(c) Time of Day Split

To check that the synthetic matrix has been split into time periods correctly the total number of trips in the synthetic matrix has been compared to TEMPRO totals at the same four geographies as for the trip purpose split as shown in the figures below.

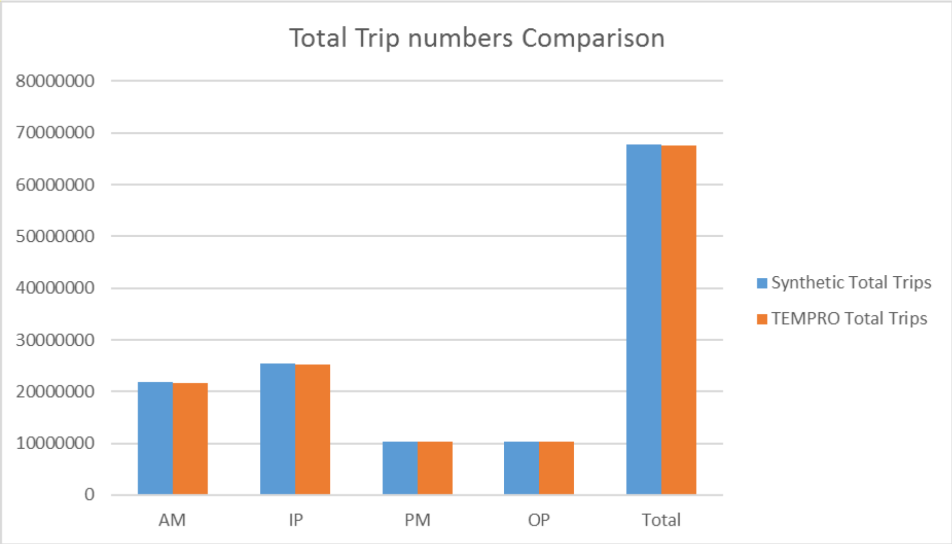


Figure 7-M - Comparison of total trips at a national level (GB)

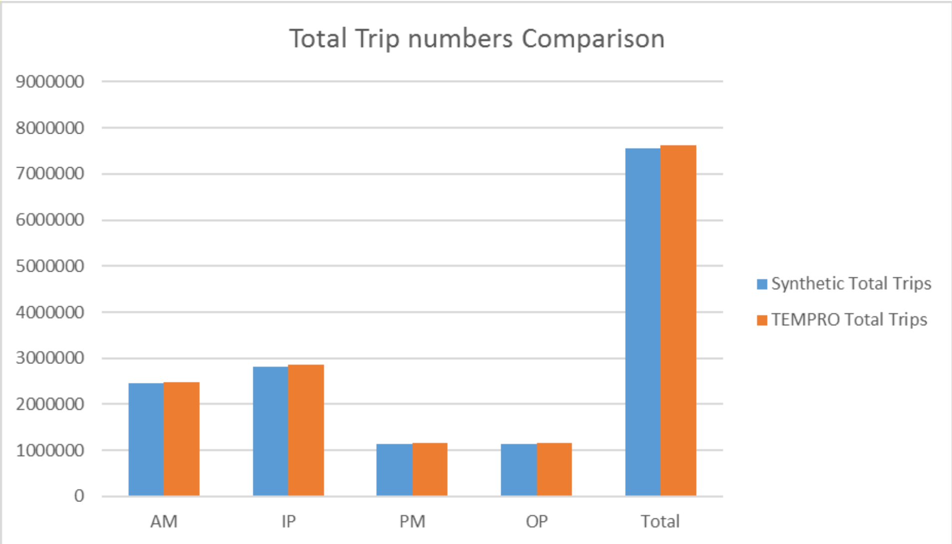


Figure 7-N - Comparison of total trips at a regional level (NW)

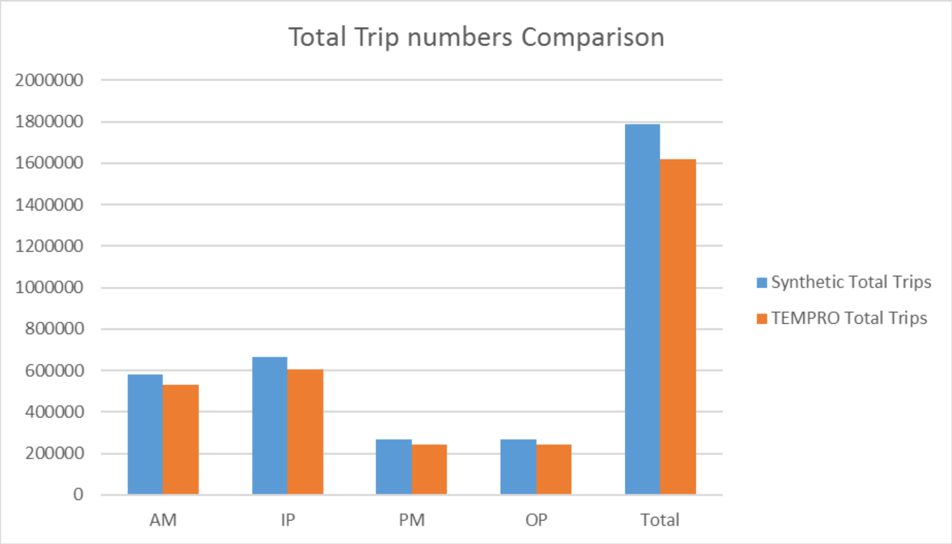


Figure 7-O - Comparison of total trips at a county level (Lancashire)

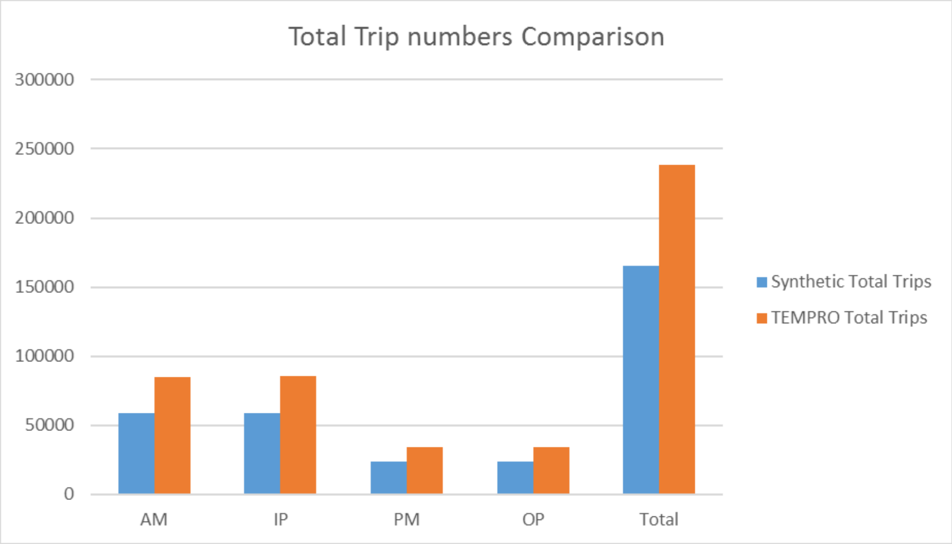


Figure 7-P - Comparison of total trips at a local level (RSI internal)

This shows that at a national, regional and county level the synthetic matrix has a very strong fit with TEMPRO. At a more local level there is a discrepancy as modelled zones do not equate to the TEMPRO zones in the area, however, if a comparison of the percentage split of the total trips by time period is reviewed (as shown in Figure 7-Q) a very strong fit is seen.

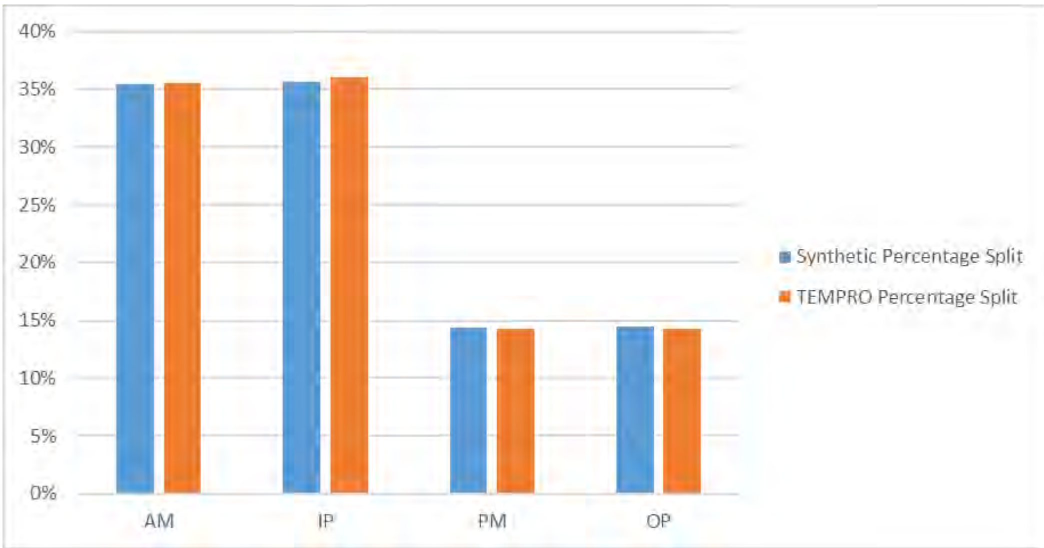


Figure 7-Q - Percentage Split of total trips by period (local level)

7.3.5 Synthetic Matrices – Goods Vehicles

The method used to generate trip ends for cars could not be applied to produce trip ends for LGVs and HGVs. This is because it relies on use of NTEM data, which is concerned only with private, rather than freight or business trips. Therefore, an alternative methodology was employed.

HGV matrices were built from the Base Year Freight Matrix (BYFM). The BYFM provides 24hr matrices for zone-zone goods vehicle movements across Great Britain at local authority district level for a 2006 base year.

The 2006 matrices were uplifted to 2013 using growth factors for HGVs from the DfT Road Traffic Forecasts 2015. The 2013 matrices were then disaggregated from local authority districts into model zones using employment data per zone weighted by goods vehicle trip rates per job type.

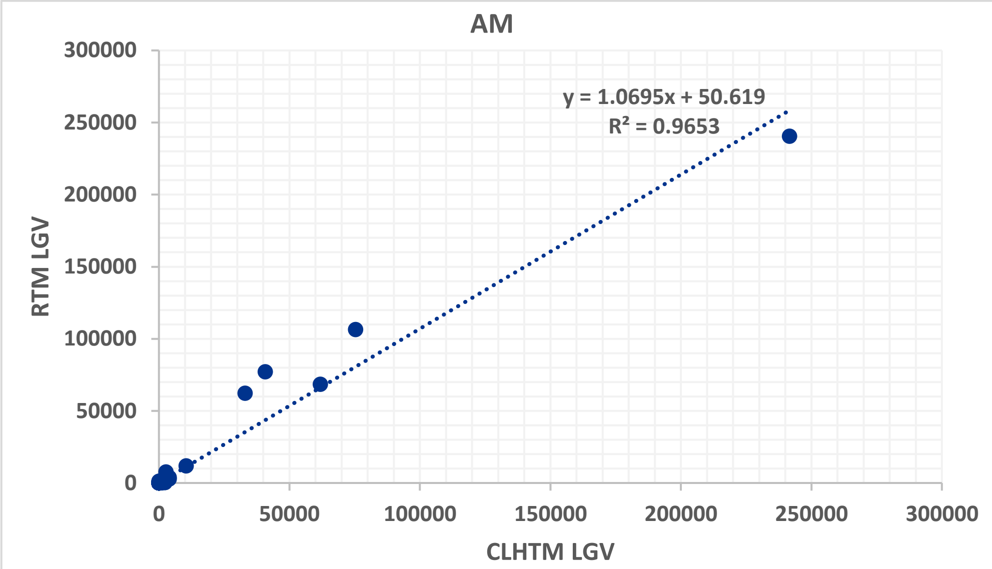
Output Area employment data was taken from an employment database[2] and summed into model zones. The HGV matrices were split from 24hr into AM and PM peak hours and a 6hr average IP hour based on manually classified count data from the RSI sites.

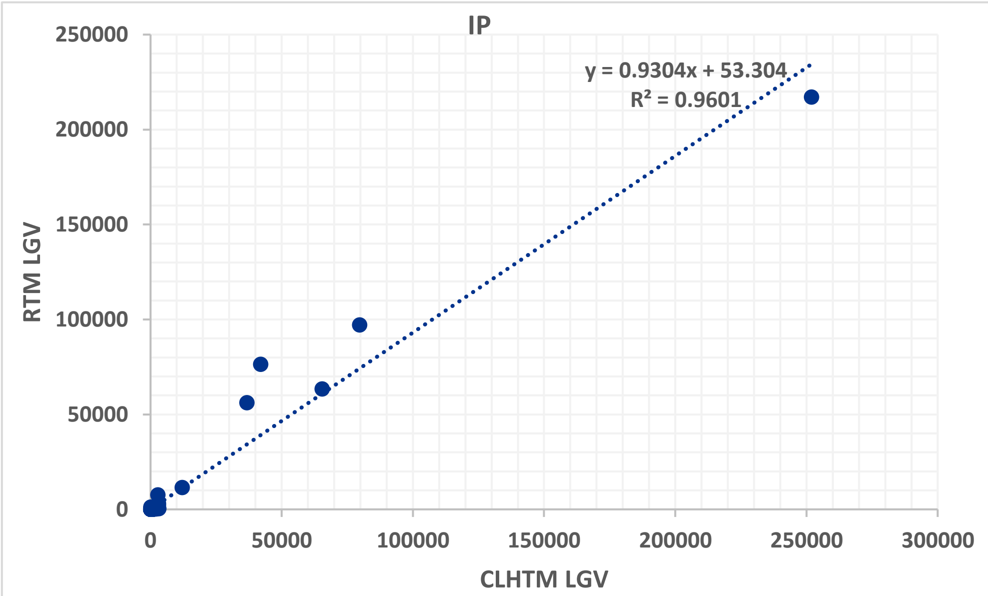
The methodology for developing LGV matrices used OGV trip rates extracted from TRICS as a proxy for HGV trips. The rates were calculated on a “per job” basis for each of the employment land use categories identified in Section 7.3.1, to generate the total OGV OD trip ends per zone. LGV trip ends were calculated by applying a factor to the HGV trip ends. The factor itself was derived from count data and represented the relative proportion of LGVs compared to HGVs.

