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East Lothian Council

proposed local development plan

transport appraisal 2016

East Lothian Local Development Plan

Transport Appraisal and Assessment Summary

East Lothian Council

Draft

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August 2016

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1 EXECUTIVE SUMMARY

Background

East Lothian Council (ELC) is preparing its Local Development Plan (LDP) following the approval of the Strategic Development Plan (SDP) for Edinburgh and South East Scotland. ELC commissioned Peter Brett Associates LLP and SIAS to undertake a Transport Appraisal to support the preparation of the Proposed LDP ready for publication and formal representation.

This document provides a summary of the process that has been undertaken to:

- assess the predicted transport impacts of the LDP;
- identify a package of proposed transport options to mitigate those impacts; and
- identify a delivery mechanism to help fund those interventions.

Requirements

The LDP Transport Appraisal has been carried out in accordance with Transport Scotland's Development Planning and Management Transport Appraisal Guidance (DPMTAG) methodology. The East Lothian Proposed Plan aligns with DPMTAG Stage 3, which provides opportunity to reconsider transport options and refresh the Transport Appraisal following MIR consultation. This would further refine deliverability of Transport Options in terms of feasibility, affordability and public acceptability.

Approach

To be compliant with DPMTAG, and reflecting that the East Lothian Local Development Plan (ELLDP) fits in with the SESplan SDP, a Level 3 Appraisal is required to support the Proposed Plan. This suggests the use of modelling tools, preliminary feasibility and design work to identify an adequate technical solution and realistic alternative options necessary to support the ELLDP.

Following discussions with ELC and Transport Scotland, it was agreed that the 2012 version of the SEStran Regional Model (SRM12) should be used for the ELLDP Appraisal. SRM12 is a multi-modal transport model, developed by Transport Scotland, which covers the entire SESplan area (including all of East Lothian) and features road and public transport (PT) assignment models (which reflect traveller route choice), a travel demand model and park and ride capability.

The SRM12 is strategic in nature, in that it contains aggregate representations of transport links and zones throughout the East Lothian area. To supplement this, more detailed traffic modelling has also been undertaken. For this, Musselburgh and Tranent Paramics micro-simulation traffic models were developed and applied to appraise the local road network in more detail. In addition, local specific junction assessments were also undertaken at certain locations to provide further information relating to the requirement for potential mitigation interventions.

Network Assessment

The Appraisal focusses on land-use and transport interventions that are directly relevant to the supply and demand for travel to, from and within East Lothian. Two core model scenarios were defined using ELLDP forecast assumptions provided by ELC Planners as follows:

- **Without LDP** land-use development scenario. This includes completed and committed development and transport schemes up to a forecast year of 2024; and

- **With LDP** land-use development scenario. This 2024 scenario is representative of the without LDP scenario plus the addition of a build-out of all identified ELLDP development sites (i.e. those up to and including 2038).

These scenarios were modelled within SRM12. Inspection of the forecast scenario road and public transport model networks demonstrated a corresponding predicted increase in road vehicle movements and public transport passengers. This indicates that the increase in ELLDP development has negative transport impacts on the road and public transport networks in terms of network performance, increased congestion, increased delays to buses and general traffic and increased crowding on the rail network.

Mitigation Assessment

Following the identification of anticipated transport network impacts, a review of potential interventions to mitigate those impacts has been undertaken to identify a package of measures that could support the delivery of the ELLDP.

Network impacts identified in SRM12 have been considered alongside a list of potential mitigation interventions that were independently prepared based on anticipated ELLDP impacts. This list of potential mitigation measures was then refined using evidence from the various modelling approaches to confirm and conceptually define the interventions to a stage suitable for inclusion in the ELLDP.

Where the SRM12 does not provide sufficient detail, local traffic modelling or local junction assessments have been undertaken. For each intervention, consideration has been given to the impacts on the transport network and the associated ELLDP development allocations. This has defined a recommended package of proposed interventions that will help address the predicted cumulative impacts associated with the ELLDP.

Where proposed interventions address impacts relating to *specific* development sites, these have been highlighted. These interventions will be allocated to *specific* development allocations in the Proposed Plan and will not be included in the wider ELLDP package where developer contribution zones will be defined.

Recommended Interventions

Following the mitigation assessment, a short-list of interventions that will address cumulative impacts is recommended for inclusion in the ELLDP as follows:

- PROP T15: Old Craighall A1(T) Junction Improvements

- PROP T17: A1(T) Interchange Improvements (Salter's Road Interchange)

- PROP T17: A1(T) Interchange Improvements (Bankton Interchange)

- PROP T9 + PROP T10: Rail Station Package

- PROP T21: Musselburgh Town Centre improvements

- PROP T27 & T28: Tranent Town Centre improvements

- PROP T3: Active Travel Corridor

Deliverability

An initial consideration of deliverability in terms of feasibility and public acceptability of the interventions has been undertaken. This has identified where further work on the conceptual interventions is required to deliver them. No significant impacts were identified at this stage.

A critical aspect of the Proposed Plan in terms of deliverability is the definition of a funding mechanism that links land-use development to the associated transport options. This is required to demonstrate that development related capacity constraints on the transport network can be alleviated and associated interventions funded, specifically in terms of developer contributions. For this, a developer contribution mechanism has been developed with defined contributions zones and the apportionment of developer obligations based on SRM12 travel demand data. Furthermore, indicative costs have been prepared for the recommended package of interventions.

Next Steps

Following completion of this network and mitigation assessment phase to support initial submission of Proposed Plan, the final ELLDP Transport Appraisal will be completed in accordance with DPMTAG. This will include verification of the mitigation assessment of road-based interventions using the full Musselburgh and Tranent Traffic Models, which was not available at this stage of submitting the Proposed Plan.

2 Introduction

2.1 Background

2.1.1 East Lothian Council (ELC) is preparing its Local Development Plan (LDP) following the approval of the Strategic Development Plan (SDP) for Edinburgh and South East Scotland. ELC commissioned Peter Brett Associates LLP and SIAS to undertake a Transport Appraisal of the implications of housing and economic land allocations on the transport network. This will support the preparation of the Proposed LDP ready for publication and formal representation.

2.1.2 This document provides a summary of the process that has been undertaken to assess the predicted transport impacts of the LDP and the identification of a package of infrastructure interventions and a delivery mechanism to support it.

2.2 Requirements

2.2.1 The LDP Transport Appraisal has been carried out in accordance with Transport Scotland's Development Planning and Management Transport Appraisal Guidance (DPMTAG) methodology. DPMTAG follows the principles set out in Scottish Transport Appraisal Guidance (STAG) which provides relevant guidance and technical methodologies for carrying out Transport Appraisal in Scotland. There has also been liaison with Transport Scotland throughout the Appraisal to agree the approach at various stages.

2.3 Development Planning and Management Transport Appraisal Guidance (DPMTAG)

2.3.1 The DPMTAG methodology details the Transport Appraisal process and aligns it with the Development Plan (DP) stages. The DPMTAG stages are summarised below.

- **Stage 1** is a baseline assessment of current and forecast performance of the strategic transport network, which feeds into the early engagement stage of the DP.

- **Stage 2** aligns with the preparation of the Main Issues Report, where the first step is to set out transport planning objectives in the context of the overall plan vision. This is followed by the identification of existing and future transport and accessibility issues resulting from land use changes. This is followed by the generation and sifting of Transport Options for Appraisal. The final step is the Appraisal of identified interventions by considering their contribution to the stated objectives.

- **Stage 3** aligns with the preparation of the Proposed Plan, where the East Lothian LPD is now. This provides an opportunity to reconsider the Transport Options and refresh the Transport Appraisal, following MIR consultation, as well as initial consideration of deliverability in terms of feasibility, affordability and public acceptability.

2.3.2 Figure 2.1 presents the current status of the East Lothian LDP at DPMTAG Stage 3, highlighting the opportunity to revisit the generation, sifting and appraisal of the transport options following the MIR public consultation.

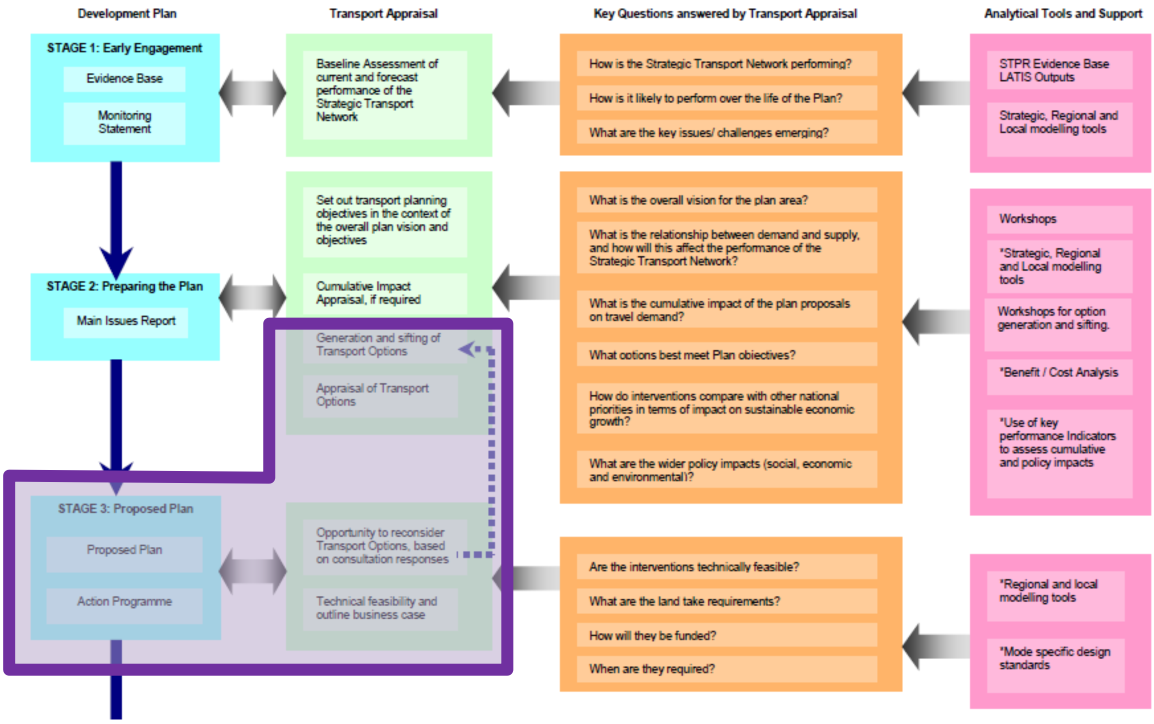

Figure 2.1: DPMTAG Stages and East Lothian LDP Appraisal Requirements

2.3.3 The level of Transport Appraisal that is required by Transport Scotland to take an informed view on the impact of proposed developments should be in line with the type of development plan and the nature of the transport options being considered.

2.4 Main Issues Report

2.4.1 This Appraisal follows on from previous work undertaken using strategic transport modelling to assist in the preparation of the Main Issues Report (MIR).

3 Approach and Data

3.1 Overview

3.1.1 To be compliant with DPMTAG, and reflecting that the East Lothian Local Development Plan (ELLDP) fits in with the SESplan SDP, a Level 3 Appraisal is required to support the Proposed Plan. This implies the use of modelling tools and preliminary feasibility and design work to identify an adequate technical solution and realistic alternative options necessary to support the ELLDP.

3.2 Transport Modelling Approach

3.2.1 The previous transport assessment for the Main Issues Report made use of the SEStran Regional Model (SRM) to consider transport network performance. For this, an enhanced version of the SRM 2007 version was used with additional detail included in the East Lothian area.

3.2.2 At the same time as the ELLDP Proposed Plan Appraisal was commenced, a 2012 based version of SRM (SRM12) was being finalised by Transport Scotland for use in the SESplan Cross-boundary Appraisal. SRM12 considers SESplan-wide transport impacts of the SDP land allocations. Following discussions with ELC and Transport Scotland, it was agreed that SRM12 should be used for the ELLDP Appraisal.

3.2.3 Reflecting the strategic nature of SRM, further more detailed traffic modelling has also been undertaken. For this the Musselburgh and Tranent Paramics micro-simulation traffic model was developed and used to look at the operation of the local road network in more detail, which is not possible using SRM. In addition, local junction assessments have been undertaken at certain locations to provide further information relating to the requirement for potential mitigation interventions.

3.3 SEStran Regional Model

3.3.1 The SEStran Regional Model (SRM) has been used to inform the Appraisal of the implications of housing and economic land allocations on the transport network.

3.3.2 SRM is a multi-modal transport model, developed by Transport Scotland, which covers the SESplan area, with the following key components:

- Trip ends – trip generation is derived from the Transport Economic Land Use Model of Scotland (TELMoS) land-use data;
- demand model – represents key traveller choices: mode choice, destination and park & ride;
- road model covering route choice (assignment) by car drivers and goods vehicles; and
- public transport (PT) model covering route choice (assignment) for public transport passengers.

3.3.3 The SRM version applied is that provided from the SESplan Cross Boundary Study (CBS) Team.

3.3.4 A review of SRM was undertaken based on initial application and model outputs to check the suitability of the model to be used to support the ELLDP Appraisal and Assessment. Reflecting the strategic nature of the model and its intended purpose, this identified some weaknesses in terms of the relative coarseness of the zone system and road network in East

Lothian. In discussion with ELC and Transport Scotland, it was considered that SRM provides sufficient information for the network assessment and to identify an initial list of required mitigation interventions supplemented later by further detail in the local traffic models.

3.3.5 Some amendments have been made to both network representation and the representation of the development plan scenario for East Lothian Council to ensure that the Proposed Plan is suitably represented at the strategic level. Otherwise no changes were made to SRM for the purpose of the ELLDP modelling assessment.

3.3.6 The model has a 2012 base year, and a single 2024 forecast year, which has currently been used to represent all future scenarios. The SRM is representative of average weekday travel movements within which the following time periods are modelled:

- Average weekday (AM) morning peak: 07:00-10:00;
- Average weekday (IP) inter peak: 10:00-16:00; and
- Average weekday (PM) evening peak: 16:00-19:00.

3.3.7 Individual factors are applied by mode and time period to create an ‘average’ peak hour.

3.4 Musselburgh and Tranent Traffic Model

3.4.1 The *Musselburgh and Tranent Traffic Base Model Report* (SIAS, June 2016), contained in Appendix A, describes the development of the Musselburgh and Tranent Traffic Model.

3.4.2 This is a Paramics micro-simulation traffic model covering the Musselburgh and Tranent areas as shown in Figure 3.1.

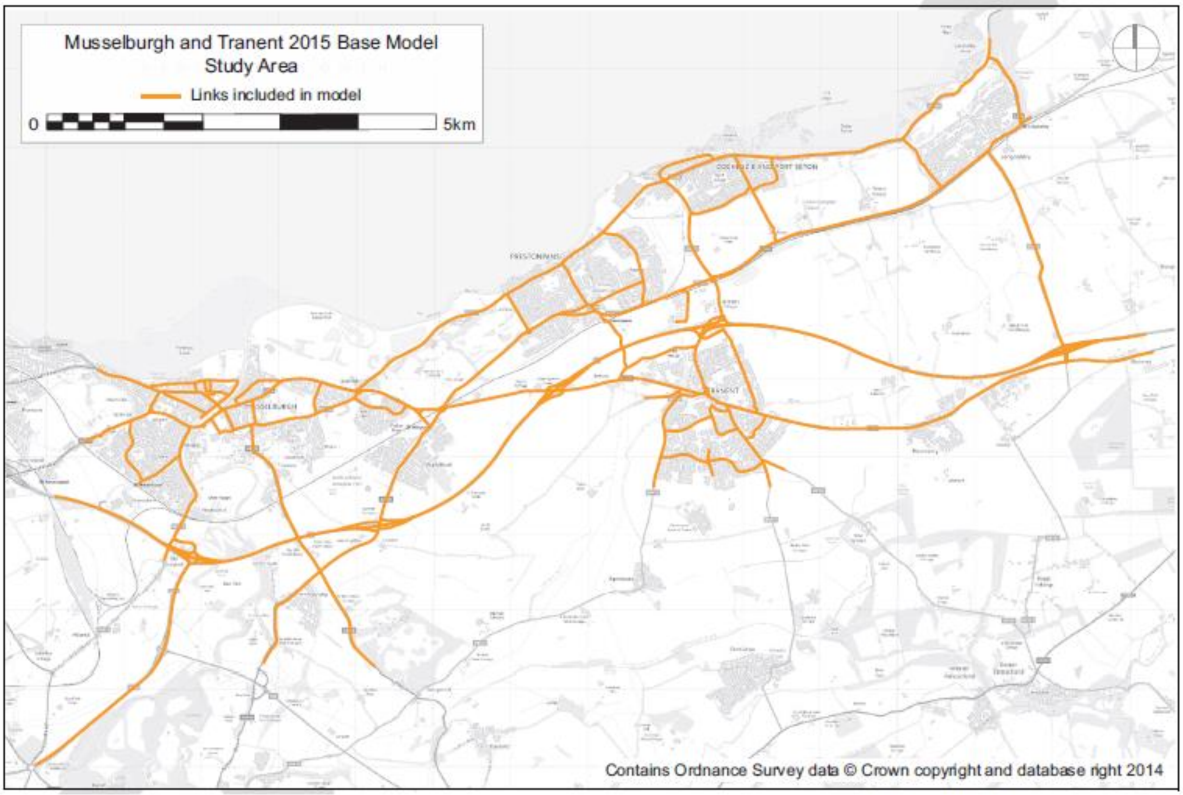

Figure 3.1 Musselburgh and Tranent Traffic Model Coverage

3.4.3 The model is representative of average weekday traffic conditions within which the following time periods are modelled:

- Average weekday (AM) morning peak: 07:00-10:00;
- Average weekday (IP) inter peak: 10:00-16:00; and
- Average weekday (PM) evening peak: 16:00-19:00.

(Noting that the time periods are consistent with the SRM12)

3.4.4 Base year traffic demand matrices were developed using available observed data, SRM sub-area traffic flows and a process of calibration including matrix estimation based on WebTAG and DMRB guidance. Following review of the model calibration and validation, the Base model was considered suitable for the purpose of Reference Case and Future Year testing.

3.4.5 Forecast traffic demand matrices were prepared based on SRM traffic forecasts for defined scenarios.

3.5 Data and Supporting Information

3.5.1 Various data and information has been used as part of the Appraisal and Assessment and this is summarised below.

Transport Survey Data

3.5.2 Data collection was undertaken as part of the traffic model development. This is described in the *Musselburgh and Tranent Traffic Base Model Report* (SIAS, June 2016), contained in Appendix A. In summary the following data was collected:

- traffic junction turning counts;
- queue length surveys;
- car journey time surveys;
- bus dwell time surveys; and
- pedestrian crossing activity.

Planning Data

3.5.3 ELC planners provided information on the land-use developments which form part of the ELLDP land-use scenarios and this is described in Section 4.

Network Data

3.5.4 Junction layout parameters were measured from CAD background mapping. Signal stages, phasing and intergreens were provided by East Lothian Council. School patrol crossing locations and their corresponding operational times were provided by East Lothian Council.

3.5.5 Traveline Scotland, the National Public Transport Access Nodes (NaPTAN) dataset and Google Maps were used to collate the public transport bus data required for the traffic model development.

4 Demand Forecasting and Network Assessment

4.1 Overview

4.1.1 The SEStran Regional Model (SRM) has been used to inform the ELLDP Transport Appraisal of the implications of housing and economic land allocations on the transport network.

4.2 Land-Use Scenarios

4.2.1 *Information Note 2 – Definition of Appraisal Forecasts* (PBA, May 2016), contained in Appendix B, provides a definition of a set of land-use assumptions which form the basis of the LDP Appraisal.

4.2.2 The Appraisal focusses on land-use and transport interventions that are directly relevant to the supply and demand for travel to, from and within East Lothian. Following the circulation of the Information Note to ELC and Transport Scotland, agreement on the modelling approach was reached prior to assessing the traffic impacts of the ELLDP scenarios.

4.2.3 Two core model scenarios were prepared to represent the LDP in a forecast year of 2024 (the available forecast year from SRM12) as follows:

- **Without LDP** land-use development scenario. This includes completed and committed development up to 2024 only; and
- **With LDP** land-use development scenario. This 2024 scenario is representative of the without LDP scenario plus the addition of a build-out of all identified ELLDP development sites (i.e. those up to and including 2038).

Overview of the Approach to Modelling Land-Use Changes

4.2.4 The SESplan Cross-boundary Appraisal forecast land-use scenarios were used as the basis of the ELLDP forecasts. This includes a recent consideration of developments across the entire SESplan area.

4.2.5 East Lothian land-use forecasts were updated with ELLDP forecast assumptions provided by ELC Planners as follows:

- Household forecasts are based on housing developments in terms of residential units.
- Forecast population figures are estimated based on the Transport Economic Land Use Model of Scotland (TELMoS) household size for East Lothian at SRM12 zonal level.
- In liaison with ELC, assumptions have been applied to estimate the number of jobs based on employment sites and anticipated usage and employment densities.

4.2.6 General assumptions regarding housing development, population and employment in the rest of the SESplan area (and beyond) remain as per the SRM cross-boundary land-use scenario.

4.2.7 Table 4.1 provides a summary of the forecast number of households, associated population projections, and number of jobs within the ELLDP scenario for the ELC local authority area.

Table 4.1 ELLDP Summary – Modelled Land-use

Location	2012 Base Year	2024 Without LDP (versus 2012 Base)			2024 With LDP (versus 2012 Base)		
Households	42,984	49,482	+6,498	*+15%*	57,313	+14,329	*+33%*
Population	98,180	102,364	+4,185	*+4%*	115,454	+17,274	*+18%*
Jobs	23,317	29,102	+5,785	*+25%*	36,862	+13,545	*+58%*

4.2.8 The land-use figures have been allocated to SRM zones based on the development locations. Where developments are split across two zones, the land-use split has been estimated based on the site boundary and consideration of the anticipated loading of trips on the transport network.

4.3 Transport Infrastructure

4.3.1 *Information Note 2 – Definition of Appraisal Forecasts* (PBA, May 2016) , contained in Appendix B, provides a definition of a set of transport assumptions which form the basis of the LDP Appraisal, detailing the main changes to the road and public networks which are assumed to have been introduced following the model base year, 2012.

4.3.2 The following **road schemes,** constructed after the 2012 base year**,** are included within the 2024 SRM12 road network:

- Forth Replacement Crossing – Connecting to M90 and M9 Spur; and
- M8 Heartlands – Extra Junction on the M8.

4.3.3 The following constructed (post 2012) or committed **public transport schemes** are assumed within the 2024 SRM public transport model:

- North Berwick Rail Line Capacity Enhancements – increased capacity on rail services to/from North Berwick with introduction of 6-car sets rolling stock;
- East Coast Mainline Timetable Changes – changes to service frequencies and stopping patterns (implemented 2013);
- Edinburgh Tram – new tramline between Edinburgh city centre and Edinburgh airport (opened 2014);
- Borders Railway – rail line between Tweedbank & Edinburgh. 2tph throughout the day with park and ride provision at each rail station (opened 2015);
- Edinburgh Gateway Station – new station at Gogar served by Fife Circles and connection with Edinburgh TRAM; and
- Edinburgh-Glasgow Improvement Project (EGIP) Phase 1 – increased capacity, 5-8 minute journey time reduction between Edinburgh and Glasgow. Journey time improvements on various services to Stirling, Aberdeen, Bathgate and Falkirk.

4.4 Travel Demand Forecasts

4.4.1 *Information Note 3 – Forecasts Transport Assessment* (PBA, August 2016), contained in Appendix C, details the ELLDP forecast year transport assessment. This describes the forecast travel demand associated with the land-use and infrastructure forecast year scenarios.

4.4.2 In summary, the following model scenarios have been prepared:

2024 Without LDP

- **Land-Use and Travel Demand** – 2012 base year land-use, plus constructed and committed future housing and employment land allocations.
- **Infrastructure** – validated 2012 network plus committed infrastructure.

2024 With LDP

- **Land-Use and Travel Demand** – 2012 base year land-use, plus constructed and committed, plus build-out of all identified LDP housing and employment land allocations.
- **Infrastructure** – validated 2012 network plus committed infrastructure.

4.4.3 The forecast number of car and public transport trips is forecast to increase in the majority of areas within East Lothian, which is in line with the land-use forecasts, particularly the population projections which drive the travel demand forecasting procedures in SRM12.

4.4.4 Inspection of the road and public transport model networks shows a corresponding increase in vehicle movements and public transport passengers that correlates with the increase in travel demand.

4.5 Network Review and Identification of Issues

4.5.1 *Information Note 3 – Forecasts Transport Assessment* (PBA, August 2016), contained in Appendix C, describes the impact of ELLDP forecast travel demand on the transport network.

4.5.2 This reveals, as expected, that the predicted increase in travel demand associated with ELLDP development has negative impacts on the road and public transport networks in terms of network performance, increased congestion, increased delays to buses and general traffic and increased crowding on the rail network.

4.5.3 Analysis of the SRM outputs highlights that the following network locations have particular capacity and performance impacts related to the additional trips generated by the LDP development:

- **Road Network**
  - A1 QMU Interchange;
  - A1 Old Craighall Interchange;
  - A1 Bankton Interchange;
  - Musselburgh Town; and
  - Tranent Town.
- **Rail Network**
  - Significant Crowding on North Berwick Line service at Musselburgh

4.5.4 It should be noted that the SRM is a strategic model with an aggregated representation of the network. Therefore, there are some locations where SRM does not provide the level of detail required to fully assess ELLDP impacts and associated mitigation requirements.

4.5.5 In particular, issues could be anticipated at the A1 Salters Road, A1 Dolphingstone, and A1 Bankton intersections, which are not all highlighted in SRM due to the complex nature of traffic routing and associated network impacts in this part of the network. Therefore, in order to provide a more robust assessment of these locations, local junction assessments have been undertaken at these locations. Similarly the SRM does not include a detailed representation of Musselburgh and Tranent town centres and micro-simulation traffic modelling was undertaken to look at the operation of the local road network in more detail.

5 Mitigation Assessment

5.1 Overview

5.1.1 Following the identification of anticipated network impacts, a review of potential mitigation interventions has been undertaken to identify a package of measures that support the ELLDP and mitigate impacts.

5.2 Long-List of Interventions

5.2.1 *Information Note 3 – Forecasts Transport Assessment* (PBA, August 2016), contained in Appendix C, describes the mitigation assessment.

5.2.2 Network impacts identified in SRM have been considered alongside a list of potential mitigation interventions that were independently prepared based on anticipated ELLDP impacts.

5.2.3 SRM queue data has been used as an indicator of strategic road network ‘hotspots’. Forecast passenger demand and equivalent capacities are considered on the rail network to highlight possible crowding issues.

5.2.4 The SRM analysis has not revealed any additional locations where mitigation is required. In addition, there are some mitigation interventions where the SRM analysis indicates that these may not be required.

5.2.5 Based on the network assessment the long-list of potential mitigation measures is presented in Table 5.1 below, in terms of observed network impacts. The issues have been scored as follows:

- ✖ Issue not identified
- 🔍 Issues that require more detailed modelling to confirm intervention requirements
- ✓ Issues identified with required intervention

5.2.6 The active travel mitigation interventions have been identified as having a positive mitigation impact given the forecast increase in car trips associated with the ELLDP and the potential for enhanced active travel provision to reduce this.

Table 5.1 Mitigation Long-List Assessment

Mitigation Option	Inclusion in LDP
Musselburgh Town Centre Road Network	🔍
A1 QMU All-Ways Interchange	✓
A1 Dolphingstone Interchange	🔍
A1 Wallyford (Salters Road) Interchange	🔍
A1 Old Craighall Interchange — Signal Control of Roundabout	✓
Larger Trains & Platforms at Musselburgh and Wallyford Rail Stations	✓
A1 Bankton Interchange	🔍
A198 Dualling north of Bankton Interchange without Rail Bridge	✗
A198 Enhance Meadowmill Roundabout	✗
Larger Trains & Platforms at Prestonpans Rail Station, Longniddry Rail Station, and Drem Rail Station	✓
Longniddry Rail Station Car Park and Drem Rail Station Car Park	✓
New Rail Station north of Blindwells and ECML Overbridge	✓
Tranent Town Centre Road Network	🔍
Ashgrove Underpass, Dunbar	✓
Segregated Active Travel Corridor	✓

5.2.7 The above table shows that there is not an identified requirement for mitigation on the A198 adjacent to the Blindwells development based on the SRM assessment. However, there is a need to consider the impact of a full build-out of Blindwells, with a total of 6,000 new dwellings, which are being proposed as safe-guarded sites in the ELLDP. It is anticipated that this level of development will require mitigation at Bankton junction, as a minimum, with possible requirement for enhancement of the A198 and Meadowmill Roundabout as well. Therefore, ELC are including these potential interventions as part of the safeguarded Blindwells development site.

5.3 Short-List Interventions Assessment

5.3.1 Following the long-list assessment and sifting, further modelling was undertaken to confirm and conceptually define the interventions to a stage suitable for inclusion in the ELLDP. As described above, where the SRM does not provide sufficient detail local traffic modelling or local junction assessments have been undertaken.

5.3.2 For each intervention consideration has been given to the impacts on the transport network and the associated ELLDP development allocations. This has defined a recommended package of interventions that will address the cumulative impact of the ELLDP.

5.3.3 Where interventions address impacts relating to specific development sites but not cumulative ELLDP impacts, these have been highlighted. These interventions will be allocated to specific development allocations in the Proposed Plan and will not be included in the wider ELLDP package where developer contribution zones will be defined (see Section 6.3).

Active Travel Measures

5.3.4 As noted above, the active travel mitigation interventions have been recommended for inclusion in the ELLDP given the forecast increase in car trips associated with the ELLDP and the potential for enhanced active travel provision to reduce this, which is a key transport objective of the Proposed Plan.

5.3.5 The Segregated Active Travel Corridor, which stretches from Dunbar to Musselburgh, will benefit a large number of development allocations and therefore, it is recommended this intervention is included in the ELLDP interventions package.

5.3.6 The Ashgrove Underpass in Dunbar is anticipated to have a local impact to improve accessibility and connectivity and, therefore, this intervention is allocated to the immediately adjacent development sites and not included in the wider package of ELLDP interventions.

SEStran Regional Model Interventions Assessment

5.3.7 *Information Note 3 – Forecasts Transport Assessment* (PBA, August 2016), contained in Appendix C, describes the mitigation assessment of the following interventions in SRM to review their effectiveness and refine scheme details:

- A1 QMU All-Ways Interchange;
- A1 Old Craighall Interchange — Signal Control of Roundabout;
- Larger Trains & Platforms on the North Berwick Line; and
- New Rail Station north of Blindwells.

5.3.8 The SRM analysis of these interventions confirms that these interventions mitigate against the ELLDP predicted impacts.

5.3.9 Signal control at the A1 Old Craighall Interchange roundabout is predicted to enhance traffic management and reduce congestion and delay. This location attracts traffic from locations across East Lothian and beyond and, therefore, the majority of ELLDP development allocations would be expected to have an impact on this junction. Therefore, it is recommended this intervention is included in the ELLDP interventions package.

5.3.10 Analysis of the A1 QMU All-Ways Interchange intervention indicates that, while this has some positive impact on the operation of the A1 Old Craighall junction with the removal of u-turns, the significant impact is on trips to/from the QMU and Craighall development sites that would benefit directly from improved access to/from Edinburgh. Therefore, this intervention is allocated to the immediately adjacent development sites and not included in the wider package of ELLDP interventions.

5.3.11 Analysis of the impact of providing larger trains and platforms on the Edinburgh to North Berwick rail line indicates this extra capacity reduces crowding, whilst attracting some additional demand, and mitigates ELLDP impacts. This section of rail line attracts passenger from locations across East Lothian and beyond and, therefore, the majority of ELLDP development allocations would be expected to have an impact on crowding at Musselburgh. Therefore, it is recommended this intervention is included in the ELLDP interventions package. It should also be noted that the delivery of this intervention would be dependent on the support of Transport Scotland, Network Rail and/or ScotRail.

5.3.12 Analysis of rail passenger trips at a new Blindwells rail station indicates this will principally be used by residents and employees at the Blindwells development site and will reduce car-based trips, a principle objective of the Transport Appraisal. It should also be noted that the delivery of this intervention would be dependent on the support of Transport Scotland, Network Rail and/or ScotRail. Therefore it has been included as aspiration within the ELLDP, with the new station intervention allocated to the Blindwells site.

Musselburgh and Tranent Traffic Model

5.3.13 Timeframes for submission of the Proposed Plan were not sufficient for assessment of the ELLDP interventions in the full Musselburgh and Tranent Traffic Model. Therefore, local sub area models were prepared representing Musselburgh and Tranent town centres.

5.3.14 The *Microsimulation Modelling - Musselburgh and Tranent LDP Mitigation Testing Note* (SIAS, August 2016), contained in Appendix D, describes the development of the sub-area models and their application to consider potential mitigation interventions in Musselburgh and Tranent town centres.

5.3.15 Forecast traffic demand matrices were prepared based on SRM traffic forecasts for defined scenarios. A series of potential scenario tests were undertaken to consider the impact of potential interventions. This identified the following interventions:

- Three new traffic signals in Musselburgh town centre at:
  - A199/New Street;
  - A199/Linkfield Road/Millhill; and
  - Pinkie Road/Inveresk Road.

5.3.16 The purpose of the A199 signals is to regulate demand at the edges of the town centre and prevent excessive congestion in the High Street area.

- Changes to traffic management arrangements in Tranent as follows:
  - New Row changed to one-way westbound; and
  - One-way gyratory system of High Street and Loch Road with a new link joining Loch Road to High Street at Winton Place.

5.3.17 Testing of the interventions indicated the mitigation operates well.

5.3.18 East/West journey times through Musselburgh are increased with the mitigation in place, but this was considered by ELC to be an acceptable impact of the proposals, which are designed to constrain traffic demand. The introduction of signals at Pinkie Road/Inveresk Road reduces queueing and journey times to less than or comparable to the 2015 Base.

5.3.19 East/West journey times in Tranent are predicted to increase significantly in the forecast year scenarios, with and without the ELLDP. The proposed mitigation interventions reduce journey times to a level comparable with or better than the 2015 Base.

5.3.20 Musselburgh and Tranent town centres are both expected to attract traffic from a wide range of locations and, therefore, many ELLDP development allocations are predicted to have an impact on the town centre road networks. Therefore, it is recommended these interventions are included in the ELLDP interventions package.

Local Junction Assessments

5.3.21 The *ELLDP Mitigation Assessment – Local Junction Modelling – A1 Junctions Technical Note* (PBA, August 2016), contained in Appendix E, describes the local junction modelling that was undertaken to consider potential mitigation interventions at the following locations where SRM was not considered to provide sufficient local detail:

- A1 Salters Road Interchange;
- A1 Dolphingstone Interchange; and
- A1 Bankton Interchange.

5.3.22 Linsig models were prepared for the Salters Road and Dolphingstone junctions as they are signalised, ARCADY was used to model the existing two roundabouts at Bankton. Traffic flows for 2024 ELLDP scenarios were estimated using a combination of 2015 observed junction turning counts and forecast modelled flows from the SRM.

5.3.23 The junction assessment at the A1 Salters Road indicates that this junction is not predicted to operate within capacity with or without the ELLDP in 2024. Review of potential mitigation interventions at this location indicated that that design solution should be possible with acceptable operational performance, however, this is likely to require significant engineering and land take. This location is expected to attract traffic from a wide area and, therefore, many ELLDP development allocations are predicted to have an impact on this junction. Therefore, it is recommended this intervention is included in the ELLDP interventions package. Further work is required on the feasibility of the intervention design including consideration of road safety.

5.3.24 The junction assessment at A1 Dolphingstone indicates that this junction is predicted to operate within capacity, with or without the ELLDP in 2024. This may be affected by an increase in the routing of traffic via this location if impacts are not addressed at A1 Salters Road intersection, however, there are development related proposals to fully signalise Dolphingstone junction and it is considered that this should offer an acceptable design solution with the addition of forecast LDP travel demand. Therefore, this intervention is not included in the recommended ELLDP interventions package.

5.3.25 The junction assessment at the A1 Bankton indicates that this junction is predicted to operate just above capacity with the ELLDP in 2024. The assessment indicates that is junction is expected to be very sensitive to changes in traffic flow where any increase in flows may indicate the requirement for the roundabout to be enhanced. Reflecting this sensitivity, a previous Blindwells Transport Assessment identified a requirement to introduce signal control at this location with revisions to lane configuration. In liaison with ELC transport officers, therefore, it was concluded that this intervention should be included as part of the ELLDP. This location is expected to attract traffic from a wide area and, therefore, many ELLDP development allocations are predicted to have an impact on this junction. Therefore, it is recommended this intervention is included in the ELLDP interventions package.

6 Recommended Transport Interventions

6.1 Recommended Package

6.1.1 Following the mitigation assessment, as presented in Section 5, a short-list of interventions that will address cumulative impacts is recommended for inclusion in the ELLDP and this is presented in Table 6.1 with indicative high-level costs.

Table 6.1 LDP Recommended Interventions

Intervention	Indicative Cost
PROP T15: Old Craighall A1(T) Junction Improvements	£500,000
PROP T17: A1(T) Interchange Improvements (Salter's Road Interchange)	£1,150,000
PROP T17: A1(T) Interchange Improvements (Bankton Interchange)	£1,150,000
PROP T9 + PROP T10: Rail Station Package	£4,753,000
PROP T21: Musselburgh Town Centre improvements	£260,000
PROP T27 & T28: Tranent Town Centre improvements	£449,000
PROP T3: Active Travel Corridor	£23,400,000

Note: PROP T9 + PROP T10: Rail Station Package includes station platform lengthening and car park extensions but excludes ScotRail rolling stock changes.

6.1.2 High-level costings have been estimated at this stage until more detailed feasibility assessment is undertaken and the potential for schemes to be taken forward has been fully investigated. The following points should be noted:

- Cost estimates have been prepared to a 2016 cost base where cost rates have been obtained from 'SPON's Civil Engineering and Highway Works Price Book 2016';
- Where appropriate cost rates are not available in SPON's, they have been sourced from relevant experience that is representative of the present competitive market;
- An estimated indicative allowance has been included for future design and investigation works, which varies between 5% and 15% of total construction costs, depending on the scale and complexity of the proposals;
- The estimates do not include any costs associated with land purchase, remediation of contaminated land, unstable ground conditions, diversion of utilities, statutory and non-statutory approvals, and contract management; and
- The indicative costs exclude Optimism Bias. When proposals are taken forward to feasibility stage of scheme development, which corresponds to 'STAG Stage 1: Programme Entry' (STAG Technical Database, Section 13), an Optimism Bias of 44% would be applied.

6.2 Preliminary Feasibility and Design

6.2.1 An initial consideration of deliverability in terms of feasibility and public acceptability of the interventions has been completed. This has identified where further work on the conceptual interventions is required to deliver them, however, no significant impacts were identified at this stage.

6.3 Deliverability and Developer Contributions

6.3.1 A critical aspect of the Proposed Plan in terms of deliverability is the definition of a funding mechanism that links land-use development to the associated transport options. This is required to demonstrate that development related capacity constraints on the transport network can be alleviated and associated interventions funded, specifically in terms of developer contributions.

6.3.2 For this, ELC have prepared a developer contribution mechanism with defined contribution zones and the apportionment of developer obligations based on SRM travel demand data.

6.3.3 The purpose of contribution zones is to facilitate a way of addressing cumulative impact equitably across different sites and time periods.

6.3.4 Contribution zones have been identified for each intervention included in the recommended package in Table 6.1, where each intervention has been identified as a requirement to address the impacts of more than one development. Any net impacts are quantified as a direct result of the development proposed and are mitigated on the basis of nil net detriment. Such an approach is consistent with government guidance and commensurate in scale and kind with the proposed development.

6.3.5 Contribution zones are based on logical and likely travel patterns of usage of the road and public transport networks verified largely by a high level assessment of likely travel movements identified using SRM. The zones seek to apportion obligations relative to the costs within that zone and the relative impact (location) of new development.

6.3.6 This approach ensures that strategic growth set out within the ELLDP is provided for and smaller allocations for housing and employment uses are accommodated in a proportionate manner. The principle of this methodology is accepted within transport planning in so far as the closer a development is to a 'congestion hot spot' the greater the impact and need for mitigation. Accordingly, transport contribution zones have been configured to reflect infrastructure need and to reflect anticipated additional total transport pressures from new development.

'Windfall' Sites

6.3.7 It is not possible to identify all circumstances in which a developer contribution may be required to provide an intervention in the Transport Appraisal assessment process. Further assessments may be necessary to identify mitigations during the Development Management process. This will explicitly consider 'windfall' development and the availability or ability to provide additional capacity for windfall proposals in addition to that needed for LDP sites. This will be assessed on a case by case basis. Such proposals will not be supported if they would undermine LDP sites. Similarly, if windfall proposals are dependent on the provision of infrastructure capacity from uncommitted projects, a lack of certainty over the timing for provision of such capacity may make windfall proposals unacceptable in planning terms.

7 Next Steps

7.1 Completion of DPMTAG

7.1.1 Following completion of the network and mitigation assessment required to support initial submission of Proposed Plan, the final ELLDP Transport Appraisal will be completed in accordance with DPMTAG.

7.1.2 This will complete the Appraisal of the recommended package of ELLDP interventions, including specific development interventions, against defined Transport Planning Objectives and STAG Government Criteria.

7.2 Verification of Mitigation Assessment

7.2.1 As noted in Section 5.3, timeframes for submission of the Proposed Plan were not sufficient for assessment of the ELLDP interventions using the full Musselburgh and Tranent Traffic Model. Therefore, in order to verify the findings of the network and mitigation assessment undertaken for the Proposed Plan, the full traffic model will be used to assess the recommended package of interventions. This will include all the road interventions where the assessment findings will be reported as part of the ELLDP Transport Appraisal as described above.

7.3 Model Maintenance and Retention of Data

7.3.1 ELC will maintain the modelling tools used for the ELLDP Appraisal and Assessment such that these can be used in future to support delivery of the Proposed Plan and provide a consistent basis for transport assessment where required.

Appendix A Musselburgh and Tranent Traffic Base Model Report

Musselburgh and Tranent

East Lothian Council

S-Paramics Model Development Report

78065
June 2016

MUSSELBURGH AND TRANENT BASE MODEL DEVELOPMENT

Description:	**Model Development Report**
Date:	**01 June 2016**
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MUSSELBURGH AND TRANENT BASE MODEL DEVELOPMENT

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FIGURES :

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1 INTRODUCTION

1.1 Overview

East Lothian Council (ELC), through the Scotland Excel Framework, issued a Study Brief in June 2014 with two key requirements of the commission:

- Development of an S-Paramics Microsimulation base model of the Musselburgh/Tranent area, and future year scenario models reflecting the Council's future land allocations
- The future management, maintenance and application of the models developed, as well as management of the use of the East Lothian Macro Simulation Model (SEStran regional model) in conjunction with the S-Paramics models

The first element is split into two distinct phases:

- Phase 1: Base Year Model Development
- Phase 2: Future Year Model development and scenario testing

1.2 Purpose of Report

SIAS Limited (SIAS) was commissioned by ELC in January 2015 to undertake the development of the Base Model. Phase 1 of the study involves the development, calibration and validation of an S-Paramics Microsimulation model covering the Musselburgh/Tranent area in East Lothian.

This Report will discuss the Phase 1 development of the Base Model and Reports details of the model calibration and validation.

2 DATA

2.1 Study Area

Various data sources were required to inform the model development process. Data was obtained for the full study area, which covers the towns of Musselburgh, Wallyford, Tranent, Prestonpans, Cockenzie, Port Seton, Longniddry, and Macmerry. The study area also contains the A1(T) from west of Old Craighall Roundabout to east of the Gladsmuir junction, the A720 Edinburgh Bypass from Old Craighall Roundabout to Sheriffhall Roundabout, and the A199 from west of Musselburgh to Gladsmuir.

The study area with roads included in the model is shown in Figure 2.1.

