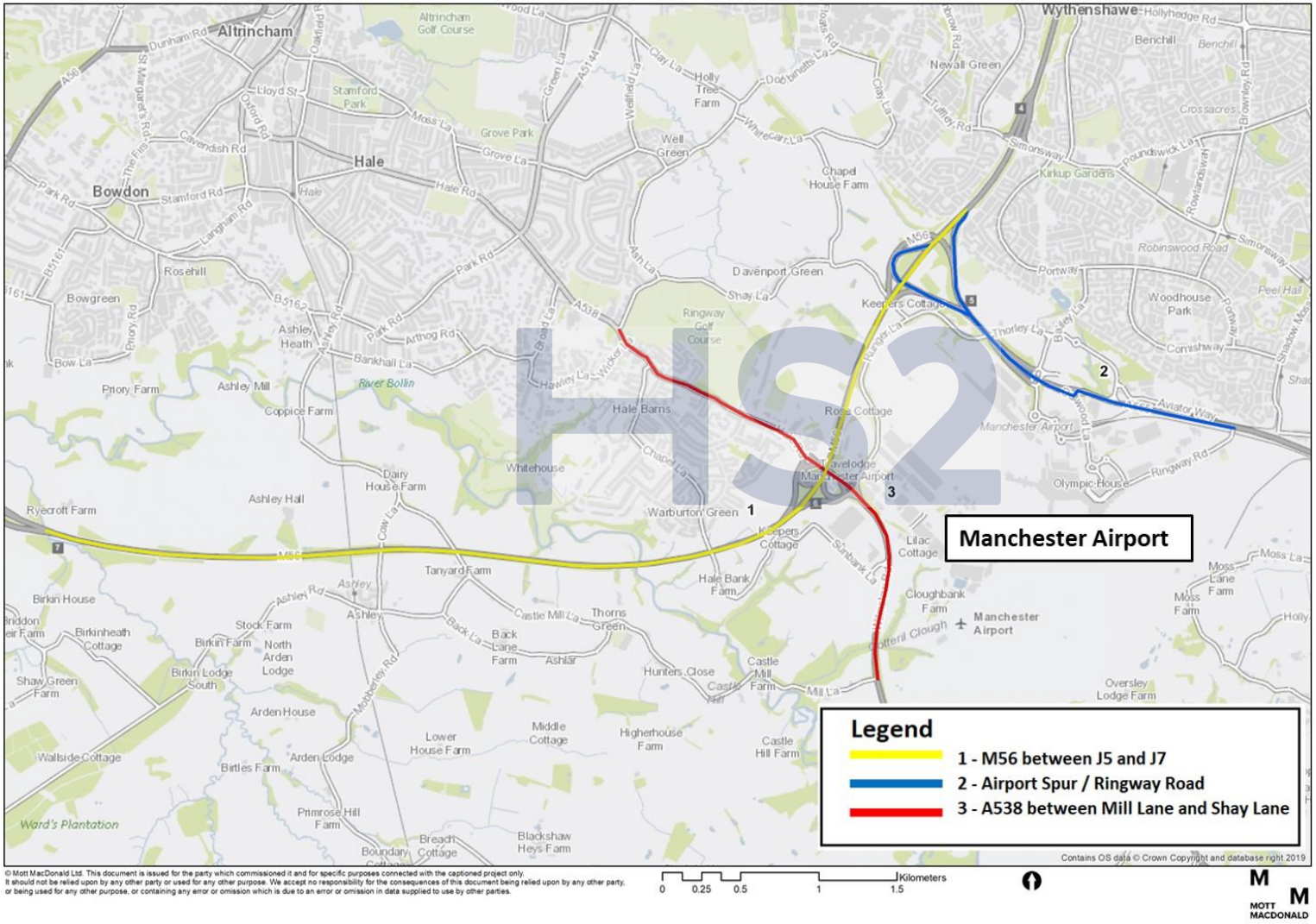
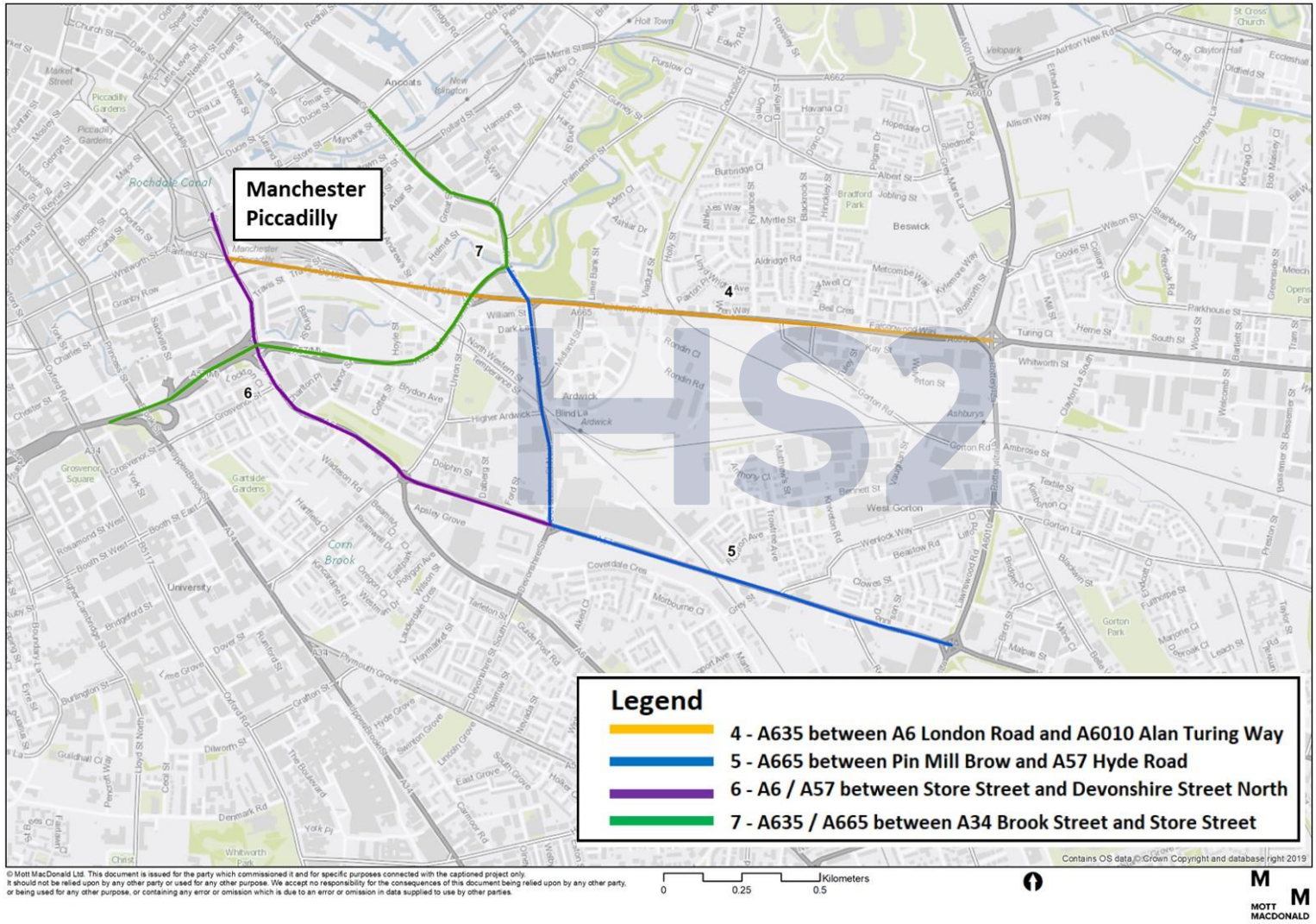


Figure 5: Manchester Piccadilly local study area – journey time routes for validation (routes 4–7)



4 Model calibration

4.1 Overview

4.1.1 This section of the report documents the model calibration steps that have been undertaken to update and enhance transport supply and demand within the defined local study areas of Manchester High Speed stations.

4.2 Transport supply – network calibration checks

4.2.1 A review of highway network detail and attributes has been completed for the Manchester High Speed station areas.

4.2.2 The following network attributes have been reviewed:

- links: distance, speeds, capacity, bus lanes, traffic regulation orders;
- junctions: type; turn saturation flows, capacity, and lane utilisation;
- traffic signal control: timings, phasing and staging; and
- routes: minimum cost paths.

4.2.3 Modelled data has been cross referenced to observed local and spatial datasets to check level of consistency between network attributes. Logic and range checks have been completed as part of the review to check the level of accuracy between datasets.

4.2.4 The review highlighted that there is a good level of detailed highway network representation within the Manchester High Speed station areas, and that this compared well with local datasets. The review also highlighted a requirement to include some additional network detail particularly in the Manchester Piccadilly area to support the Proposed Scheme TA.

4.3 Transport supply – network improvements

4.3.1 An inventory of highway network improvements is presented below with reference to local study area.

Manchester Piccadilly local study area

4.3.2 The following additional links and junctions were included in the model update for the Piccadilly area:

Highway links

- Chapeltown Street;
- Sparkle Street;
- St Andrew's Street;
- Helmet Street;
- Union Street; and
- Dark Lane.

Highway junctions

- A665 Great Ancoats Street/Chapeltown Street – three arm priority junction (left in/left out);
- Sparkle Street/Store Street – three arm priority junction;
- Travis Street/St Andrew's Street – three arm priority junction;
- St Andrew's Street/Helmet Street – three arm priority junction;
- B6469 Fairfield Street/St Andrew's Street – three arm priority junction;
- A665 Ring Road/Helmet Street – three arm priority junction (left in/left out);
- A665 Chancellor Lane/Dark Lane – three arm priority junction;
- A635 Ring Road/North Western Street – three arm priority junction (left in/left out);
- North Western Street/Dark Lane – three arm priority junction; and
- Union Street/Higher Ardwick – three arm priority junction.

4.3.3 Reference should be made to Figure 6 which shows the additional network included in the Piccadilly area.

Manchester Airport

4.3.4 The Manchester Airport local study area shows a detailed and comprehensive coverage of local highway network.

4.3.5 A review of the highway network identified a limited number of modifications to be made, and these comprised the following:

- M56 junction 6 western roundabout – inclusion of an access road to the Marriott Hotel; and
- Sunbank Lane – inclusion of intermediate access junctions and modification to zone loading for zone 291.

4.3.6 Reference should be made to Figure 7 which shows the additional baseline network included in the Manchester Airport area.

Figure 6: Manchester Piccadilly local study area – highway network updates

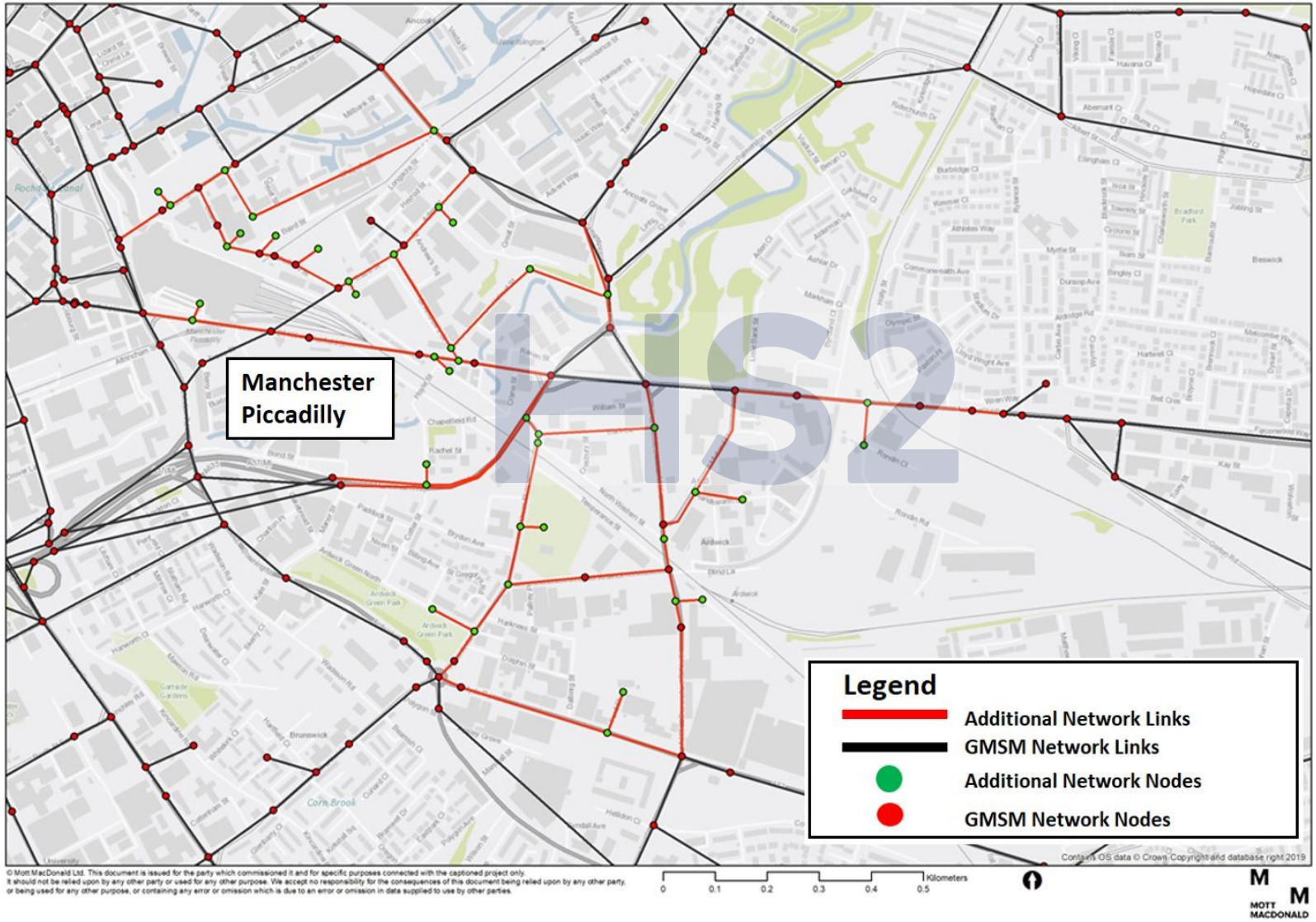
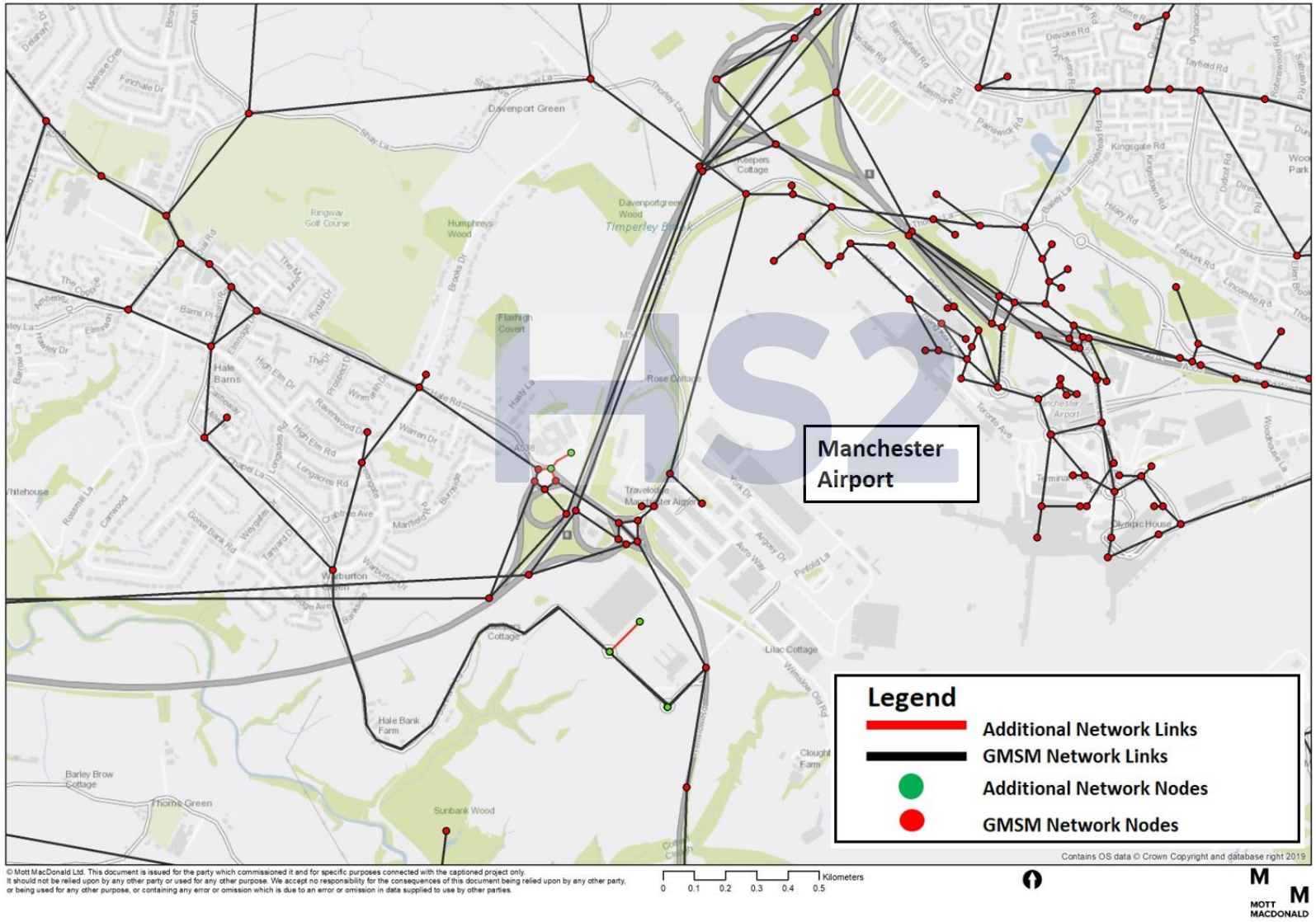


Figure 7: Manchester Airport local study area – highway network updates



4.4 Transport demand – spatial enhancements

4.4.1 This section documents the updates carried out to provide an improved level of detail in the representation of traffic demand. The trip matrices required the following modifications:

- disaggregation of three zones in the Piccadilly area to fifteen zones, with allocated proportions of demand to allow specific locations to be modelled;
- new zone near Manchester Airport to represent demand to/from the Marriott Hotel; and
- checks that the Amazon and DHL warehousing operations (as part of the World Logistics Hub development) on Sunbank Lane are appropriately represented in the matrices and, if not, remedial work to modify demand.

4.4.2 A brief description of the methodology for incorporating these changes is discussed below with reference to local study area.

Manchester Piccadilly

4.4.3 The Piccadilly local study area is represented by three large strategic model zones in TfGM's model. As a result, for the Proposed Scheme TA, there was a requirement to disaggregate these zones to include additional detail for car parks and land-use covering the Piccadilly area.

4.4.4 These zones have been split with reference to land-use planning boundaries and physical features (roads, railway lines). Reference should be made to Figure 8 which shows the splitting of zones for the Piccadilly local study area.

4.4.5 The following three zones were split into 15 zones:

- zone 161 (disaggregated into three zones);
- zone 162 (disaggregated into six zones); and
- zone 185 (disaggregated into six zones).

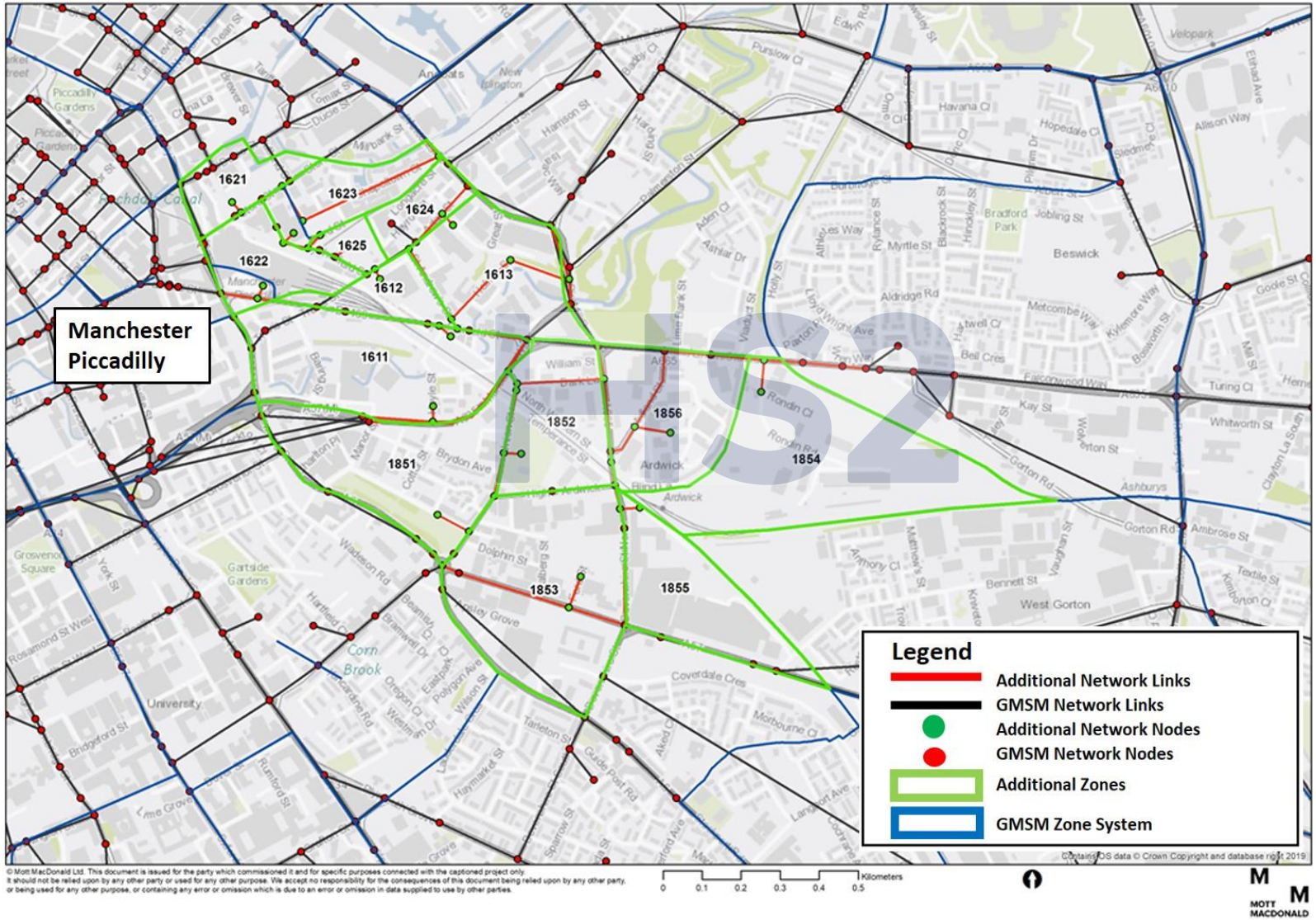
4.4.6 The method used census output area (OA) level population and jobs data for 2016 to apportion out existing demand to/from each of the old parent zones to the new zones. The percentage splits were reviewed against available land use data and adjusted where necessary.

4.4.7 This adjustment accounted for car parking capacity provision and available survey data for the following public car parks:

- Piccadilly Station long stay (857);
- Piccadilly Station permit parking (160);
- Piccadilly Station short stay (56 spaces);
- Store Street (406 spaces);
- Baird Street (160 spaces); and
- Sheffield Street (160 spaces).

4.4.8 In total, there are 1,799 public car park spaces located in the local study area of interest with Piccadilly Station accounting for around 60 percent of total parking spaces.

Figure 8: Manchester Piccadilly local study area – zone system updates



Manchester Airport

4.4.9 The local study area covering Manchester Airport shows that there is a high level of zonal detail. From a review of the zone system, there was a requirement to add a new zone to include access to the Marriott Hotel and the Manchester Airport High Speed station.

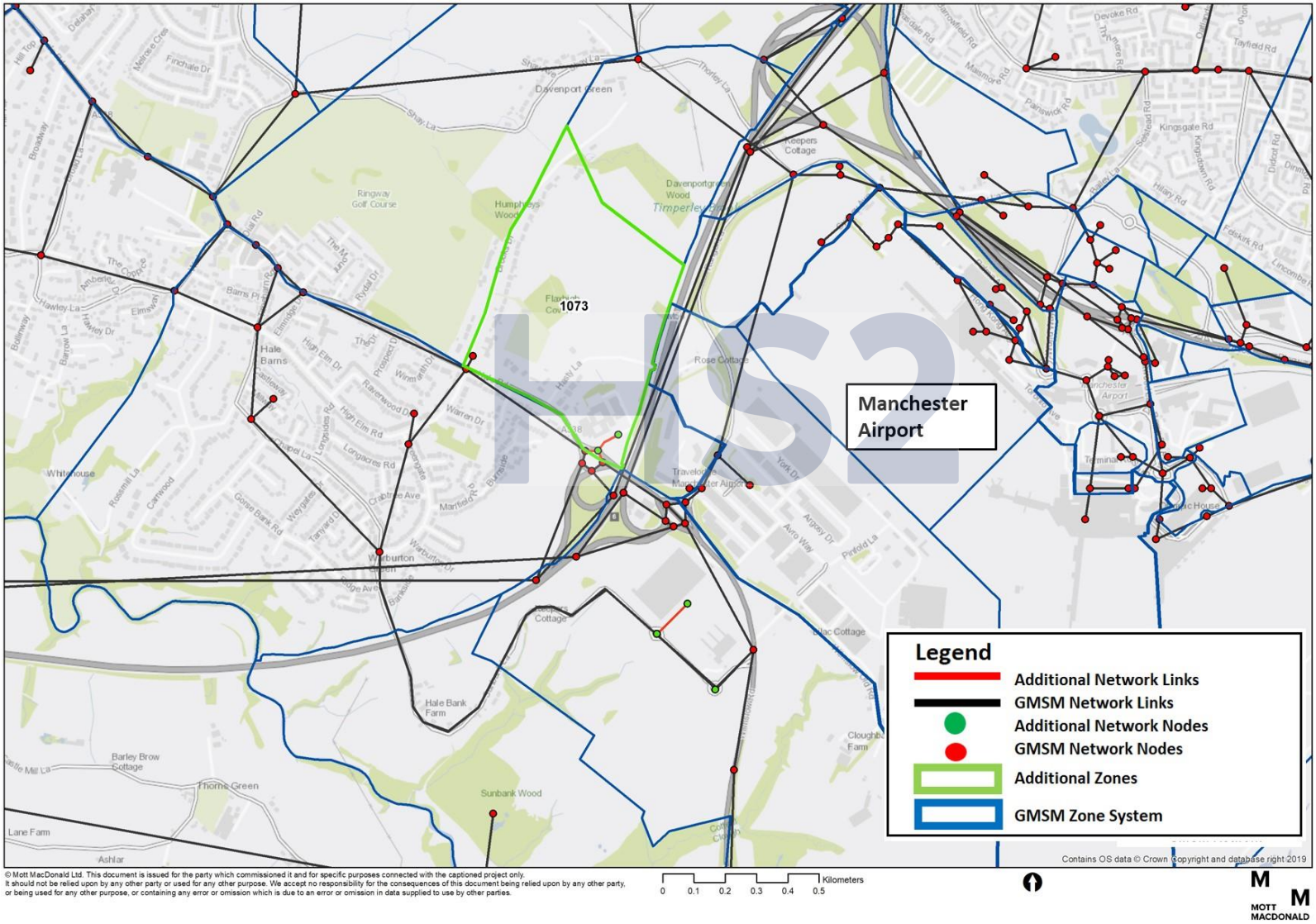
4.4.10 Reference should be made to Figure 9 which shows the proposed zonal changes. Zone 1073 was added to the zone system to represent the existing Marriott hotel; and in future years this zone will be used to model the Manchester Airport High Speed station demand.

4.4.11 Traffic count data exists for departures and arrivals at the Marriott Hotel, subdivided by vehicle type and time period. This data was used to control the number of trips to and from this zone. The method adopted used the distribution of trips for the nearby Manchester Airport Travelodge zone as a basis for apportioning trip departures and arrivals to the zone used for the Marriott Hotel.

4.4.12 There was also a requirement to modify zone 291 which includes development adjacent to Sunbank Lane located to the south of M565 junction 6 off the A538 Wilmslow Road. The zone loading point for this existing zone was moved to Sunbank Lane to reflect the movement of traffic flow through A538/Sunbank Lane junction for local junction modelling.

4.4.13 The TRICS database was used to generate trip departures and arrivals for the relevant land uses in each time period and (where possible) by vehicle type. The total number of trips derived from the database was then compared to the number of trips to/from this zone in the trip matrix. The comparison showed that demand to/from the zone was reasonable. The existing trip distribution was retained.

Figure 9: Manchester Airport local study area – zone system updates



4.5 Traffic flow calibration – before HS2 model update

4.5.1 A review of the 'Wider Model Area' traffic flow calibration performance has been carried out with reference to the following reports as provided by TfGM:

- 2014 local model validation report (April 2017); and
- 2017 local model validation – addendum report (November 2017).

4.5.2 Further to this MWJV have also carried out a review of the base year model performance based on the supplied model. Reference should be made to Table 3 which presents an individual link flow performance summary.

Table 3: Individual link flow summary – total all vehicle flow (prior to MWJV update)

Individual link flow validation – total all vehicle flow summary – DfT TAG criteria flow range or GEH < 5							
Area	**Total counts**	**AM peak hour**		**Average IP hour**		**PM peak hour**	
		Number of counts	**Percentage**	**Number of counts**	**Percentage**	**Number of counts**	**Percentage**
Manchester Piccadilly	65	31	48%	39	60%	38	58%
Manchester Airport	83	51	61%	59	71%	41	49%
Wider model area	477	445	93%	444	93%	412	86%
Total	**625**	**527**	**84%**	**542**	**87%**	**491**	**79%**

4.5.3 It is evident from the comparison of individual link flows covering the 'wider model area' that the model exceeds DfT TAG guidance criteria of greater than 85 percent of comparisons achieving flow range or GEH less than five criteria. The AM peak hour achieves a validation of 93 percent, IP hour 93 percent, and the PM peak hour 86 percent.

4.5.4 Traffic counts within the Manchester Piccadilly and Manchester Airport areas have also been compared and it is evident that that the model performs below DfT TAG guidance criteria within these areas. As a result, this has affected the overall 'total model flow' comparison with the AM peak hour achieving a validation of 84 percent, IP hour 87 percent, and the PM peak hour 79 percent.

4.5.5 The performance of the model within the Manchester Piccadilly and Airport areas supports the case for MWJV to undertake model updates to improve the correlation between observed and modelled traffic flows and journey times.

4.6 Traffic flow calibration – post HS2 model update

4.6.1 The 'wider model area' traffic flow calibration performance has been re-assessed following transport supply and zonal demand updates covering the local study areas of Manchester Piccadilly and Manchester Airport.

4.6.2 In total there are fifteen screenlines (30 by direction) that cover the wider model area; and are comprised of more than five counts. Screenlines with less than five counts have been excluded from the dataset.

4.6.3 Table 4 and Table 5 present a screenline flow summary for grouped total all vehicle flow and car flow. The results show that all time periods are within a reasonable range of DfT TAG screenline flow guidance criteria. Guidance implies that 85 percent of comparisons should ideally be within a flow difference of less than five percent. The performance across individual screenlines is documented in Table A 1, Table A 2 and Table A 3, Appendix A.

4.6.4 Table 6 and Table 7 present a summary comparison of individual link flows for total all vehicle flow and car flow. The individual link count dataset is comprised of all counts that form screenlines. The comparison shows that around 85 percent of the individual links meet either the DfT TAG flow range or GEH less than five criteria in all time periods.

4.6.5 Reference should be made to Table A 4 to Table A 9, Appendix A, which presents supporting analysis for the validation of individual link flows across screenlines.

4.6.6 In summary, it is evident that the MWJV variant model does not have a significant impact on the wider model area performance. The validation results for the wider model area show that the results following the post model update are as follows, 89 percent for AM, 92 percent for IP, and 84 percent for PM peak hour; whereas, prior to the model update the results were as follows 93 percent for AM, 93 percent for IP, and 86 percent for PM. Reference should be made to Table 6 and Table 3. Further discussion relating to the prior and post model update is presented in Section 5.4.

Table 4: Wider model area – screenline flow summary – total all vehicle flow

DfT TAG screenline criteria flow difference less than 5%			
Time period	**Total number of screenlines**	**Number of screenlines**	**Percentage**
AM peak hour	30	25	83%
Average IP hour	30	26	87%
PM peak hour	30	23	77%

Table 5: Wider model area – screenline flow summary – car vehicle type

DfT TAG screenline criteria flow difference less than 5%			
Time period	**Total number of screenlines**	**Number of screenlines**	**Percentage**
AM peak hour	30	24	80%
Average IP hour	30	24	80%

DfT TAG screenline criteria flow difference less than 5%			
PM peak hour	30	22	73%

Table 6: Wider model area – individual link flow summary – total all vehicle flow

Total all vehicle flow comparison (vehicles)							
Time period	**Number of sites**	**TAG criteria 1 flow range**		**TAG criteria 2 GEH < 5**		**TAG criteria flow range or GEH**	
		Number of counts	**Percentage**	**Number of counts**	**Percentage**	**Number of counts**	**Percentage**
AM peak hour	477	413	87%	409	86%	423	89%
Average IP hour	477	435	91%	423	89%	440	92%
PM peak hour	477	393	82%	382	80%	399	84%

Table 7: Wider model area – individual link flow summary – car vehicle type

Car flow comparison (vehicles)							
Time period	**Number of sites**	**TAG criteria 1 flow range**		**TAG criteria 2 GEH < 5**		**TAG criteria flow range or GEH**	
		Number of counts	**Percentage**	**Number of counts**	**Percentage**	**Number of counts**	**Percentage**
AM peak hour	477	415	87%	403	84%	424	89%
Average IP hour	477	436	91%	420	88%	438	92%
PM peak hour	477	397	83%	383	80%	404	85%

5 Model validation

5.1 Overview

5.1.1 This section of the report presents a review of model validation performance with reference to the following:

- HS2 Manchester Piccadilly – local study area; and
- HS2 Manchester Airport – local study area.

5.1.2 The local study area validation refers to a comparison of data that is specific to the Manchester Piccadilly High Speed and Manchester Airport High Speed station areas.

5.2 HS2 – Manchester Piccadilly – local study area

5.2.1 Presented below is a comparison of observed and modelled traffic flows and journey times for the Manchester Piccadilly local study area.

Traffic flow validation summary

5.2.2 Observed and modelled traffic flows have been compared for available count site locations within the Manchester Piccadilly local study area. In total, 75 link counts by direction have been compared, of which 30 are located on one cordon (two by direction). Reference should be made to Figure 2.

5.2.3 All traffic counts identified for model validation have also been included in model calibration as a result of the limited number of traffic counts available within the local study area. Initially, only cordon/screenline traffic counts were included in localised model calibration for the Manchester station areas; however, following a review of model flows, there was merit to also include the additional counts within model calibration to improve model performance.

5.2.4 Table 8 and Table 9 present a summary comparison of cordon flows by total all vehicles and by car vehicle type. The comparison shows that all time periods achieve a 100 percent validation of modelled traffic flows across cordons based on DfT TAG criteria. Supporting analysis is presented in Table B 1 to Table B 3, Appendix B. Table 10 and Table 11 present a summary comparison of individual link flows based on the cordon dataset for total all vehicle and by car vehicle type. The comparison shows that 85 percent of the individual links meet either the DfT TAG flow range or GEH less than five criteria in all time periods. Supporting analysis is presented in Table B 4 to Table B 6, Appendix B.

5.2.5 The validation of individual link flows across cordons is also supported by a strong validation performance of the supplementary count data set (45 traffic counts) located within the study area.

5.2.6 Table 13 present a summary comparison of individual link flows based on a supplementary count dataset for total all vehicle and by car vehicle type. The comparison shows all time periods exceed the DfT TAG individual link count criteria of greater than 85 percent of comparisons achieving flow range or GEH less than five.

5.2.7 In summary, both the cordon and individual link flow comparisons show a good match between observed and modelled link flows. This demonstrates that the model provides a good representation of observed traffic flows covering the Piccadilly area.

Table 8: Manchester Piccadilly – cordon flow summary – total all vehicle

DfT TAG screenline criteria flow difference less than 5%			
Time period	**Total number of screenlines**	**Number of screenlines**	**Percentage**
AM peak hour	2	2	100%
Average IP hour	2	2	100%
PM peak hour	2	2	100%

Table 9: Manchester Piccadilly – cordon flow summary – car vehicle type

DfT TAG screenline criteria flow difference less than 5%			
Time period	**Total number of screenlines**	**Number of screenlines**	**Percentage**
AM peak hour	2	2	100%
Average IP hour	2	2	100%
PM peak hour	2	2	100%

Table 10: Manchester Piccadilly – cordon – individual link flow – total all vehicle

Total all vehicle flow comparison (vehicles)							
Time period	**Number of sites**	**TAG criteria 1 flow range**		**TAG criteria 2 GEH < 5**		**TAG criteria flow range or GEH**	
		Number of counts	**Percentage**	**Number of counts**	**Percentage**	**Number of counts**	**Percentage**
AM peak hour	30	30	100%	27	90%	30	100%
Average IP hour	30	29	97%	29	97%	29	97%
PM peak hour	30	28	93%	27	90%	28	93%

Table 11: Manchester Piccadilly – cordon – individual link flow – car vehicle type

Car flow comparison (vehicles)							
Time period	**Number of sites**	**TAG criteria 1 flow range**		**TAG criteria 2 GEH < 5**		**TAG criteria flow range or GEH**	
		Number of counts	**Percentage**	**Number of counts**	**Percentage**	**Number of counts**	**Percentage**
AM peak hour	30	29	97%	27	90%	29	97%
Average IP hour	30	30	100%	29	97%	30	100%
PM peak hour	30	28	93%	28	93%	29	97%

Table 12: Manchester Piccadilly – supplementary counts – individual link flow – total all vehicle

Total all vehicle flow comparison (vehicles)							
Time period	Number of sites	TAG criteria 1 flow range		TAG criteria 2 GEH < 5		TAG criteria flow range or GEH	
		Number of counts	Percentage	Number of counts	Percentage	Number of counts	Percentage
AM peak hour	45	45	100%	44	98%	45	100%
Average IP hour	45	43	96%	42	93%	44	98%
PM peak hour	45	43	96%	41	91%	43	96%

Table 13: Manchester Piccadilly – supplementary counts – individual link flow – car vehicle type

Car flow comparison (vehicles)							
Time period	Number of sites	TAG criteria 1 flow range		TAG criteria 2 GEH < 5		TAG criteria flow range or GEH	
		Number of counts	Percentage	Number of counts	Percentage	Number of counts	Percentage
AM peak hour	45	45	100%	42	93%	45	100%
Average IP hour	45	45	100%	43	96%	45	100%
PM peak hour	45	44	98%	40	89%	44	98%

Journey time validation summary

5.2.8 Observed and modelled journey times have been compared for four routes by direction within the Manchester Piccadilly local study area of interest. Observed journey times are based on a weighted average of all vehicles.

5.2.9 The defined routes are as follows:

- route 4 – B6469 Fairfield Street/A635 Ashton Old Road (between A6 and A6010 ~ 2.5 km);
- route 5 – A665 (between Pin Mill Brow and A57 Hyde Road ~2.2 km);
- route 6 – A6/A57 (between Store Street and Devonshire Street North ~ 1.6 km); and
- route 7 – A635/A665 (between A34 Brook Street and Store Street ~2.1 km).

5.2.10 Table 14 to Table 16 present journey time route validation summary results for AM, IP and PM time periods. The results show that AM and PM time periods fall below the threshold of 85%; and that all routes in the average IP hour meet guidance criteria.

5.2.11 The AM peak hour validation shows that five out of the eight routes are within the 15 percent range of observed journey times; and that two of the routes that fall outside are outbound journey time routes.

5.2.12 The PM peak hour results show that six out of the eight routes are within 15 percent range of observed journey times.

5.2.13 Reference should be made to Table 10 to Table 17, Appendix B which presents supporting journey time validation comparisons. The profiles show a good correlation between observed and modelled journey times for IP time period, and that peak hour journey times

follow the same profile as observed, although in some cases the modelled journey time is slightly lower or higher than the criteria threshold.

5.2.14 The results show that there is a good validation of journey times for the tidal flow direction for both the AM and PM peak hours. The journey time validation is supported by the strong validation of individual traffic flows covering the Piccadilly area. It is recognised that it is more difficult to validate journey times in congested time periods for strategic models, and this is evident from the comparison of results for the peak hour and non-peak hour time periods. The IP hour results show that 100 percent of the routes validate.

Table 14: Manchester Piccadilly – AM peak hour – journey time validation summary

Route name	Distance (km)	Observed time (h:m:s)	Modelled time (h:m:s)	Difference (h:m:s)	Percentage difference	Lower limit (h:m:s)	Upper limit (h:m:s)	Within limits
Route 4 - EB B6469/A635	2.48	00:06:29	00:08:13	+ 00:01:44	27%	00:05:29	00:07:29	×
Route 4 – westbound (WB) B6469/A635	2.47	00:08:55	00:07:37	- 00:01:18	-15%	00:07:34	00:10:15	✓
Route 5 – eastbound (EB) A665	2.17	00:05:04	00:06:17	+ 00:01:13	24%	00:04:04	00:06:04	×
Route 5 -WB A665	2.20	00:07:53	00:06:09	- 00:01:44	-22%	00:06:43	00:09:04	×
Route 6 - EB A6/A57	1.61	00:05:13	00:05:51	+ 00:00:38	12%	00:04:13	00:06:13	✓
Route 6 - WB A6/A57	1.78	00:05:23	00:04:47	- 00:00:36	-11%	00:04:23	00:06:23	✓
Route 7 - EB A635/A665	1.82	00:03:39	00:04:28	+ 00:00:49	22%	00:02:39	00:04:39	✓
Route 7 - WB A635/A665	2.01	00:04:41	00:04:47	+ 00:00:06	2%	00:03:41	00:05:41	✓
								Pass = 5, Routes = 8, Validation = 63%

Table 15: Manchester Piccadilly - average IP peak hour - journey time validation summary

Route name	Distance (km)	Observed time (h:m:s)	Modelled time (h:m:s)	Difference (h:m:s)	Percentage difference	Lower limit (h:m:s)	Upper limit (h:m:s)	Within limits
Route 4 - EB B6469/A635	2.48	00:06:55	00:06:59	+ 00:00:04	1%	00:05:53	00:07:58	✓
Route 4 - WB B6469/A635	2.47	00:06:20	00:05:47	- 00:00:34	-9%	00:05:20	00:07:20	✓

Route name	Distance (km)	Observed time (h:m:s)	Modelled time (h:m:s)	Difference (h:m:s)	Percentage difference	Lower limit (h:m:s)	Upper limit (h:m:s)	Within limits
Route 5 - EB A665	2.17	00:05:01	00:04:52	- 00:00:09	-3%	00:04:01	00:06:01	✓
Route 5 - WB A665	2.20	00:04:23	00:04:09	- 00:00:15	-6%	00:03:23	00:05:23	✓
Route 6 - EB A6/A57	1.61	00:04:29	00:04:46	+ 00:00:17	6%	00:03:29	00:05:29	✓
Route 6 - WB A6/A57	1.78	00:04:32	00:03:53	- 00:00:38	-14%	00:03:32	00:05:32	✓
Route 7 - EB A635/A665	1.82	00:03:22	00:03:38	+ 00:00:16	8%	00:02:22	00:04:22	✓
Route 7 - WB A635/A665	2.01	00:03:34	00:03:29	- 00:00:05	-2%	00:02:34	00:04:34	✓
								Pass = 8, Routes = 8, Validation = 100%

Table 16: Manchester Piccadilly – PM peak hour – journey time validation summary

Route name	Distance (km)	Observed time (h:m:s)	Modelled time (h:m:s)	Difference (h:m:s)	Percentage difference	Lower limit (h:m:s)	Upper limit (h:m:s)	Within limits
Route 4 - EB B6469/ A635	2.48	00:07:56	00:08:40	+ 00:00:44	9%	00:06:44	00:09:07	✓
Route 4 - WB B6469/ A635	2.47	00:06:30	00:06:26	- 00:00:04	-1%	00:05:30	00:07:30	✓
Route 5 - EB A665	2.17	00:07:01	00:05:10	- 00:01:52	-27%	00:05:58	00:08:04	×
Route 5 - WB A665	2.20	00:04:58	00:05:04	+ 00:00:05	2%	00:03:58	00:05:58	✓
Route 6 - EB A6/A57	1.61	00:05:00	00:04:47	- 00:00:12	-4%	00:04:00	00:06:00	✓
Route 6 - WB A6/A57	1.78	00:06:23	00:05:14	- 00:01:09	-18%	00:05:23	00:07:23	×
Route 7 - EB A635/A665	1.82	00:04:13	00:04:33	+ 00:00:20	8%	00:03:13	00:05:13	✓
Route 7 - WB A635/A665	2.01	00:04:46	00:04:27	- 00:00:19	-7%	00:03:46	00:05:46	✓
								Pass = 6, Routes = 8, Validation = 75%

5.3 HS2 – Manchester Airport – local study area

5.3.1 Presented below is a comparison of observed and modelled traffic flows and journey times for Manchester Airport local study area.

Traffic flow validation summary

5.3.2 Observed and modelled traffic flows have been compared for available count site locations within the Manchester Airport local study area. In total, 87 link counts by direction have been compared, of which 46 are located on five screenlines (ten by direction). Reference should be made to Figure 3.

5.3.3 All traffic counts identified for model validation have also been included in model calibration as a result of the limited number of traffic counts available within the local study area.

5.3.4 Table 17 and Table 18 present a summary comparison of screenline flows by total all vehicles and by car vehicle type. The comparison shows that all time periods fall within a reasonable range of the guidance threshold of 85 percent. The total flow comparison shows that the AM time period achieves 70 percent validation and that the IP and PM time periods achieve 80 percent validation. Supporting analysis is presented in Table C 1 to Table C 6, Appendix C.

5.3.5 Table 19 and Table 20 present a summary comparison of individual link flows based on the screenline dataset for total all vehicle and by car vehicle type. The comparison shows AM and PM hour time periods are relatively close to the DfT TAG guidance threshold of greater than 85 percent of comparisons achieving flow range or GEH less than five. The average IP hour results exceed this guidance threshold. Supporting analysis is presented in Table C 4 to Table C 6, Appendix C.

5.3.6 Table 21 and Table 22 present a summary comparison of individual link flows based on a supplementary count dataset for total all vehicle and by car vehicle type. The comparison shows all time periods exceed the DfT TAG individual link count criteria of greater than 85 percent of comparisons achieving flow range or GEH less than five.

5.3.7 The supplementary count data set includes flow comparisons for M56 motorway links. Supporting analysis is presented in Table C 7 to Table C 9, Appendix C.

5.3.8 In summary, the screenline and the individual link flow comparisons show a good match between observed and modelled links flows covering the Manchester Airport local study area.

Table 17: Manchester Airport – screenline flow summary – total all vehicle

DfT TAG screenline criteria flow difference less than 5%			
Time period	**Total number of screenlines**	**Number of screenlines**	**Percentage**
AM peak hour	10	7	70%
Average IP hour	10	8	80%

DfT TAG screenline criteria flow difference less than 5%			
PM peak hour	10	8	80%

Table 18: Manchester Airport – screenline flow summary – car vehicle type

DfT TAG screenline criteria flow difference less than 5%			
Time period	**Total number of screenlines**	**Number of screenlines**	**Percentage**
AM peak hour	10	6	60%
Average IP hour	10	7	70%
PM peak hour	10	8	80%

Table 19: Manchester Airport – screenline – individual link flow – total all vehicle

Total all vehicle flow comparison (vehicles)							
Time period	**Number of sites**	**TAG criteria 1 flow range**		**TAG criteria 2 GEH < 5**		**TAG criteria flow range or GEH**	
		Number of counts	**Percentage**	**Number of counts**	**Percentage**	**Number of counts**	**Percentage**
AM peak hour	46	38	83%	38	83%	39	85%
Average IP hour	46	43	93%	44	96%	44	96%
PM peak hour	46	36	78%	36	78%	36	78%

Table 20: Manchester Airport – screenline – individual link flow – car vehicle type

Total all vehicle flow comparison (vehicles)							
Time period	**Number of sites**	**TAG criteria 1 flow range**		**TAG criteria 2 GEH < 5**		**TAG criteria flow range or GEH**	
		Number of counts	**Percentage**	**Number of counts**	**Percentage**	**Number of counts**	**Percentage**
AM peak hour	46	37	80%	39	85%	39	85%
Average IP hour	46	42	91%	43	93%	43	93%
PM Peak hour	46	35	76%	37	80%	37	80%

Table 21: Manchester Airport – supplementary counts – individual link flow – total all vehicle

Total all vehicle flow comparison (vehicles)							
Time period	**Number of sites**	**TAG criteria 1 flow range**		**TAG criteria 2 GEH < 5**		**TAG criteria flow range or GEH**	
		Number of counts	**Percentage**	**Number of counts**	**Percentage**	**Number of counts**	**Percentage**
AM peak hour	41	35	85%	38	93%	38	93%
Average IP hour	41	39	95%	38	93%	39	95%
PM peak hour	41	37	90%	37	90%	37	90%

Table 22: Manchester Airport – supplementary counts – individual link flow – car vehicle type

Total all vehicle flow comparison (vehicles)							
Time period	Number of sites	TAG Criteria 1 flow range		TAG criteria 2 GEH < 5		TAG criteria flow range or GEH	
		Number of counts	Percentage	Number of counts	Percentage	Number of counts	Percentage
AM peak hour	41	38	93%	39	95%	39	95%
Average IP hour	41	40	98%	39	95%	40	98%
PM peak hour	41	37	90%	37	90%	37	90%

Journey time validation summary

5.3.9 Observed and modelled journey times have been compared for three routes by direction within the Manchester Airport local study area of interest. Observed journey times are based on a weighted average of all vehicles.

5.3.10 The defined routes are as follows:

- route 1 – M56 junction 5 to junction 7 (~7.1 km);
- route 2 – M56 Airport Spur/Ringway Road west (~2.7 km); and
- route 3 – A538 Wilmslow Road (between Mill Lane and Shay Lane) (~3.2 km).

5.3.11 Table 23 to Table 25 present journey time route validation summary results for AM, IP and PM time periods. The results show that all time periods fall below the threshold of 85%.

5.3.12 The IP hour time period shows that five out of six routes (83 percent) validate within 15 percent or one minute if higher of observed journey times. The AM and PM peak hour time periods both show that three out of the six routes validate (50 percent). The results show that there is an underestimation of travel time for M56 northbound (NB) between junction 7 and junction 5, and A538 Wilmslow Road corridor.

5.3.13 Reference should be made to Figure C 1 to Figure C 6, Appendix C, which presents supporting journey time validation comparisons. The profiles show a good correlation between observed and modelled journey times for IP time period, and that peak hour journey times follow the same profile as observed, although in some cases the modelled journey time is slightly lower or higher than the criteria threshold.

5.3.14 In summary, the correlation between observed and modelled journey times has been improved following the model update for the assessment of the Proposed Scheme for the Manchester Airport local study area; although, there is still some evidence of underestimation of modelled journey times for some routes. The IP hour journey time validation shows a good comparison to observed journey times and it is acknowledged that it is more difficult to validate journey times in congested time periods for strategic models.

Table 23: Manchester Airport – AM peak hour – journey time validation summary

Route name	Distance (km)	Observed time (h:m:s)	Modelled time (h:m:s)	Difference (h:m:s)	Percentage difference	Lower limit (h:m:s)	Upper limit (h:m:s)	Within limits
Route 1 - north EB M56 junction 5 to junction 7	7.01	00:05:30	00:04:17	- 00:01:13	-22%	00:04:30	00:06:30	×
Route 1 - south WB M56 junction 5 to junction 7	7.10	00:04:10	00:04:29	+ 00:00:19	8%	00:03:10	00:05:10	✓
Route 2 - EB M56 Airport Spur/ Ringway Rd west	2.67	00:04:21	00:03:43	- 00:00:38	-15%	00:03:21	00:05:21	✓
Route 2 - WB M56 Airport Spur/ Ringway Rd west	2.78	00:03:44	00:03:19	- 00:00:25	-11%	00:02:44	00:04:44	✓
Route 3 - south EB A538 Wilmslow Road/Hale Rd	3.17	00:06:34	00:05:17	- 00:01:17	-20%	00:05:34	00:07:34	×
Route 3 - north WB A538 Wilmslow Road/Hale Rd	3.21	00:08:23	00:05:22	- 00:03:02	-36%	00:07:08	00:09:39	×
								Pass = 3, Routes = 6, Validation = 50%

Table 24: Manchester Airport – average IP hour – journey time validation summary

Route name	Distance (km)	Observed time (h:m:s)	Modelled time (h:m:s)	Difference (h:m:s)	Percentage difference	Lower limit (h:m:s)	Upper limit (h:m:s)	Within limits
Route 1 - north EB M56 junction 5 to junction 7	7.01	00:04:07	00:03:56	- 00:00:11	-4%	00:03:07	00:05:07	✓
Route 1 - south WB M56 junction 5 to junction 7	7.10	00:04:07	00:04:22	+ 00:00:15	6%	00:03:07	00:05:07	✓
Route 2 - EB M56 Airport Spur/ Ringway Rd West	2.67	00:03:29	00:03:38	+ 00:00:09	4%	00:02:29	00:04:29	✓
Route 2 - WB M56 Airport Spur/ Ringway Rd West	2.78	00:03:41	00:03:43	+ 00:00:02	1%	00:02:41	00:04:41	✓
Route 3 - south EB A538 Wilmslow Road / Hale Rd	3.17	00:05:17	00:04:21	- 00:00:56	-18%	00:04:17	00:06:17	✓
Route 3 - north WB	3.21	00:05:40	00:04:37	- 00:01:03	-19%	00:04:40	00:06:40	×

Route name	Distance (km)	Observed time (h:m:s)	Modelled time (h:m:s)	Difference (h:m:s)	Percentage difference	Lower limit (h:m:s)	Upper limit (h:m:s)	Within limits
A538 Wilmslow Road / Hale Rd								
								Pass = 5, Routes = 6, Validation = 83%

Table 25: Manchester Airport – PM peak hour – journey time validation summary

Route name	Distance (km)	Observed time (h:m:s)	Modelled time (h:m:s)	Difference (h:m:s)	Percentage difference	Lower limit (h:m:s)	Upper limit (h:m:s)	Within limits
Route 1 - north EB M56 junction 5 to junction 7	7.01	00:06:15	00:03:56	- 00:02:19	-37%	00:05:15	00:07:15	×
Route 1 - south WB M56 junction 5 to junction 7	7.10	00:05:14	00:04:40	- 00:00:34	-11%	00:04:14	00:06:14	✓
Route 2 - EB M56 Airport Spur/Ringway Rd west	2.67	00:07:20	00:05:44	- 00:01:36	-22%	00:06:14	00:08:26	×
Route 2 - WB M56 Airport Spur/Ringway Rd west	2.78	00:04:05	00:03:50	- 00:00:15	-6%	00:03:05	00:05:05	✓
Route 3 - south EB A538 Wilmslow Road/Hale Rd	3.17	00:05:46	00:05:14	- 00:00:32	-9%	00:04:46	00:06:46	✓
Route 3 - north WB A538 Wilmslow Road/Hale Rd	3.21	00:07:45	00:05:11	- 00:02:34	-33%	00:06:35	00:08:55	×
								Pass = 3, Routes = 6, Validation = 50%

5.4 Post HS2 model update summary

5.4.1 Table 26 presents a summary of individual link flow performance following the HS2 model update completed by MWJV. A direct comparison can be made to Table 3 which presents the results for the original model, before HS2 model update.

5.4.2 A comparison of the results show that the link flow validation for the Manchester Piccadilly and Manchester Airport station areas has significantly improved following the HS2 model update.

5.4.3 The Manchester Piccadilly area shows a validation of 100 percent for AM, 97 percent for IP, and 95 percent for PM following the model update; whereas, prior to the model update the results were as follows 48 percent for AM, 60 percent for IP, and 58 percent for PM.

5.4.4 Similarly, the results for the Manchester Airport area show a similar level of improvement. The validation results following the model update are as follows, 89 percent for AM, 95 percent for IP, and 84 percent for PM peak hour; whereas, prior to the model update the results were as follows 61 percent for AM, 71 percent for IP, and 49 percent for PM.

5.4.5 The validation results for the wider model area show that the results following the post model update are as follows, 89 percent for AM, 92 percent for IP, and 84 percent for PM peak hour; whereas, prior to the model update the results were as follows 93 percent for AM, 93 percent for IP, and 86 percent for PM. This comparison shows that there is a marginal change in wider model area performance, and that the model update has not had a significant impact in the wider area.

5.4.6 The overall total link flow validation summary shows that the results following the post model update are as follows, 90 percent for AM, 93 percent for IP, and 85 percent for PM peak hour; whereas, prior to the model update the results were as follows 84 percent for AM, 87 percent for IP and 79 percent for PM. In summary, it is evident that the model update has improved the overall link flow model performance.

Table 26: Individual link flow summary – total all vehicle flow (post MWJV update)

Individual link flow validation – total all vehicle flow summary – DfT TAG criteria flow range or GEH < 5							
Area	**Total counts**	**AM peak hour**		**Average IP hour**		**PM peak hour**	
		Number of counts	**Percentage**	**Number of counts**	**Percentage**	**Number of counts**	**Percentage**
Manchester Piccadilly	75	75	100%	73	97%	71	95%
Manchester Airport	87	77	89%	83	95%	73	84%
Wider Model Area	477	423	89%	440	92%	399	84%
Total	639	575	90%	596	93%	543	85%

6 Model convergence

6.1.1 Achieving a suitable level of convergence is necessary to provide stable, consistent and robust model results and to differentiate between real changes and those associated with differing degrees of convergence.

6.1.2 TAG provides guidance on highway model convergence with recommendations on acceptable variations in link flows and costs between iterations helping to ensure the model is sufficiently stable.

6.1.3 Table 27 presents a summary of the 2017 base year highway model convergence statistics by time period. It is evident that all modelled time periods meet the specified DfT TAG guidance for convergence.

Table 27: 2017 Base year highway model convergence

Criteria	Loop	Target	AM peak hour	Average IP hour	PM peak hour
Flow change	N-3	> 98%	98.50	98.50	98.30
	N-2		98.80	98.30	98.40
	N-1		98.40	98.90	98.10
	N		98.60	98.40	98.30
Cost change	N-3	> 98%	99.50	99.70	99.40
	N-2		99.40	99.70	99.20
	N-1		99.40	99.70	99.20
	N		99.40	99.60	99.20
Delta		< 0.1%	0.0073/21	0.0063/15	0.0109/14
% GAP		< 0.1%	0.0130	0.0140	0.0200

7 Summary and conclusions

7.1.1 The GMSM 2017 base year highway model as supplied by TfGM provides a good representation of traffic flows covering the wider model area for all model time periods.

7.1.2 The model has subsequently been updated by MWJV to GMSM–HS2 to include substantial additional network and zonal detail within the local study areas of Manchester High Speed stations to support the TA.

7.1.3 Summary tables are presented below that show the model calibration/validation performance following the model update for the Proposed Scheme TA.

7.1.4 The individual link flow validation summary shows that there is a good correlation between observed and modelled traffic flows for: the Manchester Piccadilly area; Manchester Airport area; and for the wider model area. The comparison shows that around 85 percent of the individual links meet either the DfT TAG flow range or GEH less than five criteria in all time periods.

7.1.5 The screenline flow validation summary also shows that there is a good correlation between observed and modelled traffic flows for the Manchester Piccadilly area, Manchester Airport area, and for the wider model area.

7.1.6 The journey time validation summary shows that there is a reasonable validation of modelled journey times within the Manchester Piccadilly area for all time periods. The validation of Manchester Airport journey time routes shows that there is a level of underestimation of modelled journey times for some routes during the AM and PM peak hours. The validation of average IP hour journey times for Manchester Airport shows a good correlation to observed journey times.

7.1.7 In conclusion, the GMSM-HS2 model provides a reliable forecasting base and forms a suitable tool for the assessment of the Proposed Scheme's construction and operational impacts within the Manchester Station areas; and also across the wider area of Greater Manchester. This model is the most representative tool for informing future year highway traffic conditions.

Table 28: 2017 base year highway model validation summary

Individual link flow validation – total all vehicle flow summary – DfT TAG criteria flow range or GEH < 5							
Area	**Total counts**	**AM peak hour**		**Average IP hour**		**PM peak hour**	
		Number of counts	**Percentage**	**Number of counts**	**Percentage**	**Number of counts**	**Percentage**
Manchester Piccadilly	75	75	100%	73	97%	71	95%
Manchester Airport	87	77	89%	83	95%	73	84%
Wider model area	477	423	89%	440	92%	399	84%
Total	**639**	**575**	**90%**	**596**	**93%**	**543**	**85%**

Screenline validation - total all vehicle flow summary – DfT TAG criteria flow difference less than 5%							
Area	**Total screenlines**	**AM peak hour**		**Average IP hour**		**PM peak hour**	
		Number of lines	**Percentage**	**Number of lines**	**Percentage**	**Number of lines**	**Percentage**
Manchester Piccadilly	2	2	100%	2	100%	2	100%
Manchester Airport	10	7	70%	8	80%	8	80%
Wider Model Area	30	25	83%	26	87%	23	77%
Total	**42**	**34**	**81%**	**36**	**86%**	**33**	**79%**

Table 29: Journey time validation summary

DfT TAG criteria – journey times within 15 percent (or one minute if higher) range							
Area	**Total routes**	**AM peak hour**		**Average IP hour**		**PM peak hour**	
		Number of routes	**Percentage**	**Number of routes**	**Percentage**	**Number of routes**	**Percentage**
Manchester Piccadilly	8	5	63%	8	100%	6	75%
Manchester Airport	6	3	50%	5	83%	3	50%

8 Acronyms

Table 30: Acronyms

Acronyms	
GMSM	Greater Manchester SATURN Model
GMPTM	Greater Manchester Public Transport Model
GMVDM	Greater Manchester Variable Demand Model
LMVR	Local Model Validation Report
MPR	Model Performance Report
TA	Transport Assessment
ES	Environmental Statement
DfT	Department for Transport
DMRB	Design Manual for Roads and Bridges
ATC	Automatic traffic count
MCC	Manual classified count
JTC	Junction turning count
GEH	Geoffrey Havers (statistic)
CDES	Civil Design and Environmental Services (Consultant)
PYV	Present year validation

9 References

Department for Transport (2020), *TAG unit M3.1 Highway Assignment Modelling*. Available online at: https://www.gov.uk/government/publications/webtag-tag-unit-m3-1-highway-assignment-modelling.

Greater Manchester SATURN Model – 2017 local model validation report addendum (2017). 2017 Local Model Validation Report Addendum (AECOM).

Greater Manchester SATURN Model – 2014 local model validation report (2014). 2014 Local Validation Report (TfGM).

