M25 DBFO LUS

Managed Motorways

Stage 3 – Preliminary Design

MM2 Traffic Forecasting Report – Section 5

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M25 DBFO LUS **Managed Motorways - Stage 3 – Preliminary Design**

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1. Introduction

1.1. Introduction to Project

The strategic case for providing additional capacity on the M25 was examined in 2002 by the ORBIT multi-modal study (MMS). The aim of the study was to develop a long-term multi-modal strategy for the sustainable management of the M25 and more generally for the transport corridor around London.

On 9th July 2003, the Secretary of State (SoS) responded to the ORBIT MMS by accepting the recommendation to widen the M25 to four lanes in each direction on a number of sections. In April 2004, following the SoS's decision, the widening of this section entered the Government's Targeted Programme of Improvements (TPI).

The scheme comprised widening of 107km of the remaining three-lane sections of the M25 to four lanes. Following a Stage 1 study (Option Development) of Section 2 (junction 5 to junction 7, a distance of 17km) and Section 5 (junction 23 to junction 27, a distance of 27km) in January 2009 the Department for Transport (DfT) announced[1] that these two sections would be taken forward as Dynamic Hard Shoulder Running (DHSR) schemes in place of widening to four lanes. These two sections are referred to as the M25 Later Upgraded Sections (M25 LUS).

In the Stage 2 M25 LUS study the options of widening and DHSR were assessed, both options providing additional road capacity for these congested M25 sections. It was concluded that DHSR would provide a more economically viable option and the best overall solution. Therefore the schemes assessed in Stage 3 have been focused on DHSR.

DHSR, also referred to as Managed Motorway 1 (MM1) HSR, makes use of the existing hard shoulder to provide the additional lane capacity during times of heavy congestion or during incident management. This is achieved by providing gantry mounted signals and variable message signs from a Controlled Motorway system to provide dynamic control of the use of the hard shoulder as a running lane together with emergency refuge areas (ERAs) for stopped vehicles.

In January 2012 Atkins was commissioned to undertake additional modelling work for Managed Motorway 2 (MM2) HSR schemes for M25 sections 2 and 5. MM2 HSR is the latest development in Managed Motorway systems and involves permanent conversion of the hard shoulder to a running lane under the Controlled Motorway system. The differences between MM1 HSR and MM2 HSR in terms of SATURN modelling aspects are described in Chapter 4.

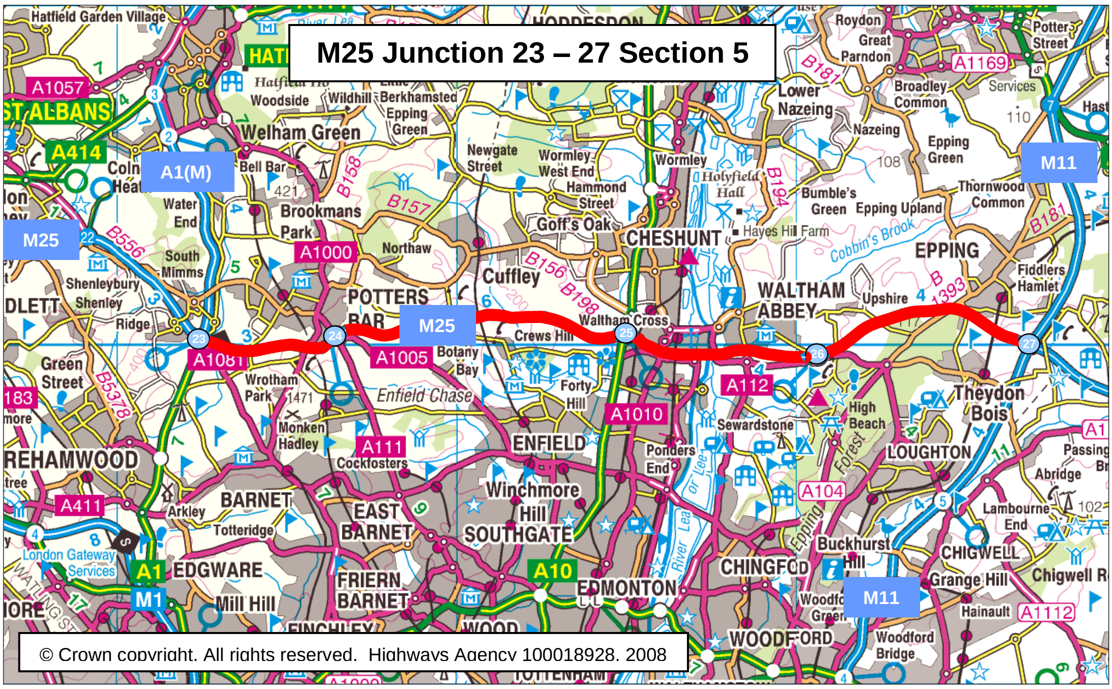
This Traffic Forecasting Report presents the modelling outputs for the MM2 HSR scheme for M25 Section 5 (junction 23 to 27). This section of motorway is currently lit and will remain lit, and runs through Epping Forest which is designated a Special Area of Conservation.

On this motorway section, the existing 3 lanes through J25, and 4 lanes through Holmesdale Tunnel will be maintained. The recently refurbished Bell Common Tunnel will provide 4 lanes, which will be joined to the widened D4M to junction 27. The 500 metre section of the M25 just east of Holmesdale Tunnel is to be permanently widened to become D4M rather than MM2 HSR in both directions. The 500 metre section just west of Bell Common Tunnel will also be widened to D4M. The westbound through link at J27 will be widened from the current 2 lane configuration to become D3M as part of the existing construction for section 4 and due for completion in Summer 2012. The eastbound link will be widened to 3 lane configuration during the Section 5 works under consideration in this report. It should be noted that there is no difference between D4M and MM2 HSR in modelling aspects, both providing identical 4 lane capacity for normal traffic.

Figure 1-1 shows the location where the M25 Section 5 MM2 HSR scheme will be implemented.

[1] *Britain's Transport Infrastructure – Motorways and Major Trunk Roads*

Figure 1-1 M25 LUS Section 5



1.2. Stage 3 Assessments

The forecasting models are developed from the M25 Assignment Model (M25AM), the development of which is described in the Local Model Validation Report[2]. Since the start of the Stage 3 MM1 assessment process in June 2010, a series of forecasting models have been developed. These have reflected combinations of changes due to network modifications or the underlying growth assumptions from NTEM and NTM, together with model versions required for sensitivity testing. The future forecasting demands are produced through the M25 Demand Model (M25DM, formerly called RDM). Changes to WebTAG 3.5.6 Values of Time and Operating Costs adopted to derive economic parameters as inputs for M25DM have also added more complexity to the version control of the forecasting models.

The M25AM model version used as the basis for the forecasting for the M25 LUS Section 5 assessment is referred to as the B602 model. A further version of this model was developed using a set of bespoke speed flow curves for the M25, this model is referred to as the B610 model and was used for sensitivity tests to examine the effects of journey time validation upon the scheme assessments for the M25 LUS sections 2 and 5. The work comparing the B602 and B610 models is summarised in Technical Note 11: Closeout of Stage 2 Caveats[3] with further details in the supporting Technical Notes 01 to 04[4].

Following the Stage 3 MM1 HSR (DHSR) study, the current programme is for the Section 2 MM2 HSR scheme to be constructed before the Section 5 MM2 HSR scheme, with the Section 5 scheme due to open 18 months after the Section 2 scheme. Thus for the appraisal period for Section 5 the network will include the Section 2 MM2 HSR scheme. Consequently both the do-minimum and do-something cases for Section 5 include the Section 2 scheme. It is noted that model results have shown there to be limited interaction between the schemes.

[2] Local Model Validation Report version 3 of 14th October 2011 (document reference 5084755-ALL-DO-TR-164 Rev B)
[3] TN11: Closeout of Stage 2 Caveats
[4] TN01: Journey Time Validation; TN02: Interim Stage 3 Forecast Do-minimum Network Assumptions; TN03: Interim Stage 3 Traffic Forecasts; and TN04 Interim Stage 3 Economic Assessment

Three forecast models have been prepared for each combination of model time period and year:

- **DHS2** – This model is the do-minimum situation (described in section 4 of this report) with the addition of the MM2 HSR scheme on M25 Section 2;
- **DHS5** - This model is the do-minimum situation (described in section 4 of this report) with the addition of the MM2 HSR scheme on M25 Section 5; and
- **DHS25** - This model is the do-minimum situation (described in section 4 of this report) with the addition of the MM2 HSR schemes on M25 Sections 2 and 5.

The scheme assessments for Section 5 use DHS25 as the do-something case and DHS2 as the do-minimum case. DHS5 is used as the do-minimum case for the Section 2 scheme.

Forecast models for the Section 5 MM2 HSR scheme assessment have been developed for three time periods, AM, inter-peak (IP) and PM peak, and three forecast years, 2015, 2030 and 2040.

Table 1-1 shows all the models developed for the Section 5 MM2 HSR study, including those used for interim forecasting and production of sensitivity tests. In total there are 14 model series, with a brief summary given as follows:

- **Models a and b**

  These are the first set of forecasting models produced in September 2010. Models a and b are based on the B602 and B610 base year models respectively. There were no major network changes apart from some coding corrections for M25 Section 5. The growth factors for car and PT (bus + rail) are based on the NTEM 5.4 dataset and those for good vehicles (LGV and HGV) are derived from NTM (AF08), the same assumptions as for the Stage 2 assessments. The models cover DHS2, DHS5, DHS25 for 3 modelled time periods (AM, IP, PM) in year 2015, 2030 and 2040;

- **Model c**

  This model was only developed for the DHS25 scenario in order to examine the potential effects of a Continuous All Lane Running (CALR) scheme on M25 Section 2. The networks are identical to model a for the AM and PM Peak periods (thus assuming that CALR operates during these periods in an identical manner to the DHSR scheme). For the IP network, it is assumed that the CALR scheme operates with a free flow speed of 70 MPH in place of the 60 MPH speed assumed for DHSR;

- **Model d**

  The model d series provided interim forecasts taking account of a number of internal and external changes. This series uses version 6 highway networks which include a number of coding corrections identified from an audit of the version 4 networks, plus revised reference case highway scheme assumptions following the Government's Comprehensive Spending Review (CSR) in October 2010. For car demands, the growth from the NTEM 5.4 dataset was still used but the commuting trips were adjusted in year 2015 to take account of observed growth levels between 2004 and 2010. The LGV and HGV growths have been applied with the latest NTM (AF09) forecast. The economic parameters for M25DM, including VOC, fuel consumption and efficiency etc., were derived from the WebTAG 3.5.6 released in March 2010 (a draft version). The fuel price has been adjusted from 2009 to 2010 and therefore affected the forecasting years after 2010. It should be noted that the underlying formula in calculating fuel assumption remained unchanged to avoid recalibrating the M25DM;

- **Model e**

  The model e forecasts provide a high growth sensitivity test based on the based on model d. The unconstrained reference demands for car demands have been applied with an uncertainty factor for high growth calculated as 2.5%*SQRT(forecasting year-base year). For simplicity, the same process has been used to derive uncertainty factors for LGV and HGV growth from NTM (AF09);

- **Model f**

  The model f forecasts provide a low growth sensitivity test based on the based on Model d. Similar to model e, but the uncertainty factors for low growth of -2.5%*SQRT(forecasting year-base year) are assumed;

- **Model g**

  This model series was used to examine the effects of high growth when combined with the bespoke speed flow curve sensitivity test. Similar to model e, but the forecasting models were based on the B610 base year version. Forecast models for model g have only been developed for the 2015 forecast year;

- **Model h**

  The model h forecasts provide the datasets used for the Stage 3 assessment of the M25 Section 2 DHSR scheme. Based on the B602 base year model version, model h has been developed using the NTEM 6.2 dataset (July 2011 definitive version) for car and PT demands. The economic parameters for M25DM have been derived from WebTAG 3.5.6 released in April 2011 (definitive version). The underlying formula in calculating fuel consumption in the M25DM has been changed which is consistent with latest WebTAG guidance. Therefore the M25DM has been recalibrated accordingly. The growth for good vehicles (LGV and HGV) is derived from NTM (AF09). The fuel price and commuting demand adjustments as used in model d have no longer been applied. Note that the model h has been applied with a highway network version 7 which has revisions to the DHSR scheme for M25 section 2 clockwise from J6 to J7;

- **Model i**

  The model i forecasts retain all the assumptions as adopted for Model h except for the network version (v10), which includes Do Minimum (DM) network changes after the Autumn Statement in November 2011 and MM2 scheme coding in the future year scenarios;

- **Model j**

  The model j forecasts provide a high growth sensitivity test based on Model i. The uncertainty factors for high growth of +2.5%*SQRT(forecasting year-base year) are assumed; and

- **Model k**

  The model k forecasts provide a low growth sensitivity test based on Model i. The uncertainty factors for low growth of -2.5%*SQRT(forecasting year-base year) are assumed.

- **Model l**

  The model l forecasts retain all the assumptions as adopted for Model i except for LGV and HGV growth, which is applied using the Road Traffic Forecast 2011 published on 24th January 2012. The network version (v10) includes Do Minimum (DM) network changes after the Autumn Statement in November 2011 and MM2 scheme coding in the future year scenarios;

- **Model m**

  The model m forecasts provide a high growth sensitivity test based on Model l. The uncertainty factors for high growth of +2.5%*SQRT(forecasting year-base year) are assumed; and

- **Model n**

  The model n forecasts provide a low growth sensitivity test based on Model l. The uncertainty factors for low growth of -2.5%*SQRT(forecasting year-base year) are assumed.

This traffic forecasting report presents the outputs from Model l, which are those used for air quality and economic assessment of the M25 LUS Section 5 MM2 scheme. Models m and n have been developed as sensitivity tests for the economic (TUBA) and air quality analyses, the results of which are presented in the economic and air quality reports.

Table 1-1 Stage 3 Forecasting Model Versions

Model Series	Highway Network version	Base Model Version	Scenarios	Time Periods	Forecasting Year	Car Growth	LGV, HGV Growth	Version of WebTAG 3.5.6	Finished Date
a	v1-v4	B602	DHS2, DHS5, DHS25	AM, IP, PM	2015, 2030, 2040	NTEM 5.4 Central	NTM (RTF08)	Apr-2009	Sep-2010
b	v1-v4	B610	DHS2, DHS5, DHS25	AM, IP, PM	2015, 2030, 2040	NTEM 5.4 Central	NTM (RTF08)	Apr-2009	Sep-2010
c	v1-v4, Inter Peak CALR	B602	DHS25	AM, IP, PM	2015, 2030, 2040	NTEM 5.4 Central	NTM (RTF08)	Apr-2009	Oct-2010
d	v6	B602	DHS2, DHS5, DHS25	AM, IP, PM	2015, 2030, 2040	NTEM 5.4 Central with Commuting trips Adjustments in 2015	NTM (RTF09)	March 2010, with fuel price adjustment from 2009 to 2010, no change to fuel consumption formula	Feb-2011
e	v6	B602	DHS2, DHS5, DHS25	AM, IP, PM	2015, 2030, 2040	NTEM 5.4 High with Commuting Trips Adjustments in 2015	NTM (RTF09) High[5]	same as model d	Jun-2011
f	v6	B602	DHS2, DHS5, DHS25	AM, IP, PM	2015, 2030, 2040	NTEM 5.4 Low with Commuting Trips Adjustments in 2015	NTM (RTF09) Low[6]	same as model d	Jun-2011
g	v6	B610	DHS2, DHS25	AM, IP, PM	2015	Same as model d	NTM (RTF09)	same as model d	Jun-2011
h	v7	B602	DHS2, DHS5, DHS25	AM, IP, PM	2015, 2030, 2040	NTEM 6.2 Central	NTM (RTF09)	Apr-2011	Aug-2011

[5] For simplicity, the high growths for LGV and HGV have been applied with a factor of +2.5%*SQRT(forecasting year-base year);
[6] For simplicity, the Low growths for LGV and HGV have been applied with a factor of -2.5%*SQRT(forecasting year-base year);

i	v10	B602	DHS5, DHS25	AM, IP, PM	2015, 2030, 2040	NTEM 6.2 Central	NTM (RTF09)	Apr-2011	Mar-2012
j	v10	B602	DHS5, DHS25	AM, IP, PM	2015, 2030, 2040	NTEM 6.2 High	NTM (RTF09) High	Apr-2011	Mar-2012
k	v10	B602	DHS5, DHS25	AM, IP, PM	2015, 2030, 2040	NTEM 6.2 Low	NTM (RTF09) Low	Apr-2011	Mar-2012
l	v10	B602	DHS2, DHS25	AM, IP, PM	2015, 2030, 2040	NTEM 6.2 Central	NTM (RTF11)	Apr-2011	Mar-2012
m	v10	B602	DHS2, DHS25	AM, IP, PM	2015, 2030, 2040	NTEM 6.2 High	NTM (RTF11) High	Apr-2011	Mar-2012
n	v10	B602	DHS2, DHS25	AM, IP, PM	2015, 2030, 2040	NTEM 6.2 Low	NTM (RTF11) Low	Apr-2011	Mar-2012

1.3. Purpose of Product

The purpose of this report is to present the traffic forecasts for the proposed MM2 HSR scheme for M25 Section 5 and demonstrate that these forecasts have been produced in accordance with WebTAG and DMRB guidance.

1.4. Structure of the Report

The aim of this report is to explain the process of developing the traffic forecasts and to provide a presentation of the results. The structure of the report is given below:

- Section 2 presents the overall objectives for the MM2 HSR scheme;
- Section 3 explains the approach to forecasting;
- Section 4 describes the network development;
- Section 5 deals with the matrix development and explains the methodology to forecast future traffic growth;
- Section 6 summarises the treatment of variable demand;
- Section 7 describe the forecast assignment process;
- Section 8 presents the traffic forecasts;
- Section 9 describes the forecasts prepared for the environmental appraisal; and,
- Section 10 contains summary conclusions.

2. Scheme Objectives

2.1. Scheme Details

The details of the MM2 HSR schemes on M25 Sections 2 and 5 are provided in Appendix A.

2.2. Overall Scheme Objectives

The overall objectives of the scheme are:

- to develop solutions that provide additional capacity, thereby relieving congestion and ensuring the safe and economic operation of the motorway;
- to make best use of existing infrastructure where possible, providing additional capacity within the existing highway boundary and, where possible, within the existing paved area;
- to take account of the requirements for ongoing maintenance, meet the needs of Highways Agency Network Operations and minimise whole life costs; and,
- to provide high value for money against whole of life costs in accordance with the Department's WebTAG guidance. An adjustment to benefit to cost ratio is effected as appropriate to reflect the non-monetised effects arising from wider impacts of the scheme.

2.3. Detailed Scheme Objectives

The detailed Transport and Safety objectives of the scheme include:

- No increase in accident numbers or severity;
- Minimising detrimental effects on traffic on the surrounding road network where possible;
- Improving journey time reliability;
- Minimising the extent of queuing of traffic onto the mainline of the motorway due to congestion at junctions; and
- Improving the currency and quality of information provided to drivers about the state of traffic flow on the motorway.

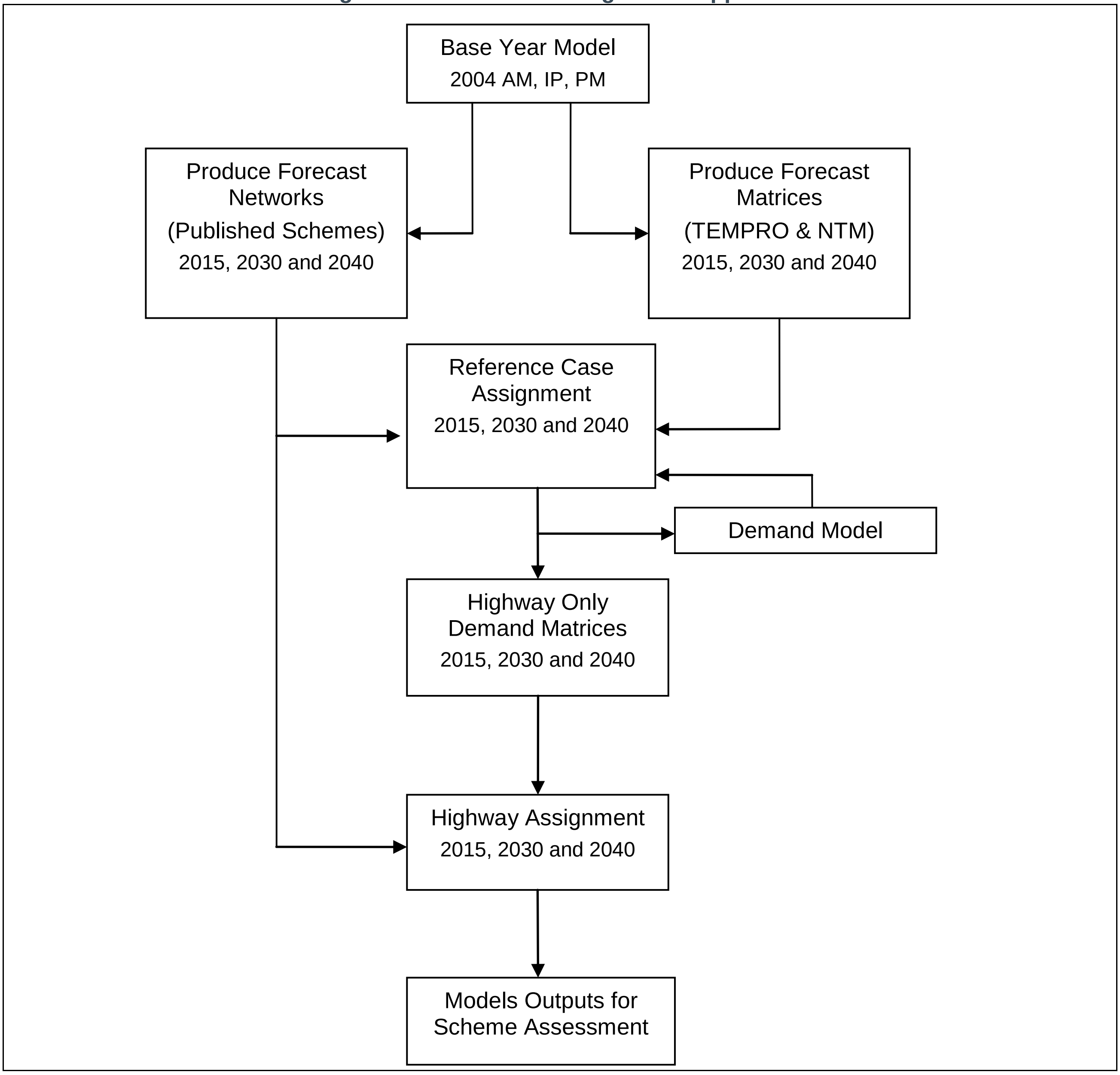
Further detailed objectives of the scheme relate to the Government's objectives for Environment, Economy, Accessibility and Integration criteria.

3. Forecasting Approach

3.1. An Overview of Forecasting Approach

As described in Chapter 1, the forecasting approach adopted for this study utilises a base year model (M25 Assignment Model B602), a bespoke variable demand model (M25 Demand Model), and forecast models. Forecast models incorporate proposed highway network schemes and forecast demand based on TEMPRO and National Transport Model (NTM) growth assumptions. A summary of the forecasting approach is shown in Figure 3-1.

Figure 3-1 M25 Forecasting Model Approach



3.2. Robustness of Base Model

The base model has been developed from the Stage 2 M25 Assignment Model (M25AM, B330 version). The development of the calibrated and validated Stage 3 base year M25AM version B602 is described in detail in the Local Model Validation Report.