To address Highways England’s comments on the original model, LGV trips were compared to TransPennine South Regional Transport Model (TPSRTM) at sector level to ensure that the matrices were sensible and included plausible level of demand. As shown in Figure 7-R, the regression analysis shows relatively good match between the two datasets, with R-squared of more than 0.96.

---

[2] Source: Blue Sheep LLP. Blue Sheep are a business-to-business data management and solutions company who collected this data for government statistics and analysis.





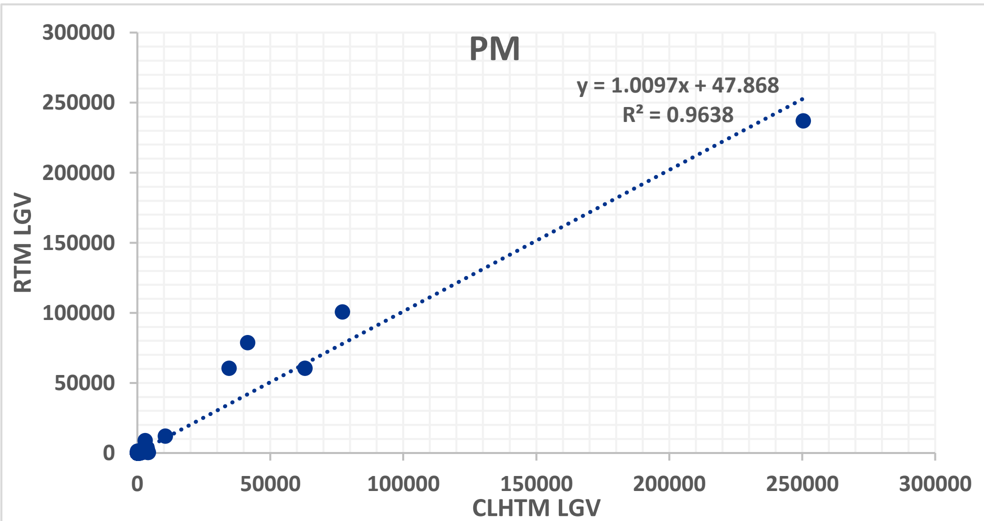


Figure 7-R - Statistical Comparison of CLHTM and RTM LGV Demand

Appendix E provides the sectoral comparison, with the external-to-external not crossing the study area greyed out. The comparison also shows a relatively close match between the two datasets; the highest differences occur at either intra-sectoral or external-to-external which do not cross through the study area. Given that majority of significant changes were in external to external movements and regression analysis showed a close fit, no change was applied to the CLHTM LGV matrix as part of the PWD FBC model re-validation.

7.4 Observed Trip Matrices

To obtain information on the movements through the Preston area, 26 roadside interview (RSI) surveys were conducted.

The survey locations are shown in Figure 7-S.

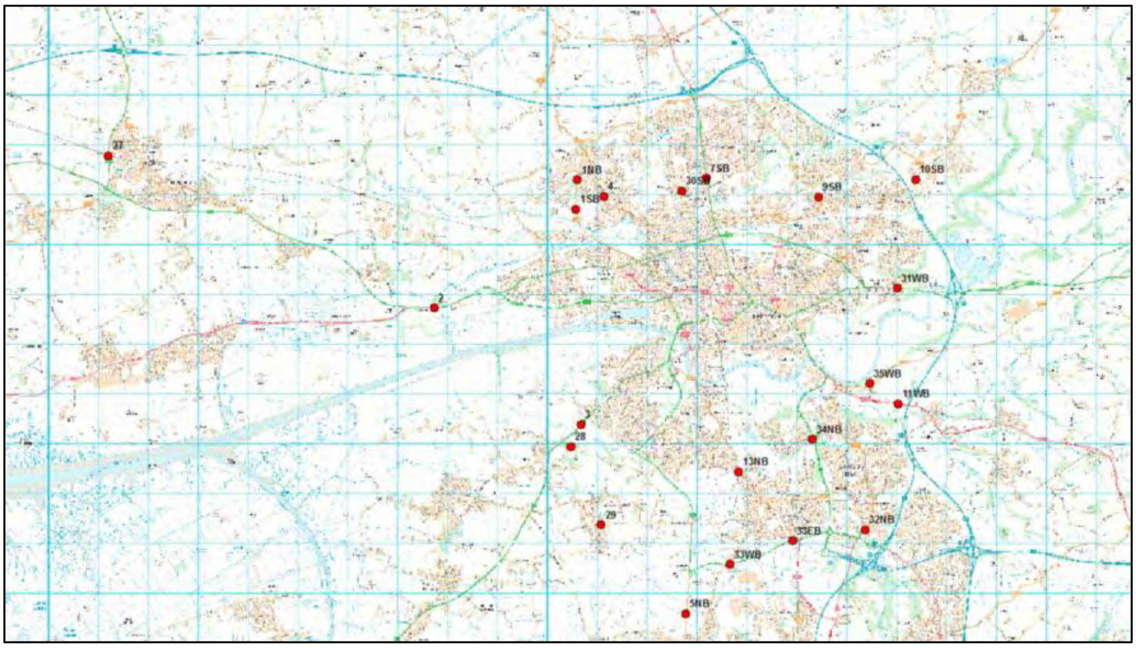


Figure 7-S - RSI Survey Locations

The survey locations form a natural cordon around Preston, in order to capture all movements with a trip end cross this cordon.

The surveys were conducted between 1st April 2014 and 1st May 2014.
Each individual site was surveyed over a single day, between 07:00 and 19:00.

The date that each site was surveyed, the number of surveys conducted and the total traffic flow through the site is summarised in Table 7-4 below.

Table 7-4 shows that the percentage of vehicles surveyed at each RSI site ranges from around 14% to 40%. The overall average percentage of vehicles surveyed is 20%.

This overall average represents a very good sample size to accurately represent observed traffic movement in the area.

Further, it should be noted that the majority of key routes were surveyed in both directions.

As detailed in the Traffic Survey Report, the surveys were conducted without any major problem, and no sites were suspended for any significant duration. This led to full data collection and surveys from all vehicle types being collected (Cars, LGVs and HGVs).

The RSI surveys were accompanied by an MCC collected on the same day of the survey, and a 2 week ATC whose collection periods included the survey day.

Further information on the processing of the observed data and the various checks that were made follows in Section 7.4.1.

Importantly, and in addition to the sample rates obtained, no site had a sample rate of less than 10%; with most sites achieving upwards of 1,000 RSI interviews in each direction across the 12-hour period.

The Traffic Survey Report provides more detail regarding the accuracy of the surveys, and demonstrates that the sample rates were acceptable for each time period.

JACOBS

Table 7-4 - RSI Survey Statistics

Site	Date of Survey	No. surveys	Total traffic flow	CAR Sample %	LGV Sample %	OGV1 Sample %	OGV2 Sample %	Overall Sample %
1NBD	Tuesday 1-Apr-14	1187	5273	23.23%	11.50%	23.96%	65.00%	22.51%
1SBD	Wednesday 2-Apr-14	1010	5394	19.64%	7.74%	12.22%	43.10%	18.72%
2EBD	Wednesday 30-Apr-14	1298	11653	11.12%	13.20%	5.83%	18.68%	11.24%
2WBD	Wednesday 30-Apr-14	1235	11837	10.99%	8.04%	5.83%	5.88%	10.53%
3NBD	Tuesday 29-Apr-14	1232	8691	14.51%	13.09%	9.68%	22.12%	14.34%
3SBD	Tuesday 29-Apr-14	1213	8734	14.27%	13.05%	10.71%	11.93%	14.04%
4NBD	Tuesday 01-Apr-14	847	4532	19.32%	18.32%	26.44%	75.00%	19.45%
4SBD	Wednesday 02-Apr-14	885	4147	22.33%	22.73%	19.28%	50.00%	22.37%
5NBD	Thursday 1-May-14	1054	8741	11.98%	12.37%	7.95%	21.20%	12.10%
7SBD	Tuesday 22-Apr-14	1185	7349	16.54%	14.62%	10.00%	20.69%	16.26%
9SBD	Thursday 3-Apr-14	1077	7286	15.83%	6.89%	0.98%	4.55%	14.78%
10SBD	Thursday 03-Apr-14	888	5713	16.21%	15.33%	10.25%	22.22%	15.87%
11WBD	Thursday 24-April-14	1224	2728	46.62%	39.30%	40.68%	43.75%	44.87%
13NBD	Wednesday 2-Apr-14	1131	6852	18.59%	6.37%	1.65%	9.84%	16.51%
27SBD	Tuesday 1-April-14	1026	5713	19.25%	10.42%	8.29%	19.20%	17.96%
28EBD	Tuesday 29-Apr-14	597	1843	33.35%	22.67%	25.71%	66.67%	32.39%
28WBD	Tuesday 29-Apr-14	565	1833	31.39%	19.46%	25.00%	100.00%	30.86%
29EBD	Thursday 1-May-14	975	2956	35.90%	14.44%	15.00%	21.05%	32.98%
29WBD	Wednesday 30-April-14	930	3832	26.31%	15.52%	7.20%	27.08%	24.27%
30SBD	Tuesday 22-Apr-14	957	4886	20.98%	10.38%	4.48%	11.11%	19.59%
31WBD	Thursday 03-Apr-14	1090	10790	19.64%	7.74%	12.22%	43.10%	18.72%
32NBD	Wednesday 23-Apr-14	975	6273	16.53%	12.47%	9.21%	16.00%	15.77%
33EBD	Tuesday 22-Apr-14	1398	10788	14.96%	6.85%	1.25%	5.22%	12.96%
33WBD	Thursday 24-Apr-14	1143	8742	15.32%	7.02%	2.42%	3.56%	13.07%
34NBD	Wednesday 23-Apr-14	1228	11109	10.92%	11.64%	9.50%	27.27%	11.05%
35WBD	Thursday 24-April-14	1045	2254	47.39%	42.58%	17.19%	57.69%	46.36%
Average		**1054**	**6536.5**	21.27%	14.76%	12.42%	31.23%	**20.37%**

7.4.1 Partial Trip Matrices from Surveys

Observed trip matrices were built exclusively from the observations made during the RSI surveys, the locations of which are illustrated in Figure 7-S.

At each site, surveys of vehicles travelling through the site were conducted over a twelve hour period. The survey collected the following information from each driver surveyed:

- *Start location (origin) of the trip being made*
- *End location (destination) of the trip being made*
- *Reason for being at the start and end locations (e.g. home, workplace, etc.)*
- *The type of vehicle (car, LGV, OGV, etc.)*
- *The number of people travelling in the vehicle*
- *The journey frequency (how often that particular trip is made)*
- *Time of the survey*
- *Return time*

A copy of the questionnaire used in the survey is in Appendix F.

Following the completion of the survey, the specified location data was converted to Ordnance Survey coordinates to pinpoint the exact location. This was done by the survey contractor and double checked by Jacobs.

At each survey location, a two-week ATC and a one day MCC was also collected.

The data from these counts was used to check the sampling level of the RSI sites, and derive expansion factors which when applied to the survey records and summed ensure that the surveys are representative of the full volume of traffic through the site.

7.4.2 Checking Survey Records

For a number of reasons, the data recorded in the survey may not be an accurate representation of the trip being made.

The survey errors generally fall into three categories:
1. Incomplete Data;
2. Location information is incorrect or does not pass the screenline; and.
3. Reason for being at the particular location is incorrect.

Reasons for incorrect locations being recorded include the driver (wilfully or accidentally) giving the wrong location of either their journey start or journey end, or the surveyor recording a different location to the one specified (for example if they misheard the given location).

To ensure that these erroneous surveys are excluded from the set of data from which observed trip matrices would be created, all records collected from the survey were checked, both in terms of the specified journey start and end locations, and the journey purpose.

(a) Check on journey start and end locations

The recorded origin and destination of each journey should represent a sensible trip movement given the location of the RSI survey.

For example, given that these particular RSI surveys were conducted in and around Preston, one would expect to observe trips between, say, Preston and Garstang, but trips between Manchester and Wigan (for example) would not be expected. Any survey records which represent illogical or unexpected trips were to be discarded so as to ensure the observed trip matrices would be representative of actual trips through Preston.