Appendix A: Area wide model validation

Screenline – grouped flow assessment

Table A 1: Wider model area – AM peak hour – screenline flows

Screenline name	Total counts	Observed flow (vehicles)				Modelled flow (vehicles)				Total flow comparison		
		Cars	LGVs	OGVs	Total	Cars	LGVs	OGVs	Total	Difference	Percentage difference	Flow difference less than 5%
Regional Centre cordon inbound	21	10,768	789	93	11,650	9,472	718	126	10,316	-1,334	-11%	×
Regional Centre cordon outbound	19	4,496	465	98	5,059	4,278	455	137	4,870	-189	-4%	✓
Intermediate Ring Road cordon inbound	37	26,382	2,147	432	28,961	24,266	2,135	520	26,921	-2,039	-7%	×
Intermediate Ring Road cordon outbound	37	12,917	1,485	389	14,791	12,283	1,430	454	14,167	-624	-4%	✓
M60 inner cordon inbound	51	45,019	5,275	946	51,240	41,534	5,028	1,572	48,134	-3,106	-6%	×
M60 inner cordon outbound	51	29,566	4,458	1,045	35,069	28,347	4,042	1,319	33,708	-1,362	-4%	✓
WIRR cordon 1 inbound	7	5,100	751	171	6,022	5,114	762	238	6,114	92	2%	✓
WIRR cordon 1 outbound	7	5,626	860	186	6,672	5,633	873	275	6,781	109	2%	✓
WIRR cordon 2 inbound	8	6,533	825	178	7,536	6,527	826	234	7,586	50	1%	✓
WIRR cordon 2 outbound	8	4,888	956	155	5,999	4,881	961	204	6,046	47	1%	✓
Trafford Centre cordon inbound	5	3,458	376	157	3,991	3,179	395	181	3,756	-236	-6%	×
Trafford Centre cordon outbound	6	2,170	292	143	2,605	2,233	301	170	2,704	99	4%	✓
Rochdale Town Centre cordon inbound	13	6,793	795	120	7,708	6,797	780	156	7,733	25	0%	✓
Rochdale Town Centre cordon outbound	13	5,097	753	87	5,937	5,153	748	120	6,020	83	1%	✓
Oldham Town Centre cordon inbound	13	8,647	919	182	9,748	8,494	915	219	9,628	-120	-1%	✓
Oldham Town Centre cordon outbound	13	6,327	954	140	7,421	6,191	932	182	7,306	-115	-2%	✓
Bolton Town Centre cordon inbound	8	2,862	200	31	3,093	2,799	201	43	3,043	-50	-2%	✓
Bolton Town Centre cordon outbound	8	1,519	208	28	1,755	1,439	205	40	1,684	-71	-4%	✓
Altrincham screenline southbound (SB)	7	4,797	407	34	5,238	4,554	426	52	5,032	-206	-4%	✓
Altrincham screenline NB	7	3,359	275	57	3,691	3,150	296	85	3,531	-160	-4%	✓
Walkden to M60 screenline WB	5	2,167	401	159	2,727	2,117	339	166	2,622	-105	-4%	✓
Walkden to M60 screenline EB	5	4,180	619	138	4,937	4,286	601	167	5,055	118	2%	✓
West of Bolton screenline WB	10	3,760	466	64	4,290	3,754	463	83	4,300	10	0%	✓
West of Bolton screenline EB	10	5,224	527	58	5,809	5,169	521	69	5,758	-50	-1%	✓
County boundary inbound counts	32	12,013	1,642	491	14,146	11,510	1,692	557	13,759	-387	-3%	✓
County boundary outbound counts	32	10,602	1,891	501	12,994	10,021	1,829	576	12,426	-568	-4%	✓
Stockport cordon inbound	17	10,880	1,284	228	12,392	10,403	1,280	348	12,031	-361	-3%	✓
Stockport cordon outbound	17	8,576	1,308	231	10,115	8,187	1,285	372	9,845	-270	-3%	✓
M60 screenline SB	5	6,890	607	385	7,882	6,393	569	326	7,287	-595	-8%	×
M60 screenline NB	5	6,951	469	514	7,934	6,930	457	453	7,840	-94	-1%	✓

Table A 2: Wider model area – average IP hour – screenline flows

Screenline name	Total counts	Observed flow (vehicles)				Modelled flow (vehicles)				Total flow comparison		
		Cars	LGVs	OGVs	Total	Cars	LGVs	OGVs	Total	Difference	Percentage difference	Flow difference less than 5%
Regional Centre cordon inbound	21	5,055	793	113	5,961	4,858	771	146	5,776	-185	-3%	✓
Regional Centre cordon outbound	19	3,782	794	114	4,690	3,565	743	159	4,467	-223	-5%	✓
Intermediate Ring Road cordon inbound	37	13,217	2,188	508	15,913	12,732	2,100	642	15,474	-438	-3%	✓
Intermediate Ring Road cordon outbound	37	12,318	2,231	518	15,067	11,692	2,134	668	14,494	-572	-4%	✓
M60 inner cordon inbound	51	26,200	4,494	1,045	31,739	25,290	4,287	1,467	31,044	-695	-2%	✓
M60 inner cordon outbound	51	26,038	4,727	1,158	31,923	25,954	4,448	1,678	32,079	156	0%	✓
WIRR cordon 1 inbound	7	3,925	683	176	4,784	3,917	685	275	4,877	93	2%	✓
WIRR cordon 1 outbound	7	3,881	718	206	4,805	3,878	720	278	4,876	71	1%	✓
WIRR cordon 2 inbound	8	4,308	722	189	5,219	4,304	722	246	5,272	52	1%	✓
WIRR cordon 2 outbound	8	4,418	767	167	5,352	4,420	764	218	5,403	51	1%	✓
Trafford Centre cordon inbound	5	3,601	335	158	4,094	3,328	362	221	3,911	-183	-4%	✓
Trafford Centre cordon outbound	6	2,619	310	156	3,085	2,786	353	220	3,358	273	9%	×
Rochdale Town Centre cordon inbound	13	5,062	827	128	6,017	4,953	806	160	5,918	-99	-2%	✓
Rochdale Town Centre cordon outbound	13	5,271	840	130	6,241	5,283	836	162	6,281	40	1%	✓
Oldham Town Centre cordon inbound	13	5,345	979	188	6,512	5,202	959	211	6,372	-141	-2%	✓
Oldham Town Centre cordon outbound	13	5,173	996	180	6,349	5,029	975	204	6,209	-140	-2%	✓
Bolton Town Centre cordon inbound	8	2,204	219	23	2,446	2,091	221	29	2,341	-106	-4%	✓
Bolton Town Centre cordon outbound	8	2,227	234	33	2,494	2,019	228	37	2,284	-210	-8%	×
Altrincham screenline SB	7	2,776	381	56	3,213	2,813	364	82	3,258	45	1%	✓
Altrincham screenline NB	7	2,766	352	52	3,170	2,699	371	69	3,139	-31	-1%	✓
Walkden to M60 screenline WB	5	2,065	495	137	2,697	2,033	474	210	2,717	20	1%	✓
Walkden to M60 screenline EB	5	2,258	454	126	2,838	2,293	469	160	2,922	84	3%	✓
West of Bolton screenline WB	10	3,300	491	56	3,847	3,278	472	74	3,823	-24	-1%	✓
West of Bolton screenline EB	10	3,099	458	52	3,609	3,124	450	64	3,638	29	1%	✓
County boundary inbound counts	32	7,987	1,564	512	10,063	7,293	1,579	651	9,523	-540	-5%	✓
County boundary outbound counts	32	7,501	1,478	515	9,494	7,454	1,479	639	9,572	78	1%	✓
Stockport cordon inbound	17	7,649	1,260	258	9,167	6,851	1,344	406	8,601	-566	-6%	×
Stockport cordon outbound	17	7,747	1,205	255	9,207	7,607	1,277	451	9,335	128	1%	✓
M60 screenline southbound (SB)	5	4,419	319	327	5,065	4,536	537	291	5,364	299	6%	×
M60 screenline NB	5	4,550	382	273	5,205	4,535	487	225	5,247	42	1%	✓

Table A 3: Wider model area – PM peak hour – screenline flows

Screenline name	Total counts	Observed flow (vehicles)				Modelled flow (vehicles)				Total flow comparison		
		Cars	LGVs	OGVs	Total	Cars	LGVs	OGVs	Total	Difference	Percentage difference	Flow difference less than 5%
Regional Centre cordon inbound	21	5,885	312	25	6,222	5,787	266	36	6,089	-133	-2%	✓
Regional Centre cordon outbound	19	9,344	494	37	9,875	8,733	488	57	9,277	-598	-6%	×
Intermediate Ring Road cordon inbound	37	15,305	1,159	148	16,612	15,471	1,072	192	16,735	123	1%	✓
Intermediate Ring Road cordon outbound	37	26,294	1,793	182	28,269	24,407	1,593	251	26,251	-2,018	-7%	×
M60 inner cordon inbound	51	36,421	3,634	420	40,475	33,867	3,316	620	37,803	-2,672	-7%	×
M60 inner cordon outbound	51	47,114	4,312	501	51,927	44,331	3,933	850	49,114	-2,813	-5%	✓
WIRR cordon 1 inbound	7	6,862	790	51	7,703	6,745	753	107	7,605	-98	-1%	✓
WIRR cordon 1 outbound	7	5,964	606	77	6,647	5,836	578	130	6,544	-103	-2%	✓
WIRR cordon 2 inbound	8	5,481	737	75	6,293	5,526	728	93	6,348	55	1%	✓
WIRR cordon 2 outbound	8	7,300	719	45	8,064	7,320	699	53	8,071	7	0%	✓
Trafford Centre cordon inbound	5	4,435	210	93	4,738	4,385	226	123	4,734	-3	0%	✓
Trafford Centre cordon outbound	6	4,260	232	84	4,576	4,242	238	116	4,596	20	0%	✓
Rochdale Town Centre cordon inbound	13	5,640	575	32	6,247	5,819	559	42	6,420	173	3%	✓
Rochdale Town Centre cordon outbound	13	7,058	575	33	7,666	7,142	563	42	7,748	82	1%	✓
Oldham Town Centre cordon inbound	13	7,482	719	67	8,268	7,029	689	80	7,799	-469	-6%	×
Oldham Town Centre cordon outbound	13	8,819	825	74	9,718	8,570	775	84	9,428	-289	-3%	✓
Bolton Town Centre cordon inbound	8	2,350	159	4	2,513	2,247	159	8	2,414	-99	-4%	✓
Bolton Town Centre cordon outbound	8	3,792	189	8	3,989	3,604	192	13	3,809	-181	-5%	✓
Altrincham screenline SB	7	3,607	273	15	3,895	3,647	296	24	3,966	71	2%	✓
Altrincham screenline NB	7	4,481	250	18	4,749	4,394	259	27	4,680	-70	-1%	✓
Walkden to M60 screenline WB	5	4,712	464	91	5,267	4,258	413	163	4,834	-433	-8%	×
Walkden to M60 screenline EB	5	2,874	243	63	3,180	3,062	266	72	3,400	220	7%	×
West of Bolton screenline WB	10	5,438	487	29	5,954	5,459	484	35	5,977	23	0%	✓
West of Bolton screenline EB	10	3,803	374	25	4,202	3,757	362	34	4,152	-50	-1%	✓
County boundary inbound counts	32	13,384	1,553	248	15,185	13,219	1,477	334	15,030	-155	-1%	✓
County boundary outbound counts	32	14,596	1,514	196	16,306	14,183	1,437	245	15,864	-442	-3%	✓
Stockport cordon inbound	17	10,196	930	105	11,231	9,471	898	139	10,507	-724	-6%	×
Stockport cordon outbound	17	11,823	926	102	12,851	11,267	918	132	12,317	-534	-4%	✓
M60 screenline SB	5	7,471	520	225	8,216	7,209	412	195	7,816	-400	-5%	✓
M60 screenline NB	5	7,178	501	196	7,875	7,020	439	148	7,607	-268	-3%	✓

Screenline – individual link flow summary

Table A 4: Wider model area – AM peak hour – total all vehicles – summary comparison

Screenline name	Total counts	TAG criteria 1 flow range acceptance		TAG criteria 2 GEH < 5 acceptance		TAG criteria flow range or GEH	
		Number of counts	Percentage	Number of counts	Percentage	Number of counts	Percentage
Regional Centre cordon inbound	21	15	71%	15	71%	16	76%
Regional Centre cordon outbound	19	13	68%	11	58%	13	68%
Intermediate Ring Road cordon inbound	37	27	73%	26	70%	28	76%
Intermediate Ring Road cordon outbound	37	32	86%	29	78%	33	89%
M60 inner cordon inbound	51	43	84%	44	86%	44	86%
M60 inner cordon outbound	51	48	94%	47	92%	48	94%
WIRR cordon 1 inbound	7	7	100%	7	100%	7	100%
WIRR cordon 1 outbound	7	7	100%	7	100%	7	100%
WIRR cordon 2 inbound	8	8	100%	8	100%	8	100%
WIRR cordon 2 outbound	8	8	100%	8	100%	8	100%
Trafford Centre cordon inbound	5	5	100%	5	100%	5	100%
Trafford Centre cordon outbound	6	6	100%	6	100%	6	100%
Rochdale Town Centre cordon inbound	13	13	100%	13	100%	13	100%
Rochdale Town Centre cordon outbound	13	11	85%	11	85%	11	85%
Oldham Town Centre cordon inbound	13	12	92%	12	92%	12	92%
Oldham Town Centre cordon outbound	13	12	92%	12	92%	12	92%
Bolton Town Centre cordon inbound	8	6	75%	6	75%	6	75%
Bolton Town Centre cordon outbound	8	8	100%	6	75%	8	100%
Altrincham screenline SB	7	6	86%	6	86%	6	86%
Altrincham screenline NB	7	7	100%	7	100%	7	100%
Walkden to M60 screenline WB	5	5	100%	5	100%	5	100%
Walkden to M60 Screenline EB	5	4	80%	5	100%	5	100%
West of Bolton screenline WB	10	10	100%	10	100%	10	100%
West of Bolton screenline EB	10	9	90%	10	100%	10	100%
County boundary inbound counts	32	29	91%	30	94%	30	94%
County boundary outbound counts	32	26	81%	26	81%	27	84%
Stockport cordon inbound	17	12	71%	13	76%	14	82%
Stockport cordon outbound	17	16	94%	16	94%	16	94%
M60 screenline SB	5	4	80%	4	80%	4	80%
M60 screenline NB	5	4	80%	4	80%	4	80%
Total	**477**	**413**	**87%**	**409**	**86%**	**423**	**89%**

Table A 5: Wider model area – AM peak hour – car vehicle type – summary comparison

Screenline name	Total counts	TAG criteria 1 flow range acceptance		TAG criteria 2 GEH < 5 acceptance		TAG criteria flow range or GEH	
		Number of counts	Percentage	Number of counts	Percentage	Number of counts	Percentage
Regional Centre cordon inbound	21	16	76%	15	71%	16	76%
Regional Centre cordon outbound	19	13	68%	11	58%	13	68%
Intermediate Ring Road cordon inbound	37	28	76%	26	70%	29	78%
Intermediate Ring Road cordon outbound	37	32	86%	27	73%	33	89%
M60 inner cordon inbound	51	43	84%	41	80%	43	84%
M60 inner cordon outbound	51	49	96%	48	94%	49	96%
WIRR cordon 1 inbound	7	7	100%	7	100%	7	100%
WIRR cordon 1 outbound	7	7	100%	7	100%	7	100%
WIRR cordon 2 inbound	8	8	100%	8	100%	8	100%
WIRR cordon 2 outbound	8	8	100%	8	100%	8	100%
Trafford Centre cordon inbound	5	5	100%	4	80%	5	100%
Trafford Centre cordon outbound	6	6	100%	6	100%	6	100%
Rochdale Town Centre cordon inbound	13	13	100%	13	100%	13	100%
Rochdale Town Centre cordon outbound	13	11	85%	11	85%	11	85%
Oldham Town Centre cordon inbound	13	12	92%	12	92%	12	92%
Oldham Town Centre cordon outbound	13	13	100%	12	92%	13	100%
Bolton Town Centre cordon inbound	8	6	75%	6	75%	6	75%
Bolton Town Centre cordon outbound	8	8	100%	6	75%	8	100%
Altrincham screenline SB	7	6	86%	6	86%	6	86%
Altrincham screenline NB	7	7	100%	7	100%	7	100%
Walkden to M60 screenline WB	5	5	100%	5	100%	5	100%
Walkden to M60 screenline EB	5	4	80%	5	100%	5	100%
West of Bolton screenline WB	10	10	100%	10	100%	10	100%
West of Bolton screenline EB	10	9	90%	10	100%	10	100%
County boundary inbound counts	32	29	91%	29	91%	29	91%
County boundary outbound counts	32	26	81%	27	84%	28	88%
Stockport cordon inbound	17	12	71%	12	71%	13	76%
Stockport cordon outbound	17	15	88%	16	94%	16	94%
M60 screenline SB	5	3	60%	4	80%	4	80%
M60 screenline NB	5	4	80%	4	80%	4	80%
Total	**477**	**415**	**87%**	**403**	**84%**	**424**	**89%**

Table A 6: Wider model area – average IP peak hour – total all vehicles – summary comparison

Screenline name	Total counts	TAG criteria 1 flow range acceptance		TAG criteria 2 GEH < 5 acceptance		TAG criteria flow range or GEH	
		Number of counts	Percentage	Number of counts	Percentage	Number of counts	Percentage
Regional Centre cordon inbound	21	16	76%	14	67%	16	76%
Regional Centre cordon outbound	19	16	84%	15	79%	16	84%
Intermediate Ring Road cordon inbound	37	35	95%	30	81%	35	95%

Screenline name	Total counts	TAG criteria 1 flow range acceptance		TAG criteria 2 GEH < 5 acceptance		TAG criteria flow range or GEH	
		Number of counts	Percentage	Number of counts	Percentage	Number of counts	Percentage
Intermediate Ring Road cordon outbound	37	32	86%	31	84%	33	89%
M60 inner cordon inbound	51	48	94%	46	90%	48	94%
M60 inner cordon outbound	51	47	92%	47	92%	47	92%
WIRR cordon 1 inbound	7	7	100%	7	100%	7	100%
WIRR cordon 1 outbound	7	7	100%	7	100%	7	100%
WIRR cordon 2 inbound	8	8	100%	8	100%	8	100%
WIRR cordon 2 outbound	8	8	100%	8	100%	8	100%
Trafford Centre cordon inbound	5	5	100%	4	80%	5	100%
Trafford Centre cordon outbound	6	5	83%	5	83%	5	83%
Rochdale Town Centre cordon inbound	13	12	92%	12	92%	12	92%
Rochdale Town Centre cordon outbound	13	13	100%	13	100%	13	100%
Oldham Town Centre cordon inbound	13	11	85%	12	92%	12	92%
Oldham Town Centre cordon outbound	13	12	92%	12	92%	12	92%
Bolton Town Centre cordon inbound	8	7	88%	7	88%	7	88%
Bolton Town Centre cordon outbound	8	7	88%	5	63%	7	88%
Altrincham screenline SB	7	7	100%	7	100%	7	100%
Altrincham screenline NB	7	7	100%	7	100%	7	100%
Walkden to M60 screenline WB	5	5	100%	5	100%	5	100%
Walkden to M60 screenline EB	5	4	80%	4	80%	4	80%
West of Bolton screenline WB	10	10	100%	10	100%	10	100%
West of Bolton screenline EB	10	10	100%	10	100%	10	100%
County boundary inbound counts	32	29	91%	29	91%	29	91%
County boundary outbound counts	32	30	94%	31	97%	31	97%
Stockport cordon inbound	17	13	76%	13	76%	14	82%
Stockport cordon outbound	17	16	94%	15	88%	16	94%
M60 screenline SB	5	4	80%	4	80%	4	80%
M60 screenline NB	5	4	80%	5	100%	5	100%
Total	**477**	**435**	**91%**	**423**	**89%**	**440**	**92%**

Table A 7: Wider model area – average IP peak hour – car vehicle type – summary comparison

Screenline name	Total counts	TAG criteria 1 flow range acceptance		TAG criteria 2 GEH < 5 acceptance		TAG criteria flow range or GEH	
		Number of counts	Percentage	Number of counts	Percentage	Number of counts	Percentage
Regional Centre cordon inbound	21	16	76%	14	67%	16	76%
Regional Centre cordon outbound	19	17	89%	15	79%	17	89%
Intermediate Ring Road cordon inbound	37	35	95%	32	86%	35	95%
Intermediate Ring Road cordon outbound	37	34	92%	30	81%	34	92%
M60 Inner cordon inbound	51	47	92%	46	90%	47	92%
M60 Inner cordon outbound	51	45	88%	45	88%	46	90%
WIRR cordon 1 inbound	7	7	100%	7	100%	7	100%

Screenline name	Total counts	TAG criteria 1 flow range acceptance		TAG criteria 2 GEH < 5 acceptance		TAG criteria flow range or GEH	
		Number of counts	Percentage	Number of counts	Percentage	Number of counts	Percentage
WIRR cordon 1 outbound	7	7	100%	7	100%	7	100%
WIRR cordon 2 inbound	8	8	100%	8	100%	8	100%
WIRR cordon 2 outbound	8	8	100%	8	100%	8	100%
Trafford Centre cordon inbound	5	4	80%	4	80%	4	80%
Trafford Centre cordon outbound	6	5	83%	5	83%	5	83%
Rochdale Town Centre cordon inbound	13	12	92%	12	92%	12	92%
Rochdale Town Centre cordon outbound	13	13	100%	13	100%	13	100%
Oldham Town Centre cordon inbound	13	12	92%	12	92%	12	92%
Oldham Town Centre cordon outbound	13	12	92%	12	92%	12	92%
Bolton Town Centre cordon inbound	8	7	88%	7	88%	7	88%
Bolton Town Centre cordon outbound	8	7	88%	5	63%	7	88%
Altrincham screenline SB	7	7	100%	7	100%	7	100%
Altrincham screenline NB	7	7	100%	7	100%	7	100%
Walkden to M60 screenline WB	5	5	100%	4	80%	5	100%
Walkden to M60 screenline EB	5	4	80%	4	80%	4	80%
West of Bolton screenline WB	10	10	100%	10	100%	10	100%
West of Bolton screenline EB	10	10	100%	10	100%	10	100%
County boundary inbound counts	32	29	91%	29	91%	29	91%
County boundary outbound counts	32	31	97%	31	97%	31	97%
Stockport cordon inbound	17	12	71%	12	71%	13	76%
Stockport cordon outbound	17	16	94%	15	88%	16	94%
M60 screenline SB	5	5	100%	5	100%	5	100%
M60 screenline NB	5	4	80%	4	80%	4	80%
Total	**477**	**436**	**91%**	**420**	**88%**	**438**	**92%**

Table A 8: Wider model area – PM peak hour – total all vehicles – summary comparison

Screenline name	Total counts	TAG criteria 1 flow range acceptance		TAG criteria 2 GEH < 5 acceptance		TAG criteria flow range or GEH	
		Number of counts	Percentage	Number of counts	Percentage	Number of counts	Percentage
Regional Centre cordon inbound	16	76%	14	67%	16	76%	16
Regional Centre cordon outbound	14	74%	14	74%	14	74%	14
Intermediate Ring Road cordon inbound	32	86%	29	78%	33	89%	32
Intermediate Ring Road cordon outbound	27	73%	25	68%	27	73%	27
M60 inner cordon inbound	43	84%	42	82%	43	84%	43
M60 inner cordon outbound	42	82%	43	84%	43	84%	42
WIRR cordon 1 inbound	4	57%	5	71%	5	71%	4
WIRR cordon 1 outbound	5	71%	5	71%	5	71%	5
WIRR cordon 2 inbound	7	88%	7	88%	7	88%	7
WIRR cordon 2 outbound	6	75%	6	75%	6	75%	6

Screenline name	Total counts	TAG criteria 1 flow range acceptance		TAG criteria 2 GEH < 5 acceptance		TAG criteria flow range or GEH	
		Number of counts	Percentage	Number of counts	Percentage	Number of counts	Percentage
Trafford Centre cordon inbound	5	100%	5	100%	5	100%	5
Trafford Centre cordon outbound	4	67%	4	67%	4	67%	4
Rochdale Town Centre cordon inbound	9	69%	11	85%	11	85%	9
Rochdale Town Centre cordon outbound	12	92%	12	92%	12	92%	12
Oldham Town Centre cordon inbound	9	69%	8	62%	9	69%	9
Oldham Town Centre cordon outbound	12	92%	11	85%	12	92%	12
Bolton Town Centre cordon inbound	7	88%	7	88%	7	88%	7
Bolton Town Centre cordon outbound	7	88%	6	75%	7	88%	7
Altrincham screenline SB	6	86%	6	86%	6	86%	6
Altrincham screenline NB	6	86%	6	86%	6	86%	6
Walkden to M60 screenline WB	5	100%	5	100%	5	100%	5
Walkden to M60 screenline EB	5	100%	5	100%	5	100%	5
West of Bolton screenline WB	10	100%	10	100%	10	100%	10
West of Bolton screenline EB	9	90%	8	80%	9	90%	9
County boundary inbound counts	26	81%	26	81%	27	84%	26
County boundary outbound counts	26	81%	25	78%	26	81%	26
Stockport cordon inbound	14	82%	13	76%	14	82%	14
Stockport cordon outbound	16	94%	15	88%	16	94%	16
M60 screenline SB	4	80%	4	80%	4	80%	4
M60 screenline NB	5	100%	5	100%	5	100%	5
Total	**393**	**82%**	**382**	**80%**	**399**	**84%**	**393**

Table A 9: Wider model area – PM peak hour – car vehicle type – summary comparison

Screenline name	Total counts	TAG criteria 1 flow range acceptance		TAG criteria 2 GEH < 5 acceptance		TAG criteria flow range or GEH	
		Number of counts	Percentage	Number of counts	Percentage	Number of counts	Percentage
Regional Centre cordon inbound	21	17	81%	14	67%	17	81%
Regional Centre cordon outbound	19	14	74%	14	74%	14	74%
Intermediate Ring Road cordon inbound	37	34	92%	30	81%	35	95%
Intermediate Ring Road cordon outbound	37	27	73%	25	68%	27	73%
M60 inner cordon inbound	51	44	86%	43	84%	44	86%
M60 inner cordon outbound	51	41	80%	42	82%	42	82%
WIRR cordon 1 inbound	7	4	57%	5	71%	5	71%
WIRR cordon 1 outbound	7	5	71%	5	71%	5	71%
WIRR cordon 2 inbound	8	7	88%	7	88%	7	88%
WIRR cordon 2 outbound	8	6	75%	6	75%	6	75%
Trafford Centre cordon inbound	5	5	100%	5	100%	5	100%
Trafford Centre cordon outbound	6	4	67%	4	67%	4	67%
Rochdale Town Centre cordon inbound	13	10	77%	11	85%	11	85%

Screenline name	Total counts	TAG criteria 1 flow range acceptance		TAG criteria 2 GEH < 5 acceptance		TAG criteria flow range or GEH	
		Number of counts	Percentage	Number of counts	Percentage	Number of counts	Percentage
Rochdale Town Centre cordon outbound	13	12	92%	12	92%	12	92%
Oldham Town Centre cordon inbound	13	9	69%	8	62%	9	69%
Oldham Town Centre cordon outbound	13	12	92%	11	85%	12	92%
Bolton Town Centre cordon inbound	8	7	88%	7	88%	7	88%
Bolton Town Centre cordon outbound	8	7	88%	6	75%	7	88%
Altrincham screenline SB	7	6	86%	6	86%	6	86%
Altrincham screenline NB	7	6	86%	6	86%	6	86%
Walkden to M60 screenline WB	5	4	80%	5	100%	5	100%
Walkden to M60 screenline EB	5	5	100%	5	100%	5	100%
West of Bolton screenline WB	10	10	100%	10	100%	10	100%
West of Bolton Screenline EB	10	9	90%	8	80%	9	90%
County boundary inbound counts	32	26	81%	26	81%	27	84%
County boundary outbound counts	32	27	84%	25	78%	27	84%
Stockport cordon inbound	17	15	88%	13	76%	15	88%
Stockport cordon outbound	17	16	94%	15	88%	16	94%
M60 screenline SB	5	3	60%	4	80%	4	80%
M60 screenline NB	5	5	100%	5	100%	5	100%
Total	**477**	**397**	**83%**	**383**	**80%**	**404**	**85%**

Appendix B: Manchester Piccadilly

Cordon – grouped flow assessment

Table B 1: Manchester Piccadilly – AM peak hour – cordon flows

Screenline name	Direction	Total counts	Observed flow (vehicles)				Modelled flow (vehicles)				Total flow comparison		
			Cars	LGVs	OGVs	Total	Cars	LGVs	OGVs	Total	Difference	Percentage difference	Flow difference less than 5%
Manchester Piccadilly cordon	Inbound	15	8345	994	567	9907	8537	946	445	9928	21	0%	✓
Manchester Piccadilly cordon	Outbound	15	8228	1080	514	9822	8216	1067	418	9701	-121	-1%	✓

Table B 2: Manchester Piccadilly - average IP hour – cordon flows

Screenline name	Direction	Total counts	Observed flow (vehicles)				Modelled flow (vehicles)				Total flow comparison		
			Cars	LGVs	OGVs	Total	Cars	LGVs	OGVs	Total	Difference	Percentage difference	Flow difference less than 5%
Manchester Piccadilly cordon	Inbound	15	6031	1127	772	7929	5908	1118	510	7536	-393	-5%	✓
Manchester Piccadilly cordon	Outbound	15	6414	1184	810	8408	6326	1176	503	8005	-403	-5%	✓

Table B 3: Manchester Piccadilly - PM peak hour – cordon flows

Screenline name	Direction	Total counts	Observed flow (vehicles)				Modelled flow (vehicles)				Total flow comparison		
			Cars	LGVs	OGVs	Total	Cars	LGVs	OGVs	Total	Difference	Percentage difference	Flow difference less than 5%
Manchester Piccadilly cordon	Inbound	15	8562	654	438	9654	8389	628	268	9285	-369	-4%	✓
Manchester Piccadilly cordon	Outbound	15	9427	660	468	10555	9290	661	245	10196	-359	-3%	✓

Cordon – individual link flow assessment

Table B 4: Manchester Piccadilly – AM peak hour – individual link flows

ID	Road name	Location	Direction	Observed flow (vehicles)				Modelled flow (vehicles)				Total flow comparison					
				Cars	LGVs	HGVs	Total	Cars	LGVs	HGVs	Total	Difference	Percentage difference	GEH	GEH < 5	Flow range	GEH or flow range
1A	A6 London Road	South of Store Street	Inbound	410	72	71	553	418	52	46	517	-36	-7%	1.58	✓	✓	✓
1A	Boad Street	South of Store Street	Inbound	106	12	6	123	190	14	3	206	83	67%	6.47	×	✓	✓
1A	Travis Street	East of Sheffield Street	Inbound	403	44	23	470	402	44	18	464	-6	-1%	0.27	✓	✓	✓
1A	A635 Ring Road	South of Pin Mill Brow junction	Inbound	1229	161	62	1452	1204	153	54	1412	-40	-3%	1.06	✓	✓	✓
1A	A6 London Road	South of Travis Street	Inbound	658	50	44	752	654	54	45	753	1	0%	0.03	✓	✓	✓
1A	A665 Great Ancoat Street	North of Pin Mill Brow junction	Inbound	1283	140	75	1497	1441	126	35	1602	105	7%	2.67	✓	✓	✓
1A	St Andrews's Street	North of Fairfield Street	Inbound	84	9	5	98	84	9	2	95	-3	-3%	0.26	✓	✓	✓
1A	A665 Devonshire Street	South of A57 Hyde Road	Inbound	718	43	12	773	650	34	7	691	-82	-11%	3.02	✓	✓	✓
1A	A57 Hyde Road	East of A665	Inbound	846	108	60	1014	861	106	46	1013	-1	0%	0.04	✓	✓	✓
1A	Brunswick Street	West of A6/A57 junction	Inbound	300	39	15	354	279	41	11	330	-24	-7%	1.31	✓	✓	✓
1A	A6 Ardwick Green South	North west of A6/A57 junction	Inbound	470	76	88	634	521	80	70	671	37	6%	1.43	✓	✓	✓
1A	A6 Stockport Road	South of A6/A57 junction	Inbound	537	54	26	617	586	53	29	668	51	8%	2.01	✓	✓	✓
1A	B6469 Fairfield Street	West of A6 London Road	Inbound	275	23	10	308	253	19	18	290	-18	-6%	1.07	✓	✓	✓
1A	Helmet Street	North of St Andrew's Street	Inbound	16	2	1	19	0	0	0	0	-19	-100%	6.18	×	✓	✓
1A	A635 Ashton Old Road	East of Rondin Road	Inbound	1012	162	69	1242	995	162	61	1217	-25	-2%	0.71	✓	✓	✓
1B	A6 London Road	South of Store Street	Outbound	521	35	43	599	569	37	5	611	12	2%	0.50	✓	✓	✓
1B	Boad Street	South of Store Street	Outbound	57	6	3	67	64	6	2	71	4	6%	0.51	✓	✓	✓
1B	Travis Street	East of Sheffield Street	Outbound	192	21	11	224	173	21	11	204	-20	-9%	1.36	✓	✓	✓
1B	A635 Ring Road	South of Pin Mill Brow junction	Outbound	1728	252	29	2009	1606	252	58	1916	-93	-5%	2.10	✓	✓	✓
1B	A665 Great Ancoat Street	North of Pin Mill Brow junction	Outbound	1489	163	87	1738	1432	159	40	1630	-108	-6%	2.64	✓	✓	✓
1B	A6 London Road	South of Travis Street	Outbound	556	83	63	702	548	83	50	681	-21	-3%	0.80	✓	✓	✓
1B	St Andrews's Street	North of Fairfield Street	Outbound	98	11	6	115	199	11	3	213	98	86%	7.67	×	✓	✓
1B	A665 Devonshire Street	South of A57 Hyde Road	Outbound	518	46	22	586	525	46	16	586	0	0%	0.02	✓	✓	✓
1B	A57 Hyde Road	East of A665	Outbound	383	77	58	518	381	81	44	506	-12	-2%	0.51	✓	✓	✓
1B	Brunswick Street	West of A6/A57 junction	Outbound	528	59	16	603	528	59	8	595	-8	-1%	0.31	✓	✓	✓
1B	A6 Ardwick Green South	North west of A6/A57 junction	Outbound	833	125	72	1030	848	123	72	1043	13	1%	0.40	✓	✓	✓
1B	A6 Stockport Road	South of A6/A57 junction	Outbound	277	36	38	351	275	36	36	347	-4	-1%	0.24	✓	✓	✓
1B	B6469 Fairfield Street	West of A6 London Road	Outbound	562	89	33	684	580	66	28	673	-11	-2%	0.40	✓	✓	✓
1B	Helmet Street	North of St Andrew's Street	Outbound	4	0	0	5	4	0	0	5	-1	-12%	0.27	✓	✓	✓
1B	A635 Ashton Old Road	East of Rondin Road	Outbound	481	77	33	590	486	86	47	618	28	5%	1.14	✓	✓	✓

Table B 5: Manchester Piccadilly – average IP hour – individual link flows

ID	Road name	Location	Direction	Observed flow (vehicles)				Modelled flow (vehicles)					Total flow comparison				
				Cars	LGVs	HGVs	Total	Cars	LGVs	HGVs	Total	Difference	Percentage difference	GEH	GEH < 5	Flow range	GEH or flow range
1A	A6 London Road	South of Store Street	Inbound	425	76	93	593	431	76	47	554	-39	-7%	1.63	✓	✓	✓
1A	Boad Street	South of Store Street	Inbound	44	7	5	56	45	16	2	63	7	13%	0.93	✓	✓	✓
1A	Travis Street	East of Sheffield Street	Inbound	193	31	21	245	193	32	15	240	-5	-2%	0.33	✓	✓	✓
1A	A635 Ring Road	South of Pin Mill Brow junction	Inbound	961	246	75	1281	960	245	65	1270	-10	-1%	0.28	✓	✓	✓
1A	A6 London Road	South of Travis Street	Inbound	322	32	76	430	260	32	47	339	-91	-21%	4.66	✓	✓	✓
1A	A665 Great Ancoat Street	North of Pin Mill Brow junction	Inbound	970	155	105	1230	982	163	48	1192	-37	-3%	1.07	✓	✓	✓
1A	St Andrews's Street	North of Fairfield Street	Inbound	75	12	8	95	70	11	4	84	-10	-11%	1.09	✓	✓	✓
1A	A665 Devonshire Street	South of A57 Hyde Road	Inbound	447	65	19	530	447	58	11	516	-14	-3%	0.61	✓	✓	✓
1A	A57 Hyde Road	East of A665	Inbound	541	98	106	745	539	99	65	703	-42	-6%	1.55	✓	✓	✓
1A	Brunswick Street	West of A6/A57 junction	Inbound	334	52	19	406	339	61	16	416	10	3%	0.51	✓	✓	✓
1A	A6 Ardwick Green South	North west of A6/A57 junction	Inbound	546	126	135	808	538	103	83	724	-84	-10%	3.02	✓	✓	✓
1A	A6 Stockport Road	South of A6/A57 junction	Inbound	352	67	37	456	351	67	38	456	1	0%	0.04	✓	✓	✓
1A	B6469 Fairfield Street	West of A6 London Road	Inbound	366	43	24	434	297	39	20	357	-77	-18%	3.88	✓	✓	✓
1A	Helmet Street	North of St Andrew's Street	Inbound	10	2	1	13	7	2	0	9	-4	-29%	1.14	✓	✓	✓
1A	A635 Ashton Old Road	East of Rondin Road	Inbound	445	116	48	609	448	114	49	610	2	0%	0.07	✓	✓	✓
1B	A6 London Road	South of Store Street	Outbound	257	26	47	330	179	6	2	187	-143	-43%	8.92	×	×	×
1B	Boad Street	South of Store Street	Outbound	39	6	4	49	48	6	2	55	6	13%	0.86	✓	✓	✓
1B	Travis Street	East of Sheffield Street	Outbound	199	32	21	252	184	32	15	231	-21	-8%	1.35	✓	✓	✓
1B	A635 Ring Road	South of Pin Mill Brow junction	Outbound	991	222	67	1280	994	220	60	1274	-6	0%	0.16	✓	✓	✓
1B	A665 Great Ancoat Street	North of Pin Mill Brow junction	Outbound	1160	185	125	1470	1160	183	55	1398	-72	-5%	1.91	✓	✓	✓
1B	A6 London Road	South of Travis Street	Outbound	642	94	94	829	652	112	56	820	-9	-1%	0.31	✓	✓	✓
1B	St Andrews's Street	North of Fairfield Street	Outbound	86	14	9	109	98	24	4	126	17	15%	1.54	✓	✓	✓
1B	A665 Devonshire Street	South of A57 Hyde Road	Outbound	387	54	18	459	385	53	13	452	-7	-2%	0.34	✓	✓	✓
1B	A57 Hyde Road	East of A665	Outbound	551	116	119	786	550	116	74	740	-46	-6%	1.67	✓	✓	✓
1B	Brunswick Street	West of A6/A57 junction	Outbound	236	33	14	283	230	33	10	273	-10	-4%	0.62	✓	✓	✓
1B	A6 Ardwick Green South	North west of A6/A57 junction	Outbound	584	114	126	823	578	107	92	777	-46	-6%	1.63	✓	✓	✓
1B	A6 Stockport Road	South of A6/A57 junction	Outbound	339	66	38	443	337	60	30	427	-16	-4%	0.78	✓	✓	✓
1B	B6469 Fairfield Street	West of A6 London Road	Outbound	318	61	60	439	314	62	28	404	-35	-8%	1.69	✓	✓	✓
1B	Helmet Street	North of St Andrew's Street	Outbound	9	1	1	11	0	0	0	0	-11	-100%	4.74	✓	✓	✓

ID	Road name	Location	Direction	Observed flow (vehicles)				Modelled flow (vehicles)				Total flow comparison				
				Cars	LGVs	HGVs	Total	Cars	LGVs	HGVs	Total	Difference	Percentage difference	GEH	GEH < 5	Flow range	GEH or flow range
1B	A635 Ashton Old Road	East of Rondin Road	Outbound	616	161	67	844	615	163	64	841	-2	0%	0.07	✓	✓	✓

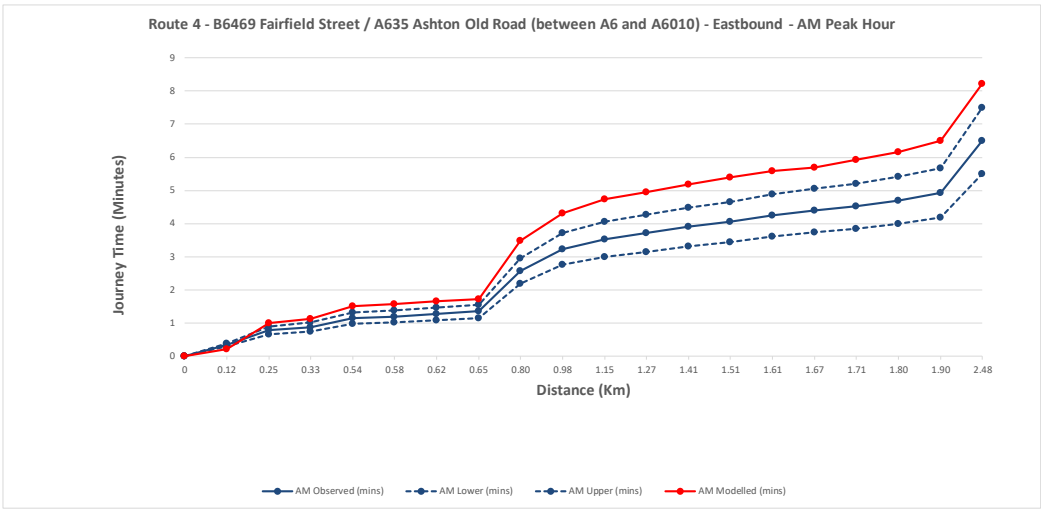
Table B 6: Manchester Piccadilly – PM peak hour – individual link flows

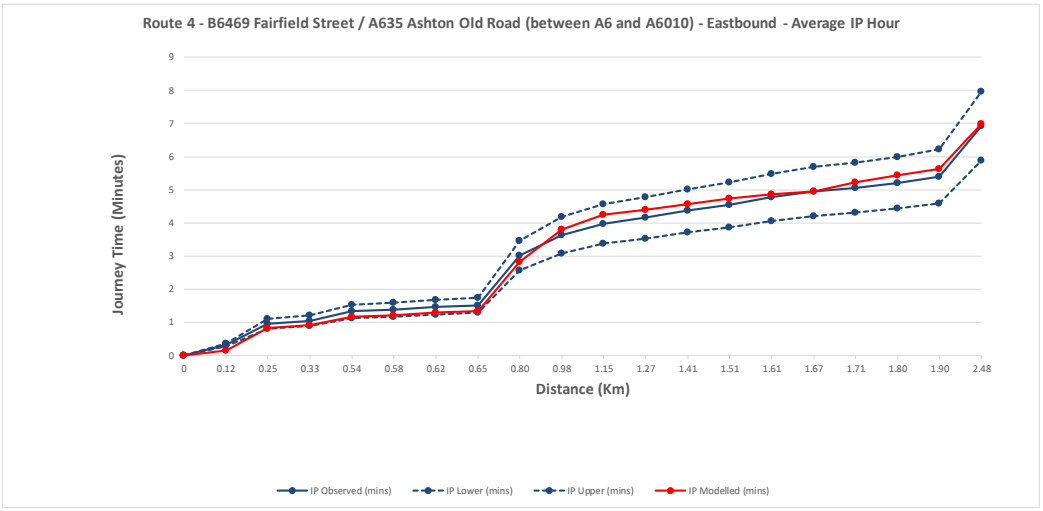
ID	Road name	Location	Direction	Observed flow (vehicles)				Modelled flow (vehicles)				Total flow comparison				
				Cars	LGVs	HGVs	Total	Cars	LGVs	HGVs	Total	Difference	Percentage difference	GEH	GEH < 5	Flow range	GEH or flow range
1A	A6 London Road	South of Store Street	Inbound	554	29	66	649	586	26	35	648	-1	0%	0.05	✓	✓	✓
1A	Boad Street	South of Store Street	Inbound	90	6	4	100	91	7	2	100	0	0%	0.04	✓	✓	✓
1A	Travis Street	East of Sheffield Street	Inbound	222	14	10	246	97	13	8	117	-128	-52%	9.52	×	×	×
1A	A635 Ring Road	South of Pin Mill Brow junction	Inbound	1690	191	33	1914	1693	167	27	1887	-27	-1%	0.62	✓	✓	✓
1A	A6 London Road	South of Travis Street	Inbound	416	19	65	500	355	15	34	404	-96	-19%	4.51	✓	✓	✓
1A	A665 Great Ancoat Street	North of Pin Mill Brow junction	Inbound	1314	86	57	1457	1311	87	14	1411	-45	-3%	1.20	✓	✓	✓
1A	St Andrews's Street	North of Fairfield Street	Inbound	92	6	4	102	121	9	1	131	29	28%	2.65	✓	✓	✓
1A	A665 Devonshire Street	South of A57 Hyde Road	Inbound	644	43	12	699	623	43	6	672	-27	-4%	1.01	✓	✓	✓
1A	A57 Hyde Road	East of A665	Inbound	449	35	57	541	435	34	26	496	-45	-8%	1.97	✓	✓	✓
1A	Brunswick Street	West of A6/A57 junction	Inbound	676	50	9	735	692	49	5	747	12	2%	0.43	✓	✓	✓
1A	A6 Ardwick Green South	North west of A6/A57 junction	Inbound	866	76	74	1016	975	77	54	1106	90	9%	2.76	✓	✓	✓
1A	A6 Stockport Road	South of A6/A57 junction	Inbound	405	40	26	471	356	40	21	417	-54	-11%	2.54	✓	✓	✓
1A	B6469 Fairfield Street	West of A6 London Road	Inbound	610	14	10	634	510	11	18	539	-95	-15%	3.93	✓	✓	✓
1A	Helmet Street	North of St Andrew's Street	Inbound	11	1	0	12	16	5	0	21	9	73%	2.18	✓	✓	✓
1A	A635 Ashton Old Road	East of Rondin Road	Inbound	523	44	11	578	529	44	15	588	10	2%	0.42	✓	✓	✓
1B	A6 London Road	South of Store Street	Outbound	265	14	40	319	201	0	0	201	-118	-37%	7.34	×	×	×
1B	Boad Street	South of Store Street	Outbound	98	6	4	108	112	6	1	119	11	10%	1.04	✓	✓	✓
1B	Travis Street	East of Sheffield Street	Outbound	346	23	15	384	273	23	10	306	-78	-20%	4.21	✓	✓	✓
1B	A635 Ring Road	South of Pin Mill Brow junction	Outbound	1196	93	23	1312	1157	93	22	1272	-40	-3%	1.11	✓	✓	✓
1B	A665 Great Ancoat Street	North of Pin Mill Brow junction	Outbound	1734	113	75	1923	1745	110	24	1878	-45	-2%	1.02	✓	✓	✓
1B	A6 London Road	South of Travis Street	Outbound	958	37	64	1059	1007	40	41	1089	30	3%	0.90	✓	✓	✓
1B	St Andrews's Street	North of Fairfield Street	Outbound	160	10	7	178	194	18	2	214	36	20%	2.58	✓	✓	✓
1B	A665 Devonshire Street	South of A57 Hyde Road	Outbound	416	23	7	446	423	24	4	450	4	1%	0.18	✓	✓	✓
1B	A57 Hyde Road	East of A665	Outbound	1254	102	62	1418	1262	103	36	1402	-16	-1%	0.44	✓	✓	✓
1B	Brunswick Street	West of A6/A57 junction	Outbound	295	30	4	329	294	30	3	327	-2	-1%	0.13	✓	✓	✓

ID	Road name	Location	Direction	Observed flow (vehicles)				Modelled flow (vehicles)					Total flow comparison				
				Cars	LGVs	HGVs	Total	Cars	LGVs	HGVs	Total	Difference	Percentage difference	GEH	GEH < 5	Flow range	GEH or flow range
1B	A6 Ardwick Green South	North west of A6/A57 junction	Outbound	492	43	72	607	503	43	43	589	-18	-3%	0.74	✓	✓	✓
1B	A6 Stockport Road	South of A6/A57 junction	Outbound	509	36	24	569	500	36	23	560	-9	-2%	0.39	✓	✓	✓
1B	B6469 Fairfield Street	West of A6 London Road	Outbound	409	20	43	472	408	27	17	451	-21	-4%	0.96	✓	✓	✓
1B	Helmet Street	North of St Andrew's Street	Outbound	21	1	1	23	0	0	0	0	-23	-99%	6.70	×	✓	✓
1B	A635 Ashton Old Road	East of Rondin Road	Outbound	1273	108	26	1408	1212	107	20	1339	-68	-5%	1.85	✓	✓	✓

Journey time route comparison

Figure B 1: Route 4 – B6469 Fairfield Street/A635 Ashton Old Road – EB





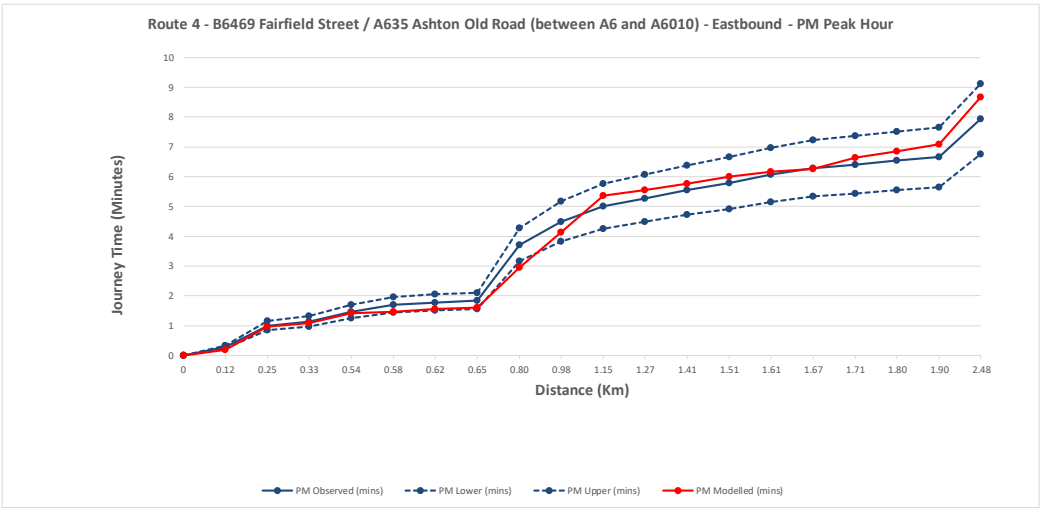
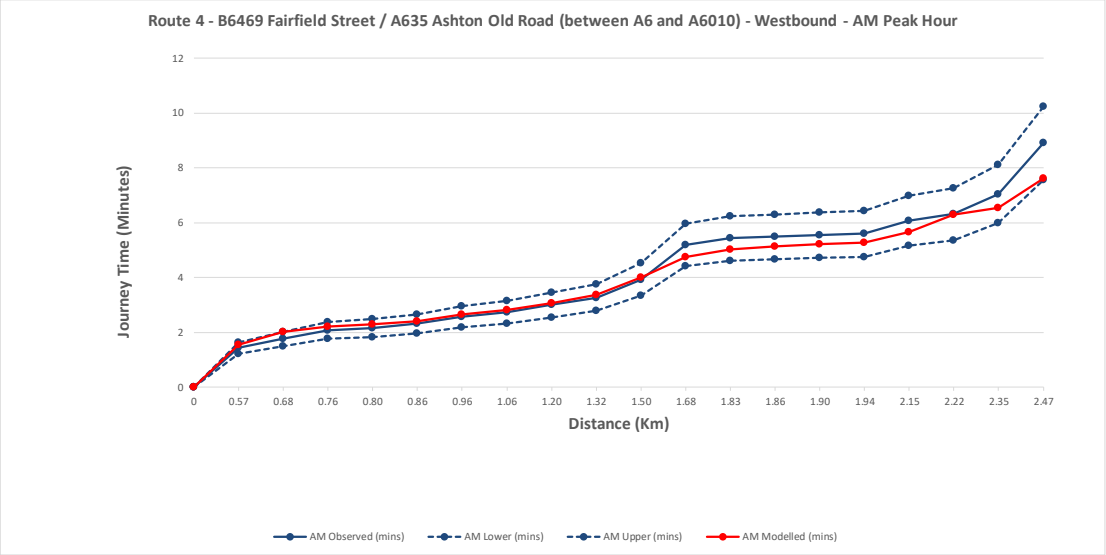
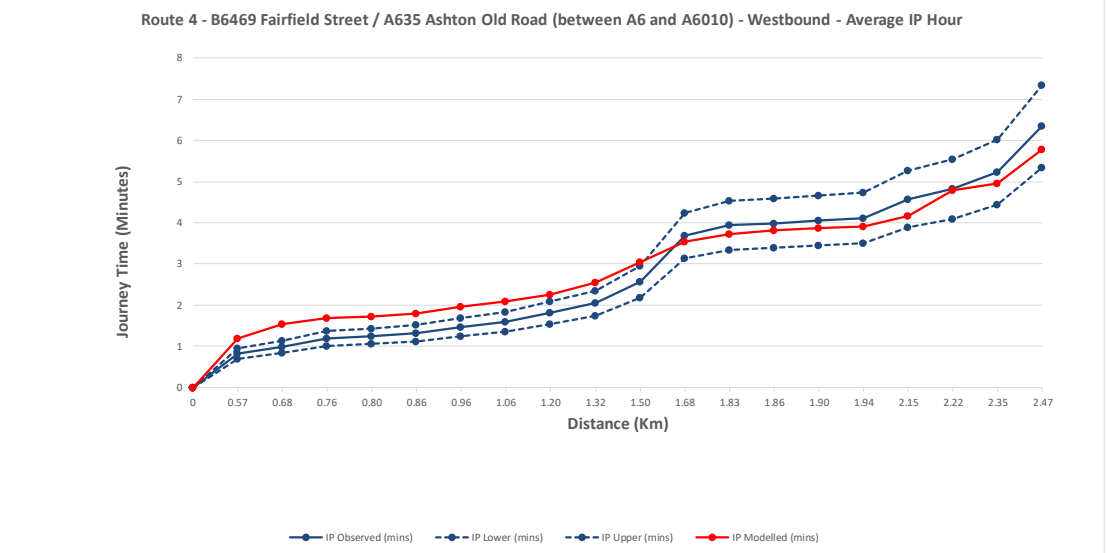


Figure B 2: Route 4 – B6469 Fairfield Street/A635 Ashton Old Road – WB





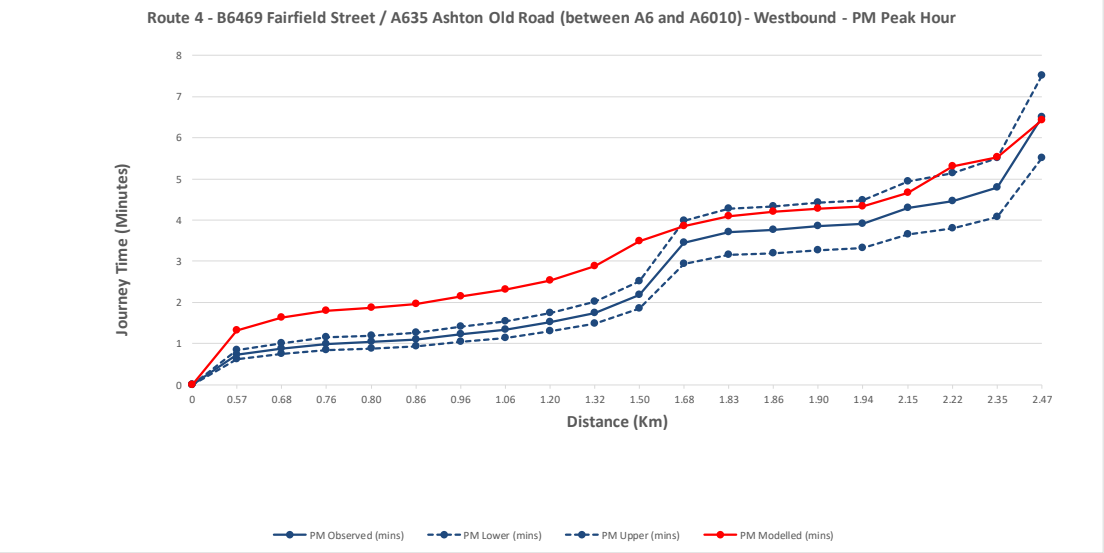
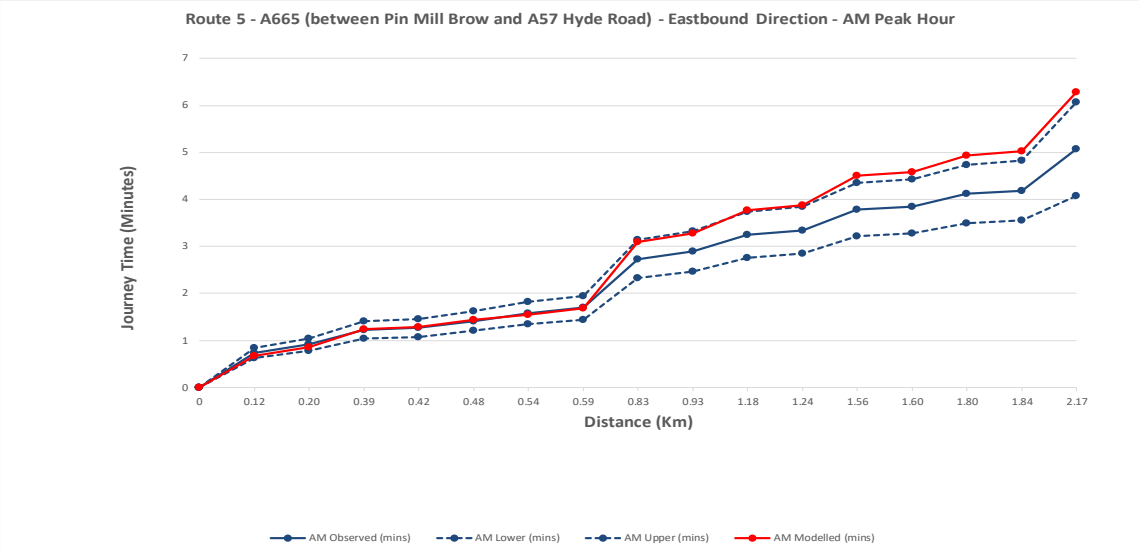
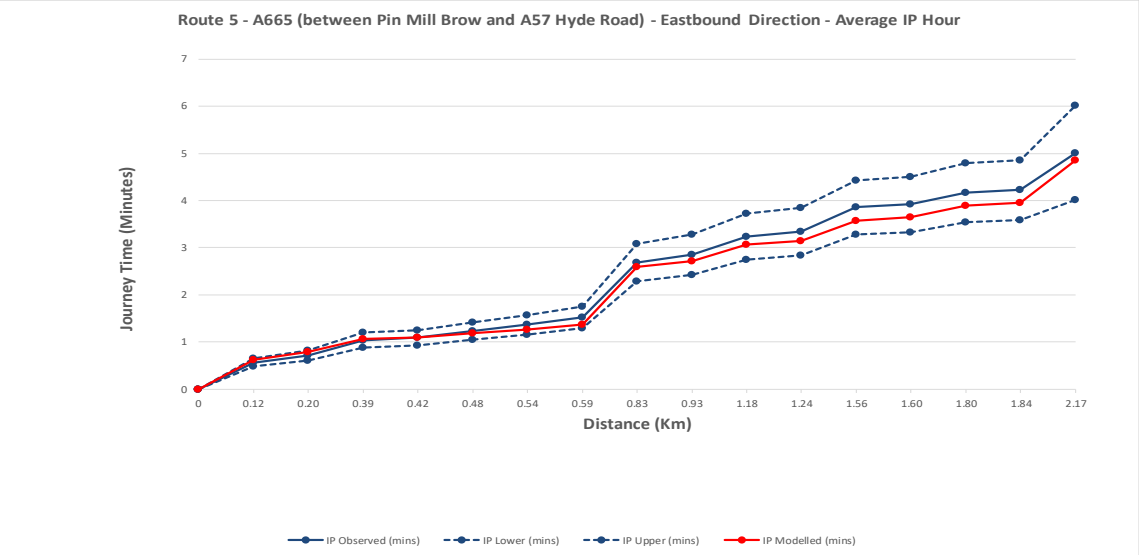


Figure B 3: Route 5 – A665 (between Pin Mill Brow and A57 Hyde Road) – EB





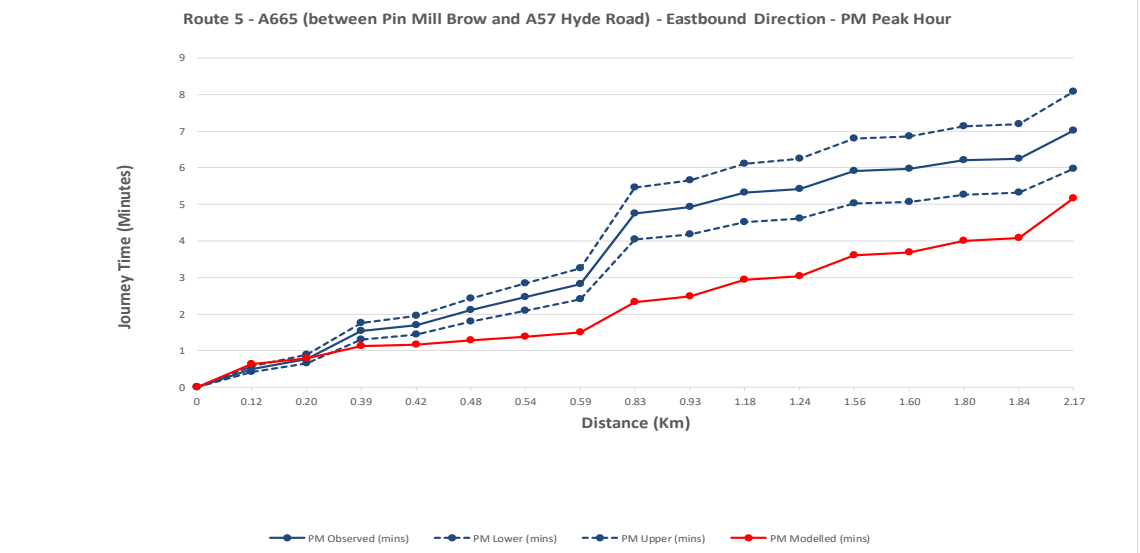
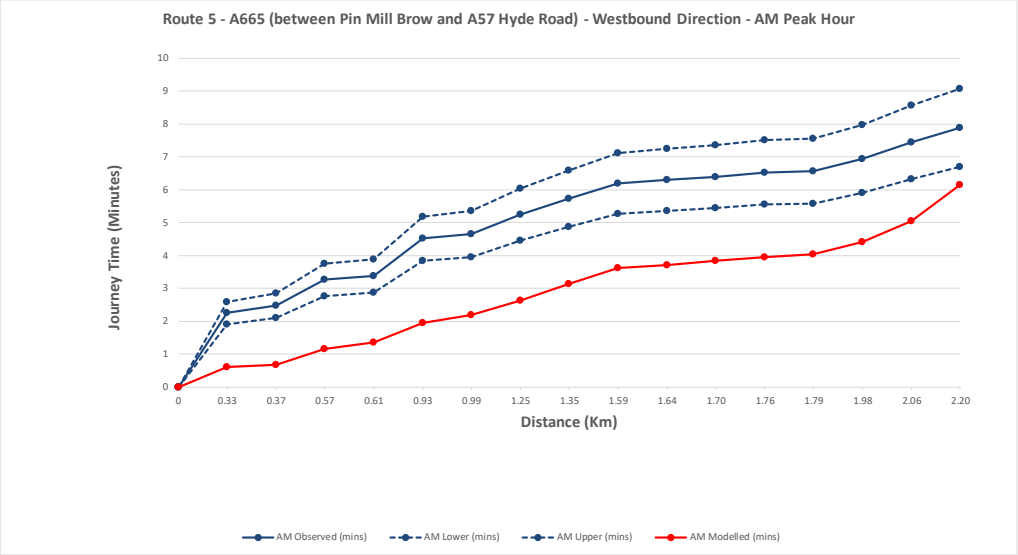
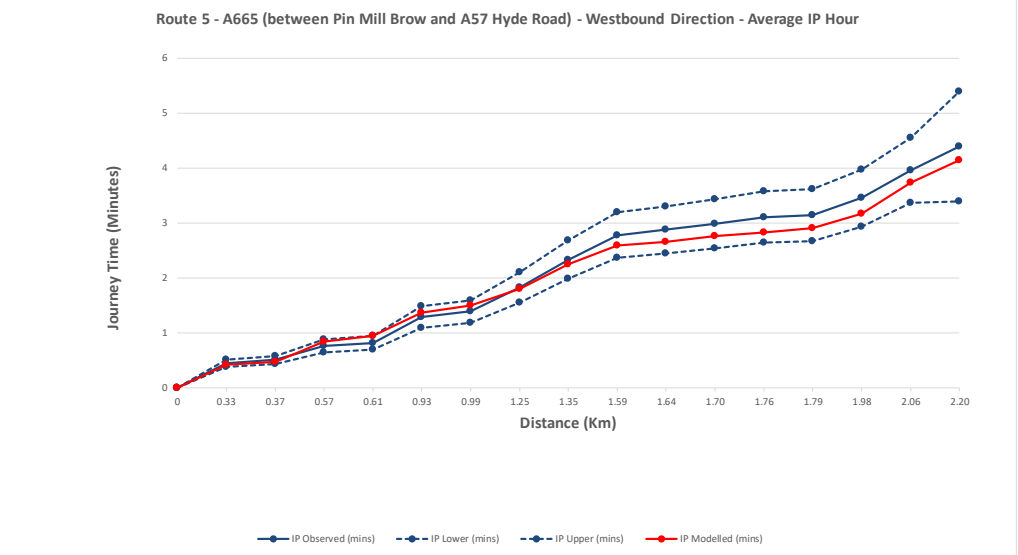


