From:	Anne Robinson
To:	A57 Link Roads
Cc:	"Keith Buchan"
Subject:	A57 Link Roads Additional documents
Date:	06 January 2022 15:43:36
Attachments:	image001.png HE551473-BBA-GEN-A57_AL_SCHEME-AS-TB-000001 P07 Economic appraisal.pdf HE551473-BBA-GEN-A57_AL_SCHEME-AS-TR-000002 P05 Trans Modelling.pdf

Dear Planning Team

As we stated at the Preliminary Meeting on 16th November, at our request we received 4 documents from National Highways (NH) on 12th November. These are:

- Trans-Pennine Upgrade Stage 3 combined modelling and appraisal report
- A57 Economic appraisal package
- A57 Transport modelling package
- A57 Transport forecasting Package.

We had been requesting information that these documents would have supplied since our first contact in March 2021 (although this apparently was not initially received by NH).

At the Preliminary Meeting we suggested dialogue with NH but this did not take place until the 15th December. At that virtual meeting on 15th December we spelt out the information it would be helpful to receive and followed up with an email immediately afterwards. Despite chasing no substantive response or specific information has been received subsequent to the standard documents sent to us just before the Preliminary Meeting. At the meeting on the 15th December we raised the issue of submitting the above basic documents. We were surprised to learn that these were not to be submitted by NH. We believe they are of a standard nature and could have been available much earlier.

On 23rd December our consultant wrote to NH saying

"This also makes our position very difficult in terms of what is in front of the DCO, particularly in relation to the documents you sent to me which I consider basic and in at least one case have been asking for since March. That document (LMVR equivalent) was almost certainly available at that time. They help make sense of my questions for further information as well clarifying some key issues. We will obviously need to consider how to handle this - I'm not sure that referring to unsubmitted documents which contain basic technical information is acceptable in terms of my professional code of conduct apart from anything else."

Having had no response to that issue and considering the matter this week, we feel we have no choice other than to submit the above four documents as soon as possible. Even though they are technical documents they should be available to everyone for scrutiny. The public can only give a sensible opinion on environmental matters if they have access to the background data on projected environmental effects. We are also profoundly concerned that the clarificatory information we have requested has not been sent and that time is extremely short. Despite this we intend to keep to the January 14th deadline and will deal with substantive issues to the best of our ability using existing documentation.

Due to the size of these 4 documents I will have to send 2 of them separately. Here are the first 2.
Best wishes
Anne

Anne Robinson
Campaigner
CPRE Peak District and South Yorkshire

[redacted]

DRIVING OUTCOMES

Routes to Market – Delivery Integration Partnership

A57 TPU

A57 Economic Appraisal Package

HE551473-BBA-GEN-A57_AL_SCHEME-AS-TB-000001
26/07/21

Notice

This document and its contents have been prepared and are intended solely as information for and use in relation to A57 TPU. Balfour Beatty Atkins assumes no responsibility to any other party in respect of or arising out of or in connection with this document and/or its contents.

This document has 93 pages including the cover.

Document history

Revision	Suitability	Purpose description	Originated	Checked	Reviewed	Authorised	Date
[redacted]							

Contents

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Executive Summary

Scheme Overview

1.1.1. Highways England (the “Applicant”) is applying to the Planning Inspectorate (“the Inspectorate”) acting on behalf of the Secretary of State for Transport (“SoS”), under Section 37 of the Planning Act 2008 (“the Act”) for a Development Consent Order (DCO). If made, the DCO would grant consent for the Applicant to build, operate and maintain the A57 Link Roads project (“the Scheme”).

1.1.2. Following feasibility studies, a package of measures referred to here as the Trans-Pennine Upgrade (TPU) was announced in the Road Investment Strategy (RIS), published by the Department for Transport (DfT) in March 2015. Further consideration of benefits related to that scheme have led to additional stages of option identification, sifting, value management, statutory consultation, design and further consultation to arrive at the current proposed scheme which is comprised of:

- Mottram Moor Link Road - a new dual-carriageway link road from M67 Junction 4 to a new junction at A57(T) Mottram Moor and a new single carriageway connecting to the A6018 Roe Cross Road
- A57(T) to A57 Link Road – a new single carriageway link from the A57 at Mottram Moor to a new junction on the A57 at Brookfield, bypassing the existing A628/A57 and A57 Woolley Lane/Woolley Bridge Road junctions
- Upgrades to M67 Junction 4 and the A57/A628 junction to improve safety and optimise flow of traffic.

Purpose

1.1.3. The network section which the A57 Link Roads scheme has been designed to improve lies on the most direct strategic route between Manchester and Sheffield. It has suffered from longstanding connectivity issues, with high levels of congestion leading to low speeds and unreliable journey times, affecting the connection between the M67 and the A628 or A57 routes across the Pennines.

1.1.4. The Client Scheme Requirements (CSR) for the scheme are:

- **Connectivity** - reducing congestion and improve the reliability of people’s journeys between the Manchester and Sheffield city regions.
- **Environmental** – improving air quality and reducing noise levels in certain areas, through reduced congestion and removal of traffic from residential areas. The scheme is also being designed to avoid unacceptable impacts on the natural environment and landscape in the Peak District National Park.
- **Societal** – re-connect local communities along the Trans-Pennine route.
- **Capacity** – reduce delays and queues that occur during busy periods and improve the performance of junctions on the route.

Scheme Benefits

1.1.5. The scheme has been forecast to deliver significant economic benefits, with key contributions being derived from journey time savings, particularly for business users making longer distance trips which may otherwise have diverted onto significantly longer distance routes to avoid the congestion and delays in this area. Commuting and other local movements will also benefit from transfer of traffic onto the proposed new links, easing localised congestion on the existing network.

1.1.6. A further significant economic benefit will be derived from improved connectivity leading to agglomeration benefits. The reduced congestion levels and improved journey reliability will effectively bring firms in the area closer together leading to increased productivity. This impact will be felt in the region immediately around the A57 Link Roads scheme but will also affect the cities of Manchester and Sheffield which represent key clusters of economic activity either side of the Pennines.

1.1.7. The bypass around Mottram will divert all but local traffic around the town, making it a safer and quieter place, with improved air quality. The removal of congestion from this area will however have the impact of increasing traffic flows at either end of the scheme and on the network as a whole. This will result in increased emissions, reduced air quality in the wider region and a forecast increase in accidents, as more traffic will use the A57 Snake Pass, which is known to be a high-risk route.

1.1.8. During its construction period impacts on traffic will be relatively limited as much of the work will be offline, while the design has ensured that any adverse environmental impacts will be limited or fully mitigated where feasible.

Value for Money

1.1.9. This document provides a detailed review of the assessment of benefits and disbenefits described above and of the cost which would be involved in building and the maintaining the scheme over its lifetime.

1.1.10. The economic assessment indicates that the scheme would return a BCR above 2, representing an economic net benefit of more than £2 for every £1 invested.

1.1.11. Certain adverse effects on the wider transport network are recognised and measures to mitigate these will be considered. These adverse effects do not however outweigh the benefits and the overall planning balance is therefore in favour of the making of the DCO to enable the Scheme to be delivered.

1. Introduction

1.1. Background

1.1.1 Highways England has been delivering £15 billion of investment to the Strategic Road Network (SRN) set out in the December 2014 Road Investment Strategy (RIS). The Trans-Pennine Upgrade (TPU) is a critical part of this investment to address Trans-Pennine connectivity, particularly between two important Northern cities of Manchester and Sheffield. The existing routes currently suffer from significant congestion, poor journey times, poor reliability, and high accident rates.

1.1.2 The proposed scheme was first identified for delivery as part of the Highways England Road Investment Strategy (RIS1), planned for delivery during the latter part of the period covering 2015 to 2020. Further development work has seen the delivery date amended, with the scheme now included in RIS2, which covers investments in the Strategic Road Network of £27.4 billion between 2020 and 2025.

1.1.3 Atkins were commissioned by HE to undertake a review of the work done by consultants Arcadis at PCF Stage 3 for the proposed A57 Link Roads scheme. The aim of this process was to strengthen the robustness of the modelling to ensure high levels of scrutiny for the Development Consent Order (DCO). Following the presentation of the review findings in the summer of 2019, Atkins were commissioned to implement their recommendations and finalise PCF Stage 3.

1.1.4 This Economic Appraisal Package (EAP) will outline the detailed assumptions and the methodology used to carry out the robust economic assessment which will help to understand the incurred cost, benefits, and the risk associated with this transport scheme in the long run.

1.2 Scheme Objectives

1.2.1 The purpose of the A57 Link Roads is to address longstanding issues of connectivity, congestion, network reliability and safety of strategic Trans-Pennine routes between the M67 at Mottram and the M1 J36 and J35A north of Sheffield.

1.2.2 The strategic objectives of the Trans-Pennine Upgrade Scheme, as set out in the Client Scheme Requirements (CSR) are:

- **Connectivity** – reducing congestion and improve the reliability of people's journeys between the Manchester and Sheffield city regions.
- **Environmental** – improving air quality and reducing noise levels in certain areas, through reduced congestion and removal of traffic from residential areas. The scheme is also being designed to avoid unacceptable impacts on the natural environment and landscape in the Peak District National Park.
- **Societal** – re-connect local communities along the Trans-Pennine route.
- **Capacity** – reduce delays and queues that occur during busy periods and improve the performance of junctions on the route.

1.2.3 In addition to these scheme specific objectives consideration has been made of the performance of the scheme in contributing to the wider RIS2 Key Performance Indicators (KPIs). These KPIs encompass:

- Improving safety for all.
- Providing fast and reliable journeys.
- A well maintained and resilient network.
- Delivering better environmental outcomes.
- Meeting the needs of all road users.
- Achieving efficient delivery.

1.2.4 Each of these overarching objectives includes sub-objectives and indicators for measuring success. A Benefits Register has been developed which records details of these and the specific performance of the scheme in each area. This register is maintained and updated as the scheme progresses through each stage of development. Key findings of this Benefits Register are presented in the Appraisal Summary Table, which is presented in the Business Case.

1.3 Proposed scheme

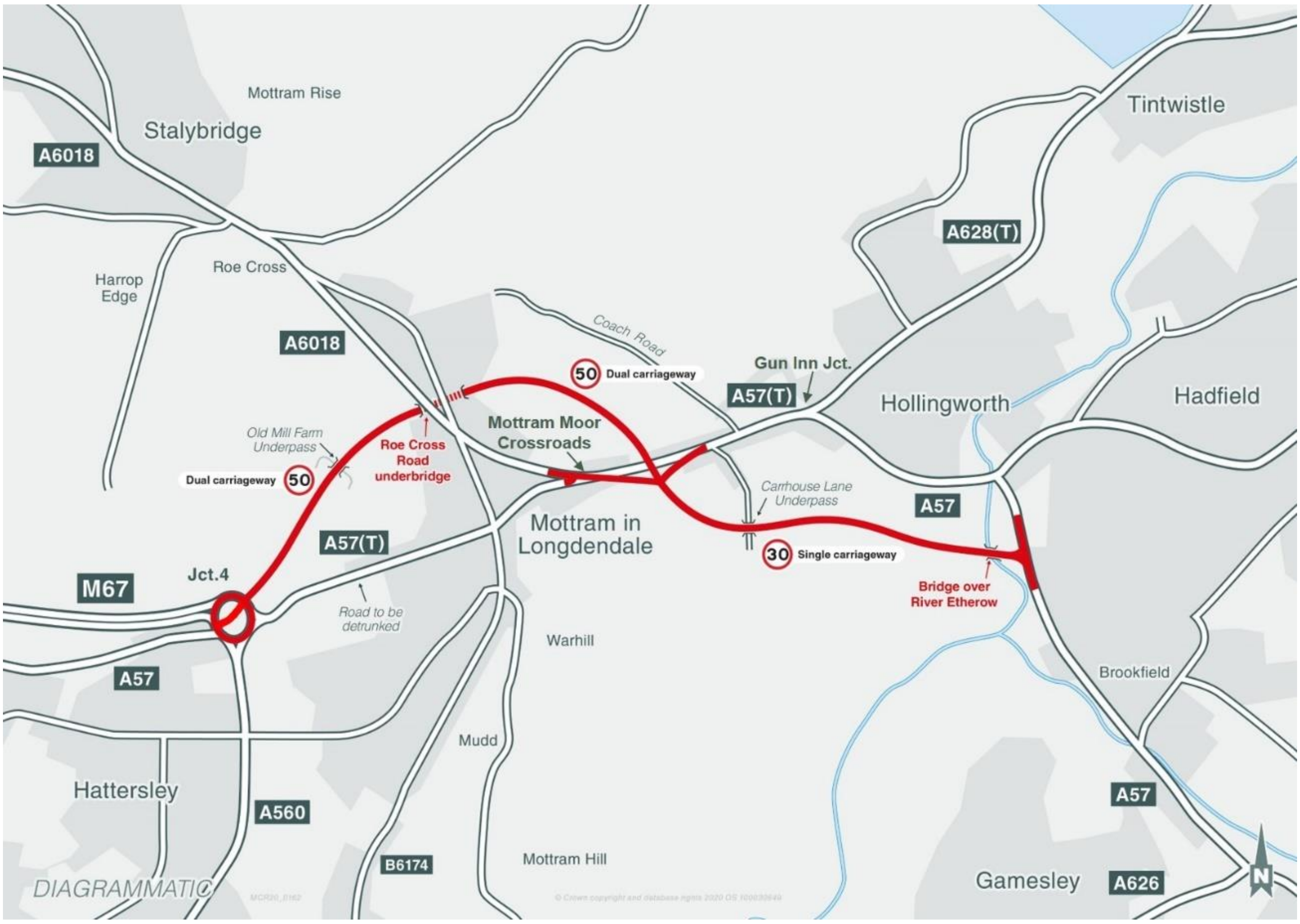
1.3.1 The Trans-Pennine route consists of a road network largely made up of A-roads which crosses the Peak District National Park. The main Trans-Pennine road route between Manchester and Sheffield is a trunk road consisting of the A57, A628, A616 and A61. This route connects the M67 at Mottram in the east of Manchester City Region with the M1 in the north-west of the Sheffield City Region. The other routes that provide connections between Manchester and Sheffield are via the A57, A6187, A623 and other local roads. These routes form the key strategic link between Manchester and Sheffield.

1.3.2 The Trans-Pennine Upgrade scheme taken forward as part of PCF Stage 3 comprises of the following scheme elements described below:

- **Mottram Moor Link Road** - a new dual-carriageway link road from the M67 terminal roundabout to a new junction at A57(T) Mottram Moor.
- The A57 / B6174 junction (Mottram crossroads): separate signal staging for Stalybridge Road and Market Street (run together in the same stage in the without scheme scenario), which permits additional green time for pedestrian movements, plus the reduction of right-turning vehicles blocking the junction whilst waiting for gaps in the traffic.
- **A57(T) to A57 Link Road** - a new single carriageway link from the A57 at Mottram Moor to a new junction on the A57 at Brookfield, bypassing the existing A628/ A57 and A57 Woolley Lane/Hadfield road junctions.
- **M67 Terminal Junction 4 Roundabout Improvements** - the addition of traffic signals, carriageway widening and a cut-through link between the M67 and the Mottram Moor link road.
- **A57 / A628 junction (Gun Inn junction)** - greater green time for pedestrian movements, reflective of improved pedestrian facilities at the Gun Inn junction.
- **A57 (Mottram Moor)** - a reduction in lane provision of the existing A57 between Mottram and the Gun Inn junction to provide parking and improved non-motorised users (NMU) facilities.

1.3.3 The proposed scheme seeks to improve the Trans-Pennine route between two important Northern cities: Manchester and Sheffield. The preferred route for the scheme is shown in Figure 1-1.

Figure 1-1 - Proposed Scheme



1.4 Purpose of the Report

1.4.1 The purpose of this report is to set out the details of the approach adopted for the estimation of economic benefits arising from the scheme and summarises the results of the assessments. This report is accompanied by a Traffic Forecasting Report which has been provided separately.

1.4.2 The report also seeks to establish the extent to which the scheme provides good value for money in relation to the impact on public accounts by considering improvements to transport economic efficiency for all users, environmental impacts, effects on the wider economy and the social and distributional effects of the scheme.

1.5 Previous Economic Assessments

1.5.1 At PCF Stage 0 (Feasibility Study) an economic assessment of four primary packages of the scheme options was produced in February 2015 by Mouchel Group consultants (now WSP). (Reference- Trans-Pennine Routes Feasibility Study Stage 3 Report', 2015).

1.5.2 At PCF Stage 1 (Options Development and First Sift), a long list of options was developed followed by the economic assessment and ranking of four strategic scheme options. (Report Reference: HE550691-HYD-GEN-TP01-TN-PM-1033). A second sift at PCF Stage 1 led to further economic assessment and ranking of four strategic scheme options (Report Reference: HE550691-HYD-GEN-TP01-TN-1049).