To ensure that illogical trips were discarded, each survey record was used to plot a desire line representing the movement for the surveyed trip. This desire line was checked against the survey location, and if it did not logically pass the site, the record was discarded. An illustration of some logical and illogical desire lines for the trips surveyed at site 1 northbound is shown in Figure 7-T and Figure 7-U below. Appendix G shows all of the logical observations for all of the remaining RSI sites that were undertaken.

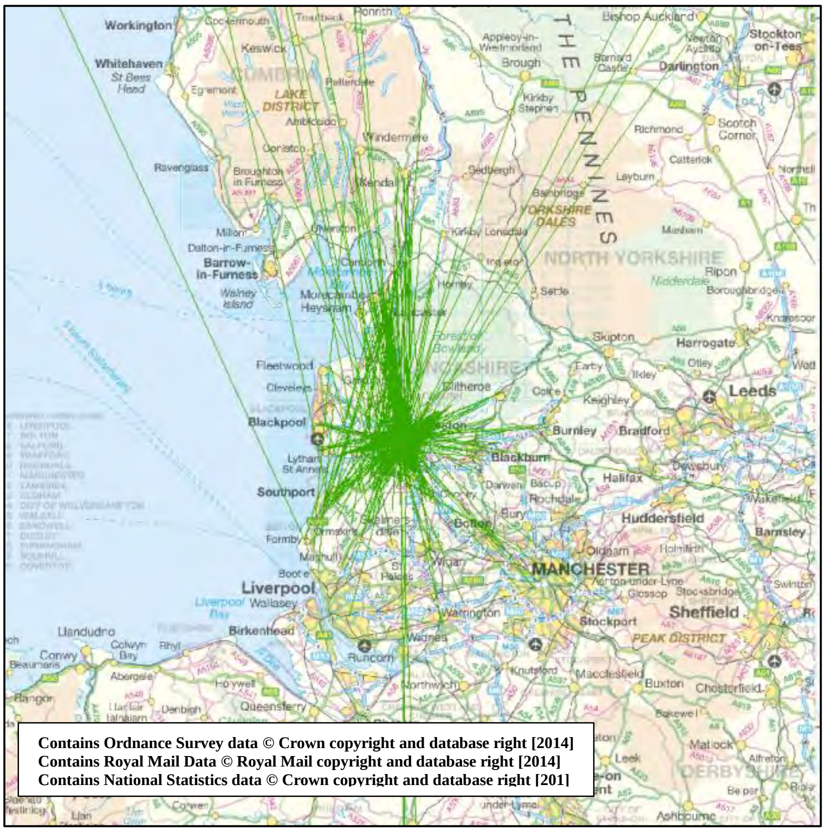


Figure 7-T – Logical Desire Lines, 1NB

Figure 7-U – Illogical Desire Lines, 1NB

There were some survey records for which the desire line would represent a logical trip were it not for the fact that the line is in the wrong direction (e.g. the desire line is northbound whilst the survey was conducted in the southbound direction).

These records were identified by comparing the compass bearing of the desire lie against the survey direction.

In those cases in which the bearing was incorrect, the record was not discarded, but the trip was either transferred to the RSI site in the opposite direction, or, if there was not a site in the opposite direction, the origin and destination locations were swapped round.

(b) Check on reason for being at the journey start/end

The specified reason for being at the journey start and end points were used to identify the journey purpose for each trip. In order to ensure that the observed trip matrices are representative, it is important that, as much as possible, the recorded trip purpose is accurate.

The amount of checks that can be done in this regard are limited, however where a description of the trip was provided it was possible to check that the trip ‘purpose’ matched the trip ‘description’.

Where the trip purpose was not provided, or counted as ‘Other’, and the trip description was provided it was possible to manually change the trip purpose to represent a more accurate journey type e.g. Commute, Leisure etc.

Surveyed trips that did not have a purpose or a description were removed from the data set.

7.4.3 Expanding records to match count data

Once the data was checked, expansion factors were calculated.

The expansion factors are used to ensure that the sample of survey records represent the full amount of traffic passing through the survey site.

The expansion factor for each time interval is calculated by dividing the total traffic volume by the number of survey records.

Below is a worked example of how expansion factors for car AM trips were calculated at site RSI site 1.

Table 7-5 provides the expansion factor derived from RSI interviews and normalised ATC flow for the AM time period. The vehicular split from the Manual Classified Counts (MCC) were applied to the average of two-week ATC data to calculate the normalised flow.

Table 7-5 - Expansion Factor for Site 1

Site	Direction	AM RSI Interviews (07:00 – 10:00)	Normalised ATC - Car (AM Peak hour)	Expansion Factor (MCC/RSI Interviews)
1	North	283	512	1.81
1	South	165	614	3.72

The peak hour expansion factors at each site throughout the survey period is summarised in Table 7-6.

Table 7-6 - Peak Hour Expansion Factors

Site	Direction	AM	IP	PM
		Car	Car	Car
1	Northbound	1.81	6.89	2.79
1	Southbound	3.72	7.42	3.67
2	Eastbound	4.65	9.31	5.1
2	Westbound	5.54	9.94	4.37
3	Northbound	3.49	9.1	2.89
3	Southbound	4.19	10.69	3.55
4	Northbound	4.09	10.33	4.43
4	Southbound	3.11	7.94	3.18
5	Northbound	3.85	9.37	2.74
5	Southbound	5.97	14.49	3.81
7	Northbound	5.23	10.07	1.79
7	Southbound	5.07	10.31	3.5
9	Northbound	5.41	9.83	2.62
9	Southbound	2.77	9.41	4.72
10	Northbound	12	13.38	2.64
10	Southbound	5.19	11.56	5.32
11	Eastbound	3.7	4.86	1.31
11	Westbound	2.64	3.43	1.39

Site	Direction	AM	IP	PM
		Car	Car	Car
13	Northbound	2.29	8.74	3.02
13	Southbound	4.36	10.97	1.06
27	Northbound	16.57	22.32	2.6
27	Southbound	4.34	11.14	3.1
28	Eastbound	3.62	6.42	2.4
28	Westbound	2.6	5.12	2.84
29	Eastbound	2.66	5.12	2.4
29	Westbound	3.82	10.24	4.02
30	Northbound	9.34	14.67	4.07
30	Southbound	2.69	9.06	3.83
31	Eastbound	6.67	14.45	3.82
31	Westbound	5.58	12.41	4.94
32	Northbound	4.4	10.66	4.48
32	Southbound	7.34	10.15	2.4
33	Eastbound	2.11	9.15	3.31
33	Westbound	2.29	9.36	4.1
34	Northbound	6.88	13.04	6.91
34	Southbound	11.02	16.91	4.71
35	Eastbound	3.36	3.11	1.52
35	Westbound	1.94	2.97	2.45

With higher expansion factors there is a greater risk of introducing bias into the survey, whereby the few trips that were observed are over represented at the expense of those which were not. This is undesirable as it is more likely to lead to trip matrices that are unrepresentative of trip movements.

7.4.4 Building trip matrices for each site

As detailed above the survey records included postcodes for the trip origin and destination. This allowed these points to be plotted on a map. The points were overlaid with a GIS layer of the modelled zone system, and within GIS a spatial join was implemented to append the number of the zone that the point lies within, to the record.

The surveyed 'reason for being' at the origin and destination location, once checked, was used to identify an overall trip purpose for each record in the survey.

The allocation of overall trip purpose to production and attraction reason is illustrated in Table 7-7.

Table 7-7 - Table of Journey Purpose

Production Purpose	Attraction Purpose									
	Home	Holiday home/Hotel	Work	On employer's business	Education	Shopping	Personal business	Visiting friend	Social or recreational	Other
Home	HBO	HBO	HBW	HBEB	HBED	HBS	HBO	HBO	HBO	HBO
Holiday home/Hotel	HBO	NHBO	NHBO	NHBEB	NHBO	NHBO	NHBO	NHBO	NHBO	NHBO
Work	HBW	NHBO	NHBEB	NHBEB	NHBO	NHBO	NHBO	NHBO	NHBO	NHBO
On employer's business	HBEB	NHBEB	NHBEB	NHBEB	NHBEB	NHBEB	NHBEB	NHBEB	NHBEB	NHBEB
Education	HBED	NHBO	NHBO	NHBEB	NHBO	NHBO	NHBO	NHBO	NHBO	NHBO
Shopping	HBS	NHBO	NHBO	NHBEB	NHBO	NHBO	NHBO	NHBO	NHBO	NHBO
Personal business	HBO	NHBO	NHBO	NHBEB	NHBO	NHBO	NHBO	NHBO	NHBO	NHBO
Visiting friend	HBO	NHBO	NHBO	NHBEB	NHBO	NHBO	NHBO	NHBO	NHBO	NHBO
Social or recreational	HBO	NHBO	NHBO	NHBEB	NHBO	NHBO	NHBO	NHBO	NHBO	NHBO
Other	HBO	NHBO	NHBO	NHBEB	NHBO	NHBO	NHBO	NHBO	NHBO	NHBO

The journey purpose codes in the table above are elaborated upon below:

- *HBW – Home based work*
- *HBEB – Home based employer's business*
- *HBED – Home based education*
- *HBS – Home based shopping*
- *HBO – Home based other*
- *NHBEB – Non-home based employer's business*
- *NHBO – Non-home based other*

Finally, the recorded time at which each particular survey was conducted was used to identify the time period; either AM peak (7-10am), interpeak (10am-4pm) or PM peak (4pm-7pm).

Following completion of all the processing steps, each surveyed record had an origin zone, destination zone, trip purpose, vehicle type, time period and expansion factor.

Using this information, a trip matrix was constructed for each site, time period, trip purpose and vehicle type (car); 798 matrices were created in total (38 sites * 3 time periods * 7 trip purposes). Each cell in the trip matrices was populated with the number of records for the corresponding origin and destination zone multiplied by the expansion factor.

7.4.5 Merging trip matrices from all sites

In order to combine the trip matrices from all sites, some consideration of the expected movements through each site was required, and it is important to ensure that when merging the data together, there was no double counting of trips.

To undertake this, the index of dispersion (based on the Erica software principles) was applied such that expanded site wise matrices were merged at cordon

level using a variance merging technique.

This was applied on a cell by cell basis at purpose/mode and time period level.

$$M_{ij} = \frac{I^O_{ij} W_{ij} + I^W_{ij} O_{ij}}{I^O_{ij} + I^W_{ij}}$$

Where:
M ij = Merged matrix

Wij = Matrix 1

Oij = Matrix 2

$I^W ij$ = Index of dispersion matrix for Matrix 1

$I^O ij$ = Index of dispersion matrix for Matrix 2

and the Index of dispersion *ij I* is a function of the variance of the trip estimate:

$$I_{ij} = Var(T_{ij}) / T_{ij}$$

For the observed data, the variance of the trip estimate may be calculated directly:

$$Var(T_{ij}) = \sum_n e_{ij}(e_{ij} - 1) + \sum_n e_{ij} KF$$

Where:
eij is the expansion factor for each record

K is the Site constant

F is the flow-related factor representing the flow level that a given degree of uncertainty applied to; Counts/1000

n is the number of recorded journeys from origin i to destination j

The RSI data from all sites were merged together and created the final observed matrix in PA format.

7.5 Merging Data from Surveys and Trip Synthesis

The synthetic and the observed demand matrices were merged based on the general principle that where the RSI surveys intercepted a trip between a given origin and destination pair, the merged matrix should be based on observed data. For an origin-destination pair that were not intercepted by the RSI surveys, the merged matrix should be based on the synthetic trips.

The merge process was carried out in PA format (for each trip purpose) and at lumpy sector level in order to smooth out the observed demand across model zones. Because the RSI surveys only intercepted a sample of all trips, the resulting observed trip matrix is ‘lumpy’. Rather than having a small number of trips for all the origin-destination pairs that travelled through the survey site, the matrix has a large number of trips for the (relatively) small number of origin-destination pairs that were actually surveyed. This apparent bias in the observed matrix needed to be removed before the data could be merged with the synthetic trip matrices.

The principle behind the ‘smoothing’ process was to take the large trip volumes from the small number of observed origin destination pairs, and portion them out to other origin-destination pairs representing a similar movement, which did not have any observed trips. In such a way, there would be more cells in the matrix containing trips, with no single cell containing inordinately more trips than any other.

Therefore, every model zone was grouped with 3 or 4 neighbouring zones based on their geographical location to form 'lumpy sectors'. The (factored) observed trips were then summed into the lumpy sector matrix. Before distributing the trips among zones in a lumpy sector, the (unfactored) number of interviews were deducted from the total trips and were allocated to the zone which had the survey data. The remaining trips were then proportioned out amongst all zones in that sector using their proportions in the total sector synthetic trips. This approach was adopted to ensure that the observed trip pattern, in terms of number of interviews, would be preserved.

The resulting PA matrices were converted into origin-destination (OD) matrices using the 'phi factors'. The phi factors determine for each outbound trip (i.e. from the production end to the attraction end) by time period and trip purpose, what the likely time period and trip purpose of the return trip will be.

