JACOBS

Table 11-8, Table 11-11 and Table 11-14 show the total trip differences between the prior and post Matrix Estimation for all time periods. The highlighted cells show sector trip movements that increase by more than 50. It is assumed that a change of less than 50 vehicles can be considered as minor given the size of the sectors. A high percentage change for the sector-to-sector movements of less than 50 is acceptable as the overall number of trips is low.

Table 11-9, Table 11-12 and Table 11-15 show the percentage differences between the prior and post Matrix Estimation for sector movements for each time period. For the purpose of the report, the table shows only the cell values that change by more than 50 vehicles and the percent difference is above 5% as a result of Matrix Estimation. These values are highlighted to help distinguish a pattern in all three time periods.

It can be seen that there are few sector to sector movement that change by more than 5%, and as expected the majority of changes that have been factored are synthetic trip movements, such as sector 2 to 1, 6 to 7 and 8 to 9.

The tables also show that generally the sector to sector movements with the greatest differences between pre-matrix estimation and post matrix estimation contain few zone to zone movements that have been observed, and therefore are frozen during the matrix estimation process.

In order to further investigate the significance of these changes, the GEH values were calculated and presented in Table 11-10, Table 11-13 and Table 11-16. As shown, in most cases the GEH is less than 5; and the level of variations in sector-to-sector movements are considered satisfactory.

The sector to sector movement changes for HGVs are shown in Appendix K. The percentage difference tables only show trip movements that differ by 5% or more, and where the number of HGVs has increased by more than 30 vehicles. It should be noted that there are large percentage changes, but in terms of the total HGV trip numbers, the number of trip changes and GEH values are relatively small in most cases.

Based on the above results, the comparison of the prior and post ME matrices did not show significant distortions and therefore is considered acceptable.

## Table 11-8 – Sector to Sector Changes - Cars AM Trips

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 9 | -25 | -12 | 6 | 0 | -3 | -1 | -3 | -7 | -3 | -1 | -3 | -4 | -1 | 0 | 0 | -1 | 0 | -1 | 2 | -1 | 1 | -5 | -3 | 0 | -1 | -4 | -3 | 3 | -4 | -12 | 13 | 2 |
| 2 | 111 | 12 | -4 | 5 | 0 | 2 | -3 | -5 | -4 | -3 | 1 | -3 | -1 | 0 | 0 | 0 | 2 | 0 | 0 | 51 | 0 | 0 | 1 | 13 | -1 | 4 | 2 | -1 | 34 | 7 | 4 | 14 | 3 |
| 3 | 15 | -8 | -3 | 3 | 1 | 36 | 22 | 18 | 0 | -6 | 2 | -10 | -4 | 0 | -1 | 0 | 0 | 0 | -3 | -3 | 8 | 1 | -6 | -4 | 0 | -1 | -6 | -1 | -5 | 5 | 8 | 10 | 21 |
| 4 | 37 | 22 | 2 | 2 | 4 | 13 | 0 | 3 | -2 | -61 | -11 | -19 | -3 | 4 | 0 | -1 | -8 | 0 | 1 | 3 | 3 | 3 | 0 | 1 | -16 | -4 | 0 | 0 | 5 | -5 | 7 | 20 | 5 |
| 5 | 7 | 9 | 2 | 4 | 23 | -9 | -57 | -57 | -42 | -1 | 1 | 0 | 7 | 27 | -1 | 0 | 2 | 0 | -23 | 36 | 3 | -1 | -28 | -4 | 1 | 7 | 12 | 0 | -1 | 15 | 0 | 3 | 2 |
| 6 | -2 | 1 | 1 | 0 | 21 | 192 | 52 | 44 | 41 | -4 | -4 | -4 | 1 | 27 | -2 | 0 | -4 | -1 | -34 | 7 | 27 | 17 | -46 | -14 | -2 | 0 | 4 | -3 | -6 | 5 | -3 | 2 | 9 |
| 7 | -3 | 0 | 1 | 0 | -3 | 39 | -1 | 21 | 8 | -2 | 0 | -1 | 0 | 9 | -1 | 0 | -1 | 0 | -15 | -10 | 7 | 1 | -14 | -7 | 0 | -1 | 0 | 0 | -4 | 0 | 0 | 2 | 3 |
| 8 | -3 | -3 | -2 | 0 | 121 | 8 | -36 | 56 | 227 | -3 | -5 | -5 | -1 | -9 | 0 | -2 | -7 | 0 | -15 | -39 | 21 | 5 | -111 | -20 | -4 | -4 | 0 | 0 | -7 | 1 | -1 | 1 | 0 |
| 9 | -4 | -6 | 0 | -2 | 2 | 19 | -1 | 102 | 59 | -2 | -1 | -3 | -2 | -34 | 0 | -1 | -7 | 0 | -2 | -71 | 21 | 6 | -20 | -8 | -3 | -3 | -2 | 0 | -4 | -3 | -1 | -3 | 3 |
| 10 | -29 | 2 | -4 | -2 | -3 | -8 | 0 | -2 | -2 | 29 | 17 | 19 | -4 | -2 | -1 | -1 | -6 | 0 | -5 | -4 | -2 | 0 | -2 | -3 | -3 | -4 | -1 | 0 | -6 | -5 | 7 | 3 | 0 |
| 11 | -1 | 0 | -1 | -12 | -1 | -6 | 0 | -5 | -3 | 91 | 0 | 0 | -10 | -1 | -7 | -6 | -3 | -1 | -18 | -2 | -6 | -1 | -2 | -2 | -1 | -2 | -9 | 0 | 0 | -19 | 0 | 0 | -2 |
| 12 | -19 | -5 | -3 | -38 | 2 | -1 | -1 | -1 | -5 | 5 | -11 | 32 | -2 | 38 | 3 | 0 | 1 | 1 | 4 | 25 | -2 | 1 | 4 | 1 | 4 | -4 | -4 | -5 | -1 | -58 | -29 | -6 | -2 |
| 13 | 14 | 32 | 0 | -5 | 3 | 2 | -1 | -3 | -6 | -4 | -8 | -5 | -1 | -1 | -1 | -1 | -6 | 0 | -7 | -10 | 0 | 0 | -3 | 3 | -2 | -1 | 1 | 2 | 7 | -4 | 2 | 5 | 0 |
| 14 | 5 | 1 | 3 | 1 | 37 | 13 | -2 | -50 | -31 | 1 | 0 | -2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | -1 | -4 | -1 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 0 |
| 15 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 3 | 4 | 1 | 0 | 0 | 4 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| 16 | 0 | 0 | 0 | 0 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 17 | 1 | 0 | 0 | -2 | 4 | 3 | 0 | 2 | -4 | -3 | -1 | 0 | -1 | 1 | 1 | 0 | 0 | 0 | 0 | 19 | 0 | 2 | 2 | 2 | 0 | 0 | -1 | 0 | 3 | -2 | 0 | 0 | 1 |
| 18 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 19 | -2 | 4 | 0 | 6 | 1 | -1 | -5 | 1 | 17 | 2 | 14 | 54 | 10 | 0 | 0 | 5 | 2 | 0 | 0 | 1 | 0 | 5 | -1 | 0 | 2 | 2 | 8 | 0 | 0 | 13 | 0 | 0 | -3 |
| 20 | 27 | 13 | 2 | 2 | -3 | 16 | -26 | -67 | -91 | -2 | -4 | -14 | 3 | -2 | 2 | -1 | -6 | 0 | 24 | -52 | 2 | 9 | -38 | -23 | -3 | -2 | 10 | 0 | 15 | 6 | 0 | 1 | 0 |
| 21 | -5 | -2 | -6 | -6 | 16 | -10 | -1 | -16 | 29 | -4 | -1 | -2 | 1 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | -2 | -1 | -1 | 0 | 0 | 0 | 0 | -4 | -4 | -1 | -2 | -29 |
| 22 | -2 | -1 | -2 | 0 | 7 | 10 | -1 | 21 | 29 | -2 | 1 | 1 | 1 | 2 | 0 | 1 | 7 | 0 | 5 | 1 | 2 | 15 | 3 | 0 | 3 | 1 | 1 | 0 | 0 | 2 | -2 | -1 | -3 |
| 23 | 4 | 5 | 0 | 4 | 57 | -11 | -17 | -83 | 171 | -1 | -1 | 7 | 5 | -23 | 0 | 2 | 14 | 0 | -4 | -18 | 0 | 23 | -26 | -7 | 6 | 0 | 6 | -1 | -2 | 11 | 0 | 1 | -3 |
| 24 | 11 | 3 | 0 | 13 | 9 | -1 | -7 | 4 | 1 | 2 | 7 | 8 | 4 | 20 | -1 | 1 | 7 | 0 | -10 | -29 | 1 | -1 | 0 | 3 | 5 | -3 | 10 | 0 | 4 | 40 | -2 | 1 | 3 |
| 25 | -1 | 1 | 0 | -27 | 7 | 5 | 0 | 3 | -5 | -6 | -1 | 21 | 0 | 8 | 1 | 0 | 0 | 1 | 3 | 12 | 0 | 2 | 2 | 3 | 0 | 0 | -3 | 0 | 1 | -35 | 0 | 0 | 0 |
| 26 | 40 | 23 | 1 | -1 | 21 | 1 | -2 | -3 | -14 | -3 | -1 | 0 | 1 | 0 | -1 | 0 | 0 | 0 | -4 | -2 | 0 | 1 | -5 | 7 | 0 | 0 | 0 | 0 | 12 | -2 | -1 | 0 | 0 |
| 27 | 6 | 18 | 1 | 0 | 21 | -1 | -8 | 1 | -2 | -2 | -1 | -3 | -1 | -1 | 0 | 0 | -1 | 0 | -1 | -2 | 1 | 0 | -1 | 1 | -1 | 1 | 1 | 0 | 2 | -2 | 1 | 2 | 0 |
| 28 | 8 | -1 | 0 | 0 | 0 | 6 | 5 | 2 | 0 | 0 | 0 | -2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | -1 | 0 | 0 | -1 | 2 | 4 | 2 |
| 29 | -41 | -39 | -1 | 0 | 1 | 7 | 54 | 0 | -7 | -1 | 3 | 1 | -5 | -1 | 0 | 0 | -2 | 0 | -5 | -6 | 0 | -1 | -11 | -2 | 0 | -1 | -2 | 0 | -8 | 10 | -3 | -11 | 12 |
| 30 | 23 | 18 | 3 | -13 | 4 | 4 | 0 | 1 | -3 | -38 | -10 | -24 | -7 | 5 | 0 | -1 | -8 | 0 | 0 | 1 | 7 | 1 | 0 | 2 | -16 | -6 | -1 | 0 | 5 | -7 | 0 | 16 | 3 |
| 31 | 5 | 13 | -10 | 1 | 4 | -2 | 0 | -2 | -5 | -35 | 0 | -1 | 0 | 0 | 0 | 0 | 0 | -2 | 0 | 0 | -1 | 0 | -1 | -2 | 0 | 0 | 1 | -3 | -3 | 0 | -1 | 21 | -3 |
| 32 | 67 | 5 | 2 | 7 | -3 | 6 | 2 | 4 | 0 | -4 | 0 | -4 | -1 | 0 | 0 | 0 | -6 | 0 | 0 | -7 | 3 | 2 | 0 | -7 | -6 | -2 | 1 | 1 | -13 | 4 | 8 | 4 | 3 |
| 33 | -9 | -5 | -22 | -8 | -2 | 6 | 8 | -1 | 5 | -7 | -3 | -7 | -3 | -1 | 0 | 0 | -2 | 0 | 3 | -2 | 8 | 1 | 0 | -8 | 0 | -1 | -4 | -4 | -10 | -6 | -2 | -2 | 0 |

## Table 11-9 – Sector to Sector % Changes - Cars AM Trips

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 2 | 14% | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 51% | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 3 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 4 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 5 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 6 | - | - | - | - | - | 11% | 6% | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 7 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 8 | - | - | - | - | 12% | - | - | 6% | 32% | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 9 | - | - | - | - | - | - | - | 33% | 13% | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 10 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 11 | - | - | - | - | - | - | - | - | - | 8% | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 12 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 13 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 14 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 15 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 16 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 17 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 18 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 19 | - | - | - | - | - | - | - | - | - | - | - | 23% | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 20 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 21 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 22 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 23 | - | - | - | - | 27% | - | - | - | 33% | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 24 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 25 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 26 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 27 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 28 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 29 | - | - | - | - | - | - | 30% | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 30 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 31 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 32 | 13% | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 33 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |

Table 11-10 – Sector to Sector GEH Values- Cars AM Trips

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 2 | 3.8 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 3.7 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 3 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 4 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 5 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 6 | - | - | - | - | - | 4.5 | 1.8 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 7 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 8 | - | - | - | - | 7.1 | - | - | 2.0 | 9.7 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 9 | - | - | - | - | - | - | - | 5.3 | 2.7 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 10 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 11 | - | - | - | - | - | - | - | - | - | 2.7 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 12 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 13 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 14 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 15 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 16 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 17 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 18 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 19 | - | - | - | - | - | - | - | - | - | - | - | 3.4 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 20 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 21 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 22 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 23 | - | - | - | - | 3.7 | - | - | - | 7.2 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 24 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 25 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 26 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 27 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 28 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 29 | - | - | - | - | - | - | 3.8 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 30 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 31 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 32 | 2.8 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 33 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |

***Table 11-11 – Sector to Sector Changes - Cars IP Trips***

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 6 | 64 | -9 | -16 | 4 | -11 | 2 | 5 | -5 | -1 | 0 | -15 | 23 | -3 | 0 | 0 | -1 | 0 | 0 | -1 | -2 | 0 | -3 | 8 | 5 | 3 | 9 | -1 | 1 | -7 | 18 | 43 | -11 |
| 2 | 67 | 29 | -4 | -9 | 6 | 4 | 1 | 5 | 0 | -1 | -1 | 0 | 51 | -1 | 0 | 2 | 1 | -1 | 3 | -1 | -2 | 1 | -3 | 10 | 0 | 2 | 8 | -1 | 26 | -10 | 11 | 8 | -4 |
| 3 | -12 | -4 | -2 | -14 | 6 | -1 | 6 | 0 | -4 | -1 | -3 | -13 | -1 | -1 | 0 | -1 | -3 | 0 | 0 | -5 | -1 | 0 | -1 | 5 | -2 | -1 | 0 | 0 | 1 | -13 | -2 | 7 | -9 |
| 4 | 17 | 7 | -7 | -4 | 2 | -5 | 0 | -2 | -3 | -5 | -6 | -9 | 0 | -1 | 0 | -1 | -3 | 0 | 2 | -1 | -1 | 0 | -2 | 3 | -9 | 0 | 0 | 0 | 0 | -3 | 0 | -2 | -5 |
| 5 | 9 | 1 | 12 | 1 | 18 | 34 | 1 | 23 | -32 | 5 | 0 | 1 | 1 | 10 | 0 | 1 | 4 | 0 | 7 | 28 | 3 | 4 | -28 | 12 | 2 | 3 | 2 | 0 | 13 | 2 | 2 | 2 | 4 |
| 6 | -3 | -2 | 5 | -5 | 45 | 258 | 100 | 27 | 18 | -2 | -4 | -5 | -5 | 0 | -1 | -1 | -5 | 0 | -10 | 18 | 8 | 10 | -15 | 6 | -2 | -5 | -7 | -1 | 8 | -7 | -1 | -1 | 9 |
| 7 | 0 | -2 | 3 | -2 | -8 | 80 | 1 | 15 | 3 | 0 | 0 | -2 | -2 | -4 | -1 | -1 | -4 | 0 | -11 | -10 | 8 | 1 | -17 | -10 | -1 | -3 | -3 | 1 | -4 | -2 | 1 | 1 | 6 |
| 8 | 2 | -2 | 1 | -4 | 54 | 29 | -16 | 24 | 183 | -1 | -3 | -3 | -3 | 11 | 0 | -1 | -5 | 0 | 2 | 5 | 7 | 7 | -19 | 0 | -2 | -5 | -3 | 0 | 1 | -2 | 2 | 0 | 0 |
| 9 | -6 | -4 | -5 | -4 | 2 | 13 | 3 | 155 | 5 | -1 | -1 | -3 | -3 | -6 | 0 | -2 | -9 | 0 | -5 | -17 | 21 | 17 | -25 | -10 | -4 | -5 | -3 | 0 | -9 | -2 | -1 | -2 | 3 |
| 10 | -9 | -3 | -4 | -8 | 1 | -3 | 0 | -3 | -1 | 15 | 2 | -32 | 1 | 3 | 0 | -1 | -3 | 0 | 2 | 2 | -2 | -1 | -1 | 0 | -7 | -1 | 0 | 0 | -1 | -9 | -14 | -4 | -4 |
| 11 | -1 | 1 | -2 | -3 | 4 | -3 | 0 | -2 | -1 | 45 | 0 | 6 | -1 | 0 | 4 | -4 | -2 | 0 | 11 | 0 | 0 | 0 | -1 | 0 | 0 | 0 | -1 | 0 | 0 | -3 | -1 | -1 | -2 |
| 12 | -11 | -3 | -4 | -24 | 3 | 0 | 0 | 0 | -3 | 24 | -1 | 4 | 0 | -5 | 6 | 0 | 0 | 2 | 28 | -8 | -5 | 1 | 4 | 0 | 5 | 0 | 0 | -2 | -1 | -32 | -8 | -9 | -6 |
| 13 | 7 | 58 | 1 | 3 | 3 | -3 | -1 | -4 | -6 | 1 | -2 | -2 | 1 | -9 | 0 | -1 | -3 | 0 | -2 | -2 | -1 | 0 | -2 | 0 | -5 | 0 | 3 | 1 | 4 | 2 | 2 | 11 | -1 |
| 14 | -2 | 0 | -3 | -2 | 55 | 1 | -4 | 31 | 18 | -1 | -1 | -14 | -5 | 0 | 0 | 0 | -1 | 0 | 0 | 2 | 0 | 2 | -5 | -1 | -1 | 0 | -3 | 0 | -2 | -3 | 0 | 0 | -1 |
| 15 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | -1 | 4 | 0 | 0 | 0 | 6 | 3 | 0 | 0 | -1 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| 16 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | -1 | -1 | 0 | 0 | -1 | 0 | -3 | 3 | 0 | 0 | 1 | 3 | -2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | -1 |
| 17 | 0 | 1 | -1 | -1 | 9 | -2 | 0 | -7 | -10 | -1 | 0 | 0 | -1 | -1 | 3 | 0 | 0 | 0 | 1 | -21 | 0 | 2 | 2 | 0 | 0 | -2 | 0 | 0 | 0 | -1 | 0 | 2 | -2 |
| 18 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | -2 | 0 | 0 | 0 | 0 | 3 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | -1 |
| 19 | 2 | 2 | 1 | 2 | 5 | 8 | 0 | 4 | 10 | 5 | -2 | 17 | 1 | 0 | 0 | 8 | 3 | 0 | 0 | -38 | 0 | 4 | -1 | 2 | 6 | 0 | 1 | 0 | 4 | 2 | 1 | -1 | -2 |
| 20 | -3 | 2 | -5 | -6 | 12 | -10 | -7 | -20 | -31 | 2 | -2 | -3 | 0 | 0 | -2 | 3 | 39 | 0 | -70 | -10 | 2 | -3 | -16 | 3 | 6 | -1 | -4 | -1 | -2 | -5 | -1 | -1 | -1 |
| 21 | -5 | -2 | -11 | -1 | 1 | -12 | -4 | -12 | 6 | -3 | -1 | -7 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | -1 | 0 | -3 | -2 | 0 | 0 | 0 | 0 | 0 | -1 | 0 | -3 | -4 | -16 |
| 22 | 0 | 0 | -1 | 0 | 6 | 12 | 2 | 15 | 25 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 8 | 0 | 1 | 0 | 0 | 12 | 7 | 1 | 3 | 1 | 0 | 0 | 2 | 0 | 0 | 0 | -2 |
| 23 | -3 | -1 | 0 | -1 | 18 | 0 | -2 | -41 | 27 | -2 | -3 | 1 | -1 | -4 | 0 | 2 | 10 | 0 | 0 | -4 | 0 | 14 | -9 | -1 | 2 | -2 | -1 | -1 | -1 | 0 | 0 | 0 | -2 |
| 24 | 17 | 6 | 3 | 1 | 27 | 2 | -6 | 6 | -4 | 2 | -1 | 0 | 2 | 9 | 0 | 0 | 5 | 0 | 4 | 50 | 0 | 1 | 2 | 1 | 2 | 2 | 2 | 0 | 10 | 0 | 1 | 1 | -2 |
| 25 | 0 | 0 | 0 | -2 | 5 | -1 | 0 | -3 | -5 | 0 | 0 | -2 | -3 | -5 | 2 | 0 | 0 | 0 | 7 | -5 | 0 | 1 | 0 | -1 | 0 | 0 | -1 | 0 | 0 | -2 | 0 | 0 | -1 |
| 26 | 0 | 0 | 0 | -1 | 10 | -5 | -1 | -10 | -15 | -2 | -1 | -2 | 3 | 0 | 0 | 0 | -4 | 0 | 0 | -1 | 0 | 0 | -6 | 0 | -1 | 0 | 0 | -1 | 4 | -1 | 0 | 0 | -1 |
| 27 | 2 | 6 | -1 | 0 | 1 | -5 | -1 | -5 | -8 | -1 | -2 | -2 | -2 | -14 | 0 | 0 | -2 | -1 | -3 | -4 | -1 | -1 | -5 | -1 | -1 | -3 | 0 | 0 | 1 | 0 | 1 | 1 | -1 |
| 28 | -3 | -2 | -1 | -2 | 0 | -3 | 0 | -1 | -1 | 0 | 0 | -3 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | -1 | 0 | 0 | 0 | 0 | 0 | 0 | -3 | 0 | 1 | -3 |
| 29 | 15 | 20 | 0 | 4 | 16 | 1 | 1 | 5 | -4 | 0 | 0 | 0 | 10 | -2 | 0 | 1 | -1 | 0 | 1 | 17 | -1 | 1 | -3 | 12 | 1 | 10 | 3 | 0 | 23 | 2 | 2 | -2 | -4 |
| 30 | 8 | 6 | -4 | -3 | 2 | -3 | -1 | -3 | -4 | -12 | -4 | -15 | -1 | -2 | 0 | -1 | -3 | 0 | -2 | -4 | -1 | 0 | -3 | -1 | -9 | -1 | -1 | 0 | 8 | -3 | -3 | -11 | -5 |
| 31 | 40 | 24 | 0 | -2 | 2 | -1 | 1 | 0 | -2 | -5 | 0 | -9 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | -1 | 0 | 0 | -7 | 37 | 21 | -3 |
| 32 | 38 | 7 | 7 | -14 | 0 | 0 | 2 | 1 | -2 | -2 | -2 | -9 | 9 | 0 | -1 | 0 | -2 | 0 | -2 | 5 | 1 | 0 | 0 | -4 | -2 | 4 | 1 | 1 | -8 | -15 | 14 | -1 | 0 |
| 33 | -6 | -2 | -11 | -9 | 0 | 1 | 5 | 2 | 2 | -2 | -2 | -6 | 1 | -1 | 0 | 0 | -3 | -1 | 0 | 0 | 2 | 0 | 0 | 1 | -1 | -2 | 2 | -1 | -3 | -7 | -1 | -2 | 0 |

**Table 11-12 – Sector to Sector % Changes - Cars IP Trips**

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | - | 11% | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 2 | 10% | - | - | - | - | - | - | - | - | - | - | - | 50% | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 3 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 4 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 5 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 6 | - | - | - | - | - | 11% | 10% | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 7 | - | - | - | - | - | 11% | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 8 | - | - | - | - | 35% | - | - | - | 39% | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 9 | - | - | - | - | - | - | - | 38% | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 10 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 11 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 12 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 13 | - | 51% | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 14 | - | - | - | - | 58% | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 15 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 16 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 17 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 18 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 19 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 20 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 21 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 22 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 23 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 24 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 36% | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 25 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 26 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 27 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 28 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 29 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 30 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 31 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 32 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 33 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |

## *Table 11-13 – Sector to Sector GEH Values- Cars IP Trips*

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | - | 2.6 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 2 | 2.5 | - | - | - | - | - | - | - | - | - | - | - | 4.5 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 3 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 4 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 5 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 6 | - | - | - | - | - | 5.1 | 3.1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 7 | - | - | - | - | - | 2.9 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 8 | - | - | - | - | 4.0 | - | - | - | 7.8 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 9 | - | - | - | - | - | - | - | 7.1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 10 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 11 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 12 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 13 | - | 4.9 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 14 | - | - | - | - | 5.0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 15 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 16 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 17 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 18 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 19 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 20 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 21 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 22 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 23 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 24 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 3.9 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 25 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 26 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 27 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 28 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 29 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 30 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 31 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 32 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 33 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |

## Table 11-14 – Sector to Sector Changes - Cars PM Trips

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 27 | 218 | 62 | 8 | 5 | -5 | 8 | -1 | -1 | 10 | 10 | -20 | 57 | -3 | -1 | 0 | -1 | -1 | -2 | 1 | -1 | -1 | 1 | 1 | 9 | 14 | 11 | 20 | 26 | 16 | -18 | 8 | 5 |
| 2 | 52 | 55 | 8 | 15 | 0 | 8 | 1 | 6 | 6 | -11 | -1 | -12 | 27 | 20 | 0 | 0 | 0 | 0 | 0 | 17 | 9 | 2 | 11 | 8 | 1 | 5 | 15 | 3 | 60 | 15 | 11 | 13 | 1 |
| 3 | -22 | -1 | -1 | -15 | 7 | -1 | 12 | 2 | -5 | 9 | 1 | -12 | -2 | -2 | -5 | 0 | -2 | 0 | -5 | -5 | -4 | -1 | -3 | -5 | -2 | -2 | 2 | 1 | -4 | -15 | -15 | -1 | -2 |
| 4 | 2 | 15 | -9 | 4 | 4 | -5 | -2 | 0 | -6 | -28 | -17 | -71 | 8 | -3 | 0 | -1 | -5 | 0 | -2 | -15 | -1 | 0 | -2 | 0 | -23 | 2 | 1 | -1 | 11 | -15 | 6 | 26 | -2 |
| 5 | 3 | 0 | -4 | 3 | 42 | 31 | -5 | 190 | -2 | 0 | -1 | -2 | 2 | 44 | 0 | 0 | 0 | 1 | -5 | 7 | 3 | 6 | -30 | -4 | -2 | 15 | 0 | 0 | 3 | 1 | -2 | 5 | 1 |
| 6 | 0 | 2 | 10 | -3 | 157 | 230 | 125 | 60 | 18 | 12 | 1 | -9 | -6 | 11 | -2 | -1 | -6 | 0 | -23 | 2 | 8 | 15 | -38 | 11 | -5 | -4 | -7 | 1 | 10 | -7 | -4 | -4 | 9 |
| 7 | -1 | -5 | 3 | -1 | -25 | 115 | -1 | 24 | 1 | 1 | -1 | -2 | -2 | -8 | -1 | -1 | -3 | 0 | -16 | -26 | 9 | -2 | -35 | -10 | -1 | -3 | -2 | 1 | -7 | -1 | 1 | -1 | 11 |
| 8 | 0 | 0 | 1 | 1 | 120 | 25 | -9 | 84 | 102 | 2 | -2 | -3 | -1 | 1 | 0 | -1 | -4 | 0 | -2 | -45 | -13 | 15 | -67 | -2 | -3 | -1 | -2 | 1 | -2 | 0 | 0 | 9 | 1 |
| 9 | -7 | -6 | -5 | -1 | 1 | 38 | 14 | 205 | 38 | -2 | -2 | -4 | -2 | -32 | 1 | -1 | -5 | 0 | 28 | -17 | 29 | 28 | -10 | -7 | -5 | -5 | -1 | -1 | -10 | -1 | -5 | -1 | 4 |
| 10 | 0 | -1 | 2 | -30 | 3 | 3 | 1 | 2 | -1 | 9 | 141 | 33 | -3 | 3 | 0 | -1 | -5 | 0 | 0 | -3 | -1 | 0 | -3 | -1 | -6 | -2 | 0 | 1 | -4 | -21 | -5 | -1 | 0 |
| 11 | -1 | -1 | 1 | -23 | 1 | -6 | 0 | -1 | -2 | -25 | 0 | 78 | -5 | -1 | -5 | -5 | -5 | -1 | -10 | -4 | 0 | -1 | -3 | -1 | -2 | -2 | -3 | 0 | -3 | -18 | 1 | -1 | 0 |
| 12 | -6 | 3 | -4 | -9 | 4 | -1 | -1 | 1 | -2 | 90 | -11 | 3 | -5 | 11 | 3 | 0 | 0 | 2 | 9 | -15 | 0 | 1 | 6 | -2 | -14 | -2 | 2 | -2 | 1 | -50 | -5 | 3 | -4 |
| 13 | 10 | 19 | 1 | -2 | 4 | -2 | -1 | -2 | -6 | -7 | -10 | -7 | 1 | -13 | 0 | -1 | -6 | 0 | -5 | -31 | -1 | 0 | -4 | 0 | -17 | 7 | -2 | 0 | 3 | -4 | 3 | 0 | 0 |
| 14 | -1 | 0 | -4 | 7 | 45 | 15 | -8 | -3 | -9 | -1 | 0 | 13 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | -1 | 0 | 3 | -3 | -4 | 4 | 2 | -1 | 0 | -4 | 7 | 0 | 1 | 0 |
| 15 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | -1 | 6 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | -1 |
| 16 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | -1 | -1 | 0 | 0 | 0 | 4 | 2 | 0 | 0 | 0 | 2 | -5 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 17 | 0 | 6 | 1 | -1 | 9 | 2 | 0 | 4 | -7 | -4 | 1 | 0 | -1 | 7 | 1 | 0 | 0 | 0 | 0 | -7 | 0 | 3 | 6 | -1 | 0 | -2 | 0 | 0 | 3 | -1 | -1 | 0 | 0 |
| 18 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| 19 | 0 | 4 | 6 | 8 | 15 | 0 | -2 | 2 | 8 | 0 | -4 | 38 | 6 | 0 | 0 | 1 | 0 | 0 | 0 | 30 | 0 | 9 | -3 | 3 | 1 | 3 | -1 | 0 | 4 | 8 | -1 | 0 | -5 |
| 20 | 6 | 55 | 0 | 1 | 8 | -5 | -11 | -67 | -99 | 0 | 0 | 12 | 8 | 0 | -4 | 0 | -10 | 0 | -65 | -41 | -1 | -3 | -48 | 8 | 54 | 2 | -6 | 0 | 8 | -6 | -2 | 16 | 0 |
| 21 | -1 | -1 | -10 | -5 | 1 | -14 | -2 | -9 | 0 | -2 | 0 | -10 | 0 | 0 | 0 | -1 | 0 | 0 | 0 | 0 | 0 | -4 | -3 | 0 | 0 | 0 | 0 | 0 | -4 | -2 | -1 | -2 | -15 |
| 22 | 0 | 2 | 1 | 0 | 11 | 9 | 10 | 15 | 10 | -1 | 0 | 2 | 1 | 1 | 0 | 0 | 2 | 0 | 2 | 7 | -2 | 20 | 14 | 3 | 1 | 1 | 0 | -1 | 3 | 0 | 0 | 0 | -2 |
| 23 | 0 | -1 | -1 | 4 | 56 | -11 | -5 | -56 | 59 | 0 | -1 | 8 | 1 | -11 | 0 | 0 | 0 | 0 | -1 | 12 | -1 | 24 | -25 | 0 | -1 | -1 | -1 | 0 | 4 | 1 | 0 | 1 | -5 |
| 24 | 2 | 7 | 4 | -6 | 103 | 7 | -7 | 57 | 11 | 0 | -5 | -6 | -5 | 38 | -1 | -1 | -2 | 0 | -4 | 100 | 0 | -3 | 52 | 0 | -8 | -4 | -4 | 1 | 3 | -3 | -1 | -2 | -2 |
| 25 | 0 | 0 | -1 | -5 | 5 | 1 | 0 | 2 | -5 | -5 | 0 | 9 | 0 | 3 | 0 | 0 | 0 | 0 | 2 | -5 | 0 | 1 | 2 | -1 | 0 | 0 | -1 | 0 | 0 | -5 | 0 | 1 | -1 |
| 26 | 0 | 0 | -1 | -2 | 22 | -1 | -1 | 0 | -10 | -5 | -2 | -4 | -2 | -4 | 0 | 0 | -2 | 0 | -1 | -4 | 0 | 0 | -6 | 0 | 0 | 0 | 0 | 0 | 2 | -3 | 0 | 0 | 1 |
| 27 | 20 | 16 | 15 | 0 | 15 | -2 | -1 | 0 | -5 | -6 | -10 | 4 | 22 | -6 | 0 | 0 | -5 | 0 | -1 | -15 | 0 | 0 | -3 | -2 | -6 | 3 | 0 | 3 | 1 | -1 | 4 | 9 | 3 |
| 28 | -7 | -1 | -1 | -1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | -5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | -1 | 0 | 0 | -1 | -1 | 0 | 0 | 0 | 0 | -1 | -1 | -1 | -1 | -1 |
| 29 | 0 | 42 | 1 | -7 | 1 | 0 | 2 | -7 | -10 | 4 | 0 | -5 | 4 | -1 | -1 | 0 | -1 | -2 | -5 | -12 | -1 | -1 | -8 | 4 | 2 | 1 | 4 | 1 | 4 | -4 | -8 | -18 | -7 |
| 30 | 3 | 9 | -3 | -2 | 7 | 1 | -1 | 1 | -5 | -42 | -18 | -71 | 6 | 0 | 0 | -1 | -6 | 0 | -2 | -18 | -2 | 0 | -4 | -4 | -27 | 3 | 0 | -1 | 1 | -5 | 5 | 16 | -2 |
| 31 | -8 | 74 | 20 | 8 | 0 | 1 | 2 | 0 | 6 | -4 | 0 | -10 | 1 | 1 | 0 | 0 | -2 | 0 | 2 | 0 | 0 | 0 | 0 | 1 | 0 | -2 | 3 | 6 | -4 | 0 | 29 | 52 | 2 |
| 32 | -15 | 17 | -6 | 7 | -1 | -3 | 0 | 1 | 1 | -3 | -3 | -9 | 10 | 0 | 0 | 0 | -2 | 0 | 0 | 9 | 0 | 0 | 3 | -6 | -5 | 1 | 4 | 1 | -20 | 1 | 5 | 4 | -3 |
| 33 | -1 | -7 | -6 | -5 | 0 | 4 | 6 | 0 | 1 | 1 | 2 | -6 | -6 | 0 | 0 | -1 | 0 | 0 | -6 | 0 | -24 | -3 | -3 | -6 | -1 | 0 | -1 | -1 | -5 | -4 | -3 | -1 | 0 |

