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Southend-on-Sea Local Plan

Regulation 19 Transport Modelling Assessment

October 2026

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Executive Summary

Southend-on-Sea City Council is preparing a new Local Plan covering the period up to 2045. This report presents the transport modelling undertaken to assess the impact of forecast housing and employment growth and to identify the transport interventions required to support that growth. The assessment builds upon the existing Southend-on-Sea Multi Modal Model (SoSMMM), supplemented by an updated 2025-base-year mesoscopic highway model to provide a more detailed understanding of highway impacts.

Three development scenarios were assessed. Scenario A represents a policy-neutral baseline with growth controlled to National Trip End Model (NTEM) forecasts. Scenario B includes additional opportunity and development sites within the existing urban area and at Fossetts Farm, while Scenario C adds further growth associated with the potential allocation on Land North of Southend (LNOS) within Southend. The modelling indicates that total highway demand increases progressively between the scenarios, with the greatest growth occurring in Scenario C by 2045.

A series of transport interventions have been tested. These were grouped into two principal mitigation packages:

- **Southend Light**, comprising a package of highway capacity, junction and corridor improvement measures focused on the existing urban area. Also comprising some bus and active travel packages coming forward from the Bus service Improvement Plan (BSIP), the Local Cycling and Walking Infrastructure Plan (LCWIP).

- **Southend Plus**, which includes all Southend Light improvements together with additional highway, public transport and active travel interventions to support higher levels of development growth.

The modelling demonstrates that the proposed mitigation packages are capable of accommodating the forecast Local Plan growth. For Scenario B, the **Southend Light package is sufficient** to mitigate the additional traffic impact and broadly return network conditions to a business-as-usual position. For Scenario C, the **Southend Plus package substantially mitigates** the forecast impacts of growth, fully mitigating conditions in the AM peak and reducing PM peak impacts to a relatively minor residual level. When considered across both peak periods, the package is judged to provide an effective mitigation strategy for the higher growth scenario.

The results are based on a proportionate forecasting approach. The demand forecasts are based on NTEM-controlled growth assumptions and relatively high local trip generation rates. The forecast highway impacts are likely to represent a robust upper bound of future traffic conditions.

Overall, the assessment demonstrates that deliverable transport mitigation packages exist to support the levels of development proposed within both Scenarios B and C. The modelling therefore provides evidence that the Local Plan growth strategy can be accommodated on the transport network, subject to implementation of the recommended transport interventions.

1 Introduction

1.1 Background

Southend-on-Sea City Council (SCC) is preparing a new Local Plan for the period 2025 to 2045. SCC required a transport assessment to assess transport impacts and identify, test and propose a package of mitigation measures. The Transport Assessment will be a key evidence-based document for SCC and will support the Local Plan through Regulation 19 consultation, submission and Examination in Public.

SCC appointed Pell Frischmann to a Transport Evidence Base (TEB) to support the final version of the Local Plan to be published under Regulation 19, enabling comments relating to legal compliance and soundness to be made and submitted for an independent examination in public.

TEB will ensure the Local Plan is informed and supported by a robust transport evidence base that is in line with national planning and transport policy and guidance, with particular focus to the National Planning Policy Framework (NPPF)[1] and Planning Practice Guidance (PPG)[2].

1.2 Purpose of the Study

The purpose of the study is to provide the transport evidence base for Regulation 19 consultation. This report details the inputs, assumptions and results of the transport model assessment.

1.3 Study Methodology

SCC has a comprehensive multi-modal transport model, known as Southend-on-Sea Multi Modal Model (SoSMMM), covering Southend-on-Sea and the surrounding area. The SoSMMM is a strategic model with a Fully Modelled Area (FMA) covering the Local Authorities (LAs) of Southend, Rochford and Castle Point, as shown below in **Figure 1-1**. It was developed by Mott MacDonald on behalf of SCC and has subsequently been provided to Pell Frischmann to be operated on the Council's behalf. It includes both highway (in SATURN software) and public transport (in PTV Visum software) assignment models, linked together by a disaggregate Variable Demand Model (VDM) used for forecasting. The base year of the current version of the model is 2018 along with forecast years of 2030 and 2040. The model covers the AM (08:00-09:00), PM (17:00-18:00) and an average hour inter-peak period.

The strategic assessment will utilise the existing SoSMMM. Owing to the size of the model and the tight programme, the SoSMMM base year will be retained. The SoSMMM will be used to understand the overall impacts of growth, while an updated mesoscopic model with a 2025 base year will be used to assess operational impacts in greater detail within the mesoscopic modelled area.

The strategic modelling will be carried out for the weekday models. New 2035 and 2045 forecast year models will be prepared. The forecast models will be used to test updated development scenarios (A–C) without any mitigation.

[1] National Planning Policy Framework - GOV.UK

[2] Transport evidence bases in plan making and decision taking - GOV.UK

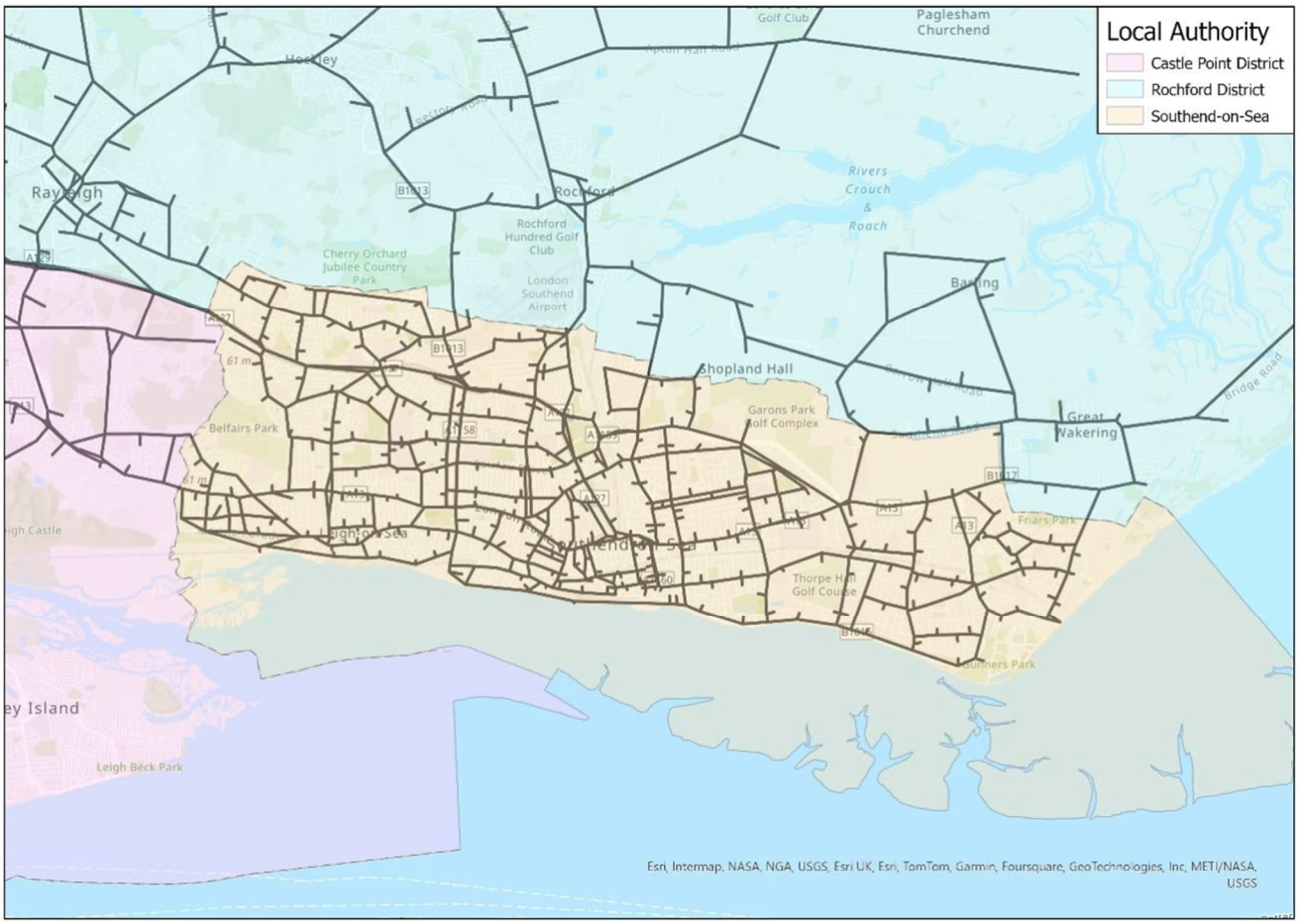


Figure 1-1 – SoSMMM Modelled Network Links in the FMA

Following this, the models will be used to identify where the network is likely to experience capacity constraints and to develop and test a range of possible mitigation measures.

The mitigation packages of measures shown in Table 1-1 below have been assumed for each future scenario (see Section 7.1.1.1 for more details).

Table 1-1 – Model Scenario Matrix

Mitigation Scenario	Future Year Demand Level Scenario		
	A	B	C
No mitigation	✓	?	?
Southend Light	✓	✓	?
Southend Plus		✓	✓
Southend + Rochford Light			✓

The above results in 6 confirmed mitigation scenarios (shown by the ticks) with a further 3 potential scenarios (shown by the question marks). If a mitigation measure proves ineffective within a lower-growth scenario, there will be no requirement to test it under scenarios with higher levels of demand.

To complement the strategic modelling, the existing mesoscopic model was updated to a 2025 base year. It was refreshed to a 2025 base year using the latest traffic count data collected by SCC. This allows the model to reflect current local network conditions more accurately than the strategic modelling.

After calibrating the 2025 mesoscopic model, 2035 and 2045 reference case scenarios were created by applying growth derived from the SATURN forecasts. The meso model was used to test the same Local Plan development scenarios (A–C) and mitigation scenarios at a more detailed, operational level.

As with the strategic modelling, the mitigation measures were modelled consistently. This detailed operational modelling will help identify specific junction or corridor issues, queueing effects, and the likely performance of mitigation measures. The mesoscopic model covers the same AM and PM time periods as the strategic model (08:00-09:00 and 17:00-18:00), more information on the rebase is included in Appendix D.

1.4 Consultation with Neighbouring Authorities

A number of meetings were scheduled with Essex County Council (ECC), Rochford District Council (RDC) and Castle Point Borough Council (CPBC) to discuss sharing of mitigation schemes and development quantum. However, although the meetings were useful, information from ECC and RDC, in particular regarding growth and mitigation, could not be shared within the timescales of the study programme. It was agreed to share the flows (from this modelling work) between the boundaries of Southend and Rochford to the modelling consultants for RDC and ECC for any further sensitivity tests they may have.

1.5 Structure of the Report

The remainder of the report is structured as follows:

- Section 2 – Modelled Scenarios, describing the scenarios assessed in more detail.
- Section 3 – Highway and Public Transport Network, setting out the changes to the highway and PT networks for modelling before mitigation scenarios are tested.
- Section 4 – Other Model Inputs, including those derived from the TAG data book.
- Section 5 – Results Without Mitigation, detailing where problems exist under each demand scenario without any mitigation.
- Section 6 – Proposed Transport Interventions to Support Future Development, detailing the proposed transport interventions applied to mitigate impacts.
- Section 7 – Mesoscopic Model Development, including the demand transfer methodology and network changes in each scenario.
- Section 8 – Results With Mitigation, presenting the results with mitigation in place.
- Section 9 – Summary and Conclusion.

2 Modelled Scenarios

2.1 Introduction

The population and employment database is a key input for SoSMMM and the data required to run the VDM is more detailed than the information required for most other strategic models due to its disaggregate nature. In order to develop the population and employment databases a combination of development information collected by the Local Authority and data from the National Trip End Model (NTEM) has been used. Three scenarios are presented in this report and have been modelled in terms of population and employment growth. The development scenarios are cumulative, and alternative distributions of development sites have not been considered. The development scenarios modelled, following instructions from SCC, are shown below in Table 2-1.

Table 2-1 – Modelled Demand Scenarios

Scenario	Development Sites	Comment
A (Do-Minimum)	Completions + Windfall + sites with planning permission Controlled to NTEM	Controlled to NTEM
B	Scenario A + potential sites within the urban area and at Fossetts Farm	
C	Scenario B + potential Bournes Green new Neighbourhood (LNOS) sites within Southend	

The remainder of this section describes the process used to develop the population and employment databases.

2.1.1 NTEM Data

NTEM, developed on behalf of the DfT and accessed via the Trip End Model Presentation Program (TEMPro), is a key national source for employment, population and trip end data for transport modelling uses, and ensures that schemes, Local Plans and other model applications can be considered on an equitable basis for different geographical areas. NTEM includes a representation of the DfT's Common Analytical Scenarios (CAS) which are used to consider the possibilities of alternate futures in terms of population and employment growth, and trip rates.

