M42 Junction 6 Development Consent Order

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8.50 Transport Modelling Hierarchy and Growth in Future Year Traffic

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Transport Modelling Hierarchy and Growth in Future Year Traffic

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1 Overview of the modelling hierarchy

1.1 Background

1.1.1 This document has been prepared in respect of the proposed M42 Junction 6 Development Consent Order (DCO) made by Highways England Company Limited (Highways England) to the Secretary of State for Transport for a DCO under section 37 of the Planning Act 2008.

1.1.2 At the third Issue Specific Hearing held on 2 July 2019, which considered the need for improvements at Junction 6 on the M42, the Examining Authority (ExA) requested that Highways England provide a note to assist the ExA explaining the relationship of the hierarchy of traffic models used and to provide clarity on job growth predictions and growth in future year traffic modelling.

1.1.3 The purpose of this document, therefore, is to explain in further detail the hierarchical approach to modelling that has been used for the M42 Junction 6 scheme (the Scheme) involving the following models:

a. the Policy Responsive Integrated Strategy Model (PRISM) for the West Midlands;

b. M42 Junction 6 Local Area Model (LAM);

c. M42 Junction 6 Operational Model (OM); and

d. operational capacity models of individual and/or linked junctions,

as well as clarifying the position regarding future year modelling.

1.1.4 The models are summarised in **Figure 1-1.**

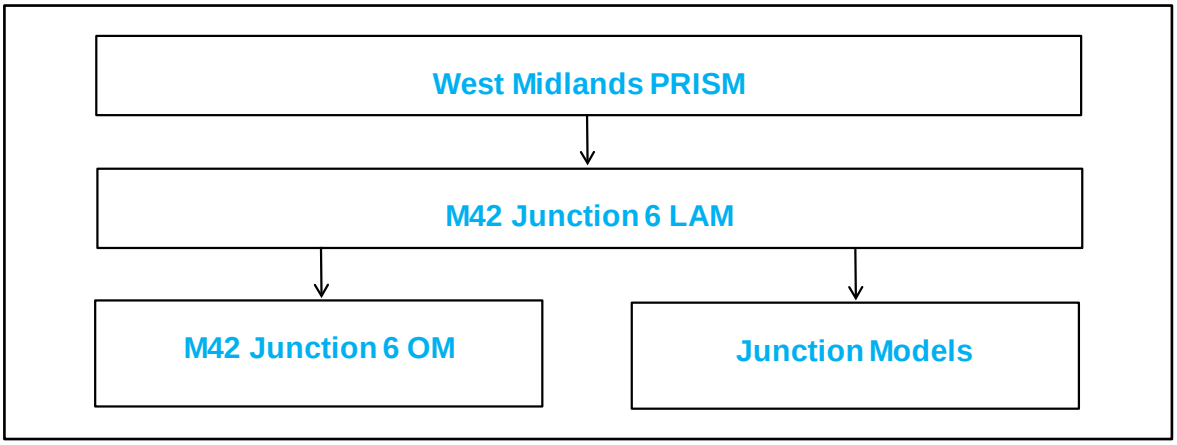

Figure 1.1 - Modelling Hierarchy

1.2 PRISM

1.2.1 PRISM provides a strategic multi-modal model covering the whole of the West Midlands and its wider hinterland. It has and continues to be used to underpin much of the modelling and forecasting work in the area to inform transport policy and planning, scheme development and appraisal. PRISM can assess strategic route choice, modal split, time of the day, shift, park and ride, etc.

1.2.2 A more detailed LAM has been developed by cordoning the highway network from PRISM and adding more zones and network detail around the study area. The LAM allows for the wider strategic highway movements from PRISM to be retained, while providing more detailed movements around junctions closer to the Scheme. Therefore, the wider variable demand modelling impacts from PRISM has been combined with more detailed routing assessment within the LAM.

1.2.3 The OM takes a cordon of the LAM to investigate in further detail the routeing of traffic and the operation of junctions in terms of queuing, delay and driving behaviour using VISSIM micro-simulation software.

1.2.4 More detailed junction operational capacity modelling has also been undertaken which has included:

i. Assessment of Roundabout Capacity and Delay (ARCADY) modelling of the proposed new Bickenhill roundabout;

ii. ARCADY modelling of the proposed new Barber's Coppice roundabout;

iii. ARCADY modelling of Junction 5A roundabouts;

iv. ARCADY modelling of the M42 southbound off-slip and East Way roundabout; and

v. LinSig modelling of Clock Interchange signalised gyratory.