1.5.3 Economic assessments for Packages A to G were carried out in PCF Stage 2. The economic assessment was undertaken over the standard 60-year appraisal with 2023 as the scheme opening year. The economic assessment used the following software packages:

- Transport user Benefit Appraisal (TUBA, version 1.9.8)
- Cost and benefit to Accidents – Light Touch (COBALT, version 2013.2)
- Queues and Delays at Roadworks (QUADRO version 4.12.1.124)

1.5.4 A summary of the benefits, costs and Benefits to Cost Ratio (BCR) is presented in Table 1-1 for Trans-Pennine Upgrade (TPU) schemes, Packages A to D with Climbing lanes, Greenhouse gases and Noise assessment. At the time, the assessment for Greenhouse gases and Noise was not undertaken for Packages E and F. Additionally, the Safety and Technology scheme costs were included in the Present Value of Cost (PVC), however the corresponding benefits were not considered the Present Value of Benefits (PVB)

Table 1-1 - Total Road User Benefit (£million), Cost and BCR for TPU schemes (£m)

Package	TUBA	Accident	Green House Gases	Noise	Climbing Lanes	PVB	PVC	BCR
Package A	✓	✓	✓	✓	✓	524.89	170.87	3.07
Package B	✓	✓	✓	✓	✓	460.96	196.93	2.34
Package C	✓	✓	✓	✓	✓	398.10	155.45	2.56
Package D	✓	✓	✓	✓	✓	586.37	181.57	3.23
Package E	✓	✓	x	x	✓	640.47	163.65	3.91
Package F	✓	✓	x	x	✓	516.01	190.99	2.70
Package G	✓	✓	x	x	X	587.69	148.21	3.97

Note: All monetary values are in 2010 market prices discounted to 2010

1.5.5 Details relating to economic analyses are documented within the Economic Assessment Report, document reference: HE551473-ARC-GEN-ZZZ-TP-TR-2030 version 3.0

1.5.6 At PCF Stage 3 (Preliminary design), in 2019 an economic assessment, based on TUBA version 1.9.10, was undertaken over the standard 60-year appraisal with 2023 as the scheme opening year. From the analysis, TPU scheme was expected to generate user benefits of approximately £264million (in 2010 prices, discounted to 2010) for the core growth scenario. The scheme has an initial BCR of 1.7 without reliability and wider economic benefits and an adjusted BCR of 2.4 including the reliability and wider economic benefits.

1.5.7 A TUBA user benefit assessment was carried out using the AM, IP, and PM periods for the core growth scenario. The total benefits after accounting for operator revenue and indirect tax revenue, generated by the scheme was £277.07 million. In terms of user benefit by Time period, the PM Peak was accounted for the largest proportion of benefits of approx. 42% closely followed by Inter-Peak (41%).

1.5.8 Details relating to PCF Stage 3 economic analyses are documented within the Stage 3 Combined Modelling and Appraisal Report, document reference: HE551473-ARC-HGN-TPU-RP-D-3061 (17 May 2019).

1.5.9 Subsequently to this assessment revisions have been made to the scheme design with modelling and economic assessment being updated.[1]

[1] As a result of the specification changes the Trans-Pennine Upgrade (TPU) Scheme has been renamed as the A57 Link Roads Scheme

1.5.10 Improvements to Westwood Roundabout, at the intersection between the A61 and A616 have been removed, to be assessed independently, while addition of technology schemes along the A628(T) have been excluded, focussing the scheme more on the immediate area set out in the figure above.

1.5.11 In addition, safety improvements have been included in this area, to provide non-motorised users (NMUs) improved access by upgrading the design and including additional pedestrian phases for signals at the A57/A628 junction at Gun Inn. Further, a cut-through of Hattersley Roundabout has been included to improve efficiency of this junction.

1.5.12 Scheme costs and benefits have been updated to reflect these design changes and also to capture impacts of updates to the transport model, changes in guidance and variations to forecasts of economic growth which have occurred over this period. Details of the updated assessments are set out in this document and in the supporting Traffic Forecasting Report.

1.6 Structure of the Report

1.6.1 The report is divided into six sections, the brief details of which are as follows:

- **Chapter 2 Economic Appraisal Approach** – provides an overview of the approach used in the economic assessment and the transport modelling used to support it;
- **Chapter 3 Estimation of scheme costs** – explains the derivation of scheme costs;
- **Chapter 4 Estimation of Benefits** - outlines the methodology for the quantification of each element of scheme benefits;
- **Chapter 5 Economic appraisal results** - presents the results of the economic assessments;
- **Chapter 6 Sensitivity Testing** - outlines the assessment of the sensitivity tests; and
- **Chapter 7 Summary** - provides a summary and the overall conclusions of the report.

2. Economic Appraisal Approach

2.1 Introduction

2.1.1 This section provides details on the methodology used to undertake economic assessment based on the output of transport models to access the economic viability of this transport scheme.

2.1.2 The appraisal of the economic elements associated with the scheme has been undertaken in accordance with TAG unit A1-1 Cost-Benefit Analysis. The scope of the economic appraisal comprises the assessment of:

- User benefits during normal operation, using TUBA version 1.9.14 with economics file "Economics_TAG_db1_14_0.txt" based on TAG 1.14. This included sensitivity tests of low growth/optimistic scenarios.
- Construction user dis-benefits (an assessment of delays to travellers during construction and maintenance has been undertaken).
- Accident savings using COBA-LT version 2013.2 with economic parameters file version 2020.2.
- Monetised environmental impacts (the impact of the scheme on Greenhouse gas emissions, Local air quality and noise) in line with TAG.
- Social impacts have been assessed in line with TAG Unit A4-1.
- Distributional impacts have been assessed in line with TAG Unit A4-2.
- Journey time reliability impacts have been assessed in line with TAG Unit A1-3.
- Wider economic impacts have been assessed in line with TAG Unit A2-2.

2.1.3 The aim of economic assessment was to assess the performance of the scheme, in terms of the total benefits generated against the total associated costs of construction, operations and maintenance.

2.1.4 The economic assessment compares the monetised costs and benefits of the proposed scheme (the Do Something or DS) against the alternative without-scheme scenario (the Do Minimum or DM).

2.1.5 The costs of the scheme used in the assessment comprise the overall scheme investment costs (data provided by the Highways England Commercial team) and the cost of maintaining the new network section over the appraisal period.

2.2 TPU Transport Model

2.2.1 **Background**

2.2.2 The 2015 Trans-Pennine South Regional Transport Model (TPS RTM) was calibrated and validated at PCF Stage 2 of the TPU scheme. No changes to the model specification have been made since PCF Stage 2. Details of the validated base model developed at PCF Stage 2 are provided in the corresponding Local Model Validation Report (LMVR).

2.2.3 The validated base model developed during PCF Stage 2 has been used as a starting point for the development of the PCF Stage 3 TPU strategic model. Comprehensive details regarding the TPU model specification are outlined in the PCF Stage 2 LMVR, therefore have not been repeated in the PCF Stage 3 Transport Model Package.

2.2.4 An initial PCF Stage 3 Transport Model Package was produced by Arcadis in November 2018. However, following refinements to the PCF Stage 3 TPU model by Atkins, this has been superseded. Comprehensive details regarding the TPU model specification are outlined in the PCF Stage 2

LMVR[2], whilst details of the base model developments undertaken by Atkins during the finalisation of PCF Stage 3 are provided in the Transport Model Package[3]. The forecasting process adopted for PCF Stage 3 of the A57 Link Roads scheme is derived from the Trans-Pennine South Regional Traffic Model (TPS RTM).

2.2.5 **Need for Model Refinement**

2.2.6 Initial air quality (AQ) modelling undertaken by Arcadis in July 2018 indicated that an unmitigated TPU scheme could have significant AQ effects and jeopardise the application for development consent. Changes in traffic flow and speed as a result of the scheme were predicted to cause exceedances of the AQ strategy objectives for annual mean nitrogen dioxide (NO2). The primary locations where a negative AQ impact was reported were the village of Tintwistle on the A628 and the roads Dinting Vale and Glossop High Street on the A57.

2.2.7 Atkins was commissioned by HE to undertake a review of the work done by consultants Arcadis at PCF Stage 3 for the proposed TPU scheme. The aim of this process was to strengthen the robustness of the modelling, under high levels of scrutiny for the DCO. Following the presentation of the review findings in the summer of 2019, Atkins was commissioned to implement its recommendations and finalise PCF Stage 3.

2.2.8 **Scope of Modelling**

2.2.9 The simulation boundary of the TPS RTM has been retained, but the focus of the TPU model is concentrated on the Area of Detailed Modelling (ADM) highlighted in Figure 2-1.

Figure 2-1 - Area of Detailed Modelling (ADM) – TPU PCF Stage 3

[2] Stage 2 TPU LMVR (August 2017): HE551473-ARC-GEN-ZZZ-RP-TR-2017

[3] Stage 3 TPU Transport Model Package (April 2021): HE551473-BBA-GEN-A57_AL_SCHEME-AS-TR-000002

2.2.10 To help with the analysis and identifying key impacts in their geographical context, a sector system was developed with a total of 25 sectors, of which 8 are internal (in the area of detailed modelling around the scheme), 11 are buffer and 6 are external. Section 4.2.10 sets out the coverage of the 25 defined sectors and identifies the regions within the model defined as "internal", "buffer" and "external".

2.2.11 **Demand and Time Periods**

2.2.12 The time periods for forecast years are:

- AM Peak Average Hour: 07:00 – 10:00
- Inter-peak Average Hour: 10:00 – 16:00
- PM Peak Average Hour: 16:00 – 19:00

2.2.13 The traffic model used for forecasting splits the traffic flows into different vehicle categories and different journey purposes. The future year matrices consist of 5 vehicle type and journey purpose combinations ('User Classes'):

- User Class 1: Car used for Commuting;
- User Class 2: Car used for Employer's Business;
- User Class 3: Car used for Other Purpose;
- User Class 4: Light Goods Vehicles (LGVs);
- User Class 5: Heavy Goods Vehicles (HGVs).

2.2.14 **Forecast Years**

2.2.15 The TPS RTM (Trans-Pennine Regional Traffic Model) has been developed to represent a validated base year 2015 and three forecast years have been modelled, namely:

- 2025 - opening year
- 2040 - design year, 15 years after opening
- 2051 - horizon year

2.2.16 The growth in demand between the base year and the forecast years is derived from three sources:

- National long-term population, employment and transport forecasts published by the DfT in the National Trip End Model (NTEM) dataset version 7.2.
- Local planning data summarised in the Uncertainty log, provided by the relevant Local Authorities.
- Light Goods Vehicles (LGV) and Heavy Good Vehicles (HGV) growth rates derived from the DfT Road Traffic Forecasts (RTF18).

2.2.17 **Modelling Approach**

2.2.18 The TPU Stage 3 traffic model is developed from the TPS RTM, which includes a SATURN (v11.3.12) Highway Assignment Model (HAM) combined with a DIADEM Variable Demand Model (VDM) (DIADEM v6.3.4 and HEIDI v5.3).

2.2.19 The first step of the forecasting process is to derive Reference Case demand matrices which reflect changes in population, employment, car ownership and other demographic and economic factors. The Reference Case demand matrices utilise the validated base year demand matrices as a basis. The transport supply element of the model is also updated for each forecast year which includes network changes and generalised cost assumptions (i.e. value of time (pence per minute: PPM) and vehicle operating costs (pence per kilometre: PPK), both by vehicle type and purpose). This is to derive the most likely 'without scheme' scenario against which the impact of the 'with scheme' scenario can be tested.

2.2.20 The Reference Case forecasts do not account for induced changes in travel demand in response to changes in future traffic conditions. Therefore, the Variable Demand Model (VDM) modifies the

Reference Case forecasts to reflect the impact on demand, of changes in congestion on the road network.

2.2.21 **Modelled Scenarios**

2.2.22 Three scenarios have been modelled for each forecast year: Core, Low and Optimistic growth. For each growth scenario, the following assumptions have been made regarding inclusion of future schemes which are under consideration:

- **Core Scenario** - Near Certain and More Than Likely infrastructure schemes and developments, constrained to TEMPro (NTEM 7.2).
- **Optimistic Scenario** - Near Certain, More Than Likely and Reasonably Foreseeable infrastructure schemes and developments, constrained to high growth national uncertainty.
- **Low Growth Scenario** – Near Certain and More Than Likely infrastructure schemes and developments, constrained to low growth national uncertainty.

2.2.23 **Do Minimum (DM) network**

2.2.24 The PCF Stage 3 TPU[4] DM network coding has been adopted from the TPS RTM forecast year models, which include relevant LA and RIS highway schemes across the modelled simulation area.

2.2.25 The validated PCF Stage 3 TPU 2015 base year model network was used as a basis for the forecast year DM scenario. The existing DM road alignment is shown in Figure 1-1.

2.2.26 The TPS RTM includes forecast years of 2021 and 2041. Therefore, schemes predicted to be completed by 2021 are included in the TPU 2025 opening year, whilst schemes predicted to be completed by 2041 are included in the TPU 2040 design year. The highway infrastructure schemes included in the 2051 horizon year are identical to 2040.

2.2.27 **Do Something (DS) Network**

2.2.28 The PCF Stage 3 TPU DS network coding incorporates the A57 Link Roads Scheme, in addition to the schemes present in the DM network. The latest DS scheme alignment is presented in Figure 1-1 and was coded based on the RTM coding manual.

2.2.29 For determining an initial set of signal timings to be used in the SATURN model, a set of LinSig models were produced for all scheme junctions.

2.2.30 Signal timing and phasing were reviewed for junctions with high levels of delay. Existing timings that were found to be unreasonable for the assigned flow were optimised based on observation and judgment.

2.2.31 Further information regarding the modelling methodology, assumptions and scenario specifications can be found in the Transport Forecasting Report.

[4] "PCF Stage 3 TPU" in this context relates to the name of the traffic model, which has been updated for the purpose of assessing the A57 Link Roads Scheme

2.3 Economic Appraisal Overview

2.3.1 The essence of the economic appraisal is the identification and the estimation of all the associated expenditures and the benefits over the lifetime of the project to determine to what extent value for money would be delivered as a return on taxpayer investment. As per the TAG Unit A1.2, an economic assessment is undertaken with an objective to facilitate the quantification and monetisation, where possible, of scheme costs and benefits.

2.3.2 The economic assessment, undertaken over a 60-year period from the date of the scheme becoming operational, compares the monetised costs and benefits of the proposed scheme against the alternative without scheme scenario.

2.3.3 The costs of the scheme used in the assessment comprise the scheme construction costs (provided by the Highways England Commercial team), Land Cost, preparation cost, operating and maintenance costs. These costs are considered further in Section 3.

2.3.4 The benefits of the scheme are the net benefit experienced by the road user and wider society with and without the scheme, which has been calculated from a number of sources, such as:

- User benefits during normal operation (savings relating to travel times, vehicle operating costs and user charges) have been assessed using TUBA;
- Reliability impact due to changes in Journey time variability;
- Accident savings have been forecast using COBALT;
- Wider economic impacts have been assessed using WITA;
- Environmental impacts have been assessed in line with TAG A-3; and
- Social and distributional impacts have been assessed in line with TAG A4-1 and A4-2.

2.3.5 An initial Benefit Cost Ratio (BCR) has been calculated over the 60-year appraisal period that excludes the outputs of the journey time reliability assessment and wider economic impacts, with an adjusted BCR also reported that includes these impacts.

2.3.6 To ensure consistency of outputs across all elements of assessment, both costs and benefits from each of the above analyses have been output in 2010 market prices, discounted to 2010.

2.3.7 The results of the assessment are presented in the following tables:

- The Transport Economy Efficiency (TEE) table;
- The Public Accounts (PA) table; and
- The Analysis of Monetised Costs and Benefits (AMCB) table.

2.3.8 The methodology for the quantification of scheme benefits is presented in Chapter 4 and the results are presented in Chapter 5 of this report.

2.3.9 The economic appraisal has been undertaken for the core scenario of the identified single option and is supplemented with sensitivity tests.

3. Estimation of scheme costs

3.1 Approach

3.1.1 To ensure value for public money and secure funding, the project requires precise estimation of the costs of the transport scheme.

3.1.2 Costs of the proposed scheme have been developed by Highways England and prepared for inclusion in the cost-benefits analysis based on the TAG Unit A1.2 which provides specific guidance on presentation of the costs associated with the scheme, predominantly construction, operating and maintenance costs. Any unrealistic cost estimates could adversely affect the robustness of the assessment of affordability and value for money of a scheme.

3.1.3 The costs have been estimated under two broad categories – construction costs and operating and maintenance costs

3.2 Construction Costs

3.2.1 Scheme construction costs have been estimated by and received from the Highways England Commercial team. These include the results of a quantified risk assessment (rather than Optimism Bias) and the effects of real-terms construction price inflation. The costs have been provided on a year by year basis as factor costs in 2010 prices.

3.2.2 A summary of the costs, along with their respective cost profiles, are provided in Table 3-1 and Table 3-2. The full Scheme Cost Estimates can be found in Appendix B. These figures were correct at the time of compiling this report. Any significant changes in cost may require the calculations to be reviewed.

Table 3-1 - Total Scheme Construction Costs (£m)

Cost Type	Core Scenario
Preparation	£13.62
Supervision	£2.73
Works	£77.87
Lands	£8.52
Total	**£102.74**

Note: All monetary values are in 2010 market prices discounted to 2010

Table 3-2 - Scheme Construction cost profiles (£m)

Year	Capital Expenditure, by Year and Component (£m)				
	Preparation	Supervision	Works	Land	Total
2021	£5.95	-	£0.07	£1.92	£7.93
2022	£7.68	-	£0.08	£0.77	£8.53
2023	£2.06	£0.82	£41.87	£3.35	£46.04
2024	-	£1.43	£35.01	£0.91	£37.06
2025	-	£0.73	£0.84	£0.74	£2.32
2026	-	£0.04	-	£0.62	£0.66
2027	-	-	-	£0.11	£0.11
2028	-	-	-	£0.04	£0.04
2029	-	-	-	£0.03	£0.03
2030	-	-	-	£0.02	£0.02
2031	-	-	-	£0.01	£0.01
Total	**£13.62**	**£2.73**	**£77.87**	**£8.52**	**£102.74**

Note: All monetary values are in 2010 market prices discounted to 2010

3.2.3 To convert the costs to Present Value Costs (PVC), the following calculations have been performed:

- Conversion to market prices (using a factor for the average rate of indirect taxation in the economy of 1.19).
- Discounting to 2010 at 3.5% per annum.

3.3 Maintenance Costs

3.3.1 The capital cost of maintenance is the cost of people, machinery, and materials to maintain the network and its assets.

3.3.2 The cost of periodic repairs and replacement of the new sections of carriageway have been calculated in line with QUADRO data, setting out typical repair and spend profiles and costs for each phase of repair for the relevant network sections.