**Table 11-15 – Sector to Sector % Changes - Cars PM Trips**

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | - | 26% | 13% | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 2 | 10% | 6% | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 42% | - | - | - | - |
| 3 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 4 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 5 | - | - | - | - | - | - | - | 30% | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 6 | - | - | - | - | 22% | 12% | 22% | 12% | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 7 | - | - | - | - | - | 14% | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 8 | - | - | - | - | 28% | - | - | 9% | 19% | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 9 | - | - | - | - | - | - | - | 56% | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 10 | - | - | - | - | - | - | - | - | - | - | 13% | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 11 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 12 | - | - | - | - | - | - | - | - | - | 18% | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 13 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 14 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 15 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 16 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 17 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 18 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 19 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 20 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 20% | - | - | - | - | - | - | - | - |
| 21 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 22 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 23 | - | - | - | - | 37% | - | - | - | 23% | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 24 | - | - | - | - | 33% | - | - | 31% | - | - | - | - | - | - | - | - | - | - | - | 21% | - | - | 33% | - | - | - | - | - | - | - | - | - | - |
| 25 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 26 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 27 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 28 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 29 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 30 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 31 | - | 41% | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 32 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 33 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |

***Table 11-16 - Sector to Sector GEH Values- Cars PM Trips***

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | - | 7.1 | 2.7 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 2 | 2.2 | 1.7 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 4.6 | - | - | - | - |
| 3 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 4 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 5 | - | - | - | - | - | - | - | 7.1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 6 | - | - | - | - | 5.6 | 5.4 | 4.9 | 2.6 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 7 | - | - | - | - | - | 3.9 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 8 | - | - | - | - | 5.4 | - | - | 2.7 | 4.2 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 9 | - | - | - | - | - | - | - | 9.4 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 10 | - | - | - | - | - | - | - | - | - | - | 4.2 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 11 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 12 | - | - | - | - | - | - | - | - | - | 3.8 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 13 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 14 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 15 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 16 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 17 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 18 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 19 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 20 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 3.1 | - | - | - | - | - | - | - | - |
| 21 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 22 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 23 | - | - | - | - | 4.2 | - | - | - | 3.5 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 24 | - | - | - | - | 5.4 | - | - | 3.9 | - | - | - | - | - | - | - | - | - | - | - | 4.4 | - | - | 3.8 | - | - | - | - | - | - | - | - | - | - |
| 25 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 26 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 27 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 28 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 29 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 30 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 31 | - | 5.0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 32 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 33 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |

# 12 Assignment, Calibration and Validation

## 12.1 Introduction

This chapter details the calibration and validation results within the Central Lancashire Highways Transport Model, in relation to the required model standards, as outlined in Section 3.

## 12.2 Model Convergence

Model assignment of trips to the highway network remained consistent with the original model and was undertaken based on a 'Wardrop User Equilibrium', which seeks to minimise travel costs on all routes for traffic flows in the network through an iterative process. Convergence of the model was monitored as a measurement of the stability of the traffic model, i.e. traffic flows remain stable between successive iterations providing a robust platform for further modelling and confidence for the user.

A converged model is therefore stable and produces results that are consistent and robust.

Convergence results as set out in WebTAG M3.1 are shown in Table 12-1.

***Table 12-1 - Model Convergence Results***

| Time Period | Assignment Simulation Loop | Loop | Delta% (Less than 0.1% or at least stable with convergence fully documented and all other criteria met) | %Gap (Less than 0.1% or at least stable with convergence fully documented and all other criteria met) | % Flow (Link Flows Differing by < 1% Between Assignment & Simulation) | % Delays (Turn Delays Differing by < 1% Between Assignment & Simulation) | RAAD (% Relative Average Absolute Difference in Link Flows) |
|---|---|---|---|---|---|---|---|
| AM | 18 | 15 | 0.0014 | 0.0015 | 98.3 | 99.7 | 0.036 |
| | | 16 | 0.0013 | 0.0011 | 98.6 | 99.8 | 0.035 |
| | | 17 | 0.001 | 0.0013 | 98.7 | 99.8 | 0.03 |
| | | 18 | 0.0012 | 0.00094 | 98.9 | 99.8 | 0.03 |
| IP | 12 | 9 | 0.0011 | 0.0019 | 99.1 | 99.9 | 0.019 |
| | | 10 | 0.0009 | 0.0017 | 98.3 | 99.9 | 0.029 |
| | | 11 | 0.0008 | 0.0015 | 98.8 | 99.9 | 0.022 |
| | | 12 | 0.0007 | 0.0013 | 99.2 | 100 | 0.017 |
| PM | 38 | 35 | 0.0009 | 0.0018 | 99 | 99.5 | 0.02 |
| | | 36 | 0.0007 | 0.0019 | 98.2 | 99.5 | 0.04 |
| | | 37 | 0.0016 | 0.0024 | 98.3 | 99.5 | 0.04 |
| | | 38 | 0.0012 | 0.0012 | 98.4 | 99.4 | 0.04 |

The results show that the model achieves a high level of convergence, in line with WebTAG Unit M3.1, Table 4. Results are stable for at least four consecutive assignment/simulation loops and the delta values and other indicators comfortably exceed the targets specified in WebTAG. As a result, the model can be said to be suitably converged, with suitably low % GAP values in particular.

## 12.3 Count Calibration

The locations of counts used for calibration (i.e. those counts used as part of the creation of the trip matrices and/or the matrix estimation) are shown in Figure 12-A.

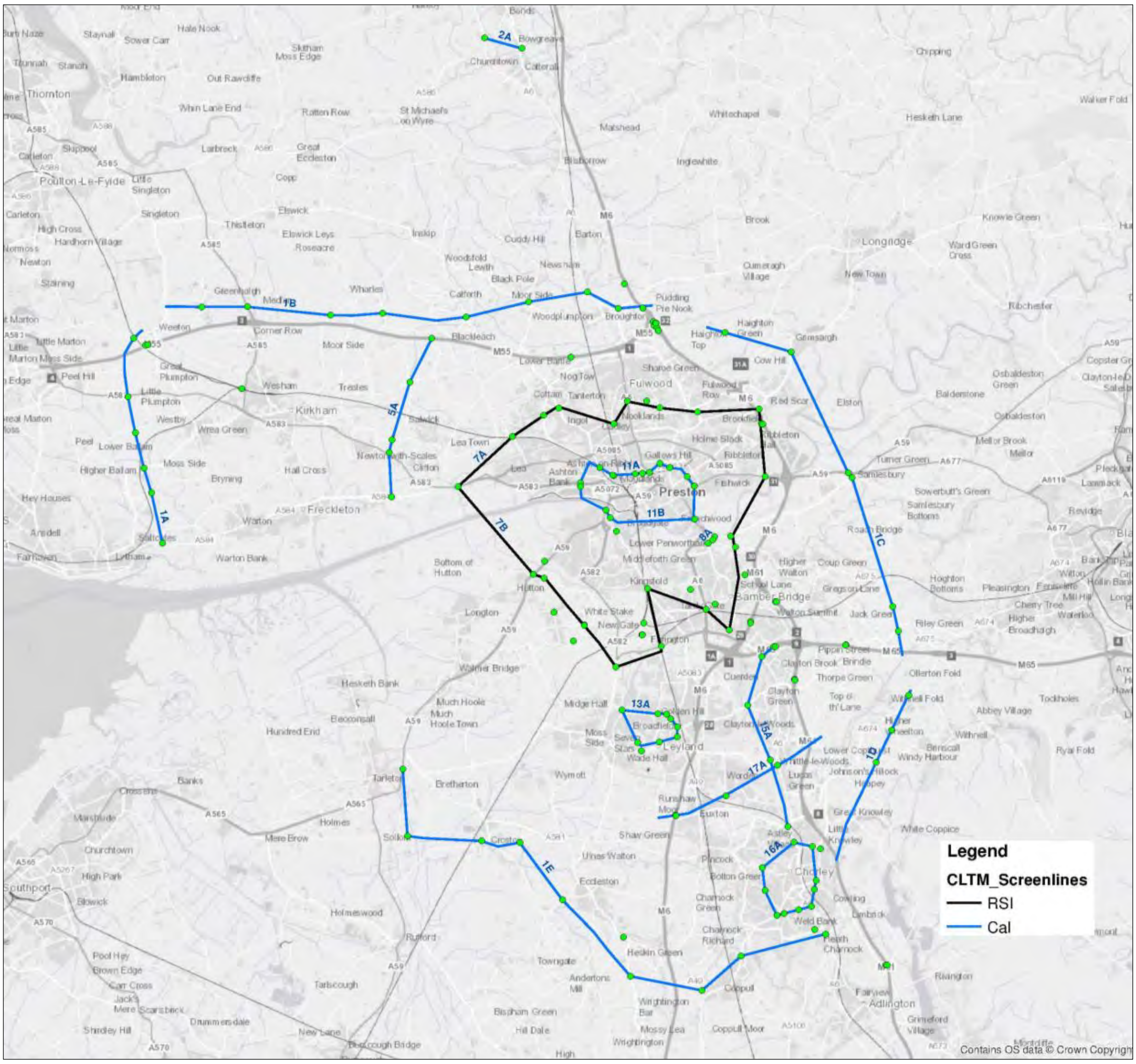


***Figure 12-A - Location of Calibration Counts***

The performance of the model in terms of comparisons with count data are measured in two ways. The first of these is the GEH statistic, as defined below:

$$GEH = \sqrt{\frac{(M - O)^2}{(M + O)/2}}$$

Where: *M* is the modelled flow on a link, and *O* is the observed.

The second is made by reference to the following table, extracted from WebTAG Unit M 3-1:

*Table 12-2 - Link Flow Validation Criterion*

| Size of observed flow | Criteria for valid modelled flow |
|---|---|
| < 700 vehicles/hour | Modelled flow within 100 vehicles/hour of observed flow |
| 700-2,700 vehicles/hour | Modelled flow within 15% of observed flow |
| > 2,700 vehicles/hour | Modelled flow within 400 vehicles/hour of observed |

WebTAG advises that in ordinary circumstances the practitioner should aim to reach a state where 85% of modelled links have a GEH of less than 5 or satisfy the criterion in link flow.

There were 189 calibration counts used in the base year model. The comparison of modelled flows against these counts is summarised in Table 12-3, Table 12-4 and Table 12-5, for all time periods.

*Table 12-3 - Calibration Count Summary – AM Peak Hour*

| WebTAG Guideline Values | All Vehicles | | | | Cars | | | |
|---|---|---|---|---|---|---|---|---|
| | Total Count | % Compliant | PASS /FAIL | Num. not compliant | Total Count | % Compliant | PASS /FAIL | Num. not compliant |
| Individual flows within 100 vph for <700 vph | 170 | 89% | Pass | 19 | 185 | 88% | Pass | 22 |
| Individual flows within 15% for 700-2,700 vph | 57 | 95% | Pass | 3 | 52 | 98% | Pass | 1 |
| Individual flows within 400 vph for >2,700 vph | 14 | 100% | Pass | 0 | 4 | 100% | Pass | 0 |
| **Total of above** | **241** | **91%** | **Pass** | **22** | **241** | **90%** | **Pass** | **23** |
| **GEH: Individual flows GEH <5** | **241** | **84%** | **Fail** | **38** | **241** | **84%** | **Fail** | **38** |
| **Links meeting either WebTAG criteria** | **241** | **91%** | **Pass** | **22** | **241** | **90%** | **Pass** | **23** |

*Table 12-4 - Calibration Count Summary – IP Average Peak Hour*

| WebTAG Guideline Values | All Vehicles | | | | Cars | | | |
|---|---|---|---|---|---|---|---|---|
| | Total Count | % Compliant | PASS /FAIL | Num. not compliant | Total Count | % Compliant | PASS /FAIL | Num. not compliant |
| Individual flows within 100 vph for <700 vph | 193 | 95% | Pass | 10 | 204 | 94% | Pass | 12 |
| Individual flows within 15% for 700-2,700 vph | 44 | 98% | Pass | 1 | 35 | 97% | Pass | 1 |
| Individual flows within 400 vph for >2,700 vph | 4 | 100% | Pass | 0 | 2 | 100% | Pass | 0 |
| **Total of above** | **241** | **95%** | **Pass** | **11** | **241** | **95%** | **Pass** | **13** |
| **GEH: Individual flows GEH <5** | **241** | **90%** | **Pass** | **23** | **241** | **90%** | **Pass** | **25** |
| **Links meeting either WebTAG criteria** | **241** | **95%** | **Pass** | **11** | **241** | **95%** | **Pass** | **13** |

*Table 12-5 - Calibration Count Summary – PM Peak Hour*

| WebTAG Guideline Values | All Vehicles | | | | Cars | | | |
|---|---|---|---|---|---|---|---|---|
| | Total Count | % Compliant | PASS /FAIL | Num. not compliant | Total Count | % Compliant | PASS /FAIL | Num. not compliant |
| Individual flows within 100 vph for <700 vph | 167 | 88% | Pass | 20 | 178 | 89% | Pass | 20 |
| Individual flows within 15% for 700-2,700 vph | 56 | 89% | Pass | 6 | 55 | 96% | Pass | 2 |
| Individual flows within 400 vph for >2,700 vph | 18 | 100% | Pass | 0 | 8 | 100% | Pass | 0 |
| **Total of above** | **241** | **89%** | **Pass** | **26** | **241** | **91%** | **Pass** | **22** |
| **GEH: Individual flows GEH <5** | **241** | **82%** | **Fail** | **43** | **241** | **83%** | **Fail** | **41** |
| **Links meeting either WebTAG criteria** | **241** | **89%** | **Pass** | **26** | **241** | **91%** | **Pass** | **22** |

In line with guidance, the statistics are shown for all vehicles combined and for cars separately.

The table demonstrates that 85% of sites meet link flow criteria, and nearly 85% of sites meet GEH.

This is encouraging as it gives confidence that modelled flows as a whole are representative of real life traffic flows.

PM peak calibration is slightly low in GEH terms but similar in terms of DMRB criteria, indicating a difference of 7-8 links when compared to other time periods, with generally low flow routes being impacted.

A full breakdown of the comparison at the individual count level is included in Appendix L. A summary of the Strategic Road Network statistics are shown in Table 12-6. All links meet the requirements across all time periods for both all vehicles and cars.

*Table 12-6 - Strategic Road Network Calibration Count Summary*

| Time Period | All Vehicles | | | Cars | | |
|---|---|---|---|---|---|---|
| | Flow Difference (%Pass) | GEH (%Pass) | Passes at least 1 criterion | Flow Difference (%Pass) | GEH (%Pass) | Passes at least 1 criterion |
| AM | 100% | 100% | 100% | 100% | 97% | 100% |
| IP | 100% | 100% | 100% | 100% | 100% | 100% |
| PM | 97% | 97% | 97% | 97% | 94% | 97% |

## 12.4 Calibration Screenlines

As indicated above, many of the counts are arranged along screenlines. WebTAG has a separate criterion for total screenline flows, which is that total modelled flows on all links crossing a screenline should be within 5% of the observed totals.

The performance of the models along the calibration screenlines are summarised in the tables below.