For example, the morning period, home based work trip purpose PA matrix will contain a number of trips between a production (home) and attraction (work). The PA matrix effectively provides the OD matrix for the outbound (from home) trip. The PA matrix also contains details of the return trip (back home from work) and the phi factors specify in what time period the trip will return, and what the trip purpose would be. The return trip purpose may be different to the outbound trip purpose if for example the individual stopped at the shops on the way home from work (the return trip purpose would therefore by home based shopping). There are a set of phi factors for morning peak home based work trips, which determine the return trip purpose and time period. In this specific example the following proportions are applied to the return trips for AM commute (note due to rounding the figures below add up to 99%):

- *63% of trips will return as a home based work trip in the evening peak,*
- *19% will return as home based work in the interpeak,*
- *8% will return as home based work in the off peak*
- *4% will return as home based work in the morning peak*
- *2% will return as home based shopping in the evening peak*
- *2% will return as home based employers business in the evening peak*
- *1% will return as home based shopping in the interpeak*

Similar factors were specified for all combinations of outbound trip purpose and time period.

For each time period, the matrices by trip purpose were aggregated to the user classes in the model. A vehicle occupancy factor was then used to convert the matrices from person trips to vehicle trips, and a further factor applied to convert from the time period to the modelled hour. The factors were derived from the RSI surveys.

7.6 Sector Factoring and Final Prior Demand Matrices

The merged synthetic and observed matrices were then assigned to the network, and went through several iterations of controlled modification in order to improve the screenline and individual link results at an aggregated level to minimise the changes made by Matrix Estimation (ME) for final calibration.

The modifications took the form of sector factoring, applying an increase or decrease to sector-sector movements depending on the modelled level of traffic compared to observed at count sites on links that form routes between the sectors.

The overall change at matrix level (by purpose) and trip length distribution were closely monitored to ensure that modifications did not significantly distort the matrices. As shown in Table 2, the change at matrix level was less than 5% in all time periods, except Employers Business in IP which is slightly higher than 5%.

The trip length distributions are compared using a Coincidence Ratio (CR) and Regression Analysis (specifically R-Squared). CR is used to compare two distributions by measuring the percent of area that "coincides" for the two curves. It is calculated by dividing the sum of the lower value of the two distributions at each distance band by the sum of the higher value of the two distributions at each distance band. As presented in Table 7-8, both CR and R-squared are close to 1 at all time periods across all trip purposes, indicating identical distributions between the two datasets. Trip length distribution histograms and regression analysis plots are available upon request.

Table 7-8 - Prior Matrix Sector Factoring Changes

Period	Purpose	Primary Prior Trips	Final Prior Trips	%Difference	TLD (CR)	TLD R^2
AM	Commute	230,224	230,026	-0.10%	0.99	0.999
	Business	31,927	32,437	1.60%	0.98	0.999
	Other	165,074	167,204	1.30%	0.98	0.999
IP	Commute	50,260	52,585	4.60%	0.95	0.999
	Business	27,718	29,484	6.40%	0.94	0.999
	Other	208,716	219,000	4.90%	0.95	0.999
PM	Commute	197,280	199,225	1.00%	0.99	0.999
	Business	31,886	32,624	2.30%	0.98	0.999
	Other	243,976	247,554	1.50%	0.98	0.999

8 Prior Matrices Calibration and Validation

This section provides the result of prior matrices before running ME. The map of screenlines is shown in Figure 8-A.

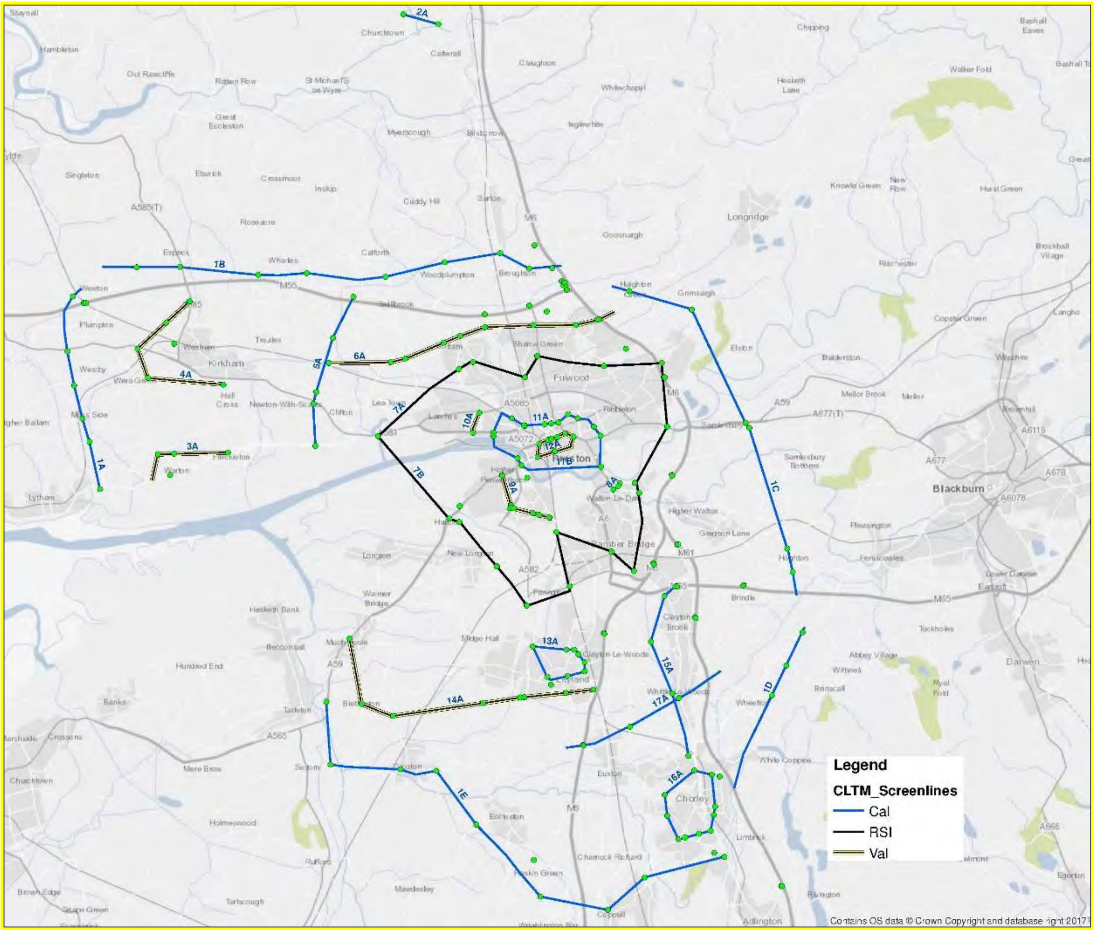


Figure 8-A - Map of Screenlines

Table 8-1 to Table 8-3 show the calibration screenline comparisons for the AM, IP and PM time periods, respectively.

All screen lines in the AM and PM and majority of the screenlines in the IP are within 15% of the total observed screenline counts.

It should be noted that the screenlines with differences of >20% in the IP peak are associated with relatively low flow screenlines and that is as expected.

It can be seen that all the RSI screenline total counts, highlighted in the tables, are within 5% for all three time periods.

Table 8-1 - Prior Calibration Screenlines AM

Screenline Number	Inbound/ Outbound	Observed Flow	Modelled Flow	% of Links Compliant	Actual Difference	% Difference
SL_1A	Inbound	3,558	3,630	100%	72	2%
SL_1B	Inbound	5,523	5,636	100%	112	2%
SL_1C	Inbound	6,220	5,977	100%	-242	-4%
SL_1D	Inbound	3,701	3,693	75%	-8	0%
SL_1E	Inbound	4,085	3,997	78%	-88	-2%
SL_2A	Inbound	761	775	100%	13	2%
SL_5A	Inbound	4,246	4,394	100%	148	3%
SL_7A	Inbound	6,573	6,421	100%	-152	-2%
SL_7B	Inbound	6,831	7,072	70%	240	4%
SL_8A	Inbound	1,341	1,352	33%	11	1%
SL_11A	Inbound	5,433	5,311	85%	-122	-2%
SL_11B	Inbound	5,257	5,387	100%	130	2%
SL_13A	Inbound	3,394	3,254	57%	-140	-4%
SL_15A	Inbound	4,461	4,442	100%	-19	0%
SL_16A	Inbound	4,760	4,725	60%	-35	-1%
SL_17A	Inbound	7,515	7,501	50%	-14	0%
SL_1A	Outbound	3,773	3,736	100%	-37	-1%
SL_1B	Outbound	4,569	4,737	100%	168	4%
SL_1C	Outbound	5,612	5,622	100%	11	0%
SL_1D	Outbound	3,674	3,539	100%	-134	-4%
SL_1E	Outbound	3,074	3,127	78%	54	2%
SL_2A	Outbound	792	781	100%	-11	-1%
SL_5A	Outbound	4,431	4,564	100%	133	3%
SL_7A	Outbound	5,702	5,825	100%	123	2%
SL_7B	Outbound	6,060	6,031	90%	-29	0%
SL_8A	Outbound	778	697	100%	-80	-10%
SL_11A	Outbound	4,330	4,437	77%	107	2%
SL_11B	Outbound	2,333	2,467	67%	134	6%
SL_13A	Outbound	2,700	2,529	75%	-172	-6%
SL_15A	Outbound	4,294	4,272	60%	-22	-1%
SL_16A	Outbound	3,499	3,509	60%	9	0%
SL_17A	Outbound	7,332	7,188	100%	-143	-2%

Table 8-2 - Prior Calibration Screenlines IP

Screenline Number	Inbound/ Outbound	Observed Flow	Modelled Flow	% of Links Compliant	Actual Difference	% Difference
SL_1A	Inbound	2,453	2,374	100%	-79	-3%
SL_1B	Inbound	4,306	4,454	100%	148	3%
SL_1C	Inbound	3,664	3,673	100%	9	0%
SL_1D	Inbound	2,569	2,521	100%	-48	-2%
SL_1E	Inbound	2,683	2,664	89%	-19	-1%
SL_2A	Inbound	552	554	100%	2	0%
SL_5A	Inbound	2,850	2,889	100%	39	1%
SL_7A	Inbound	4,481	4,627	63%	145	3%
SL_7B	Inbound	4,910	5,006	90%	96	2%
SL_8A	Inbound	882	679	33%	-203	-23%
SL_11A	Inbound	5,168	4,945	69%	-223	-4%
SL_11B	Inbound	3,100	3,188	100%	88	3%
SL_13A	Inbound	2,780	2,731	57%	-49	-2%
SL_15A	Inbound	2,889	2,898	80%	9	0%
SL_16A	Inbound	3,514	3,466	70%	-48	-1%
SL_17A	Inbound	5,225	5,305	75%	80	2%
SL_1A	Outbound	2,590	2,643	100%	54	2%
SL_1B	Outbound	4,363	4,407	90%	44	1%
SL_1C	Outbound	3,464	3,339	100%	-126	-4%
SL_1D	Outbound	2,668	2,770	75%	102	4%
SL_1E	Outbound	2,783	2,744	89%	-38	-1%
SL_2A	Outbound	693	712	100%	20	3%
SL_5A	Outbound	2,862	2,946	100%	84	3%
SL_7A	Outbound	4,368	4,541	75%	173	4%
SL_7B	Outbound	5,006	5,203	90%	197	4%
SL_8A	Outbound	756	595	67%	-161	-21%
SL_11A	Outbound	4,971	4,570	69%	-402	-8%
SL_11B	Outbound	3,150	3,280	67%	131	4%
SL_13A	Outbound	2,738	2,733	50%	-5	0%
SL_15A	Outbound	2,990	2,900	40%	-90	-3%
SL_16A	Outbound	3,268	3,199	50%	-70	-2%
SL_17A	Outbound	6,245	6,339	100%	94	2%

Table 8-3 - Prior Calibration Screenlines PM

Screenline Number	Inbound/ Outbound	Observed Flow	Modelled Flow	% of Links Compliant	Actual Difference	% Difference
SL_1A	Inbound	3,683	3,705	100%	22	1%
SL_1B	Inbound	5,078	5,247	100%	169	3%
SL_1C	Inbound	5,971	5,949	100%	-22	0%
SL_1D	Inbound	4,119	4,129	75%	10	0%
SL_1E	Inbound	3,267	3,193	78%	-74	-2%
SL_2A	Inbound	823	853	100%	30	4%
SL_5A	Inbound	4,655	4,749	100%	94	2%
SL_7A	Inbound	6,382	6,189	100%	-193	-3%
SL_7B	Inbound	6,444	6,435	100%	-9	0%
SL_8A	Inbound	1,041	1,000	100%	-41	-4%
SL_11A	Inbound	5,395	5,341	85%	-54	-1%
SL_11B	Inbound	3,147	3,299	100%	152	5%
SL_13A	Inbound	2,987	2,635	57%	-352	-12%
SL_15A	Inbound	4,994	5,180	80%	186	4%
SL_16A	Inbound	4,445	4,351	60%	-94	-2%
SL_17A	Inbound	7,301	7,223	25%	-78	-1%
SL_1A	Outbound	3,759	3,681	100%	-78	-2%
SL_1B	Outbound	5,887	6,000	90%	113	2%
SL_1C	Outbound	6,155	6,015	100%	-141	-2%
SL_1D	Outbound	4,109	3,976	75%	-134	-3%
SL_1E	Outbound	4,133	4,236	89%	103	2%
SL_2A	Outbound	787	774	100%	-13	-2%
SL_5A	Outbound	4,458	4,568	100%	109	2%
SL_7A	Outbound	6,310	6,236	88%	-75	-1%
SL_7B	Outbound	7,130	7,354	90%	223	3%
SL_8A	Outbound	1,364	1,328	100%	-36	-3%
SL_11A	Outbound	5,807	5,689	77%	-117	-2%
SL_11B	Outbound	5,438	5,405	100%	-34	-1%
SL_13A	Outbound	3,327	3,198	50%	-129	-4%
SL_15A	Outbound	5,118	4,904	40%	-214	-4%
SL_16A	Outbound	4,187	4,021	30%	-167	-4%
SL_17A	Outbound	9,341	9,153	75%	-188	-2%

Table 8-4 to Table 8-6 show the validation screenline comparisons. It can be seen the total counts across all the screenlines in all three time periods are within 10% of the observed total screenline count.