Figure B 4: Route 5 – A665 (between Pin Mill Brow and A57 Hyde Road) – WB





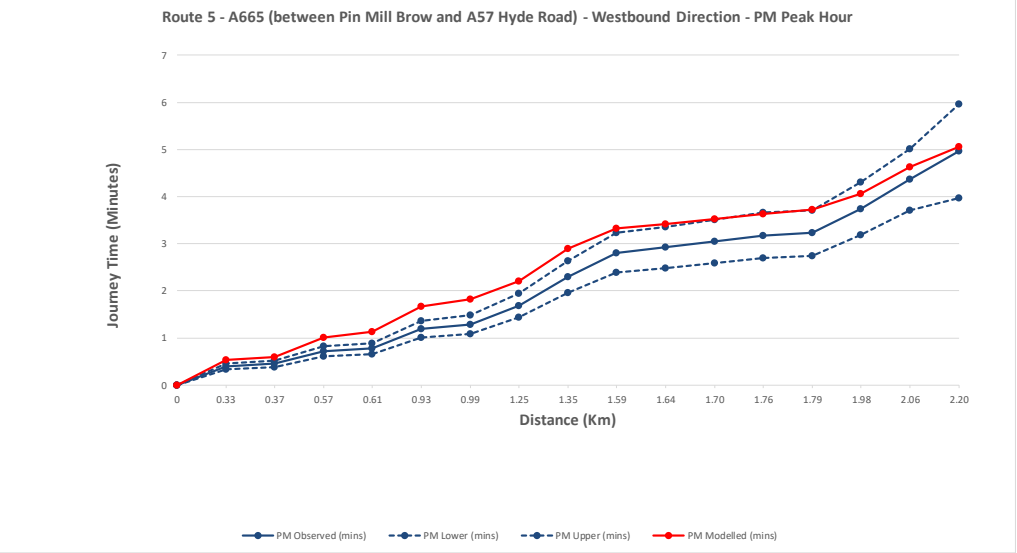
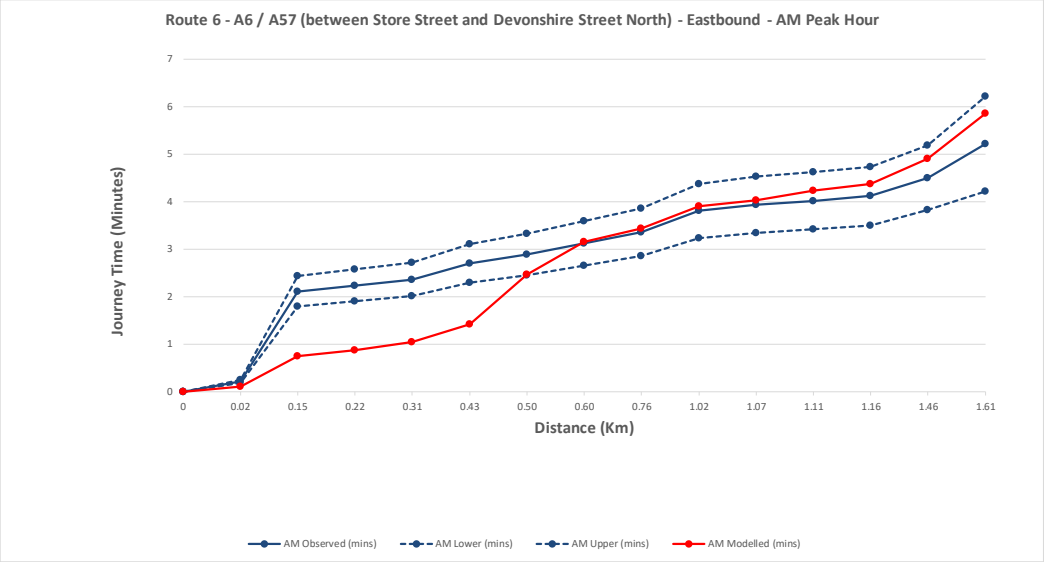


Figure B 5: Route 6 – A6/A57 (between Store Street and Devonshire Street North) – EB



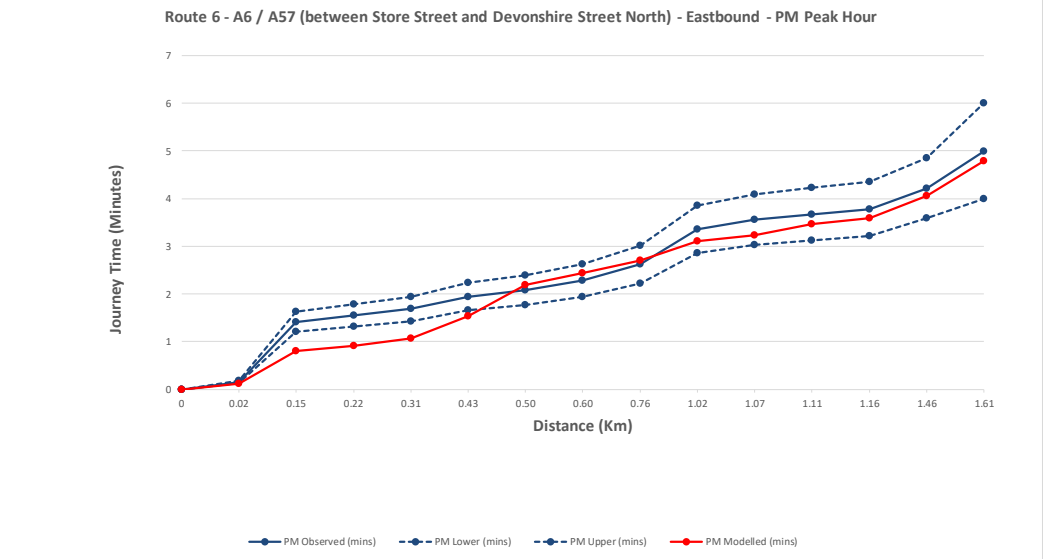
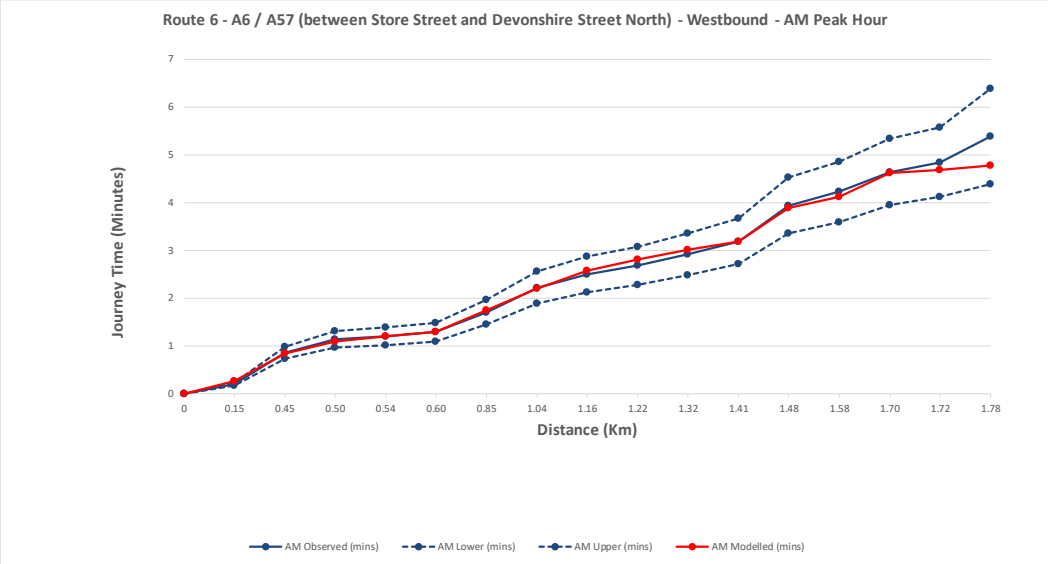


Figure B 6: Route 6 – A6/A57 (between Store Street and Devonshire Street North) – WB



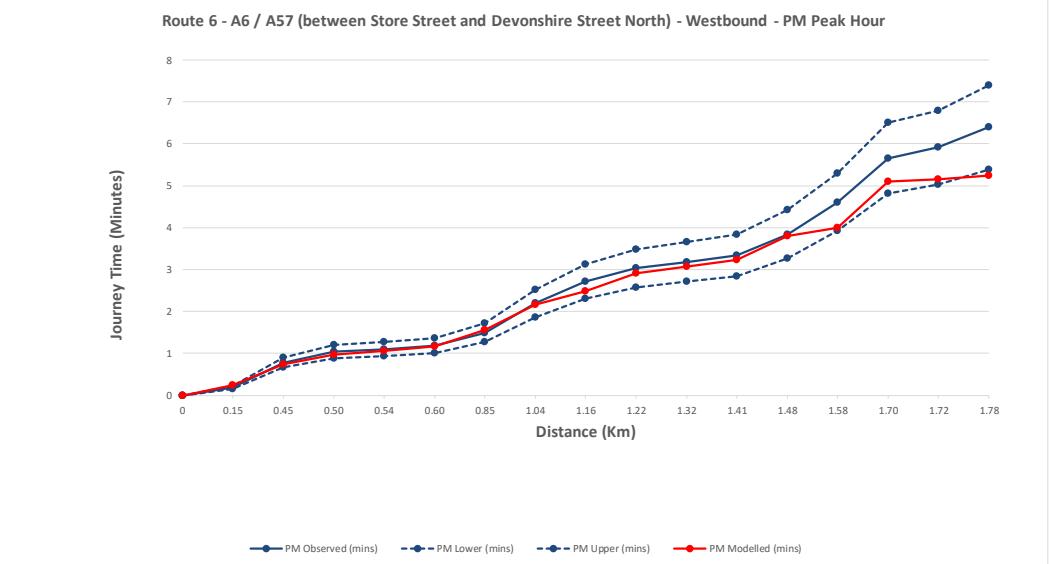
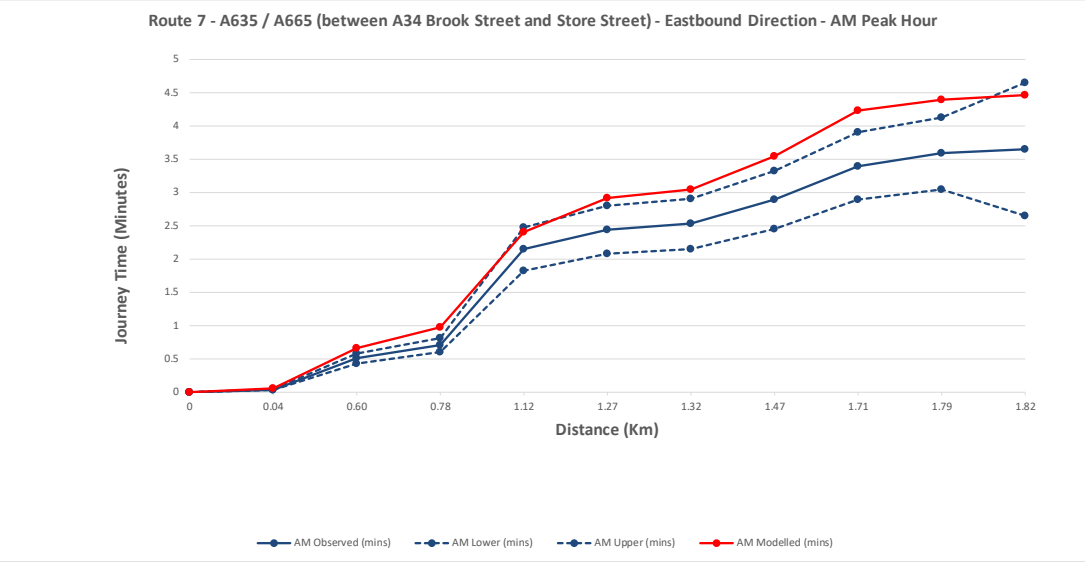
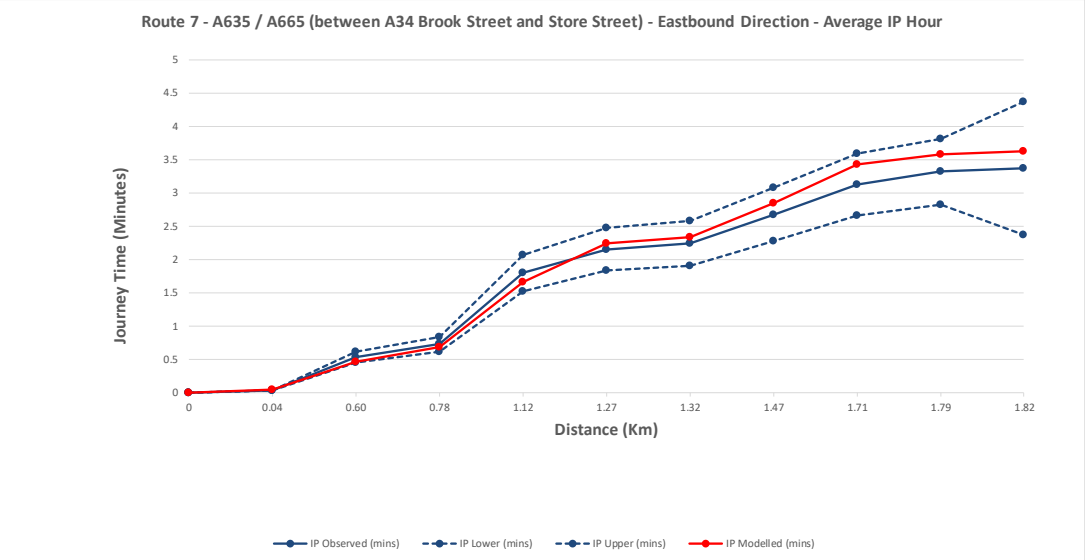


Figure B 7: Route 7 – A635/A665 (between A34 Brook Street and Store Street) – EB





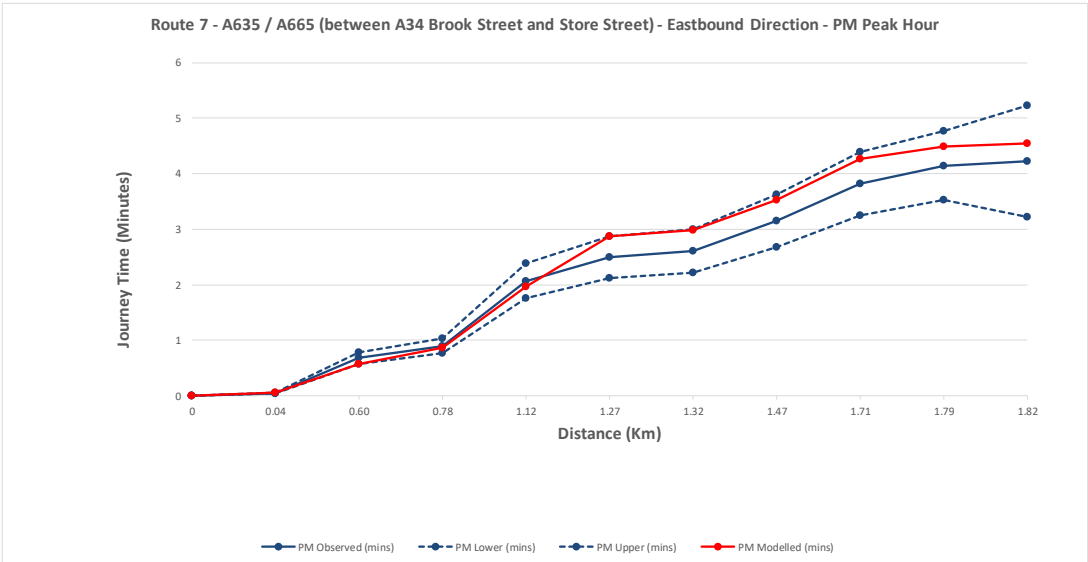
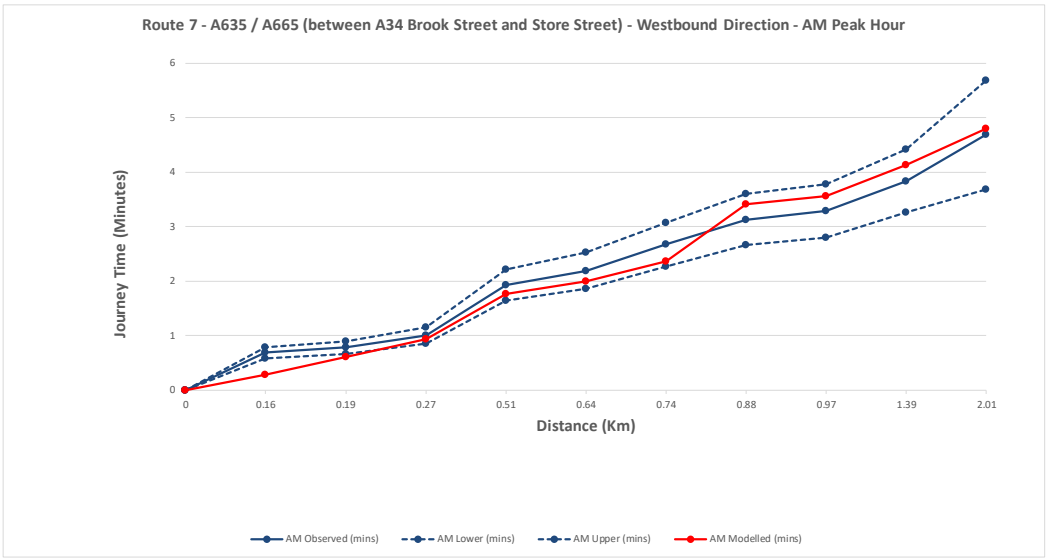
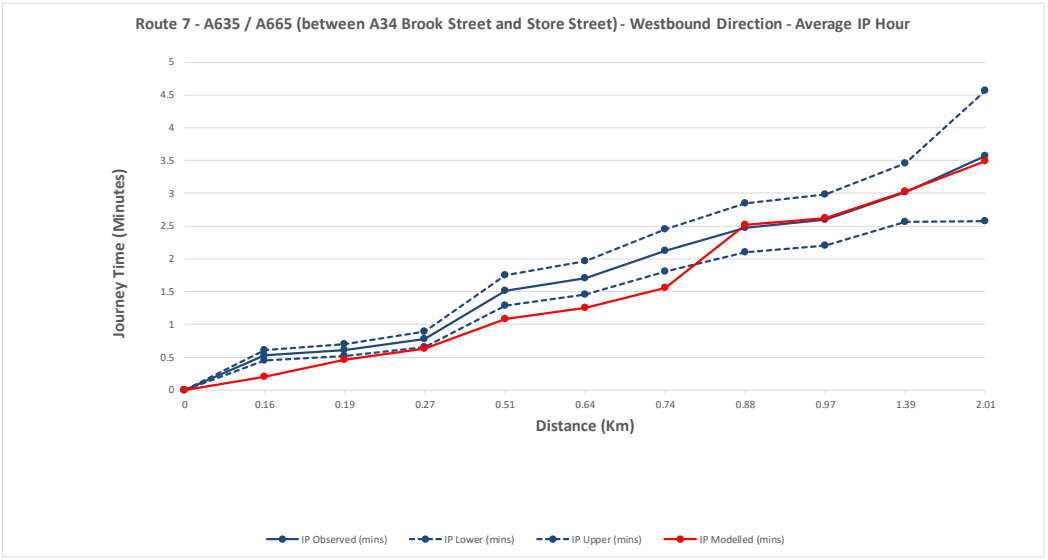
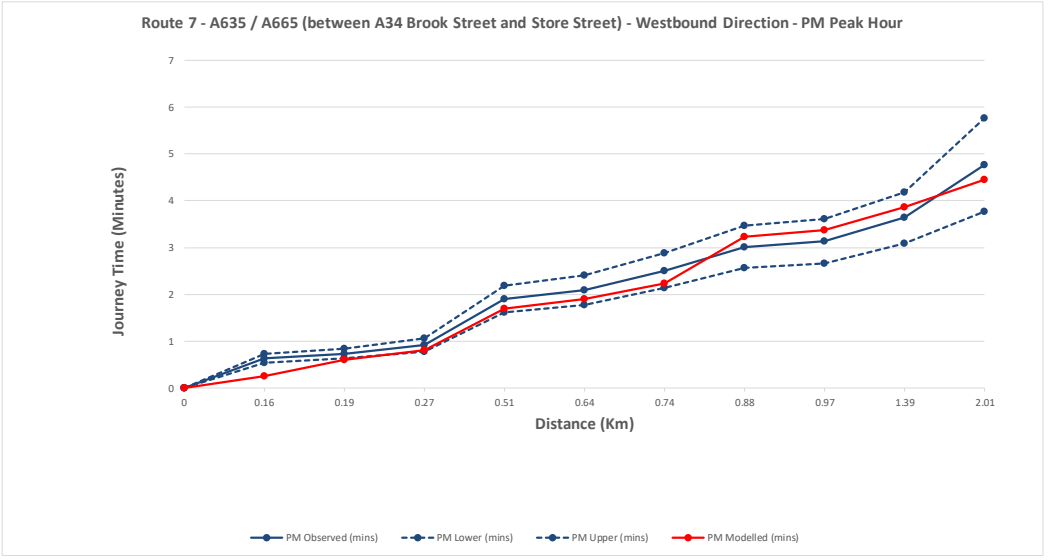


Figure B 8: Route 7 – A635/A665 (between A34 Brook Street and Store Street) – WB







Appendix C: Manchester Airport

Screenline – grouped flow assessment

Table C 1: Manchester Airport – AM peak hour – screenline flows

Screenline name	Direction	Total counts	Observed flow (vehicles)				Modelled flow (vehicles)			Total flow comparison			
			Cars	LGVs	OGVs	Total	Cars	LGVs	OGVs	Total	Difference	Percentage difference	Flow difference less than 5%
East Airport screenline	WB	5	3196	198	105	3499	3089	216	97	3402	-97	-3%	✓
East Airport screenline	EB	5	2916	198	80	3194	2806	297	110	3212	18	1%	✓
East of M56 screenline	EB	6	5923	660	222	6805	5520	595	193	6308	-497	-7%	×
East of M56 screenline	WB	6	4832	510	166	5508	4376	504	158	5039	-469	-9%	×
West of M56 screenline	EB	5	2820	160	101	3081	2780	187	82	3049	-31	-1%	✓
West of M56 screenline	WB	5	2585	231	82	2899	2286	248	52	2586	-313	-11%	×
North of A538 Wilmslow Road	NB	3	5641	726	251	6618	5570	663	225	6458	-159	-2%	✓
North of A538 Wilmslow Road	SB	3	4906	642	234	5782	4960	641	211	5812	29	1%	✓
Airport screenline	SB	4	1919	210	58	2187	2044	132	40	2216	29	1%	✓
Airport screenline	NB	4	1548	169	47	1764	1552	131	37	1719	-45	-3%	✓

Table C 2: Manchester Airport – average IP hour – screenline flows

Screenline name	Direction	Total counts	Observed flow (vehicles)				Modelled flow (vehicles)			Total flow comparison			
			Cars	LGVs	OGVs	Total	Cars	LGVs	OGVs	Total	Difference	Percentage difference	Flow difference less than 5%
East Airport screenline	WB	5	2020	171	104	2295	1964	233	121	2318	23	1%	✓
East Airport screenline	EB	5	2182	193	70	2446	2050	201	78	2330	-116	-5%	✓
East of M56 screenline	EB	6	3686	588	217	4490	3583	607	176	4365	-125	-3%	✓
East of M56 screenline	WB	6	3648	621	215	4484	3622	628	187	4436	-48	-1%	✓
West of M56 screenline	EB	5	1721	179	69	1970	1784	191	65	2040	70	4%	✓
West of M56 screenline	WB	5	1762	182	64	2008	1687	175	39	1901	-107	-5%	×
North of A538 Wilmslow Road	NB	3	3659	699	271	4629	3621	699	234	4553	-76	-2%	✓
North of A538 Wilmslow Road	SB	3	3583	678	261	4522	3623	672	234	4529	8	0%	✓
Airport screenline	SB	4	1548	247	80	1875	1750	247	55	2052	177	9%	×
Airport screenline	NB	4	1455	233	75	1763	1566	212	67	1845	82	5%	✓

Table C 3: Manchester Airport – PM peak hour – screenline flows

Screenline name	Direction	Total counts	Observed flow (vehicles)				Modelled flow (vehicles)			Total flow comparison			
			Cars	LGVs	OGVs	Total	Cars	LGVs	OGVs	Total	Difference	Percentage difference	Flow difference less than 5%
East Airport screenline	WB	5	2897	115	52	3065	2944	137	64	3145	80	3%	✓
East Airport screenline	EB	5	3246	139	54	3439	3140	197	58	3395	-44	-1%	✓

Screenline name	Direction	Total counts	Observed flow (vehicles)				Modelled flow (vehicles)				Total flow comparison			
			Cars	LGVs	OGVs	Total	Cars	LGVs	OGVs	Total	Difference	Percentage difference		Flow difference less than 5%
East of M56 screenline	EB	6	5712	393	85	6191	5558	388	96	6042	-149	-2%		✓
East of M56 screenline	WB	6	5775	413	98	6287	5549	375	84	6008	-279	-4%		✓
West of M56 screenline	EB	5	2499	123	49	2671	2529	118	36	2683	12	0%		✓
West of M56 screenline	WB	5	2884	95	76	3055	2668	115	18	2801	-255	-8%		×
North of A538 Wilmslow Road	NB	3	4504	360	84	4949	4506	357	80	4943	-6	0%		✓
North of A538 Wilmslow Road	SB	3	6640	489	114	7242	6617	475	113	7205	-37	-1%		✓
Airport screenline	SB	4	1573	103	17	1693	1748	113	12	1872	180	11%		×
Airport screenline	NB	4	1832	120	20	1972	1861	131	26	2017	45	2%		✓

Screenline – individual link flow assessment

Table C 4: Manchester Airport – AM peak hour – individual link flows

ID	Anode	Bnode	Road name	Observed flow (vehicles)				Modelled flow (vehicles)				Total flow comparison					
				Cars	LGVs	HGVs	Total	Cars	LGVs	HGVs	Total	Difference	Percentage difference	GEH	GEH < 5	Flow range	GEH or flow range
1A	43282	43283	B5166 Styal Road	689	75	40	804	687	49	19	755	-49	-6%	1.76	✓	✓	✓
1A	4215	34216	Finney Lane	1075	18	29	1122	930	39	28	997	-125	-11%	3.84	✓	✓	✓
1A	8793	4166	A560 Gatley Road	588	12	29	629	632	18	26	675	46	7%	1.79	✓	✓	✓
1A	43878	37149	A538 Wilmslow Road	840	92	49	981	836	106	37	979	-2	0%	0.06	✓	✓	✓
1A	90044	6715	Sunbank Lane	4	0	0	5	5	4	0	9	4	82%	1.53	✓	✓	✓
1B	43283	43282	B5166 Styal Road	581	64	34	679	588	68	9	666	-13	-2%	0.50	✓	✓	✓
1B	34216	4215	Finney Lane	823	13	17	853	592	46	21	660	-193	-23%	7.03	×	×	×
1B	4166	8793	A560 Gatley Road	549	16	16	581	658	76	46	780	199	34%	7.63	×	×	×
1B	37149	43878	A538 Wilmslow Road	948	104	55	1106	938	104	47	1088	-18	-2%	0.54	✓	✓	✓
1B	6715	90044	Sunbank Lane	15	2	1	18	30	3	0	32	15	84%	2.95	✓	✓	✓
2A	14615	1846	Hollyhedge Road	585	26	6	617	376	34	13	423	-194	-31%	8.50	×	×	×
2A	5130	3339	Simonsway	838	92	49	978	839	63	40	941	-37	-4%	1.19	✓	✓	✓
2A	32910	33899	M56 Airport Spur EB	2255	298	123	2676	2259	244	81	2585	-91	-3%	1.77	✓	✓	✓
2A	37153	43881	Thorley Lane	549	37	24	610	548	38	13	599	-11	-2%	0.46	✓	✓	✓
2A	38752	50288	Avro Way	446	49	26	521	447	58	12	517	-4	-1%	0.18	✓	✓	✓
2A	35132	37149	Wimslow Road	1250	158	70	1478	1051	158	61	1270	-208	-14%	5.62	×	✓	✓
2B	1846	14615	Hollyhedge Road	964	37	18	1019	652	32	19	703	-316	-31%	10.76	×	×	×
2B	3339	5130	Simonsway	563	62	33	657	554	59	32	645	-12	-2%	0.49	✓	✓	✓
2B	33900	32911	M56 Airport Spur WB	1623	215	88	1926	1622	213	71	1906	-20	-1%	0.45	✓	✓	✓
2B	43881	37153	Thorley Lane	552	38	19	609	510	38	12	560	-49	-8%	2.04	✓	✓	✓
2B	50288	38752	Avro Way	131	14	8	153	131	16	5	152	0	0%	0.03	✓	✓	✓
2B	37149	35132	Wimslow Road	999	145	47	1191	907	146	45	1098	-93	-8%	2.73	✓	✓	✓
3A	6712	35139	Hale Road	804	46	23	873	842	68	21	930	57	7%	1.90	✓	✓	✓

ID	Anode	Bnode	Road name	Observed flow (vehicles)				Modelled flow (vehicles)				Total flow comparison					
				Cars	LGVs	HGVs	Total	Cars	LGVs	HGVs	Total	Difference	Percentage difference	GEH	GEH < 5	Flow range	GEH or flow range
3A	7150	7151	Shay Lane	138	3	1	142	137	3	1	142	0	0%	0.04	✓	✓	✓
3A	6710	7146	Clay Lane	388	42	23	453	387	42	7	436	-16	-4%	0.77	✓	✓	✓
3A	7165	7164	Clay Lane	548	15	3	566	433	13	4	449	-117	-21%	5.17	×	×	×
3A	3794	8742	A560 Altrincham Road	942	54	74	1070	981	62	67	1110	40	4%	1.21	✓	✓	✓
3B	35139	6712	Hale Road	683	122	39	844	685	121	29	835	-9	-1%	0.32	✓	✓	✓
3B	7151	7150	Shay Lane	93	6	0	99	92	6	1	99	0	0%	0.02	✓	✓	✓
3B	7146	6710	Clay Lane	211	23	12	247	213	24	6	243	-4	-1%	0.23	✓	✓	✓
3B	7164	7165	Clay Lane	821	23	6	850	666	27	1	694	-156	-18%	5.62	×	×	×
3B	8742	3794	A560 Altrincham Road	777	57	40	874	631	71	31	732	-142	-16%	5.01	×	×	×
4A	6711	7150	Shay Lane	245	12	7	264	248	15	2	264	0	0%	0.03	✓	✓	✓
4A	32870	32869	M56	4554	602	248	5404	4553	557	199	5310	-94	-2%	1.28	✓	✓	✓
4A	35131	43879	Runger Lane	842	112	46	1000	769	91	27	887	-113	-11%	3.68	✓	✓	✓
4B	7150	6711	Shay Lane	191	11	3	205	190	11	2	204	-1	-1%	0.10	✓	✓	✓
4B	35926	32871	M56	4380	579	238	5198	4384	578	195	5156	-41	-1%	0.58	✓	✓	✓
4B	43879	35131	Runger Lane	335	52	42	429	386	52	17	455	26	6%	1.23	✓	✓	✓
5A	38751	43759	Sydney Avenue	181	20	11	211	181	2	1	184	-27	-13%	1.92	✓	✓	✓
5A	35142	33897	World Way	558	61	32	651	677	61	30	768	117	18%	4.40	✓	×	✓
5A	42800	44258	Outwood Lane	876	96	51	1023	882	68	24	974	-49	-5%	1.54	✓	✓	✓
5A	33708	43883	Ringway Road	304	33	18	355	303	1	7	311	-44	-12%	2.43	✓	✓	✓
5B	43759	38751	Sydney Avenue	163	18	9	190	164	18	4	186	-4	-2%	0.32	✓	✓	✓
5B	33897	35142	World Way	392	43	23	458	393	43	20	456	-2	0%	0.09	✓	✓	✓
5B	44258	42800	Outwood Lane	802	88	47	937	805	69	22	896	-40	-4%	1.34	✓	✓	✓
5B	43883	33708	Ringway Road	191	21	11	223	190	0	11	201	-21	-10%	1.46	✓	✓	✓

Table C 5: Manchester Airport – average IP hour – individual link flows

ID	Anode	Bnode	Road name	Observed flow (vehicles)				Modelled flow (vehicles)				Total flow comparison					
				Cars	LGVs	HGVs	Total	Cars	LGVs	HGVs	Total	Difference	Percentage difference	GEH	GEH < 5	Flow range	GEH or flow range
1A	43282	43283	B5166 Styal Road	315	50	34	399	315	18	16	349	-51	-13%	2.62	✓	✓	✓
1A	4215	34216	Finney Lane	671	24	16	711	584	87	36	707	-4	-1%	0.14	✓	✓	✓
1A	8793	4166	A560 Gatley Road	551	19	47	617	547	29	58	633	16	3%	0.65	✓	✓	✓
1A	43878	37149	A538 Wilmslow Road	477	76	52	604	512	96	24	632	28	5%	1.11	✓	✓	✓
1A	90044	6715	Sunbank Lane	6	1	1	8	6	3	1	9	1	18%	0.48	✓	✓	✓
1B	43283	43282	B5166 Styal Road	342	55	37	433	341	55	17	413	-20	-5%	0.98	✓	✓	✓
1B	34216	4215	Finney Lane	725	26	15	766	623	23	15	661	-105	-14%	3.93	✓	✓	✓
1B	4166	8793	A560 Gatley Road	596	29	11	636	551	40	25	615	-21	-3%	0.82	✓	✓	✓

ID	Anode	Bnode	Road name	Observed flow (vehicles)				Modelled flow (vehicles)				Total flow comparison					
				Cars	LGVs	HGVs	Total	Cars	LGVs	HGVs	Total	Difference	Percentage difference	GEH	GEH < 5	Flow range	GEH or flow range
1B	37149	43878	A538 Wilmslow Road	514	82	56	652	531	82	34	647	-5	-1%	0.21	✓	✓	✓
1B	6715	90044	Sunbank Lane	5	1	1	7	5	1	0	6	-1	-8%	0.22	✓	✓	✓
2A	14615	1846	Hollyhedge Road	458	33	6	497	342	31	12	385	-112	-23%	5.35	×	×	×
2A	5130	3339	Simonsway	517	83	56	656	518	56	40	613	-42	-6%	1.67	✓	✓	✓
2A	32910	33899	M56 Airport Spur EB	1599	305	140	2045	1597	291	83	1971	-73	-4%	1.64	✓	✓	✓
2A	37153	43881	Thorley Lane	379	38	21	438	379	38	14	431	-7	-2%	0.33	✓	✓	✓
2A	38752	50288	Avro Way	161	26	17	204	175	87	8	270	66	33%	4.31	✓	✓	✓
2A	35132	37149	Wimslow Road	572	104	51	727	572	104	47	723	-4	-1%	0.16	✓	✓	✓
2B	1846	14615	Hollyhedge Road	435	39	4	478	408	32	10	450	-28	-6%	1.28	✓	✓	✓
2B	3339	5130	Simonsway	510	81	55	646	513	81	38	632	-14	-2%	0.56	✓	✓	✓
2B	33900	32911	M56 Airport Spur WB	1629	311	143	2083	1629	306	100	2036	-47	-2%	1.04	✓	✓	✓
2B	43881	37153	Thorley Lane	316	33	19	368	312	32	12	356	-12	-3%	0.63	✓	✓	✓
2B	50288	38752	Avro Way	199	32	22	253	199	51	9	260	7	3%	0.43	✓	✓	✓
2B	37149	35132	Wimslow Road	560	125	50	735	561	125	45	731	-3	0%	0.13	✓	✓	✓
3A	6712	35139	Hale Road	534	82	22	638	635	98	24	758	119	19%	4.52	✓	×	✓
3A	7150	7151	Shay Lane	35	4	2	41	35	6	2	42	1	3%	0.16	✓	✓	✓
3A	6710	7146	Clay Lane	104	17	11	132	104	17	5	126	-6	-5%	0.53	✓	✓	✓
3A	7165	7164	Clay Lane	303	19	1	323	353	24	3	380	57	18%	3.02	✓	✓	✓
3A	3794	8742	A560 Altrincham Road	745	58	42	845	656	46	50	752	-93	-11%	3.27	✓	✓	✓
3B	35139	6712	Hale Road	512	77	23	611	514	77	18	609	-2	0%	0.09	✓	✓	✓
3B	7151	7150	Shay Lane	39	5	1	45	42	5	1	48	3	7%	0.45	✓	✓	✓
3B	7146	6710	Clay Lane	102	16	11	129	102	16	5	123	-7	-5%	0.60	✓	✓	✓
3B	7164	7165	Clay Lane	298	24	1	323	313	31	3	347	24	7%	1.30	✓	✓	✓
3B	8742	3794	A560 Altrincham Road	811	60	39	910	716	46	30	792	-118	-13%	4.03	✓	✓	✓
4A	6711	7150	Shay Lane	119	14	4	137	119	14	6	138	2	1%	0.13	✓	✓	✓
4A	32870	32869	M56	3135	598	275	4009	3135	598	214	3947	-62	-2%	0.98	✓	✓	✓
4A	35131	43879	Runger Lane	405	87	43	535	367	87	20	473	-61	-11%	2.73	✓	✓	✓
4B	7150	6711	Shay Lane	122	15	2	139	122	15	3	140	1	0%	0.06	✓	✓	✓
4B	35926	32871	M56	3164	604	278	4045	3185	598	216	4000	-46	-1%	0.72	✓	✓	✓
4B	43879	35131	Runger Lane	297	59	32	388	316	59	20	395	7	2%	0.33	✓	✓	✓
5A	38751	43759	Sydney Avenue	119	19	13	151	321	19	0	340	189	125%	12.06	×	×	×
5A	35142	33897	World Way	453	72	49	575	453	72	38	563	-12	-2%	0.51	✓	✓	✓
5A	42800	44258	Outwood Lane	695	111	75	881	696	111	33	839	-42	-5%	1.42	✓	✓	✓
5A	33708	43883	Ringway Road	280	45	30	356	280	45	9	334	-22	-6%	1.16	✓	✓	✓
5B	43759	38751	Sydney Avenue	145	23	16	184	145	23	7	175	-9	-5%	0.67	✓	✓	✓

ID	Anode	Bnode	Road name	Observed flow (vehicles)				Modelled flow (vehicles)				Total flow comparison					
				Cars	LGVs	HGVs	Total	Cars	LGVs	HGVs	Total	Difference	Percentage difference	GEH	GEH < 5	Flow range	GEH or flow range
5B	33897	35142	World Way	388	62	42	492	493	64	34	592	100	20%	4.29	✓	✓	✓
5B	44258	42800	Outwood Lane	749	120	81	950	754	120	35	909	-41	-4%	1.33	✓	✓	✓
5B	43883	33708	Ringway Road	174	28	19	220	174	5	15	193	-27	-12%	1.86	✓	✓	✓

Table C 6: Manchester Airport – PM peak hour – individual link flows

ID	Anode	Bnode	Road name	Observed flow (vehicles)				Modelled flow (vehicles)				Total flow comparison					
				Cars	LGVs	HGVs	Total	Cars	LGVs	HGVs	Total	Difference	Percentage difference	GEH	GEH < 5	Flow range	GEH or flow range
1A	43282	43283	B5166 Styal Road	531	35	23	588	531	35	6	572	-16	-3%	0.66	✓	✓	✓
1A	4215	34216	Finney Lane	907	14	12	933	849	15	15	879	-54	-6%	1.80	✓	✓	✓
1A	8793	4166	A560 Gatley Road	560	8	24	592	663	22	35	721	129	22%	5.03	×	×	×
1A	43878	37149	A538 Wilmslow Road	892	58	39	989	892	64	18	975	-14	-1%	0.44	✓	✓	✓
1A	90044	6715	Sunbank Lane	8	1	0	9	8	1	0	9	0	2%	0.07	✓	✓	✓
1B	43283	43282	B5166 Styal Road	677	44	29	751	682	44	8	734	-17	-2%	0.62	✓	✓	✓
1B	34216	4215	Finney Lane	898	10	21	929	568	20	13	601	-328	-35%	11.85	×	×	×
1B	4166	8793	A560 Gatley Road	637	17	14	668	649	66	23	737	69	10%	2.61	✓	✓	✓
1B	37149	43878	A538 Wilmslow Road	1026	67	44	1137	1241	67	25	1332	195	17%	5.55	×	×	×
1B	6715	90044	Sunbank Lane	8	1	0	9	0	1	0	1	-8	-90%	3.58	✓	✓	✓
2A	14615	1846	Hollyhedge Road	821	23	11	855	692	24	17	733	-122	-14%	4.31	✓	✓	✓
2A	5130	3339	Simonsway	868	57	38	962	886	38	24	947	-15	-2%	0.49	✓	✓	✓
2A	32910	33899	M56 Airport Spur EB	1739	131	47	1917	1633	129	30	1792	-126	-7%	2.92	✓	✓	✓
2A	37153	43881	Thorley Lane	743	53	19	815	755	53	9	818	3	0%	0.09	✓	✓	✓
2A	38752	50288	Avro Way	119	8	5	132	230	22	11	263	131	99%	9.31	×	×	×
2A	35132	37149	Wimslow Road	1422	122	37	1581	1363	122	29	1514	-67	-4%	1.70	✓	✓	✓
2B	1846	14615	Hollyhedge Road	607	26	6	639	394	8	7	409	-230	-36%	10.04	×	×	×
2B	3339	5130	Simonsway	752	49	33	834	758	44	20	822	-12	-1%	0.43	✓	✓	✓
2B	33900	32911	M56 Airport Spur WB	2380	179	65	2623	2420	179	42	2641	18	1%	0.35	✓	✓	✓
2B	43881	37153	Thorley Lane	604	43	27	674	583	28	12	623	-51	-8%	1.99	✓	✓	✓
2B	50288	38752	Avro Way	407	27	18	451	407	27	4	438	-13	-3%	0.61	✓	✓	✓
2B	37149	35132	Wimslow Road	1025	90	31	1146	986	89	22	1097	-49	-4%	1.47	✓	✓	✓
3A	6712	35139	Hale Road	565	43	12	620	803	41	5	849	229	37%	8.44	×	×	×
3A	7150	7151	Shay Lane	68	3	1	72	64	5	1	70	-2	-2%	0.21	✓	✓	✓
3A	6710	7146	Clay Lane	276	18	12	306	277	18	3	298	-7	-2%	0.42	✓	✓	✓
3A	7165	7164	Clay Lane	737	17	1	755	439	19	1	459	-296	-39%	12.00	×	×	×
3A	3794	8742	A560 Altrincham Road	853	42	38	933	946	35	42	1023	90	10%	2.89	✓	✓	✓
3B	35139	6712	Hale Road	805	27	10	842	787	28	8	823	-19	-2%	0.66	✓	✓	✓

ID	Anode	Bnode	Road name	Observed flow (vehicles)				Modelled flow (vehicles)				Total flow comparison					
				Cars	LGVs	HGVs	Total	Cars	LGVs	HGVs	Total	Difference	Percentage difference	GEH	GEH < 5	Flow range	GEH or flow range
3B	7151	7150	Shay Lane	122	4	1	127	116	2	1	119	-8	-6%	0.73	✓	✓	✓
3B	7146	6710	Clay Lane	296	19	13	328	296	19	3	318	-10	-3%	0.54	✓	✓	✓
3B	7164	7165	Clay Lane	474	16	2	492	616	32	0	648	156	32%	6.54	×	×	×
3B	8742	3794	A560 Altrincham Road	1187	29	64	1280	854	34	21	909	-371	-29%	11.23	×	×	×
4A	6711	7150	Shay Lane	184	15	2	201	180	13	3	196	-5	-3%	0.37	✓	✓	✓
4A	32870	32869	M56	3572	268	97	3938	3571	267	64	3902	-36	-1%	0.58	✓	✓	✓
4A	35131	43879	Runger Lane	748	77	30	855	755	77	19	850	-5	-1%	0.16	✓	✓	✓
4B	7150	6711	Shay Lane	233	13	2	248	207	5	1	212	-36	-14%	2.34	✓	✓	✓
4B	35926	32871	M56	5695	428	155	6278	5711	422	101	6234	-44	-1%	0.56	✓	✓	✓
4B	43879	35131	Runger Lane	712	48	21	781	699	48	15	762	-19	-2%	0.69	✓	✓	✓
5A	38751	43759	Sydney Avenue	124	8	5	138	124	2	0	126	-12	-8%	1.00	✓	✓	✓
5A	35142	33897	World Way	394	26	17	437	613	37	19	669	232	53%	9.87	×	×	×
5A	42800	44258	Outwood Lane	715	47	31	793	710	62	7	779	-14	-2%	0.51	✓	✓	✓
5A	33708	43883	Ringway Road	339	22	15	376	301	12	8	320	-55	-15%	2.96	✓	✓	✓
5B	43759	38751	Sydney Avenue	142	9	6	157	136	20	6	161	3	2%	0.28	✓	✓	✓
5B	33897	35142	World Way	461	30	20	511	465	30	21	515	4	1%	0.17	✓	✓	✓
5B	44258	42800	Outwood Lane	1033	67	45	1145	1038	51	11	1099	-46	-4%	1.36	✓	✓	✓
5B	43883	33708	Ringway Road	196	13	9	218	222	31	12	265	48	22%	3.06	✓	✓	✓

M56 Motorway – individual link flow comparisons

Table C 7: M56 – AM peak hour – individual link flows

ID*	Anode	Bnode	Road name	Observed flow (vehicles)				Modelled flow (vehicles)				Total flow comparison					
				Cars	LGVs	HGVs	Total	Cars	LGVs	HGVs	Total	Difference	Percentage difference	GEH	GEH < 5	Flow range	GEH or flow range
	32867	32910	M56 J5 SB off-slip	1213	160	66	1439	1224	159	62	1446	7	0%	0.18	✓	✓	✓
	32911	35926	M56 J5 SB on-slip	787	104	43	934	793	104	34	930	-4	0%	0.12	✓	✓	✓
	32911	42840	M56 J5 NB on-slip	822	109	45	975	829	110	37	976	1	0%	0.03	✓	✓	✓
	5152	2865	M56 J4 NB on-slip	474	63	26	562	468	63	42	574	12	2%	0.49	✓	✓	✓
	2864	32867	M56 J4 to J5 SB	4776	631	260	5667	4815	633	223	5672	5	0%	0.07	✓	✓	✓
	42841	2865	M56 J4 to J5 NB	4399	582	239	5220	4347	582	218	5147	-73	-1%	1.01	✓	✓	✓
	2864	5130	M56 J4 SB off-slip	849	112	46	1007	865	114	37	1016	9	1%	0.27	✓	✓	✓
	32867	35926	M56 J5 mainline - mid junction SB	3572	472	194	4238	3591	474	161	4226	-12	0%	0.19	✓	✓	✓
	32869	32866	M56 J5 mainline - mid junction NB	3497	462	190	4150	3518	473	181	4171	21	1%	0.33	✓	✓	✓
	5718	32872	M56 J6 to J7 EB	4239	560	231	5030	4347	582	206	5135	105	2%	1.47	✓	✓	✓
	32873	39694	M56 J6 to J7 WB	3767	498	205	4470	3790	495	167	4453	-17	0%	0.26	✓	✓	✓
	32872	32870	M56 J6 mainline - mid junction NEB	3541	468	193	4202	3552	450	160	4162	-41	-1%	0.63	✓	✓	✓
	32871	32873	M56 J6 mainline - mid junction SWB	3335	441	181	3957	3284	412	143	3840	-117	-3%	1.88	✓	✓	✓

**ID not defined*

Table C 8: M56 – average IP hour – individual link flows

ID*	Anode	Bnode	Road name	Observed flow (vehicles)				Modelled flow (vehicles)			Total flow comparison						
				Cars	LGVs	HGVs	Total	Cars	LGVs	HGVs	Total	Difference	Percentage difference	GEH	GEH < 5	Flow range	GEH or flow range
	32867	32910	M56 J5 SB off-slip	967	185	85	1236	1003	189	77	1269	33	3%	0.92	✓	✓	✓
	32911	35926	M56 J5 SB on-slip	656	125	58	839	659	119	45	823	-16	-2%	0.56	✓	✓	✓
	32911	42840	M56 J5 NB on-slip	953	182	84	1219	971	187	55	1212	-7	-1%	0.19	✓	✓	✓
	5152	2865	M56 J4 NB on-slip	458	88	40	586	460	88	45	594	8	1%	0.31	✓	✓	✓
	2864	32867	M56 J4 to J5 SB	3528	673	310	4511	3529	668	248	4445	-66	-1%	0.99	✓	✓	✓
	42841	2865	M56 J4 to J5 NB	3581	684	314	4579	3511	682	263	4457	-122	-3%	1.81	✓	✓	✓
	2864	5130	M56 J4 SB off-slip	453	86	40	579	453	87	31	570	-8	-1%	0.35	✓	✓	✓
	32867	35926	M56 J5 mainline - mid junction SB	2552	487	224	3263	2526	479	171	3176	-86	-3%	1.52	✓	✓	✓
	32869	32866	M56 J5 mainline - mid junction NB	2496	476	219	3192	2541	496	208	3244	53	2%	0.93	✓	✓	✓
	5718	32872	M56 J6 to J7 EB	2828	540	248	3616	2819	535	194	3548	-69	-2%	1.15	✓	✓	✓
	32873	39694	M56 J6 to J7 WB	2927	559	257	3742	2927	550	200	3678	-65	-2%	1.06	✓	✓	✓
	32872	32870	M56 J6 mainline - mid junction NEB	2477	473	217	3167	2512	469	171	3152	-16	0%	0.28	✓	✓	✓

ID*	Anode	Bnode	Road name	Observed flow (vehicles)				Modelled flow (vehicles)			Total flow comparison						
				Cars	LGVs	HGVs	Total	Cars	LGVs	HGVs	Total	Difference	Percentage difference	GEH	GEH < 5	Flow range	GEH or flow range
	32871	32873	M56 J6 mainline - mid junction SWB	2593	495	228	3316	2591	484	174	3248	-68	-2%	1.18	✓	✓	✓

**ID not defined*

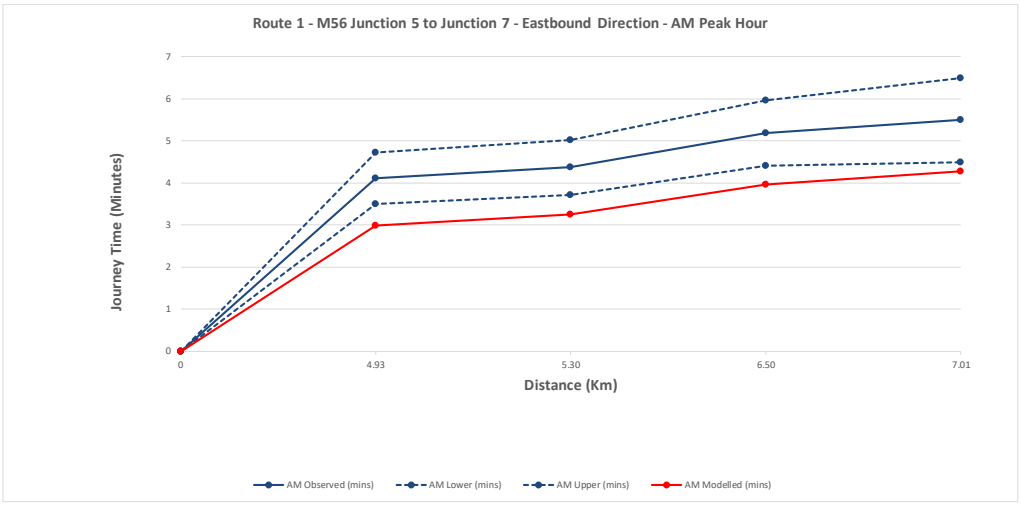
Table C 9: M56 – PM peak hour – individual link flows

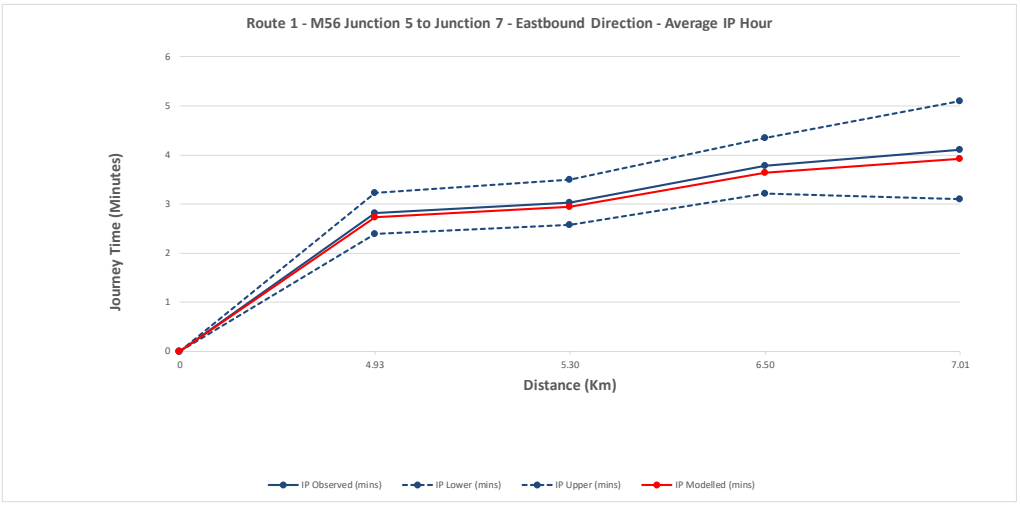
ID*	Anode	Bnode	Road name	Observed flow (vehicles)				Modelled flow (vehicles)			Total flow comparison						
				Cars	LGVs	HGVs	Total	Cars	LGVs	HGVs	Total	Difference	Percentage difference	GEH	GEH < 5	Flow range	GEH or flow range
	32867	32910	M56 J5 SB off-slip	979	74	27	1080	968	75	19	1061	-18	-2%	0.56	✓	✓	✓
	32911	35926	M56 J5 SB on-slip	1180	89	32	1301	1206	88	20	1314	14	1%	0.38	✓	✓	✓
	32911	42840	M56 J5 NB on-slip	1183	89	32	1305	1214	91	21	1327	22	2%	0.61	✓	✓	✓
	5152	2865	M56 J4 NB on-slip	634	48	17	699	633	53	44	731	32	5%	1.19	✓	✓	✓
	2864	32867	M56 J4 to J5 SB	5439	408	148	5996	5473	409	99	5980	-16	0%	0.20	✓	✓	✓
	42841	2865	M56 J4 to J5 NB	4077	306	111	4494	4121	303	74	4498	4	0%	0.05	✓	✓	✓
	2864	5130	M56 J4 SB off-slip	742	56	20	818	783	72	13	867	49	6%	1.70	✓	✓	✓
	32867	35926	M56 J5 mainline - mid junction SB	4482	337	122	4941	4505	334	80	4919	-21	0%	0.30	✓	✓	✓
	32869	32866	M56 J5 mainline - mid junction NB	2874	216	78	3168	2906	212	53	3171	3	0%	0.05	✓	✓	✓
	5718	32872	M56 J6 to J7 EB	3529	265	96	3890	3498	292	79	3869	-21	-1%	0.34	✓	✓	✓
	32873	39694	M56 J6 to J7 WB	5253	394	143	5791	5295	398	102	5796	5	0%	0.07	✓	✓	✓
	32872	32870	M56 J6 mainline - mid junction NEB	2772	208	76	3055	2751	207	55	3012	-43	-1%	0.78	✓	✓	✓
	32871	32873	M56 J6 mainline - mid junction SWB	4541	341	124	5006	4620	344	80	5044	38	1%	0.53	✓	✓	✓

**ID not defined*

Journey time comparisons

Figure C 1: Route 1 – M56 junction 5 to junction 7 – EB





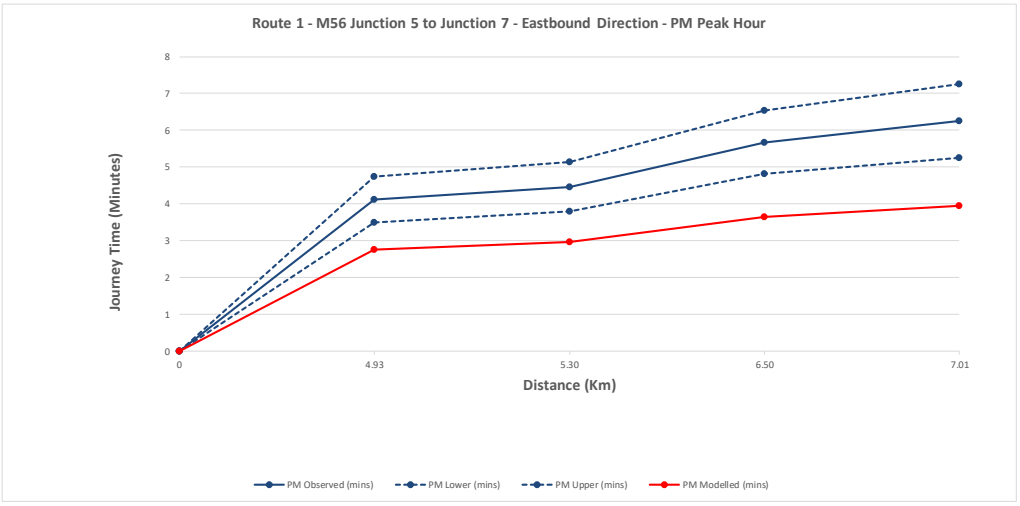
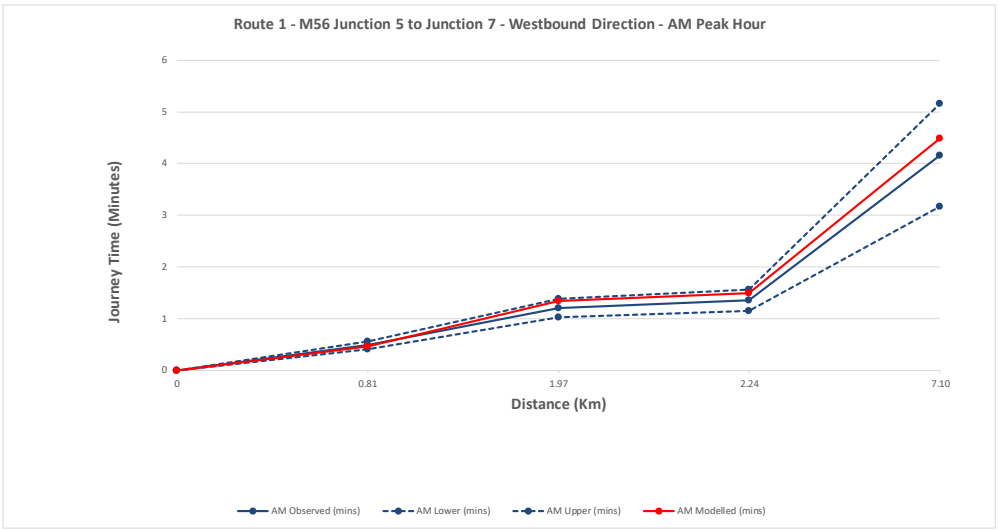
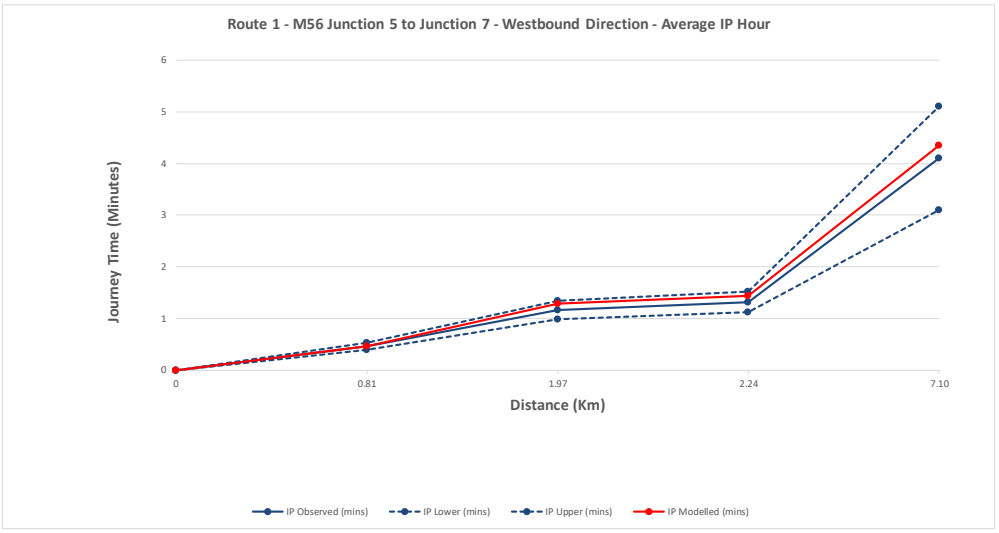


Figure C 2: Route 1 – M56 junction 5 to junction 7 – WB





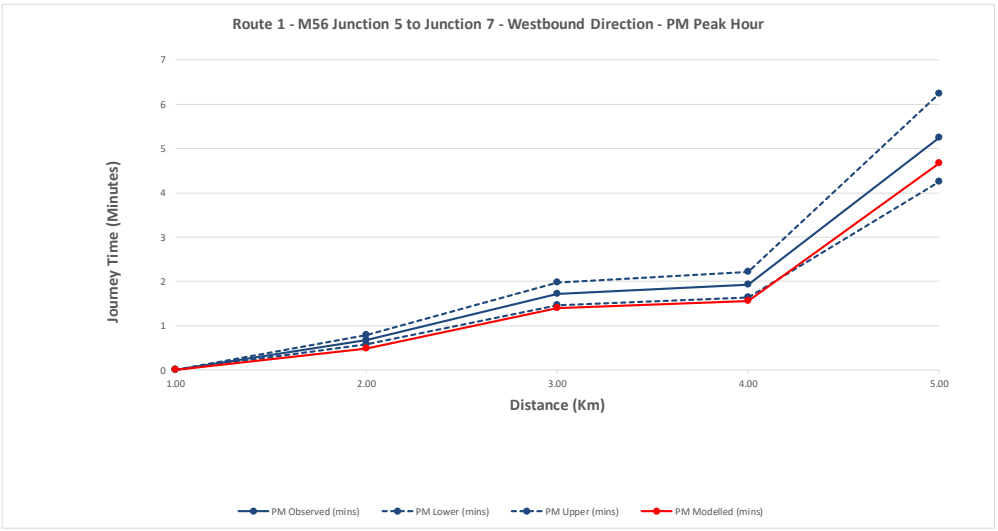
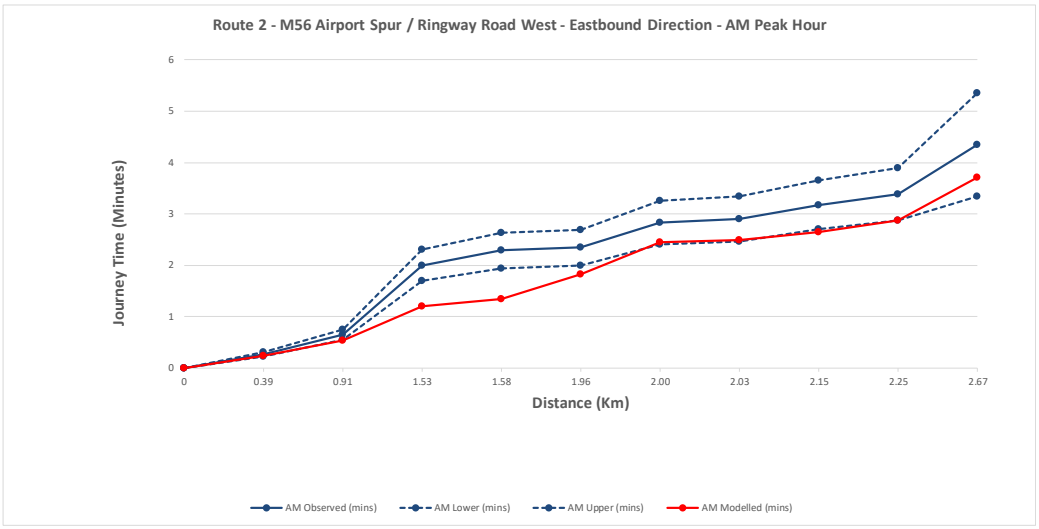
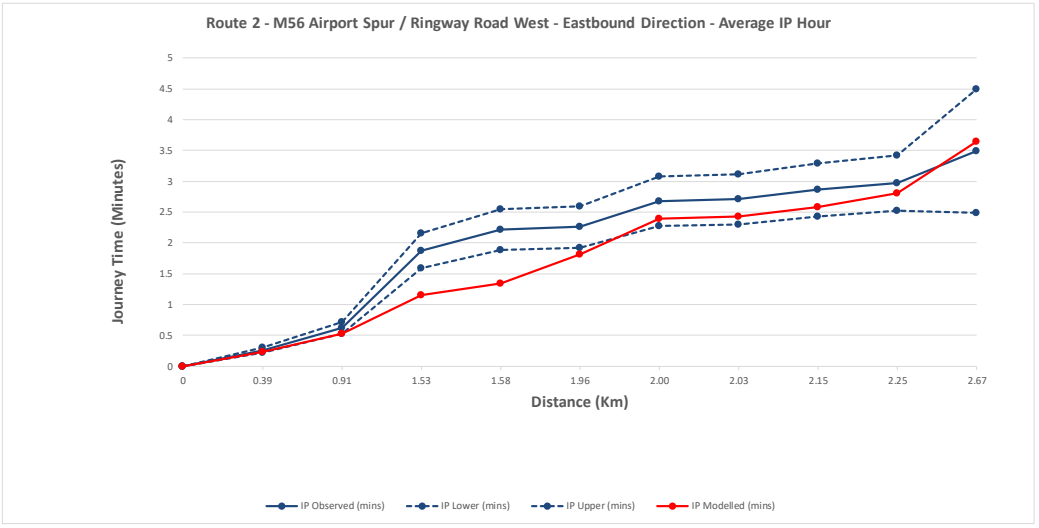