The B602 M25AM was developed using SATURN suite of program which is capable of modelling junction delays and link capacity restraints based on speed/flow relationships. The B602 M25AM network consists of both simulation and buffer network. The simulation network has been coded to model delays at junctions and the majority of the buffer network has been coded with speed/flow curves.

The area covered by the SATURN simulation network includes the entire area within the M25 and an area bounded approximately by Luton, Reading, Guildford, Crawley, Maidstone, Chelmsford and Stansted. Inside the simulation area, all motorways, A and B roads, as well as important unclassified roads, have been included in the modelled network. Junctions have been coded in detail to model junction delays, queues and interactions between junctions to ensure accurate determination of route choices.

In the buffer area, outside the simulation area, the road network in the M25AM has been generally limited to motorways, A roads and primary B roads. Buffer network links are coded with fixed speeds to reflect the fact that only a partial representation of trips is loaded on to the network. The methodology for dealing with issues with future year model convergence in the buffer area is detailed in section 9 of the Local Model Validation Report.

The model convergence statistics for the B602 M25AM show the morning, average inter-peak and the evening peak hour models are stable with post simulation GAP less than 0.05%. All three models are much better than the DMRB convergence criteria and the delta values are: 0.0337, 0.0407, 0.0355 for the morning, average inter-peak and evening peak hour models respectively. The model's tighter convergence statistics indicate the model's robustness to provide the basis for preparing economic analysis.

The model calibration results of all 3391 count sites across the modelled area show the match between observed and modelled flows is good. The percentage of links meeting the DMRB validation criteria in each of the modelled time periods is as follows:

- AM peak 84%;
- Inter-peak 88%; and
- PM peak 84%.

Using the GEH criteria, the percentage of sites with less than 5.0 is 79% in the AM peak hour, 84% in the IP hour, and 80% in the PM peak hour. The number of calibration count sites in the vicinity of Section 5 that meet the GEH criteria is; 92%, 88% and 88% in the AM, IP and PM peaks respectively. The overall model results and the results for the Section 5 indicate that the M25AM provides a reliable platform on which to produce forecasts for the proposed Section 5 scheme.

3.3. Forecast Years

Forecasts have been prepared for the following years, for the purposes of the environmental and economic appraisals.

- 2015 MM2 HSR scheme opening year;
- 2030 design year; and
- 2040 horizon year.

3.4. Time Periods

To be consistent with the base year model, forecast models have been produced for an average October weekday for:

- morning peak hour, 0800-0900 hours;
- inter peak hour, an average hour of 1000-1600 hours; and
- evening peak hour, 1700-1800 hours.

3.5. Forecast Scenarios for M25 Section 5 Forecasting

The following forecast network cases for M25 Section 5 have been prepared:

- A do-minimum case representing network assumptions in the without-scheme case; the network is referred as DHS2 during the stage 3 modelling which is assumed as a true do-minimum case[7] plus MM2 HSR implemented on Section 2 (between M25 J5 and J7);
- A do something case represents the core scenario network, which is referred as DHS25 comprising a true reference case, MM2 HSR on Section 2 (between M25 J5 and J7) and MM2 HSR on section 5 (between M25 J23 and J27).

As described in Chapter 1, this traffic forecasting report only presents results for Model series l, which assumes central growth from NTEM 6.2 for cars and NTM (RTF11) for good vehicles. Results from high and low growth scenarios (Model series m and n, respectively) are documented in the Air Quality and Economic Appraisal Reports.

[7] The true reference case scenario has also been used for the M25 Demand Model (M25DM) as a pivot base for producing post demand matrices for DHS2, DHS5 and DHS25 scenarios.

4. Forecast Network Development

4.1. Introduction

For the purpose of ascertaining changes in traffic forecasts due to the proposed scheme, future year networks have been developed with and without the proposed improvements for the opening year 2015, 2030 design year and 2040 horizon year. The networks without the proposed scheme are referred to as the Do Minimum network. The Do Minimum network for each of the forecast year includes schemes that are in the DfT/HA National Road's programme as described in Britain's Transport Infrastructure; Motorways and Major Trunk Roads (dated January 2009), taking account of changes arising from the Comprehensive Spending Review in October 2010, and schemes already implemented or being constructed currently. For example, construction of the M25 widening from 3 lanes to 4 lanes between junctions 16 to 23 and 27 to 30 commenced earlier 2009 therefore these schemes are included in the Do Minimum network.

The development of the forecasting highway networks for M25 LUS MM2 HSR assessment is detailed in Atkins' technical note[8]. The Stage 2 study (Further Appraisal) for Section 5 was undertaken by Hyder Halcrow Joint Venture (HHJV) using a version of the M25AM model numbered B110, referred to as the North of Thames Model (NOTM). The Stage 2 Forecast for Section 2 was undertaken using a version of the M25AM model numbered B330. HHJV transferred version M25AM B602 models (comprising base year 2004 and forecast years 2015, 2030 and 2040) to Atkins in the summer of 2010. These models are referred to as v1 models by Atkins and comprise:

- Base Year model – Base;
- Do-minimum model – DM;
- Do-Something model including Section 2 only (DM + MM2 HSR in Section 2) – DHS2;
- Do-Something model including Section 5 only (DM + MM2 HSR in Section 5) – DHS5; and
- Do-Something model including Section 2 and Section 5 (DM + MM2 HSR in Section 2 and Section 5) – DHS25

4.2. True Do Minimum Networks

The schemes that have been included in the v1 DM models for each of the model years 2015, 2030 and 2040 are shown in Table 4-1. After reviewing the v1 models Atkins made a number of changes (mainly network coding improvements) to create subsequent versions referred to as v2, v3 and v4. Atkins used v4 models of the DHS2 scenario and v1 models of the other scenarios to produce interim Stage 2/3 forecasts[9] in September 2010. During the production of the interim forecasts, Atkins identified a number of network improvements required for all of the DM, DHS2, DHS5 and DHS25 models and created v5 networks in September 2010. It should be noted that all schemes in the v1 DM models have been carried forward to the v5 DM networks.

In October 2010 the Government published its revised investment plans for national[10] and local[11] transport schemes following the Comprehensive Spending Review (CSR). These revised plans have significantly changed the assumptions to be made for the Do-Minimum schemes. In addition, a thorough investigation by Atkins has found several local authority schemes that should have been included as Do-Minimum schemes but were missed in all previous modelling exercises for M25 LUS. A v6 of the model network has been subsequently created and further enhanced to v7 network[12], as used for the Stage 3 MM1 study. The major scheme changes for the v6 networks following the CSR 2010 announcement are shown in Table 4-2 in comparison with the pre CSR 2010 v5 networks.

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[8] See *Technical Note 09: Stage 3 Network Development*, 9 February 2012.
[9] *TN03 Interim Stage 3 Traffic Forecasts v2* – Atkins. Sep 2010.
[10] *Investment in Highways Transport Scheme*. Department for Transport, October 2010. (Web: http://www.dft.gov.uk/press/speechesstatements/statements/hammond20101026)
[11] *Investment in Local Major Transport Schemes*. Department for Transport, October 2010.
[12] *The v7 network has some revision to the coding for DHSR on M25 Section 2, which only affects the DHS2 and DHS25 scenarios. The v7 and v6 networks are identical for the True Do Minimum and DHS5 scenarios.*

The 2011 Autumn Statement, made by the Chancellor of the Exchequer on Tuesday 29 November, listed a number of major infrastructure investments in road and public transport. After reviewing the list, it is considered that the following schemes (as shown in Table 4-3) could have direct impacts on the M25 LUS MM2 scheme assessments for Section 2 and Section 5. These therefore require DM network changes from the previous v6 networks. Meanwhile, after the 2011 Autumn Statement, DfT announced a further 25 local major transport schemes across the country on 14th December 2011, including public transport, roads and mixed package schemes. However, after reviewing these schemes, none will be included since their impacts are likely to be insignificant on the M25 MM2 scheme assessments for both Section 2 and 5. An updated v10[13] DM network has been produced to take account of the autumn 2011 schemes. Full details of the revised Do-Minimum scheme assumptions are documented in Atkins Technical Note[14].

Table 4-1 List of schemes included in the Stage 2 (v1) Do Minimum (DM) Models

Years	Scenario	Network Details
2015	DM	• Existing 2004 network • Peripheral highway improvements 2004 to 2015: • Widening M25 Section 3 Widening J1b-3 plus A2/A282 link (inc A2 widening to Bean) • Widening of M25 Section 1 - J16 to 23 • Widening of M25 Section 4 - J27 to 30/31 • Widening of M25 J12 to 15 - part of Heathrow T5 improvements • M25 Junction 28 Brook Street Improvements • Widening of M1 Junction 6a to 10 • Widening of M1 Junction 10 to 13 HSR • M2 Junction 2 Reconfiguration • M27 J3-J4 Widening • M40 / A404 Handy Cross Improvements • M42 J3a to J7 Active Traffic Management • A10 Cambridge Road • A11 Attleborough Bypass Dualling • A120 Braintree to Marks Tey • A249 Iwade to Queenborough • A3 Hindhead • A47 Thorney By-Pass • A419 Blunsdon Bypass • A421 Bedford to M1 Junction 13 Improvement Scheme • A421 Great Barford Bypass (Bedford Southern Bypass) • A428 Caxton Common to Hardwick Improvement • A428 to Caxton Dualling • A4010 Chapel Lane Junction Improvement • A4146 Stoke Hammond and Linslade Western Bypass • A5 - M1 Dunstable Northern Bypassg • A503 Finsbury Park Improvements • A505 Baldock Bypass • A505 / A1081 Luton East Corridor Dualling • A6 Elstow to Wilstead Dualling • Bedford Western Bypass • Hunton Bridge Roundabout Traffic Management • Ridgmont Bypass • S071 Lower Earley Way • S020 & S055 A2 Bean to Cobham • M25 J30 Improvements in Essex • Blackwall River Crossing

[13] *v8 and v9 network versions have been used for sensitivity test during the stage 3 MM2 study therefore a v10 network version is created to maintain model identity.*
[14] *TN08 Forecast DM Network Assumptions v7.pdf.* Atkins. February 2011.

Years	Scenario	Network Details
		• A11 Fiveways to Thetford Dualling • A14 Ellington to Fen Ditton • A21 Lamberhurst Kippings Cross Bypass • A21 Tonbridge to Pembury dualling • M25 ramp metering[15]
2030	DM	• Widening of M4 Junction 3 to 12 HSR • Widening of M3 Junction 2 to 4a HSR • West Thurrock Regeneration • A12 Widening (M25 to Chelmsford) • A23 Handcross to Warninglid • A24 Horsham to Capel Improvements • A228 Main Road to Ropers Lane • Third Thames Bridge at Reading • Thames Gateway (Gallions Reach) River Crossing • M20 J3 to J5 (Maidstone) • M23 J8 to J10 (Gatwick)
2040	DM	• Same as 2030 DM networks

Table 4-2 Do Minimum Scheme Changes between v5 and v7 models

ID	Scheme	2015	2030	2040
1	M4 Junction 3 to 12 Hard Shoulder Running	Excluded	Retained	Retained
2	M3 Junction 2 to 4a Hard Shoulder Running	Excluded	Retained	Retained
3	A414 Hastingwood R/A	Included	Included	Included
4	A14 Ellington to Fen Ditton	Excluded	Retained[16]	Retained
5	A21 Kippings Cross to Lamberhurst Improvements	Excluded	Excluded	Excluded
6	A21 Tonbridge to Pembury dualling	Excluded	Retained	Retained
7	A5 - M1 Dunstable Northern Bypass	Excluded	Excluded	Excluded
8	M25 J30 Improvements	Excluded	Retained	Retained
9	A23 Handcross to Warninglid	Included	Included	Included
10	M40 J1a/M25 J16 Junction Improvement	Included	Included	Included
11	M25 J12 and M3 New Road Layout	Included	Included	Included
12	M4 J4 Improvement	Included	Included	Included
13	M4 Bus Lane	Excluded	Excluded	Excluded
14	A130/A13 Sadlers Farm Grade-separation	Included	Included	Included
15	A244 Walton Bridge	Included	Included	Included
16	A14 Kettering Bypass	N/A	Included	Included
17	Dartford Crossing Free Flow with Toll Increment	Included	Included	Included

Note:

Included: New scheme which was not coded in V5 models, but is coded in v6 models;

Excluded: Scheme which was coded in v5 models but is taken out in v6 models;

Retained: Scheme which was coded in v5 models and is retained in v6 models.

[15] Although ramp metering has been introduced on some entry slip roads on the M25 as a measure to smooth flows at merge, these have not been included in forecast schemes as the operation of it cannot be modelled in SATURN.
[16] A14 E to FD: Only online improvement is retained for 2030 and 2040.

Table 4-3 Do Minimum Scheme Changes between v6 (v7) and v10 models

Scheme ID	Project listed in 2011 Autumn Statement	Scheme description	Current status in Stage 3 MM1 forecasting	Proposed status in Stage 3 MM2 forecasting
1	Managed motorway schemes on the M3 (J2-4a)	HSR running	excluded in 2015 included in 2030 & 2040	included assume open in 2015
2	A14 Kettering Bypass J7-9 widening	Widening of dual carriageway to three lanes in each direction between Junctions 7-9	excluded in 2015, included in 2030 & 2040	included assume open in 2015
3	A14 improvements between Huntingdon and Cambridge	Online improvement (not full E-FD scheme)	excluded in 2015, included in 2030 & 2040	excluded in 2015, included in 2030 & 2040
4	Additional Thames river crossings, for example at Silvertown	Government work with TfL	excluded	excluded
5	Lower Thames Crossing	Three possible locations identified, public consultation in 2013	excluded	excluded
6	M1 Junction 10a Improvement	Scheme approved as shown in Autumn Statement Figure 1.1. Work could begin in early 2013 and complete during 2014	excluded	included assume open in 2015

The location of the Do Minimum core scenario schemes are shown in Figure 4-1 and Figure 4-2 for forecasting years 2015 and 2030 respectively.

Figure 4-1 2015 Do Minimum Network Schemes

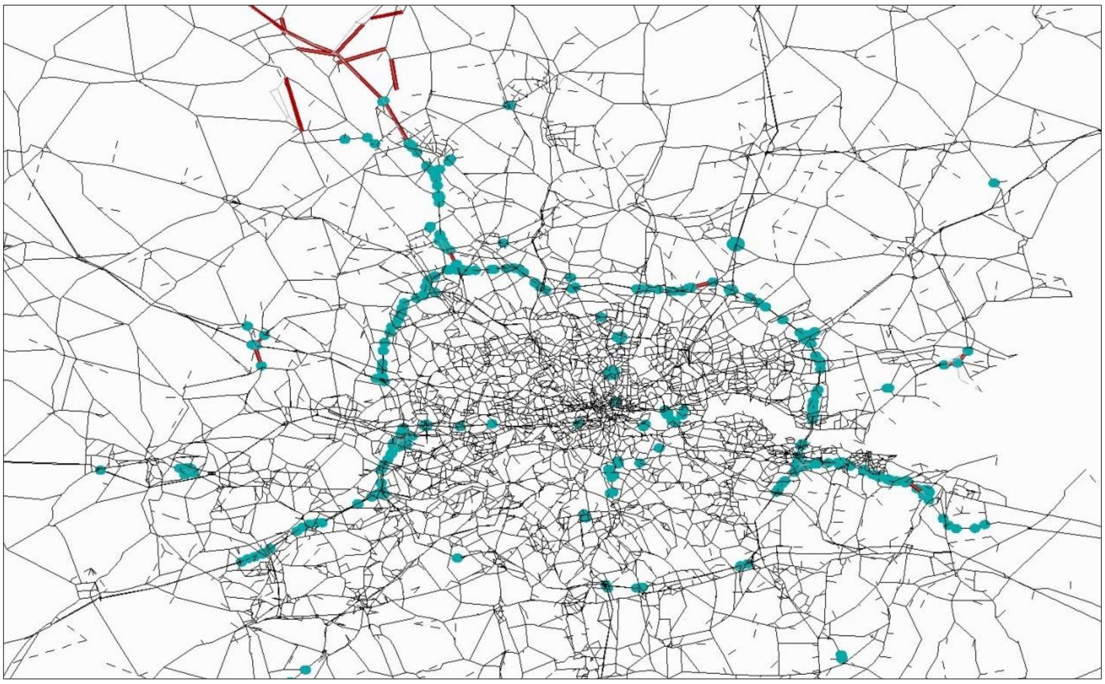


Figure 4-2 2030 Do Minimum Network Schemes

4.3. Do Something Networks – Section 2 only (DHS2)

The figure A-1 in Appendix A depicts the proposed MM2 HSR design between J5 and J7. The location of the changes made to create the DHS2 Do Something SATURN networks is shown in Figure 4-3.

The existing carriageway between J5 and J7 is 17 km in length. Between Junctions 5 and 6 it is a 3 lane motorway (D3M) in both directions. Between Junctions 6 and 7 it is four lanes in the anticlockwise direction and four lanes for part of the clockwise carriageway between Junction 6 and 7. Only the section that is not already four lanes will be subject to HSR operation.

The MM2 HSR scheme is expected to operate as a normal 4 lane motorway with a maximum speed limit of 70mph in accordance with a COBA style D4M speed flow curve, as shown in Table 4-4 below. This contrasts to the Stage 3 MM1 DHSR scheme which assumed a maximum speed of 60mph during hard shoulder operation.

The existing layout for the M25 Clockwise from J6 to J7 has a short section (approximately 1 km long) of 3 lanes. The on-slip clockwise from Junction J6 is a wide 1 lane taper style merge. Under the MM2 operation, the on-slip will be altered to become 1 lane gain (nearside lane) plus 1 lane ghost island (offside lane) merge. MM2 HSR will not be implemented as through junction running for the clockwise direction at M25 Junction 6. Therefore the link section through Junction 6 has been maintained as D3M.

Figure 4-3 Do Something Network Changes (DHS2)

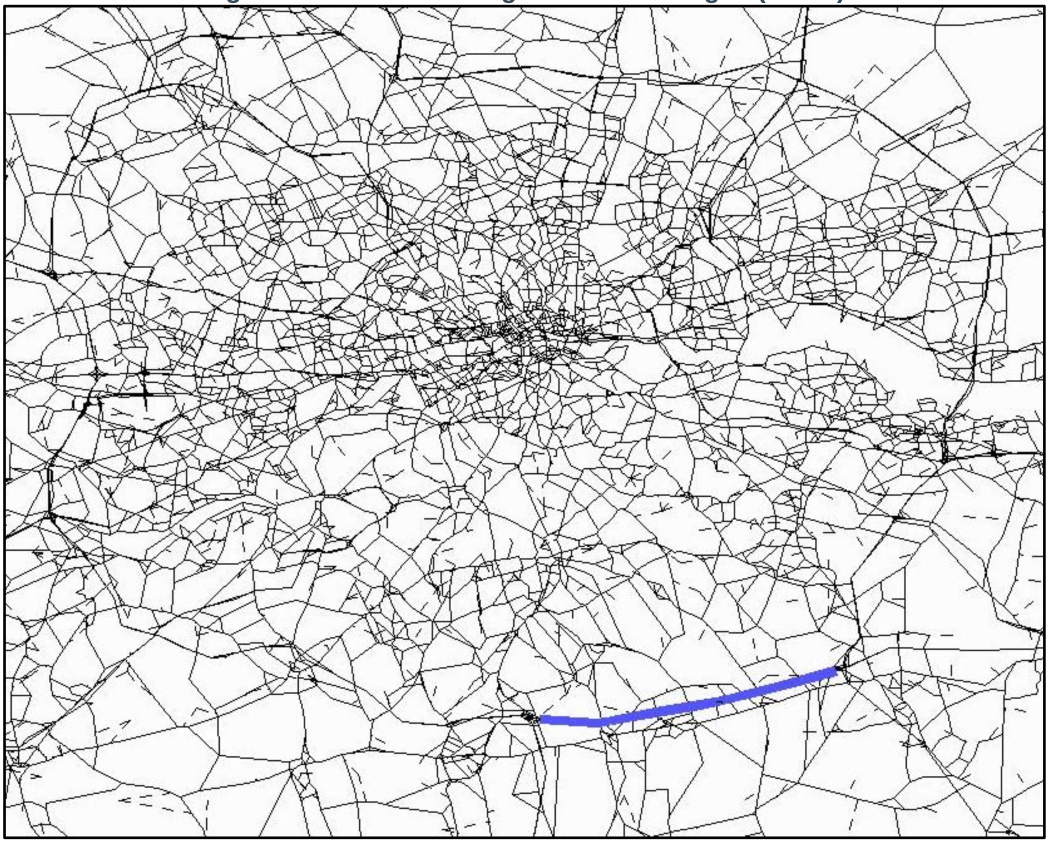


Table 4-4 Speed Flow Curve Relationship for MM2 HSR

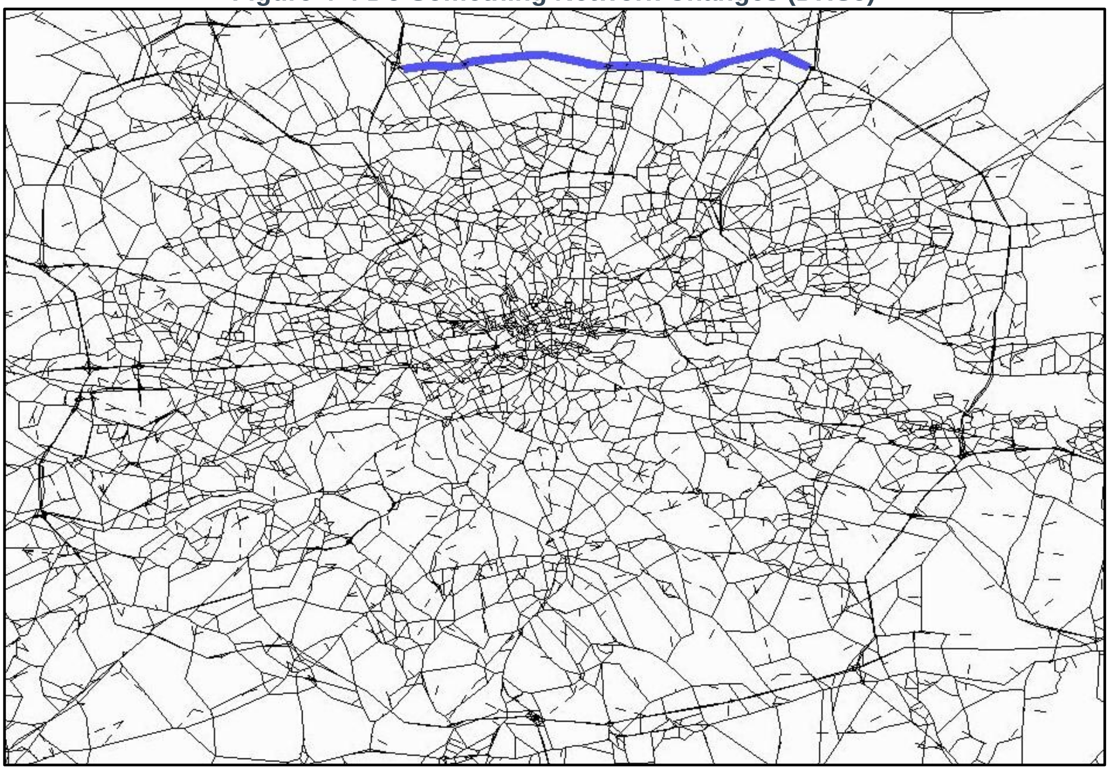
Motorway Sections	Free Flow Speed (KPH)	Speed at Capacity (KPH)	Capacity (PCUs)	Power
D3M	113	73	6990	2.6
D4M	113	73	9320	2.3

4.4. Do Something Networks – Section 5 only (DHS5)

The Do Something Networks including Section 5 (DHS5) were developed by coding the MM2 HSR on M25 Section 5 between Junction 23 to J27. The scheme drawing is shown in Figure A-2 in Appendix A. The location of the changes made to create the DHS5 Do Something SATURN network is shown in Figure 4-4.