For this Local Plan project, the latest dataset, NTEM 8.1, has been utilised, with only the core scenario used. For the Do-Minimum (DM) Scenario A, total growth (from 2025 to 2035, and from 2035 to 2045) has been controlled to the NTEM data, with the further scenarios (B and C) using this as a basis with additional growth added on cumulatively. This provides a policy-neutral baseline that is consistent with national forecasts.

The growth in all other authorities (including Rochford and Castle Point) has been derived from NTEM in scenario A, and then held constant for other scenarios.

2.2 Development Site Information

2.2.1 Data Summary

SCC has collected data on projected development sites within the Local Authority over the plan period. The data is subdivided into a series of categories as shown in Table 2-2. As described above, the totals for dwellings and jobs were controlled to NTEM totals in scenario A. To achieve this, adjustments were made to the Windfall development assumptions, which were considered the most uncertain element of the development forecasts, while growth associated with identified development sites and sites with planning permission was retained unchanged and within the precise locations identified. For jobs – the NTEM control had to be dealt with differently due to phasing across years. The forecast in NTEM is for 3,147 additional jobs from 2025 to 2045 – however of which only 528 are between 2035 and 2045 with the majority of the growth in that first decade. The planned development phasing is not so skewed to the first decade. As such we have controlled the total growth up to 2045 rather than using the phasing from NTEM.

Table 2-2 presents both the Windfall assumptions provided by SCC and the revised Windfall figures used to control growth to NTEM.

Table 2-2 – Site Contributions

Name	Description	Gross Dwellings 2025-2035	Gross Dwellings 2025-2045	Gross Jobs 2025-2035	Gross Jobs 2025-2045	Inclusion	From LA
Completions	Sites that have been completed since the base year of 2018	2,122	2,122			A, B, C	yes
Windfall (Controlled to NTEM)	Adjusted Windfall – to match overall NTEM target	1,124	4,086	*1,147	1,147	A, B, C	No
Windfall (Assumed by Local Authority)	Anticipated smaller sites which are not yet in the planning process (assigned by neighbourhood)	1,000	3,000			-	yes
Allocated sites with planning permission	Developments allocated to specific sites that have planning permission	2,590	3,470	869	2,000	A, B, C	yes
Non-allocated sites with planning permission	Developments not allocated to specific sites that have planning permission	10	10	0	0	A, B, C	yes
Relatively certain Allocated and opportunity sites without planning permission	As decided on the basis of TAG guidance on uncertainty in forecasting	757	3,344	506	975	B, C	yes
LNOS sites	LNOS sites	1,100	4,900	125	470	C	yes
	Summary Totals Below						
Total Growth from 2025 Scenario A	NTEM controlled – Scenario A excluding Completions as they are 2018->2025	3,724	7,566	869	3,147	A	
Total Growth from 2025 Scenario B	Including Allocated and Opportunity Sites	4,481	10,910	1,375	4,122	B	
Total Growth from 2025 Scenario C	Including LNOS	5,581	15,810	1,500	4,592	C	
Total Growth from 2025 Scenario C	If ignoring NTEM control	5,457	14,724	353	3,445	*	yes

Combining the developments for each scenario produces the following totals (for dwellings per scenario; as a consequence of the NTEM control the final numbers for scenarios B and C are higher in 2045 than had we not controlled. This will mean that the results in this report err on the side of the worst-case scenario for traffic

growth, hence if the mitigations are able to accommodate the growth in these modelled scenarios, we can have confidence they would work in a more realistic but lower growth scenario.

Table 2-3– Total Dwellings by Scenario and Location (NTEM-controlled)

Year and Demand Scenario	2025	2035			2045		
		A	B	C	A	B	C
Southend	80,750	84,474	85,231	85,231	88,316	91,660	91,660
LNOS Southend				1,100			4,900
TOTALS	**80,750**	**84,474**	**85,231**	**86,331**	**88,316**	**91,660**	**96,560**
Total increase from 2025		*3,724*	*4,481*	*5,581*	*7,566*	*10,910*	*15,810*

2.2.2 Development Sites

Figure 2-1 illustrates the location of the developments (dwellings and employment) described in Table 2.2 (excluding Windfall). These developments have been mapped to existing zones in most locations. For the Green Belt sites, and for certain large development sites, new model zones were created.

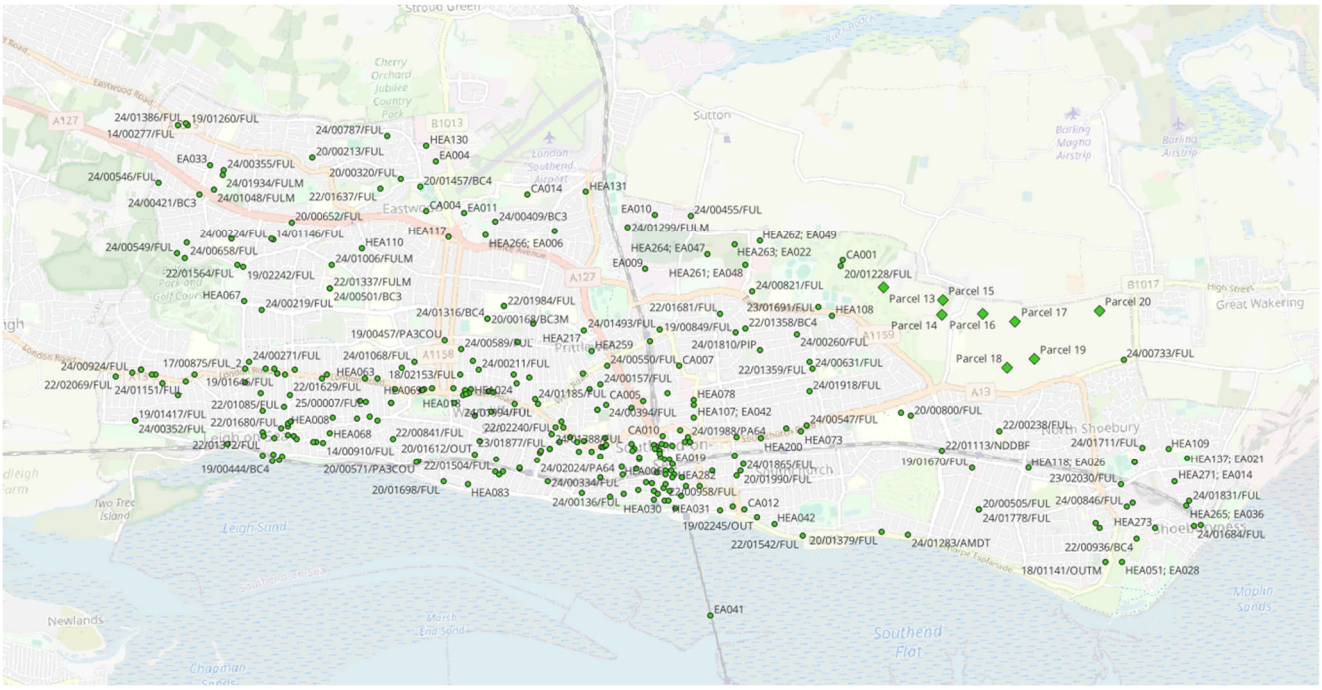


Figure 2-1– Development Site locations within SoSMMM

2.2.3 Sample Locations

The population and employment data required by the demand model for the FMA to generate forecasts is more detailed than can usually be provided based on developer plans only, with the employment data required as total, service and retail categories, and splits for the population data required for each of the following categories:

- Males;
- Females;
- Population aged 0-19;
- Population aged 20-44;
- Population aged 45-64;
- Population aged 65+;

- Full-time workers;
- Part-time workers;
- Students;
- Single person households;
- Lone parent households;
- Couple households without children;
- Couple households with children;
- Other households; and
- Total income by zone.

So that the required information can be generated, SCC provided sample postcode locations to use for the detailed splits for each development site. These sample locations are areas which are considered to have similar characteristics to the developments in question in terms of types of housing or business. The postcodes provided are mapped to model zones and the detailed splits have been adopted from the base year data for which detailed information is already available, from census and other sources.

2.2.4 Windfall Contributions

One category of development included within the forecasts is Windfall development. Unlike allocated sites or sites with planning permission, these developments are not associated with specific locations within the planning process. Instead, they represent smaller sites that are expected to come forward over the plan period within defined neighbourhoods.

Information on Windfall development was provided at a neighbourhood level rather than for individual model zones. This was calculated from an analysis of passed trends. Accordingly, Windfall dwellings and employment were distributed proportionately across all zones within each neighbourhood. For example, if the Eastwood neighbourhood required a 2% increase to achieve the forecast level of development, base-year households and employment within each zone of that neighbourhood were scaled by a factor of 1.02. This approach was considered an appropriate method of distributing development while preserving the established spatial patterns observed in the base year.

The demographic characteristics of the additional households generated through Windfall development were derived using neighbourhood-average demographic profiles rather than the profiles of individual zones. This approach avoids introducing unrealistic demographic variations where individual zones may exhibit atypical household characteristics that are not representative of the wider neighbourhood.

The scale and distribution of Windfall development were provided by SCC and are based on historic completion trends averaged over a 24-year period. The forecasts therefore assume that small-scale developments will continue to come forward within each neighbourhood at rates broadly consistent with those observed historically.

Table 2-4 Distribution of growth

Neighbourhood	Share of growth
Eastwood	2.3%
Leigh	16.7%
Prittlewell	7.0%
Shoeburyness	13.8%
Fossetts	0.0%
Southchurch	14.8%
Southend Central	27.3%
Thorpe Bay	1.9%
Westcliff	16.2%
Green Belt	0.02%
Total	100.0%

Employment growth was not distributed the same manner. There is less certainty regarding the locations at which future employment growth may occur within SCC, however, to reach the NTEM target, a large additional

Windfall contribution was required on top of those sites within the planning process. These jobs have been distributed evenly across the whole of Southend.

2.3 Ageing Population

For future-year population categories, NTEM population forecasts were reviewed to determine the proportion of population within each age group. The forecasts indicate that the population of age ranges 65-74 and 75+ increase in proportion compared to the other age ranges reflecting the ageing population trend expected within the study area.

Table 2-5 Population change of age ranges

Change in Low Scn			Change in High Scn		
	2035-25	2045-35		2035-25	2045-35
0-15	-3.0%	-0.9%	0-15	-2.9%	-0.6%
16-19	-0.3%	-0.5%	16-19	-0.4%	-0.7%
20-44	-0.5%	-0.9%	20-44	0.1%	-0.8%
45-64	-0.2%	0.4%	45-64	-0.4%	0.5%
65-74	2.0%	-0.6%	65-74	1.8%	-0.7%
75+	2.0%	2.5%	75+	1.8%	2.3%

The change in ages was provided by SCC. It was agreed with SCC to use the low scenario for growth derived for scenarios A and B, as this was consistent with current trends. For growth in the LNOS (Scenarios C and D), it was agreed to use the high scenario, as this represented an ambition of attracting younger families than currently, which may be better achieved with the new developments.

For the purpose of deriving detailed demographic splits (per site or for Windfall neighbourhoods as described above), the ageing factors were applied to the base year data first to derive a new breakdown in the source before applying to the developments.

2.4 Developing the Do-Minimum Population and Employment Databases

Using the information previously described, the following process has been implemented to develop the DM population database for the Southend Local Authority:

1) For each development site (including completions), a population distribution per dwelling was calculated (in terms of the input categories as outlined in Section 2.2.3) based upon the sample location provided. An initial contribution for the development was calculated based on the total number of dwellings for the site and the sample distribution.
2) For Windfall developments (for which a total number of dwellings was specified by neighbourhood), factors were calculated by neighbourhood which could be applied to generate the total number of additional dwellings required. Based on this, a specific contribution per model zone was calculated for Windfall.
    a) These Windfall numbers were then controlled so that the overall total would match the NTEM total in Scenario A (the Do-Minimum).
3) An adjustment was subsequently applied to account for the effects of an ageing population.
    a) This was considered important for Southend, which already has a significantly higher proportion of older residents than the national average, and whose population is also increasing at a higher rate than other age categories. The adjustment applied was based on the expected proportion of population in each modelled age category according to the NTEM forecasts (up to 2025) and then local forecasts thereafter.
4) The employment sites were distributed based on location where information was available, and for remaining NTEM required sites, these were distributed proportionately across Southend.

A similar process was undertaken to produce forecasts for the Rochford and Castle Point LAs, for which the same detailed population splits are required (though in these cases no detailed development site information

has been provided). For these locations, Local Authority wide factors were applied to the base population and employment databases to match absolute household and jobs growth in NTEM 8.1. Ageing population was accounted for using NTEM derived forecasts. A more simplified process has been applied for all external zones, i.e. everything outside Southend, Rochford, and Castle Point, since only high-level population and employment figures were required for these locations rather than the detailed splits needed for the FMA. A correspondence between MSOAs and external zones was used to assign absolute growth in population and jobs from NTEM to the external zones.