Figure C 3: Route 2 – M56 Airport Spur/Ringway Road West – EB





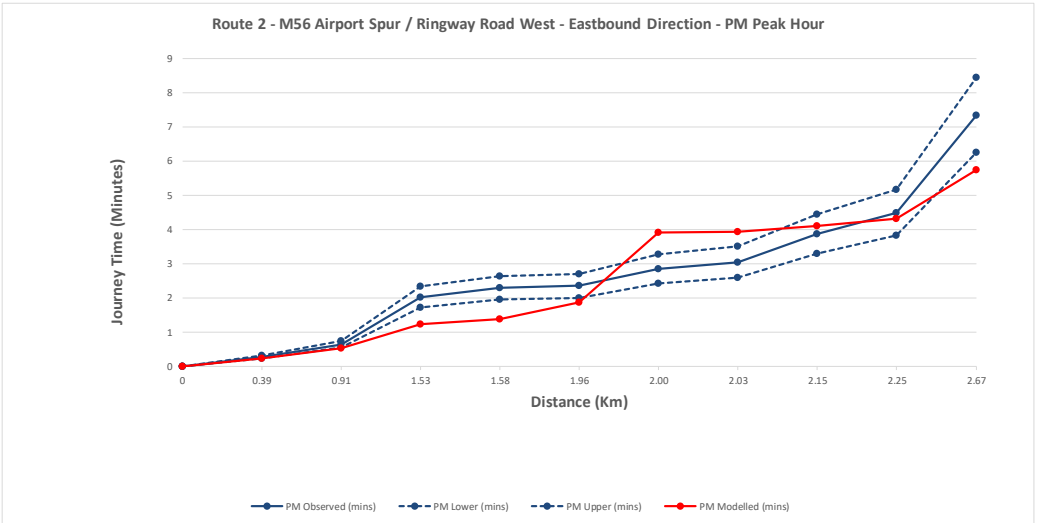
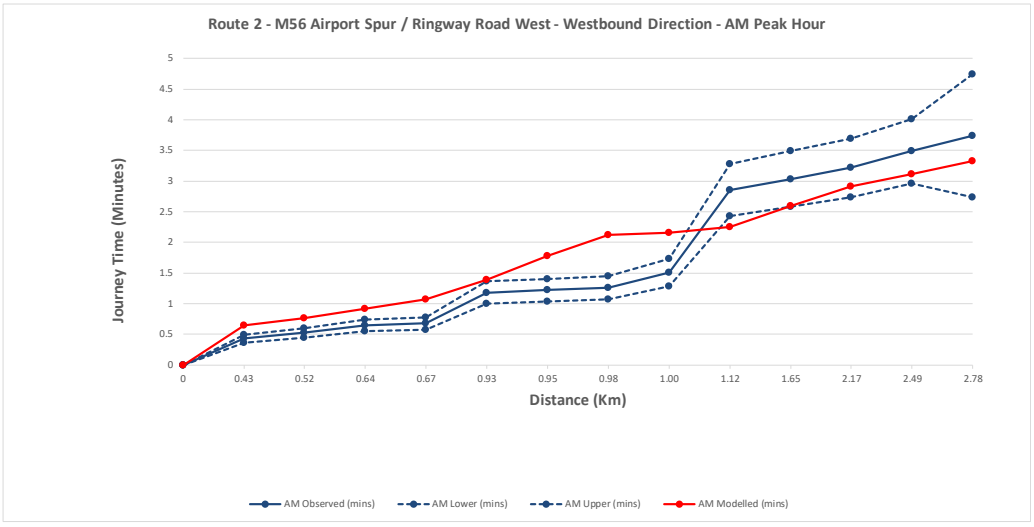
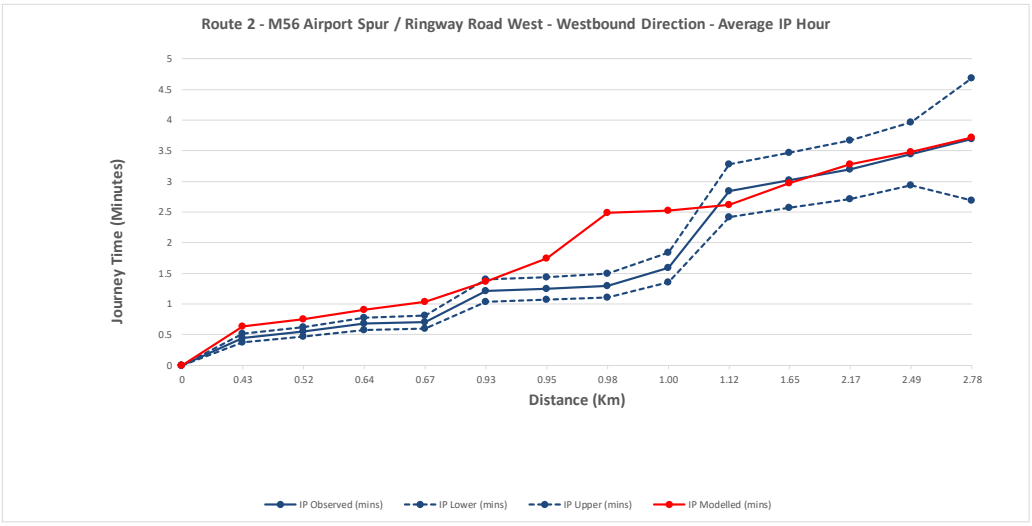


Figure C 4: Route 2 – M56 Airport Spur/Ringway Road West – WB





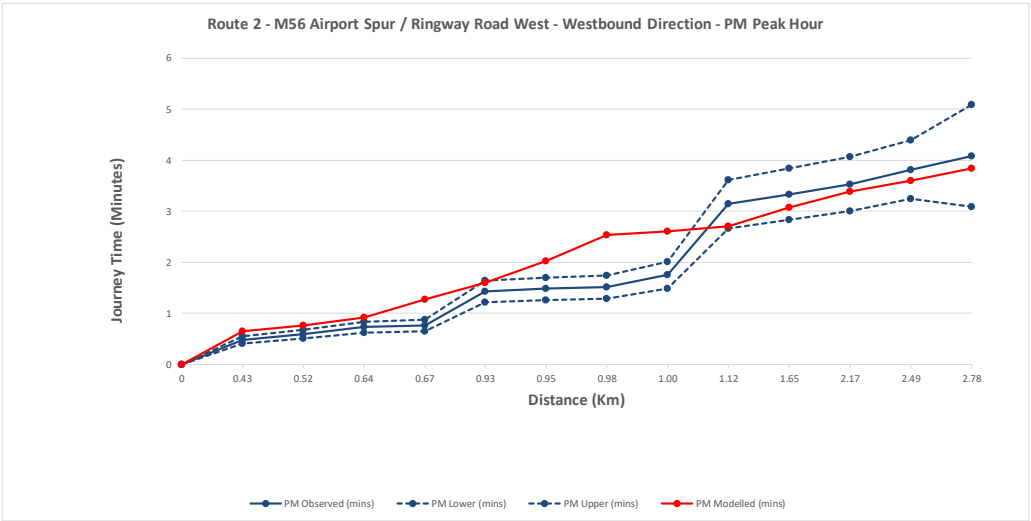
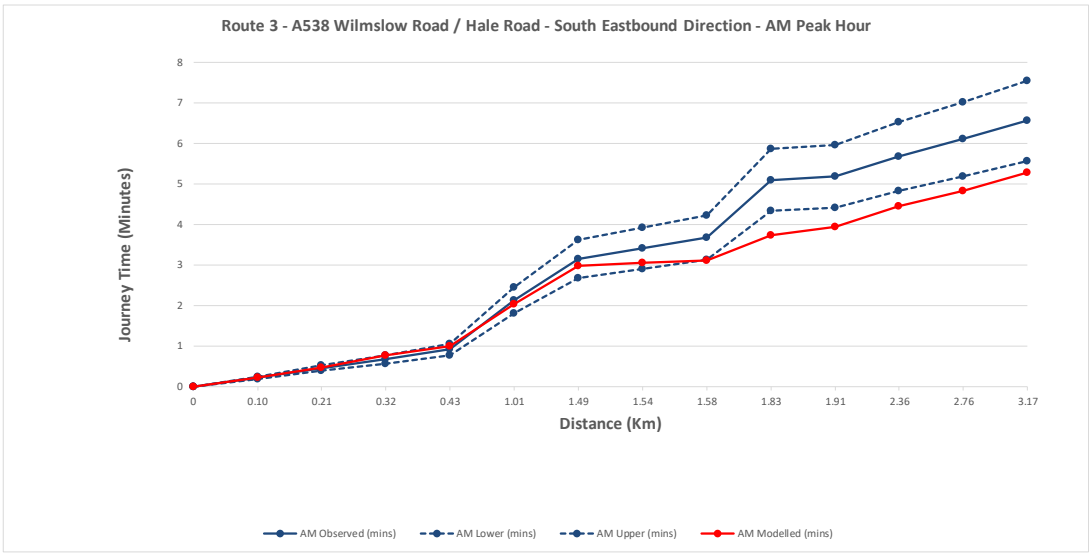
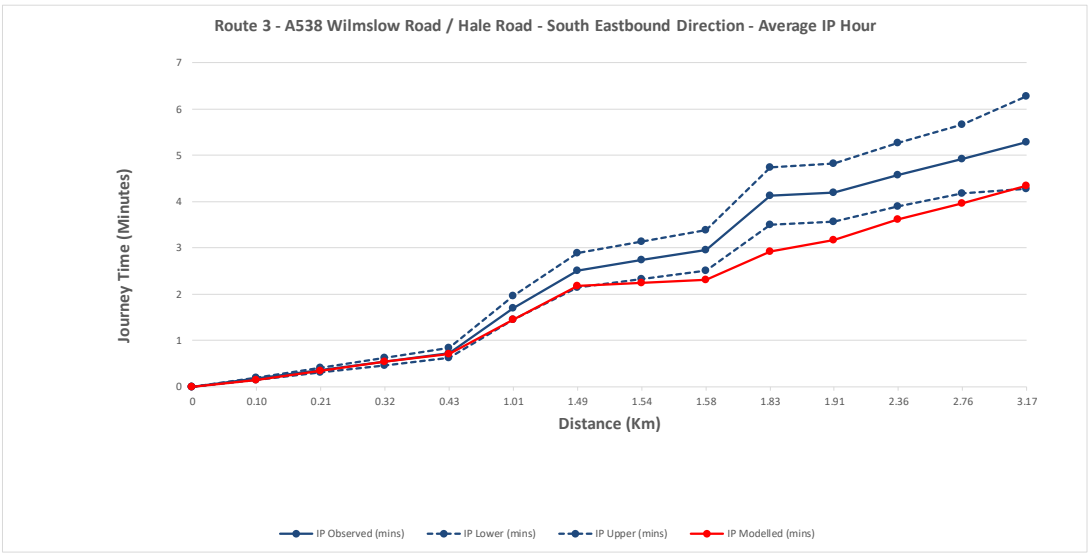


Figure C 5: Route 3 – A538 Wilmslow Road/Hale Road – south EB





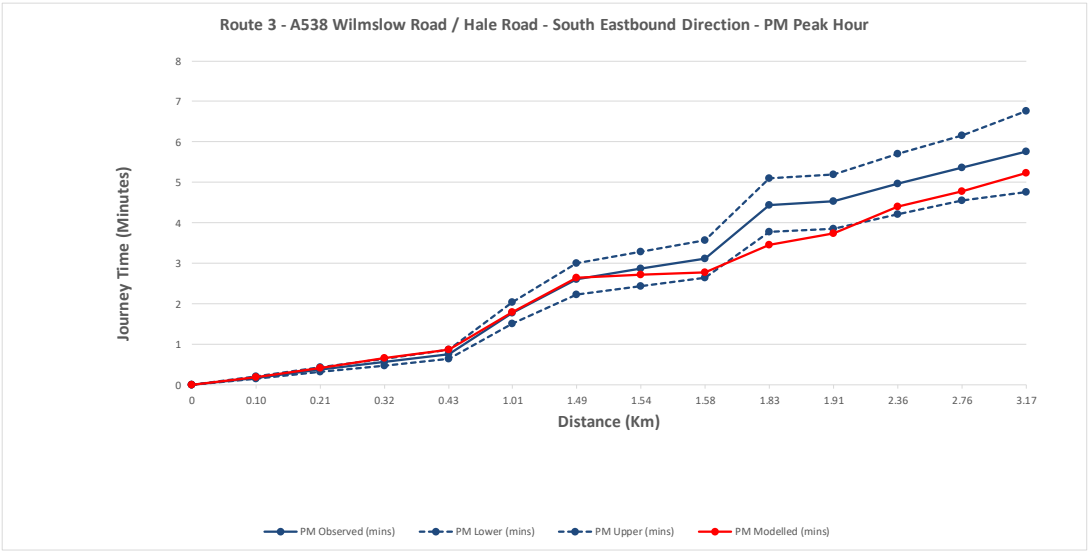
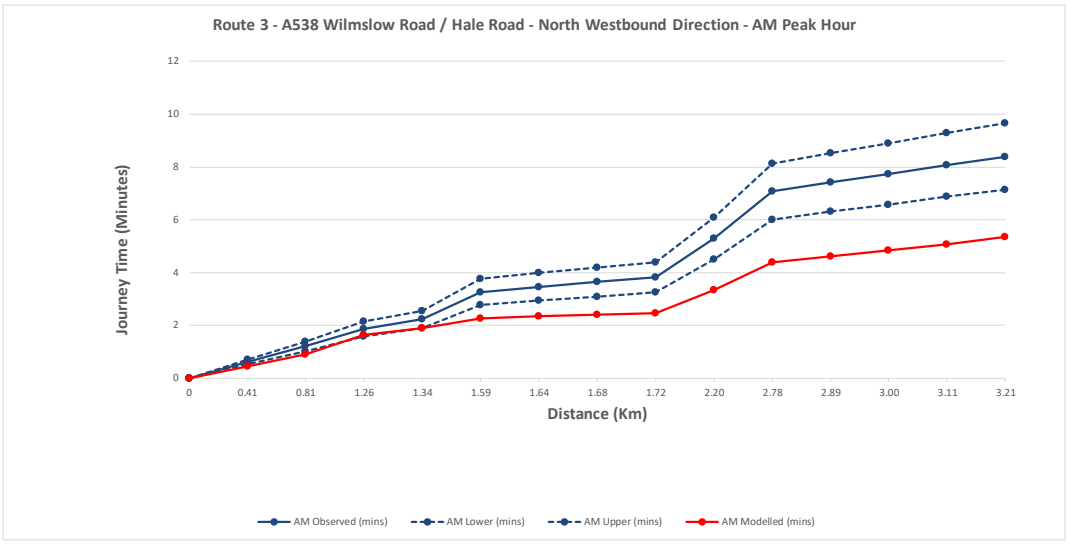
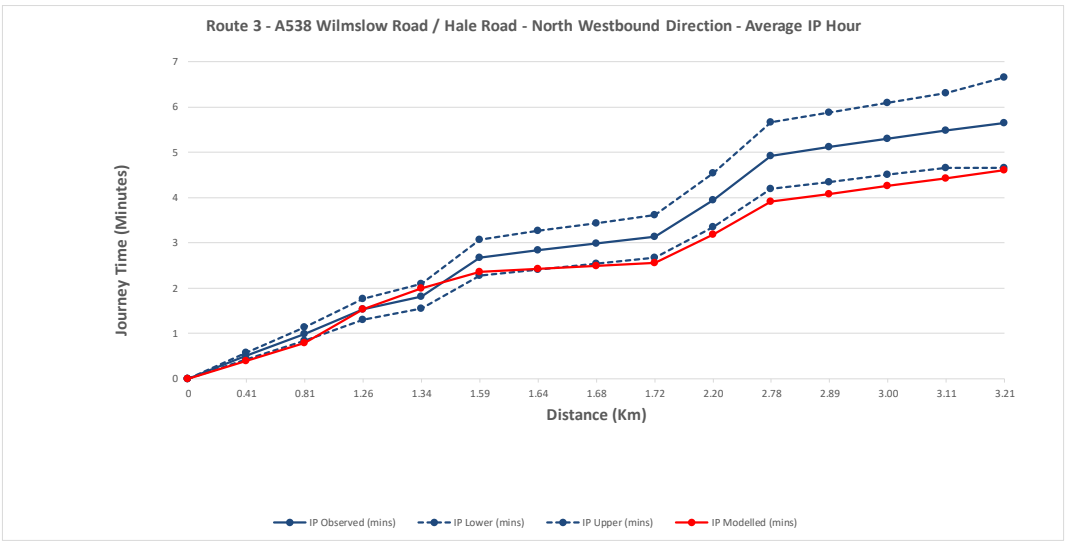
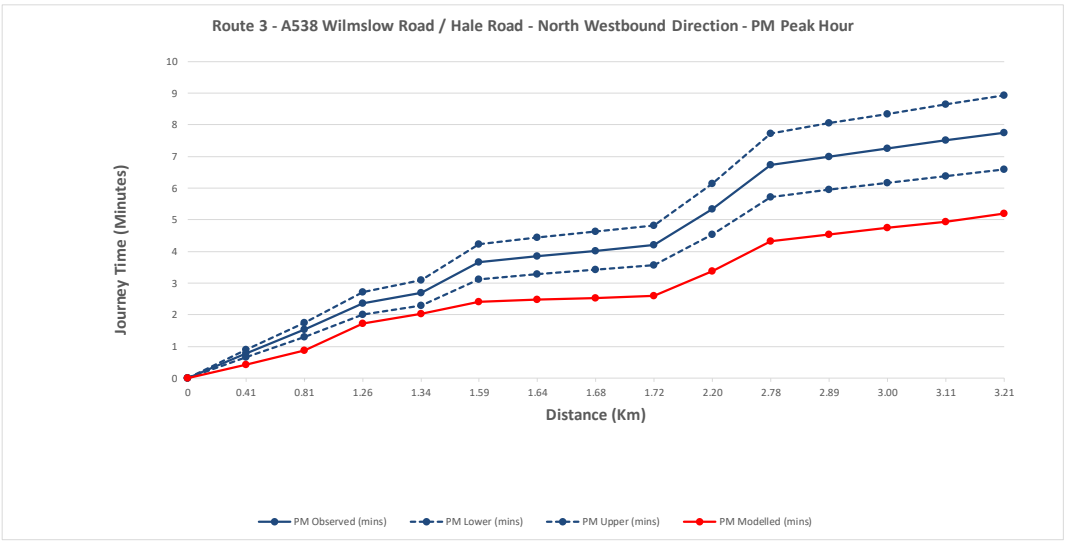


Figure C 6: Route 3 – A538 Wilmslow Road/Hale Road – north WB







Annex D: Model performance report – M6 Junction 19 Model

Contents

Tables

Figures

1 Introduction

1.1 Background information

1.1.1 This report provides documentation of the model performance review that has been carried out for the M6 Junction 19 Model.

1.1.2 Highways England (HE) released to HS2 Ltd copies of the latest available M6 Junction 19 Model versions as of November 2017.

1.1.3 The M6 Junction 19 Model has subsequently been updated by HS2 Ltd transport consultants, Mott MacDonald WSP Joint Venture (MWJV), to include localised improvements within Proposed Scheme area of interest.

1.1.4 The purpose of this report is to provide evidence that this highway assignment model is suitable to support the Transport Assessment (TA) of the Proposed Scheme.

1.1.5 For the Proposed Scheme TA, the route is split into a number of geographical areas referred to as community areas (CA). The M6 Junction 19 Model has been utilised to provide an evidence base for the Proposed Scheme TA for the CA referred to as MA03 and MA06.

1.1.6 Reference should be made to Figure 1 which shows the geographic coverage of strategic transport models that have been utilised for the Proposed Scheme TA.

1.2 Model framework

1.2.1 The M6 Junction 19 Model is comprised of the following:

- variable demand model (DIADEM); and
- strategic highway assignment model.

1.2.2 The M6 Junction 19 Model is a strategic highway assignment model that has been developed within the SATURN model software platform (version 11.3.12), and the variable demand model has been developed in DIADEM.

1.2.3 For the Proposed Scheme TA, only the strategic highway assignment model has been utilised by MWJV to provide an evidence base.

1.2.4 The detailed local area of interest for the M6 Junction 19 Model covers the M6/M56/A556 triangle and has wider network and zone system detail to provide a representation of the external area supply and demand. Reference should be made to Figure 2.

1.2.5 The M6 Junction 19 Model reflects 2015 base year transport conditions.

1.3 Model development

1.3.1 The M6 Junction 19 Model has been developed by Highway England's appointed transport consultants to provide an evidence base to support the business case for the M6 junction 19 improvement scheme.

1.4 Model description

1.4.1 Highway England's, M6 Junction 19 strategic highway assignment Model has been developed for the following years:

- 2015 base year;
- 2021 first future year;
- 2036 second future year; and
- 2051 horizon future year.

1.4.2 The model is representative of the following time periods:

- average AM peak hour – 07:00–10:00;
- average inter peak hour – 10:00–16:00; and
- average PM peak hour – 16:00–19:00.

1.4.3 The model is comprised of the following demand user-classes:

- car commute;
- car employers business;
- car other;
- light goods vehicles; and
- other goods vehicles.

1.5 Model application objectives

1.5.1 For the assessment of the Proposed Scheme, the M6 Junction 19 highway assignment Model will:

- provide preliminary traffic data to inform scheme design;
- provide traffic data for the construction and operational phases of the Proposed Scheme on which to base the assessment of significant effects for the Environmental Statement;
- provide changes in traffic flows, congestion, and journey times to inform the TA for the Proposed Scheme; and
- provide changes in traffic flows between the base year and forecast scenarios for application to local models.

1.5.2 The model will be used primarily to assess the likely impacts of HS2 construction and operational traffic in order to provide an evidence base for the Proposed Scheme TA.

Figure 1: Strategic transport model coverage for the Proposed Scheme Transport Assessment

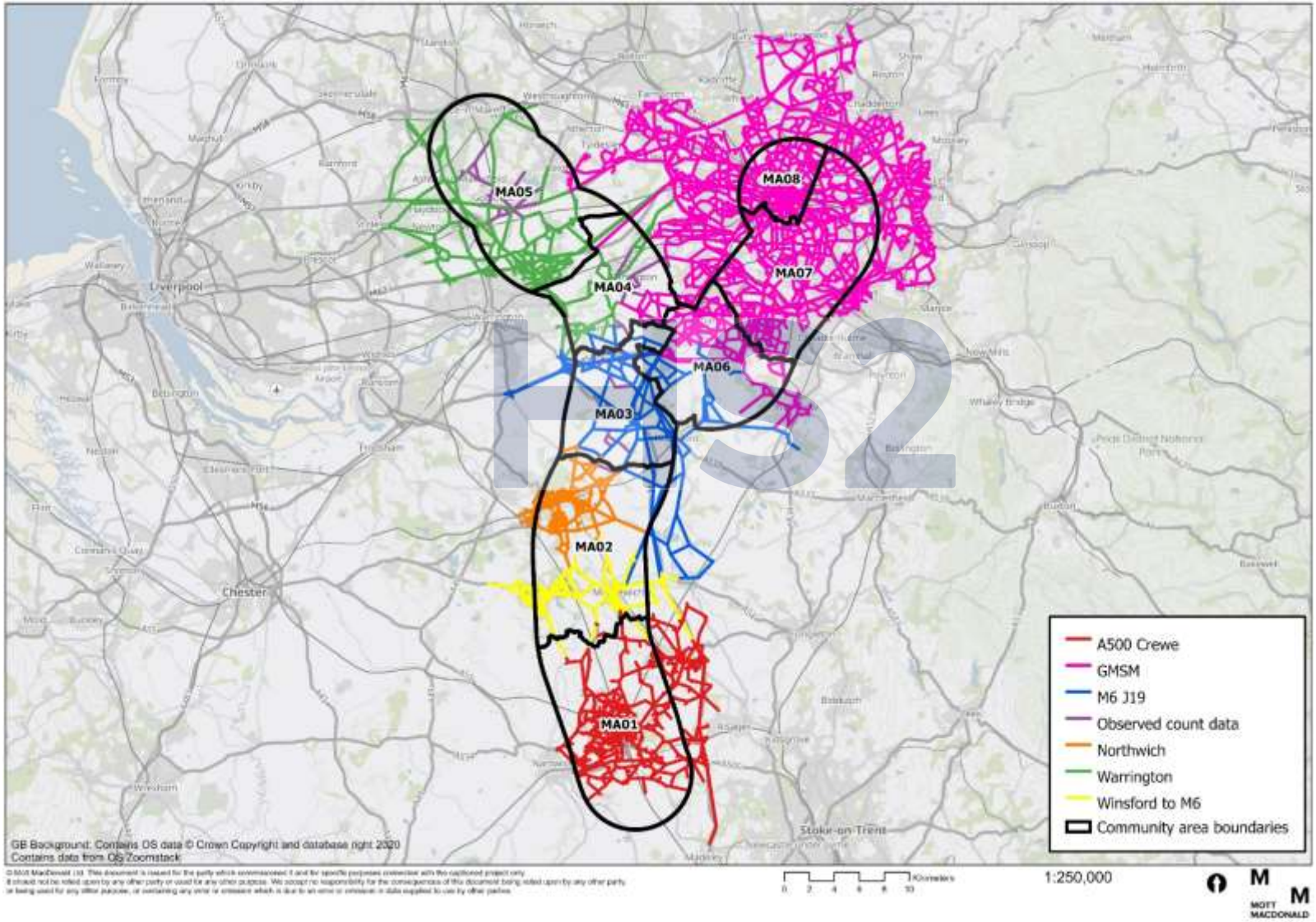
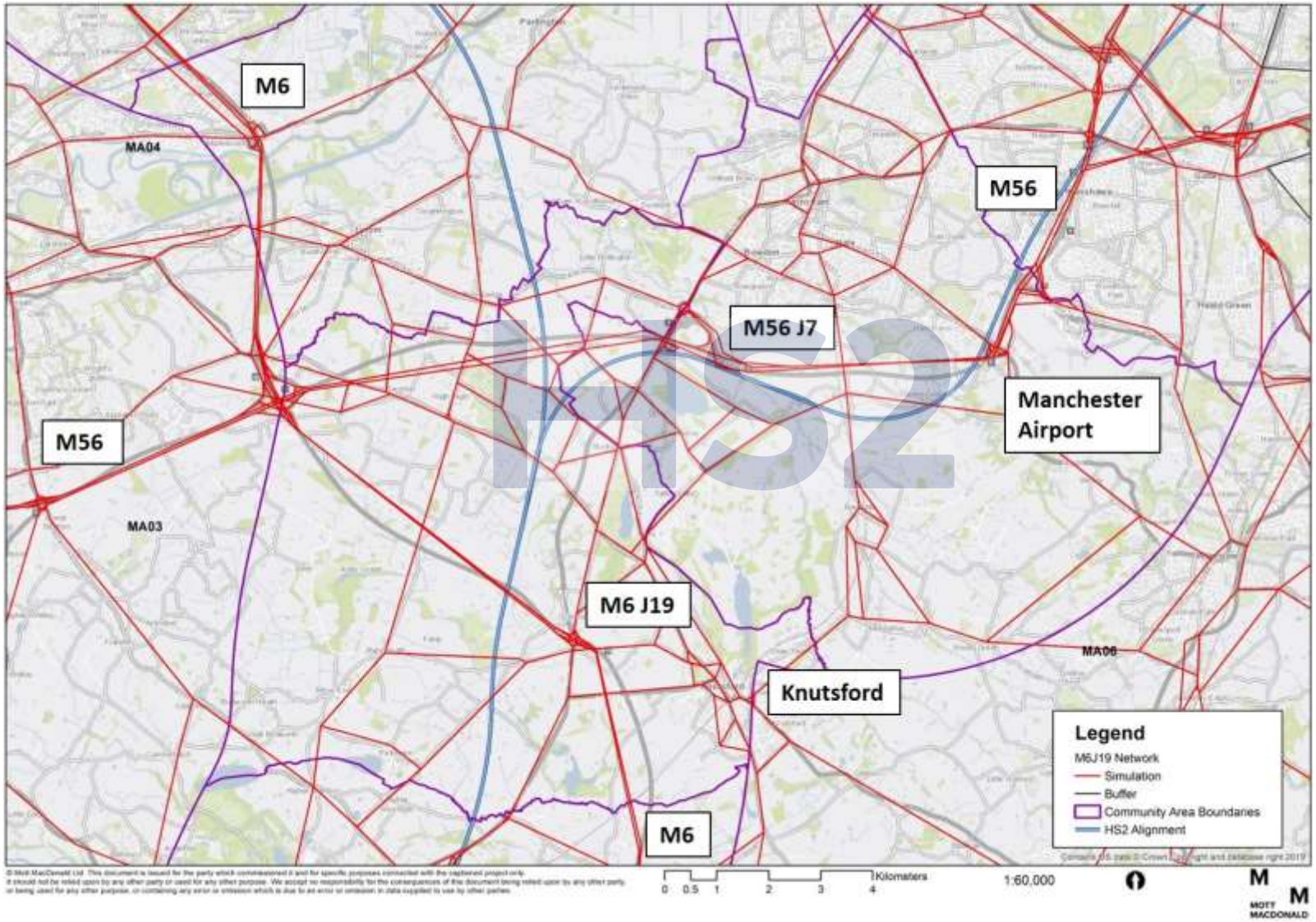


Figure 2: Model study area



2 Guidance used

2.1 Introduction

2.1.1 This strategic highway model development makes reference to the following Transport Analysis Guidance as published by the Department for Transport (DfT): TAG Unit M3.1 Highway Assignment Modelling (May 2020).

2.2 Highway model guidance

2.2.1 In relation to providing an assessment of model calibration and validation performance, reference has been made to Section 3.2 of TAG Unit M3.1 (Table 1, Table 2, and Table 3).

2.2.2 The criteria for the assessment of model calibration and validation of traffic flows and journey time performance is presented in Table 1.

Table 1: DfT – TAG validation criteria

Criteria	Acceptability guideline
Assigned hourly flows	
Individual flows within +/-15% for flows 700-2,700 vph	>85% of cases
Individual flows within +/-100 vph for flows <700 vph	>85% of cases
Individual flows within +/-400 vph for flows >2,700 vph	>85% of cases
Screenline flows (normally >5 links) to be within 5%	All or nearly all screenlines
GEH statistic	
Individual flows GEH <5	>85% of cases
Screenline totals GEH <4	All or nearly all screenlines
Journey times	
Modelled journey times within 15% (or 1 minute if higher)	>85% of cases

Source: Table 1, Table 2, Table 3, DfT TAG Unit M3.1 Highway Assignment Modelling (May 2020)

2.2.3 The criteria for the assessment of highway model assignment convergence is presented in Table 2.

Table 2: Summary of convergence measures and base model acceptable values

Measures of convergence	Acceptability guidelines
Delta and %GAP	Less than 0.1% or at least stable with convergence fully documented and all other criteria met
Percentage of links with flow change (P) <1%	Four consecutive iterations greater than 98%
Percentage of links with cost change (P2) <1%	Four consecutive iterations greater than 98%
Percentage change in total user costs of links with flow change (V) <1%	Four consecutive iterations less than 0.1% (SUE only)

Source: Table 4, DfT TAG Unit M3.1 Highway Assignment Modelling (May 2020)

3 Data for model development

3.1 Overview

3.1.1 This section of the report presents details of traffic survey data that has been collected for the purpose of assessing model calibration and validation performance within the M6 Junction 19 detailed Model study area.

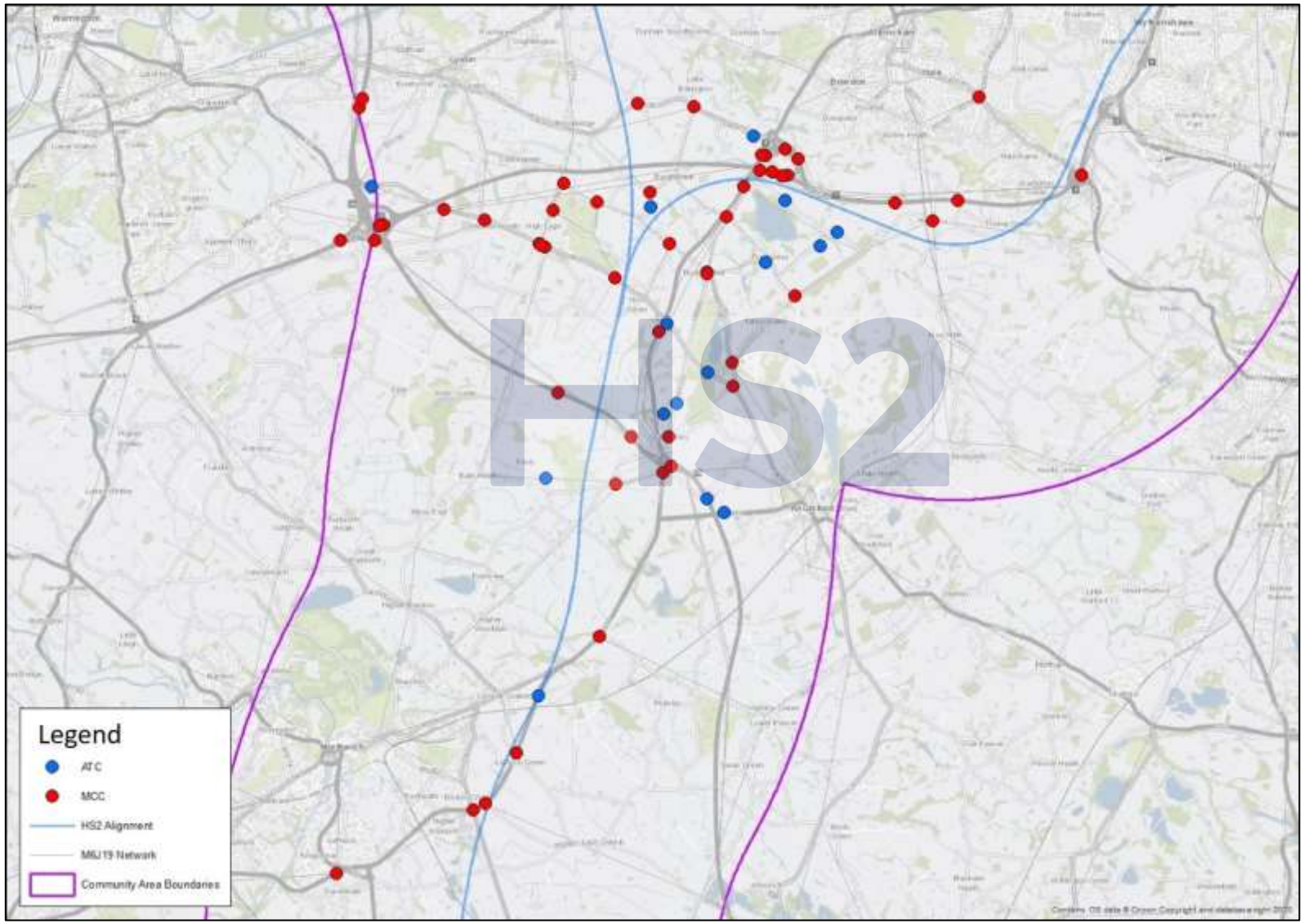
3.2 Traffic survey data commission

3.2.1 MWJV commissioned a programme of traffic count surveys in 2017/2018 to support the Proposed Scheme TA. This was also supported by a further traffic survey commission in 2020 that was completed prior to the on-set of COVID-19 restrictions.

3.2.2 In addition, traffic count data has also been sourced from Highways England's programme of traffic surveys in 2020 (prior to COVID-19) and Webtris data for motorway and trunk road links within the local study area.

3.2.3 Traffic count surveys have been used from different years and months to update the base year model. The traffic counts have been factored to June 2018 to develop a consistent dataset. Reference should be made to Figure 3 which shows the location of traffic surveys.

Figure 3: Location of traffic counts



4 Model development

4.1 Overview

4.1.1 A review of base year model traffic flows identified that there was scope to undertake some localised improvements to the traffic model in order to provide a more robust assessment in the Proposed Scheme area of interest.

4.1.2 This localised model update has focussed on the improvement to the validation of traffic flows covering the Proposed Scheme area of interest, and no changes to journey time validation have been undertaken.

4.1.3 The model has been converted from an average hour model to a peak hour model to coincide with the defined peak hours for the Proposed Scheme TA: AM peak hour 08:00–09:00 and PM peak hour 17:00–18:00.

4.1.4 The model has been updated by MWJV using available traffic count survey data that has been collected between 2017 and 2020.

4.2 Transport supply

4.2.1 A review of highway network detail and attributes has been completed for the model area that is included in the Proposed Scheme area of interest (CA: MA03 and MA06).

4.2.2 The 2021 future year baseline (Do Minimum) model network as supplied by Highways England was referenced for the purpose of developing a 2018 baseline model for the Proposed Scheme TA. This model includes the new A556 Knutsford to Bowdon Improvement Scheme which was opened to traffic in March 2017.

4.2.3 The following network attributes have been reviewed and checked:

- links: distance, speeds, capacity, bus lanes, traffic regulation orders;
- junctions: type; turn saturation flows, capacity, and lane utilisation;
- traffic signal control: timings, phasing, and staging; and
- routes: minimum cost paths.

4.2.4 The review highlighted that there is a good level of detailed highway network representation within the Proposed Scheme area, and that this compared well with local data-sets.

4.2.5 The generalised cost values (PPM/PPK) for model assignment have also been updated to reflect the latest values from the DfT TAG databook (version: May 2020).

4.2.6 In summary, the model includes a sufficiently detailed level of network infrastructure to support the Proposed Scheme TA.

4.3 Transport demand

4.3.1 The M6 Junction 19 Model includes a detailed representation of spatial demand. The model zone system contains 275 model zones and accounts for future land-use development zones.

4.3.2 The model zone system provides a detailed representation of strategic and local transport demand to support the original model objectives (A556, and M6 junction 19 improvement schemes).

4.3.3 The demand matrices have been adjusted from 2015 to 2018 from carrying out an interpolation between base and first future year matrices. This interpolated 2018 matrix (prior matrix) has then been subject to matrix estimation using the available 2018 count data; and a localised traffic flow calibration exercise has been carried out to improve the correlation between observed and modelled traffic flows within the local areas of interest.

4.3.4 The M6 Junction 19 Model has also been converted from an average hour to a peak hour model from the application of local traffic growth factors.

5 Model performance

5.1 Overview

5.1.1 This section of the report focusses on the performance of the 2018 base model as produced by MWJV against observed traffic flow data.

5.2 Traffic flow

5.2.1 Observed and modelled traffic flows have been compared for available count site locations within the Proposed Scheme CA MA03 and MA06. In total, 197 individual link counts by direction have been compared.

5.2.2 Table 3 and Table 4 present a summary comparison of individual link flows for all vehicles and by the car vehicle type for the prior matrix assignment. The comparison shows that both time periods fall below the DfT TAG individual link count criteria of greater than 85 percent of comparisons achieving flow and GEH criteria of less than five (as shown in Table 3).

Table 3: M6 junction 19 – individual link flow – total all vehicle – prior

Total all vehicle flow comparison (vehicles)							
Time period	Number of sites	TAG criteria 1 flow range		TAG criteria 2 GEH < 5		TAG criteria flow range or GEH	
		Number of counts	Percentage	Number of counts	Percentage	Number of counts	Percentage
AM peak hour	197	113	57%	78	40%	115	58%
PM peak hour	197	104	53%	73	37%	107	54%

Table 4: M6 junction 19 – individual link flow – car vehicle type – prior

Car flow comparison (vehicles)							
Time period	Number of sites	TAG criteria 1 flow range		TAG criteria 2 GEH < 5		TAG criteria flow range or GEH	
		Number of counts	Percentage	Number of counts	Percentage	Number of counts	Percentage
AM peak hour	197	116	59%	83	42%	116	59%
PM peak hour	197	106	54%	72	37%	107	54%

5.2.3 Figure 4 and Figure 5 show the locations of the link counts and the respective AM and PM peak hour model performance for the prior matrix assignment.

5.2.4 Table 5 and Table 6 present a summary comparison of individual link flows for all vehicles and by the car vehicle type for the post matrix estimation assignment. Table 5 shows that 90 percent of all vehicle modelled flows in the AM peak hour and 83 percent of all vehicle modelled flows in the PM peak hour are within the DfT TAG guidelines for individual links for flow or GEH (as shown in Table 1). For car vehicle type, the equivalent values are 91 percent and 83 percent for the AM and PM peak hours, respectively.

Table 5: M6 junction 19 – individual link flow – total all vehicles – post

Total all vehicle flow comparison (vehicles)							
Time period	**Number of sites**	**TAG criteria 1 flow range**		**TAG criteria 2 GEH < 5**		**TAG criteria flow range or GEH**	
		Number of counts	**Percentage**	**Number of counts**	**Percentage**	**Number of counts**	**Percentage**
AM peak hour	197	177	90%	151	77%	178	90%
PM peak hour	197	161	82%	143	73%	163	83%

Table 6: M6 junction 19 – individual link flow – car vehicle type – post

Car flow comparison (vehicles)							
Time period	**Number of sites**	**TAG criteria 1 flow range**		**TAG criteria 2 GEH < 5**		**TAG criteria flow range or GEH**	
		Number of counts	**Percentage**	**Number of counts**	**Percentage**	**Number of counts**	**Percentage**
AM peak hour	197	178	90%	161	82%	180	91%
PM peak hour	197	162	82%	146	74%	164	83%

5.2.5 Figure 6 and Figure 7 show the location of the link counts and the respective AM and PM peak hour model performance for the post matrix assignment.

5.2.6 Reference should be made to Table A 1 and Table A 2, Appendix A, which presents supporting details of the individual link flow performance.

Figure 4: AM peak hour – traffic flow performance – prior

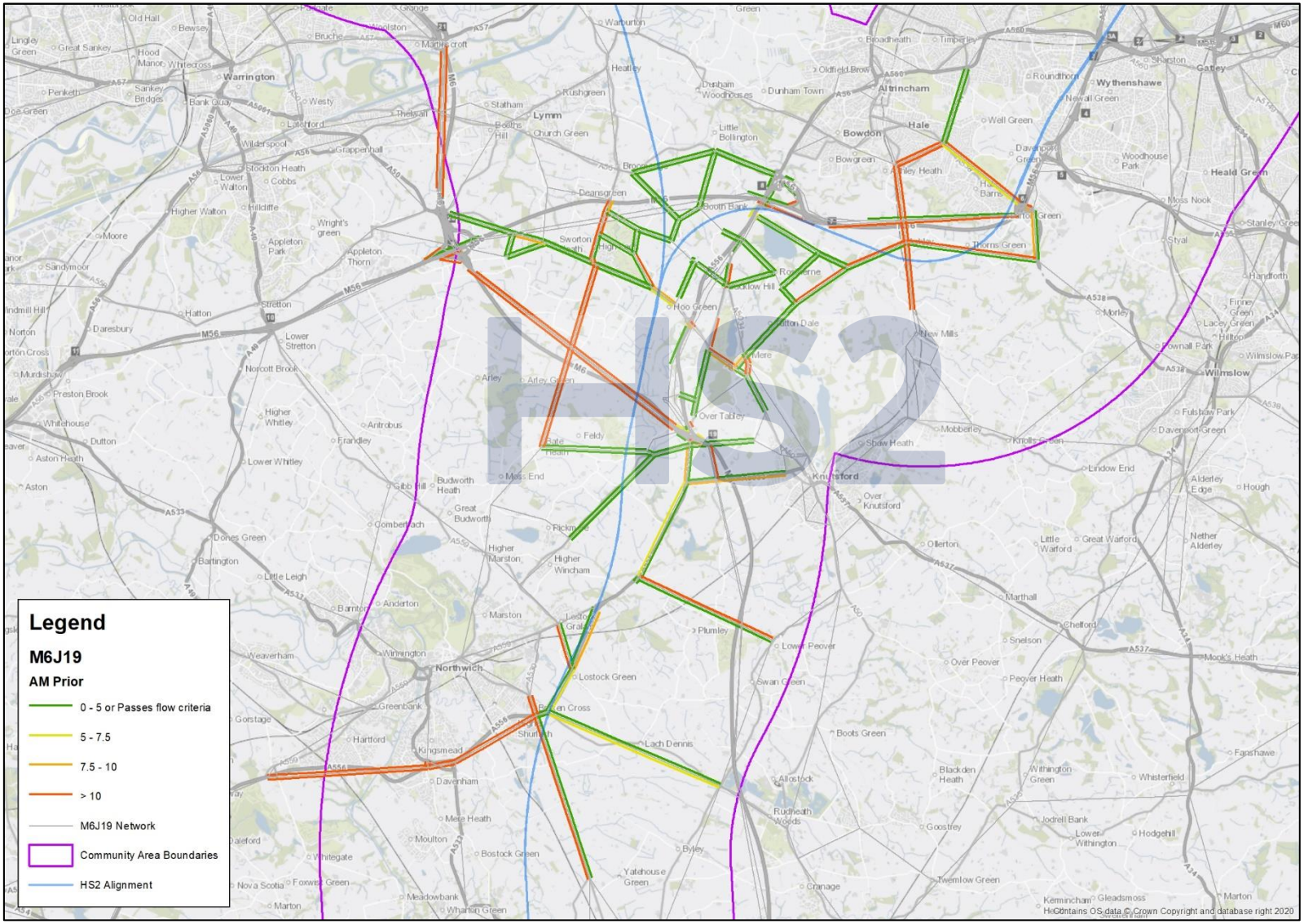


Figure 5: PM peak hour – traffic flow performance – prior

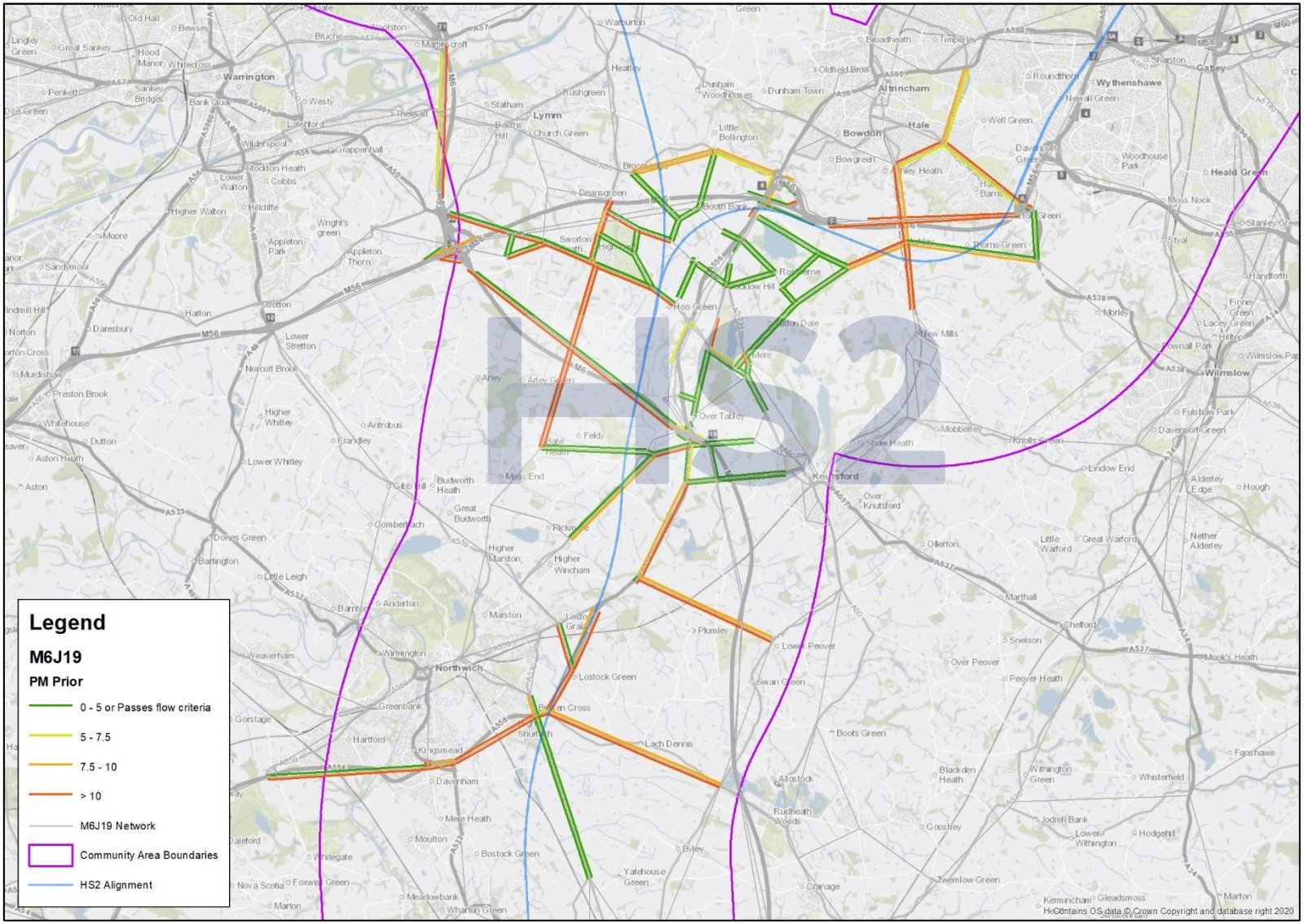


Figure 6: AM peak hour – traffic flow performance – post

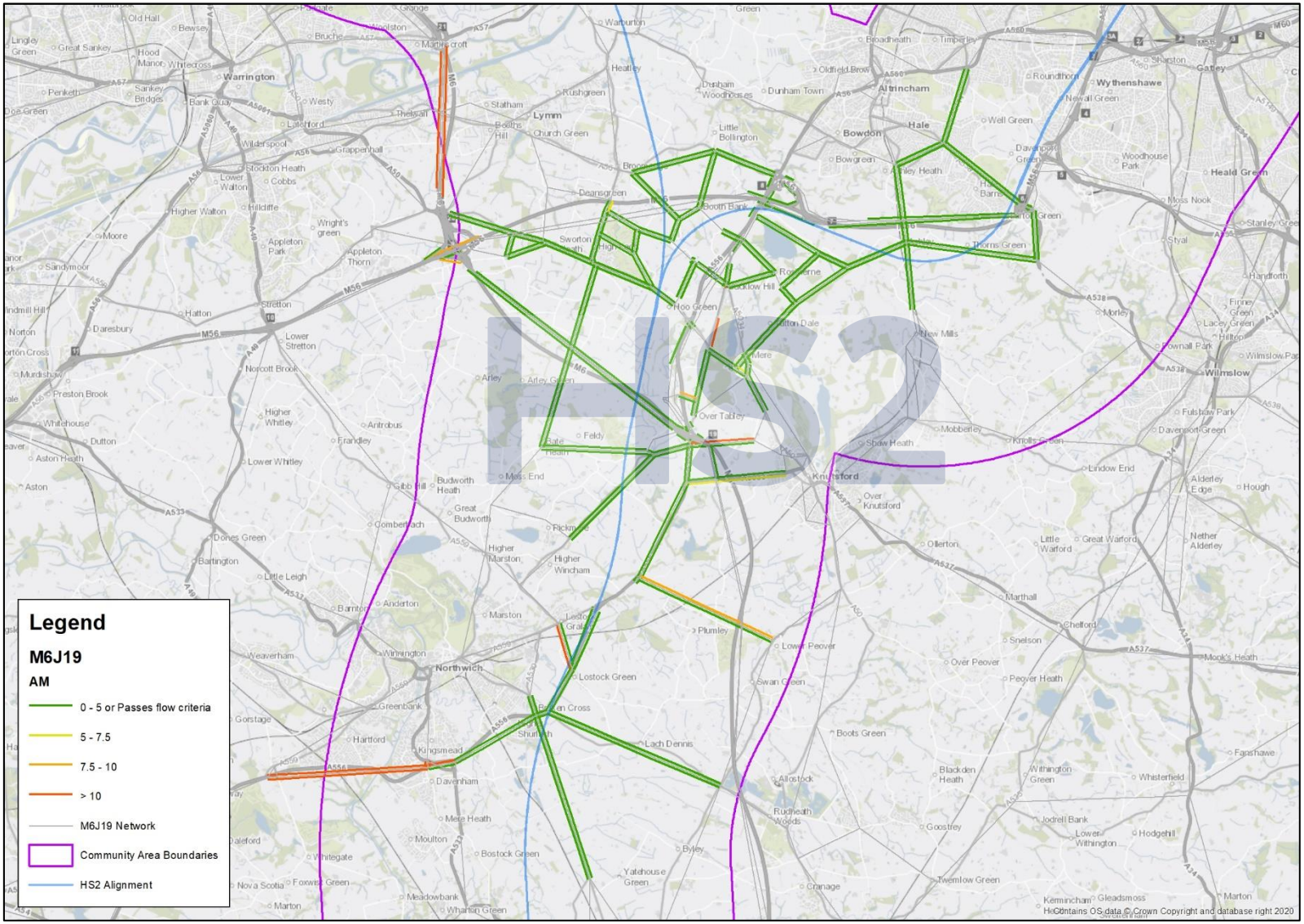
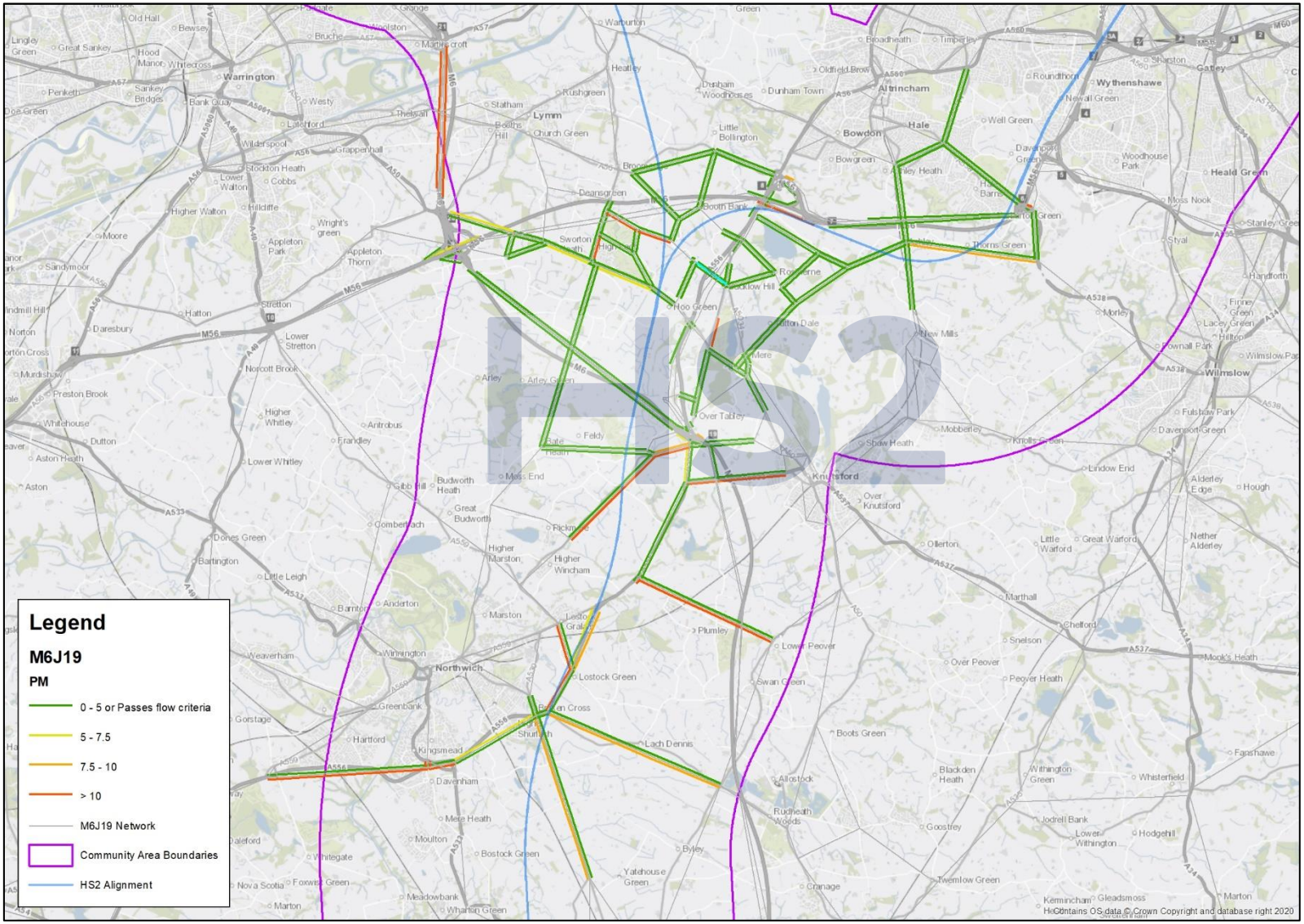


Figure 7: PM peak hour – traffic flow performance – post



6 Model convergence

6.1.1 Achieving a suitable level of model convergence is necessary to provide stable, consistent, and robust model results and to differentiate between real changes and those associated with differing degrees of convergence.

6.1.2 DfT TAG provides guidance on highway model convergence with recommendations on acceptable variations in link flows and costs between iterations helping to ensure the model is sufficiently stable.

6.1.3 Table 7 presents a summary of the 2018 baseline highway model convergence statistics by time period. It is evident that all modelled time periods meet the specified DfT TAG guidance for convergence.

Table 7: PM peak hour – traffic flow performance – post

Criteria	Loop	Target	AM peak hour	PM peak hour
Flow change	N-3	> 98%	98.60	98.30
	N-2		98.70	98.20
	N-1		100.00	99.90
	N		98.30	98.40
Cost change	N-3	> 98%	99.30	98.90
	N-2		99.30	98.90
	N-1		99.60	99.00
	N		99.20	98.90
Delta		< 0.1%	0.0036/20	0.0049/13
%GAP		< 0.1%	0.0052	0.0081

7 Summary and conclusions

7.1.1 The M6 Junction 19 2015 average hour base year highway Model as supplied by Highways England has been converted to a peak hour model. It has been uplifted to a 2018 base year by network updates, interpolated demand and 2018 traffic survey data feeding into matrix estimation.

7.1.2 Table 8 is a summary of the individual link flow model performance for all modelled time periods. It is evident that 90 percent of the all vehicle modelled flows in the AM peak hour and 83 percent of all vehicle modelled flows in the PM peak hour are within the DfT TAG guidelines for individual links for flow or GEH.

Table 8: Summary of individual link flows

Total all vehicle flow comparison (vehicles)							
Time period	**Number of sites**	**TAG criteria 1 flow range**		**TAG criteria 2 GEH < 5**		**TAG criteria flow range or GEH**	
		Number of counts	**Percentage**	**Number of counts**	**Percentage**	**Number of counts**	**Percentage**
AM peak hour	197	177	90%	151	77%	178	90%
PM peak hour	197	161	82%	143	73%	163	83%

7.1.3 In conclusion, the updated M6 Junction 19 Model provides a reliable forecasting base and forms a suitable tool for the assessment of HS2 construction and operational impacts within the Proposed Scheme area of interest.

8 Acronyms

Table 9: Acronyms

Acronyms	
HE	Highways England
LMVR	Local model validation report
MPR	Model performance report
TA	Transport Assessment
ES	Environmental Statement
DfT	Department for Transport
DMRB	Design Manual for Roads and Bridges
ATC	Automatic traffic count
MCC	Manual classified count
JTC	Junction turning count
GEH	Geoffrey Havers (statistic)

9 References

Department for Transport (2020), *TAG unit M3.1 Highway Assignment Modelling*. Available online at: https://www.gov.uk/government/publications/webtag-tag-unit-m3-1-highway-assignment-modelling.