It is noted the MM2 HSR is not implemented as through junction running at M25 Junction 25 in both clockwise and anti-clockwise directions. The 500 metre section of the M25 just east of Holmesdale Tunnel is to be permanently widened to become D4M rather than MM2 HSR in both directions. The 500 metre section just west of Bell Common Tunnel between J26 and J27 will also be widened to D4M. The M25 on the east side of the Tunnel will also be widened to become D4M to J27. The D4M sections will be subject to Variable Mandatory Speed Limits as applied to the adjacent MM2 HSR links. The through links at J27 will be widened from the current 2 lane configuration to become D3M for both directions.

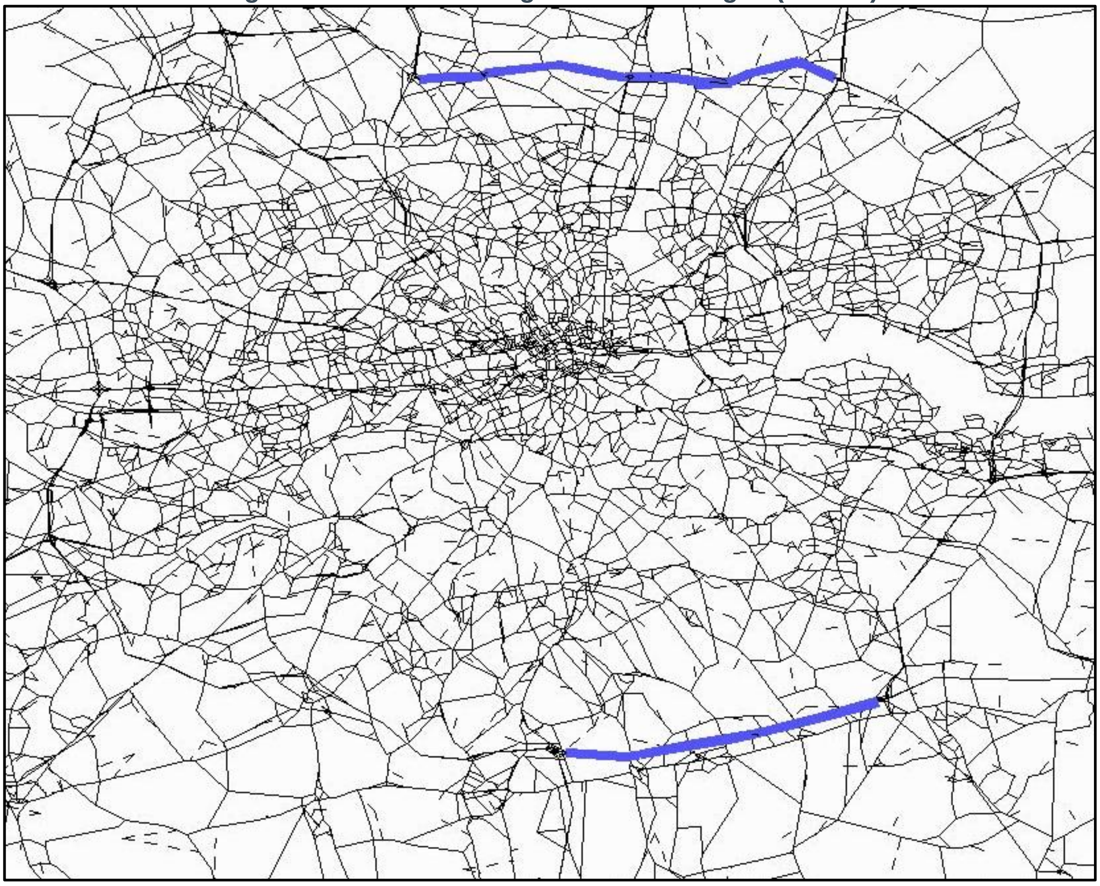
Figure 4-4 Do Something Network Changes (DHS5)



4.5. Do Something Networks (DHS25)

The Do Something Network DHS25 including the MM2 HSR schemes on both Sections 2 and Sections 5 comprises the combination of the changes described above for the DHS2 and DHS5 networks, as shown in Figure 4-5.

Figure 4-5 Do Something Network Changes (DHS25)



5. Matrix Development

5.1. Overview of Matrix Development Process

The forecast matrices were developed by applying growth rates obtained from TEMPRO and Journey to Work data to the base year matrix. The methodology adopted for developing the Car, Public Transport and HGV matrices is described in the following sections.

5.2. Zone and Sector System

The zone structure adopted for forecast models is the same as the M25AM base year model. In this forecast model there are a total 1417 zones.

5.3. Data Sources for Traffic Forecasts

The forecast growth assumptions for the M25 forecast models have been based on the Department for Transport's Trip End Model Presentation Program (TEMPRO). The software version at the time of producing the forecast models was TEMPRO Version 6.2 and the NTEM database 6.2 (definitive version July 2011). This provides access to the National Trip End Model (NTEM) projections of growth in travel demand, the underlying car ownership and planning data projections. As all new significant development proposals have been assumed to be included within the TEMPRO planning data projections, this negates the need for the individual developments to be explicitly modelled. TEMPRO has been used along with the Journey to Work data to estimate growth in trip ends by different modes of transport (Car, PT Rail and PT Bus). The effect of rising incomes and fuel prices have been modelled within the Demand Model developed for this study.

Forecasting of light and heavy goods vehicles has been based on the National Transport Model (RTF11) assumptions.

Airport Trips

Airport trips for the forecast years were provided by the consultants commissioned for the following studies:

- Heathrow Airport Surface Access Modelling, Heathrow Employee Surface Access Model (HESAM), R1 Release Version 1, Sinclair Knight Merz (SKM), June 2006;
- London Airports Surface Access Modelling, LASAM Estimation Report, Version 2, SKM, July 2006;
- Stansted Airport Surface Access Modelling, Stansted Employee Surface Access Model (SESAM), R 1, SKM, November 2005.

The trips to the airport were divided into the following categories:

- Business passenger trips (treated as Car Business trips in the assignment model);
- Leisure passenger trips (treated as Car Other trips in the assignment model); and,
- Employee (commuting) trips (treated as Car Commuting trips in the assignment model).

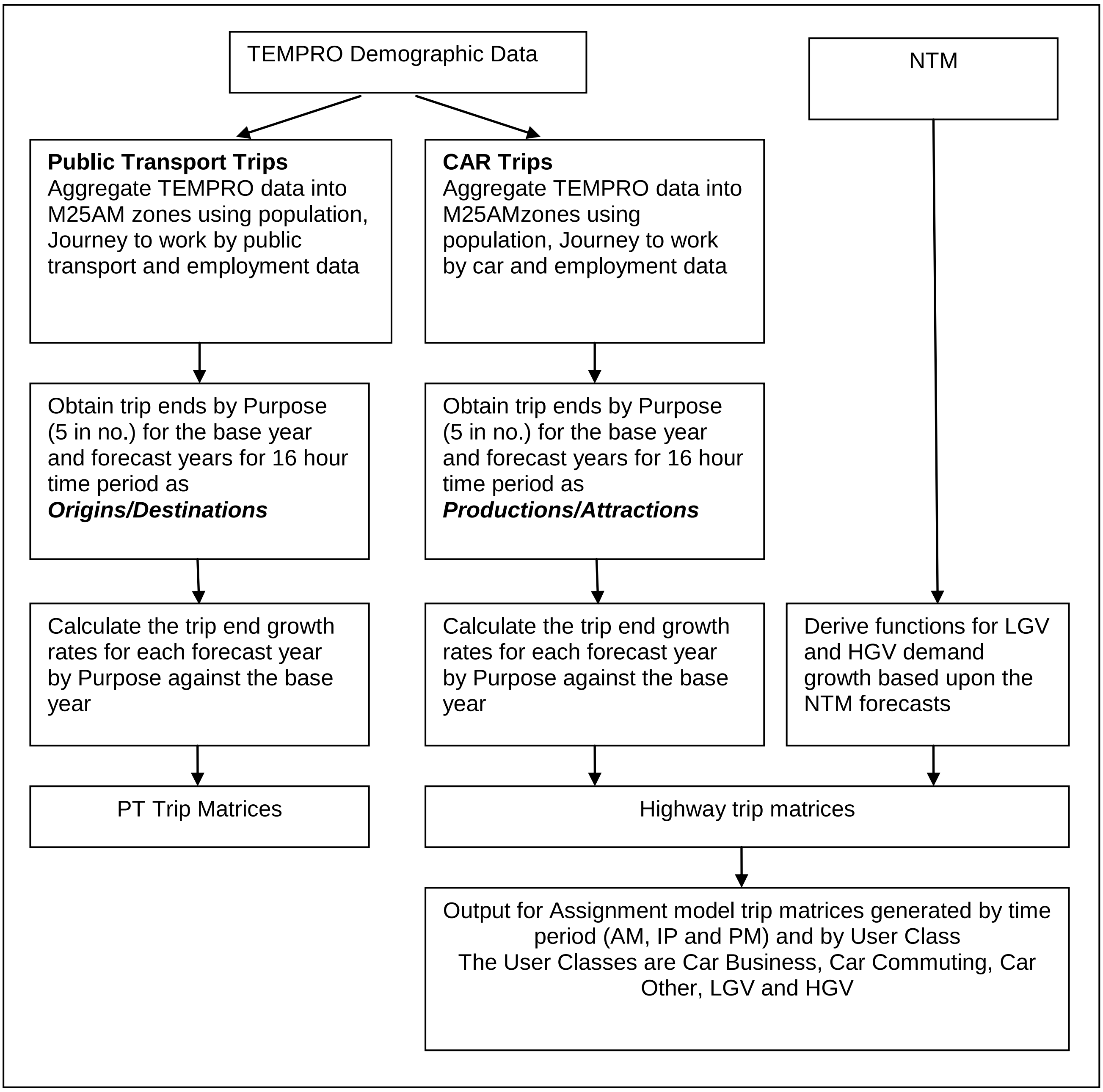
The trip matrices were developed for the years 2015 and 2030. Airport trips for 2040 were assumed to be the same as for 2030 for the purposes of this assessment. The airport trips are treated as fixed and are not subject to the variable demand process, reflecting the constrained nature of such trips which will be related to the level of airport development. Given the relatively low proportion of total traffic that is airport related and the small changes introduced by the M25DM the effect of this assumption upon the traffic flows on Section 5 of the M25 is likely to be insignificant.

5.4. Derivation of Forecast Growth Factors

The NTEM has about 2,500 zones covering Great Britain, which nest within local authority areas, whilst the M25AM forecast model developed for this study has 1417 zones, covering the same geographic area as NTEM.

To develop the growth factors, TEMPRO data was converted into M25AM forecast model zones using population and employment data from TEMPRO and Journey to Work data. Figure 5-1 shows the process of developing forecast matrices as a flow chart.

Figure 5-1 Developing growth rates for trip matrices for forecast years



TEMPRO produces output for the following 15 trip purposes:

- Home Based Work (HBW);
- Home Based Employers Business (HBEB);
- Home Based Other – Education (HBOE);
- Home Based Other – Shopping (HBOS);
- Home Based Other – Personal Business (HBOPB);
- Home Based Other – Recreation and Social (HBORS);
- Home Based Other – Visiting Friends and Relatives (HBOVFR);
- Home Based Other – Holiday and Day Trip (HBOHDT);
- Non Home Based Work (NHBW);
- Non Home Based Employers Business (NHBEB);
- Non Home Based Other – Education (NHBOE);
- Non Home Based Other – Shopping (NHBOS);
- Non Home Based Other – Personal Business (NHBOPB);
- Non Home Based Other – Recreation and Social (NHBORS); and
- Non Home Based Other – Holiday and Day Trip (NHBOHDT).

When a model zone falls wholly within a TEMPRO zone, the traffic growth factor for the TEMPRO zone was used directly. However, when a M25 model zone falls into more than one TEMPRO zone, the TEMPRO data was divided between M25 model zones using a combination of factors as shown in Table 5-1. An explanation for the factors used is provided after the table.

Table 5-1 Data used for converting TEMPRO data to M25 AM data

	Car (Driver and Passenger)		Rail, Bus	
Trip-Purpose	**Productions-weighting**	**Attractions-weighting**	**Origins-weighting**	**Destinations-weighting**
HBW	B	C	D	E
HBEB	B	C	D	E
HBOE	A	A	A	A
HBOS	A	F	A	F
HBOPB	A	F	A	F
HBORS	A	F	A	F
HBOVFR	A	A	A	A
HBOHDT	A	A	A	A
NHBO	G	C	G	E
NHBEB	G	E	G	E
NHBOE	G	F	G	F
NHBOS	G	F	G	F
NHBOPB	G	F	G	F
NHBORS	G	F	G	F
NHBOHDT	G	A	G	A

- Factor A: TEMPRO - Population;
- Factor B: Journey to Work – Car Origin - Productions;
- Factor C: Journey to Work – Car Destination - Attractions;

- Factor D: Journey to Work – Origin – All Employment;
- Factor E: Journey to Work – Destination – All Employment;
- Factor F: A combined factor based on population (20%) and Journey to Work – Destination – All Employment (80%); and
- Factor G: A combined factor based on population (50%) and Journey to Work – Destination – All Employment (50%).

The demand model requires 16 hour TEMPRO forecast growth factors. The output from TEMPRO was generated for the following trips for the forecast years for:

- Car Driver and Car Passenger;
- Rail and Underground; and
- Bus and Coach.

The trips ends for Car Driver and Car Passenger was derived from TEMPRO as Productions and Attractions, while Public Transport trip ends were derived as Origins and Destinations. The 15 TEMPRO trip purposes were combined to the following five trip purposes and are shown in Table 5-2.

- Home Based Employers Business (HBEB)
- Home Based Other (HBO)
- Home Based Work (HBW)
- Non Home Based Employers Business (NHBEB)
- Non Home Based Other (NHBO)

Table 5-2 Combination of Trip Purposes

	HBEB	HBO	HBW	NHBEB	NHBO
HBW			X		
HBEB	X				
HBOE		X			
HBOS		X			
HBOPB		X			
HBORS		X			
HBOVFR		X			
HBOHDT		X			
NHBO					X
NHBEB				X	
NHBOE					X
NHBOS					X
NHBOPB					X
NHBORS					X
NHBOHDT					X

The growth rates for each of the forecast years were derived as a ratio of the data for the forecast year and the base year (2004). These growth rates were derived for all the five purposes mentioned above. The 16 hour trip ends and the growth factors are detailed in Appendix B.

A furness process was used in the application of the growth rates for the car and PT matrices for the inter-zonal movements. Intra-zonal trips (car only as there are no intra-zonal trips in the PT matrices) have been increased by the relevant origin zone growth rate. LGV and HGV matrices were subject to global growth factors from NTM as shown above and thus no furness process was required for these movements.

5.5. Methodology for Deriving Goods Vehicle Growth Factors from NTM

During the preparation of the M25 Section 5 traffic forecasts, DfT published the Road Transport Forecasts 2011 (RTF11) on January 24th 2012, which present the results from the latest National Transport Model. After consulting with HA TAME, it was agreed that the RTF11 forecasts should be adopted for goods vehicle (LGV and HGV) growths. The growth factors derived were based on the 'Motorways in the South East' values as being more appropriate for the M25 than the 'All Roads in London' growth values applied in previous Stage 3 RTF09 forecasts.

Table 5-3 below compares the goods vehicle growth values from the RTF09 and RTF11 forecasts. It is found that in general the growth values from RTF11 for 'Motorways in the South East' are around 9% higher for LGVs and 12 to 13% higher for HGVs than the RTF09 values for 'All Roads in London' in 2030 and 2040.

Table 5-3 Goods Vehicle Growth Comparisons between RTF09 and RTF11

	NTM(RTF09)		NTM(RTF11)			
	London, All Road		SE, Motorways		Difference	
Year	LGV	HGV	LGV	HGV	LGV	HGV
2004	1.000	1.000	1.000	1.000	-	-
2015	1.273	1.058	1.293	1.112	1.6%	5.1%
2030	1.760	1.179	1.917	1.334	8.9%	13.1%
2040	2.159	1.287	2.363	1.444	9.4%	12.2%

5.6. User Classes

Using the growth rates for the Car, LGV and HGV, forecast trip matrices were produced for the following five user classes:

- Car Business
- Car Commuting
- Car Other
- LGV and
- HGV

5.7. Reference Case Forecast Matrices

The application of the forecast growth factors calculated using the methods described above resulted in a set of Reference Case forecast trip matrices whose totals excluding intra trips are given in Table 5-4 with the forecast trip matrix index (2004 = 100) is given in Table 5-5. These tables show that there are similar levels of growth from 2004 in the two peak hours, ranging from 14% in 2015 to 45% in 2040 (total trips). Growth in the inter-peak period is higher, ranging from 15% in 2015 to 51% in 2040. These growth levels are prior to the application of the variable demand model, which is described in the next chapter.

Table 5-4 Forecast Trip Matrix Totals by User Class

Year	Total	Car - Business	Car - Commuting	Car - Other	LGV	HGV
AM(08:00-09:00)						
2004	1,393,385	132,087	472,334	559,335	98,512	131,117
2015	1,588,464	146,932	519,404	648,951	127,376	145,801
2030	1,847,209	160,835	559,125	763,493	188,847	174,909
2040	2,014,944	170,377	586,400	836,053	232,783	189,332
IP (average 10:00-16:00)						
2004	1,119,606	151,023	91,642	645,664	97,450	133,827
2015	1,292,118	168,897	100,769	747,636	126,002	148,815
2030	1,536,933	185,163	108,258	878,177	186,811	178,525
2040	1,694,224	196,339	113,477	960,889	230,274	193,246
PM (17:00-18:00)						
2004	1,347,250	137,357	460,239	571,364	99,856	78,434
2015	1,534,110	153,015	504,969	659,795	129,113	87,218
2030	1,777,856	167,732	541,731	772,339	191,423	104,630
2040	1,937,449	177,826	567,079	843,328	235,959	113,258

Table 5-5 Forecast Trip Matrix Index (2004 = 100) by User Class

Year	Total	Car - Business	Car - Commuting	Car - Other	LGV	HGV
AM						
2015	114	111	110	116	129	111
2030	133	122	118	137	192	133
2040	145	129	124	149	236	144
IP						
2015	115	112	110	116	129	111
2030	137	123	118	136	192	133
2040	151	130	124	149	236	144
PM						
2015	114	111	110	115	129	111
2030	132	122	118	135	192	133
2040	144	129	123	148	236	144

6. Treatment of Variable Demand

6.1. An Overview

A bespoke variable demand model, the M25 Demand Model (M25DM) has been developed in accordance with WebTAG requirements in order to estimate the demand response due to the proposed improvements. AECOM was commissioned to develop this model for the Stage 2 forecasting process. The development of this variable demand model was documented in the M25 Demand Model Development and Validation Report – October 2009[17] for the M25 LUS Stage 2 forecasts.

The economic parameters such as value of time (VOT), vehicle operating cost (VOC) for fuel and non fuel components, VOT growth and fuel efficiency etc. for the M25DM were based on WebTAG 3.5.6 (released in April 2009). These parameters do not include the impacts of fuel cost changes and the economic recession in recent years. In 2011 the Department for Transport (DfT) released an updated version of WebTAG 3.5.6 which became a definitive version from April 2011. Most of the economic parameters in the April 2011 version of WebTAG 3.5.6 have been changed from the April 2009 version, with the real measured values in 2009 and 2010 adopted where available. The April 2011 version includes a fundamental change in the formula for calculating fuel consumption. As detailed in the WebTAG document, the revised function improves the relationship between speed and fuel consumption especially at low speeds (down to 5 KPH). Consequently the original M25DM has been recalibrated with trip distribution lambda values changed so that the fuel and journey time elasticities from the demand model realism tests are compliant with the latest WebTAG guidance. The process of recalibrating the M25DM is detailed in the technical note prepared by AECOM[18].

The demand model is a trip-based model and uses the pivot point method which allows forecasts to be built based on the calibrated and validated base year observed trip patterns. The development of the M25DM is consistent with the supply model M25AM link volumes and skimmed costs. Calibration and realism tests confirm that the supply model responses are satisfactorily reflected with the demand model.

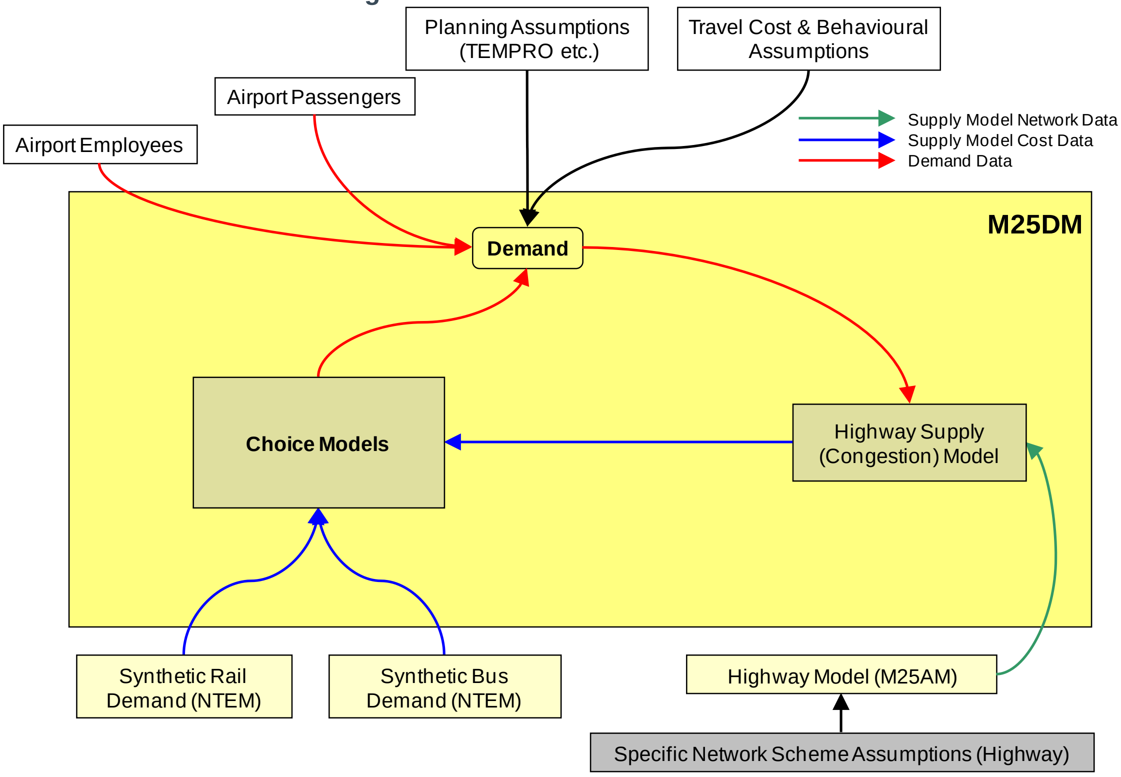
The main objectives of the M25DM are to provide:

- Forecasts of changes in traffic over time, as a result of changes in land-use, economic growth, travel costs and committed transport supply changes;
- Forecasts of the demand responses of highway traffic and public transport trips to changes to the transport system; and
- Forecasts that are the results of convergence between the demand and supply models.