*Table 12-7 - AM Calibration Screenlines – All Vehicles*

| Screenline Number | Inbound/ Outbound | Observed Flow | Modelled Flow | Actual Difference | % Difference | PASS /FAIL | GEH | PASS /FAIL |
|---|---|---|---|---|---|---|---|---|
| SL_1A | Inbound | 3,558 | 3,560 | 2 | 0% | PASS | 0 | PASS |
| SL_1B | Inbound | 5,523 | 5,431 | -92 | -2% | PASS | 1 | PASS |
| SL_1C | Inbound | 6,220 | 6,212 | -8 | 0% | PASS | 0 | PASS |
| SL_1D | Inbound | 3,701 | 3,677 | -23 | -1% | PASS | 0 | PASS |
| SL_1E | Inbound | 4,085 | 4,060 | -25 | -1% | PASS | 0 | PASS |
| SL_2A | Inbound | 761 | 764 | 2 | 0% | PASS | 0 | PASS |
| SL_5A | Inbound | 4,246 | 4,270 | 24 | 1% | PASS | 0 | PASS |
| SL_8A | Inbound | 1,341 | 1,314 | -27 | -2% | PASS | 1 | PASS |
| SL_11A | Inbound | 5,433 | 5,534 | 101 | 2% | PASS | 1 | PASS |
| SL_11B | Inbound | 5,257 | 5,367 | 110 | 2% | PASS | 2 | PASS |
| SL_13A | Inbound | 3,394 | 3,377 | -18 | -1% | PASS | 0 | PASS |
| SL_15A | Inbound | 4,461 | 4,487 | 26 | 1% | PASS | 0 | PASS |
| SL_16A | Inbound | 4,760 | 4,714 | -46 | -1% | PASS | 1 | PASS |
| SL_17A | Inbound | 7,515 | 7,765 | 251 | 3% | PASS | 3 | PASS |
| SL_7A | Inbound | 6,573 | 6,601 | 28 | 0% | PASS | 0 | PASS |
| SL_7B | Inbound | 6,831 | 7,008 | 177 | 3% | PASS | 2 | PASS |
| SL_1A | Outbound | 3,773 | 3,766 | -7 | 0% | PASS | 0 | PASS |
| SL_1B | Outbound | 4,569 | 4,671 | 103 | 2% | PASS | 2 | PASS |
| SL_1C | Outbound | 5,612 | 5,579 | -33 | -1% | PASS | 0 | PASS |
| SL_1D | Outbound | 3,674 | 3,670 | -4 | 0% | PASS | 0 | PASS |
| SL_1E | Outbound | 3,074 | 3,065 | -9 | 0% | PASS | 0 | PASS |
| SL_2A | Outbound | 792 | 802 | 11 | 1% | PASS | 0 | PASS |
| SL_5A | Outbound | 4,431 | 4,438 | 7 | 0% | PASS | 0 | PASS |
| SL_8A | Outbound | 778 | 754 | -23 | -3% | PASS | 1 | PASS |
| SL_11A | Outbound | 4,330 | 4,464 | 134 | 3% | PASS | 2 | PASS |
| SL_11B | Outbound | 2,333 | 2,354 | 21 | 1% | PASS | 0 | PASS |
| SL_13A | Outbound | 2,700 | 2,668 | -33 | -1% | PASS | 1 | PASS |
| SL_15A | Outbound | 4,294 | 4,482 | 188 | 4% | PASS | 3 | PASS |
| SL_16A | Outbound | 3,499 | 3,369 | -130 | -4% | PASS | 2 | PASS |
| SL_17A | Outbound | 7,332 | 7,141 | -190 | -3% | PASS | 2 | PASS |
| SL_7A | Outbound | 5,702 | 5,801 | 99 | 2% | PASS | 1 | PASS |
| SL_7B | Outbound | 6,060 | 6,125 | 66 | 1% | PASS | 1 | PASS |
| Total Passing | | | | | | 100% | | 100% |

*Table 12-8 - IP Calibration Screenlines – All Vehicles*

| Screenline Number | Inbound/ Outbound | Observed Flow | Modelled Flow | Actual Difference | % Difference | PASS /FAIL | GEH | PASS /FAIL |
|---|---|---|---|---|---|---|---|---|
| SL_1A | Inbound | 2,453 | 2,429 | -25 | -1% | PASS | 0 | PASS |
| SL_1B | Inbound | 4,306 | 4,343 | 37 | 1% | PASS | 1 | PASS |
| SL_1C | Inbound | 3,664 | 3,681 | 18 | 0% | PASS | 0 | PASS |
| SL_1D | Inbound | 2,569 | 2,541 | -28 | -1% | PASS | 1 | PASS |
| SL_1E | Inbound | 2,683 | 2,668 | -15 | -1% | PASS | 0 | PASS |
| SL_2A | Inbound | 552 | 556 | 4 | 1% | PASS | 0 | PASS |
| SL_5A | Inbound | 2,850 | 2,845 | -5 | 0% | PASS | 0 | PASS |
| SL_8A | Inbound | 882 | 850 | -32 | -4% | PASS | 1 | PASS |
| SL_11A | Inbound | 5,168 | 5,201 | 34 | 1% | PASS | 0 | PASS |
| SL_11B | Inbound | 3,100 | 3,106 | 6 | 0% | PASS | 0 | PASS |
| SL_13A | Inbound | 2,780 | 2,785 | 4 | 0% | PASS | 0 | PASS |
| SL_15A | Inbound | 2,889 | 2,890 | 2 | 0% | PASS | 0 | PASS |
| SL_16A | Inbound | 3,514 | 3,519 | 5 | 0% | PASS | 0 | PASS |
| SL_17A | Inbound | 5,225 | 5,288 | 63 | 1% | PASS | 1 | PASS |
| SL_7A | Inbound | 4,481 | 4,540 | 58 | 1% | PASS | 1 | PASS |
| SL_7B | Inbound | 4,910 | 4,953 | 42 | 1% | PASS | 1 | PASS |
| SL_1A | Outbound | 2,590 | 2,585 | -4 | 0% | PASS | 0 | PASS |
| SL_1B | Outbound | 4,363 | 4,293 | -70 | -2% | PASS | 1 | PASS |
| SL_1C | Outbound | 3,464 | 3,444 | -20 | -1% | PASS | 0 | PASS |
| SL_1D | Outbound | 2,668 | 2,702 | 34 | 1% | PASS | 1 | PASS |
| SL_1E | Outbound | 2,783 | 2,761 | -21 | -1% | PASS | 0 | PASS |
| SL_2A | Outbound | 693 | 696 | 3 | 0% | PASS | 0 | PASS |
| SL_5A | Outbound | 2,862 | 2,863 | 1 | 0% | PASS | 0 | PASS |
| SL_8A | Outbound | 756 | 736 | -20 | -3% | PASS | 1 | PASS |
| SL_11A | Outbound | 4,971 | 4,777 | -195 | -4% | PASS | 3 | PASS |
| SL_11B | Outbound | 3,150 | 3,185 | 36 | 1% | PASS | 1 | PASS |
| SL_13A | Outbound | 2,738 | 2,687 | -51 | -2% | PASS | 1 | PASS |
| SL_15A | Outbound | 2,990 | 3,024 | 33 | 1% | PASS | 1 | PASS |
| SL_16A | Outbound | 3,268 | 3,168 | -100 | -3% | PASS | 2 | PASS |
| SL_17A | Outbound | 6,245 | 6,267 | 22 | 0% | PASS | 0 | PASS |
| SL_7A | Outbound | 4,368 | 4,417 | 49 | 1% | PASS | 1 | PASS |
| SL_7B | Outbound | 5,006 | 5,059 | 53 | 1% | PASS | 1 | PASS |
| Total Passing | | | | | | 100% | | 100% |

*Table 12-9 - PM Calibration Screenlines – All Vehicles*

| Screenline Number | Inbound/ Outbound | Observed Flow | Modelled Flow | Actual Difference | % Difference | PASS /FAIL | GEH | PASS /FAIL |
|---|---|---|---|---|---|---|---|---|
| SL_1A | Inbound | 3,683 | 3,647 | -36 | -1% | PASS | 1 | PASS |
| SL_1B | Inbound | 5,078 | 5,213 | 135 | 3% | PASS | 2 | PASS |
| SL_1C | Inbound | 5,971 | 5,925 | -45 | -1% | PASS | 1 | PASS |
| SL_1D | Inbound | 4,119 | 4,114 | -5 | 0% | PASS | 0 | PASS |
| SL_1E | Inbound | 3,267 | 3,264 | -3 | 0% | PASS | 0 | PASS |
| SL_2A | Inbound | 823 | 840 | 17 | 2% | PASS | 1 | PASS |
| SL_5A | Inbound | 4,655 | 4,639 | -16 | 0% | PASS | 0 | PASS |
| SL_8A | Inbound | 1,041 | 1,033 | -7 | -1% | PASS | 0 | PASS |
| SL_11A | Inbound | 5,395 | 5,469 | 74 | 1% | PASS | 1 | PASS |
| SL_11B | Inbound | 3,147 | 3,169 | 23 | 1% | PASS | 0 | PASS |
| SL_13A | Inbound | 2,987 | 2,767 | -220 | -7% | FAIL | 4 | PASS |
| SL_15A | Inbound | 4,994 | 5,000 | 5 | 0% | PASS | 0 | PASS |
| SL_16A | Inbound | 4,445 | 4,359 | -86 | -2% | PASS | 1 | PASS |
| SL_17A | Inbound | 7,301 | 7,640 | 339 | 5% | PASS | 4 | PASS |
| SL_7A | Inbound | 6,382 | 6,348 | -34 | -1% | PASS | 0 | PASS |
| SL_7B | Inbound | 6,444 | 6,459 | 15 | 0% | PASS | 0 | PASS |
| SL_1A | Outbound | 3,759 | 3,736 | -23 | -1% | PASS | 0 | PASS |
| SL_1B | Outbound | 5,887 | 5,749 | -138 | -2% | PASS | 2 | PASS |
| SL_1C | Outbound | 6,155 | 6,132 | -24 | 0% | PASS | 0 | PASS |
| SL_1D | Outbound | 4,109 | 4,107 | -3 | 0% | PASS | 0 | PASS |
| SL_1E | Outbound | 4,133 | 4,152 | 19 | 0% | PASS | 0 | PASS |
| SL_2A | Outbound | 787 | 789 | 2 | 0% | PASS | 0 | PASS |
| SL_5A | Outbound | 4,458 | 4,414 | -45 | -1% | PASS | 1 | PASS |
| SL_8A | Outbound | 1,364 | 1,386 | 22 | 2% | PASS | 1 | PASS |
| SL_11A | Outbound | 5,807 | 5,929 | 122 | 2% | PASS | 2 | PASS |
| SL_11B | Outbound | 5,438 | 5,543 | 104 | 2% | PASS | 1 | PASS |
| SL_13A | Outbound | 3,327 | 3,027 | -299 | -9% | FAIL | 5 | FAIL |
| SL_15A | Outbound | 5,118 | 5,350 | 232 | 5% | PASS | 3 | PASS |
| SL_16A | Outbound | 4,187 | 4,159 | -28 | -1% | PASS | 0 | PASS |
| SL_17A | Outbound | 9,341 | 9,323 | -18 | 0% | PASS | 0 | PASS |
| SL_7A | Outbound | 6,310 | 6,337 | 27 | 0% | PASS | 0 | PASS |
| SL_7B | Outbound | 7,130 | 7,235 | 105 | 1% | PASS | 1 | PASS |
| Total Passing | | | | | | 94% | | 97% |

A total of 28 calibration screenlines and 4 observed screenlines, highlighted in yellow in the tables above, were used. The tables above show that all of calibration screenlines meet the 5% difference criterion in the AM and IP Average Peak Hours, and nearly all screenlines pass in the PM peak hour, including those screenlines that are near to the proposed scheme.

Screenline 13A and 13B, which fail the 5% difference criterion in the PM, are in the southern areas of the model and are far from the proposed PWD scheme, as shown in Figure 12-B. It is however important to note that the flows at these screenlines that do not pass are generally close to passing particularly with respect to GEH values, and therefore are still considered to be acceptable. It is assumed that a GEH of less than 4 is considered as a pass. Calibration screenlines results for each vehicle type are provided in Appendix L.

The above results are summarised in Table 12-10. The table shows the percentage of screenlines meeting the 5% difference criterion for all vehicle types, as outlined in WebTAG unit M3.1. Since percentage difference is not always the best measure, particularly for low flows, the percentage of links passing a relaxed GEH criterion has also been provided.

Given that not all screenlines for cars pass in PM peak, Figure 12-C is provided to demonstrate that the key screenlines around the PWD scheme all pass.

In relation to LGV and HGV, as expected the overall performance when evaluated against 5% difference the percentage of screenlines passing the criteria is below the threshold. This is because total flows are low and so even a low difference between modelled and observed flows results in a high percentage difference. On the other hand, when the modelled and observed flows are compared using the GEH statistics, the results show that nearly all screenlines pass the requirement.

***Table 12-10 - Summary Results of Calibration Cordons and Screenlines***

| All Vehicles | Time Period | 5% Difference | GEH |
|---|---|---|---|
| | AM | 100% | 100% |
| | IP | 100% | 100% |
| | PM | 94% | 94% |
| **Cars** | **Time Period** | **5% Difference** | **GEH** |
| | AM | 100% | 100% |
| | IP | 100% | 100% |
| | PM | 88% | 91% |
| **LGV** | **Time Period** | **5% Difference** | **GEH** |
| | AM | 56% | 94% |
| | IP | 72% | 100% |
| | PM | 63% | 97% |
| **HGV** | **Time Period** | **5% Difference** | **GEH** |
| | AM | 75% | 100% |
| | IP | 78% | 97% |
| | PM | 56% | 100% |