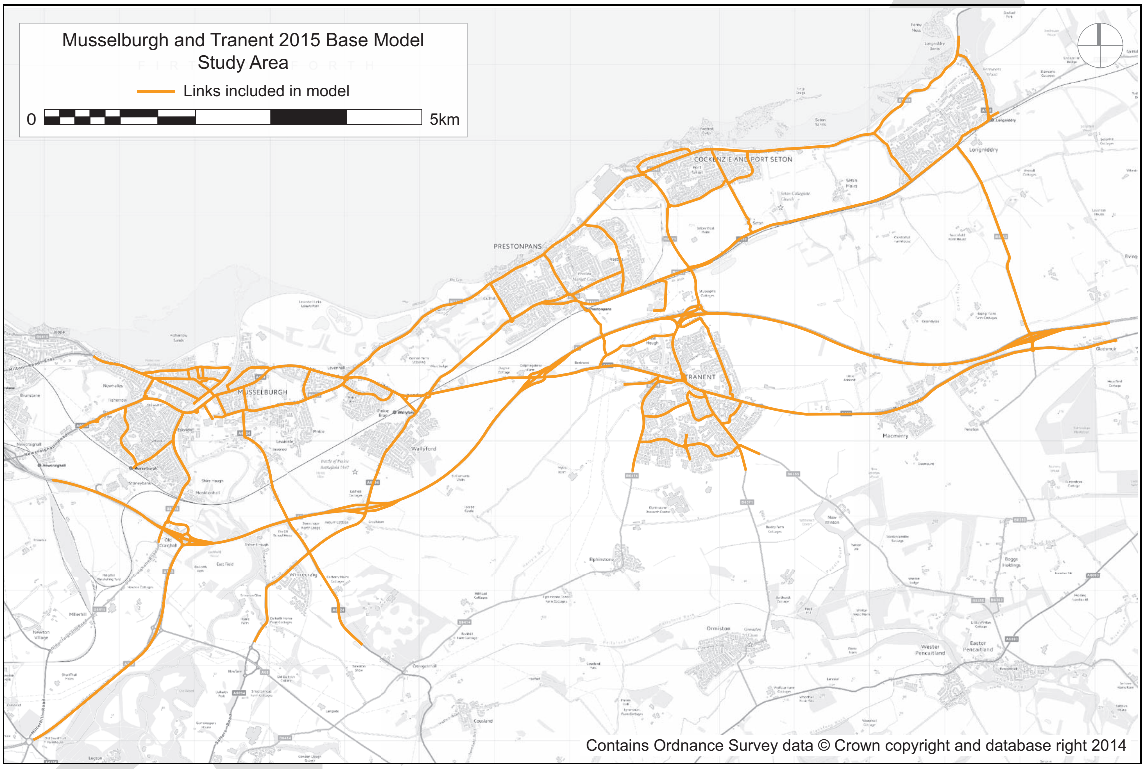

Figure 2.1 : Study Area

2.2 Manual Classified Count Data

Manual Classified Count (MCC) surveys were undertaken by Streetwise Services on Tuesday 21, Wednesday 22, Thursday 23, and Tuesday 28 April 2015 from 07:00 – 19:00 at 93 junctions in the study area. One junction was resurveyed on Wednesday 6 May. Data was collected in 5min intervals and classified as follows:

- Car
- LGV
- OGV1
- OGV2
- Bus

Surveys were undertaken by video, with the video files provided along with the count data.

The MCC locations are shows in Figure 2.2 and Figure 2.3. The full list of locations is included in Appendix A.

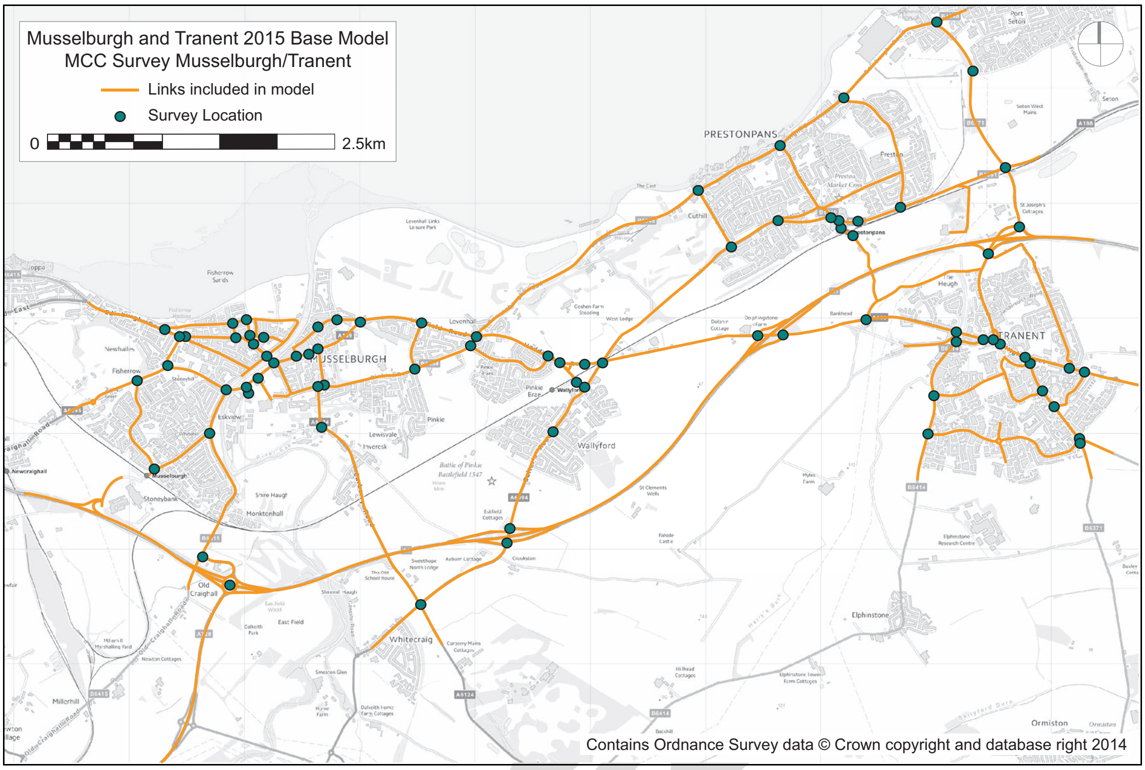

Figure 2.2 : MCC Locations, Musselburgh/Tranent

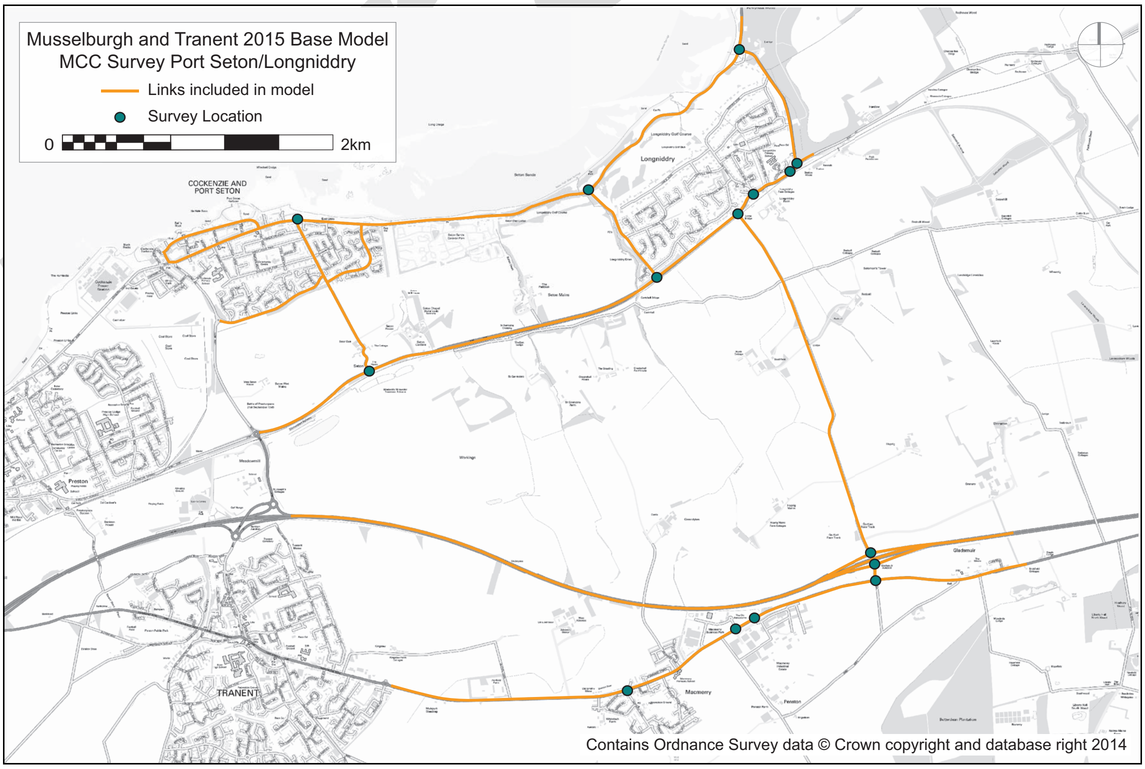

Figure 2.3 : MCC Locations, Port Seton/Longniddry

2.3 Queue Length Surveys

Queue length data was collected at 33 of the MCC locations, on the same dates. Surveys were undertaken by Streetwise Services. The maximum queue length occurring in vehicles was collected in 5min intervals from 07:00 – 19:00 for each relevant junction approach.

Surveys were undertaken by video, with the video files provided along with the data.

The locations of the queue length surveys are indicated by bold text in the lists in Appendix A.

2.4 Journey Time Routes

Ten journey time routes were surveyed throughout the survey period 21 April to 23 April 2015. The journey time routes are shown in Figure 2.4.

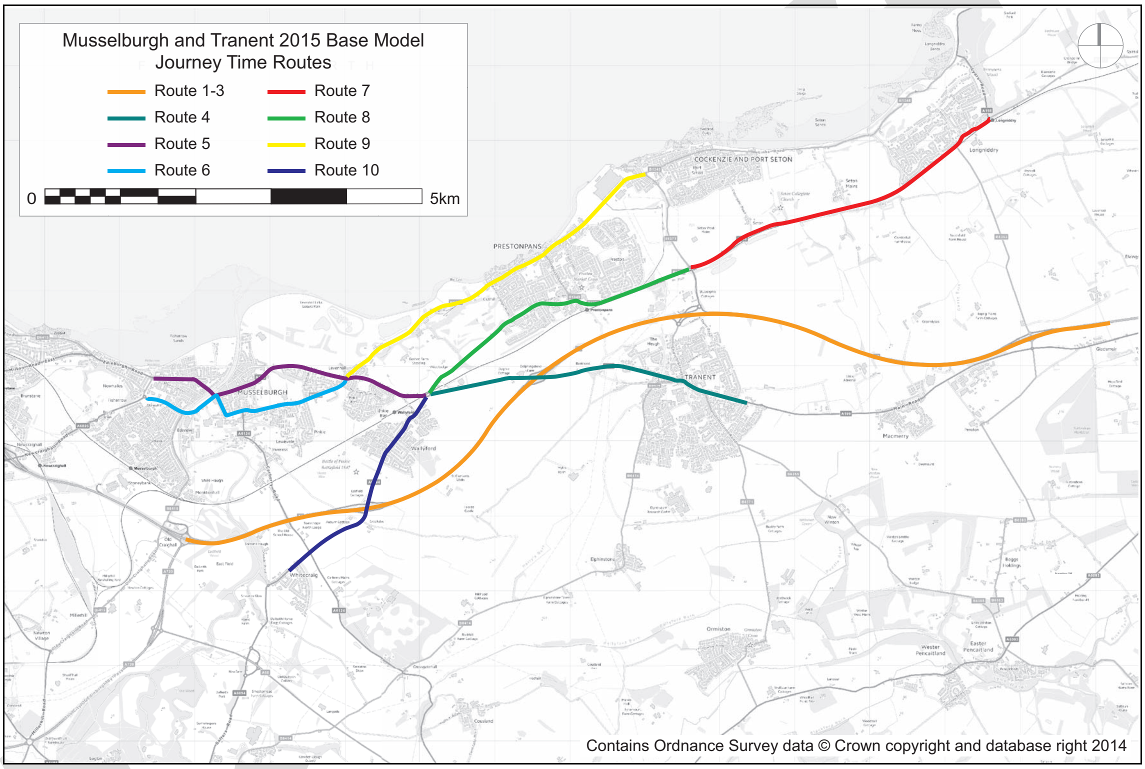

Figure 2.4 : Journey Time Routes

Each route was surveyed in both directions; the start and end point of each are listed as follows:

- Route 1, 2, 3:
  A1(T) between Old Craighall Roundabout and Gladsmuir Junction (multiple days on the same route)
- Route 4:
  A199 between Wallyford Roundabout and Haddington Road/Muirpark Terrace (Tranent)
- Route 5:
  A199 between Edinburgh Road/Newhailes Road (Musselburgh) and Wallyford Roundabout
- Route 6:
  B6095/B6454 between Newhailes Road/Olive Bank Road roundabout and Levenhall Links
- Route 7:
  A198 between Longniddry roundabout at Main Street/station entrance and roundabout at A198/B6371/B1361
- Route 8:
  B1361 between Wallyford Roundabout and roundabout at A198/ B6371/B1361
- Route 9:
  B1348 between Levenhall Links and Edinburgh Road/East Lorimer Place (Cockenzie)
- Route 10:
  A6094 Salter's Road between Wallyford Roundabout and Whitecraig Road

The corresponding survey dates for each route is as follows:

- April 21: Routes 1, 2, 3, 4
- April 22: Routes 1, 2, 3, 5, 7, 8
- April 23: Routes 1, 2, 3, 6, 9, 10

The surveys were undertaken by Streetwise Services.

The journey time information was gathered using the moving observer method, gathering GPS breadcrumb data over the length of the route. A minimum of six surveyed journey time runs were provided for each route and direction for the hours 07:00 – 10:00, 12:00 – 14:00, and 16:00 – 19:00.

On board dashboard camera video footage was provided along with the GPS data.

2.5 Public Transport Routes and Timetables

Traveline Scotland, the National Public Transport Access Nodes (NaPTAN) dataset and Google Maps were used to collate the public transport bus data required for the study. This included location of bus stops, bus service routeing information and timetable information.

A total of 20 services are included in the model:

- Lothian Buses: 15, 26/X26, 30, 40, 44/44A/X44, 45, 104, 113
- Eve Coaches: 128, 129
- First: 106, 108, X8, X25, X25, 124, 125
- Prentice Coaches: 110
- E&M Horsburgh: T1, T2

2.6 Bus Dwell Times

Bus dwell time surveys were undertaken at five locations:

- April 23: Musselburgh High Street westbound (Police station)
- April 23: Musselburgh High Street eastbound (just before Shorthope Street)
- April 23: Musselburgh High Street eastbound (outside St Peter's Episcopal Church)
- April 21: Musselburgh, Newbigging Road northbound (opp Loretto Primary School)
- April 21: Tranent High Street eastbound (opposite Police station)

The surveys were undertaken by Streetwise Services.

Bus dwell times were monitored and recorded throughout the survey period 07:00 – 19:00.

Surveys were undertaken by video, with the video files provided along with the data.

2.7 Pedestrian Crossing Activity

Three signalised Pelican pedestrian crossing locations were surveyed to monitor the number of times traffic was stopped by signal activation. The locations were:

- April 23: Musselburgh High Street at Shorthope Street
- April 23: Musselburgh High Street at Kilwinning Street
- April 21: Tranent High Street at Wilson Place

The surveys were undertaken by Streetwise Services.

Pedestrian activity was monitored and recorded throughout the survey period 07:00 – 19:00.

Surveys were undertaken by video, with the video files provided along with the data.

2.8 School Patrol Crossings

ELC provided a list of active school patrol crossing locations throughout the study area and their corresponding operational times.

2.9 Signalised Junctions

Fifteen junctions within the study area are signalised. Timing information was provided by ELC for many of these locations, but not all, and the decision was taken to not use this information due to most of the junctions running a variable signal plan (the information provided only presented maximum green times). Signal timings were therefore extracted from the count survey videos.

2.10 Mapping

ELC provided digital OS mapping information of the study area, required to construct the base network.

2.11 Survey Videos

The survey contractor provided all camera footage from the junction counts, journey time surveys, bus dwell time surveys, and pedestrian crossing surveys. The footage was reviewed to confirm driver behaviour at junctions, such as lane usage and gap acceptance.

2.12 SEStran Regional Transport Model

Development of the demand matrices, discussed in Section 4, relied on the output of cordon matrices for the study area from the wide area SEStran Regional transport Model (SRM). SRM is a multi-modal highway and public transport model which sits within Transport Scotland's Land Use and Transport Integration in Scotland (LATIS) model hierarchy. SYSTRA completed an update of the model to a 2012 Base Year and supplied cordon matrices to SIAS.

3 NETWORK DEVELOPMENT

The Base Model was created using S-Paramics version 2014.1.

3.1 Model Coverage

ELC provided OS mapping data files for the existing road layout of the study area. The OS data was used to code the basic network in terms of road alignments, lane widths, etc.

The model extent is shown in Figure 3.1. Figures for the entire modelled area, broken up into six sections, are shown in Appendix B.

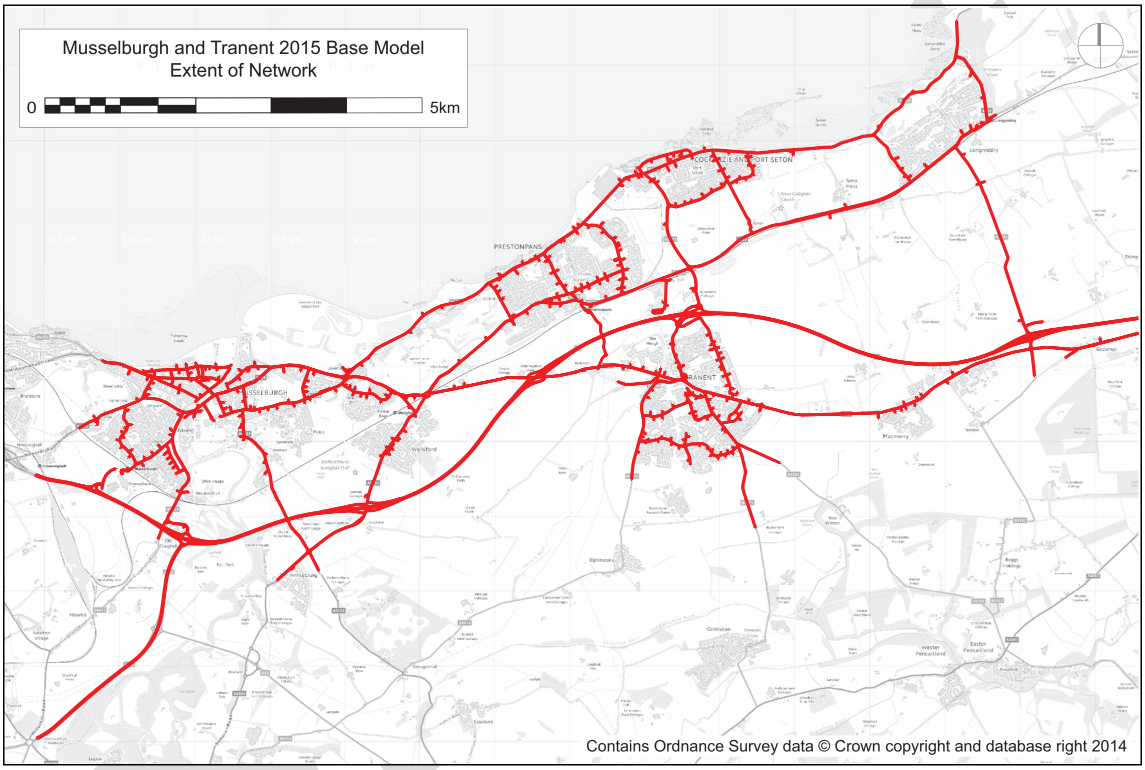

Figure 3.1 : 2015 Base Model Extents

3.2 Modelled Periods

The Base model was developed to represent average or "typical" weekday traffic conditions. Three distinct time periods as below are coded within the model to ensure that the key differences in traffic patterns and network features (signal timings, bus dwell times, etc.) can be robustly reflected in the model. The model represents a 12hr period covering the following times:

- AM peak period 07:00 – 10:00
- Inter-peak period 10:00 – 16:00
- PM peak period 16:00 – 19:00

3.3 Model Parameters

The network coding and adoption of various model parameters followed best practice in line with SIAS's *Microsimulation Consultancy Good Practice Guide.* This includes adopting standard coding practices in terms of visibility and gap acceptance.

3.3.1 Visibility

A review of all junction approach visibilities was undertaken using Google Streetview in the first instance. Where visibility was deemed to be "good", a 30m visibility length was set for the approach link (or the approach link length was used, if this was shorter). If review of the junction showed poor visibility (such as many minor residential arms), the default visibility of 0m remained.

At key locations, such as A1(T) junctions, visibilities greater than 0m but less than 30m were applied as appropriate to ensure throughput/queueing reflected observations. These locations are as follows:

- Old Craighall roundabout west approach: 20m
- Old Craighall roundabout east approach: 25m
- A1(T) northbound off ramp at Bankton: 20m
- All approaches to Church Street roundabout, Tranent: 10m

The only instances of visibility greater than 30m are at the following locations:

- Old Craighall roundabout north approach: 36.7m (link length)
- Old Craighall roundabout south approach: 40m
- A1(T) southbound off ramp at Bankton: 35m

3.3.2 Gap Acceptance

At each junction and roundabout in the model, gap acceptance (GA) look next was switched on for links which vehicles have to 'look through' to the next link in order to judge suitable gaps in opposing traffic. Common locations for this requirement are on roundabouts which have short splitter islands or junctions with a short right turn lane flare (vehicles in the side arm would benefit from "looking through" the short flare link). Default GA look next settings remained at all other junctions.

Gap acceptance can also be adjusted by changing the default "gap acceptance modifiers", which set the "size" of a buffer zone vehicles must allow for when giving way to opposing traffic. The unit for this parameter is seconds and the default settings are:

- Lane Merge = 4s
- Lane Cross = 4s
- Path Cross = 3s

These modifiers were changed at a number of roundabout locations and are listed as follows. In all cases, survey videos showed vehicles taking quite small gaps to enter the roundabout. Modelled approach queue lengths were also too long without an adjustment to the modifiers.

- Old Craighall Roundabout north approach: lane merge 2, lane cross 2
- Old Craighall Roundabout west approach: lane merge 2, lane cross 2
- A1(T) southbound off ramp at Bankton: lane merge 0, lane cross 0

3.4 S-Paramics Link Characteristics

Links in S-Paramics are coded as either Highway or Urban. Highway links were used on all A1(T) and A720(T) mainline sections to achieve correct lane usage and a appropriate distribution of speeds for these roads. All other links in the model are coded as Urban.

Major and Minor links are used in S-Paramics to influence vehicle route choice. All strategic links in the study area (A and B roads and main thoroughfares) are coded as Major links. All other roads (such as side roads or residential roads within towns) are Minor. This helps ensure long trips will not unnecessarily deviate from the main signposted routes.

The figures in Appendix B highlight the Major/Minor link hierarchy used for the Base model

The signposted speed limits were used in all areas of the model and were obtained by reviewing the journey time route video footage or Google Streetview.

3.4.1 Headways

S-Paramics Headway factors have been applied on several links in the network:

- All A1(T) merge links with on-ramps: set to 0.6, as per best practice
- All A1(T) links where diverge signposts start: set to 0.6, as per best practice
- Tranent High Street between Church Street and Ormiston Road: set to 3.0s
- Musselburgh High street between Dalrymple Loan and Newbigging: set to 3.0s

Increasing the headways on the two main high street locations in the model was done to mimic the slower pace of high street locations and introduce appropriate delays along these sections.

3.4.2 Hazard Signpost Distance

All hazard signpost distances have been left as default (750m on highway links, 250m on urban links), except at the following locations. Adjustments have been made at these locations to ensure that traffic begins to get into lane for upcoming network features at an appropriate distance away:

- Bypass approach hazard to Old Craighall lengthened to 500m, to allow vehicles to get in lane sooner
- Confluence hazard at merge points for all A1(T) on-ramps shortened to 500m
- Widen at A1(T) southbound diverge at Old Craighall lengthened to 800m to extend back to QMU junction
- Widen at A1(T) northbound diverge at Wallyford junction lengthened to 1000m
- Widen at A1(T) southbound diverge at Dolphingstone junction lengthened to 950m
- Widen at A1(T) northbound diverge at Dolphingstone junction lengthened to 900m
- Widen at A1(T) southbound diverge at Bankton junction lengthened to 900m
- Widen at A1(T) northbound diverge at Bankton junction lengthened to 1000m
- Widen at A1(T) southbound diverge at Gladsmuir junction lengthened to 1000m
- Widen at A1(T) northbound diverge at Gladsmuir junction shortened to 700m

3.5 Vehicle Types

Seven vehicle types are represented in the model:

- Car
- Light Goods Vehicle (LGV)
- Rigid Heavy Goods Vehicle (OGV1)
- Articulated Heavy Goods Vehicle (OGV2)
- Coach
- Sprinter Type Buses – Fixed Route
- Double Deck Buses – Fixed Route

Top speed varies by vehicle type and has been altered from default specifically for OGV1 and OGV2 only. The top speeds applied to all vehicle types in the model are as follows:

- Car 100mph
- LGV 80mph
- OGV1 60mph
- OGV2 60mph
- Coach 80mph
- Double deck bus 40mph
- Sprinter bus 40mph

3.6 Public Transport Coding

Buses in S-Paramics are coded separately as a 'fixed route vehicle type' and are not included in the vehicle demand matrix. Network bus stops, service routes, and service timetables were all specified during model development for the routes detailed in Section 2.5.

Bus dwell times were derived from the bus stop survey for the locations mentioned in Section 2.6. For all other locations, a default dwell time of 10s was applied.

During the calibration process, the survey videos showed that on some single carriageway areas of the network, vehicles could pass dwelling buses despite there being no bus lay-by. The only area of the model adjusted to account for this was on Pinkie Road westbound, where bus dwell times were removed entirely to reflect the fact that traffic is not generally delayed by dwelling buses in these locations.

3.7 Signalised Junctions and Crossings

The survey videos provided by the contractor were used to observe a sample of the stage and phase timings at each junction over the course of the day, and average timings were derived separately for the AM, IP, and PM based on these observations. Phase intergreens were taken from the signal data provided by ELC or from observations of the video footage if these were not provided for a particular junction. The MCC list of junctions in Appendix A indicates which junctions are signalised.

For the surveyed pedestrian crossing locations, the number of calls per hour and the average green man time were used to design signal plans to ensure the green man is called that number of times in each hour. For the non-surveyed pedestrian signal controlled crossings in the study area, the pedestrian phase has been coded to be called once every 5min.

For each school crossing location, the pedestrian phase has been coded to be called once every 90s while the crossing is in operation. If the crossing is controlled by a signalised junction, no adjustment to the signals was made. If the crossing is controlled by an existing Pelican crossing operating on a 5min cycle time, a signal plan has been implemented to increase the frequency to every 90s during the school crossing operational times.

3.8 Route Choice Parameters

3.8.1 Generalised Cost Equation

S-Paramics uses a generalised cost equation (GCE) to determine the perceived cost of a route between each origin and destination pair. By default, S-Paramics uses a GCE based solely on time. For this study, the GCE parameters were taken from the SRM12 Model Development Report *Table 3: Road Assignment Coefficients for 2012 Base Year*. The Distance values were in kilometres, so the following is the result after converting to miles (divided by 0.62):

- Car in-work — Time = 1 Distance = 0.4258
- Car non-work commute — Time = 1 Distance = 1.0452
- Car non-work other — Time = 1 Distance = 0.7839
- LGV — Time = 1 Distance = 1.3048
- HGV — Time = 1 Distance = 2.0177

An All Car GCE was required for the model, so an average was generated based on car purpose matrix totals found in the SRM12 Report, *Table 26: Road Assignment "Post" Matrix Totals (PCUs per hour)*.

The final GCEs for use in the model are as follows:

- Matrix 1 Car: Time = 1 Distance = 0.862
- Matrix 2 LGV: Time = 1 Distance = 1.305
- Matrix 3 Heavies: Time = 1 Distance = 2.018

3.8.2 Perturbation

Perturbation varies a vehicle's perception of the lowest cost route through the network.

A perturbation of 5% was applied to all vehicle types.

3.8.3 Dynamic Feedback

Dynamic feedback has been enabled in the model, which allows familiar drivers to account for delays in their routeing considerations.

A feedback of interval of 2 minutes and feedback factor of 0.5 have been applied, in line with best practice.

3.8.4 Familiarity

Familiarity affects vehicle route choice decisions. Familiar vehicles do not perceive a difference in cost between major and minor routes, while unfamiliar vehicles perceive minor routes to be twice as expensive as major routes. Familiar vehicles are also able to take account of delays in the model when considering which route to take.

The following levels of familiarity were set for the Base model based on typical values used in other model developments of this nature:

- Car 70% Familiarity
- LGV 70% Familiarity
- OGV1 5% Familiarity
- OGV2 5% Familiarity
- Coach 50% Familiarity

During the calibration process, some familiar vehicles travelling from A1(T) west to the Bypass were observed to reroute to the next A1(T) junction and "u turn" in response to delays at the Old Craighall eastbound off slip. Anecdotal evidence suggests that queues extending onto the mainline are not unlikely.

Further matrix levels representing Car (Matrix 4), LGV (Matrix 5) and HGV (Matrix 6) were created, and all trips from A1(T) west to the Bypass were moved to these matrix levels. Duplicate vehicle types with 0% familiarity were assigned to these matrices, such that no traffic making the A1(T) to Bypass movement at Old Craighall would react to the eastbound off slip queueing.

3.8.5 Cost Factors

During model calibration, some links have had cost factors applied to make a route more or less expensive, and better reflect local routeing patterns. These cost factors have been applied by use of a suitable link category cost factor. These include:

Musselburgh:

- A6124 Inveresk Road and Dalrymple Loan, westbound/northbound only: 1.2
- New Street Area and Market Street Area (north and south of North High Street): 2.0
- Millhill Street Area: 1.5
- Newbigging northbound (from High Street to Pinkie Road): 0.8; southbound: 1.2

Tranent:

- Brickworks Road northbound: 1.2; southbound: 2.0
- Coalgate Road/Northfield/Ormiston Crescent West/Ormiston Avenue: 1.2
- Muirpark Terrace: 2.0

Elsewhere:

- Dean Road (national speed limit section): 3.0
- Fishergate Road (national speed limit section) northbound: 2.0; southbound: 2.5
- Macbeth Moir Road: 1.2
- B6363 (Gladsmuir to Longniddry): 0.7
- Alder Road/Fishers Road/Long Craigs: 1.2

3.8.6 Strategic Routes

Strategic routes are used in S-Paramics to remove the impact of perturbation, where alternate routes are available but not observed to be used.

Strategic start links (placed on links before a route choice decision point) and end links define an area where perturbation is switched off and vehicles take the cheapest route. For example, a trip along the full length of the A1(T) could take a junction off ramp and the immediate on ramp because this small diversion is only marginally more expensive than staying on the mainline in terms of the entire route cost. With a strategic start placed on the link before the diverge for the off ramp and a strategic end placed on the link immediately after the on ramp merge, the vehicle will take the cheapest route between start and end links, which is to stay on the mainline.

The areas of the model that required strategic routes were:

- All A1(T) junctions (including the roundabout directly south of Gladsmuir junction)
- The links forming a loop at Muirpark Terrace in Tranent
- The triangle formed at Bridge Street/New Row/Birsley Road in Tranent
- The loop formed by Edinburgh Road/High Street/Seton Place in Port Seton
- The triangle formed by B1361/Station Road/Preston Road in Prestonpans
- The triangle formed by Salter’s Road/Haddington Road/The Loan at Wallyford
- The loop formed by the bus stop near Fa’Side Avenue North at Wallyford
- The loop formed at Hope Place near Levenhall roundabout
- For all approaches and exits through Levenhall roundabout

4 TRIP MATRIX DEVELOPMENT

4.1 Background

This section outlines the data sources and methodology employed in the development of the traffic demand matrices for the Musselburgh Tranent Base model.

The trip matrix for all zone to zone movements was developed using a Matrix Estimation (ME) process. This involved developing a prior (starter) matrix, a routeing file and a survey file for each modelled period for use in the S-Paramics built in ME module.

4.2 Data Sources

The ME process relied on the following data sources, each of which is discussed in more detail, as follows:

- Turn count and link flow dataset for the study area
- Cordon matrix for the study area from the wide area SEStran Regional transport Model (SRM)
- 2011 Census car ownership data at Output Area level, for the study area

4.3 Interface with SEStran model

Consistency between SRM and the Musselburgh and Tranent Base S-Paramics model was maintained throughout the S-Paramics model development process in the following ways:

- Zoning System (the S-Paramics zoning system is based on a disaggregation of the SEStran zoning system, discussed below)
- Routeing parameters
- Matrix levels

4.4 Zoning System

Zones are used to control the release and destination of vehicles in the network. The network trip matrix is composed of the volume of vehicles travelling from zone to zone.

Car parks can provide additional control over the release and destination of vehicles from zones across multiple access points, effectively producing a sub-zoning system.

The SRM sub area zoning system for the study area was provided as a shapefile and loaded into MapInfo along with the 2011 Census Output Areas. An S-Paramics zoning system was developed by grouping relevant Output Areas within each SRM zone, based on land use, proximity to links for loading onto the network or if an Output Area directly loaded onto a surveyed junction. There were also "external" zones identified at the cordon points around the study area, which are not associated with any Output Areas. The SRM sub area zone system consisted of 52 zones. This disaggregation of the SRM zones resulted in 93 S-Paramics zones in the model. A total of 333 car parks were used to reflect the vehicle loading points within each zone.

4.5 Vehicle Type Matrix Levels

Traffic demand is released by vehicle type by assigning demand to different matrix levels. More than one vehicle type can be assigned to a matrix level, as long as the proportion of the demand for each type is set.

Six matrix levels were used for the Base Model: Car, LGV, and HGV (or all heavy vehicles). Matrices 4 – 6 are effectively duplicate matrices for one specific vehicle movement, as discussed in Section 3.8.4.

- Matrix 1 & 4: Car
- Matrix 2 & 5: LGV
- Matrix 3 & 6: OGV1, OGV2, Coach

The proportion of OGV1, OGV2 and Coach in Matrix 3 was calculated from the turn count data collected during the survey programme and separate proportions applied for each period as follows:

- Matrix 3 & 6:
  - AM Period: OGV1 56%, OGV2 23%, Coach 21%
  - Inter Peak: OGV1 59%, OGV2 30%, Coach 11%
  - PM Period: OGV1 45%, OGV2 28%, Coach 27%

4.6 Prior Matrix Development

4.6.1 SRM to S-Paramics

A peak hour cordon matrix from SRM was provided for the study area by vehicle matrix level and time period. This was converted to the S-Paramics model zoning system, and expanded to peak period for use as the start point for matrix development.

Each SRM zone is associated with of one or several S-Paramics zones (which were determined by aggregating Census Output Areas). For each SRM zone, the associated S-Paramics zones were given a proportional value based on the 2011 Census Output Area Data relating to car ownership. These proportions then determined the proportion of traffic to/from each S-Paramics zone in each SRM zone, i.e.: the proportion of traffic to and from S-Paramics Zone A contributing to the overall movement to and from SRM Zone B. By proportioning the SRM zone trips, this allowed the SRM cordon matrices to be “split out” to S-Paramics zone level by vehicle matrix and time period.

These matrices were expanded from peak hour to AM (3hr), IP (6hr) and PM (3hr) volumes by deriving expansion factors according to the peak hour segments as set out in Section 2.4.10 of the *SEStran Regional transport Model 2012 (SRM12) Model Development Report* prepared by SYSTRA, summarised as follows:

- AM: peak hour is 0.38 of AM period, expansion factor is 2.63
- IP: peak hour is 1/6 of IP period, expansion factor is 6.00
- PM: peak hour is 0.36 of PM period, expansion factor is 2.78

Where surveyed junction turn counts highlighted known zone to zone movements, these movements were inserted directly into the matrix by vehicle matrix and time period.

4.6.2 Refining the Prior Matrix

The turn count data was used to define origin and destination trip ends for each zone by matrix level and time period, where data coverage allowed. Comparison of surveyed trip ends and prior matrix zone totals showed that the existing totals for many of the zone origins or destinations as defined by SRM or disaggregation of the SRM matrix did not match the surveyed values. Entire zone rows or columns were adjusted within the prior proportionally to meet the trip ends while maintaining the original SRM distribution. Matching observed Origin totals was given slight priority over matching Destinations, though Destinations were also adjusted. In this initial stage trips relating to the four rail stations within the study area also had to be adjusted, because from the SRM matrices, the AM only contained trips to the stations and the PM only had departing trips, with no trips to or from stations in the IP. The PM distribution was simply applied for AM trips departing the stations, and AM distribution used for PM trips to the stations, and both periods were used to the cover IP trips to and from the stations.

The resulting prior matrix was run through the model and turn and link count information by hour was extracted and compared to the surveyed flows. Further stages of matrix refinement and checking against surveyed flows followed, using the latest version of the prior each time. Most cordon points, such as the A1(T) west and east, the A720(T) Bypass, and the A198 to Aberlady required adjustment to meet trip ends as well as alteration of trip distribution compared to the original SRM distribution. The SRM distribution was also altered for many areas within town or associated with certain land uses, such as Industrial parks or retail zones, to better reflect the surveyed counts.

The outcome of these steps was a set of demands, or prior, which reflected the available observed trip ends for the AM, IP, and PM, for Car, LGV, and HGV vehicle types.

4.7 Matrix Estimation

When the prior was developed as far as possible, it was applied to the S-Paramics model to generate routeing information for each period. The output of this process consists of a set of PIJA files which estimate the proportion of trips travelling from points A to B that are theoretically assigned to each link and turn in the model.

The routeing files, survey information (turn count totals by period and matrix level), and prior were applied to the ME module in S-Paramics. ME was carried out with five iterations and the new demand files generated were assigned to the model and calibration checks undertaken. The ME process continued, with further refinement to the prior and new routeing information collected each time, until finally ME was run with 10 iterations. The ME process was deemed complete once satisfactory demand files were achieved for each period, based on consideration of the calibration checks.

The original periodic SRM matrix totals and the final matrix totals for each matrix level and period are detailed in Table 4.1 and Table 4.2 respectively.

Table 4.1 : Periodic SRM Cordon Matrix Totals

SRM Cordon Matrix Totals	Vehicle Type	AM	IP	PM
Matrix 1	Car	24,437	41,595	30,342
Matrix 2	LGV	2,038	4,102	1,761
Matrix 3	All heavy	2,163	5,099	1,631
Total		28,638	50,797	33,734

Table 4.2 : Final Matrix Totals after ME

Matrix Totals after ME	Vehicle Type	AM	IP	PM
Matrix 1	Car	30,077	57,321	37,996
Matrix 2	LGV	4,949	8,486	3,748
Matrix 3	All heavy	1,757	3,722	820
Total		36,783	69,528	42,564

4.8 Demand Release Profiles

S-Paramics uses profiles to control the release of traffic onto the network and ensure that the variation in demand throughout each modelled time period is robustly reflected. Profiles can be specified by matrix level for individual zone to zone movements or more generally from one zone to all zones. Each profile specifies the proportion of the total demand for the associated movements to be released in each 5min interval.

The observed 5min turn count data and a few of the hourly ATC sites “smoothed” to 5min intervals were used to develop 117 profiles for the model. Profiles were developed for each modelled period. At key zones loading onto the network, such as all “external” cordon zones, profiles were disaggregated to “lights” and “heavies” to ensure the release of these vehicle types were modelled correctly.

5 MODEL CALIBRATION AND VALIDATION

5.1 Introduction

The calibration process involves checking the network description, demand matrices, and model inputs and parameters to ensure the model achieves a satisfactory representation of traffic flows and conditions in the study area.

The calibration and validation of the model uses the guidelines set out within *WebTAG Unit M3.1* and the *Design Manual for Roads and Bridges (DMRB), Vol. 12 Section 2 Part 1*.

The calibration of the model was undertaken by comparing modelled turn counts to the observed data set. Further to this, queue comparisons were undertaken, however no criteria for queue length comparisons is presented in *WebTAG/DMRB*.

5.2 Turn Count Calibration

The turn count calibration process was carried out in accordance with the criteria specified in WebTAG and DMRB. These guidelines are summarised in Table 5.1.

Table 5.1 : Turn and Link Count Criteria Summary Table

Table 2 Link Flow and Turning Movement Validation Criteria and Acceptability Guidelines

Criteria	Description of Criteria	Acceptability Guidelines
1	Individual flows within 100vph (for flows <700vph)	>85% cases
	Individual flows within 15% of counts (for flows 700-2700vph)	>85% cases
	Individual flows within 400VPH (for flows >2700vph)	>85% cases
2	GEH < 5 for individual flows	>85% cases

The GEH statistic is used in the calibration and validation of the model to compare the difference between observed and modelled flows on a link, and is defined as follows:

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

Where C = observed traffic flow and M = modelled traffic flow.

The Base Model calibration was undertaken using individual turning flows from the April 2015 surveys. The observed versus modelled comparison included 999 turn and link count locations for each hour modelled. Table 5.2 shows the summary of GEH comparison by hour, with the percentage of comparisons falling within a GEH of < 7, < 5 and < 3 shown.

Table 5.2 : Turn and Link Count GEH Comparison

Period	Time (HH:MM)	Eligible Comparisons	GEH < 3 %	GEH < 5 %	GEH < 7 %
AM	07:00 - 08:00	999	85%	97%	99%
	08:00 - 09:00	999	85%	97%	99%
	09:00 - 10:00	999	87%	97%	99%
IP	10:00 - 11:00	999	89%	98%	100%
	11:00 - 12:00	999	90%	98%	100%
	12:00 - 13:00	999	89%	98%	99%
	13:00 - 14:00	999	90%	99%	100%
	14:00 - 15:00	999	89%	98%	100%
	15:00 - 16:00	999	88%	98%	99%
PM	16:00 - 17:00	999	88%	98%	99%
	17:00 - 18:00	999	88%	97%	100%
	18:00 - 19:00	999	86%	97%	100%

The Base model results show that in all cases the hourly GEH comparisons meet the criteria for GEH less than 5 in 85% of cases. In 85% of cases the turn and link count comparisons also yield a GEH value less than 3.

Table 5.3 shows the summary of individual flow comparisons by hour, with the percentage of comparisons meeting each specified criteria shown.

Table 5.3 : Turn and Link Count Individual Flow Comparison

Period	Time (HH:MM)	Flows < 700vph	Flows within 100 vph	Flows >2,700vph	Flows within 400 vph	Flows 700 to 2,700vph	Flows within 15%
AM	07:00 - 08:00	980	99%	1	100%	18	94%
	08:00 - 09:00	985	100%	0	-	14	100%
	09:00 - 10:00	989	100%	0	-	10	100%
IP	10:00 - 11:00	989	100%	0	-	10	100%
	11:00 - 12:00	989	100%	0	-	10	100%
	12:00 - 13:00	990	100%	0	-	9	100%
	13:00 - 14:00	989	100%	0	-	10	100%
	14:00 - 15:00	988	100%	0	-	11	100%
	15:00 - 16:00	988	99%	0	-	11	100%
PM	16:00 - 17:00	984	100%	0	-	15	100%
	17:00 - 18:00	982	100%	1	100%	16	94%
	18:00 - 19:00	987	99%	0	-	12	92%

The Base model results show that in all but one hour the individual flow comparisons meet the specified criteria in 85% of cases.

5.3 S-Paramics Screenline Calibration

The screenline calibration process was carried out in accordance with the criteria specified in WebTAG and *DMRB*. These guidelines are summarised in Table 5.4.

Table 5.4 : Screenline Criteria Summary Table

Table 1 Screenline Flow Validation Criterion and Acceptability Guideline	
Criteria	**Acceptability Guidelines**
Differences between modelled flows and counts should be less than 5% of the counts	All or nearly all screenlines
GEH < 4 for individual screenline totals	All or nearly all screenlines

Due to the nature of the model, each screenline could only consist of four links. The locations of the screenlines are shown in Figure 5.1.

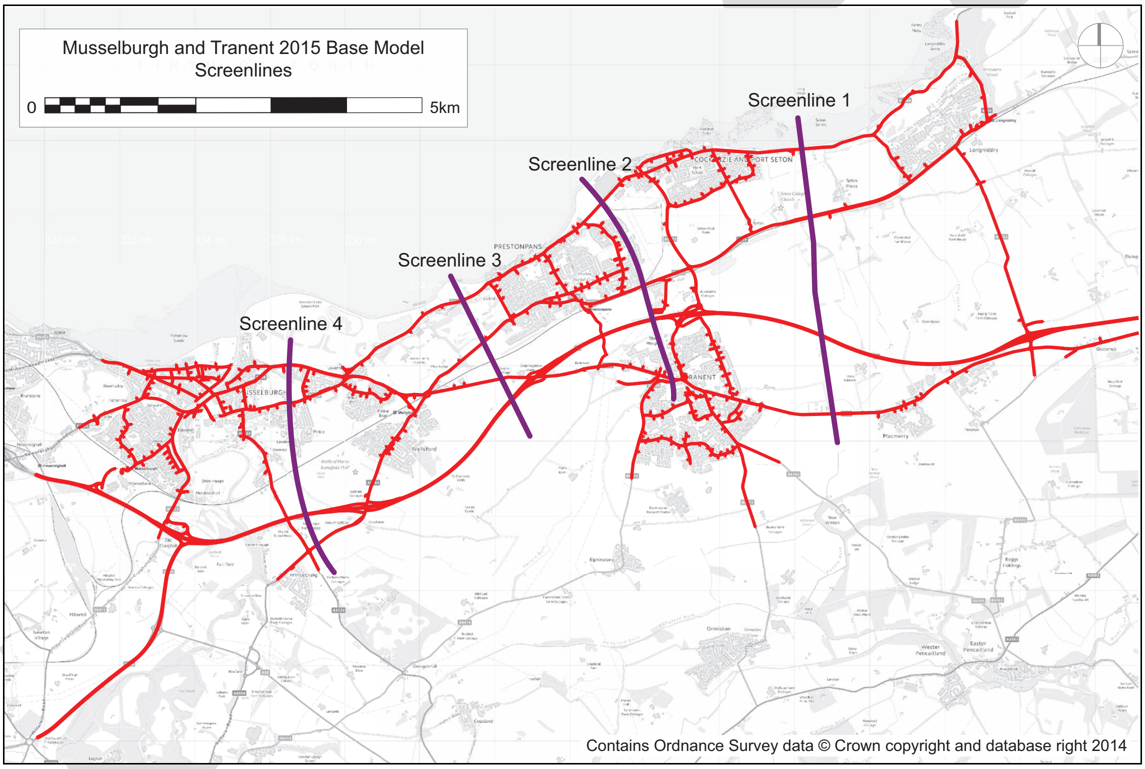

Figure 5.1 : Screenline Locations

Results for screenline flows within 5% of counts and total flow GEH statistics for westbound and eastbound screenlines are shown in Table 5.5 to Table 5.8.

