Stamford Model Update

Forecast Report

January 2018

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1 Introduction

1.1 Background

Mouchel (more recently WSP) have been commissioned to develop and update the Stamford Transport Model to help provide evidence in support of a land allocation known as the Land North of Stamford Development.

The allocation comprises two separate residential led developments – one in South Kesteven for up to circa 1,350 dwellings (promoted by Burghley Estates), and one immediately to the west of this in Rutland, for up to circa 650 dwellings (promoted by Larkfleet Homes). In total, the Land North of Stamford development comprises 2000 residential dwellings and a number of other retail/commercial units.

The Land North of Stamford development is being assessed as part of the Local Plan Reviews of both South Kesteven District Council and Rutland County Council. The evidence provided will inform the decision to include this allocation in the forthcoming Local Plan(s). In addition this report and model will provide information to inform a Transport Assessment to support a possible future planning application for the Land North of Stamford development.

In addition to the development plans, a link road that provides access to the individual units of the development could be included as part of the coordinated approach and is included in the model forecasts. The link road would run from the B1081 Casterton Road from the west, through to Little Casterton Road, on to the A6121 Ryhall Road to the east. This road may provide additional benefits to Stamford.

The model forecasts are being developed by WSP, utilising forecast inputs agreed between PBA and Lincolnshire County Council Highways Alliance, including the number of dwellings and retail unit surface area, and trip generation figures associated with each of the development units.

1.2 Purpose of this Report

This Traffic Forecasting Report describes the inputs, assumptions and procedures involved in setting up and running the future year forecasts for the Stamford Model, along with the demand and assignment results of those forecasts. The procedures have been designed to comply with the Transport Appraisal Guidance (TAG) set up by the Department for Transport (DfT), covering the following units:

- Unit M3-1: Highway Assignment Modelling
- Unit M4: Forecasting and Uncertainty

1.3 Structure of this Report

The report describes the various stages of the model system development, recalibration and revalidation processes and is structured as follows:

- Section 2 – Overview of Base Year model
- Section 3 – Overview of Forecasting Processes
- Section 4 – Forecasting Inputs & Assumptions
- Section 5 – Demand Forecast Outputs
- Section 6 – Traffic Assignment Results

- Section 7 – Summary and Conclusions

2 Overview of Base Year Model

2.1 Background

This section provides an overview of the validated Stamford Transport Model. More information regarding the model development and validation process is provided in the *Local Model Validation Report*, August 2017. The model was originally developed in 2009 by Jacobs, and was subsequently reviewed and updated to a new base year of 2017 by WSP.

An approach was favoured by Lincolnshire County Council Highways Alliance that minimised time and cost by utilising the existing model and matrices where possible. It was agreed with Lincolnshire County Council Highways Alliance that the model would reach a level of validation that can be considered 'fit for the purpose of assessing the forecast impacts of the development'. Whilst the model was not expected to fully comply with standard WebTAG validation criteria the model has validated against typical WebTAG criteria in most aspects.

2.2 Model Structure

The VISUM model covered was provided by Jacobs and updated by WSP to the base year of 2017. The network coverage stretches from just South of Grantham (to the North) to Peterborough (to the South).

Figure 2-1 VISUM Model network coverage

2.3 Zoning System

The model contains 142 zones, eight of which are external development zones for the Land North of Stamford development. Of the 134 base model zones, 98 are within Stamford, 29 are buffer zones and seven are external zones representing the rest of Great Britain.

2.4 Model Matrices

The original matrices were verified by checking against Mobile Phone Origin Destination (MPOD) and Census Journey to Work data. Trips to and from Stamford were retained (with minimal rezoning), whilst external-external trips (representing traffic travelling along the A1

West of Stamford) were replaced by MPOD data. LGV and HGV matrices were constructed from Trafficmaster OD data.

2.5 Modelled Time Periods

The modelled time periods are:

- AM Peak Hour (08:00-09:00)
- PM Peak Hour (17:00-18:00)

2.6 Vehicle Classes

Three vehicle classes have been modelled in the Stamford Traffic Model:

- Cars;
- Light Goods Vehicles (LGV);
- Heavy Goods Vehicles (HGV).

3 Overview of Forecasting Processes

3.1 Introduction

This section outlines the processes involved in forecasting future year traffic demand for modelling the Land North of Stamford development. The developments to be included and the scenario definitions have been agreed between PBA and Lincolnshire County Council Highways Alliance. WSP has used all scenario definitions, trip rates and trip end forecasts agreed between PBA and Lincolnshire County Council Highways Alliance in the forecast modelling.

3.2 Overview of Demand Forecasting Procedures

Growth in demand is calculated through TEMPRO for car trips and NTM for LGVs and HGVs. TEMPRO makes use of local planning information and national forecasts, whilst NTM forecasts vehicle kilometres, which are used as a proxy for vehicle trip frequency for LGVs and HGVs. Trip generation figures for the Land North of Stamford development in the model forecasts were calculated by PBA and agreed with Lincolnshire County Council. Care is taken to avoid double counting of trips resulting from the Land North of Stamford development which may be present in the more general planning information incorporated through TEMPRO growth factors.

3.3 Forecast Time Periods and Years

The time periods adopted in the base year (AM peak of 08:00 – 09:00 and PM peak of 17;00 – 18:00) are also used in the forecast models.

Three model forecast years have been agreed between PBA and Lincolnshire County Council Highways Alliance and are used by WSP in the forecast models:

- Opening Year 2020;
- Intermediate Year 2026, representing a partial build out of the Land North of Stamford development;
- Design Year 2036, representing the data of full delivery of the Land North of Stamford development.

4 Forecasting Inputs & Assumptions

4.1 Introduction

This chapter describes in detail the processes for generating growthed traffic demand for future years and outlines the assumptions involved.