3.3.3 For the dual carriageway sections it is proposed to use a Long Life Flexible Pavement (LLP) and for the Single Carriageway section a Determinate Life Flexible Pavement (DLP) is proposed. The maintenance profiles and spend for these surfaces are set out in Table 3-3.

Table 3-3 – Maintenance Profiles (£000s per km)[5]

DLP (single 2 lane)					LLP (Dual 2 lane)			
Year	Works	Cost	Duration (days)		Year	Works	Cost	Duration (days)
0	New	0	0		0	New	0	0
11	TS	66	4		11	TS	168	6
22	Ov	240	12		22	In	354	7
32	TS	66	4		32	In	576	12
42	Ov	252	12		42	In	354	7
52	TS	66	4		52	In	354	7

Note: All monetary values are in 2010 market prices discounted to 2010

Costs are total for both directions and include the cost of traffic management

Traffic management assumes day working for single and dual

TS = Thin Surfacing (typically 30mm)

Ov = Overlay (height 50/100mm)

In = Inlay (depths 50/100mm)

3.3.4 Assessed over the 60 year appraisal period this cost profile returns a PVC of **£1.3m** in 2010 market prices.

3.3.5 In addition to this cost of maintaining the carriageways themselves, bridges and underpasses constructed at crossing points will also incur maintenance and renewal costs over the appraisal period.

3.3.6 Estimates of costs for the individual structures have been prepared and whole life costs of maintaining each asset assessed. Maintenance has been assumed to be carried out periodically, with major investment required 25 years after scheme opening and at 15-year periods thereafter. A summary of these costs is set out in Table 3-4.

Table 3-4 – Maintenance Costs for Structures (£m)

Structure	Total Maintenance Cost	
	Cost in 2020 factor prices	PVC in 2010 market prices
Roe Cross Road Bridge	0.8	0.3
River Etherow Bridge	1.5	0.6
Carrhouse Lane Underpass	0.35	0.1
Old Mill Farm Underpass	0.35	0.1
Mottram Underpass	6.0	2.3
Total	**9.0**	**3.5**

Note: All monetary values are in 2010 market prices discounted to 2010 unless otherwise stated

[5] Maintenance profiles, phasing and costs set out in this table are based on Table 4/1 of Part 2 of the QUADRO Manual, July 2020

3.4 Total Costs

3.4.1 Table 3-5 sets out the total cost of the scheme over the appraisal period, bringing together the elements described above.

3.4.2 In addition to the scheme related costs a small change in value of revenue is forecast to be generated by the scheme. This will occur at locations including Dunham bridge, Humber bridge, Kingsway tunnel, M6 mainline, M6 ramp, Queensway tunnel and Warburton Bridge Road. These impacts are calculated through the transport model and TUBA assessment which are described later in this document, but the output is reported here to provide a full overview of the Present Value of Cost of the scheme. The impact on revenue collection is a reduction of £0.2m over the appraisal period, which is presented here as an addition to the PVC, giving a total value of £107.7m.

Table 3-5 – Total Cost (£m)

Cost Item	PVC
Capital Investment	102.7
Carriageway Maintenance	1.3
Structure Maintenance	3.5
Toll Revenue	0.2
Total Cost	**107.7**

Note: All monetary values are in 2010 market prices discounted to 2010

4. Methodology for Assessing Benefits

4.1.1 For monetising the proposed scheme impact, the overall benefit of the scheme can be estimated in terms of net travel time saving (DS compared against DM), reduced vehicle operating costs, impacts during the construction phase, road user safety impact, reliability, environmental impacts and wider economic impacts. In addition to monetised benefits, social impacts and distributional impacts have been assessed.

4.1.2 The results of the assessment can be presented in terms of following parameters.

4.2 Transport Economy Efficiency (TEE)

4.2.1 Transport Economic Efficiency (TEE) benefits have been captured in accordance with TAG Unit A1.3 (July 2020). Impacts on transport users and providers typically make up the majority of benefits for transport business cases. This TAG unit provides specific guidance on how impacts on transport users and providers (including travel time and vehicle operating cost savings) should be estimated, valued and reported in transport appraisal.

Software Used for the Appraisal

4.2.2 The calculation of main economic benefits to road users incorporates use of the DfT's Transport Users Benefit Appraisal (TUBA) program.

4.2.3 TUBA is a software package developed for the appraisal of highway and public transport schemes. TUBA compares the economic costs for the Do Something (DS) situation with the costs for the Do Minimum (DM) situation to establish the value of forecast savings in travel time and vehicle operating costs. A BCR is calculated by comparing these values, together with those of other relevant costs and benefits, with the construction and operation costs, over a 60-year period for the scheme. TUBA version 1.9.14 has been used in the appraisal.

Economic Parameters

4.2.4 TUBA version 1.9.14 provides a complete set of default economic parameters in its 'Standard Economics File[6]'. This contains values of time, vehicle operating cost data, tax rates, economic growth rates and formally adopts the variation in the value of time by distance for car and rail business trips within the default economic parameters file. TUBA reports economic values in 2010 prices, discounted to a present value of 2010.

Modelled Forecast Year

4.2.5 Traffic forecasts were prepared for the following years:

- Opening Year - 2025
- Design Year - 15 years after opening – 2040
- Horizon Year - 2051

Appraisal Period

4.2.6 A 60-year appraisal period was used from the Scheme opening year of 2025 therefore providing a final appraisal year of 2084.

[6] "Economics_TAG_db1_14_0.txt" dated 28/08/2020, based on the Sensitivity Test TAG Data Book v1.14.

Time slice and Annualisation Factors

4.2.7 The annualisation factors adopted for the A57 Link Roads Stage 3 assessment are presented in Table 4-1. The appraisal has been based on AM peak, interpeak and PM peak modelled periods. The annualisation approach therefore assumes 253 weekdays per year excluding the weekends and the bank holidays. For each period an average hour is modelled so the factors applied to each period are derived by multiplying either 3 or 6 hours by 253.

Table 4-1 - Annualisation factors

Time Period	Period Length	Annualisation Factor
AM Peak Period (0700-1000)	3	3 x 253 = 759
Inter-peak Period (1000-1600)	6	6 x 253 = 1518
PM Peak Period (1600-1900)	3	3 x 253 = 759

4.2.8 Off peak and weekend flows have not been captured in the modelling and no benefits have been represented for these times in the TUBA assessment. Congestion in the DM scenario will be more limited during these periods and so both trip numbers and benefits per trip will be reduced compared to the modelled hours.

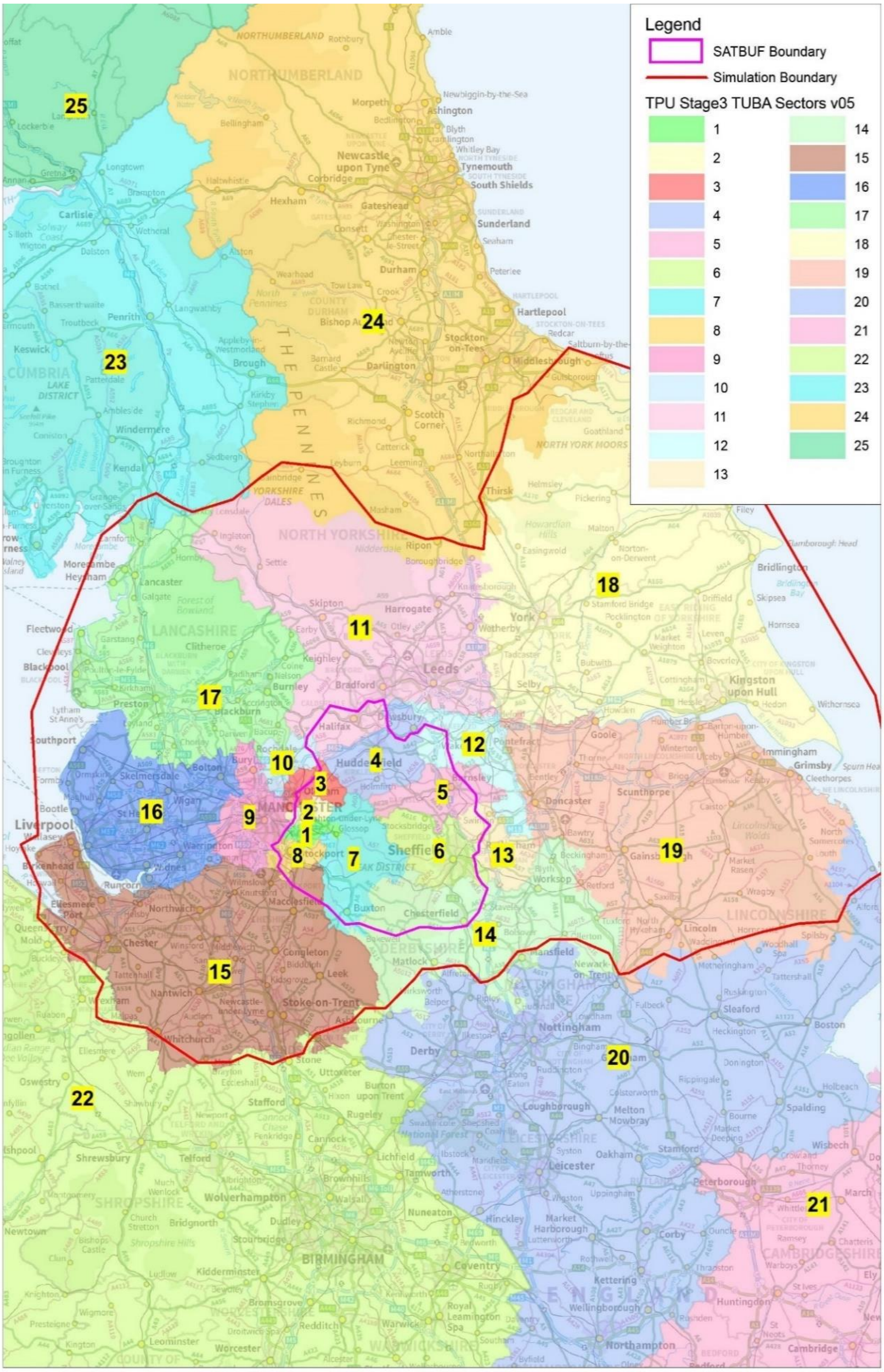
4.2.9 RIS schemes typically consider impact over weekends, so for consistency consideration of these impacts should be made during the next stage of assessment. It is more than likely there will be an upside opportunity for the PVB in the weekend but there is no guarantee of this until the analysis has been undertaken.

TUBA Sectors

4.2.10 The study area comprises model zones, which have been aggregated to sectors to enable more detailed analysis of the TUBA outputs. These sectors are listed below.

4.2.11 The sectors are indicated in Figure 4-1, which also shows the division of sectors between “internal”, “buffer” and “external”. Further specifications of the sectors are set out in Appendix C.

Figure 4-1 - Sectors definitions



4.3 User Classes and Journey Purposes

4.3.1 The TPU Stage 3 traffic model comprises five user classes. The modelled user classes were split into seven user classes as required for the TUBA economic appraisal, as shown in Table 4-2 below:

Table 4-2 - Correspondence of Modelled User Classes to TUBA User Classes -Weekday

Modelled User Class	TUBA User Class	Factors
Car Business	Car Business	1.000
Car Commute	Car Commute	1.000
Car Other	Car Other	1.000
LGV	LGV Personal	0.120
	LGV Freight	0.880
HGV	OGV1	0.192*
	OGV2	0.208*

* Includes conversion from Passenger Car Units, or PCUs (the traffic model's unit of traffic flow) to vehicles as required for input to TUBA. The model represents an HGV as 2.5 PCUs. The two HGV factors therefore need to sum to 0.4 (the inverse of 2.5).

4.3.2 The LGV user class was disaggregated into LGV Personal and LGV Freight using the TAG Data Book Table A1.3.4 (July 2020), giving a default proportional split of 12 % for LGV Personal and 88 % for LGV Freight. HGVs were split into OGV1 (48%) and OGV2 (52%) calculated from Highways England's WebTRIS database. Accordingly, the factors for the OGV1 and OGV2 were 0.192 and 0.208 respectively in TUBA, taking into account the PCU factor for HGV as 2.5. The above-mentioned factors and splits were retained against the TPU Stage 3 ComMA report (17 May 2019) produced by Arcadis.

4.4 User Benefits

Travel Time Savings

4.4.1 Travel time savings are calculated in TUBA using the 'rule of a half' applied to generalised time skims from the TPU Stage 3 traffic model . The 'rule of a half' relates to the change in the consumer surplus resulting from a reduction in travel costs such that existing users receive the full benefit while new users receive half of the benefit.

4.4.2 Travel times in the traffic model are represented in seconds. These are converted to vehicle hours and annualised for each time period, so that annual travel time savings can be calculated.

4.4.3 Annual time savings are calculated for each modelled year. Benefits for non-modelled years are calculated via linear interpolation between modelled years, and flat-line extrapolation beyond the final modelled year. However, the impact of discounting and growth in values of time on estimated benefits means that the benefits 'curve' does not represent a straight line through the appraisal period.

4.4.4 Default economic assumptions have been applied, as contained in the TUBA software (v1.9.14) and Economic parameter file "Economics_TAG_db1_14_0.txt".

Vehicle Operating Cost Savings

4.4.5 Vehicle operating costs (VOCs) are calculated for both fuel and non-fuel elements of the journey, based on formulae set out in the DfT's TAG guidance. The 'rule of a half' formula is broadly applied as for travel times, but with vehicle operating costs being based on distance travelled (vehicle-kilometres) and average vehicle speeds.

4.4.6 All assumptions relating to fuel costs, duty and vehicle efficiency are those contained in the default TUBA economics file. The same annualisation factors as defined above are applied to derive VOC benefits.

4.5 Masking of Impacts

Masking approach

4.5.1 A relatively large transport model (TPU Stage 3 traffic model) was developed on behalf of Highways England and has been used for appraisal of the A57 Link Roads Scheme .

4.5.2 While every effort has been made to refined and update this model to best represent the impacts of the scheme, it has been necessary for focus to be been placed on validation of performance around the scheme area. The model contains large cities including Manchester and Sheffield which, as part of a strategic model, can be particularly sensitive in terms of variations to traffic flow and congestion at busy junctions.

4.5.3 Furthermore, the scope of the model, whose simulation area extends as far as the east and west coasts of England, contains a very high number of trips and hence a large overall cost of travel, making relatively small fluctuations in modelled behaviour, potentially influential on overall performance.

4.5.4 To minimise this effect a fixed cost function (FCF) has been applied, whereby a cordon is set within the model and costs outside of this cordon fixed to ensure uniform behaviour between the DM and DS scenarios. Further detail on this approach and the cordon used are set out in the Transport Forecasting Package.

4.5.5 Despite use of the FCF it was observed that the value of TUBA Sensitivity in the initial TUBA runs was much weaker than TAG would recommend to indicate a reliable assessment[7].

4.5.6 In order to reduce the model noise and improve the value of TUBA Sensitivity in line with TAG recommendation, a masking approach was adopted.

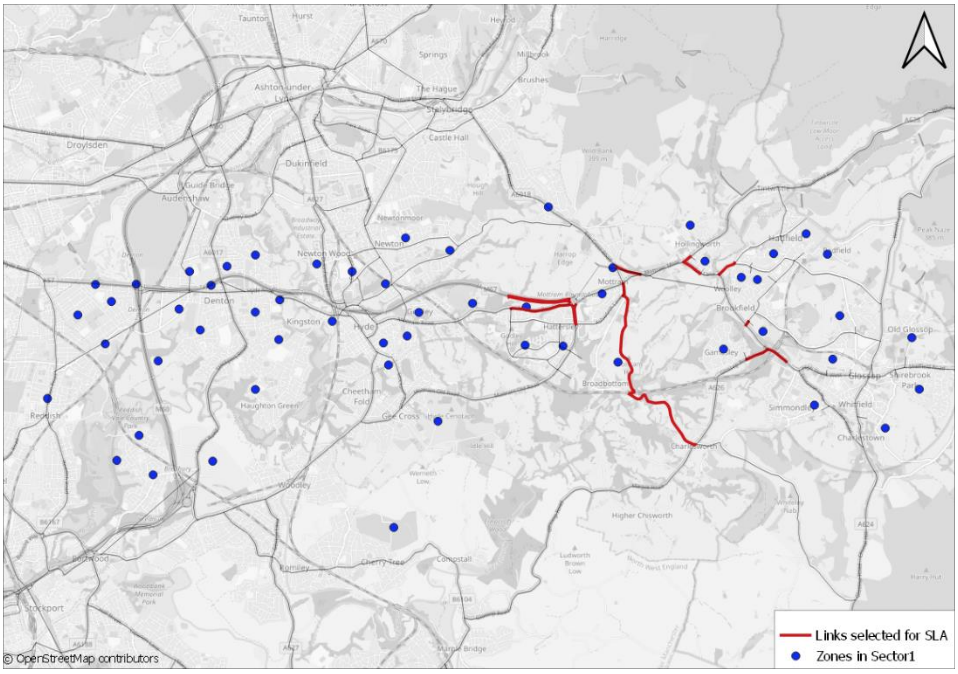
4.5.7 This was based on analysis which focussed on identifying the OD pairs which are directly impacted by the scheme and those which can reasonably be understood to experience an indirect impact.

4.5.8 This was achieved by performing select link analysis (SLA) on a selection of links, illustrated in Figure 4-2, which are either part of the scheme directly or are used to enter or exit the scheme. The extraction of this information from DM and DS scenarios provided all the OD pairs which are definitely impacted by the scheme. The SLA had captured every OD pair using the scheme or passing through a small scheme area in any scenario during any peak modelled hour. In addition all movements to or from Sector 1 zones were retained as these are in the immediate vicinity of the scheme and changes in flows through this region, whether passing through the scheme or not, can be reasonably expected to be influenced by changes to resulting traffic patterns.