Figure 6-1 shows the overview of the M25DM structure.

[17] M25 Demand Model (September 2009) – Model Development and Validation Report (revision 4 of 14th October 2009)
[18] See Local Model Validation Report version 3 of 14th October 2011 (document reference 5084755-ALL-DO-TR-164 Rev B), Appendix I - Technical Note - M25DM Update July 2011

Figure 6-1 M25DM Structure



The mode choice model of the M25DM uses a hierarchical model formulation to model the choice between travel alternatives and takes into consideration time period choice (macro), choice between car and public transport, trip distribution and public transport sub-mode choice. The model estimates changes in demand due to changes in generalised costs. The M25DM model adopts the pivot point approach in line with the Department of Transport's WebTAG guidance. This allows forecasts to be built relative to the base year pattern of observed movements. The process, as shown in Figure 6-2, uses a supply and demand relationship. Point A assumes a well converged Base Year model. Point B represents a reference case matrix produced by applying growth factors to the base year matrix. Point C is obtained by pivoting off the costs of the base year model and the reference case demand (B). The Do Something point D is then pivoted off point C. It should be noted that the Do Minimum for the demand model is referred as a True Do Minimum scenario without any HSR for either M25 Section 2 or Section 5.

The iterative process used to generate generalised costs due for the Do Minimum and Do Something schemes to produce the corresponding demand trip matrices is shown in Figure 6-3 and Figure 6-4.

Figure 6-2 Supply and Demand Relationship

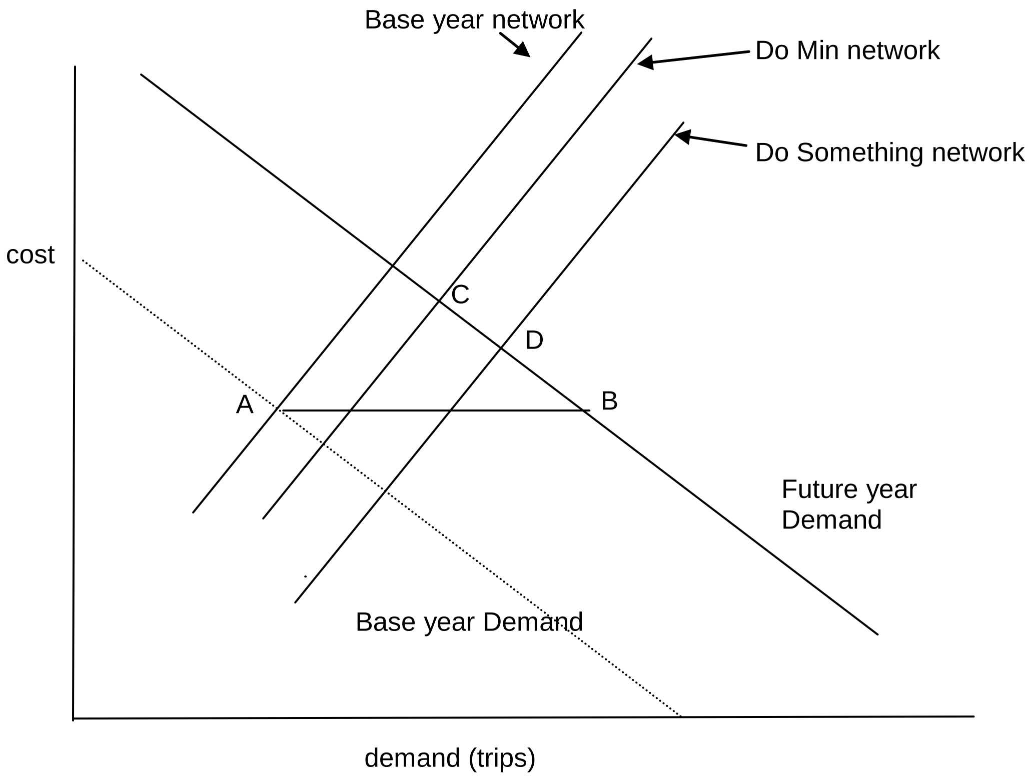


Figure 6-3 Reference Case – Pre and Post Demand modelling process

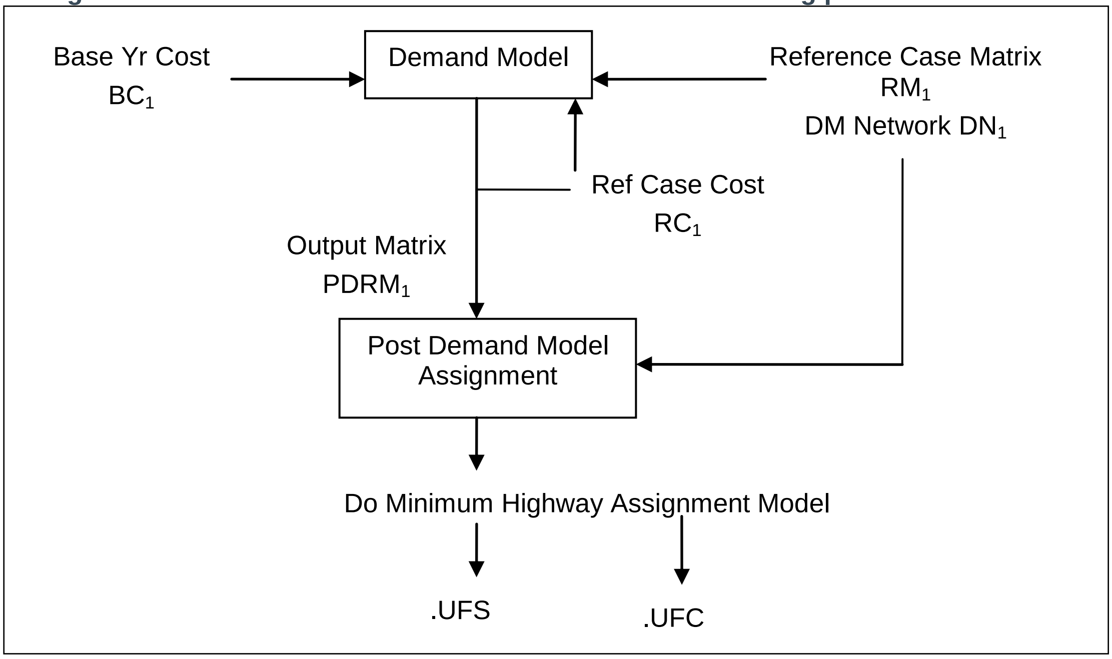
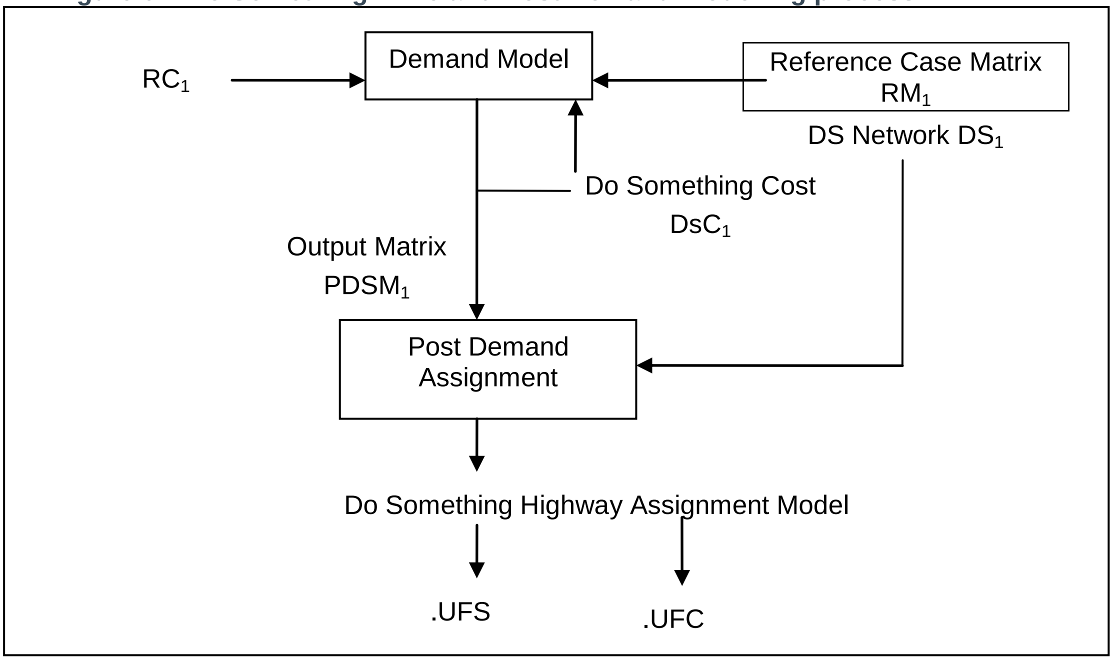


Figure 6-4 Do Something – Pre and Post Demand modelling process



6.2. Demand Model Convergence

The recommended indicator for measuring convergence between supply and demand models is the percentage gap between the two. To measure convergence of the demand and supply models, the M25DM used the demand-supply gap function as recommended by WebTAG Unit 3.10.4. The percentage gap statistic G takes the following form:

$$\frac{\sum_{ijctm} C(X_{ijctm}) \left| D(C(X_{ijctm})) - X_{ijctm} \right|}{\sum_{ijctm} C(X_{ijctm}) X_{ijctm}} * 100$$

Where;

X_{ijctm} is the current flow vector or matrix from the model

$C(X_{ijctm})$ is the generalised cost vector or matrix obtained by assigning that matrix

$D(C(X_{ijctm}))$ is the flow vector or matrix output by the demand model, using the costs $C(X_{ijctm})$ as input

$ijctm$ represents origin i, destination j, demand segment/user class c, time period t and mode m

- i = origin;
- j = destination;
- t = time period; and
- p = purpose.

In addition to calculating the aggregate % Gap as given above, M25DM also calculates the % Gap statistic for each of the five car purposes and LGV/HGV for each of the three main time periods. Table 6-1 shows the % Gap statistics that were calculated during the base year car fuel cost elasticity test, which converged in 7 demand-supply iterations.

Table 6-1 M25DM %Gap Statistics, Fuel Cost Elasticity Test

Period	Purpose	M25DM Demand-Supply Iteration						
		1	2	3	4	5	6	7
AM Peak	HBW	1.790	0.572	0.478	0.178	0.088	0.040	0.027
	HBEB	3.177	1.147	0.984	0.296	0.118	0.057	0.041
	HBO	3.016	0.664	0.555	0.164	0.066	0.038	0.031
	NHBEB	2.460	1.316	1.114	0.321	0.132	0.072	0.059
	NHBO	3.687	0.806	0.674	0.204	0.092	0.050	0.038
	LGV	0.000	0.976	0.878	0.336	0.194	0.090	0.064
	HGV	0.000	0.644	0.559	0.188	0.108	0.048	0.029
Inter peak	HBW	1.488	0.189	0.164	0.106	0.051	0.023	0.014
	HBEB	3.313	0.436	0.232	0.155	0.080	0.041	0.029
	HBO	2.680	0.248	0.140	0.082	0.047	0.027	0.023
	NHBEB	2.582	0.544	0.291	0.170	0.091	0.058	0.044
	NHBO	2.746	0.276	0.186	0.115	0.061	0.037	0.026

Period	Purpose	M25DM Demand-Supply Iteration						
		1	2	3	4	5	6	7
	LGV	0.000	0.436	0.402	0.289	0.140	0.074	0.049
	HGV	0.000	0.269	0.217	0.160	0.075	0.041	0.023
PM Peak	HBW	2.097	0.714	0.958	0.821	0.532	0.166	0.055
	HBEB	3.485	1.254	1.741	1.519	0.985	0.320	0.097
	HBO	2.588	0.718	0.880	0.719	0.451	0.137	0.059
	NHBEB	2.132	1.562	2.026	1.694	1.082	0.356	0.140
	NHBO	3.556	0.963	1.204	0.966	0.610	0.205	0.079
	LGV	0.000	1.234	1.781	1.502	0.934	0.345	0.116
	HGV	0.000	0.797	1.218	1.046	0.656	0.258	0.076
Aggregate %Gap		**2.159**	**0.550**	**0.552**	**0.360**	**0.215**	**0.080**	**0.039**

HGV and LGV have a %Gap statistic of zero in iteration 1 because freight generalised cost is unchanged in this car fuel cost elasticity test and hence, as the fuel cost reduction is not applied to freight vehicles, they experience no cost change. In subsequent iterations, changing patterns of car traffic have a secondary effect on freight.

The data in the table show that the %Gap statistic after seven iterations is lower than 0.1 which is the threshold value recommended by WebTAG. The tight %Gap statistics achieved should result in stable economic benefits resulting from scheme appraisal.

6.3. Post M25DM Demand Matrices

The post demand model matrices were assigned to the respective Do Something networks (DHS2 and DHS25). Note that the post M25DM assignments for the Do Minimum scenario were not implemented as the scenario is only used for pivoting Do Something from Do Minimum as advised in WebTAG guidance.

The trip matrix totals, excluding intra-zonal trips, for DHS2 and DHS25 are shown in Table 6-2 and Table 6-3 respectively. Comparing these totals with the pre-demand model totals in Table 5-4 shows that the demand model has reduced the matrix totals by 2.7% in the AM peak and 2.3% in the PM peak in 2040. There is only a very small reduction of 0.7% in the matrix total in the inter-peak period trips in 2040. The total trip levels in the DHS2 and DHS25 matrices post M25DM are very similar.

Table 6-2 Do Something (DHS2) Demand Forecast Trip Matrix Totals by User Class

Year	Car - Business	Car - Commuting	Car - Other	LGV	HGV	Total
AM						
2015	145053	498746	615973	127402	145827	1533001
2030	160108	552375	744812	188846	174910	1821051
2040	169003	570453	799043	232757	189332	1960589
IP						
2015	167588	98142	718969	125991	148811	1259501
2030	187026	110091	878422	186822	178534	1540895
2040	197975	114108	947168	230316	193261	1682829
PM						
2015	151258	485341	630250	129131	87236	1483217
2030	167634	538823	756789	191424	104649	1759320
2040	177323	555889	810352	235936	113269	1892768

Table 6-3 Do Something (DHS25) Demand Forecast Trip Matrix Totals by User Class

Year	Car - Business	Car - Commuting	Car - Other	LGV	HGV	Total
AM						
2015	145078	498716	615904	127406	145828	1532932
2030	160143	552327	744742	188894	174932	1821039
2040	168995	570193	798711	232695	189303	1959897
IP						
2015	167635	98140	718954	126017	148825	1259571
2030	187067	110073	878264	186835	178542	1540780
2040	198030	114086	947058	230375	193296	1682845
PM						
2015	151254	485256	630047	129093	87232	1482881
2030	167647	538803	756547	191405	104655	1759057
2040	177418	556217	810459	235958	113290	1893341

7. Forecast Assignments

7.1. Routing Parameters

Forecast assignments were carried out using the same routing parameters as for the base year model. The model uses an equilibrium assignment technique and the generalised cost is based on time and distance. The time and distance cost coefficients (PPK and PPM respectively) have been updated with the published WebTAG 3.5.6 for each forecasting year.

7.2. Model Convergence

Highway Assignment Model

It is critical to achieve model convergence that is very close to the true equilibrium point in order for the subsequent economic appraisal to be robust. For the highway assignment the following indicators are used to ascertain model convergence and stability:

- The number of iterations;
- The percentage of links on which flows change by less than 5% between successive iterations (P);
- The difference between the costs along the chosen routes and those along the minimum cost routes, summed across the whole network, and expressed as a percentage of the minimum costs (delta);
- The degree to which the area under the speed-flow relationships is minimised, (epsilon); and
- The percentage change in total user costs or time spent in the network between successive iterations (V).

DMRB states that the first measure should not be used on its own as it provides no indication of the extent to which equilibrium has been reached. The last measure should not be used as the main indicator unless other indicators are not available.

The percentage of links on which flows change by less than 5% is a measure of stability rather than convergence and DMRB recommends that the assignment model iterations should continue until at least four successive values of P in excess of 90% have been obtained. This parameter has been modified within the M25 AM such that four successive values of P in excess of 99% are required.

With respect to the delta and epsilon measures, DMRB recommends the use of delta, since epsilon cannot be calculated for multi user class assignments. Both delta and epsilon generally decrease towards a minimum value as the number of iterations increases. It is recommended that the assignment procedure should continue until the value of delta is less than 1%.

In order to monitor and ensure convergence, the SATURN parameters which were coded explicitly (in place of using defaults) and which relate to assignment and convergence controls are as follows:

- ISTOP = 100 (the assignment process will terminate when flows on ISTOP% of links are within PCNEAR% in successive iterations)
- PCNEAR = 1
- NITA = 20 (this is the maximum number of assignment iterations)
- NITS = 20 (this is the maximum number of simulation iterations)

- MASL = 250 (this is the maximum number of assignment / simulation loops)
- LTP = 60 (this is the number of minutes making up the duration of the simulation time period)
- DIDDLE = T (this ensures that each assignment after the first commences with the final set of flows from the previous assignment)
- UNCRTS = 0.02~0.035 (the maximum percentage of uncertainty in the objective function)
- NISTOP = 4 (Number of successive iterations where the values of P are in excess of ISTOP%)

Setting ISTOP to 100 and PCNEAR to 1.0 will allow greater stability to be reached through additional model iterations (and effectively reach the position where flows differ by less than 1% on 99.5% of the network links). Setting NISTOP to 4 ensures further stability, although this approach has been recognised by the developers of SATURN as ad hoc since it offers no direct link to the gap value. As a consequence a specific gap value at convergence has been targeted through the use of STPGAP and KONSTP parameters.

KONSTAP = 1 changes the convergence measure from link flow 'proximity' to a direct test of gap values. With STPGAP set to 0.2% for forecasting year 2015 and 0.035% for the forecast years 2030 and 2040[19], convergence is judged on the model gap falling below this value on (NISTOP) successive iterations.

As an additional convergence aid, each run was started from a previous converged assignment using a similar network (a 'warm start' using UPDATE = T), allowing congested speed/flow curves to be used in early iterations. This provides a more realistic starting point for path-building.

The convergence statistics for the base year model and each of the forecast models are shown in Table 7-1 for each of the three modelled time periods. The convergence statistics show that the criteria have been met in the base model and all future year models and thus the models demonstrate a satisfactory level of convergence.

Table 7-1 Convergence Statistics for Post-M25DM Assignment

Case	Year	AM			IP			PM		
		%Flow	%Delay	%Gap	%Flow	%Delay	%Gap	%Flow	%Delay	%Gap
Do Something (DHS2))	2015	99.4	99.5	0.018	99.0	99.6	0.015	99.4	99.5	0.020
	2030	98.7	98.6	0.029	98.4	99.0	0.024	98.3	98.7	0.032
	2040	98.8	98.8	0.031	98.4	98.8	0.034	98.8	99.0	0.022
Do Something (DHS25)	2015	99.5	99.5	0.020	99.0	99.6	0.017	98.9	99.2	0.019
	2030	98.7	98.7	0.034	98.2	98.9	0.034	98.1	98.7	0.033
	2040	98.7	98.6	0.031	98.7	99.0	0.030	98.3	98.4	0.034

[19] The %GAP criteria are slightly less tight for forecasting year 2030 and 2040 so as to cut excessive assignment time.

8. Traffic Forecasts

8.1. Introduction

Traffic forecasts have been produced for the DHS2 and DHS25 scenarios for the forecast years 2015, 2030 and 2040. The MM2 HSR forecasts enable assessments to be carried out regarding the air quality and road traffic noise impacts of the scheme. The MM2 HSR and widening forecasts allow comparison of the economic performance of the alternative schemes.

The model calibration and validation was undertaken against 4 orbital cordons and 15 radial screenlines, broadly radiating from the centre of London, as shown in Figure 8-1 and Figure 8-2. The same cordons and screenlines are used to demonstrate forecast traffic growth for each of the forecast years for schemes being assessed.

The cordons and screenlines are described as below:

- Cordon 2: a cordon inside the South/North Circular Road corridor;
- Cordon 3: M25 cordon – predominantly inside M25;
- Cordon 4: M25 cordon – predominantly outside M25;
- Cordon 5: Outer cordon – selected principal radials at a distance of around 30 kms from Central London.
- Screenline 1: M3 screenline
- Screenline 2: M3/ M4 sector
- Screenline 3: M4/ M40 sector
- Screenline 4: M40/ M1 corridor
- Screenline 5: M1 radial
- Screenline 6: A1(M) corridor
- Screenline 7: East of A1(M)
- Screenline 8: West of M11
- Screenline 9: East of M11
- Screenline 10: A13/ A127 corridor (Southend)
- Screenline 11: M20 corridor
- Screenline 12: A21 corridor
- Screenline 13: M23/A22 corridor
- Screenline 14: A24/M23 corridor
- Screenline 15: A3 radial

The comparisons of M25 mainline flows and speeds, over time, are also presented in this section.