Table 5.5 : Eastbound Total Screenline Flows within 5% of Counts

Period	Time (HH:MM)	Total Screenline Flows within 5% Eastbound Flows			
		Screenline 1	Screenline 2	Screenline 3	Screenline 4
AM	07:00 - 08:00	-6.7%	-0.1%	2.1%	-1.2%
	08:00 - 09:00	10.5%	-1.9%	-1.5%	-1.6%
	09:00 - 10:00	5.1%	-3.2%	3.9%	-1.3%
IP	10:00 - 11:00	2.8%	8.3%	14.5%	11.0%
	11:00 - 12:00	1.2%	1.2%	4.5%	1.2%
	12:00 - 13:00	8.0%	-1.0%	1.0%	-2.1%
	13:00 - 14:00	-1.6%	-1.3%	-1.6%	-3.2%
	14:00 - 15:00	4.1%	-5.6%	-5.6%	-5.8%
	15:00 - 16:00	4.7%	0.8%	-1.5%	-5.7%
PM	16:00 - 17:00	2.0%	-0.5%	-0.1%	0.1%
	17:00 - 18:00	0.2%	0.6%	3.0%	0.6%
	18:00 - 19:00	2.6%	-0.5%	6.7%	1.3%

Table 5.6 : Westbound Total Screenline Flows within 5% of Counts

Period	Time (HH:MM)	Total Screenline Flows within 5% Westbound Flows			
		Screenline 1	Screenline 2	Screenline 3	Screenline 4
AM	07:00 - 08:00	-3.6%	-0.3%	-4.2%	-6.9%
	08:00 - 09:00	-0.8%	-0.5%	4.6%	4.5%
	09:00 - 10:00	2.5%	3.5%	0.7%	5.3%
IP	10:00 - 11:00	4.1%	2.2%	-1.2%	-0.9%
	11:00 - 12:00	-2.6%	-3.0%	-2.8%	-3.5%
	12:00 - 13:00	4.3%	4.4%	4.4%	2.4%
	13:00 - 14:00	3.7%	-5.5%	-2.6%	-2.6%
	14:00 - 15:00	-3.7%	-4.9%	-2.3%	-4.9%
	15:00 - 16:00	-2.2%	-2.8%	2.4%	-2.7%
PM	16:00 - 17:00	-0.2%	-0.5%	4.4%	4.7%
	17:00 - 18:00	2.8%	2.0%	2.0%	0.4%
	18:00 - 19:00	-0.4%	-4.6%	2.8%	0.9%

The Base model results show westbound flows within 5% of the observed count occur in 91% of cases. Eastbound flows within 5% of the observed count occur in 75% of cases, with the first hour of the IP (10:00 – 11:00) showing the poorest results.

Table 5.7 : Eastbound Total Screenline Flows with GEH < 4

Period	Time (HH:MM)	Total Screenline Flows with GEH < 4 Eastbound Flows Screenline 1	Screenline 2	Screenline 3	Screenline 4
AM	07:00 - 08:00	2.7	0.1	0.9	0.5
	08:00 - 09:00	4.2	0.9	0.7	0.8
	09:00 - 10:00	1.9	1.4	1.6	0.6
IP	10:00 - 11:00	1.1	3.4	5.8	4.9
	11:00 - 12:00	0.5	0.5	2.0	0.6
	12:00 - 13:00	3.0	0.5	0.5	1.1
	13:00 - 14:00	0.6	0.6	0.7	1.6
	14:00 - 15:00	1.6	2.7	2.8	3.1
	15:00 - 16:00	1.9	0.4	0.8	3.3
PM	16:00 - 17:00	0.9	0.3	0.0	0.1
	17:00 - 18:00	0.1	0.3	1.8	0.4
	18:00 - 19:00	1.1	0.3	3.7	0.8

Table 5.8 : Westbound Total Screenline Flows with GEH < 4

Period	Time (HH:MM)	Total Screenline Flows with GEH < 4 Westbound Flows Screenline 1	Screenline 2	Screenline 3	Screenline 4
AM	07:00 - 08:00	1.6	0.1	2.6	4.6
	08:00 - 09:00	0.4	0.3	2.6	2.8
	09:00 - 10:00	1.0	1.6	0.3	2.8
IP	10:00 - 11:00	1.5	0.9	0.6	0.4
	11:00 - 12:00	1.0	1.3	1.3	1.7
	12:00 - 13:00	1.7	1.9	2.0	1.2
	13:00 - 14:00	1.4	2.5	1.2	1.3
	14:00 - 15:00	1.5	2.3	1.1	2.5
	15:00 - 16:00	1.0	1.4	1.1	1.4
PM	16:00 - 17:00	0.1	0.2	2.2	2.5
	17:00 - 18:00	1.2	1.0	1.0	0.2
	18:00 - 19:00	0.1	2.1	1.2	0.4

The Base model results show that screenlines for both directions meet the GEH < 4 criteria in nearly all cases.

5.4 Journey Time Validation

A number of routes were coded into the model to reflect the moving observer journey time surveys undertaken. The model records journey times for vehicles completing these routes. This allowed for an independent data validation between observed and modelled journey times.

Comparison of the modelled journey times against the observed data set has been made based on guidelines in WebTAG and *DMRB*. The guidelines are summarised in Table 5.9.

Table 5.9 : Journey Time Criteria Summary Table

Table 3 Journey Time Validation Criterion and Acceptability Guideline

Criteria	Acceptability Guidelines
Modelled times along routes should be within 15% of surveyed times (or 1 minute, if higher)	>85% cases

The routes for comparison are shown in Figure 5.2.

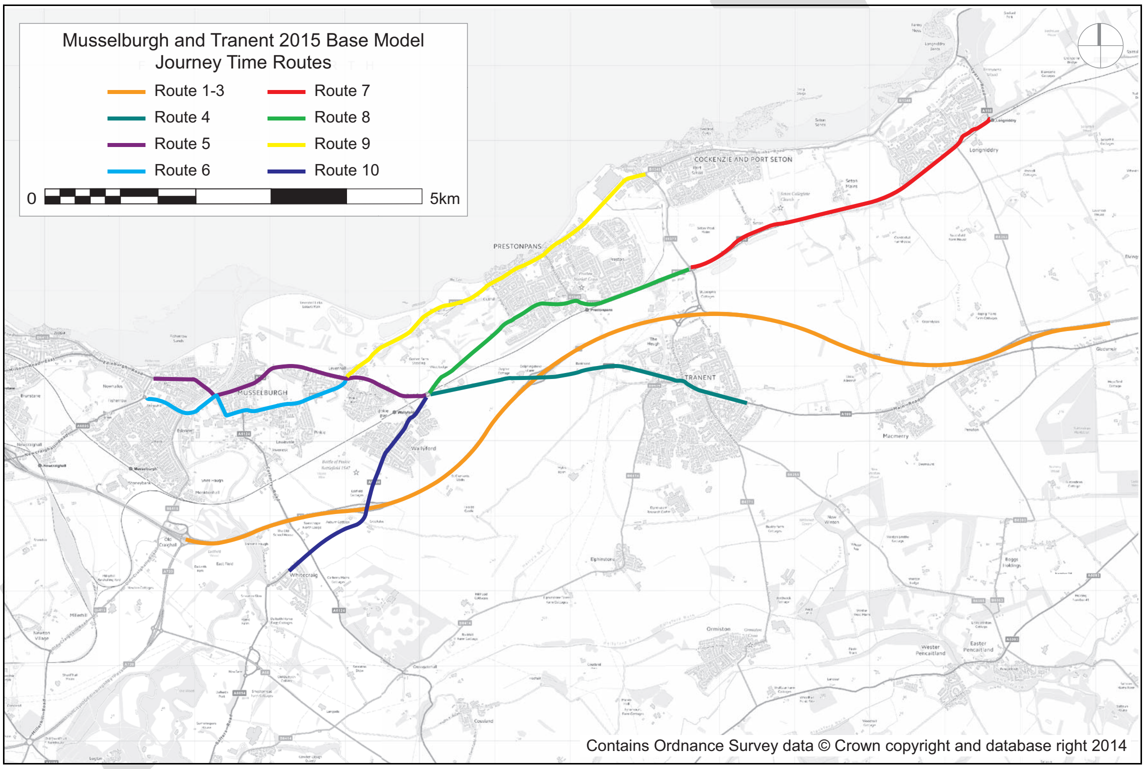

Figure 5.2 : Journey Time Routes for Comparison

The comparisons between the observed and average modelled journey times within the AM, IP, and PM periods for all routes are shown in Table 5.10 to Table 5.17.

Table 5.10 : Journey Time Comparisons: Route 1, 2, and 3

Route	Direction	Period	Time (HH:MM)	Observed (MM:SS)	Modelled (MM:SS)	Difference (MM:SS)	Difference %	*DMRB* Standard
1, 2, 3	**EB**	**AM**	07:00 - 08:00	08:52	07:58	-00:55	-10.3%	✓
			08:00 - 09:00	08:38	08:04	-00:34	-6.6%	✓
			09:00 - 10:00	08:43	08:05	-00:39	-7.4%	✓
		IP	12:00 - 13:00	08:48	08:09	-00:39	-7.4%	✓
			13:00 - 14:00	08:33	08:08	-00:25	-4.8%	✓
		PM	16:00 - 17:00	08:37	08:13	-00:24	-4.7%	✓
			17:00 - 18:00	08:57	08:19	-00:38	-7.1%	✓
			18:00 - 19:00	08:38	08:07	-00:32	-6.1%	✓
	WB	**AM**	07:00 - 08:00	08:41	08:40	-00:01	-0.1%	✓
			08:00 - 09:00	08:30	08:38	00:08	1.5%	✓
			09:00 - 10:00	08:36	08:14	-00:22	-4.4%	✓
		IP	12:00 - 13:00	09:00	08:16	-00:44	-8.2%	✓
			13:00 - 14:00	08:39	08:15	-00:25	-4.7%	✓
		PM	16:00 - 17:00	08:36	08:33	-00:04	-0.7%	✓
			17:00 - 18:00	08:22	08:06	-00:16	-3.2%	✓
			18:00 - 19:00	08:20	07:50	-00:30	-6.0%	✓

Table 5.11 : Journey Time Comparisons: Route 4

Route	Direction	Period	Time (HH:MM)	Observed (MM:SS)	Modelled (MM:SS)	Difference (MM:SS)	Difference %	*DMRB* Standard
4	**EB**	**AM**	07:00 - 08:00	06:07	05:09	-00:59	-16.0%	✓
			08:00 - 09:00	06:44	05:17	-01:27	-21.5%	×
			09:00 - 10:00	05:35	05:11	-00:24	-7.3%	✓
		IP	12:00 - 13:00	05:35	05:25	-00:10	-3.1%	✓
			13:00 - 14:00	06:13	05:25	-00:47	-12.7%	✓
		PM	16:00 - 17:00	06:56	05:43	-01:13	-17.6%	×
			17:00 - 18:00	08:29	06:57	-01:32	-18.1%	×
			18:00 - 19:00	06:33	06:13	-00:20	-5.1%	✓
	WB	**AM**	07:00 - 08:00	05:51	05:53	00:02	0.6%	✓
			08:00 - 09:00	06:58	05:56	-01:02	-14.9%	✓
			09:00 - 10:00	06:15	05:35	-00:40	-10.6%	✓
		IP	12:00 - 13:00	06:30	05:36	-00:54	-13.8%	✓
			13:00 - 14:00	05:49	05:35	-00:15	-4.2%	✓
		PM	16:00 - 17:00	06:28	05:44	-00:44	-11.2%	✓
			17:00 - 18:00	07:00	05:57	-01:03	-14.9%	✓
			18:00 - 19:00	05:40	05:45	00:05	1.4%	✓

Table 5.12 : Journey Time Comparisons: Route 5

Route	Direction	Period	Time (HH:MM)	Observed (MM:SS)	Modelled (MM:SS)	Difference (MM:SS)	Difference %	*DMRB* Standard
5	EB	AM	07:00 - 08:00	05:00	05:14	00:14	4.7%	✓
			08:00 - 09:00	05:29	05:40	00:11	3.2%	✓
			09:00 - 10:00	06:03	05:25	-00:38	-10.3%	✓
		IP	12:00 - 13:00	07:04	06:12	-00:52	-12.3%	✓
			13:00 - 14:00	07:25	06:08	-01:17	-17.3%	✗
		PM	16:00 - 17:00	07:01	06:48	-00:13	-3.0%	✓
			17:00 - 18:00	06:59	06:55	-00:04	-0.9%	✓
			18:00 - 19:00	06:39	06:16	-00:23	-5.7%	✓
	WB	AM	07:00 - 08:00	07:35	06:46	-00:49	-10.7%	✓
			08:00 - 09:00	07:49	08:42	00:53	11.3%	✓
			09:00 - 10:00	07:31	07:12	-00:18	-4.1%	✓
		IP	12:00 - 13:00	07:47	07:50	00:03	0.6%	✓
			13:00 - 14:00	09:04	08:01	-01:03	-11.6%	✓
		PM	16:00 - 17:00	09:29	08:26	-01:03	-11.1%	✓
			17:00 - 18:00	07:56	08:02	00:06	1.3%	✓
			18:00 - 19:00	08:29	07:21	-01:08	-13.4%	✓

Table 5.13 : Journey Time Comparisons: Route 6

Route	Direction	Period	Time (HH:MM)	Observed (MM:SS)	Modelled (MM:SS)	Difference (MM:SS)	Difference %	*DMRB* Standard
6	EB	AM	07:00 - 08:00	07:02	06:01	-01:01	-14.4%	✓
			08:00 - 09:00	06:43	07:00	00:17	4.3%	✓
			09:00 - 10:00	07:45	06:39	-01:05	-14.1%	✓
		IP	12:00 - 13:00	07:28	07:25	-00:03	-0.7%	✓
			13:00 - 14:00	08:34	07:13	-01:22	-15.9%	✗
		PM	16:00 - 17:00	09:50	06:48	-03:02	-30.9%	✗
			17:00 - 18:00	07:37	06:57	-00:40	-8.8%	✓
			18:00 - 19:00	07:37	06:17	-01:20	-17.6%	✗
	WB	AM	07:00 - 08:00	06:26	06:51	00:26	6.6%	✓
			08:00 - 09:00	06:52	08:25	01:33	22.6%	✗
			09:00 - 10:00	05:43	06:32	00:49	14.2%	✓
		IP	12:00 - 13:00	07:24	07:02	-00:23	-5.1%	✓
			13:00 - 14:00	07:29	06:56	-00:33	-7.4%	✓
		PM	16:00 - 17:00	06:22	08:44	02:21	37.0%	✗
			17:00 - 18:00	07:11	07:50	00:39	9.1%	✓
			18:00 - 19:00	07:14	07:42	00:28	6.5%	✓

Table 5.14 : Journey Time Comparisons: Route 7

Route	Direction	Period	Time (HH:MM)	Observed (MM:SS)	Modelled (MM:SS)	Difference (MM:SS)	Difference %	*DMRB* Standard
7	**EB**	**AM**	07:00 - 08:00	04:08	03:22	-00:46	-18.6%	✓
			08:00 - 09:00	03:56	03:25	-00:30	-12.8%	✓
			09:00 - 10:00	03:55	03:29	-00:27	-11.3%	✓
		IP	12:00 - 13:00	04:10	03:28	-00:42	-16.7%	✓
			13:00 - 14:00	04:06	03:28	-00:38	-15.4%	✓
		PM	16:00 - 17:00	04:00	03:29	-00:31	-12.9%	✓
			17:00 - 18:00	04:01	03:29	-00:32	-13.3%	✓
			18:00 - 19:00	03:59	03:28	-00:31	-12.8%	✓
	WB	**AM**	07:00 - 08:00	04:05	03:45	-00:20	-8.2%	✓
			08:00 - 09:00	04:03	03:42	-00:20	-8.4%	✓
			09:00 - 10:00	04:03	03:31	-00:32	-13.2%	✓
		IP	12:00 - 13:00	04:04	03:31	-00:33	-13.4%	✓
			13:00 - 14:00	03:59	03:31	-00:28	-11.7%	✓
		PM	16:00 - 17:00	03:50	03:37	-00:14	-6.0%	✓
			17:00 - 18:00	03:50	03:30	-00:20	-8.5%	✓
			18:00 - 19:00	03:51	03:29	-00:22	-9.4%	✓

Table 5.15 : Journey Time Comparisons: Route 8

Route	Direction	Period	Time (HH:MM)	Observed (MM:SS)	Modelled (MM:SS)	Difference (MM:SS)	Difference %	*DMRB* Standard
8	**EB**	**AM**	07:00 - 08:00	04:41	04:05	-00:36	-12.7%	✓
			08:00 - 09:00	04:37	04:07	-00:30	-10.8%	✓
			09:00 - 10:00	04:34	04:09	-00:25	-9.2%	✓
		IP	12:00 - 13:00	04:40	04:11	-00:29	-10.5%	✓
			13:00 - 14:00	04:40	04:08	-00:32	-11.4%	✓
		PM	16:00 - 17:00	04:38	04:40	00:02	0.9%	✓
			17:00 - 18:00	04:38	05:10	00:33	11.8%	✓
			18:00 - 19:00	04:38	04:47	00:09	3.2%	✓
	WB	**AM**	07:00 - 08:00	04:39	03:57	-00:42	-15.1%	✓
			08:00 - 09:00	04:44	03:55	-00:49	-17.1%	✓
			09:00 - 10:00	04:39	03:55	-00:44	-15.8%	✓
		IP	12:00 - 13:00	04:31	03:54	-00:37	-13.5%	✓
			13:00 - 14:00	04:46	03:56	-00:49	-17.3%	✓
		PM	16:00 - 17:00	04:42	04:02	-00:41	-14.4%	✓
			17:00 - 18:00	04:43	03:56	-00:47	-16.6%	✓
			18:00 - 19:00	04:43	03:57	-00:46	-16.3%	✓

Table 5.16 : Journey Time Comparisons: Route 9

Route	Direction	Period	Time (HH:MM)	Observed (MM:SS)	Modelled (MM:SS)	Difference (MM:SS)	Difference %	*DMRB* Standard
9	EB	AM	07:00 - 08:00	06:17	05:54	-00:22	-6.0%	✓
			08:00 - 09:00	05:46	05:47	00:01	0.2%	✓
			09:00 - 10:00	06:04	06:04	-00:01	-0.3%	✓
		IP	12:00 - 13:00	06:06	06:07	00:02	0.4%	✓
			13:00 - 14:00	06:07	06:09	00:03	0.7%	✓
		PM	16:00 - 17:00	06:19	06:18	-00:01	-0.2%	✓
			17:00 - 18:00	06:19	06:31	00:12	3.2%	✓
			18:00 - 19:00	05:57	06:31	00:34	9.7%	✓
	WB	AM	07:00 - 08:00	06:17	06:28	00:11	3.0%	✓
			08:00 - 09:00	05:54	05:56	00:01	0.4%	✓
			09:00 - 10:00	06:09	06:20	00:11	3.1%	✓
		IP	12:00 - 13:00	06:28	06:28	00:00	0.0%	✓
			13:00 - 14:00	06:32	06:11	-00:21	-5.4%	✓
		PM	16:00 - 17:00	06:39	06:24	-00:16	-3.9%	✓
			17:00 - 18:00	05:48	06:04	00:16	4.5%	✓
			18:00 - 19:00	06:04	06:16	00:12	3.3%	✓

Table 5.17 : Journey Time Comparisons: Route 10

Route	Direction	Period	Time (HH:MM)	Observed (MM:SS)	Modelled (MM:SS)	Difference (MM:SS)	Difference %	*DMRB* Standard
10	EB	AM	07:00 - 08:00	04:22	03:31	-00:51	-19.6%	✓
			08:00 - 09:00	04:20	03:25	-00:55	-21.1%	✓
			09:00 - 10:00	03:50	03:18	-00:32	-14.0%	✓
		IP	12:00 - 13:00	04:29	03:18	-01:11	-26.2%	×
			13:00 - 14:00	04:11	03:18	-00:54	-21.3%	✓
		PM	16:00 - 17:00	05:18	03:49	-01:29	-28.1%	×
			17:00 - 18:00	05:53	04:00	-01:53	-32.0%	×
			18:00 - 19:00	04:16	03:40	-00:36	-14.1%	✓
	WB	AM	07:00 - 08:00	05:13	03:32	-01:40	-32.1%	×
			08:00 - 09:00	04:39	03:37	-01:03	-22.4%	×
			09:00 - 10:00	04:26	03:28	-00:58	-21.7%	✓
		IP	12:00 - 13:00	04:38	03:25	-01:13	-26.2%	×
			13:00 - 14:00	04:23	03:28	-00:55	-21.0%	✓
		PM	16:00 - 17:00	04:41	03:49	-00:52	-18.6%	✓
			17:00 - 18:00	04:23	03:45	-00:38	-14.3%	✓
			18:00 - 19:00	04:46	03:36	-01:10	-24.4%	×

The journey time comparisons show good validation on routes 1, 2, 3, 7, 8, and 9 in all three modelled periods. For Eastbound, Route 4 meets the criteria in 63% of the hourly comparisons, Route 5 in 88%, Route 6 in 63% and Route 10 in 63%. For Westbound, Route 4 meets the criteria in 100% of the hourly comparisons, Route 5 in 100%, Route 6 in 75% and Route 10 in 50%. In general where these routes fail to meet the criteria was due to the modelled journey times being too fast.

Routes 4, 5, 6, and 10 all pass through the more built up town centre high streets of Musselburgh, Wallyford and Tranent. A slower pace is likely to occur on these high streets during peak periods, as evidenced by the survey videos which showed multiple incidents taking place such as vehicles trying to park, vehicles parked in restricted area, jaywalking pedestrians, buses unable to pull into lay-bys due to parked vehicles, etc. These incidents are not reflected directly in the model.

With the high streets modelled at the sign posted 30mph, the speed distribution set for the model as a whole meant that vehicles often exceed 30mph if travelling down the high street unimpeded. Increasing the headway factor along Musselburgh and Tranent high streets introduced some delay, but the combined effect still resulted in a faster modelled journey times than observed through these sections.

5.5 Queue Length Comparison

There are no set criteria against which queue lengths can be validated due to the subjectivity of measuring queue lengths during surveys. Comparisons for all 33 surveyed junctions for observed versus modelled queue lengths are available to view within an accompanying spreadsheet. The results of the comparisons showed in the majority of cases the model corresponds well to the surveyed queue lengths.

An example of the comparisons at the junction of Bridge Street/High Street in Musselburgh is presented, as follows, to demonstrate that the model broadly corresponds to observed queue lengths at some locations and in others the model does not correspond as well.

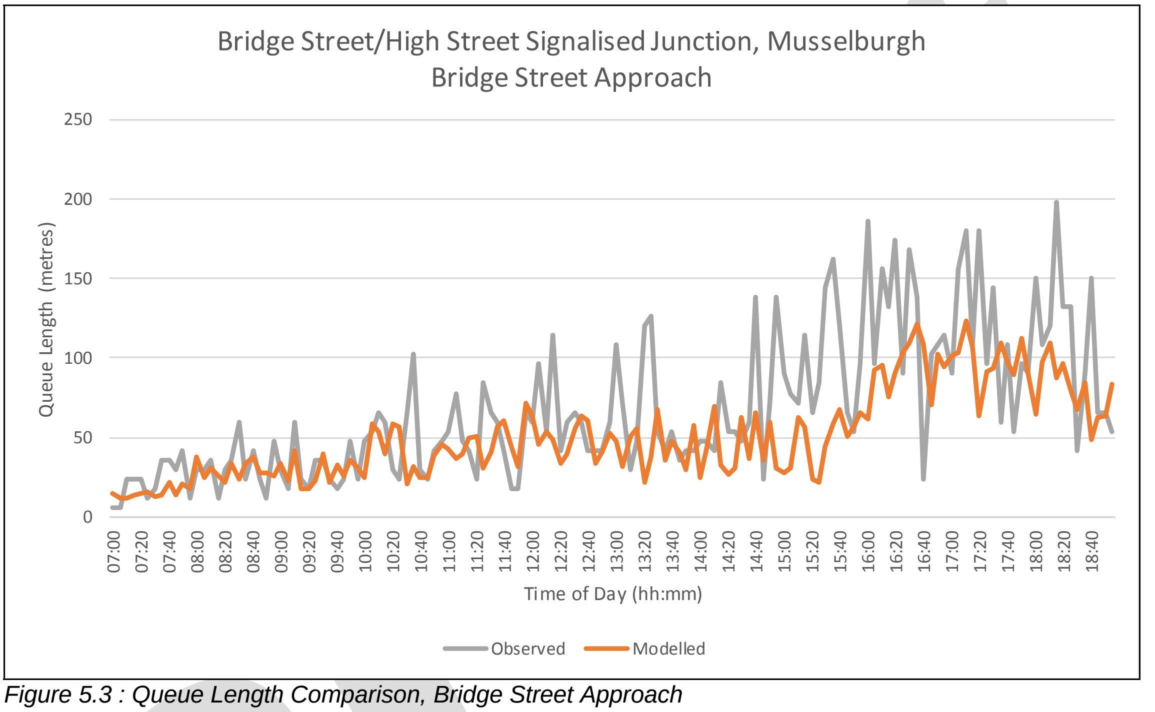

Figure 5.3 : Queue Length Comparison, Bridge Street Approach

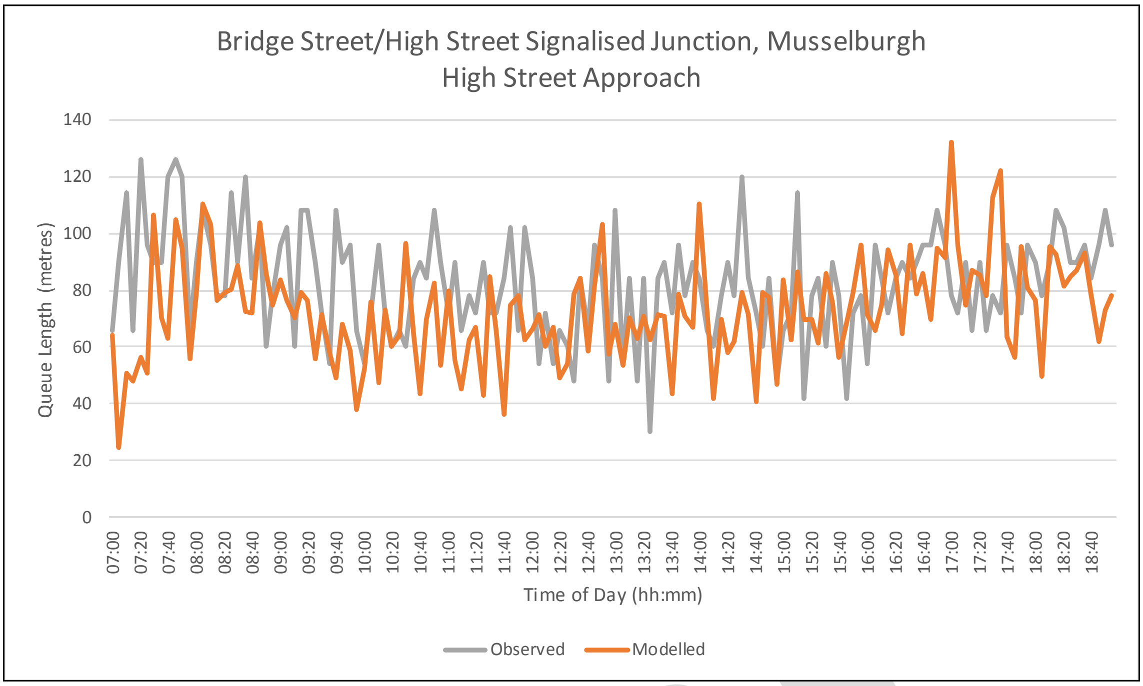

Figure 5.4 : Queue Length Comparison, High Street Approach

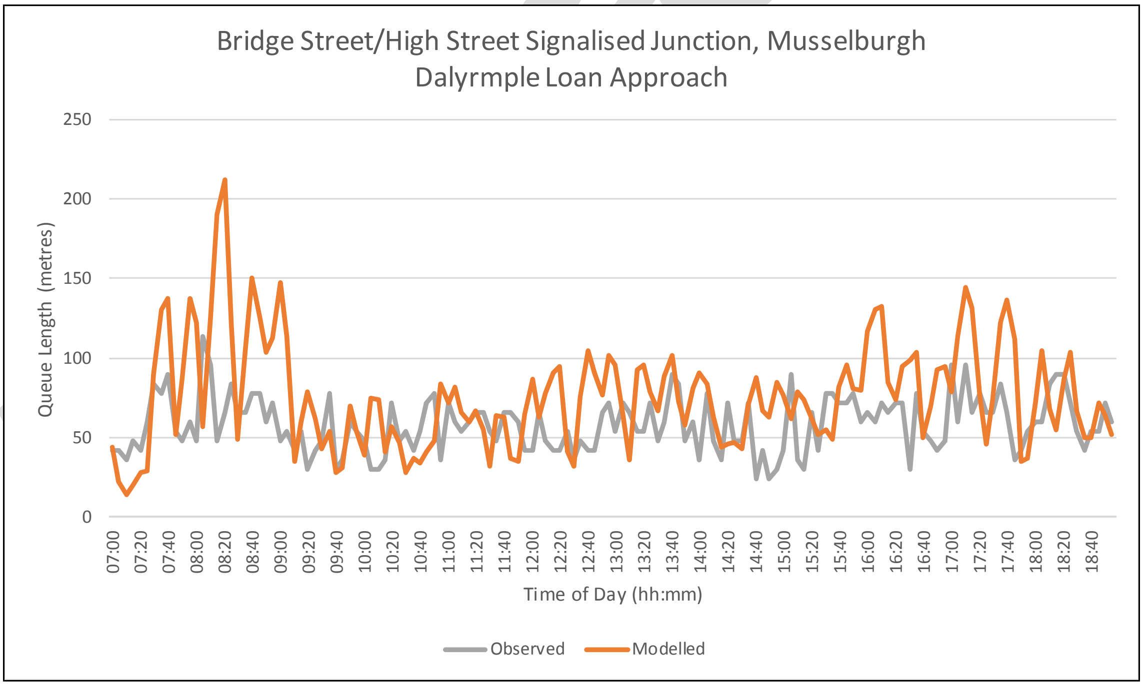

Figure 5.5 : Queue Length Comparison, Dalrymple Loan Approach

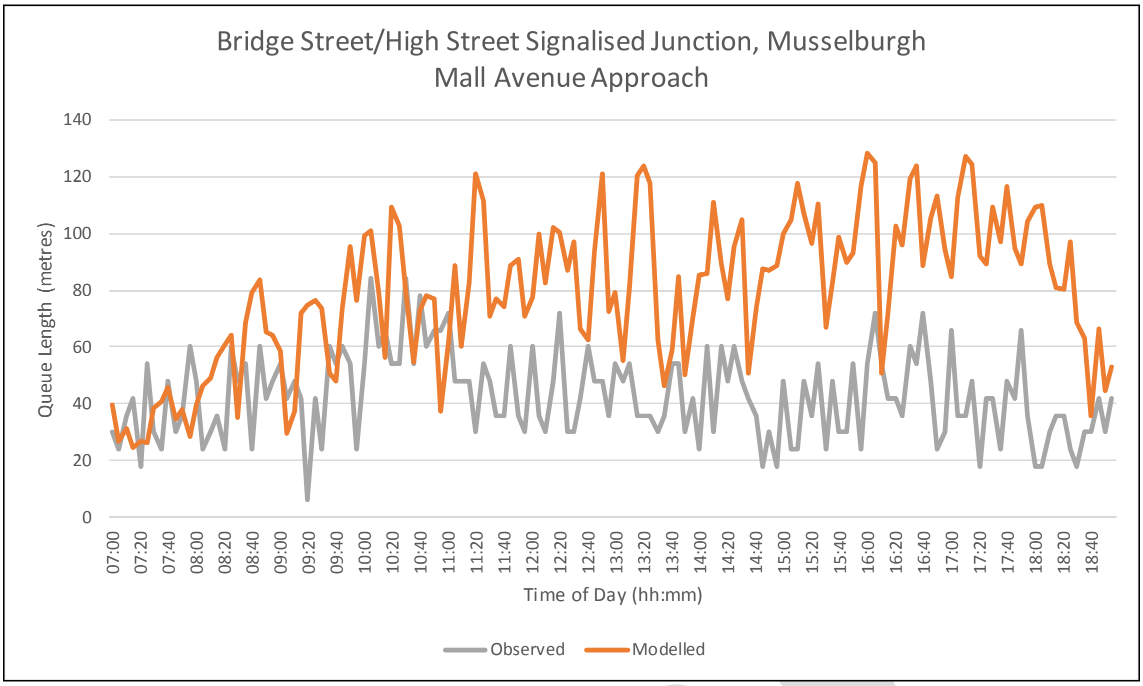

Figure 5.6 : Queue Length Comparison, Mall Avenue Approach

In the case of the Mall Avenue approach, it is evident that the surveyed length is inaccurate as survey videos clearly showed queues often reach back to the yellow box junction at Mall Avenue/Inveresk Road, which is greater than 80m back from the stop line at Mall Avenue/Bridge Street. In this case the modelled queues are believed to be more representative.

6 SUMMARY AND CONCLUSIONS

6.1 Summary

As part of the Scotland Excel Framework, SIAS has been commissioned by East Lothian Council to develop a microsimulation model of the Musselburgh and Tranent area, encompassing the A1(T), Wallyford, Prestonpans, Cockenzie, Port Seton, Longniddry, and Macmerry. The purpose of the model is to create a Base against which future year scenario models can be built to test the Council's future land allocation schemes.

The model was developed using S-Paramics microsimulation software and OS mapping information. The simulation runs the AM period (07:00 – 10:00), IP period (10:00 – 16:00), and PM period (16:00 – 19:00) independently.

Traffic surveys were undertaken in April 2015 to provide the traffic data information required to develop the model. Turn count, moving observer journey time surveys, bus dwell time surveys and pedestrian crossing surveys were undertaken as part of this process.

The model has been calibrated and validated based on WebTAG and *DMRB* guidance and SIAS's *Microsimulation Consultancy Good Practice Guide*. Video footage from the surveys was also utilised to ensure the general behaviour of traffic in the model reflected the conditions on site.

6.2 Conclusions

The Musselburgh and Tranent 2015 Base model meets *DMRB* turn count and individual link flow criteria very well, with 85% of cases meeting a GEH value < 3 as well as < 5. Screenline criteria are met in nearly all cases, with eastbound IP screenlines showing the poorest result.

Half of the journey time routes (Routes 4 5, 6, and 10), which all pass through high street locations within the towns being modelled, show some hours which do not meet the criteria, though the majority of the AM and PM peak hour (08:00 – 09:00 and 17:00 – 18:00) journey times do pass for Routes 5, 6, and 10. Only Route 4 fails consistently in the AM and PM peak hours. The other half of the journey time routes (Routes 1 – 3, 7, 8, and 9) meet the journey time criteria in 100% of cases.

Queue length comparisons at the majority of junction locations correspond well with the observed data.

The Base model is considered fit for the purpose of Reference Case and Future Year testing.

A MANUAL CLASSIFIED COUNT LOCATIONS

Table A.1 : Manual Classified Count Locations 1 of 3 (Queue Survey Location in Bold)

No.	Description	Type	Control	Date
1	**A199 Edinburgh Road / New Street**	**3 arm junction**	**Priority**	**23/04/2015**
2	A199 Edinburgh Road / Newhailes Road	3 arm junction	Signals	23/04/2015
3	North High Streeet / Market Street	3 arm junction	Priority	23/04/2015
4	New Street / Fishers Wynd / Beach Lane	4 arm junction	Priority	23/04/2015
5	New Street / Links View / The Volunteer Arms	4 arm junction	Priority	23/04/2015
6	North High Street / Fishers Wynd	3 arm junction	Priority	23/04/2015
7	North High Street / The Volunteer Arms	3 arm junction	Priority	23/04/2015
8	Bridge Street / Ladywell Way	3 arm junction	Priority	23/04/2015
9	North High Street / Ladywell Way	3 arm junction	Priority	23/04/2015
10	**A6095 Newhailes Road / Olive Bank Road**	**4 arm roundabout**	**Priority**	**23/04/2015**
11	**A6095 Newhailes Road / Clayknowes Road**	**3 arm junction**	**Signals**	**23/04/2015**
12	White Farm Road / Clayknowes Road	3 arm roundabout	Priority	23/04/2015
13	**Stoneybank Terrace / Eskview Terrace**	**3 arm junction**	**Signals**	**23/04/2015**
14	**Olive Bank Road / Eskview Terrace**	**3 arm junction**	**Signals**	**23/04/2015**
15	Olive Bank Road / Tesco access	4 arm roundabout	Priority	23/04/2015
16	Station Road / Eskmills Road (to Inveresk Industrial Estate)	3 arm junction	Priority	23/04/2015
17	**Olive Bank Road / Inveresk Road**	**3 arm junction**	**Signals**	**23/04/2015**
18	Bridge Street / Eskside West	4 arm junction	Priority	06/05/2015
19	**Bridge Street / Mall Avenue / High Street / Dalrymple Loan**	**4 arm junction**	**Signals**	**23/04/2015**
20	High Street / Shorthope Street	3 arm junction	Priority	23/04/2015
21	High Street / Kilwinning Street	3 arm junction	Priority	23/04/2015
22	**High Street / Newbigging / car park**	**4 arm junction**	**Signals**	**23/04/2015**
23	Millhill / James Street	3 arm junction	Priority	23/04/2015
24	Millhill / Balcarres Road	3 arm junction	Priority	23/04/2015
25	Millhill / Linkfield Road	3 arm junction	Priority	23/04/2015
26	**Newbigging / Pinkie Road**	**3 arm junction**	**Signals**	**23/04/2015**
27	**Newbigging / Inveresk Road**	**3 arm junction**	**Priority**	**23/04/2015**
28	Inveresk Brae / Inveresk Village Road	4 arm junction	Priority	23/04/2015
29	Linkfield Road / Ashgrove	3 arm junction	Priority	22/04/2015
30	Pinkie Road / Ashgrove / Pinkie Terrace	4 arm junction	Priority	22/04/2015
31	Pinkie Road / MacBeth Moir Road	3 arm junction	Priority	22/04/2015
32	**Linkfield Road / Haddington Road / Pinkie Road**	**4 arm roundabout**	**Priority**	**22/04/2015**
33	Haddington Road / MacBeth Moir Road	3 arm junction	Priority	22/04/2015
34	**Haddington Road / The Loan**	**3 arm junction**	**Priority**	**22/04/2015**
35	Haddington Road / Wallyford Station car park	3 arm junction	Priority	22/04/2015
36	The Loan / Wallyford Station car park	3 arm junction	Priority	22/04/2015

Table A.2 : Manual Classified Count Locations 2 of 3 (Queue Survey Location in Bold)

No.	Description	Type	Control	Date
37	**A199 Haddington Road / A6094 Salter's Road / B1361**	**4 arm roundabout**	**Priority**	**22/04/2015**
38	**A6094 Salter's Road / The Loan**	**3 arm junction**	**Priority**	**22/04/2015**
39	**A6094 Salter's Road / Drummohr Ave / Wallyford industrial estate**	**4 arm junction**	**Priority**	**22/04/2015**
40	B1348 High Street / Prestongrange Road	3 arm junction	Priority	22/04/2015
41	**B1348 High Street / B1349 Ayres Wynd**	**3 arm junction**	**Signals**	**22/04/2015**
42	**B1348 High Street / Appin Drive**	**3 arm junction**	**Signals**	**22/04/2015**
43	**B1348 Edinburgh Road / East Lorimer Place**	**3 arm junction**	**Priority**	**21/04/2015**
44	B1361 / Prestongrange Road / Jim Bush Drive	4 arm roundabout	Priority	22/04/2015
45	B1361 / Preston Road	3 arm junction	Priority	22/04/2015
46	B1361 / B1349 Station Road	3 arm junction	Priority	22/04/2015
47	B1361 / Johnnie Cope's Road	3 arm junction	Priority	22/04/2015
48	Johnnie Cope's Road / 1-4 JCR & Prestonpans Station car park	3 arm junction	Priority	22/04/2015
49	Johnnie Cope's Road / Prestonpans Station south car park	3 arm junction	Priority	22/04/2015
50	B1361 / Prestonpans Station car park	3 arm junction	Priority	22/04/2015
51	B1361 / Shaw Road	3 arm junction	Priority	22/04/2015
52	**B1361 / A198 / B6371**	**4 arm roundabout**	**Priority**	**21/04/2015**
53	B6371 / Alder Road	3 arm roundabout	Priority	21/04/2015
54	A199 / Brickworks Road	4 arm junction	Priority	22/04/2015
55	A199 Edinburgh Road / B6414 / Market View	4 arm junction	Signals	21/04/2015
56	**B6414 New Road / B6414 Elphinstone Road**	**3 arm roundabout**	**Priority**	**21/04/2015**
57	**B6414 New Road / Bridge Street**	**3 arm junction**	**Priority**	**21/04/2015**
58	**A199 Bridge Street / A199 High Street / Church Street**	**3 arm roundabout**	**Priority**	**21/04/2015**
59	A199 High Street / Winton Place	3 arm junction	Priority	21/04/2015
60	**A199 High Street / Ormiston Road**	**3 arm junction**	**Signals**	**21/04/2015**
61	B6371 Ormiston Road / Loch Road	3 arm junction	Priority	21/04/2015
62	A199 Haddington Road / Ormiston Avenue	3 arm junction	Priority	21/04/2015
63	A199 Haddington Road / Muirpark Terrace	3 arm junction	Priority	21/04/2015
64	B6371 Ormiston Road / Blawearie Road	3 arm junction	Priority	21/04/2015
65	B6371 Ormiston Road / Muirpark Road	3 arm junction	Priority	21/04/2015
66	B6371 Ormiston Road / B6355	3 arm junction	Priority	21/04/2015
67	B6371 Ormiston Road / Waterloo Road	3 arm junction	Priority	21/04/2015
68	B6414 Elphinstone Road / Caponhall Road	3 arm junction	Priority	22/04/2015
69	B6414 Elphinstone Road / Castle Road	3 arm junction	Signals	22/04/2015

Table A.3 : Manual Classified Count Locations 3 of 3 (Queue Survey Location in Bold)

No.	Description	Type	Control	Date
70	B6415 access to A1 Old Craighall Junction	4 arm roundabout	Priority	23/04/2015
71	**A1 Old Craighall grade separated junction (Musselburgh)**	**4 arm roundabout**	**Priority**	**23/04/2015**
72	**A1 eastbound ramps for A6094 (Wallyford)**	**4 arm junction**	**Signals**	**22/04/2015**
73	**A1 westbound ramps for A6094 (Wallyford)**	**4 arm junction**	**Priority**	**22/04/2015**
74	A6094 Salter's Road / A6124 Carberry Road	4 arm roundabout	Priority	22/04/2015
75	**A1 eastbound ramps for A199 (Dolphingstone)**	**4 arm junction**	**Signals**	**22/04/2015**
76	**A1 westbound ramps for A199 (Dolphingstone)**	**4 arm junction**	**Priority**	**23/04/2015**
77	**A1 eastbound ramps for A198 (Bankton)**	**4 arm roundabout**	**Priority**	**21/04/2015**
78	**A1 westbound ramps for A198 (Bankton)**	**5 arm roundabout**	**Priority**	**21/04/2015**
79	B1348 Links Road / Fishers Road	3 arm junction	Priority	21/04/2015
80	A198 / Fishergate Road	3 arm junction	Priority	21/04/2015
81	B1348 Links Road / Dean Road	3 arm junction	Priority	21/04/2015
82	A198 / Dean Road	3 arm junction	Priority	21/04/2015
83	B1348 / A198	3 arm junction	Priority	21/04/2015
84	**A198 / B1377**	**3 arm roundabout**	**Priority**	**21/04/2015**
85	A198 / Longniddry rail car park access	3 arm junction	Priority	21/04/2015
86	A198 / Links Road	3 arm junction	Priority	28/04/2015
87	A198 / B6363	3 arm junction	Priority	21/04/2015
88	A199 / Westbank Road	3 arm junction	Priority	21/04/2015
89	A199 / Macmerry Business Park access	3 arm junction	Priority	21/04/2015
90	A199 / Macmerry Industrial Estate access	3 arm junction	Priority	21/04/2015
91	**A1 eastbound ramps for A199 (Gladsmuir)**	**4 arm roundabout**	**Priority**	**21/04/2015**
92	**A1 westbound ramps for A199 (Gladsmuir)**	**4 arm roundabout**	**Priority**	**21/04/2015**
93	A199 / B6363	4 arm roundabout	Priority	21/04/2015