[7] The TUBA Sensitivity value is a ratio between
- the change in total network cost between DM and DS scenarios; and
- the total network cost in the DM scenario.

This indicates how sensitive the results are to convergence in the transport model and should be no less than around 10 times the corresponding convergence %GAP values reported for the transport model. The smaller the TUBA Sensitivity value, the more susceptible TUBA results will be to convergence noise.

Figure 4-2 - Enhanced Masking version 2 (SLA + Sector 1)



4.5.9 This two-streamed approach ensured that:

- Local impacts, whether positive or negative are retained;
- Movements across the scheme area which will be affected are retained; but
- Other movements which won't experience either direct or indirect impacts are excluded.

4.6 User costs during construction and maintenance

4.6.1 The delays during construction have been estimated using the strategic model and TUBA runs to represent the impacts of different phases of construction. As diversionary impacts could, potentially contribute significantly to the total delay, this approach has been considered to provide a better representation of wider network effects within the cordoned model area than use of the QUADRO tool which is more focussed on the immediate area of effect. Each construction stage has been modelled in a single-year assignment run using the 2025 demand matrix in a fixed matrix assignment for the cordoning as illustrated in Figure 4-3 below.

4.6.2 The outputs from the modelling assignment have been compared against the DM 2025 model in TUBA in order to monetise the disbenefits during construction phases of the scheme.

4.6.3 Table 4-3 below summarises the traffic management (TM) information that was provided by Balfour Beatty on 25th November 2020.

Table 4-3 - Traffic Management Phases

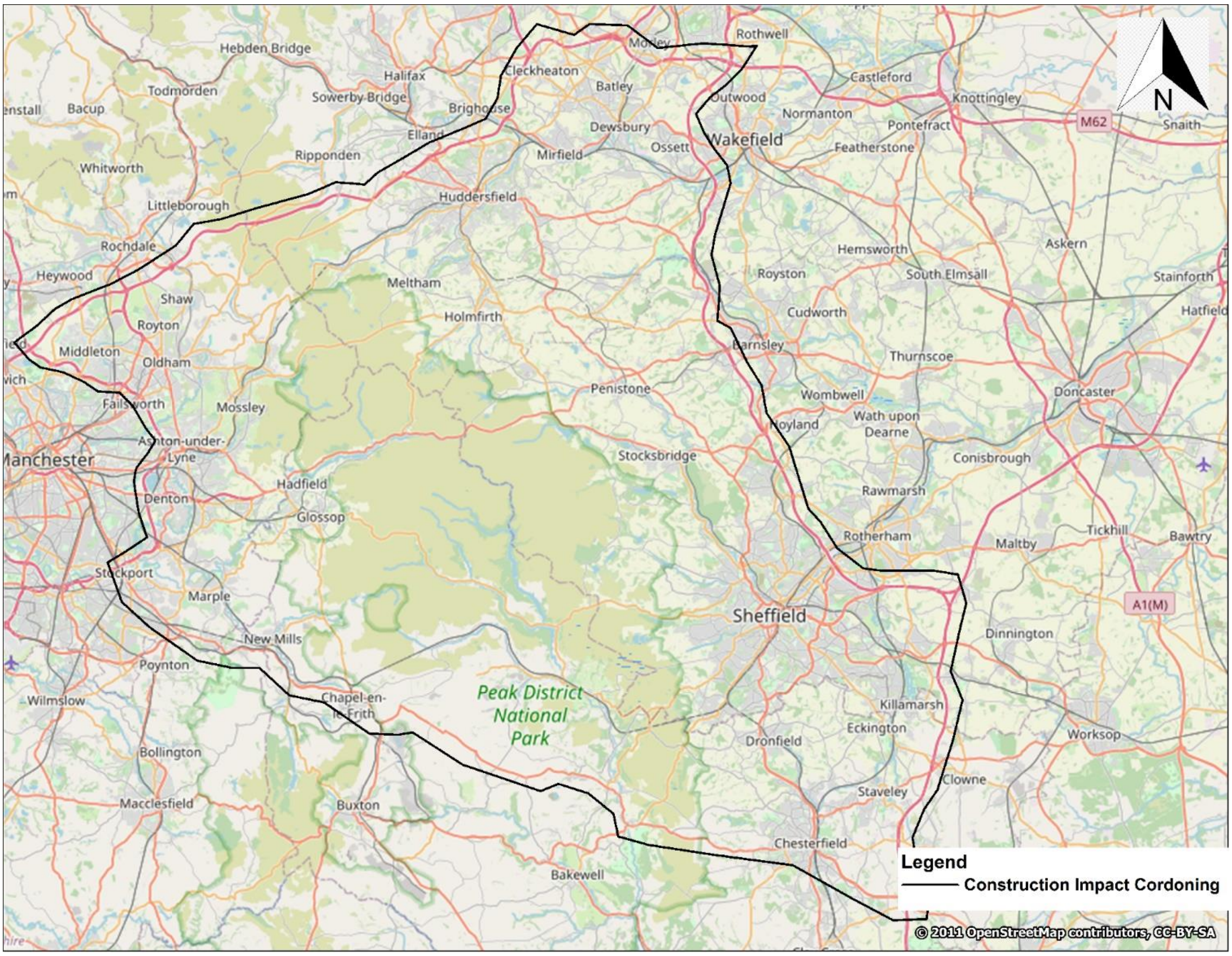
TM Phase	Work	Expected Duration
1	During Traffic Management Phase 1, • properties above the underpass demolished, • underpass pilings started, • pre-casted piles to the west of River Etherow installed, and Traffic Outcome: • no changes made to the existing traffic flow.	Sept 22 to Mar 23 (182 days)

<table>
<tr><th>TM Phase</th><th>Work</th><th>Expected Duration</th></tr>
<tr><td>2</td><td>During Traffic Management Phase 2,
Underpass construction continued, along with excavation of main cutting to the east of the underpass;
Fill materials from cutting transported to the west of River Etherow embankment;
Traffic restricted on Mottram Moor eastbound to one lane through plant crossing;
Plant crossing used to move muck from west to east.
Traffic Outcome:
Addition of a traffic signal junction on Mottram moor road with suitable inter green time.</td><td>Apr 23 to Sep 23 (183 days)</td></tr>
<tr><td>3</td><td>Traffic management Phase 3 primarily comprised of
Complete underpass construction including temporary diversion of the Roe Cross Road;
Modification of the existing roundabout, and two lanes of traffic maintained on the roundabout
Construction of Mottram Moor junction and restricting Mottram Moor to one lane in the eastbound direction.
Tie into the Woolley Bridge road with no restriction to existing road network during peak hours
Traffic Outcome:
Mottram Moor reduced to one lane in eastbound direction</td><td>Oct 23 to Mar 24 (182 days)</td></tr>
<tr><td>4</td><td>During Traffic Management Phase 4,
cut material from underpass moved to the mainline to fill west of underpass.
a complete dual carriageway throughout the section, and
Traffic Outcome:
no restrictions to the existing road network</td><td>Apr 24 to Oct 24 (184 days)</td></tr>
<tr><td>5</td><td>Traffic Management Phase 5 comprised of de-trunking work to old A57. The entire phase was divided into two sub-phases, namely Phase 5_1 and Phase 5_2, to account for contraflow.

Phase 5_1:
De-trunking works confined to old West Hyde road for the duration of 2 months
Traffic Outcome:
West Hyde Road signalised to allow just one direction at a time to account for contra-flow.
Phase 5_2:
De-trunking works to old East Mottram moor road for a duration of 1 month.
Traffic Outcome:
East Hyde Road signalised to allow just one direction at a time to account for contra-flow.</td><td>Oct 24 to Dec 24 (5_1: 61 days,
5_2: 31 days)</td></tr>
</table>

4.6.4 A detailed breakdown of the sequence of the traffic management phases is provided in Appendix A.

Figure 4-3 - Construction Impact Cordoning



4.7 Accident Savings

4.7.1 A safety assessment has been carried out using DfT's COBALT software to analyse the impact of the scheme on road traffic accidents, providing a monetised impact. It estimates the number of accidents for each road link over the 60-year appraisal period, based on the product of:

- the accident rate per million vehicle kilometres;
- the road length; and
- the forecast annual traffic flow.

4.7.2 Accidents at junctions can also be separately assessed based on junction design and through-flow, or link and junction accidents can be assessed in combination.

4.7.3 Personal injury accidents (PIAs) are considered, split between fatal, serious and slight injuries, with national average rates of accidents and severities by link or junction type applied. The calculation uses relationships contained in the program to take account of changes in accident and casualty rates over time.

4.7.4 The current version of the COBALT software (2013.02) and economic parameters file (2020.2) were used for the appraisal.

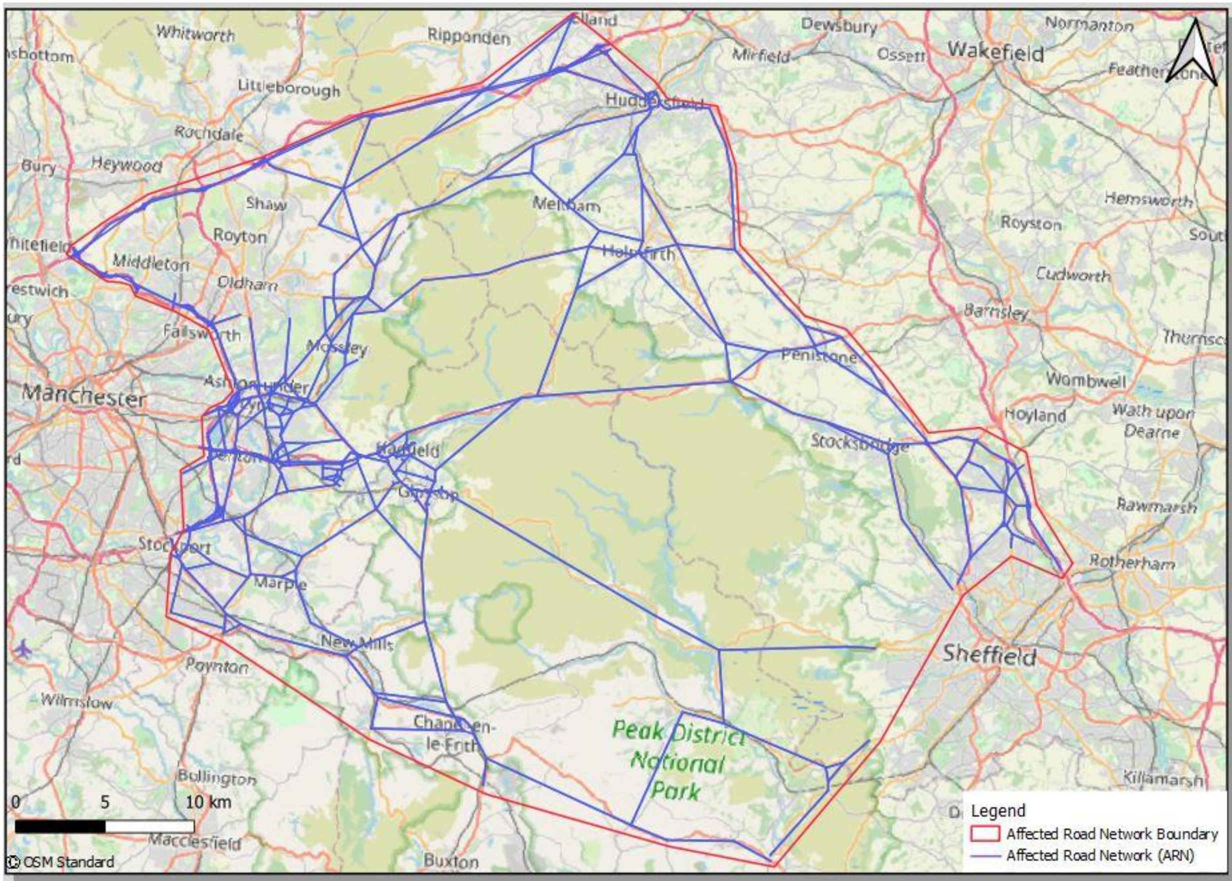
Study Area

4.7.5 The geographical coverage of the COBALT assessment includes only the Affected Road Network (ARN) rather than the whole model area. The extent of the network for the assessment has been identified through review of the modelling to identify where significant changes in flow[8] are generated by the scheme which could induce a change in accident numbers. The ARN is confined to Huddersfield in the North, Sheffield in the East, Buxton in the South, and Whitefield in the West adjacent to Manchester area. The ARN includes strategic road networks mainly M60, M62, M67, A57, and the A629.

4.7.6 The central Manchester and Sheffield areas have been excluded as these are highly sensitive to model noise. This sensitivity could result in traffic using alternative routes for reasons unrelated to the A57 Link Roads Scheme , which could distort the assessment. The geographic extent of the affected road network is presented in Figure 4-4.

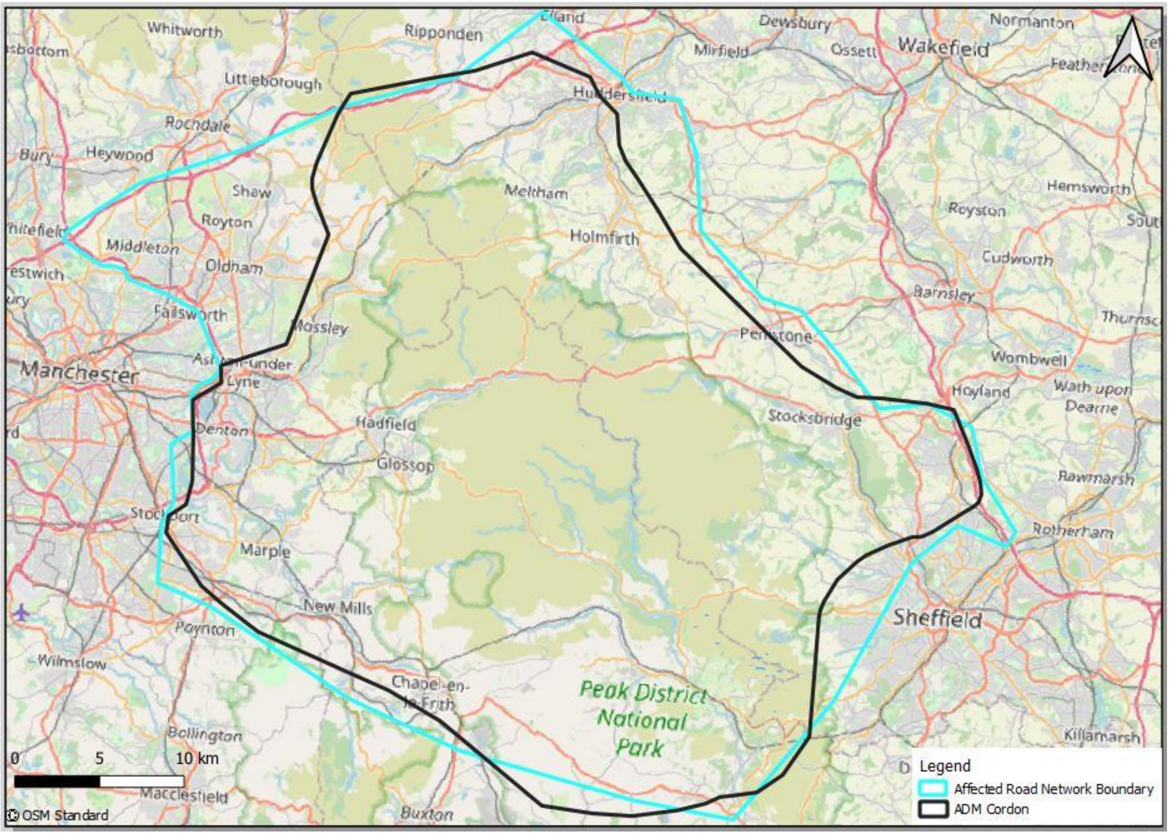
4.7.7 This area is broadly comparable to the Area of Detailed Modelling, but with certain strategic links added at the periphery, where flow changes resulting from the A57 Link Roads Scheme are forecast to be significant enough to warrant examination of the impacts on safety. A comparison between the two areas is illustrated in Figure 4-5.

Figure 4-4 - COBALT Study Area



[8] There is not a precise definition of what change in flow is considered "significant", as this will vary from scheme to scheme based on the scale of impacts created. Professional judgement has been used through review of flow difference plots from the SATURN model to identify the area over which flows are most impacted by the scheme.

Figure 4-5 - COBALT Study Area Relative to the Area of Detailed Modelling



4.7.8 For assessing the accident benefits generated by the scheme, the entire ARN has been divided into three different categories based on the assessment approach, namely:

- Junction Only
- Link Only
- Combined Link and Junction

4.7.9 These three methods are provided within COBALT to enable detailed disaggregate assessments of network sections which may have specific properties or layouts, or which vary between scenarios, while providing a more generic assessment approach to cover larger sections of the network.

4.7.10 Within the proposal, the junctions which will be significantly altered in design as a part of the scheme, or which exist in one scenario but not the other, are assessed under the “Junction Only” approach. It has been identified that Hattersley Roundabout and Gun Inn junctions will undergo significant changes in DS compared to DM in terms of geometric design once the scheme has been implemented. Specific treatment of these junctions is discussed further below. In addition to this, a new junction will be constructed at Woolley Bridge as part of the DS proposed scheme. Each of these junctions have been assessed using the “Junction Only” approach.

4.7.11 Within COBALT junctions are defined to include the network section 50m in each direction from the junction. Any newly introduced links adjacent to the junctions described above, excluding these 50m sections have been captured within the “Link Only” approach. This ensures no double counting of accidents related to the junctions.

4.7.12 Certain variations to the modelled network have also been introduced whereby modelled links do not connect to physical junctions, but represent separate sections of a single stretch of carriageway. In such cases “junction only” and “link only” assessments have been used to deliver the most representative outcome.