Figure 8-1 M25 Assignment Model Orbital Screenlines

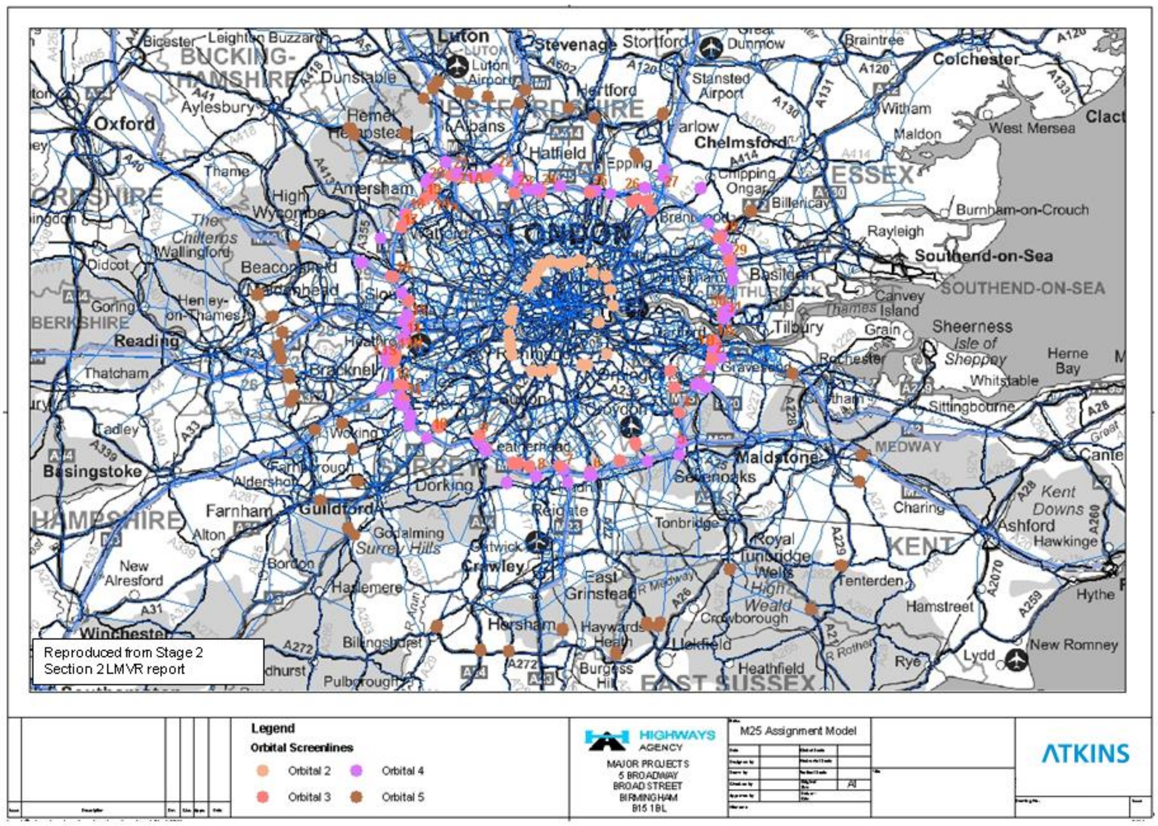
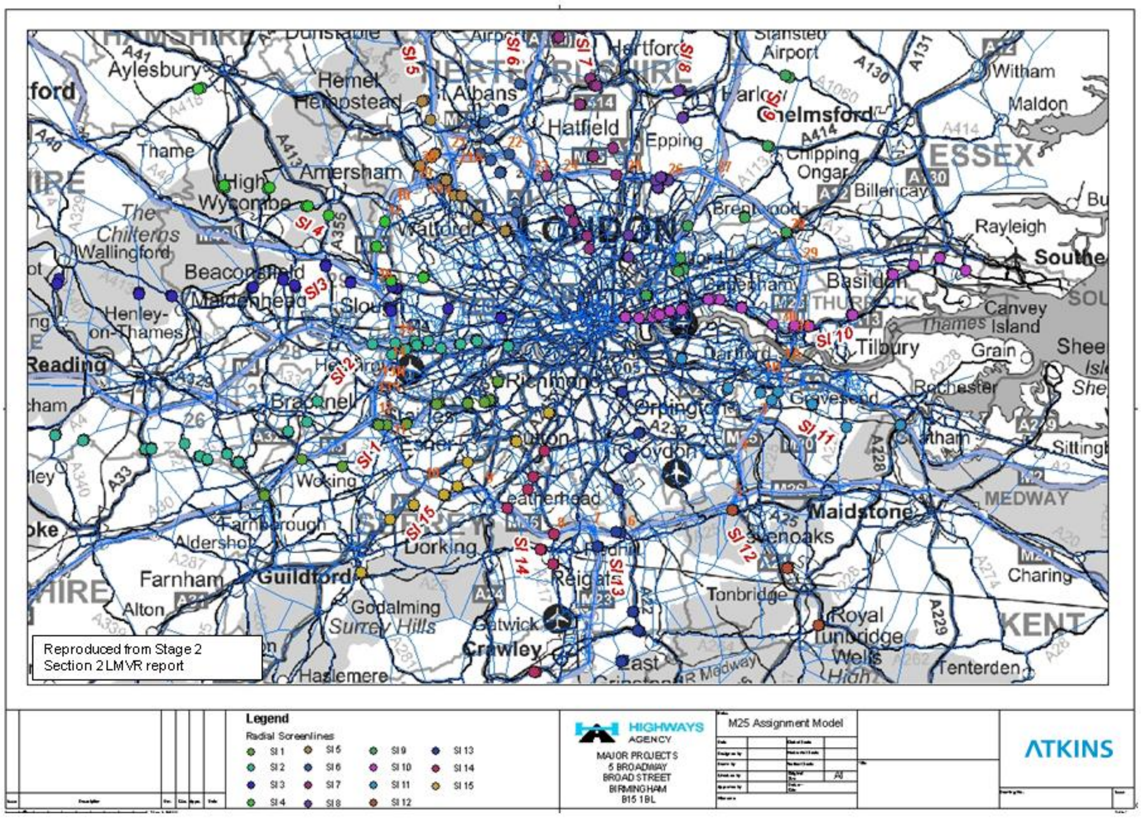


Figure 8-2 M25 Assignment Model Radial Screenlines



8.2. Forecast Flow Comparison

Total flows for M25 DHS2 and DHS25 at the aforementioned cordons and screenlines are shown in the following Tables 8-1 to 8-6 for the AM peak hour, the average Inter Peak hour and PM peak hour periods for each of the three forecast years. The growth figures for each forecast scenario from the base year 2004 modelled flows are also presented.

Morning Peak Hour

Table 8-1 and Table 8-2 show that the flows in the morning peak on cordons 2 and 5 for DHS2 and DHS25 are similar across forecasting years 2015, 2030 and 2040. For DHS25, total flows on cordons 3 and 4 have increased slightly more than DHS2, an increase of approximate 0.26% to 0.33% being modelled across 3 forecasting years. This indicates that overall the M25 MM2 HSR schemes will attract trips both inside and outside the M25.

Compared to DHS2, the flows on screenline no. 7 for DHS25 are increased by 4.2%, 4.7% and 5.0% in the forecasting years 2015, 2030 and 2040 respectively. The flows for DHS25 on screenline no. 6 along the A1(M) corridor are also increased by 2.1% to 2.3% across the three forecasting years. These highlight the impacts of increased M25 capacity in the AM peak period between J23 and J27 as a result of the MM2 HSR scheme.

Overall comparison to the 2004 base year modelled flows shows that the total cordon and screenline flows for DHS25 are increased by 7.9%, 22.5% and 28.0% in 2015, 2030 and 2040 respectively.

Table 8-1 Forecast Flow Comparison – AM Peak (pcus)

Screenline Segment	No. of Links	BASE	DHS2			DHS25		
		2004 (modelled)	2015	2030	2040	2015	2030	2040
Cordon2	66	55,656	58,943	64,466	66,696	58,983	64,469	66,595
Cordon3	104	115,103	123,656	139,450	145,841	124,005	139,877	146,295
Cordon4	130	170,891	184,238	206,184	213,175	184,853	206,721	213,731
Cordon5	95	122,855	134,429	155,069	162,916	134,528	155,225	163,096
Screenline1	21	28,118	30,025	32,616	33,704	29,998	32,560	33,645
Screenline2	46	44,832	46,433	53,843	56,951	46,463	53,795	56,873
Screenline3	26	35,401	38,088	43,012	44,854	38,148	43,038	44,873
Screenline4	18	27,491	30,400	35,641	37,684	30,540	35,780	37,804
Screenline5	26	34,656	36,181	41,646	44,131	36,408	41,887	44,356
Screenline6	24	31,667	32,797	37,450	39,047	33,499	38,320	39,948
Screenline7	28	28,593	30,829	35,257	37,216	32,128	36,900	39,088
Screenline8	26	23,244	25,911	30,177	31,716	25,882	30,124	31,690
Screenline9	23	30,515	33,723	39,668	41,513	33,953	39,945	41,889
Screenline10	40	31,551	31,703	37,722	40,730	31,706	37,753	40,648
Screenline11	14	19,105	21,346	25,062	26,320	21,308	25,046	26,298
Screenline12	6	4,635	4,977	5,530	5,665	4,975	5,530	5,664
Screenline13	18	22,426	24,681	27,596	28,771	24,637	27,537	28,723
Screenline14	13	14,429	15,569	16,901	17,395	15,549	16,868	17,354
Screenline15	16	24,295	25,990	28,492	29,421	25,956	28,427	29,352
Total	740	865,462	929,919	1,055,780	1,103,748	933,520	1,059,801	1,107,924

Table 8-2 Forecast Percentage Change compared with Base Year – AM Peak

Screenline Segment	No. of Links	BASE	DHS2			DHS25		
		2004 (modelled)	2015	2030	2040	2015	2030	2040
Cordon2	66	-	5.9%	15.8%	19.8%	6.0%	15.8%	19.7%
Cordon3	104	-	7.4%	21.2%	26.7%	7.7%	21.5%	27.1%
Cordon4	130	-	7.8%	20.7%	24.7%	8.2%	21.0%	25.1%
Cordon5	95	-	9.4%	26.2%	32.6%	9.5%	26.3%	32.8%
Screenline1	21	-	6.8%	16.0%	19.9%	6.7%	15.8%	19.7%
Screenline2	46	-	3.6%	20.1%	27.0%	3.6%	20.0%	26.9%
Screenline3	26	-	7.6%	21.5%	26.7%	7.8%	21.6%	26.8%
Screenline4	18	-	10.6%	29.6%	37.1%	11.1%	30.2%	37.5%
Screenline5	26	-	4.4%	20.2%	27.3%	5.1%	20.9%	28.0%
Screenline6	24	-	3.6%	18.3%	23.3%	5.8%	21.0%	26.2%
Screenline7	28	-	7.8%	23.3%	30.2%	12.4%	29.1%	36.7%
Screenline8	26	-	11.5%	29.8%	36.5%	11.4%	29.6%	36.3%
Screenline9	23	-	10.5%	30.0%	36.0%	11.3%	30.9%	37.3%
Screenline10	40	-	0.5%	19.6%	29.1%	0.5%	19.7%	28.8%
Screenline11	14	-	11.7%	31.2%	37.8%	11.5%	31.1%	37.7%
Screenline12	6	-	7.4%	19.3%	22.2%	7.3%	19.3%	22.2%
Screenline13	18	-	10.1%	23.1%	28.3%	9.9%	22.8%	28.1%
Screenline14	13	-	7.9%	17.1%	20.6%	7.8%	16.9%	20.3%
Screenline15	16	-	7.0%	17.3%	21.1%	6.8%	17.0%	20.8%
Total	740	-	7.4%	22.0%	27.5%	7.9%	22.5%	28.0%

Average Inter Peak Hour

Table 8-3 and Table 8-4 show that the flows in the inter peak on cordons 2 and 5 for DHS2 and DHS25 are similar across the forecasting years 2015, 2030 and 2040. The flows on cordons 3 and 4 for DHS25 are increased by 0.3% to 0.7% across the three forecasting years.

Compared to DHS2, the flows on screenline no. 7 for DHS25 are increased by 4.5%, 5.7% and 6.1% in the forecasting years 2015, 2030 and 2040 respectively. Flows on screenlines no. 6 and no. 9 are also increased for DHS25 compared to DHS2, but less significantly than screenline no.7. These highlight the impacts of increased M25 capacity in the inter-peak period between J23 and J27 as a result of the MM2 HSR scheme.

Overall comparison to the 2004 modelled flows shows that the total cordon and screenline flows for DHS25 are increased by 11.2%, 33.3% and 42.4% in 2015, 2030 and 2040 respectively.

Table 8-3 Forecast Flow Comparison – Inter Peak (pcus)

Screenline Segment	No. of Links	BASE	DHS2			DHS25		
		2004 (modelled)	2015	2030	2040	2015	2030	2040
Cordon2	66	50,271	54,127	60,389	63,003	54,161	60,466	62,953
Cordon3	104	81,721	91,755	112,310	121,244	92,397	112,878	121,893
Cordon4	130	130,488	144,397	172,940	183,727	144,866	173,444	184,306
Cordon5	95	89,480	100,470	122,971	133,092	100,658	123,270	133,192
Screenline1	21	23,289	25,516	29,580	31,152	25,448	29,484	31,013
Screenline2	46	34,149	35,648	43,172	46,727	35,654	43,161	46,680
Screenline3	26	29,804	33,097	39,089	41,452	33,155	39,194	41,505
Screenline4	18	23,060	26,669	32,693	35,101	26,815	32,903	35,318
Screenline5	26	28,969	31,503	38,626	41,570	31,784	38,981	41,813
Screenline6	24	25,298	26,356	31,786	34,037	26,937	32,743	34,843
Screenline7	28	24,642	27,293	31,999	33,906	28,511	33,815	35,976
Screenline8	26	18,022	20,550	24,745	26,740	20,338	24,537	26,492
Screenline9	23	25,314	29,859	35,659	38,038	30,343	36,284	38,913
Screenline10	40	27,172	28,334	34,576	36,946	28,334	34,594	36,979
Screenline11	14	16,536	18,951	23,237	24,789	18,952	23,267	24,799
Screenline12	6	3,639	4,053	4,788	5,043	4,055	4,792	5,049
Screenline13	18	18,807	21,079	25,306	27,091	21,002	25,178	26,895
Screenline14	13	11,991	13,554	15,943	16,856	13,516	15,925	16,762
Screenline15	16	21,229	23,294	27,105	28,632	23,220	27,019	28,472
Total	740	683,881	756,506	906,913	969,146	760,145	911,935	973,854

Table 8-4 Forecast Percentage Change compared with Base Year – Inter Peak

Screenline Segment	No. of Links	BASE	DHS2			DHS25		
		2004 (modelled)	2015	2030	2040	2015	2030	2040
Cordon2	66	-	7.7%	20.1%	25.3%	7.7%	20.3%	25.2%
Cordon3	104	-	12.3%	37.4%	48.4%	13.1%	38.1%	49.2%
Cordon4	130	-	10.7%	32.5%	40.8%	11.0%	32.9%	41.2%
Cordon5	95	-	12.3%	37.4%	48.7%	12.5%	37.8%	48.9%
Screenline1	21	-	9.6%	27.0%	33.8%	9.3%	26.6%	33.2%
Screenline2	46	-	4.4%	26.4%	36.8%	4.4%	26.4%	36.7%
Screenline3	26	-	11.1%	31.2%	39.1%	11.2%	31.5%	39.3%
Screenline4	18	-	15.7%	41.8%	52.2%	16.3%	42.7%	53.2%
Screenline5	26	-	8.7%	33.3%	43.5%	9.7%	34.6%	44.3%
Screenline6	24	-	4.2%	25.6%	34.5%	6.5%	29.4%	37.7%
Screenline7	28	-	10.8%	29.9%	37.6%	15.7%	37.2%	46.0%
Screenline8	26	-	14.0%	37.3%	48.4%	12.9%	36.1%	47.0%
Screenline9	23	-	18.0%	40.9%	50.3%	19.9%	43.3%	53.7%
Screenline10	40	-	4.3%	27.2%	36.0%	4.3%	27.3%	36.1%
Screenline11	14	-	14.6%	40.5%	49.9%	14.6%	40.7%	50.0%
Screenline12	6	-	11.4%	31.6%	38.6%	11.4%	31.7%	38.7%
Screenline13	18	-	12.1%	34.6%	44.0%	11.7%	33.9%	43.0%
Screenline14	13	-	13.0%	33.0%	40.6%	12.7%	32.8%	39.8%
Screenline15	16	-	9.7%	27.7%	34.9%	9.4%	27.3%	34.1%
Total	740	-	10.6%	32.6%	41.7%	11.2%	33.3%	42.4%

Evening Peak Hour

Table 8-5 and Table 8-6 show that the flows in the evening peak on cordons 2 and 5 for DHS2 and DHS25 are similar across the forecasting years 2015, 2030 and 2040. The flows on cordons 3 and 4 for DHS25 are increased by 0.2% to 0.3% across the three forecasting years, less than the increase in the AM peak.

Compared to DHS2, the flows on screenline no.7 for DHS25 are increased by 3.3%, 4.4% and 4.4% in the forecasting years 2015, 2030 and 2040 respectively. The flows for DHS25 on screenline no. 6 along the A1(M) corridor are also increased by 1.7% to 2.2% across the three forecasting years.

Overall comparison to the 2004 modelled flows shows that the total cordon and screenline flows for DHS25 are increased by 6.9%, 20.8% and 26.1% in 2015, 2030 and 2040 respectively.

Table 8-5 Forecast Flow Comparison – PM (pcus)

Screenline Segment	No. of Links	BASE	DHS2			DHS25		
		2004 (modelled)	2015	2030	2040	2015	2030	2040
Cordon2	66	57,362	59,314	64,167	66,369	59,345	64,105	66,419
Cordon3	104	114,731	121,666	138,086	143,884	122,043	138,357	144,218
Cordon4	130	167,783	179,660	200,693	207,885	180,082	201,210	208,405
Cordon5	95	122,134	133,073	153,941	161,787	133,241	154,011	161,784
Screenline1	21	28,407	29,865	32,519	33,417	29,871	32,511	33,412
Screenline2	46	42,917	44,526	51,662	54,525	44,530	51,663	54,526
Screenline3	26	34,892	37,607	42,937	44,780	37,665	42,984	44,789
Screenline4	18	27,450	30,504	35,525	37,334	30,637	35,641	37,445
Screenline5	26	33,910	34,455	39,728	41,303	34,664	39,826	41,448
Screenline6	24	31,015	31,260	35,258	37,089	31,798	36,037	37,818
Screenline7	28	27,563	29,767	34,003	35,846	30,761	35,499	37,421
Screenline8	26	23,337	25,393	29,105	30,613	25,425	29,041	30,555
Screenline9	23	31,069	34,310	39,391	41,454	34,671	39,713	41,689
Screenline10	40	31,475	31,716	36,696	39,311	31,806	36,760	39,360
Screenline11	14	19,422	21,939	24,858	25,603	21,898	24,792	25,653
Screenline12	6	4,656	4,990	5,352	5,510	4,991	5,354	5,513
Screenline13	18	23,089	24,637	27,598	28,749	24,625	27,524	28,706
Screenline14	13	16,066	17,006	17,932	18,655	16,996	17,897	18,615
Screenline15	16	25,320	26,896	29,289	30,097	26,906	29,223	30,060
Total	740	862,598	918,584	1,038,742	1,084,212	921,956	1,042,147	1,087,838

Table 8-6 Forecast Percentage Change compared with Base Year – PM Peak

Screenline Segment	No. of Links	BASE	DHS2			DHS25		
		2004 (modelled)	2015	2030	2040	2015	2030	2040
Cordon2	66	-	3.4%	11.9%	15.7%	3.5%	11.8%	15.8%
Cordon3	104	-	6.0%	20.4%	25.4%	6.4%	20.6%	25.7%
Cordon4	130	-	7.1%	19.6%	23.9%	7.3%	19.9%	24.2%
Cordon5	95	-	9.0%	26.0%	32.5%	9.1%	26.1%	32.5%
Screenline1	21	-	5.1%	14.5%	17.6%	5.2%	14.4%	17.6%
Screenline2	46	-	3.7%	20.4%	27.0%	3.8%	20.4%	27.0%
Screenline3	26	-	7.8%	23.1%	28.3%	7.9%	23.2%	28.4%
Screenline4	18	-	11.1%	29.4%	36.0%	11.6%	29.8%	36.4%
Screenline5	26	-	1.6%	17.2%	21.8%	2.2%	17.4%	22.2%
Screenline6	24	-	0.8%	13.7%	19.6%	2.5%	16.2%	21.9%
Screenline7	28	-	8.0%	23.4%	30.1%	11.6%	28.8%	35.8%
Screenline8	26	-	8.8%	24.7%	31.2%	9.0%	24.4%	30.9%
Screenline9	23	-	10.4%	26.8%	33.4%	11.6%	27.8%	34.2%
Screenline10	40	-	0.8%	16.6%	24.9%	1.1%	16.8%	25.1%
Screenline11	14	-	13.0%	28.0%	31.8%	12.7%	27.6%	32.1%
Screenline12	6	-	7.2%	14.9%	18.3%	7.2%	15.0%	18.4%
Screenline13	18	-	6.7%	19.5%	24.5%	6.7%	19.2%	24.3%
Screenline14	13	-	5.9%	11.6%	16.1%	5.8%	11.4%	15.9%
Screenline15	16	-	6.2%	15.7%	18.9%	6.3%	15.4%	18.7%
Total	740	-	6.5%	20.4%	25.7%	6.9%	20.8%	26.1%

8.3. M25 Mainline Forecast Flows and Speeds – Section 5

The forecast traffic flows and speeds on the M25 Section 5 mainline for each modelled period and forecast year are shown in Figure 8-3 to Figure 8-14. The results are described for each time period in turn.

A diagrammatic representation of the opening year (2015) and design year (2030) link flows (AADT) and percentage changes on the M25 mainline between Junctions 23 and 27 and the main links intersecting the M25 junctions for the DM and MM2 HSR scenarios are shown in Appendix C.

Morning Peak Hour

Tables 8-7 to 8-10 show the impacts of traffic growth in terms of total flows (PCUs) and speed (KPH) for the base and forecast years for the both clockwise and anti-clockwise directions on the M25 Section 5 for the DHS2 and DHS25 scenarios in the morning peak hour.

Compared to the base year 2004, traffic flows are increased by 23% to 25% in the clockwise direction on M25 Section 5 in 2015 for the DHS25 scenario. Without the MM2 HSR scheme, flows are increased by 9% to 11% from the base year 2004 to 2015, as shown by the DHS2 scenario outputs. By 2030, traffic flows for DHS25 in the clockwise direction are increased by 34% to 41% from the base year. In contrast, flows are increased by 18% to 24% in the DHS2 scenario. By 2040, traffic flows for DHS25 in the clockwise direction are increased by 38% to 48% from the base year.

In the anticlockwise direction on M25 Section 5, the proposed MM2 HSR improvements in the DHS25 scenario increase traffic flows by 19 to 23% in 2015 from the base year 2004. Without the MM2 HSR scheme in the DHS2 scenario, flows are only increased by 7% to 11% from the base year 2004 to 2015. By 2030, traffic flows for the DHS25 scenario in the clockwise direction are increased by 41% to 52% from the base year. In contrast, flows are increased by 23% to 30% for DHS2. By 2040, traffic flows for DHS25 in the clockwise direction are increased by 47% to 61% from the base year.

The forecast results show that speed is reduced to as low as 59 KPH in 2040 on M25 clockwise from J23 to J24 if there is no MM2 HSR scheme. In contrast, speed is increased to 80 KPH in 2040 for the DHS25 scenario. In the anti-clockwise direction, speed is reduced to as low as 49 KPH in 2040 on the M25 from J24 to J23 if there is no MM2 HSR scheme; and speed is increased to 79 KPH when the scheme is in place.

Total flows and speed comparisons for the base year and forecast years for the DHS2 and DHS25 scenarios are presented graphically in Figure 8-3 to Figure 8-6.