B MODEL EXTENTS

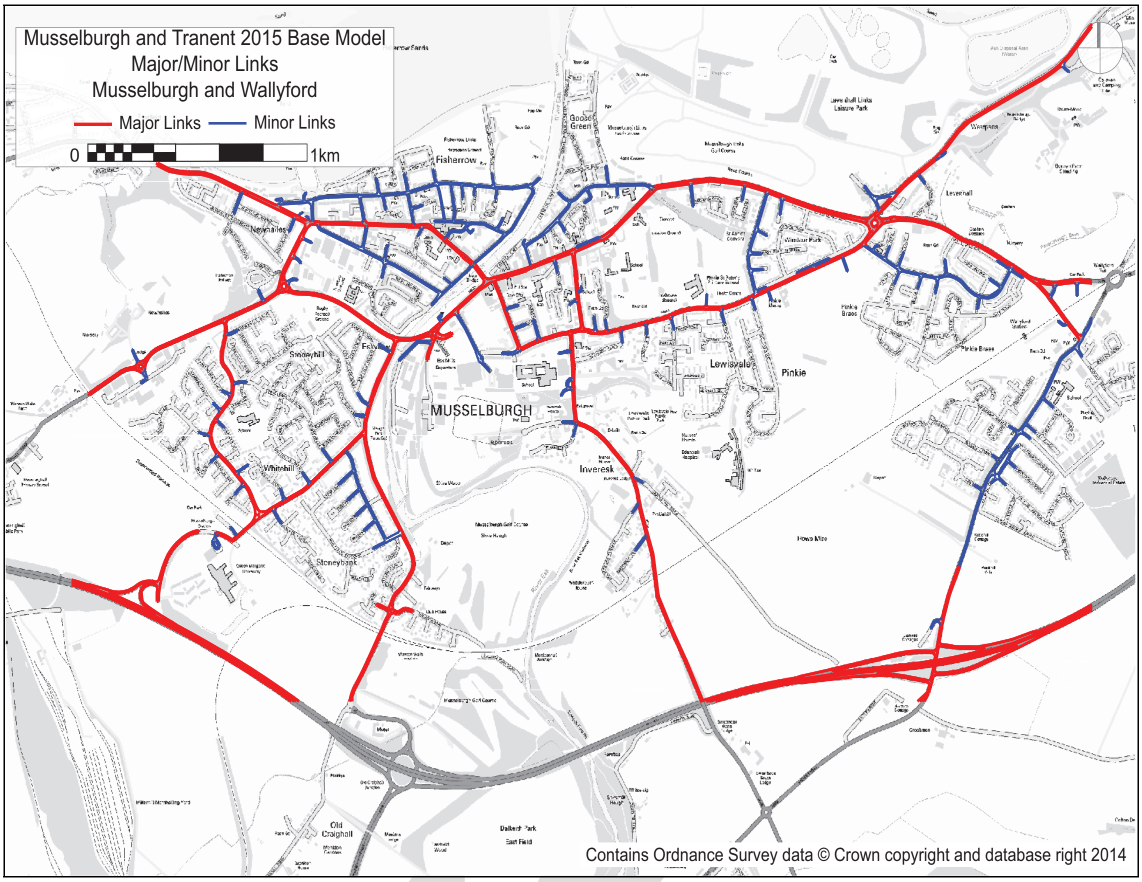

Figure B.1 : Musselburgh and Tranent 2015 Base Model Link Hierarchy: Musselburgh and Wallyford

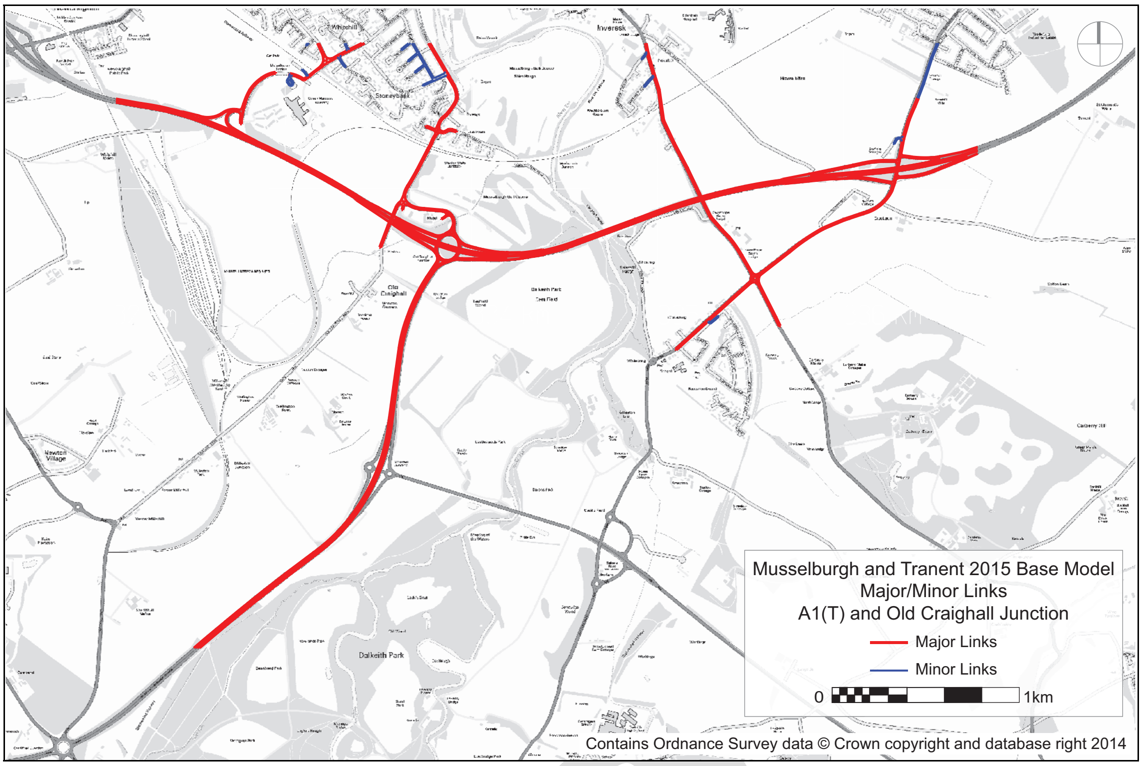

Figure B.2 : Musselburgh and Tranent 2015 Base Model Link Hierarchy: A1(T) Old Craighall

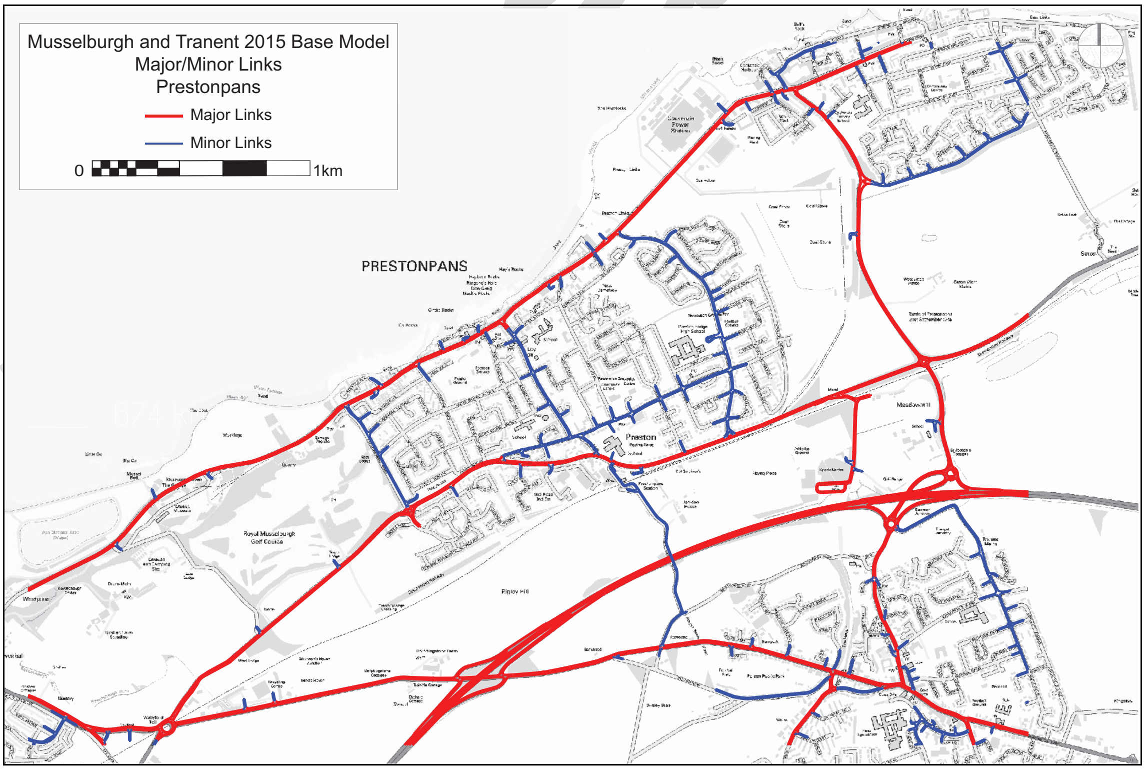

Figure B.3 : Musselburgh and Tranent 2015 Base Model Link Hierarchy: Prestonpans

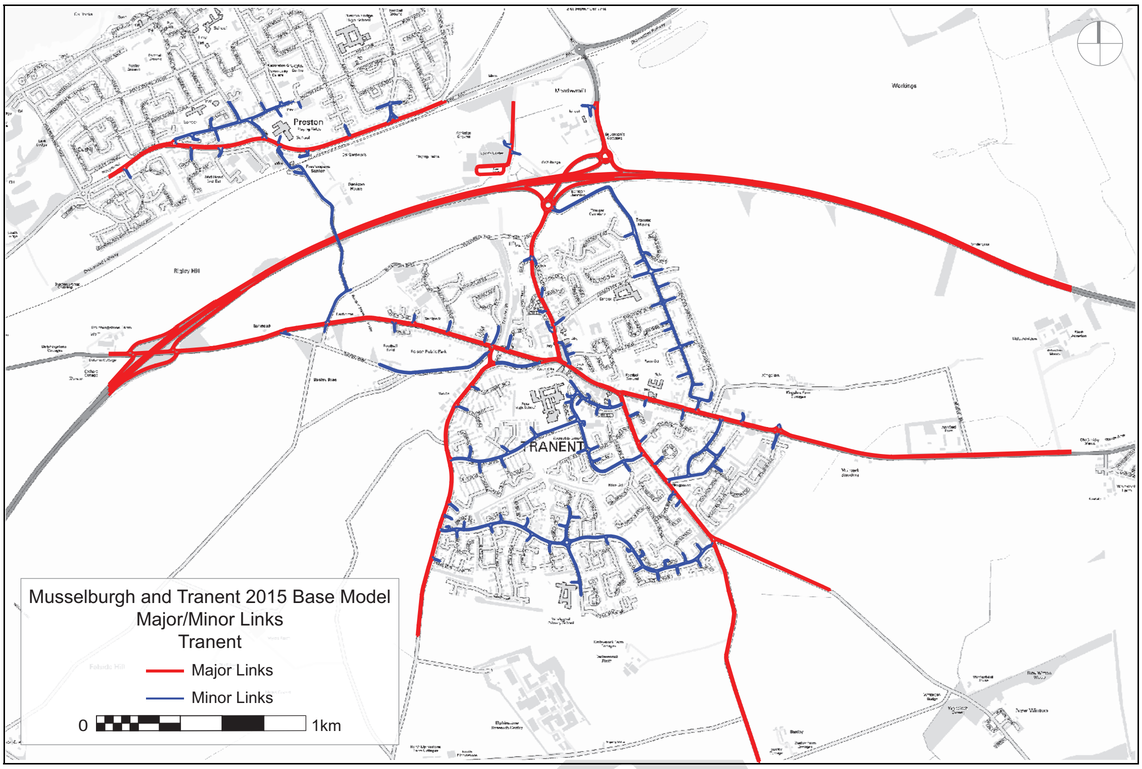

Figure B.4 : Musselburgh and Tranent 2015 Base Model Link Hierarch: Tranent

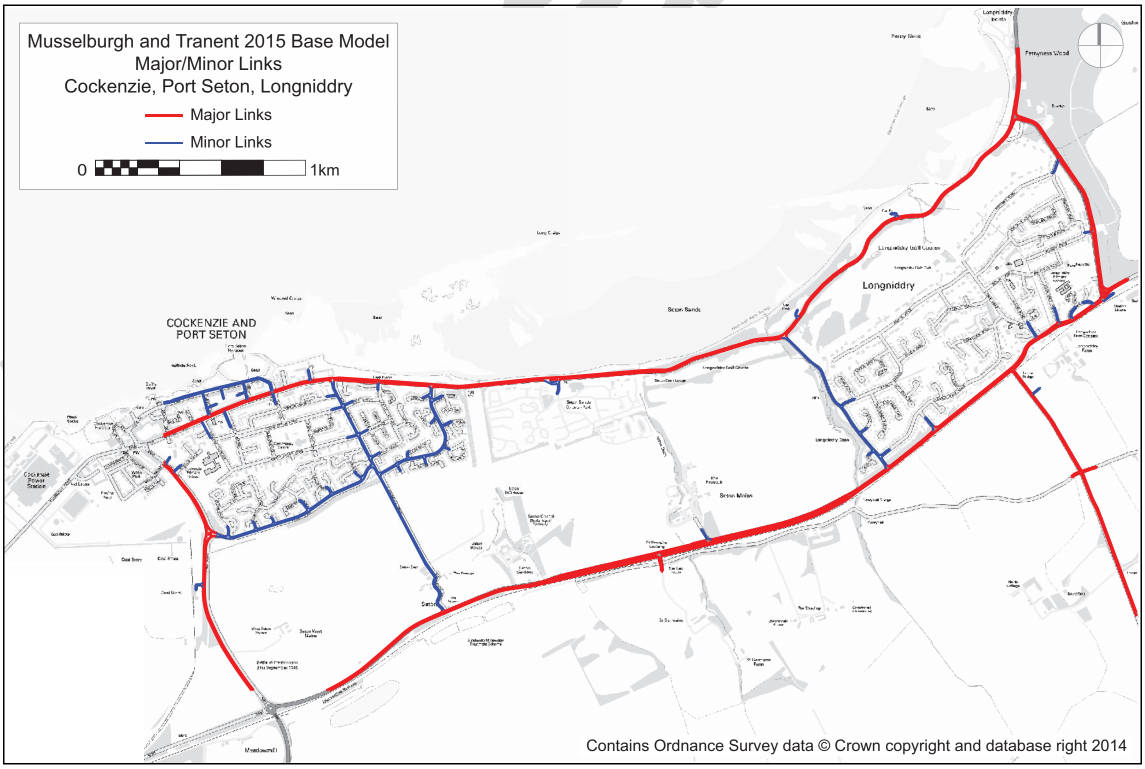

Figure B.5 : Musselburgh and Tranent 2015 Base Model Link Hierarchy: Cockenzie, Port Seton, Longniddry

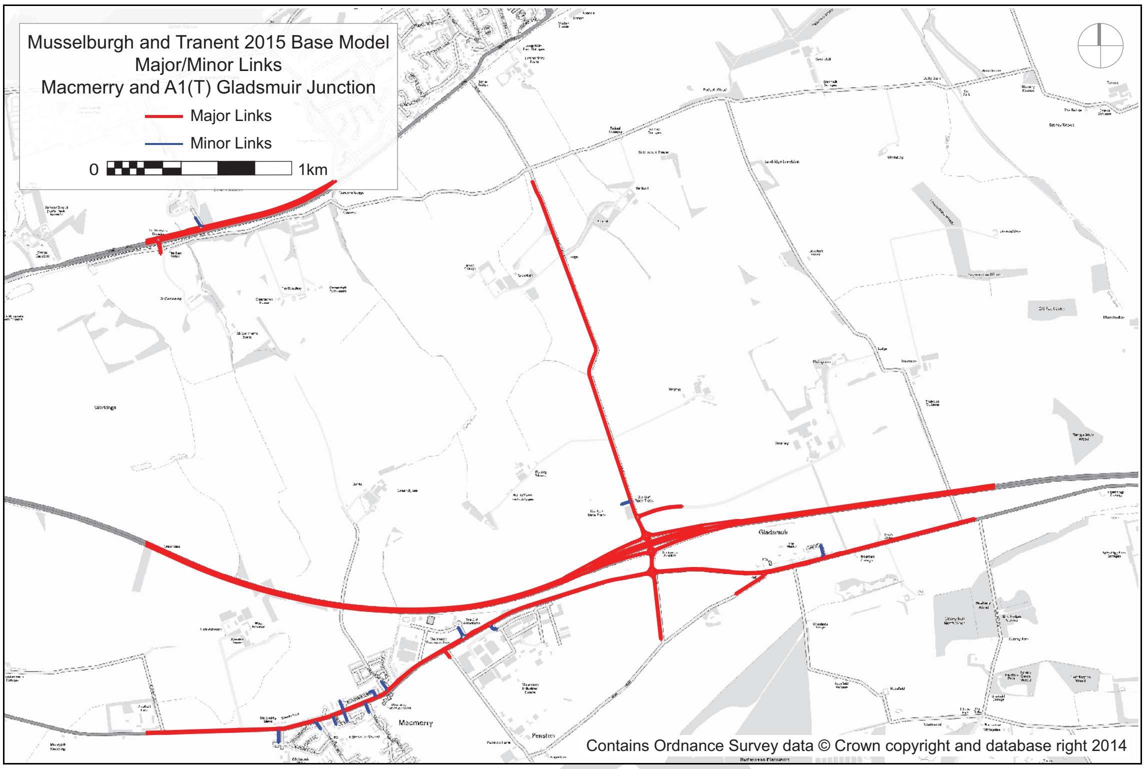

Figure B.6 : Musselburgh and Tranent 2015 Base Model Link Hierarchy: Macmerry and A1(T) Gladsmuir

Appendix B Information Note 2 – Definition of Appraisal Forecasts

Job Name:	East Lothian Local Development Plan Transport Appraisal
Job Number:	31335
Note Number:	002
Date:	20 July 2016
Prepared by:	Brendan Reynolds and Andrew Bagnall
Subject:	Definition of Appraisal Forecasts

1 INTRODUCTION

1.1 Overview

1.1.1 East Lothian Council (ELC) is preparing its Local Development Plan (LDP) following the approval of the Strategic Development Plan (SDP) for Edinburgh and South East Scotland. ELC have commissioned Peter Brett Associates LLP to undertake a Transport Appraisal of the implications of housing and economic land allocations on the transport network. This will support the preparation of the Proposed LDP ready for publication and formal representation.

1.1.2 The LDP Transport Appraisal is being carried out in accordance with Transport Scotland's Development Planning and Management Transport Appraisal Guidance (DPMTAG) methodology. DPMTAG follows the principles set out in Scottish Transport Appraisal Guidance (STAG) which provides relevant guidance and technical methodologies for carrying out Transport Appraisal in Scotland.

1.1.3 This Information Note provides a definition of a set of land-use and transport assumptions which will form the basis of LDP appraisal.

1.1.4 The appraisal forecast definitions focus on land-use and transport interventions that are directly relevant to the supply and demand for travel to, from and within East Lothian. The impacts of changes in supply and demand will be predicted using the SEStran Regional Model 2012 (SRM12).

1.1.5 Two core model scenarios will be prepared to represent the LDP in a forecast year of 2024 (the available forecast year from SRM12) as follows:

- **LUS1: Without LDP** land-use development scenario. This will include completed and committed development up to 2024 only; and
- **LUS2: With LDP** land-use development scenario. This will include build-out of identified LDP development sites.

1.1.6 With respect to transport scheme interventions, the 'reference case' networks will include transport interventions that are **committed** and will be completed by the appraisal forecast year of 2024. The same transport network will be used as the basis for modelling each land use scenario. The networks are described in further detail in Sections 3 and 4 of this Note.

1.1.7 For the LDP scenario (LUS2), a series of option tests will be undertaken to help define and predict the impact of potential mitigation measures.

2 LAND-USE AND DEMOGRAPHIC FORECASTS

2.1 Overview

2.1.1 This section describes the land-use developments which form part of the **land-use scenarios**. It distinguishes between those completed prior to the end of March 2015 (post the 2012 SRM12 base year) and the 'future' committed/LDP development, which will be assumed to take place beyond March 2015.

2.1.2 There are some committed and LDP allocated developments that are due to be phased in beyond the available SRM12 modelled forecast year of 2024. In order to predict potential impacts beyond 2024, it will be necessary to undertake scenario testing which may introduce 'all' committed and allocated development within the existing modelled forecast year of 2024. An alternative method would be to prepare additional forecast year scenarios.

2.1.3 Following discussions with ELC and Transport Scotland, it was agreed that **a single set of model forecasts** is initially prepared for 2024 which would include **all developments regardless of anticipated build-out years**. This will provide a proportionate representation of the impact of the full LDP development build out within East Lothian, but may underestimate travel growth generated outside East Lothian post 2024. This will result in the following LDP scenario definition:

- **LUS2: With LDP** land-use development scenario. This will be a 2024 scenario, but will be representative of a build-out of all identified LDP development sites (i.e. those up to and including 2038).

2.1.4 We will consider the potential need for an additional forecast year (2032 and possibly beyond) scenarios once we have assessed the impacts of the 2024 scenarios. In parallel, we will explore the availability and suitability of travel demand forecasts post 2024 from the Transport Model for Scotland, including a review of traffic levels and public transport patronage on key routes in East Lothian, for example on the A1 and East Coast Main Line.

2.2 Overview of the Approach to Modelling Land-Use Changes

2.2.1 The LATIS/TELMoS models (which cover the whole of Scotland) will be used to prepare initial land use and travel demand information for input to the East Lothian LDP (ELLDP) travel demand forecasts within SRM12.

2.2.2 The SESplan Cross-boundary Appraisal forecast land-use scenario 2024 LA and 2024 LB will be used as the basis of the ELLDP forecasts. This includes a recent consideration of developments across the entire SESplan area. However, the data reflecting the ELLDP in that modelling may have changed with respect to the predicted uptake of development as defined by LATIS/TELMoS. It is therefore necessary to remove all of the East Lothian development from the TELMoS starting scenario and update it with the ELLDP forecast assumptions noted in this document. This approach will ensure that the resulting model inputs match the current ELLDP. These will then be nested within the aforementioned LATIS/TELMoS scenario (Note that: we are not proposing to rerun the full LATIS/TELMoS process to create a full new Scotland-wide land-use scenario[1]).

2.2.3 As noted above, we will assume that ***all*** of the allocated ELLDP housing will be completed and occupied within the specified modelled years, initially 2024 as discussed above.

2.2.4 In addition to the housing developments, a number of strategic employment developments within East Lothian will be considered as part of the ELLDP appraisal. Details of these are

[1] The TELMoS model does not necessarily fulfil all housing or employment land allocations, as it is constrained by the total Scotland-wide economic and demographic scenario.

provided in Section 2.4 below. General assumptions regarding employment in the rest of the SESplan area (and beyond) will remain as per the SRM cross-boundary TELMoS scenario which will form the starting point for this study.

2.3 Housing Developments Assumed within the 2024 ELLDP

2.3.1 The following series of tables summarises the assumed number of residential units in each forecast scenario. Appendix A includes a complete record of individual housing sites and the assumed development profile. These figures will be allocated to SRM zones based on the development locations. Where developments are split across two zones, the number of households will be estimated based on the site boundary. Forecast population figures will be estimated based on the TELMoS household densities for East Lothian at SRM12 zonal level.

2.3.2 Table 1 lists the completed and committed housing developments to be assumed within the ELLDP scenarios.

Table 1 Completed and Committed Housing Developments – Number of Residential Units

Location	Completed by March 2015	Committed March 2015 to 2023/24	Committed 2024/25 to 2031/32	Committed 2032/33 to 2037/38
Musselburgh	131	1,965	310	0
Prestonpans	239	209	0	0
Tranent	28	337	0	0
Haddington	21	1,397	0	0
Dunbar	153	748	0	0
Blindwells	0	0	0	0
North Berwick	88	872	0	0
Total	**660**	**5,528**	**310**	**0**

2.3.3 Table 2 provides a summary of the additional allocated housing developments to be assumed within the ELLDP scenario by area.

Table 2 ELLDP Housing Developments Summary – Number of Residential Units

Location	December 2015 to 2023/24	2024/25 to 2031/32	2032/33 to 2037/38
Musselburgh	1,915	1,200	0
Prestonpans	450	0	0
Tranent	1,083	100	0
Haddington	156	129	0
Dunbar	679	75	0
Blindwells	291	801	508
North Berwick	444	0	0
Total	**5,018**	**2,305**	**508**

2.3.4 In addition to the figures detailed in the above tables there are a further 4,400 potential residential units at **Blindwells**, which currently being proposed as a safe-guarded sites in the

ELLDP. Following discussions with ELC and Transport Scotland it is suggested that this potential **extra housing** allocation at Blindwells is included as a **sensitivity test** in the ELLDP Appraisal to consider the impact on the transport network and the effectiveness of mitigation measures with additional travel demand.

2.4 Employment Locations Assumed with the 2024 ELLDP Scenario

2.4.1 The following series of tables summarises the assumed employment site development in each forecast scenario and the associated estimated number of jobs. Currently there is no information relating to the phased introduction and uptake of employment and no information relating to industry sector. Therefore, it is initially proposed that the model forecasts assume a full build-out by the 2024 model year. These figures will be allocated to SRM zones based on the development locations. Where developments are split across two zones the number of jobs will be estimated based on the site boundary.

2.4.2 Table 3 lists the committed and allocated LDP economic developments assumed to be within the ELLDP scenarios.

Table 3 LDP Economic Developments – Site Area

Site Ref/Name	Committed Employment Site in Hectares	LDP Employment Site in Hectares
Musselburgh	33.70	46.50
Prestonpans	5.50	1.00
Blindwells	0.00	10.00
Tranent	38.30	33.80
Haddington	10.90	8.75
Dunbar	11.40	22.60
North Berwick	2.00	2.50
Total	**101.80**	**125.15**

2.4.3 In liaison with ELC, the following assumptions have applied to estimate the number of jobs associated with the employment sites:

- For the purposes of the ELLDP appraisal, employment numbers are estimated using assumed employment densities based upon current or adjacent site use. Whilst it does not specifically reflect a diverse range of expected activities, it is considered a robust estimate and applicable to the broadly anticipated development purposes and staffing levels;
- The estimated number of jobs is based on floorspace using densities taken from the Employment Densities Guide 2nd Edition 2, which is a widely accepted source of information. This provides an estimate of the number of full time employee per Gross Internal Area (GIA) floorspace for different commercial uses;
- Total site hectares are converted to estimate GIA using figures based on previous studies with a typical ratio of 0.20 for industrial uses, and 0.40 for business park and mixed commercial uses including retail.
- ELC planners have reviewed the site usage, employment density and floorspace ratio assumptions and, for a small number of locations, provided information based on existing or previous planning applications or local knowledge;

[2] authored by Drivers Jonas Deloitte for the Homes and Community Agency and other planning bodies: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/484133/employment_density_guide_3rd_edition.pdf

- Hotel employment numbers are based on the number of rooms with densities available from the Employment Densities Guide 2nd Edition; and
- Care home and sheltered housing site employment figures are based on the number of beds with densities assumed from previous studies.

2.4.4 Appendix B provides a breakdown of the assumptions used to estimate the number of jobs at each site. Table 3 provides a summary of the number of jobs by area and indicates a total of 13,545 additional jobs by 2024 for the committed plus ELLDP scenario compared with the base year. Whilst it has been necessary to make a number of assumptions to derive these forecasts it is considered a robust scenario in terms of the estimated number of jobs and associated traffic generation.

Table 4 LDP Economic Developments – Estimated Number of Jobs

Site Ref/Name	Committed Employment Sites	LDP Employment Sites
Musselburgh	2,380	3,833
Prestonpans	264	111
Blindwells	0	426
Tranent	2,099	1,593
Haddington	606	445
Dunbar	397	1,226
North Berwick	41	126
Total	**5,785**	**7,760**

2.5 No East Lothian Development Sensitivity Test

2.5.1 A potential sensitivity test, scenario LUS0, will be considered to review the impact of forecast travel demand outside East Lothian only. This would assume that no further development occurs within East Lothian beyond the completed residential units noted in Table 1. This scenario would be hypothetical only to inform the ELLDP Appraisal and assess the impact of growth in travel demand from outside East Lothian on the transport network.

3 ROAD INTERVENTIONS

3.1 Overview

3.1.1 In this section we list the main changes to the road network which are assumed to have been introduced following the model base year, 2012.

3.2 Reference Case Road Schemes in the SESTRAN/SRM Area

3.2.1 The following committed road schemes will be assumed within the 2024 SRM12 road network:

- Forth Replacement Crossing – Connecting to M90 and M9 Spur; and
- M8 Heartlands – Extra Junction on the M8.

3.2.2 We are not aware of any committed road schemes post 2024 and, therefore, all forecast Reference Case road networks will be the same.

3.2.3 At present, no additional future year road schemes have been assumed. However, this assumption will be reviewed when SRM forecasts become available and the relevant 2024 modelled traffic conditions are assessed (i.e. to determine if any additional mitigation measures need to be assumed to create a robust forecast for the remainder of the Study).

4 PUBLIC TRANSPORT INTERVENTIONS

4.1 Overview

4.1.1 In this section we list the main changes to the public transport network which are assumed to have been introduced following the model base year, 2012.

4.1.2 Changes to the public transport network focus on the measures and changes which can be modelled within the SRM12.

4.2 Reference Case Public Transport Schemes in the SESTRAN/SRM Area

4.2.1 The following constructed (post 2012) or committed public transport schemes will be assumed within the 2024 SRM public transport model:

- **East Coast Mainline Timetable Changes** – changes to service frequencies and stopping patterns (implemented 2013);
- **Edinburgh Tram** – new tramline between Edinburgh city centre and Edinburgh airport (opened 2014);
- **Borders Railway** – rail line between Tweedbank & Edinburgh. 2tph throughout the day with park and ride provision at each rail station (opened 2015);
- **Edinburgh Gateway Station** – new station at Gogar served by Fife Circles and connection with Edinburgh TRAM; and
- **Edinburgh-Glasgow Improvement Project (EGIP) Phase 1** – increased capacity, 5-8 minute journey time reduction between Edinburgh and Glasgow. Journey time improvements on various services to Stirling, Aberdeen, Bathgate and Falkirk.

4.2.2 We are not aware of any committed public transport schemes post 2024 and, therefore, all forecast Reference Case road networks will be the same.

4.2.3 At present, no additional future year public transport schemes have been assumed. However, this assumption will be reviewed when SRM forecasts become available and the relevant 2024 modelled traffic conditions are assessed (i.e. to determine if any additional mitigation measures need to be assumed to create a robust forecast for the remainder of the Study).

DOCUMENT ISSUE RECORD

Document	Rev	Date	Prepared	Checked	Reviewed (Discipline Lead)	Approved (Project Director)
31335_IN2	V3.1	20/07/16	Brendan Reynolds and Andrew Bagnall	Andrew Bagnall	Andrew Bagnall	Kevin Lumsden

Peter Brett Associates LLP, 160 West George Street, Glasgow G2 2HG

Appendix C Information Note 3 – Forecasts Transport Assessment

Job Name:	East Lothian Local Development Plan Transport Appraisal
Job Number:	31335
Note Number:	003
Date:	26 August 2016
Prepared by:	Andrew Weir
Subject:	Forecast Year Transport Assessment

1 INTRODUCTION

1.1 Overview

1.1.1 East Lothian Council (ELC) is preparing its Local Development Plan (LDP) following the approval of the Strategic Development Plan (SDP) for Edinburgh and South East Scotland. ELC commissioned Peter Brett Associates LLP to undertake a Transport Appraisal of the implications of housing and economic land allocations on the transport network. This will support the preparation of the Proposed LDP ready for publication and formal representation.

1.1.2 The LDP Transport Appraisal was carried out in accordance with Transport Scotland's Development Planning and Management Transport Appraisal Guidance (DPMTAG) methodology. DPMTAG follows the principles set out in Scottish Transport Appraisal Guidance (STAG) which provides relevant guidance and technical methodologies for carrying out Transport Appraisal in Scotland.

1.1.3 This Information Note describes the East Lothian Local Development Plan (ELLDP) forecast year transport assessment, which has been undertaken using the SEStran Regional Model (SRM). The network impacts have been considered alongside a list of potential mitigation infrastructure interventions with identification of a recommended package of interventions that will address the cumulative impact of the ELLDP.

2 MODELLING APPROACH

2.1 Overview

2.1.1 The SEStran Regional Model (SRM) has been used to inform the Appraisal of the implications of housing and economic land allocations on the transport network.

2.1.2 The SRM12 version applied is that provided from the SESplan Cross Boundary Study (CBS) Team. Some amendments have been made to both network representation and the representation of the development plan scenario for East Lothian Council (ELC) to ensure that the proposed plan is suitably represented.

2.1.3 The network assessment presented in this report, undertaken using the SRM, provides sufficient information to identify an initial list of required mitigation interventions. The Musselburgh and Tranent Paramics micro-simulation traffic model and local junction modelling has also been used as part of the mitigation assessment, in particular to look at the operation of the local road network in more detail, which was not possible using the SRM.

2.2 Sector System

2.2.1 For the purposes of analysing the LDP scenarios, a matrix sector system has been prepared as illustrated in Figure 2.1 and presented in Table 2.1. A sector system combines a number of zones together for the purpose of reporting. This sector system represents East Lothian via eight sectors and aggregates the other local authorities. In addition to these, the external trips (all movements to\from outwith the SRM area) have been included in a single sector. It should be noted that due to the scale of the development, Blindwells has been defined as a separate sector.

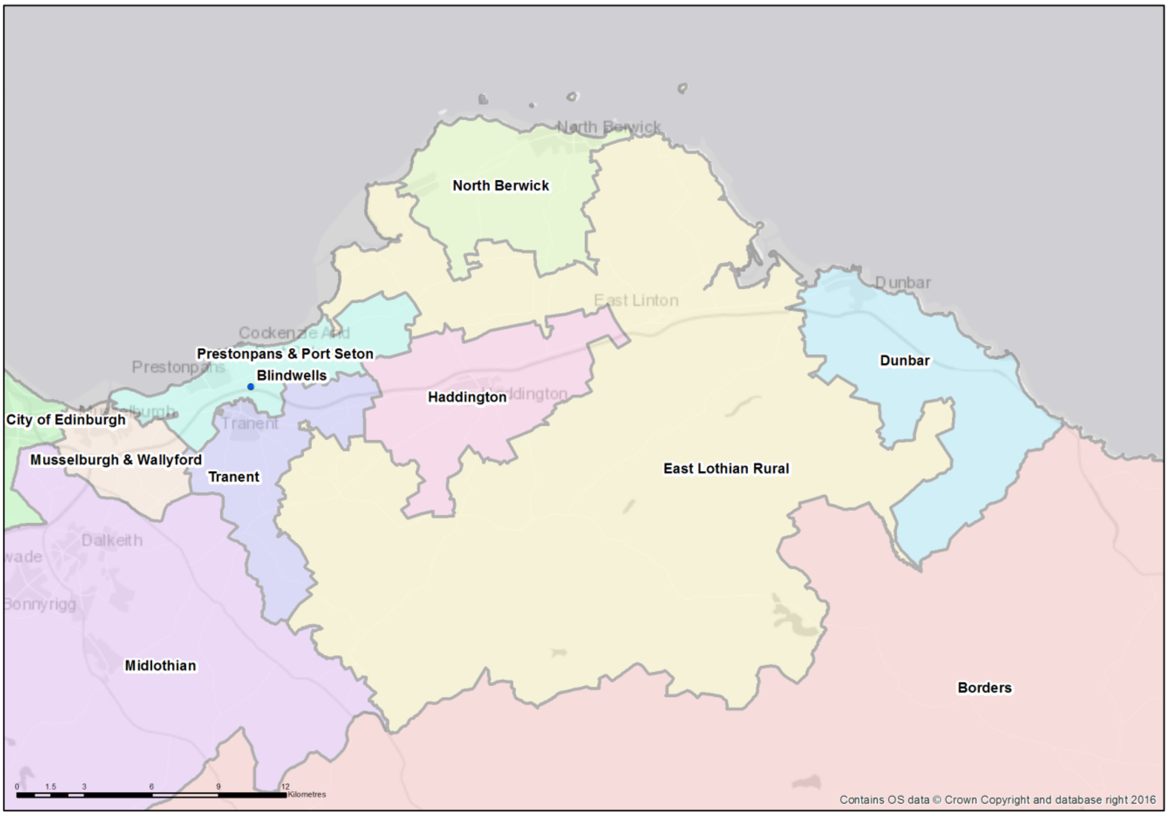

Figure 2.1 Sector System Map

Table 2.1 Sector System

Sector	Sector Name	Sector	Sector Name
1	East Lothian Rural	10	City of Edinburgh
2	Musselburgh & Wallyford	11	Falkirk
3	Tranent	12	Fife
4	Prestonpans & Port Seton	13	Midlothian
5	Haddington	14	Perth & Kinross
6	North Berwick	15	Borders
7	Dunbar	16	Stirling
8	Blindwells	17	West Lothian
9	Clackmannanshire	18	External

2.3 SRM Model Dimensions

2.3.1 The model has a 2012 Base year, and a single 2024 forecast year, which has been used to represent all future year scenarios.

2.3.2 The SRM is representative of average weekday travel movements within which the following time periods are modelled:

- Average weekday (AM) morning peak: 07:00-10:00;
- Average weekday (IP) inter peak: 10:00-16:00; and
- Average weekday (PM) evening peak: 16:00-19:00.

2.3.3 Individual factors are applied by mode and time period to create an 'average' peak hour.

2.3.4 The road assignment model includes five assigned vehicle types and journey purposes as follows:

- Car In-Work;
- Car Non-Work Commuter;
- Car Non-Work Other;
- LGV; and
- HGV.

2.3.5 The PT assignment model includes three assigned PT purposes as follows:

- PT In-Work;
- PT Non-Work Commute; and
- PT Non-Work Other.

2.4 SRM Observations for ELLDP

2.4.1 The initial application of SRM12 for the ELLDP demonstrated intuitive responses of acceptable degrees of magnitude at the strategic level. However, there were instances in the model outputs where delays and capacity issues were found at locations where this would not be expected. These included (for example):

- "Dummy" nodes – (Nodal points on the road network to improve the visual representation of the links) capacity constraints at dummy nodes resulting in higher V/C (volume / capacity) values than preceding and following road network segments
- Diverges – delays and capacity issues at dual carriageway diverges, due to shared lane capacity reductions

2.4.2 These issues were reviewed and were not considered to impact on the key model comparisons between ELLDP scenarios.

3 PREPARATION OF SCENARIOS

3.1 Introduction

3.1.1 *Information Note 2 – Definition of Appraisal Forecasts* (PBA, May 2016) provides a definition of a set of land-use and transport assumptions which form the basis of the LDP appraisal.

3.1.2 The appraisal focusses on land-use and transport interventions that are directly relevant to the supply and demand for travel to, from and within East Lothian. The impacts of these changes in supply and demand have been predicted using the SEStran Regional Model 2012 (SRM12).

3.1.3 Following the circulation of the Information Note to ELC and Transport Scotland, general agreement on the modelling approach was reached prior to assessing the traffic impacts of the ELLDP scenarios.

3.2 Forecast Land-Use Scenarios

3.2.1 *Information Note 2 – Definition of Appraisal Forecasts* (PBA, May 2016) provides a definition of a set of land-use assumptions which form the basis of LDP appraisal.

3.2.2 ELC planners have provided information on the land-use developments which form part of the **land-use scenarios**. It distinguishes between those completed prior to the end of March 2015 (post the 2012 SRM12 base year) and the 'future' committed/LDP development, which will be assumed to take place beyond March 2015.

3.2.3 There are some committed and LDP allocated developments that are due to be phased in beyond the available SRM12 modelled forecast year of 2024. In order to predict potential impacts beyond 2024, it was necessary to undertake scenario testing which introduced 'all' committed and allocated development within the existing modelled forecast year of 2024.

3.2.4 Following discussions with ELC and Transport Scotland, it was agreed that **a single set of model forecasts** be initially prepared for 2024 which would include **all developments regardless of anticipated build-out years**. This provided a proportionate representation of the impact of the full LDP development build out within East Lothian, but may underestimate travel growth generated outside East Lothian post 2024.

3.2.5 Two core model scenarios were prepared to represent the LDP in a forecast year of 2024 (the available forecast year from SRM12) as follows:

- **Without LDP** land-use development scenario. This includes completed and committed development up to 2024 only; and
- **With LDP** land-use development scenario. This 2024 scenario is representative of a build-out of all identified LDP development sites (i.e. those up to and including 2038).

Overview of the Approach to Modelling Land-Use Changes

3.2.6 The LATIS/TELMoS models (which cover the whole of Scotland) were used to prepare initial land use and travel demand information for input to the East Lothian LDP (ELLDP) travel demand forecasts within SRM12.

3.2.7 The SESplan Cross-boundary Appraisal forecast land-use scenarios 2024 LA and 2024 LB were used as the basis of the ELLDP forecasts. This includes a recent consideration of developments across the entire SESplan area. However, the data reflecting the ELLDP in that modelling has changed with respect to the predicted uptake of development as defined by LATIS/TELMoS. It was therefore necessary to remove all of the East Lothian development from the TELMoS starting scenario and update it with the ELLDP forecast assumptions noted in this document. This approach ensures that the resulting model inputs match the current ELLDP. These were then nested within the aforementioned LATIS/TELMoS scenario (Note that we have not rerun the full LATIS/TELMoS process to create a full new Scotland-wide land-use scenario[1]).

3.2.8 General assumptions regarding housing development, population and employment in the rest of the SESplan area (and beyond) remain as per the SRM cross-boundary TELMoS scenario which formed the starting point for this study.

[1] The TELMoS model does not necessarily fulfil all housing or employment land allocations, as it is constrained by the total Scotland-wide economic and demographic scenario.

Housing Developments Assumed within the 2024 ELLDP

3.2.9 Table 3.1 provides a summary of the allocated housing developments to be assumed within the ELLDP scenario by area.

Table 3.1 ELLDP Housing Developments Summary – Modelled Number of Households

Location	2012 Base Year	2024 Without LDP (versus 2012 Base)			2024 With LDP (versus 2012 Base)		
East Lothian Rural	4,461	4,837	376	*8%*	5,232	771	*17%*
Musselburgh & Wallyford	9,849	12,499	2,650	*27%*	15,614	5,765	*59%*
Tranent	7,315	7,554	239	*3%*	8,491	1,176	*16%*
Prestonpans & Port Seton	8,136	8,340	204	*3%*	8,870	734	*9%*
Haddington	4,492	5,861	1,369	*30%*	6,136	1,644	*37%*
North Berwick	4,771	5,550	779	*16%*	5,875	1,104	*23%*
Dunbar	3,960	4,841	881	*22%*	5,495	1,535	*39%*
Blindwells	0	0	0	-	1,600	1,600	-
ELC Total	**42,984**	**49,482**	**6,498**	***15%***	**57,313**	**14,329**	***33%***
Rest of SRM	686,471	784,566	98,095	*14%*	784,566	98,095	*14%*
SRM Total	729,455	834,048	104,593	*14%*	841,879	112,424	*15%*

3.2.10 The housing figures have been allocated to SRM zones, including greenfield zones, based on the development locations. Where developments are split across two zones, the number of households has been estimated based on the site boundary and consideration of the anticipated loading of trips on the transport network.

Population Projections

3.2.11 Forecast population figures have been estimated based on the TELMoS household size for East Lothian at SRM12 zonal level. It should be noted that this generally predicts a reduction in the number of persons in each household in East Lothian over time. In some locations where there is only a slight increase in households this can lead to a net reduction in population compared with the 2012 Base.

Table 3.2 ELLDP Housing Developments Summary – Modelled Population

Location	2012 Base Year	2024 Without LDP (versus 2012 Base)			2024 With LDP (versus 2012 Base)		
East Lothian Rural	10,129	9,684	-446	*-4%*	10,298	168	*2%*
Musselburgh & Wallyford	21,866	24,591	2,724	*12%*	29,847	7,981	*36%*
Tranent	17,064	16,327	-737	*-4%*	18,022	958	*6%*
Prestonpans & Port Seton	19,182	18,533	-649	*-3%*	18,787	-395	*-2%*
Haddington	9,905	10,921	1,016	*10%*	11,412	1,507	*15%*
North Berwick	10,809	11,030	221	*2%*	11,642	833	*8%*
Dunbar	9,224	11,279	2,055	*22%*	12,847	3,623	*39%*
Blindwells	0	0	0	-	2,599	2,599	-
ELC Total	**98,180**	**102,364**	**4,185**	***4%***	**115,454**	**17,274**	***18%***
Rest of SRM	1,496,518	1,612,718	116,199	*8%*	1,612,718	116,199	*8%*
SRM Total	1,594,698	1,715,082	120,384	*8%*	1,728,172	133,474	*8%*

Employment Locations Assumed with the 2024 ELLDP Scenario

3.2.12 The following series of tables summarises the assumed employment site development in each forecast scenario and the associated estimated number of jobs. When the modelling was undertaken, there was no information relating to the phased introduction and uptake of employment and no information relating to industry sector. Therefore, it was decided that the model forecasts assume a full build-out by the 2024 model year. These figures were allocated to SRM zones based on the development locations. Where developments are split across two zones the number of jobs was estimated based on the site boundary.

3.2.13 In liaison with ELC, assumptions have been applied to estimate the number of jobs associated with the employment sites. Table 3.3 provides a summary of the number of jobs by area and indicates a total of 13,545 additional jobs by 2024 for the With LDP scenario compared with the base year.