4.2 Scenario Definition

A set of scenarios are required for the modelling work that is supporting the Land North of Stamford development. The following Do Minimum and Do Something scenarios were defined by PBA for the opening, intermediate and design years, and adopted by WSP for the forecast modelling work.

The number of residential dwellings to be included in the partial build-out scenarios has been indicated in the model scoping report by PBA. It has been assumed by WSP that no retail units are to be included in the partial build-out scenarios, which PBA have specified.

Table 4-1 – Land North of Stamford Development Scenarios

Scenario	Supply - network	Demand – matrices
Opening Year 2020		
Do Minimum (DM)	Base Year model network	Demand matrices: - Cars controlled to TEMPRO district - LGVs/HGVs controlled to NTM forecasts
Do Something (DS)	As DM plus access road to Land North of Stamford development, and zone connectors to each of the eight zones for the development	As DM plus partial build-out of Land North of Stamford development trips: -110 residential dwellings - no retail units
Do Something HE scenario (DS_HE)	As DM plus access road to Land North of Stamford development, and zone connectors to each of the eight zones for the development	As DM plus full build-out of Land North of Stamford development trips: -2000 residential dwellings - all retail units (5450m2) (scenario is required by Highways England)
Intermediate Year 2026		
Do Minimum (DM)	Base Year model network	Demand matrices: - Cars controlled to TEMPRO district - LGVs/HGVs controlled to NTM forecasts
Do Something (DS)	As DM plus access road to Land North of Stamford development, and zone connectors to each of the eight zones for the development	As DM plus partial build-out of Land North of Stamford development trips: -770 residential dwellings - no retail units
Design Year 2036		
Do Minimum (DM)	Base Year model network	Demand matrices: - Cars controlled to TEMPRO district - LGVs/HGVs controlled to NTM forecasts
Do Something	As DM plus access road	As DM plus full build-out of Land North

(DS)	to Land North of Stamford development, and zone connectors to each of the eight zones for the development	of Stamford development trips: -2000 residential dwellings - all retail units (5450m2)

4.3 Land North of Stamford developments

The Land North of Stamford development comprises circa 1350 dwellings promoted by Burghley Estates and circa 650 dwellings promoted by Larkfleet Homes. The following table shows the breakdown of dwellings/units by development as provided by PBA in the model scoping report.

Table 4-2 – Land North of Stamford Development dwellings/units by zone

Development	Model Zone	C3 Resi	A1 Retail	A1 Supermarket	A3 Restaurant	Pub A4	D1 Community Building
		Units	m^2	m^2	m^2	m^2	m^2
1	136	325	0	0	0	0	0
2	142	325	0	0	0	0	0
3	140	0	720	1,200	150	280	375
4	141	425	0	0	0	0	0
5	139	375	0	0	0	0	0
6	135	0	720	1,200	150	280	375
7	138	400	0	0	0	0	0
8	137	150	0	0	0	0	0
Total		**2,000**	**1,440**	**2,400**	**300**	**560**	**750**

4.4 Land North of Stamford Forecast Trip Generation

PBA have calculated forecast trip ends from the developments using trip rates derived from TRICS, which have been agreed with Lincolnshire County Council Highways Alliance.

The following trip ends have been calculated, as provided by PBA in the model scoping note.

Table 4-3 – Land North of Stamford Development dwellings/units by zone

Development	Model Zone	Land - Use	AM Peak (08:00-09:00)			PM Peak (17:00-18:00)		
			Arr.	Dept.	Total	Arr.	Dept.	Total
1	136	C3	44	123	167	106	57	162
2	142	C3	44	123	167	106	57	162
3	140	A1 Food	53	49	103	92	95	186
		A1 Retail	32	30	62	55	57	112
		A3	0	0	0	9	3	12
		A4	0	0	0	8	5	13
		D1	5	3	8	2	4	6
4	141	C3	57	161	218	138	74	212

5	139	C3	51	142	193	122	65	187
6	135	A1 Food	53	49	103	92	95	186
		A1 Retail	32	30	62	55	57	112
		A3	0	0	0	9	3	12
		A4	0	0	0	8	5	13
		D1	5	3	8	2	4	6
7	138	C3	54	152	206	130	70	200
8	137	C3	20	57	77	49	26	75
Total			**451**	**922**	**1372**	**981**	**675**	**1656**

4.5 Background Growth Factors

TEMPRO 7.2 was used to derive growth factors for car trips from the base year to the opening, intermediate and design years.

The 134 base year model zones (excluding the 8 external input zones for the Land North of Stamford development) were aggregated to 69 custom TEMPRO sectors and 13 custom TEMPRO higher sectors based on the geography of Stamford and the extent of the modelled network and demand.

The greatest spatial detail at which TEMPRO trip ends are available is the Middle Super Output Area (MSOA) level. TEMPRO trip ends for base and future years (2020, 2026 and 2036) were downloaded at MSOA level for Stamford and nearby areas in the buffer area, Local Authority district for the rest of the buffer area, and at County or Government Office Region for the external zones. Trip ends were aggregated to the custom TEMPRO sectors and higher sectors, and a set of growth factors were derived for each TEMPRO sector, per time period.

LGV and HGV growth factors are derived from NTM 2015 forecasts. Total vehicle kilometres travelled by vehicle class are available at Government Office Region. These are used as a proxy for number of trip ends. In NTM the goods vehicle classes available are LGV, rigid and articulated. The latter two categories are added together to represent HGVs.

Data are available at intervals of five years. The trend is interpolated to derive the base year and future year vehicle kilometres – the ratio between base and future year is adopted as the growth factor for LGV and HGV matrices.

4.6 Committed Development Growth

No committed developments have been identified by Lincolnshire County Council Highways Alliance for inclusion. Therefore TEMPRO is used to calculate the background growth with the calculated trip ends provided by PBA added on top.