2.5 Developing the Population and Employment Databases for Scenario B onwards

Further contributions have been calculated in the same manner as the DM Scenario A sites by applying the sample location splits to the gross values, however, no adjustment has been applied to account for NTEM. Instead, the population and employment figures have been added directly to the Scenario A values.

2.6 Use of New Zones for Development Sites

New zones have been coded in the forecast models for larger development sites, or larger clusters of development sites only. Whilst it is often desirable for developments to be modelled as separate zones such that the direct impact of development traffic on the networks can be better understood in isolation, it is not appropriate to allocate separate zones for very small developments.

For Windfall development, additional population has always been assigned to the existing model zones, based on the existing distribution of housing (and employment) since precise locations are not known.

2.7 School Enrolment Inputs

Enrolment inputs for the forecast year models were calculated based on the final change in the 0-19 year old population. As most education sites do not have detailed sites, there is an assumption that enrolment to school places will remain constant based on the catchment of the local 0-19 population – as such ratios are derived from base year data and then applied to future years after any increases in population and changes related to aging cohorts. The distribution of schools is kept relatively the same as in the base, but the total education places increases in line with forecast population change.

3 Highway and Public Transport Networks

3.1 Public Transport Networks – Without Mitigation

The Southend public transport network was comprehensively updated to reflect bus and rail services operating during the 2025 base year, replacing the previous 2018 representation with a network based on current timetable information. GTFS[3] bus data from the Essex Bus Open Data service and rail timetable data from the Open Rail portal were used to update services, stops and routes. Significant changes between 2018 and 2025 networks required the creation of additional public transport links and stops, together with the addition of missing connectivity within the network coding, to ensure services could be successfully imported and represented within the model.

Following review of timetable availability and network coverage, the model was updated using bus and rail timetables representative of 26 November 2025, providing a suitable neutral weekday basis for forecasting. The resulting network was subject to a series of quality assurance checks, including review of service connectivity, airport access arrangements and local bus routing, to ensure that public transport accessibility was represented realistically. Seasonal services, such as the Southend 99 open-top bus, were excluded as they do not operate during the representative model period and were not considered material to the appraisal. The updated network is therefore considered an appropriate basis for forecasting and assessment of future-year transport interventions.

Public transport fares were assumed to remain constant in real terms across all forecast years. This is consistent with TAG guidance and reflects the absence of any committed fare strategies or policies that would materially alter fare levels over the forecast period.

3.2 Highway Networks – Without Mitigation

3.2.1 Transport Schemes

The initial schemes included within the forecast models are listed in Table 3-1. These schemes represent schemes that either have been delivered already since the base year or are committed schemes due to be delivered since 2018. This is consistent with the previous forecast models supplied by SCC and have been included following agreement with the Council.

Table 3-1 Highway Schemes – Without Mitigation

Scheme Name	Network Update	In 2035	In 2045
The Bell Junction	Increased number of lanes in both directions on A127: Dedicated left turn lane onto Rochford Road. Dedicated right turn lane onto Hobleythick Lane.	✓	✓
Queensway/Whitegate Road	Signalised right turn for southbound traffic on Queensway onto Whitegate Road.	✓	✓
Queensway/York Road	Signalised right turn added for southbound traffic on the Queensway onto York Road.	✓	✓
Bournemouth Park Road NPIF Scheme	Junction now signalised. Right turn option out of Bournemouth Park Road.	✓	✓
Better Queensway	Various changes including removal of the Queensway underpass and introduction of new pedestrian crossings.	✓	✓

[3] General Transit Feed Specification – This has been developed as an industry standard way to store and transmit public transport timetable information and routes/stops/fares etc.

3.2.2 Access to Development Sites

A number of new developments are expected to come in as planning applications from developers within the Green Belt area (Land North of Southend). In the Do Minimum scenario, in the absence of a dedicated access road serving the development, new zones for these developments were placed in similar locations, connected to the existing road network.

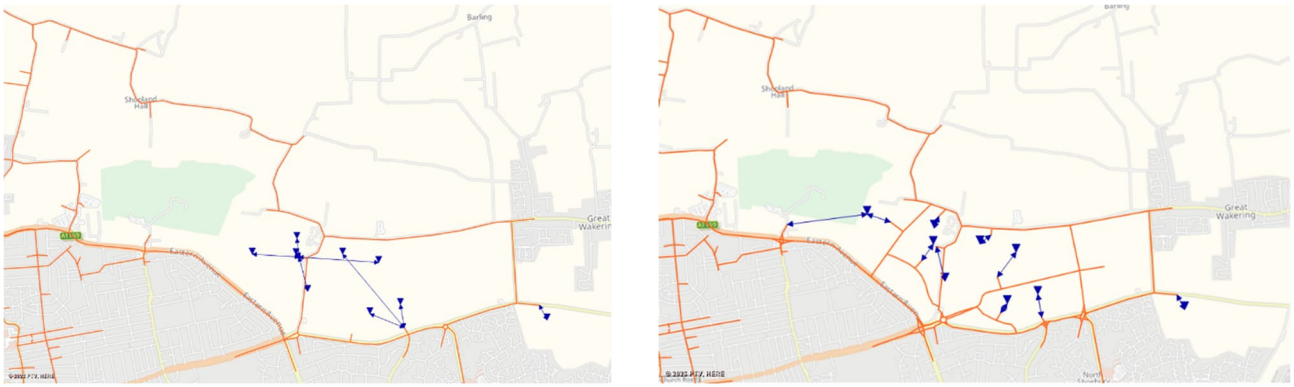


Figure 3-1 – Development sites in Green Belt area in the DM and in SP

There are several non-Green Belt developments elsewhere in Southend that have also been included in forecast scenarios, e.g. ones in central Southend and in Shoeburyness. For these sites, the new zones that represent them have also been connected to the existing network, using nearby stub links.

3.2.3 Generalised Cost Parameters

Assignment of vehicles is based on the lowest generalised cost route, combining journey time, vehicle operating costs and toll charges.

The generalised cost coefficients used within the assignment process, expressed as pence per minute (PPM); and pence per kilometre (PPK), are shown in Table 3-2 and Table 3-3. These values are based on a 2023 price base, consistent with TAG data book v2.02 November 2025. The latest available version of the TAG data book was used within the mesoscopic modelling. As the mesoscopic model provides the primary representation of local network delays for the Local Plan assessment, it was considered appropriate to use the most up-to-date parameter values available.

Table 3-2 AM Generalised Cost Coefficients

		Car Business	Car Commute	Car Other	LGV	HGV
2025	PPM	73.30	49.16	33.91	56.56	113.71
	PPK	17.16	8.41	8.41	19.24	56.20
2035	PPM	83.82	56.21	38.78	64.68	130.04
	PPK	12.87	6.03	6.03	15.32	50.68
2045	PPM	98.31	65.93	45.48	75.85	152.51
	PPK	10.59	4.60	4.60	13.71	48.92

Table 3-3 PM Generalised Cost Coefficients

		Car Business	Car Commute	Car Other	LGV	HGV
2025	PPM	74.36	49.32	35.51	56.56	113.71
	PPK	17.16	8.41	8.41	19.24	56.20
2035	PPM	85.03	56.41	40.61	64.68	130.04
	PPK	12.87	6.03	6.03	15.32	50.68
2045	PPM	99.72	66.15	47.63	75.85	152.51
	PPK	10.59	4.60	4.60	13.71	48.92

4 Other Model Inputs

4.1 External-External and Goods Vehicle Trips

External-external trips and goods vehicle trips are treated as exogenous inputs to the model system. The forecast matrices have been derived by applying factors from the DfT's National Road Traffic Projections (NRTP22) to the calibrated base-year matrices, as follows:

- The "vehicle miles" statistics have been used to calculate the growth factors;
- Data used has been restricted to the "Eastern England" region;
- As there are no motorways only the forecasts for trunk roads, A roads and minor roads have been used;
- Data has been extracted separately for cars, LGVs and HGVs.
- The 5-year interval data has been interpolated to calculate values for the 2018 base year; and
- Growth factors have been calculated from the interpolated 2018 values to the 2035 and 2045 forecast years.

The growth factors applied to the base year matrices are shown in Table 4-1.

Table 4-1 – Factors Applied to Exogenous Trip Forecasts

Vehicle Class	2035	2045
Cars (external to external trips only)	1.237	1.334
LGVs (all trips)	1.223	1.368
HGVs (all trips)	1.074	1.139

4.2 Economic and Other Parameters Developed From TAG data book

The TAG data book is used for several key economic parameters in the model. The SoSMMM VDM retains the same TAG-based economic parameters as used in previous modelling. These parameters were developed using the May 2024 TAG data book and have been carried forward for the current study.

During the earlier model update, it was identified that adjusting the demand model parameters could result in unrealistically large increases in long-distance car travel. This reflected the interaction between the model's calibrated distance sensitivity parameters and the substantial reductions in forecast fuel costs contained within the updated TAG data book. As a result, an adjusted approach to updating vehicle operating cost (VOC) parameters was adopted to produce more realistic forecasting behaviour. The adopted approach examined the differences between the TAG data book used during the model calibration and more recent versions, applying incremental adjustments rather than a full parameter update.

To maintain consistency with the previously validated forecasting approach, the existing parameter set has been retained. Consequently, the demand model parameters, including the approach to VOCs, values of time (VoT) and household income growth assumptions, have been retained unchanged from the previous modelling exercise. This maintains consistency with the existing validated model and avoids introducing untested changes that could materially affect forecast sensitivity.

5 Results – Without Mitigation Scenarios

5.1 Demand Model and Assignment Convergence

The SoSMMM model was used to produce an initial estimate of forecast demand before transferring to the mesoscopic model for mitigation testing. It is important to check that the model converges well and that growth forecasts are robust and defensible. This section demonstrates that the forecast model outputs provide a robust and suitable basis for subsequent highway modelling and mitigation testing.

5.1.1 Demand Model Convergence

The guidance in TAG indicates that it is desirable to achieve a % gap statistic for the whole VDM system of less than 0.1%, though notes that in certain model systems (for example when there is a significant amount of housing development in the forecast) it may not be possible to achieve a % gap of less than 0.2%.

Table 5-1 provides a summary of the demand model gap and the number of iterations to reach a gap of less than 0.1% for each model run. It can be observed that, in all cases, the achieved values are below the 0.1%; although some model years required a greater number of iterations than others.

Table 5-1 Demand Model Convergence Statistics

	2025		2035		2045	
	Iterations	GAP	Iterations	GAP	Iterations	GAP
Scenario A DM	9	0.066%	13	0.075%	19	0.088%
Scenario B DM			13	0.099%	21	0.091%
Scenario C DM			14	0.092%	19	0.097%

5.1.2 Highway Assignment Convergence

Table 5-2 provides a summary of the highway assignment convergence (% gap) values achieved across the model runs. The guidance indicates that % gap values of less than 0.1% should be achieved, which can be seen to be the case for all assignments. The highway assignment was deliberately run to considerably tighter convergence criteria than required in order to aid the demand model convergence.

Table 5-2 SOSMMM Highway Assignment Model Convergence

	AM	IP	PM
Scenario A 2035	0.0019%	0.0015%	0.0022%
Scenario A 2045	0.0078%	0.013%	0.0061%
Scenario B 2035	0.011%	0.013%	0.0032%
Scenario B 2045	0.0093%	0.012%	0.0046%
Scenario C 2035	0.0019%	0.0011%	0.0022%
Scenario C 2045	0.0057%	0.0076%	0.0058%

5.2 High Level Demand Summaries

Table 5-3 to Table 5-5 present the baseline demand forecasts. For ease of presentation, demand has been aggregated into 12 hour daily average trips rather than showing peak periods separately. The growth for each peak period is largely consistent. Table 5-3 shows forecast demand growth for Scenario A relative to the 2025 base-year.

The overall scale of growth is consistent with previous applications of the model and reflects the forecast increase in housing across the study area. This is in line with previous Southend model forecasts and is

marginally higher than national averages, reflecting local demographic and socio-economic characteristics, including relatively high household incomes and lower average household occupancy. This may be slightly higher than expected. However, as forecasts are towards the upper end of the plausible range, confidence can be placed in the robustness of the mitigation assessment representing a reasonable worst-case scenario.

Whilst growth is evident across all journey purposes, commute demand grows more slowly than other trip purposes in the later forecast period. Between 2035 and 2045, commute demand increases by 3.7%, compared with 4.7% growth in other trips. This reflects the changing demographic profile assumed in the forecasts, with an ageing population resulting in proportionately lower growth in commuting demand than in other travel purposes.