Table 3.3 LDP Economic Developments – Modelled Number of Jobs

Location	2012 Base Year	2024 Without LDP (versus 2012 Base)			2024 With LDP (versus 2012 Base)		
East Lothian Rural	1,232	1,421	189	*15%*	1,489	257	*21%*
Musselburgh & Wallyford	6,322	8,701	2,380	*38%*	12,535	6,213	*98%*
Tranent	3,938	6,037	2,099	*53%*	7,630	3,692	*94%*
Prestonpans & Port Seton	2,225	2,489	264	*12%*	2,600	375	*17%*
Haddington	4,192	4,797	606	*14%*	5,242	1,050	*25%*
North Berwick	2,791	2,832	41	*1%*	2,915	124	*4%*
Dunbar	2,618	2,825	208	*8%*	4,025	1,408	*54%*
Blindwells	0	0	0	-	426	426	-
ELC Total	**23,317**	**29,102**	**5,785**	***25%***	**36,862**	**13,545**	***58%***
Rest of SRM	641,439	720,090	78,651	*12%*	720,090	78,651	*12%*
SRM Total	664,756	749,192	84,436	*13%*	756,952	92,196	*14%*

3.3 Transport Infrastructure

3.3.1 *Information Note 2 – Definition of Appraisal Forecasts* (PBA, May 2016) provides a definition of a set of transport assumptions which form the basis of LDP appraisal, detailing the main changes to the road and public networks which are assumed to have been introduced following the model base year, 2012.

3.3.2 The same transport network has been used as the basis for modelling each land use scenario. Further model tests were then undertaken to assess potential mitigation interventions that may be required to support the LDP.

3.3.3 The following committed **road schemes** are assumed within the 2024 SRM12 road network:

- Forth Replacement Crossing – Connecting to M90 and M9 Spur; and
- M8 Heartlands – Extra Junction on the M8.

3.3.4 The following constructed (post 2012) or committed **public transport schemes** were assumed within the 2024 SRM public transport model:

- North Berwick Rail Line Capacity Enhancements – increased capacity on rail services to/from North Berwick with introduction of 6-car sets rolling stock;
- East Coast Mainline Timetable Changes – changes to service frequencies and stopping patterns (implemented 2013);
- Edinburgh Tram – new tramline between Edinburgh city centre and Edinburgh airport (opened 2014);
- Borders Railway – rail line between Tweedbank & Edinburgh. 2tph throughout the day with park and ride provision at each rail station (opened 2015);
- Edinburgh Gateway Station – new station at Gogar served by Fife Circles and connection with Edinburgh TRAM; and

- Edinburgh-Glasgow Improvement Project (EGIP) Phase 1 – increased capacity, 5-8 minute journey time reduction between Edinburgh and Glasgow. Journey time improvements on various services to Stirling, Aberdeen, Bathgate and Falkirk.

3.4 Summary of Model Scenarios

3.4.1 In summary, the following model scenarios were prepared:

2024 Without LDP

- **Land-Use and Travel Demand** – 2012 base year land-use, plus constructed and committed future housing and employment land allocations.
- **Infrastructure** – validated 2012 network plus committed infrastructure.

2024 With LDP

- **Land-Use and Travel Demand** – 2024 Without LDP, plus build-out of all identified LDP housing and employment land allocations.
- **Infrastructure** – validated 2012 network plus committed infrastructure.

4 TRAVEL DEMAND FORECASTS

4.1 Introduction

4.1.1 This section describes the forecast travel demand and network impacts predicted from the SRM.

4.2 Trip Origins and Destinations

4.2.1 The forecast number of car and public transport trips in terms of total productions and attractions by sector is shown in Table 4.1 and Table 4.2, respectively, presented as a 12-hour total. Inspection of these tables reveals an increase in trips in the majority of areas within East Lothian, which is in line with the land-use forecasts, particularly the population projections which drive the travel demand forecasting procedures in SRM12.

Table 4.1 Summary 12 hour Trip Productions

Sector	2012 Base	2024 Without LDP (versus 2012 Base)			2024 With LDP (versus 2024 Without LDP)		
East Lothian Rural	12,001	11,645	-356	-3%	13,049	1,404	12%
Musselburgh & Wallyford	44,555	47,831	3,277	7%	55,979	8,147	17%
Tranent	16,803	17,476	673	4%	22,703	5,228	30%
Prestonpans	21,136	20,461	-676	-3%	21,594	1,134	6%
Haddington	14,046	14,334	287	2%	15,795	1,461	10%
North Berwick	16,339	15,154	-1,185	-7%	16,591	1,436	9%
Dunbar	10,834	13,592	2,758	25%	16,094	2,502	18%
Blindwells	88	84	-4	-5%	2,583	2,500	2990%
ELC Total	**135,802**	**140,576**	**4,774**	**4%**	**164,388**	**23,812**	**17%**

Table 4.2 Summary 12 hour Trip Attractions

Sector	2012 Base	2024 Without LDP (versus 2012 Base)			2024 With LDP (versus 2024 Without LDP)		
East Lothian Rural	12,375	12,056	-319	-3%	13,506	1,450	12%
Musselburgh & Wallyford	44,402	47,693	3,292	7%	56,304	8,611	18%
Tranent	16,954	17,794	840	5%	23,389	5,595	31%
Prestonpans	21,585	20,824	-762	-4%	21,989	1,165	6%
Haddington	14,084	14,555	471	3%	16,163	1,608	11%
North Berwick	16,369	15,277	-1,093	-7%	16,674	1,397	9%
Dunbar	10,873	13,526	2,653	24%	16,159	2,634	19%
Blindwells	88	83	-4	-5%	2,994	2,910	3493%
ELC Total	**136,730**	**141,807**	**5,078**	**4%**	**167,178**	**25,370**	**18%**

4.2.2 Figure 4.1 shows the modelled public transport mode share, expressed as a percentage for each defined sector, for each scenario. It should be noted that this excludes non-motorised modes, which are not modelled in SRM. This shows a reduction in public transport mode share in most areas comparing the 2024 Without LDP scenario with the 2012 Base. This could be due to increasing car ownership, the availability of PT services at development sites or capacity restraint on the rail network that may limit future growth in rail travel demand, which is considered in the following Section of this Note. Comparing the 2024 With LDP scenario versus the 2024 Without LDP scenario indicates smaller differences with Musselburgh and Wallyford indicating a more notable drop in PT mode share of around 1 percentage point, which is where rail service crowding is greatest.

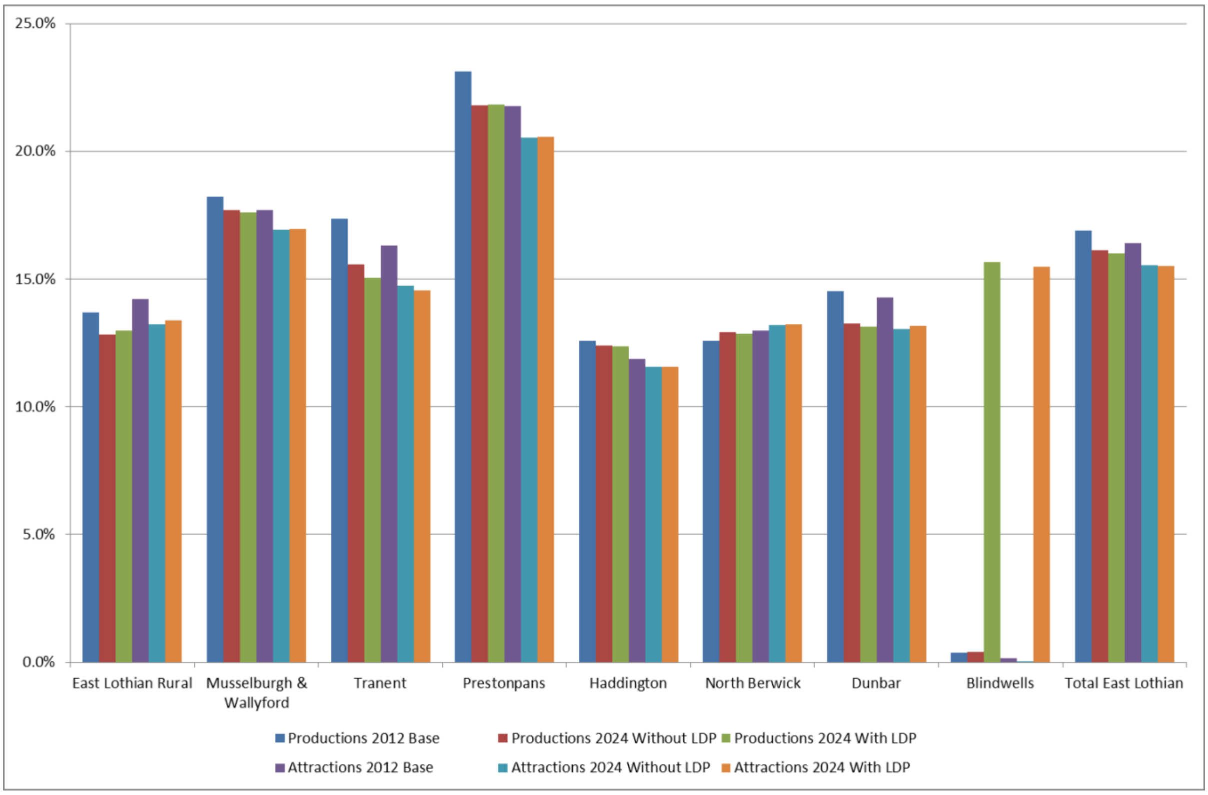

Figure 4.1 Public Transport Mode Share

4.3 Travel Demand on Network

4.3.1 Total vehicle distance, in kilometres, in each sector area for each scenario is shown in Table 4.3 for the AM peak hour. This shows an increase in vehicle distance that correlates with the increase in travel demand associated with ELLDP development sites.

Table 4.3 Vehicle Distance (AM Peak Hour, Kilometres)

Sector	2012 Base	2024 Without LDP (versus 2012 Base)			2024 With LDP (versus 2024 Without LDP)		
East Lothian Rural	34,121	41,635	7,514	**+22%**	45,860	4,225	**+10%**
Musselburgh & Wallyford	38,190	46,782	8,592	**+22%**	53,271	6,489	**+14%**
Tranent	15,859	20,966	5,107	**+32%**	26,483	5,517	**+26%**
Prestonpans	31,950	36,597	4,647	**+15%**	39,932	3,335	**+9%**
Haddington	23,835	32,805	8,970	**+38%**	37,147	4,342	**+13%**
North Berwick	8,540	9,348	808	**+9%**	9,837	489	**+5%**
Dunbar	11,194	17,890	6,696	**+60%**	19,518	1,628	**+9%**
Blindwells	5,329	5,729	400	**+8%**	5,976	247	**+4%**
ELC Total	169,018	211,752	42,734	**+25%**	238,024	26,272	**+12%**

4.3.2 Total public transport based distance, in kilometres, for each scenario is shown in Table 4.4 for the AM peak hour. This shows an increase in passenger distance that correlates with the increase in travel demand associated with ELLDP development sites.

Table 4.4 Passenger Distance (AM Peak Hour, Kilometres)

Sector	2012 Base	2024 Without LDP (versus 2012 Base)			2024 With LDP (versus 2024 Without LDP)		
East Lothian Rural	2,622	2,689	67	**+3%**	3,013	324	**+12%**
Musselburgh & Wallyford	8,585	8,882	297	**+3%**	10,362	1,480	**+17%**
Tranent	2,534	2,786	252	**+10%**	3,361	575	**+21%**
Prestonpans	5,996	5,956	-40	**-1%**	7,088	1,132	**+19%**
Haddington	2,149	3,593	1,444	**+67%**	3,916	323	**+9%**
North Berwick	586	667	81	**+14%**	742	75	**+11%**
Dunbar	1,985	2,356	371	**+19%**	2,453	97	**+4%**
Blindwells	157	151	-6	**-4%**	204	53	**+35%**
ELC Total	24,614	27,080	2,466	**+10%**	31,139	4,059	**+15%**

5 ELLDP NETWORK IMPACTS AND MITIGATION

5.1 Introduction

5.1.1 This Section describes the impact of the change in travel demand associated with the ELLDP on the modelled transport network.

5.1.2 Analysis of the SRM outputs highlighted the following network locations where the SRM outputs suggest capacity and performance issues related to the additional trips generated by the LDP development.

- **Road Network**
  - A1 QMU Interchange
  - A1 Old Craighall Interchange
  - A1 Bankton Interchange
  - Musselburgh Town
  - Tranent Town
- **Rail Network**
  - Musselburgh Rail Station and Wallyford Rail Station
  - Prestonpans Rail Station, Longniddry Rail Station and Drem Rail Station
  - New Rail Station north of Blindwells

5.1.3 It should be noted that the SRM is a strategic model with an aggregated representation of the network. Therefore, there are some locations where the SRM does not provide the level of detail required to fully assess ELLDP impacts and associated mitigation requirements. This is highlighted where relevant in the network assessment below.

5.1.4 In particular issues could be anticipated at the A1 Salters Road, A1 Wallyford, and A1 Bankton intersections, which are not all highlighted in SRM due to the complex nature of traffic routing and associated network impacts in this part of the network. Therefore, in order to provide a robust assessment of ELLDP impacts and supporting intervention requirements local junction assessments were undertaken at these locations. Similarly the SRM does not include a detailed representation of Musselburgh and Tranent town centres and micro-simulation traffic modelling was used to look at the operation of the local road network in more detail.

5.2 Potential Mitigation Interventions

5.2.1 The network impacts were considered alongside the short-list of potential mitigation interventions that had previously been prepared based on anticipated ELLDP impacts. The SRM analysis has not revealed any additional locations where mitigation is required. In addition, there were some mitigation interventions where the SRM analysis indicated that these may not be required.

5.2.2 The potential interventions to mitigate impacts are discussed below. Where relevant, average queue lengths, in PCUs, are presented graphically to highlight issues on the road network. It should be noted that the modelled average queues do not represent maximum queues, which would be expected to be longer and would vary depending on the profile of traffic demand. Therefore, the strategic model average queues should be used as an indicator of network ‘hotspots’ rather than absolute predictions of worst case queuing. Forecast passenger demand and equivalent capacities are considered on the rail network to highlight possible crowding issues.

5.3 SRM Trip Rates

5.3.1 The SRM has an implied set of trip rates within all zones, and as such trip making relating to new development is broadly in line with the respective zones into which they are allocated. However, on analysing the outputs of the initial LDP scenario, it was apparent that the absolute level of trips generated and attracted was not of the order which would be expected from some of the developments. This could be partly explained by the application of future year household densities from TELMoS, which may underestimate ELLDP population growth at some locations.

5.3.2 Given these concerns with respect to the inferred trip rates it was considered prudent to undertake a further test with forecast travel demand adjusted to be more in-line with TRICS to provide more confidence in the assessment of network impacts and mitigation requirements. Adjustments were made to zones with 100 or more ELLDP new dwellings/jobs. The development travel demand for the Without LDP scenario was unaltered. Some of the key sites within these zones included:

- Blindwells;
- Craighall, northwest and southwest of QMU;
- Old Craighall Junction; and
- Sites south of Tranent.

5.3.3 The results of this test were considered a more likely reflection of the transport network impacts at this stage. Therefore, this scenario formed the basis for the discussion below, with comparison made against the Without LDP scenario.

5.4 Road Network

A1 QMU Interchange

Relevant Development	Employment associated with the Craighall development northwest of QMU.
Impacts	Employment at this location attracts new trips during the AM peak hour, and generates additional trips in the PM peak hour.
Network Operation	The existing QMU junction is predicted to accommodate ELLDP traffic in all modelled time periods, however, there is congestion on A1 Old Craighall junction, as shown in Figure 5.1 below. This is due to the considerable volume of ELLDP traffic where westbound trips exiting from QMU currently need to travel via Old Craighall.
Suggested Mitigation	A1 QMU All-Ways Interchange
Mitigation Effects	The addition of westbound slips would remove a significant volume of traffic from the eastbound A1 and Old Craighall junction, alleviating congestion.
Mitigation Required	Yes

A1 Old Craighall Interchange

Relevant Development	The strategically important location of Old Craighall junction, forming the interchange between the A1 and A720, is likely to experience traffic from the majority of ELLDP developments across East Lothian.
Impacts	The additional ELLDP trips are expected to add pressure to this key interchange, which is already congested.
Network Operation	Old Craighall junction exhibits some congestion issues in the base year, which get considerably worse under the Without LDP scenario and are then exacerbated by the additional ELLDP traffic. All approaches to the junction are heavily congested in both the With and Without LDP scenarios, as shown in the figures below. The average queue lengths increase considerably as a result of additional traffic coming from QMU.
Suggested Mitigation	A1 Old Craighall Interchange — Signal Control
Mitigation Effects	Signalising and enlarging of the roundabout would provide more efficient operation and increase effective capacity. Testing of this potential intervention is required to quantify the extent to which this intervention can successfully handle the additional traffic generated by the LDP. Whilst this can be assessed within SRM to an extent, the local micro-simulation model would be required for a full assessment where there are complex vehicle interactions.
Mitigation Required	Yes

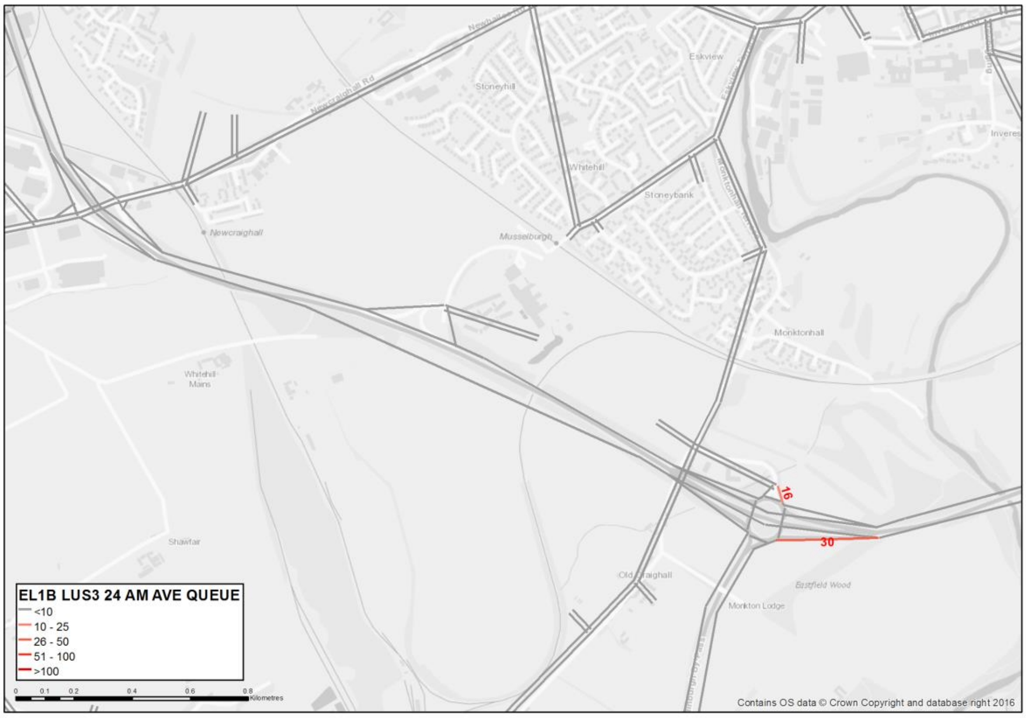

Figure 5.1 Average Queues (PCUs) at A1 Old Craighall Junction – Without LDP Scenario – AM Peak Hour

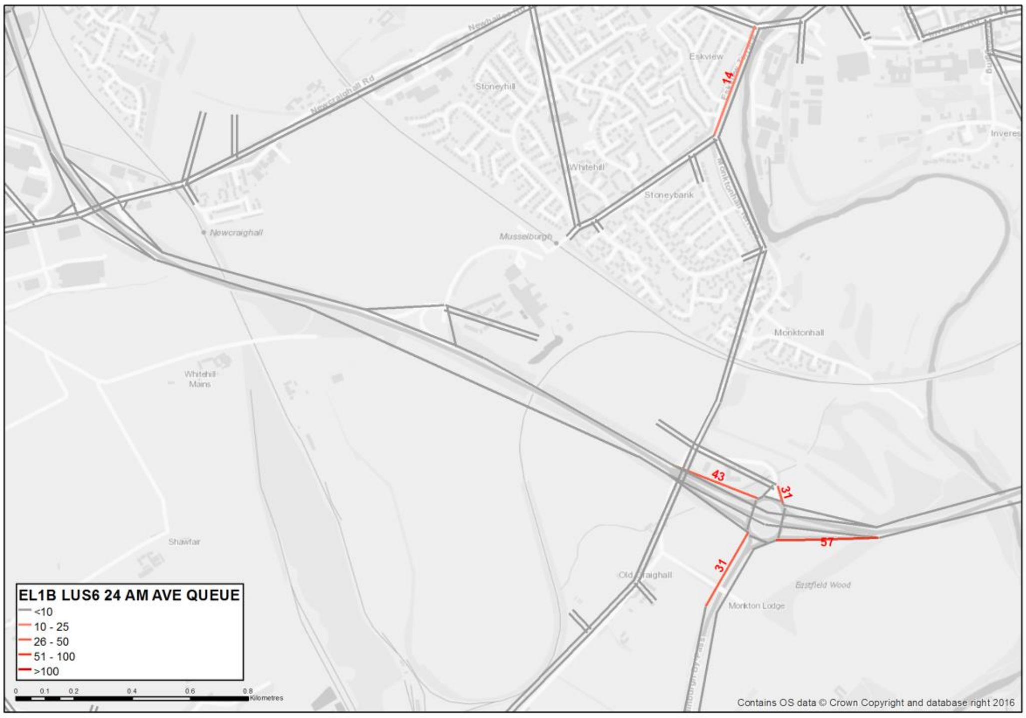

Figure 5.2 Average Queues (PCUs) at A1 Old Craighall Junction – With LDP Scenario – AM Peak Hour

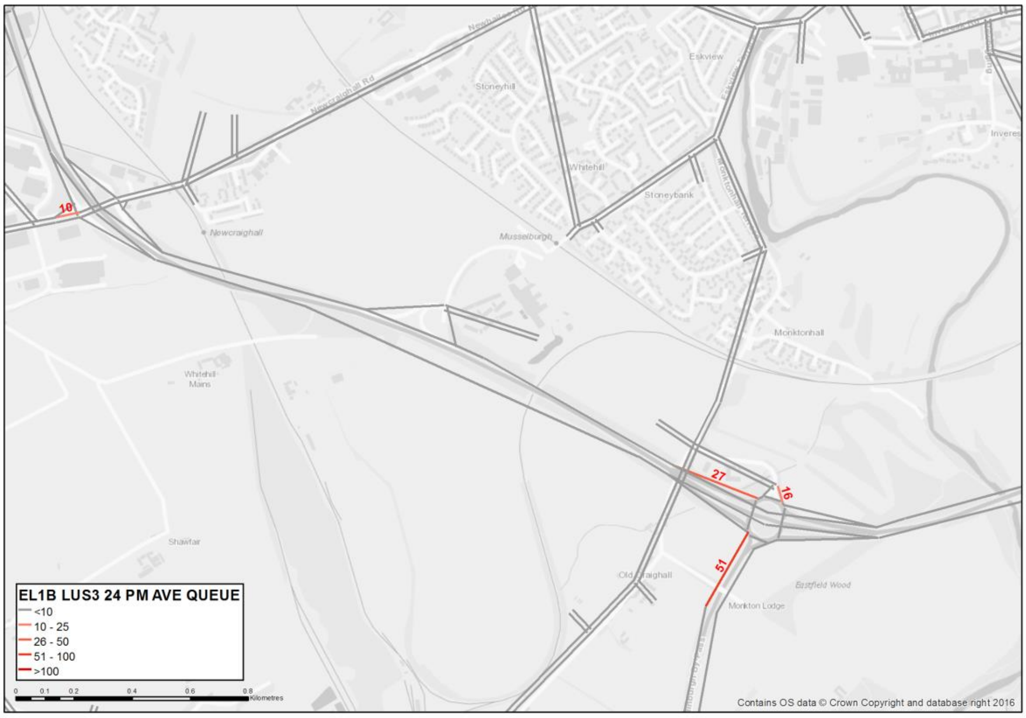

Figure 5.3 Average Queues (PCUs) at A1 Old Craighall Junction – Without LDP Scenario – PM Peak Hour

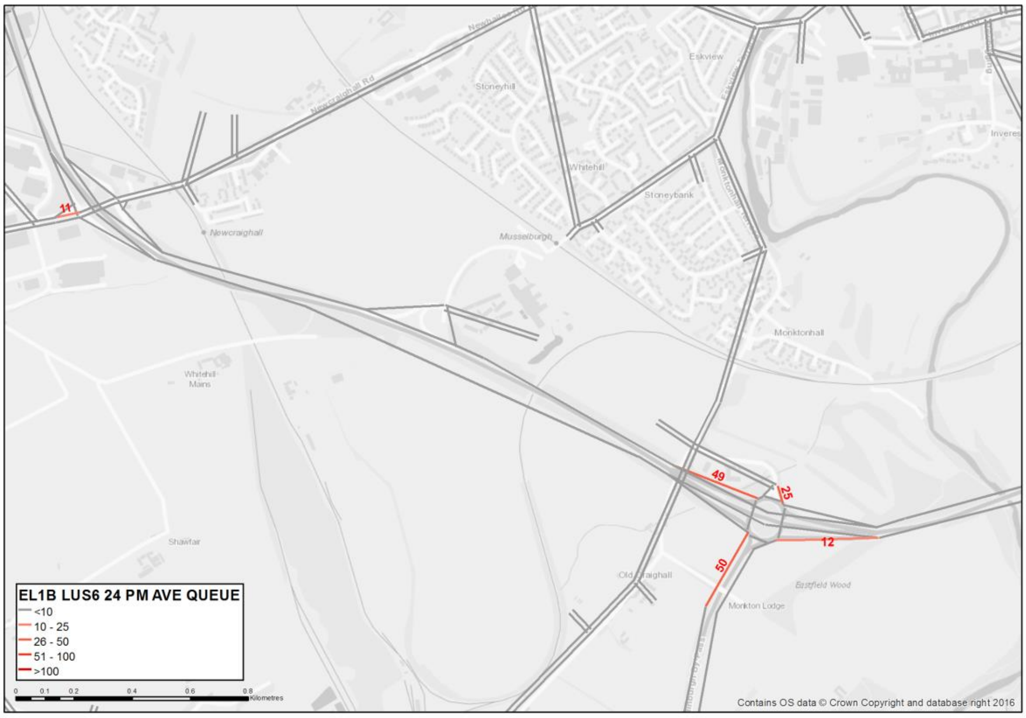

Figure 5.4 Average Queues (PCUs) at A1 Old Craighall Junction – With LDP Scenario – PM Peak Hour

A1 Bankton Interchange

Relevant Development	Residential and employment at Blindwells and developments around Tranent.
Impacts	The Blindwells development is expected to generate approximately 500 additional trips in the AM peak, as well as attract around 250 trips to employment there. The PM broadly reverses this pattern. Developments around Tranent also result in extra traffic.
Network Operation	The existing junction shows no significant issues in the Without LDP scenario, although there is some queuing on the eastbound off slip in the PM. The addition of circulatory traffic to/from Blindwells has the effect of significantly reducing stopline capacity for approaches to the south dumbbell from Tranent. The eastbound off slip also reaches capacity in the PM peak, due to conflicting movements on the north dumbbell, resulting in moderate queue lengths, shown in Figure 5.5 below.
Suggested Mitigation	A1 Bankton Interchange
Mitigation Effects	The full mitigation intervention would increase capacity at both northern and southern dumbbells by redesigning and signalising the roundabouts. The modelling results do not suggest problems sufficient enough to justify this intervention, although further development at Blindwells beyond the initial phase is likely to result in the junction having significant capacity issues.
Mitigation Required	Detailed modelling to confirm intervention requirements

5.4.1 There is also a requirement to consider the impact of a full build-out of Blindwells, with a total of 6,000 new dwellings, which are being proposed as safe-guarded sites in the ELLDP. A sensitivity test will be undertaken to support the ELLDP Appraisal to consider the impact on the transport network and the effectiveness of mitigation measures with additional travel demand. It is anticipated that this will identify the need for mitigation at Bankton junction, as a minimum, with possible requirement for enhancement of the A198 and Meadowmill Roundabout as well.

Figure 5.5 Average Queues (PCUs) at A1 Bankton Junction – With LDP Scenario – PM Peak Hour

Musselburgh Town

Relevant Development	Residential and employment developments in and around Musselburgh and Wallyford.
Impacts	Additional traffic generated by these developments will add to congestion in Musselburgh town centre.
Network Operation	The network detail in the strategic SRM model is not sufficient to accurately analyse the local traffic impacts within Musselburgh; and local microsimulation traffic modelling is required. However, high level analysis in SRM suggests that there could be some congestion issues in both the AM and PM LDP scenario on Eskview Terrace and at the High Street/Bridge Street junction, as shown in the figures below.
Suggested Mitigation	Inveresk Road, Musselburgh Whitehill Farm Road Link Road, Musselburgh Town Centre One-Way Gyratory, Musselburgh Bus Stop Relocations on High Street, Musselburgh
Mitigation Effects	The interventions would be expected to help alleviate congestion issues in the town, with the one-way gyratory expected to create a more efficient traffic flow; however, there is insufficient local detail in SRM to fully assess this.
Mitigation Required	Detailed modelling to confirm intervention requirements

Figure 5.6 Average Queues (PCUs) in Musselburgh Town Centre – With LDP Scenario – PM Peak Hour

Figure 5.7 Average Queues (PCUs) in Musselburgh Town Centre – With LDP Scenario – PM Peak Hour

Tranent Town

Relevant Development	Residential and employment developments in and around Tranent, with the Blindwells development nearby.
Impacts	Additional traffic generated by these developments will add to congestion in Tranent town centre.
Network Operation	The network detail in the strategic SRM model is not sufficient to accurately analyse the local traffic impacts within Tranent; and local microsimulation traffic modelling is required. However, high level analysis in SRM suggests minor congestion at the Bridge Street/Church Street roundabout in the AM and PM Without LDP scenario is exacerbated by additional LDP traffic, as shown in the figures below.
Suggested Mitigation	One Way Operation of New Row, Tranent Bridge Street/Church Street Junction, Tranent Tranent One Way System at High Street and Loch Road
Mitigation Effects	The interventions would be expected to help alleviate congestion issues in the town, in particular at the Bridge Street/Church Street roundabout; however, there is insufficient local detail in SRM to fully assess this.
Mitigation Required	Detailed modelling to confirm intervention requirements

Figure 5.8 Average Queues (PCUs) in Tranent Town Centre – With LDP Scenario – AM Peak Hour

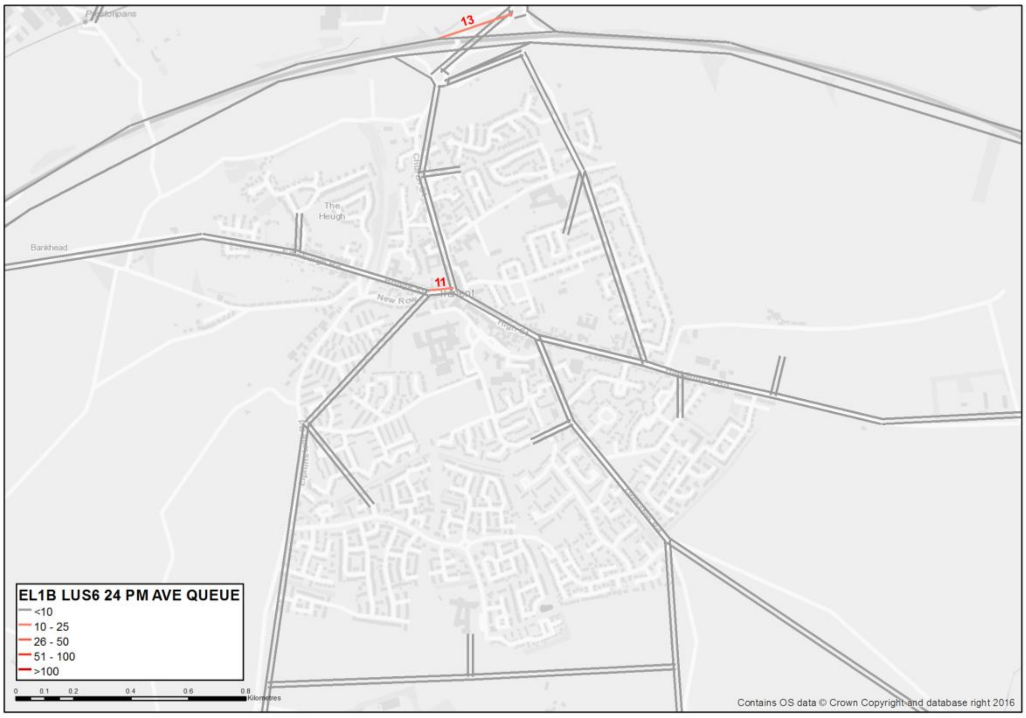

Figure 5.9 Average Queues (PCUs) in Tranent Town Centre – With LDP Scenario – PM Peak Hour

5.5 Public Transport Network

5.5.1 Analysis of the impacts on the public transport network has been undertaken, in particular the local rail services along the ECML between Edinburgh and North Berwick. It should be noted that in the forecast year scenarios, services are assumed to be operated by 6-car trains in line with current plans as per the defined Reference Case.

5.5.2 There is evidence that lack of capacity on the rail network is constraining the growth in PT travel which results in the PT mode share in East Lothian decreasing slightly between the base year and forecast years by approximately 1 percentage point. The decrease is greatest in Musselburgh, Wallyford and Tranent, suggesting that despite the additional capacity provided by 6-car trains, it is not sufficient to meet future demand on the network during peak times.

Musselburgh Rail Station and Wallyford Rail Station

Relevant Development	A number of sites are within driving distance of the stations, which have substantial P&R facilities. The largest sites within walking distance are: ▪ Employment associated with the Craighall development northwest of QMU ▪ Residential at Dolphingstone ▪ Residential at Wallyford
Impacts	The residential and employment developments around Musselburgh and Wallyford result in a considerable number of additional PT trips, putting pressure on train capacities.
Network Operation	The 6-car services are shown to have very high load factors between Wallyford, Musselburgh and Edinburgh in both the With and Without LDP scenarios; this is focused on westbound services in the AM and eastbound services in the PM, reflecting commuting patterns. Some additional demand from the LDP scenario is likely supressed due to lack of capacity. The figures below show loadings in the Without LDP (LUS3) and With LDP (LUS6) scenarios.
Suggested Mitigation	Larger Trains & Platforms at Musselburgh and Wallyford Rail Stations
Mitigation Effects	Introducing 8-car trains, with associated platform extensions, would provide extra capacity on congested services, potentially encouraging more PT trips and as a result, reducing road traffic.
Mitigation Required	Yes

5.5.3 The figures below show train boardings and alightings at each of the stations along the North Berwick line as follows:

- Without LDP boardings (orange bar) and alightings (red bar)
- With LDP boardings (light blue bar) and alightings (dark blue bar)
- Without LDP loading on departure (red line with triangle markers)
- With LDP loading on departure (blue line with triangle markers)
- Seated capacities and crush capacities – square and circle marker series respectively

5.5.4 The graphs clearly show the seating capacity line being exceeded between Wallyford, Musselburgh and Edinburgh in both scenarios.

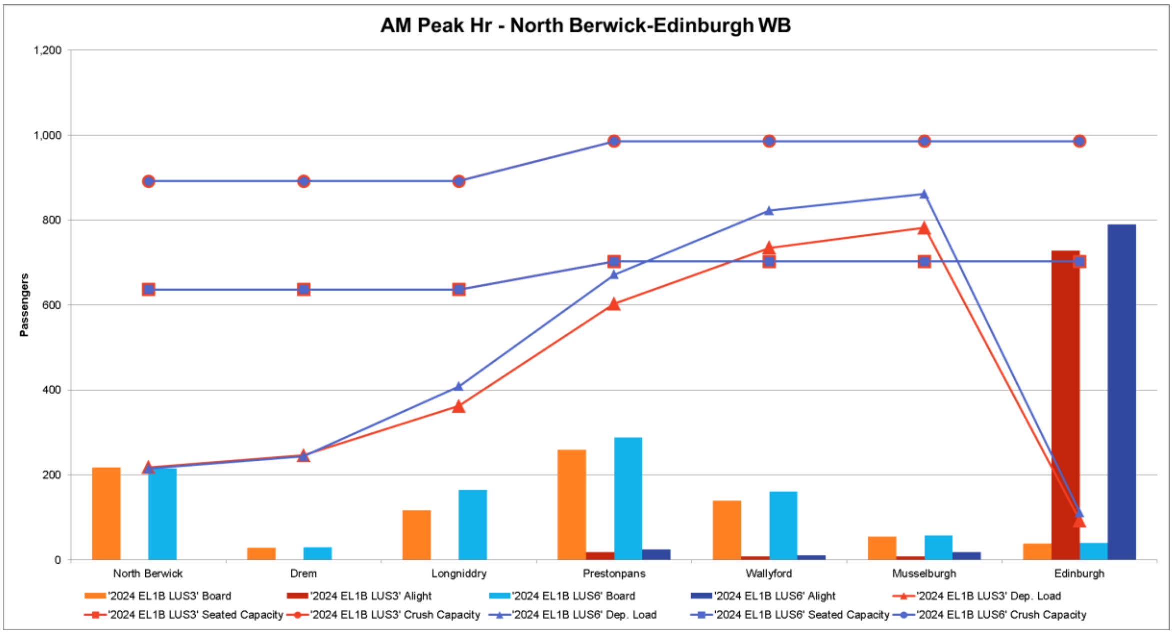

Figure 5.10 AM Westbound Rail Loadings

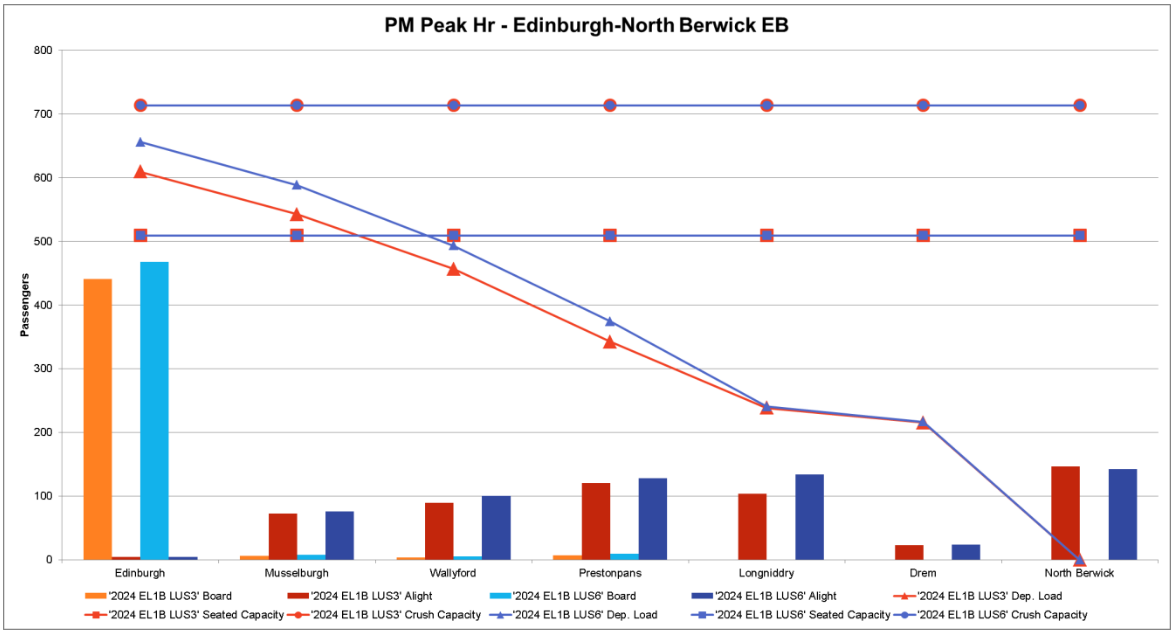

Figure 5.11 PM Eastbound Rail Loadings

Prestonpans Rail Station, Longniddry Rail Station and Drem Rail Station

Relevant Development	A number of sites east of Wallyford are within driving distance of the stations, which have P&R facilities.
Impacts	The residential and employment developments around Musselburgh and Wallyford result in a considerable number of additional PT trips, putting pressure on train capacities.
Network Operation	The 6-car services are shown to have very high load factors between Wallyford, Musselburgh and Edinburgh in both the With and Without LDP scenarios, although rail crowding is considerably less pronounced east of here. Examination of the modelled park and ride usage indicates that there is spare capacity, however, this is contrary to local anecdotal evidence and may be a function of the model validation.
Suggested Mitigation	Larger Trains & Platforms at Prestonpans Rail Station, Longniddry Rail Station, and Drem Rail Station Longniddry Rail Station Car Park and Drem Rail Station Car Park
Mitigation Effects	Introducing 8-car trains, with associated platform extensions would provide extra capacity on congested services; this would be required across the length of the line. Addition car parking could also be provided at Longniddry and Drem stations, however, this would need to be in conjunction with increase train capacities otherwise any increase in park and ride demand could exacerbate crowding issues potentially limiting public transport mode shift.
Mitigation required	Yes

New Rail Station North of Blindwells

Relevant Development	Residential and employment development at Blindwells.
Impacts	The large residential and employment development at Blindwells generates a considerable number of additional trips to and from the site. The lack of a rail station means the attractiveness of PT travel is considerably less than could be achieved with direct rail access.
Network Operation	The lack of direct rail access results in a high proportion of road based trips to/from the site, putting pressure on the road network. On the rail network, the 6-car services are shown to have very high load factors between Wallyford, Musselburgh and Edinburgh in both the With and Without LDP scenarios, although congestion is considerably less pronounced east of here; if 8-car trains were introduced, these capacity constraints would likely be relieved.
Suggested Mitigation	New Rail Station north of Blindwells and ECML Overbridge
Mitigation Effects	Constructing a station at Blindwells would give direct rail access for residents and employees at the site, reducing dependence on road based transport and the associated pressure on the road network. Introducing 8-car trains, with associated platform extensions, would provide considerable extra capacity on a very congested service; this would be required across the length of the line, and as such a new Blindwells station would also be designed to accommodate 8-car trains.
Mitigation required	Yes

5.6 Long-List of Interventions

5.6.1 Based on the network assessment described above, and analysis of other network locations undertaken, the full list of potential mitigation measures is presented in Table 5.1 below, in terms of observed network impacts under each scenario. The location of each mitigation measure, and the associated status, is shown in Figure 5.12 below. The issues have been scored as follows:

- ✘ Issue not identified
- 🔍 Issues that require more detailed modelling to confirm intervention requirements
- ✓ Issues identified with required intervention

5.6.2 The active travel mitigation interventions have been identified as required given the forecast increase in car trips associated with the ELLDP and the potential for enhanced active travel provision to reduce this.

Table 5.1 Mitigation Requirements Summary Table

Mitigation Option	Sufficient Detail in SRM?	2012 Base	2024 Without LDP	2024 With LDP
Musselburgh Town Centre Road Network	No	✗	🔍	🔍
A1 QMU All-Ways Interchange	Yes	✗	🔍	✓
A1 Dolphingstone Interchange	Yes	✗	🔍	🔍
A1 Wallyford (Salters Road) Interchange	Yes	✗	🔍	🔍
A1 Old Craighall Interchange — Signal Control	Yes	✓	✓	✓
Larger Trains & Platforms at Musselburgh and Wallyford Rail Stations	Yes	✓	✓	✓
A1 Bankton Interchange	Yes	✗	🔍	🔍
A198 Dualling north of Bankton Interchange without Rail Bridge	Yes	✗	✗	✗
A198 Enhance Meadowmill Roundabout	Yes	✗	✗	✗
Larger Trains & Platforms at Prestonpans Rail Station, Longniddry Rail Station, and Drem Rail Station	Yes	✗	✓	✓
Longniddry Rail Station Car Park and Drem Rail Station Car Park	Yes	✗	✓	✓
New Rail Station north of Blindwells and ECML Overbridge	Yes	✗	✗	✓
Tranent Town Centre Road Network	No	✗	🔍	🔍
Ashgrove Underpass, Dunbar	No	n/a	n/a	✓
Segregated Active Travel Corridor	No	n/a	n/a	✓

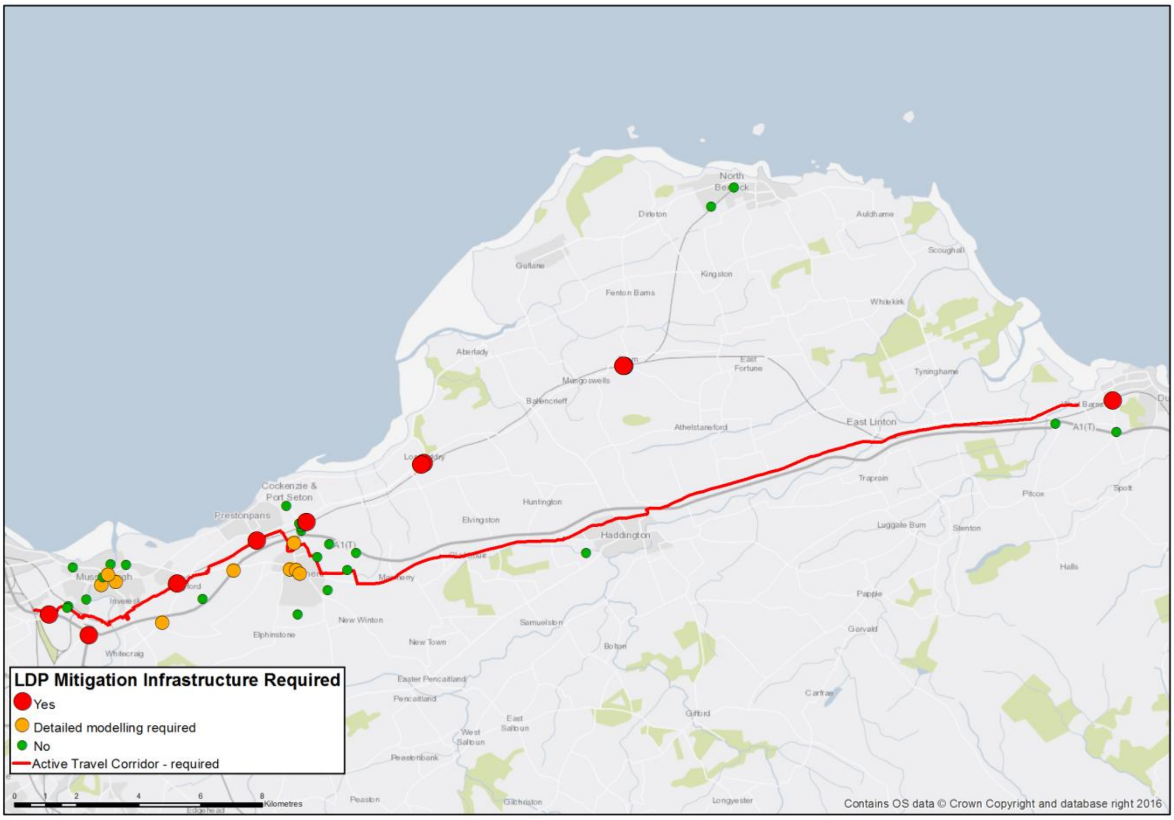

Figure 5.12 LDP Mitigation Requirements

5.7 Short-List Interventions Assessment

5.7.1 Following the long-list assessment and sifting, further modelling was undertaken to confirm and conceptually define the interventions to a stage suitable for inclusion in the ELLDP. As described above, where the SRM does not provide sufficient detail local traffic modelling or local junction assessments have been undertaken.