A procedure was set up to avoid double counting of the development trips which may be included within background growth. Trips from neighbouring areas are scaled down where necessary to accommodate growth within Stamford whilst not exceeding TEMPRO growth data overall.

5 Traffic Assignment Results

5.1 Introduction

A detailed review of the model assignment results relating to the VISUM model runs has been carried out to identify the impacts of the Link Road and Northern Development. Information such as the PPM and PPK values, model convergence as well as the Do Something modelling are included in this this section.

Explanation is also provided of the model outputs used to assess the DM and DS Network Configuration performance.

5.2 Future Cost Parameters

The formulation of the generalised cost was based on the latest values of time and operating costs provided in the TAG Databook of July 2017. Table 5-1 presents the cost parameters adopted for this study for the Base year, the opening and the design year respectively.

Generalised Cost (Pence) = PPM x Time + PPK x Distance

Where:

PPK = Distance related cost in pence per Kilometre

PPM = Time related cost in pence per minute

Table 5-1 – PPM and PPK Values

User Class	Time period	2016		2020		2026		2036	
		PPM	PPK	PPM	PPK	PPM	PPK	PPM	PPK
Car	AM Peak	19.34	6.87	20.22	6.57	22.29	6.48	26.70	6.29
	PM Peak	18.81	6.57	19.66	6.26	21.66	6.19	25.95	6.01
LGV	AM Peak	21.27	13.32	22.24	13.37	24.51	13.65	29.36	13.93
	PM Peak	21.27	13.32	22.24	13.37	24.51	13.65	29.36	13.93
HGV	AM Peak	49.67	37.76	51.92	38.72	57.22	41.57	68.55	44.03
	PM Peak	49.67	37.76	51.92	38.72	57.22	41.57	68.55	44.03

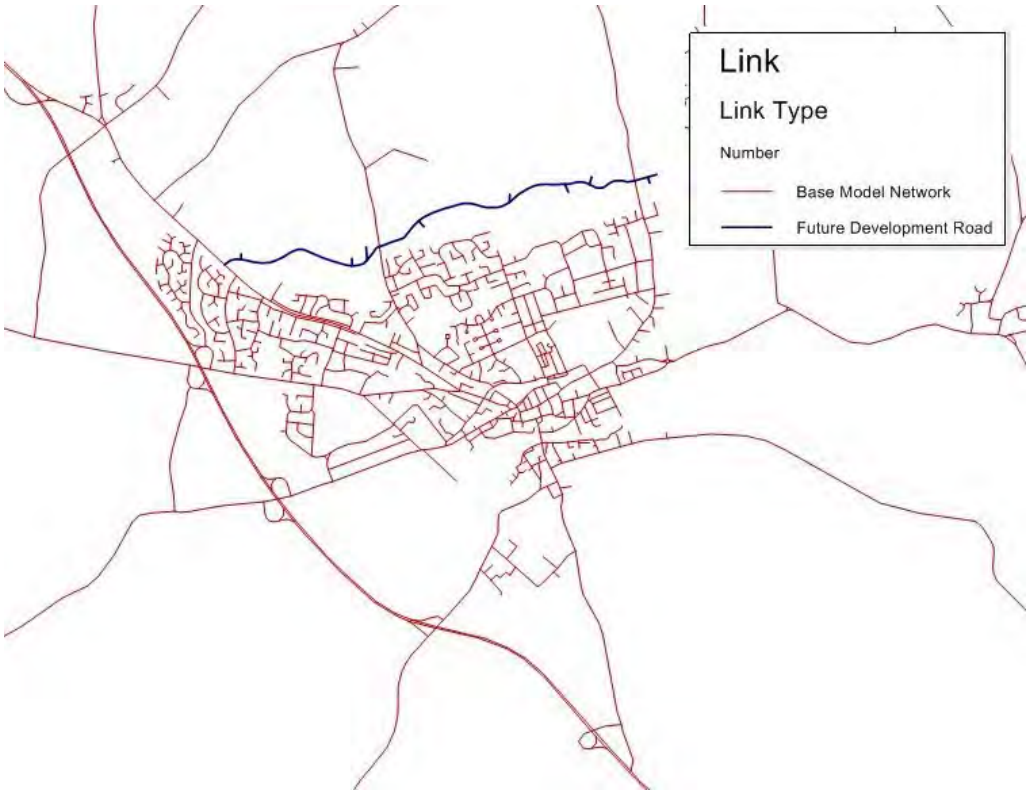
5.3 Forecast Model

Two different networks have been coded to assist in comparison of the Do Minimum (DM) and Do Something (DS) scenarios. The Do Minimum network coincides with the Base Year Model since no network changes have been included in Stamford nor the surrounding area. This has been confirmed following research with LCC.

The Do Something network includes the future road and junctions that will connect the northern development to Stamford existing roads.

Figure 5-1 shows the Do Something networks.

Figure 5-1 Do Something Network



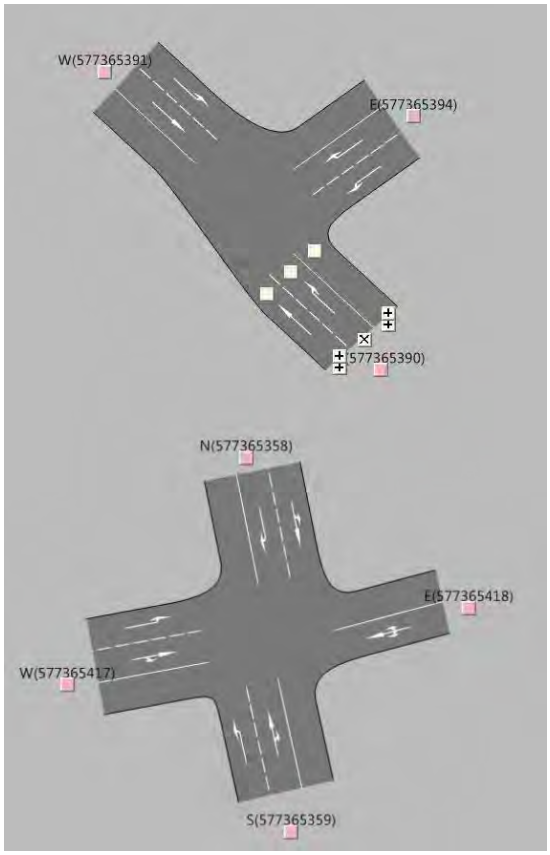
Three additional junctions have been modelled in detail as follows:

- Site Access West / B1081 Old Great North Road. Type: Signalised Junction.
- Site Access North / Little Casterton Road. Type: Roundabout.
- Site Access East / A6121 Ryhall Road. Type: Signalised Junction.