Table 8-7 M25 Clockwise on Section 5 Total Flows (PCUs) Comparison-AM Peak (08:00-09:00)

Scenario	Year	M25 J23-J24		M25 J24-J25		M25 J25-J26		M25 J26-J27	
		flows	(%)	flows	(%)	flows	(%)	flows	(%)
Base	2004	5789	-	5321	-	4665	-	4591	-
DHS2	2015	6381	10%	5780	9%	5186	11%	5100	11%
	2030	6856	18%	6324	19%	5806	24%	5712	24%
	2040	6959	20%	6537	23%	6100	31%	6003	31%
DHS25	2015	7209	25%	6567	23%	5811	25%	5647	23%
	2030	7770	34%	7257	36%	6577	41%	6398	39%
	2040	8014	38%	7559	42%	6917	48%	6746	47%

Table 8-8 M25 Clockwise on Section 5 Speed (KPH) Comparison-AM Peak (08:00-09:00)

Scenario	Year	M25 J23-J24	M25 J24-J25	M25 J25-J26	M25 J26-J27
Base	2004	83	88	94	95
DHS2	2015	76	83	89	87
	2030	65	78	83	80
	2040	59	75	80	77
DHS25	2015	86	90	95	94
	2030	82	86	90	89
	2040	80	84	88	87

Table 8-9 M25 Anti-Clockwise on Section 5 Total Flows (PCUs) Comparison-AM Peak (08:00-09:00)

Scenario	Year	M25 J27-J26		M25 J26-J25		M25 J25-J24		M25 J24-J23	
		flows	(%)	flows	(%)	flows	(%)	flows	(%)
Base	2004	4691	-	5173	-	5141	-	5446	-
DHS2	2015	5187	11%	5630	9%	5497	7%	5842	7%
	2030	6106	30%	6346	23%	6358	24%	6785	25%
	2040	6399	36%	6504	26%	6601	28%	6990	28%
DHS25	2015	5779	23%	6343	23%	6205	21%	6492	19%
	2030	7143	52%	7405	43%	7427	44%	7654	41%
	2040	7537	61%	7651	48%	7786	51%	8002	47%

Table 8-10 M25 Anti-Clockwise on Section 5 Speed (KPH) Comparison-AM Peak (08:00-09:00)

Scenario	Year	M25 J27-J26	M25 J26-J25	M25 J25-J24	M25 J24-J23
Base	2004	94	89	90	85
DHS2	2015	89	85	87	81
	2030	80	77	78	64
	2040	76	75	75	49
DHS25	2015	95	92	93	90
	2030	86	85	85	82
	2040	84	83	82	79

Figure 8-3 M25 Section 5 Clockwise – AM Peak – Traffic Flows (pcu)

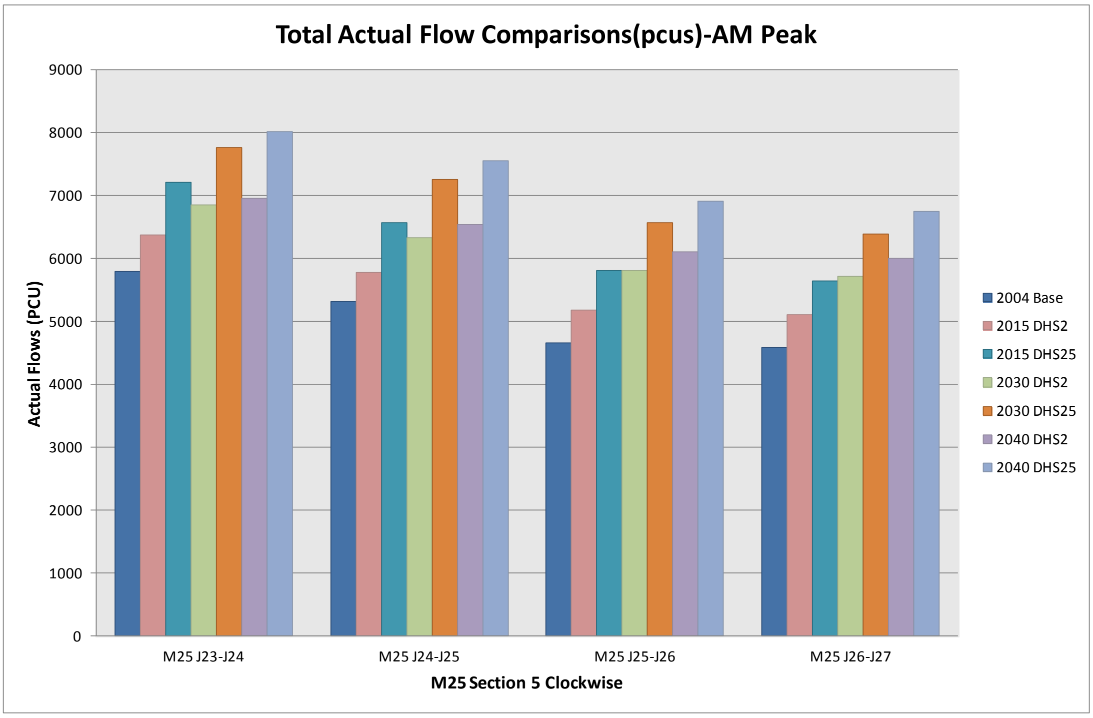


Figure 8-4 M25 Section 5 Anticlockwise – AM Peak – Traffic Flows (pcu)

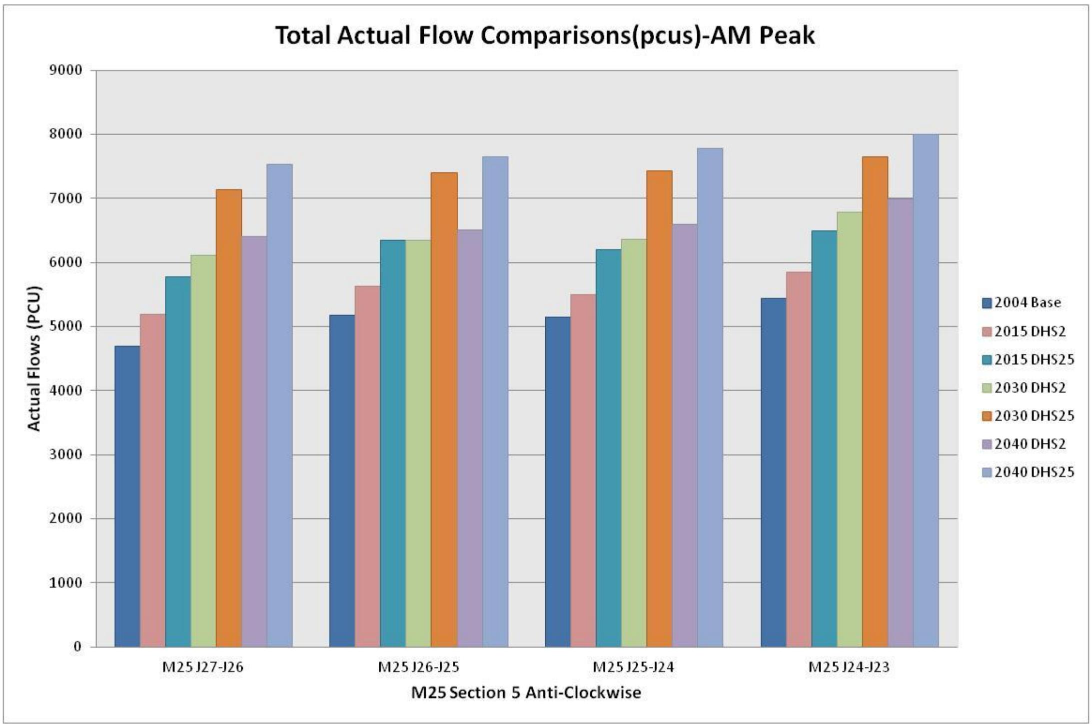


Figure 8-5 M25 Section 5 Clockwise – AM Peak – Average Speed (KPH)

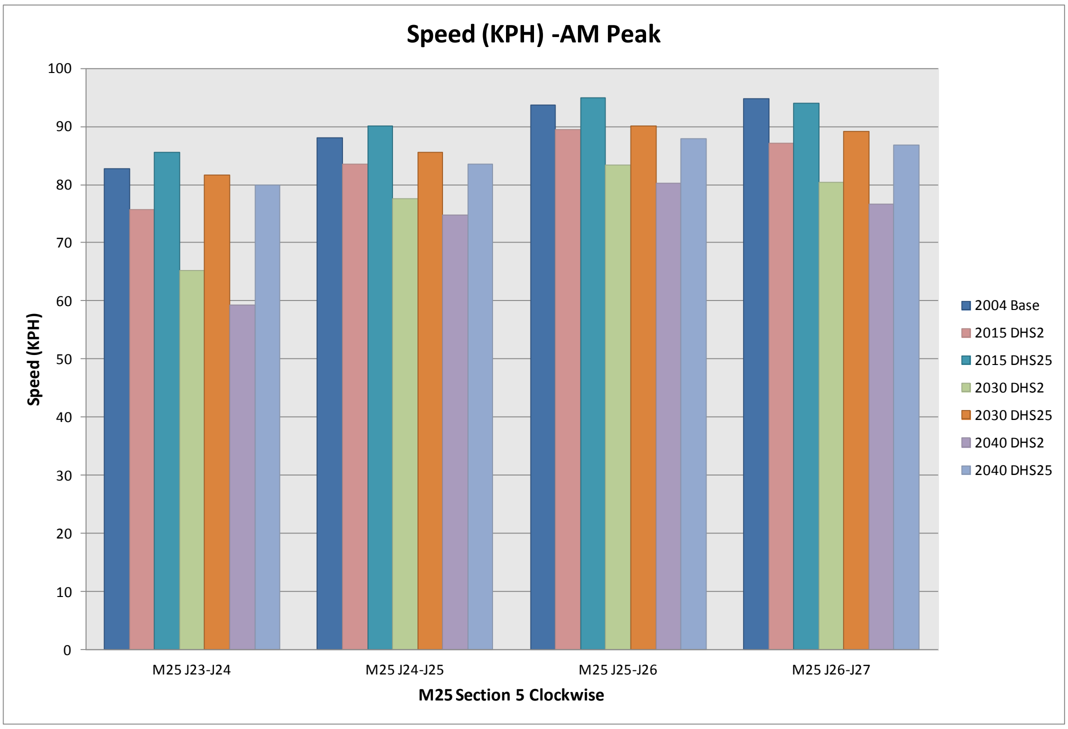
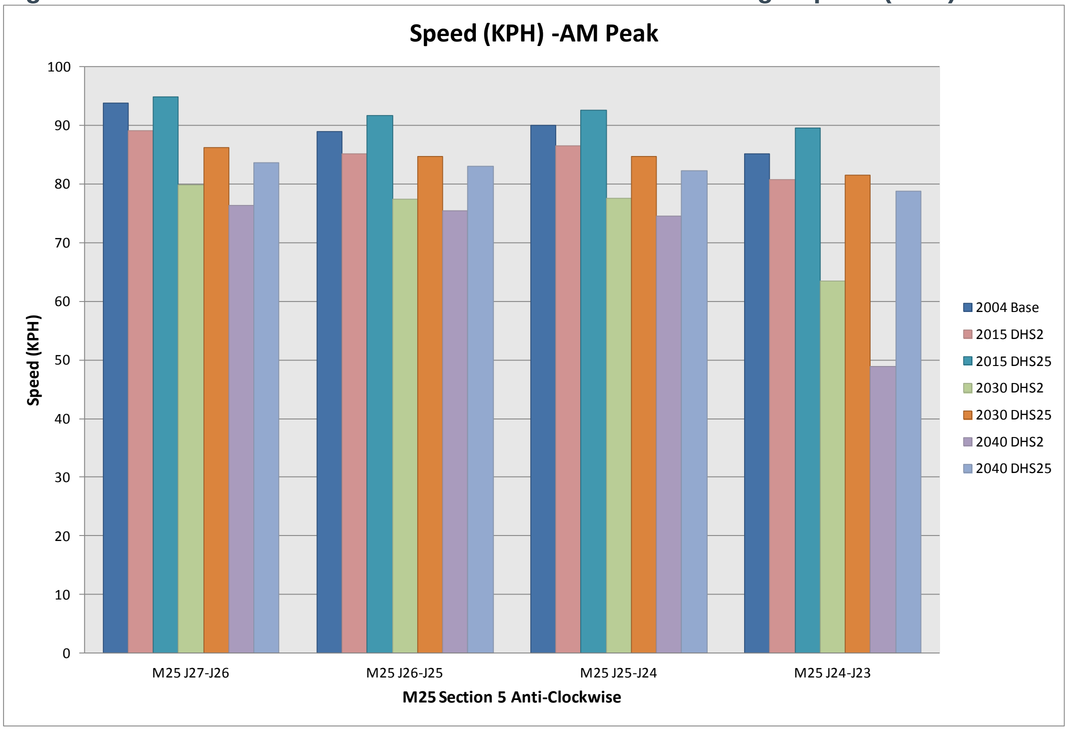


Figure 8-6 M25 Section 5 Anti-Clockwise – AM Peak – Average Speed (KPH)



Average Inter Peak Hour

Tables 8-11 to 8-14 show the impacts of traffic growth in terms of total flows (PCUs) and speed (KPH) for the base and forecast years for the both clockwise and anti-clockwise directions on M25 Section 5 for DHS2 and DHS25 scenarios in the average inter-peak hour between 10:00 and 16:00.

Compared to the base year 2004, traffic flows are increased by 22% to 23% in the clockwise direction on M25 Section 5 in 2015 for the DHS25 scenario. Without the MM2 HSR scheme, flows are increased by 8% to 11% from the base year 2004 to 2015, as shown by the DHS2 scenario outputs. By 2030, traffic flows for DHS25 in the clockwise direction are increased by 44% to 49% from the base year. In contrast, flows are increased by 24% to 32% in the DHS2 scenario. By 2040, traffic flows for DHS25 in the clockwise direction are increased by 50% to 58% from the base year.

In the anticlockwise direction on M25 Section 5, the proposed MM2 HSR improvements in the DHS25 scenario increase traffic flows by 26 to 31% in 2015 from the base year 2004. Without the MM2 HSR scheme in the DHS2 scenario, flows are only increased by 14% to 20% from the base year 2004 to 2015. By 2030, traffic flows for the DHS25 scenario in the clockwise direction are increased by 49% to 55% from the base year. In contrast, flows are increased by 29% to 34% for DHS2. By 2040, traffic flows for DHS25 in the clockwise direction are increased by 55% to 64% from the base year.

The forecast results show that speed is reduced to as low as 57 KPH in 2040 on M25 clockwise from J23 to J24 if there is no MM2 HSR scheme. In contrast, speed is increased to 77 KPH in 2040 for the DHS25 scenario. In the anti-clockwise direction, speed is reduced to as low as 49 KPH in 2040 on the M25 from J24 to J23 if there is no MM2 HSR scheme; and speed is increased to 79 KPH when the scheme is in place.

Total flows and speed comparisons for the base year and forecast years for the DHS2 and DHS25 scenarios are presented graphically in Figure 8-7 to Figure 8-10.

Table 8-11 M25 Clockwise on Section 5 Total Flows (PCUs) Comparison- Inter Peak (10:00-16:00)

Scenario	Year	M25 J23-J24		M25 J24-J25		M25 J25-J26		M25 J26-J27	
		flows	(%)	flows	(%)	flows	(%)	flows	(%)
Base	2004	5611	-	5356	-	5011	-	4794	-
DHS2	2015	6140	9%	5773	8%	5567	11%	5315	11%
	2030	6964	24%	6692	25%	6593	32%	6341	32%
	2040	6990	25%	6810	27%	6787	35%	6576	37%
DHS25	2015	6869	22%	6510	22%	6169	23%	5859	22%
	2030	8090	44%	7828	46%	7458	49%	7131	49%
	2040	8434	50%	8218	53%	7888	57%	7589	58%

Table 8-12 M25 Clockwise on Section 5 Speed (KPH) Comparison- Inter Peak (10:00-16:00)

Scenario	Year	M25 J23-J24	M25 J24-J25	M25 J25-J26	M25 J26-J27
Base	2004	85	88	91	93
DHS2	2015	79	84	86	85
	2030	59	72	74	71
	2040	57	70	71	66
DHS25	2015	88	91	93	93
	2030	79	82	84	84
	2040	77	79	81	81

Table 8-13 M25 Anti-Clockwise on Section 5 Total Flows (PCUs) Comparison-Inter Peak (10:00-16:00)

Scenario	Year	M25 J27-J26		M25 J26-J25		M25 J25-J24		M25 J24-J23	
		flows	(%)	flows	(%)	flows	(%)	flows	(%)
Base	2004	4429	-	4614	-	4882	-	5165	-
DHS2	2015	5299	20%	5467	18%	5595	15%	5908	14%
	2030	5952	34%	6099	32%	6322	29%	6720	30%
	2040	6177	39%	6325	37%	6605	35%	6990	35%
DHS25	2015	5813	31%	6064	31%	6220	27%	6522	26%
	2030	6860	55%	7135	55%	7416	52%	7702	49%
	2040	7245	64%	7430	61%	7798	60%	8023	55%

Table 8-14 M25 Anti-Clockwise on Section 5 Speed (KPH) Comparison- Inter Peak (10:00-16:00)

Scenario	Year	M25 J27-J26	M25 J26-J25	M25 J25-J24	M25 J24-J23
Base	2004	96	94	92	88
DHS2	2015	88	87	86	80
	2030	81	80	78	66
	2040	79	78	75	49
DHS25	2015	95	93	92	89
	2030	88	87	85	81
	2040	86	85	82	79

Figure 8-7 M25 Section 5 Clockwise – Inter Peak – Traffic Flows (pcu)

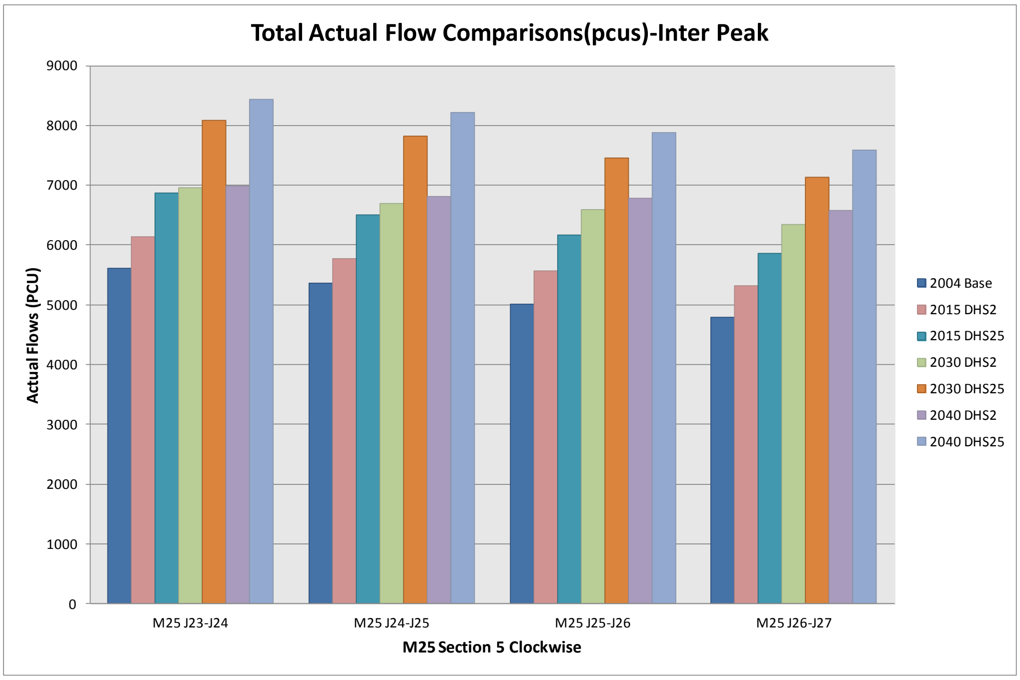


Figure 8-8 M25 Section 5 Anti-Clockwise – Inter Peak – Traffic Flows (pcu)

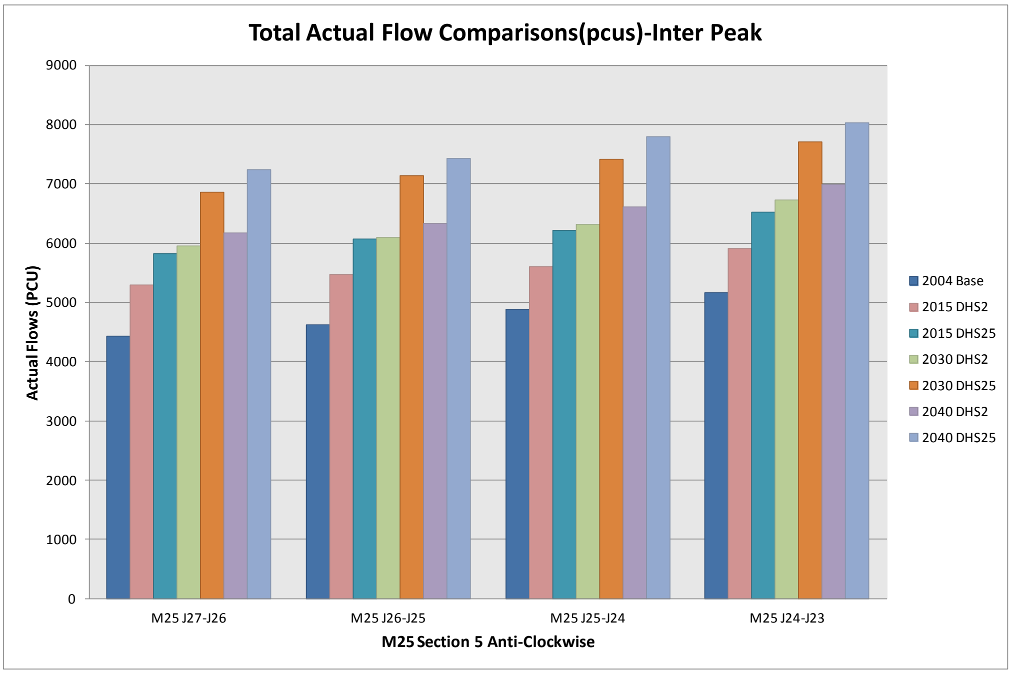


Figure 8-9 M25 Section 5 Clockwise – Inter Peak – Average Speed (KPH)

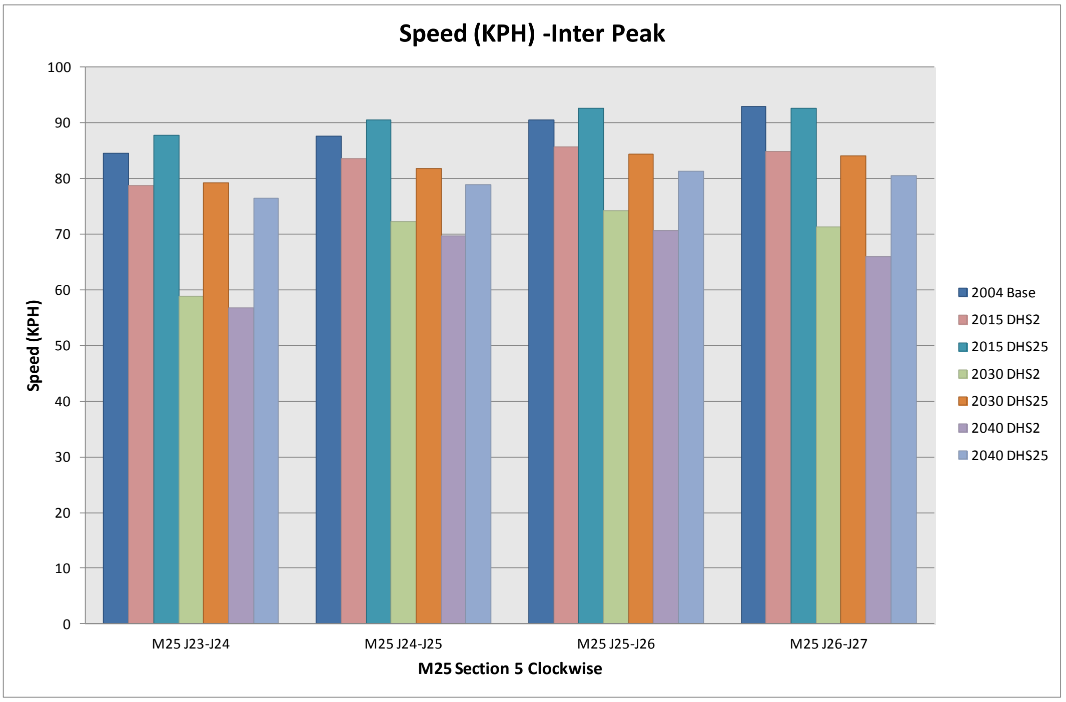
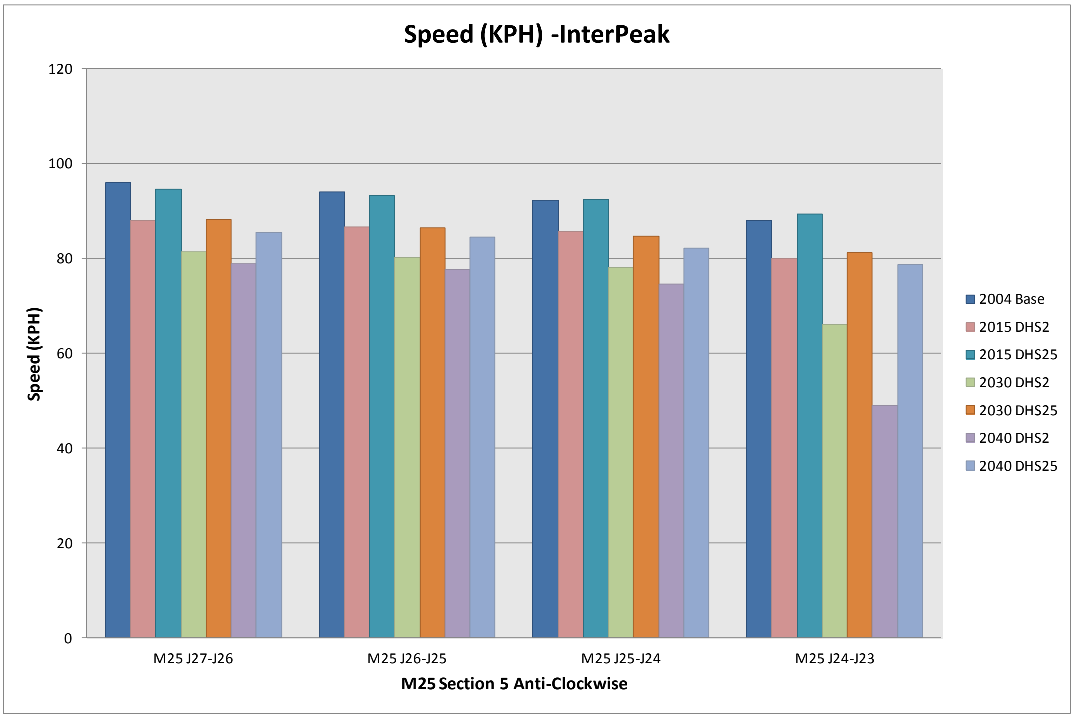


Figure 8-10 M25 Section 5 Anti-Clockwise – Inter Peak – Average Speed (KPH)



Evening Peak Hour

Tables 8-15 to 8-18 show the impacts of traffic growth in terms of total flows (PCUs) and speed (KPH) for the base and forecast years for the both clockwise and anti-clockwise directions on M25 Section 5 for the DHS2 and DHS25 scenarios in the evening peak hour.