1.3 Local Area Model

1.3.1 The LAM was coded in VISUM software and includes enhanced network and zoning details in the vicinity of the Scheme as shown in **Figure 1-2**.

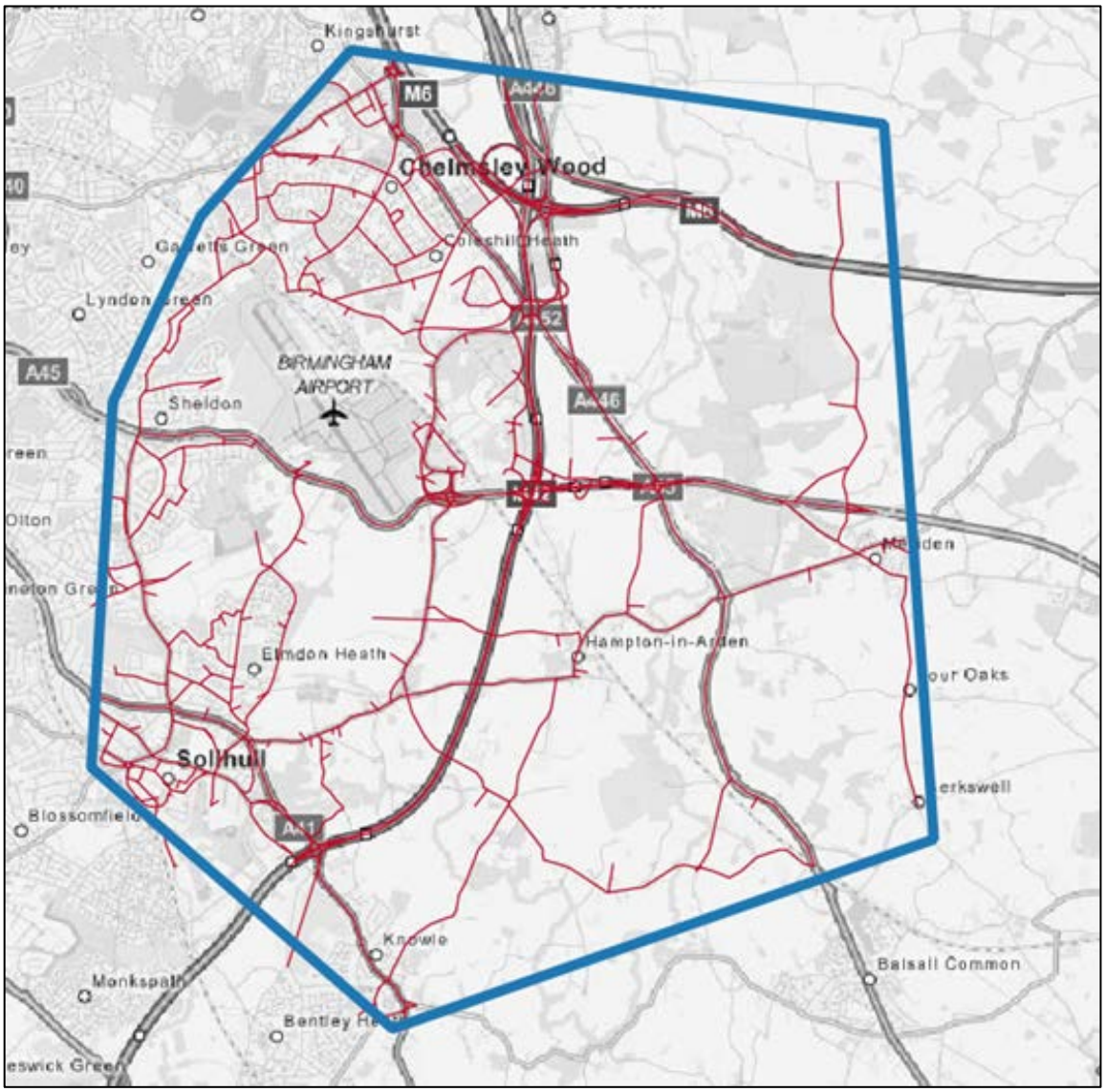

Figure 1-2 - Detailed LAM area with additional network and zoning

1.3.2 The LAM also includes a wider network and zoning system based directly on PRISM as shown in **Figure 1-3**.

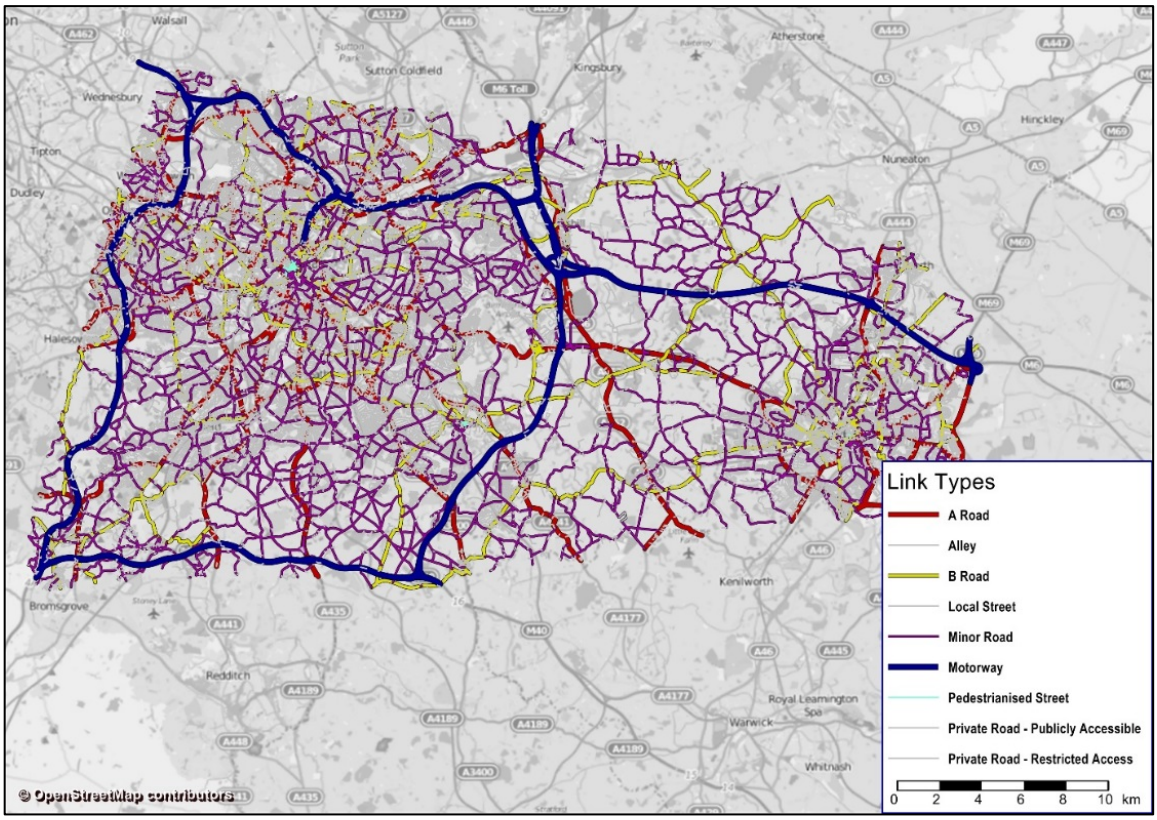

Figure 1-3 - Wider LAM area based on PRISM

1.3.3 The peak hours modelled in the LAM are the same as those modelled in PRISM, namely:

a. AM peak hour between 08:00-09:00 (of peak period 07:00 – 09:30);

b. Inter-peak (IP) average hour between 09:30-15:30; and

c. PM peak hour between 17:00-18:00 (of peak period 15:30 – 19:00).

1.3.4 The LAM has been set up to model the following years:

a. 2016 calibrated/validated base year;

b. 2021 ‘Do Minimum’ (DM) without the Scheme and ‘Do Something’ (DS) with the Scheme;

c. 2026 DM and DS with HS2;

d. 2031 DM and DS; and

e. 2041 DM and DS.

1.4 Operational Model

1.4.1 The OM, coded in VISSIM micro-simulation software, contains a similar level of network and zoning detail as the LAM although within a smaller defined ‘area of influence’ surrounding the Scheme. The 2041 ‘DS’ network is shown in Figure 1-4, which also includes the private National Exhibition Centre (NEC) road network.

Figure 1-4 - 2041 Do-Something operational model network

1.4.2 The peak hours modelled in the OM are:

a. AM peak hour between 08:00-09:00; and

b. PM peak hour between 17:00-18:00.