Both signalised junctions were given a preset cycle and green times. However, a cycle and green time optimisation procedure was set up for both junctions. In addition, after running the assignment of the matrices some queues and delays were observed. So the geometry of both signalised junctions was improved until it did not provide a constraint in estimating the impact of the future developments on traffic conditions. The chosen solution consisted of adding an extra dedicated lane turn of 20 metres length on the approaches to relieve significant delays and queues.

Figure 5-2 shows the modelled geometry configuration for both signalised junctions.

Figure 5-2 Junction Detailed Geometry. Old Great North Road (Left) and Ryhall Road (Right)



5.4 Convergence

Convergence is the measure used to determine model stability during the assignment process. A suitably converged model can be expected to produce consistent outputs with minimal model noise.

The convergence criteria recommended in TAG are given in Table 7-1 below.

Table 5-2 TAG Convergence Criteria

Measure of Convergence	Base Model Acceptable Values
Delta and % Gap	less than 0.1% or at least stable with convergence fully documented and all other criteria met
percentage of links with flow change (P) < 1%	four consecutive iterations greater than 98%
percentage of links with cost change (P2) < 1%	four consecutive iterations greater than 98%
Percentage change in total user costs (V)	Four consecutive iterations > 0.1%

The measure of convergence has been adapted to the parameters that can be obtained after running the ICA assignment as shown in Table 5-3 below.

Table 5-3 TAG Convergence Criteria for ICA assignment.

No.	Condition	Convergence Criteria
1	The final delays of the equilibrium assignment and those obtained from running ICA are closed, i.e. ICA produces delays that are consistent with the assignment result	More than 90% of turns have a relative difference in delay less than 5%

2	The turn volumes from the last equilibrium assignment are close to the smoothed volumes; and	More than 98% of turns have a GEH less than 1
3	The turn volumes from the last equilibrium assignment are close to those from the previous assignment.	More than 98% of turns have a GEH less than 1
4	The difference between the costs along the chosen routes and those along the minimum cost routes, summed across the whole network, and expressed as the percentage of the minimum costs	Less than 0.1% or at least stable with convergence fully documented and all other criteria met

Table 5-4 to Table 5-15 present convergence statistics from the three base year time periods including the iteration loop at which these criteria were all met over four consecutive iterations.

Table 5-4 Do Minimum 2020 Model Assignment Convergence Criteria 1 to 3

Criteria	Target	AM		PM	
		No. of Iterations	Achieved	Number of Iterations	Achieved
1	90%	1	94.85%	4	97.76%
		2	95.79%	5	95.79%
		3	96.90%	6	96.98%
		4	98.52%	7	98.61%
2	98%	1	100.00%	4	99.89%
		2	99.00%	5	98.70%
		3	99.88%	6	99.54%
		4	99.95%	7	99.93%
3	98%	1	99.22%	4	99.72%
		2	96.72%	5	97.73%
		3	99.61%	6	99.98%
		4	99.74%	7	100.00%

Table 5-5 Do Minimum 2020 Model Assignment Converge Criterion 4

Time Period	Iteration No.	Target	Target Achieved			
			Car	HGV	LGV	Overall
AM	1	<0.1% or at least stable	0.29%	0.03%	0.22%	0.26%
AM	2		0.17%	0.01%	0.06%	0.14%
AM	3		0.13%	0.01%	0.05%	0.11%
AM	4		0.11%	0.01%	0.04%	0.09%
PM	4		1.15%	0.01%	0.55%	1.03%
PM	5		0.85%	0.01%	0.44%	0.76%
PM	6		0.77%	0.01%	0.41%	0.69%
PM	7		0.70%	0.01%	0.34%	0.63%

Table 5-6 Do Minimum 2026 Model Assignment Convergence Criteria 1 to 3

Criteria	Target	AM		PM	
		No. of Iterations	Achieved	Number of Iterations	Achieved
1	90%	3	95.28%	4	96.83%
		4	96.12%	5	97.87%
		5	97.87%	6	98.32%
		6	99.03%	7	98.41%
2	98%	3	98.91%	4	98.96%
		4	99.72%	5	99.54%
		5	99.79%	6	99.79%
		6	99.93%	7	99.96%

3	98%	3	96.30%	4	97.25%
		4	98.71%	5	99.91%
		5	99.54%	6	99.65%
		6	99.98%	7	99.56%

Table 5-7 Do Minimum 2026 Model Assignment Converge Criterion 4

Time Period	Iteration No.	Target	Target Achieved			
			Car	HGV	LGV	Overall
AM	3	<0.1% or at least stable	0.17%	0.02%	0.06%	0.15%
AM	4		0.20%	0.01%	0.05%	0.16%
AM	5		0.16%	0.01%	0.05%	0.13%
AM	6		0.13%	0.01%	0.04%	0.11%
PM	4		0.72%	0.06%	0.47%	0.66%
PM	5		0.60%	0.02%	0.41%	0.55%
PM	6		0.64%	0.01%	0.46%	0.58%
PM	7		0.60%	0.01%	0.37%	0.54%