SEStran Regional Model Interventions Assessment

5.7.2 A mitigation assessment has been undertaken in SRM of the following interventions to review their effectiveness and refine scheme details:

- A1 QMU All-Ways Interchange;
- A1 Old Craighall Interchange — Signal Control of Roundabout;
- Larger Trains & Platforms on the North Berwick Line; and
- New Rail Station north of Blindwells.

5.7.3 Signal control at the A1 Old Craighall Interchange roundabout is predicted to enhance traffic management and reduce congestion and delay, as shown in Figure 5.13 to Figure 5.16. This location attracts traffic from locations across East Lothian and beyond and, therefore, the majority of ELLDP development allocations would be expected to have an impact on this junction. Therefore, it is recommended this intervention is included in the ELLDP interventions package.

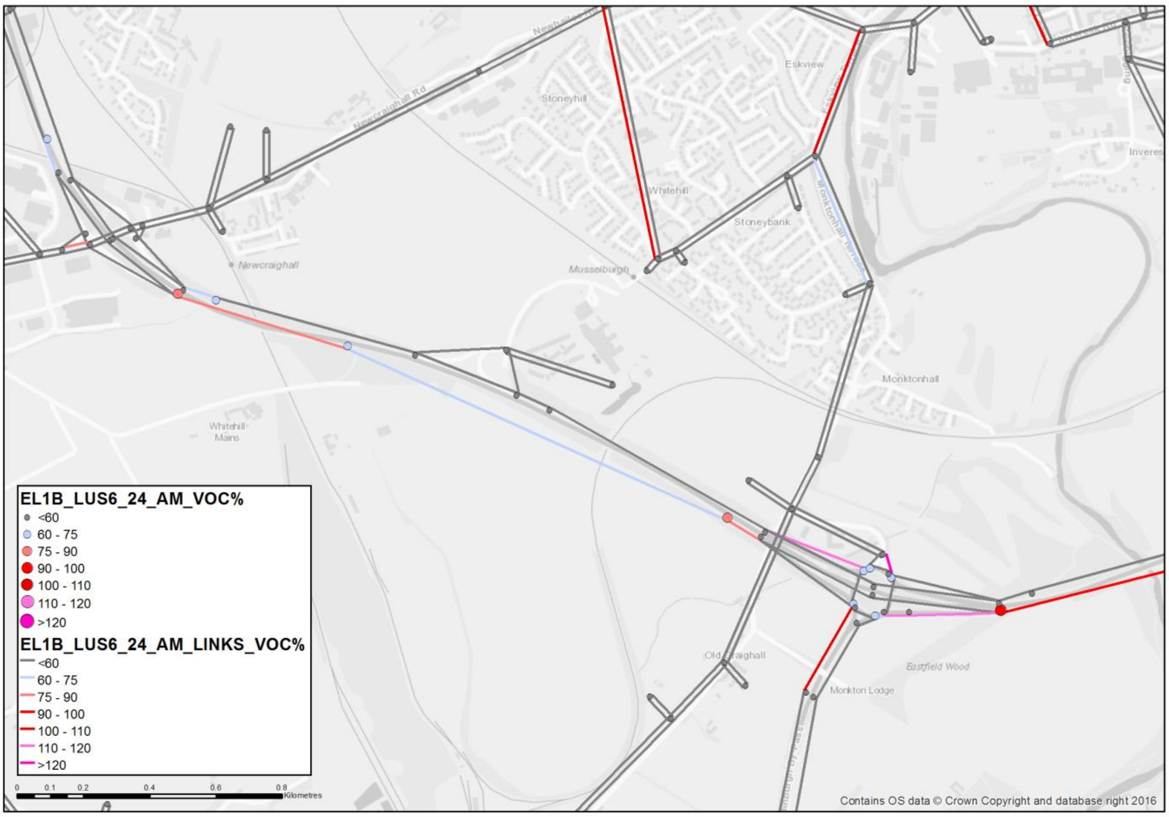

Figure 5.13 Old Craighall AM – LDP with no mitigation

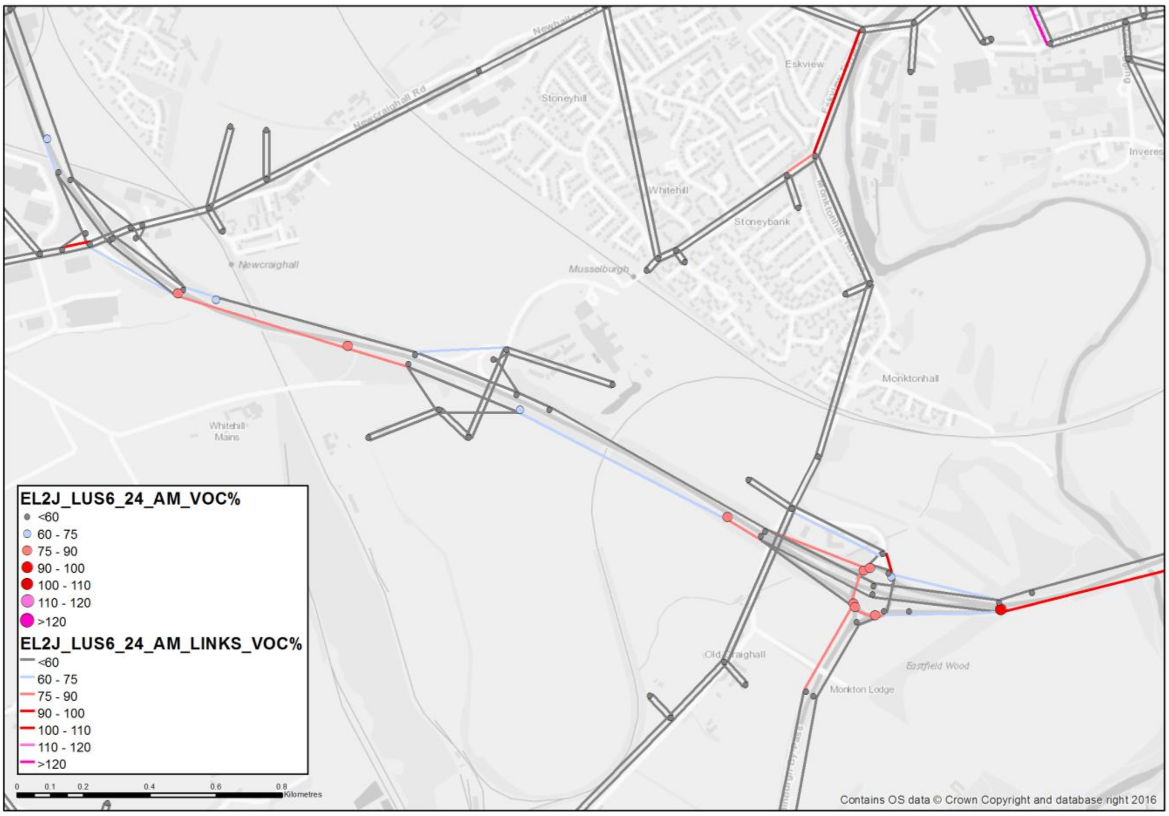

Figure 5.14 Old Craighall AM – LDP with mitigation

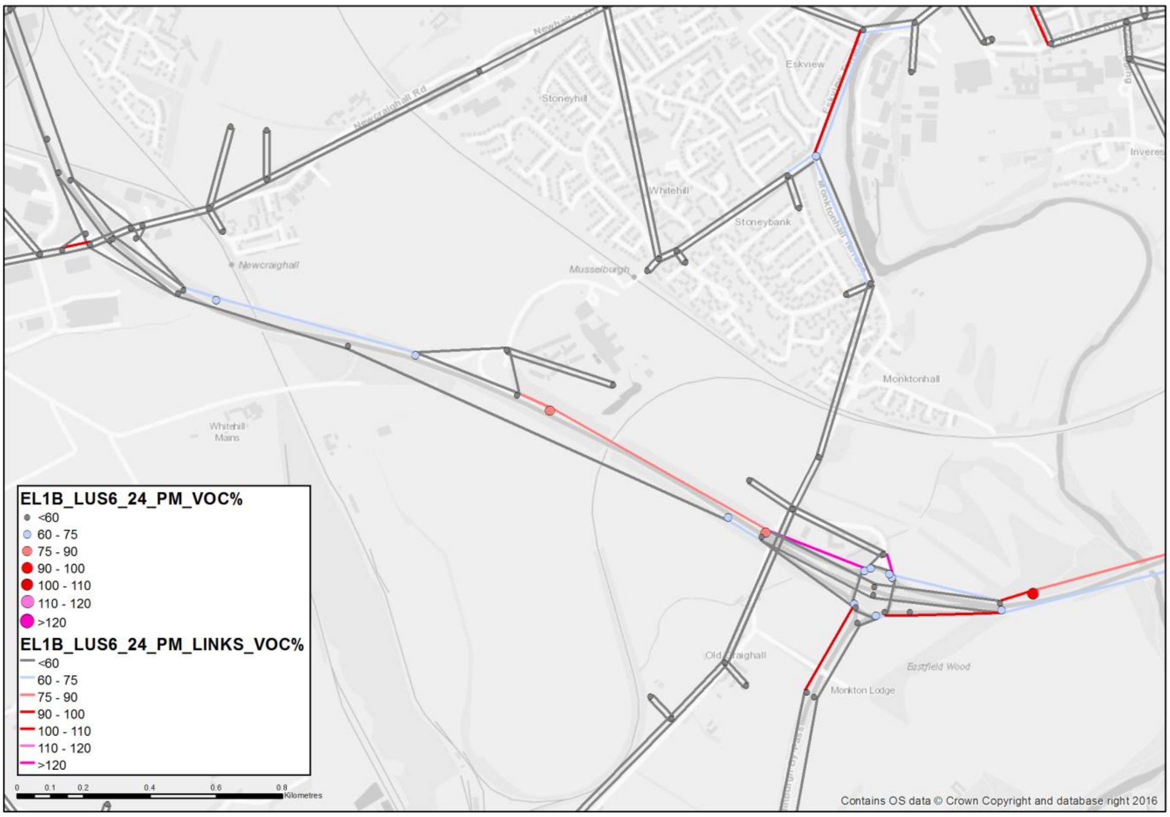

Figure 5.15 Old Craighall PM – LDP with no mitigation

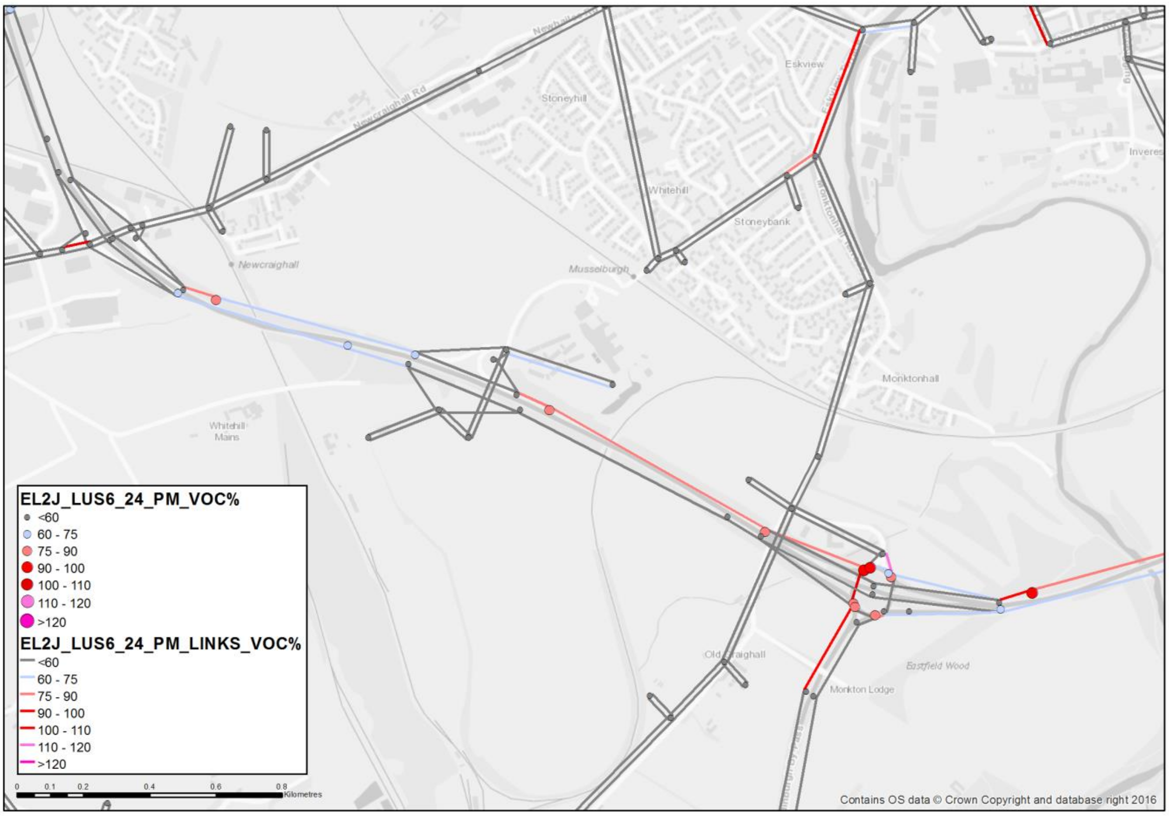

Figure 5.16 Old Craighall PM – LDP with mitigation

5.7.4 Analysis of the A1 QMU All-Ways Interchange intervention indicates that, while this has some positive impact on the operation of the A1 Old Craighall junction with the removal of u-turns, the significant impact is on trips to/from the QMU and Craighall development sites that would benefit directly from improved access to/from Edinburgh. Therefore, it is suggested this intervention is allocated to the immediately adjacent development sites and not included in the wider package of ELLDP interventions.

5.7.5 Analysis of the impact of providing larger trains and platforms on the Edinburgh to North Berwick rail line indicates this extra capacity reduces crowding, whilst attracting some additional demand, and mitigates ELLDP impacts. The blue lines representing loadings against seated and crush capacity under the 8-car trains scenario in Figure 5.17 and Figure 5.18 highlight the improved position in comparison to the no mitigation scenario (red lines).

5.7.6 This section of rail line attracts passenger from locations across East Lothian and beyond and, therefore, the majority of ELLDP development allocations would be expected to have an impact on crowding at Musselburgh. Therefore, it is recommended this intervention is included in the ELLDP interventions package. It should also be noted that the delivery of this intervention would be dependent on the support of Transport Scotland, Network Rail and/or ScotRail.

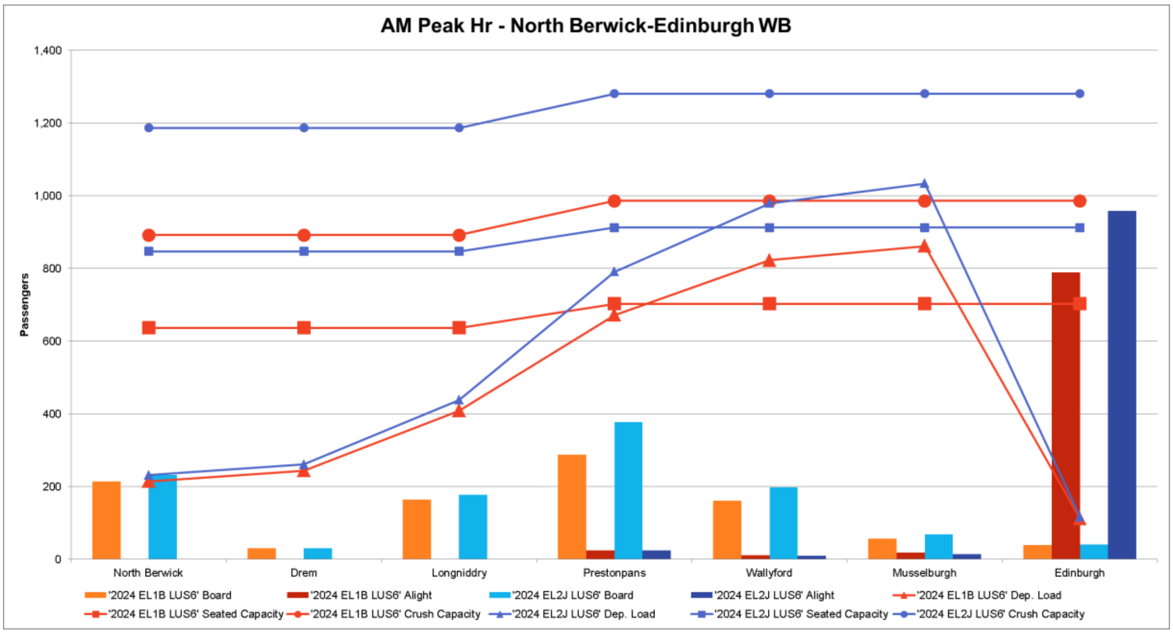

Figure 5.17 North Berwick Line Westbound AM – LDP without and with mitigation

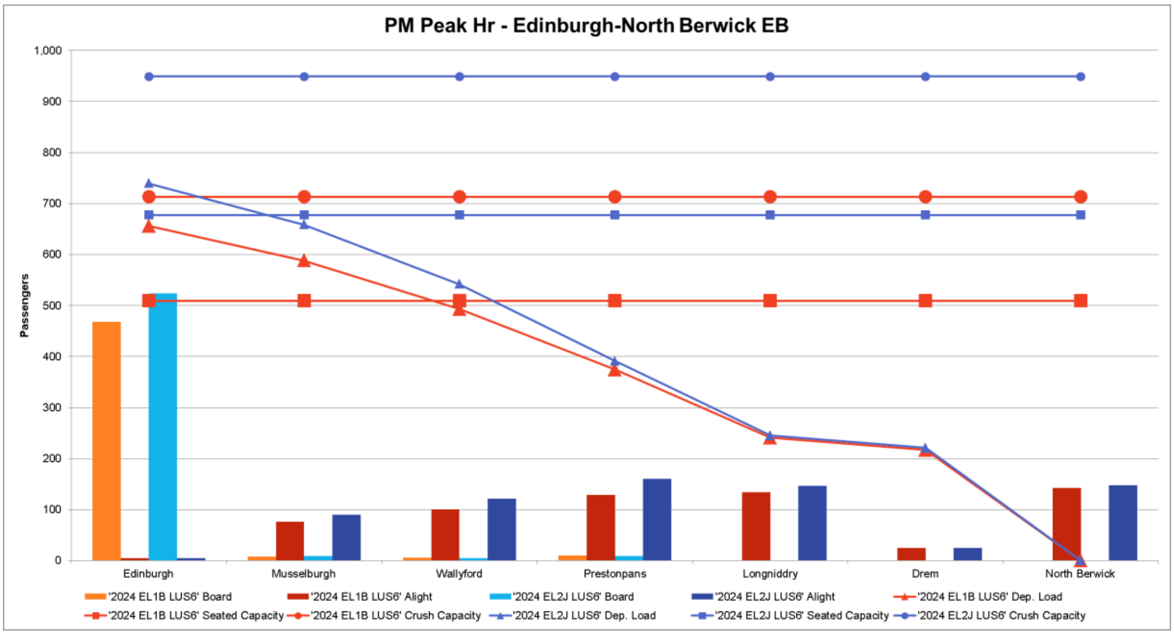

Figure 5.18 North Berwick Line Westbound PM – LDP without and with mitigation

5.7.7 Analysis of rail passenger trips at a new Blindwells rail station indicates this will principally be used by residents and employees at the Blindwells development site and will reduce car-based trips, a principle objective of the Transport Appraisal. It should also be noted that the delivery of this intervention would be dependent on the support of Transport Scotland, Network Rail and/or ScotRail. Therefore it has been included as aspiration within the ELLDP, with the new station intervention allocated to the Blindwells site.

Musselburgh and Tranent Traffic Model

5.7.8 Interventions in Musselburgh and Tranent town centres have been assessed using local sub area models extracted from the Musselburgh and Tranent Traffic Model. This assessment is presented in the Microsimulation Modelling - Musselburgh and Tranent LDP Mitigation Testing Note (SIAS, August 2016).

Local Junction Assessments

5.7.9 Local junction models have been prepared to consider potential mitigation interventions at the following locations where SRM was not considered to provide sufficient local detail:

- A1 Salters Road Interchange;
- A1 Dolphingstone Interchange; and
- A1 Bankton Interchange.

5.7.10 This assessment is reported in the ELLDP Mitigation Assessment – Local Junction Modelling – A1 Junctions Technical Note (PBA, August 2016).

Active Travel Measures

5.7.11 As noted above, the active travel mitigation interventions have been recommended for inclusion in the ELLDP given the forecast increase in car trips associated with the ELLDP and the potential for enhanced active travel provision to reduce this, which is a key transport objective of the Proposed Plan.

6 SUMMARY

6.1 Conclusions

6.1.1 This Note has described the East Lothian Local Development Plan (ELLDP) forecast year transport assessment. The SEStran Regional Model (SRM) has been used to inform the ELLDP Transport Appraisal of the implications of housing and economic land allocations on the transport network. This has revealed, as expected, a predicted increase in travel demand associated with the ELLDP development with negative impacts on the road and public transport networks. The network impacts have been considered alongside a list of potential mitigation interventions, which have been assessed using SRM.

6.1.2 Following the long-list assessment, further modelling has been undertaken to confirm and conceptually define the interventions to a stage suitable for inclusion in the ELLDP. Where the SRM does not provide sufficient detail, local traffic modelling or local junction assessments have been undertaken. For each intervention consideration has been given to the impacts on the transport network and the associated ELLDP development allocations. This has defined a recommended package of interventions that will address the cumulative impact of the ELLDP.

DOCUMENT ISSUE RECORD

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Appendix D Microsimulation Modelling - Musselburgh and Tranent LDP Mitigation Testing Note

East Lothian Council
Local Development Plan Microsimulation Modelling
Musselburgh and Tranent LDP mitigation testing

Date :	**25 August 2016**	*Distribution :*	
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1 INTRODUCTION

SIAS Limited (SIAS) was commissioned by East Lothian Council (ELC) in 2015 to develop an S-Paramics Microsimulation model of the Musselburgh and Tranent area. The purpose of the model was primarily for use in examining the impacts of ELC's Local Development Plan (LDP) proposals.

The development, calibration and validation of the model is detailed in the Report *East Lothian Council, S-Paramics Model Development Report (SIAS Ref. 78065, June 2016).*

The model covers the towns of Musselburgh, Tranent, Prestonpans, Port Seton, Longniddry, Macmerry, and Wallyford, as well as the key routes between the towns and the A1 in the vicinity of these towns.

Timeframes for submission of the LDP did not permit examination of the LDP proposals in the full model. Modelling being undertaken by PBA in parallel using the SESTRANS regional strategic model is being used as the primary modelling in support of the LDP proposals.

The strategic model does not allow for a robust examination of the impacts of the LDP proposals in the town centres of Musselburgh and Tranent. As a result, SIAS was requested to undertake modelling of the LDP infrastructure proposals in these two areas, for submission alongside the LDP, with the full modelling to follow in advance of the examination of the LDP proposals.

Two sub area models were developed from the existing base model, and used to undertake the required testing. This Note details the development of these models, and future year scenarios, as well as the results of the testing programme undertaken.

2 BASE MODEL DEVELOPMENT

The coverage of the full base model is shown in Figure 2.1.

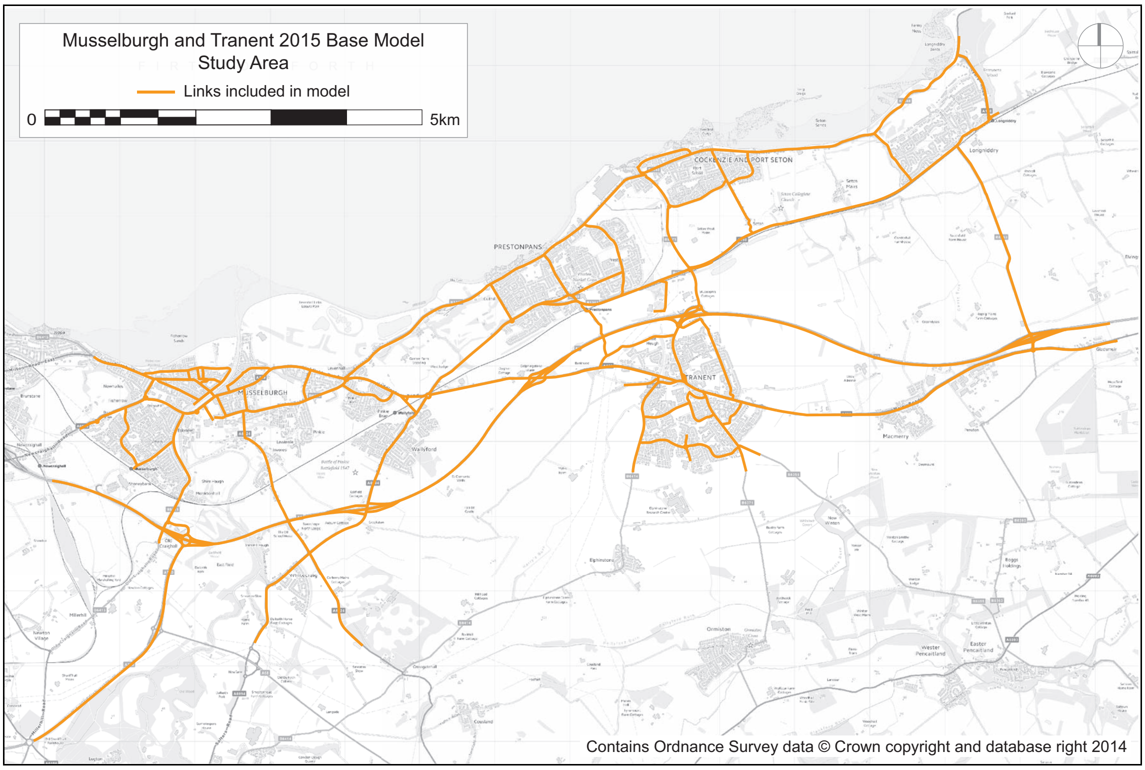

Figure 2.1 : ELC S-Paramics model coverage

As noted in the previous section, the development of this model is detailed in the SIAS Report *East Lothian Council, S-Paramics Model Development Report (SIAS Ref. 78065, June 2016).*

The model reflects three distinct time periods, reflecting normal traffic conditions in 2015.

- AM Period 07:00 – 10:00
- IP Period 10:00 – 16:00
- PM period 16:00 – 19:00

Two sub area models were extracted from the full model, one covering Musselburgh Town Centre, the other Tranent Town Centre, as detailed in Figures 2.2 and 2.3.

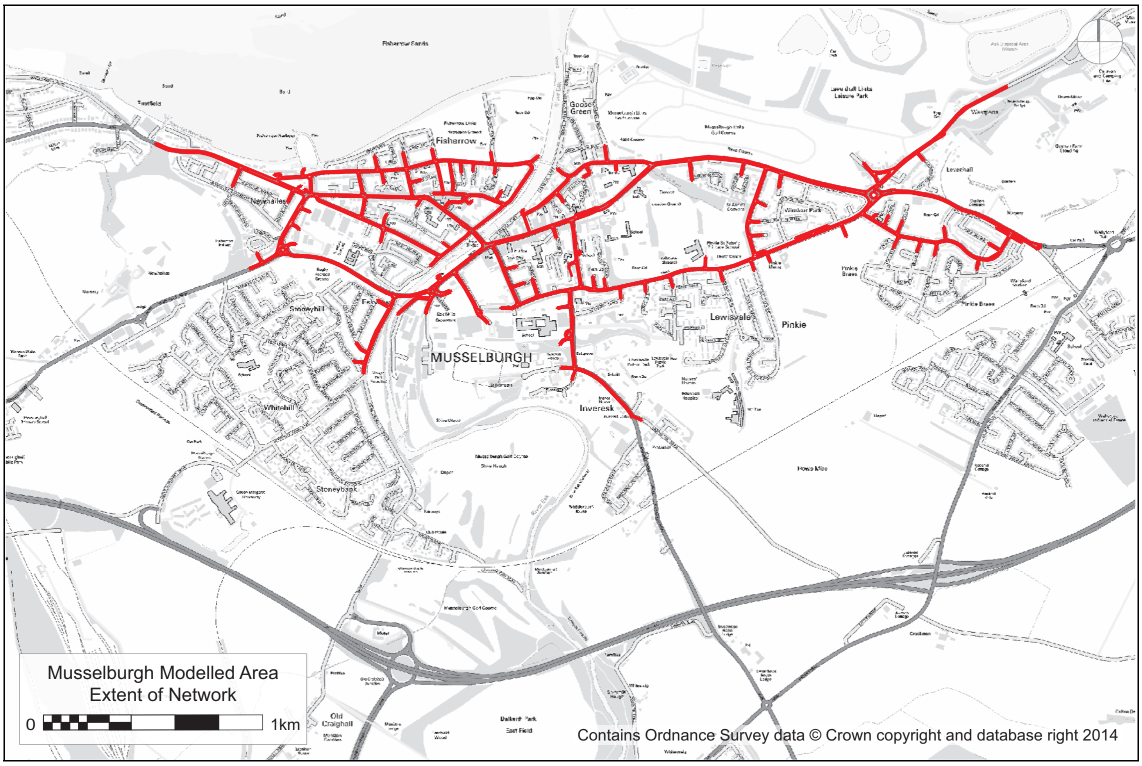

Figure 2.2 : Musselburgh Town Centre Sub Area Model

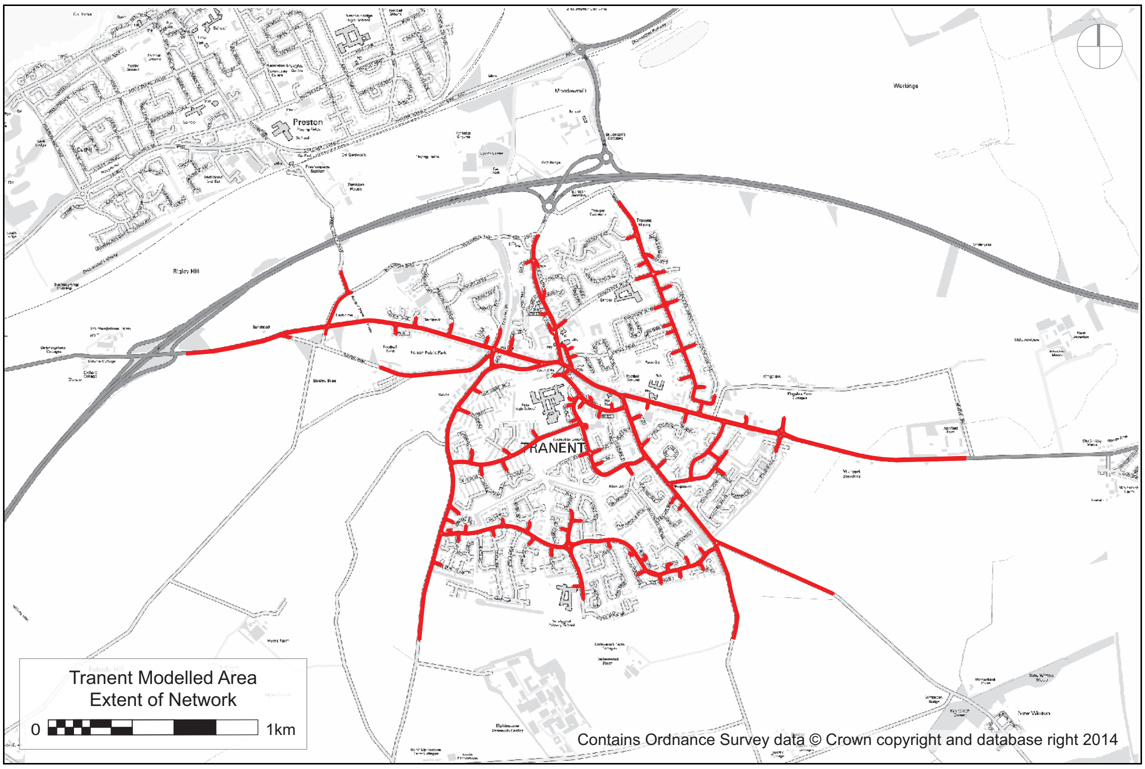

Figure 2.3 : Tranent Town Centre Sub Area Model

New zoning systems were developed for each sub area model, which retained existing zones internal to the sub areas, and added new zones at the periphery of each.

The existing traffic demands from the full base model were retained for movements between the internal zones within each sub area. Demands for movements to, from and between the new external zones for each sub area were extracted from the assigned traffic volumes in the base model.

Traffic release profiles for the remaining internal zones were retained from the full model. New profiles were developed for the new external zones using the assigned traffic volumes at each location. Profiles were developed for each external zone for light and heavy vehicles separately.

The resulting traffic demands and profiles were used to assign traffic to the sub area models. The resulting traffic volumes were compared to the observed 2015 survey dataset for each sub area (as detailed in the model development report), using the GEH statistic as defined in the *Design Manual for Roads and Bridges*, Volume 12. *DMRB* guidance suggests that 85% of movements within a model should have a GEH value of 5 or less when compared to surveyed values, to ensure that the model robustly reflects observed volumes.

Tables 2.1 and 2.2 present the modelled/observed flow comparisons for the two sub area models for each hour in each modelled period. The percentage of comparisons achieving a GEH of less than 3 and less than 7 are also included for reference.

Table 2.1 : Musselburgh Sub Area Model; Turn Count Comparisons

Period	Time (HH:MM)	Eligible Comparisons	GEH < 3 %	GEH < 5 %	GEH < 7 %
AM	07:00 - 08:00	333	84%	93%	98%
	08:00 - 09:00	333	80%	92%	96%
	09:00 - 10:00	333	83%	95%	98%
IP	10:00 - 11:00	333	86%	95%	98%
	11:00 - 12:00	333	83%	95%	97%
	12:00 - 13:00	333	85%	94%	97%
	13:00 - 14:00	333	86%	95%	98%
	14:00 - 15:00	333	84%	95%	98%
	15:00 - 16:00	333	77%	95%	97%
PM	16:00 - 17:00	333	79%	92%	97%
	17:00 - 18:00	333	83%	94%	97%
	18:00 - 19:00	333	78%	91%	97%

Table 2.2 : Tranent Sub Area Model; Turn Count Comparisons

Period	Time (HH:MM)	Eligible Comparisons	GEH < 3 %	GEH < 5 %	GEH < 7 %
AM	07:00 - 08:00	138	83%	97%	99%
	08:00 - 09:00	138	80%	94%	100%
	09:00 - 10:00	138	83%	96%	99%
IP	10:00 - 11:00	138	83%	100%	100%
	11:00 - 12:00	138	88%	98%	100%
	12:00 - 13:00	138	90%	99%	100%
	13:00 - 14:00	138	88%	100%	100%
	14:00 - 15:00	138	86%	99%	100%
	15:00 - 16:00	138	86%	96%	99%
PM	16:00 - 17:00	138	88%	98%	100%
	17:00 - 18:00	138	86%	96%	100%
	18:00 - 19:00	138	79%	93%	98%

Tables 2.1 and 2.2 show that in all hours, both sub area models exceed 85% of comparisons meeting the GEH less than 5 criteria, suggesting that the sub area models reflect the observed traffic volumes very well.

3 FUTURE YEAR MODEL DEVELOPMENT

3.1 Demand Development

The impacts of the LDP proposals are being considered in a future year scenario reflecting 2024. The impact of the LDP proposals is compared against a Do-Minimum situation in 2024, which includes committed development within East Lothian, and also a representation of the future planning aspirations of the surrounding authorities.

PBA supplied sub area matrices for the two study areas from SRM, for the following scenarios:

- SRM base year 2012
- SRM forecast year 2024, including ELC committed development, but with no ELC LDP proposals included (Do-Minimum)
- SRM forecast year 2024, including LDP infrastructure and mitigation

Details of the SRM modelling undertaken can be found in the PBA Report *Information Note 3 – Forecasts Transport Assessment (PBA, August 2016)*. Matrices were supplied for each of the five road based vehicle classes reflected in SRM:

- Car In Work
- Car Non Work, Commute
- Car non Work, Other
- LHV
- HGV

The S-Paramics models reflect three vehicle classes only: car, LGV, and HGV, so the three SRM car purposes were aggregated.

These matrices were used to develop the future year traffic demands for the sub area models of Musselburgh and Tranent.

Growth increments were developed to apply to the sub area base year demands, as follows:

- 2015 Base –to 2024 Do-Minimum. 9/12ths of SRM Do-Minimum minus SRM 2012 base
- 2024 Do-Minimum to 2024 LDP. SRM 2024 LDP minus 2024 SRM Do-Minimum

SRM reflects a peak hour for each of the AM, IP, and PM periods, so the resulting growth increments required expansion from peak hour to peak period before application to the sub area models. The peak hour factors used in the development of SRM were adopted for this expansion, as follows:

- AM 2.63
- IP 6
- PM 2.78

This is consistent with the approach adopted when utilising SRM information during the development of the full base model.

The SRM sub area matrices supplied reflected the SRM zone system. A number of SRM zones reflected the internal demand for each area. The S-Paramics sub area models generally include multiple internal zones associated with each internal SRM zone.

Internal demands from SRM were, therefore, divided between the relevant sub area zones in the models, for each of the three matrix levels individually, using the proportion of any given zone's trip ends to the total trip ends for zones associated with the SRM zone.

Tables 3.1 and 3.2 show the resulting matrix totals, and overall growth levels for each scenario.

Table 3.1 : Musselburgh Sub Area Forecast Matrix totals (vehs), overall growth

	AM	IP	PM
2015 Base Car	8,786	19,712	11,864
2015 Base LGV	1,219	2,245	867
2015 Base HGV	222	599	73
2024 Do Min Car	9,339	20,248	11,906
2024 Do Min LGV	1,318	2,426	916
2024 Do Min HGV	278	679	92
2024 LDP Car	9,288	20,628	12,509
2024 LDP LGV	1,416	2,592	984
2024 LDP HGV	302	715	102
2024 Do Min Car % from 2015	6%	3%	0%
2024 Do Min LGV % from 2015	8%	8%	6%
2024 Do Min HGV % from 2015	25%	13%	25%
2024 LDP Car % from Do Min	-1%	2%	5%
2024 LDP LGV % from Do Min	7%	7%	7%
2024 LDP HGV % from Do Min	9%	5%	12%

Table 3.2 : Tranent Sub Area Forecast Matrix totals (vehs), overall growth

	AM	IP	PM
2015 Base Car	6,052	10,411	7,788
2015 Base LGV	1,012	1,584	865
2015 Base HGV	219	412	86
2024 Do Min Car	6,483	10,840	8,380
2024 Do Min LGV	1,298	2,099	1,095
2024 Do Min HGV	335	653	173
2024 LDP Car	7,545	12,238	9,093
2024 LDP LGV	1,489	2,558	1,314
2024 LDP HGV	391	807	220
2024 Do Min Car % from 2015	7%	4%	8%
2024 Do Min LGV % from 2015	28%	32%	27%
2024 Do Min HGV % from 2015	53%	59%	101%
2024 LDP Car % from Do Min	16%	13%	9%
2024 LDP LGV % from Do Min	15%	22%	20%
2024 LDP HGV % from Do Min	17%	24%	27%

3.2 Network Changes

The 2024 Do-Minimum Model and the 2024 LDP Model were derived from the 2015 Base Model with the following network changes made from the 2015 Base, as agreed with ELC:

- New signalised junction at Ashgrove/Pinkie Road in Musselburgh to reflect the proposed signalisation of the junction in 2016.
- Left turn filter lane on Birsley Road in Tranent added to the current signal junction at A199 Bridge Street/Brisley Road. On review of the 2024 Do-Minimum model operation, it was clear a left turn filter would significantly improve queueing on Birsley Road and Elphinstone Road. Given its relatively inexpensive implementation, ELC advised that the filter arrow head should be considered to be in place by 2024.

4 MITIGATION TESTING

4.1 Introduction

The Report *East Lothian Local Development Plan: Interventions Pre-Feasibility Assessment (PBA, April 2016)* provided details of mitigation options shortlisted for further consideration and inclusion in the LDP appraisal.

Mitigation options from the document that were specific for either Musselburgh or Tranent town centres were considered for testing. It was agreed with ELC that high level testing of incremental mitigation measures would first be undertaken to discount any mitigation measures that either added no benefit or did not operate satisfactorily. On completion of this high level review and through further discussion with ELC a mitigation testing programme was undertaken as detailed in the following sections.

4.2 Musselburgh Mitigation Testing

In Musselburgh, the LDP mitigation tested is comprised of 3 new signalised junctions at:

- A199/New Street
- A199/Linkfield Road/Millhill
- Pinkie Road/Inveresk Road

A 2024 Musselburgh LDP Mitigation model was created from the 2024 LDP model by coding these three signalised junctions into the model. Signal timings were manually derived with the signals on the A199 given a 60s cycle time and green time for the AM, IP, and PM periods sets by flow proportion at each arm. The aim of the mitigation on the A199 is to regulate traffic entering the town centre and, as such, timings were manually adjusted on visual reviews of the model operation. The green time was then set to ensure town centre congestion was minimised.

The new signalised junction at Pinkie Road/Inveresk Road was required to mitigate against extensive queueing seen northbound on the Inveresk approach to the junction in the 2024 LDP Model. Signal timings for the junction were synchronised with the adjacent existing signalised junction of Pinkie Road/Newbigging to ensure any queues on the approach arms were minimised.

The operation of the 2024 Musselburgh LDP Mitigation model was assessed against the 2015 Base, 2024 Do-Minimum Model and the 2024 LDP Model using a number of journey time routes as shown in Figure 4.1.

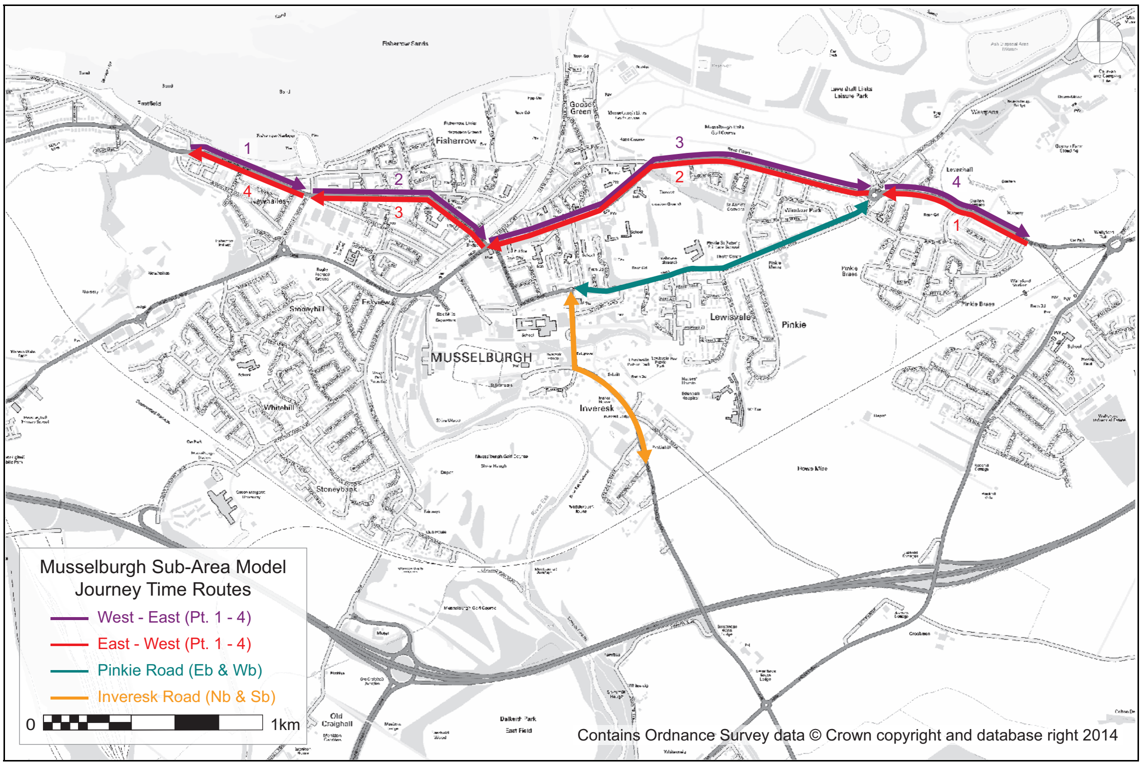

Figure 4.1 : Musselburgh Journey Time Routes

The results of the journey time comparisons between the Musselburgh 2015 Base, Musselburgh 2024 Do-Minimum, 2024 LDP, and 2024 LDP Mitigation models are detailed in Appendix A for the worst case AM, IP, and PM hours of 08:00 – 09:00, 15:00 – 16:00, and 17:00 – 18:00.