1.4.3 The OM has been set up to model the following years:

a. 2016 calibrated/validated base year; and

b. 2041 DM and DS.

1.5 Junction models

1.5.1 Junction models were used for detailed operational capacity assessment to assist in the preliminary design process. They were coded using measured parameters from layout plans and signal times where appropriate. The assessment was based on the 2041 AM and PM peak hour LAM traffic forecasts.

1.6 Application of the models

1.6.1 The LAM was used for the following purposes:

a. to provide traffic forecasts for use in the highway/junctions design;

b. to provide forecast traffic flows for input to the OM and the junction operational capacity models used in the junctions' designs;

c. to provide traffic forecasts for the use in air quality and noise assessment, and in pavement design; and

d. to provide inputs to the economic appraisal.

1.6.2 The OM was used for the following purposes:

a. to assess the operational performance of the network to inform the highway/junctions design and to assess the signage strategy; and

b. to provide visual real-time forecasting and assessment.

1.6.3 The junction models were used:

a. to assess the operational performance of junctions in terms of volume to capacity ratios, queue lengths and delay to vehicles.

1.6.4 The Scheme's LAM uses VISUM software which forecasts the assignment of traffic across a network. The software models both link and junction capacity. Where junctions experience traffic demand flows greater than capacity, the model shows queues. At each junction the model shows both 'demand' and 'actual' flows. 'Demand' flows represent all traffic across the modelled network travelling from its origin to its destination within the modelled period. However, queues can and do occur in the modelled period thereby restricting how much traffic can travel to downstream junctions. As a result of queuing, not all the forecast traffic will arrive at each junction. The traffic that does arrive is the 'actual' flow.

1.6.5 For design purposes, 'demand' flows have been used for all junctions except for Mainline link road Barbers Coppice roundabout. Because the ARCADY results for this roundabout with 'demand' flows exceeded 0.85, the results with actual flows

were also tested to confirm that the junction will work within capacity. This was not done for any other junction because all other junctions had forecasts below 0.85.

2 Base Year Model Validation

2.1.1 The LAM was successfully calibrated / validated to meet the Department for Transport's (DfT's) Web-based Transport Analysis Guidance (WebTAG) criteria, as set out in the Scheme's Local Model Validation Report (LMVR), 2017. The base year is 2016.

2.1.2 The OM was also successfully calibrated / validated to meet DfT's WebTAG criteria, as set out via spreadsheet reporting of the flow and journey time validation, again with a 2016 base year.