Table 5-8 Do Minimum 2036 Model Assignment Convergence Criteria 1 to 3

Criteria	Target	AM		PM	
		No. of Iterations	Achieved	Number of Iterations	Achieved
1	90%	1	93.82%	2	97.39%
		2	96.92%	3	97.88%
		3	97.87%	4	98.64%
		4	98.41%	5	98.91%
2	98%	1	100.00%	2	99.95%
		2	99.93%	3	99.95%
		3	99.98%	4	100.00%
		4	99.98%	5	100.00%
3	98%	1	98.68%	2	98.89%
		2	98.52%	3	99.05%
		3	99.44%	4	99.63%
		4	99.61%	5	99.89%

Table 5-9 Do Minimum 2036 Model Assignment Converge Criterion 4

Time Period	Iteration No.	Target	Target Achieved			
			Car	HGV	LGV	Overall
AM	1	<0.1% or at least stable	0.66%	0.03%	0.42%	0.57%
AM	2		0.54%	0.06%	0.46%	0.49%
AM	3		0.44%	0.04%	0.33%	0.39%
AM	4		0.39%	0.02%	0.29%	0.34%
PM	2		0.91%	0.12%	0.88%	0.86%
PM	3		0.77%	0.07%	0.75%	0.72%
PM	4		0.67%	0.03%	0.65%	0.63%
PM	5		0.58%	0.03%	0.58%	0.55%

Table 5-10 Do Something 2020 Model Assignment Convergence Criteria 1 to 3

Criteria	Target	AM		PM	
		No. of Iterations	Achieved	Number of Iterations	Achieved
1	90%	2	97.17%	6	96.50%
		3	94.84%	7	97.22%
		4	96.56%	8	98.37%
		5	98.23%	9	98.71%

2	98%	2	99.90%	6	99.06%
		3	98.62%	7	99.91%
		4	99.83%	8	99.98%
		5	99.69%	9	100.00%
3	98%	2	97.80%	6	98.72%
		3	96.22%	7	99.95%
		4	98.60%	8	99.74%
		5	99.55%	9	99.37%

Table 5-11 Do Something 2020 Model Assignment Converge Criterion 4

Time Period	Iteration No.	Target	Target Achieved			
			Car	HGV	LGV	Overall
AM	2	<0.1% or at least stable	0.22%	0.02%	0.12%	0.19%
AM	3		0.16%	0.00%	0.06%	0.14%
AM	4		0.13%	0.00%	0.04%	0.11%
AM	5		0.13%	0.13%	0.05%	0.12%
PM	6		0.39%	0.01%	0.21%	0.35%
PM	7		0.33%	0.01%	0.18%	0.30%
PM	8		0.28%	0.00%	0.16%	0.26%
PM	9		0.24%	0.01%	0.15%	0.22%

Table 5-12 Do Something 2026 Model Assignment Convergence Criteria 1 to 3

Criteria	Target	AM		PM	
		No. of Iterations	Achieved	Number of Iterations	Achieved
1	90%	4	98.86%	2	97.92%
		5	95.30%	3	97.87%
		6	97.40%	4	98.18%
		7	98.51%	5	98.50%
2	98%	4	99.91%	2	99.77%
		5	98.76%	3	99.98%
		6	99.84%	4	99.98%
		7	99.91%	5	99.91%
3	98%	4	99.37%	2	98.41%
		5	96.87%	3	99.46%
		6	99.95%	4	99.65%
		7	99.98%	5	99.58%

Table 5-13 Do Something 2026 Model Assignment Converge Criterion 4

Time Period	Iteration No.	Target	Target Achieved			
			Car	HGV	LGV	Overall
AM	4	<0.1% or at least stable	0.38%	0.01%	0.24%	0.33%
AM	5		0.15%	0.00%	0.03%	0.13%
AM	6		0.14%	0.01%	0.03%	0.12%
AM	7		0.14%	0.09%	0.07%	0.13%
PM	2		2.19%	0.23%	1.57%	2.01%
PM	3		1.56%	0.05%	0.89%	1.41%
PM	4		1.10%	0.02%	0.62%	0.99%
PM	5		0.90%	0.04%	0.58%	0.82%

Table 5-14 Do Something 2036 Model Assignment Convergence Criteria 1 to 3

Criteria	Target	AM		PM	
		No. of Iterations	Achieved	Number of Iterations	Achieved

1	90%	1	92.75%	4	97.31%
		2	95.77%	5	97.99%
		3	96.91%	6	98.50%
		4	98.41%	7	99.06%
2	98%	1	100.00%	4	99.69%
		2	99.79%	5	100.00%
		3	100.00%	6	100.00%
		4	100.00%	7	100.00%
3	98%	1	97.31%	4	99.72%
		2	96.68%	5	99.79%
		3	99.55%	6	99.86%
		4	99.97%	7	99.98%

Table 5-15 Do Something 2036 Model Assignment Converge Criterion 4

Time Period	Iteration No.	Target	Target Achieved			
			Car	HGV	LGV	Overall
AM	1	<0.1% or at least stable	0.85%	0.77%	0.47%	0.79%
AM	2		0.69%	0.55%	0.43%	0.65%
AM	3		0.60%	0.44%	0.37%	0.55%
AM	4		0.55%	0.51%	0.46%	0.54%
PM	4		0.69%	0.04%	0.68%	0.65%
PM	5		0.61%	0.03%	0.61%	0.57%
PM	6		0.66%	0.03%	0.62%	0.61%
PM	7		0.73%	0.04%	0.71%	0.69%

Both the modelled peaks converge to a high level within a relatively low number of iterations. This indicates model stability resultant from clear route choice alternatives and will prove beneficial in travel demand forecasting.

5.5 Network Summary Statistics

The following summary highway network tabular and graphical information is provided:

1. total number of assigned trips;
2. total network travelled distance as vehicle kilometres;
3. total network travelled time as vehicle hours; and
4. average network speeds.