Modelled journey times were compared on an east to west and a west to east route through Musselburgh town centre. The routes were also split into 4 sections to clearly show where any changes in journey times occurred. Journey times were also compared in both directions on Pinkie Road and Inveresk Road in order to assess the impact of the new signalised junction at Inveresk/Pinkie Road.

The mitigation measures on the A199 were aimed at regulating traffic through Musselburgh town centre using signalised junctions at either side of the town centre. The impact of these mitigation measures was, as expected, to increase journey times for vehicles travelling through Musselburgh. The comparisons graphs show that the increase in journey times is primarily due to the signalised junction at the A199/Linkfield Road/Millhill junction, as reflected in routes East-West_Pt2 and West-East_Pt3.

The new signalised junction at Pinkie Road/Inveresk Road helps reduce journey times northbound on Inveresk Road, particularly in the IP and PM, where the 2024 LDP model shows high journey times.

4.3 Tranent Mitigation Testing

In Tranent, the LDP mitigation tested is comprised of the following infrastructure changes:

- New Row changed to one-way westbound
- One-way gyratory system of High Street and Loch Road with a new link joining Loch Road to High Street at Winton Place

The above infrastructure was coded into a variant of the 2024 LDP Model to create a 2024 Tranent LDP Mitigation model. The gyratory is detailed in *East Lothian Local Development Plan: Interventions Pre-Feasibility Assessment (PBA, April 2016).* The creation of the gyratory results in the High Street/Orminston Road junction reverting to priority, with the southbound movement from High Street to Orminston Road given full priority. The priorities at Orminston Road/Loch Road junction were changed to give the Orminston Road right turn to Loch Road full priority. The new crossroad junction of High Street/Loch Road/Winton Place operates as a priority junction, with the left turn from Loch Road to High Street given full priority and Winton Place set to left turn only. All existing pedestrian facilities are to be kept in place on the gyratory with an additional crossing added on Loch Road and given the same call frequency in the model as the existing High Street pedestrian facilities. The gyratory also resulted in some bus routes that currently travel westbound on High Street being redirected accordingly.

The 2024 Tranent LDP Mitigation model was assessed against the 2015 Base, 2024 Do-Minimum Model and the 2024 LDP Model using a number of journey time routes as shown in Figure 4.2.

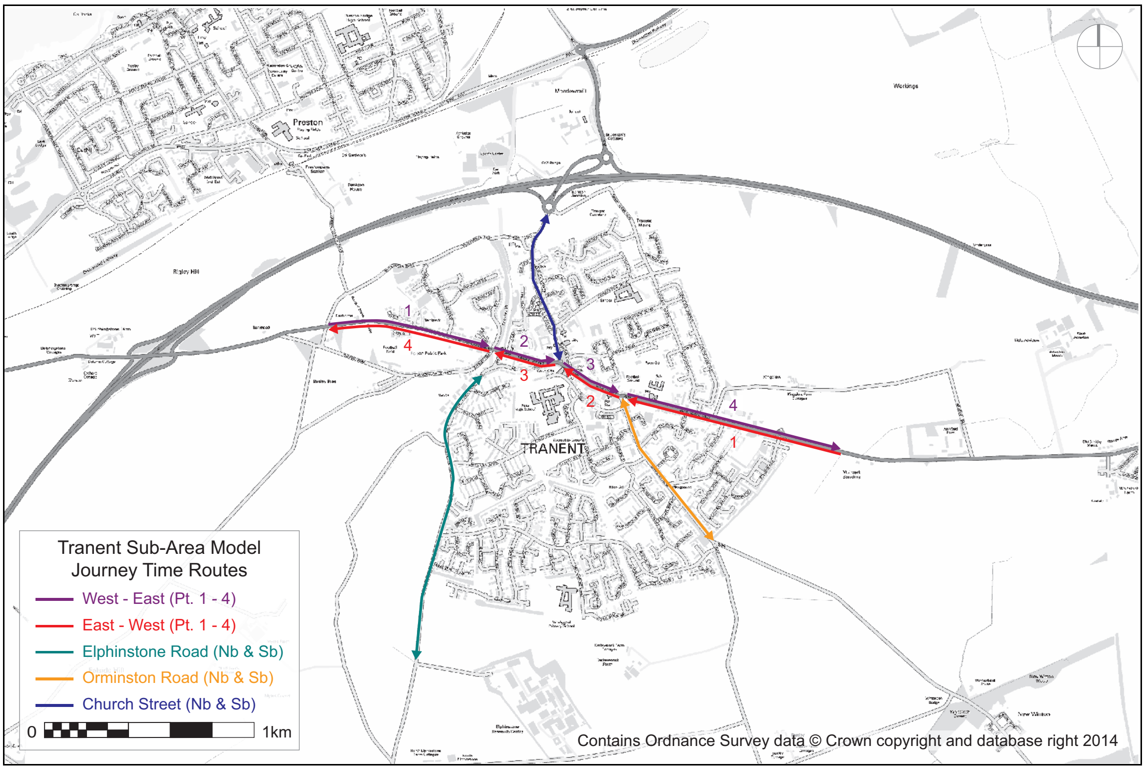

Figure 4.2 : Tranent Journey Time Routes

The results of the journey time comparisons between the Tranent 2015 Base, Tranent 2024 Do-Minimum, 2024 LDP and 2024 LDP Mitigation models are shown in Appendix B for the worst case AM, IP, and PM hours of 08:00 – 09:00, 15:00 – 16:00, and 17:00 – 18:00.

Modelled journey times were compared on an east to west and a west to east route through Tranent town centre. The routes were also split into four sections to clearly show where any changes in journey times occurred. Journey times were also compared in both directions on Elphinstone Road, Orminston Road, and Church Street.

The mitigation measures in Tranent were aimed at improving the flow of traffic through the town centre primarily by removing conflict points within the network. The journey time comparison graphs show that the full LDP scenario with no mitigation in place results in increased journey times for vehicles travelling through Tranent. Through the introduction of the mitigation measures, journey times improve both eastbound and westbound through the town centre. Journey times eastbound on Tranent High Street (route West-East_Pt3) are reduced significantly in all periods.

5 SUMMARY

SIAS has developed an S-Paramics microsimulation model covering the Musselburgh and Tranent area on behalf of East Lothian Council (ELC) for use in examining LDP proposals. Due to time constraints it has not been possible to utilise this model in advance of the LDP submission.

Two sub area models were created from this larger model, covering the town centres of Musselburgh and Tranent, to allow LDP mitigation proposals within the two town centres to be examined in detail.

Two future year demand scenarios have been examined; 2024 Do-Minimum (inc. committed development) and 2024 LDP. The operation of the proposed mitigation has been examined in the 2024 LDP scenario. Traffic demands for the future year scenarios were developed based on information from the SESTRANS Regional Model.

The proposals for Musselburgh are to introduce three new traffic signals at:

- A199/New Street
- A199/Linkfield Road/Millhill
- Pinkie Road/Inveresk Road

The purpose of the A199 signals is to regulate demand at the edges of the town centre and prevent excessive congestion in the High Street area.

The proposals for Tranent are:

- New Row changed to one-way westbound
- One-way gyratory system of High Street and Loch Road with a new link joining Loch Road to High Street at Winton Place

Testing shows both sets of mitigation to operate well.

East/West journey times through Musselburgh are increased with the mitigation in place, but this is an acceptable impact of the proposals, which are designed to constrain traffic demand. The introduction of signals at Pinkie Road/Inveresk Road reduces the northbound queueing introduced in the 2024 demand scenarios, resulting in journey times less than or comparable to the 2015 Base.

East/West journey times in Tranent are increased significantly in the future year scenarios without any mitigation, as a result of the increased traffic using the High Street. The proposed mitigation reduces journey times to a level comparable with or better than the 2015 Base.

A MUSSELBURGH JOURNEY TIME COMPARISONS

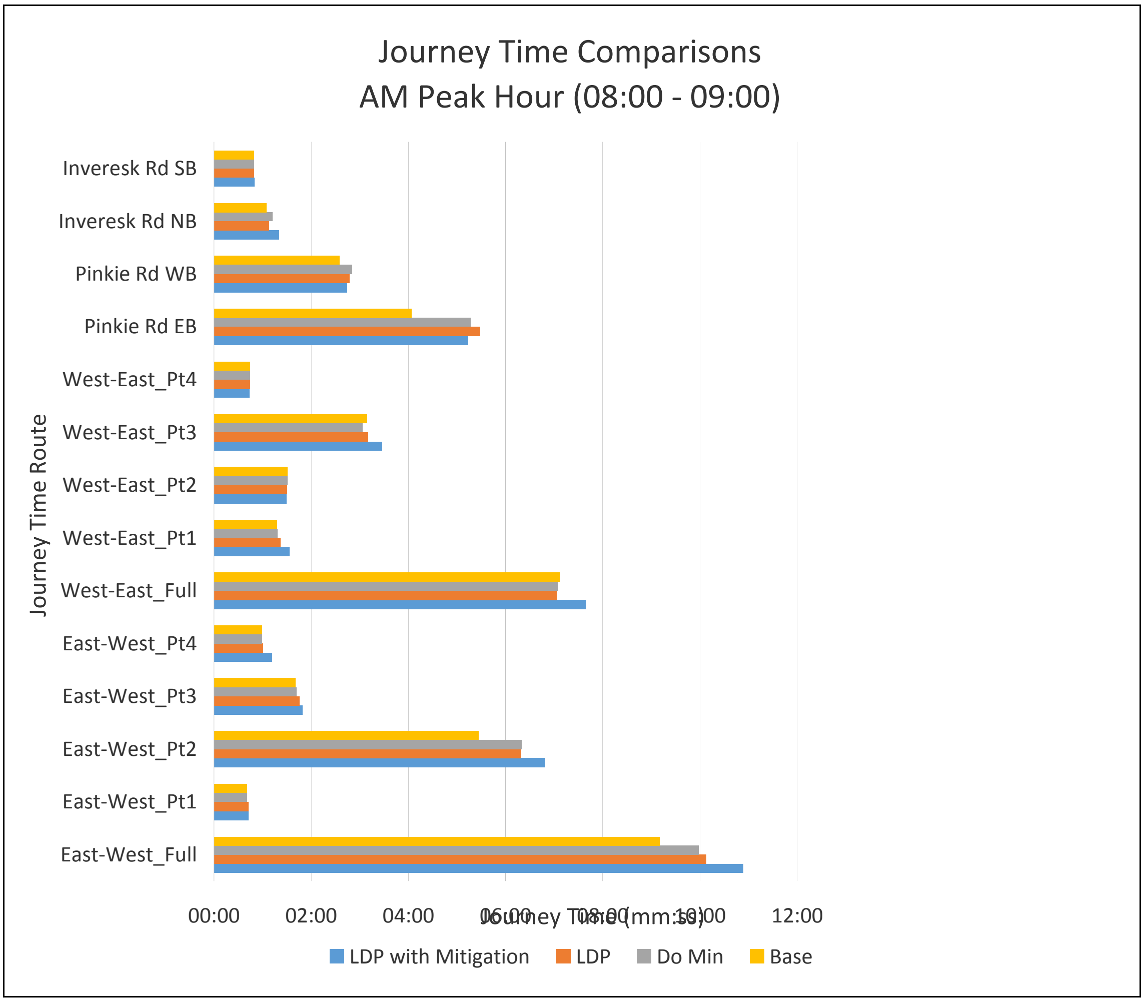

Figure A.1 : Musselburgh Journey Time Comparisons 08:00 – 09:00

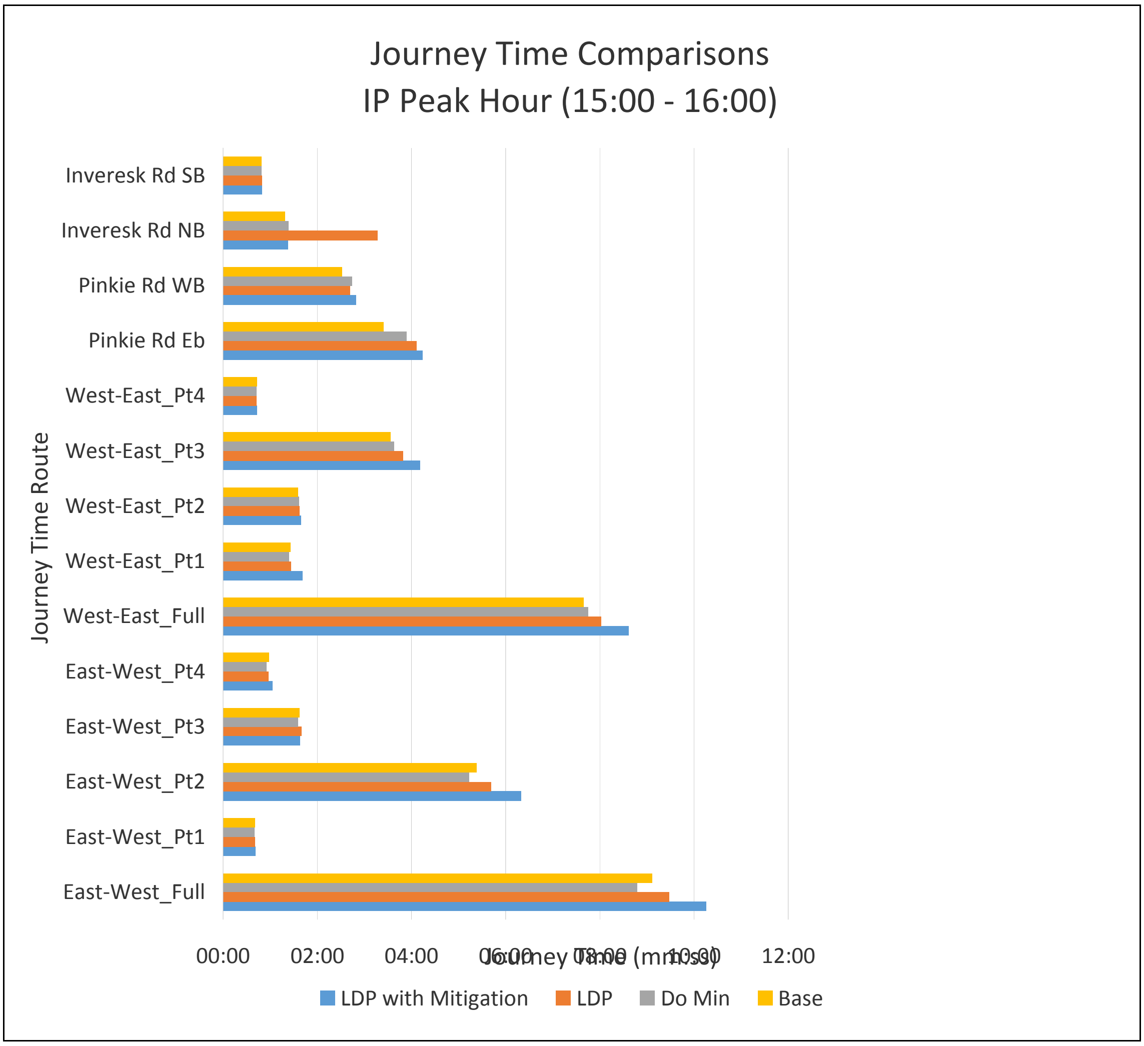

Figure A.2 : Musselburgh Journey Time Comparisons 15:00 – 16:00

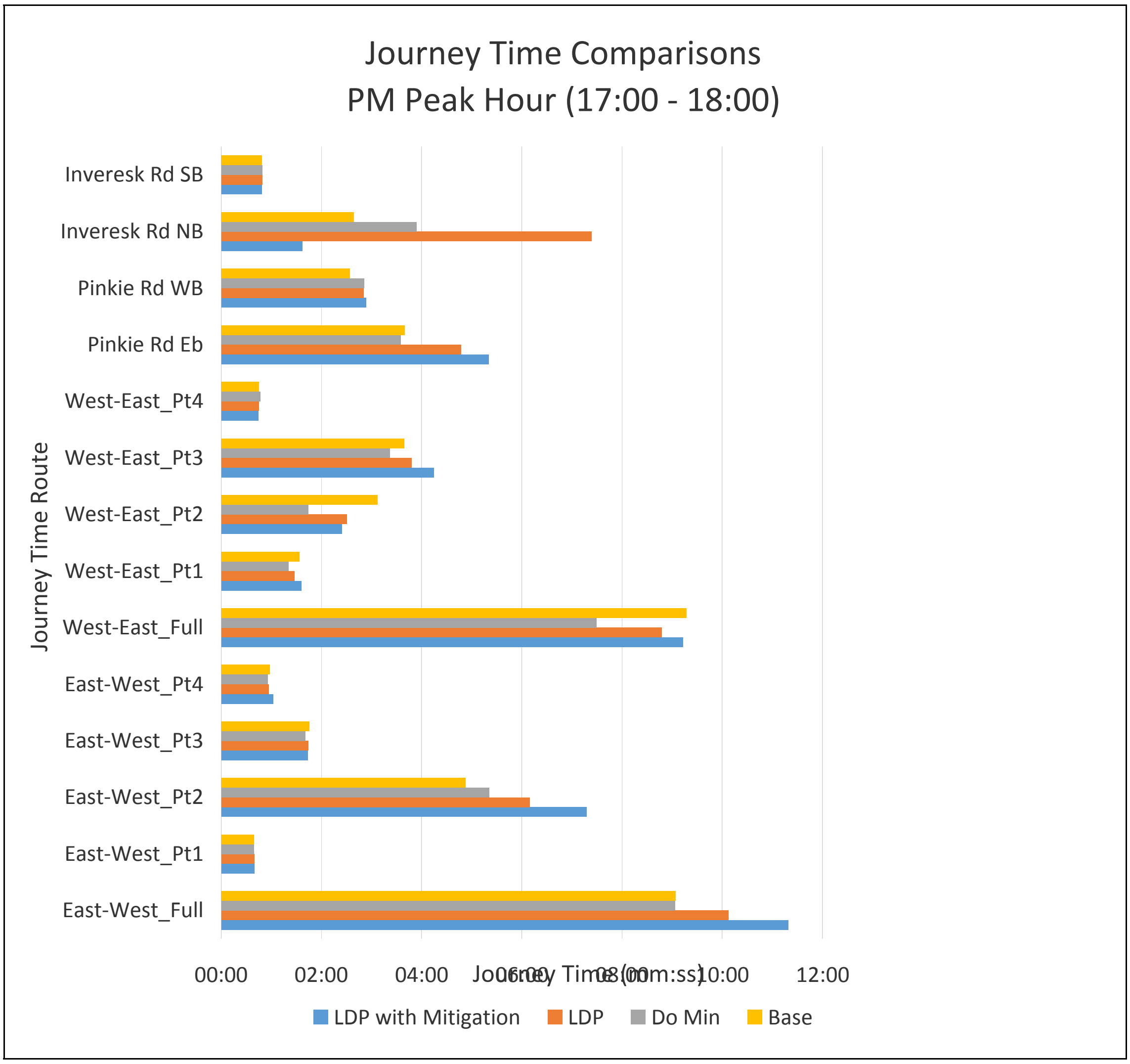

Figure A.3 : Musselburgh Journey Time Comparisons 17:00 – 18:00

B TRANENT JOURNEY TIME COMPARISONS

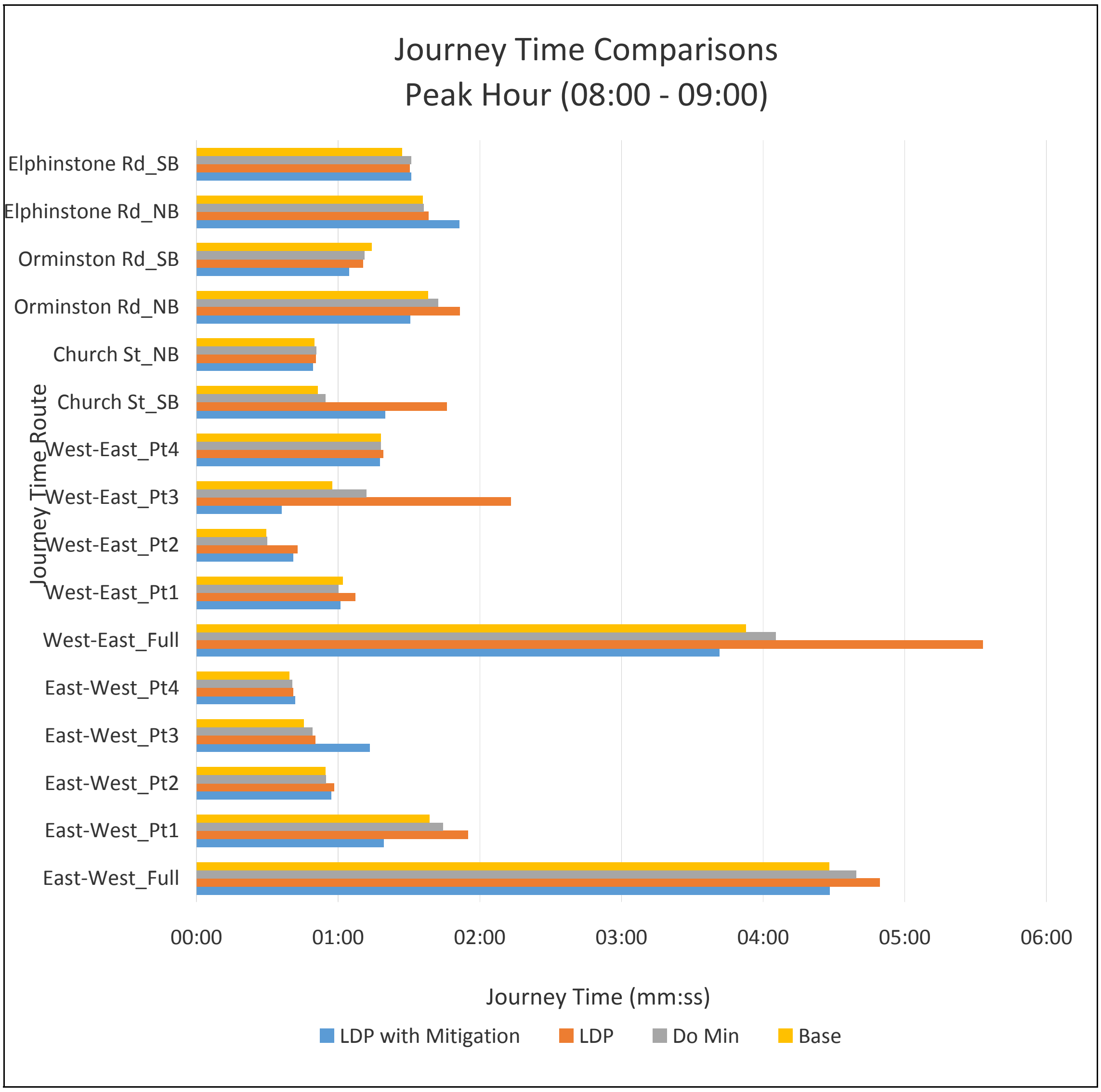

Figure B.1 : Tranent Journey Time Comparisons 08:00 – 09:00

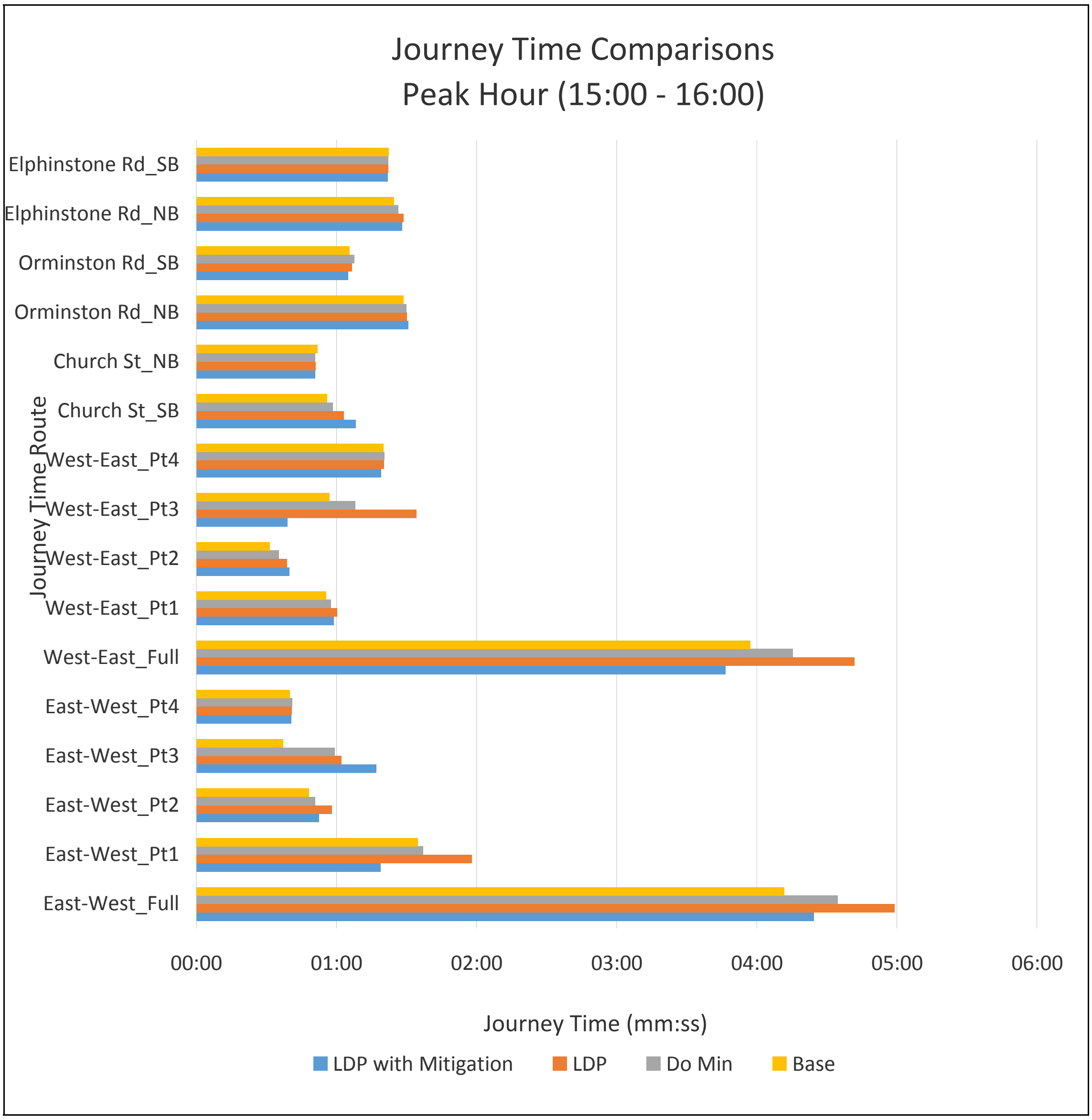

Figure B.2 : Tranent Journey Time Comparisons 15:00 – 16:00

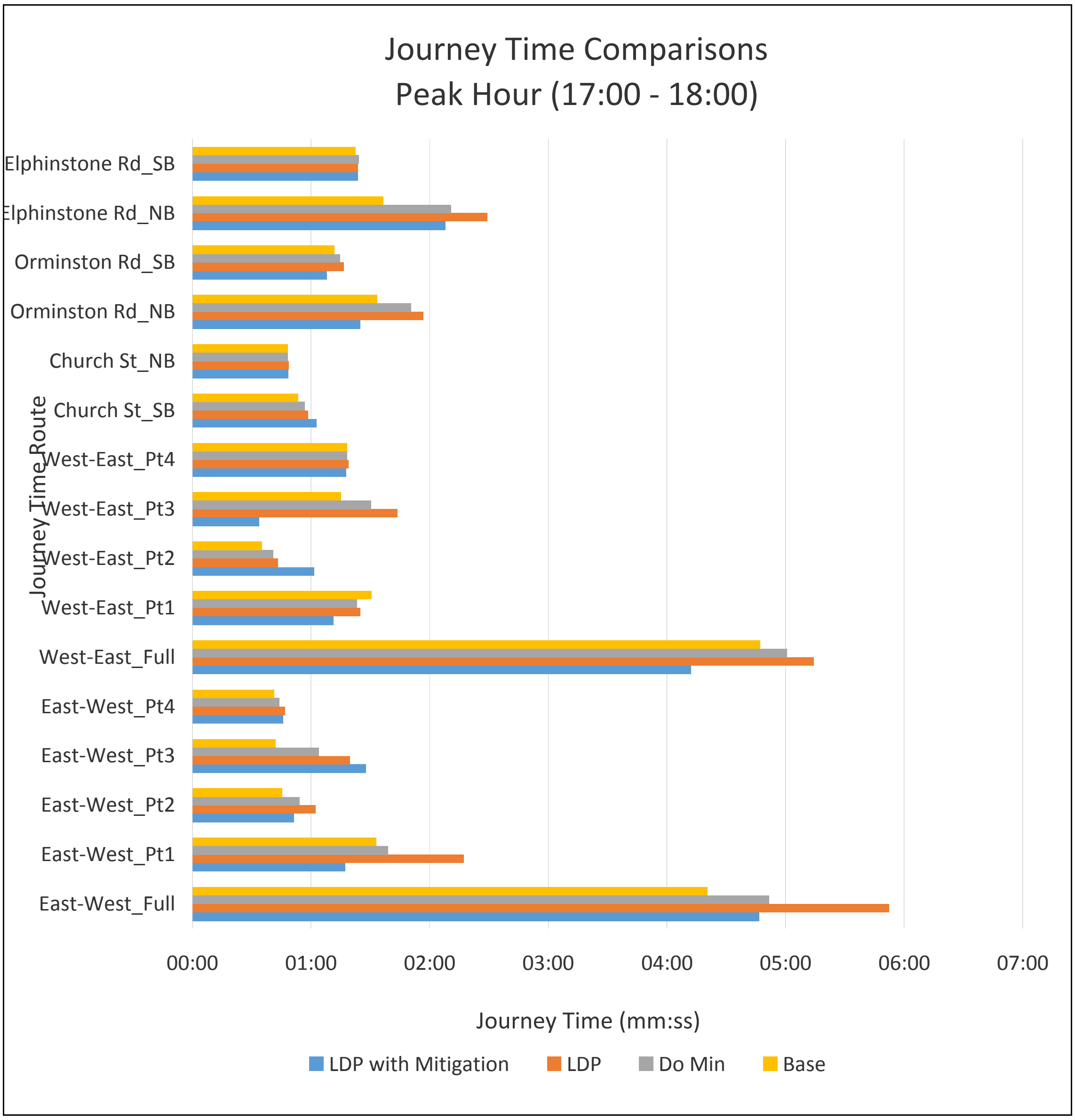

Figure B.3 : Tranent Journey Time Comparisons 17:00 – 18:00

Appendix E ELLDP Mitigation Assessment – Local Junction Modelling – A1 Junctions Technical Note

TECHNICAL NOTE

Project Name: **East Lothian Local Development Plan Transport Appraisal**

Project Ref: **31335**

Date: **12th August 2016**

Prepared By: **Gordon Scott**

Subject: **ELLDP Mitigation Assessment – Local Junction Modelling – A1 Junctions**

1.1 Project Purpose

1.1.1 East Lothian Council (ELC) has commissioned Peter Brett Associates LLP to undertake a Transport Appraisal of the implications of housing and economic land allocations on the transport network. This will support the preparation of the Proposed Local Development Plan (LDP) ready for publication and formal representation.

1.2 Background

1.2.1 ELC is preparing its LDP following the approval of the Strategic Development Plan (SDP) for Edinburgh and South East Scotland.

1.2.2 The LDP Transport Appraisal is being carried out in accordance with Transport Scotland's Development Planning and Management Transport Appraisal Guidance (DPMTAG) methodology. DPMTAG follows the principles set out in Scottish Transport Appraisal Guidance (STAG) which provides relevant guidance and technical methodologies for carrying out Transport Appraisal in Scotland.

1.2.3 The SEStran Regional Model (SRM) has been used to inform the Appraisal of the implications of housing and economic land allocations on the transport network.

1.2.4 This Information Note follows on from a previous Note (003) which describes the East Lothian Local Development Plan (ELLDP) forecast year transport assessment and has been undertaken using the SEStran Regional Model (SRM). The network impacts have been considered alongside the short-list of potential mitigation interventions that have previously been prepared based on anticipated ELLDP impacts.

1.3 Scope of Study

1.3.1 The scope of this study is to appraise the implications of increased traffic due to housing and economic land allocations on three key junctions on the A1 in East Lothian:

- A1 at Salters Road;
- A1 at Dolphingstone; and
- A1 at Bankton, North of Tranent.

Figure 1 Junction Locations

1.3.2 The purpose is to demonstrate the need (or not) for mitigation measures to support the implementation of the LDP. The AM and PM peak during the following scenarios, from the strategic transport model, will be considered:

- 2015 Base Year;
- 2024 Without LDP; and
- 2024 With LDP.

1.4 Key Design Parameters

1.4.1 The following key design parameters are being used:

- Junction layout parameters have been measured from CAD background mapping;
- Linsig models have been prepared for the Salters Road and Dolphingstone junctions as they are signalised, ARCADY has been used to model the existing two roundabouts at Bankton;
- Signal stages, phasing and intergreens have been provided by East Lothian Council.

1.5 Junction Layouts

1.5.1 The existing junction layouts are shown in Annex A.

1.6 Traffic Flows

1.6.1 The isolated junction models require traffic flow forecasts. These have been estimated using a combination of observed junction turning counts and forecast modelled flows from the SRM (for the forecast year 2024). This approach ensures that the isolated junction modelling reflects local observed conditions, which may not be accurately represented in the strategic model, whilst also incorporating the predicted change in traffic flow associated with new development sites, including the Blindwells development.

1.6.2 Surveyed flows were collected in April 2015.

1.6.3 The following rules have been applied to estimate the traffic flows for the isolated junction models:

- where no 2015 observed flow was available, the demand flow from the 2024 SRM model was used;
- if both base and forecast SRM flows are zero, then the 2015 observed flow was used;
- if the 2012 SRM flow was zero and the forecast 2024 SRM flow was greater than zero, then the largest of the 2015 observed and 2024 SRM flows was used;
- if the 2012 SRM flow was between 1 and 50 PCUs, the SRM forecast growth was applied to the 2015 observed flow in absolute terms, eg +20 PCUs; and
- if the 2012 SRM flow was greater than or equal to 50 PCUs, the 2024 SRM forecast growth was applied to the 2015 observed flow in percentage terms, eg +10%.

1.6.4 An overview of the traffic flows used in the assessment is shown in the Figure below.

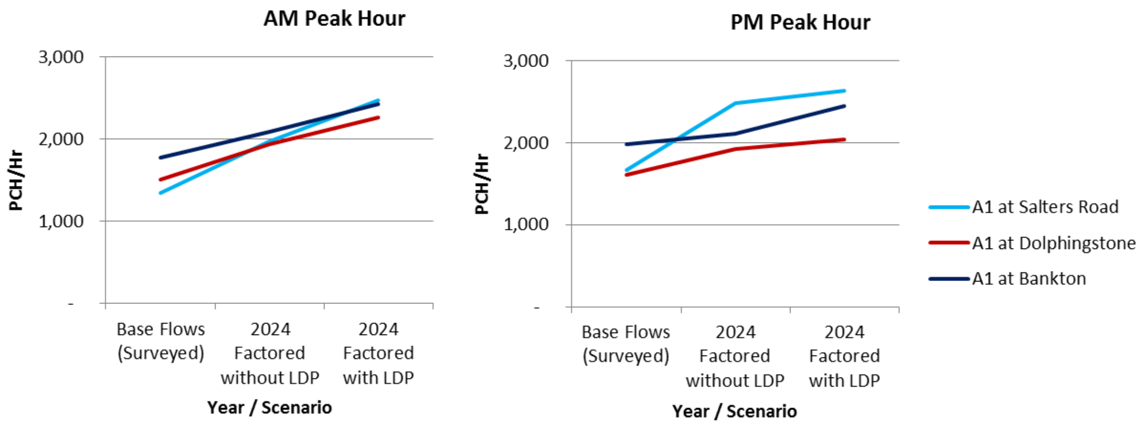

Figure 2 Traffic Flow Overview

1.6.5 The significant increase at Salters Road in the PM can largely be attributed to a forecast increase in the number of vehicles travelling northbound on the A6094 overpass. Details of the turning movements are shown in the model output diagrams.

1.7 Model Results

Glossary of Modelling Terms

1.7.1 In this section a number of terms used to report model results are referred to, these are defined below.

LINSIG

1.7.2 Linsigv3 has been used to model the Salters Road and Dolphinstone junctions because they include traffic signals. It has been used to calculate the optimum signal timings to minimise delay with geometric parameters measured from AutoCAD drawings provided.

1.7.3 The following performance parameters are reported on:

- **Degree of Saturation (%).** This is defined as the ratio of demand to capacity on each approach to the junction, with a value of 100% meaning that demand and capacity are equal and no further traffic is able to progress through the junction. Values over 90% are typically regarded as suffering from traffic congestion, with queues of vehicles beginning to form.

- **Total Delay (PCU / Hr).** This is the total aggregate delay suffered by traffic using the modelled Network.

- **Mean Maximum Queue (PCU).** The Mean Maximum Queue represents the maximum queue within a typical cycle averaged over all the cycles within the modelled time period.

ARCADY

1.7.4 Analysis of the Bankton junction was undertaken using the industry standard computer modelling package Junctions9 (version 9.0.1.4546) which includes ARCADY for roundabout junctions.

1.7.5 Critical geometric parameters of the junctions were measured from AutoCAD drawings provided.

1.7.6 The performance of the junctions has been measured using three standard outputs for ARCADY - Ratio of Flow to Capacity (RFC), Maximum Queuing (Q) and Inclusive Queuing Delay (IQD), defined as follows:

- **RFC** provides a basis for judging the acceptability of junction designs and typically an RFC of less than 0.85 is considered to indicate satisfactory performance. This depends however on the context of the study and so the user’s own judgement is also required. Also known as V/C ratio (traffic volume/capacity ratio);

- **Delay** is the Average Delay (seconds) per Arriving Vehicle and represents the average time that an average vehicle must wait at the junction. (This is unrelated to Geometric Delay, which is reported elsewhere); and

- **Queue** is the average number of queuing vehicles during the associated peak hour.

1.7.7 Reference is also made to Level of Service (LOS) which is a qualitative measure used to relate the quality of traffic service. LOS is used to analyse roads and junctions by categorising traffic flow and assigning quality levels of traffic based on performance measure like speed, density etc. These can be defined as:

- **A: free flow.** Traffic flows at or above the posted speed limit and motorists have complete mobility between lanes. The average spacing between vehicles is about 550 ft (167 m) or 27 car lengths. Motorists have a high level of physical and psychological comfort. The effects of incidents or point breakdowns are easily absorbed. LOS A generally occurs late at night in urban areas and frequently in rural areas.

- **B: reasonably free flow.** LOS A speeds are maintained, manoeuvrability within the traffic stream is slightly restricted. The lowest average vehicle spacing is about 330 ft

(100 m) or 16 car lengths. Motorists still have a high level of physical and psychological comfort.

- **C: stable flow, at or near free flow.** Ability to manoeuvre through lanes is noticeably restricted and lane changes require more driver awareness. Minimum vehicle spacing is about 220 ft (67 m) or 11 car lengths. Most experienced drivers are comfortable, roads remain safely below but efficiently close to capacity, and posted speed is maintained. Minor incidents may still have no effect but localized service will have noticeable effects and traffic delays will form behind the incident. This is the target LOS for some urban and most rural highways.

- **D: approaching unstable flow.** Speeds slightly decrease as traffic volumes slightly increase. Freedom to manoeuvre within the traffic stream is much more limited and driver comfort levels decrease. Vehicles are spaced about 160 ft (50m) or 8 car lengths. Minor incidents are expected to create delays. Examples are a busy shopping corridor in the middle of a weekday, or a functional urban highway during commuting hours. It is a common goal for urban streets during peak hours, as attaining LOS C would require prohibitive cost and societal impact in bypass roads and lane additions.

- **E: unstable flow, operating at capacity.** Flow becomes irregular and speed varies rapidly because there are virtually no usable gaps to manoeuvre in the traffic stream and speeds rarely reach the posted limit. Vehicle spacing is about 6 car lengths, but speeds are still at or above 50 mi/h(80 km/h). Any disruption to traffic flow, such as merging ramp traffic or lane changes, will create a shock wave affecting traffic upstream. Any incident will create serious delays. Drivers' level of comfort become poor. This is a common standard in larger urban areas, where some roadway congestion is inevitable.

- **F: forced or breakdown flow.** Every vehicle moves in lockstep with the vehicle in front of it, with frequent slowing required. Travel time cannot be predicted, with generally more demand than capacity. A road in a constant traffic jam is at this LOS, because LOS is an average or typical service rather than a constant state. For example, a highway might be at LOS D for the AM peak hour, but have traffic consistent with LOS C some days, LOS E or F others, and come to a halt once every few weeks.

Model Results

1.7.8 Details of the model results in the AM and PM peak hour for each scenario are included in Annex B and summarised below.

A1 at Salters Road

1.7.9 This junction does not operate within capacity in any of the 2024 scenarios with traffic signals in operation at both parts of the junction. There are operational problems primarily caused by the high volume of vehicles turning right from the A6094 onto the A1 eastbound on-ramp (161) in conflict with a high number travelling south onto the A6094 overpass (1053).

1.7.10 Similarly, there are problems accommodating vehicles turning right from the A6094 onto the A1 Westbound on-ramp.

Figure 3 A1 at Salters Road Traffic Flows

Mitigation Measures

1.7.11 A number of potential mitigation measures have been considered to allow this junction to operate within capacity in the 2024 scenarios. These included changes to the junction layout, within the confines of potential available land, as well as signal staging and phasing.

1.7.12 One potential option has been identified, though this would very likely require significant engineering and third party land to accommodate the following:

- A6094 North – additional land on the east and west side of the carriageway to accommodate a straight ahead northbound movement and short right-turn lane onto the Eastbound on-ramp;
- Land south of the Westbound off-ramp to realign this link and form a crossroads at the southern junction with a left turn merge lane onto the A6094. This would also therefore require land east of the A6094 south; and
- Land west of the A6094 south to accommodate an additional northbound lane for vehicles turning left onto the Westbound on-ramp.

1.7.13 The possible extents of the above are illustrated below.

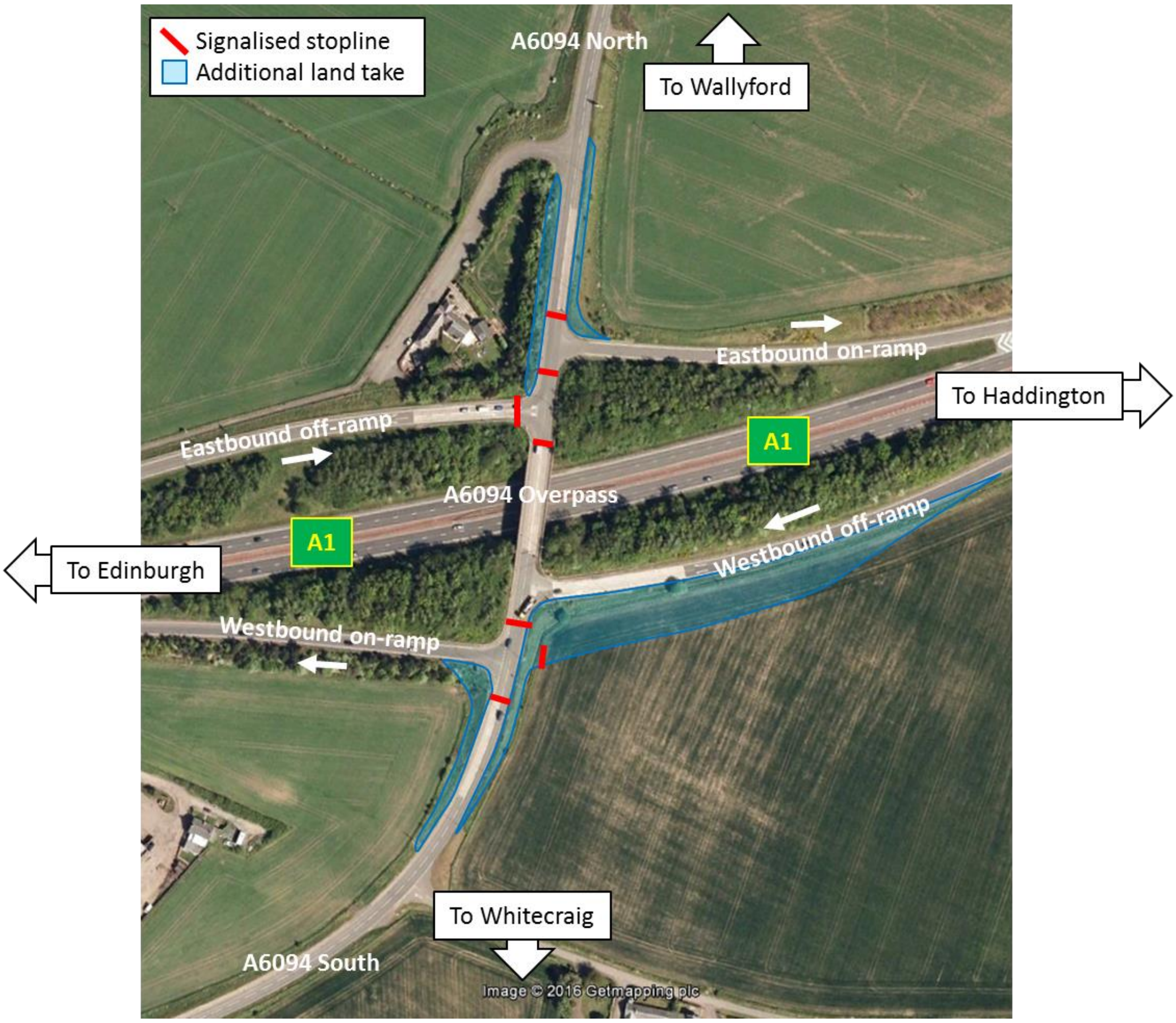

Figure 4 A1 at Salters Road Remedial Measures

1.7.14 With a design incorporating the above elements the model results suggest that the junction would operate close to capacity. Model results are summarised in Annex C.