Table 8-4 - Prior Validation Screenline Performance AM

Screenline Number	Inbound/ Outbound	Observed Flow	Modelled Flow	Actual Difference	% Difference
SL_3A	Inbound	2,024	2,049	25	1%
SL_4A	Inbound	2,518	2,446	-72	-3%
SL_6A	Inbound	7,554	7,607	54	1%
SL_9A	Inbound	3,345	3,447	102	3%
SL_10A	Inbound	1,691	1,736	45	3%
SL_12A	Inbound	4,655	4,241	-413	-9%
SL_14A	Inbound	2,117	2,172	55	3%
SL_3A	Outbound	1,462	1,510	48	3%
SL_4A	Outbound	2,506	2,387	-118	-5%
SL_6A	Outbound	7,961	8,092	130	2%
SL_9A	Outbound	1,895	1,924	30	2%
SL_10A	Outbound	1,383	1,397	14	1%
SL_12A	Outbound	3,709	3,641	-68	-2%
SL_14A	Outbound	2,336	2,329	-7	0%

Table 8-5 - Prior Validation Screenline Performance IP

Screenline Number	Inbound/ Outbound	Observed Flow	Modelled Flow	Actual Difference	% Difference
SL_3A	Inbound	1,059	1,075	16	1%
SL_4A	Inbound	1,560	1,527	-33	-2%
SL_6A	Inbound	6,302	6,041	-261	-4%
SL_9A	Inbound	2,205	2,334	129	6%
SL_10A	Inbound	1,242	1,328	86	7%
SL_12A	Inbound	3,489	3,438	-51	-1%
SL_14A	Inbound	1,648	1,697	48	3%
SL_3A	Outbound	1,193	1,228	35	3%
SL_4A	Outbound	1,642	1,586	-56	-3%
SL_6A	Outbound	6,218	6,187	-31	0%
SL_9A	Outbound	2,350	2,420	70	3%
SL_10A	Outbound	1,141	1,260	119	10%
SL_12A	Outbound	3,976	4,025	49	1%
SL_14A	Outbound	1,632	1,724	92	6%

Table 8-6 - Prior Validation Screenline Performance PM

Screenline Number	Inbound/ Outbound	Observed Flow	Modelled Flow	Actual Difference	% Difference
SL_3A	Inbound	1,587	1,576	-10	-1%
SL_4A	Inbound	2,422	2,440	17	1%
SL_6A	Inbound	8,603	8,527	-77	-1%
SL_9A	Inbound	2,445	2,561	116	5%
SL_10A	Inbound	1,589	1,580	-10	-1%
SL_12A	Inbound	3,731	3,667	-64	-2%
SL_14A	Inbound	2,196	2,228	32	1%
SL_3A	Outbound	2,328	2,269	-59	-3%
SL_4A	Outbound	2,479	2,394	-85	-3%
SL_6A	Outbound	8,617	8,565	-52	-1%
SL_9A	Outbound	3,312	3,453	141	4%
SL_10A	Outbound	1,567	1,631	63	4%
SL_12A	Outbound	5,007	5,517	510	10%
SL_14A	Outbound	2,328	2,548	220	9%

9 Network Calibration and Validation

9.1 Overview

This chapter details the checks undertaken on the network coding to ensure the model reflects realistic road conditions.

9.2 Network Checking and Calibration

Based on the coded characteristics of each link, a number of checks of the network were made.

The first of these was the standard network check offered by the modelling packages, which checked network connectivity and any illogical coding of junctions (SEMI-FATAL errors).

To further extend the checks, a network check list, informed by advice in TAG Unit M3.1 was created and the model was checked against each aspect of the list.

SATURN produces warning messages if the coded link length is significantly different from the crow–fly distance, and these warnings were checked and verified.

Additional checking focussed on the coded attributes of the links, including link speeds, number of lanes and capacity, as detailed below.

Free flow link speeds are a function of the link type (as specified in Appendix B) and the speeds in the model were checked by plotting in GIS and colouring links according to speed, in set bands as shown below.

This plot is shown below in Figure 9-A for the detailed study area.

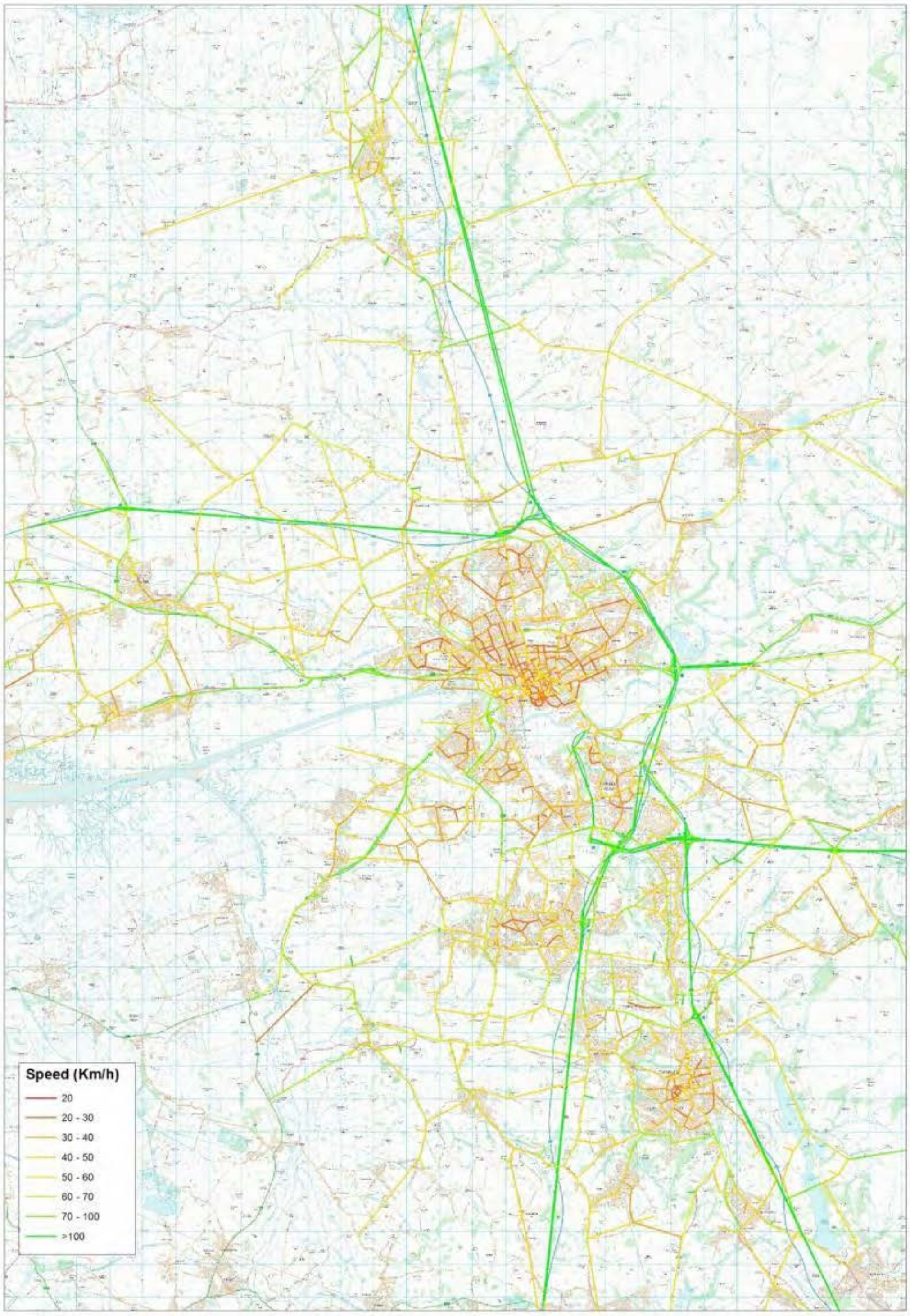


Figure 9-A - Model Link Speeds

The plot shows that urban areas such as Preston, Broughton, Leyland had coded free flow speeds of around 30-50kph on residential streets, and 50-60kph on main through roads.

In rural areas the free flow speed is generally between 70kph and 100kph; unless where speed limits prevent. Finally, it’s notable that the free flow speed on the M6, M55 and surrounding motorways were in excess of 100kph, as would be expected for motorway links.

The coded number of lanes was checked in a similar manner, with the plot of this shown in Figure 9-B below.

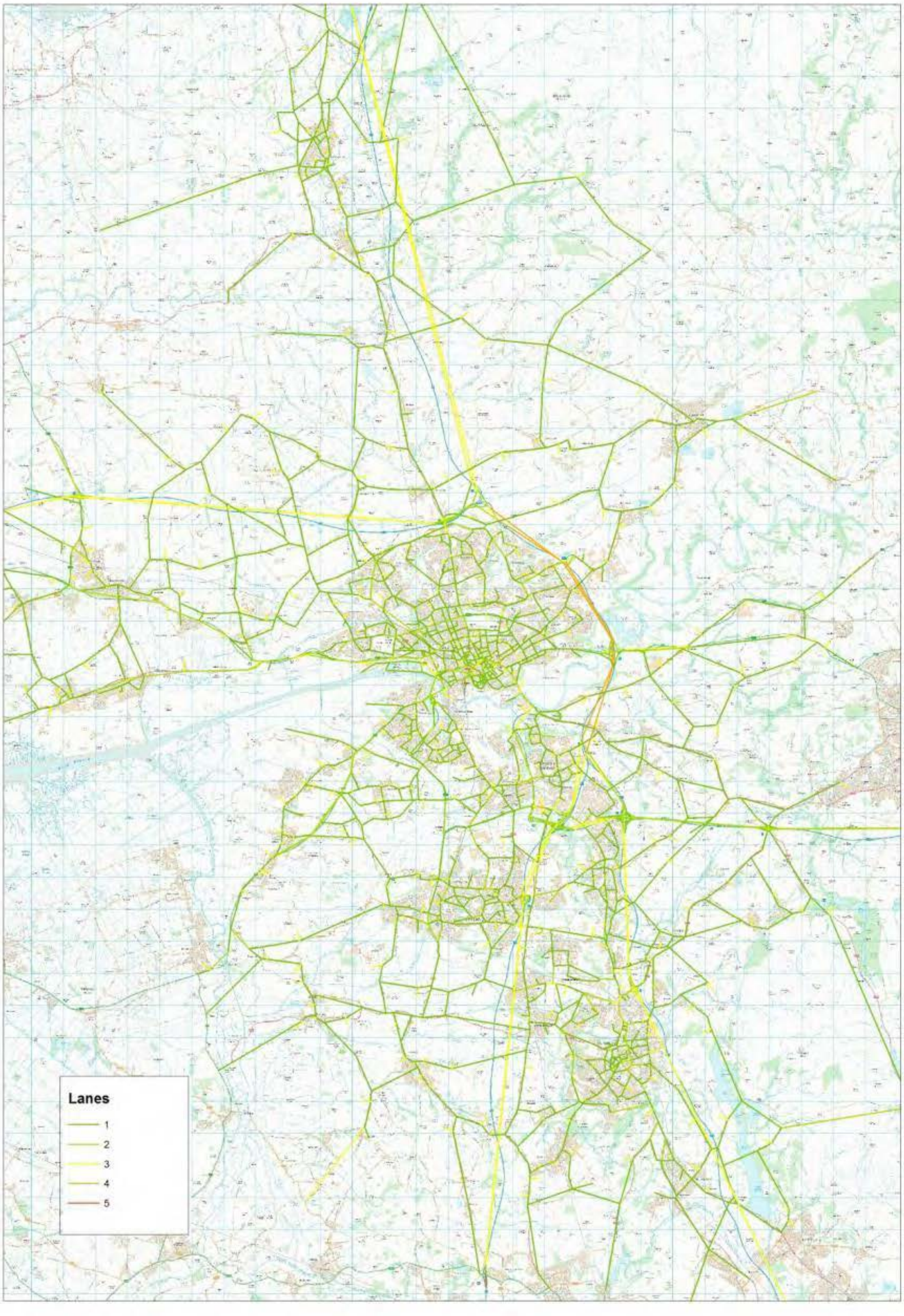


Figure 9-B - Number of Lanes

To aid checks on the network, 'stress testing' was undertaken, in which the base year matrices were factored up and assigned to the network, to see where the increased demand leads to excessive delays. This more easily identified junctions which required investigation.

In line with WebTAG guidance, other network checks included checking appropriate junction types, turn restrictions, and appropriate link saturation flows.

Finally, it should be noted that checks were made to ensure that there was consistency of coding across all time periods, with only signal timings differing across the periods. A detailed list of network checks that were undertaken is listed in Appendix H.

During the model revalidation, a comprehensive review of the base year network was undertaken to ensure that coding of junctions and links, both in simulation and buffer areas, are correct and consistent across the whole study area. The network checks included but are not limited to; junction types and configuration, assigned speed flow curves, link distance, and error/warning messages. The network was found to be accurately developed originally based on the existing 2013 road network and only minor changes were made to correct the errors and adjust the lane configuration at a few junctions.