Compared to the base year 2004, traffic flows are increased by 19% to 20% in the clockwise direction on M25 Section 5 in 2015 for the DHS25 scenario. Without the MM2 HSR scheme, flows are increased by 8% to 11% from the base year 2004 to 2015, as shown by the DHS2 scenario outputs. By 2030, traffic flows for DHS25 in the clockwise direction are increased by 40% to 47% from the base year. In contrast, flows are increased by 23% to 32% in the DHS2 scenario. By 2040, traffic flows for DHS25 in the clockwise direction are increased by 46% to 55% from the base year.

In the anticlockwise direction on M25 Section 5, the proposed MM2 HSR improvements in the DHS25 scenario increase traffic flows by 21% to 24% in 2015 from the base year 2004. Without the MM2 HSR scheme in the DHS2 scenario, flows are only increased by 11% to 12% from the base year 2004 to 2015. By 2030, traffic flows for the DHS25 scenario in the clockwise direction are increased by 34% to 41% from the base year. In contrast, flows are increased by 20% to 22% for DHS2. By 2040, traffic flows for DHS25 in the clockwise direction are increased by 37% to 46% from the base year.

The forecast results show that speed is reduced to as low as 60 KPH in 2040 on M25 clockwise from J26 to J27 if there is no MM2 HSR scheme. In contrast, speed is increased to 81 KPH in 2040 for the DHS25 scenario. In the anti-clockwise direction, speed is reduced to 71 KPH in 2040 on the M25 from J24 to J23 if there is no MM2 HSR scheme; and speed is increased to 84 KPH when the MM2 HSR scheme is in place.

Total flows and speed comparisons for the base year and forecast years for the DHS2 and DHS25 scenarios are presented graphically in the Figure 8-11 to Figure 8-14.

Table 8-15 M25 Clockwise on Section 5 Total Flows (PCUs) Comparison- PM Peak (17:00-18:00)

Scenario	Year	M25 J23-J24		M25 J24-J25		M25 J25-J26		M25 J26-J27	
		flows	(%)	flows	(%)	flows	(%)	flows	(%)
Base	2004	5449	-	4901	-	5010	-	4890	-
DHS2	2015	5905	8%	5302	8%	5537	11%	5398	10%
	2030	6695	23%	6143	25%	6487	29%	6443	32%
	2040	6925	27%	6434	31%	6779	35%	6731	38%
DHS25	2015	6483	19%	5854	19%	6006	20%	5858	20%
	2030	7620	40%	7073	44%	7303	46%	7200	47%
	2040	7960	46%	7483	53%	7711	54%	7579	55%

Table 8-16 M25 Clockwise on Section 5 Speed (KPH) Comparison- PM Peak (17:00-18:00)

Scenario	Year	M25 J23-J24	M25 J24-J25	M25 J25-J26	M25 J26-J27
Base	2004	86	92	91	92
DHS2	2015	81	88	86	84
	2030	70	80	76	69
	2040	62	76	71	60
DHS25	2015	90	95	94	93
	2030	83	87	85	84
	2040	80	84	83	81

Table 8-17 M25 Anti-Clockwise on Section 5 Total Flows (PCUs) Comparison- PM Peak (17:00-18:00)

Scenario	Year	M25 J27-J26		M25 J26-J25		M25 J25-J24		M25 J24-J23	
		flows	(%)	flows	(%)	flows	(%)	flows	(%)
Base	2004	4740	-	4709	-	4738	-	5274	-
DHS2	2015	5284	11%	5289	12%	5274	11%	5850	11%
	2030	5783	22%	5639	20%	5802	22%	6327	20%
	2040	6033	27%	5794	23%	6022	27%	6543	24%
DHS25	2015	5851	23%	5835	24%	5845	23%	6365	21%
	2030	6667	41%	6513	38%	6679	41%	7071	34%
	2040	6879	45%	6663	41%	6896	46%	7250	37%

Table 8-18 M25 Anti-Clockwise on Section 5 Speed (KPH) Comparison- PM Peak (17:00-18:00)

Scenario	Year	M25 J27-J26	M25 J26-J25	M25 J25-J24	M25 J24-J23
Base	2004	93	93	94	87
DHS2	2015	88	88	89	81
	2030	83	85	84	75
	2040	81	83	81	71
DHS25	2015	95	95	95	90
	2030	89	91	90	86
	2040	88	90	88	84

Figure 8-11 M25 Section 5 Clockwise – PM Peak – Traffic Flows (pcu)

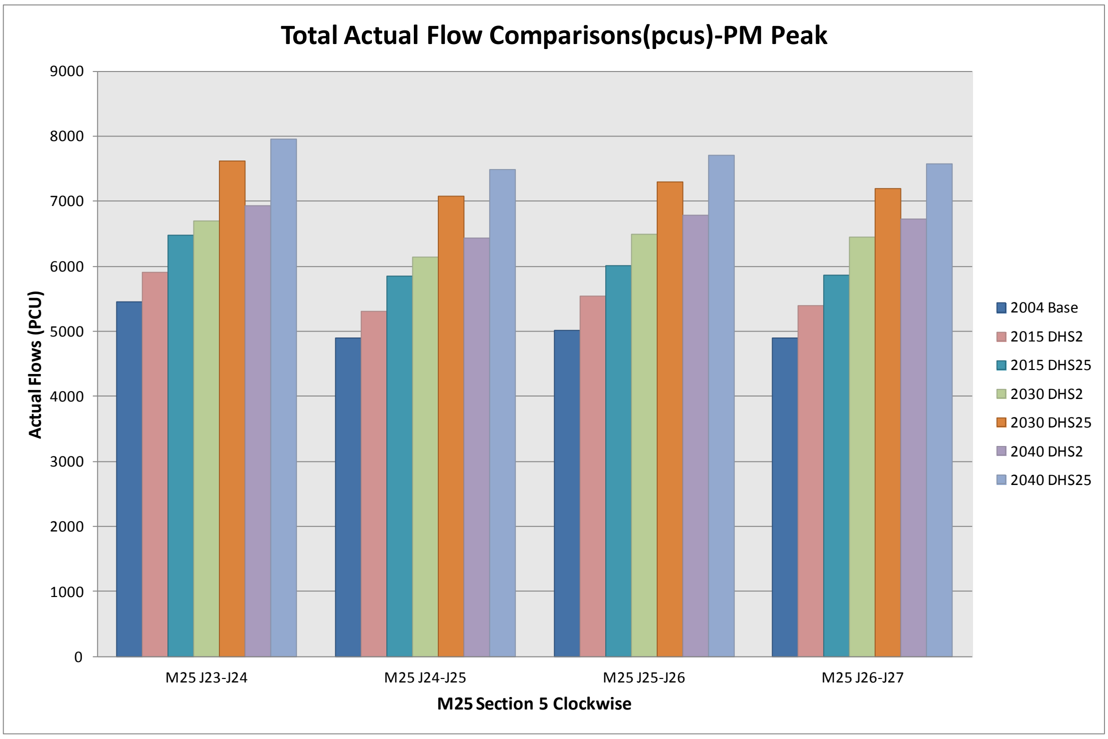


Figure 8-12 M25 Section 5 Anti-Clockwise – PM Peak – Traffic Flows (pcu)

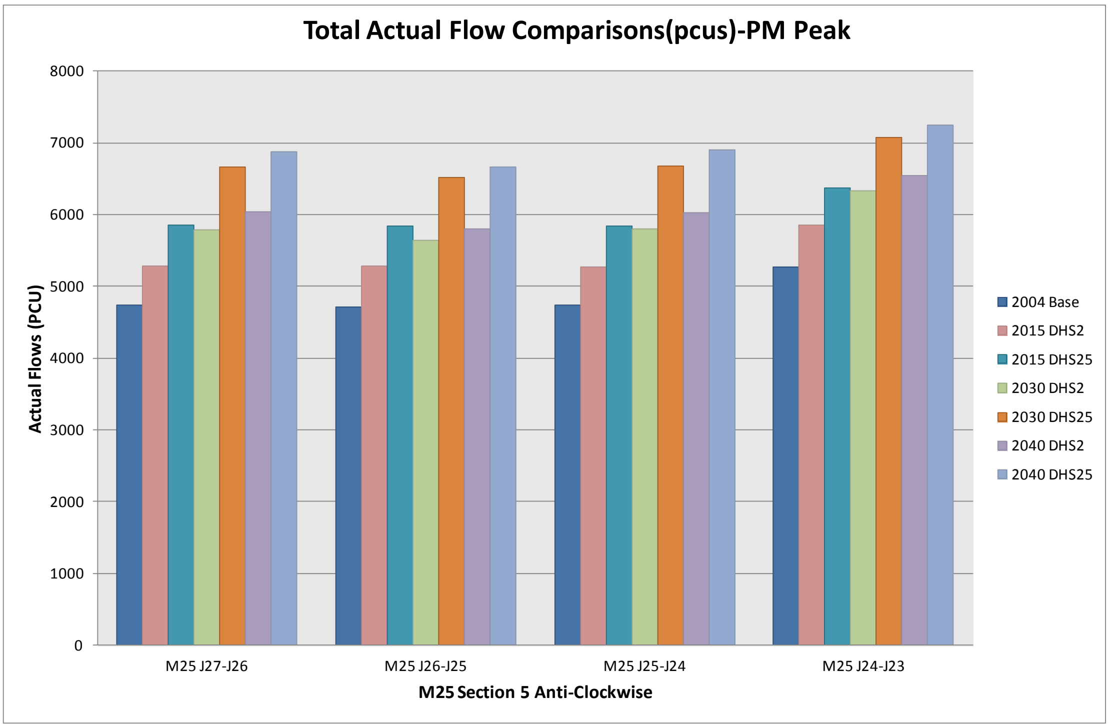


Figure 8-13 M25 Section 5 Clockwise – PM Peak –Speeds (KPH)

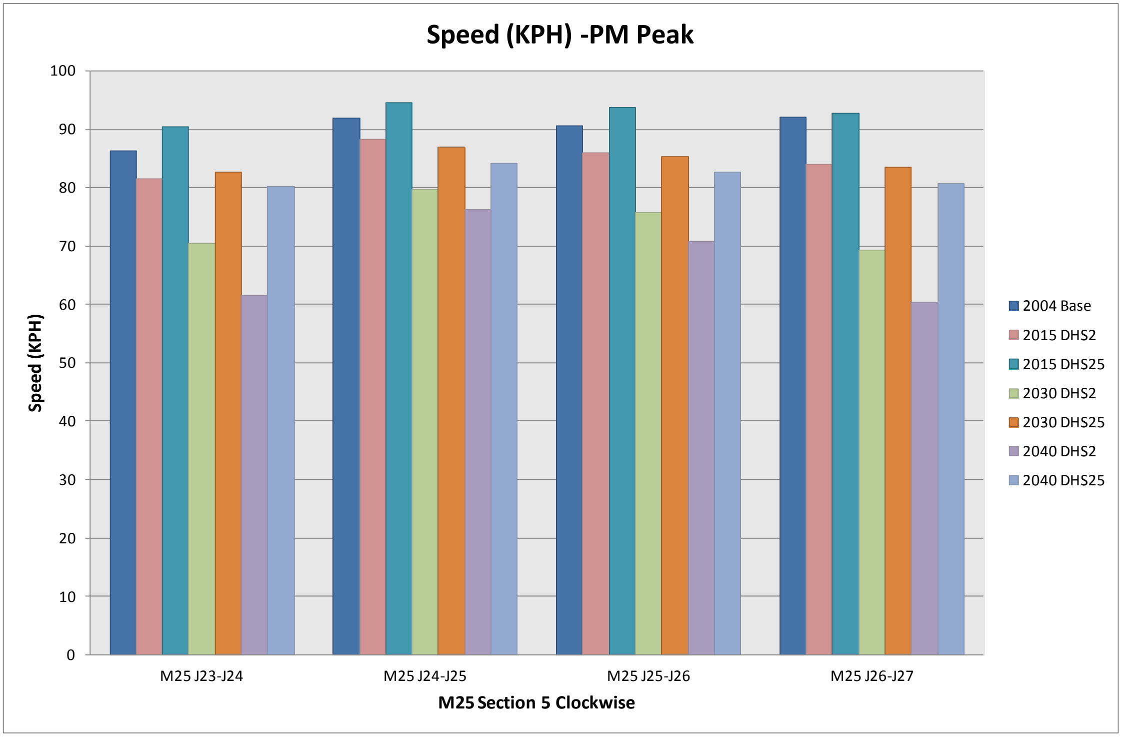
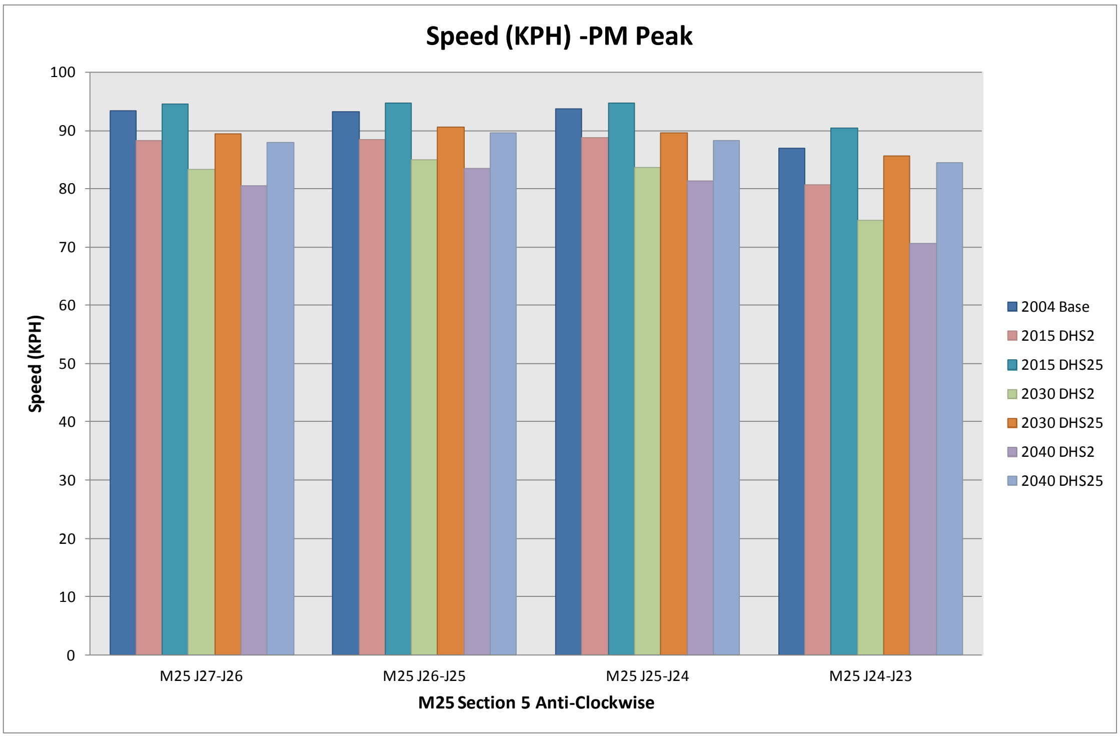


Figure 8-14 M25 Section 5 Anti-Clockwise – PM Peak –Speeds (KPH)



9. Traffic Forecasts for Environmental Appraisal

9.1. Introduction

The forecast data requested by the air quality and noise teams comprises the following:

Data for Air Quality and Greenhouse Gas Assessment:

- AM peak traffic flows (lights and heavies), average speed, queue speed and queue lengths (0800-0900);
- Average inter peak traffic flows (lights and heavies), average speed, queue speed and queue lengths (1000-1600);
- PM peak traffic flows (lights and heavies), average speed, queue speed and queue lengths (1700-1800);
- Night-time 12hr traffic flows (1900-0700) and speeds (1900 - 0700);
- 24hr Annual Average Daily Traffic (AADT);
- Number of lanes on the road;
- Average Daily Speed; and
- Road Types (D3M, D2AP, Rural S2 etc).

Also a temporal flow traffic profile for five weekday average (Mon – Fri), Saturday and Sunday was provided. The 72 hour profile was provided to enable the environmental team to convert the Annual Average Daily Traffic (AADT) flow to a flow for any particular hour for an average weekday or Saturday or Sunday.

Data for Noise Assessment:

- 24 hour weekday traffic flows (lights and heavies) and percentage HGV (0000-2400);
- AM peak, inter-peak and PM peak speeds and queue speeds;
- 18hr Annual Average Weekday Traffic (AAWT); and
- Average Daily Speed.

In all cases traffic data for environmental appraisal was drawn from the variant of the model introduced as Model 'I' in section 1.2 of this report. This uses April 2011 forecasting parameters including NTEM 6.2 growth assumptions and LGV and HGV growths are applied from the Road Traffic Forecast 2011 published in 24th January 2012.

9.2. Estimation of Annual Averages of Flow and Speed

The model base year is an average October weekday in 2004. Outputs for five user classes are currently available; car business, car commuting, car other, LGV and HGV. For the purposes of the calculation of traffic flow factors two categories are considered; light vehicles and heavy (goods) vehicles.

As no modelled data is available for the night time period, this data was generated from the modelled data. The approach is outlined below:

Long term Automatic Traffic Count (ATC) traffic data was obtained from the HA's HATRIS database. The data was collected for 24 hours a day and for all days of 2010 (most recent full year available). The data was collected for light and heavy vehicles separately.

All missing data was estimated by assuming the average of the flows (in the same period) on the same days of the week in the same month. Where data was unavailable throughout a particular month, COBA M-Factors were used to factor from a month for which data was available.

The temporal flow profiles from the following sites were used for different road types to calculate the 72hr temporal profile used in the detailed Air Quality assessment.

Table 9-1 Traffic Sites used for Temporal Flow Profiles

Road Type	Road Used	Location
Motorway	M25	J25– J26
Non-motorway – Strategic	A1 and A12	A1 - A5135 Junction; A12 - Brentwood
Non-motorway - Other	A1089 and A41	A1089- between Tilbury and A126; A41 - Tylers Way

From the 72hr temporal profiles separate factors were applied to the weekday AM peak model hour (0800 – 0900) to derive each of the hourly flows during the AM peak *period* (0700 – 1000). Likewise, factors were applied to the modelled PM peak hour flows (1700-1800) to derive each of the hourly flows during the PM peak period (1600 – 1900). The same approach was used for Saturdays and Sundays; separate factors were applied to the AM peak or PM peak weekday hourly flows, to derive hourly flows in each of the weekend AM and weekend PM 'peak' periods respectively. The weekend hours falling into either of the weekend AM or weekend PM peak periods were selected on the basis of the observed hourly flow (taken as 4,500 veh/hr, the same as the trigger for MM1 DHSR operation), and categorised as notional 'AM' or 'PM' hours according to the observed tidality of flow. Thus hours during the 'weekend AM' period exhibit the same tidality as those in the modelled weekday AM peak hour (irrespective of whether or not they actually occur before or after noon).

Combined weekday and weekend peak period factors to apply to each of the AM peak and PM peak modelled flows were calculated from the above – by adding the weekday factors to the weekend factors (AM weekday to AM weekend, and PM to PM), duly weighted to reflect the five weekdays per week. The resulting factors comprised the means of calculating the peak periods' contributions to the 12hr AADT.

For the weekday inter-peak period (1000 – 1600) a factor of six was applied to the 'average 1000 – 1600 hour' modelled flow. Coupled with the weekday peak period factors this covers 12 weekday hours (0700-1900):There was no separate treatment of the weekend 'inter-peak', as all hours with sufficiently high weekend flows (4,500 veh/hr or more) had already been assigned to either the 'weekend AM' or 'weekend PM' periods, as discussed above.

All of the above factors were assumed to apply to those periods when the DHSR would be operational. Thus for Do-Minimum forecast hourly flows the factors were applied to Do-Minimum model outputs and for Do-Something forecast hourly flow, the factors were applied to Do-Something model outputs.

Thus the above factors were used to calculate the 12hr (0700 – 1900) AADT values. A separate set of factors was derived from the observed traffic data to be applied to this 12 hr AADT value to calculate the rest of the 24hr period (i.e. 1900 – 0700).

Similar steps were taken to provide annual average weekday (18 hour) daily flows (AAWT) 0600-2400 for the noise assessment. All the factors derived for AADT and AAWT calculations are shown in Appendix D.

The Highways Agency HATRIS database has average speed data, but has a very limited coverage to analyse annual average daily speeds. In the absence of a database to estimate daily speeds, the approach used to estimate the annual average speeds was to take flow weighted averages of the speeds in each of the modelled hours, on a link by link basis.

10. Summary

The M25AM Base Model version B602 has been used to develop forecast models for the assessment of the M25 Section 5 MM2 HSR scheme proposals. This Traffic Forecasting Report describes the development of forecast Do Minimum and Do Something networks, the development of Reference Case forecast trip matrices, the assignment procedures and the forecast model results.

The forecast models make use of the M25 Demand Model that was specifically developed for this study. This demand model uses a Variable Demand Modelling approach that closely follows the DfT WebTAG guidance.

Forecast models have been developed for the opening year 2015 and forecast years 2030 and 2040. Forecast flows have been modelled for the Do-Minimum and MM2 HSR scenarios. The convergence statistics of the forecast models indicate that convergence is better than that required by the relevant DMRB criteria.

Process and conversion factors from peak hour flows to AADT and 18hr AAWT have been developed to provide inputs for environmental assessment.

The forecast models are shown to be a reliable tool for carrying out the economic and environmental appraisal for the M25 Section 5 MM2 HSR scheme.