4.7.13 For the rest of the links and the junctions in the ARN, the "Combined Link and Junction" approach has been adopted.

4.7.14 The required inputs for COBALT are summarised below, along with their source, and are discussed in detail in the subsequent sections.

- 24 Hour Annual Average Daily Traffic (AADT) flows for all links in the study area for the Base, DM and DS scenarios have been provided from the Trans-Pennine Upgrade (TPU) model;
- Link details, including link length, speed limit, link and junction type, etc have been determined from the TPU Stage 3 traffic model network details;
- Junction details, including number of arms, junction layout and inflow from each arm have been extracted from the TPU Stage 3 traffic model and informed by the scheme design; and
- Observed accidents for specific network sections have been taken from DfT STATS19 accident data.

Network Details

4.7.15 For the "Combined link and Junction" and "Link only" approach, the main input parameters for COBALT include link length, speed limit and COBALT link type for each link. Whereas for "Junction only" assessment, the input includes COBALT junction type, speed limit, Major Arm type and Highest carriageway standard.

4.7.16 The objectives behind these data requirements was to allow the lookup of relevant national average accident rates for the new/improved links and existing links. The definition of each link type can be found in the COBALT user manual (2013.2). For junctions the input details determine the formula applied to calculate the relationship between flow and accidents.

4.7.17 Within the COBALT assessment some links and junctions vary in structure between DM and DS scenarios. These network sections have been coded twice, with and without the scheme, for COBALT to evaluate the impact of the scheme.

4.7.18 The COBALT output file returns details of errors or warnings. There were 7 warnings in the output file for the A57 Link Roads Scheme COBALT assessment. One was related to the lower limit of flow for the minor arm of Hattersley Roundabout, where traffic levels in DS are significantly reduced and the rest of the warnings were related to the higher observed accident rates which have been checked and found consistent with the high number of accidents observed.

Traffic Flows

4.7.19 24 Hour AADT flows for all links in the study area for the Base, DM and DS scenarios have been provided from the TPU Stage 3 traffic model. The model forecasts are based on average flows over the respective peak periods for a neutral month (i.e. a month not distorted by holiday periods) and cover only the 12-hour peak period during weekdays. Therefore, observed data used to develop the base year model is used to pro-rate the modelled link flows in order to estimate the annual number of trips expected on each[9].

4.7.20 The Development of the annual average daily traffic (AADT) forecasts followed the approach set out below:

- The Base, DM and DS hourly traffic flows were extracted from the TPU Stage 3 traffic model for each modelled time period and forecast year.

[9] While off-peak and weekend flow data has been used to calculate the annual traffic flow, the same data has not been used at this stage to estimate off-peak journey time savings. This is because the relationship between flow and benefits is more complex, with benefits per trip also increasing as trip numbers increase due to congestion rising in both DM and DS scenarios.

- These were converted to peak period flows using the factors of 3, 6 and 3 for AM, IP and PM respectively to calculate the 12-hour average weekday traffic (AWT).
- 12-hour AWT was converted into 12-hour average annual weekday traffic (AAWT) to account for seasonality of flow.
- 12-hour AAWT calculated in the previous step was then converted into 24-hour AAWT.
- 24-hour AAWT was then converted to the annual average daily traffic (AADT) which also includes weekend flows.

4.7.21 The individual factors are as shown in Table 4-4

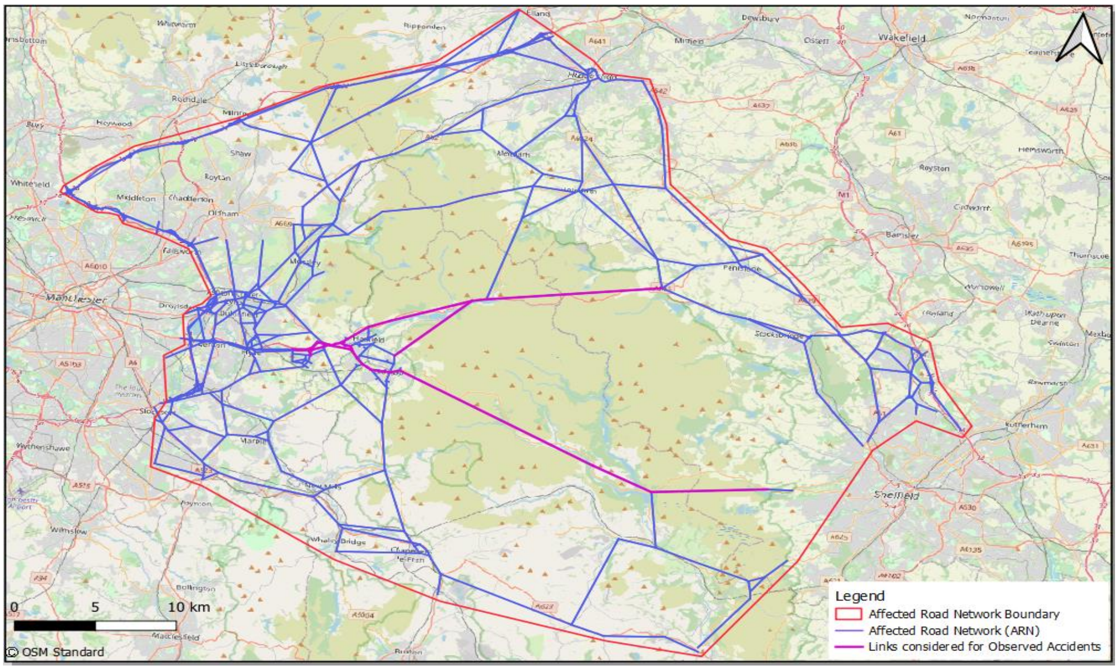
Table 4-4 - Traffic flow conversion factors

Traffic Flow	Conversion Factor	Lights	Heavies
AM	Average Hour to Period	3	3
IP	Average Hour to Period	6	6
PM	Average Hour to Period	3	3
AM AAWT	AM Peak-AWT to AAWT	0.88	0.87
IP AAWT	IP Peak-AWT to AAWT	0.90	0.88
PM AAWT	PM Peak-AWT to AAWT	0.89	0.87
24Hr AAWT	12Hr AAWT to 24Hr AAWT	1.30	1.29
24Hr AADT	24Hr AAWT to 24Hr AADT	0.95	0.79

Observed Accidents

4.7.22 Accidents over last five-years between January 2014 and December 2018 (the most recent five calendar years available across the network) were extracted from Statement of Administrative Sources (STATS19) Road Safety Database for the links within the study area. Details of these records are shown in Appendix F. The locations of links which used observed data to define accident rates are illustrated in Figure 4-6. These links have been selected as being those on which traffic flows are forecast to be most affected by the scheme.

Figure 4-6 – Observed Accident Data



4.7.23 Elements of this observed accident data applied to network sections captured within the “Combined Link and Junction”, “Link Only” and “Junction Only “approaches as shown in Appendix F.

Hattersley Roundabout

4.7.24 Observed accidents have been used to assess the accident saving analysis for Hattersley roundabout and Gun Inn junction. In the case of Hattersley roundabout, while actual observed accident data was used for the DM scenario, for the DS scenario an adjustment has been applied. The upgraded junction has been designed to improve safety. However, default accident rates for this type of junction, which would normally be applied, indicate a significant increase in accident rates as these do not take into account the local behaviour of traffic and actual speeds of travel.

4.7.25 To better reflect the safety impacts of the scheme at this junction an adjustment has been applied whereby a proportional change between the default rates for the DM and DS junction designs has been calculated. This proportion has then been applied to the observed accident numbers to generate an adjusted rate for the junction in the DS scenario.

4.7.26 This adjustment to the observed accident data has been calculated as a reduction to about 20% of the current observed rates to capture the geometric design changes and signalisation in the DS scenario. The rate has been applied through a factoring of the observed accident data as shown in Appendix F.

Gun Inn Junction

4.7.27 As part of the scheme design Gun Inn junction on the intersection between the A628 and A57 has been upgraded. This upgrade has considered geometric safety improvements for traffic and the addition of more frequent pedestrian phases to make crossing safer.

4.7.28 However, the changes to design do not change the type of junction as considered by the COBALT tool and so would not result in any change to the output of accident numbers. In addition COBALT does not take account of pedestrian facilities when considering accident rates. Therefore, while it is recognised qualitatively that this junction is forecast to experience a reduction in accidents as a result of the scheme, the approach used for assessment of safety benefits is not sufficiently sensitive to monetise these benefits.

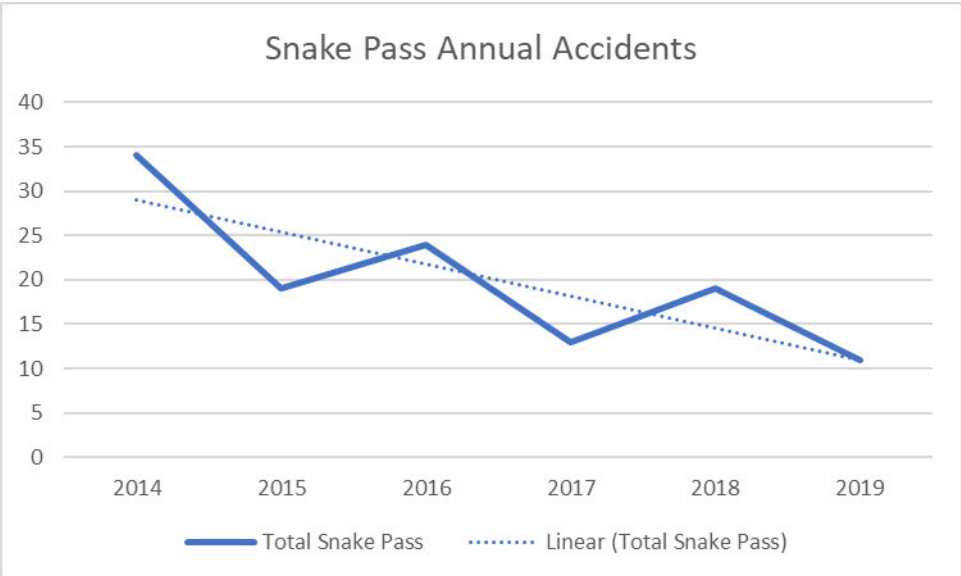
4.7.29 This junction has been treated within the COBALT assessment as "junction only", but the purpose for this is not related to the junction itself. It is rather that adjacent links vary and are split between DM and DS scenarios requiring "link only" assessment. Therefore, Gun Inn junction has been treated this way to avoid double counting of junction related accident costs.

Snake Pass

4.7.30 Although Snake Pass road is comparatively far away from the scheme area, considering the historical accident hotspot record of the Snake Pass, observed accidents have been used to assess the accident saving benefits on the Snake Pass road. It is understood that measures have been taken in recent years to address this historically high accident rate and it was observed that post 2014, the number of accidents that occurred along Snake Pass shows a declining trend as shown in Figure 4-7 which suggests a measure of success having been achieved in bringing accident rates down.

4.7.31 It has therefore been considered that a refined analysis period for Snake road alone as 2015-2019, unlike 2014-2018 used for the rest of the links in the network, would be more representative of the present accident rates on this route. Observed accidents along Snake Pass from 2015-19 are shown in Table F-4.

Figure 4-7 – Accident trend along Snake Pass



4.7.32 In addition, as the contribution of the Snake Pass route to the total effect of the scheme on accident numbers is significant, further analysis of the flows on these links was conducted. As a rural area within a large-scale model the level of detail of modelling at this location is low, having used large zones to cover wide areas of dispersed population and very long links with few access/egress points. The result is that traffic modelled as using these links behaves consistently between DM and DS scenarios, but may not be entirely representative of reality. To ensure the most accurate relationship between accidents and flow, the observed accident data on these links has been matched with observed flow data using most recent counts. This observed flow data has been used in place of the modelled base year flow data in the COBALT assessment.

4.7.33 These two observed inputs generate an accurate accident rate per vehicle km, which is then used with the modelled change in flow between DM and DS scenarios to calculate the impact of the scheme on the accident numbers. It has been recognised that the forecast year DM and DS flows on these links will have the same limitations as the base year flow. However, the change in flow between DM and DS is driven by changes in behaviour across the much wider network, with only a negligible affect from the few zones directly connected to the Snake Pass links.

4.7.34 For the rest of the network in the study area, COBALT default accident rates have been applied.

4.8 Environmental impacts

4.8.1 This section discusses the methodologies and results for assessing the monetised air quality, noise and greenhouse gas impacts of the link road elements of the A57 Link Roads Scheme .

4.8.2 The scheme has been assessed in accordance with the DfT's Transport Analysis Guidance (TAG) , Unit A3 Environmental Impact Assessment (May 2019) and associated worksheets (updated July 2020), with reference to methodologies within the Highways Agency Design Manual for Roads and Bridges (DMRB), Air Quality, revision November 2019 (DMRB LA105).

4.8.3 The TAG monetised assessment of environmental impacts includes:

- Air Quality
  - An assessment of the overall change in mass emissions of NOx and fine particulate matter (PM2.5) in tonnes over the 60-year appraisal period; and
  - Monetisation of changes in air quality.
- Greenhouse Gas Emissions
  - An assessment of the change in mass emissions of total carbon dioxide equivalent (CO2e) in tonnes for the opening year;
  - An assessment of the change in mass emissions of CO2e in tonnes over the 60-year appraisal period; and
  - Monetisation of changes in CO2e emissions.

Air Quality Assessment

4.8.4 The assessment of local air quality has been undertaken using traffic flows, the proportion of heavy duty vehicles (HDV), speed band data, and road link lengths for the opening year (2025) and a future year (2040), for both the without scheme (do-minimum) and with scheme (do-something) scenario.

4.8.5 The change in total emissions of NOx and PM10 for the traffic reliability area (TRA) were calculated (using Highways England speed band emissions factors version 3.1 derived from EFT V10.1). PM10 emissions were converted to PM2.5 using the conversion factor included in TAG Databook version 1.14 table A 3.2.4. A factor of 0.673 (road transport) was applied to the total PM10 emissions.

4.8.6 The change in NOx and PM2.5 emissions were then monetised as documented in the TAG guidance which considers an appraisal period of 60 years from the opening year of the scheme. The change in NOx and PM2.5 emissions over time is calculated by linear interpolation between the opening year and future year and then assumed to be constant for the remainder of the 60-year appraisal period in the absence of any other data.

4.8.7 Where there are areas where NO2 and PM legal limits for human health are expected to be exceeded, the economic valuation is determined using the Marginal Abatement Cost (MAC) approach[10]. Where the scheme is unlikely to affect legal limits and the NPV is not greater than £50 million, the damage cost approach is followed for the economic valuation of NOx and PM emissions.

4.8.8 The costs are derived from analysis by the Inter Departmental Group on Costs and Benefits (Air Quality) (IGCB(A)) of the typical health impacts arising from changes in air pollution.

[10] Details of this approach are discussed in the Environmental Statement.

4.8.9 There are no exceedances of legal air quality limits expected either with or without the scheme and consequently the damage cost approach has been followed throughout. This was determined on the basis of Defra Pollution Climate Model (PCM) concentrations for relevant road links in the scheme opening year and scheme specific air quality modelling undertaken for compliance risk assessment purposes.

4.8.10 The values calculated for the 60 years of the appraisal period were discounted at standard HM Treasury rates to give a present value for that particular year. This was then summed over the appraisal period, to give the net present value (NPV) of the change in air quality using the latest version of the TAG Air Quality Sensitivity Workbook which is aligned with TAG data book v1.14 (July 2020).

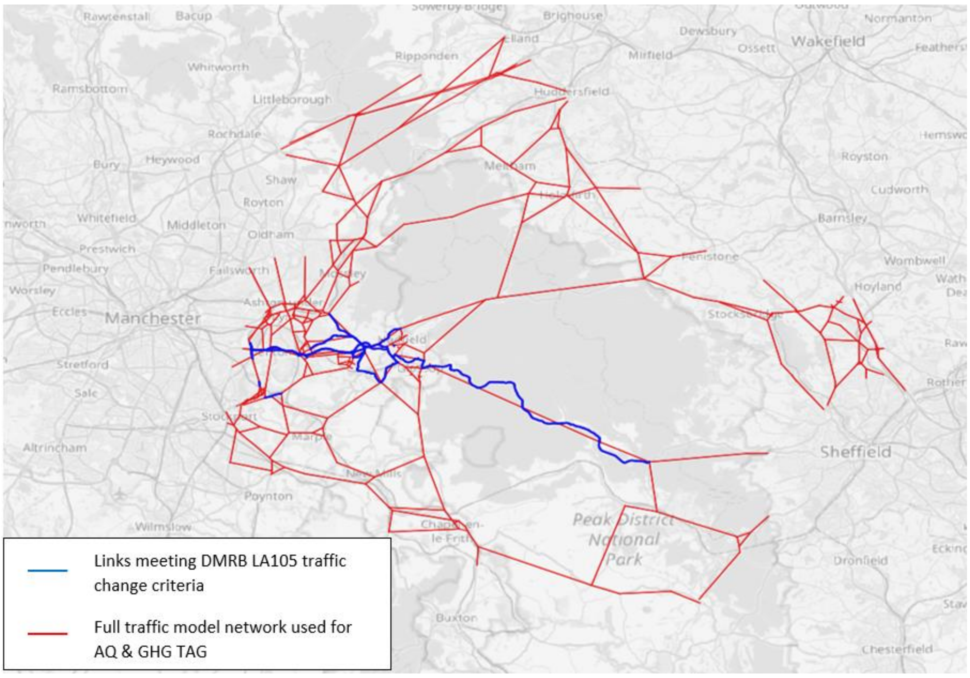
Greenhouse Gases

4.8.11 The change in total emissions of CO2e for the TRA were calculated using Highways England speed band emissions factors version 3.1 derived from EFT V10.1.