Modelled flows and link travel times in the study area, comparing the DM and the DS, are also plotted against a simple network background. Plots of the flow, queue and delay difference between the DM and DS are also provided to further indicate the impact of the scheme. Tables and plots of forecast flows for key parts of the highway network within the study area are also appended.

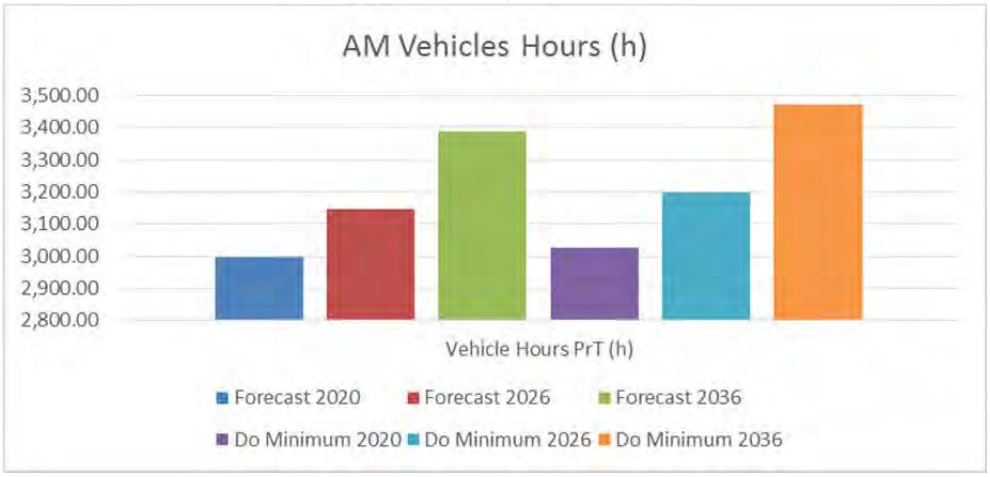
The Figure below shows the chosen study area:

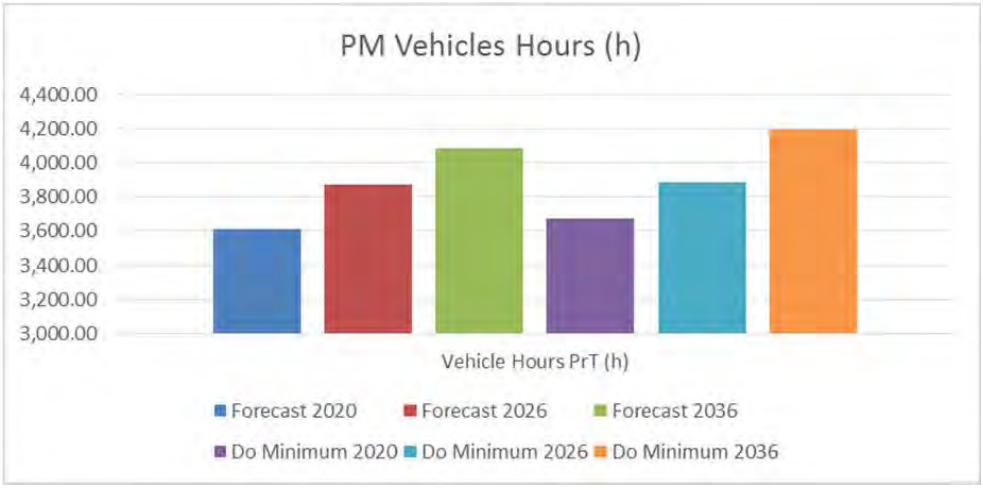
Figure 5-3 Network Study Area

5.6 Network Summary Statistics

Distance, journey time and total delays are reported in Figure 5-4 to Figure 5-6. Speeds are shown in Figure 5-7. All figures are included in Table 5-16.

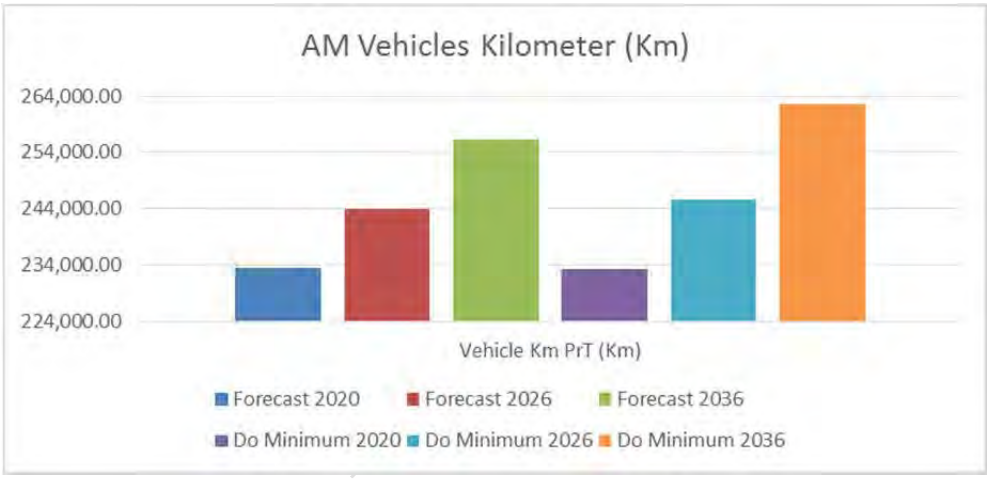
Figure 5-4 Network Vehicle Hours.