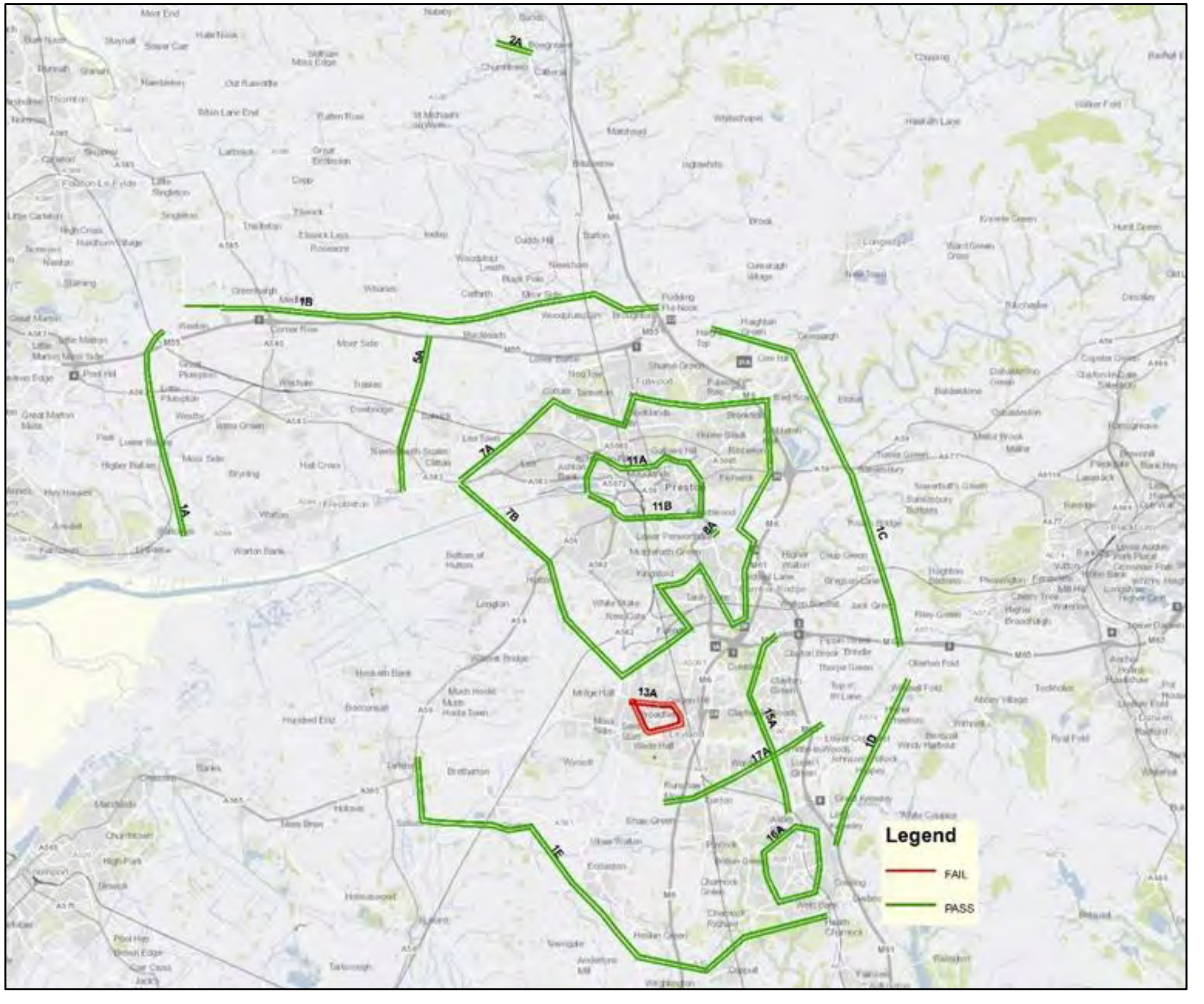


***Figure 12-B - Calibration Screenlines Performance by 5% Difference – All Vehicles, PM Peak Hour***

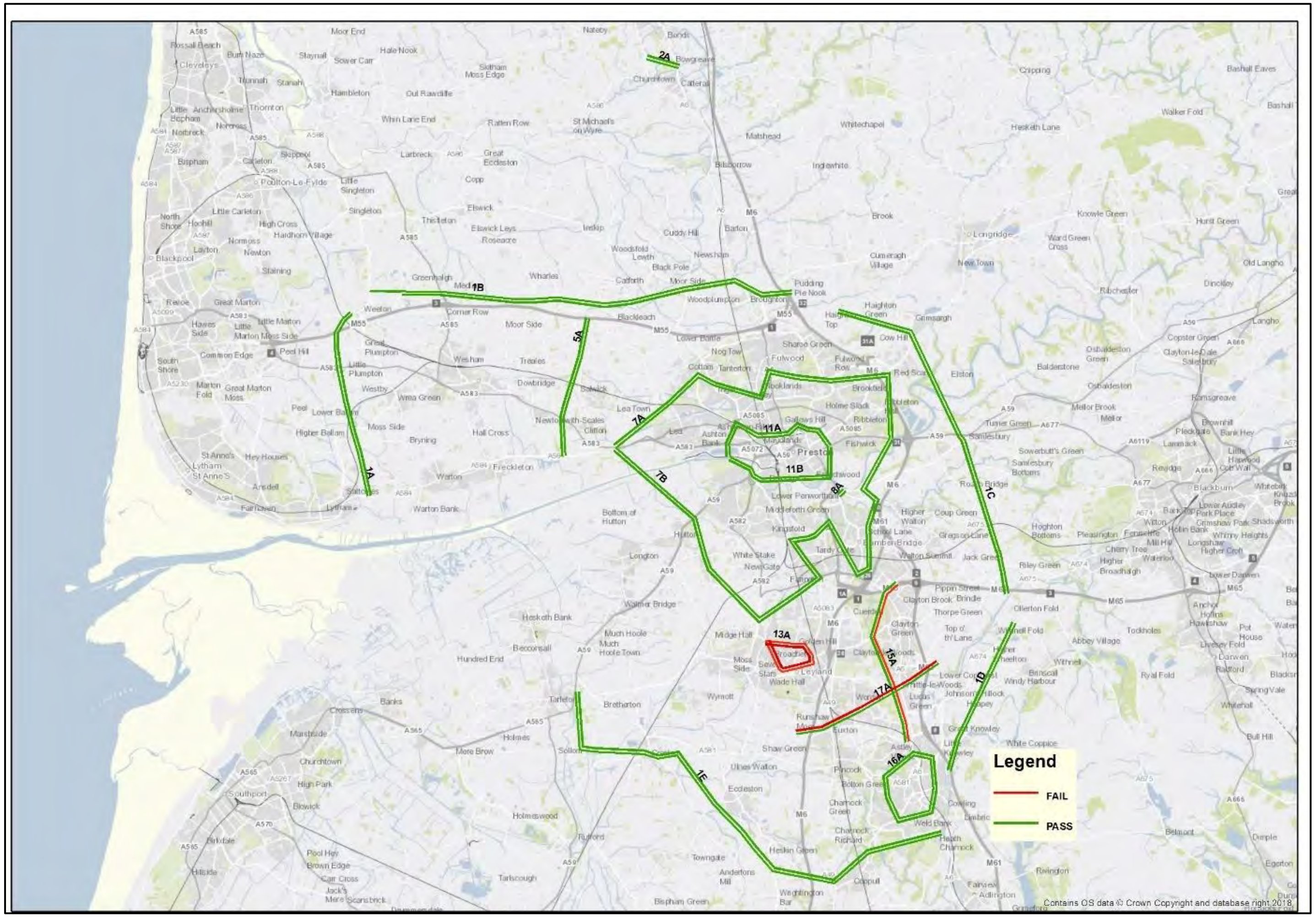


*Figure 12-C - Calibration Screenlines Performance by 5% Difference – Cars, PM Peak Hour*

The tables above include high traffic flow links, including motorway links. Table 12-11 to Table 12-13 show the screenline statistics excluding high flow links as required by WebTAG Unit M-3. It can be seen that there are only minor changes between the two sets of tables and in all time periods nearly all screenlines pass the 5% flow difference criterion. Majority of those failing to meet this requirement pass based on the GEH values.

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*Table 12-11 - AM Calibration Screenlines Excluding High Flows – All Vehicles*

| Screenline Number | Inbound/ Outbound | Observed Flow | Modelled Flow | Actual Difference | % Difference | PASS /FAIL | GEH | PASS /FAIL |
|---|---|---|---|---|---|---|---|---|
| SL_1A | Inbound | 3,558 | 3,560 | 2 | 0% | PASS | 0 | PASS |
| SL_1B | Inbound | 5,523 | 5,431 | -92 | 2% | PASS | 1 | PASS |
| SL_1C | Inbound | 2,978 | 2,970 | -8 | 0% | PASS | 0 | PASS |
| SL_1D | Inbound | 654 | 661 | 7 | 1% | PASS | 0 | PASS |
| SL_1E | Inbound | 4,085 | 4,060 | -25 | 1% | PASS | 0 | PASS |
| SL_2A | Inbound | 761 | 764 | 2 | 0% | PASS | 0 | PASS |
| SL_5A | Inbound | 1,599 | 1,631 | 31 | 2% | PASS | 1 | PASS |
| SL_7A | Inbound | 6,573 | 6,601 | 28 | 0% | PASS | 0 | PASS |
| SL_7B | Inbound | 6,831 | 7,008 | 177 | 3% | PASS | 2 | PASS |
| SL_8A | Inbound | 1,341 | 1,314 | -27 | 2% | PASS | 1 | PASS |
| SL_11A | Inbound | 5,433 | 5,534 | 101 | 2% | PASS | 1 | PASS |
| SL_11B | Inbound | 5,257 | 5,367 | 110 | 2% | PASS | 2 | PASS |
| SL_13A | Inbound | 3,394 | 3,377 | -18 | 1% | PASS | 0 | PASS |
| SL_15A | Inbound | 1,903 | 1,931 | 28 | 1% | PASS | 1 | PASS |
| SL_16A | Inbound | 4,760 | 4,714 | -46 | 1% | PASS | 1 | PASS |
| SL_17A | Inbound | 3,375 | 3,581 | 206 | 6% | FAIL | 3 | PASS |
| SL_1A | Outbound | 3,773 | 3,766 | -7 | 0% | PASS | 0 | PASS |
| SL_1B | Outbound | 4,569 | 4,671 | 103 | 2% | PASS | 2 | PASS |
| SL_1C | Outbound | 2,595 | 2,605 | 10 | 0% | PASS | 0 | PASS |
| SL_1D | Outbound | 793 | 789 | -4 | 1% | PASS | 0 | PASS |
| SL_1E | Outbound | 3,074 | 3,065 | -9 | 0% | PASS | 0 | PASS |
| SL_2A | Outbound | 792 | 802 | 11 | 1% | PASS | 0 | PASS |
| SL_5A | Outbound | 1,682 | 1,686 | 4 | 0% | PASS | 0 | PASS |
| SL_7A | Outbound | 5,702 | 5,801 | 99 | 2% | PASS | 1 | PASS |
| SL_7B | Outbound | 6,060 | 6,125 | 66 | 1% | PASS | 1 | PASS |
| SL_8A | Outbound | 778 | 754 | -23 | 3% | PASS | 1 | PASS |
| SL_11A | Outbound | 4,330 | 4,464 | 134 | 3% | PASS | 2 | PASS |
| SL_11B | Outbound | 2,333 | 2,354 | 21 | 1% | PASS | 0 | PASS |
| SL_13A | Outbound | 2,700 | 2,668 | -33 | 1% | PASS | 1 | PASS |
| SL_15A | Outbound | 2,012 | 2,062 | 50 | 3% | PASS | 1 | PASS |
| SL_16A | Outbound | 3,338 | 3,167 | -171 | 5% | PASS | 3 | PASS |
| SL_17A | Outbound | 1,174 | 1,211 | 37 | 3% | PASS | 1 | PASS |
| **Total Passing** | | | | | | **97%** | | **100%** |

*Table 12-12 - IP Calibration Screenlines Excluding High Flows – All Vehicles*

| Screenline Number | Inbound/ Outbound | Observed Flow | Modelled Flow | Actual Difference | % Difference | PASS /FAIL | GEH | PASS /FAIL |
|---|---|---|---|---|---|---|---|---|
| SL_1A | Inbound | 2,453 | 2,429 | -25 | 1% | PASS | 0 | PASS |
| SL_1B | Inbound | 4,306 | 4,343 | 37 | 1% | PASS | 1 | PASS |
| SL_1C | Inbound | 3,664 | 3,681 | 18 | 0% | PASS | 0 | PASS |
| SL_1D | Inbound | 2,569 | 2,541 | -28 | 1% | PASS | 1 | PASS |
| SL_1E | Inbound | 2,683 | 2,668 | -15 | 1% | PASS | 0 | PASS |
| SL_2A | Inbound | 552 | 556 | 4 | 1% | PASS | 0 | PASS |
| SL_5A | Inbound | 2,850 | 2,845 | -5 | 0% | PASS | 0 | PASS |
| SL_7A | Inbound | 4,481 | 4,540 | 58 | 1% | PASS | 1 | PASS |
| SL_7B | Inbound | 4,910 | 4,953 | 42 | 1% | PASS | 1 | PASS |
| SL_8A | Inbound | 882 | 850 | -32 | 4% | PASS | 1 | PASS |
| SL_11A | Inbound | 5,168 | 5,201 | 34 | 1% | PASS | 0 | PASS |
| SL_11B | Inbound | 3,100 | 3,106 | 6 | 0% | PASS | 0 | PASS |
| SL_13A | Inbound | 2,780 | 2,785 | 4 | 0% | PASS | 0 | PASS |
| SL_15A | Inbound | 2,889 | 2,890 | 2 | 0% | PASS | 0 | PASS |
| SL_16A | Inbound | 3,514 | 3,519 | 5 | 0% | PASS | 0 | PASS |
| SL_17A | Inbound | 2,324 | 2,347 | 23 | 1% | PASS | 0 | PASS |
| SL_1A | Outbound | 2,590 | 2,585 | -4 | 0% | PASS | 0 | PASS |
| SL_1B | Outbound | 4,363 | 4,293 | -70 | 2% | PASS | 1 | PASS |
| SL_1C | Outbound | 3,464 | 3,444 | -20 | 1% | PASS | 0 | PASS |
| SL_1D | Outbound | 2,668 | 2,702 | 34 | 1% | PASS | 1 | PASS |
| SL_1E | Outbound | 2,783 | 2,761 | -21 | 1% | PASS | 0 | PASS |
| SL_2A | Outbound | 693 | 696 | 3 | 0% | PASS | 0 | PASS |
| SL_5A | Outbound | 2,862 | 2,863 | 1 | 0% | PASS | 0 | PASS |
| SL_7A | Outbound | 4,368 | 4,417 | 49 | 1% | PASS | 1 | PASS |
| SL_7B | Outbound | 5,006 | 5,059 | 53 | 1% | PASS | 1 | PASS |
| SL_8A | Outbound | 756 | 736 | -20 | 3% | PASS | 1 | PASS |
| SL_11A | Outbound | 4,971 | 4,777 | -195 | 4% | PASS | 3 | PASS |
| SL_11B | Outbound | 3,150 | 3,185 | 36 | 1% | PASS | 1 | PASS |
| SL_13A | Outbound | 2,738 | 2,687 | -51 | 2% | PASS | 1 | PASS |
| SL_15A | Outbound | 1,640 | 1,549 | -91 | 6% | FAIL | 2 | PASS |
| SL_16A | Outbound | 3,128 | 2,949 | -179 | 6% | FAIL | 3 | PASS |
| SL_17A | Outbound | 3,236 | 3,225 | -11 | 0% | PASS | 0 | PASS |
| **Total Passing** | | | | | | **94%** | | **100%** |

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*Table 12-13 - PM Calibration Screenlines Excluding High Flows – All Vehicles*

| Screenline Number | Inbound/ Outbound | Observed Flow | Modelled Flow | Actual Difference | % Difference | PASS /FAIL | GEH | PASS /FAIL |
|---|---|---|---|---|---|---|---|---|
| SL_1A | Inbound | 3,683 | 3,647 | -36 | 1% | PASS | 1 | PASS |
| SL_1B | Inbound | 2,446 | 2,507 | 61 | 3% | PASS | 1 | PASS |
| SL_1C | Inbound | 2,965 | 3,017 | 52 | 2% | PASS | 1 | PASS |
| SL_1D | Inbound | 714 | 759 | 45 | 6% | FAIL | 2 | PASS |
| SL_1E | Inbound | 3,267 | 3,264 | -3 | 0% | PASS | 0 | PASS |
| SL_2A | Inbound | 823 | 840 | 17 | 2% | PASS | 1 | PASS |
| SL_5A | Inbound | 1,771 | 1,818 | 47 | 3% | PASS | 1 | PASS |
| SL_7A | Inbound | 6,382 | 6,348 | -34 | 1% | PASS | 0 | PASS |
| SL_7B | Inbound | 6,444 | 6,459 | 15 | 0% | PASS | 0 | PASS |
| SL_8A | Inbound | 1,041 | 1,033 | -7 | 1% | PASS | 0 | PASS |
| SL_11A | Inbound | 5,395 | 5,469 | 74 | 1% | PASS | 1 | PASS |
| SL_11B | Inbound | 3,147 | 3,169 | 23 | 1% | PASS | 0 | PASS |
| SL_13A | Inbound | 2,987 | 2,767 | -220 | 7% | FAIL | 4 | PASS |
| SL_15A | Inbound | 2,404 | 2,528 | 124 | 5% | PASS | 2 | PASS |
| SL_16A | Inbound | 4,445 | 4,359 | -86 | 2% | PASS | 1 | PASS |
| SL_17A | Inbound | 3,454 | 3,814 | 360 | 10% | FAIL | 6 | FAIL |
| SL_1A | Outbound | 3,759 | 3,736 | -23 | 1% | PASS | 0 | PASS |
| SL_1B | Outbound | 3,077 | 3,111 | 34 | 1% | PASS | 1 | PASS |
| SL_1C | Outbound | 3,006 | 3,078 | 72 | 2% | PASS | 1 | PASS |
| SL_1D | Outbound | 594 | 639 | 45 | 8% | FAIL | 2 | PASS |
| SL_1E | Outbound | 4,133 | 4,152 | 19 | 0% | PASS | 0 | PASS |
| SL_2A | Outbound | 787 | 789 | 2 | 0% | PASS | 0 | PASS |
| SL_5A | Outbound | 1,665 | 1,682 | 17 | 1% | PASS | 0 | PASS |
| SL_7A | Outbound | 6,310 | 6,337 | 27 | 0% | PASS | 0 | PASS |
| SL_7B | Outbound | 7,130 | 7,235 | 105 | 1% | PASS | 1 | PASS |
| SL_8A | Outbound | 1,364 | 1,386 | 22 | 2% | PASS | 1 | PASS |
| SL_11A | Outbound | 5,807 | 5,929 | 122 | 2% | PASS | 2 | PASS |
| SL_11B | Outbound | 5,438 | 5,543 | 104 | 2% | PASS | 1 | PASS |
| SL_13A | Outbound | 3,327 | 3,027 | -299 | 9% | FAIL | 5 | FAIL |
| SL_15A | Outbound | 2,740 | 2,743 | 4 | 0% | PASS | 0 | PASS |
| SL_16A | Outbound | 3,967 | 4,074 | 107 | 3% | PASS | 2 | PASS |
| SL_17A | Outbound | 1,357 | 1,354 | -3 | 0% | PASS | 0 | PASS |
| Total Passing | | | | | | 84% | | 94% |

### 12.5 Count Validation

Count validation relies on making similar comparisons to the ones made for the count calibration, but against *independent* counts, i.e. those not used in the model building process up to this point, in either the matrix building or the matrix estimation.

The locations of these counts are show in Figure 12-D.

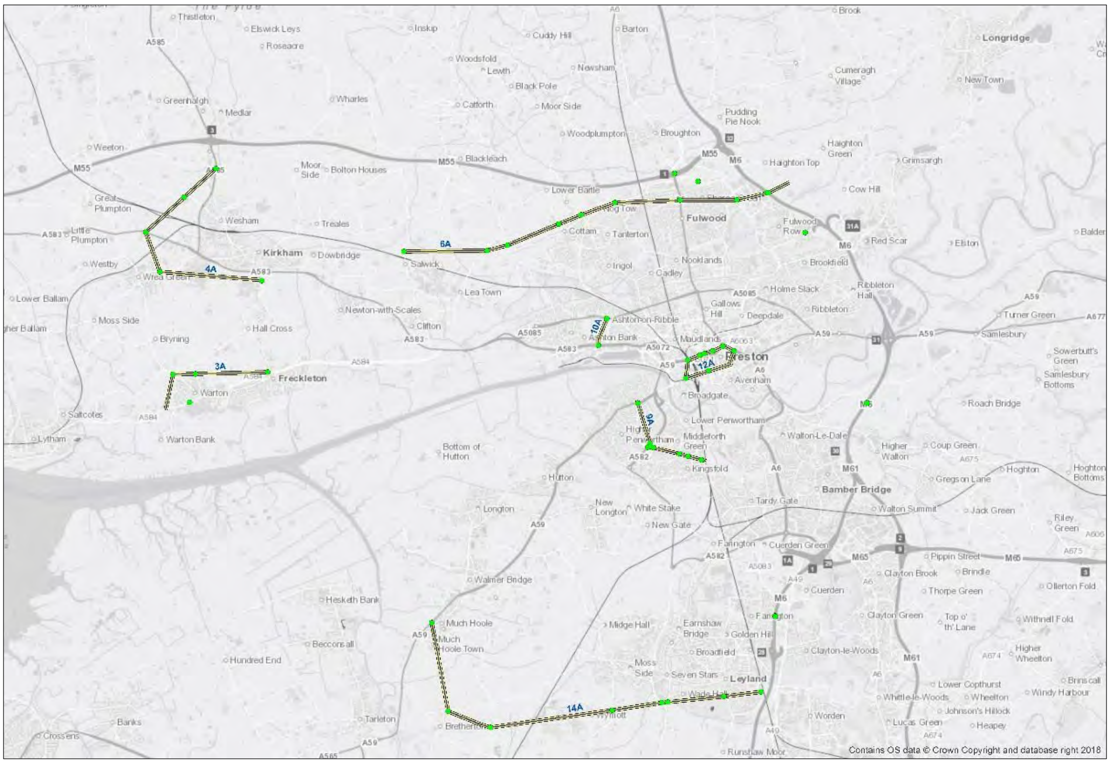

***Figure 12-D - Locations of Validation Counts Location and Respective Screenlines***

Table 12-14 to Table 12-16 below provide a summary of the detailed results. Full validation results are contained in Appendix L.