Additionally, during the OBC stage, a few minor coding errors were spotted in the model, which did not have any impact on the results; however, it was prudent to correct them prior to recalibration of the model.

10 Route Choice Calibration and Validation

10.1 Introduction

This chapter assesses the performance of the highway model in terms of route choice between zones in different parts of Central Lancashire.

In relation to the Preston Western Distributor scheme, emphasis is placed within this chapter on movements across and through Preston to demonstrate the plausibility of routing in the model.

Route choice is particularly important to assess prior to further calibration processes; such as Matrix Estimation.

10.2 Routing Through the Modelled Network

The model was further checked by examining shortest paths and minimum generalised cost routes through the network. These checks were done at an early stage of the model development, prior to matrix estimation to ensure suitability, and again towards the end of the model development process, with final versions of the trip matrices.

Major urban areas covered by the network were identified, and routes between them checked against local knowledge, common sense, and also routes suggested by Google Maps based on historic travel times and routing information. The urban areas identified are listed below:

- *Garstang*
- *Preston*
- *Blackpool*
- *Chorley*
- *Woodplumpton*
- *Broughton*
- *Blackburn*
- *Tarleton*
- *Samlesbury*
- *Warton*

In accordance to TAG unit M3.1 guidance, the number of routes that should be checked is defined by:

$$Number\ of\ OD\ Pairs = (Number\ of\ Zones)^{0.25} * (Number\ of\ User\ Classes)$$
$$Number\ of\ OD\ Pairs = 579^{0.25} * 5$$
$$Number\ of\ OD\ Pairs = 24.52$$

On that basis, with 579 zones, and 5 user classes, 24 routes should be checked. To ensure a robust network, an additional 2 routes were identified, making it 26 checked routes in total. Those routes selected were developed with LCC and Highways England, and the routes selected by combinations of the urban areas listed above all meet the criteria for routes which advise that they should:

- *Relate to significant number of trips*
- *Are of significant length*
- *Pass through areas of interest*
- *Include both directions of travel*
- *Link different compass areas*
- *Coincide with journey time routes as appropriate*

Some examples of the routes checked in the model are illustrated in Figure 10-A to Figure 10-C with the route shown in red:

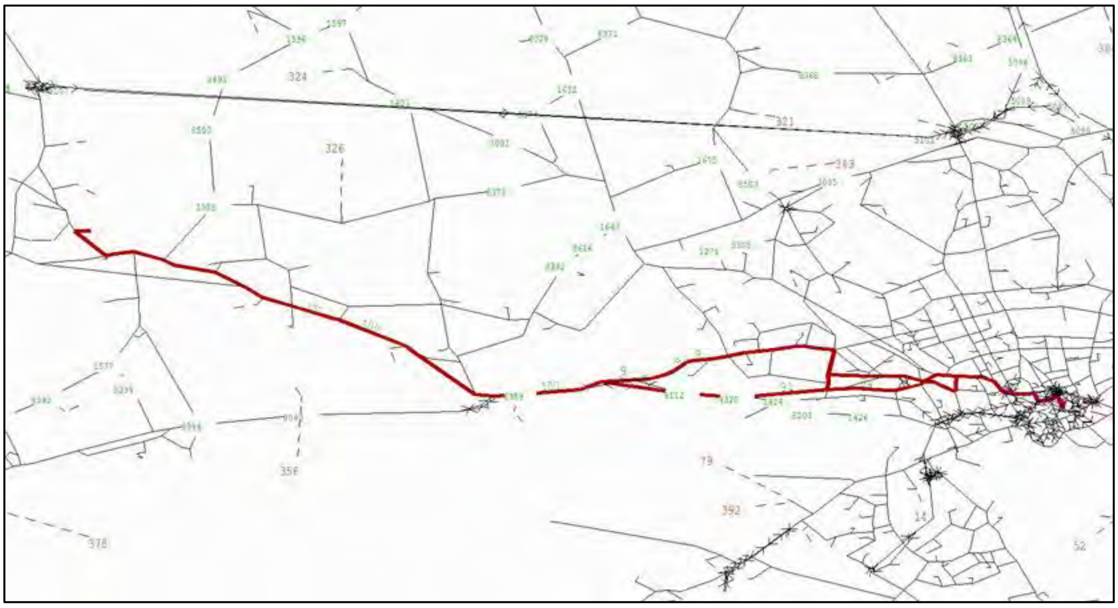


Figure 10-A - Kirkham to Preston

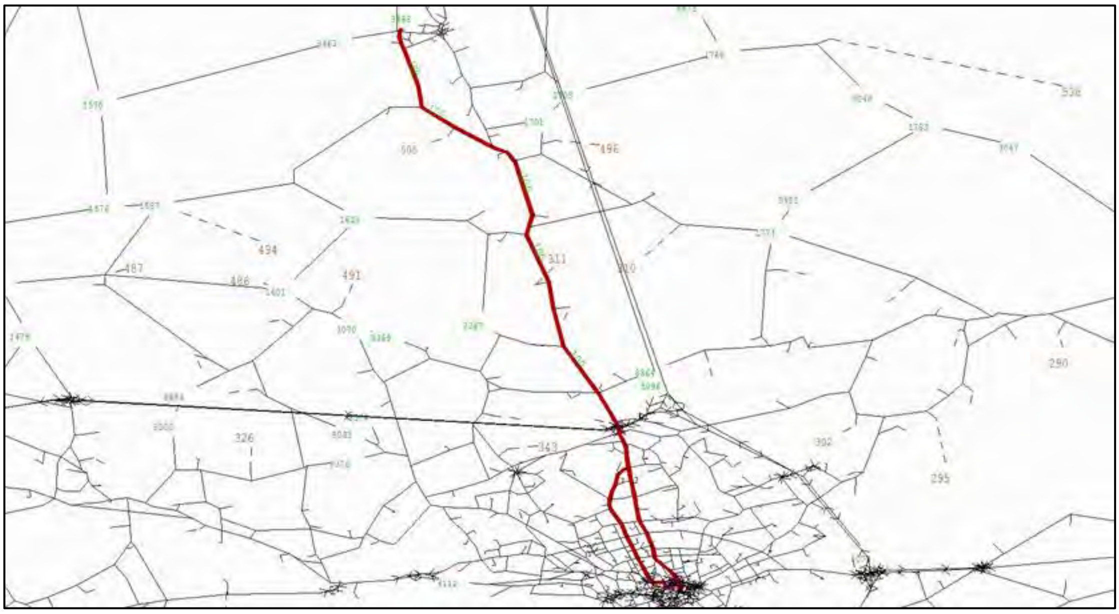


Figure 10-B - Garstang to Preston

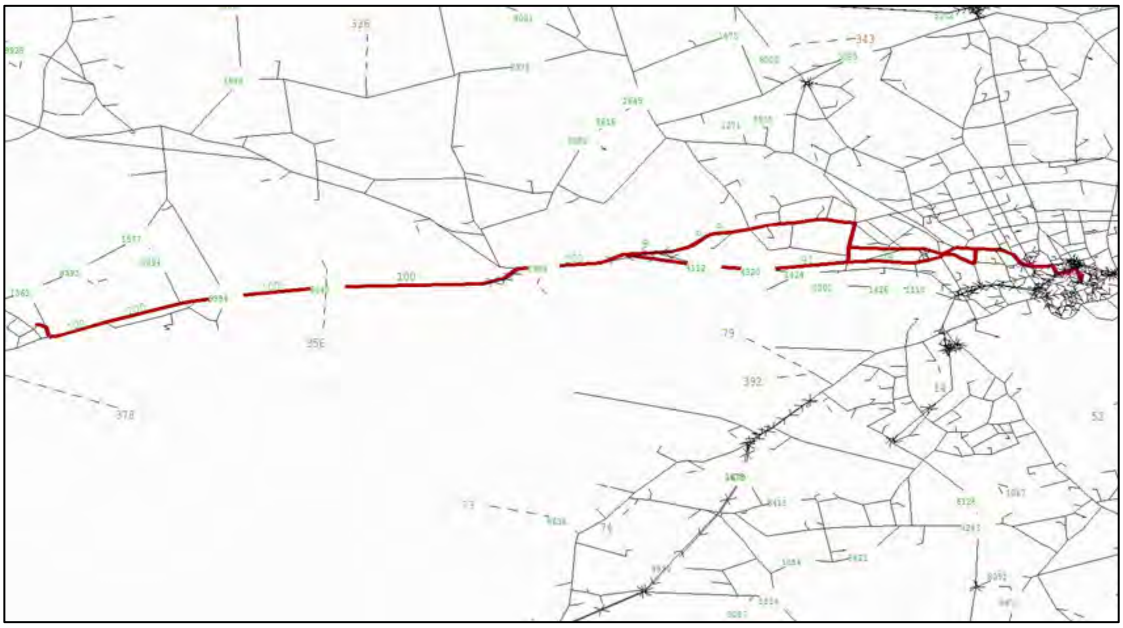


Figure 10-C - Warton to Preston

Where the route used in the model was contrary to expectations, the modelled network was adjusted to correct the route.

In most cases a change of link type as per the 77 defined in the coding manual, or junction capacity was sufficient to correct the route; in a small number of cases centroid connectors were altered.

To meet with the WebTAG criteria, the routes that were checked are detailed in 0.

It should be noted that both Car Commute and HGV routings were checked for logical movements.

11 Trip Matrix Calibration and Validation

11.1 Matrix estimation

Following the prior matrix assignment and refining of the modelled network, the trip matrices underwent a process of 'matrix estimation' whereby trip matrices are adjusted such that the resulting assigned flows matches are able to match count data better; in a controlled as possible process.

The following parameters were used for matrix estimation:

- *XAMAX – 2.0*
- *Number of iterations – 9*

It is important when running a matrix estimation process that the original 'prior' (to estimation) trip matrices are not distorted in such a way that the underlying trip patterns are altered.

To ensure that there was minimum distortion, short screenlines (Combined constraints) were applied. Counts used as constraints in matrix estimation were derived from count data, and applied at the Car, LGV and HGV level.

In addition to the short screenline approach, a frozen cell matrix was also setup to ensure that fully observed car trips were not altered in the process, and the only car trips impacted were developed through trip synthesis.

All HGV trip movements were left unfrozen due to the synthetic nature of demand. LGV matrices as produced in the original CLHTM model showed a good fit with the observed counts and external data (RTM model) and therefore did not require further update.

To test whether this altering process has occurred, and resulted in minimum distortion to the trip matrices, the guidelines set out within WebTAG unit M3-1 were applied to the prior - and post-ME matrices, as detailed below:

Table 11-1 - Significance of Matrix Estimation Changes

Measure	Significance Criteria
Matrix zonal cell values	Slope within 0.98 and 1.02 Intercept near zero R^2 in excess of 0.95
Matrix zone trip ends	Slope within 0.99 and 1.01 Intercept near zero R^2 in excess of 0.98
Trip length distributions	Means within 5% Standard deviations within 5%
Sector to sector level matrices	Differences within 5%

The significance of matrix estimation for each measure listed in the above table is described in the following section.

11.1.1 Matrix Cell Value Changes

Table 11-2 below shows for each time period and vehicle type (cars and HGVs), the cell values of the prior matrix plotted against the values in the same cell of the post matrix. The graphs are provided in Appendix J.

A trend line, with equation and R^2 value has also been plotted. The results are provided for both the full matrix and also just for trips less than 500; the latter test ensures that cells with a large number of trips do not mask changes occurring to cells with lower values.

The guidance states that the trend line must have a gradient between 0.98 and 1.02, an intercept close to zero, and an R^2 value exceeding 0.95. These conditions are met for all matrices.

Table 11-2 - Summary of Matrix Cell Value Changes

Measurement		Requirement	AM		IP		PM	
			Value	Pass/Fail	Value	Pass/Fail	Value	Pass/Fail
Total Matrix - Car	Slope	Within 0.98 and 1.02	1.000	Yes	1.000	Yes	1.000	Yes
	Intercept	Near 0	0.003	Yes	0.004	Yes	0.007	Yes
	R-Sq	> 0.95	1.000	Yes	1.000	Yes	0.999	Yes
Trips Less than 500 - Car	Slope	Within 0.98 and 1.02	1.002	Yes	1.002	Yes	1.004	Yes
	Intercept	Near 0	0.002	Yes	0.003	Yes	0.005	Yes
	R-Sq	> 0.95	0.993	Yes	0.996	Yes	0.992	Yes
Total Matrix - HGV	Slope	Within 0.98 and 1.02	1.000	Yes	1.000	Yes	1.000	Yes
	Intercept	Near 0	0.001	Yes	0.001	Yes	0	Yes
	R-Sq	> 0.95	1.000	Yes	1.000	Yes	1.000	Yes
Trips Less than 500 - HGV	Slope	Within 0.98 and 1.02	1.000	Yes	1.000	Yes	0.999	Yes
	Intercept	Near 0	0.001	Yes	0.001	Yes	0	Yes
	R-Sq	> 0.95	0.999	Yes	0.999	Yes	0.999	Yes

11.1.2 Matrix Trip End Changes

The check on how much matrix trip ends have been affected by matrix estimation is a similar one to the check on individual cell values in that the prior and post trip ends must be plotted on a graph and a trend line added. The graphs showing these are provided in Appendix J.