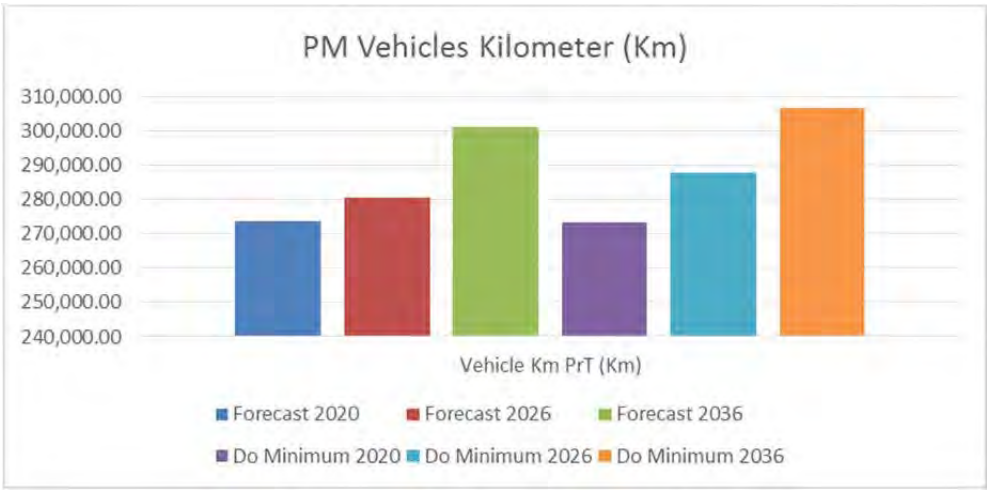




The results show an increment in the journey times between 2020 and 2036 for both scenarios. However, the DM outputs show a bigger increase in time when compared to the DS results. In 2036 the difference between the DM and DS journey time will be reduced by 2.43% in the AM peak and 2.64% in the PM.

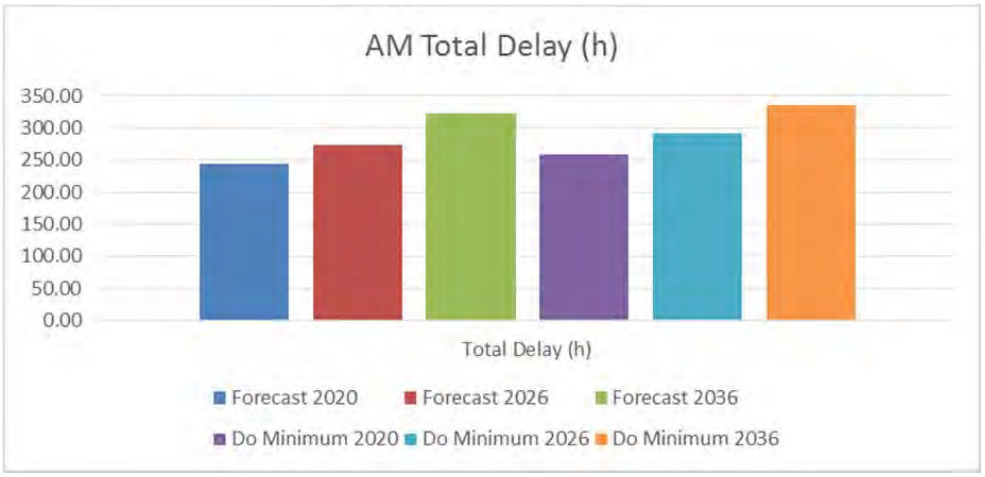
Figure 5-5 Network Vehicle Kilometres.

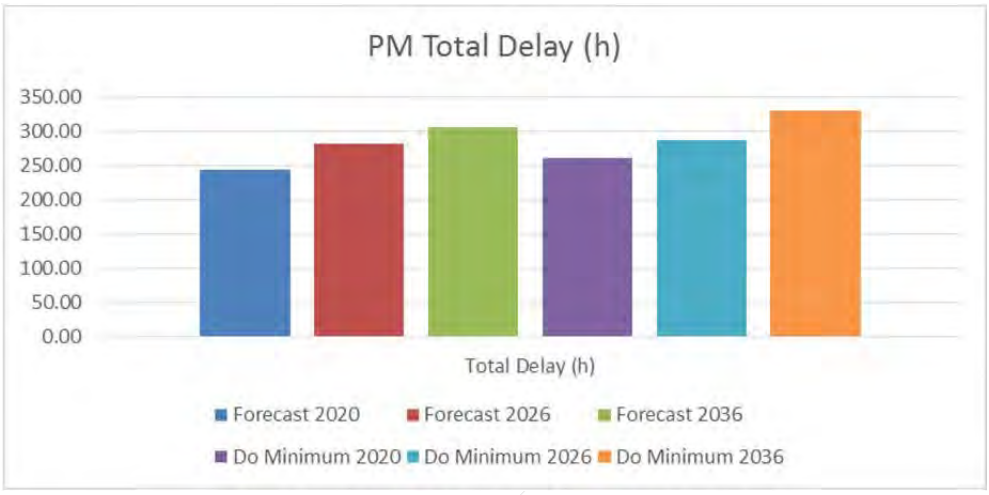




Similarly to the observed in the results of journey time, the distance increases together with the demand between the forecast years. The Do Something model shows a better performance reducing the travelled distance circa 6.500 (2.40%) and 5.500 (1.77%) kilometres in the AM and PM peaks of the horizon year respectively.