Table 12-14 - Validation Count Summary – AM Peak Hour

| WebTAG Guideline Values | All Vehicles | | | | Cars | | | |
|---|---|---|---|---|---|---|---|---|
| | Total Count | % Compliant | PASS /FAIL | Num. not compliant | Total Count | % Compliant | PASS /FAIL | Num. not compliant |
| Individual flows within 100 vph for <700 vph | 69 | 80% | Fail | 14 | 78 | 88% | Pass | 9 |
| Individual flows within 15% for 700-2,700 vph | 22 | 82% | Fail | 4 | 14 | 86% | Pass | 2 |
| Individual flows within 400 vph for >2,700 vph | 6 | 100% | Pass | 0 | 5 | 100% | Pass | 0 |
| **Total of above** | **97** | **81%** | Fail | **18** | **97** | **89%** | Pass | **11** |
| **GEH: Individual flows GEH <5** | **97** | **75%** | **Fail** | **24** | **97** | **79%** | **Fail** | **20** |
| **Links meeting either WebTAG criteria** | **97** | **81%** | Fail | **18** | **97** | **89%** | Pass | **11** |

Table 12-15 - Validation Count Summary – IP Average Peak Hour

| WebTAG Guideline Values | All Vehicles | | | | Cars | | | |
|---|---|---|---|---|---|---|---|---|
| | Total Count | % Compliant | PASS /FAIL | Num. not compliant | Total Count | % Compliant | PASS /FAIL | Num. not compliant |
| Individual flows within 100 vph for <700 vph | 83 | 83% | Fail | 14 | 85 | 85% | Fail | 13 |
| Individual flows within 15% for 700-2,700 vph | 8 | 63% | Fail | 3 | 8 | 88% | Pass | 1 |
| Individual flows within 400 vph for >2,700 vph | 6 | 100% | Pass | 0 | 4 | 100% | Pass | 0 |
| **Total of above** | **97** | **82%** | Fail | **17** | **97** | **86%** | Pass | **14** |
| **GEH: Individual flows GEH <5** | **97** | **68%** | **Fail** | **31** | **97** | **74%** | **Fail** | **25** |
| **Links meeting either WebTAG criteria** | **97** | **82%** | **Fail** | **17** | **97** | **86%** | Pass | **14** |

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*Table 12-16 - Validation Count Summary – PM Peak Hour*

| WebTAG Guideline Values | All Vehicles | | | | Cars | | | |
|---|---|---|---|---|---|---|---|---|
| | Total Count | % Compliant | PASS /FAIL | Num. not compliant | Total Count | % Compliant | PASS /FAIL | Num. not compliant |
| Individual flows within 100 vph for <700 vph | 65 | 78% | Fail | 14 | 71 | 82% | Fail | 13 |
| Individual flows within 15% for 700-2,700 vph | 26 | 73% | Fail | 7 | 20 | 70% | Fail | 6 |
| Individual flows within 400 vph for >2,700 vph | 6 | 100% | **Pass** | 0 | 6 | 100% | **Pass** | 0 |
| **Total of above** | **97** | **78%** | Fail | **21** | **97** | **80%** | Fail | **19** |
| **GEH: Individual flows GEH <5** | **97** | **64%** | **Fail** | **35** | **97** | **69%** | **Fail** | **30** |
| **Links meeting either WebTAG criteria** | **97** | **78%** | **Fail** | **21** | **97** | **80%** | **Fail** | **19** |

The above results show that the traffic model doesn't fully meet 85% criteria for all link flows; however the model is close - especially in the AM and IP time periods. For cars, the validation criteria for link flows are satisfied in the AM and IP Average Peak Hours, with PM peak hour passing at 80% of links.

However, in all time periods it is important to note that the count sites close to the proposed PWD scheme validate well, and the overall model statistics are affected by sites that can be classed as being far away from the scheme(s); including count sites in central and southern areas that are located in fully synthetic parts of the model. Model validation performance is above 85% with this area excluded, as highlighted in Table 12-17 below.

*Table 12-17 - Summary of Validation Link Counts in Vicinity of PWD*

| Time Period | All Vehicles | Cars |
|---|---|---|
| AM | 95% | 98% |
| IP | 93% | 98% |
| PM | 90% | 93% |

A summary of the Strategic Road Network statistics is shown in Table 12-18. All strategic road network flows in the core simulation area meet criteria.

*Table 12-18 - Strategic Road Network Validation Summary*

| Time Period | All Vehicles | | | Cars | | |
|---|---|---|---|---|---|---|
| | Flow Difference (%Pass) | GEH (%Pass) | Passes at least 1 criterion | Flow Difference (%Pass) | GEH (%Pass) | Passes at least 1 criterion |
| AM | 100% | 100% | 100% | 100% | 100% | 100% |
| IP | 100% | 100% | 100% | 100% | 100% | 100% |
| PM | 100% | 100% | 100% | 100% | 100% | 100% |

## 12.6 Validation Screenlines

Similar to the calibration counts, the validation counts are also arranged along screenlines. The performance of the models along the validation screenlines are provided in the tables below.

***Table 12-19 - AM Validation Screenlines – All Vehicles***

| Screenline Number | Inbound/ Outbound | Observed Flow | Modelled Flow | Actual Difference | % Difference | PASS /FAIL | GEH | PASS /FAIL |
|---|---|---|---|---|---|---|---|---|
| SL_3A | Inbound | 2,024 | 2,004 | -20 | -1% | PASS | 0 | PASS |
| SL_4A | Inbound | 2,518 | 2,473 | -45 | -2% | PASS | 1 | PASS |
| SL_6A | Inbound | 7,554 | 7,505 | -49 | -1% | PASS | 1 | PASS |
| SL_9A | Inbound | 3,345 | 3,379 | 34 | 1% | PASS | 1 | PASS |
| SL_10A | Inbound | 1,691 | 1,649 | -42 | -2% | PASS | 1 | PASS |
| SL_12A | Inbound | 4,655 | 4,275 | -380 | -8% | FAIL | 6 | FAIL |
| SL_14A | Inbound | 2,117 | 2,053 | -64 | -3% | PASS | 1 | PASS |
| SL_3A | Outbound | 1,462 | 1,479 | 17 | 1% | PASS | 0 | PASS |
| SL_4A | Outbound | 2,506 | 2,429 | -77 | -3% | PASS | 2 | PASS |
| SL_6A | Outbound | 7,961 | 8,064 | 103 | 1% | PASS | 1 | PASS |
| SL_9A | Outbound | 1,895 | 1,898 | 3 | 0% | PASS | 0 | PASS |
| SL_10A | Outbound | 1,383 | 1,381 | -2 | 0% | PASS | 0 | PASS |
| SL_12A | Outbound | 3,709 | 3,581 | -127 | -3% | PASS | 2 | PASS |
| SL_14A | Outbound | 2,336 | 2,507 | 170 | 7% | FAIL | 3 | PASS |
| Total Passing | | | | | | 86% | | 93% |

*Table 12-20 - IP Validation Screenlines – All Vehicles*

| Screenline Number | Inbound/ Outbound | Observed Flow | Modelled Flow | Actual Difference | % Difference | PASS /FAIL | GEH | PASS /FAIL |
|---|---|---|---|---|---|---|---|---|
| SL_3A | Inbound | 1,059 | 1,081 | 21 | 2% | PASS | 1 | PASS |
| SL_4A | Inbound | 1,560 | 1,579 | 18 | 1% | PASS | 0 | PASS |
| SL_6A | Inbound | 6,302 | 5,945 | -357 | -6% | FAIL | 5 | FAIL |
| SL_9A | Inbound | 2,205 | 2,202 | -3 | 0% | PASS | 0 | PASS |
| SL_10A | Inbound | 1,242 | 1,306 | 64 | 5% | PASS | 2 | PASS |
| SL_12A | Inbound | 3,489 | 3,406 | -83 | -2% | PASS | 1 | PASS |
| SL_14A | Inbound | 1,648 | 1,707 | 59 | 4% | PASS | 1 | PASS |
| SL_3A | Outbound | 1,193 | 1,207 | 14 | 1% | PASS | 0 | PASS |
| SL_4A | Outbound | 1,642 | 1,566 | -76 | -5% | PASS | 2 | PASS |
| SL_6A | Outbound | 6,218 | 6,041 | -176 | -3% | PASS | 2 | PASS |
| SL_9A | Outbound | 2,350 | 2,311 | -39 | -2% | PASS | 1 | PASS |
| SL_10A | Outbound | 1,141 | 1,208 | 67 | 6% | FAIL | 2 | PASS |
| SL_12A | Outbound | 3,976 | 3,922 | -55 | -1% | PASS | 1 | PASS |
| SL_14A | Outbound | 1,632 | 1,757 | 126 | 8% | FAIL | 3 | PASS |
| **Total Passing** | | | | | | **79%** | | **93%** |

*Table 12-21 - PM Validation Screenlines – All Vehicles*

| Screenline Number | Inbound/ Outbound | Observed Flow | Modelled Flow | Actual Difference | % Difference | PASS /FAIL | GEH | PASS /FAIL |
|---|---|---|---|---|---|---|---|---|
| SL_3A | Inbound | 1,587 | 1,519 | -68 | -4% | PASS | 2 | PASS |
| SL_4A | Inbound | 2,422 | 2,605 | 182 | 8% | FAIL | 4 | PASS |
| SL_6A | Inbound | 8,603 | 8,501 | -102 | -1% | PASS | 1 | PASS |
| SL_9A | Inbound | 2,445 | 2,494 | 49 | 2% | PASS | 1 | PASS |
| SL_10A | Inbound | 1,589 | 1,539 | -50 | -3% | PASS | 1 | PASS |
| SL_12A | Inbound | 3,731 | 3,615 | -116 | -3% | PASS | 2 | PASS |
| SL_14A | Inbound | 2,196 | 2,226 | 30 | 1% | PASS | 1 | PASS |
| SL_3A | Outbound | 2,328 | 2,317 | -11 | 0% | PASS | 0 | PASS |
| SL_4A | Outbound | 2,479 | 2,522 | 43 | 2% | PASS | 1 | PASS |
| SL_6A | Outbound | 8,617 | 8,389 | -228 | -3% | PASS | 2 | PASS |
| SL_9A | Outbound | 3,312 | 3,508 | 196 | 6% | FAIL | 3 | PASS |
| SL_10A | Outbound | 1,567 | 1,566 | -1 | 0% | PASS | 0 | PASS |
| SL_12A | Outbound | 5,007 | 5,541 | 534 | 11% | FAIL | 7 | FAIL |
| SL_14A | Outbound | 2,328 | 2,539 | 211 | 9% | FAIL | 4 | FAIL |
| **Total Passing** | | | | | | **71%** | | **86%** |

The performance of the model along the validation screenlines, summarised in Table 12-22 show that across all time periods, the majority of screenlines for all vehicles and cars pass the flow difference and GEH criteria, particularly in the AM and IP Average Peak Hours. The majority of the screenlines which do not pass on the grounds of both requirements are far from the proposed scheme, except screenline 6A in the IP Average

Peak Hour which just falls out of the required tolerance ranges. It should also be noted that the remaining screenlines which do not satisfy the thresholds are all fairly close to meeting the standards.

The performance of LGVs and HGVs along validation screenlines are below the threshold with respect to flow difference requirements, which can be explained by the low volume of these vehicle types across screenlines. However, evaluating these against the GEH value shows a significant improvement in the number of screenlines passing.

Validation screenlines results for each vehicle type are provided in Appendix L.

Similar to the overall calibration screenline traffic totals, overall traffic levels throughout all the validation screenlines represent a very close fit.

***Table 12-22 - Summary Results of Validation Screenlines***

| | Time Period | 5% Difference | GEH |
|---|---|---|---|
| **All Vehicles** | AM | 86% | 93% |
| | IP | 79% | 93% |
| | PM | 71% | 86% |
| **Cars** | **Time Period** | **5% Difference** | **GEH** |
| | AM | 93% | 100% |
| | IP | 79% | 100% |
| | PM | 71% | 79% |
| **LGV** | **Time Period** | **5% Difference** | **GEH** |
| | AM | 29% | 86% |
| | IP | 36% | 93% |
| | PM | 43% | 86% |
| **HGV** | **Time Period** | **5% Difference** | **GEH** |
| | AM | 7% | 71% |
| | IP | 14% | 71% |
| | PM | 14% | 71% |

## 12.7 Journey Times

Journey times within the model were checked by comparison of the modelled journey times against the observed times along the routes identified in Section 3.2.3.

As explained in Section 5.5, TrafficMaster data was used to calculate observed journey times.

The weighted average of the vehicle types captured by TrafficMaster were used to provide the average journey time for each of the identified journey time routes.

These averaged journey times were then compared with the averaged PCU journey times within the SATURN models.

WebTAG requires that for the total route length, the modelled journey time from start to finish be within 15% (or 1 minute) of the observed time, and this must be the case for 85% of all the routes. However, that simple comparison ignores the fact that modelled and observed journey times could deviate significantly from each other along specific sections of a route, and the overall time still be within the specified acceptance criteria.

To ensure rigour in the modelled delays and journey times, the modelled times have been compared to the observed times not just for the total time along the routes, but also along the sections within each route. To that end, distance versus time graphs for the modelled and observed times are provided in Appendix M.

Figure 12-E shows the journey time routes and Table 12-23 to Table 12-25 summarise the performance of the model in terms of the WebTAG criteria for each modelled time period.

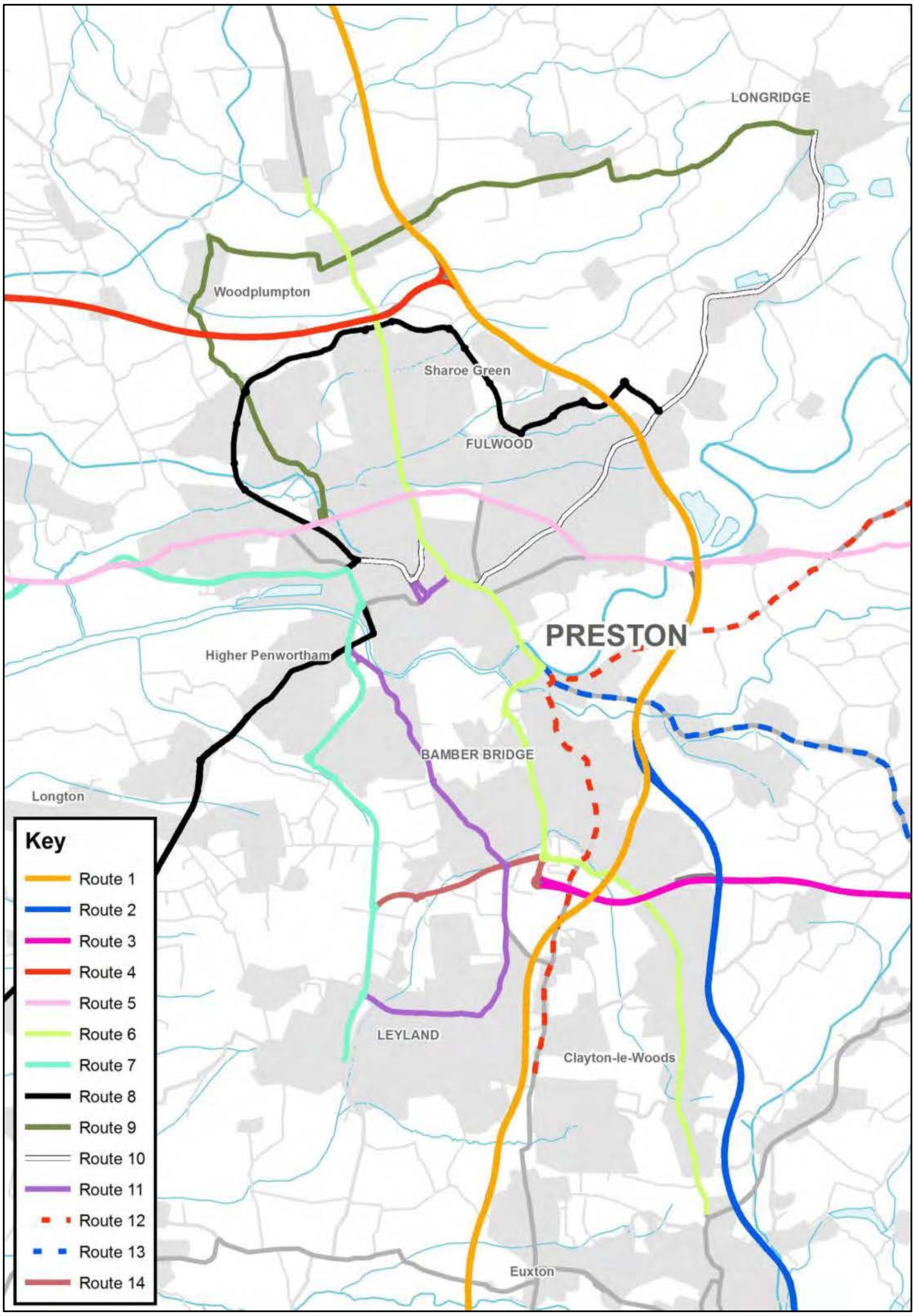


*Figure 12-E - Journey Time Routes*

*Table 12-23 - Comparison of Modelled Journey Time against the Observed, AM Peak*