The guidance on these trend lines is the following:

- *Slope to be within 0.99 and 1.01*
- *Intercept near zero*
- *R Squared in excess of 0.98*

As shown in Table 11-3 and Table 11-4, in majority of cases the effect of ME on trip end values fall within the guidelines prescribed by WebTAG for both vehicle types. The values that do not meet the criteria are not far off from the guidance thresholds. The highest values (close to 4) occur at the y-intercept for PM car trip ends in the full matrix. The trip end intercepts are judged to have failed if less than -1 or greater than +1.

Table 11-3 - Matrix Row Total Changes - Trend Line Statistics

Measurement		Requirement	AM		IP		PM	
			Value	Pass/Fail	Value	Pass/Fail	Value	Pass/Fail
Row Total - Total Car	Slope	Within 0.99 and 1.01	1	Yes	1.003	Yes	1	Yes
	Intercept	Near 0	1.329	No	1.984	No	3.628	No
	R-Sq	> 0.98	1	Yes	1	Yes	1	Yes
Row Total - Car Trips Less than 500	Slope	Within 0.99 and 1.01	1.013	No	1.042	No	1.039	No
	Intercept	Near 0	-0.779	Yes	-1.207	No	-1.618	No
	R-Sq	> 0.98	0.984	Yes	0.983	Yes	0.984	Yes
Row Total - Total HGV	Slope	Within 0.99 and 1.01	1	Yes	1	Yes	0.999	Yes
	Intercept	Near 0	0.921	Yes	0.329	Yes	0.067	Yes
	R-Sq	> 0.98	0.999	Yes	1	Yes	1	Yes
Row Total - HGV Trips Less than 500	Slope	Within 0.99 and 1.01	1.015	No	1.02	No	0.969	No
	Intercept	Near 0	0.742	Yes	0.142	Yes	0.434	Yes
	R-Sq	> 0.98	0.986	Yes	0.992	Yes	0.977	No

Table 11-4 - Matrix Column Total Changes - Trend Line Statistics

Measurement		Requirement	AM		IP		PM	
			Value	Pass/Fail	Value	Pass/Fail	Value	Pass/Fail
Column Total - Total Car	Slope	Within 0.99 and 1.01	1	Yes	0.999	Yes	1	Yes
	Intercept	Near 0	1.572	No	2.473	No	3.953	No
	R-Sq	> 0.98	1	Yes	1	Yes	1	Yes
Column Total - Car Trips Less than 500	Slope	Within 0.99 and 1.01	1.031	No	1.031	No	1.047	No
	Intercept	Near 0	-0.39	Yes	-0.167	Yes	-0.554	Yes
	R-Sq	> 0.98	0.986	Yes	0.987	Yes	0.978	No
Column Total - Total HGV	Slope	Within 0.99 and 1.01	1	Yes	1	Yes	0.999	Yes
	Intercept	Near 0	0.867	Yes	0.539	Yes	-0.005	Yes
	R-Sq	> 0.98	1	Yes	1	Yes	1	Yes
Column Total - HGV Trips Less than 500	Slope	Within 0.99 and 1.01	1.043	No	0.995	Yes	0.974	No
	Intercept	Near 0	0.299	Yes	0.556	Yes	0.274	Yes
	R-Sq	> 0.98	0.991	Yes	0.994	Yes	0.989	Yes

11.1.3 Trip length distributions

For trip length distributions, it is stipulated in WebTAG that both the mean and standard deviation of the post matrix trip lengths should not differ by more than 5% from those of the prior matrices.

Whilst the change in average and standard deviation tip lengths for non E-E trips is minimal and well within guidelines, a more detailed assessment has been undertaken to derive the means and standard deviations broken down by internal and external movements as summarised in Table 11-5 and Table 11-6 for cars and HGVs respectively. It can be seen that all variations are in line with 5% tolerance required by the WebTAG, except the HGV AM internal to internal trips which are -7.8%, not far off from the required criteria.

Table 11-5 - ME Trip Length Distribution Changes – Cars

Measurement			Requirement	AM		IP		PM	
				Value	Pass/Fail	Value	Pass/Fail	Value	Pass/Fail
Mean Trip Length	Internal - Internal	Prior	Within 5%	7.29	Yes	6.43	Yes	7.31	Yes
	Internal - Internal	Post		7.15		6.24		7.13	
	Internal - Internal	Diff		-1.94%		-3.05%		-2.46%	
	Internal - External	Prior	Within 5%	29.65	Yes	32.57	Yes	28.78	Yes
	Internal - External	Post		29.38		32.19		28.34	
	Internal - External	Diff		-0.91%		-1.18%		-1.55%	
	External - Internal	Prior	Within 5%	26.88	Yes	32.62	Yes	30.33	Yes
	External - Internal	Post		27.07		32.79		30.57	
	External - Internal	Diff		0.70%		0.53%		0.77%	
	External - External	Prior	Within 5%	53.86	Yes	54.31	Yes	53.3	Yes
	External - External	Post		53.96		54.54		53.35	
	External - External	Diff		0.19%		0.41%		0.10%	
	Total	Prior	Within 5%	38.27	Yes	38.33	Yes	38.3	Yes
	Total	Post		38.17		38.08		37.97	
	Total	Diff		-0.26%		-0.64%		-0.85%	
Trip Length Standard Deviation	Internal - Internal	Prior	Within 5%	7.36	Yes	6.97	Yes	7.71	Yes
	Internal - Internal	Post		7.21		6.76		7.57	
	Internal - Internal	Diff		-2.03%		-3.02%		-1.80%	
	Internal - External	Prior	Within 5%	32.92	Yes	41.05	Yes	33.71	Yes

Measurement			Requirement	AM		IP		PM	
				Value	Pass/Fail	Value	Pass/Fail	Value	Pass/Fail
	Internal - External	Post		32.28		40.93		32.91	
	Internal - External	Diff		-1.96%		-0.29%		-2.37%	
	External - Internal	Prior		29.48		42.02		33.23	
	External - Internal	Post	Within 5%	30.12	Yes	42.33	Yes	33.49	Yes
	External - Internal	Diff		2.15%		0.74%		0.78%	
	External - External	Prior		49.96		57.13		51.27	
	External - External	Post	Within 5%	50.15	Yes	57.7	Yes	51.34	Yes
	External - External	Diff		0.38%		0.99%		0.15%	
	Total	Prior		40.52		46.65		41.88	
	Total	Post	Within 5%	40.57	Yes	46.83	Yes	41.7	Yes
	Total	Diff		0.12%		0.39%		-0.44%	

Table 11-6 - ME Trip Length Distribution Changes – HGVs

Measurement			Requirement	AM		IP		PM	
				Value	Pass/Fail	Value	Pass/Fail	Value	Pass/Fail
Mean Trip Length	Internal - Internal	Prior		11.1		11.88		8.7	
	Internal - Internal	Post	Within 5%	10.63	Yes	11.42	Yes	8.85	Yes
	Internal - Internal	Diff		-4.23%		-3.88%		1.81%	
	Internal - External	Prior		100.92		101.29		99.7	
	Internal - External	Post	Within 5%	98.67	Yes	100.39	Yes	98.9	Yes
	Internal - External	Diff		-2.23%		-0.89%		-0.80%	
	External - Internal	Prior		98.53		98.93		107.55	
	External - Internal	Post	Within 5%	94.81	Yes	96.93	Yes	105.94	Yes
	External - Internal	Diff		-3.78%		-2.02%		-1.50%	
	External - External	Prior	Within 5%	140.24	Yes	138.26	Yes	147.58	Yes

Measurement			Requirement	AM		IP		PM	
				Value	Pass/Fail	Value	Pass/Fail	Value	Pass/Fail
	External - External	Post		140.07		138.25		147.4	
	External - External	Diff		-0.13%		-0.01%		-0.12%	
	Total	Prior		130.71		129.88		134.18	
	Total	Post	Within 5%	129.48	Yes	129.3	Yes	133.34	Yes
	Total	Diff		-0.94%		-0.45%		-0.62%	
Trip Length Standard Deviation	Internal - Internal	Prior		23.37		24.85		20.63	
	Internal - Internal	Post	Within 5%	21.55	No	23.61	Yes	19.77	Yes
	Internal - Internal	Diff		-7.76%		-5.00%		-4.17%	
	Internal - External	Prior		87.57		86.06		94.28	
	Internal - External	Post	Within 5%	87.44	Yes	85.71	Yes	93.79	Yes
	Internal - External	Diff		-0.15%		-0.40%		-0.53%	
	External - Internal	Prior		92.93		90.87		101.47	
	External - Internal	Post	Within 5%	91.66	Yes	90.33	Yes	101.72	Yes
	External - Internal	Diff		-1.37%		-0.60%		0.24%	
	External - External	Prior		90.61		89.04		100.72	
	External - External	Post	Within 5%	90.47	Yes	89.06	Yes	100.5	Yes
	External - External	Diff		-0.16%		0.02%		-0.21%	
	Total	Prior		88.94		87.59		97.59	
	Total	Post	Within 5%	88.49	Yes	87.43	Yes	97.17	Yes
	Total	Diff		-0.51%		-0.19%		-0.43%	

Figure 11-A to Figure 11-F show the trip lengths distribution in distance bands for prior and post matrices for all time periods for both cars and HGVs. As these figures show

the matrix estimation process has generally increased the number of trips within all distance bands.