Appendix A: Model performance

Individual link flow performance

Table A 1: M6 Junction 19 Model – AM peak hour – individual link flows

ID*	Road name	Location	Direction	Observed flow (vehicles)				Modelled flow (vehicles)				Total flow comparison					
				Cars	LGVs	HGVs	Total	Cars	LGVs	HGVs	Total	Difference	Percentage difference	GEH	GEH < 5	Flow range	GEH or flow range
	A50 Cliff Lane	North of Heath Lane	EB	376	74	16	468	363	73	21	457	-11	-2%	0.51	✓	✓	✓
	Wrenshot Lane	South of Broadoak Lane	NB	3	1	0	3	0	3	0	3	0	6%	0.10	✓	✓	✓
	Wrenshot Lane	South of Broadoak Lane	SB	3	3	0	6	38	3	3	44	38	628%	7.57	×	✓	✓
	Broadoak Lane	North of Wrenshot Lane	NB	8	1	0	9	0	3	0	3	-5	-63%	2.21	✓	✓	✓
	Broadoak Lane	North of Wrenshot Lane	SB	7	1	0	8	9	2	1	12	4	57%	1.37	✓	✓	✓
	A50	South of B5159	WB	187	21	15	223	178	23	14	214	-8	-4%	0.56	✓	✓	✓
	B5159 - West Lane	North of A50	NB	145	20	3	168	147	26	2	174	6	4%	0.49	✓	✓	✓
	A50	South of B5159	EB	365	65	19	448	397	67	22	487	38	9%	1.78	✓	✓	✓
	B5159 - West Lane	North of A50	SB	176	22	1	200	122	19	3	143	-57	-28%	4.33	✓	✓	✓
	Wrenshot Lane	South of Broadoak Lane	EB	51	6	0	57	28	1	3	32	-25	-44%	3.71	✓	✓	✓
	B5159 - West Lane	East of Mowpen Brow	NB	292	38	4	335	288	42	4	334	-1	0%	0.04	✓	✓	✓
	West Lane	North of Mowpen Brow	SB	222	30	5	258	151	23	4	178	-80	-31%	5.39	×	✓	✓
	West Lane	North of Mowpen Brow	NB	306	39	4	350	288	45	4	338	-13	-4%	0.67	✓	✓	✓
	Swineyard Lane	East of Heath Lane	WB	49	6	2	57	49	6	3	58	1	2%	0.14	✓	✓	✓
	A50	North of Swineyard Lane	WB	207	24	14	244	207	25	14	246	2	1%	0.11	✓	✓	✓
	A50 Cliff Lane	North of Heath Lane	WB	214	29	14	257	214	28	15	257	0	0%	0.00	✓	✓	✓
	Heath Lane	West of Swineyard Lane	SB	8	6	1	14	9	9	1	19	5	32%	1.13	✓	✓	✓
	A50 Cliff Lane	North of Heath Lane	EB	377	87	20	486	354	65	20	439	-47	-10%	2.18	✓	✓	✓
	Swineyard Lane	East of Heath Lane	EB	111	18	2	131	111	7	2	120	-11	-8%	0.94	✓	✓	✓
	Heath Lane	West of Swineyard Lane	NB	14	5	2	20	20	5	1	27	7	34%	1.40	✓	✓	✓
	A50	North of Swineyard Lane	EB	399	79	21	500	354	65	20	439	-61	-12%	2.80	✓	✓	✓
	A50 Cliff Lane	North of Heath Lane	WB	197	21	15	232	194	22	14	230	-2	-1%	0.11	✓	✓	✓
	West Lane	North of Mowpen Brow	SB	267	32	5	305	160	25	5	190	-115	-38%	7.31	×	×	×
	A556	South of Manchester Road	SB	920	150	83	1,158	889	128	78	1,095	-63	-5%	1.87	✓	✓	✓
	A556	South of Manchester Road	NB	921	103	68	1,093	926	138	72	1,136	44	4%	1.30	✓	✓	✓
	Station Road - Lostock Hollow - Lostock Green - Birches Lane	South of Hall Lane	NB	120	38	2	160	0	0	2	2	-158	-98%	17.50	×	×	×

ID*	Road name	Location	Direction	Observed flow (vehicles)				Modelled flow (vehicles)				Total flow comparison					
				Cars	LGVs	HGVs	Total	Cars	LGVs	HGVs	Total	Difference	Percentage difference	GEH	GEH < 5	Flow range	GEH or flow range
	A556	North of Penny Lane	SB	912	129	83	1,126	889	128	78	1,095	-31	-3%	0.92	✓	✓	✓
	A556	North of Penny Lane	NB	913	130	79	1,124	926	138	74	1,139	15	1%	0.44	✓	✓	✓
	A556	West of B5082	WB	1133	167	90	1,397	1,205	159	87	1,452	54	4%	1.44	✓	✓	✓
	A556	West of B5082	EB	1312	168	74	1,556	1,321	187	91	1,599	43	3%	1.08	✓	✓	✓
	King Street	West of Pennys Lane	NB	330	62	15	409	329	62	21	412	3	1%	0.15	✓	✓	✓
	King Street	West of Pennys Lane	SB	624	108	27	759	606	108	41	756	-4	0%	0.13	✓	✓	✓
	Warrington Road	West of Clamhunger Lane	EB	362	56	16	435	345	55	16	417	-18	-4%	0.89	✓	✓	✓
	Warrington Road	West of Clamhunger Lane	WB	357	40	17	415	357	41	17	415	0	0%	0.02	✓	✓	✓
	Clamhunger Lane	East of Warrington Road	NB	53	9	3	65	53	14	1	68	3	4%	0.36	✓	✓	✓
	Mereside Road	East of Clamhunger Lane	NB	194	21	10	225	155	16	4	176	-50	-22%	3.50	✓	✓	✓
	Mereside Road	East of Clamhunger Lane	SB	226	26	21	275	229	33	14	276	2	1%	0.10	✓	✓	✓
	Mereside Road	East of Clamhunger Lane	NB	182	25	10	217	172	25	5	203	-14	-7%	0.98	✓	✓	✓
	Clamhunger Lane	East of Warrington Road	SB	25	4	1	30	29	8	1	38	8	26%	1.32	✓	✓	✓
	Mereside Road	East of Clamhunger Lane	SB	583	52	26	666	527	38	14	578	-88	-13%	3.52	✓	✓	✓
	Ashley Road	East if Rostherne Lane	EB	251	23	3	277	252	31	3	286	9	3%	0.52	✓	✓	✓
	Ashley Road	East if Rostherne Lane	WB	123	11	1	135	126	17	1	144	8	6%	0.72	✓	✓	✓
	Mobberley Road	North of Pepper Street	SB	326	35	2	362	292	25	2	318	-44	-12%	2.38	✓	✓	✓
	Mobberley Road	North of Pepper Street	NB	450	39	2	490	361	38	3	401	-89	-18%	4.21	✓	✓	✓
	Chester Road	West of Rotherne Lane	NB	38	15	5	57	19	7	0	26	-32	-55%	4.91	✓	✓	✓
	A50	Crosses over A556	SB	355	56	15	428	338	58	21	417	-11	-3%	0.56	✓	✓	✓
	A50	Crosses over A556	NB	368	43	19	432	369	44	19	432	0	0%	0.01	✓	✓	✓
	A56 Lymm Road	West of Bowdon	EB	634	57	5	697	607	57	5	669	-28	-4%	1.07	✓	✓	✓
	Budworth Road	West of Pickmere Lane	EB	35	4	2	41	35	4	1	40	0	-1%	0.07	✓	✓	✓
	Budworth Road	West of Old Hall Lane	EB	21	20	1	42	21	1	0	22	-20	-48%	3.61	✓	✓	✓
	Millington Lane	North of Chester Road	EB	4	3	2	9	4	3	0	7	-1	-17%	0.52	✓	✓	✓
	Peacock Lane	West of Moss Lane	EB	67	5	0	73	9	2	1	12	-61	-84%	9.42	×	✓	✓
	A56 Lymm Road	West of Reddy Lane	EB	579	50	5	637	584	50	5	639	2	0%	0.08	✓	✓	✓
	M56 J8 to J7 EB Mainline	M56 J8 to J7 EB Mainline	EB	2,064	525	717	3,311	2,075	520	716	3,312	1	0%	0.01	✓	✓	✓
	M56 J7 EB Merge	M56 J7 EB Merge	EB	1,639	328	195	2,167	1,475	313	157	1,945	-222	-10%	4.90	✓	✓	✓
	M56 J7 EB Diverge	M56 J7 EB Diverge	EB	315	63	38	417	315	20	5	340	-77	-18%	3.96	✓	✓	✓
	M6 J7 to J6 EB Mainline	M6 J7 to J6 EB Mainline	EB	3,240	824	1,125	5,196	3,255	815	860	4,929	-268	-5%	3.76	✓	✓	✓
	B5569 Chester Road	Between Chester Road and A556 slip roads	EB	188	24	7	219	84	14	3	102	-117	-53%	9.25	×	×	×
	Chapel Lane	Between Hulseheath Lane and A5034 Chester Road	EB	43	6	1	50	0	0	0	0	-50	-100%	9.98	×	✓	✓
	A5033 Northwich Road	Between A556 and A50	EB	539	41	24	607	541	40	20	600	-6	-1%	0.25	✓	✓	✓
	Cherry Tree Lane	Between Millington Lane and Ashley Road	EB	11	2	0	13	0	0	0	0	-13	-100%	5.08	×	✓	✓

ID*	Road name	Location	Direction	Observed flow (vehicles)				Modelled flow (vehicles)				Total flow comparison					
				Cars	LGVs	HGVs	Total	Cars	LGVs	HGVs	Total	Difference	Percentage difference	GEH	GEH < 5	Flow range	GEH or flow range
	M6 East on slip	M6 S s/b entry slip, M6 S entry Southeast bound	EB	756	263	99	1,117	725	187	99	1,011	-106	-9%	3.25	✓	✓	✓
	Tabley Hill Lane 50mph	Tabley Hill Lane, Tabley Hill La Eastbound	EB	196	19	6	221	68	17	0	85	-136	-62%	11.00	×	×	×
	Pickmere Lane 50mph	B5391 Pickmere Lane, B5391 Pickmere La Eastbound	EB	81	18	12	111	132	23	11	167	55	50%	4.70	✓	✓	✓
	M6 West off slip	M6 N s/b exit slip, M6 N exit Southeast bound	EB	555	123	111	789	557	116	28	701	-88	-11%	3.23	✓	✓	✓
	West Lane	West Lane, Arm A Exit	EB	222	23	10	254	213	29	2	245	-9	-4%	0.60	✓	✓	✓
	A556 - Plumley Moor Road	Plumley Moor Road (E), Arm B Exit	EB	337	48	6	392	226	18	1	245	-147	-37%	8.22	×	×	×
	A50 - Wrenshot Lane	A50 (W), Arm C Approach	EB	423	68	18	509	402	67	18	488	-21	-4%	0.95	✓	✓	✓
	Hulseheath Lane - Chapel Lane	Chapel Lane (W), Arm C Approach	EB	72	6	1	78	0	0	0	0	-78	-100%	12.51	×	✓	✓
	Broadoak Lane - Peacock Lane	Peacock Lane (E), Arm A Exit	EB	68	7	1	75	0	0	0	0	-75	-100%	12.27	×	✓	✓
	B5162/Delahays Road	Hale Road (E), Arm B Exit	EB	589	46	21	673	592	53	0	645	-28	-4%	1.10	✓	✓	✓
	A538 Wilmslow Road/Hale Four Seasons Roundabout	A538 Wilmslow Road	EB	863	142	63	1,077	860	116	0	976	-102	-9%	3.17	✓	✓	✓
	Cicely Mill Road	Cicely Mill Lane (W) to Rostherne Lane (E)	EB	5	7	1	13	0	0	0	0	-13	-100%	5.14	×	✓	✓
	Marsh Lane	Rostherne Lane (W) to Birkinheath Lane (E)	EB	2	3	2	7	0	0	0	0	-7	-100%	3.62	✓	✓	✓
	Birkinheath Lane	Cherry Tree Lane (W) to Ashley Road (E)	EB	3	3	2	8	0	0	0	0	-8	-100%	4.00	✓	✓	✓
	A556_A5034	Arm B Mereside Road Exit	EB	562	59	11	636	493	35	0	528	-109	-17%	4.50	✓	×	✓
	A556 London Road	Arm B - A556 (E) Exit	EB	1,775	135	62	1974	1,143	121	0	1,265	-709	-36%	17.63	×	×	×
	A556 London Road	Arm D - A556 (W) Approach	EB	1,531	112	38	1,687	1,109	84	0	1,193	-494	-29%	13.03	×	×	×
	A556 A530	Arm D - A556 (W) Approach	EB	1,106	121	57	1,285	1,143	121	0	1,265	-21	-2%	0.58	✓	✓	✓
	A556 Birches Lane	Arm D - Birches Lane (W)	EB	1	4	3	7	0	0	0	0	-7	-100%	3.75	✓	✓	✓
	Ashley Road - Mobberley Road	Arm B - Back Lane (E) exit	EB	222	21	3	246	162	20	0	183	-64	-26%	4.35	✓	✓	✓
	Ashley Road - Mobberley Road	Arm D - Ashley Road (W) approach	EB	298	37	2	337	252	31	0	283	-54	-16%	3.07	✓	✓	✓
	M56 J9 EB Mainline	M56 J9 EB Mainline	EB	1,065	271	370	1,708	1,066	273	0	1,339	-369	-22%	9.46	×	×	×
	Chester Road	South of A50	NB	84	14	6	105	84	14	3	102	-3	-3%	0.32	✓	✓	✓
	Rostherne Lane	North of Ashley Road	NB	5	4	0	9	7	3	0	10	1	11%	0.33	✓	✓	✓
	Rostherne Lane	South of Chester Road	NB	3	1	1	4	7	3	0	10	6	151%	2.28	✓	✓	✓
	Agden Lane	North of Boothbank Lane	NB	23	4	1	28	23	5	0	28	0	-1%	0.07	✓	✓	✓
	Reddy Lane	North of Millington Lane	NB	23	7	1	31	23	7	0	30	0	-1%	0.03	✓	✓	✓

ID*	Road name	Location	Direction	Observed flow (vehicles)				Modelled flow (vehicles)				Total flow comparison					
				Cars	LGVs	HGVs	Total	Cars	LGVs	HGVs	Total	Difference	Percentage difference	GEH	GEH < 5	Flow range	GEH or flow range
	M6 J19 NB Mainline mid-section	M6 J19 NB Mainline mid-section	NB	1,829	465	635	2,934	1,823	465	698	2,986	52	2%	0.96	✓	✓	✓
	M56 J7 - Slip road from A556 NB to Bowdon Rbt	M56 J7 - Slip road from A556 NB to Bowdon Rbt	NB	433	87	52	573	387	60	52	498	-75	-13%	3.23	✓	✓	✓
	A556 NB mainline	Between M6 J19 and A50	NB	1,214	309	421	1,947	1,336	305	203	1,844	-103	-5%	2.36	✓	✓	✓
	M6 J20 to J19 NB Mainline	M6 J20 to J19 NB Mainline	NB	2,076	528	721	3,331	2,181	527	721	3,429	98	3%	1.69	✓	✓	✓
	A50 Hoo Green	Between Wrenshot Lane and Bucklow Hill Lane	NB	243	44	13	303	206	26	15	247	-56	-18%	3.36	✓	✓	✓
	B5391 Pickmere Lane	Between A559 Marston Lane and Budworth Road	NB	91	19	3	113	106	20	10	137	24	22%	2.18	✓	✓	✓
	Ashley Road	Between A5034 Mereside Road and Rostherne Lane	NB	218	52	7	276	225	39	6	271	-5	-2%	0.33	✓	✓	✓
	A50 Manchester Road	Between Warrington Road and Green Lane	NB	482	42	19	545	483	49	20	552	7	1%	0.31	✓	✓	✓
	A5034 Chester Road	Between Millington Hall Lane and Chapel Lane	NB	14	5	3	21	0	0	0	0	-21	-100%	6.50	×	✓	✓
	A556	A556 N Knutsford-Bowdon bypass, A556 N Northbound	NB	1,568	329	209	2,105	1,419	318	206	1,943	-162	-8%	3.60	✓	✓	✓
	A556 60mph	A556 S Chester Road, A556 S Northbound	NB	778	175	123	1,075	897	192	105	1,194	118	11%	3.52	✓	✓	✓
	A5034 Mereside Rd	A5034 Mereside Rd, Arm A Exit	NB	32	10	5	47	0	0	0	0	-47	-100%	9.64	×	✓	✓
	A50	A50, Arm B Exit	NB	246	27	15	288	255	29	17	302	15	5%	0.85	✓	✓	✓
	A50	A50, Arm C Approach	NB	324	34	16	374	324	48	16	389	15	4%	0.79	✓	✓	✓
	Thowler Lane	Back Lane (S) to Agden Lane (N)	NB	5	5	1	10	0	0	0	0	-10	-100%	4.56	✓	✓	✓
	A556 - Plumley Moor Road	A556 B5569 (N), Arm A Exit	NB	1,109	136	70	1,315	1,128	185	96	1,409	95	7%	2.56	✓	✓	✓
	A556 - Plumley Moor Road	A556 B5569 (S), Arm C Approach	NB	1,296	156	72	1,524	1,211	172	95	1,478	-47	-3%	1.21	✓	✓	✓
	A556 - Pickmere Lane	A556 (N), Arm A Exit	NB	1,141	157	98	1,397	1,013	213	117	1,343	-54	-4%	1.45	✓	✓	✓
	A556 - MossLane	Chester Road (N), Arm A Exit	NB	10	5	1	15	0	0	0	0	-15	-100%	5.39	×	✓	✓
	Halliwells Brow	Halliwell's Brow (S), Arm C Approach	NB	132	19	3	153	118	25	0	143	-10	-6%	0.80	✓	✓	✓
	Hulseheath Lane - Chapel Lane	Hulseheath Lane (S), Arm B Approach	NB	20	5	1	25	0	0	2	2	-23	-91%	6.15	×	✓	✓
	B5162/Delahays Road	Delahays Road, Arm A Exit	NB	384	34	9	429	381	33	0	414	-15	-4%	0.74	✓	✓	✓
	B5162/Delahays Road	Park Road, Arm C Approach	NB	349	16	4	372	348	19	0	367	-5	-1%	0.26	✓	✓	✓
	A556 - Cherry Tree Lane	A556 Southbound Offslip (S) to M56 North Cheshire Motorway (N)	NB	1,539	231	166	1,940	1,548	321	0	1,869	-71	-4%	1.62	✓	✓	✓
	A556_A5034	Arm D Chester Road Approach	NB	50	9	7	65	0	0	0	0	-65	-100%	11.38	×	✓	✓
	A556 London Road	Arm A - London Road (N) Exit	NB	1,015	81	17	1,129	260	18	0	278	-851	-75%	32.09	×	×	×

ID*	Road name	Location	Direction	Observed flow (vehicles)				Modelled flow (vehicles)				Total flow comparison					
				Cars	LGVs	HGVs	Total	Cars	LGVs	HGVs	Total	Difference	Percentage difference	GEH	GEH < 5	Flow range	GEH or flow range
	A556 A530	Arm C - A530 (S) Approach	NB	503	67	34	605	555	97	0	653	47	8%	1.89	✓	✓	✓
	A556 B5082	Arm B - B5082 Penny's Lane (S)	NB	321	32	9	367	320	30	0	350	-17	-5%	0.91	✓	✓	✓
	Ashley Road - Mobberley Road	Arm A - Cow Lane (N) exit	NB	486	47	3	536	445	46	0	491	-45	-8%	1.99	✓	✓	✓
	Wilmslow Road	Wilmslow Road	NB	928	45	32	1,006	929	80	0	1,009	3	0%	0.08	✓	✓	✓
	M6 J20 to J21 NB Mainline	M6 J20 to J21 NB Mainline	NB	4,353	1,107	1,511	6,983	4,296	1,098	0	5,395	-1588	-23%	20.19	×	×	×
	M6 J20 Slip Rd M56 EB M6 NB	M6 J20 Slip Rd M56 EB M6 NB	NB	2,326	466	277	3,069	2,257	459	0	2,716	-353	-12%	6.57	×	✓	✓
	Boothbank Lane	South of Reddy Lane	NEB	32	8	1	41	28	5	0	33	-8	-20%	1.38	✓	✓	✓
	A50 Warrington Road	North of Moss Lane	NWB	403	41	19	464	328	33	16	377	-88	-19%	4.27	✓	✓	✓
	Chester Road	South of A50	SB	51	14	5	70	65	14	6	84	15	21%	1.67	✓	✓	✓
	Rostherne Lane	North of Ashley Road	SB	20	6	0	26	18	6	0	24	-2	-7%	0.37	✓	✓	✓
	Rostherne Lane	South of Chester Road	SB	9	5	1	14	18	6	0	24	10	75%	2.36	✓	✓	✓
	Reddy Lane	North of Millington Lane	SB	20	5	1	25	18	5	1	24	-1	-3%	0.13	✓	✓	✓
	Agden Lane	North of Boothbank Lane	SB	29	5	1	35	28	5	0	33	-2	-7%	0.40	✓	✓	✓
	M56 J7 - Slip road from M56 WB to A556 SB	M56 J7 - Slip road from M56 WB to A556 SB	SB	1,280	256	153	1,692	1,253	210	152	1,615	-77	-5%	1.91	✓	✓	✓
	M56 J7 - slip road from Bowdon Rbt to A556 SB	M56 J7 - slip road from Bowdon Rbt to A556 SB	SB	734	147	88	971	726	131	88	945	-26	-3%	0.83	✓	✓	✓
	M6 J20 to J19 SB Mainline	M6 J20 to J19 SB Mainline	SB	2,138	543	742	3,429	2,319	564	790	3,674	245	7%	4.10	✓	✓	✓
	M6 J19 to J18 SB Mainline	M6 J19 to J18 SB Mainline	SB	2,474	629	859	3,968	2,483	634	864	3,980	12	0%	0.19	✓	✓	✓
	A50 Hoo Green	Between Wrenshot Lane and Bucklow Hill Lane	SB	415	52	23	491	440	70	22	532	41	8%	1.79	✓	✓	✓
	B5391 Pickmere Lane	Between A559 Marston Lane and Budworth Road	SB	56	13	4	73	55	28	4	87	14	19%	1.54	✓	✓	✓
	Ashley Road	Between A5034 Mereside Road and Rostherne Lane	SB	61	10	4	75	62	12	4	78	3	4%	0.32	✓	✓	✓
	A50 Manchester Road	Between Warrington Road and Green Lane	SB	476	60	24	561	522	75	29	625	64	11%	2.61	✓	✓	✓
	A5034 Chester Road	Between Millington Hall Lane and Chapel Lane	SB	500	37	15	554	493	35	11	538	-16	-3%	0.67	✓	✓	✓
	A556	A556 N Knutsford-Bowdon bypass, A556 N Southbound	SB	1,254	258	238	1,750	1,262	278	204	1,743	-7	0%	0.16	✓	✓	✓
	A556 50mph	A556 S Chester Road, A556 S Southbound	SB	909	143	117	1,169	905	144	115	1,165	-4	0%	0.11	✓	✓	✓
	Chester Road B5569	Chester Road B5569, Arm A Approach	SB	121	18	12	151	0	0	0	0	-151	-100%	17.35	×	×	×
	A5034 Mereside Rd	A5034 Mereside Rd, Arm A Approach	SB	527	51	22	605	493	35	11	538	-66	-11%	2.77	✓	✓	✓

ID*	Road name	Location	Direction	Observed flow (vehicles)				Modelled flow (vehicles)				Total flow comparison					
				Cars	LGVs	HGVs	Total	Cars	LGVs	HGVs	Total	Difference	Percentage difference	GEH	GEH < 5	Flow range	GEH or flow range
	A50	A50, Arm B Approach	SB	478	71	34	582	464	70	22	557	-25	-4%	1.05	✓	✓	✓
	A50	A50, Arm C Exit	SB	531	76	32	638	519	86	25	630	-8	-1%	0.33	✓	✓	✓
	Thowler Lane	Agden Lane (N) to Back Lane (S)	SB	5	5	1	11	0	0	0	0	-11	-100%	4.62	✓	✓	✓
	A556 - Plumley Moor Road	A556 B5569 (N), Arm A Approach	SB	989	182	89	1263	977	162	109	1248	-15	-1%	0.42	✓	✓	✓
	A556 - Plumley Moor Road	A556 B5569 (S), Arm C Exit	SB	1,059	185	92	1,340	1,038	151	110	1,299	-41	-3%	1.14	✓	✓	✓
	A556 - Pickmere Lane	A556 (N), Arm A Approach	SB	1,204	249	113	1,569	1,066	190	119	1,375	-193	-12%	5.04	×	✓	✓
	A556 - MossLane	Chester Road (N), Arm A Approach	SB	22	4	2	27	0	0	0	0	-27	-100%	7.28	×	✓	✓
	Halliwells Brow	Halliwell's Brow (S), Arm C Exit	SB	110	18	1	129	117	18	0	135	7	5%	0.57	✓	✓	✓
	Hulseheath Lane - Chapel Lane	Hulseheath Lane (S), Arm B Exit	SB	20	3	1	24	0	0	7	7	-17	-71%	4.28	✓	✓	✓
	B5162/Delahays Road	Delahays Road, Arm A Approach	SB	507	61	17	593	506	76	0	582	-11	-2%	0.45	✓	✓	✓
	A556 - Cherry Tree Lane	M56 North Cheshire Motorway (N) to A556 Southbound Offslip (S)	SB	1,469	239	143	1,859	1,709	305	0	2,014	155	8%	3.53	✓	✓	✓
	A556_A5034	Arm D Chester Road Exit	SB	55	14	7	75	0	0	0	0	-75	-100%	12.23	×	✓	✓
	A556 London Road	Arm A - London Road (N) Approach	SB	1,298	120	50	1,477	401	69	0	469	-1008	-68%	32.30	×	×	×
	A556 A530	Arm C - A530 (S) Exit	SB	478	83	53	616	471	80	0	551	-64	-10%	2.65	✓	✓	✓
	A556 B5082	Arm B - B5082 Penny's Lane (S)	SB	360	48	7	417	395	48	0	444	26	6%	1.26	✓	✓	✓
	Ashley Road - Mobberley Road	Arm A - Cow Lane (N) approach	SB	348	26	3	377	352	28	0	379	2	1%	0.12	✓	✓	✓
	Wilmslow Road	Wilmslow Road	SB	1,071	56	15	1,143	1,079	115	0	1,194	51	4%	1.49	✓	✓	✓
	M6 J21 to J20 SB Mainline	M6 J21 to J20 SB Mainline	SB	3,939	1,001	1,368	6,319	3,940	994	0	4,934	-1384	-22%	18.46	×	×	×
	B5162/Delahays Road	Park Road, Arm C Exit	SB	285	49	9	345	291	18	0	308	-37	-11%	2.03	✓	✓	✓
	A50 Warrington Road	North of Moss Lane	SEB	423	42	31	497	292	41	15	349	-148	-30%	7.20	×	×	×
	Boothbank Lane	South of Reddy Lane	SWB	23	7	1	31	23	5	0	28	-3	-11%	0.62	✓	✓	✓
	A56 Lymm Road	West of Bowdon	WB	224	41	6	272	224	40	6	269	-3	-1%	0.17	✓	✓	✓
	Budworth Road	West of Pickmere Lane	WB	66	12	3	80	65	4	2	71	-10	-12%	1.10	✓	✓	✓
	Millington Lane	North of Chester Road	WB	12	7	2	20	12	7	0	19	-1	-5%	0.24	✓	✓	✓
	Budworth Road	West of Old Hall Lane	WB	15	13	1	30	15	1	1	17	-13	-43%	2.68	✓	✓	✓
	Peacock Lane	West of Moss Lane	WB	23	3	1	27	0	3	0	3	-24	-88%	6.11	×	✓	✓
	A56 Lymm Road	West of Reddy Lane	WB	231	35	4	271	206	35	4	245	-26	-10%	1.63	✓	✓	✓
	M56 J8 WB Merge	M56 J8 WB Merge	WB	383	77	46	506	270	36	31	337	-170	-33%	8.26	×	×	×
	M56 J8 to J7 WB Mainline	M56 J8 to J7 WB Mainline	WB	1,718	437	596	2,755	1,542	399	597	2,538	-217	-8%	4.22	✓	✓	✓
	M56 J7 to J6 WB Mainline	M56 J7 to J6 WB Mainline	WB	2,448	622	850	3,927	2,909	635	755	4,298	372	9%	5.80	×	✓	✓

ID*	Road name	Location	Direction	Observed flow (vehicles)				Modelled flow (vehicles)				Total flow comparison					
				Cars	LGVs	HGVs	Total	Cars	LGVs	HGVs	Total	Difference	Percentage difference	GEH	GEH < 5	Flow range	GEH or flow range
	B5569 Chester Road	Between Chester Road and A556 slip roads	WB	79	10	8	98	65	14	6	84	-14	-14%	1.43	✓	✓	✓
	Chapel Lane	Between Hulseheath Lane and A5034 Chester Road	WB	21	3	1	26	0	0	0	0	-26	-100%	7.16	×	✓	✓
	A5033 Northwich Road	Between A556 and A50	WB	318	29	20	369	399	59	19	477	108	29%	5.24	×	×	×
	Cherry Tree Lane	Between Millington Lane and Ashley Road	WB	1	1	0	3	0	0	0	0	-3	-100%	2.35	✓	✓	✓
	M6 East off slip	M6 S n/b exit slip, M6 S exit Northwest bound	WB	1,147	164	127	1,438	918	187	124	1,229	-209	-15%	5.72	×	✓	✓
	Tabley Hill Lane 50mph	Tabley Hill Lane, Tabley Hill La Westbound	WB	20	5	3	27	2	1	2	4	-23	-85%	5.81	×	✓	✓
	Pickemere Lane 50mph	B5391 Pickmere Lane, B5391 Pickmere La Westbound	WB	111	14	5	130	111	31	5	147	17	13%	1.47	✓	✓	✓
	M6 West on slip	M6 N n/b entry slip, M6 N entry Northwest bound	WB	340	90	22	452	351	62	26	439	-13	-3%	0.61	✓	✓	✓
	West Lane	West Lane, Arm A Approach	WB	197	21	6	224	199	25	6	231	7	3%	0.44	✓	✓	✓
	A556 - Plumley Moor Road	Plumley Moor Road (E), Arm B Approach	WB	220	32	7	259	183	13	2	197	-62	-24%	4.10	✓	✓	✓
	A50 - Wrenshot Lane	A50 (W), Arm C Exit	WB	197	23	15	235	206	23	14	244	9	4%	0.56	✓	✓	✓
	Hulseheath Lane - Chapel Lane	Chapel Lane (W), Arm C Exit	WB	65	7	1	72	0	0	0	0	-72	-100%	12.02	×	✓	✓
	B5159 - Wrenshot Lane	Wrenshot Lane (E), Arm B Approach	WB	48	8	0	56	0	0	0	0	-56	-100%	10.55	×	✓	✓
	A538 Wilmslow Road/Hale Four Seasons Roundabout	A538 Wilmslow Road	WB	1,193	209	71	1,487	1,191	166	0	1,357	-130	-9%	3.43	✓	✓	✓
	Cicely Mill Road	Rostherne Lane (E) to Cicely Mill Lane (W)	WB	4	4	2	10	0	0	0	0	-10	-100%	4.41	✓	✓	✓
	Marsh Lane	Birkinheath Lane € to Rostherne Lane (W)	WB	4	4	2	9	0	0	0	0	-9	-100%	4.33	✓	✓	✓
	Birkinheath Lane	Ashley Road (E) to Cherry Tree Lane (W)	WB	10	9	2	21	0	0	0	0	-21	-100%	6.45	×	✓	✓
	A556_A5034	Arm B Mereside Road Approach	WB	117	17	3	137	0	0	0	0	-137	-100%	16.58	×	×	×
	A556 London Road	Arm B - A556 (E) Approach	WB	414	86	30	535	411	84	0	495	-40	-8%	1.78	✓	✓	✓
	A556 London Road	Arm D - A556 (W) Exit	WB	826	123	38	992	514	98	0	612	-380	-38%	13.43	×	×	×
	A556 A530	Arm D - A556 (W) Exit	WB	1,257	141	57	1,460	1,108	137	0	1,245	-215	-15%	5.84	×	✓	✓
	Ashley Road - Mobberley Road	Arm B - Back Lane (E) approach	WB	61	16	2	79	60	11	0	71	-7	-9%	0.84	✓	✓	✓
	Ashley Road - Mobberley Road	Arm D - Ashley Road (W) exit	WB	123	15	2	140	126	17	0	143	3	2%	0.22	✓	✓	✓
	M56 J9 WB Mainline	M56 J9 WB Mainline	WB	1,117	284	388	1,791	1,245	445	0	1,691	-100	-6%	2.40	✓	✓	✓
	M56 J9 Slip Rd M6 NB M56 WB	M56 J9 Slip Rd M6 NB M56 WB	WB	551	110	66	728	446	44	0	490	-237	-33%	9.61	×	×	×

ID*	Road name	Location	Direction	Observed flow (vehicles)				Modelled flow (vehicles)				Total flow comparison					
				Cars	LGVs	HGVs	Total	Cars	LGVs	HGVs	Total	Difference	Percentage difference	GEH	GEH < 5	Flow range	GEH or flow range
	Broadoak Lane - Peacock Lane	Peacock Lane (E), Arm A Approach	WB	27	3	1	31	0	0	0	0	-31	-100%	7.82	×	✓	✓
	B5162/Delahays Road	Hale Road (E), Arm B Approach	WB	657	74	21	760	655	59	0	714	-46	-6%	1.69	✓	✓	✓

**ID not defined*

Table A 2: M6 Junction 19 Model – PM peak hour – individual link flows

ID*	Road name	Location	Direction	Observed flow (vehicles)				Modelled flow (vehicles)				Total flow comparison					
				Cars	LGVs	HGVs	Total	Cars	LGVs	HGVs	Total	Difference	Percentage difference	GEH	GEH < 5	Flow range	GEH or flow range
	A50 Cliff Lane	North of Heath Lane	EB	260	17	5	283	369	32	8	409	126	45%	6.78	×	×	×
	Wrenshot Lane	South of Broadoak Lane	NB	4	1	0	5	6	2	1	9	5	101%	1.75	✓	✓	✓
	Wrenshot Lane	South of Broadoak Lane	SB	4	1	0	5	15	3	1	19	15	332%	4.32	✓	✓	✓
	Broadoak Lane	North of Wrenshot Lane	NB	3	0	0	3	6	2	1	9	7	261%	2.73	✓	✓	✓
	Broadoak Lane	North of Wrenshot Lane	SB	10	1	0	10	15	1	0	17	7	70%	1.91	✓	✓	✓
	A50	South of B5159	WB	670	49	16	734	567	49	14	631	-104	-14%	3.97	✓	✓	✓
	B5159 - West Lane	North of A50	NB	176	13	0	189	176	13	0	189	1	0%	0.05	✓	✓	✓
	A50	South of B5159	EB	263	20	5	289	323	31	8	362	73	25%	4.02	✓	✓	✓
	B5159 - West Lane	North of A50	SB	216	21	0	237	154	12	1	168	-69	-29%	4.85	✓	✓	✓
	Wrenshot Lane	South of Broadoak Lane	EB	45	2	0	48	0	2	0	2	-46	-95%	9.09	×	✓	✓
	B5159 - West Lane	East of Mowpen Brow	NB	296	18	0	314	297	18	1	316	1	0%	0.07	✓	✓	✓
	West Lane	North of Mowpen Brow	SB	344	26	1	373	297	19	1	317	-56	-15%	3.04	✓	✓	✓
	West Lane	North of Mowpen Brow	NB	366	23	0	388	303	20	2	325	-64	-16%	3.37	✓	✓	✓
	Swineyard Lane	East of Heath Lane	WB	228	24	1	252	228	14	2	243	-9	-3%	0.55	✓	✓	✓
	A50	North of Swineyard Lane	WB	579	48	18	647	567	48	17	632	-15	-2%	0.58	✓	✓	✓
	A50 Cliff Lane	North of Heath Lane	WB	599	64	14	679	540	53	15	608	-71	-10%	2.79	✓	✓	✓
	Heath Lane	West of Swineyard Lane	SB	65	6	0	71	64	6	1	71	0	0%	0.01	✓	✓	✓
	A50 Cliff Lane	North of Heath Lane	EB	286	25	8	319	304	26	7	337	18	6%	1.02	✓	✓	✓
	Swineyard Lane	East of Heath Lane	EB	85	9	2	95	85	8	0	93	-2	-3%	0.26	✓	✓	✓
	Heath Lane	West of Swineyard Lane	NB	14	6	1	21	25	6	0	31	11	53%	2.13	✓	✓	✓
	A50	North of Swineyard Lane	EB	300	24	7	332	304	26	8	338	6	2%	0.34	✓	✓	✓
	A50 Cliff Lane	North of Heath Lane	WB	569	57	18	646	515	47	15	577	-69	-11%	2.80	✓	✓	✓
	West Lane	North of Mowpen Brow	SB	312	19	2	335	312	20	1	334	-1	0%	0.08	✓	✓	✓
	A556	South of Manchester Road	SB	1,375	83	35	1,495	1,076	107	28	1,211	-284	-19%	7.71	×	×	×
	A556	South of Manchester Road	NB	876	75	50	1,002	751	63	32	847	-156	-16%	5.12	×	×	×

ID*	Road name	Location	Direction	Observed flow (vehicles)				Modelled flow (vehicles)				Total flow comparison					
				Cars	LGVs	HGVs	Total	Cars	LGVs	HGVs	Total	Difference	Percentage difference	GEH	GEH < 5	Flow range	GEH or flow range
	Station Road - Lostock Hollow - Lostock Green - Birches Lane	South of Hall Lane	NB	134	49	4	187	0	0	8	8	-179	-96%	18.11	×	×	×
	A556	North of Penny Lane	SB	1,178	93	40	1,312	1,076	107	28	1,211	-101	-8%	2.84	✓	✓	✓
	A556	North of Penny Lane	NB	1,189	90	40	1,321	751	63	40	855	-466	-35%	14.11	×	×	×
	A556	West of B5082	WB	1,654	147	35	1,838	1,562	181	34	1,778	-60	-3%	1.41	✓	✓	✓
	A556	West of B5082	EB	1,261	106	50	1,419	1,087	93	50	1,230	-189	-13%	5.19	×	✓	✓
	King Street	West of Pennys Lane	NB	603	71	9	684	591	70	21	682	-2	0%	0.08	✓	✓	✓
	King Street	West of Pennys Lane	SB	549	59	14	624	673	43	34	750	126	20%	4.81	✓	×	✓
	Warrington Road	West of Clamhunger Lane0	EB	257	10	5	273	256	15	5	276	3	1%	0.16	✓	✓	✓
	Warrington Road	West of Clamhunger Lane0	WB	724	45	11	782	799	46	11	855	73	9%	2.54	✓	✓	✓
	Clamhunger Lane	East of Warrington Road	NB	22	3	0	25	22	3	0	25	1	3%	0.14	✓	✓	✓
	Mereside Road	East of Clamhunger Lane	NB	120	6	2	128	105	6	2	112	-16	-13%	1.47	✓	✓	✓
	Mereside Road	East of Clamhunger Lane	SB	277	15	7	299	213	16	2	231	-68	-23%	4.18	✓	✓	✓
	Mereside Road	East of Clamhunger Lane	NB	195	13	3	211	152	13	2	168	-43	-20%	3.11	✓	✓	✓
	Clamhunger Lane	East of Warrington Road	SB	47	6	0	53	47	10	2	58	5	9%	0.65	✓	✓	✓
	Mereside Road	East of Clamhunger Lane	SB	389	20	6	415	337	20	2	359	-55	-13%	2.81	✓	✓	✓
	Ashley Road	East if Rostherne Lane	EB	157	5	0	162	156	17	3	177	15	9%	1.17	✓	✓	✓
	Ashley Road	East if Rostherne Lane	WB	136	6	1	142	134	21	0	155	13	9%	1.06	✓	✓	✓
	Mobberley Road	North of Pepper Street	SB	355	18	1	374	332	18	1	351	-23	-6%	1.22	✓	✓	✓
	Mobberley Road	North of Pepper Street	NB	351	23	2	375	330	23	1	354	-21	-5%	1.08	✓	✓	✓
	Chester Road	West of Rotherne Lane	NB	44	1	1	46	17	1	0	18	-28	-62%	5.02	×	✓	✓
	A50	Crosses over A556	SB	275	9	4	290	300	23	6	329	40	14%	2.26	✓	✓	✓
	A50	Crosses over A556	NB	892	64	15	972	886	52	14	951	-20	-2%	0.66	✓	✓	✓
	M6 West off slip	West of Bowdon	EB	467	41	44	551	429	42	4	475	-76	-14%	3.37	✓	✓	✓
	M6 East on slip	West of Pickmere Lane	EB	1,438	106	13	1,557	1,076	106	51	1,234	-323	-21%	8.65	×	×	×
	M56 J9 EB Mainline	West of Old Hall Lane	EB	1,251	188	303	1,743	1,256	191	0	1,446	-297	-17%	7.43	×	×	×
	M56 J7 EB Diverge	North of Chester Road	EB	467	42	21	532	479	26	6	511	-20	-4%	0.89	✓	✓	✓
	A556_A5034	West of Moss Lane	EB	273	20	1	295	276	18	0	294	-2	-1%	0.10	✓	✓	✓
	Cicely Mill Road	West of Reddy Lane	EB	3	4	1	8	0	0	0	0	-8	-100%	4.09	✓	✓	✓
	Cherry Tree Lane	M56 J8 to J7 EB Mainline	EB	9	2	0	11	0	0	0	0	-11	-100%	4.60	✓	✓	✓
	Millington Lane	M56 J7 EB Merge	EB	13	0	0	13	1	1	0	2	-11	-86%	4.01	✓	✓	✓
	Broadoak Lane - Peacock Lane	M56 J7 EB Diverge	EB	24	0	0	25	0	0	0	0	-25	-100%	6.99	×	✓	✓
	A50 - Wrenshot Lane	M6 J7 to J6 EB Mainline	EB	286	22	5	314	246	22	5	272	-41	-13%	2.40	✓	✓	✓
	West Lane	Between Chester Road and A556 slip roads	EB	264	17	5	286	242	16	0	258	-28	-10%	1.71	✓	✓	✓
	Peacock Lane	Between Hulseheath Lane and A5034 Chester Road	EB	20	1	0	23	15	1	0	17	-5	-24%	1.23	✓	✓	✓
	A56 Lymm Road	Between A556 and A50	EB	238	18	2	259	248	35	2	284	25	10%	1.53	✓	✓	✓

ID*	Road name	Location	Direction	Observed flow (vehicles)				Modelled flow (vehicles)				Total flow comparison					
				Cars	LGVs	HGVs	Total	Cars	LGVs	HGVs	Total	Difference	Percentage difference	GEH	GEH < 5	Flow range	GEH or flow range
	A56 Lymm Road	Between Millington Lane and Ashley Road	EB	231	29	2	262	231	29	1	261	-1	0%	0.04	✓	✓	✓
	B5162/Delahays Road	M6 S s/b entry slip, M6 S entry Southeast bound	EB	569	29	4	605	590	33	0	623	18	3%	0.71	✓	✓	✓
	Tabley Hill Lane 50mph	Tabley Hill Lane, Tabley Hill La Eastbound	EB	49	4	1	54	61	6	0	67	13	23%	1.62	✓	✓	✓
	A5033 Northwich Road	B5391 Pickmere Lane, B5391 Pickmere La Eastbound	EB	376	27	6	409	366	20	4	391	-18	-4%	0.92	✓	✓	✓
	Pickemere Lane 50mph	M6 N s/b exit slip, M6 N exit Southeast bound	EB	185	15	6	207	79	15	1	95	-111	-54%	9.08	×	×	×
	Budworth Road	West Lane, Arm A Exit	EB	39	2	0	40	40	2	0	42	2	5%	0.29	✓	✓	✓
	Budworth Road	Plumley Moor Road (E), Arm B Exit	EB	14	8	1	24	14	0	0	14	-9	-39%	2.12	✓	✓	✓
	M56 J8 to J7 EB Mainline	A50 (W), Arm C Approach	EB	2,191	330	530	3,052	2,209	335	619	3,162	110	4%	1.97	✓	✓	✓
	A556 - Plumley Moor Road	Chapel Lane (W), Arm C Approach	EB	186	16	1	203	180	15	1	196	-7	-4%	0.52	✓	✓	✓
	A556 Birches Lane	Peacock Lane (E), Arm A Exit	EB	1	1	0	2	0	0	0	0	-2	-100%	1.73	✓	✓	✓
	A556 A530	Hale Road (E), Arm B Exit	EB	1,158	81	33	1,272	950	101	0	1,051	-221	-17%	6.50	×	×	×
	A556 London Road	A538 Wilmslow Road	EB	902	111	25	1,040	950	101	0	1,051	11	1%	0.33	✓	✓	✓
	A556 London Road	Cicely Mill Lane (W) to Rostherne Lane (E)	EB	984	106	18	1,108	992	105	0	1,096	-12	-1%	0.35	✓	✓	✓
	M6 J7 to J6 EB Mainline	Rostherne Lane (W) to Birkinheath Lane (E)	EB	2,998	450	725	4,176	3,010	439	678	4,127	-49	-1%	0.76	✓	✓	✓
	A538 Wilmslow Road/Hale Four Seasons Roundabout	Cherry Tree Lane (W) to Ashley Road (E)	EB	937	82	22	1,044	669	57	0	726	-318	-30%	10.70	×	×	×
	Ashley Road - Mobberley Road	Arm B Mereside Road Exit	EB	208	17	0	225	156	17	0	173	-51	-23%	3.64	✓	✓	✓
	Marsh Lane	Arm B - A556 (E) Exit	EB	2	1	1	4	0	0	0	0	-4	-100%	2.98	✓	✓	✓
	Birkinheath Lane	Arm D - A556 (W) Approach	EB	3	3	1	7	0	0	0	0	-7	-100%	3.73	✓	✓	✓
	Ashley Road - Mobberley Road	Arm D - A556 (W) Approach	EB	113	10	2	124	46	9	0	54	-70	-56%	7.43	×	✓	✓
	Hulseheath Lane - Chapel Lane	Arm D - Birches Lane (W)	EB	72	6	1	78	0	0	0	0	-78	-100%	12.51	×	✓	✓
	B5569 Chester Road	Arm B - Back Lane (E) exit	EB	90	11	3	104	122	9	3	135	32	31%	2.92	✓	✓	✓
	M56 J7 EB Merge	Arm D - Ashley Road (W) approach	EB	1,595	145	71	1,816	1,263	131	73	1,467	-350	-19%	8.63	×	×	×
	Chapel Lane	M56 J9 EB Mainline	EB	16	2	0	18	0	0	0	0	-18	-100%	6.04	×	✓	✓
	M6 J19 NB Mainline mid-section	South of A50	NB	1,715	257	414	2,388	1,738	273	488	2,499	110	5%	2.23	✓	✓	✓
	M6 J20 to J19 NB Mainline	North of Ashley Road	NB	2,065	310	499	2,876	2,069	311	500	2,881	5	0%	0.09	✓	✓	✓
	M6 J20 Slip Rd M56 EB M6 NB	South of Chester Road	NB	2,303	210	103	2,616	2,335	208	0	2,543	-73	-3%	1.44	✓	✓	✓
	M6 J20 to J21 NB Mainline	North of Boothbank Lane	NB	4,741	712	1,147	6,605	4,735	707	0	5,441	-1,164	-18%	14.99	×	×	×
	A5034 Chester Road	North of Millington Lane	NB	15	3	0	18	0	0	0	0	-18	-100%	6.04	×	✓	✓
	A556_A5034	M6 J19 NB Mainline mid-section	NB	33	2	1	35	0	0	0	0	-35	-100%	8.38	×	✓	✓

ID*	Road name	Location	Direction	Observed flow (vehicles)				Modelled flow (vehicles)				Total flow comparison					
				Cars	LGVs	HGVs	Total	Cars	LGVs	HGVs	Total	Difference	Percentage difference	GEH	GEH < 5	Flow range	GEH or flow range
	Reddy Lane	M56 J7 - Slip road from A556 NB to Bowdon Rbt	NB	22	6	1	28	17	6	0	23	-5	-17%	0.91	✓	✓	✓
	A50 Hoo Green	Between M6 J19 and A50	NB	480	47	10	538	589	53	15	656	118	22%	4.83	✓	×	✓
	Hulseheath Lane - Chapel Lane	M6 J20 to J19 NB Mainline	NB	4	1	0	5	0	0	1	1	-3	-74%	1.99	✓	✓	✓
	Thowler Lane	Between Wrenshot Lane and Bucklow Hill Lane	NB	3	6	1	10	60	5	0	65	55	527%	8.90	×	✓	✓
	A50	Between A559 Marston Lane and Budworth Road	NB	738	64	20	821	743	63	14	820	-1	0%	0.04	✓	✓	✓
	A50	Between A5034 Mereside Road and Rostherne Lane	NB	609	62	20	691	795	62	19	876	185	27%	6.61	×	×	×
	Agden Lane	Between Warrington Road and Green Lane	NB	79	1	0	80	85	8	0	93	12	15%	1.32	✓	✓	✓
	B5162/Delahays Road	Between Millington Hall Lane and Chapel Lane	NB	358	24	5	388	357	21	0	378	-10	-3%	0.52	✓	✓	✓
	B5162/Delahays Road	A556 N Knutsford-Bowdon bypass, A556 N Northbound	NB	559	32	11	602	565	33	0	598	-4	-1%	0.18	✓	✓	✓
	A556 - Pickmere Lane	A556 S Chester Road, A556 S Northbound	NB	1,005	111	53	1,171	866	108	58	1,032	-140	-12%	4.21	✓	✓	✓
	A556 60mph	A5034 Mereside Rd, Arm A Exit	NB	978	107	87	1,173	827	94	57	977	-196	-17%	5.96	×	×	×
	Halliwells Brow	A50, Arm B Exit	NB	136	12	1	148	161	12	0	173	26	17%	2.02	✓	✓	✓
	B5391 Pickmere Lane	A50, Arm C Approach	NB	51	12	1	65	51	14	1	65	1	1%	0.09	✓	✓	✓
	A556 - Plumley Moor Road	Back Lane (S) to Agden Lane (N)	NB	935	94	50	1,081	821	87	50	958	-123	-11%	3.86	✓	✓	✓
	A556 London Road	A556 B5569 (N), Arm A Exit	NB	1,015	67	2	1,088	364	43	0	407	-681	-63%	24.93	×	×	×
	A556 B5082	A556 B5569 (S), Arm C Approach	NB	329	30	2	361	484	77	0	561	201	56%	9.34	×	×	×
	A556 A530	A556 (N), Arm A Exit	NB	670	75	33	779	538	30	0	568	-211	-27%	8.13	×	×	×
	A556 - Plumley Moor Road	Chester Road (N), Arm A Exit	NB	1,025	98	49	1,174	893	84	49	1,025	-149	-13%	4.50	✓	✓	✓
	A556 - MossLane	Halliwell's Brow (S), Arm C Approach	NB	32	0	1	33	0	0	0	0	-33	-100%	8.06	×	✓	✓
	Ashley Road	Hulseheath Lane (S), Arm B Approach	NB	68	16	1	85	115	11	2	128	43	51%	4.18	✓	✓	✓
	A5034 Mereside Rd	Delahays Road, Arm A Exit	NB	101	10	1	113	60	5	0	65	-48	-42%	5.06	×	✓	✓
	Rostherne Lane	Park Road, Arm C Approach	NB	5	2	0	7	6	1	0	7	0	7%	0.17	✓	✓	✓
	Rostherne Lane	A556 Southbound Offslip (S) to M56 North Cheshire Motorway (N)	NB	6	1	1	7	6	1	0	7	0	-1%	0.02	✓	✓	✓
	Ashley Road - Mobberley Road	Arm D Chester Road Approach	NB	417	29	0	446	422	29	0	451	5	1%	0.24	✓	✓	✓
	A50 Manchester Road	Arm A - London Road (N) Exit	NB	762	35	8	807	856	41	11	909	102	13%	3.49	✓	✓	✓
	Chester Road	Arm C - A530 (S) Approach	NB	126	7	4	139	122	9	3	135	-3	-2%	0.28	✓	✓	✓

ID*	Road name	Location	Direction	Observed flow (vehicles)				Modelled flow (vehicles)				Total flow comparison					
				Cars	LGVs	HGVs	Total	Cars	LGVs	HGVs	Total	Difference	Percentage difference	GEH	GEH < 5	Flow range	GEH or flow range
	Wilmslow Road	Arm B - B5082 Penny's Lane (S)	NB	929	41	37	1,006	935	76	0	1,012	5	1%	0.16	✓	✓	✓
	A556	Arm A - Cow Lane (N) exit	NB	1,768	158	102	2,028	1,555	160	102	1,817	-210	-10%	4.80	✓	✓	✓
	A556 NB mainline	Wilmslow Road	NB	1,229	184	297	1,712	1,433	150	99	1,682	-30	-2%	0.73	✓	✓	✓
	A556 - Cherry Tree Lane	M6 J20 to J21 NB Mainline	NB	1,762	94	94	1,956	1,776	163	0	1,940	-16	-1%	0.36	✓	✓	✓
	M56 J7 - Slip road from A556 NB to Bowdon Rbt	M6 J20 Slip Rd M56 EB M6 NB	NB	649	59	29	739	620	59	28	707	-32	-4%	1.19	✓	✓	✓
	Boothbank Lane	South of Reddy Lane	NEB	11	2	0	13	12	2	0	14	1	10%	0.34	✓	✓	✓
	A50 Warrington Road	North of Moss Lane	NWB	798	49	14	861	752	36	9	797	-64	-7%	2.23	✓	✓	✓
	A556 - Pickmere Lane	South of A50	SB	1,459	139	47	1,647	1,341	143	47	1,532	-116	-7%	2.90	✓	✓	✓
	M6 J19 to J18 SB Mainline	North of Ashley Road	SB	2,915	438	705	4,062	2,931	434	707	4,071	9	0%	0.15	✓	✓	✓
	M6 J20 to J19 SB Mainline	South of Chester Road	SB	2,331	350	564	3,249	2,270	369	666	3,305	56	2%	0.98	✓	✓	✓
	M6 J21 to J20 SB Mainline	North of Millington Lane	SB	4,700	706	1,137	6,548	4,710	705	0	5,415	-1,133	-17%	14.65	×	×	×
	A556_A5034	North of Boothbank Lane	SB	90	8	2	100	0	0	0	0	-100	-100%	14.13	×	✓	✓
	A5034 Chester Road	M56 J7 - Slip road from M56 WB to A556 SB	SB	318	23	3	344	276	18	2	295	-49	-14%	2.72	✓	✓	✓
	Rostherne Lane	M56 J7 - slip road from Bowdon Rbt to A556 SB	SB	3	0	0	3	10	2	0	12	9	291%	3.22	✓	✓	✓
	A50 Hoo Green	M6 J20 to J19 SB Mainline	SB	264	31	5	301	261	25	5	292	-9	-3%	0.50	✓	✓	✓
	Hulseheath Lane - Chapel Lane	M6 J19 to J18 SB Mainline	SB	28	5	0	32	0	0	4	4	-28	-86%	6.48	×	✓	✓
	Halliwells Brow	Between Wrenshot Lane and Bucklow Hill Lane	SB	229	23	1	253	234	21	0	255	2	1%	0.15	✓	✓	✓
	A50	Between A559 Marston Lane and Budworth Road	SB	417	25	11	452	478	43	9	530	78	17%	3.51	✓	✓	✓
	A50	Between A5034 Mereside Road and Rostherne Lane	SB	342	25	11	377	389	33	8	431	54	14%	2.66	✓	✓	✓
	Reddy Lane	Between Warrington Road and Green Lane	SB	13	4	1	17	13	1	0	15	-2	-13%	0.57	✓	✓	✓
	Agden Lane	Between Millington Hall Lane and Chapel Lane	SB	15	3	0	18	12	2	0	14	-4	-21%	0.94	✓	✓	✓
	Thowler Lane	A556 N Knutsford-Bowdon bypass, A556 N Southbound	SB	4	3	1	8	0	0	0	0	-8	-100%	3.89	✓	✓	✓
	Ashley Road - Mobberley Road	A556 S Chester Road, A556 S Southbound	SB	375	26	0	400	369	24	0	393	-7	-2%	0.37	✓	✓	✓
	B5162 / Delahays Road	Chester Road B5569, Arm A Approach	SB	432	26	6	464	431	27	0	458	-6	-1%	0.26	✓	✓	✓
	Wilmslow Road	A5034 Mereside Rd, Arm A Approach	SB	1,138	32	6	1,176	1,131	41	0	1,172	-5	0%	0.14	✓	✓	✓
	A556 50MPH	A50, Arm B Approach	SB	1,011	107	52	1,170	876	130	46	1,051	-119	-10%	3.57	✓	✓	✓
	A556 - Plumley Moor Road	A50, Arm C Exit	SB	1,480	121	37	1,639	1,350	138	44	1,532	-108	-7%	2.71	✓	✓	✓
	B5391 Pickmere Lane	Agden Lane (N) to Back Lane (S)	SB	154	18	1	173	427	6	1	434	260	150%	14.94	×	×	×

ID*	Road name	Location	Direction	Observed flow (vehicles)				Modelled flow (vehicles)				Total flow comparison					
				Cars	LGVs	HGVs	Total	Cars	LGVs	HGVs	Total	Difference	Percentage difference	GEH	GEH < 5	Flow range	GEH or flow range
	A556 - Plumley Moor Road	A556 B5569 (N), Arm A Approach	SB	1,757	143	38	1,939	1,247	126	42	1,414	-525	-27%	12.83	×	×	×
	A556 B5082	A556 B5569 (S), Arm C Exit	SB	262	20	2	283	336	30	0	365	82	29%	4.55	✓	✓	✓
	A556 A530	A556 (N), Arm A Approach	SB	728	69	28	827	696	73	0	768	-58	-7%	2.07	✓	✓	✓
	A556 London Road	Chester Road (N), Arm A Approach	SB	1,057	80	12	1,155	392	56	0	448	-708	-61%	25.00	×	×	×
	Chester Road	Halliwell's Brow (S), Arm C Exit	SB	81	9	2	92	79	12	2	93	1	1%	0.10	✓	✓	✓
	A50 Manchester Road	Hulseheath Lane (S), Arm B Exit	SB	431	39	6	476	447	28	7	481	5	1%	0.23	✓	✓	✓
	Ashley Road	Delahays Road, Arm A Approach	SB	112	12	1	125	108	12	2	122	-3	-2%	0.25	✓	✓	✓
	Rostherne Lane	M56 North Cheshire Motorway (N) to A556 Southbound Offslip (S)	SB	7	2	0	9	10	2	0	12	3	30%	0.85	✓	✓	✓
	A5034 Mereside Rd	Arm D Chester Road Exit	SB	268	14	3	285	276	18	2	295	11	4%	0.64	✓	✓	✓
	A556 – Moss Lane	Arm A - London Road (N) Approach	SB	10	1	1	12	0	0	0	0	-12	-100%	4.80	✓	✓	✓
	A556	Arm C - A530 (S) Exit	SB	1,825	218	129	2,172	1,827	203	94	2,125	-47	-2%	1.02	✓	✓	✓
	A556 - Cherry Tree Lane	Arm B - B5082 Penny's Lane (S)	SB	1,829	59	87	1,978	2,044	210	0	2,254	277	14%	6.02	×	✓	✓
	M56 J7 - Slip road from M56 WB to A556 SB	Arm A - Cow Lane (N) approach	SB	1,564	143	70	1,782	1,476	143	70	1,689	-92	-5%	2.22	✓	✓	✓
	M56 J7 - slip road from Bowdon Rbt to A556 SB	Wilmslow Road	SB	1,019	93	45	1,160	1,021	92	48	1,161	1	0%	0.02	✓	✓	✓
	Chester Road B5569	M6 J21 to J20 SB Mainline	SB	179	11	2	192	0	0	0	0	-192	-100%	19.59	×	×	×
	B5162/Delahays Road	Park Road, Arm C Exit	SB	278	13	5	296	296	13	0	310	14	5%	0.78	✓	✓	✓
	A50 Warrington Road	North of Moss Lane	SEB	259	12	7	278	234	12	4	251	-27	-10%	1.69	✓	✓	✓
	Boothbank Lane	South of Reddy Lane	SWB	100	3	0	103	25	3	0	28	-76	-73%	9.36	×	✓	✓
	M6 East off slip	West of Bowdon	WB	1,091	100	54	1,245	1,200	98	55	1,353	108	9%	3.00	✓	✓	✓
	M56 J9 WB Mainline	West of Pickmere Lane	WB	1,708	257	413	2,380	2,157	310	0	2,467	87	4%	1.77	✓	✓	✓
	M56 J9 Slip Rd M6 NB M56 WB	North of Chester Road	WB	547	50	24	622	480	50	0	531	-91	-15%	3.80	✓	✓	✓
	M56 J8 to J7 WB Mainline	West of Old Hall Lane	WB	2,536	381	614	3,534	1,678	354	612	2,645	-889	-25%	15.99	×	×	×
	Chapel Lane	West of Moss Lane	WB	54	5	0	59	60	5	0	65	6	10%	0.73	✓	✓	✓
	A56 Lymm Road	West of Reddy Lane	WB	629	30	3	664	631	32	3	666	3	0%	0.11	✓	✓	✓
	A556_A5034	M56 J8 WB Merge	WB	116	15	1	131	60	5	0	65	-66	-50%	6.68	×	✓	✓
	Millington Lane	M56 J8 to J7 WB Mainline	WB	14	1	0	14	21	2	0	24	10	68%	2.20	✓	✓	✓
	A50 - Wrenshot Lane	M56 J7 to J6 WB Mainline	WB	739	49	13	801	583	51	14	647	-154	-19%	5.72	×	×	×
	Hulseheath Lane - Chapel Lane	Between Chester Road and A556 slip roads	WB	89	6	0	95	60	5	0	65	-30	-32%	3.35	✓	✓	✓

ID*	Road name	Location	Direction	Observed flow (vehicles)				Modelled flow (vehicles)				Total flow comparison					
				Cars	LGVs	HGVs	Total	Cars	LGVs	HGVs	Total	Difference	Percentage difference	GEH	GEH < 5	Flow range	GEH or flow range
	B5159 - Wrenshot Lane	Between Hulseheath Lane and A5034 Chester Road	WB	31	3	0	34	0	0	0	0	-34	-100%	8.20	×	✓	✓
	Peacock Lane	Between A556 and A50	WB	131	11	0	142	6	2	1	9	-133	-94%	15.28	×	×	×
	West Lane	Between Millington Lane and Ashley Road	WB	210	15	6	231	383	24	6	413	182	79%	10.16	×	×	×
	A56 Lymm Road	M6 S n/b exit slip, M6 S exit Northwest bound	WB	612	38	3	655	618	31	3	652	-4	-1%	0.14	✓	✓	✓
	Pickemere Lane 50mph	Tabley Hill Lane, Tabley Hill La Westbound	WB	84	7	2	92	480	9	2	491	398	431%	23.32	×	×	×
	Budworth Road	B5391 Pickmere Lane, B5391 Pickmere La Westbound	WB	63	4	1	68	65	4	1	69	2	3%	0.21	✓	✓	✓
	Budworth Road	M6 N n/b entry slip, M6 N entry Northwest bound	WB	52	28	3	83	53	3	0	56	-27	-33%	3.27	✓	✓	✓
	M56 J7 to J6 WB Mainline	West Lane, Arm A Approach	WB	3,421	514	828	4,767	3,417	508	685	4,610	-157	-3%	2.29	✓	✓	✓
	A556 A530	Plumley Moor Road (E), Arm B Approach	WB	1,405	118	29	1,554	1,428	114	0	1,542	-12	-1%	0.30	✓	✓	✓
	A556 London Road	A50 (W), Arm C Exit	WB	1,468	84	12	1,564	912	67	0	979	-585	-37%	16.42	×	×	×
	A556 London Road	Chapel Lane (W), Arm C Exit	WB	1,524	86	15	1,627	979	85	0	1,065	-562	-35%	15.33	×	×	×
	A538 Wilmslow Road/Hale Four Seasons Roundabout	Wrenshot Lane (E), Arm B Approach	WB	1,327	99	18	1,455	1,333	100	0	1,433	-22	-2%	0.58	✓	✓	✓
	M6 West on slip	A538 Wilmslow Road	WB	472	39	2	513	333	39	11	383	-130	-25%	6.16	×	×	×
	Birkinheath Lane	Rostherne Lane (E) to Cicely Mill Lane (W)	WB	14	8	2	23	8	1	0	9	-15	-62%	3.64	✓	✓	✓
	Cicely Mill Road	Birkinheath Lane € to Rostherne Lane (W)	WB	4	4	1	9	0	0	0	0	-9	-100%	4.25	✓	✓	✓
	Cherry Tree Lane	Ashley Road (E) to Cherry Tree Lane (W)	WB	3	1	0	5	8	1	0	9	4	84%	1.55	✓	✓	✓
	Marsh Lane	Arm B Mereside Road Approach	WB	5	3	1	10	0	0	0	0	-10	-100%	4.40	✓	✓	✓
	Ashley Road - Mobberley Road	Arm B - A556 (E) Approach	WB	238	24	0	262	141	22	0	163	-99	-38%	6.76	×	✓	✓
	Tabley Hill Lane 50mph	Arm D - A556 (W) Exit	WB	58	6	3	66	37	1	0	39	-27	-42%	3.79	✓	✓	✓
	A5033 Northwich Road	Arm D - A556 (W) Exit	WB	631	28	8	667	1,072	35	8	1,116	448	67%	15.02	×	×	×
	A556 - Plumley Moor Road	Arm B - Back Lane (E) approach	WB	373	35	3	410	220	4	0	225	-185	-45%	10.40	×	×	×
	B5569 Chester Road	Arm D - Ashley Road (W) exit	WB	138	12	3	154	79	12	2	93	-61	-40%	5.51	×	✓	✓
	Ashley Road - Mobberley Road	M56 J9 WB Mainline	WB	191	15	1	206	85	14	0	99	-107	-52%	8.68	×	×	×
	M56 J8 WB Merge	M56 J9 Slip Rd M6 NB M56 WB	WB	476	43	21	542	453	24	24	501	-40	-7%	1.77	✓	✓	✓
	Broadoak Lane - Peacock Lane	Peacock Lane (E), Arm A Approach	WB	144	10	0	154	0	0	0	0	-154	-100%	17.52	×	×	×
	B5162 / Delahays Road	Hale Road (E), Arm B Approach	WB	692	32	10	736	692	34	0	725	-11	-1%	0.40	✓	✓	✓

Annex E: Model performance report – Winsford and Middlewich Model

Contents

Tables

Figures

1 Introduction

1.1 Background information

1.1.1 This report provides documentation of the model performance review that has been carried out for the Winsford and Middlewich Model.

1.1.2 The local authority, Cheshire West and Chester Council (CWaC) released to HS2 Ltd copies of the latest available Winsford and Middlewich Model versions as of January 2019.

1.1.3 The Winsford and Middlewich Model has subsequently been updated by HS2 Ltd transport consultants, Mott MacDonald WSP Joint Venture (MWJV), to include localised improvements within the Proposed Scheme area of interest.

1.1.4 The purpose of this report is to provide evidence that this highway assignment model is suitable to support the Transport Assessment (TA) of the Proposed Scheme.

1.1.5 For the Proposed Scheme TA, the route is split into a number of geographical areas referred to as community areas (CA). The Winsford and Middlewich Model has been utilised to provide an evidence base for the Proposed Scheme TA for the CA referred to as MA02.

1.1.6 Reference should be made to Figure 1 which shows the geographic coverage of strategic transport models that have been utilised for the Proposed Scheme TA.

1.2 Model framework

1.2.1 The Winsford and Middlewich Model is a strategic highway assignment model that has been developed within the SATURN model software platform (version 11.3.1oe).

1.2.2 The detailed modelled study area for the Winsford and Middlewich Model covers Winsford, Middlewich and surrounding areas; and has supporting network and zone system detail to provide representation of external area supply and demand. Reference should be made to Figure 2.

1.2.3 The Winsford and Middlewich Model is representative of 2014 base year transport conditions.

1.3 Model development

1.3.1 The Winsford and Middlewich Model has been developed by CWaC's appointed transport consultants to provide an evidence base to support the Winsford Transport Strategy study.