| Description | Route | Total Observed JT | Total Modelled JT | Difference | % Diff | WebTAG Compliant |
|---|---|---|---|---|---|---|
| Route 1 | 1 NB | 1,607 | 1,800 | 193 | 12% | Pass |
| | 1 SB | 1,538 | 1,672 | 134 | 9% | Pass |
| Route 2 | 2 SB | 284 | 283 | -1 | 0% | Pass |
| | 2 NB | 318 | 341 | 23 | 7% | Pass |
| Route 3 | 3 EB | 299 | 302 | 3 | 1% | Pass |
| | 3 WB | 269 | 329 | 60 | 22% | Pass |
| Route 4 | 4 WB | 645 | 658 | 13 | 2% | Pass |
| | 4 EB | 639 | 658 | 19 | 3% | Pass |
| Route 5 | 5 NB | 2,128 | 2,330 | 202 | 9% | Pass |
| | 5 SB | 1,957 | 2,173 | 216 | 11% | Pass |
| Route 6 | 6 SB | 2,059 | 2,161 | 102 | 5% | Pass |
| | 6 NB | 2,248 | 2,437 | 189 | 8% | Pass |
| Route 7 | 7 SB | 1,416 | 1,594 | 178 | 13% | Pass |
| | 7 NB | 1,530 | 1,698 | 168 | 11% | Pass |
| Route 8 | 8 NB | 2,184 | 2,282 | 98 | 4% | Pass |
| | 8 SB | 2,054 | 2,317 | 263 | 13% | Pass |
| Route 9 | 9 NB | 1,438 | 1,421 | -17 | -1% | Pass |
| | 9 SB | 1,476 | 1,364 | -112 | -8% | Pass |
| Route 10 | 10 NB | 1,480 | 1,767 | 287 | 19% | Fail |
| | 10 SB | 1,487 | 2,052 | 565 | 38% | Fail |
| Route 11 | 11 NB | 1,789 | 1,993 | 204 | 11% | Pass |
| | 11 SB | 1,764 | 1,966 | 202 | 11% | Pass |
| Route 12 | 12 NB | 1,414 | 1,487 | 73 | 5% | Pass |
| | 12 SB | 1,373 | 1,532 | 159 | 12% | Pass |
| Route 13 | 13 SB | 614 | 613 | -1 | 0% | Pass |
| | 13 NB | 650 | 635 | -15 | -2% | Pass |
| Route 14 | 14 EB | 339 | 346 | 7 | 2% | Pass |
| | 14 WB | 274 | 322 | 48 | 17% | Pass |
| **Total Passing (%)** | | | | | | **93%** |

*Table 12-24 - Comparison of Modelled Journey Time against the Observed, IP*

| Description | Route | Total Observed JT | Total Modelled JT | Difference | % Diff | WebTAG Compliant |
|---|---|---|---|---|---|---|
| Route 1 | 1 NB | 1,567 | 1,627 | 60 | 4% | Pass |
| | 1 SB | 1,562 | 1,654 | 92 | 6% | Pass |
| Route 2 | 2 SB | 287 | 280 | -7 | -2% | Pass |
| | 2 NB | 284 | 306 | 22 | 8% | Pass |
| Route 3 | 3 EB | 257 | 267 | 10 | 4% | Pass |
| | 3 WB | 255 | 280 | 25 | 10% | Pass |
| Route 4 | 4 WB | 631 | 638 | 7 | 1% | Pass |
| | 4 EB | 654 | 649 | -5 | -1% | Pass |
| Route 5 | 5 NB | 1,903 | 2,092 | 189 | 10% | Pass |
| | 5 SB | 1,901 | 2,037 | 136 | 7% | Pass |
| Route 6 | 6 SB | 1,897 | 2,086 | 189 | 10% | Pass |
| | 6 NB | 1,934 | 2,191 | 257 | 13% | Pass |
| Route 7 | 7 SB | 1,382 | 1,548 | 166 | 12% | Pass |
| | 7 NB | 1,318 | 1,497 | 179 | 14% | Pass |
| Route 8 | 8 NB | 1,787 | 1,962 | 175 | 10% | Pass |
| | 8 SB | 1,883 | 2,123 | 240 | 13% | Pass |
| Route 9 | 9 NB | 1,324 | 1,294 | -30 | -2% | Pass |
| | 9 SB | 1,385 | 1,359 | -26 | -2% | Pass |
| Route 10 | 10 NB | 1,398 | 1,745 | 347 | 25% | Fail |
| | 10 SB | 1,419 | 1,908 | 489 | 34% | Fail |
| Route 11 | 11 NB | 1,516 | 1,789 | 273 | 18% | Fail |
| | 11 SB | 1,632 | 1,885 | 253 | 16% | Fail |
| Route 12 | 12 NB | 1,322 | 1,418 | 96 | 7% | Pass |
| | 12 SB | 1,339 | 1,431 | 92 | 7% | Pass |
| Route 13 | 13 SB | 601 | 601 | 0 | 0% | Pass |
| | 13 NB | 612 | 590 | -22 | -4% | Pass |
| Route 14 | 14 EB | 274 | 308 | 34 | 12% | Pass |
| | 14 WB | 252 | 297 | 45 | 18% | Pass |
| **Total Passing (%)** | | | | | | **86%** |

Table 12-25 - Comparison of Modelled Journey Time against the Observed, PM Peak

| Description | Route | Total Observed JT | Total Modelled JT | Difference | % Diff | WebTAG Compliant |
|---|---|---|---|---|---|---|
| Route 1 | 1 NB | 1,568 | 1,711 | 143 | 9% | Pass |
| | 1 SB | 1,593 | 1,814 | 221 | 14% | Pass |
| Route 2 | 2 SB | 289 | 297 | 8 | 3% | Pass |
| | 2 NB | 286 | 328 | 42 | 15% | Pass |
| Route 3 | 3 EB | 263 | 298 | 35 | 13% | Pass |
| | 3 WB | 262 | 314 | 52 | 20% | Pass |
| Route 4 | 4 WB | 637 | 653 | 16 | 3% | Pass |
| | 4 EB | 645 | 663 | 18 | 3% | Pass |
| Route 5 | 5 NB | 2,249 | 2,310 | 61 | 3% | Pass |
| | 5 SB | 2,164 | 2,276 | 112 | 5% | Pass |
| Route 6 | 6 SB | 2,129 | 2,462 | 333 | 16% | Fail |
| | 6 NB | 2,299 | 2,426 | 127 | 6% | Pass |
| Route 7 | 7 SB | 1,820 | 2,035 | 215 | 12% | Pass |
| | 7 NB | 1,509 | 1,711 | 202 | 13% | Pass |
| Route 8 | 8 NB | 1,902 | 2,156 | 254 | 13% | Pass |
| | 8 SB | 2,440 | 2,548 | 108 | 4% | Pass |
| Route 9 | 9 NB | 1,335 | 1,335 | 0 | 0% | Pass |
| | 9 SB | 1,393 | 1,369 | -24 | -2% | Pass |
| Route 10 | 10 NB | 1,641 | 1,967 | 326 | 20% | Fail |
| | 10 SB | 1,550 | 2,069 | 519 | 34% | Fail |
| Route 11 | 11 NB | 2,061 | 2,068 | 7 | 0% | Pass |
| | 11 SB | 2,311 | 2,276 | -35 | -2% | Pass |
| Route 12 | 12 NB | 1,374 | 1,512 | 138 | 10% | Pass |
| | 12 SB | 1,495 | 1,506 | 11 | 1% | Pass |
| Route 13 | 13 SB | 601 | 657 | 56 | 9% | Pass |
| | 13 NB | 594 | 604 | 10 | 2% | Pass |
| Route 14 | 14 EB | 386 | 344 | -42 | -11% | Pass |
| | 14 WB | 342 | 338 | -4 | -1% | Pass |
| **Total Passing (%)** | | | | | | **89%** |

The above results show that the traffic model validates well against journey times, exceeding the WebTAG criteria, with more than 85% of journey time routes within the required criteria.

It can be seen that 93% of journey time routes pass in the AM time period, 86% of journey times pass in the IP time period, and 89% of journey time routes pass in the PM time period. The failing routes are mostly Route 10 (in all time periods) and Route 11 (only in the IP peak) to the eastern and southern ends of the model and are considered far from the PWD scheme. In addition, Route 6 marginally fails in the PM peak hour.

The journey time routes tables and graphical representation of the results are shown in Appendix M.

It is also notable that the differences in times are not consistently positive or negative, suggesting there is no underlying bias of high or low journey times in the model.

Furthermore, the graphs in Appendix M show that the majority of timing points along each journey time route are met.

## 12.8 Calibrated and Validation Results – Conclusion

The model has been calibrated and validated using the measures and criteria recommended in WebTAG M3.1.

The analysis shows that the model exceeds the WebTAG acceptability guidelines for Strategic Road Network performance, screenline performance, calibration traffic flows, and journey time validation requirements in each time period, which gives more confidence in the model's abilities to represent actual traffic conditions.

A range of count data has been used independently of those used in model calibration, that are close to meeting standards at the overall model scale. However, when considering the area in vicinity of the proposed PWD scheme, the results exceed the requirement of 85% on the passing links. The majority of sites that do not validate to individual GEH/DMRB criteria are unlikely to be affected as a result of the scheme being implemented.

These include count sites in largely around Leyland and south of Chorley that do not meet WebTAG criteria in all or nearly all time periods, affecting the overall model validation statistics.

This is due to the fact that the model is largely synthetic in this area; prior to intersecting the RSI cordon.

The model has also been shown to be stable by exceeding acceptable levels of convergence.

# 13 Variable Demand Model Building and Validation

## 13.1 Background

Following discussions with the DfT in early 2018, it was agreed that it would be a risk to pursue the Preston Western Distributor scheme to Full Approval without undertaking Variable Demand Modelling (VDM).

Subsequently VDM has been undertaken for the PWD scheme, in accordance with the scope and specifications outlined in a technical note produced by Jacobs (April 2018) and which was subsequently agreed with the DfT. The specification note is provided in Appendix N.

## 13.2 Demand Model Overview

WebTAG states that "any change to transport conditions will, in principle, cause a change in demand. The purpose of variable demand modelling is to predict and quantify these changes.

DIADEM (Dynamic Integrated Assignment and Demand Modelling) is a computer software package that was developed to assess variable demand for traffic models. DIADEM is used to model variable demand responses. WebTAG Unit M2 (Variable Demand Modelling) states that "The DIADEM framework controls iteration within assignment and between demand and assignment, to ensure that the calculations reach an acceptable equilibrium".

The demand model has been implemented using DIADEM 5.0 software. The demand model has been calibrated in accordance with the methodology laid out in WebTAG Unit M2. This process has involved adjusting the model parameters, in accordance with the values outlined in WebTAG Unit M2 until plausible results were produced from the realism testing. This section sets out the results obtained using the typical lambda values from WebTAG Unit M2 and those obtained when adjusting model parameters.

## 13.3 Variable Demand Model Structure

The Variable Demand model is run as an incremental Origin-Destination based model using the same purpose definitions as the assignment model. The spatial coverage of the Variable Demand model is the same as the Highway model and they use the same zone system and generalised cost parameters.

The traffic model has been developed for three time periods;

- *Weekday AM peak hour = 08:00 – 09:00.*
- *Weekday Inter-Peak (IP) hour = average hour between 1000 and 1600*
- *Weekday PM peak hour = 17:00 – 18:00*

This is in line with guidance, with states that actual peak hour models are to be preferred in most circumstances.

The model area has been divided into two areas; the "internal" area and the "external" area. The internal area is the area where trip movements could potentially be impacted on by the scheme, in this area the network is generally fully defined and the model validated. The external area is the area outside this- generally the buffer area.

In the demand model calibration exercise all calculations are based on the following movements:

- internal to internal
- internal to external
- external to internal; and
- any external to external movement's which influence the simulation area.

The following movements are treated as fixed, and are excluded from the demand model calculations:

- external to external trips which do not pass through the fully modelled area.

Freight is also excluded from variable demand calculations.

## 13.4 Demand Model User Classes

In the highway assignment model, the assignment user classes are consistent with those in the demand model (there is a 1:1 correspondence). Road traffic has been sub-divided into 8 user classes covering all journey purpose and vehicle combinations.

For some journey purposes fixed and variable demand user classes have been separately identified, where "fixed demand" relates to origin-destination movements that will not be subject to variable demand modelling, and "variable demand" relates to origin-destination movements that will be subject to variable demand modelling. Separate assignment parameters have been produced for each of the user classes to reflect traffic behaviour accurately in the assignment process.

***Table 13-1 - Demand Model User Classes***

| Assignment User Class | Demand Segment | Vehicle Type | Demand Model Segment |
|---|---|---|---|
| User Class 1 (UC1) | 1 | CAR | Distribution - variable |
| | 6 | | Fixed |
| User Class 2 (UC2) | 2 | CAR | Distribution - variable |
| | 7 | | Fixed |
| User Class 3 (UC3) | 3 | CAR | Frequency & Distribution - variable |
| | 8 | | Fixed |
| 4 | 4 | LGV | LGV - fixed |
| 5 | 5 | HGV | HGV - fixed |

Currently, the guidance recommends that LGV and HGV vehicle types are treated as fixed. Hence, variable demand modelling is only applied to car user classes.

## 13.5 Doubly-Constrained or Singly-Constrained

Within the PWD VDM modelling:

- Commute trips are doubly-constrained in all time periods, reflecting the confidence in the measures of attraction (employment) for commuting trips;

- Employers Business trips singly constrained AM/IP (Origin), PM (Destination); and

- Other trips are singly constrained (Orign) in all time periods.

## 13.6 Demand Model Responses

Table 13-2 below, indicates the DIADEM responses which have been modelled for the Preston Western Distributor scheme, as agreed with the DfT. The suitability of each of the above demand responses is discussed in a technical note produced by Jacobs (April 2018).

***Table 13-2 - Scope of VDM for PWD***

| Modelled | Not Modelled |
|---|---|
| Trip Frequency (for optional trip purposes) | Mode choice |
| Trip Distribution | Time of day choice |
| Cost damping | Micro time choice |

## 13.7 Demand Model Calibration - Realism Testing

The VDM guidance prescribes that where variable demand is assessed, realism tests should be carried out on the base year model to ensure that the it behaves realistically to changes in travel costs and time, and the overall model response conforms to general guidelines.

The DIADEM model is an iterative process which starts with a set of base demand car matrices and costs. Through the process the highway demand matrices and travel costs are allowed to change at each iteration until convergence is reached.

When used in forecasting mode the future year demands are calculated using the calibrated base year costs and demands as a pivot point.

DIADEM requires that model parameters are defined for each of the selected responses. For logit based models the spread (dispersion) parameter Lambdas ($\lambda$) must be defined for the choice at the bottom of the hierarchy and for choices above the bottom the scaling parameter Thetas ($\theta$) is required.

## 13.8 WebTAG Unit M2 Requirements

WebTAG Unit M2 provides guidance on the calibration of demand models. It recommends a number of realism tests that should be carried out and provides a range of appropriate parameter values and expected responses from the model. It recommends that the following should be carried out:

- *Car fuel cost elasticities;*
- *Car journey time elasticities; and*
- *Public transport fare elasticities.*

For the purposes of modelling the PWD only calibration based on car fuel elasticities and car journey time elasticities have been considered. The public transport fare elasticities have not been considered.

## 13.9 Fuel Cost Elasticities – Guidelines

WebTAG Unit M2 recommends that demand model calibration is undertaken so that model achieves the following:

- *The annual average fuel cost elasticity should lie in the range -0.25 to -0.35*
- *The pattern of annual average elasticities:*
  - *Employers Business near -0.1;*
  - *Discretionary trips near to -0.4;*
  - *Commuting and Education somewhere near the average*
- *Pattern of all-purpose elasticities should show peak period elasticities which are lower than inter peak which are lower than off peak.*

Calculations are matrix based, and network based using car vehicle kilometre changes calculated from car trip matrices and skimmed distance matrices. Calculations are based on demand segments and model areas with variable demand, i.e. excludes 'external to external' trips, intrazonal demand and freight.

WebTAG Unit M2 also provides the recommended range for parameter values; these are shown in Table 13-3.

***Table 13-3 - WebTAG Unit M2 Lambda Targets***

| Purpose | WebTAG Targets | | |
|---|---|---|---|
| | Minimum | Median | Maximum |
| Commute | 0.049 | 0.065 | 0.081 |
| Employer Business | 0.05 | 0.067 | 0.084 |
| Other | 0.068 | 0.09 | 0.113 |

Combined with the WebTAG Unit M2 requirement the distribution parameters should ideally lie within 25% of the median Lambda values. For the purposes of the PWD Model, the HB purposes have been used as the median Lambda values for employer business and the other trip purpose.