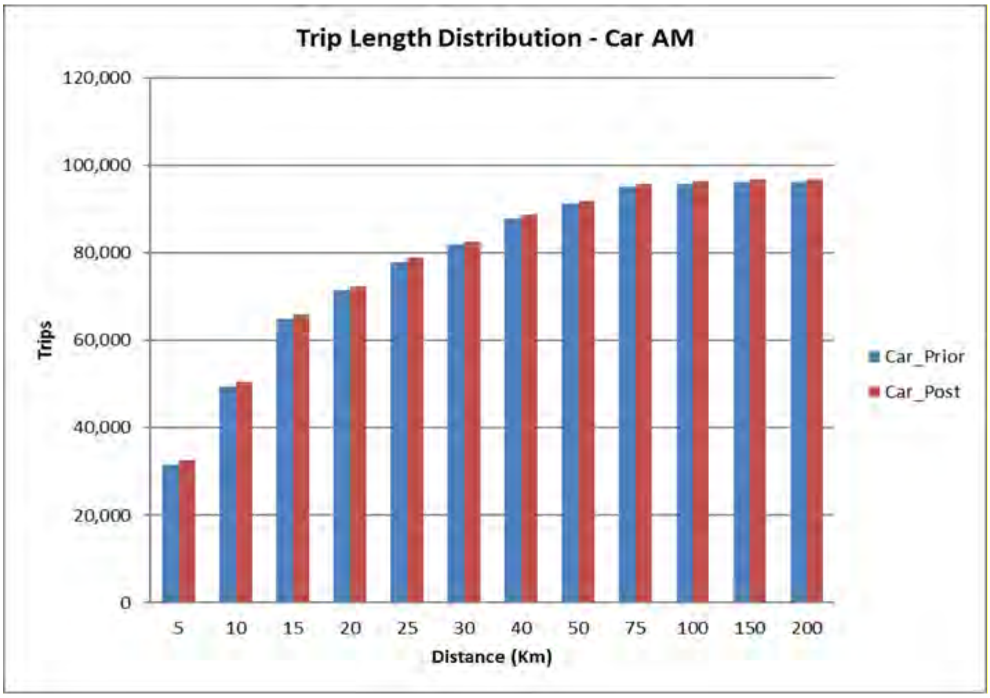


Figure 11-A - AM Cars

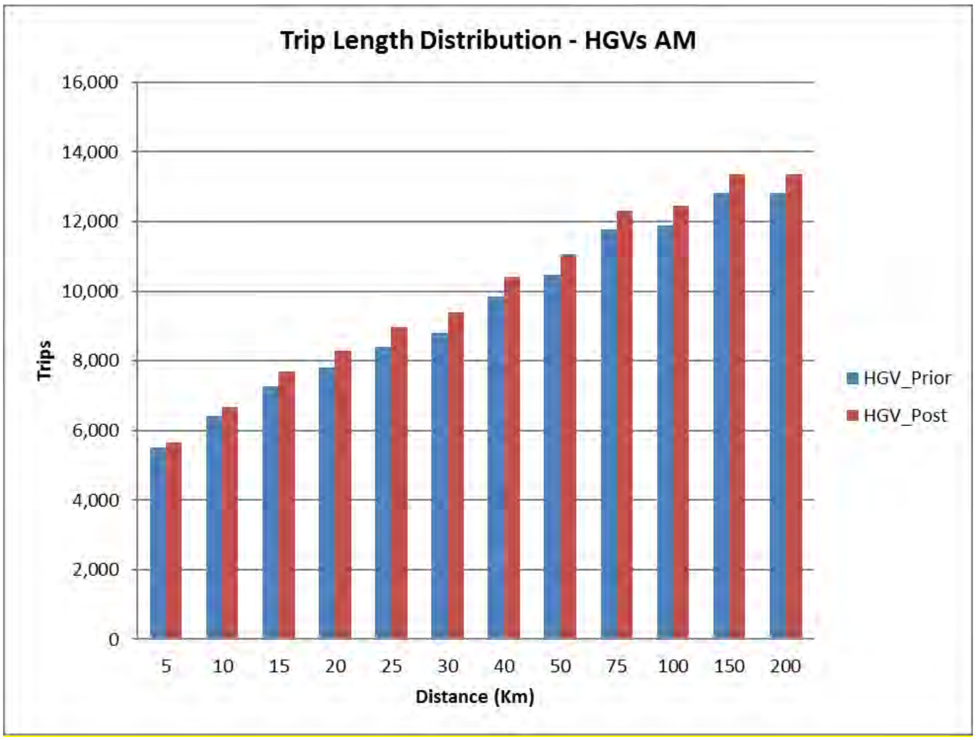


Figure 11-B - AM HGVs

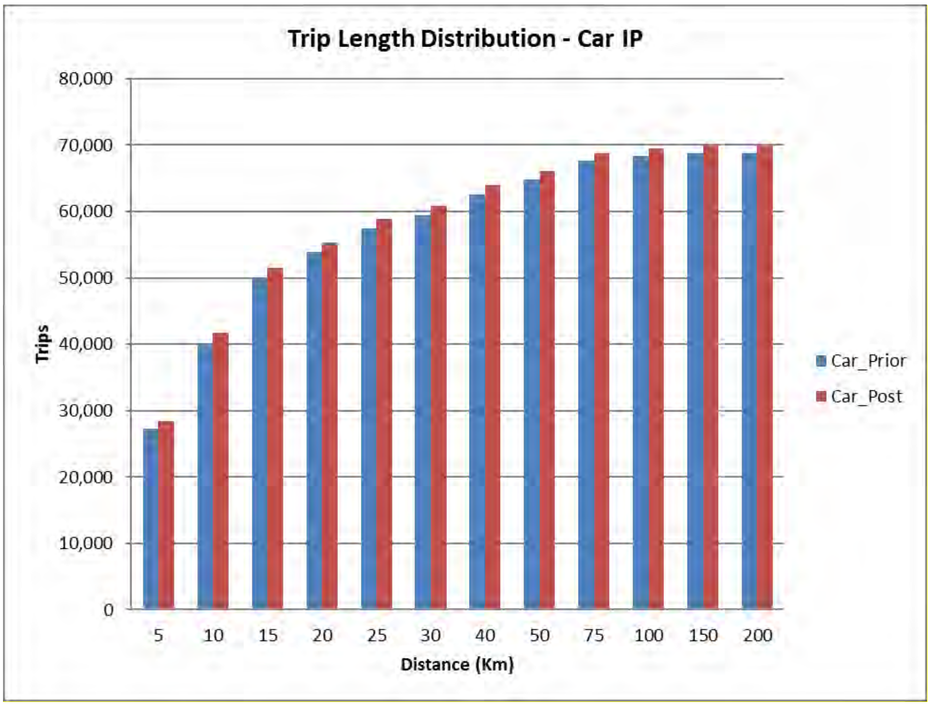


Figure 11-C - IP Cars

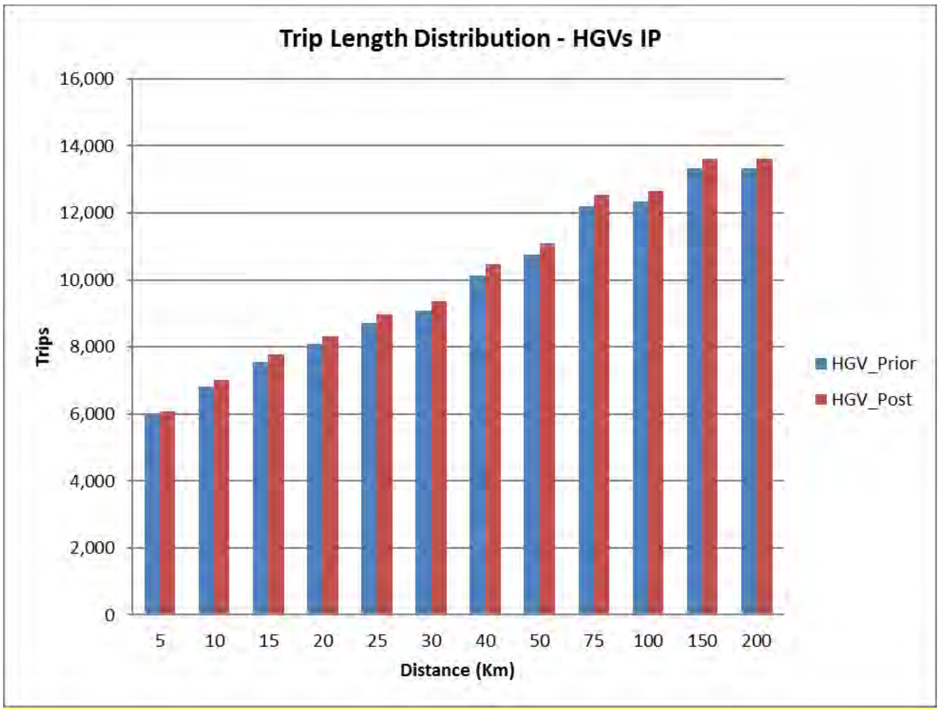


Figure 11-D - IP HGVs

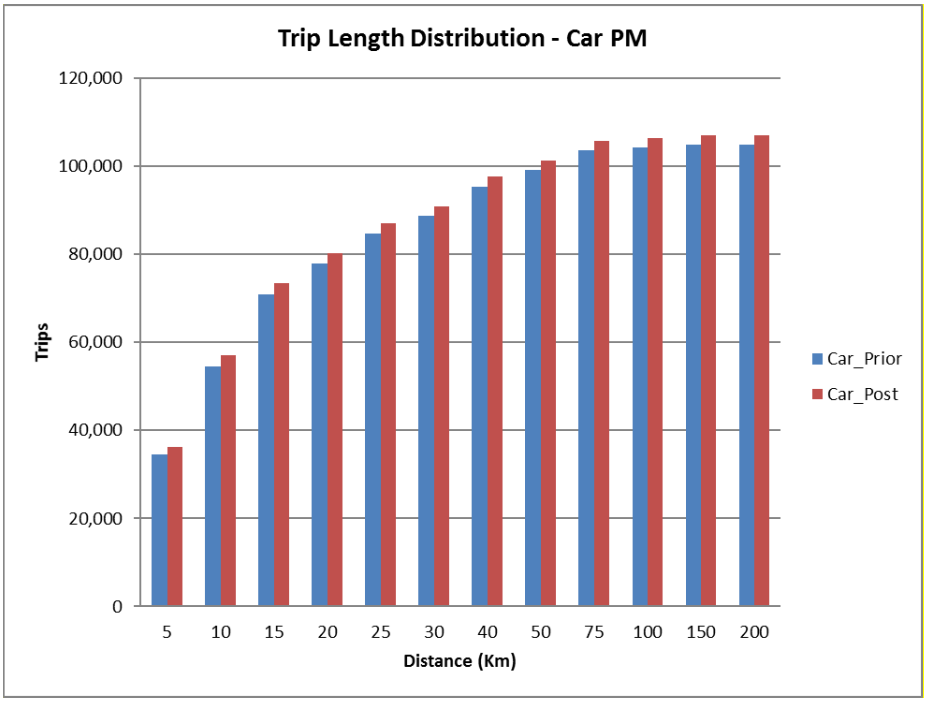


Figure 11-E - PM Cars

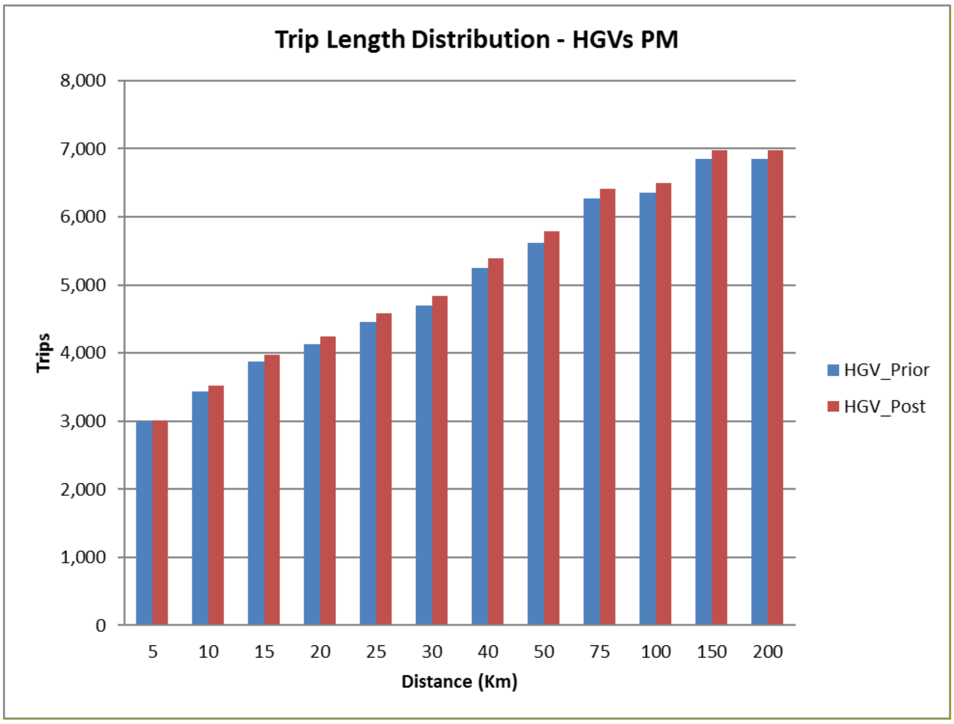


Figure 11-F - PM HGVs

11.1.4 Sector to Sector movements

Finally, the guidelines require a check on the matrix cells on a sector basis.

The guidelines state that trips should not change by more than 5% prior and post Matrix Estimation.

The same zone to sector system as identified in Section 4.2.1 was used for this purpose.

Table 11-7 shows the percentage of zone to zone movements within the sector movements that were frozen.

A high proportion of trip movements that are frozen, as a result of a particular zone to zone movement being observed, mean that it is expected that these sector to sector movements will change relatively little, compared to sector to sector movements with a low proportion of observed zone to zone movements.

Table 11-7 - Percentage of zones that are frozen

	Preston City Centre	Inner North Preston	Inner South Preston	North Preston	East Preston	South Preston	Leyland	South of Outer	Chorley	West Outer Screenline	Blackpool	Fleetwood / Garstang	North of Model –	Manchester	South	Scotland	North	Midlands	Wales	South of Model –
Preston City Centre	0%	3%	7%	21%	12%	15%	23%	8%	11%	12%	19%	11%	16%	82%	1%	9%	41%	27%	30%	18%
Inner North Preston	4%	8%	3%	17%	5%	6%	13%	3%	4%	8%	20%	6%	11%	70%	1%	5%	21%	13%	13%	7%
Inner South Preston	8%	3%	9%	6%	7%	14%	25%	5%	4%	4%	15%	2%	7%	47%	1%	9%	17%	11%	16%	9%
North Preston	27%	23%	7%	5%	3%	5%	4%	1%	1%	5%	8%	1%	3%	25%	0%	2%	7%	7%	5%	4%
East Preston	11%	5%	7%	3%	3%	5%	5%	1%	2%	3%	4%	1%	2%	8%	0%	2%	4%	3%	3%	2%
South Preston	19%	7%	13%	5%	5%	6%	8%	2%	2%	4%	13%	2%	4%	44%	0%	13%	16%	7%	6%	5%
Leyland	24%	13%	23%	5%	5%	8%	0%	0%	2%	6%	18%	1%	2%	0%	0%	0%	8%	13%	5%	0%
South Outer Screenline	9%	4%	5%	1%	1%	1%	0%	0%	0%	2%	3%	0%	0%	0%	0%	2%	2%	1%	0%	0%
Chorley	15%	6%	4%	2%	2%	2%	0%	0%	0%	2%	6%	0%	0%	0%	0%	0%	0%	0%	0%	0%
West Outer Screenline	12%	8%	4%	4%	3%	3%	6%	2%	2%	7%	10%	4%	6%	30%	1%	7%	16%	10%	11%	5%
Blackpool	25%	21%	14%	7%	6%	13%	21%	4%	4%	10%	4%	4%	7%	43%	2%	0%	19%	21%	14%	8%
Fleetwood / Garstang	12%	7%	2%	1%	1%	1%	1%	0%	0%	4%	3%	0%	0%	2%	0%	0%	1%	3%	2%	1%
North of Model – Lancaster etc	18%	12%	7%	4%	2%	4%	2%	0%	1%	5%	4%	0%	1%	4%	0%	4%	0%	2%	1%	2%
Manchester	86%	71%	45%	22%	13%	41%	0%	0%	0%	27%	43%	2%	4%	0%	0%	100%	0%	50%	0%	4%
South	1%	1%	1%	0%	0%	0%	0%	0%	0%	1%	2%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Scotland	9%	5%	5%	2%	2%	16%	0%	2%	0%	7%	14%	0%	4%	0%	0%	0%	0%	0%	0%	6%
North	41%	21%	14%	6%	3%	18%	8%	1%	0%	16%	14%	2%	0%	0%	0%	0%	0%	17%	7%	5%
Midlands	25%	11%	8%	3%	2%	15%	0%	1%	0%	7%	21%	2%	2%	50%	0%	0%	17%	25%	0%	3%
Wales	28%	17%	15%	6%	3%	7%	10%	0%	0%	9%	9%	2%	2%	0%	0%	20%	0%	0%	0%	0%
South of Model – Blackburn etc	16%	8%	8%	4%	2%	4%	2%	0%	0%	5%	9%	1%	2%	4%	0%	6%	6%	4%	0%	1%