1.7.15 Further consideration should be given to the layout, phasing, and staging to determine if an option like this is feasible. Appropriate consideration should also be given to road safety issues and relevant design standards, such as the Design Manual for Roads and Bridges.

A1 at Dolphingstone

1.7.16 Both junctions which form this interchange are predicted to operate within capacity across all time periods and scenarios with their current layout where signals are operational on the western junction only.

1.7.17 This is partly attributed to the low flow of right turn vehicles on the A199 overpass (both directions).

1.7.18 Consideration of the routing of adjacent development traffic flows via this junction versus the Salters Road junction should be taken into account. SRM is currently predicting westbound traffic will route via Salters Road, which is potentially exacerbating the predicted issues as noted above and also underestimating possible future issues at Dolphingstone. However, we are aware of development related proposals to fully signalise Dolphingstone junction and it is considered that this should offer an acceptable design solution with the addition of forecast LDP travel demand.

A1 at Bankton

1.7.19 Given its size, the Blindwells development is likely to generate a significant number of trips which will use this junction. The Transport Assessment (TA) for the development, produced by WYG in September 2014 and commissioned by Hargreaves Surface Mining Ltd (Hargreaves) outlines the number of trips predicted to be generated.

1.7.20 A comparison of the number of trips generated by the TA and used in this modelling exercise are shown in the table below.

Table 1 Blindwells Trips

	AM		PM	
	Arrivals	Departures	Arrivals	Departures
Blindwells TA Total	293	438	499	332
Blindwells TA via Roundabout	220	266	374	198
SRM via Roundabout	190	443	399	117

1.7.21 The Table above shows that the volumes of trips generated by the Blindwells development, and using the northern roundabout at this junction, are comparable to those contained within the TA.

1.7.22 Both roundabouts which form this interchange operate within capacity across all time periods and scenarios with their current layout. However the A198 north approach arm operates very close to capacity at 86% RFC, and a level of service of C, suggesting there is little scope to accommodate additional vehicles. This should be borne in mind when considering the infrastructure that may be required to support further development at Blindwells, where we are aware of significant additional development proposals beyond the LDP allocation.

1.8 Recommendations

1.8.1 The table below summarises the recommendations to come from the mitigation assessment.

Table 2 Summary of Recommendations

Junction	2024 Model Results with Current Layout	Identified Mitigation Measures
A1 at Salters Road	Does not operate within capacity in any 2024 scenario.	Significant engineering and land take. Further work required on feasibility and to consider road safety.
A1 at Dolphingstone	Operates within capacity in all 2024 scenarios.	None required.
A1 at Bankton	Operates close to capacity in 2024 with DLP scenario	Any increase in flows above what was modelled may require the roundabout to be signalised (with revisions to lane configuration).

Annex A Junction Layouts

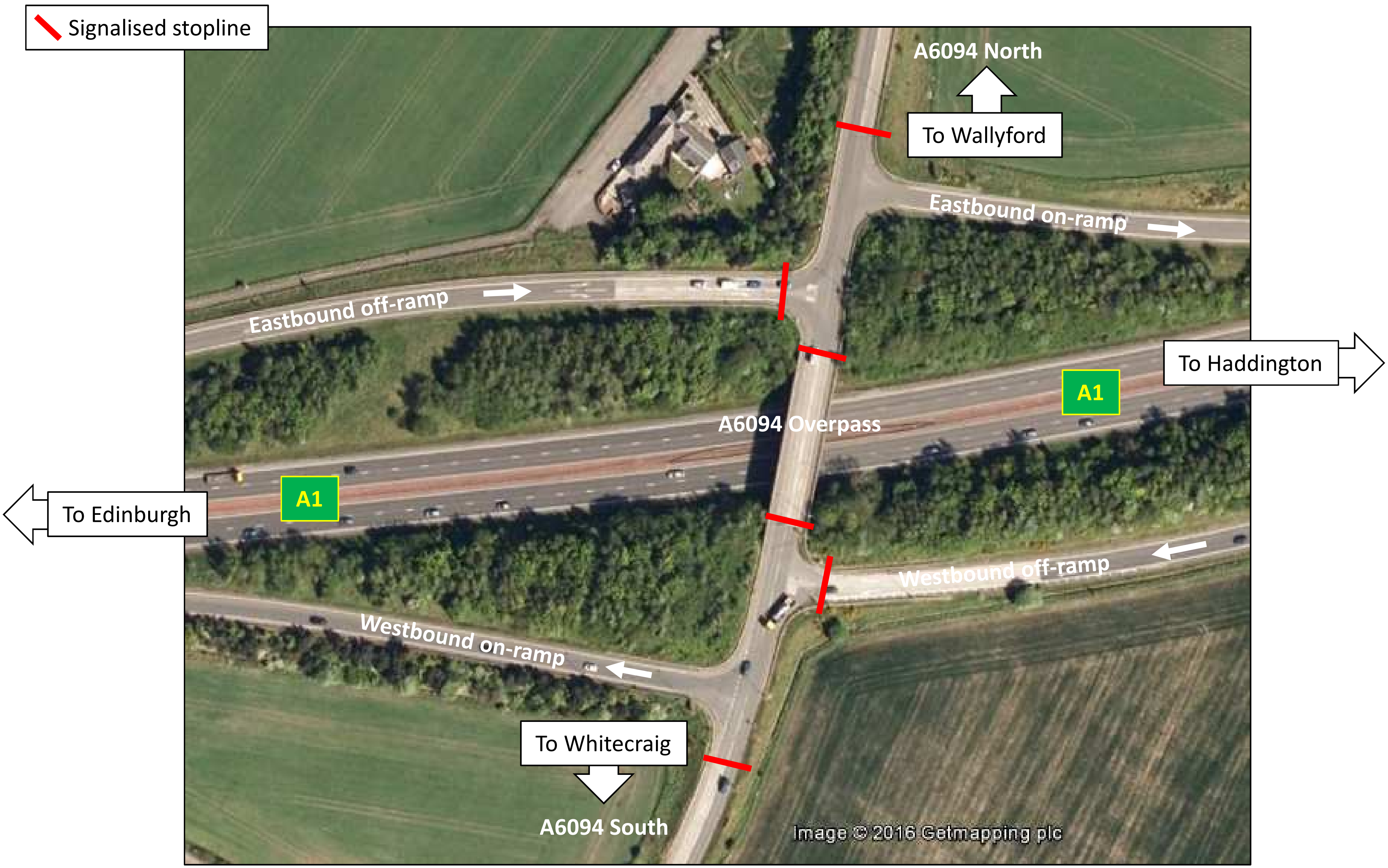

Figure A1

A1 at Salters Road

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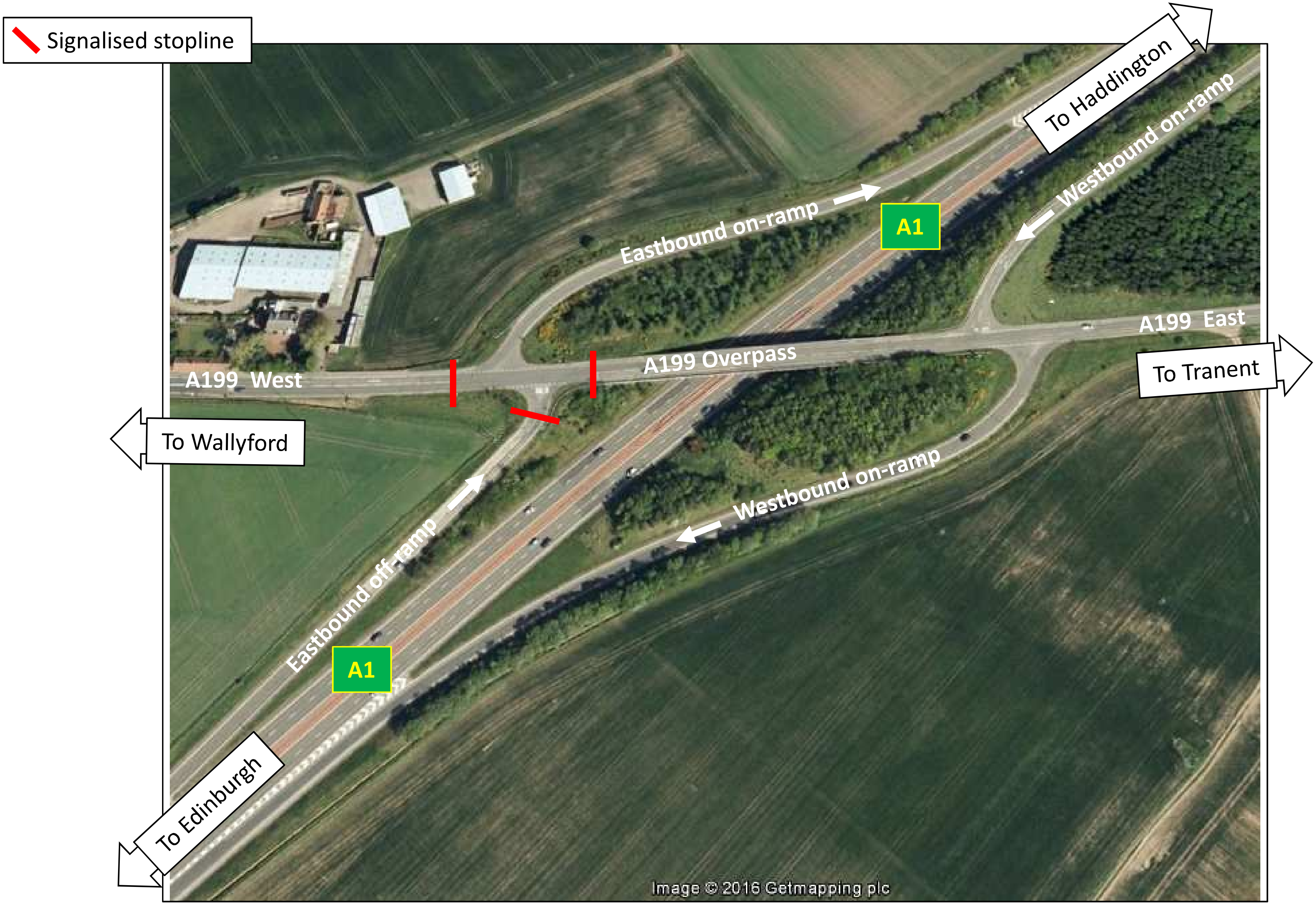

Figure A2

A1 at Dolphingstone

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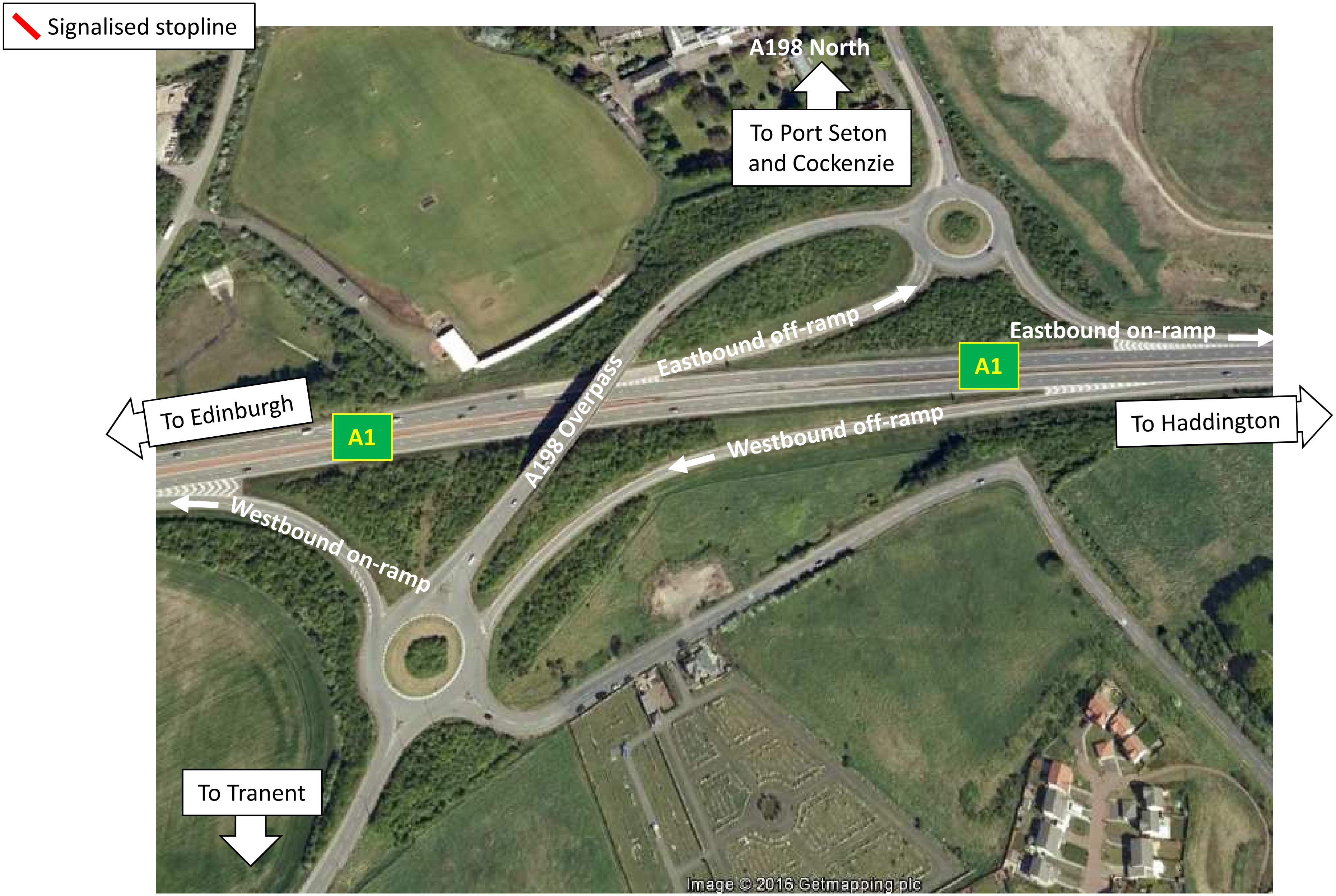

Figure A3

A1 at Bankton Junction

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peterbrett

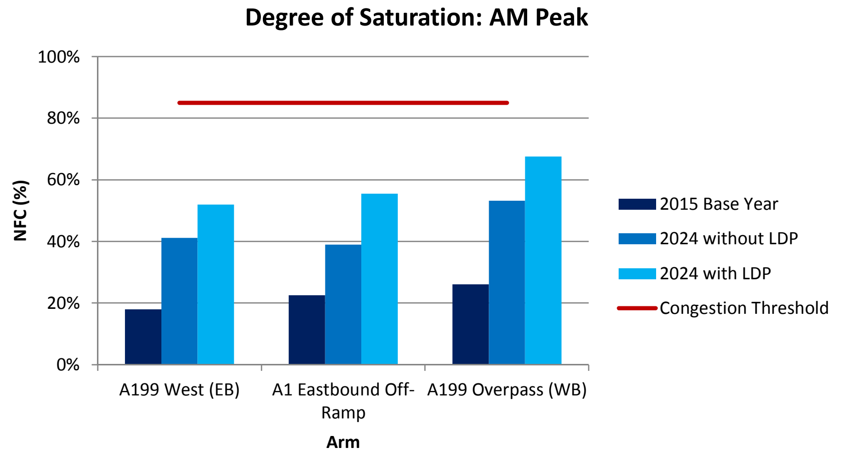
Annex B Model Results

A1 at Dolphinstone

East Junction (Eastbound on / off ramps)

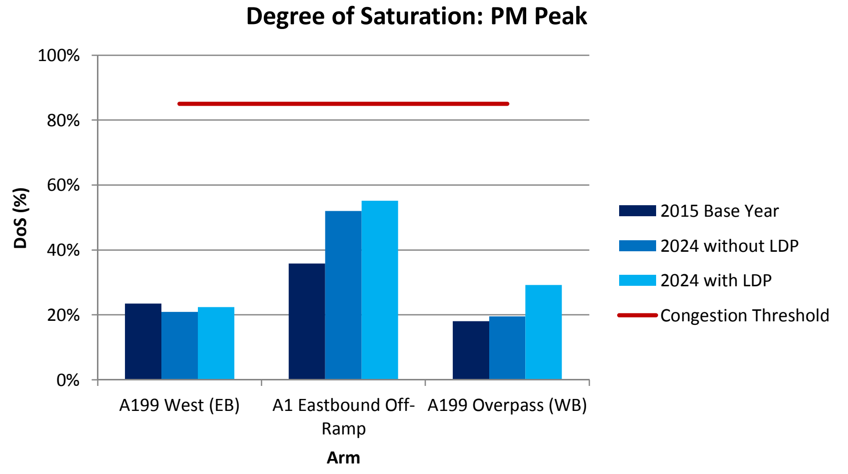
AM Peak

Arm	Name	2015 Base Year			2024 without LDP			2024 with LDP		
		Total Delay (PCU / Hr)	MMQ (PCU)	DoS (%)	Total Delay (PCU / Hr)	MMQ (PCU)	DoS (%)	Total Delay (PCU / Hr)	MMQ (PCU)	DoS (%)
1	A199 West (EB)	0.2	1.5	17.9%	1.5	6.7	41.1%	2.3	9.6	52.0%
3	A1 Eastbound Off-Ramp	0.3	1.8	22.5%	1.3	5.4	39.0%	2.3	9.0	55.5%
6	A199 Overpass (WB)	0.4	2.7	26.1%	2.6	10.8	53.2%	3.4	13.8	67.6%
Junction Total				26%			53%			68%



PM Peak

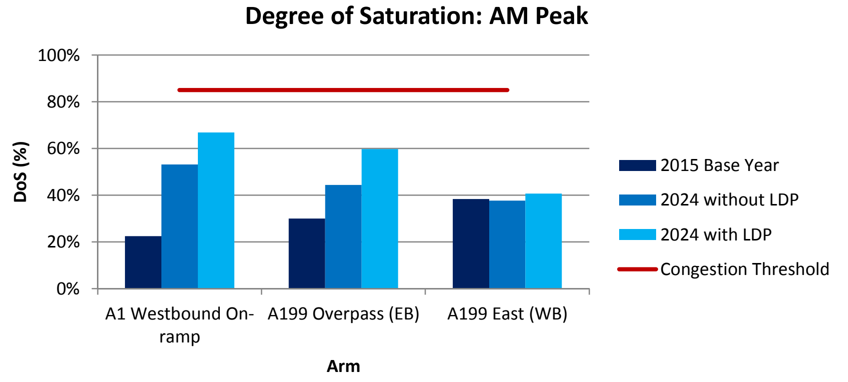
Arm	Name	2015 Base Year			2024 without LDP			2024 with LDP		
		Total Delay (PCU / Hr)	MMQ (PCU)	DoS (%)	Total Delay (PCU / Hr)	MMQ (PCU)	DoS (%)	Total Delay (PCU / Hr)	MMQ (PCU)	DoS (%)
1	A199 West (EB)	0.3	2.1	23.5%	0.3	1.9	20.9%	0.4	2.2	22.4%
3	A1 Eastbound Off-Ramp	0.5	3.3	35.8%	1.0	5.9	52.0%	1.3	7.4	55.2%
6	A199 Overpass (WB)	0.2	1.8	18.1%	0.3	2.1	19.6%	0.5	2.9	29.2%
Junction Total				36%			52%			55%



West Junction (Westbound on / off ramps)

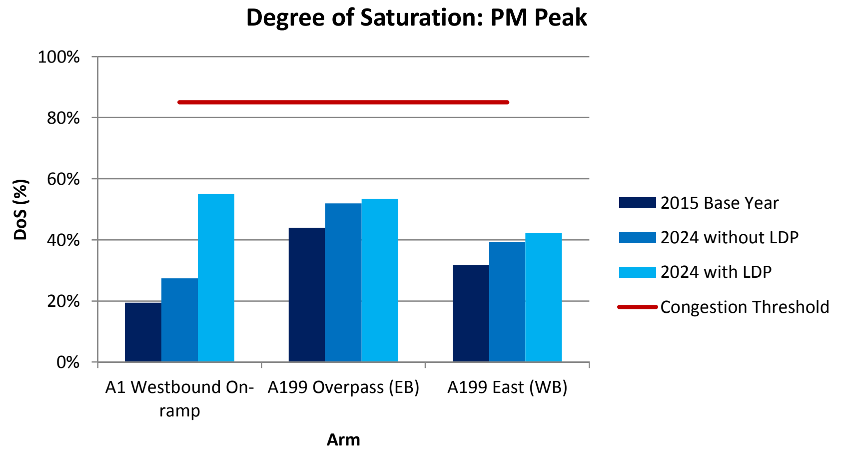
AM Peak

Arm	Name	2015 Base Year			2024 without LDP			2024 with LDP		
		Total Delay (PCU / Hr)	MMQ (PCU)	DoS (%)	Total Delay (PCU / Hr)	MMQ (PCU)	DoS (%)	Total Delay (PCU / Hr)	MMQ (PCU)	DoS (%)
7	A1 Westbound On-ramp	0.2	0.4	22.5%	1.5	4.9	53.1%	2.6	5.8	66.9%
5	A199 Overpass (EB)	0.2	0.2	30.0%	0.5	9.5	44.4%	1.7	22.4	59.7%
10	A199 East (WB)	0.3	0.3	38.4%	0.3	0.3	37.7%	0.3	0.3	40.7%
Junction Total				38%			53%			67%
Junction Cycle Time (s)		90			90			90		



PM Peak

Arm	Name	2015 Base Year			2024 without LDP			2024 with LDP		
		Total Delay (PCU / Hr)	MMQ (PCU)	DoS (%)	Total Delay (PCU / Hr)	MMQ (PCU)	DoS (%)	Total Delay (PCU / Hr)	MMQ (PCU)	DoS (%)
7	A1 Westbound On-ramp	0.1	0.5	19.4%	0.3	0.9	27.4%	1.4	2.7	55.0%
5	A199 Overpass (EB)	0.4	0.4	44.0%	0.5	0.5	51.9%	0.6	0.6	53.4%
10	A199 East (WB)	0.2	0.2	31.8%	0.3	0.3	39.4%	0.4	0.4	42.3%
Junction Total				44%			52%			55%
Junction Cycle Time (s)		90			90			90		

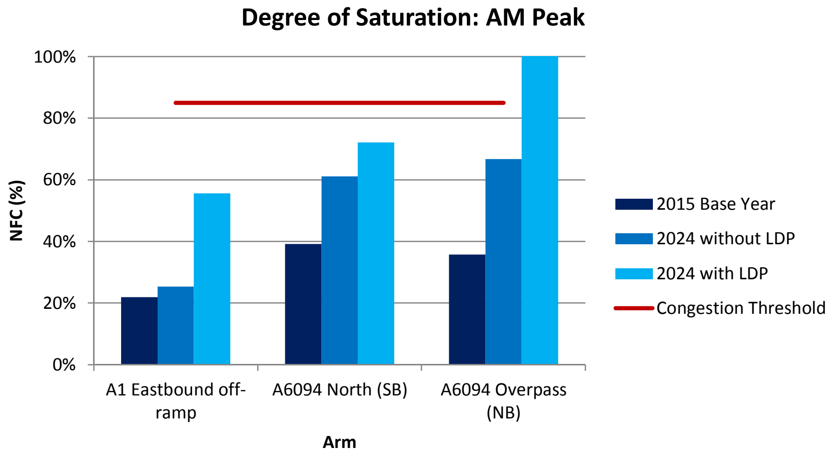


A1 at Salters Road

Northern Junction (Eastbound on / off ramps)

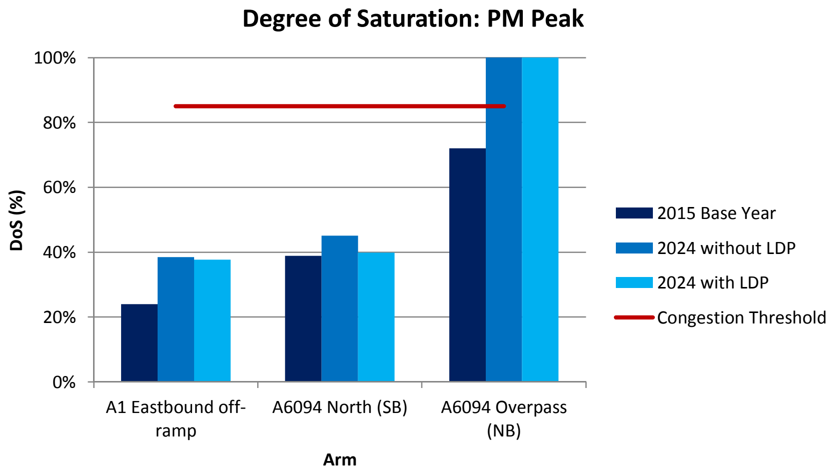
AM Peak

Arm	Name	2015 Base Year			2024 without LDP			2024 with LDP		
		Total Delay (PCU / Hr)	MMQ (PCU)	DoS (%)	Total Delay (PCU / Hr)	MMQ (PCU)	DoS (%)	Total Delay (PCU / Hr)	MMQ (PCU)	DoS (%)
7	A1 Eastbound off-ramp	0.8	1.9	21.9%	0.9	2.1	25.3%	2.2	4.5	55.6%
10	A6094 North (SB)	1.2	5.9	39.2%	2.4	11.5	61.1%	3.1	15.7	72.1%
5	A6094 Overpass (NB)	0.7	3.7	35.7%	2.0	6.7	66.7%	76.1	82.5	144.3%
Junction Total				39%			67%			144%
Junction Cycle Time (s)		90			90			90		



PM Peak

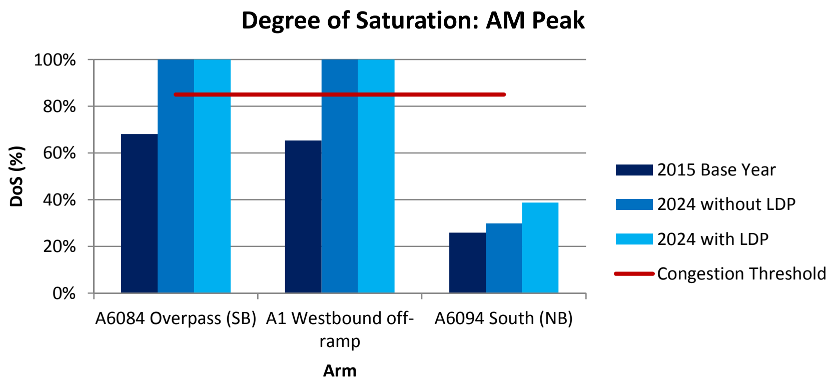
Arm	Name	2015 Base Year			2024 without LDP			2024 with LDP		
		Total Delay (PCU / Hr)	MMQ (PCU)	DoS (%)	Total Delay (PCU / Hr)	MMQ (PCU)	DoS (%)	Total Delay (PCU / Hr)	MMQ (PCU)	DoS (%)
7	A1 Eastbound off-ramp	1.0	2.9	24.0%	1.7	4.0	38.5%	1.6	3.7	37.7%
10	A6094 North (SB)	1.8	6.2	38.9%	1.7	7.6	45.1%	1.3	6.2	39.9%
5	A6094 Overpass (NB)	3.3	9.3	72.0%	102.1	115.7	128.5%	127.0	143.5	130.7%
Junction Total				72%			129%			131%
Junction Cycle Time (s)		90			90			90		



Southern Junction (Westbound on / off ramps)

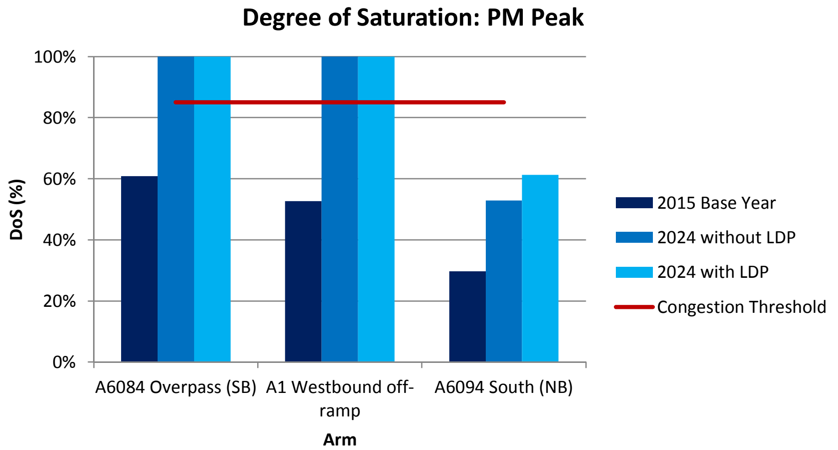
AM Peak

Arm	Name	2015 Base Year			2024 without LDP			2024 with LDP		
		Total Delay (PCU / Hr)	MMQ (PCU)	DoS (%)	Total Delay (PCU / Hr)	MMQ (PCU)	DoS (%)	Total Delay (PCU / Hr)	MMQ (PCU)	DoS (%)
6	A6084 Overpass (SB)	1.6	7.6	68.1%	65.6	85.5	112.9%	266.9	286.0	161.8%
3	A1 Westbound off-ramp	2.5	4.5	65.4%	23.9	27.7	112.6%	46.7	49.9	144.7%
2	A6094 South (NB)	0.4	2.6	25.9%	0.6	3.4	29.9%	0.7	4.2	38.7%
Junction Total				68%			113%			162%
Junction Cycle Time (s)		90			90			90		



PM Peak

Arm	Name	2015 Base Year			2024 without LDP			2024 with LDP		
		Total Delay (PCU / Hr)	MMQ (PCU)	DoS (%)	Total Delay (PCU / Hr)	MMQ (PCU)	DoS (%)	Total Delay (PCU / Hr)	MMQ (PCU)	DoS (%)
6	A6084 Overpass (SB)	1.2	7.1	60.8%	106.4	120.3	132.9%	156.7	166.7	168.2%
3	A1 Westbound off-ramp	1.9	3.8	52.7%	31.2	33.8	132.0%	62.4	66.2	154.8%
2	A6094 South (NB)	0.6	3.5	29.7%	1.1	6.8	52.9%	1.7	9.8	61.3%
Junction Total				61%			133%			168%
Junction Cycle Time (s)		90			90			90		

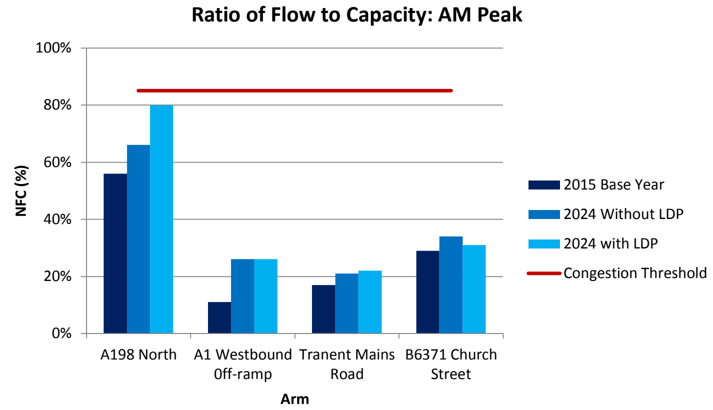


A1 at Bankton: Base Scenario

Northern Roundabout

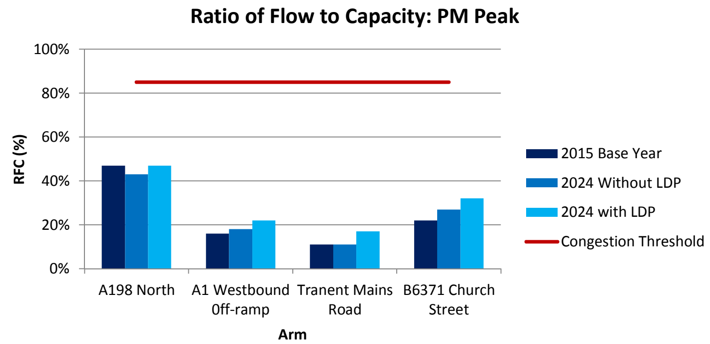
AM Peak

Arm	Name	2015 Base Year				2024 Without LDP				2024 with LDP			
		Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
S1	A198 North	56%	5.4	1.4	A	66%	7.0	2.1	A	80%	11.6	4.2	B
S2	A1 Westbound 0ff-ramp	11%	3.8	0.1	A	26%	4.9	0.4	A	26%	5.5	0.4	A
S3	Tranent Mains Road	17%	5.2	0.2	A	21%	6.4	0.3	A	22%	7.2	0.3	A
S4	B6371 Church Street	29%	6.1	0.5	A	34%	7.0	0.6	A	31%	7.3	0.5	A
Junction Total					A				A				A



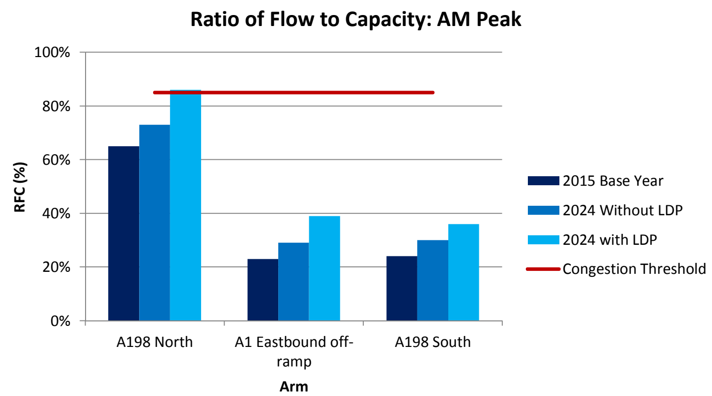
PM Peak

Arm	Name	2015 Base Year				2024 Without LDP				2024 with LDP			
		Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
S1	A198 North	47%	4.5	1.0	A	43%	4.2	0.8	A	47%	4.5	1.0	A
S2	A1 Westbound 0ff-ramp	16%	3.7	0.2	A	18%	3.7	0.2	A	22%	4.0	0.3	A
S3	Tranent Mains Road	11%	4.4	0.1	A	11%	4.4	0.1	A	17%	4.8	0.2	A
S4	B6371 Church Street	22%	4.9	0.3	A	27%	5.3	0.4	A	32%	5.9	0.5	A
Junction Total					A				A				A



AM Peak

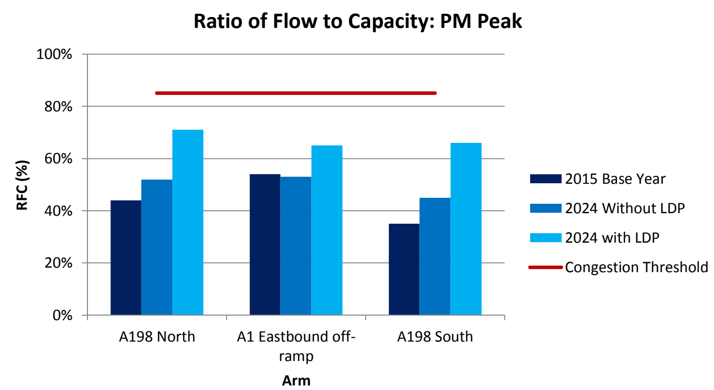
Arm	Name	2015 Base Year				2024 Without LDP				2024 with LDP			
		Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
N1	A198 North	65%	7.1	2.0	A	73%	9.6	2.9	A	86%	19.3	6.4	C
N3	A1 Eastbound off-ramp	23%	3.3	0.3	A	29%	3.6	0.4	A	39%	5.1	0.7	A
N4	A198 South	24%	3.7	0.3	A	30%	4.1	0.5	A	36%	4.8	0.6	A
Junction Total					A				A				A



Southern Roundabout

PM Peak

Arm	Name	2015 Base Year				2024 Without LDP				2024 with LDP			
		Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS	Max RFC	Max Delay (s)	Max Queue (PCU)	Max LOS
N1	A198 North	44%	4.5	0.9	A	52%	5.4	1.2	A	71%	9.7	2.6	A
N3	A1 Eastbound off-ramp	54%	4.9	1.3	A	53%	4.9	1.3	A	65%	6.9	2.0	A
N4	A198 South	35%	5.2	0.6	A	45%	6.2	0.9	A	66%	11.0	2.1	B
Junction Total					A				A				A



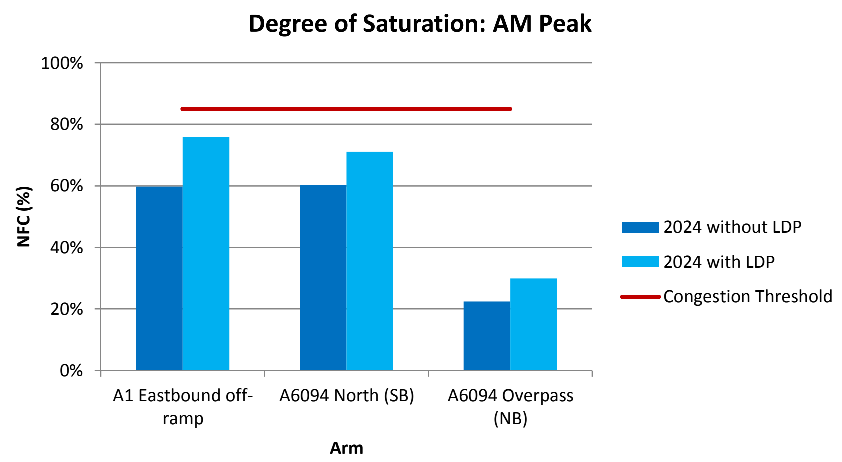
Annex C Remedial Measures Model Results

A1 at Salters Road

Northern Junction (Eastbound on / off ramps)

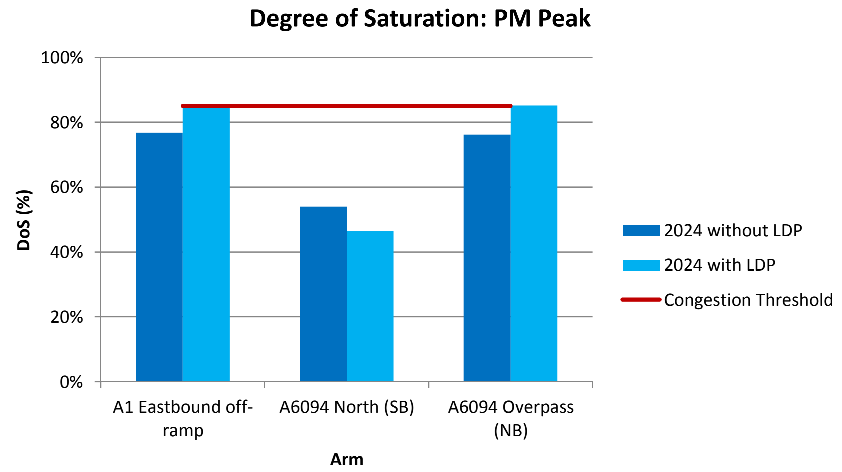
AM Peak

Arm	Name	2024 without LDP Total Delay (PCU / Hr)	2024 without LDP MMQ (PCU)	2024 without LDP DoS (%)	2024 with LDP Total Delay (PCU / Hr)	2024 with LDP MMQ (PCU)	2024 with LDP DoS (%)
7	A1 Eastbound off-ramp	3.9	9.2	59.8%	5.4	11.5	75.9%
10	A6094 North (SB)	3.1	15.8	60.3%	4.0	21.2	71.1%
5	A6094 Overpass (NB)	0.4	1.1	22.4%	0.7	5.5	29.9%
Junction Total				60%			76%
Junction Cycle Time (s)		120			120		



PM Peak

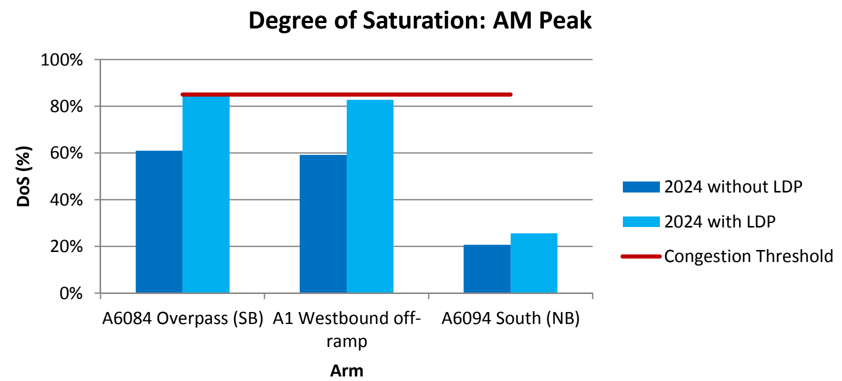
Arm	Name	2024 without LDP Total Delay (PCU / Hr)	2024 without LDP MMQ (PCU)	2024 without LDP DoS (%)	2024 with LDP Total Delay (PCU / Hr)	2024 with LDP MMQ (PCU)	2024 with LDP DoS (%)
7	A1 Eastbound off-ramp	6.8	19.6	76.8%	8.6	22.2	84.8%
10	A6094 North (SB)	3.7	13.3	54.0%	2.8	10.9	46.4%
5	A6094 Overpass (NB)	5.5	22.4	76.2%	5.0	29.4	85.2%
Junction Total				77%			85%
Junction Cycle Time (s)		120			120		



Southern Junction (Westbound on / off ramps)

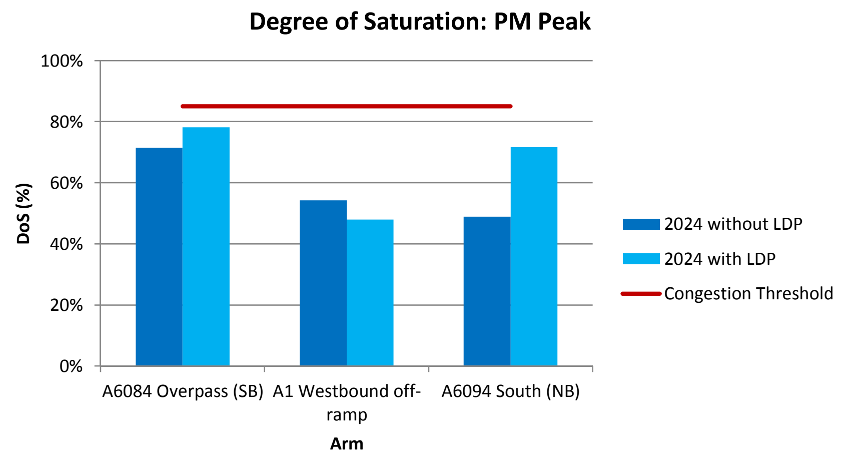
AM Peak

Arm	Name	2024 without LDP Total Delay (PCU / Hr)	2024 without LDP MMQ (PCU)	2024 without LDP DoS (%)	2024 with LDP Total Delay (PCU / Hr)	2024 with LDP MMQ (PCU)	2024 with LDP DoS (%)
6	A6084 Overpass (SB)	1.2	15.6	61.0%	5.2	33.3	85.8%
3	A1 Westbound off-ramp	3.6	8.7	59.2%	5.5	10.2	82.7%
2	A6094 South (NB)	0.6	3.6	20.7%	0.5	3.5	25.6%
Junction Total				61%			86%
Junction Cycle Time (s)		120			120		



PM Peak

Arm	Name	2024 without LDP Total Delay (PCU / Hr)	2024 without LDP MMQ (PCU)	2024 without LDP DoS (%)	2024 with LDP Total Delay (PCU / Hr)	2024 with LDP MMQ (PCU)	2024 with LDP DoS (%)
6	A6084 Overpass (SB)	3.3	18.3	71.4%	5.3	18.2	78.2%
3	A1 Westbound off-ramp	2.9	6.5	54.2%	2.9	8.0	48.0%
2	A6094 South (NB)	1.6	9.9	48.9%	5.2	22.0	71.7%
Junction Total				71%			78%
Junction Cycle Time (s)		120			120		



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