Additionally WebTAG Unit M2 paragraph 6.4.14 expects that:

- *the annual average fuel cost elasticity should lie on the right side of -0.3, taking account of the levels of income and average trip lengths prevailing in the modelled area.*

The characteristics of the study area were compared against the national characteristics in order to determine which side of -0.3 the annual average fuel cost elasticity should lie. The result of this comparison is presented in Table 13-4.

**_Table 13-4 - Fuel cost elasticity – right side test_**

| Conditions for elasticity weaker than -0.30 | Condition met? |
|---|---|
| Trip lengths shorter than average | North West (NTS 2013/14) = 6.5miles<br>England (NTS 2013/14) = 7.1miles<br>**Yes** - Shorter than NTS for majority of trips (across all purposes) |
| Car mode share higher than average | North West (Census 2011) = 63%<br>England (Census 2011) = 58%<br>**Yes** - Higher than national |
| EB proportion higher than average | North West (TEMPRO 7.2) = 7%<br>GB (TEMPRO 7.2) = 8%<br>**No** - Lower than national |
| Higher income levels | North West (ONS 2013) = £15,791<br>England (ONS 2013) = £18,020<br>**No** - Lower than national |

Given that half of the conditions are met, it is reasonable to conclude that elasticity should lie between -0.30 and -0.35, as the income is lower than the national average.

## 13.10 Process for Realism Testing

The realism testing approach uses a two-staged calibration method:

- *Changing model generalised cost coefficients (the distance coefficient) in the validated base model to reflect a 20% fuel increase. This has a different impact for different trip purposes. (WebTAG Unit M2 recommends a 10%-20% fuel increase). The 20% increase has been used to reduce the impact that model noise has on the calculations; and*

- *Modifying the model parameters to achieve the overall target fuel cost elasticity in the range -0.30 to -0.35. The individual purposes are calibrated to different values as suggested in WebTAG Unit M2.*

**Stage 1 - Calculating generalised cost parameters to reflect fuel cost increase**

A new SATURN Vehicle Operating Cost parameter PPK (Pence per Kilometre) has been calculated from the validated model PPK for each user class.

Table 13-5 shows the PPK values used in the validated base assignment model and the PPK values that reflect a 20% fuel cost increase. As part of the realism tests, the fuel cost element of the model generalised cost coefficient (the distance coefficient) was increased by 20%. The 20% increase was used to reduce the impact that model noise has on the calculations.

***Table 13-5 - Fuel elasticities Generalised Cost co-efficient***

| Vehicle type | Trip Purpose | Time Period | Vehicle operating cost / PPK (p/km) | |
|---|---|---|---|---|
| | | | Validated Base Year | 20% Fuel Cost Increase |
| Car | Commute | AM | 7.86 | 9.43 |
| Car | Business | AM | 13.9 | 15.21 |
| Car | Other | AM | 7.86 | 9.43 |
| Car | Commute | IP | 7.8 | 9.36 |
| Car | Business | IP | 13.73 | 15.03 |
| Car | Other | IP | 7.8 | 9.36 |
| Car | Commute | PM | 7.91 | 9.49 |
| Car | Business | PM | 14.03 | 15.35 |
| Car | Other | PM | 7.91 | 9.49 |

## Stage 2 - Calculating Model Parameters

The second stage of the calibration process is to calculate the demand model parameters required to achieve the overall target fuel cost elasticity of in the range -0.30 to -0.35. The median values of Lambdas **(λ)** and Thetas **(θ)** parameters given as in the latest WebTAG Unit M2 guidance are used as the starting point and then these are systematically modified until a satisfactory elasticity for the base year is achieved. The model is run after each adjustment and the elasticity calculated using the arc-elasticity formulation, which for a 20% fuel increase, is given by:

$$Fuel\ Cost\ Elasticity = \frac{In\left(\frac{Veh\_km^1}{Veh\_km^0}\right)}{In(1.20)}$$

Where the superscript 0 indicates the value from the base year model and 1 indicates the results from the model run with the increased distance coefficient. Similarly, the car journey time elasticity is calculated based on the equation below:

$$Car\ Journey\ Time\ Elasticity = \ Elasticity^{Fuel\ Cost}\frac{aT}{bK}$$

Where a is the cost per hour, b is cost per km, K is vehicle kilometres and T is total vehicle hours.

## Cost Damping

To further improve and adjust the outturn realism test results to ensure that the change in travel costs and time are realistic, cost damping has been utilised.

There is evidence that long distance trips are less sensitive to changes in costs than short distance trips and WebTAG Unit M2 recommends that cost damping functions are included in the variable demand process. The idea behind cost damping is to adjust the costs for longer trips so that their sensitivity to individual cost components (such as fuel cost or travel time) is reduced.

WebTAG Unit M2 provides the following advice on cost damping:

Para 3.3.2 states *"not all models will need to use cost damping but, if it is employed, then functions of one of the forms specified below should generally be used. The choice of the* *following cost damping mechanisms is a matter for the analyst. If analysts wish to use other forms of cost damping, they should consult the Department before doing so."*

Additionally, para 3.3.3 states *"It is not necessary for analysts to conduct tests using each of the forms specified below and to prove that one is better than the others. This is because the form of cost damping and the cost damping parameter values will interact with other aspects of the model, such as the demand model parameter values and values of time. While the cost damping parameter values, demand model parameter values and values of time should all be kept within certain limits specified below and in Section 6, it is the performance of the combination of all these aspects of the model in yielding satisfactory realism test results that is important."*

The use of cost damping was deemed necessary as initial realism tests using median value parameters and varying them within the permitted 25% ranges did not give acceptable elasticities. This is further discussed in the following section.

DIADEM offers a range of different methods of applying cost damping. The approach used for this study is the first option, damping by a Function of Distance.

The damped cost is given by the formula:

$$G' = (d/k)^{-\alpha}.(t + c/VOT),$$

Where:

t = time (minutes)
c = cost (pence)
VOT = value of time (pence per minute)
*d' = trip length; and*
*α and $k$ = parameters that need to be calibrated.*

WebTAG acknowledges that whilst there is no firm guidance provided on setting the parameters for cost damping, WebTAG Unit M2, paragraph 3.3.10 provides the following commonly used parameters which were adopted.

***Table 13-6 - Cost Damping WebTAG Unit M2 Parameters***

| Parameter | Description | Commonly used value |
|---|---|---|
| α | must be positive and less than 1 and should be determined by experimentation in the course of adjusting a model so that it meets the requirements of realism tests | 0.5 |
| *k* | must also be positive and in the same units as d' | 30 km |
| *d'* | calculated by skimming distances | 30 km |

## 13.11 Realism Testing Results

This section presents outturn results from the following analysis;

- *Car fuel cost elasticities;*
- *Network based elasticities;*
- *Journey time elasticities; and*
- *DIADEM Convergence.*

### 13.11.1 Car fuel cost elasticities

Calibration of the destination model parameters was conducted in line with guidance from WebTAG Unit M2 para 6.6.5 using median values taken from Table 5.1 of the same document. A sequence of model runs were conducted, as described below, in order to achieve calibration.

Run 1 used the median parameter settings from WebTAG Unit M2 Table 5.1 for all time periods. The results indicate that in all time periods for employer business and other purposes the response is very sensitive and too strong; while, commute elasticity is close to -0.30.

Run 2 aims to decrease the distribution parameters by -25% below median values for employer business and other purposes. The elasticities weakened, but largely remained too sensitive (particularly for other purpose) and strong for all time periods.

As a next step Run 3 introduced distance based cost damping for employer business and other purposes, based on the commonly used values quoted in WebTAG Unit M2 paragraph 3.3.10, namely **k** and **d'** set to 30km and alpha to 0.5. This again reduced and weakened the sensitivity for all time periods. However, the responses remained too sensitive and strong for those journey purposes.

In Run 4, k and d' were reduced to 20km to further reduce the elasticities. For the employer business and other journey purposes the sensitivity was under responsive in the AM and IP. Therefore, the sensitivities from this test did not fully satisfy the target values.

These sequences of runs gave reductions from the initial over-sensitive responses towards more acceptable responses for all journey purposes. As a next step and the final elasticity run the cost damping was slackened (i.e. alpha value increased) to compensate for slightly stronger response. Consequently, based on WebTAG Unit M2 paragraph 3.3.4 which recognises the following;

"It may also be necessary to vary cost damping parameters by trip purpose. However, these variations by mode and purpose should be avoided unless it is essential to achieve acceptable model performance".

Different variation of cost damping was applied to the AM and IP, since IP elasticities were farther from the target values compared to those of the AM. Moreover, given that the reduction of Lambda values was exhausted for the employer business and other trip purposes, the commute Lambda values in these two time periods (AM and IP) were also slightly lowered to adjust the overall sensitivity of the model. This change resulted in variations of distributing lambdas by time period for the commute trips.

The input parameters and the results of the sequence of runs are presented in Table 13-7 and Table 13-8 respectively.

The outturn fuel cost elasticities from the realism testing of the final run are presented in Table 13-9.

*Table 13-7 - Car fuel cost elasticities - Parameters*

| Run ID | Distribution Parameter Trip (Lambda) | | | | | | Cost Damping | | | Frequency |
|---|---|---|---|---|---|---|---|---|---|---|
| | Commute | EB | Other | Commute | EB | Other | Commute | EB | Other | Other |
| Run01 | Median | Median | Median | -0.065 | -0.067 | -0.090 | - | - | - | 0.08 |
| Run02 | Median | -25% | -25% | -0.065 | -0.050 | -0.068 | - | - | - | 0.08 |
| Run03 | Median | -25% | -25% | -0.065 | -0.050 | -0.068 | - | d'=k=30000m, alpha =0.5 | d'=k=30000m, alpha =0.5 | 0.08 |
| Run04 | Median | -25% | -25% | -0.065 | -0.050 | -0.068 | - | d'=k=20000m, alpha =0.5 | d'=k=20000m, alpha =0.5 | 0.08 |
| Run05 | Equal or less than Median | -25% | -25% | AM: -0.06 IP: -0.055 PM: -0.065 | -0.050 | -0.068 | - | d'=k=20000m, alpha: AM =0.6 IP= 0.63 PM=0.5 | d'=k=20000m, alpha: AM =0.6 IP=0.62 PM=0.5 | 0.08 |

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*Table 13-8 - Car fuel cost elasticities - Results*

| Run ID | AM | | | | IP | | | | PM | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Commute | EB | Other | Overall | Commute | EB | Other | Overall | Commute | EB | Other | Overall |
| Target Elasticity | -0.25 to -0.3 | near -0.1 | near -0.4 | -0.30 to -0.35 | -0.25 to -0.3 | near -0.1 | near -0.4 | -0.30 to -0.35 | -0.25 to -0.3 | near -0.1 | near -0.4 | -0.30 to -0.35 |
| Run01 | -0.29 | -0.39 | -0.92 | -0.46 | -0.32 | -0.42 | -1.04 | -0.75 | -0.29 | -0.35 | -0.96 | -0.56 |
| Run02 | -0.29 | -0.31 | -0.76 | -0.41 | -0.33 | -0.33 | -0.84 | -0.63 | -0.29 | -0.28 | -0.77 | -0.49 |
| Run03 | -0.30 | -0.14 | -0.54 | -0.33 | -0.33 | -0.16 | -0.55 | -0.42 | -0.30 | -0.13 | -0.52 | -0.37 |
| Run04 | -0.30 | -0.12 | -0.46 | -0.31 | -0.33 | -0.13 | -0.47 | -0.37 | -0.31 | -0.11 | -0.44 | -0.34 |

*Table 13-9 - Car fuel cost elasticities – Final Results*

| Time Period | Matrix Based | | | |
|---|---|---|---|---|
| | Commute | Employer Business | Other | Overall |
| Target | -0.25 to -0.30 | Near -0.1 | Near -0.4 | -0.30 to -0.35 |
| **AM** | -0.28 | -0.1 | -0.41 | -0.29 |
| **IP** | -0.29 | -0.1 | -0.41 | -0.32 |
| **PM** | -0.31 | -0.11 | -0.44 | -0.34 |
| **Elasticity Results_12 Hour (excl. weekends)** | -0.29 | -0.1 | -0.41 | -0.31 |
| **Elasticity Results_12 Hour (incl. weekends)** | -0.29 | -0.1 | -0.41 | -0.31 |

The table indicates final demand model calibration results, based on the changes outlined above. The resulting elasticities (based on all non-fixed trips which are subject to variable demand) have:

- All-purpose all day elasticities on the right side of -0.3 (result -0.31, is in range of -0.30 to -0.35);
- Commute elasticity (by period and all day) close to the all-purpose values;
- Employers business elasticities have a weaker response;
- Other purpose elasticities have a stronger response;
- IP elasticity for all-purposes is higher than AM but marginally lower than PM. Whilst the proportion of Other trips is higher in IP which would normally result in higher IP elasticity when compared to AM and PM, the calibrated PM Other elasticity, as demonstrated in the table above, is higher than IP Other. This results in higher overall PM elasticity. This pattern is considered acceptable given that WebTAG guidance indicates that there is little or no empirical evidence to support the pattern that IP should be higher than peak periods.

### 13.11.2 Network Based Elasticities

Network based elasticities were calculated, and are presented in Table 13-10 below. This indicates that the elasticities are close to the matrix based values summarised above.

*Table 13-10 – Network Based Elasticities - Results*

| Time Period | Network Based | | | |
|---|---|---|---|---|
| | Commute | Employer Business | Other | Overall |
| **Target** | **-0.25 to -0.30** | **Near -0.1** | **Near -0.4** | **-0.25 to -0.35** |
| **AM** | -0.3 | -0.07 | -0.37 | -0.28 |
| **IP** | -0.32 | -0.1 | -0.4 | -0.31 |
| **PM** | -0.33 | -0.1 | -0.41 | -0.33 |
| **Elasticity Results_12 Hour (excl. weekends)** | -0.31 | -0.09 | -0.4 | -0.31 |
| **Elasticity Results_12 Hour (incl. weekends)** | -0.32 | -0.1 | -0.4 | -0.31 |

### 13.11.3 Journey Time Elasticity

Car journey time elasticities were calculated using the fuel cost elasticities and cost damping, using the equation below:

$$E^{time} = E^{fuel} \frac{p^{time}}{p^{fuel}}$$

Where $p^{time}$ is cost of travel as a proportion of generalised cost; and $p^{fuel}$ is the cost of fuel as a proportion of total generalised cost.

Furthermore, if the total vehicle kilometres (K) and total vehicle hours (T) are known then the following relationship can be derived:

$$\frac{p^{time}}{p^{fuel}} = \frac{aT}{bK}$$

where ***a*** is the cost per hour; and ***b*** is the cost per km.

Consequently, using the above relationship, the car elasticities of vehicle kms with respect to journey time elasticities have been derived and the results are presented within Table 13-11 below.

*Table 13-11 - Car Journey time elasticities - Results*

| Time Period | Purpose | Matrix based | Network based |
|---|---|---|---|
| AM | Commute | -0.61 | -0.71 |
| | EB | -0.16 | -0.12 |
| | Other | -0.69 | -0.68 |
| IP | Commute | -0.60 | -0.74 |
| | EB | -0.17 | -0.16 |
| | Other | -0.67 | -0.72 |
| PM | Commute | -0.66 | -0.78 |
| | EB | -0.19 | -0.18 |
| | Other | -0.74 | -0.77 |

The above table demonstrates that the car journey time elasticities are below the WebTAG recommended threshold of -2.0 and are therefore WebTAG compliant and acceptable to be used as part of forecasting for the PWD scheme.

### 13.11.4 DIADEM Convergence

Based on the lambda parameters derived in the realism tests, the forecast models have been run through DIADEM. In assessing the outputs of the model runs, the main parameter of importance is the 'relative gap', which is the measure of convergence between demand and supply. Current WebTAG guidance recommends a relative gap of at least 0.2%. However, to further increase the robustness of the modelling of the PWD scheme, the DIADEM criterion has been set to achieve a relative gap of 0.145%.

Consequently, the DIADEM models achieved a relative gap convergence level of 0.145% or less in all cases, which suggests the demand - supply convergence of the variable demand traffic model is acceptable. It has therefore been shown that the traffic model is stable and has converged to an acceptable standard.

## 13.12 Conclusion

The variable demand model for the CLHTM model has been calibrated using the DIADEM software in accordance with the methodology and recommendations set out in WebTAG unit M2.

Realism tests have readily converged giving a relative gap of 0.145% (in line with WebTAG Unit M2).

The results presented in the preceding sections demonstrate that;

- *The demand model structure and response hierarchy have been set up correctly and comply with WebTAG Unit M2 requirements;*
- *The calculations and the methodology used for fuel cost elasticities are compliant to WebTAG Unit M2 guidance;*
- *The outturn elasticity results fall within the WebTAG Unit M2 expectations and requirements; and*
- *The distribution parameters that are adopted in the model are WebTAG Unit M2 compliant and within recommendations.*

Overall, the demand model responses to change are realistic and within the requirements of WebTAG Unit M2. Thus, these calculated parameters will be considered suitable for variable demand modelling for future year forecasting and to appraise the proposed PWD scheme.