4.8.12 Greenhouse gas impacts to determine the carbon dioxide equivalent (CO2e) emissions over the 60-year appraisal period were computed using the standard TAG Greenhouse Gases Workbook. The value of these benefits over the 60-year appraisal period was calculated using valuations presented in TAG data book v1.14 (July 2020) based on the approach set out in TAG Unit A3 Chapter 4. In addition to this a sensitivity is presented based on the upper estimate NPV of greenhouse gas emissions which uses high carbon values.

4.8.13 Both greenhouse gas impacts and air quality have been assessed over the area illustrated in Figure 4-8.

Figure 4-8 – Area of Network Considered for Air Quality and Greenhouse Gas Assessments



Noise Assessment

4.8.14 TAG Unit A3 outlines the approach for the assessment of traffic related noise and the valuation of noise level in monetary term, which follows guidance set out in DMRB Volume 11 concerning noise and vibration. This captures noise impacts during the construction period, including impacts of traffic diversions and during the 60 year operational period based on data from the opening and design year transport modelling. The assessment has been based on the inclusion of embedded noise and mitigation measures which have been incorporated into the design. Full details of the approach are set out in the Environmental Statement.

4.8.15 The results of this assessment are provided in the Section 5.5.

4.9 Estimation of Journey Reliability Benefits

4.9.1 The reliability impacts of the scheme were estimated using the approach set out in TAG Unit A1.3 on reliability for urban roads. This provides an estimate of the change in the level of journey time variability depending on the change in average journey time for each origin/destination pair due to the scheme and the demand and distance between each pair. The process uses the same input parameters and assumptions as the TUBA assessment. Only weekday impacts are included, and no benefits are counted for journeys of less than 0.5km in length as the method becomes increasingly sensitivity for shorter distance trips and journeys of shorter distance than this are not considered to be sufficiently accurately represented by the strategic model.

4.9.2 The TAG 'Urban Roads' method was considered the most appropriate approach to assessing reliability for the appraisal of the A57 Link Roads Scheme. Whilst the Highways England MyRIAD software for assessing the Journey Time Variability impacts of dual-carriageway schemes was considered, MyRIAD focuses on capturing the impacts of motorway widening and technology schemes along defined links and cannot represent junction changes or new links, so it was deemed not to be suitable for this scheme.

4.9.3 While the urban roads approach was developed using empirical data from studies of traffic in cities, the behaviour can be broadly translated to networks for which a range of alternative route choices are available while passing through smaller urban areas. Longer trips are less well represented using this method, but the calculation of reliability benefits includes an inverse relationship with journey distance, meaning that for longer distance journeys the calculated reliability benefits are increasingly reduced. Therefore, these longer trips outside of the core urban areas will have little impact on the calculated reliability benefits.

4.10 Wider economic impacts (WEIs)

4.10.1 TAG Unit A2.1 (July 2020) sets out approaches for estimating a range of wider economic impacts that can be considered to be supplementary to the welfare economic benefits captured through conventional appraisal described in the previous sections (termed Level 1 appraisal), and occur as individuals and businesses change their behaviour and / or economic activities in response to the transport change[11].

4.10.2 The WEI identified in TAG are categorised into two levels:

- **Level 2 WEI** based on connectivity improvements only, without explicit land use change, including: static agglomeration, more people working and increased output in imperfectly competitive markets; and
- **Level 3 WEI** involving explicit land use change and/or additional economic modelling, including: dynamic agglomeration, move to more productive jobs and dependent development.

4.10.3 For the purposes of this assessment:

- Static agglomeration was quantified as it was deemed to account for a significant part of the WEIs and align well with the nature of the intervention;

[11] Conventional appraisal is based on the assumption that transport markets behave in a theoretical 'perfect' manner. However, in reality markets are imperfect and wider economic impacts occur as the impacts of the transport scheme transmit from the transport markets to other markets as businesses and individuals change their behaviour.

- Benefits associated with increased output in imperfectly competitive markets were quantified as 10% of the conventional impacts on business users (inclusive of reliability benefits), in line with TAG Unit A2.2 (July 2020);
- Other Level 2 impacts such as labour market effects (more people working) were only looked at qualitatively and deemed to be beneficial; and
- Dependent development impacts or move to more productive jobs were deemed less significant or relevant to the nature of the scheme and therefore not assessed.

4.10.4 The remainder of this sub-section is focused on the methodology adopted for assessing static agglomeration impacts, which represent GVA impacts from productivity uplift as a result of enhanced access to economic mass (ATEM) brought by transport investment. There is clear economic evidence showing a causal relationship between agglomeration and productivity as documented and referenced in relevant guidance. Agglomeration benefits represent the uplift in business productivity as a result of improvement in ATEM, which is a metric to measure agglomeration. The calculation of agglomeration is mainly determined by the product of the following three factors:

- the uplift in productivity per worker (derived from comparing ATEM with and without the proposed intervention)
- the quantum of employment (i.e. number of jobs)
- the average GDP per worker

4.10.5 Therefore, the value of agglomeration benefits is informed by a combination of the three factors above. High agglomeration benefit could be the result of a marginal increase in connectivity that is linked with locations with high number of jobs and average productivity, or a significant journey cost saving linked with locations with modest quantum of employment.

4.10.6 The calculation of agglomeration impact is based on DfT's WITA Beta 2.0 so the assessment process and its implementation are in line with TAG Unit A2.4.

4.10.7 The zoning system of the agglomeration model in WITA has a national coverage and is based on the 380 Local Authority Districts (LAD), illustrated in Figure G.2 of Appendix G, which are also compatible with the spatial resolution of the economic data (jobs and GVA) in DfT's wider impacts dataset. Information from the latter is also fed into the WITA model as required for agglomeration assessment. The current sensitivity test version of the wider impacts dataset (issued by DfT) was used for consistency purpose as the transport model output (and TUBA assessment) was based on DfT's Databook v1.14 (sensitivity test version)

4.10.8 The WITA model used the same highway model output as that used for TUBA. This involves the consolidation of the more detailed transport model zoning system to the WITA model of 380 zones with the help of a GIS tool. Any output used (such as time and distance) was demand-weighted during the consolidation process. Overall, transport model output in forecasting year 2025, 2040 and 2051 was used (opening year 2025).

4.10.9 A representation of the future baseline rail travel cost was also used for completeness purpose as agglomeration assessment requires a representation of travel costs by both highway and rail. Omission of this will usually lead to significant overestimation of agglomeration benefits. This was based on a dataset developed by Atkins during the course of delivering similar studies elsewhere. Information fed into the rail travel costs involves data like timetables, fare, NRTS survey on average access/egress time and information from automated online journey planning queries. It is noted that the focus on the particular assessment is highway intervention, so rail travel costs were assumed to remain unchanged in any tests.

4.10.10 Overall, the aforementioned methodology in this assessment was based on a review of similar work that was undertaken in a previous iteration of the study (with a bespoke spreadsheet). Mitigations were proposed in the latest approach in order to address potential limitations in the previous exercise in every aspect of the assessment, as summarised in Table 4-5 below.

Table 4-5 – A demonstration of key considerations informing our methodology

Area of observations		Observations in the previous forecasts	Mitigations in the new approach
Data	Transport connectivity	Unable to check / bespoke process	Improved transparency and assurance through the use of WITA
	Economic data	Observations on the discrepancies with DfT dataset (jobs and GVA)	Latest DfT wider impacts dataset used
	Other economic parameters	Consistent with the latest guidance in TAG	No changes
Calculation	Step 1 – GTC	See “Transport connectivity”	Python scripts developed to consolidate input from transport models
	Step 2 – ATEM	PT travel costs appears to be unrealistic for certain movements	Use of Atkins dataset applied elsewhere based on timetable and fare
	Step 3 – Annual impacts	Constrained to a selection of sectors excluding Manchester and Sheffield	Manchester and Sheffield included in one of the options
	Step 4 – Profiling over 60 years	VoT growth and discounting need update in new forecast	Incorporated in WITA

4.10.11 Additional detail on the method used for assessing agglomeration impacts is set out in Appendix G. Results of the WEI analysis are presented in Section 5.7.

4.11 Social and distributional impacts (SIs and DIs)

4.11.1 Social impacts (SIs) consider the human experience of the transport system and its impact on social factors, where not considered as part of economic or environmental impacts. SIs include the impacts of accidents, physical activity, security, severance, journey quality, option and non-use values, accessibility and personal affordability.

4.11.2 For SIs, the appraisal has been carried out in accordance with TAG Unit A4.1 Social Impact Appraisal (May 2020). A qualitative approach was deemed suitable for most indicators, although a quantitative assessment was undertaken where evidence was available. The results are presented using a seven-point scale of beneficial, neutral or adverse.

4.11.3 Distributional impacts (DIs) consider the variance of impacts across different social groups and are assessed as part of the appraisal and an assessment entered into the Appraisal Summary Table (AST). The DI assessment has followed guidance set out in TAG Unit A4.2 Distributional Impact Appraisal (May 2020). The distributional analysis aims to evaluate whether the preferred route unduly favours or disadvantages any particular social or vulnerable groups within the study area.

4.11.4 Both beneficial and/or adverse SDIs of transport interventions are considered, along with the identification of social groups within the geographical area which are likely to be affected. The indicators considered for social and distributional impacts are shown in Table 4-6. Where indicators have been assessed elsewhere in the Economic Appraisal Package these have not been considered within the SI assessment to avoid duplication.

Table 4-6 Indicators considered for social and distributional impacts

Indicator	Social Impact	Distributional Impact
User Benefits		✓
Air Quality		✓
Noise		✓
Personal Security	✓	✓
Severance	✓	✓
Accessibility	✓	✓
Personal Affordability	✓	✓
Collisions	✓	✓
Physical Activity	✓	
Journey Quality	✓	
Option Values and Non-Use Values	✓	

4.11.5 Full detail on the methodologies and results can be found in the Social and Distributional Impact Assessment Report, the location of which is provided in Appendix I.

5. Economic appraisal results

5.1.1 This chapter sets out the results of the economic appraisal for the core scenario in line with the assessment methodologies set out in chapter 4.

5.2 Transport Economic Efficiency (TEE)

5.2.1 All benefits and costs were calculated in monetary terms and expressed as present values (PV) in 2010 market prices, discounted to 2010.This enables direct economic comparison with other schemes which may have very different timescales.

5.2.2 The scheme is forecast to produce user benefits derived through TUBA for the operational period of £179.8m (PV) over the 60-year appraisal period. These benefits are generated by travel time savings of £165.64m and vehicle operating cost benefits of £14.2m due to the proposed scheme generating reductions in congestion which requires less fuel to be consumed.

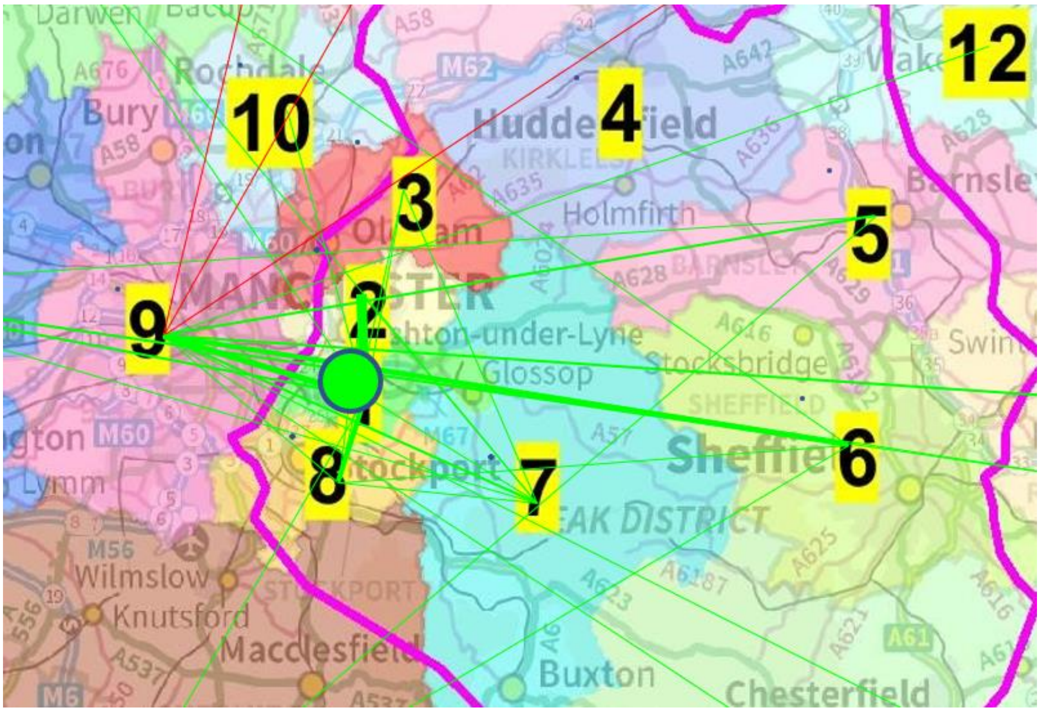
5.2.3 A number of detailed analyses were undertaken on the TUBA user benefit outputs to ensure that the results are logical and in line with expectations, as reported subsequent section. Table 5-3 shows the user travel time benefits over the 60-year appraisal.

Spatial analysis of benefits

5.2.4 To understand the spatial distribution of benefits from the scheme, sector analysis was carried out. The traffic model zones were aggregated into twenty-five sectors as set out in Figure 4-1

5.2.5 Figure 5-1 indicates the benefit distribution across the sectors in the vicinity of the Trans-Pennine Upgrade scheme.

Figure 5-1 - A57 Link Roads Scheme Benefit Distribution



Thickness of bands represents scale of 2-directional benefits for inter-sector movements

Size of circles represent scale of benefits for intra-sector movements

Green = benefit, Red = disbenefit

5.2.6 This shows a dominant source of benefits being movements within the central area of sector 1, with the majority of remaining benefits being generated on east to west and west to east movements across the scheme and shorter north to south and south to north movements also experience benefits as congestion is eased at key junctions. The movements which would be anticipated to have the greatest benefits would be:

- Sector 1 to Sector 1 = £27.98m;
- Sector 2 to Sector 1 = £11.92m;
- Sector 9 to Sector 1 = £10.24m;
- Sector 1 to Sector 9 = £6.73m; and
- Sector 8 to Sector 1 = £6.24m.

Note: All monetary values are in 2010 market prices discounted to 2010

5.2.7 Some sector-to-sector movements are forecast to experience a dis-benefit, and the movements with the highest dis-benefits are:

- Sector 9 to Sector 18 = -£0.70m;
- Sector 18 to Sector 9 = -£0.65m;
- Sector 11 to Sector 9 = -£0.64m;
- Sector 21 to Sector 17 = -£0.61m; and
- Sector 24 to Sector 9 = -£0.53m.

Note: All monetary values are in 2010 market prices discounted to 2010

5.2.8 A summary of how journey time benefits break down by scale of time saving per trip is set out in Table 5-1. Values indicated are the net position of benefits and disbenefits within each range. This shows the scheme will generate the majority of the time savings for trips which experience a change in journey time of more than 5 minutes. A similar scale of benefits for trips with savings between 2 and 5 minutes will be generated. Changes in journey times of less than 2 minutes largely balance out between benefits and disbenefits, resulting in only a small net benefit.

Table 5-1 Time benefits (£000s) by size of time saving

User	0 to 2 mins	2 to 5 mins	>5 mins
Business	10,975	40,610	42,907
Non business	-1,835	34,800	38,186

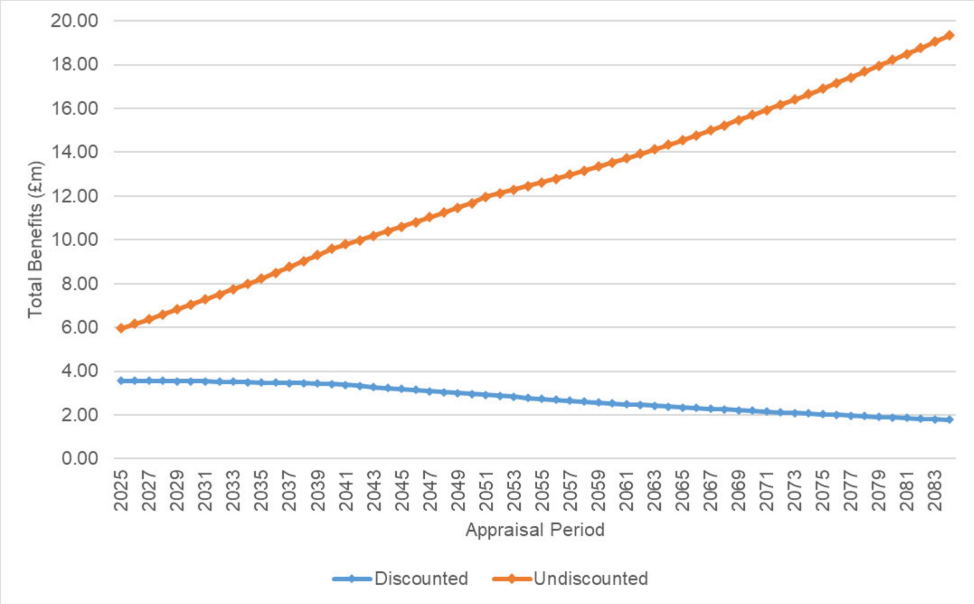
Note: All monetary values are in 2010 market prices discounted to 2010

5.2.9 Further detail on this distribution of benefits is set out in Appendix D.

Profile of benefits over 60-year Appraisal Period

5.2.10 Figure 5-2 shows the profile of the user journey time benefits across the 60-year appraisal period. The figure shows that although benefits rise through the forecast years from 2025 to 2051 as demand and hence congestion levels increase, once discounting has been applied this increase is largely levelled out. After 2051 the continued rate of discounting exceeds the rate of growth in values of time and so benefits decline afterwards until the end of the appraisal period in 2084.