1.4 Model description

1.4.1 The Winsford and Middlewich Model has been developed for the following years:

- 2014 base year; and
- 2030 future year.

1.4.2 The model is representative of the following time periods:

- AM peak hour – 07:45–08:45;
- average inter peak hour – 10:00–16:00; and
- PM peak hour – 17:00–18:00.

1.4.3 The model is comprised of the following demand user-classes:

- car commute;
- car employers business;
- car other;
- light goods vehicles; and
- other goods vehicles.

1.5 Model application objectives

1.5.1 For the assessment of the Proposed Scheme, the Winsford and Middlewich highway assignment Model will:

- provide preliminary traffic data to inform scheme design;
- provide traffic data for the construction and operational phases of the Proposed Scheme on which to base the assessment of significant effects for the Environmental Statement;
- provide changes in traffic flows, congestion, and journey times to inform the TA for the Proposed Scheme; and
- provide changes in traffic flows between the base year and forecast scenarios for application to local models.

1.5.2 The model will be used primarily to assess the likely impacts of HS2 construction and operational traffic in order to provide an evidence base for the Proposed Scheme TA.

Figure 1: Strategic transport model coverage for the Proposed Scheme Transport Assessment

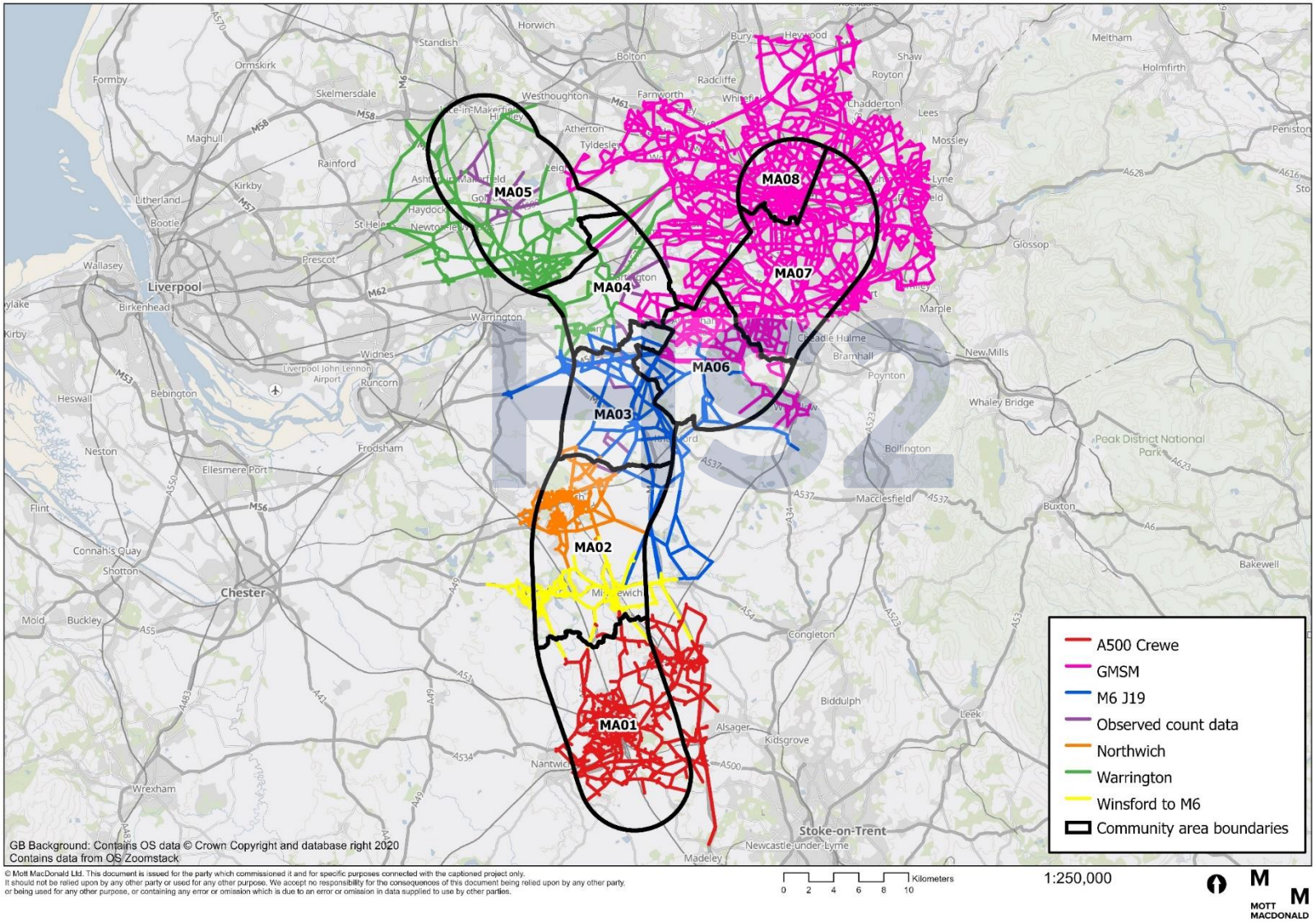
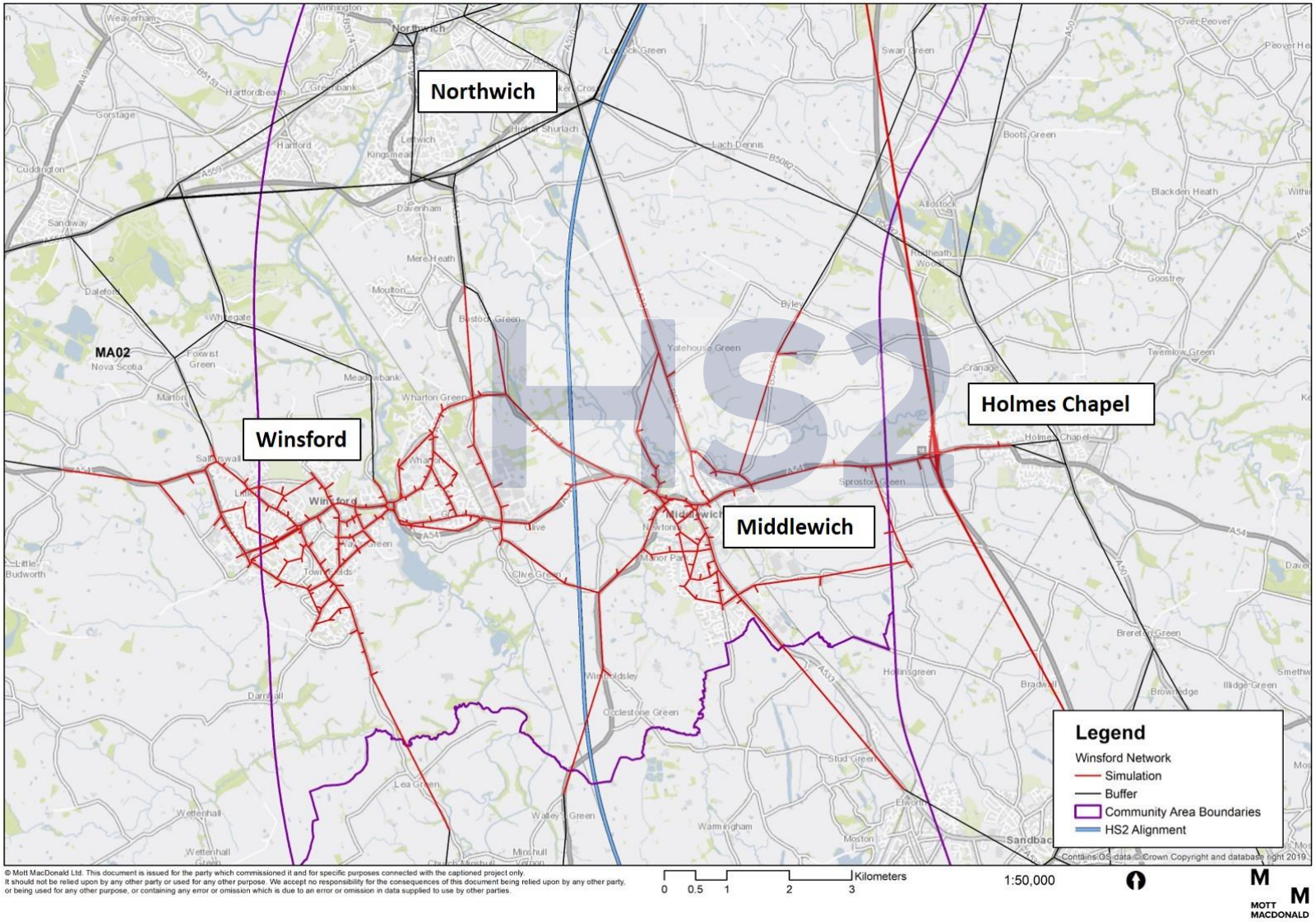


Figure 2: Model study area



2 Guidance used

2.1 Introduction

2.1.1 The strategic highway model development makes reference to the following Transport Analysis Guidance as published by the Department for Transport (DfT): TAG Unit M3.1 Highway Assignment Modelling (May 2020).

2.2 Highway model guidance

2.2.1 In relation to providing an assessment of model calibration and validation performance, reference has been made to Section 3.2 of TAG Unit M3.1 (Table 1, Table 2, and Table 3).

2.2.2 The criteria for the assessment of model calibration and validation of traffic flows and journey time performance is presented in Table 1.

Table 1: DfT – TAG validation criteria

Criteria	Acceptability guideline
Assigned hourly flows	
Individual flows within +/-15% for flows 700-2,700 vph	>85% of cases
Individual flows within +/-100 vph for flows <700 vph	>85% of cases
Individual flows within +/-400 vph for flows >2,700 vph	>85% of cases
Screenline flows (normally >5 links) to be within 5%	All or nearly all screenlines
GEH statistic	
Individual flows GEH <5	>85% of cases
Screenline totals GEH <4	All or nearly all screenlines
Journey times	
Modelled journey times within 15% (or 1 minute if higher)	>85% of cases

Source: Table 1, Table 2, Table 3, DfT TAG Unit M3.1 Highway Assignment Modelling (May 2020)

2.2.1 The criteria for the assessment of highway model assignment convergence is presented in Table 2.

Table 2: Summary of convergence measures and base model acceptable values

Measures of convergence	Acceptability guidelines
Delta and %GAP	Less than 0.1% or at least stable with convergence fully documented and all other criteria met
Percentage of links with flow change (P) <1%	Four consecutive iterations greater than 98%
Percentage of links with cost change (P2) <1%	Four consecutive iterations greater than 98%
Percentage change in total user costs of links with flow change (V) <1%	Four consecutive iterations less than 0.1% (SUE only)

Source: Table 4, DfT TAG Unit M3.1 Highway Assignment Modelling (May 2020)

3 Data for model development

3.1 Overview

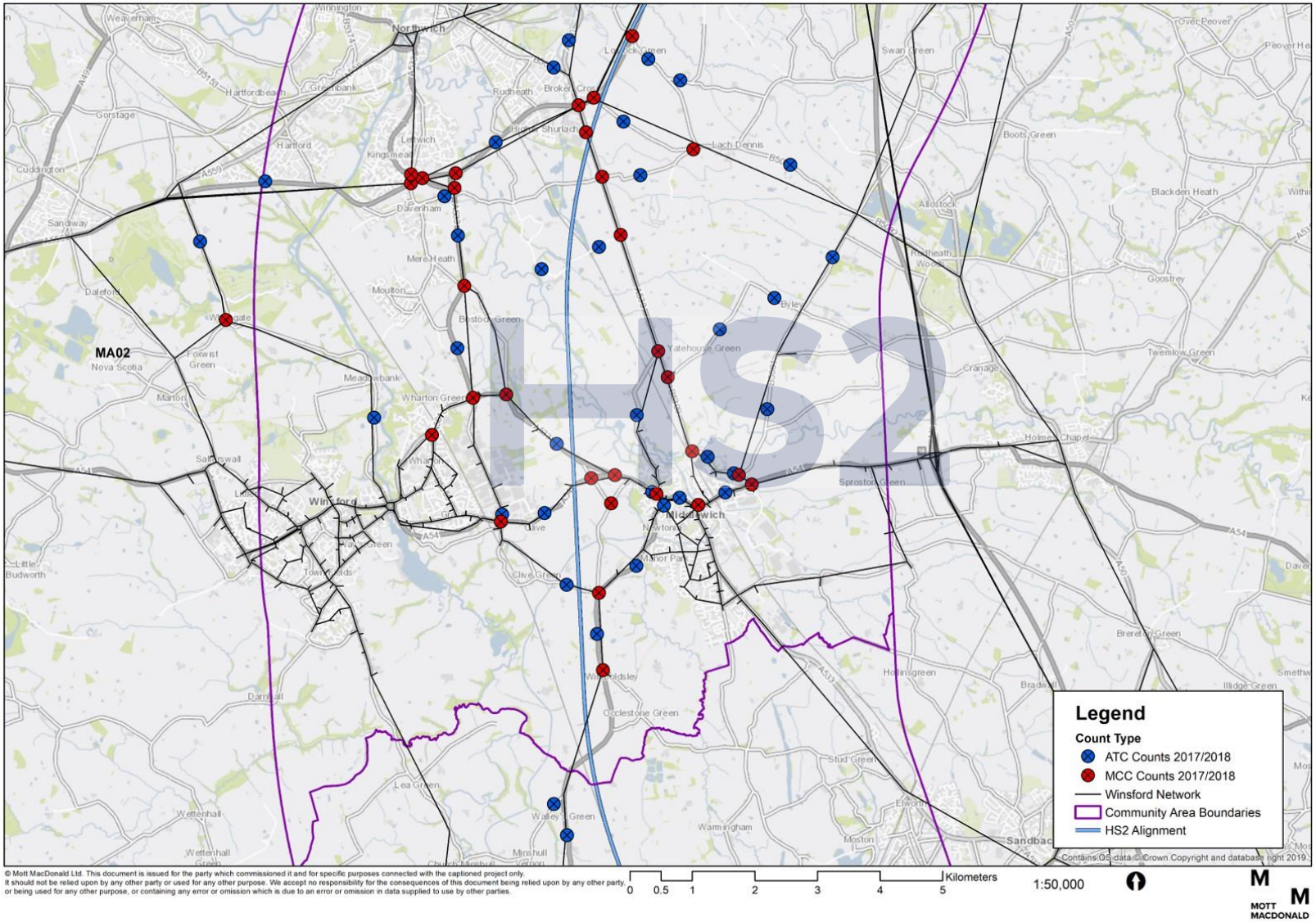
3.1.1 This section of the report presents details of traffic survey data that has been collected for the purpose of calibrating the Winsford and Middlewich Model.

3.2 Traffic survey data commission

3.2.1 MWJV commissioned a programme of traffic count surveys in 2017/2018 to support the Proposed Scheme TA.

3.2.2 Traffic count surveys have been used from different years and months to update the base year model. The traffic counts have been factored to June 2018 to develop a consistent dataset. Figure 3 shows the location of traffic count surveys.

Figure 3: Location of traffic counts



4 Model development

4.1 Overview

4.1.1 A review of base year model traffic flows identified that there was scope to undertake some localised improvements to the traffic model in order to provide a more robust assessment in the Proposed Scheme area of interest.

4.1.2 The 2017 base year model has been updated to a 2018 (June) base year model by MWJV using traffic count survey data that was collected between November 2017 and March 2020 (prior to COVID-19). Traffic count data has been normalised to June 2018 traffic conditions using local count data.

4.1.3 This localised model update has focused on the improvement to the validation of traffic flows covering the Proposed Scheme area of interest, and no changes to journey time validation have been undertaken.

4.1.4 The model time periods represent the following peak hours for the Proposed Scheme TA:

- AM peak hour – 08:00–09:00; and
- PM peak hour – 17:00–18:00.

4.1.5 The AM peak hour (08:00–09:00) for the Proposed Scheme assessment is different to the original AM model time period (07:45–08:45), and therefore an adjustment was made to the model using local traffic count data.

4.2 Transport supply

4.2.1 A review of the highway network detail and attributes has been completed for the modelled area that is included in the Wimboldsley to Lostock Gralam area (MA02).

4.2.2 Following the review, network coding changes were implemented at a number of roundabout junctions in the model simulation area covering the Proposed Scheme area that have been coded as single node junctions. These were changed to exploded junctions to provide an improved representation of junction queues and delays at the locations listed below:

- A54 Holmes Chapel Road/Pochin Way;
- A533 Booth Lane/Middlewich Eastern Bypass (affects future year only);
- A533 Bostock Road/Road One; and
- B5309 Centurian Way/Pennymoor Drive.

4.2.3 The following network attributes have been reviewed and checked:

- links: distance, speeds, capacity, bus lanes, traffic regulation orders;
- junctions: type; turn saturation flows, capacity, and lane utilisation;
- traffic signal control: timings, phasing, and staging; and
- routes: minimum cost paths.

4.2.4 The generalised cost values (PPM/PPK) for model assignment have also been updated to reflect the latest values from the DfT TAG databook (version: May 2020).

4.2.5 In summary, the model includes a sufficiently detailed level of network infrastructure to support the Proposed Scheme TA.

4.3 Transport demand

4.3.1 The Winsford and Middlewich Model was reviewed and confirmed to include a detailed representation of spatial demand. The model zone system contains 206 model zones and accounts for future land use development zones.

4.3.2 The demand matrices have been adjusted from 2014 to 2018 from carrying out an interpolation between base and first future year matrices. This interpolated 2018 matrix (prior matrix) has then been subject to matrix estimation using the available 2018 count data; and a localised traffic flow calibration exercise has been carried out to improve the correlation between observed and modelled traffic flows within the local areas of interest.

5 Model performance

5.1 Overview

5.1.1 This section of the report focuses on the performance of the 2018 base model produced by MWJV against observed traffic flow data.

5.2 Traffic flow

5.2.1 Observed and modelled traffic flows have been compared for the count site locations within the HS2 CA MA02. In total, 119 individual link counts by direction have been compared.

5.2.2 Table 3 and Table 4 present a summary comparison of individual link flows for all vehicles and by the car vehicle type for the prior matrix assignment. The comparison shows that both time periods fall below the DfT TAG individual link count criteria of greater than 85 percent of comparisons achieving the flow and GEH criteria.

Table 3: Winsford and Middlewich – individual link flow – total all vehicle – prior

Total all vehicle flow comparison (vehicles)							
Time period	Number of sites	TAG criteria 1 flow range		TAG criteria 2 GEH < 5		TAG criteria flow range or GEH	
		Number of counts	Percentage	Number of counts	Percentage	Number of counts	Percentage
AM peak hour	119	64	54%	57	48%	65	55%
PM peak hour	119	69	58%	64	54%	74	62%

Table 4: Winsford and Middlewich – individual link flow – car vehicle type – prior

Car flow comparison (vehicles)							
Time period	Number of sites	TAG criteria 1 flow range		TAG criteria 2 GEH < 5		TAG criteria flow range or GEH	
		Number of counts	Percentage	Number of counts	Percentage	Number of counts	Percentage
AM peak hour	119	63	53%	57	48%	64	54%
PM peak hour	119	70	59%	61	51%	73	61%

5.2.3 Figure 4 and Figure 5 show the locations of the link counts and the respective AM and PM peak hour model performance for the prior matrix assignment.

5.2.4 Table 5 and Table 6 present a summary comparison of individual link flows for all vehicles and by car vehicle type for the post matrix estimation assignment. Table 5 shows that 91 percent of all vehicle modelled flows in the AM peak hour and 90 percent of all vehicle modelled flows in the PM peak hour are within the DfT TAG guidelines for individual links for flow or GEH (as shown in Table 1). For car vehicle type, the equivalent values are 89 percent and 90 percent for the AM and PM peak hours, respectively.

Table 5: Winsford and Middlewich – individual link flow – total all vehicle – post ME

Total all vehicle flow comparison (vehicles)							
Time period	**Number of sites**	**TAG criteria 1 flow range**		**TAG criteria 2 GEH < 5**		**TAG criteria flow range or GEH**	
		Number of counts	**Percentage**	**Number of counts**	**Percentage**	**Number of counts**	**Percentage**
AM peak hour	119	106	89%	103	87%	108	91%
PM peak hour	119	107	90%	98	82%	107	90%

Table 6: Winsford and Middlewich – individual link flow – car vehicle type – post ME

Car flow comparison (vehicles)							
Time period	**Number of sites**	**TAG criteria 1 flow range**		**TAG criteria 2 GEH < 5**		**TAG criteria flow range or GEH**	
		Number of counts	**Percentage**	**Number of counts**	**Percentage**	**Number of counts**	**Percentage**
AM peak hour	119	106	89%	100	84%	106	89%
PM peak hour	119	107	90%	101	85%	107	90%

5.2.5 Figure 6 and Figure 7 show locations of the link counts and the respective AM and PM peak hour model performance for the post matrix assignment.

5.2.6 Reference should be made to Table A 1 and Table A 2, Appendix A, which presents supporting details of the individual link flow performance.

5.2.7 The Winsford and Middlewich model has been used to support the Proposed Scheme TA for the Winsford and Middlewich areas (as shown in Figure 1). The performance of the model is of relevance covering these areas, as the northern part of CA MA02 is represented by the Northwich Traffic Model.

Figure 4: AM peak hour – traffic flow performance – prior

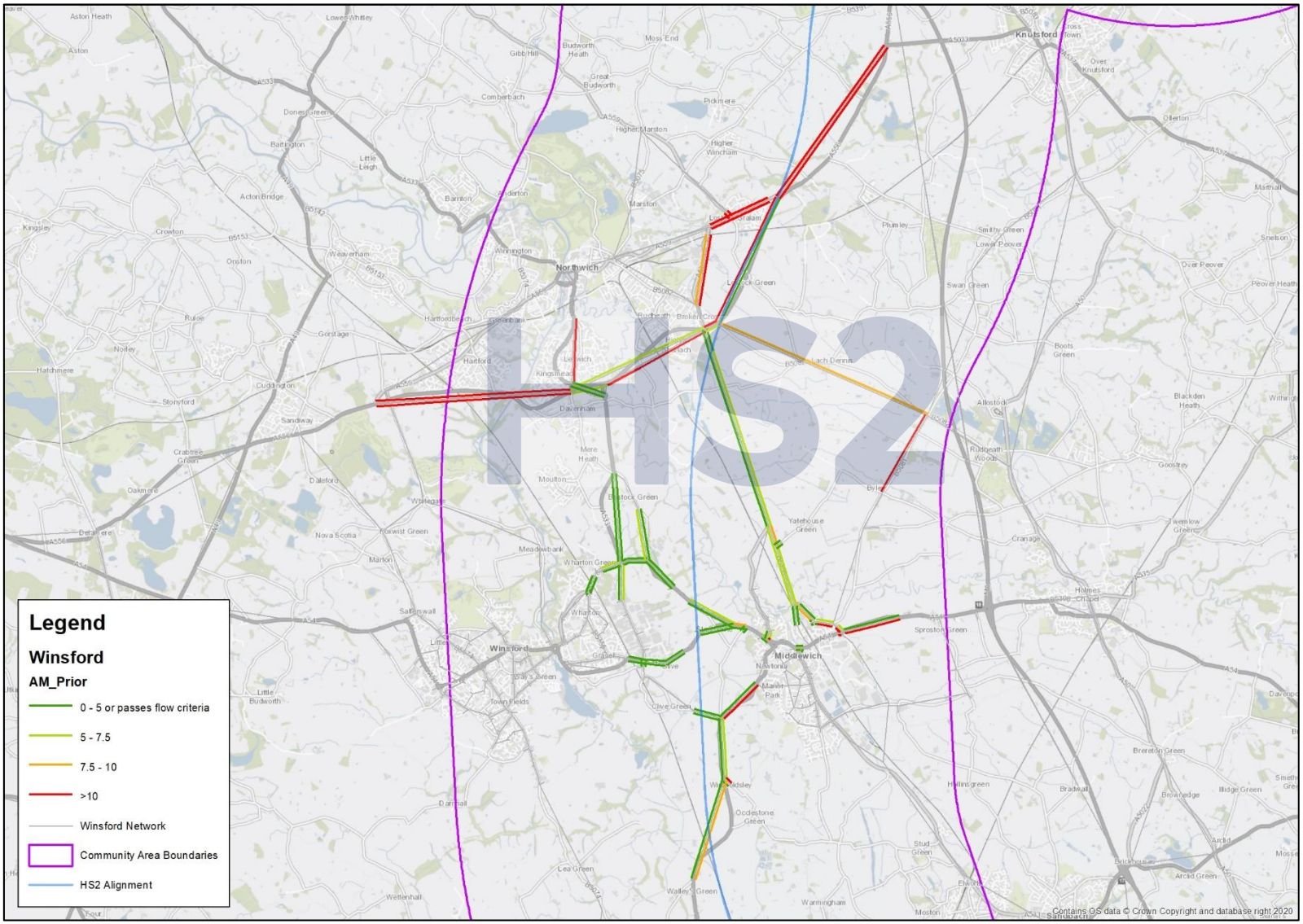


Figure 5: PM peak hour – traffic flow performance – prior

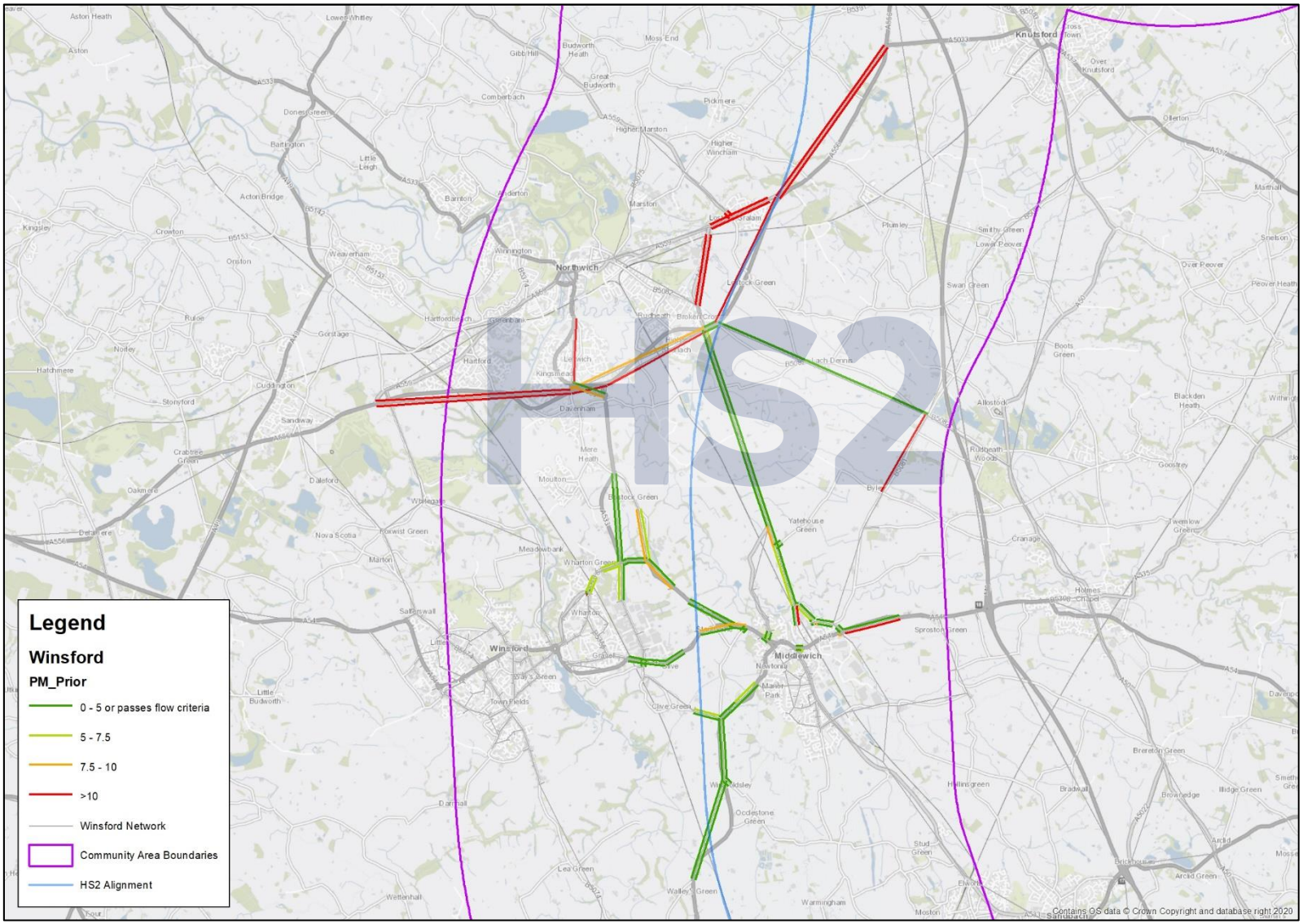


Figure 6: AM peak hour – traffic flow performance – post

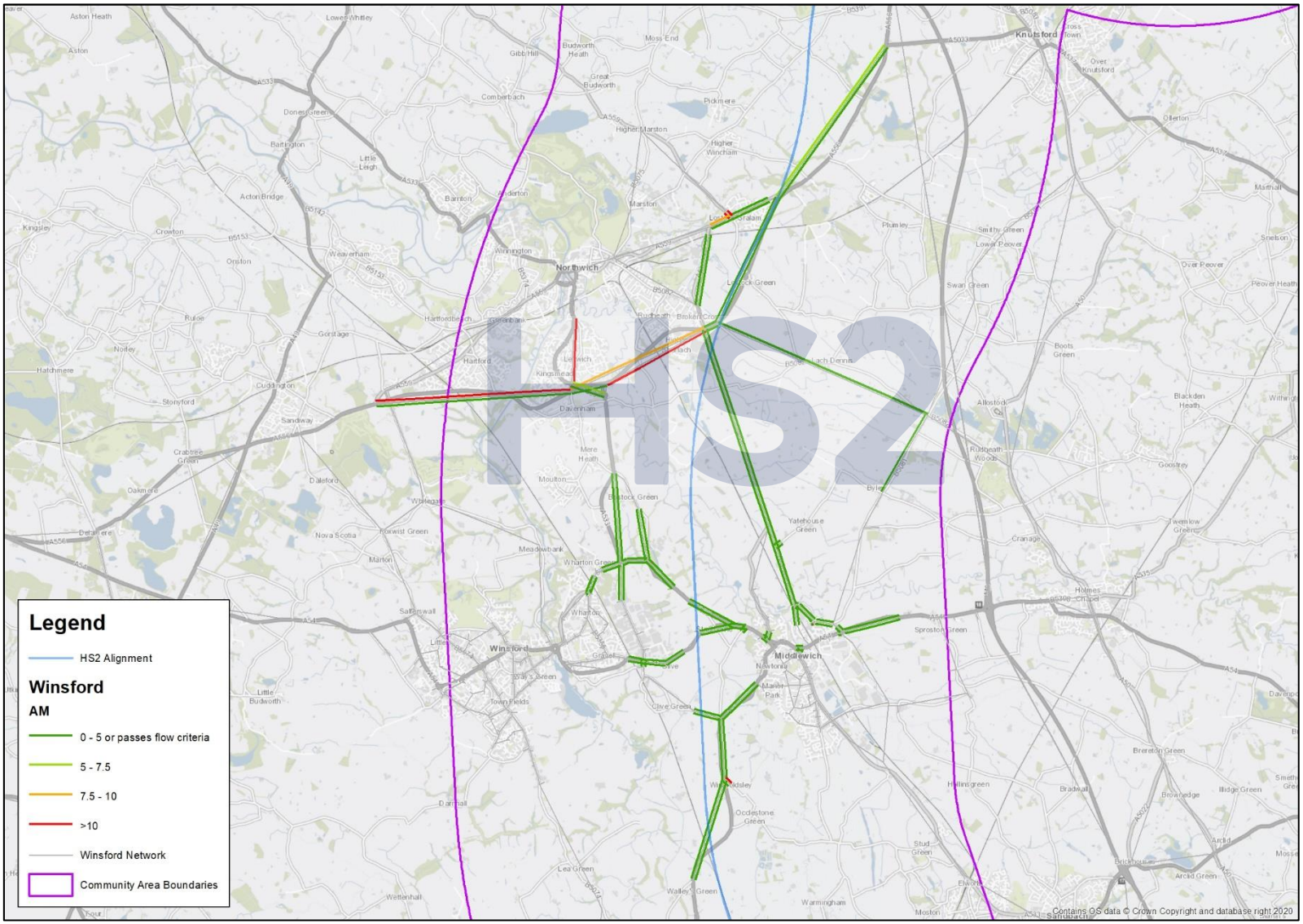
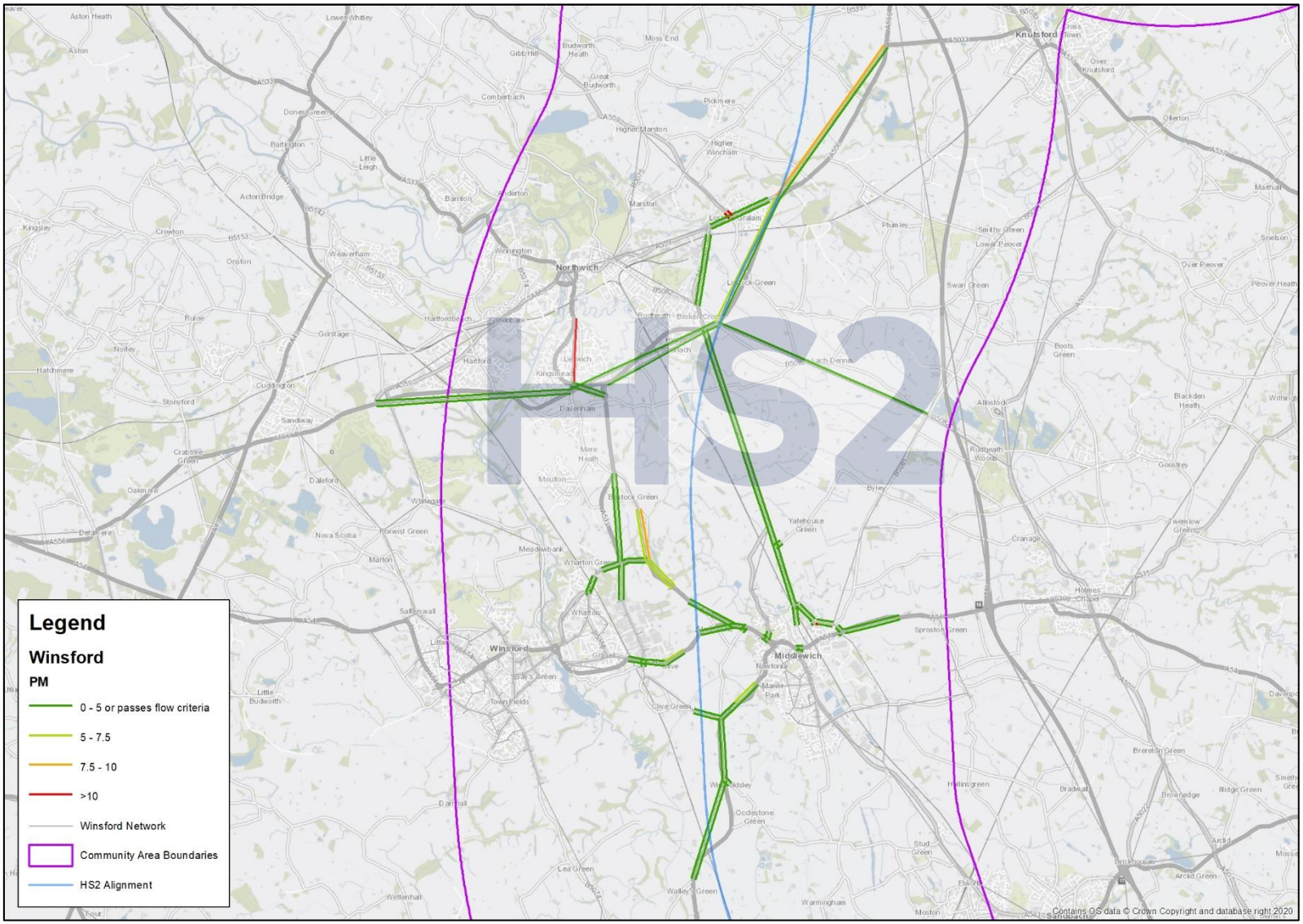


Figure 7: PM peak hour – traffic flow performance – post



6 Model convergence

6.1.1 Achieving a suitable level of model convergence is necessary to provide stable, consistent, and robust model results and to differentiate between real changes and those associated with differing degrees of convergence.

6.1.2 DfT TAG provides guidance on highway model convergence with recommendations on acceptable variations in link flows and costs between iterations helping to ensure the model is sufficiently stable.

6.1.3 Table 7 presents a summary of the 2018 baseline highway model convergence statistics by time period. It is evident that all modelled time periods meet the specified DfT TAG guidance for convergence.

Table 7: 2018 baseline highway model convergence

Criteria	Loop	Target	AM peak hour	PM peak hour
Flow change	N-3	> 98%	99.20	99.60
	N-2		99.10	99.90
	N-1		99.30	99.90
	N		99.30	99.90
Cost change	N-3	> 98%	99.80	99.50
	N-2		99.80	99.50
	N-1		99.80	99.90
	N		99.90	99.80
Delta		< 0.1%	0.0417/20	0.0337/20
%GAP		< 0.1%	0.0380	0.0500

7 Summary and conclusions

7.1.1 The Winsford and Middlewich Model as supplied by CWaC has been updated to a 2018 base year model by MWJV to support the Proposed Scheme TA. This update has been comprised of localised improvements to the highway network, an uplift of traffic demand, and the application of 2018 traffic survey data to support model calibration.

7.1.2 Table 8 is a summary of the individual link flow model for both modelled time periods. It is evident that 91 percent of all vehicle modelled flows in the AM peak hour and 90 percent of all vehicle modelled flows in the PM peak hour are within the DfT TAG guidelines for individual links for flow or GEH.

Table 8: Summary of individual link flows

Total all vehicle flow comparison (vehicles)							
Time period	**Number of sites**	**TAG criteria 1 flow range**		**TAG criteria 2 GEH < 5**		**TAG criteria flow range or GEH**	
		Number of counts	**Percentage**	**Number of counts**	**Percentage**	**Number of counts**	**Percentage**
AM peak hour	119	106	89%	103	87%	108	91%
PM peak hour	119	107	90%	98	82%	107	90%

7.1.3 In conclusion, the updated Winsford and Middlewich Model provides a reliable forecasting base and forms a suitable tool for the assessment of HS2 construction and operational impacts within the Proposed Scheme area of interest.

8 Acronyms

Table 9: Acronyms

Acronyms	
CWaC	Cheshire West and Chester Council
LMVR	Local model validation report
MPR	Model performance report
TA	Transport Assessment
ES	Environmental Statement
DfT	Department for Transport
DMRB	Design Manual for Roads and Bridges
ATC	Automatic traffic count
MCC	Manual classified count
JTC	Junction turning count
GEH	Geoffrey Havers (statistic)

9 References

Department for Transport (2020), *TAG unit M3. 1 Highway Assessment Modelling.* Available online at: https://www.gov.uk/government/publications/webtag-tag-unit-m3-1-highway-assignment-modelling.

Appendix A – model performance

Individual link flow performance

Table A 1: Winsford and Middlewich Model – AM peak hour – individual link flows

ID*	Road name	Location	Direction	Observed flow (vehicles)				Modelled flow (vehicles)				Total flow comparison					
				Cars	LGVs	HGVs	Total	Cars	LGVs	HGVs	Total	Difference	Percentage difference	GEH	GEH < 5	Flow range	GEH or flow range
	Bostock Road	North of Wharton Road	NB	880	124	35	1,045	910	124	79	1,114	69	7%	2.09	✓	✓	✓
	Bostock Road	North of Wharton Road	SB	563	113	32	714	573	82	56	711	-3	0%	0.10	✓	✓	✓
	Bostock Road	East of Road One	EB	93	23	13	129	91	19	21	131	2	2%	0.21	✓	✓	✓
	Bostock Road	East of Road One	WB	111	22	14	148	197	22	19	238	90	61%	6.47	×	✓	✓
	Coalpit Lane	South of Chester Road	SB	6	2	0	7	6	0	0	6	-1	-17%	0.47	✓	✓	✓
	Coalpit Lane	South of Chester Road	NB	25	3	1	28	25	0	0	25	-3	-11%	0.61	✓	✓	✓
	Middlewich Road	North of Beckett Avenue	EB	313	104	24	444	278	60	50	388	-56	-13%	2.74	✓	✓	✓
	Nantwich Road	East of Clivegreen Lane	EB	481	59	6	546	511	61	31	603	57	10%	2.37	✓	✓	✓
	Nantwich Road	South of Clivegreen Lane	SB	667	86	25	784	584	80	54	718	-65	-8%	2.39	✓	✓	✓
	Nantwich Road	East of Clivegreen Lane	WB	494	57	4	560	498	59	31	588	28	5%	1.18	✓	✓	✓
	Nantwich Road	West of Brynlow Drive	NB	499	62	7	572	511	63	33	607	34	6%	1.41	✓	✓	✓
	Nantwich Road	South of Clivegreen Lane	NB	787	105	31	924	783	106	71	959	35	4%	1.14	✓	✓	✓
	School Lane	North of Lea Drive	EB	122	13	1	136	21	7	4	31	-106	-77%	11.55	×	×	×
	School Lane	North of Lea Drive	WB	95	12	1	109	73	9	6	89	-20	-18%	2.02	✓	✓	✓
	Middlewich Road	North of Beckett Avenue	WB	215	168	35	421	334	58	49	441	20	5%	0.96	✓	✓	✓
	Nantwich Road	West of Brynlow Drive	SB	454	64	8	527	494	65	34	592	65	12%	2.77	✓	✓	✓
	Holmes Chapel Road	North of Pochin Way	EB	822	150	83	1,056	739	109	109	957	-99	-9%	3.13	✓	✓	✓
	Holmes Chapel Road	North of Pochin Way	WB	387	86	66	542	385	85	75	546	4	1%	0.18	✓	✓	✓
	Centurion Way	North of Pochin Way	WB	500	76	50	628	498	58	65	621	-7	-1%	0.29	✓	✓	✓
	Holmes Chapel Road	Northeast of Pochin Way	EB	599	114	110	826	599	115	129	842	16	2%	0.55	✓	✓	✓
	Centurion Way	North of Pochin Way	EB	404	43	50	500	404	61	64	529	29	6%	1.27	✓	✓	✓
	B5309	South of King Street	WB	243	37	34	316	247	19	38	304	-12	-4%	0.68	✓	✓	✓
	B5309	South of King Street	EB	261	34	24	320	261	35	35	331	11	3%	0.62	✓	✓	✓
	King Street	North of B5309	NB	398	59	35	492	392	45	49	486	-5	-1%	0.24	✓	✓	✓
	King Street	North of B5309	SB	227	38	24	290	227	39	37	303	13	5%	0.76	✓	✓	✓
	Yatehouse Lane	East of King Street	EB	24	5	1	30	26	1	1	28	-2	-6%	0.31	✓	✓	✓
	Yatehouse Lane	East of King Street	WB	39	5	0	45	39	0	0	40	-5	-11%	0.76	✓	✓	✓
	Holmes Chapel Road	Northeast of Pochin Way	WB	433	92	94	623	433	76	103	612	-11	-2%	0.43	✓	✓	✓

ID*	Road name	Location	Direction	Observed flow (vehicles)				Modelled flow (vehicles)				Total flow comparison					
				Cars	LGVs	HGVs	Total	Cars	LGVs	HGVs	Total	Difference	Percentage difference	GEH	GEH < 5	Flow range	GEH or flow range
	A5018 Bostock Road	West of Road one	EB	955	117	26	1,103	926	117	79	1,122	19	2%	0.57	✓	✓	✓
	A533 Bostock Road	East of Road One	EB	98	24	13	135	106	19	21	146	12	9%	0.98	✓	✓	✓
	A54 Middlewich Road	West of Clive Lane	EB	564	70	28	665	571	79	55	704	39	6%	1.50	✓	✓	✓
	A54 Middlewich Road	West of Bostock Road	EB	272	56	33	365	277	60	50	388	23	6%	1.19	✓	✓	✓
	A54 Chester Road	East of Bostock Road	EB	550	99	50	705	554	100	81	734	30	4%	1.11	✓	✓	✓
	A54 Middlewich Road	East of Clive Lane	EB	281	61	33	378	276	60	50	386	9	2%	0.45	✓	✓	✓
	A54 St Michaels Way	West of Leadsmithy Street	EB	754	131	59	952	753	132	94	979	27	3%	0.87	✓	✓	✓
	A54 Kinderton Street	East of Leadsmithy Street	EB	949	133	68	1,155	931	134	108	1,174	19	2%	0.56	✓	✓	✓
	A5018_B5356 Rdbt	A5018 Wharton Park Road (W), Arm D Approach	EB	619	84	28	731	622	84	59	766	35	5%	1.27	✓	✓	✓
	A556 London Road	A556 (E), Arm B Exit	EB	1,471	131	61	1,664	1,128	130	100	1,359	-306	-18%	7.86	×	×	×
	A556 London Road	A556 (W), Arm D Approach	EB	1,564	114	38	1,723	1,059	82	55	1,196	-527	-31%	13.79	×	×	×
	Kingsmead - London Road	A553 (E), Arm B Exit	EB	608	63	22	695	452	60	31	544	-151	-22%	6.08	×	×	×
	A556 - A530 Roundabout	A556 (E), Arm B Exit	EB	1,340	172	76	1,589	1,326	171	133	1,630	41	3%	1.02	✓	✓	✓
	Station Road - Hall Lane	A559 Manchester Road (E), Arm B Exit	EB	433	71	29	533	433	55	46	533	0	0%	0.00	✓	✓	✓
	Station Road - Hall Lane	A559 Manchester Road (W), Arm D Approach	EB	492	89	15	597	666	89	50	805	208	35%	7.85	×	×	×
	A559 - A556	A559 Manchester Road (E), Arm A Exit	EB	1,239	159	72	1,472	1,453	170	130	1,753	281	19%	7.01	×	×	×
	B5039/Centurion Way/White Park Close/Pennymoor Drive Rdbt	Centurion Way Exit (VEH)	EB	410	45	14	470	292	43	34	369	-101	-22%	4.95	✓	×	✓
	B5039/Centurion Way/White Park Close/Pennymoor Drive Rdbt	Pennymoor Drive Entry (VEH)	EB	69	0	0	69	146	10	5	161	92	134%	8.61	×	✓	✓
	Road One	South of Bostock Road	NB	179	77	31	287	175	33	31	240	-48	-17%	2.95	✓	✓	✓
	Road One	North of A54	NB	507	70	29	607	504	67	52	623	17	3%	0.67	✓	✓	✓
	Clive Lane	South of A54	NB	367	46	23	436	375	55	46	476	41	9%	1.90	✓	✓	✓
	A533 Bostock Road	South of London Road	NB	382	49	15	447	289	39	27	355	-92	-21%	4.60	✓	✓	✓
	A533 Bostock Road	North of A54	NB	285	39	13	339	289	39	27	355	16	5%	0.86	✓	✓	✓
	A530 Nantwich Road	South of Clivegreen Lane	NB	725	97	24	846	727	98	66	890	44	5%	1.49	✓	✓	✓
	A530 Croxton Lane	North of A54	NB	250	36	4	290	255	26	17	299	9	3%	0.52	✓	✓	✓
	B5309 King Street	South of Croxton Lane	NB	442	63	36	542	425	45	49	519	-23	-4%	0.99	✓	✓	✓
	Leadsmithy Street	South of A54	NB	688	72	33	798	670	57	40	766	-32	-4%	1.14	✓	✓	✓
	B5309 Centurian Way	East of King Street	NB	306	64	36	408	311	19	40	369	-39	-9%	1.96	✓	✓	✓
	London Road	North of A533	NB	281	31	2	314	283	20	9	311	-3	-1%	0.17	✓	✓	✓
	A533	North of Bostock Road	NB	730	120	46	903	732	120	94	946	43	5%	1.40	✓	✓	✓
	A530 King Street	North of Croxton Lane	NB	632	89	44	765	632	71	60	763	-3	0%	0.10	✓	✓	✓

ID*	Road name	Location	Direction	Observed flow (vehicles)				Modelled flow (vehicles)				Total flow comparison					
				Cars	LGVs	HGVs	Total	Cars	LGVs	HGVs	Total	Difference	Percentage difference	GEH	GEH < 5	Flow range	GEH or flow range
	B5309_King Street	King Street (S), Arm C Approach	NB	244	28	1	273	230	28	12	271	-2	-1%	0.15	✓	✓	✓
	A5018_B5356 Rdbt	Collingtree Avenue (N), Arm A Exit	NB	38	12	1	51	38	0	0	38	-13	-25%	1.90	✓	✓	✓
	A5018_B5356 Rdbt	B5355 Wharton Road (S), Arm C Approach	NB	253	40	4	302	253	39	20	312	9	3%	0.53	✓	✓	✓
	A530 - Davenham Road - Crowder's Lane	A530 (N), Arm A Exit	NB	519	77	35	632	519	71	55	645	13	2%	0.51	✓	✓	✓
	A530 - Davenham Road - Crowder's Lane	A530 (S), Arm C Approach	NB	611	94	37	744	610	71	61	742	-2	0%	0.09	✓	✓	✓
	Station Road - Hall Lane	A559 Hall Lane (N), Arm A Exit	NB	272	56	26	354	0	0	0	0	-354	-100%	26.61	×	×	×
	Griffiths Road	Cottage Close (S) to A559 Manchester Road (N)	NB	238	43	13	296	238	41	18	297	1	0%	0.06	✓	✓	✓
	Chester Road	Birches Lane (S) to A556 Manchester Road (N)	NB	941	105	69	1,116	1,020	131	112	1,263	147	13%	4.25	✓	✓	✓
	B5081/Moss Lane/Drakelow Lane	B5081 (N) Exit (VEH)	NB	236	26	7	269	230	27	17	274	5	2%	0.29	✓	✓	✓
	B5039/Centurion Way/White Park Close/Pennymoor Drive Rdbt	White Park Close Entry (VEH)	NB	214	5	0	218	0	0	0	0	-218	-100%	20.90	×	×	×
	Clivegreen Lane	West of A530	NWB	330	49	24	403	373	55	46	473	70	17%	3.33	✓	✓	✓
	A54 Chester Road	West of Croxton Lane	NWB	632	96	42	775	622	95	75	792	18	2%	0.63	✓	✓	✓
	A54 Chester Road	East of Croxton Lane	NWB	795	119	40	959	796	120	92	1,009	50	5%	1.59	✓	✓	✓
	A533	North of Bostock Road	SB	701	98	44	849	652	119	85	856	7	1%	0.23	✓	✓	✓
	Road One	South of Bostock Road	SB	499	67	23	589	498	56	37	591	3	0%	0.10	✓	✓	✓
	Road One	North of A54	SB	130	65	34	230	131	30	34	195	-35	-15%	2.44	✓	✓	✓
	London Road	North of A533	SB	295	22	3	322	381	22	10	413	91	28%	4.74	✓	✓	✓
	A533 Bostock Road	South of London Road	SB	378	41	15	436	280	40	30	350	-86	-20%	4.34	✓	✓	✓
	A533 Bostock Road	North of A54	SB	279	43	17	341	277	40	30	347	6	2%	0.30	✓	✓	✓
	A530 Croxton Lane	North of A54	SB	388	59	8	458	395	48	21	464	6	1%	0.29	✓	✓	✓
	A530 King Street	North of Croxton Lane	SB	472	65	30	568	478	83	57	618	50	9%	2.04	✓	✓	✓
	Leadsmithy Street	South of A54	SB	319	79	34	437	316	62	36	414	-23	-5%	1.11	✓	✓	✓
	B5309 Centurian Way	East of King Street	SB	202	36	10	249	202	35	30	267	18	7%	1.14	✓	✓	✓
	B5309 King Street	South of Croxton Lane	SB	261	39	24	325	247	39	37	324	-2	0%	0.09	✓	✓	✓
	Clive Lane	South of A54	SB	169	26	20	216	182	29	28	239	23	10%	1.50	✓	✓	✓
	A530 Nantwich Road	South of Clivegreen Lane	SB	571	73	18	667	581	75	52	707	41	6%	1.56	✓	✓	✓
	B5309_King Street	King Street (S), Arm C Exit	SB	51	12	3	66	52	5	2	60	-7	-10%	0.83	✓	✓	✓
	A5018_B5356 Rdbt	Collingtree Avenue (N), Arm A Approach	SB	140	19	1	160	140	16	7	164	3	2%	0.25	✓	✓	✓

ID*	Road name	Location	Direction	Observed flow (vehicles)				Modelled flow (vehicles)				Total flow comparison					
				Cars	LGVs	HGVs	Total	Cars	LGVs	HGVs	Total	Difference	Percentage difference	GEH	GEH < 5	Flow range	GEH or flow range
	A5018_B5356 Rdbt	B5355 Wharton Road (S), Arm C Exit	SB	178	36	5	224	159	15	9	183	-41	-18%	2.91	✓	✓	✓
	A530 - Davenham Road - Crowder's Lane	A530 (N), Arm A Approach	SB	457	84	43	586	462	84	53	599	13	2%	0.53	✓	✓	✓
	A530 - Davenham Road - Crowder's Lane	A530 (S), Arm C Exit	SB	455	83	32	572	474	83	57	614	41	7%	1.69	✓	✓	✓
	Kingsmead - London Road	London Road (N), Arm A Approach	SB	409	34	4	450	598	79	39	716	266	59%	11.03	×	×	×
	A556 - B5082 Penny's Lane	B5082 Penny's Lane (S), Arm B Exit	SB	368	49	7	426	370	49	27	446	20	5%	0.95	✓	✓	✓
	Station Road - Hall Lane	A559 Hall Lane (N), Arm A Approach	SB	392	64	32	487	0	0	0	0	-487	-100%	31.22	×	×	×
	Griffiths Road	A559 Manchester Road (N) to Cottage Close (S)	SB	310	47	16	375	238	36	16	289	-86	-23%	4.74	✓	✓	✓
	Chester Road	A556 Manchester Road (N) to Birches Lane (S)	SB	940	154	85	1183	944	155	131	1,230	47	4%	1.36	✓	✓	✓
	B5039/Centurion Way/White Park Close/Pennymoor Drive Rdbt	White Park Close Exit (VEH)	SB	52	5	0	57	77	14	13	103	46	81%	5.15	×	✓	✓
	Clivegreen Lane	West of A530	SEB	174	31	22	229	187	31	29	247	18	8%	1.19	✓	✓	✓
	A54 Chester Road	West of Croxton Lane	SEB	623	102	53	785	620	102	82	804	19	2%	0.66	✓	✓	✓
	A54 Chester Road	East of Croxton Lane	SEB	925	148	55	1,137	924	148	101	1,173	36	3%	1.05	✓	✓	✓
	A54 Middlewich Road	West of Clive Lane	WB	473	87	28	590	474	70	55	599	9	1%	0.36	✓	✓	✓
	A5018 Bostock Road	West of Road one	WB	595	97	27	723	596	94	61	752	28	4%	1.03	✓	✓	✓
	A533 Bostock Road	East of Road One	WB	114	22	13	151	194	22	19	236	85	56%	6.12	×	✓	✓
	A54 Middlewich Road	East of Clive Lane	WB	369	63	32	467	360	62	51	473	5	1%	0.25	✓	✓	✓
	A54 Chester Road	East of Bostock Road	WB	631	98	46	779	622	97	76	795	16	2%	0.57	✓	✓	✓
	A54 Middlewich Road	West of Bostock Road	WB	347	58	33	442	334	58	49	440	-1	0%	0.06	✓	✓	✓
	A54 Kinderton Street	East of Leadsmithy Street	WB	413	101	58	576	410	101	84	595	19	3%	0.77	✓	✓	✓
	A54 St Michaels Way	West of Leadsmithy Street	WB	586	92	49	735	578	92	72	742	8	1%	0.28	✓	✓	✓
	A5018_B5356 Rdbt	A5018 Wharton Park Road (W), Arm D Exit	WB	479	83	28	591	481	83	53	617	26	4%	1.05	✓	✓	✓
	A556 London Road	A556 (E), Arm B Approach	WB	423	88	31	547	428	88	61	578	31	6%	1.31	✓	✓	✓
	A556 London Road	A556 (W), Arm D Exit	WB	844	126	39	1,013	718	124	78	920	-93	-9%	3.00	✓	✓	✓
	Kingsmead - London Road	A553 (E), Arm B Approach	WB	875	114	52	1,044	878	114	90	1,083	39	4%	1.20	✓	✓	✓
	A556 - A530 Roundabout	A556 (E), Arm B Approach	WB	1,157	170	92	1,427	1,144	196	152	1,491	64	4%	1.68	✓	✓	✓
	A556 - A530 Roundabout	A556 (W), Arm D Exit	WB	1,284	144	58	1,491	854	144	111	1,109	-382	-26%	10.60	×	×	×
	Station Road - Hall Lane	A559 Manchester Road (E), Arm B Approach	WB	329	48	27	408	329	48	47	424	16	4%	0.81	✓	✓	✓
	Station Road - Hall Lane	A559 Manchester Road (W), Arm D Exit	WB	569	78	15	665	569	78	45	692	27	4%	1.03	✓	✓	✓

ID*	Road name	Location	Direction	Observed flow (vehicles)				Modelled flow (vehicles)				Total flow comparison					
				Cars	LGVs	HGVs	Total	Cars	LGVs	HGVs	Total	Difference	Percentage difference	GEH	GEH < 5	Flow range	GEH or flow range
	A559 - A556	A559 Manchester Road (E), Arm A Approach	WB	1,105	204	93	1,407	1,220	204	158	1,582	174	12%	4.51	✓	✓	✓
	B5039/Centurion Way/White Park Close/Pennymoor Drive Rdbt	Centurion Way Entry (VEH)	WB	374	90	52	519	331	30	51	412	-107	-21%	4.94	✓	×	✓
	B5039/Centurion Way/White Park Close/Pennymoor Drive Rdbt	Pennymoor Drive Exit (VEH)	WB	18	1	0	19	0	0	0	0	-19	-100%	6.16	×	✓	✓
	Pochin Way	South of Centurion Way	SB	188	29	16	233	190	23	22	235	2	1%	0.16	✓	✓	✓

**ID not defined*

Table A 2: Winsford and Middlewich Model – PM peak hour – individual link flows

ID*	Road name	Location	Direction	Observed flow (vehicles)				Modelled flow (vehicles)				Total flow comparison					
				Cars	LGVs	HGVs	Total	Cars	LGVs	HGVs	Total	Difference	Percentage difference	GEH	GEH < 5	Flow range	GEH or flow range
	Bostock Road	North of Wharton Road	NB	623	57	10	695	617	49	28	694	-1	0%	0.04	✓	✓	✓
	Bostock Road	North of Wharton Road	SB	948	89	10	1,052	954	80	42	1,076	24	2%	0.73	✓	✓	✓
	Bostock Road	East of Road One	EB	133	10	7	151	129	10	10	149	-2	-1%	0.17	✓	✓	✓
	Bostock Road	East of Road One	WB	93	11	10	114	43	1	8	51	-63	-55%	6.94	×	✓	✓
	Coalpit Lane	South of Chester Road	SB	4	0	2	6	4	0	0	4	-2	-29%	0.75	✓	✓	✓
	Coalpit Lane	South of Chester Road	NB	21	3	1	25	21	0	0	21	-4	-14%	0.74	✓	✓	✓
	Middlewich Road	North of Beckett Avenue	EB	311	137	20	471	280	42	31	353	-118	-25%	5.82	×	×	×
	Nantwich Road	East of Clivegreen Lane	EB	555	48	2	609	554	52	24	630	21	3%	0.84	✓	✓	✓
	Nantwich Road	South of Clivegreen Lane	SB	674	30	7	712	659	66	32	757	45	6%	1.66	✓	✓	✓
	Nantwich Road	East of Clivegreen Lane	WB	450	45	2	498	473	45	21	539	41	8%	1.82	✓	✓	✓
	Nantwich Road	West of Brynlow Drive	NB	456	24	2	483	550	52	24	627	144	30%	6.13	×	×	×
	Nantwich Road	South of Clivegreen Lane	NB	946	55	13	1,022	857	76	48	981	-41	-4%	1.30	✓	✓	✓
	School Lane	North of Lea Drive	EB	85	11	1	96	85	7	3	94	-2	-2%	0.22	✓	✓	✓
	School Lane	North of Lea Drive	WB	90	14	2	105	12	3	2	18	-88	-83%	11.18	×	✓	✓
	Middlewich Road	North of Beckett Avenue	WB	179	153	14	348	350	40	21	411	63	18%	3.23	✓	✓	✓
	Nantwich Road	West of Brynlow Drive	SB	550	33	2	590	473	45	22	541	-49	-8%	2.05	✓	✓	✓
	Holmes Chapel Road	North of Pochin Way	EB	592	70	34	699	592	70	49	711	12	2%	0.45	✓	✓	✓
	Holmes Chapel Road	North of Pochin Way	WB	326	41	29	396	310	41	39	390	-6	-1%	0.29	✓	✓	✓
	Centurion Way	North of Pochin Way	WB	474	43	17	536	528	18	29	575	39	7%	1.65	✓	✓	✓
	Holmes Chapel Road	Northeast of Pochin Way	EB	639	83	57	782	660	83	78	821	39	5%	1.37	✓	✓	✓

ID*	Road name	Location	Direction	Observed flow (vehicles)				Modelled flow (vehicles)				Total flow comparison					
				Cars	LGVs	HGVs	Total	Cars	LGVs	HGVs	Total	Difference	Percentage difference	GEH	GEH < 5	Flow range	GEH or flow range
	Centurion Way	North of Pochin Way	EB	326	43	25	395	323	38	35	397	2	1%	0.10	✓	✓	✓
	B5309	South of King Street	WB	393	38	15	447	424	10	26	460	13	3%	0.59	✓	✓	✓
	B5309	South of King Street	EB	216	26	20	263	216	22	24	262	-1	0%	0.03	✓	✓	✓
	King Street	North of B5309	NB	501	50	29	581	557	34	36	627	45	8%	1.85	✓	✓	✓
	King Street	North of B5309	SB	276	39	17	332	276	39	31	347	14	4%	0.77	✓	✓	✓
	Yatehouse Lane	East of King Street	EB	40	4	1	44	29	1	0	30	-14	-32%	2.32	✓	✓	✓
	Yatehouse Lane	East of King Street	WB	110	10	1	120	110	0	0	111	-9	-8%	0.84	✓	✓	✓
	Holmes Chapel Road	Northeast of Pochin Way	WB	385	48	58	491	373	24	48	445	-47	-9%	2.15	✓	✓	✓
	A5018 Bostock Road	West of Road one	EB	622	63	10	700	615	63	35	712	12	2%	0.47	✓	✓	✓
	A533 Bostock Road	East of Road One	EB	135	9	7	152	134	10	10	153	1	1%	0.11	✓	✓	✓
	A54 Middlewich Road	West of Clive Lane	EB	427	44	16	492	427	44	20	492	-1	0%	0.04	✓	✓	✓
	A54 Middlewich Road	West of Bostock Road	EB	263	30	17	315	279	42	31	352	36	12%	1.99	✓	✓	✓
	A54 Chester Road	East of Bostock Road	EB	541	51	25	623	596	69	48	714	91	15%	3.53	✓	✓	✓
	A54 Middlewich Road	East of Clive Lane	EB	382	42	18	447	317	42	31	389	-58	-13%	2.83	✓	✓	✓
	A54 St Michaels Way	West of Leadsmithy Street	EB	691	53	21	776	679	53	43	776	0	0%	0.02	✓	✓	✓
	A54 Kinderton Street	East of Leadsmithy Street	EB	619	55	26	705	637	56	41	733	29	4%	1.07	✓	✓	✓
	A5018_B5356 Rdbt	A5018 Wharton Park Road (W), Arm D Approach	EB	519	44	10	573	516	44	22	583	9	2%	0.38	✓	✓	✓
	A556 London Road	A556 (E), Arm B Exit	EB	1,052	98	29	1,181	982	81	57	1,119	-62	-5%	1.82	✓	✓	✓
	A556 London Road	A556 (W), Arm D Approach	EB	1,005	109	18	1,132	855	84	50	988	-143	-13%	4.41	✓	✓	✓
	Kingsmead - London Road	A553 (E), Arm B Exit	EB	513	40	4	558	523	40	20	584	26	5%	1.08	✓	✓	✓
	A556 - A530 Roundabout	A556 (E), Arm B Exit	EB	1,288	108	51	1,449	1,280	115	88	1,483	34	2%	0.89	✓	✓	✓
	Station Road - Hall Lane	A559 Manchester Road (E), Arm B Exit	EB	348	37	8	396	304	37	23	365	-31	-8%	1.58	✓	✓	✓
	Station Road - Hall Lane	A559 Manchester Road (W), Arm D Approach	EB	541	60	6	609	541	60	30	631	21	3%	0.86	✓	✓	✓
	A559 - A556	A559 Manchester Road (E), Arm A Exit	EB	1,115	105	50	1,272	1,381	131	94	1,606	334	26%	8.80	×	×	×
	B5039/Centurion Way/White Park Close/Pennymoor Drive Rdbt	Centurion Way Exit (VEH)	EB	233	18	13	264	196	18	24	238	-26	-10%	1.65	✓	✓	✓
	B5039/Centurion Way/White Park Close/Pennymoor Drive Rdbt	Pennymoor Drive Entry (VEH)	EB	25	1	0	26	57	12	8	77	51	195%	7.07	×	✓	✓
	Road One	South of Bostock Road	NB	597	45	16	661	586	44	31	661	-1	0%	0.03	✓	✓	✓
	Road One	North of A54	NB	240	24	25	291	235	4	20	259	-32	-11%	1.92	✓	✓	✓
	Clive Lane	South of A54	NB	455	46	19	524	395	29	27	451	-73	-14%	3.29	✓	✓	✓
	A533 Bostock Road	South of London Road	NB	433	48	10	492	286	37	24	347	-145	-30%	7.09	×	×	×
	A533 Bostock Road	North of A54	NB	282	42	9	333	273	37	24	334	1	0%	0.08	✓	✓	✓