2.1.3 A summary of the data inputs and outputs between the various model is shown in **Figure 2-1**.

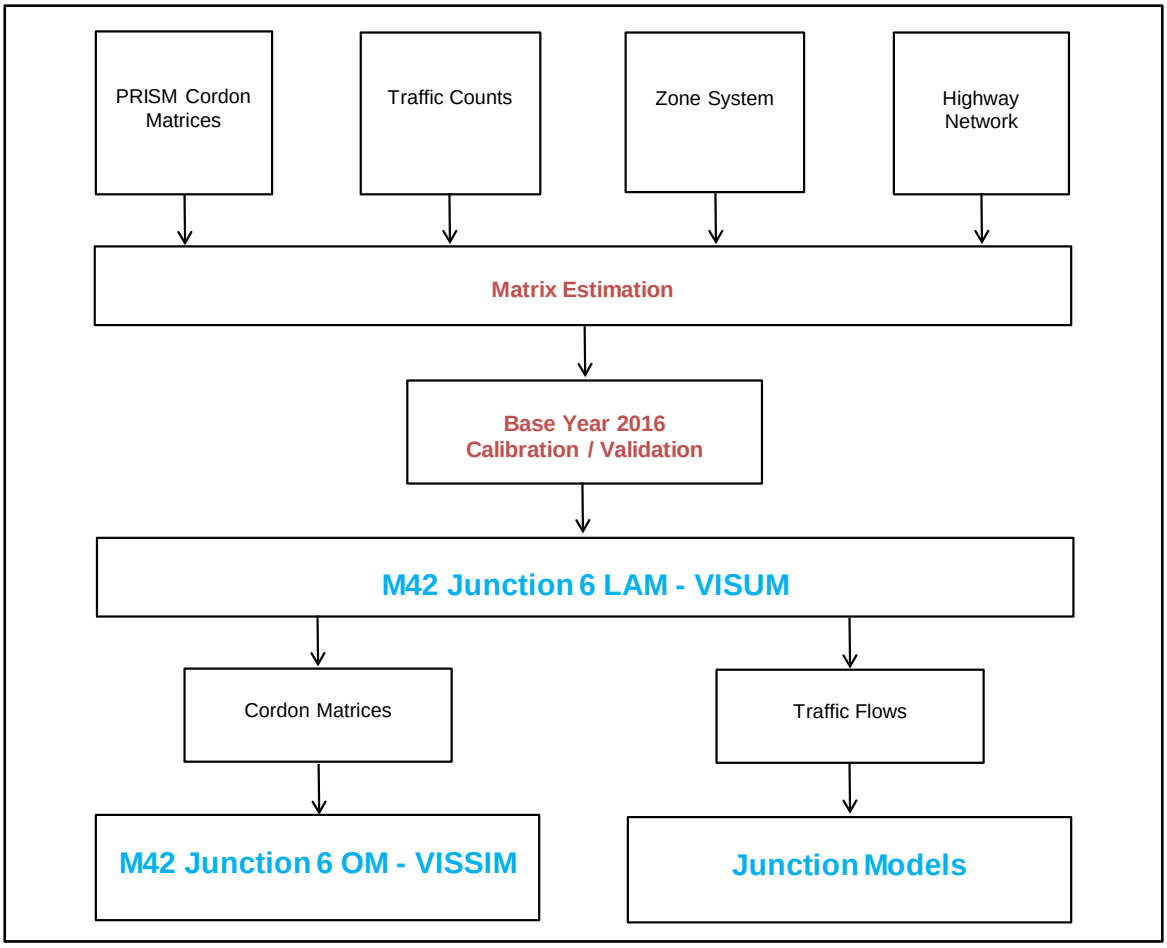

Figure 2-1 - Summary of Base Year Models

3 Future Year Modelling

3.1 Process and hierarchy

3.1.1 The process and hierarchy of models used for future year forecasting is summarised in **Figure 3-1**.

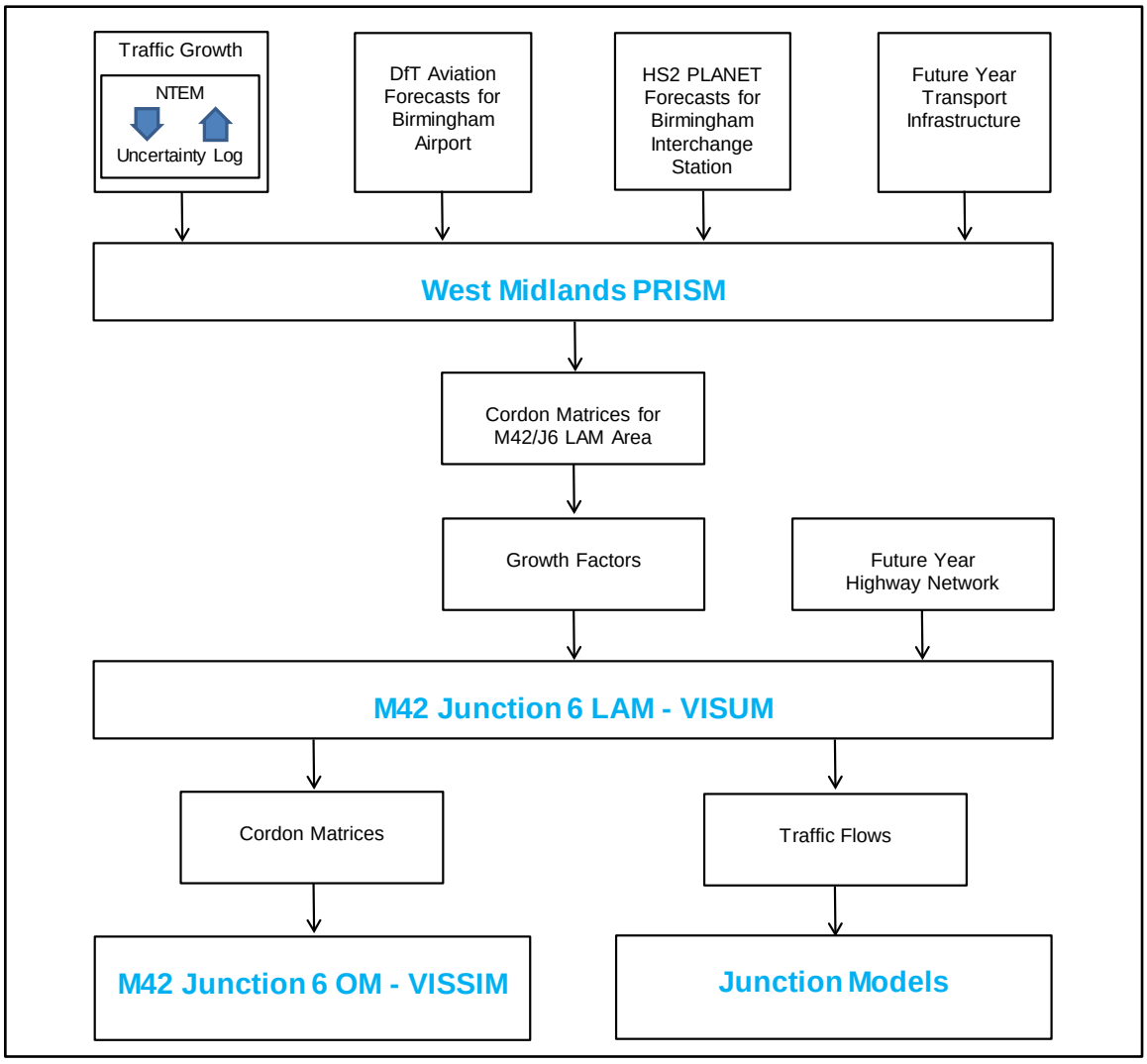

Figure 3-1 - Summary of Future Year Models

3.1.2 The key inputs to the future year forecasts are:

a. general traffic growth;
b. projected increases in air passengers and air freight at Birmingham Airport;
c. projected rail passengers at HS2 Birmingham Interchange station; and
d. future transport infrastructure.

3.2 General Traffic Growth

3.2.1 An 'uncertainty log' for the Scheme was developed. It was based on the one previously produced for the M6 Junctions 2-4 Smart Motorway scheme in 2015 and was updated in February 2017.

3.2.2 The uncertainty log information for land use development and transport infrastructure schemes were provided as input to the PRISM model runs that were commissioned for the M42 Junction 6 study. As is standard practice, the forecasts within PRISM are based on socio-economic data projections, subsequently controlled to the DfT's National Trip End Model (NTEM). The only explicit modelling of individual developments in PRISM is for Birmingham Airport and the planned HS2 Interchange station for which passenger forecasts are generated through separate 'special generator' models.

3.2.3 The approach to forecasting population and employment data was to first make an initial estimate using relevant available local housing policy and other assumptions. This initial estimate was then adjusted so that the district totals match those given in NTEM. The final step was to send the data to each Local Authority and make any adjustments based on their detailed local knowledge.