Figure 5-2 - Profile of User masked benefits over Appraisal Period



Note: All monetary values are in 2010 market prices discounted to 2010

User Benefits by Journey Purpose

5.2.11 Table 5-2 below provides a summary of the user benefits disaggregated by journey purpose over the 60-year appraisal period.

Table 5-2 - User Benefits by Journey Purpose (£m)

Purpose	Travel Time	Vehicle Operating Cost	Total	Proportion
Business	£94.49	£17.47	£111.96	62.3%
Commute	£42.16	-£0.58	£41.58	23.1%
Other	£29.00	-£2.69	£26.31	14.6%
Total	£165.64	£14.20	£179.85	100%

Note: All monetary values are in 2010 market prices discounted to 2010

5.2.12 Analysis of user benefits show that more of the scheme benefits are attributed to business trips than commuting and other trips. As can be seen, the user benefits claimed by business purpose trips account for approx. 62% of the total user benefits, with 23% and 15% for commuting and other trips respectively. The significantly higher proportion of benefits attributed to business trips compared to commuting and others is expected as the scheme serves as part of a key inter-urban route and connects many businesses in the region and the value of time for business trips are higher than commuting and other trips. Movements such as Glossop to Manchester, Hyde and Stockport all benefit as do longer distance trips between Manchester and Sheffield, which are more frequently made for business purposes.

5.2.13 Some vehicle operating cost benefits are achieved for business trips, relating primarily to avoiding the need for lengthy diversions when making trans-Pennine movements. Modelling indicates rerouting of trips, which use the M62 and M1 in the DM scenario for travelling between Manchester and Sheffield, but which transfer onto the A628 and A57 in the DS scenario due to reduced congestion levels in the vicinity of the A57 Link Roads Scheme. This is a much shorter journey, resulting in reduced operating costs.

User Benefits by Time Period

5.2.14 Table 5-3 provides a summary of the user benefits in terms of time savings and vehicle operating cost benefits by time period, for each forecast year and also for the 60-year appraisal period. To enable direct comparison a summary is also provided showing only a single annualised hour per day, rather than the usual 3 hour peak periods and 6 hour interpeak.

Table 5-3 - User Benefits by Forecast Year and Period (£000s)

	Type	2025	2040	2051	60 Years
AM Peak	Total	£455	£550	£478	£25,938
Interpeak	Total	£2,744	£2,080	£1,600	£98,600
PM Peak	Total	£896	£1,070	£1,074	£55,309
Total	Total	£4,095	£3,700	£3,153	£179,847
AM Peak	per Hour	£152	£183	£159	£8,646
Interpeak	per Hour	£457	£347	£267	£16,433
PM Peak	per Hour	£299	£357	£358	£18,436

Note: All monetary values are in 2010 market prices discounted to 2010

5.2.15 The benefits show a similar level of impact during the Interpeak and PM peak hours, with a lower level of benefit during the AM peak. This highlights the directional nature of the congestion in the DM scenario. Delays on the A57(T) through Mottram in the PM peak by the design year of 2040 are forecast to be approximately double the length of those in the AM peak and considerably higher in the eastbound direction for flows all the way from Hattersley Roundabout to the A628(T).

5.2.16 These delays will be relieved through implementation of the A57 Link Roads Scheme, leading to a larger reduction in journey time, and therefore increase in benefit, for those trips experiencing the greatest delay in the DM scenario.

5.2.17 There are some fluctuations in how benefits by time period develop over the modelled years. The AM peak shows a reasonably stable level of benefit across the forecast years having been discounted to 2010, as does the PM peak. The interpeak period however shows a reduction over time in discounted benefits reflecting a relatively low rate of growth.

5.2.18 The distribution of time saving benefits by scale of change in journey time and change in trip numbers, measured at an OD pair level and aggregated across the network is set out in Appendix H.

5.3 User Costs During Construction

5.3.1 The results of the TUBA analysis of the construction impacts are shown in Table 5-4 (2010 prices, discounted to 2010):

Table 5-4 - Traffic Management (TM) User Disbenefits (£000) Unmasked

TM Phase	Construction Duration (days)	Commuting	Other	Business	Indirect Tax	Total
1	182	No Impact during construction				
2	183	-£55	-£99	-£13	£16	**-£155**
3	182	-£226	-£265	-£136	£29	**-£605**
4	184	No Impact during construction				
5_1	61	-£47	-£68	-£82	£10	**-£189**
5_2	31	-£25	-£38	-£34	£3	**-£95**
Total		**-£353**	**-£470**	**-£265**	**£58**	**-£1,044**

Note: All monetary values are in 2010 market prices discounted to 2010

5.3.2 The total net disbenefit during construction is -£1.04m occurring mainly during Traffic Management Phase 2, phase 3, and phase 5. Of these, phase 3 is the most detrimental, representing a 6 month period during which Mottram Moor will be reduced to a single lane in the eastbound direction.

5.3.3 It has been noted that the construction impact during Traffic Management phase 1 and phase 4 does not have any disbenefits as there was no restriction to the existing network during these construction periods.

5.3.4 Impacts on users during maintenance of the new network have been considered but have not been monetised. It has been assumed that delays during maintenance of the DM network will have a greater adverse impact than maintenance of the DS network. The newly introduced links add resilience to the existing network by adding capacity and providing alternative route options for use when traffic management measures are in place. This will reduce the need for lengthy diversions while maintenance is carried out.

5.4 COBALT: Accident Savings

5.4.1 Results of the COBALT assessment the A57 Link Roads Scheme's impact on the frequency and cost of traffic accidents is set out below. Table 5-5 summarises the accident impact of the scheme over the 60-year appraisal period.

Table 5-5 - Accidents and Casualties over Appraisal Period (Whole Network) (£m)

Scenario	Accident Summary (PIAs)	Casualty Summary (by Severity)			Economic Impact
		Fatal	Serious	Slight	
Do-Minimum	34,884	431	4,691	43,599	£1,304
Do-Something	34,986	438	4,718	43,755	£1,311
Scheme Impact	-102	-6	-28	-156	-£7.33

Note: All monetary values are in 2010 market prices discounted to 2010

5.4.2 The results show an increase in accident numbers on the assessed area of the modelled network, resulting in a monetised cost of accidents which is higher in the DS scenarios than the DM scenario. This means that the scheme provides an accident disbenefit. The accident impact from the proposed scheme is -£7.33m. This relates to a forecast increase of 102 accidents over the appraisal period, or an average of 1.7 accidents per year. This would lead to an estimated additional 6 fatal casualties, 28 serious casualties, and 156 slight casualties over 60 years.

5.4.3 A more detailed analysis of impacts across the network shows that the A57 Snake Pass, which is known to have a high accident rate, is forecast to experience an increase of more than 160 accidents. This alone exceeds the total impact across the rest of the network combined. Small increases in accidents are also expected through Glossop and along the A628. The scheme does not make any of these roads intrinsically less safe but increases traffic flow, leading to a higher potential for accidents to occur. Flow is reduced elsewhere on the network, such as along the M62, but motorways are safer than other road types and so the net impact of the combined rerouting is negative.

5.4.4 As Snake Pass is a known accident hotspot which will see flow increased as a result of the A57 Link Roads Scheme, measures should be pursued to minimise these negative impacts.

Impact on Strategic Road Network (SRN)

5.4.5 Within the COBALT assessment analysis has been performed of the impact of the scheme on the SRN in isolation. Figure 5-3 below indicates the network sections which have been included in this analysis. The existing A57 through Mottram has been included as part of the SRN in the DM scenario, but following de-trunking it is not included in the DS scenario, with the new link road replacing it as part of the SRN. Table 5-6 sets out the results of this analysis.

Table 5-6 - Accidents and Casualties over Appraisal Period (SRN only) (£m)

Scenario	Accident Summary (PIAs)	Causality Summary (by Severity)			Economic Impact
		Fatal	Serious	Slight	
Do-Minimum	3,561	66	482	4,880	£143.2m
Do-Something	3,511	67	482	4819	£143.0m
Scheme Impact	50	-1	0	61	£0.2m

Note: All monetary values are in 2010 market prices discounted to 2010

5.4.6 This shows a small benefit of £0.2m on the SRN, arising from a reduction of 61 slight injuries and the related damage caused by these accidents. The forecast show part of this saving to be offset by an increase of 1 fatality on the SRN over the 60 year period. This marginally higher fatality rate is driven by the increased flow on the A628 which has a slightly higher risk of this type of accident than other parts of the SRN.

5.4.7 The reduction in overall accident numbers is largely achieved through the junction improvements at Hattersley Roundabout and Gun Inn.

Spatial Distribution of Benefits

5.4.8 The spatial distribution of safety benefits by link, as forecast through the COBALT assessment, is set out in Figure 5-3. This shows that the most significant negative impacts will be on the A57 Snake Pass and the A628. These are both long distance routes which will see increases in flow. As a result, the vehicle-kilometres will be increased leading to a forecast growth in accident numbers.

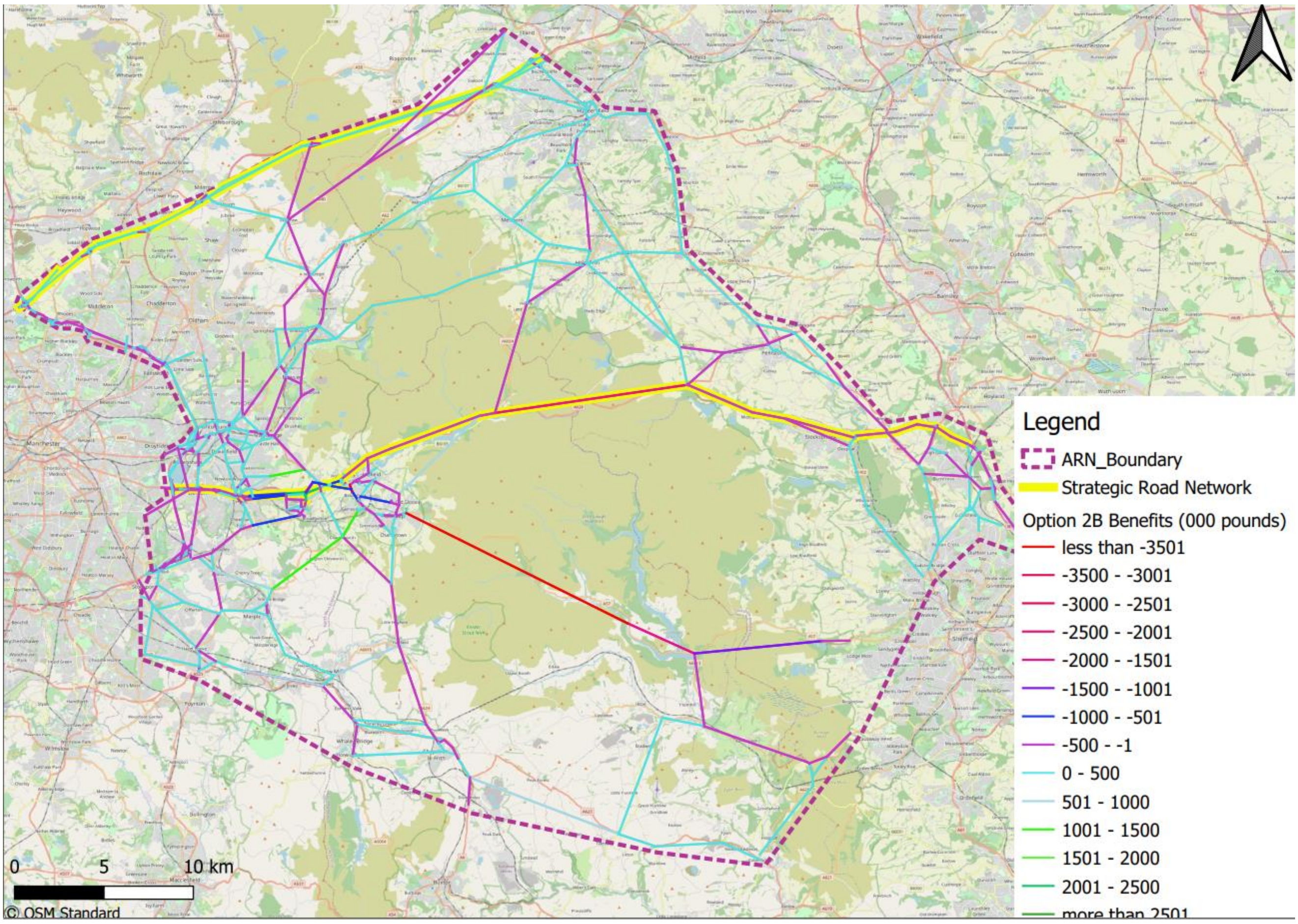
5.4.9 Similarly, the M67 and A560 will experience increases in flow, as the scheme makes these routes more desirable, leading to increases in accident numbers.

5.4.10 The links seeing the greatest improvements will be the A57 through Mottram, as traffic diverts onto the new link road and the A626 which will experience a reduction in flow as traffic diverts onto the A560.

5.4.11 Additional benefits which are not indicated in this figure will occur at Hattersley Roundabout and Gun Inn, as these junctions are upgraded to provide improved safety.

5.4.12 The SRN sections which have been assessed are indicated in the figure. The M60 Ring Road, the A627(M) and A663 have not been considered in this part of the analysis, as flow changes resulting from the scheme are negligible and within the range of model noise. Impacts at Hattersley Roundabout and Gun Inn junctions have been included within the SRN analysis.

Figure 5-3 – Spatial Distribution of Safety Impacts



5.5 Environmental Impacts

Air Quality Assessment

5.5.1 Air quality benefits over the 60-year appraisal period were computed as part of the Environmental Assessment using the standard TAG Air Quality Workbook. The value of these benefits over 60 years, is set out in Table 5-7.

Table 5-7 – Summary of Air Quality Outputs over 60 Years

Air Quality Output	Value
Increase in NOx emissions (tonnes)	284
Value of change in NOx emissions (NPV)	-£1.14m
Increase in $PM_{2.5}$ emissions (tonnes)	37
Value of change in $PM_{2.5}$ emissions (NPV)	-£2.63m
Total Air Quality (NPV)	-£3.77m

Note: All monetary values are in 2010 market prices discounted to 2010

Greenhouse Gases

5.5.2 Greenhouse gas benefits over the 60-year appraisal period were computed as part of the Environmental Assessment using the standard TAG Greenhouse Gases Workbook. The value of these benefits over 60 years is set out in Table 5-8.

Table 5-8 – Summary of Greenhouse Gas Outputs over 60 Years

Greenhouse Gas Output	Value
Change in CO_2e emissions (tonnes)	399,867
Greenhouse Gas (NPV) Central Carbon Values	-£17.4m

Note: All monetary values are in 2010 market prices discounted to 2010

Noise Assessment

5.5.3 Noise benefits over the 60-year appraisal period were computed as set out in Chapter 4. The value of these benefits over 60 years, in 2010 prices discounted to 2010 is £3.17m.

5.5.4 Although some significant adverse impacts are predicted during the construction phase, none of these are predicted during the night-time.

5.5.5 The scheme routes traffic away from an existing Noise Important Area, which is where most of the reductions in daytime and night-time noise will occur. The traffic is routed along a new route through areas that already affected by road traffic noise, however the dominant noise source changes. This is particularly evident around Mottram Moor junction where the existing A57 is relocated further from the front facades of receptors, but the new route of the A57 would introduce noise predominantly affecting the rear facades of the same receptors.

5.5.6 There are forecast to be 1619 perceptible adverse changes and 416 perceptible beneficial changes from the Scheme by the design year. However, the variation in scale of these impacts is such the overall result is a net positive value of benefit related to changes in noise levels.

5.5.7 Monetised benefits related to noise impacts are set out in Table 5-9.

Table 5-9 - Noise benefits (£m)

Economic parameters	Present value of reliability impact
Sleep disturbance	£1.42
Amenity	£1.08
AMI	£0.64
Stroke	£0.01
Dementia	£0.02
Total	**£3.17**

Note: All monetary values are in 2010 market prices discounted to 2010

Non-monetised Impacts

5.5.8 The anticipated non-monetised impacts, which cannot be reflected in the cost-benefit analysis above, are:

- A moderate impact on landscape features is expected at the point of scheme opening, but within 15 years these will be been remedied. Details of the affected receptors are recorded in the Environmental Statement.
- A moderate adverse impact on townscape features at a small number of receptors has been identified during both the construction and operational phases.
- A neutral impact on the historic environment.
- No significant adverse impact on biodiversity have been predicated as a result of the scheme.
- A moderate adverse impact on the water environment at the River Etherow is expected during the construction period. No further significant effects are anticipated during the operational period.

5.5.9 These are described more fully in the Appraisal Summary Table, which may differ from the Environmental Statement results due to being assessed against different criteria.

5.6 Journey Time Reliability

5.6.1 The overall results of the application of the TAG 'Urban Roads' reliability benefits calculation are summarised in Table 5-10,

Table 5-10 - Reliability benefits (£m)

Trip Purpose	Scheme Impacts
Business	£6.2
Commute	£2.4
Other	£2.1
Total	**£10.7**

Note: All monetary values are in 2010 market prices discounted to 2010

5.6.2 The reliability benefits were reviewed at the sector level, allowing the key impacts on the individual sector to sector movements to be identified with their geographical context. The largest impacts were:

- Within Sector 1 (Mottram): this sector alone gives a reliability benefit of around £3.6m.

- Movements from Sector 2 (Rest of Tameside) to Sector 1 produces the second largest benefit of around £1.10m followed by movements from Sector 8 (Stockport) to Sector 1 £0.6m.
- Sector 7 (Rest of High Peak) to sector 1 is having some reliability disbenefits at -£0.1m

5.6.3 Table 5-11 provides a further breakdown of the reliability benefits by vehicle type. This shows that cars account for the largest benefit of the impact at around £8.4m (79%). LGV and HGV account for roughly of around £1.5m (14%) and £0.7m (7%) respectively.