ID*	Road name	Location	Direction	Observed flow (vehicles)				Modelled flow (vehicles)				Total flow comparison					
				Cars	LGVs	HGVs	Total	Cars	LGVs	HGVs	Total	Difference	Percentage difference	GEH	GEH < 5	Flow range	GEH or flow range
	A530 Nantwich Road	South of Clivegreen Lane	NB	869	73	19	969	861	76	47	984	15	2%	0.47	✓	✓	✓
	A530 Croxton Lane	North of A54	NB	352	28	5	386	346	35	15	396	10	2%	0.48	✓	✓	✓
	B5309 King Street	South of Croxton Lane	NB	603	56	43	702	621	34	36	691	-11	-2%	0.42	✓	✓	✓
	Leadsmithy Street	South of A54	NB	566	52	11	634	606	45	21	672	38	6%	1.49	✓	✓	✓
	B5309 Centurian Way	East of King Street	NB	370	31	10	411	283	9	19	311	-100	-24%	5.25	×	✓	✓
	London Road	North of A533	NB	363	37	1	401	243	37	16	296	-105	-26%	5.63	×	×	×
	A533	North of Bostock Road	NB	797	54	15	871	790	55	39	884	14	2%	0.47	✓	✓	✓
	A530 King Street	North of Croxton Lane	NB	783	60	50	895	795	45	41	881	-13	-1%	0.44	✓	✓	✓
	B5309_King Street	King Street (S), Arm C Approach	NB	163	24	1	189	228	27	12	267	78	41%	5.17	×	✓	✓
	A5018_B5356 Rdbt	Collingtree Avenue (N), Arm A Exit	NB	128	19	0	147	128	1	1	130	-16	-11%	1.40	✓	✓	✓
	A5018_B5356 Rdbt	B5355 Wharton Road (S), Arm C Approach	NB	204	23	0	232	203	8	8	218	-13	-6%	0.87	✓	✓	✓
	A530 - Davenham Road - Crowder's Lane	A530 (N), Arm A Exit	NB	678	75	27	782	680	51	40	772	-10	-1%	0.36	✓	✓	✓
	A530 - Davenham Road - Crowder's Lane	A530 (S), Arm C Approach	NB	755	78	22	857	765	45	42	852	-5	-1%	0.16	✓	✓	✓
	Station Road - Hall Lane	A559 Hall Lane (N), Arm A Exit	NB	431	48	9	489	0	0	0	0	-489	-100%	31.27	×	×	×
	Griffiths Road	Cottage Close (S) to A559 Manchester Road (N)	NB	254	17	11	283	254	19	8	281	-2	-1%	0.12	✓	✓	✓
	Chester Road	Birches Lane (S) to A556 Manchester Road (N)	NB	895	77	51	1,024	1,062	96	80	1,237	214	21%	6.35	×	×	×
	B5081/Moss Lane/Drakelow Lane	B5081 (N) Exit (VEH)	NB	67	5	3	75	147	10	7	163	88	118%	8.11	×	✓	✓
	B5039/Centurion Way/White Park Close/Pennymoor Drive Rdbt	White Park Close Entry (VEH)	NB	73	2	0	75	0	0	0	0	-75	-100%	12.23	×	✓	✓
	Clivegreen Lane	West of A530	NWB	340	28	8	380	353	29	27	409	29	8%	1.47	✓	✓	✓
	A54 Chester Road	West of Croxton Lane	NWB	588	67	11	669	626	80	46	752	84	13%	3.14	✓	✓	✓
	A54 Chester Road	East of Croxton Lane	NWB	860	86	15	966	884	107	58	1,049	83	9%	2.61	✓	✓	✓
	A533	North of Bostock Road	SB	767	61	20	851	764	61	41	866	15	2%	0.50	✓	✓	✓
	Road One	South of Bostock Road	SB	196	26	8	231	207	23	15	245	15	6%	0.94	✓	✓	✓
	Road One	North of A54	SB	452	37	12	502	419	37	30	486	-15	-3%	0.69	✓	✓	✓
	London Road	North of A533	SB	358	17	2	378	206	17	7	230	-147	-39%	8.45	×	×	×
	A533 Bostock Road	South of London Road	SB	468	27	9	506	335	27	17	379	-126	-25%	6.01	×	×	×
	A533 Bostock Road	North of A54	SB	278	21	8	309	319	27	17	363	54	18%	2.96	✓	✓	✓
	A530 Croxton Lane	North of A54	SB	448	51	4	503	452	51	24	527	23	5%	1.03	✓	✓	✓
	A530 King Street	North of Croxton Lane	SB	632	48	20	701	641	74	46	762	61	9%	2.25	✓	✓	✓

ID*	Road name	Location	Direction	Observed flow (vehicles)				Modelled flow (vehicles)				Total flow comparison					
				Cars	LGVs	HGVs	Total	Cars	LGVs	HGVs	Total	Difference	Percentage difference	GEH	GEH < 5	Flow range	GEH or flow range
	Leadsmithy Street	South of A54	SB	553	48	14	622	525	48	31	603	-18	-3%	0.73	✓	✓	✓
	B5309 Centurian Way	East of King Street	SB	244	22	14	281	243	22	24	289	9	3%	0.51	✓	✓	✓
	B5309 King Street	South of Croxton Lane	SB	260	40	14	315	260	39	31	330	15	5%	0.84	✓	✓	✓
	Clive Lane	South of A54	SB	259	27	3	289	267	27	14	308	19	7%	1.09	✓	✓	✓
	A530 Nantwich Road	South of Clivegreen Lane	SB	537	53	4	595	590	62	31	683	88	15%	3.49	✓	✓	✓
	B5309_King Street	King Street (S), Arm C Exit	SB	164	22	0	187	156	19	8	184	-2	-1%	0.18	✓	✓	✓
	A5018_B5356 Rdbt	Collingtree Avenue (N), Arm A Approach	SB	67	9	1	77	67	7	3	77	0	0%	0.01	✓	✓	✓
	A5018_B5356 Rdbt	B5355 Wharton Road (S), Arm C Exit	SB	309	35	0	349	270	32	15	317	-32	-9%	1.74	✓	✓	✓
	A530 - Davenham Road - Crowder's Lane	A530 (N), Arm A Approach	SB	731	65	25	823	655	78	47	779	-44	-5%	1.55	✓	✓	✓
	A530 - Davenham Road - Crowder's Lane	A530 (S), Arm C Exit	SB	696	65	22	785	656	75	46	776	-9	-1%	0.33	✓	✓	✓
	Kingsmead - London Road	London Road (N), Arm A Approach	SB	250	17	1	270	619	30	15	663	393	146%	18.20	×	×	×
	A556 - B5082 Penny's Lane	B5082 Penny's Lane (S), Arm B Exit	SB	267	20	2	289	265	20	12	297	8	3%	0.45	✓	✓	✓
	Station Road - Hall Lane	A559 Hall Lane (N), Arm A Approach	SB	308	33	7	349	0	0	0	0	-349	-100%	26.42	×	×	×
	Griffiths Road	A559 Manchester Road (N) to Cottage Close (S)	SB	413	19	12	445	333	22	9	365	-80	-18%	4.00	✓	✓	✓
	Chester Road	A556 Manchester Road (N) to Birches Lane (S)	SB	1,405	85	36	1,527	1,405	117	76	1,598	71	5%	1.81	✓	✓	✓
	B5039/Centurion Way/White Park Close/Pennymoor Drive Rdbt	White Park Close Exit (VEH)	SB	140	5	0	145	368	20	9	397	252	174%	15.33	×	×	×
	Clivegreen Lane	West of A530	SEB	216	16	4	237	235	27	14	276	39	16%	2.42	✓	✓	✓
	A54 Chester Road	West of Croxton Lane	SEB	612	72	24	714	610	70	49	729	14	2%	0.53	✓	✓	✓
	A54 Chester Road	East of Croxton Lane	SEB	980	114	27	1,128	974	112	69	1,155	27	2%	0.80	✓	✓	✓
	A54 Middlewich Road	West of Clive Lane	WB	784	75	15	877	772	76	33	881	4	1%	0.15	✓	✓	✓
	A5018 Bostock Road	West of Road one	WB	929	86	21	1,039	940	80	50	1,070	32	3%	0.98	✓	✓	✓
	A533 Bostock Road	East of Road One	WB	98	13	10	120	106	1	8	114	-6	-5%	0.57	✓	✓	✓
	A54 Middlewich Road	East of Clive Lane	WB	330	40	15	387	355	40	21	416	29	8%	1.47	✓	✓	✓
	A54 Chester Road	East of Bostock Road	WB	588	76	22	688	622	77	45	744	57	8%	2.11	✓	✓	✓
	A54 Middlewich Road	West of Bostock Road	WB	307	35	14	357	350	40	21	411	54	15%	2.78	✓	✓	✓
	A54 Kinderton Street	East of Leadsmithy Street	WB	656	72	21	750	608	69	46	723	-27	-4%	0.99	✓	✓	✓
	A54 St Michaels Way	West of Leadsmithy Street	WB	741	74	13	833	708	62	38	808	-25	-3%	0.86	✓	✓	✓
	A5018_B5356 Rdbt	A5018 Wharton Park Road (W), Arm D Exit	WB	678	54	10	743	695	54	29	779	36	5%	1.29	✓	✓	✓
	A556 London Road	A556 (E), Arm B Approach	WB	1,499	86	12	1,598	1,251	76	42	1,369	-229	-14%	5.93	×	✓	✓

ID*	Road name	Location	Direction	Observed flow (vehicles)				Modelled flow (vehicles)				Total flow comparison					
				Cars	LGVs	HGVs	Total	Cars	LGVs	HGVs	Total	Difference	Percentage difference	GEH	GEH < 5	Flow range	GEH or flow range
	A556 London Road	A556 (W), Arm D Exit	WB	1,557	88	15	1,662	1,484	88	48	1,620	-42	-2%	1.03	✓	✓	✓
	Kingsmead - London Road	A553 (E), Arm B Approach	WB	944	83	13	1,045	941	83	46	1,071	26	2%	0.80	✓	✓	✓
	A556 - A530 Roundabout	A556 (E), Arm B Approach	WB	1,689	150	36	1,877	1,688	184	107	1,979	102	5%	2.33	✓	✓	✓
	A556 - A530 Roundabout	A556 (W), Arm D Exit	WB	1,435	121	29	1,587	1,432	121	75	1,627	41	3%	1.01	✓	✓	✓
	Station Road - Hall Lane	A559 Manchester Road (E), Arm B Approach	WB	523	36	11	571	452	36	26	513	-58	-10%	2.49	✓	✓	✓
	Station Road - Hall Lane	A559 Manchester Road (W), Arm D Exit	WB	709	57	7	775	768	57	30	854	80	10%	2.79	✓	✓	✓
	A559 - A556	A559 Manchester Road (E), Arm A Approach	WB	1,818	139	39	1,998	1,818	152	95	2,065	67	3%	1.49	✓	✓	✓
	B5039/Centurion Way/White Park Close/Pennymoor Drive Rdbt	Centurion Way Entry (VEH)	WB	514	38	11	563	547	13	21	581	18	3%	0.75	✓	✓	✓
	B5039/Centurion Way/White Park Close/ Pennymoor Drive Rdbt	Pennymoor Drive Exit (VEH)	WB	48	3	0	51	0	0	0	0	-51	-100%	10.09	✗	✓	✓
	Pochin Way	South of Centurion Way	SB	36	7	22	66	62	7	3	72	6	10%	0.77	✓	✓	✓

**ID not defined*

Annex F: Model performance report – A500 Crewe Model

Contents

Tables

Figures

1 Introduction

1.1 Background information

1.1.1 This report provides documentation of the model performance review that has been carried out for the A500 Crewe Model.

1.1.2 The local authority, Cheshire East Council (CE), released to HS2 Ltd copies of the latest available A500 Crewe Model versions as of June 2020.

1.1.3 The A500 Crewe Model has subsequently been updated by HS2 Ltd transport consultants, Mott MacDonald WSP Joint Venture (MWJV), to include localised improvements within the Proposed Scheme area of interest.

1.1.4 The purpose of this report is to provide evidence that this highway assignment model is suitable to support the Transport Assessment (TA) of the Proposed Scheme.

1.1.5 For the Proposed Scheme TA, the route is split into a number of geographical areas referred to as community areas (CA). The A500 Crewe Model has been utilised to provide an evidence base for the Proposed Scheme TA for the CA referred to as Hough to Walley's Green (MJA01).

1.1.6 Reference should be made to Figure 1 which shows the geographic coverage of strategic transport models that have been utilised for the Proposed Scheme TA.

1.2 Model framework

1.2.1 The A500 Crewe Model framework is comprised of the following models:

- variable demand model (DIADEM);
- strategic highway assignment model (SATURN); and
- strategic rail assignment model (VISUM).

1.2.2 For the Proposed Scheme TA, only the strategic highway assignment model has been utilised by MWJV to provide an evidence base.

1.2.3 The A500 Crewe strategic highway assignment Model has been developed within the SATURN model software platform (version: 11.4.06D). The variable demand model and strategic rail model are used to develop forecast demands and are not described in this report.

1.2.4 The variable demand model focuses on forecasting overall travel demand with the strategic rail model dealing with rail assignment. Within this area, there is unlikely to be any impacts resulting from the Proposed Scheme on modal shift or on local rail passenger movements. Accordingly, these models were not used and are therefore not described in this report.

1.2.5 The detailed modelled study area covers Crewe and surrounding areas. There is supporting network and zone system detail to provide a representation of the external area supply and demand. Reference should be made to Figure 2.

1.2.6 The A500 Crewe Model is representative of 2017 base year transport conditions.

1.3 Model development

1.3.1 The A500 Crewe Model has been developed by Cheshire East Council's appointed transport consultants to provide an evidence base to support the business case for the A500 upgrade scheme between Meremoor Moss roundabout and M6 junction 16 to dual carriageway standard.

1.4 Model description

1.4.1 The A500 Crewe strategic highway assignment Model has been developed for the following years:

- 2017 base year;
- 2021 future year; and
- 2016 horizon year.

1.4.2 The model is representative of the following time periods:

- AM peak hour – 08:00–09:00;
- average inter peak hour – 10:00–16:00; and
- PM peak hour – 17:00–18:00.

1.4.3 The model is comprised of the following demand user-classes:

- car commute;
- car employers business;
- car other;
- light goods vehicles; and
- other good vehicles.

1.5 Model application objectives

1.5.1 For the assessment of the Proposed Scheme, the A500 Crewe highway assignment Model will:

- provide preliminary traffic data to inform scheme design;
- provide traffic data for the construction and operational phases of the Proposed Scheme on which to base the assessment of significant effects for the Environmental Statement;

- provide changes in traffic flows, congestion and journey times to inform the TA for the Proposed Scheme; and
- provide changes in traffic flows between the base year and the forecast scenarios for application to local models.

1.5.2 The model will be used primarily to assess the likely impacts of the Proposed Scheme's construction and operational traffic in order to provide an evidence base for the Proposed Scheme TA.

Figure 1: Strategic transport model coverage for the Proposed Scheme Transport Assessment

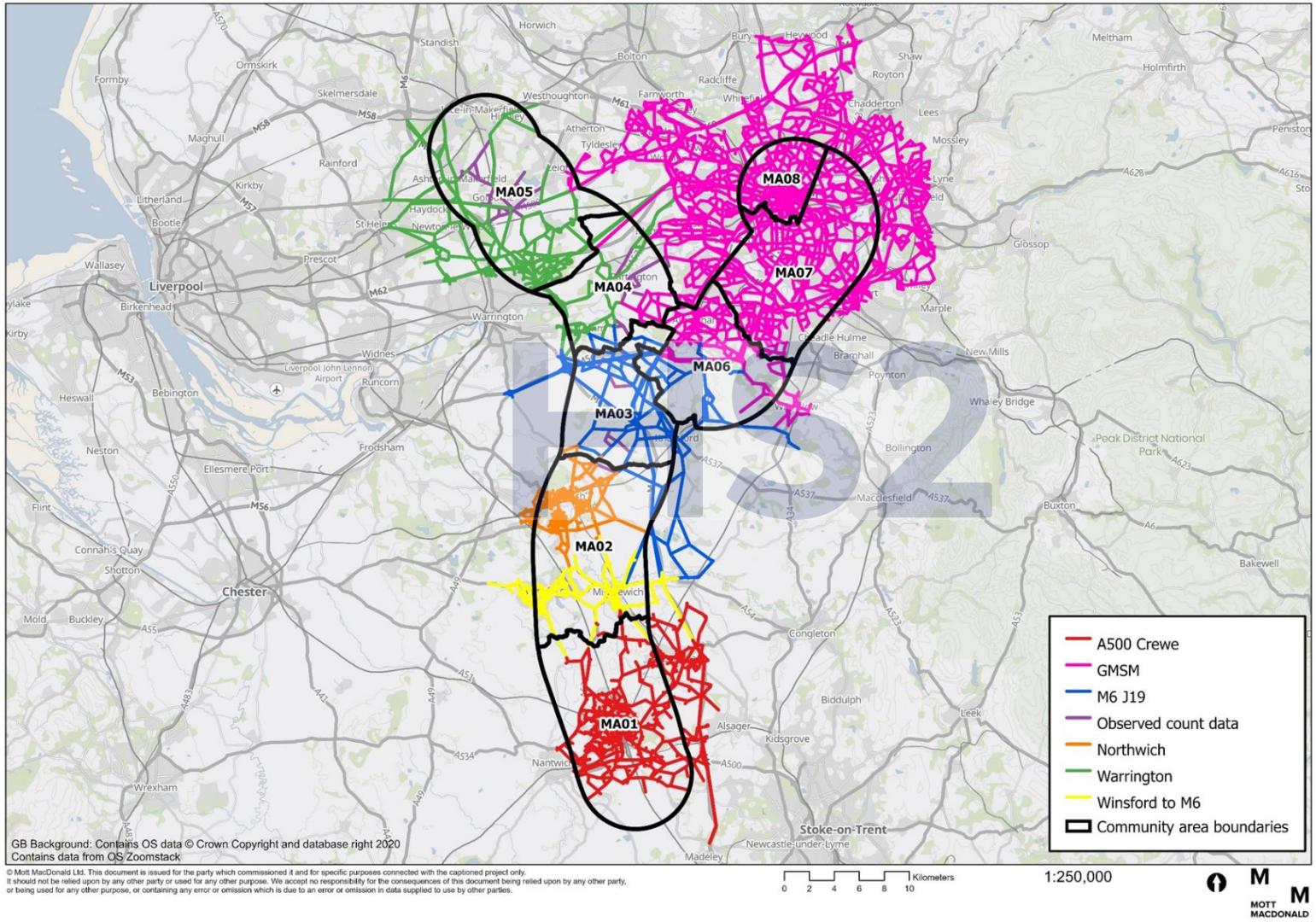
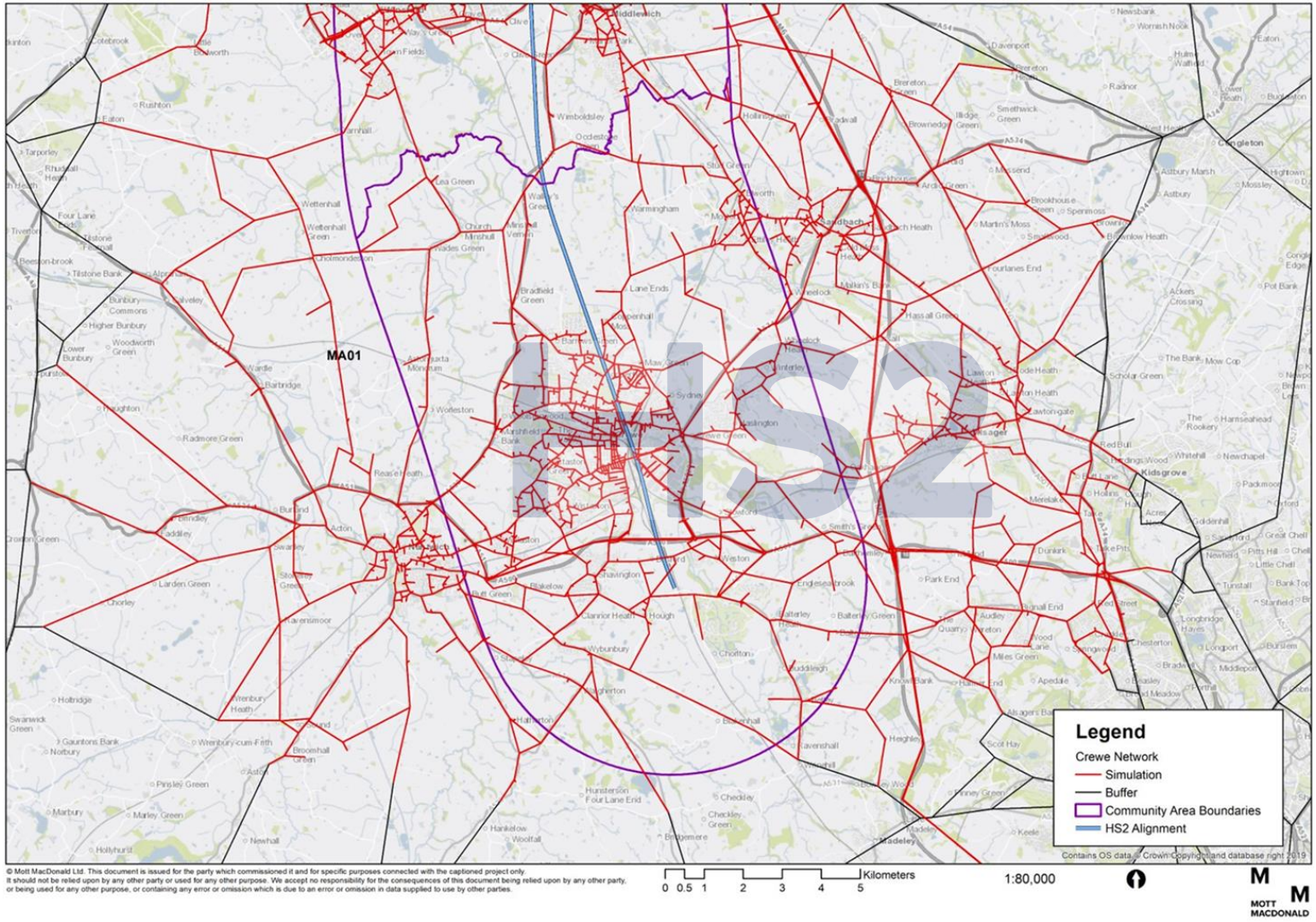


Figure 2: Model study area



2 Guidance used

2.1 Introduction

2.1.1 This strategic highway model development makes reference to the following Transport Analysis Guidance as published by the Department for Transport (DfT): TAG Unit M3.1 Highway Assignment Modelling (May 2020).

2.2 Highway model guidance

2.2.1 In relation to providing an assessment of model calibration and validation performance, reference has been made to Section 3.2 of TAG Unit M3.1 (Table 1, Table 2, and Table 3).

2.2.2 The criteria for the assessment of model calibration and validation of traffic flows and journey time performance is presented in Table 1: DfT – TAG validation criteria, below.

Table 1: DfT – TAG validation criteria

Criteria	Acceptability guidance
Assigned hourly flows	
Individual flows within +/-15% for flows 700-2,700 vph	>85% of cases
Individual flows within +/-100 vph for flows <700 vph	>85% of cases
Individual flows within +/-400 vph for flows >2,700 vph	>85% of cases
Screenline flows (normally >5 links) to be within 5%	All or nearly all screenlines
GEH statistic	
Individual flows GEH <5	>85% of cases
Screenline totals GEH <4	All or nearly all screenlines
Journey times	
Modelled journey times within 15% (or 1 minute if higher)	>85% of cases

Source: Table 1, Table 2, Table 3, DfT TAG Unit M3.1 Highway Assignment Modelling (May 2020)

2.2.3 The criteria for the assessment of highway model assignment convergence is presented in Table 2 below.

Table 2: Summary of convergence measures and base model acceptable values

Measures of convergence	Acceptability guidelines
Delta and %GAP	Less than 0.1% or at least stable with convergence fully documented and all other criteria met
Percentage of links with flow change (P) <1%	Four consecutive iterations greater than 98%
Percentage of links with cost change (P2) <1%	Four consecutive iterations greater than 98%
Percentage change in total user costs of links with flow change (V) <1%	Four consecutive iterations less than 0.1% (SUE only)

3 Data for model development

3.1 Overview

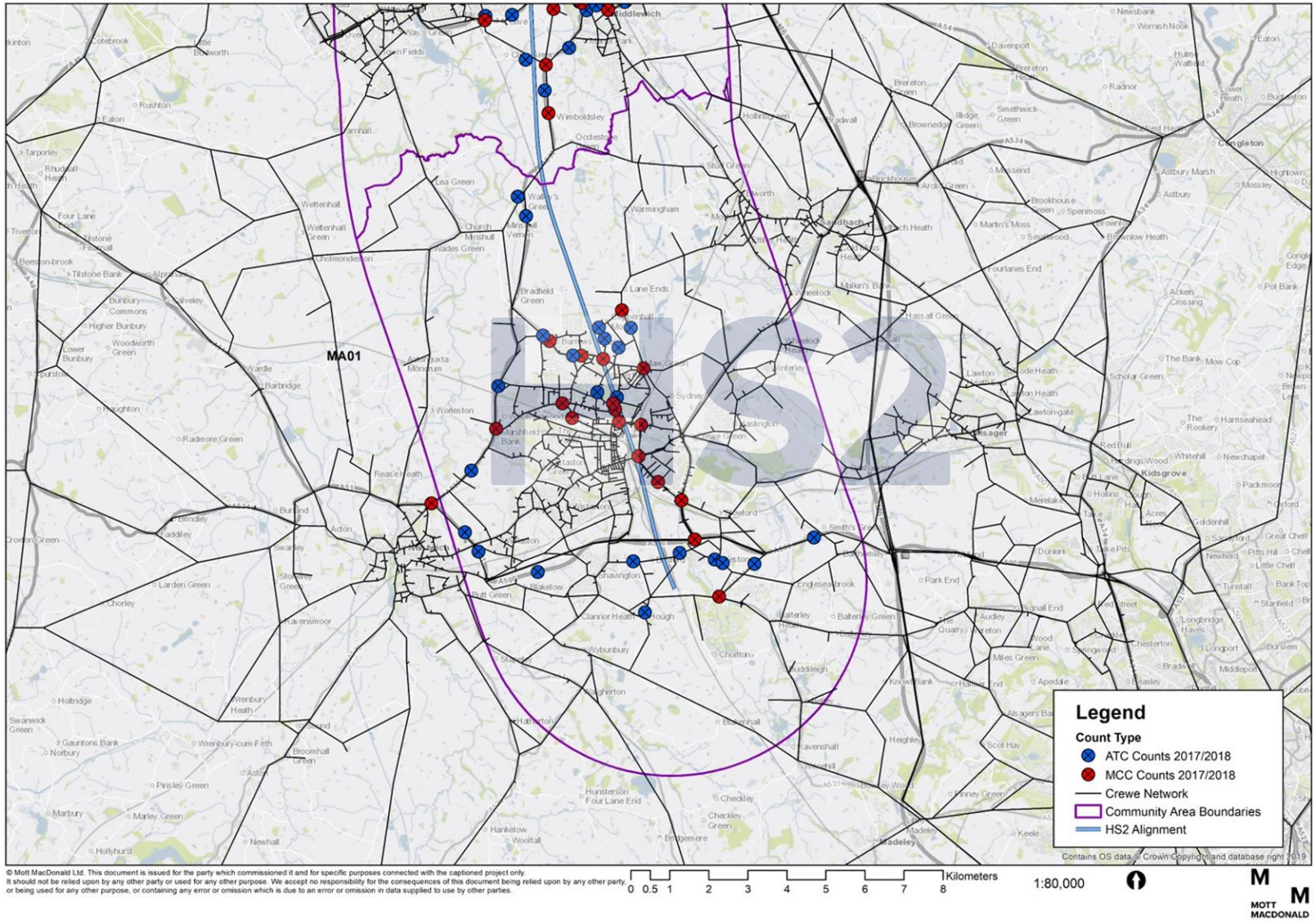
3.1.1 This section of the report presents details of traffic survey data that has been collected for the purpose of calibrating the A500 Crewe Model study area.

3.2 Traffic survey data commission

3.2.1 MWJV commissioned a programme of traffic count surveys in 2017/2018 to support the Proposed Scheme TA.

3.2.2 Traffic Count Surveys have been used from different years and months to update the base year model. The traffic counts have been factored to June 2018 to develop a consistent dataset. Figure 3 shows the location of traffic surveys.

Figure 3: Location of traffic counts (MWJV survey commission)



4 Model calibration

4.1 Overview

4.1.1 A review of base year model traffic flows identified that there was scope to undertake some localised improvements to the traffic model in order to provide a more robust assessment in the Proposed Scheme area of interest.

4.1.2 The 2017 base year model has been updated to a 2018 (June) base year model by MWJV using traffic count survey data that was collected between November 2017 and March 2020 (prior to COVID-19). Traffic count data has been normalised to June 2018 traffic conditions using local count data.

4.1.3 This localised model update has focused on the improvement to the validation of traffic flows covering the Proposed Scheme area of interest, and no changes to journey time validation have been undertaken.

4.1.4 The model time periods represent the following peak hours:

- AM peak hour – 08:00–09:00; and
- PM peak hour – 17:00–18:00.

4.2 Transport supply

4.2.1 A review of highway network detail and attributes has been completed for the model area that is included in the Proposed Scheme area of interest (CA: MA01).

4.2.2 The following network attributes have been reviewed and checked:

- links: distance, speeds, capacity, bus lanes, traffic regulation orders;
- junctions: type; turn saturation flows, capacity and lane utilisation;
- traffic signal control: timings, phasing, and staging; and
- route: minimum cost paths.

4.2.3 The review highlighted that there is a good level of detailed highway network representation within the Proposed Scheme area, and that this compared well with local datasets.

4.2.4 The base year model highway supply has not been subject to any network improvements as part of this model update. The Crewe Green Roundabout improvement scheme was opened in autumn 2018, and the base year model reflects 2018 traffic conditions prior to the opening of this scheme. This scheme has been included in the future year forecast models.

4.2.5 The latest future year model versions (2025 and 2040) received from Cheshire East Council include:

- the Crewe Green Roundabout scheme;
- the Sydney Road Bridge improvement scheme;
- A500 improvement to dual carriageway standard between Meremoor Moss roundabout and M6 J16;
- North West Crewe Package of Schemes in Leighton; and
- Middlewich Eastern Bypass.

4.2.6 The generalised cost values (PPM/PPK) for model assignment have also been updated to reflect the latest values from the DfT TAG databook (version: May 2020).

4.2.7 In general, the model includes a sufficiently detailed level of network infrastructure to support Proposed Scheme TA.

4.3 Transport demand

4.3.1 The A500 Crewe Model includes a detailed representation of spatial demand. The model zone system contains 671 model zones and accounts for future land-use development zones.

4.3.2 The demand matrices have been adjusted from 2017 to 2018 from carrying out an interpolation between base and first future year matrices. This interpolated 2018 matrix (prior matrix) has then been subject to matrix estimation using the available 2018 count data; and a localised traffic flow calibration exercise has been carried out to improve the correlation between observed and modelled traffic flows within the local areas of interest.

5 Model performance

5.1 Overview

5.1.1 This section of the report focuses on the performance of the 2018 base model as produced by MWJV against observed traffic flow data.

5.2 Traffic flow

5.2.1 Observed and modelled traffic flows have been compared for the count site locations within the Proposed Scheme area of interest (CA: MA01). In total, 138 individual link counts by direction have been compared.

5.2.2 Table 3 and Table 4 present a summary comparison of individual link flows for all vehicles and by the car vehicle type for the prior matrix assignment. The comparison shows that both time periods fall below the DfT TAG individual link count criteria of greater than 85 percent of comparisons achieving the flow and GEH criteria.

Table 3: A500 Crewe Model – individual link flow – total all vehicle – prior

Total all vehicle flow comparison (vehicles)							
Time period	Number of sites	TAG criteria 1 flow range		TAG criteria 2 GEH < 5		TAG criteria flow range or GEH	
		Number of counts	Percentage	Number of counts	Percentage	Number of counts	Percentage
AM peak hour	138	61	44%	65	47%	67	49%
PM peak our	138	72	52%	72	52%	76	55%

Table 4: A500 Crewe – individual link flow – car vehicle type – prior

Car flow comparison (vehicles)							
Time period	Number of sites	TAG criteria 1 flow range		TAG criteria 2 GEH < 5		TAG criteria flow range or GEH	
		Number of counts	Percentage	Number of counts	Percentage	Number of counts	Percentage
AM peak hour	138	70	51%	66	48%	74	54%
PM peak hour	138	71	51%	68	49%	75	54%

5.2.3 Figure 4 and Figure 5 show the locations of the link counts and the respective AM and PM peak hour model performance for the prior matrix assignment. This is based on pass or fail for the flow criteria and shows GEH values in bands.

5.2.4 Table 5 and Table 6 present a summary comparison of individual link flows for all vehicles and by the car vehicle type for the post matrix estimation assignment. The comparison shows that both time periods meet the DfT TAG individual link count criteria of greater than 85 percent of comparisons achieving flow and GEH criteria.

Table 5: A500 Crewe – individual link flow – total all vehicle – post ME

Total all vehicle flow comparison (vehicles)							
Time period	**Number of sites**	**TAG criteria 1 flow range**		**TAG criteria 2 GEH < 5**		**TAG criteria flow range or GEH**	
		Number of counts	**Percentage**	**Number of counts**	**Percentage**	**Number of counts**	**Percentage**
AM peak hour	138	123	89%	125	91%	126	91%
PM peak hour	138	124	90%	127	92%	128	93%

Table 6: A500 Crewe – individual link flow – car vehicle type – post ME

Total all vehicle flow comparison (vehicles)							
Time period	**Number of sites**	**TAG criteria 1 flow range**		**TAG criteria 2 GEH < 5**		**TAG criteria flow range or GEH**	
		Number of counts	**Percentage**	**Number of counts**	**Percentage**	**Number of counts**	**Percentage**
AM peak hour	138	124	90%	123	89%	125	91%
PM peak hour	138	129	93%	125	91%	129	93%

5.2.7 Figure 6 and Figure 7 show locations of the link counts and the respective AM and PM peak hour model performance for the post matrix assignment. This is based on pass or fail for the flow criteria and shows GEH values in bands.

5.2.8 Reference should be made to Table A 1 and Table A 2, Appendix A, which presents supporting details of the individual link flow performance for AM and PM time periods.

Figure 4: AM peak hour – traffic flow performance – prior

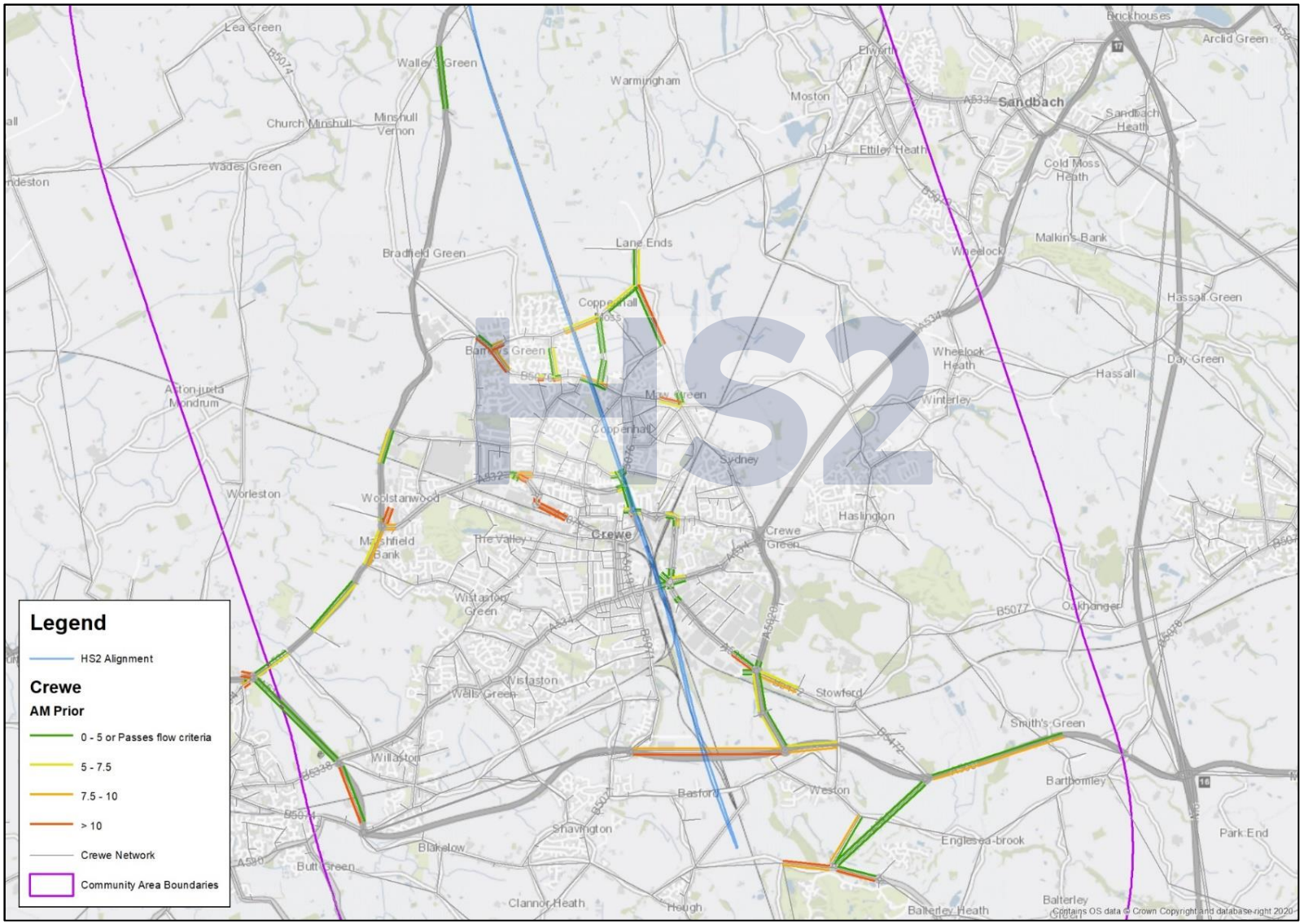


Figure 5: PM peak hour – traffic flow performance – prior

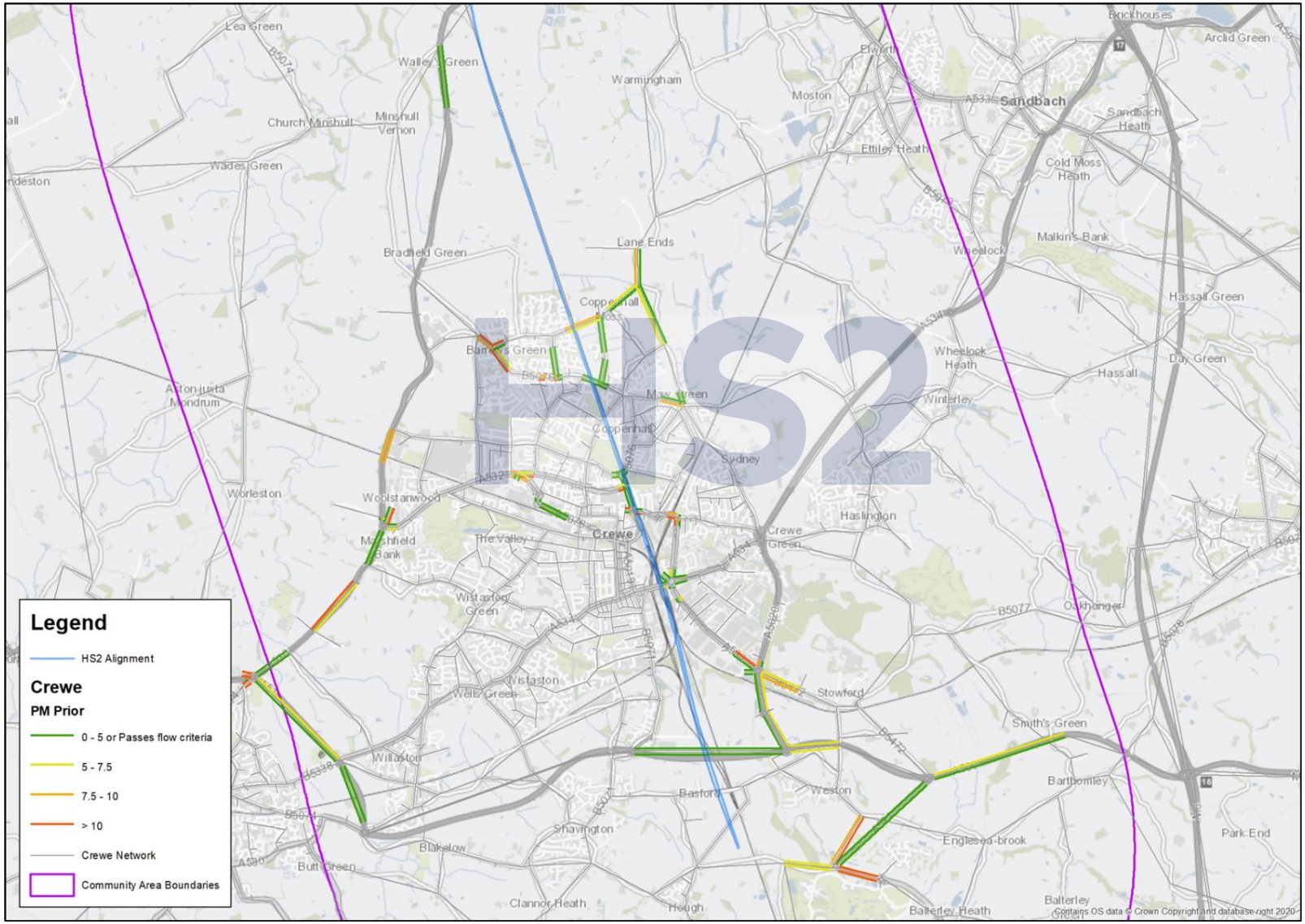


Figure 6: AM peak hour – traffic flow performance – post

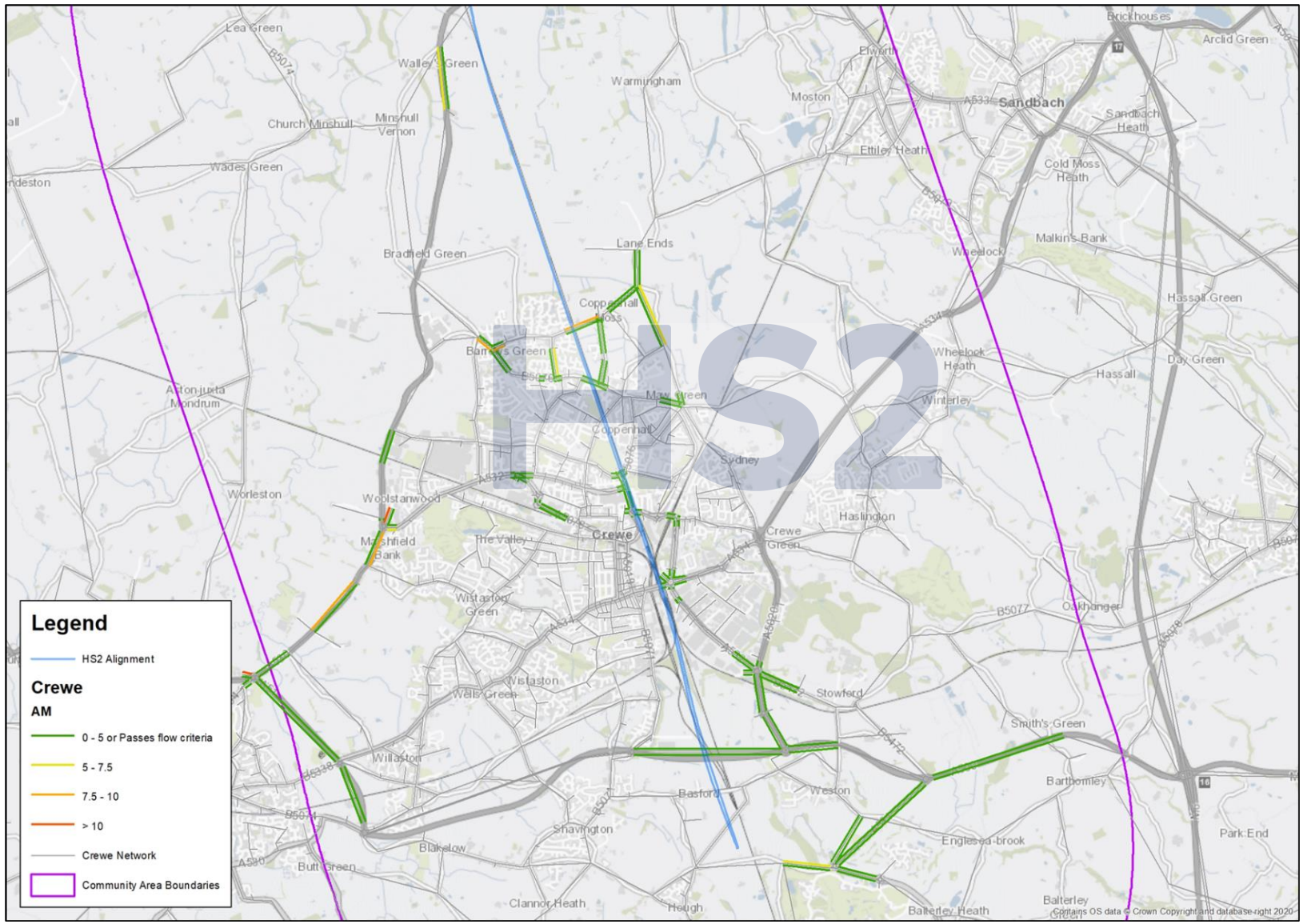
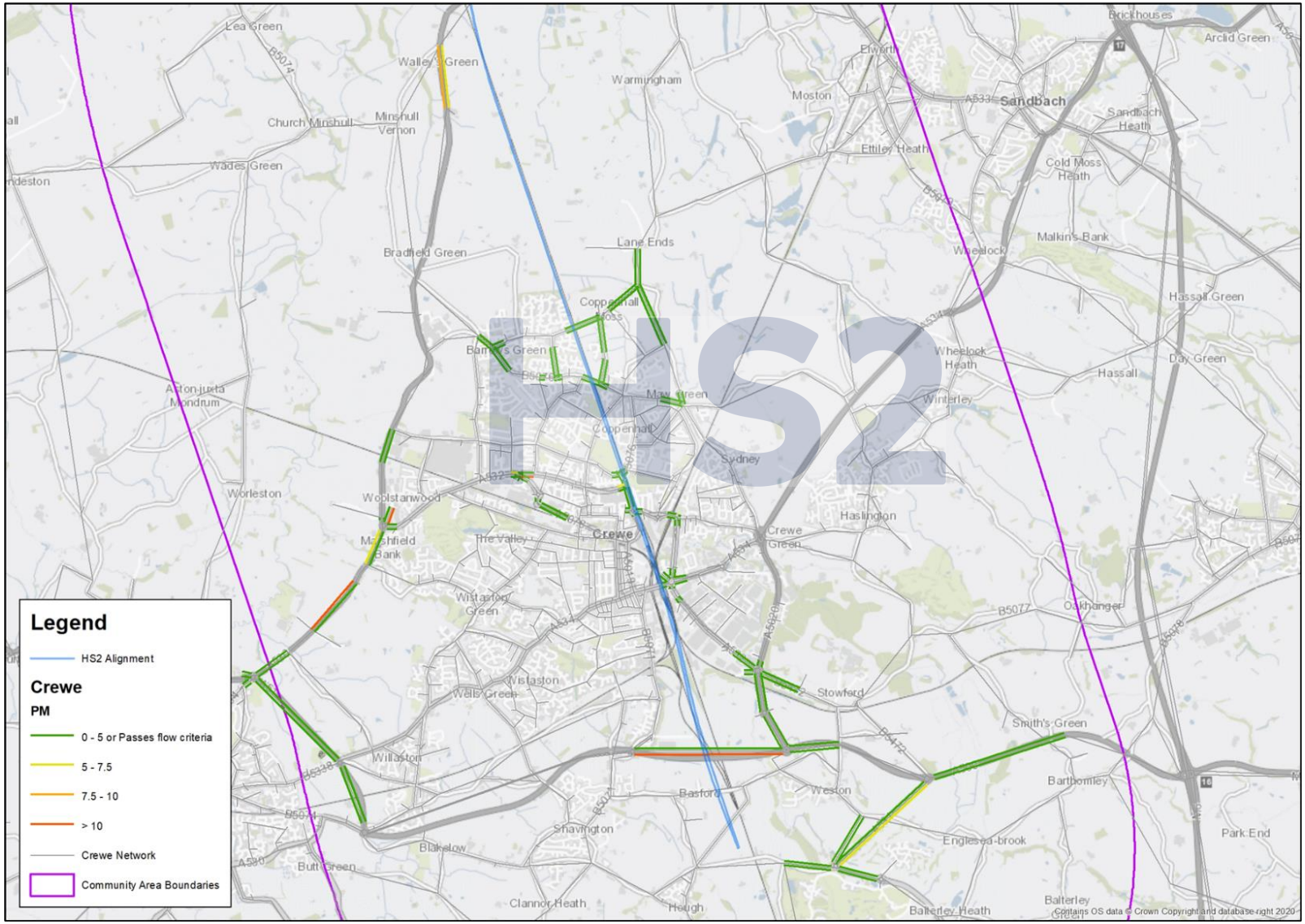


Figure 7: PM peak hour – traffic flow performance – post



6 Model convergence

6.1.1 Achieving a suitable level of model convergence is necessary to provide stable, consistent and robust model results and to differentiate between real changes and those associated with differing degrees of convergence.

6.1.2 DfT TAG provides guidance on highway model convergence with recommendations on acceptable variations in link flows and costs between iterations helping to ensure the model is sufficiently stable.

6.1.3 Table 7 presents a summary of the 2018 base year highway model convergence statistics by time period. It is evident that the AM flow change convergence measure is very close to meeting the guidance criteria of four loops greater than 98 percent, and the PM falls below the target. The change in cost measure and percentage GAP values exceed the DfT TAG guidance criteria. The impact of the change in flow measure falling slightly short of the guidance criteria is that this may result in some model instability and this would be more apparent when traffic flow volumes are greater in future year model forecasts.

Table 7: 2018 baseline highway model convergence

Criteria	Loop	Target	AM peak hour	PM peak hour
Flow change	N-3	> 98%	97.60	95.00
	N-2		97.40	94.00
	N-1		97.30	95.00
	N		99.00	94.60
Cost change	N-3	> 98%	99.80	99.80
	N-2		99.70	99.70
	N-1		99.70	99.80
	N		99.80	99.70
Delta		< 0.1%	0.0008/25	0.0006/14
%Gap		< 0.1%	0.0019	0.0026

7 Summary and conclusions

7.1.1 The A500 Crewe 2017 base year highway Model as supplied by Cheshire East Council has been uplifted to a 2018 base year by network updates, interpolated demand and the use of 2018 traffic surveys feeding into matrix estimation.

7.1.2 Table 8 below is a summary of the individual link flow model performance for all modelled time periods. The comparison shows that both time periods exceed the 85 percent threshold of individual links meeting either the DfT TAG flow range or GEH less than five criteria.

Table 8: Summary of individual link flows

Total all vehicle flow comparison (vehicles)							
Time period	**Number of sites**	**TAG criteria 1 flow range**		**TAG criteria 2 GEH < 5**		**TAG criteria flow range or GEH**	
		Number of counts	**Percentage**	**Number of counts**	**Percentage**	**Number of counts**	**Percentage**
AM peak hour	138	123	89%	125	91%	126	91%
PM peak hour	138	124	90%	127	92%	128	93%

7.1.3 In conclusion, the updated A500 Crewe Model provides a reliable forecasting base and forms a suitable tool for the assessment of the Proposed Scheme's construction and operational impacts within the Proposed Scheme area of interest.

8 Acronyms

Table 9: Acronyms

Acronyms	
CE	Cheshire East Council
LMVR	Local model validation report
MPR	Model performance report
TA	Transport Assessment
ES	Environmental Statement
DfT	Department for Transport
DMRB	Design Manual for Roads and Bridges
ATC	Automatic traffic count
MCC	Manual classified count
JTC	Junction turning count
GEH	Geoffrey Havers (statistic)

9 References

Department for Transport (2020), *TAG unit M3.1 Highway Assignment Modelling*. Available online at: https://www.gov.uk/government/publications/webtag-tag-unit-m3-1-highway-assignment-modelling.

Appendix A: Model performance

Individual link flow performance

Table A 1: Crewe Model – AM peak hour – individual link flows

ID*	Road name	Location	Direction	Observed flow (vehicles)				Modelled flow (vehicles)				Total flow comparison					
				Cars	LGVs	HGVs	Total	Cars	LGVs	HGVs	Total	Difference	Percentage difference	GEH	GEH <5	Flow range	GEH or flow range
	A500	West of David Whitby Way	EB	1,130	121	80	1,339	933	125	56	1,114	-14	-1%	0.42			
	Nantwich Bypass	South of Nantwich Bypass NB	NB	784	59	39	886	787	59	39	885	-1	0%	0.02	✓	✓	✓
	Marshfield Bank	Marshfield Bank NB	NB	86	12	4	101	1	12	1	14	-87	-86%	11.45	×	✓	✓
	Coppenhall Lane	West of A532 Coppenhall Lane EB	EB	510	33	3	547	427	33	8	468	-79	-14%	3.52	✓	✓	✓
	Marshfield Bank	Marshfield Bank SB	SB	351	11	2	364	3	11	1	15	-349	-96%	25.35	×	×	×
	A530 Middlewich Road	South of Pyms Lane	SB	817	58	12	887	725	58	5	788	-99	-11%	3.41	✓	✓	✓
	Coppenhall Lane	West of A532 Coppenhall Lane WB	WB	378	22	1	403	377	26	7	410	7	2%	0.34	✓	✓	✓
	Bradfield Road - Parkers Road	B5076 Bradfield Road (NW), Arm C Approach	SE	918	62	4	992	918	66	17	1,001	9	1%	0.27	✓	✓	✓
	Bradfield Road	South of Parkers Lane	NB	437	28	2	472	393	28	5	427	-45	-10%	2.14	✓	✓	✓
	West Street	West of A532 West Street EB	EB	554	37	4	598	691	37	13	741	143	24%	5.54	×	×	×
	West Street	West of A532 West Street WB	WB	608	52	3	666	608	52	13	673	7	1%	0.28	✓	✓	✓
	Bessemer Way	North of Bessemer Way NB	SB	31	3	0	34	31	3	0	34	0	0%	0.02	✓	✓	✓
	Dunwoody Street	North of Dunwoody Way SB	EB	420	28	2	453	323	28	9	360	-93	-20%	4.60	✓	✓	✓
	West Street	East of A532 West Street EB	EB	384	23	2	409	410	23	4	437	28	7%	1.38	✓	✓	✓
	Bessemer Way	North of Bessemer Way SB	NB	22	2	0	24	37	2	1	40	16	68%	2.86	✓	✓	✓
	Dunwoody Way	North of Dunwoody Way NB	WB	580	38	2	624	581	38	9	628	4	1%	0.18	✓	✓	✓
	West Street	East of A532 West Street WB	WB	287	29	1	317	64	29	3	96	-221	-70%	15.39	×	×	×
	Dunwoody Way	A5078 Dunwoody Way NB	NB	480	23	1	505	483	24	8	516	10	2%	0.46	✓	✓	✓
	Dunwoody Way	A5078 Dunwoody Way SB	SB	349	22	1	372	338	22	8	368	-4	-1%	0.23	✓	✓	✓
	Bradfield Road	East of Bradfield Road EB	EB	346	161	10	519	388	44	9	441	-78	-15%	3.56	✓	✓	✓
	Bradfield Road	East of Bradfield Road WB	WB	293	121	10	425	331	29	6	366	-60	-14%	3.00	✓	✓	✓
	Mablins Lane	South of Mablins Lane SB	SB	136	7	2	146	136	10	9	155	10	7%	0.79	✓	✓	✓
	Mablins Lane	South of Mablins Lane NB	NB	201	16	1	219	199	16	6	220	1	1%	0.10	✓	✓	✓
	Bradfield Road	East of B5076 Bradfield Road WB	EB	532	48	9	596	533	48	18	599	3	0%	0.11	✓	✓	✓
	Bradfield Road	West of B5076 Bradfield Road WB	WB	376	26	4	411	337	26	6	369	-42	-10%	2.13	✓	✓	✓
	Dunwoody Way	East of A5078 Dunwoody Way EB	EB	341	22	1	365	338	22	3	363	-2	-1%	0.12	✓	✓	✓
	Bradfeld Road	East of B5076 Bradfield Road EB	WB	528	38	4	579	530	38	11	580	1	0%	0.05	✓	✓	✓
	Dunwoody Way	East of A5078 Dunwoody Way WB	WB	482	24	1	507	483	24	3	510	3	1%	0.14	P	P	P

ID*	Road name	Location	Direction	Observed flow (vehicles)				Modelled flow (vehicles)				Total flow comparison					
				Cars	LGVs	HGVs	Total	Cars	LGVs	HGVs	Total	Difference	Percentage difference	GEH	GEH <5	Flow range	GEH or flow range
	Bradfield Road	West of Broughton Road	EB	547	31	7	586	539	31	10	580	-6	-1%	0.26	✓	✓	✓
	Bradfield Road	West of Broughton Road	WB	613	45	3	664	619	45	3	666	2	0%	0.08	✓	✓	✓
	Bradfield Road	East of Broughton Road	EB	576	33	8	621	569	33	10	612	-8	-1%	0.33	✓	✓	✓
	Broughton Road	North of Bradfield Road	NB	80	10	0	90	80	10	1	91	1	1%	0.11	✓	✓	✓
	Parkers Road	West of Broughton Road	WB	219	108	5	333	220	34	4	257	-76	-23%	4.42	✓	✓	✓
	Broughton Road	Parkers Road (N) to Bradfield Road (S)	SB	41	39	3	84	41	6	0	47	-36	-44%	4.50	✓	✓	✓
	Badger Avenue	West of Vernon Way	EB	342	25	1	368	345	25	1	370	2	1%	0.11	✓	✓	✓
	A532 West Street	West of Vernon Way	EB	386	27	3	416	271	27	3	301	-115	-28%	6.09	×	×	×
	Badger Avenue	West of Vernon Way	WB	361	24	1	386	352	24	1	377	-9	-2%	0.46	✓	✓	✓
	Vernon Way	North of Vernon Way SB	SB	393	33	1	429	385	32	15	432	3	1%	0.15	✓	✓	✓
	Middlewich Street	West of Middlewich Street NB	EB	571	41	1	613	558	41	12	611	-2	0%	0.07	✓	✓	✓
	Market Close	Market close NB	NB	4	0	0	4	0	6	0	7	3	67%	1.16	✓	✓	✓
	Vernon Way	North of Vernon Way NB	NB	613	39	1	652	611	38	13	662	10	2%	0.39	✓	✓	✓
	Vernon Way	South of Vernon Way SB	SB	404	33	1	439	387	32	16	435	-4	-1%	0.20	✓	✓	✓
	Warmingham Road	South of Groby Road	NB	321	14	0	339	322	14	6	341	2	1%	0.13	✓	✓	✓
	Earle Street	West of Earle Street EB	EB	240	15	1	257	269	15	18	302	45	17%	2.69	✓	✓	✓
	Middlewich Street	North of Vernon Way NB	WB	368	34	0	404	338	30	15	384	-21	-5%	1.05	✓	✓	✓
	A532 West Street	West of Vernon Way	WB	301	25	3	331	212	23	2	238	-93	-28%	5.53	×	✓	✓
	Vernon Way	South of Vernon Way NB	NB	600	35	2	637	605	36	14	655	19	3%	0.73	✓	✓	✓
	A532 Vernon Way	South of West Street	SB	555	44	3	602	550	43	18	611	9	1%	0.36	✓	✓	✓
	Earle Street	West of Earle Street WB	WB	215	14	1	230	218	14	27	259	29	13%	1.86	✓	✓	✓
	A532 Vernon Way	South of West Street	NB	673	44	3	720	709	44	16	768	48	7%	1.75	✓	✓	✓
	Vernon Way	South of Vernon Way SB	SB	628	40	1	668	625	39	1	664	-4	-1%	0.14	✓	✓	✓
	Earle Street	Earle Street EB	EB	860	61	3	926	856	61	8	926	0	0%	0.01	✓	✓	✓
	Warmingham Road	South of Groby Road	SB	266	29	2	298	263	29	4	296	-3	-1%	0.16	✓	✓	✓
	Warmingham Road/Groby Road	Groby Road (E), Arm B Exit	EB	212	19	0	234	176	14	0	190	-43	-19%	2.97	✓	✓	✓
	Warmingham Road	North of Groby Road	NB	476	26	0	505	430	26	6	462	-43	-9%	1.96	✓	✓	✓
	Earle Street	Earle Street WB	WB	893	56	3	952	893	57	14	964	12	1%	0.39	✓	✓	✓
	Tommy's Lane	South of Tommy's lane SB	EB	71	6	1	78	71	3	0	74	-4	-5%	0.42	✓	✓	✓
	Warmingham Road/Groby Road	Groby Road (E), Arm B Approach	WB	262	21	0	282	174	12	0	186	-96	-34%	6.25	×	✓	✓
	A534 Nantwich Road	West of A532 Weston Road	WB	743	46	6	798	747	58	16	821	23	3%	0.81	✓	✓	✓
	A532 Manchester Bridge	West of Macon Way	EB	894	66	4	966	992	66	9	1,067	101	10%	3.16	✓	✓	✓
	Tommy's Lane	South of Tommy's lane NB	WB	79	6	0	84	79	5	0	84	-1	-1%	0.07	✓	✓	✓
	A532 Weston Road	South of A534 Nantwich Road	NB	592	43	12	649	591	35	14	640	-8	-1%	0.33	✓	✓	✓
	A532 Macon Way	North of A534 Nantwich Road	NB	668	38	4	709	666	35	4	705	-4	-1%	0.16	✓	✓	✓