3.2.4 A method was developed for the 2016 base year to distribute the forecast trips from each PRISM larger zone across the corresponding smaller LAM zones. The method has been described in the Scheme's LMVR.

3.2.5 In order to apply the method of disaggregation for the forecast years, an assessment was undertaken for the spatial distribution of the land uses based on the Scenario 2 development plan in the Solihull Economic Gateway Study report (2013). This scenario represented a central estimate of the potential future density of land use development. The employment land uses were then used to derive an associated job total. This process was undertaken for each modelled time period and future year.

3.2.6 The job totals for each LAM zone within the corresponding PRISM zone were totalled to derive a proportion of the total employment growth for each LAM zone. The resulting proportions were then applied to the employment purpose trip ends from PRISM to distribute the PRISM growth to the corresponding LAM zones. This approach was adopted for each journey purpose trip matrix.

3.2.7 Finally, the total trip end growth by purpose was used to calculate a growth factor for each of the LAM zones that was applied to the base matrices to derive the various sets of forecast matrices.

3.2.8 PRISM does not explicitly model individual development proposals and the LAM is based on growth factors derived from cordons from PRISM. However, the trip ends in those LAM zones that constitute a larger PRISM zone were derived with direct reference to the specific development proposals captured within the uncertainty log for those zones. Accordingly, it is considered that the LAM provides an appropriately proportionate approach to the modelling of developments.

3.2.9 The 'uncertainty log' is shown in the Transport Assessment Report (TAR) [**APP-172/Volume 7.2**]in Section 3.4 and in Appendix A.