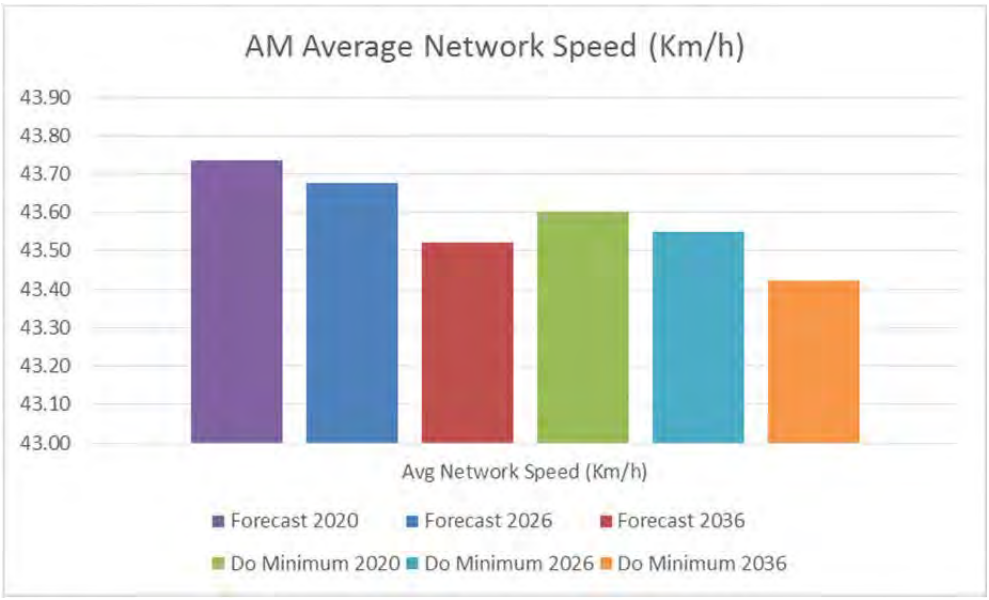
Figure 5-6 Network Total Delay.

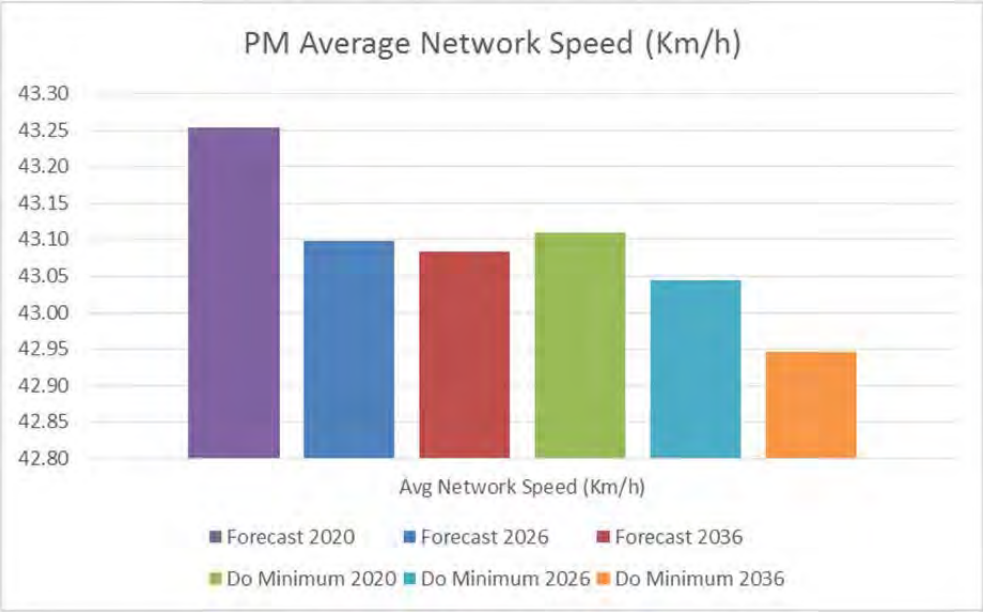




In terms of delay, it is appreciated that the delays are always smaller in the DS scenarios than in the DM ones. The DS model reduces the delays on last forecast year by 3.84% and 7.25% in the AM and PM peaks.

Figure 5-7 Network Average Speed (Km/h)





Traffic patterns show declining speed across the modelled area into the future. However, the future development does not significant impact on the average speeds and the difference of the averages is always smaller than 1 Km/h in both peaks.

Table 5-16 Results Summary

Scenario	Peak	Avg Network Speed (Km/h)	Vehicle Hours PrT (h)	Vehicle Km PrT (Km)	Total Delay (h)	Demand Car	Demand HGV	Demand LGV
DS 2020	AM	43.74	2,997	233,435	245	10,588	322	1,445
DS 2026	AM	43.68	3,145	243,934	273	10,904	334	1,675
DS 2036	AM	43.52	3,389	256,189	323	11,378	360	2,019
DM 2020	AM	43.60	3,027	233,345	258	10,588	322	1,445
DM 2026	AM	43.55	3,197	245,737	291	10,904	334	1,675
DM 2036	AM	43.42	3,473	262,495	336	11,378	360	2,019
DS 2020	PM	43.25	3,612	273,683	244	12,169	152	1,159
DS 2026	PM	43.10	3,874	280,477	281	12,527	159	1,343
DS 2036	PM	43.08	4,088	301,261	306	13,063	171	1,619
DM 2020	PM	43.11	3,672	273,320	260	12,168	152	1,159
DM 2026	PM	43.04	3,884	287,887	286	12,527	159	1,343
DM 2036	PM	42.95	4,199	306,686	330	13,063	171	1,619

A detailed list of link outputs for the area of study can be found in Appendix A.

The following Figures show the flow difference between the DS and DM scenario.

Figure 5-8 2020 AM Flow Differences

Figure 5-9 2026 AM Flow Differences

Figure 5-10 2036 AM Flow Differences

Figure 5-11 2020 PM Flow Differences

Figure 5-12 2026 PM Flow Differences

Figure 5-13 2036 PM Flow Differences

Both peaks show a reduction on the trips using Stamford town centre roads as well as Tolehorpe Road located in the north of the future development. The proposed road will also provide not only with a new route to the residential area on the north of the town centre but also a by-pass road avoiding the most congested junctions of Stamford.

Further flow plots can be found in Appendix B.

The delays have also dropped down in the town centre of Stamford as consequence of the development's road. On the other hand, some delays have turned out in the future location of the junctions with the new road.

The following Figures show the average delay difference between the DS and DM scenario.