Table 5-3 Demand Matrix 12hr Totals – 2025 Base vs DM Forecasts

User Class	2025	2035 A	2045 A	2025 -> 2035	2045 -> 2035
Business	59,770	61,380	62,670	2.7%	2.1%
Commute	145,370	151,590	157,190	4.3%	3.7%
Other	261,850	273,530	286,470	4.5%	4.7%
Car Total	**466,990**	**486,490**	**506,330**	**4.2%**	**4.1%**

Table 5-4 and

Table 5-5 compares the alternative development scenarios against Scenario A. Thereby testing the cumulative impact of the potential allocations without permission within the emerging Local Plan. In 2035, differences between the scenarios are relatively modest, with total car demand in Scenario C only 0.9% higher than in Scenario A. This is consistent with the limited divergence in housing growth assumptions during the first ten years of the plan period.

By 2045, more substantial differences emerge. Total car demand in Scenario B is 1.5% higher than Scenario A, whilst Scenario C is a further 2.4% higher than Scenario B. This reflects the greater levels of housing growth assumed in Scenario C during the second half of the forecast period. The increase is particularly apparent for commuting trips, where demand in Scenario C exceeds Scenario B by 2.5%. This is consistent with the demographic assumptions associated with the additional development locations, which are expected to attract a higher proportion of working-age households and families relative to the baseline scenario.

Table 5-4 Demand Matrix 12hr Totals – 2035 Scenarios

User Class	2035 A	2035 B	2035 C	A -> B	B -> C
Business	61,380	61,700	62,040	0.5%	0.5%
Commute	151,590	152,140	152,930	0.4%	0.5%
Other	273,530	274,220	276,080	0.3%	0.7%
Car Total	**486,490**	**488,070**	**491,050**	**0.3%**	**0.6%**

Table 5-5 Demand Matrix 12hr Totals – 2045 Scenarios

User Class	2045 A	2045 B	2045 C	A -> B	B -> C
Business	62,670	63,630	64,960	1.5%	2.1%
Commute	157,190	159,320	163,250	1.4%	2.5%

Other	286,470	291,060	298,110	1.6%	2.4%
Car Total	**506,330**	**514,010**	**526,320**	**1.5%**	**2.4%**

5.3 SATURN Flow Difference Plots

Figure 5-1 to Figure 5-4 (reproduced at a larger scale in Appendix C) show the distribution of growth in some of the key scenarios. As shown, the growth in Scenario A is relatively evenly distributed across the full modelled area, this is shown in Figure 5-1 showing the growth from 2025 to 2035, and Figure 5-2 showing the growth up to 2045 from 2035.

In Scenario B, additional growth is concentrated around the town centre area (including Fossetts Farm) which is consistent with the spatial location of those opportunity sites. The full difference to 2045 is shown in Figure 5-3. The additional growth in Scenario C is again spatially focussed on the LNOS within Southend, which is consistent with the demand assumptions (shown in Figure 5-4).

In these plots – it should be noted that growth is highlighted as green (for positive numbers) and any decline is shown in blue. For brevity the AM plots are shown here in the main report, however the plots in Appendix C include other time periods).