Appendix A – Section 2 and 5 MM2 HSR Scheme Drawing

Figure A- 1 M25 Section 2 HSR Scheme Drawing

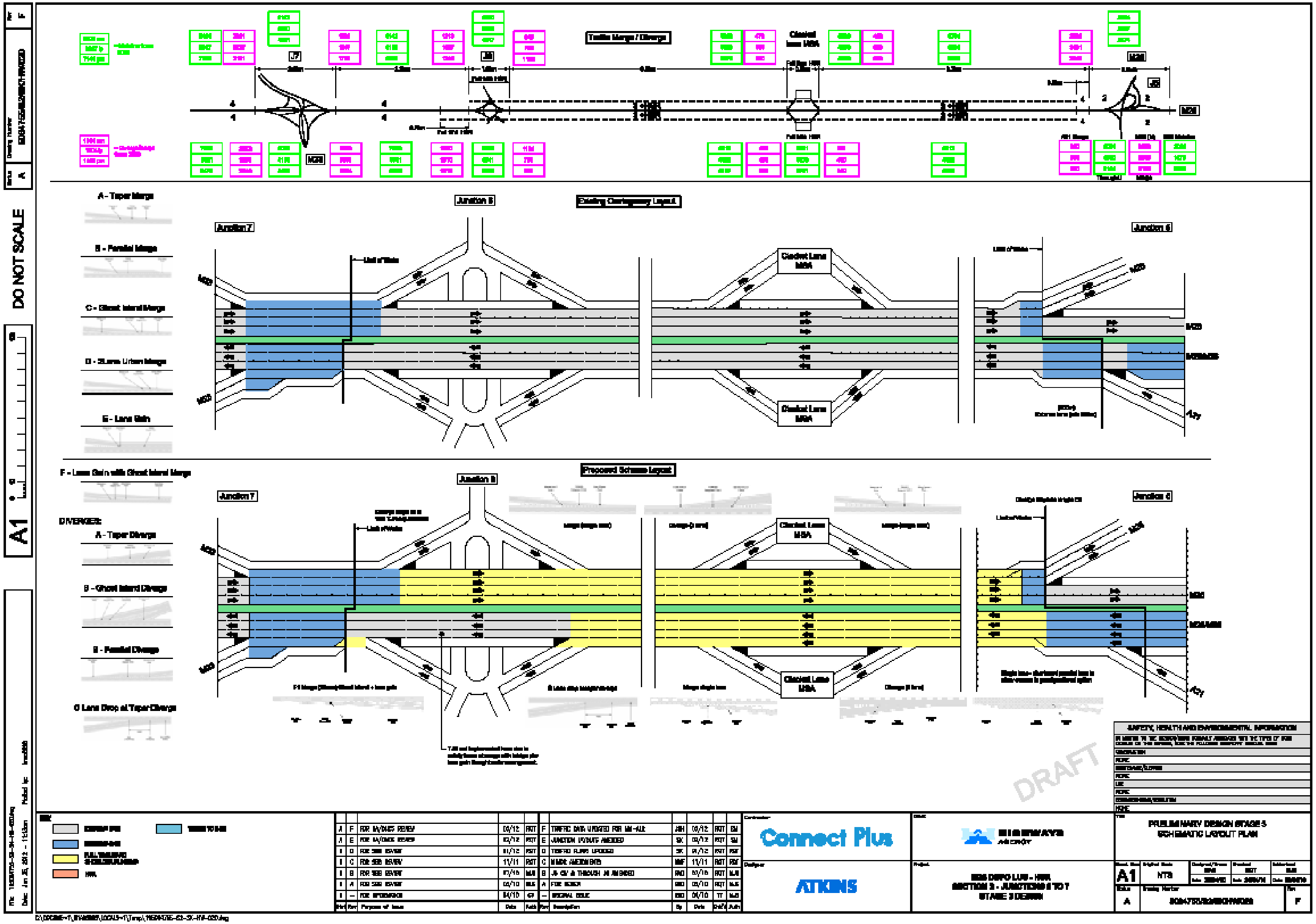
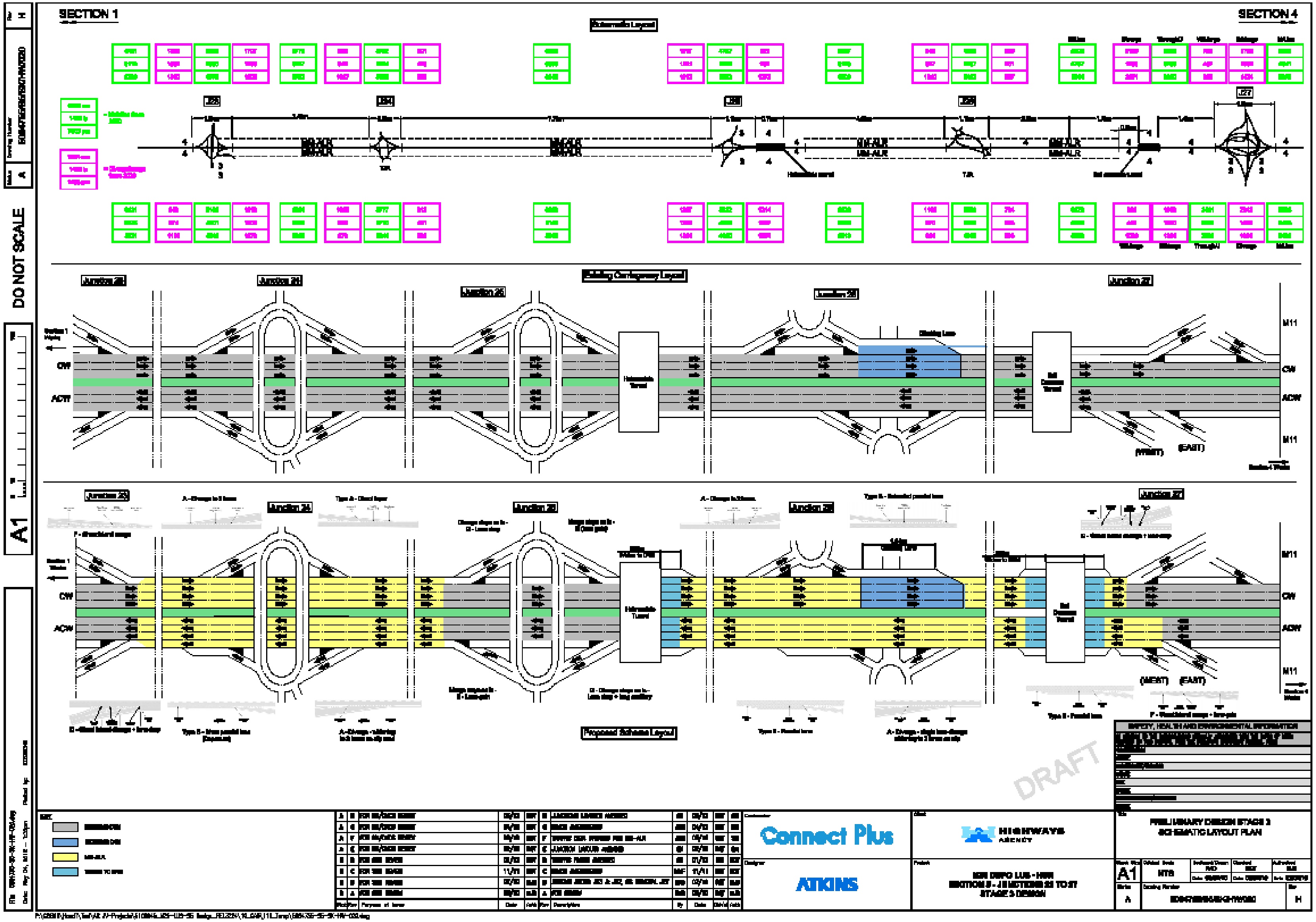


Figure A- 2 M25 Section 5 HSR Scheme Drawing



Appendix B – TEMPRO 16 Hour Growth Factors

Car Driver+Car Passenger (PA)

Model Year	Data Type	Total 16 hr total Tours/trips and GF by years											
		HB Employers Business (EB)		HBO		HB Work		NHB Employers Business (EB)		NHBO		Total	
		Production	Attraction	Production	Attraction	Production	Attraction	Production	Attraction	Production	Attraction	Production	Attraction
2004	Tours/Trips	1,872,990	1,874,181	31,105,736	31,019,826	15,103,334	15,120,775	2,797,881	2,793,775	10,211,241	10,205,160	61,091,182	61,013,717
2015	Tours/Trips	1,974,747	1,978,114	34,853,788	34,798,014	15,940,866	15,974,791	2,970,159	2,965,447	11,180,059	11,173,404	66,919,619	66,889,770
	GF	1.05	1.06	1.12	1.12	1.06	1.06	1.06	1.06	1.09	1.09	1.10	1.10
2030	Tours/Trips	2,135,006	2,139,345	39,278,841	39,255,442	16,980,412	17,019,568	3,203,001	3,197,272	12,365,956	12,358,611	73,963,216	73,970,238
	GF	1.14	1.14	1.26	1.27	1.12	1.13	1.14	1.14	1.21	1.21	1.21	1.21
2040	Tours/Trips	2,253,916	2,259,261	41,791,767	41,793,924	17,730,360	17,774,659	3,372,584	3,365,819	13,099,779	13,091,514	78,248,406	78,285,177
	GF	1.20	1.21	1.34	1.35	1.17	1.18	1.21	1.20	1.28	1.28	1.28	1.28

Bus (OD)

Model Year	Data Type	Total 16 hr total Tours/trips and GF by years											
		HB Employers Business (EB)		HBO		HB Work		NHB Employers Business (EB)		NHBO		Total	
		Production	Attraction	Production	Attraction	Production	Attraction	Production	Attraction	Production	Attraction	Production	Attraction
2004	Tours/Trips	103,621	103,683	8,568,730	8,566,975	2,995,218	2,993,150	59,818	58,941	683,769	678,961	12,411,156	12,401,710
2015	Tours/Trips	105,542	105,451	8,848,344	8,846,780	2,955,615	2,953,774	62,287	61,345	717,576	712,582	12,689,364	12,679,932
	GF	1.02	1.02	1.03	1.03	0.99	0.99	1.04	1.04	1.05	1.05	1.02	1.02
2030	Tours/Trips	107,896	107,820	9,402,440	9,400,725	2,907,632	2,905,807	65,451	64,445	770,341	764,873	13,253,760	13,243,670
	GF	1.04	1.04	1.10	1.10	0.97	0.97	1.09	1.09	1.13	1.13	1.07	1.07
2040	Tours/Trips	109,271	109,190	9,597,674	9,595,722	2,875,290	2,873,517	67,646	66,587	794,686	789,404	13,444,567	13,434,420
	GF	1.05	1.05	1.12	1.12	0.96	0.96	1.13	1.13	1.16	1.16	1.08	1.08

Rail (OD)

Model Year	Data Type	Total 16 hr total Tours/trips and GF by years											
		HB Employers Business (EB)		HBO		HB Work		NHB Employers Business (EB)		NHBO		Total	
		Production	Attraction	Production	Attraction	Production	Attraction	Production	Attraction	Production	Attraction	Production	Attraction
2004	Tours/Trips	152,625	152,743	1,189,908	1,190,402	2,152,590	2,150,976	68,304	68,569	317,191	315,446	3,880,618	3,878,136
2015	Tours/Trips	158,294	158,362	1,287,245	1,287,647	2,244,972	2,243,347	71,880	72,105	338,386	336,514	4,100,777	4,097,975
	GF	1.04	1.04	1.08	1.08	1.04	1.04	1.05	1.05	1.07	1.07	1.06	1.06
2030	Tours/Trips	166,652	166,771	1,397,245	1,397,392	2,304,684	2,303,018	76,340	76,549	365,889	363,775	4,310,810	4,307,505
	GF	1.09	1.09	1.17	1.17	1.07	1.07	1.12	1.12	1.15	1.15	1.11	1.11
2040	Tours/Trips	172,934	172,946	1,460,220	1,460,398	2,345,285	2,343,528	79,524	79,747	381,668	379,442	4,439,631	4,436,061
	GF	1.13	1.13	1.23	1.23	1.09	1.09	1.16	1.16	1.20	1.20	1.14	1.14

Appendix C – M25 Mainline Link Flows (AADT)

Figure C.1: 2015 Do Minimum Mainline AADT Flows (DHS2)

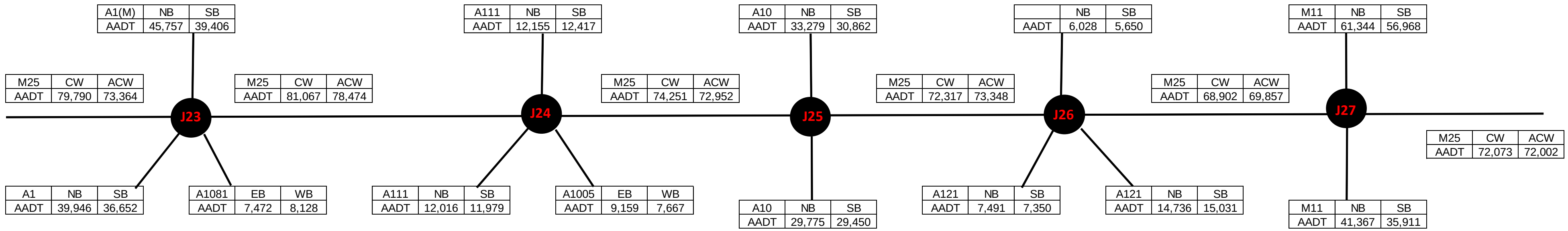


Figure C.2: 2015 Hard Shoulder Running Mainline AADT Flows (DHS25)

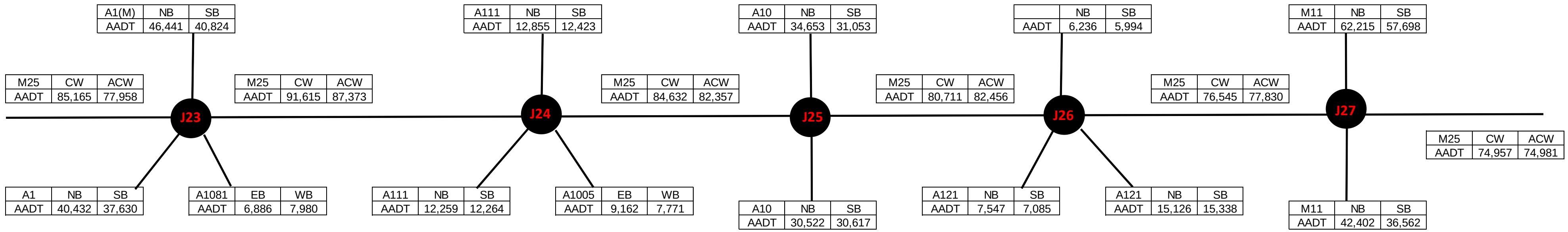


Figure C.3: 2015 AADT Flows Changes (DHS25 vs. DHS2)

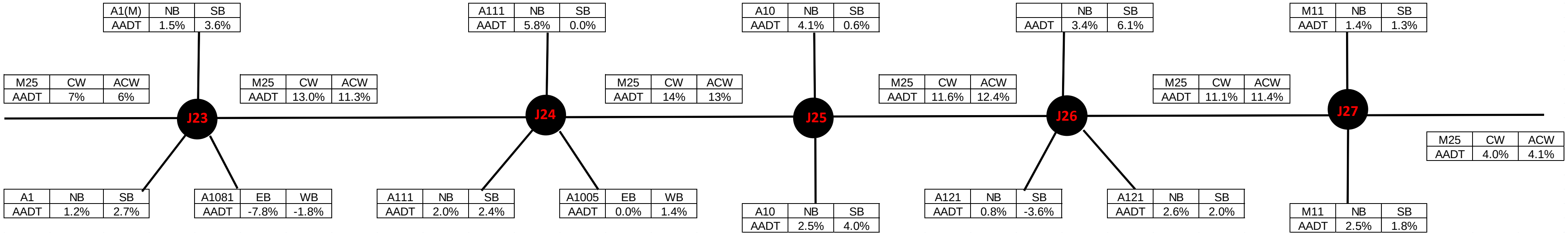


Figure C.4: 2030 Do Minimum Mainline AADT Flows (DHS2)

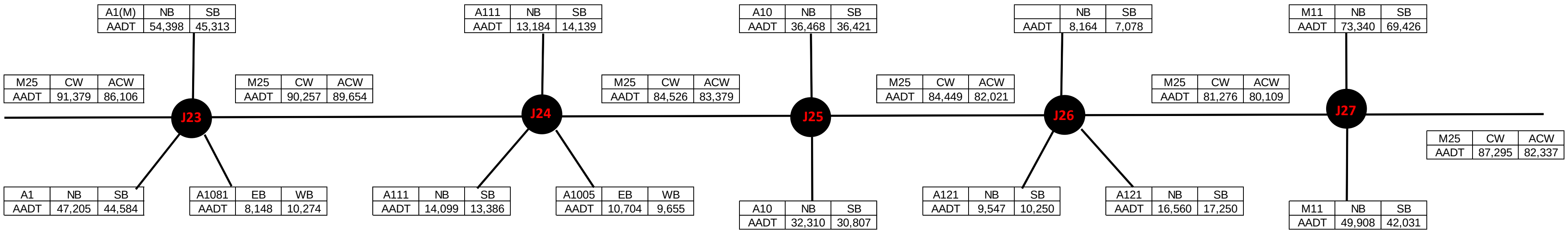


Figure C.5: 2030 Hard Shoulder Running Mainline AADT Flows (DHS25)

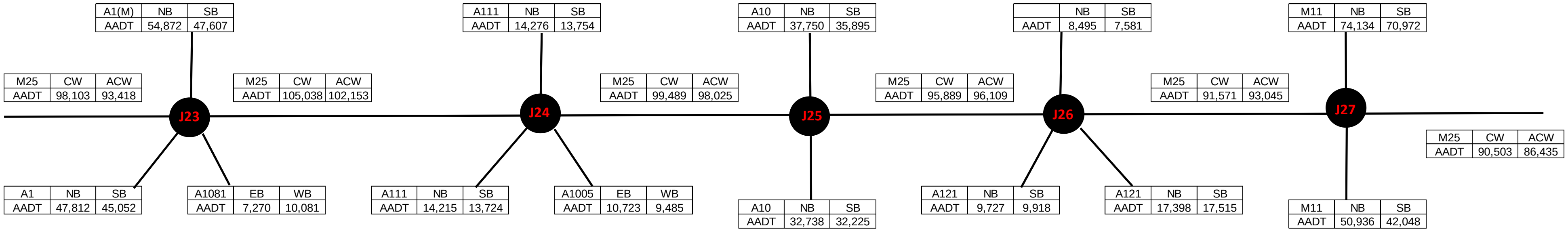
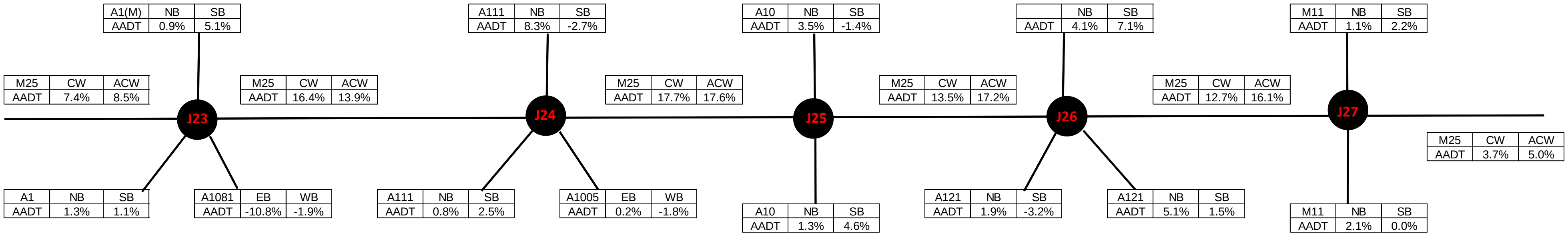


Figure C.6: 2030 AADT Flows Changes (DHS25 vs. DHS2)



Appendix D – Summary Flow Factors

Table D.1: Summary Factors for Air Quality Assessment

Factors to Convert Modelled Flows to 24 Hour Annual Average Daily Traffic (AADT) Flows

Factors to Apply to:	Lights								Heavies							
Road Type	**AM (DM)**	**AM(DS)**	**IP(DM)**	**IP(DS)**	**PM(DM)**	**PM(DS)**	**OP (DM)**	**OP (DS)**	**AM (DM)**	**AM(DS)**	**IP(DM)**	**IP(DS)**	**PM(DM)**	**PM(DS)**	**OP (DM)**	**OP (DS)**
Motorway	2.943297	2.943297	6.503798	6.503798	2.469992	2.469992	0.342319	0.342319	2.599119	2.599119	4.975586	4.975586	2.360021	2.360021	0.496372	0.496372
Non-motorway Strategic	2.777746	2.777746	6.490125	6.490125	2.322357	2.322357	0.329271	0.329271	2.632396	2.632396	4.989843	4.989843	2.347919	2.347919	0.370661	0.370661
Non-motorway Strategic	2.659776	2.659776	6.050849	6.050849	2.170335	2.170335	0.277848	0.277848	2.431248	2.431248	4.744609	4.744609	2.294397	2.294397	0.242685	0.242685

Colour Code:

- (Orange) Factors to be applied to **AM (0800 - 0900)** traffic model flows - apply on DM and DS models as appropriate
- (Red) Factors to be applied to **IP (1000 - 1600)** traffic model flows - apply on DM and DS models as appropriate
- (Green) Factors to be applied to **PM (1700 - 1800)** traffic model flows - apply on DM and DS models as appropriate
- (Lilac) Factors to be applied to **12 peak hour AADT (0700 - 1900)** calculated by using model flows and the above factors - to calculate 1900 - 0700 flows

Table D.2: Summary Factors for Noise Assessment

Factors to Convert Modelled Flows to 24 Hour Annual Average Weekday Traffic (AAWT) Flows

Factors to Apply to:	Lights								Heavies							
Road Type	**AM (DM)**	**AM(DS)**	**IP(DM)**	**IP(DS)**	**PM(DM)**	**PM(DS)**	**OP (DM)**	**OP (DS)**	**AM (DM)**	**AM(DS)**	**IP(DM)**	**IP(DS)**	**PM(DM)**	**PM(DS)**	**OP (DM)**	**OP (DS)**
Motorway	2.95699	2.95699	6.00000	6.00000	2.86818	2.86818	0.27201	0.27201	3.23456	3.23456	6.00000	6.00000	3.05932	3.05932	0.27301	0.27301
Non-motorway Strategic	2.89303	2.89303	6.00000	6.00000	2.77535	2.77535	0.26864	0.26864	3.29666	3.29666	6.00000	6.00000	3.06914	3.06914	0.22587	0.22587
Non-motorway Strategic	2.72734	2.72734	6.00000	6.00000	2.70482	2.70482	0.22434	0.22434	3.09792	3.09792	6.00000	6.00000	3.07576	3.07576	0.14027	0.14027

Colour Code:

Orange	Factors to be applied to **AM (0800 - 0900)** traffic model flows - apply on DM and DS models as appropriate
Red	Factors to be applied to **IP (1000 - 1600)** traffic model flows - apply on DM models
Grey	Factors to be applied to **IP (1000 - 1600)** traffic model flows - apply on DS models
Green	Factors to be applied to **PM (1700 - 1800)** traffic model flows
Lilac	Factors to be applied to **12 peak hour AADT (0700 - 1900)** calculated by using model flows and the above factors

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