3.2.10 The total numbers of jobs and population are controlled to the DfT's NTEM. The future year jobs shown in the uncertainty log are only for major developments and used to adjust the distribution of jobs and population to traffic model zones.

3.2.11 Future traffic growth in the Scheme's LAM has been derived from the PRISM model which in turn is adjusted to traffic growth derived from the DfT's NTEM. The PRISM forecasts are based on NTEM 6.2, which for Solihull has 111,876 jobs in 2016 and 129,942 jobs by 2041, which is an increase of 18,066 jobs, or +16%. The jobs in the uncertainty log (Appendix A of the TAR) have been used to refine the distribution of future year jobs to traffic model zones.

3.3 Birmingham Airport

3.3.1 The approach to the development of forecasts for Birmingham Airport is explained in the TAR in the following terms:

"A separate access model has been developed for Birmingham International Airport. The airport model calculates, for externally given growth figures, where passengers would come from and which mode they would use. The model applies only to passengers and visitors, as the workers at the airport are governed by the standard home-to-work element of the model.

The external forecasts for growth are calculated from DfT UK Aviation Forecasts, January 2013 Constrained Central Forecast, and CAA Passenger Survey Report, 2011. The forecasts are for 12.2 and 17.3 million passengers by 2021 and 2031 respectively. These forecasts are then used to calculate the number of surface access passengers to the airport on an average weekday."

3.3.2 Highways England has checked the assumptions which went into the PRISM run that informed the development of the Scheme's LAM forecasts and the modelling for the 2041 was based on 27.9 million passengers per annum (mppa).

3.3.3 Within the DfT UK Aviation forecasts, January 2013, the constrained central forecast for the airport at 2040 is 28 mppa (Table 5.5). The updated DfT UK Aviation forecasts 2017[1] document shows the constrained central forecast for the airport at 2040 to be 27 mppa (Table 32). From interpolating the forecasts for the years between those reported for 2040 and 2050, the figure of 27 mppa would become 27.4 mppa by 2041.

3.3.4 The traffic modelling for the design year is therefore not under-estimated and instead is slightly higher by around 0.5 mppa. The Applicant notes that the interim years will have some small differences.

3.4 High Speed 2 (HS2)

3.4.1 PRISM uses the PRISM-Location choice Engine for New Stations (PRISM-LENS) module based on the HS2 PLANET Modelling Assumptions. These assumptions cover:

a. highway network changes, including:

[1] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/781281/uk-aviation-forecasts-2017.pdf

i. connectivity to new HS2 stations;
ii. connectivity to new developments; and
iii. other changes related to HS2 or as a result of changes to the public transport network.

b. public transport network changes, including:
i. HS2 services;
ii. connectivity of existing and new services to HS2 stations;
iii. connectivity to existing and new services to new developments; and
iv. other changes related to HS2 or as a result of changes to the highway network

c. demographics:
i. population and jobs for new developments, and whether these are abstracted at a local, regional or national level, or in addition to the growth assumed in NTEM.

3.5 Model Networks

3.5.1 The future year networks were created based on PRISM. The schemes included are listed in the DCO Transport Assessment Report [**APP-174/Volume 7.2**] in **Table 3.1**.

3.5.2 From 2026, the HS2 ‘enabling works’ were also included in the network, to comprise the complete “DM” network.

4 Overview of traffic forecasts

4.1.1 A summary of the forecasting procedure is as follows:

a. LAM forecasting:

i. the PRISM model was run for 2021, 2026, 2031 and 2041 both without the Scheme (the 'DM') and with the Scheme (the 'DS');

ii. the 'DM' and 'DS' PRISM model forecast runs were cordoned for the LAM area to produce trip matrices by time of day and vehicle user class;

iii. the cordoned matrices were divided by the 2016 matrices to define growth factors by LAM zone;

iv. the growth factors were applied to the base year calibrated/validated 2016 LAM matrices to produce future year LAM matrices;

v. future year highway schemes were coded into the 2016 LAM calibrated/validated network to produce future year networks; and

vi. the future year LAM matrices were assigned to the future year LAM networks to produce future year traffic forecasts across the network;

b. OM forecasting:

i. the 2041 future year LAM models were cordoned to produce future year OM matrices;

ii. future year highway schemes were coded into the 2016 OM calibrated/validated network to produce 2041 future year networks; and

iii. the future year OM matrices were assigned to the future year OM networks to produce future year traffic forecasts across the network.