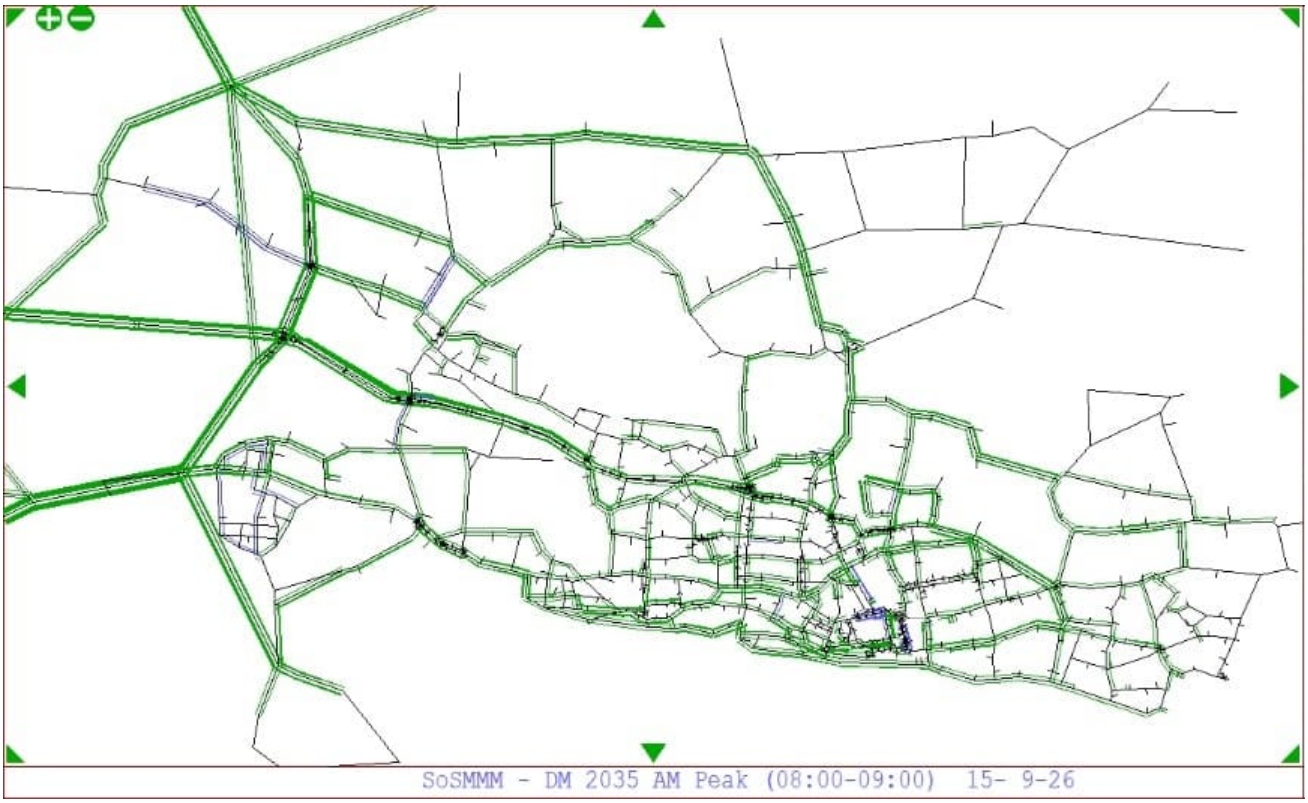


Figure 5-1 2025 Base model vs 2035 A DM

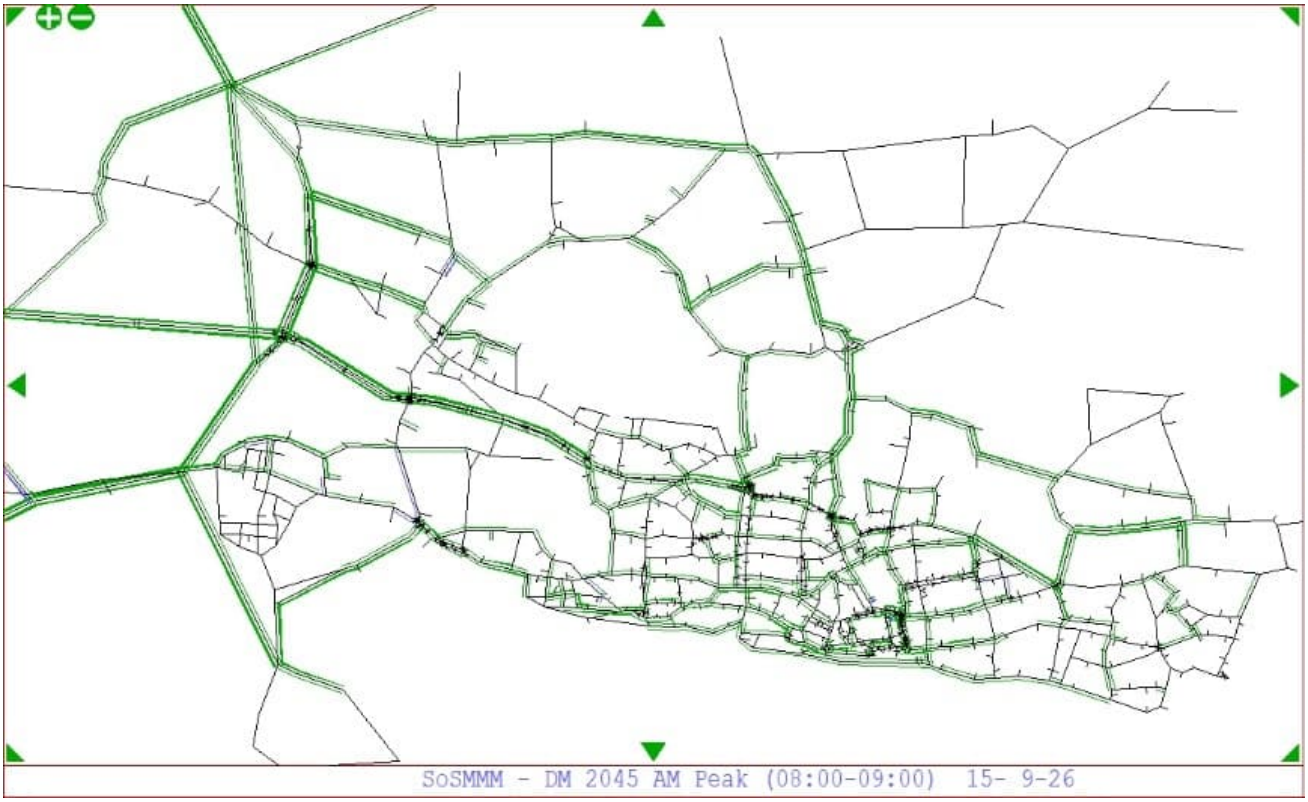


Figure 5-2 2035 A DM vs 2045 A DM

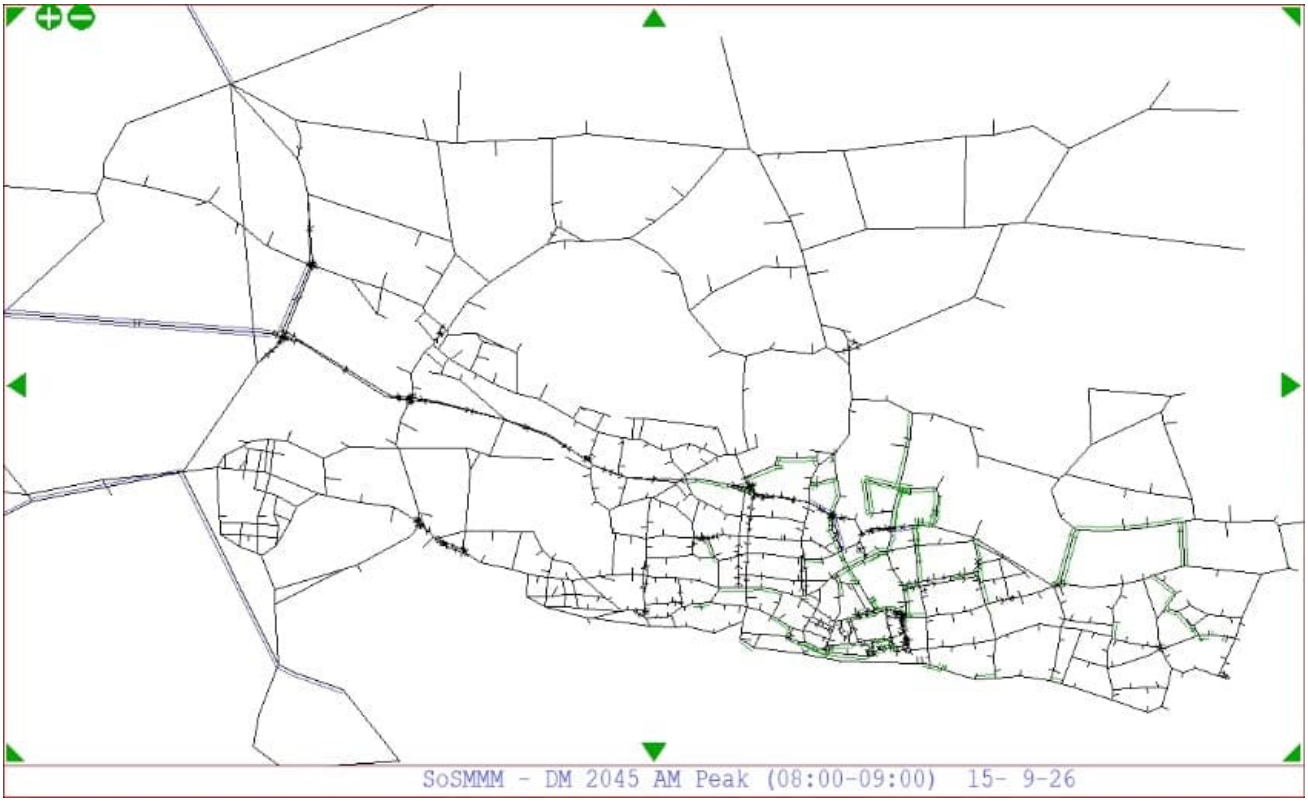


Figure 5-3 2045 A DM vs 2045 B DM

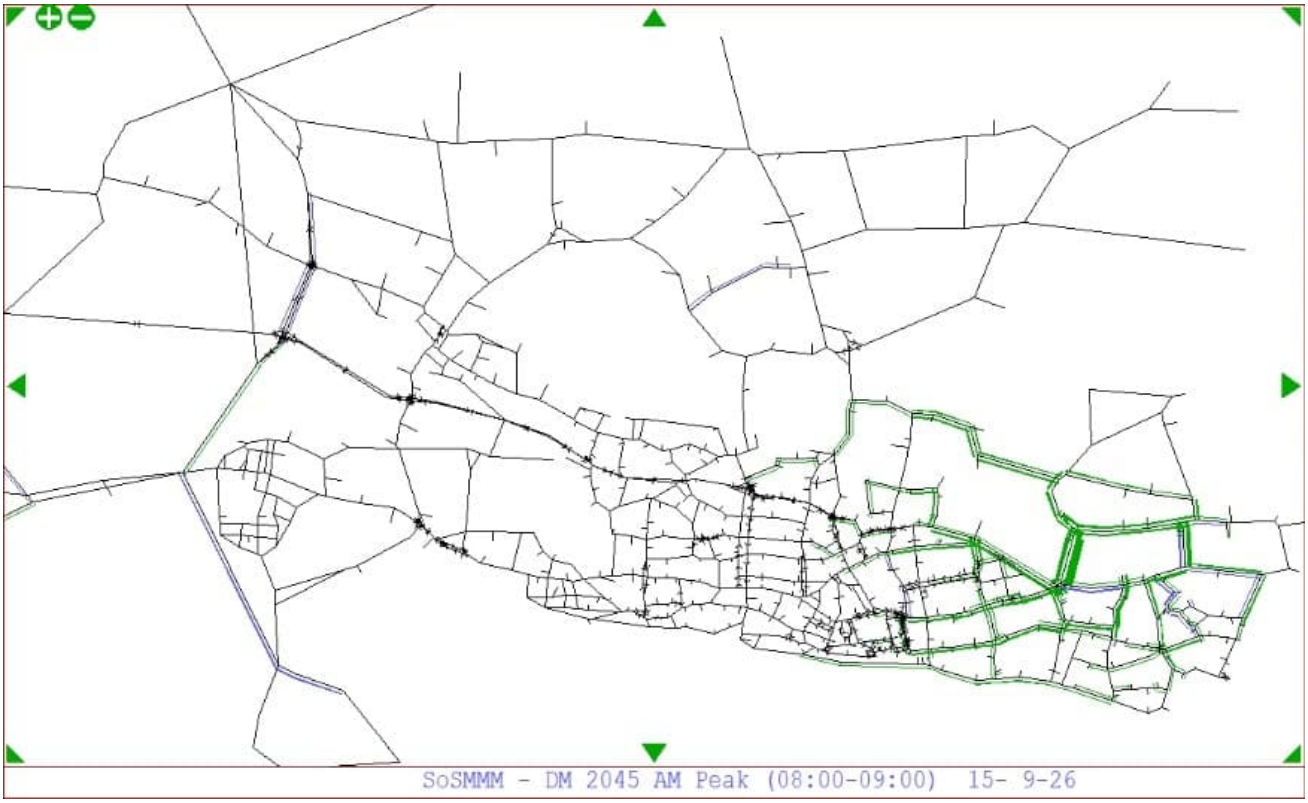


Figure 5-4 2045 B DM vs 2045 C DM

5.4 Conclusion and suitability for use of these demand predictions

The demand growth presented is consistent with the increased land use assumptions. The relatively high car trip rates reflect the demographic and socio-economic characteristics represented within the forecasting assumptions. This may be slightly higher than expected. However, as forecasts are towards the upper end of the plausible range, confidence can be placed in the robustness of the mitigation assessment representing a reasonable worst-case scenario.

The concentration of demand growth is focussed around the model area of the mesoscopic model (i.e. the Green Belt area to the North East and Central corridor of Southend City). This confirms that the mesoscopic model is well suited to assessing the operational impacts of growth in the locations where the greatest transport pressures are forecast to occur.

6 Proposed Transport Interventions to Support Future Development

6.1 Overview

The mitigation packages developed for the previous Regulation 18 assessment have been reviewed and updated to reflect schemes that have progressed since that work was undertaken. This section sets out the individual schemes and packages that have been identified for highways, public transport and identifies whether, and how, each scheme has been represented within the modelling. The individual schemes have been incorporated into packages with each successive package building upon the interventions included within the preceding package.

6.2 Highway Measures

The highway interventions have been identified from previous modelling work, the emerging LTP4 programme and more recent scheme development activities, including Nestuda Way proposal arising from a recent feasibility study. The schemes are summarised in Table 6-1 and illustrated in Figure 6-1 and Figure 6-2 for the Southend Light and Southend Plus packages, respectively.

Table 6-1 – Highway Mitigation Schemes

Scheme	Description	Modelled
	Southend Light	
Site 1	Harp House Roundabout Upgrade	✓
Site 5	Eastern Avenue/Sutton Road Roundabout Upgrade	✓
Site 6	Eastern Avenue/Fossetts Way Roundabout Upgrade	✓
Site 7	Eastern Avenue/Royal Artillery Way/Hamstel Road Roundabout Upgrade	✓
Site 9	Nestuda Way	✓
Site 10	Fairfax Drive	✓
Site 11	A127 Progress Rd Fairway	✓
Site 12	Victoria Avenue/East Street/West Street	✓
Site 13	Victoria Gateway	✓
	Southend Plus	
Site 3	Cuckoo Corner Roundabout Improvements	×
Site 4a	Priory Crescent 4-lane Dual Carriageway Upgrade	✓
Site 4b	New A1159 Eastern Avenue Active Travel Bridge	×
Site 8a	Bournes Green – Thorpe Estates	✓
Site 8b	Bournes Green - Bellway Homes Junctions	✓

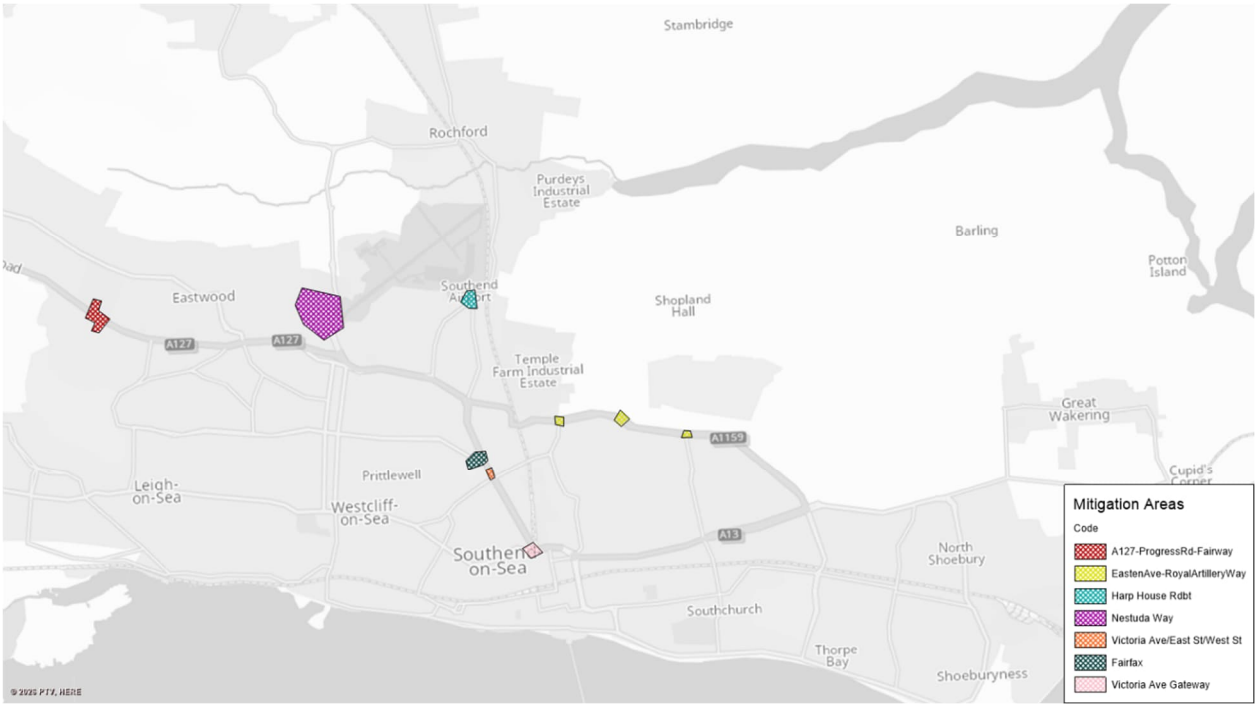


Figure 6-1 – Southend Light Schemes



Figure 6-2 – Southend Plus Schemes

Further details on each intervention are provided within the Cost Estimates Technical Note included as Appendix B.

6.2.1 Rochford Fairglen Mitigation (A127/A130)

The proposed improvements at the Fairglen Interchange were reviewed as part of the modelling process. However, the scheme is located within the SATURN buffer network, where detailed junction layouts and operational changes cannot be explicitly represented. The scheme also lies outside the extent of the mesoscopic model used for the detailed assessment of network performance and delay and as such, has not been explicitly modelled within the mesoscopic model.

Although the Fairglen scheme has not been explicitly modelled within the detailed network, sensitivity testing was undertaken within the SATURN buffer network through adjustments to link capacities and speeds to reflect the anticipated increase in capacity. This testing indicated that the scheme had a negligible effect on strategic traffic assignment and the matrices supplied to the mesoscopic model.

The omission of a detailed representation is therefore not considered to materially affect the conclusions of the Southend Plus assessment. A comprehensive evaluation of the scheme's interaction with the proposed interventions would require a dedicated study area extending to the A127/A130 interchange and a more detailed representation of existing operational conditions in both Saturn and Mesoscopic models.

6.3 Public Transport and Active Travel Measures

The public transport and active travel interventions have been identified through previous modelling work, the emerging LTP4 programme and additional schemes identified by SCC and although they are not modelled in detail here a 10% shift onto PT and active travel for the LNOS growth has been included to account for them. The schemes are shown in Table 6-2 by package.

Table 6-2 – Public Transport and Active Travel Schemes

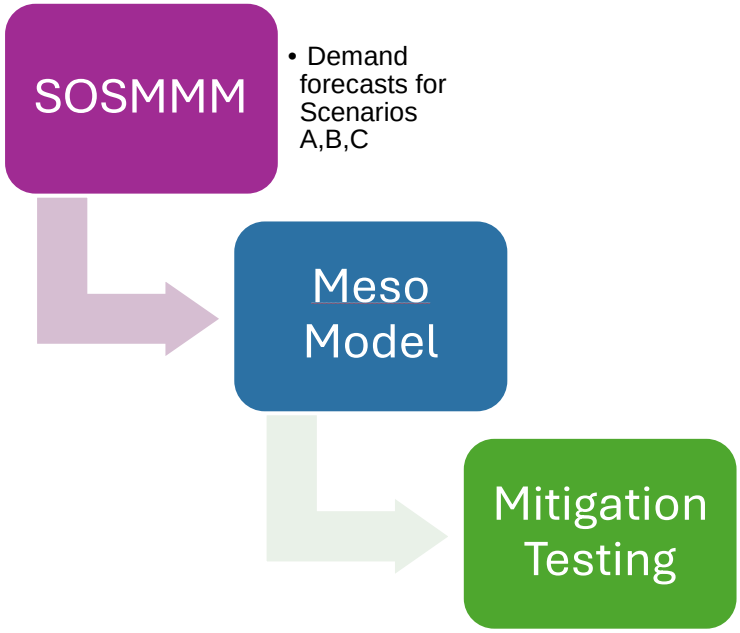
Scheme	Description	Modelled
Southend Light		
602-604(AT)	Various LCWIP identified Active Travel Routes	×
605(AT)	Bournemouth Park Road Improvements	×
607(AT)	Bike Share Expansion	×
Southend Plus		
301(PT)	Bus Priority UTC Signals	×
302(PT)	Real Time Passenger Information	×
303(PT)	Mobility Hubs & Mini-Hubs	×
305(PT)	Integrated Ticketing Infrastructure	×
307(PT)	New Strategic Bus Infrastructure within Growth Areas	×
402(PT)	Assumed improvements and new Bus routes to serve key destinations, following BSIP and LTP	✓
606(AT)	Active Travel Routes Along New Highway Corridors	×

7 Mesoscopic Model Development

Figure 7-1 summaries the methodology that was outlined earlier in 1.3, the next stage is to transfer the demand into the mesoscopic model and perform mitigation testing with it.