ID*	Road name	Location	Direction	Observed flow (vehicles)				Modelled flow (vehicles)				Total flow comparison					
				Cars	LGVs	HGVs	Total	Cars	LGVs	HGVs	Total	Difference	Percentage difference	GEH	GEH <5	Flow range	GEH or flow range
	A532 Macon Way	North of A534 Nantwich Road	SB	576	38	3	617	578	40	5	624	7	1%	0.29	✓	✓	✓
	A534 Crewe Road	East of A532 Weston Road	EB	431	27	3	467	431	27	7	465	-2	-1%	0.11	✓	✓	✓
	A532 Manchester Bridge	West of Macon Way	WB	1,006	63	3	1,072	1,005	63	14	1,083	11	1%	0.33	✓	✓	✓
	A532 Macon Way	South of A532 Manchester Bridge	NB	795	37	3	835	679	37	3	720	-116	-14%	4.15	✓	✓	✓
	A532 Macon Way	South of A532 Manchester Bridge	SB	466	39	3	508	468	39	6	512	4	1%	0.18	✓	✓	✓
	Weston Road	Weston Road Service Road (N) to Unnamed Road (S)	SB	608	35	10	656	607	35	12	655	-1	0%	0.04	✓	✓	✓
	Hungerford Road	East of A532 Macon Way	EB	717	51	1	771	698	51	3	753	-18	-2%	0.67	✓	✓	✓
	Groby Road	North of Sydney Road	SB	181	13	0	194	181	16	0	197	2	1%	0.17	✓	✓	✓
	Hungerford Road	East of A532 Macon Way	WB	499	50	1	550	500	50	12	561	12	2%	0.49	✓	✓	✓
	Weston Road	Unnamed Road (S) to Weston Road Service Road (N)	NB	485	32	6	525	487	35	9	531	6	1%	0.26	✓	✓	✓
	Groby Road	North of Sydney Road	NB	168	12	0	180	169	15	1	185	5	3%	0.36	✓	✓	✓
	Sydney Road	South of Groby Road	NB	495	45	2	545	495	45	17	558	13	2%	0.55	✓	✓	✓
	Savoy Road	East of Savoy road EB	EB	118	5	4	127	118	5	1	124	-3	-3%	0.28	✓	✓	✓
	Savoy Road	East of Savoy road WB	WB	12	1	5	18	14	0	4	19	1	8%	0.32	✓	✓	✓
	A532 Weston Road	West of A5020 University Way	NB	321	42	51	417	321	30	29	380	-37	-9%	1.87	✓	✓	✓
	A5020 David Whitby Way	South of A532	SB	868	64	18	952	866	63	18	946	-5	-1%	0.17	✓	✓	✓
	A5020 University Way	North of Weston Road	NB	445	47	10	503	445	47	9	501	-2	0%	0.09	✓	✓	✓
	A5020 University Way	North of Weston Road	SB	579	55	11	647	572	55	11	638	-8	-1%	0.32	✓	✓	✓
	B5472 Weston Road	East of David Whitby Way	EB	941	68	9	1,019	933	68	5	1,006	-13	-1%	0.40	✓	✓	✓
	A5020 David Whitby Way	South of A532	NB	279	36	29	349	279	36	30	345	-4	-1%	0.22	✓	✓	✓
	A500	West of David Whitby Way	WB	933	126	62	1,128	1,354	128	46	1,528	400	35%	10.97	×	×	×
	A5020 David Whitby Way	North of A500	SB	284	28	32	348	283	28	32	343	-4	-1%	0.22	✓	✓	✓
	Parkers Road	West of Broughton Road	EB	347	114	6	468	347	25	4	377	-91	-20%	4.44	✓	✓	✓
	Parkers Road	East of Bradfield Road	WB	226	22	1	250	227	22	8	257	7	3%	0.42	✓	✓	✓
	Bradfield Road - Parkers Road	B5076 Bradfield Road (NW), Arm C Exit	NW	569	38	3	615	575	42	14	631	16	3%	0.64	✓	✓	✓
	Bradfield Road	South of Parkers Lane	SB	514	36	3	558	474	36	6	516	-42	-7%	1.80	✓	✓	✓
	Parkers Road	East of Bradfield Road	EB	498	38	2	542	489	38	11	538	-4	-1%	0.18	✓	✓	✓
	A534 Nantwich Road	West of A532 Weston Road	EB	672	47	6	732	674	47	13	735	3	0%	0.11	✓	✓	✓
	A534 Crewe Road	East of A532 Weston Road	WB	567	31	9	609	568	31	14	613	3	1%	0.13	✓	✓	✓
	A532 Weston Road	South of A534 Nantwich Road	NB	627	38	6	672	631	38	8	677	5	1%	0.20	✓	✓	✓

ID*	Road name	Location	Direction	Observed flow (vehicles)				Modelled flow (vehicles)				Total flow comparison					
				Cars	LGVs	HGVs	Total	Cars	LGVs	HGVs	Total	Difference	Percentage difference	GEH	GEH <5	Flow range	GEH or flow range
	Market Close	Market close SB	SB	8	0	0	8	2	10	0	12	4	55%	1.35	✓	✓	✓
	Vernon Way	South of Vernon Way NB	NB	695	43	1	739	696	43	1	739	0	0%	0.01	✓	✓	✓
	Remer Street	West of Groby Road	EB	420	34	7	462	418	34	7	459	-2	-1%	0.11	✓	✓	✓
	Bradfield Road	East of Broughton Road	WB	655	50	3	711	661	50	4	715	4	1%	0.15	✓	✓	✓
	Bradfield Road	West of B5076 Bradfield Road EB	EB	438	42	8	493	402	42	9	453	-40	-8%	1.83	✓	✓	✓
	Broughton Road	Bradfield Road (S) to Parkers Road (N)	NB	54	27	2	85	54	10	1	65	-20	-24%	2.32	✓	✓	✓
	Broughton Road	North of Bradfield Road	SB	67	7	1	77	67	7	0	74	-3	-4%	0.33	✓	✓	✓
	A532 Weston Road	West of A5020 University Way	SB	1,208	85	21	1,316	1,198	71	18	1,286	-29	-2%	0.82	✓	✓	✓
	Middlewich Road	North of B5334 SB	WB	617	40	2	660	579	40	7	626	-34	-5%	1.36	✓	✓	✓
	Middlewich Road	North of B5334 NB	EB	632	52	3	689	591	51	8	650	-39	-6%	1.51	✓	✓	✓
	Nantwich Bypass	South of Nantwich Bypass SB	SB	713	72	44	843	696	71	44	810	-32	-4%	1.12	✓	✓	✓
	A530 Middlewich Road	South of Brookhouse Lane	SB	258	263	11	533	284	93	13	390	-143	-27%	6.65	×	×	×
	A530 Middlewich Road	South of Brookhouse Lane	NB	373	310	17	702	371	93	19	483	-219	-31%	8.99	×	×	×
	A51	South of Nantwich Tennis Club	WB	712	74	39	826	711	74	37	822	-5	-1%	0.16	✓	✓	✓
	Middlewich Road	South of Nantwich Road NB	EB	770	68	11	850	762	67	12	841	-10	-1%	0.34	✓	✓	✓
	A51 - A530	A51 Nantwich Bypass (S), Arm C Exit	SB	701	90	35	829	682	88	35	805	-24	-3%	0.82	✓	✓	✓
	Middlewich Road	South of Nantwich Road SB	WB	646	38	4	690	650	38	9	697	8	1%	0.29	✓	✓	✓
	A530 Middlewich Road	South of Wistaston Green Road	NB	391	221	7	620	798	99	12	908	288	46%	10.41	×	×	×
	A51 - A531	A51 Nantwich Bypass (S), Arm C Approach	NB	682	76	42	801	707	76	40	823	21	3%	0.75	✓	✓	✓
	A530 Middlewich Road	South of Wistaston Green Road	SB	387	278	17	684	728	73	13	814	129	19%	4.72	✓	×	✓
	A530 Middlewich Road	North of Wistaston Green Road	NB	669	58	11	740	828	57	16	901	161	22%	5.61	×	×	×
	A530 Middlewich Road	North of Wistaston Green Road	SB	1,055	57	4	1,118	1,058	58	11	1,127	9	1%	0.26	✓	✓	✓
	A530 Middlewich Road	South of Pyms Lane	NB	575	37	9	622	539	37	9	584	-38	-6%	1.54	✓	✓	✓
	A530 Middlewich Road	North of A532 Coppenhall Lane	SB	821	49	5	875	820	50	5	875	0	0%	0.00	✓	✓	✓
	A530 Middlewich Road	North of A532 Coppenhall Lane	NB	567	39	9	616	541	41	9	591	-24	-4%	0.99	✓	✓	✓
	A51	South of Nantwich Tennis Club	EB	760	100	39	901	741	98	38	876	-25	-3%	0.84	✓	✓	✓
	Unnamed Road	Near to Alvaston Business Park	WB	30	3	1	34	30	10	1	41	7	21%	1.15	✓	✓	✓
	Unnamed Road	Near to Alvaston Business Park	EB	109	8	1	117	162	25	0	187	70	59%	5.64	×	✓	✓
	Warmingham Road	North of Groby Road	SB	372	39	2	416	373	44	4	421	4	1%	0.20	✓	✓	✓
	A5020 David Whitby Way	North of A500	SB	879	64	18	963	830	63	18	911	-52	-5%	1.71	✓	✓	✓
	Newcastle Road	North of Chorlton Lane	EB	318	33	2	355	318	33	2	353	-2	0%	0.09	✓	✓	✓
	A500	East of David Whitby Way	EB	973	130	61	1,170	973	102	61	1,137	-33	-3%	0.97	✓	✓	✓
	Newcastle Road	North of Chorlton Lane	WB	386	31	0	417	388	31	3	422	4	1%	0.21	✓	✓	✓
	Main Road	South of Snape Lane	SB	172	14	1	189	172	14	5	191	2	1%	0.12	✓	✓	✓
	A531	South of A500	NB	171	17	2	192	171	17	1	189	-3	-1%	0.20	✓	✓	✓

ID*	Road name	Location	Direction	Observed flow (vehicles)				Modelled flow (vehicles)				Total flow comparison					
				Cars	LGVs	HGVs	Total	Cars	LGVs	HGVs	Total	Difference	Percentage difference	GEH	GEH <5	Flow range	GEH or flow range
	Newcastle Road	Between A531 roundabout and Abbey Park Way roundabout	EB	775	51	2	832	775	47	4	826	-6	-1%	0.20	✓	✓	✓
	A500	East of David Whitby Way	WB	848	85	66	1,000	847	70	66	983	-17	-2%	0.54	✓	✓	✓
	Main Road	South of Snape Lane	NB	371	25	1	399	371	25	3	399	0	0%	0.01	✓	✓	✓
	Newcastle Road	Between A531 roundabout and Abbey Park Way roundabout	WB	445	27	1	475	442	27	5	475	0	0%	0.01	✓	✓	✓
	A531	South of A500	SB	270	24	3	299	374	24	3	401	102	34%	5.45	×	×	×
	A500	East of B5472	EB	1,116	147	61	1,330	1,216	147	62	1,425	95	7%	2.56	✓	✓	✓
	A500	East of B5472	WB	1,213	106	79	1,398	1,214	107	69	1,389	-9	-1%	0.24	✓	✓	✓
	B5472 Weston Road	East of David Whitby Way	WB	401	41	27	470	410	41	5	456	-14	-3%	0.66	✓	✓	✓

** ID not defined*

Table A 2: Crewe Model – AM peak hour – individual link flows

ID*	Road name	Location	Direction	Observed flow (vehicles)				Modelled flow (vehicles)				Total flow comparison					
				Cars	LGVs	HGVs	Total	Cars	LGVs	HGVs	Total	Difference	Percentage difference	GEH	GEH <5	Flow range	GEH or flow range
	A500	West of David Whitby Way	EB	933	126	62	1,128	933	125	56	1,114	-14	-1%	0.42	✓	✓	✓
	Nantwich Bypass	South of Nantwich Bypass NB	NB	784	59	39	886	787	59	39	885	-1	0%	0.02	✓	✓	✓
	Marshfield Bank	Marshfield Bank NB	NB	86	12	4	101	1	12	1	14	-87	-86%	11.45	×	✓	✓
	Coppenhall Lane	West of A532 Coppenhall Lane EB	EB	510	33	3	547	427	33	8	468	-79	-14%	3.52	✓	✓	✓
	Marshfield Bank	Marshfield Bank SB	SB	351	11	2	364	3	11	1	15	-349	-96%	25.35	×	×	×
	A530 Middlewich Road	South of Pyms Lane	SB	817	58	12	887	725	58	5	788	-99	-11%	3.41	✓	✓	✓
	Coppenhall Lane	West of A532 Coppenhall Lane WB	WB	378	22	1	403	377	26	7	410	7	2%	0.34	✓	✓	✓
	Bradfield Road - Parkers Road	B5076 Bradfield Road (NW), Arm C Approach	SE	918	62	4	992	918	66	17	1001	9	1%	0.27	✓	✓	✓
	Bradfield Road	South of Parkers Lane	NB	437	28	2	472	393	28	5	427	-45	-10%	2.14	✓	✓	✓
	West Street	West of A532 West Street EB	EB	554	37	4	598	691	37	13	741	143	24%	5.54	×	×	×
	West Street	West of A532 West Street WB	WB	608	52	3	666	608	52	13	673	7	1%	0.28	✓	✓	✓
	Bessemer Way	North of Bessemer Way NB	SB	31	3	0	34	31	3	0	34	0	0%	0.02	✓	✓	✓
	Dunwoody Way	North of Dunwoody way SB	EB	420	28	2	453	323	28	9	360	-93	-20%	4.60	✓	✓	✓
	West Street	East of A532 West Street EB	EB	384	23	2	409	410	23	4	437	28	7%	1.38	✓	✓	✓
	Bessemer Way	North of Bessemer Way SB	NB	22	2	0	24	37	2	1	40	16	68%	2.86	✓	✓	✓
	Dunwoody Way	North of Dunwoody way NB	WB	580	38	2	624	581	38	9	628	4	1%	0.18	✓	✓	✓
	West Street	East of A532 West Street WB	WB	287	29	1	317	64	29	3	96	-221	-70%	15.39	×	×	×
	Dunwoody Way	A5078 Dunwoody Way NB	NB	480	23	1	505	483	24	8	516	10	2%	0.46	✓	✓	✓
	Dunwoody Way	A5078 Dunwoody Way SB	SB	349	22	1	372	338	22	8	368	-4	-1%	0.23	✓	✓	✓
	Bradfield Road	East of Bradfield Road EB	EB	346	161	10	519	388	44	9	441	-78	-15%	3.56	✓	✓	✓
	Bradfield Road	East of Bradfield Road WB	WB	293	121	10	425	331	29	6	366	-60	-14%	3.00	✓	✓	✓

ID*	Road name	Location	Direction	Observed flow (vehicles)				Modelled flow (vehicles)				Total flow comparison					
				Cars	LGVs	HGVs	Total	Cars	LGVs	HGVs	Total	Difference	Percentage difference	GEH	GEH <5	Flow range	GEH or flow range
	Mablins Lane	South of Mablins Lane SB	SB	136	7	2	146	136	10	9	155	10	7%	0.79	✓	✓	✓
	Mablins Lane	South of Mablins Lane NB	NB	201	16	1	219	199	16	6	220	1	1%	0.10	✓	✓	✓
	Bradfield Road	East of B5076 Bradfield Road WB	EB	532	48	9	596	533	48	18	599	3	0%	0.11	✓	✓	✓
	Bradfield Road	West of B5076 Bradfield Road WB	WB	376	26	4	411	337	26	6	369	-42	-10%	2.13	✓	✓	✓
	Dunwoody Way	East of A5078 Dunwoody Way EB	EB	341	22	1	365	338	22	3	363	-2	-1%	0.12	✓	✓	✓
	Bradfield Road	East of B5076 Bradfield Road EB	WB	528	38	4	579	530	38	11	580	1	0%	0.05	✓	✓	✓
	Dunwoody Way	East of A5078 Dunwoody Way WB	WB	482	24	1	507	483	24	3	510	3	1%	0.14	✓	✓	✓
	Bradfield Road	West of Broughton Road	EB	547	31	7	586	539	31	10	580	-6	-1%	0.26	✓	✓	✓
	Bradfield Road	West of Broughton Road	WB	613	45	3	664	619	45	3	666	2	0%	0.08	✓	✓	✓
	Bradfield Road	East of Broughton Road	EB	576	33	8	621	569	33	10	612	-8	-1%	0.33	✓	✓	✓
	Broughton Road	North of Bradfield Road	NB	80	10	0	90	80	10	1	91	1	1%	0.11	✓	✓	✓
	Parkers Road	West of Broughton Road	WB	219	108	5	333	220	34	4	257	-76	-23%	4.42	✓	✓	✓
	Broughton Road	Parkers Road (N) to Bradfield Road (S)	SB	41	39	3	84	41	6	0	47	-36	-44%	4.50	✓	✓	✓
	Badger Avenue	West of Vernon Way	EB	342	25	1	368	345	25	1	370	2	1%	0.11	✓	✓	✓
	A532 West Street	West of Vernon Way	EB	386	27	3	416	271	27	3	301	-115	-28%	6.09	×	×	×
	Badger Avenue	West of Vernon Way	WB	361	24	1	386	352	24	1	377	-9	-2%	0.46	✓	✓	✓
	Vernon Way	North of Vernon Way SB	SB	393	33	1	429	385	32	15	432	3	1%	0.15	✓	✓	✓
	Middlewich Street	West of Middlewich Street NB	EB	571	41	1	613	558	41	12	611	-2	0%	0.07	✓	✓	✓
	Market Close	Market close NB	NB	4	0	0	4	0	6	0	7	3	67%	1.16	✓	✓	✓
	Vernon Way	North of Vernon Way NB	NB	613	39	1	652	611	38	13	662	10	2%	0.39	✓	✓	✓
	Vernon Way	South of Vernon Way SB	SB	404	33	1	439	387	32	16	435	-4	-1%	0.20	✓	✓	✓
	Warmingham Road	South of Groby Road	NB	321	14	0	339	322	14	6	341	2	1%	0.13	✓	✓	✓
	Earle Street	West of Earles Street EB	EB	240	15	1	257	269	15	18	302	45	17%	2.69	✓	✓	✓
	Middlewich Street	North of Vernon Way NB	WB	368	34	0	404	338	30	15	384	-21	-5%	1.05	✓	✓	✓
	A532 West Street	West of Vernon Way	WB	301	25	3	331	212	23	2	238	-93	-28%	5.53	×	✓	✓
	Vernon Way	South of Vernon Way NB	NB	600	35	2	637	605	36	14	655	19	3%	0.73	✓	✓	✓
	A532 Veron Way	South of West Street	SB	555	44	3	602	550	43	18	611	9	1%	0.36	✓	✓	✓
	Earle Street	West of Earle Street WB	WB	215	14	1	230	218	14	27	259	29	13%	1.86	✓	✓	✓
	A532 Veron Way	South of West Street	NB	673	44	3	720	709	44	16	768	48	7%	1.75	✓	✓	✓
	Vernon Way	South of Vernon Way SB	SB	628	40	1	668	625	39	1	664	-4	-1%	0.14	✓	✓	✓
	Earle Street	Earle Street EB	EB	860	61	3	926	856	61	8	926	0	0%	0.01	✓	✓	✓
	Warmingham Road	South of Groby Road	SB	266	29	2	298	263	29	4	296	-3	-1%	0.16	✓	✓	✓
	Warmingham Road/Groby Road	Groby Road (E), Arm B Exit	EB	212	19	0	234	176	14	0	190	-43	-19%	2.97	✓	✓	✓
	Warmingham Road	North of Groby Road	NB	476	26	0	505	430	26	6	462	-43	-9%	1.96	✓	✓	✓
	Earle Street	Earle Street WB	WB	893	56	3	952	893	57	14	964	12	1%	0.39	✓	✓	✓

ID*	Road name	Location	Direction	Observed flow (vehicles)				Modelled flow (vehicles)				Total flow comparison					
				Cars	LGVs	HGVs	Total	Cars	LGVs	HGVs	Total	Difference	Percentage difference	GEH	GEH <5	Flow range	GEH or flow range
	Tommy's Lane	South of Tommy's lane SB	EB	71	6	1	78	71	3	0	74	-4	-5%	0.42	✓	✓	✓
	Warmingham Road/Groby Road	Groby Road (E), Arm B Approach	WB	262	21	0	282	174	12	0	186	-96	-34%	6.25	×	✓	✓
	A534 Nantwich Road	West of A532 Weston Road	WB	743	46	6	798	747	58	16	821	23	3%	0.81	✓	✓	✓
	A532 Manchester Bridge	West of Macon Way	EB	894	66	4	966	992	66	9	1,067	101	10%	3.16	✓	✓	✓
	Tommy's Lane	South of Tommy's lane NB	WB	79	6	0	84	79	5	0	84	-1	-1%	0.07	✓	✓	✓
	A532 Weston Road	South of A534 Nantwich Road	NB	592	43	12	649	591	35	14	640	-8	-1%	0.33	✓	✓	✓
	A532 Macon Way	North of A534 Nantwich Road	NB	668	38	4	709	666	35	4	705	-4	-1%	0.16	✓	✓	✓
	A532 Macon Way	North of A534 Nantwich Road	SB	576	38	3	617	578	40	5	624	7	1%	0.29	✓	✓	✓
	A534 Crewe Road	East of A532 Weston Road	EB	431	27	3	467	431	27	7	465	-2	-1%	0.11	✓	✓	✓
	A532 Manchester Bridge	West of Macon Way	WB	1,006	63	3	1,072	1,005	63	14	1,083	11	1%	0.33	✓	✓	✓
	A532 Macon Way	South of A532 Manchester Bridge	NB	795	37	3	835	679	37	3	720	-116	-14%	4.15	✓	✓	✓
	A532 Macon Way	South of A532 Manchester Bridge	SB	466	39	3	508	468	39	6	512	4	1%	0.18	✓	✓	✓
	Weston Road	Weston Road Service Road (N) to Unnamed Road (S)	SB	608	35	10	656	607	35	12	655	-1	0%	0.04	✓	✓	✓
	Hungerford Road	East of A532 Macon Way	EB	717	51	1	771	698	51	3	753	-18	-2%	0.67	✓	✓	✓
	Groby Road	North of Sydney Road	SB	181	13	0	194	181	16	0	197	2	1%	0.17	✓	✓	✓
	Hungerford Road	East of A532 Macon Way	WB	499	50	1	550	500	50	12	561	12	2%	0.49	✓	✓	✓
	Weston Road	Unnamed Road (S) to Weston Road Service Road (N)	NB	485	32	6	525	487	35	9	531	6	1%	0.26	✓	✓	✓
	Groby Road	North of Sydney Road	NB	168	12	0	180	169	15	1	185	5	3%	0.36	✓	✓	✓
	Sydney Road	South of Groby Road	SB	583	47	7	637	584	48	7	638	1	0%	0.05	✓	✓	✓
	Remer Street	West of Groby Road	EB	340	32	2	376	341	32	17	390	14	4%	0.70	✓	✓	✓
	Sydney Road	South of Groby Road	NB	495	45	2	545	495	45	17	558	13	2%	0.55	✓	✓	✓
	Savoy Road	East of Savoy Road EB	EB	118	5	4	127	118	5	1	124	-3	-3%	0.28	✓	✓	✓
	Savoy Road	East of Savoy Road WB	WB	12	1	5	18	14	0	4	19	1	8%	0.32	✓	✓	✓
	A532 Weston Road	West of A5020 University Way	NB	321	42	51	417	321	30	29	380	-37	-9%	1.87	✓	✓	✓
	A5020 David Whitby Way	South of A532	SB	868	64	18	952	866	63	18	946	-5	-1%	0.17	✓	✓	✓
	A5020 University Way	North of Weston Road	NB	445	47	10	503	445	47	9	501	-2	0%	0.09	✓	✓	✓
	A5020 University Way	North of Weston Road	SB	579	55	11	647	572	55	11	638	-8	-1%	0.32	✓	✓	✓
	B5472 Weston Road	East of David Whitby Way	EB	941	68	9	1,019	933	68	5	1,006	-13	-1%	0.40	✓	✓	✓
	A5020 David Whitby Way	South of A532	NB	279	36	29	349	279	36	30	345	-4	-1%	0.22	✓	✓	✓
	A500	West of David Whitby Way	WB	933	126	62	1,128	1,354	128	46	1,528	400	35%	10.97	×	×	×
	A5020 David Whitby Way	North of A500	SB	284	28	32	348	283	28	32	343	-4	-1%	0.22	✓	✓	✓

ID*	Road name	Location	Direction	Observed flow (vehicles)				Modelled flow (vehicles)				Total flow comparison					
				Cars	LGVs	HGVs	Total	Cars	LGVs	HGVs	Total	Difference	Percentage difference	GEH	GEH <5	Flow range	GEH or flow range
	Parkers Road	West of Broughton Road	EB	347	114	6	468	347	25	4	377	-91	-20%	4.44	✓	✓	✓
	Parkers Road	East of Bradfield Road	WB	226	22	1	250	227	22	8	257	7	3%	0.42	✓	✓	✓
	Bradfield Road - Parkers Road	B5076 Bradfield Road (NW), Arm C Exit	NW	569	38	3	615	575	42	14	631	16	3%	0.64	✓	✓	✓
	Bradfield Road	South of Parkers Lane	SB	514	36	3	558	474	36	6	516	-42	-7%	1.80	✓	✓	✓
	Parkers Road	East of Bradfield Road	EB	498	38	2	542	489	38	11	538	-4	-1%	0.18	✓	✓	✓
	A534 Nantwich Road	West of A532 Weston Road	EB	672	47	6	732	674	47	13	735	3	0%	0.11	✓	✓	✓
	A534 Crewe Road	East of A532 Weston Road	WB	567	31	9	609	568	31	14	613	3	1%	0.13	✓	✓	✓
	A532 Weston Road	South of A534 Nantwich Road	NB	627	38	6	672	631	38	8	677	5	1%	0.20	✓	✓	✓
	Market Close	Market close SB	SB	8	0	0	8	2	10	0	12	4	55%	1.35	✓	✓	✓
	Vernon Way	South of Vernon Way NB	NB	695	43	1	739	696	43	1	739	0	0%	0.01	✓	✓	✓
	Remer Street	West of Groby Road	EB	420	34	7	462	418	34	7	459	-2	-1%	0.11	✓	✓	✓
	Bradfield Road	East of Broughton Road	WB	655	50	3	711	661	50	4	715	4	1%	0.15	✓	✓	✓
	Bradfield Road	West of B5076 Bradfield Road EB	EB	438	42	8	493	402	42	9	453	-40	-8%	1.83	✓	✓	✓
	Broughton Road	Bradfield Road (S) to Parkers Road (N)	NB	54	27	2	85	54	10	1	65	-20	-24%	2.32	✓	✓	✓
	Broughton Road	North of Bradfield Road	SB	67	7	1	77	67	7	0	74	-3	-4%	0.33	✓	✓	✓
	A532 Weston Road	West of A5020 University Way	SB	1,208	85	21	1,316	1,198	71	18	1,286	-29	-2%	0.82	✓	✓	✓
	Middlewich Road	North of B5334 SB	WB	617	40	2	660	579	40	7	626	-34	-5%	1.36	✓	✓	✓
	Middlewich Road	North of B5334 NB	EB	632	52	3	689	591	51	8	650	-39	-6%	1.51	✓	✓	✓
	Nantwich Bypass	South of Nantwich Bypass SB	SB	713	72	44	843	696	71	44	810	-32	-4%	1.12	✓	✓	✓
	A530 Middlewich Road	South of Brookhouse Lane	SB	258	263	11	533	284	93	13	390	-143	-27%	6.65	×	×	×
	A530 Middlewich Road	South of Brookhouse Lane	NB	373	310	17	702	371	93	19	483	-219	-31%	8.99	×	×	×
	A51	South of Nantwich Tennis Club	WB	712	74	39	826	711	74	37	822	-5	-1%	0.16	✓	✓	✓
	Middlewich Road	South of Nantwich Road NB	EB	770	68	11	850	762	67	12	841	-10	-1%	0.34	✓	✓	✓
	A51 - A530	A51 Nantwich Bypass (S), Arm C Exit	SB	701	90	35	829	682	88	35	805	-24	-3%	0.82	✓	✓	✓
	Middlewich Road	South of Nantwich Road SB	WB	646	38	4	690	650	38	9	697	8	1%	0.29	✓	✓	✓
	A530 Middlewich Road	South of Wistaston Green Road	NB	391	221	7	620	798	99	12	908	288	46%	10.41	×	×	×
	A51 - A531	A51 Nantwich Bypass (S), Arm C Approach	NB	682	76	42	801	707	76	40	823	21	3%	0.75	✓	✓	✓
	A530 Middlewich Road	South of Wistaston Green Road	SB	387	278	17	684	728	73	13	814	129	19%	4.72	✓	×	✓
	A530 Middlewich Road	North of Wistaston Green Road	NB	669	58	11	740	828	57	16	901	161	22%	5.61	×	×	×
	A530 Middlewich Road	North of Wistaston Green Road	SB	1,055	57	4	1,118	1,058	58	11	1,127	9	1%	0.26	✓	✓	✓
	A530 Middlewich Road	South of Pyms Lane	NB	575	37	9	622	539	37	9	584	-38	-6%	1.54	✓	✓	✓
	A530 Middlewich Road	North of A532 Coppenhall Lane	SB	821	49	5	875	820	50	5	875	0	0%	0.00	✓	✓	✓
	A530 Middlewich Road	North of A532 Coppenhall Lane	NB	567	39	9	616	541	41	9	591	-24	-4%	0.99	✓	✓	✓
	A51	South of Nantwich Tennis Club	EB	760	100	39	901	741	98	38	876	-25	-3%	0.84	✓	✓	✓
	Unnamed Road	Near to Alvaston Business Park	WB	30	3	1	34	30	10	1	41	7	21%	1.15	✓	✓	✓

ID*	Road name	Location	Direction	Observed flow (vehicles)				Modelled flow (vehicles)				Total flow comparison					
				Cars	LGVs	HGVs	Total	Cars	LGVs	HGVs	Total	Difference	Percentage difference	GEH	GEH <5	Flow range	GEH or flow range
	Unnamed Road	Near to Alvaston Business Park	EB	109	8	1	117	162	25	0	187	70	59%	5.64	×	✓	✓
	Warmingham Road	North of Groby Road	SB	372	39	2	416	373	44	4	421	4	1%	0.20	✓	✓	✓
	A5020 David Whitby Way	North of A500	SB	879	64	18	963	830	63	18	911	-52	-5%	1.71	✓	✓	✓
	Newcastle Road	North of Chorlton Lane	EB	318	33	2	355	318	33	2	353	-2	0%	0.09	✓	✓	✓
	A500	East of David Whitby Way	EB	973	130	61	1,170	973	102	61	1,137	-33	-3%	0.97	✓	✓	✓
	Newcastle Road	North of Chorlton Lane	WB	386	31	0	417	388	31	3	422	4	1%	0.21	✓	✓	✓
	Main Road	South of Snape Lane	SB	172	14	1	189	172	14	5	191	2	1%	0.12	✓	✓	✓
	A531	South of A500	NB	171	17	2	192	171	17	1	189	-3	-1%	0.20	✓	✓	✓
	Newcastle Road	Between A531 roundabout and Abbey Park Way roundabout	EB	775	51	2	832	775	47	4	826	-6	-1%	0.20	✓	✓	✓
	A500	East of David Whitby Way	WB	848	85	66	1,000	847	70	66	983	-17	-2%	0.54	✓	✓	✓
	Main Road	South of Snape Lane	NB	371	25	1	399	371	25	3	399	0	0%	0.01	✓	✓	✓
	Newcastle Road	Between A531 roundabout and Abbey Park Way roundabout	WB	445	27	1	475	442	27	5	475	0	0%	0.01	✓	✓	✓
	A531	South of A500	SB	270	24	3	299	374	24	3	401	102	34%	5.45	×	×	×
	A500	East of B5472	EB	1,116	147	61	1,330	1,216	147	62	1,425	95	7%	2.56	✓	✓	✓
	A500	East of B5472	WB	1,213	106	79	1,398	1,214	107	69	1,389	-9	-1%	0.24	✓	✓	✓
	B5472 Weston Road	East of David Whitby Way	WB	401	41	27	470	410	41	5	456	-14	-3%	0.66	✓	✓	✓

** ID not defined*

Annex G: Model performance report – Northwich Traffic Model

Contents

Tables

Figures

1 Introduction

1.1 Background information

1.1.1 This report provides documentation of a model performance review that has been carried out for the Northwich Traffic Model.

1.1.2 The local authority, Cheshire West and Chester Council (CWaC), released copies of the latest available model versions (as of January 2019) to HS2 Ltd.

1.1.3 The purpose of this report is to provide evidence that this highway assignment model is suitable to support the Transport Assessment (TA) of the Proposed Scheme.

1.1.4 For the purpose of assessment, the route of the Proposed Scheme is split into a number of geographical areas referred to as community areas (CA). The Northwich Traffic Model has been utilised to provide an evidence base for the Proposed Scheme TA for the CA Wimboldsley to Lostock Gralam referred to as MA02.

1.1.5 Reference should be made to Figure 1 which shows the geographic coverage of strategic transport models that have been utilised for the Proposed Scheme TA.

1.1.6 The Northwich Traffic Model has been used in forecasting mode by HS2 Ltd transport consultants, Mott MacDonald WSP Joint Venture (MWJV), and the base year model has not been subject to any updates. A 2018 baseline model forecast has been produced by MWJV to support the Proposed Scheme TA.

1.2 Model framework

1.2.1 The Northwich Traffic Model is a strategic highway assignment model that has been developed within the SATURN model software platform (version 11.3.12u).

1.2.2 The detailed modelled study area for the Northwich Traffic Model covers Northwich and surrounding areas and has supporting network and zone system detail to provide representation of external area supply and demand. Reference should be made to Figure 2.

1.2.3 The Northwich Traffic Model is representative of 2016 base year transport conditions.

1.3 Model development

1.3.1 The Northwich Traffic Model has been developed by CWaC's transport consultants to provide an evidence base to support the Northwich Transport Strategy study

1.4 Model description

1.4.1 The Northwich Traffic Model has been developed for the following years:

- 2016 base year; and
- 2030 future year.

1.4.2 The model is representative of the following time periods:

- AM peak hour – 08:00–09:00;
- average inter peak hour – 10:00–16:00; and
- PM peak hour – 17:00–18:00.

1.4.3 The model is comprised of the following demand user-classes:

- car commute;
- car other;
- car employers business;
- light goods vehicles; and
- other goods vehicles.

1.5 Model application objectives

1.5.1 For the assessment of the Proposed Scheme, the Northwich Traffic highway assignment Model has been used to:

- provide preliminary traffic data to inform scheme design;
- provide traffic data for the construction and operational phases of the Proposed Scheme on which to base the assessment of significant effects for the Environmental Statement;
- provide changes in traffic flows, congestion, and journey times to inform the TA for the Proposed Scheme; and
- provide changes in traffic flows between the base year and forecast scenarios for application to local models.

1.5.2 The model has been used primarily to assess the likely impacts of the Proposed Scheme's construction and operational traffic in order to provide an evidence base for the TA for the Proposed Scheme

Figure 1: Strategic transport model coverage for the Proposed Scheme Transport Assessment

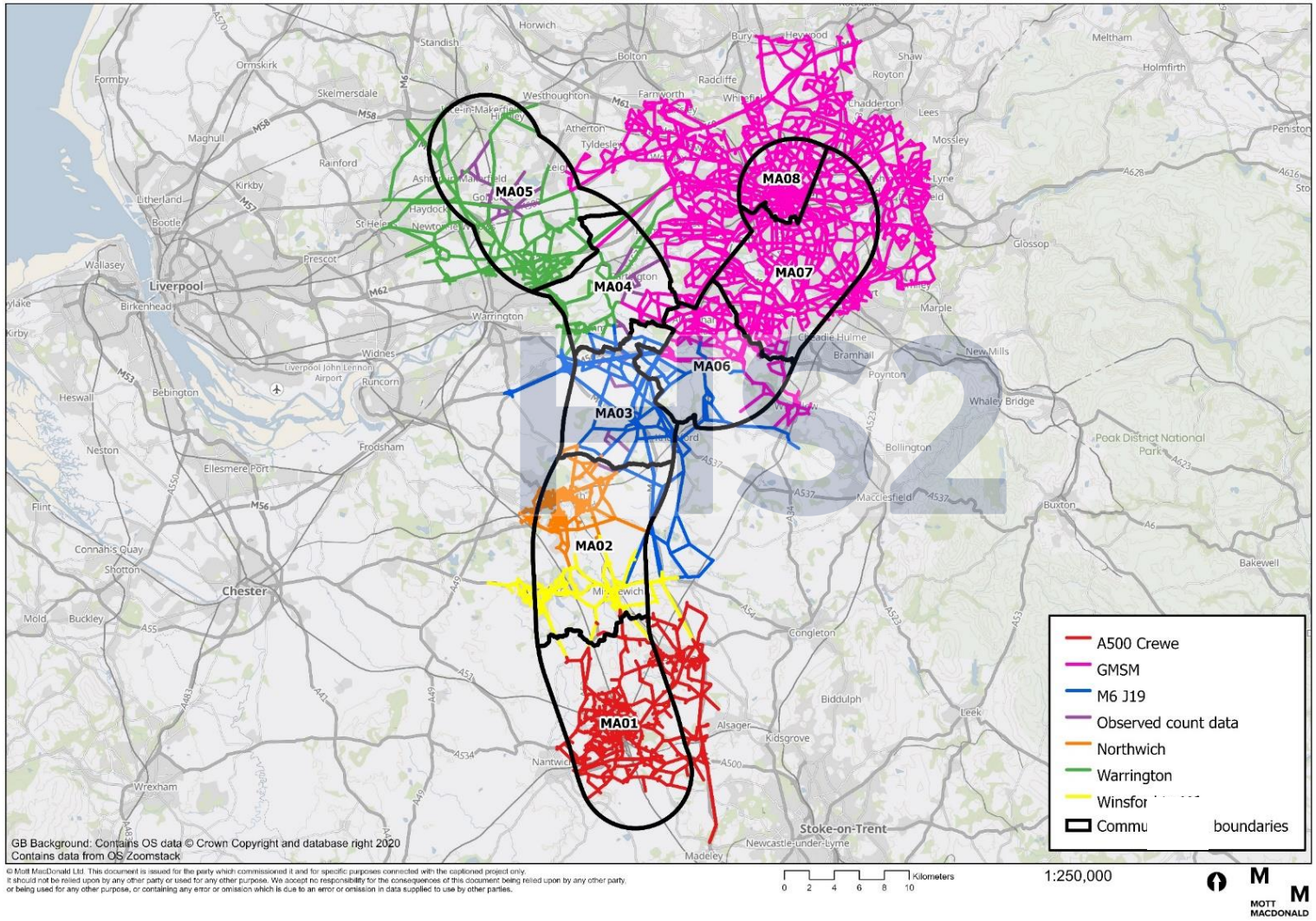
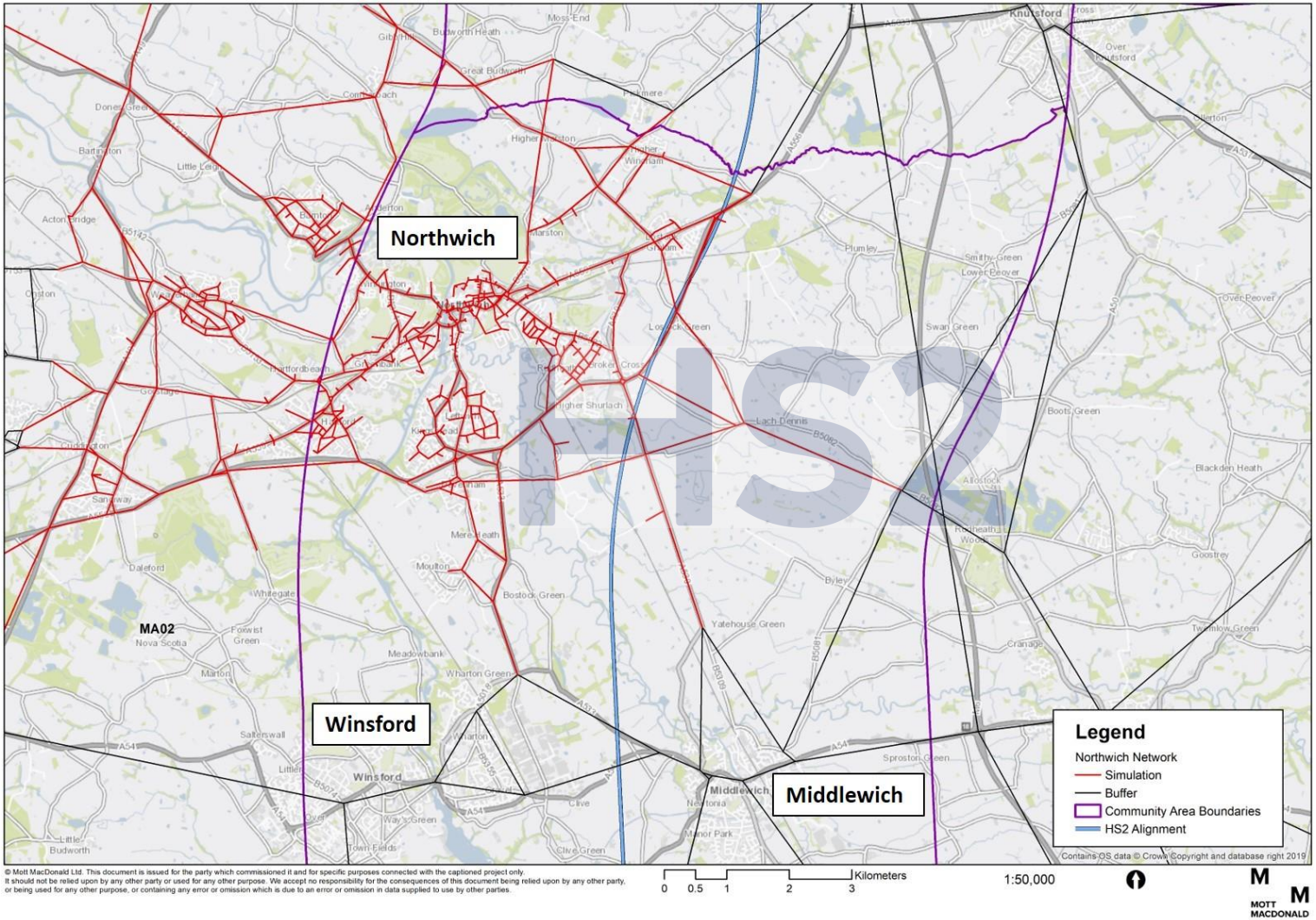


Figure 2: Model study area



2 Guidance used

2.1 Introduction

2.1.1 The strategic highway model development makes reference to the following Transport Analysis Guidance as published by the Department for Transport (DfT): TAG Unit M3.1 Highway Assignment Modelling (May 2020).

2.2 Highway model guidance

2.2.1 In relation to providing an assessment of model calibration and validation performance, reference has been made to Section 3.2 of TAG Unit M3.1 (Table 1, Table 2, and Table 3).

2.2.2 The criteria for the assessment of model calibration and validation of traffic flows and journey time performance is presented in Table 1, below.

Table 1: DfT – TAG validation criteria

Criteria	Acceptability guideline
Assigned hourly flows	
Individual flows within +/-15% for flows 700-2,700 vph	>85% of cases
Individual flows within +/-100 vph for flows <700 vph	>85% of cases
Individual flows within +/-400 vph for flows >2,700 vph	>85% of cases
Screenline flows (normally >5 links) to be within 5%	All or nearly all screenlines
GEH statistic	
Individual flows GEH <5	>85% of cases
Screenline totals GEH <4	All or nearly all screenlines
Journey times	
Modelled journey times within 15% (or 1 minute if higher)	>85% of cases

Source: Table 1, Table 2, Table 3, DfT TAG Unit M3.1 Highway Assignment Modelling (May 2020)

2.2.3 The criteria for the assessment of highway model assignment convergence is presented in Table 2, below.

Table 2: Summary of convergence measures and base model acceptable values

Measures of convergence	Acceptability guidelines
Delta and %GAP	Less than 0.1% or at least stable with convergence fully documented and all other criteria met
Percentage of links with flow change (P) <1%	Four consecutive iterations greater than 98%
Percentage of links with cost change (P2) <1%	Four consecutive iterations greater than 98%
Percentage change in total user costs of links with flow change (V) <1%	Four consecutive iterations less than 0.1% (SUE only)

Source: Table 4, DfT TAG Unit M3.1 Highway Assignment Modelling (May 2020)

3 Traffic survey data

3.1 Overview

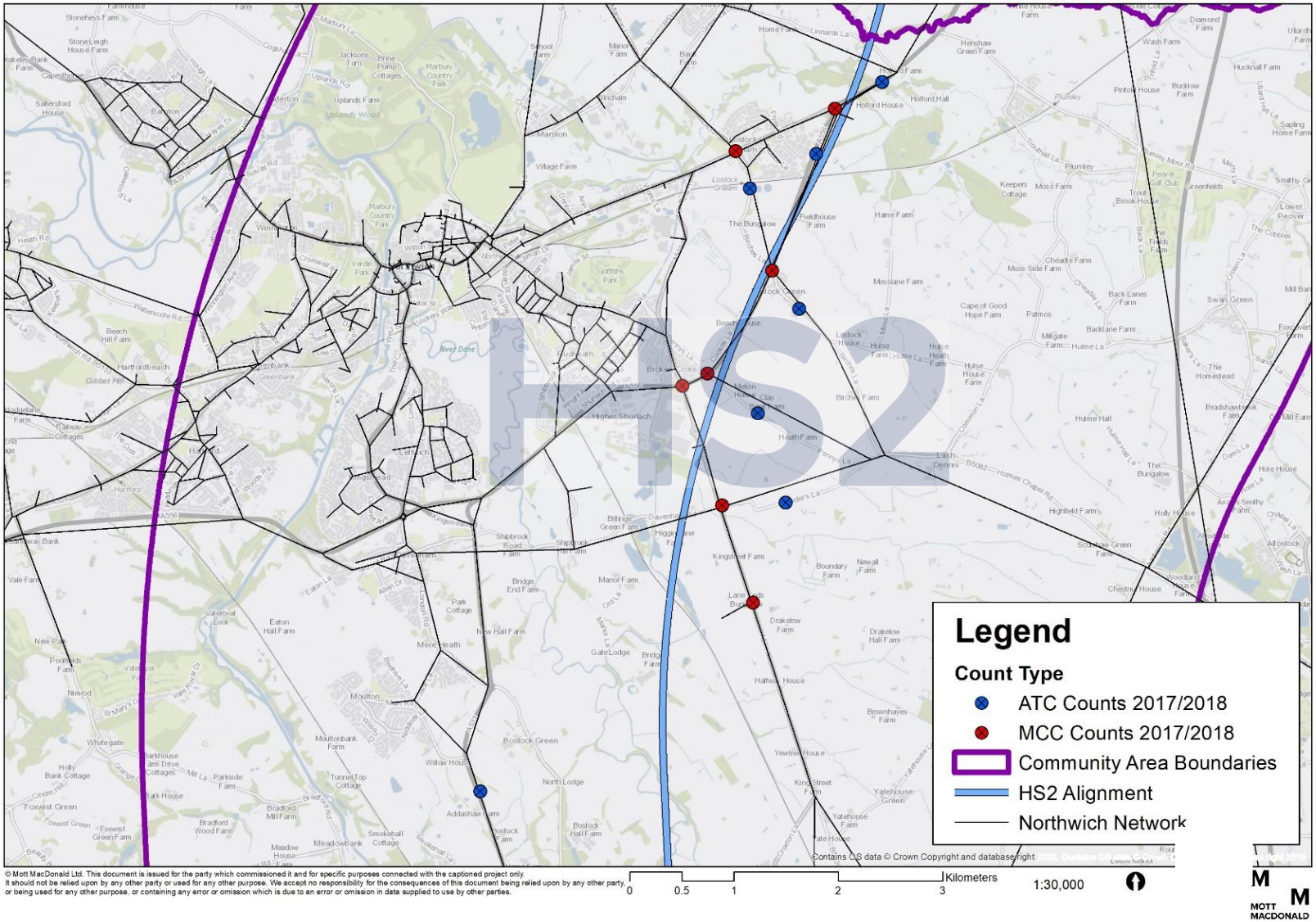
3.1.1 This section of the report presents details of traffic survey data that has been collected for the purpose of comparing observed and modelled traffic flows for the 2018 baseline model forecast.

3.2 Traffic survey data commission

3.2.1 MWJV commissioned a programme of traffic count surveys in 2017/2018 to support the Proposed Scheme TA. Reference should be made to Figure 3 which shows the location of traffic count surveys that have been used to compare against modelled traffic flows.

3.2.2 Traffic count surveys have been collected for different years and months and have been converted to a consistent 2018 dataset to compare against 2018 baseline modelled traffic flows.

Figure 3: Location of traffic counts



4 Model review

4.1 Overview

4.1.1 The 2016 base year as supplied by CWaC has been used as a reference model for developing a 2018 baseline model forecast produced by MWJV.

4.2 Transport supply

4.2.1 A review of the highway network detail and attributes has been completed for the modelled area that is included in CA MA02.

4.2.2 The following network attributes have been reviewed and checked:

- links: distance, speeds, capacity, bus lanes, traffic regulation orders;
- junctions: type; turn saturation flows, capacity, and lane utilisation;
- traffic signal control: timings, phasing, and staging; and
- routes: minimum cost paths.

4.2.3 The generalised cost values (PPM/PPK) for model assignment have also been updated to reflect the latest values from the DfT TAG databook (version: May 2020).

4.2.4 In summary, the model includes a sufficiently detailed level of network infrastructure to support Proposed Scheme TA.

4.3 Transport demand

4.3.1 The Northwich Traffic Model was reviewed and confirmed to include a detailed representation of spatial demand. The model zone system contains 220 model zones and accounts for future land-use development zones.

4.3.2 The demand matrices as supplied by CWaC have been adjusted from 2016 to 2018 using local traffic growth factors. These uplifted matrices have been applied directly in model assignment to produce a 2018 baseline forecast, and they have not been subject to a further round of matrix estimation by MWJV.

5 Model performance

5.1 Overview

5.1.1 This section of the report focuses on the performance of the 2018 baseline model forecast that has been produced by MWJV.

5.2 Traffic flow

5.2.1 Observed and modelled traffic flows have been compared for the count site locations within the CA MA02. In total, 38 individual link counts by direction have been compared.

5.2.2 Table 3 and Table 4 present a summary comparison of individual link flows for 'total all vehicles' and by the car vehicle type. Table 3 shows that 82 percent of link flow comparisons achieve DfT TAG criteria for the AM peak hour and that the equivalent value for the PM peak hour is 84 percent. These values are close to the 85 percent threshold of individual links meeting either the DfT TAG flow range or GEH less than five criteria.

5.2.3 For car vehicle type, the equivalent values are 89 percent and 82 percent for the AM and PM peak hours, respectively. These values are close to or exceed the 85 percent threshold of individual links meeting either the DfT TAG flow range or GEH less than five criteria.

Table 3: 2018 Northwich Traffic Model – individual link flow – total all vehicle

Total all vehicle flow comparison (vehicles)							
Time period	Number of sites	TAG criteria 1 flow range		TAG criteria 2 GEH < 5		TAG criteria flow range or GEH	
		Number of counts	Percentage	Number of counts	Percentage	Number of counts	Percentage
AM peak hour	38	30	79%	27	71%	31	82%
PM peak hour	38	31	82%	30	79%	32	84%

Table 4: 2018 Northwich Traffic Model – individual link flow – car vehicle type

Car flow comparison (vehicles)							
Time period	Number of sites	TAG criteria 1 flow range		TAG criteria 2 GEH < 5		TAG criteria flow range or GEH	
		Number of counts	Percentage	Number of counts	Percentage	Number of counts	Percentage
AM peak hour	38	33	87%	31	82%	34	89%
PM peak hour	38	29	76%	28	74%	31	82%

5.2.4 Reference should be made to Table A 1 and Table A 2, Appendix A, which presents supporting details of the individual link flow performance.

6 Model convergence

6.1.1 Achieving a suitable level of model convergence is necessary to provide stable, consistent, and robust model results and to differentiate between real changes and those associated with differing degrees of convergence.

6.1.2 DfT TAG provides guidance on highway model convergence with recommendations on acceptable variations in link flows and costs between iterations helping to ensure the model is sufficiently stable.

6.1.3 Table 5 presents a summary of the 2018 forecast baseline highway model convergence statistics by time period. It is evident that all modelled time periods meet the specified DfT TAG guidance for convergence.

Table 5: 2018 baseline highway model convergence

Criteria	Loop	Target	AM peak hour	PM peak hour
Flow change	N-3	> 98%	99.80	99.90
	N-2		99.80	100.00
	N-1		100.00	100.00
	N		99.80	99.90
Cost change	N-3	> 98%	100.00	99.90
	N-2		99.90	99.90
	N-1		100.00	100.00
	N		99.90	99.90
Delta		< 0.1%	0.0110/20	0.0142/20
%GAP		< 0.1%	0.0170	0.0140

7 Summary and conclusions

7.1.1 The Northwich Traffic Model as supplied by CWaC has been used by MWJV to support the Proposed Scheme TA. A 2018 baseline forecast model has been developed by MWJV to support the assessment for the Proposed Scheme TA.

7.1.2 The 2018 baseline forecast model has been compared to observed traffic count data within the Proposed Scheme area of interest.

7.1.3 Table 6 below is a summary of the individual link flow model performance for both modelled time periods. It is evident that 82 percent of link flow comparisons achieve DfT TAG criteria for the AM peak hour and that the equivalent value for the PM peak hour is 84 percent. These values are close to the 85 percent threshold of individual links meeting either the DfT TAG flow range or GEH less than five criteria.

Table 6: Summary of individual link flows

Total all vehicle flow comparison (vehicles)							
Time period	**Number of sites**	**TAG criteria 1 flow range**		**TAG criteria 2 GEH < 5**		**TAG criteria flow range or GEH**	
		Number of counts	**Percentage**	**Number of counts**	**Percentage**	**Number of counts**	**Percentage**
AM peak hour	38	30	79%	27	71%	31	82%
PM peak hour	38	31	82%	30	79%	32	84%

7.1.4 In conclusion, the Northwich Traffic Model provides a reasonable reflection of 2018 baseline traffic conditions and forms a suitable tool for the assessment of the Proposed Scheme's construction and operational impacts within the Proposed Scheme area of interest.

8 Acronyms

Table 7: Acronyms

Acronyms	
CWaC	Cheshire West and Chester Council
LMVR	Local model validation report
MPR	Model performance report
TA	Transport Assessment
ES	Environmental Statement
DfT	Department for Transport
DMRB	Design Manual for Roads and Bridges
ATC	Automatic Traffic Count
MCC	Manual classified count
JTC	Junction turning count
GEH	Geoffrey Havers (statistic)

9 References

Department for Transport (2020), *TAG unit M3.1.* (2020), *Highway Assignment Modelling*. Available online at: https://www.gov.uk/government/publications/webtag-tag-unit-m3-1-highway-assignment-modelling.

Appendix A – model performance

Individual link flow performance

Table A 1: Northwich Traffic Model – AM peak hour – individual link flows

ID*	Road name	Location	Direction	Observed flow (vehicles)				Modelled flow (vehicles)				Total flow comparison					
				Cars	LGVs	HGVs	Total	Cars	LGVs	HGVs	Total	Difference	Percentage difference	GEH	GEH < 5	Flow range	GEH or flow range
	A533	Between Jack Lane and Bostock Road	SB	712	117	52	881	935	101	25	1061	179	20%	5.75	×	×	×
	A559 Manchester Road	Between Station Road and Lodge Lane	EB	423	69	29	521	328	33	20	380	-141	-27%	6.62	×	×	×
	A559 Manchester Road	Between Cheshire Business Park and A556	EB	478	75	33	586	457	49	20	526	-59	-10%	2.51	✓	✓	✓
	A556	Between Birches Lane and A559 Manchester Road	EB	918	102	69	1089	1002	139	80	1222	133	12%	3.90	✓	✓	✓
	A559 Hall Lane	Between A559 Manchester Road and Townshend Road	NB	265	55	26	346	218	57	33	308	-37	-11%	2.05	✓	✓	✓
	A559 Manchester Road	Between A530 Griffiths Road and Station Road	EB	480	87	16	583	520	79	29	628	45	8%	1.84	✓	✓	✓
	A559 Hall Lane	Between Townshend Road and A559 Manchester Road	SB	383	62	31	476	396	59	5	459	-16	-3%	0.76	✓	✓	✓
	A559 Manchester Road	Between Lodge Lane and Station Road	WB	322	47	30	398	308	47	21	376	-22	-6%	1.13	✓	✓	✓
	A530 King Street	Between A556 and Cookes Lane	NB	329	62	17	408	326	77	22	426	18	4%	0.89	✓	✓	✓
	A559 Manchester Road	Between Station Road and A530 Griffiths Road	WB	555	77	18	649	703	102	29	834	185	29%	6.81	×	×	×
	A530 King Street	Between Morrisons and Crowders Lane	SB	415	82	34	530	457	66	40	563	33	6%	1.42	✓	✓	✓
	Crowder's Lane		WB	40	27	4	72	156	0	0	157	85	118%	7.92	×	✓	✓
	A530 King Street	Between Whatcroft Hall Lane and Crowder's Lane	NB	619	88	43	750	695	80	22	796	47	6%	1.69	✓	✓	✓
	Davenham Road	Between Shurlach Lane and A530 King Street	EB	156	20	2	178	86	9	0	95	-83	-47%	7.09	×	✓	✓
	B5082 Penny's Lane	Between Crowder's Lane and A556	WB	168	66	12	246	175	24	33	232	-14	-6%	0.93	✓	✓	✓
	A556	Between A530 King Street and B5082 Penny's Lane	EB	1319	161	76	1555	1384	178	109	1671	116	7%	2.88	✓	✓	✓
	A556	Between A530 King Street and Gadbrook Road	WB	1253	141	62	1455	1404	158	78	1640	185	13%	4.70	✓	✓	✓
	Lostock Green	Between Lostock Hollow and Birches Lane	SB	8	5	1	14	0	0	0	0	-14	-100%	5.35	×	✓	✓
	A556	Between A559 Manchester Road and Birches Lane	WB	917	150	87	1154	1042	154	93	1289	135	12%	3.87	✓	✓	✓

ID*	Road name	Location	Direction	Observed flow (vehicles)				Modelled flow (vehicles)				Total flow comparison					
				Cars	LGVs	HGVs	Total	Cars	LGVs	HGVs	Total	Difference	Percentage difference	GEH	GEH < 5	Flow range	GEH or flow range
	Birches Lane	Between Hangman's Lane and A556	NB	8	17	3	27	0	0	0	0	-27	-99%	7.27	×	✓	✓
	A556	Between Truck Stop and Birches Lane	EB	997	119	67	1182	1088	163	107	1358	176	15%	4.93	✓	✓	✓
	B5569 Chester Road		EB	1311	0	189	1500	1177	149	98	1425	-75	-5%	1.97	✓	✓	✓
	B5082 Middlewich Road	Between West Ave and East Ave	EB	315	0	23	338	250	17	18	285	-53	-16%	3.03	✓	✓	✓

**ID not defined.*

Table A 2: Northwich traffic Model – PM peak hour – individual link flows

ID*	Road name	Location	Direction	Observed flow (vehicles)				Modelled flow (vehicles)				Total flow comparison					
				Cars	LGVs	HGVs	Total	Cars	LGVs	HGVs	Total	Difference	Percentage difference	GEH	GEH < 5	Flow range	GEH or flow range
	A533	Between Jack Lane and Bostock Road	SB	777	53	20	850	868	57	11	936	86	10%	2.89	✓	✓	✓
	A559 Manchester Road	Between Station Road and Lodge Lane	EB	340	37	10	386	359	41	3	403	17	4%	0.87	✓	✓	✓
	A559 Manchester Road	Between Cheshire Business Park and A556	EB	396	29	8	432	497	43	3	543	111	26%	5.02	×	×	×
	A556	Between Birches Lane and A559 Manchester Road	EB	873	75	51	999	703	84	41	828	-171	-17%	5.66	×	×	×
	A559 Hall Lane	Between A559 Manchester Road and Townshend Road	NB	421	47	10	477	366	40	14	420	-57	-12%	2.71	✓	✓	✓
	A559 Manchester Road	Between A530 Griffiths Road and Station Road	EB	528	59	9	595	577	62	4	643	49	8%	1.95	✓	✓	✓
	A559 Hall Lane	Between Townshend Road and A559 Manchester Road	SB	301	33	8	341	336	39	2	377	37	11%	1.95	✓	✓	✓
	A559 Manchester Road	Between Lodge Lane and Station Road	WB	511	35	12	558	438	26	5	470	-88	-16%	3.88	✓	✓	✓
	A530 King Street	Between A556 and Cookes Lane	NB	602	71	9	682	597	60	30	686	5	1%	0.19	✓	✓	✓
	A559 Manchester Road	Between Station Road and A530 Griffiths Road	WB	692	56	9	756	758	54	14	826	70	9%	2.49	✓	✓	✓
	A530 King Street	Between Morrisons and Crowders Lane	SB	700	59	24	783	730	61	10	800	17	2%	0.61	✓	✓	✓
	Crowder's Lane		WB	66	63	3	132	186	11	0	197	65	49%	5.04	×	✓	✓
	A530 King Street	Between Whatcroft Hall Lane and Crowder's Lane	NB	765	59	50	874	875	49	30	954	81	9%	2.67	✓	✓	✓
	Davenham Road	Between Shurlach Lane and A530 King Street	EB	9	7	0	15	61	7	0	69	54	357%	8.28	×	✓	✓
	B5082 Penny's Lane	Between Crowder's Lane and A556	WB	113	47	4	163	108	64	23	195	32	20%	2.40	✓	✓	✓

ID*	Road name	Location	Direction	Observed flow (vehicles)				Modelled flow (vehicles)				Total flow comparison					
				Cars	LGVs	HGVs	Total	Cars	LGVs	HGVs	Total	Difference	Percentage difference	GEH	GEH < 5	Flow range	GEH or flow range
	A556	Between A530 King Street and B5082 Penny's Lane	EB	1244	102	50	1396	1153	132	62	1347	-49	-3%	1.32	✓	✓	✓
	A556	Between A530 King Street and Gadbrook Road	WB	1400	118	31	1549	1516	155	49	1719	171	11%	4.23	✓	✓	✓
	Lostock Green	Between Lostock Hollow and Birches Lane	SB	5	2	1	8	0	0	0	0	-8	-100%	3.88	✓	✓	✓
	A556	Between A559 Manchester Road and Birches Lane	WB	1371	83	37	1490	1356	159	48	1563	73	5%	1.87	✓	✓	✓
	Birches Lane	Between Hangman's Lane and A556	NB	36	54	5	95	67	0	0	67	-28	-29%	3.09	✓	✓	✓
	A556	Between Truck Stop and Birches Lane	EB	1016	68	50	1133	981	110	61	1152	19	2%	0.56	✓	✓	✓
	B5569 Chester Road		EB	1103	0	97	1200	1000	100	44	1144	-56	-5%	1.63	✓	✓	✓
	B5082 Middlewich Road	Between West Ave and East Ave	EB	326	0	17	343	366	26	4	395	52	15%	2.73	✓	✓	✓
	B5082 Middlewich Road	Between East Ave and West Ave	WB	399	0	12	411	319	31	8	358	-53	-13%	2.70	✓	✓	✓
	Lostock Green	Between Birches Lane and Lostock Hollow	NB	134	49	4	187	278	26	19	324	137	73%	8.58	×	×	×
	A556	Between Birches Lane and Truck Stop	WB	1351	102	34	1487	1338	148	47	1533	46	3%	1.19	✓	✓	✓
	Crowder's Lane		EB	33	9	2	45	34	1	0	35	-9	-21%	1.50	✓	✓	✓
	B5082 Penny's Lane	Between A556 and Crowder's Lane	EB	165	65	3	233	172	21	2	195	-39	-17%	2.63	✓	✓	✓
	Davenham Road	Between A530 King Street and Shurlach Lane	WB	194	11	0	205	236	26	0	262	58	28%	3.77	✓	✓	✓
	Birches Lane	Between A556 and Hangman's Lane	SB	37	31	2	70	85	11	1	97	27	38%	2.92	✓	✓	✓
	A533	Between Bostock Road and Jack Lane	NB	748	59	23	831	892	55	32	979	148	18%	4.93	✓	×	✓
	A530 King Street	Between Crowder's Lane and Morrisons	NB	656	71	23	750	739	35	30	804	54	7%	1.94	✓	✓	✓
	A556	Between Linnards Lane and A559	WB	1570	0	145	1716	1485	169	52	1706	-10	-1%	0.24	✓	✓	✓
	A556	Between Gadbrook Road and A530 King Street	EB	1155	81	33	1268	1135	98	45	1277	9	1%	0.26	✓	✓	✓
	A556	Between A530 King Street and B5082 Pennys Lane	WB	1669	140	35	1843	1443	212	70	1725	-118	-6%	2.80	✓	✓	✓
	A530 King Street	Between Cookes Lane and A556	SB	547	59	16	622	723	66	9	799	177	28%	6.63	×	×	×
	A559 Manchester Road	Between A556 and Cheshire Business Park	WB	541	44	10	594	326	21	4	352	-242	-41%	11.15	×	×	×
	A530 King Street	Between Crowder's Lane and Whatccroft Hall Lane	SB	617	46	20	683	843	66	10	919	236	35%	8.33	×	×	×

**ID not defined.*

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