The following sections explain the process for transferring demand growth and what interventions have been coded.

Figure 7-1 Modelling Methodology



7.1 Demand Transfer Methodology

The transfer of demand between the SoSMMM SATURN model and the mesoscopic model utilised an established demand transfer process that has been applied successfully on previous studies. As an initial step, a cordon-based representation of the strategic model was created. This converts longer-distance trips passing through the study area into equivalent movements between cordon zones located on the model boundary, whilst retaining the strategic travel patterns represented in the SATURN forecasts. Demand was then translated from the SATURN zone system to the mesoscopic model zone system using an existing zone correspondence. Following the 2025 extension of the mesoscopic model, additional zone matching was undertaken using GIS-based spatial analysis to ensure that all new zones were correctly represented in the transfer process.

Once the demand had been mapped to the mesoscopic zone system, an automated Python-based process was used to disaggregate the strategic demand matrices into the format required by the mesoscopic model. Unlike the strategic model, which operates using peak-hour matrices, the mesoscopic model represents demand using a series of 15-minute time-slice matrices. This allows traffic demand to be loaded progressively through the simulation period, providing a more realistic representation of the build-up and dissipation of congestion.

As part of the 2025 mesoscopic model update, observed traffic counts were used to calibrate the distribution of demand across the 15-minute time slices. The forecasting approach therefore retained the calibrated temporal demand profiles whilst applying growth forecast by the SoSMMM demand model. Future-year matrices were produced using a matrix pivoting process that applies forecast growth from the strategic model to the 2025 base matrices while maintaining realistic temporal and spatial travel patterns. Appropriate controls were

incorporated within the process to avoid anomalous growth factors where base demand levels were low. This methodology has been successfully applied in previous forecasting studies and provides a robust mechanism for transferring strategic demand forecasts into the more detailed operational model.

The resulting outputs comprised a complete set of forecast demand matrices for the 2035 and 2045 assessment years, segmented by 15-minute time period and reflecting the demand growth associated with each development scenario. These demand forecasts were then assigned within the mesoscopic model and used as the basis for testing future highway conditions and the mitigation measures described in the following section.

7.1.1 PT and Active travel adjustments

The mesoscopic highway model does not explicitly represent mode shift arising from public transport or active travel interventions. Therefore, an alternative approach was required to assess the potential impact of these measures on highway demand;

1. Assume no mode shift would result from any of the interventions.
2. Apply the mode shift assumptions used in assessment, whereby 10% of car commute demand associated with new development is assumed to transfer to public transport. This figure is based on that derived from previous work looking at new build sites elsewhere in the country (see also 7.1.1.1).
3. Attempt to represent the public transport interventions within the SoSMMM demand model and estimate mode shift directly from the resulting forecasts.

In principle, the third approach would provide the most comprehensive assessment. However, the public transport and active travel measures considered at this stage of the study remain strategic in nature and could be implemented in a variety of ways. Developing detailed representations of these schemes within the demand model would therefore require a number of assumptions regarding their future form and operation, introducing additional uncertainty into the forecasting process.

Consistent with a vision-led approach, the primary forecasts have based on the second option, assuming the modal transfer of new car demand. This reflects the ambition of the package of sustainable transport measures and policy interventions identified through the study and provides an assessment of network performance under the intended future transport strategy. For this, we have applied the mode shift to commute trips only representing transfer away from car to public transport (and/or active travel options). This adjustment is only made to trips to/from the new development zones.

Recognising that the level of mode shift ultimately achieved will depend on the detailed design, delivery and uptake of these measures, a sensitivity test was also undertaken assuming a lower level of mode shift (i.e. the first option) represented by no reduction in car demand from newly arising households. This provides an indication of the potential highway impacts should the full benefits of the sustainable transport interventions not be realised.

7.1.1.1 Mode share evidence from other developments

A package of public transport and active travel measures has been identified as part of the Southend Plus mitigation strategy. To inform the modelling assumptions, a review was undertaken of comparable developments and public transport schemes elsewhere in England to understand the scale of mode shift that may reasonably be achieved through sustained investment in sustainable transport infrastructure.

The evidence demonstrates a wide range of outcomes depending on the nature of the development, the quality of public transport provision and the supporting policy measures. Given this variation, a simple and proportionate assumption has been adopted whereby 10% of commuting trips associated with the new development areas are assumed to travel by bus.

It is important to note that the conclusions of this study are not dependent on achieving precisely this level of mode shift. As demonstrated in Section 8 and the accompanying appendices, the proposed mitigation

packages are capable of substantially mitigating congestion impacts even under more conservative assumptions. The mode shift assumption should therefore be viewed as a reasonable representation of the wider sustainable transport strategy rather than a critical threshold upon which the findings depend.

This assumption represents an increase in bus mode share from approximately 4% of commuting trips, as observed in the 2021 Census, to around 10%. Achieving this level of bus use would be broadly equivalent to reducing the proportion of trips made as a car driver from approximately 60% to 54% (so a 10% reduction). Within the modelling, this adjustment has only been applied to commute trips associated with the new development zones.

The primary case study is Beaulieu Park, Chelmsford, which provides a particularly relevant comparator due to its similar role as a strategic urban extension accommodating substantial housing growth. The development was supported by a coordinated package of dedicated bus services, public transport priority measures, walking and cycling infrastructure, and travel planning initiatives aimed at reducing car dependency. This combination of land-use growth and sustainable transport investment closely reflects the objectives of the Southend Plus strategy, making it a useful benchmark for assessing the potential scale of mode shift that could be achieved. Similar measures are proposed as part of the Southend Plus package, including new bus services, bus priority infrastructure, active travel improvements and mobility hubs. Travel plan monitoring indicates that these measures achieved significant reductions in car use alongside substantial growth in public transport patronage.

The Beaulieu Park case study along with other comparable UK examples are summarised in Table 7-1 below.

Table 7-1 – Comparable UK Case Studies

Case Study	Key Features	Key Similarities to Southend Plus	Observed Outcomes
Beaulieu Park, Celmsford	Strategic urban extension supported by dedicated bus services, bus priority measures, walking and cycling infrastructure, and travel planning initiatives.	A large-scale urban extension where sustainable transport measures were delivered alongside significant housing growth. The scale of development and integrated package of bus, active travel and travel planning measures are comparable to those proposed for Southend Plus.	Bus Patronage increase by 44% from 2018 to 2019. AM Car trips rates were 30% lower than forecast, and PM 16% lower. Active travel levels also increased
Crawley Fastway	Bus rapid transit network incorporating extensive bus priority and high-quality public transport infrastructure.	Demonstrates the benefits of high-quality bus priority infrastructure and rapid transit style services, reflecting ambitions to improve bus journey times, reliability and attractiveness on key corridors.	160% patronage growth and 19% reduction in traffic levels.
South East Hampshire BRT (Eclipse)	Bus rapid transit scheme with dedicated infrastructure and improved service quality.	A strong example of how dedicated bus infrastructure and service enhancements can encourage mode shift from private car travel, similar to the proposed bus priority and service improvements.	48% patronage growth and around 2% mode shift from car to bus.
Mansfield Public Transport Interchange	New bus station with interchange to rail station. Also increased provision for cycling at the station.	Illustrates the benefits of improved interchange between transport modes, aligning with the proposed mobility hub concept and enhanced connectivity with rail services, including access to Airport Station.	7% increase in passenger demand during the first year.

Fastrack, Kent Thameside	High-quality bus rapid transit system serving major growth areas and providing attractive alternatives to car travel.	A public transport network developed to support major housing growth areas, demonstrating how attractive bus services can capture trips that would otherwise be made by car.	Approx. 19% of users previously travelled by car.
Leigh Guided Busway	Guided busway and associated bus priority measures providing faster and more reliable journeys.	Shows the potential for high-quality bus priority measures to provide a credible alternative to car travel through faster and more reliable journeys.	20-25% modal shift from car with substantial patronage growth.

Evidence from Beaulieu Park, Chelmsford and comparable UK public transport schemes demonstrates that targeted investment in high-quality bus services, public transport priority measures and supporting sustainable transport infrastructure can successfully increase public transport use and reduce dependence on private cars. In this context, the assumption of a 10% bus mode share for commuting trips is considered a realistic and proportionate assumption for strategic transport modelling purposes.

7.1.1.2 Inclusion in Southend Plus

The mode shift assumption has only been applied within the Southend Plus scenario. This reflects the fact that Southend Plus includes a substantially more ambitious package of public transport and active travel interventions, specifically targeted at improving accessibility to and from the proposed development areas north of Southend. These measures include enhanced public transport provision, mobility hubs, active travel improvements and wider network interventions intended to influence travel behaviour. The Southend Light scenario does not include the same scale of intervention and, therefore, a comparable level of mode shift would not be justified.

7.2 Highway Network Changes

The following text descriptions give an overview of the various packages modelled and how they have been incorporated.

7.2.1 Signal Timings

Traffic signal timings are an important component of the mesoscopic model and can have a significant influence on network performance. To ensure that delays reflected future network conditions rather than arbitrary signal settings, traffic signals were reviewed and optimised within each model scenario.

Where available, LinSig models and existing signal information were used to provide initial estimates of signal staging, cycle times and inter-green periods. These timings were then refined using the signal optimisation tools available within the modelling software. In addition to optimising individual junctions, particular attention was given to the coordination of signal-controlled corridors, such as Victoria Avenue and the A127, where progression between successive signals can have a substantial effect on journey times and congestion.

To ensure consistency across all scenarios, an automated process was developed to optimise signal offsets and coordinate key signal corridors based on forecast traffic demand. The optimisation was undertaken iteratively alongside the traffic assignment until stable results were achieved. This approach provides a repeatable and objective method for signal optimisation and reduces the risk that differences between scenarios arise from signal settings rather than the underlying demand or mitigation measures being tested.

Following completion of the signal optimisation process, each scenario was assigned using multiple random seeds to assess network performance and result stability.

7.2.2 Southend Light network Changes

The following schemes have been coded into the model, below a brief description of key aspects of the modelling assumptions have been provided.

Table 7-2 Southend Light Schemes

	Southend Light
Site 1	Harp House Rbt upgrade
Site 5	Eastern Avenue/Sutton Road Roundabout Upgrade
Site 6	Eastern Avenue/Fossetts Way Roundabout Upgrade
Site 7	Eastern Ave/Royal Artillery Way/Hamstel Rd Roundabout Upgrade
Site 9	Nestuda Way
Site 10	Fairfax Drive
Site 11	A127-Progress Rd Fairway
Site 12	Victoria Avenue/East Street/West Street
Site 13	Victoria Gateway

7.2.2.1 Site 1 - Harp House Rbt upgrade

- Addition of a third approach lane on Manners Way northbound approach, including a dedicated lanes for London Southend Airport and Airport Retail Park.
- Additional lane on the western section of the roundabout including additional stacking capacity for Airport Retail Park.
- Segregated left turn lane for traffic on the Rochford Road / Southend Road southbound approach onto Manners Way southbound.

7.2.2.2 Site 5 - Eastern Avenue/Sutton Road Roundabout Upgrade

- An additional approach lane added to all roundabout approaches
- An increase in the number of lanes within the roundabout to three around the majority of its circumference.
- Signalisation of the roundabout

7.2.2.3 Site 6 - Eastern Avenue/Fossetts way Roundabout Upgrade

- An additional approach lane added to all roundabout approaches
- An increase in the number of lanes within the roundabout to three around the majority of its circumference.

7.2.2.4 Site 7 - Eastern Avenue/Royal Artillery Way/Hamstel Rd Roundabout Upgrade

- Additional approach lane on the A1159 RoyalArtillery Way, Hamstel Road, and Eastern Avenue approaches
- An increase in the number of lanes within the roundabout to three around across the northern portion of the roundabout.
- Signalisation of the roundabout

7.2.2.5 Site 9 - Nestuda way

- New left turn link road from Eastwoodbury Ln westbound onto Nestuda way southbound
- New left turn link road from Nestuda way northbound onto Eastwoodbury Ln westbound
- Signalisation of Junctions

7.2.2.6 Site 11 - A127 – Progress Rd Fairway

- Addition of one extra lane in each direction on the A127 Southend Arterial Road between Progress Road and Bellhouse Road.

7.2.2.7 Site 12 - Victoria Avenue (including Site 10 changes for Fairfax)

- Addition flared lane approach toward Priory Crescent/Fairfax Drive junction southbound
- Extend flared lane approaching East St/West St junction southbound
- The Site 10, Fairfax scheme is largely beyond the border of the mesoscopic model so has not been fully modelled beyond impact with Victoria Avenue intersection.

7.2.2.8 Site 13 - Victoria Gateway

- Additional lane on Victoria Avenue southbound
- Additional bus Lane on Queensway westbound

7.2.3 Southend Plus network Changes

Table 7-3 Southend Plus Schemes

	Southend Plus
Site 4	Priory Crescent 4 lane dual carriageway upgrade
Site 8	Bournes Green – Thorpe Estates
Site 8	Bournes Green - Bellway Homes Junctions

7.2.3.1 Site 4 - Priory Crescent 4 lane dual carriageway upgrade

- Additional lanes to make a four-lane carriageway

7.2.3.2 Site 8 - Bournes Green – Thorpe Estates

- Maplin Way North Roundabout – Additional arm to the north
- Bournes Green Roundabout – Additional arm to the north
- Added western circulatory to the Eastern Access Roundabout
- Signalisation of Access Roundabouts
- Additional link from A1159 Royal Artillery way southbound to Eastern Access Roundabout

7.2.3.3 Site 8 - Bournes Green – Bellway Homes

- Additional signalised junction to access the Bellway Homes site from Royal Artillery Way
- Additional access to the Bellway Homes site from Parsons Corner Roundabout

8 Results – With Mitigation Scenarios

This section contains the main results from the modelling. The following table shows the scenarios that have been modelled in the Mesoscopic model. As you move to the right (from A to B to C) more demand is in the model which will increase overall congestion, however as you move down the mitigation scenarios, various interventions are added that reduce the delay and mitigate back to the initial conditions or as close as possible.

- The light red shaded cell is the reference scenario we shall be testing mitigations against.
- The two dark shaded scenarios show the scenarios that are under serious consideration for mitigating the demand,
    - Southend Light for Scenario B and Southend Plus for Scenario C.
- The remaining light shaded scenarios are included for reference only.

Table 8-1 – Model Scenario Matrix

Mitigation Scenario	Future Year Demand Level Scenario		
	A	B	C
Do Minimum (unmitigated)	✓	✓	✓
Southend Light	✓	✓	✓
Southend Plus		✓	✓
Southend Plus with Rochford Light			✓

As a reminder from section 2, the three scenarios can be thought of as:

A. NTEM controlled scenario, including all committed developments
B. With the addition of proposed allocated and opportunity sites
C. With the addition of LNOS Greenbelt sites.

The results are presented in two main formats; total vehicle hours, and delay plots. The change total vehicle hours is a measure of average congestion experienced in the model and hence the difference in this between scenarios gives an easy indication of how well the mitigations work. Whilst average results tell one story, some areas affected of the network will be more congested than others, and so there will be some areas that will improve more than others – and some released demand may cause more delay elsewhere in the model. The delay plots give some context into this wider picture. An appendix provides a series of plots from the model, however some key plots are presented in the main body to highlight some observations.

8.1 Assignment Convergence and Result Stability

As with the strategic demand model, convergence within the mesoscopic model is an important consideration when interpreting forecast results. However, unlike a conventional deterministic assignment, mesoscopic simulation incorporates stochastic processes that influence the timing and routing of individual vehicle movements. As a result, repeated runs using different random seeds will not produce identical outputs, even where the underlying demand and network remain unchanged.

To account for this, each forecast scenario was simulated using multiple random seeds and the reported results are based primarily on average performance across the accepted model runs. This approach reduces the influence of any individual simulation and provides a more robust estimate of network conditions. The variation observed between random seeds was generally limited to a few percent but there would be a few outliers, which is consistent with that observed during the base year calibration and validation process.

The use of multiple random seeds also allows the range of possible outcomes to be assessed. In addition to average results, consideration has therefore been given to the best-performing and worst-performing seeds to understand the uncertainty inherent within the simulation process.

As part of the quality assurance process, runs exhibiting atypical behaviour were excluded from the averaging process. This includes runs where vehicles remained within the simulation at the end of the modelled period, preventing delays from being fully recorded. Following the signal optimisation process described previously in Section 7.2.1, such cases requiring us to discard a seed were very rare, providing confidence that the reported results are based on a stable and converged set of model runs.

The assignments are allowed up to 50 iterations (or 55 if that helps remove excess vehicles); through testing the results do not deviate much after say 30 iterations provided all vehicles have exited the network – however we retained the limit 50 to keep consistency with the base.

8.2 Vehicle Hours – Overall Comparisons

Vehicle-hours provide a measure of the total time spent travelling within the network and are therefore a useful indicator of congestion, with higher values reflecting slower journeys and increased delay.

The following tables show the change in congestion for trips within the modelled area as a consequence of both increased demand from the various scenarios, and improved network infrastructure from the mitigation packages. The key results are highlighted in **Bold**.

Scenario B we can see is **fully mitigated in the AM with Southend-Light** package with congestion falling by around 4% on average. The variability in random seeds is relatively low – and is clearly dwarfed by the improvement. Scenario C we can see if also is **fully mitigated in the AM with Southend-Plus package** with congestion falling by 11%.

The SP scenario includes an assumption about mode-shift – however we have included a sensitivity test (SP with no mode shift) to explore a worst case. Whilst this scenario does not perform as well, it shows the highway packages still make a significant contribution towards mitigating congestion.

Table 8-2 – Vehicle hours in 2045 AM models (Bold main scenarios of interest**)**

		Vehicle Hours - AM			Average Gap
		Average	Seed Variability	Change from 2045-A DM	
Scenario A	**DM**	**6,906**	**2%**		0.016%
	SL	6,351	1%	-8%	0.012%
Scenario B	DM	7,183	1%	4%	0.016%
	SL	**6,644**	**1%**	**-4%**	0.009%
	SP	6,093	1%	-12%	0.006%
Scenario C	DM	7,537	2%	9%	0.019%
	SL	7,174	1%	4%	0.016%
	SP (no mode shift)	6,222	1%	-10%	0.008%
	SP	**6,114**	**0%**	**-11%**	0.008%

The PM results show a similar picture to the AM, however the congestion is much worse and improvements reduced. This is particularly noticeable in the unmitigated Scenario C results that show 19% increase in vehicle-hours.

Within the mitigation scenarios, the PM is no longer fully mitigated by Southend-Light in Scenario B but is mitigated by Southend Plus in Scenario C. The table also shows combining the peak hour congestion from both AM and PM models and that overall, the improvement in the AM outweighs the PM conditions for scenario B and becomes a definite improvement in Scenario C. We can see that if the interventions are further

combined with Public Transport or Active Travel interventions that reduce car demand then the congestion can be mitigated further. More targeted interventions would have more potential.

Table 8-3 – Vehicle hours in 2045 PM models and Combined Peaks

		Vehicle Hours - PM			Average Gap	AM + PM	
		Average	Seed Variability	Change			Change
Scenario A	**DM**	**6,964**	**0%**		0.008%	**13,870**	
	SL	6,415	1%	-8%	0.017%	12,766	-8%
Scenario B	DM	7,692	1%	10%	0.011%	14,876	7%
	SL	**7,139**	**1%**	**3%**	0.011%	**13,783**	**-1%**
	SP	6,588	1%	-5%	0.007%	12,681	-9%
Scenario C	DM	8,291	1%	19%	0.012%	15,828	14%
	SL	7,244	2%	4%	0.011%	14,418	4%
	SP (no mode shift)	6,957	1%	0%	0.009%	13,179	-5%
	SP	**6,918**	**1%**	**-1%**	0.008%	**13,033**	**-6%**

8.2.1 2035 Vehicle Hour Results

These are included, with an additional mitigation scenario, as part of Appendix A.

8.3 Journey time path analysis

In order to break down the impact of each individual scheme we created paths along scheme areas and used the average link and turning travel times from the model as an indication of localised congestion. The routes selected for analysis are shown in Figure 8-1 to Figure 8-6 and presented in Table 8-4. The journey times presented represent the duration of both directions (i.e. there and back again), for example the Route 10 (major East<->West) duration of 3600s represents ~30mins in each direction, or 1 hour for there and back again.

These times are the result of averaging across multiple random-seeds from DM network with Scenario A, SL in B and SP in C for the AM.

Table 8-4 AM scheme journey times (seconds)

Route	A DM	B Southend Light	C SP	percentage change A DM to B SL	percentage changes A DM to C SP
Route 1 - Harp House	165	135	145	-19%	-13%
Route 2 - Eastern Avenue/Sutton Road	295	345	185	17%	-38%
Route 3 - Eastern Avenue/Fossetts way	125	140	120	12%	-2%
Route 4 - Eastern Avenue/Royal Artillery way	165	175	190	7%	15%

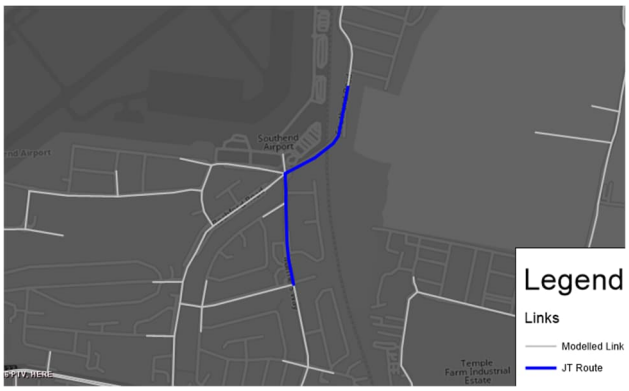
Route 5 - A127	1,695	1,615	1,660	-5%	-2%
Route 6 -Victoria Avenue/East Street/West Street	430	710	415	65%	-4%
Route 7 - Victoria Gateway	285	225	270	-21%	-5%
Route 8 - Priory Crescent	1,195	1,200	1,055	1%	-11%
Route 9 - Bournes Green	485	600	520	24%	7%
Route 10 - Major East<->West	3,600	3,375	3,375	-6%	-6%

From the table it's clear that the Southend Plus package is able to mitigate journey times for more paths through the network than Southend Light. The Roundabout access for Eastern Avenue/Royal Artillery way is however causing more concerns – possible due to synchronisation with the signals at Bournes Green. Those roundabouts are very sensitive to operational settings. Victoria avenue is aided through the introduction of Priory Crescent producing a more stable flow of traffic down from Cuckoo corner roundabout – although the signals here are also very sensitive to operational conditions.

The overall route (major East<->West) shows a 6% decrease due to mitigation – while sections of it performed less well in Scenario C (see A127 route) due to increased demand, this is then mitigated by the dualling of Priory Crescent for example.

The times above reflect the total travel time there-and-back in the routes below (for those routes with multiple parts, these have been summed together). See the routes shown in blue below.

Figure 8-1 Route 1 Harp House



Route 2 Eastern Avenue with Sutton Road

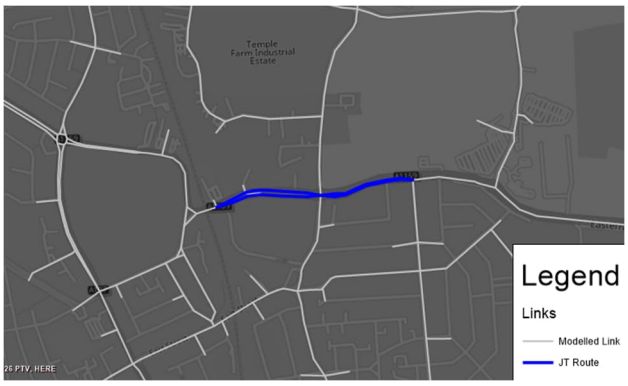


Figure 8-2 Route 3 Eastern Avenue Fossetts Way

Route 4 Eastern Avenue with Royal Artillery Way

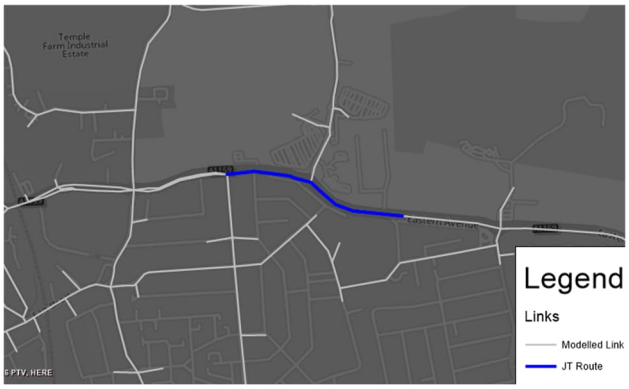
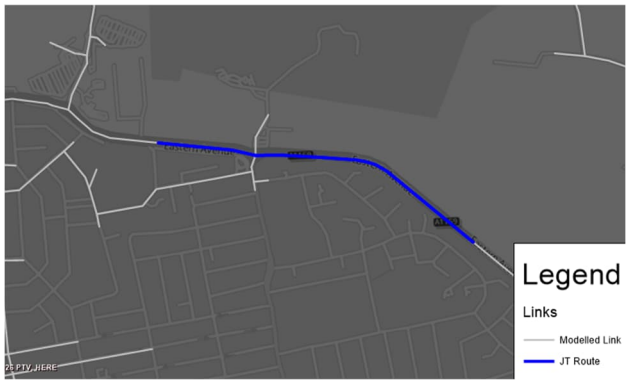


Figure 8-3 Route 5 A127



Route 6 Victoria Avenue



Figure 8-4 Route 7 Victoria Gateway (part 1)



Route 7 Victoria Gateway (part2)

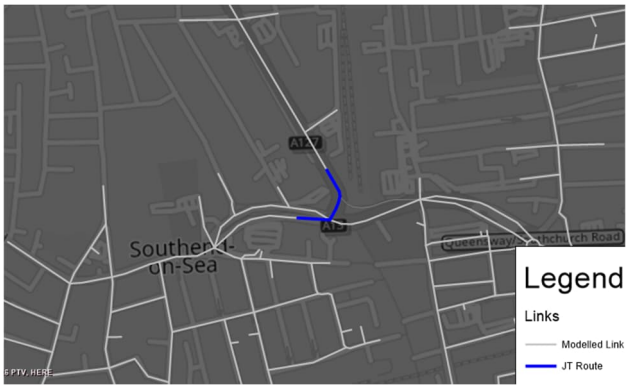
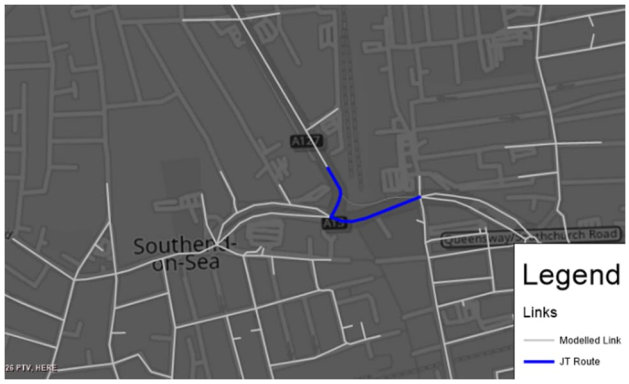


Figure 8-5 Route 8 Priory Cresent (part1)



Route 8 Priory Cresent (part2)



Figure 8-6 Route 9 Bournes Green



Route 10 Major Route (East <-> West)


Legend
Links
Modelled Link
JT Route


Leigh-
on-Sea
A13
Legend
Links
Modelled Link
JT Route

9 Summary and Conclusion

9.1 Summary of Results

The modelling demonstrates that future traffic growth associated with the Southend Local Plan can be accommodated through a combination of planned transport interventions. Without mitigation, all development scenarios result in increased congestion across the highway network, with the largest impacts occurring in the 2045 forecast year and under the higher growth scenario.

For Scenario B, representing growth associated with proposed allocations and opportunity sites in urban development locations, the modelling indicates that the Southend Light package is sufficient to mitigate the additional traffic demand. In the AM peak, congestion is reduced below the equivalent Do Minimum scenario, while in the PM peak congestion is nearly returned to business-as-usual conditions. Most Journey time routes show improvement although the route along Victoria ave did generate more congestion. A more detailed view of the operational element of signals (e.g. using Vissim) would be recommended. Overall, taking the AM and PM periods together, the average delay experienced decreases so the average road user will experience a benefit. As such this package is considered sufficient to offset the effects of the additional growth forecast under Scenario B.

For Scenario C, which includes the additional Green Belt development sites, a larger intervention package is required. The Southend Plus package substantially reduces the impact of growth and returns AM peak conditions to below those observed in the equivalent Do Minimum scenario and brings the PM to a level similar to the Do Minimum scenario. When looking at the combined AM and PM results, we see that the package is successful in fully mitigating the forecast impacts of development.

9.2 Recommended Intervention Implementation

On the basis of the modelling undertaken, the Southend Light package is considered an appropriate mitigation strategy should the Local Plan proceed with development broadly equivalent to Scenario B. Should the Local Plan include the additional Green Belt allocations represented by Scenario C, the Southend Plus package should be taken forward as the preferred mitigation strategy.

The modelling has also identified several locations where further design development and assessment would be beneficial:

- Parts of the A127 corridor continues to experience high levels of demand and congestion in future-year scenarios, even with mitigation in place. Further corridor-based assessment may therefore be warranted as schemes develop.

- The signalised roundabouts at Eastern Avenue / Royal Artillery Way and Eastern Avenue / Sutton Road were found to be particularly sensitive to signal timing assumptions. Careful signal design and optimisation will be important during subsequent design stages.

- At Cuckoo Corner, the tested concept includes dualling of Priory Crescent together with alterations to lane allocations on the roundabout approaches and exits. The modelling suggests that further consideration should be given to the balance of capacity between the eastern entry and exit arms. However, the strategic mesoscopic model is not intended to replace detailed junction design and microsimulation, and further investigation would therefore be recommended before progressing any preferred layout

It should be noted this has been a strategic look at the packages combined, for each development site that comes forward will be subject to further transport modelling using SCC's VISSIM model to determine the detailed mitigation required. The mitigation measures identified in this document are indicative only and may

benefit from further design refinement. As planning applications are submitted, each site will be assessed on its own merits, and SCC may require additional mitigation.

9.3 Conclusion

The transport modelling provides evidence that the forecast impacts of Local Plan growth can be mitigated through the proposed transport intervention packages. **Scenario B can be accommodated through delivery of the Southend Light** package, while **Scenario C can be accommodated through delivery of the Southend Plus** package. Although some residual congestion remains in the PM peak, the scale of impact is modest when compared with the substantial increases that would otherwise occur without intervention. Overall, the modelling demonstrates that an appropriate and proportionate package of transport improvements exists to support the planned growth strategy.

Appendices

Appendix A - Further Model Results (2035)
Appendix B - High Level Cost Estimates for Highway Mitigation Schemes and PT and AT Schemes
Appendix C - Flow Difference Plots from SOSMMM demand model scenarios
Appendix D - Mesoscopic Model 2025 Update Calibration and Validation note
Appendix E - Mesoscopic Model Results - Delay Plots
Appendix F - Mesoscopic Model Results – Volume over Capacity Plots

A. Further Model Results (2035)

The following section includes additional model results:

- Rochford Light Sensitivity Test
  - An additional mitigation package (known as Rochford Light) has been added to Southend Plus. This is described first.
- Model Results for Vehicle hours in 2035 and 2045
  - This is an extension of the results in section 8.2, now including an extra row in the table for Rochford Light – and including the 2035 results.

A.1 Rochford Light Sensitivity Test

This section describes network coding for a sensitivity test that includes network changes for the scheme Rochford Light.

Network Changes

The highway intervention has been identified from previous modelling work, the emerging LTP4 programme and more recent scheme development activities. The scheme for Rochford light is illustrated in Figure A-1 and summarised in Table A-1 Rochford Light scheme



Figure A-1 Southend Plus Schemes with Rochford Light Scheme

Table A-1 Rochford Light scheme

	Rochford Light
Site 2	New Warners Bridge Rail Overbridge (ROB)

New Warners Bridge Rail Overbridge (ROB)

- New roundabout to the east of the London Liverpool Street to Southend Line, providing connection between LNOS Growth Zone / Green Belt highway link, Southend Road, and Rochford Road towards Harp House roundabout.
- Approach roads to roundabout are assumed to be single carriageway with 30mph speed limit.

- New road bridge over London Liverpool Street to Southend Line connecting new roundabout with Harp House roundabout.
- The current bridge carrying Rochford Road over the London Liverpool Street to Southend Line would be replaced by the new bridge and removed

A.2 Model Results – 2035 and 2045

The Rochford Light Scheme alongside the Southend Plus Schemes was run for Scenario C in 2045 and 2035 and can be seen below.

Rochford Light results

In summary we can see that the introduction of this scheme would produce a further significant improvement to overall congestion. This is most clear in the 2045-AM results where it adds an additional ~4% improvement, however other time periods and peaks have a more muted improvement (between 2 and 3%). The 2035 PM results however show a marginal drop. It is noted that the 2035 PM results have a much higher seed variability for all runs (around 2-3% compared to 0-1% for 2045 PM) so it is likely that the counter-intuitive result is the result of model performance.

Vehicle Hour Results – All Scenarios

The tables for 2045 results (from 8.2) have been copied for ease of reference, below are presented 2035 and 2045 – with tables expanded to include Rochford Light.

The following tables show the change in congestion for trips within the modelled area as a consequence of both increased demand from the various scenarios, and improved network infrastructure from the mitigation packages. The key results are highlighted in **Bold**.

From the 2045 results we saw that Southend Plus fully mitigated congestion in Scenario C (to 10% below Do Minimum) and Southend Light likewise can mitigate Scenario B. This pattern is repeated in 2035 shown in Table A-2.

Table A-2 – Vehicle hours in 2035 AM models (**Bold** main scenarios of interest)

		Vehicle Hours - AM			Average Gap
		Average	Seed Variability	Change	
Scenario A	**DM**	**6,131**	**1%**		0.010%
	SL	5,710	1%	-7%	0.009%
Scenario B	DM	6,225	1%	2%	0.012%
	SL	**5,930**	**0%**	**-3%**	**0.009%**
	SP	5,707	2%	-7%	0.009%
Scenario C	DM	6,212	0%	1%	0.010%
	SL	5,951	1%	-3%	0.010%
	SP	**5,692**	**1%**	**-7%**	**0.008%**
	SP_RL	5,681	2%	-7%	0.004%

Table A-3 – Vehicle hours in 2045 AM models (**Bold** main scenarios of interest)

		Vehicle Hours - AM			Average Gap
		Average	Seed Variability	Change from 2045-A DM	
Scenario A	**DM**	**6,906**	**2%**		0.016%
	SL	6,351	1%	-8%	0.012%
Scenario B	DM	7,183	1%	4%	0.016%
	SL	**6,644**	**1%**	**-4%**	0.009%
	SP	6,093	1%	-12%	0.006%
Scenario C	DM	7,537	2%	9%	0.019%
	SL	7,174	1%	4%	0.016%
	SP (no mode shift)	6,222	1%	-10%	0.008%
	SP	**6,114**	**0%**	**-11%**	0.008%
	SP_RL	5,873	1%	-15%	0.003%

The PM results for 2045 and 2035 in Table A-4 show a similar picture to the AM, however the congestion is much worse, this is particularly noticeable in the unmitigated Scenario C results that show 6% increase in vehicle-hours. Within the mitigation scenarios, despite the increase in congestion the mitigation schemes still bring the congestion down and does not alter the overall conclusion that the mitigation packages are effective. The table also shows combining the peak hour congestion from both AM and PM models and that overall, there is an improvement in the highway network.

Table A-4 – Vehicle hours in 2035 PM models and Combined Peaks

		Vehicle Hours - PM			Average Gap	AM + PM	
		Average	Seed Variability	Change			Change
Scenario A	**DM**	**6,625**	**2%**		0.006%	**12,756**	
	SL	6,398	2%	-3%	0.012%	12,108	-5%
Scenario B	DM	6,883	3%	4%	0.011%	13,108	3%
	SL	**6,480**	**2%**	**-2%**	0.010%	**12,411**	**-3%**
	SP	6,183	1%	-7%	0.007%	11,890	-7%
Scenario C	DM	7,030	2%	6%	0.008%	13,242	4%
	SL	6,416	3%	-3%	0.010%	12,367	-3%
	SP	**6,370**	**1%**	**-4%**	**0.009%**	**12,062**	**-5%**
	SP_RL	6,110	1%	-8%	0.008%	11,791	-8%

Table A-5 – Vehicle hours in 2045 PM models and Combined Peaks

		Vehicle Hours - PM			Average Gap	AM + PM	
		Average	Seed Variability	Change			Change
Scenario A	**DM**	**6,964**	**0%**		0.008%	**13,870**	
	SL	6,415	1%	-8%	0.017%	12,766	-8%
Scenario B	DM	7,692	1%	10%	0.011%	14,876	7%
	SL	**7,139**	**1%**	**3%**	0.011%	**13,783**	**-1%**
	SP	6,588	1%	-5%	0.007%	12,681	-9%
Scenario C	DM	8,291	1%	19%	0.012%	15,828	14%
	SL	7,244	2%	4%	0.011%	14,418	4%
	SP (no mode shift)	6,957	1%	0%	0.009%	13,179	-5%
	SP	**6,918**	**1%**	**-1%**	0.008%	**13,033**	**-6%**
	SP_RL	6,764	0%	-3%	0.007%	12,637	-9%

B. High Level Cost Estimates for Highway Mitigation Schemes and PT and AT Schemes

C. Flow Difference Plots from SOSMMM demand model scenarios

D. Mesoscopic Model 2025 Update Calibration and Validation note

E. Mesoscopic Model Results - Delay Plots

F. Mesoscopic Model Results – Volume over Capacity Plots