Table 5-11 - Reliability benefits by vehicle type (£m)

Vehicle type	Scheme Impacts
Car	£8.4
LGV	£1.5
HGV	£0.7
Total	£10.7

Note: All monetary values are in 2010 market prices discounted to 2010

5.7 Wider Economic Impacts (WEIs)

5.7.1 The following sections outline headline findings from the WEI assessment.

Agglomeration

5.7.2 Agglomeration reflects the increased productivity caused by firms being closer in physical or travel time terms to other firms and potential employees.

5.7.3 The WITA model outputs a total agglomeration forecast for the 60-year appraisal period and also provides separate forecasts for individual LADs. It is noted that due to the varying level of details in the transport model and the level of modelling noise present and masking applied, the robustness of agglomeration forecast by LAD also varies.

5.7.4 In light of the varying level of robustness in the forecasts, alterative perspectives of interpreting the output were established. This involves three different areas in which agglomeration benefits may be claimed, as illustrated in options A, B and C in Figure 5-4 and Table 5-12.

Figure 5-4 – Three options in interpreting agglomeration forecasts

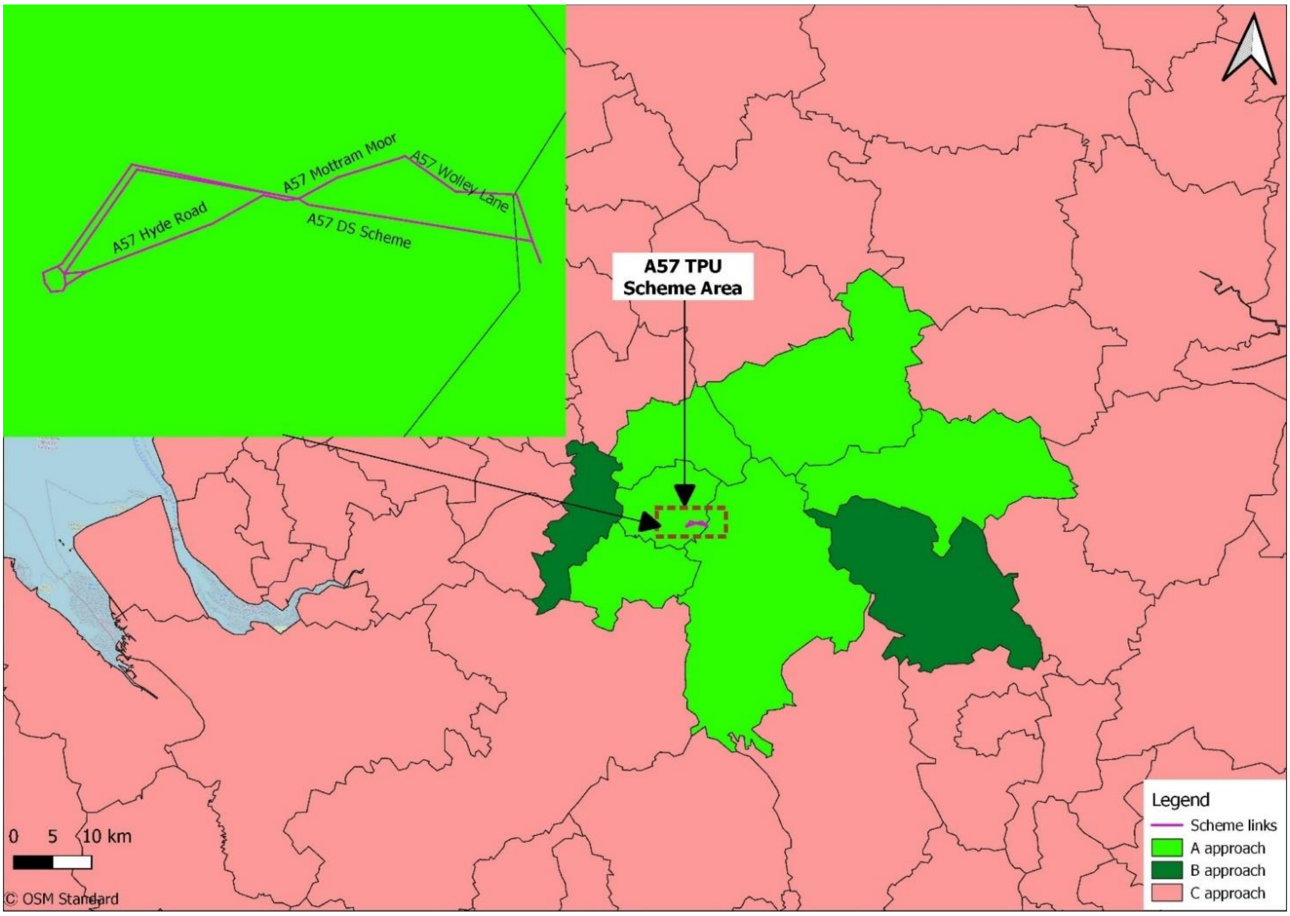


Table 5-12 – Agglomeration benefits forecasts from three different geographic perspectives (£m)

Perspective	Benefits	Commentary
Option A – benefits from High Peak, Oldham, Stockport, Tameside, Barnsley, Kirklees	£60	Areas located mostly within the ADM and are directly relevant to the geography of the scheme. Reasonable consistency in the forecast benefits between the masked and unmasked runs, which implies robustness.
Option B – Option A plus impacts from Manchester and Sheffield	£86	Including two clusters of economic activities at either side of the Pennine. Sensible (positive) forecasts obtained for Manchester and Sheffield when the masked transport model output was used.
Option C – Option B plus the rest of the country	£130	Significantly higher benefit when modelling ‘noise’ was dealt with by masking. Generally lower level of robustness for agglomeration forecasts with significant level of masking but it demonstrates the scope for additional benefits (vs Option A)

Note: All monetary values are in 2010 market prices discounted to 2010

5.7.5 Table 5-12 also outlines the reasons behind the choice of the three different approaches for interpreting agglomeration forecasts. Option A brings higher robustness and consistency although maybe on the conservative side. Option C is less reliable but certainly demonstrate the scope for potential legitimate benefits on a national stage but the exact figure is to be refined. Option B appears to bring a reasonable balance between robustness and representation of the scheme's real benefit in this context so it is the recommended figure to take forward for further assessment in the appraisal.

5.7.6 Furthermore, Table 5-13 also presents the top 10 LAD with the highest agglomeration benefits, along with an indication of the total employment present and which option each LAD falls into. It is clear from this that the top 10 locations are generally sensible in relation to the geography and nature of the intervention, and Option B captures these top locations reasonably well, hence offering a good blend of capturing the benefits whilst maintaining the robustness of the assessment.

Table 5-13 – Agglomeration benefits forecasts top 10 breakdown (by LAD on a national stage)

	LADs	Benefits	Employment	Option A	Option B	Option C
1	Tameside	£23,506,770	87,327	y	y	y
2	High Peak	£16,779,946	41,325	y	y	y
3	Stockport	£14,740,932	138,789	y	y	y
4	Sheffield	£13,080,189	297,476		y	y
5	Manchester	£12,596,494	350,836		y	y
6	Trafford	£5,607,028	142,976			y
7	Oldham	£4,853,746	97,431	y	y	y
8	Salford	£4,204,621	125,197			y
9	Bury	£2,676,751	80,299			y
10	Derbyshire Dales	£1,925,050	41,594			y

Note: All monetary values are in 2010 market prices discounted to 2010

Increased Output in Imperfectly Competitive Markets

5.7.7 This reflects the additional margin firms make on each unit of output they produce, and these impacts are anticipated to be modest.

5.7.8 The estimated value of this impact is driven directly by the value of business user benefits generated by the scheme and therefore has been calculated as outlined above in section 4.10 giving an additional contribution of £11.7m.

Labour Market

5.7.9 Labour Market impacts reflect the tax revenue from additional people joining the labour market or employment relocating to more productive locations and these impacts are anticipated to be insignificant.

5.7.10 It is expected to be beneficial as there is an overall reduction in journey time and cost. Due to the Trans-Pennine nature of the intervention, the direct impacts on (potential) commuters who are making this journey are likely to be small.

5.8 Social and Distributional Impacts (SIs and DIs)

5.8.1 Based on the approaches described in Section 4.11 this section sets out the identified Social and Distributional Impacts of the A57 Link Roads Scheme.

5.8.2 A summary of the findings of the analysis undertaken for the SI assessment accompanied with a brief conclusion is presented in Table 5-14.

Table 5-14 – Summary of Social Impacts

Indicator	Assessment	Conclusion
Collisions	Moderate Adverse	There is a relatively small increase in the number of casualties and associated collision costs as a result of the A57 Link Roads Scheme.
Physical Activity	Neutral	Small increases in active mode trips are to some extent counter-balanced by some walking and cycling trips moving to private modes. As a result, no impact to physical activity is expected as a result of the scheme.
Security	Neutral	The scheme is unlikely to significantly affect the security of drivers, but it will provide new and replacement street lighting which will enable some users to be more secure, especially pedestrians and cyclists.
Severance	Slight Beneficial	The detrunking of a section of the existing A57 will help to decrease the severance of the communities close to this road as the speed limit is decreased and the volume of traffic decreases leading to improvements in traffic flow. All new and improved junctions will be provided with upgraded WCH facilities (Gun Inn Junction, Mottram Moor, Wooley Bridge and M67 Junction 4) making crossing easier and improving safety. Consultation with landowners has been on-going throughout the Scheme's design to reduce severance on agricultural holdings. However, increases in traffic flow in Glossop will have slight adverse impact on access to amenities, and therefore the overall impact is expected to be slight beneficial.
Journey Quality	Slight Beneficial	Reduced congestion will reduce traveller stress along the Trans-Pennine route. The proposed scheme improvements are also expected to improve facilities and the environment for motorists. Overall, a positive impact on the quality of journeys is expected for motorists, pedestrians and cyclists.
Option and Non-Use Values	Not Assessed	No changes to public transport services or routes are proposed the scheme, so this indicator was not assessed.
Accessibility	Neutral	The scheme will not directly affect the accessibility of services and activities for non-car users, since it does not change any public transport routes, service frequencies or passenger facilities and does not impact upon disadvantaged communities. Nevertheless, it may allow some small opportunity for public transport improvements and hence better access on some local roads for which the scheme provides traffic relief. Overall the impact is assessed as neutral.
Personal Affordability	Neutral	The scheme will cause a slight increase in vehicle operating costs likely as a result of increased vehicle speeds in the area. However, there is a slight benefit for low income groups. The overall impact is assessed as neutral.

5.8.3 A summary of findings for the eight distributional impact indicators is provided in Table 5-15.

Table 5-15 – Summary of Distributional Impacts

DI indicators	Assessment	Conclusion
Accessibility	Not Assessed	This indicator was screened out of the DI assessment.
Severance	Slight Beneficial	The detrunking of a section of the existing A57 will help to decrease the severance of the communities close to this road as the speed limit is decreased and the volume of traffic decreases. These decreases in flows and traffic speeds are expected to lead to a reduced perception of severance for children, no car households and DLA claimants. Therefore, the impact is expected to be slight beneficial.
Security	Not Assessed	This indicator was screened out of the DI assessment.
Collisions	Moderate Adverse	Collision rates are expected to increase for income deprived residents and slightly for motorcyclists and young male drivers and very slightly for cyclists as a result of the TPU scheme. Mitigation in the form of improved crossings and signalisation at Hattersley Roundabout has been introduced which will reduce the negative impact of accidents on cyclists.
Air quality	Slight Beneficial	Air quality is expected to improve for the most income deprived residents as a result of the scheme. Both beneficial and adverse impacts to air quality for children are expected. It is however noted that the air quality assessment presented within the Environmental Statement focuses on areas of poor air quality used to inform the judgement of significant air quality effects and limit value compliance where as DfT's TAG appraisal considers the changes in air quality across the entire study area irrespective of whether there are areas exceeding government air quality thresholds i.e. it is a representation of overall changes of emissions, which may lead to a total increase but still see benefits in areas of poor air quality, as is the case for this scheme.
Noise	Slight Beneficial	Noise levels are expected to decrease for the most income deprived residents. However, there is an adverse noise impact for income quintiles 3 and 5.
User benefits	Moderate Beneficial	A proportionate beneficial impact to user benefits is expected for the 20% most income deprived residents.
Personal affordability	Slight Beneficial	There is a large beneficial impact to affordability for income quintile 1, but a moderate adverse impact for income quintile 2. Hence, the affordability assessment is considered slight beneficial.

5.8.4 The variance of impacts across quintiles of income deprivation is shown in Table 5-16.

Table 5-16 Distribution of measures across income quintiles

	Distributional impact of income deprivation (0-20% = most deprived)					Are the impacts evenly distributed?	Key impacts – Qualitative statements
	0-20%	20-40%	40-60%	60-80%	80-100%		
Accessibility	-						This indicator was screened out of the assessment.
Air Quality	✓	✓✓✓	✓	×	×	**No**	There are beneficial impacts to air quality for income quintiles 1-3, but adverse impacts for income quintiles 4 and 5.
Noise	✓	✓	×××	**0**	×××	**No**	There are beneficial impacts to noise for income quintiles 1 and 2, but adverse impacts for income quintiles 3 and 5.
User Benefits	✓✓✓	✓	✓✓✓	✓	✓✓	**No**	There are beneficial user benefits for all income quintiles, however, these vary in magnitude from slight to large.
Affordability	✓✓✓	××	✓✓✓	××	××	**No**	There are beneficial impacts to affordability for income quintiles 1 and 3, but adverse impacts for income quintiles 2, 4 and 5.

5.8.5 A copy of the full SDI report from which these results have been drawn can be found at the location indication in Appendix I.

5.9 Reporting the Economic Assessment Results

5.9.1 **Transport Economic Efficiency (TEE) Table**

5.9.2 The TEE table brings together the benefits to transport users and providers derived from the TUBA runs. The TEE table is a key component in the reporting of the economic assessment impacts and is set out in section 5.10.

Public Accounts (PA) Table

5.9.3 The PA table brings together the costs of the scheme and the revenue and tax changes which would result. The revenue and tax changes which follow from changes in traffic routes and speeds are derived from the TUBA output, while the capital and operating costs have been prepared as described in Chapter 3. The PA table is set out in Section 5.11.

Analysis of Monetised Costs and Benefits (AMCB) Table

5.9.4 The AMCB table brings together all quantified scheme costs and benefits to help determine the economic worth of the A57 Link Roads Scheme. This table is based on those elements of the economic appraisal which are considered to produce robust monetised estimates of the impacts. The AMCB table includes:

- User benefits, such as time savings and vehicle operating cost saving, over the 60-year appraisal period;
- Effects of delays during construction;
- Changes in user charge revenues;
- Indirect taxation benefits;
- Accident benefits;
- Monetised environment impacts; and
- Costs of construction and maintenance.

5.9.5 The benefits less costs provide an initial estimate of the Net Present Value (NPV) of the scheme. The ratio of these benefits to costs is referred to as the Initial BCR.

5.9.6 In the AMCB table, four critical values are presented:

- **The Present Value of Benefits (PVB)** is the summation of the stream of discounted initial benefits over the appraisal period, reduced by the discounted value of the developer contribution.
- **The Present Value of Costs (PVC)** is the summation of the stream of discounted costs from the current year forward through the 60-year appraisal period, less the discounted value of the developer contribution, although the majority of investment costs are likely to occur before the scheme opening year. The PVC indicates the total cost of the scheme which will be considered against the benefits.
- **The Net Present Value (NPV)** is the PVB less the PVC and indicates whether there are positive or negative benefits, and their scale, from a scheme.
- **The Benefit-Cost Ratio (BCR)** is the ratio of the PVB and the PVC.

5.9.7 The AMCB table is set out in section 5.12. Following the production of the AMCB table, the relevant values in the TEE/PA/AMCB tables are then transcribed to the AST.

Adjusted BCR

5.9.8 Following calculation of the Initial BCR other benefits whose estimation are considered to be less robust are added to the appraisal, as explained in DfT’s Value for Money Assessment Advice Note (December 2013). These are benefits from changes in journey time reliability and wider economic impacts (WEIs) arising from implementation of the scheme.

5.9.9 The results of these calculations were used to derive an Adjusted PVB and an Adjusted BCR, set out in Table 5-20. The same PVC is used to generate the Initial and Adjusted BCRs.

5.10 Transport Economic Efficiency

The final Transport Economic Efficiency, Public Accounts and Analysis of Monetised Costs and Benefits tables are presented below in Table 5-17, Table 5-18 and Table 5-19 respectively.

Table 5-17 - Transport Economic Efficiency (TEE) Table (£m)

Non-Business: Commuting	
Travel Time	£42.16
Vehicle Operating Costs	-£0.58
User Charges	£0.58
Net Non-Business Benefits: Commuting	**£42.15**
Non-Business: Other	
Travel Time	£29.00
Vehicle Operating Costs	-£2.69
User Charges	£2.06
Net Non-Business Benefits: Other	**£28.37**
Business User Benefits	
Travel Time	£94.49
Vehicle Operating Costs	£17.47
User Charges	-£1.24
Net Business Benefits	**£110.72**
Total	
Present Value of Transport Economic Efficiency	**£181.25**

Note: All monetary values are in 2010 market prices discounted to 2010

5.11 Public Accounts

Table 5-18 - Public Accounts (PA) Table (£m)

Local Government Funding	
Revenue	£0
Operating Costs	£3.49
Investment Costs	£0
Developer and Other Contributions	£0
Grant/Subsidy Payments	£0
Net Impact	**£3.49**
Central Government Funding: Transport	
Revenue	£0.18
Operating Costs	£1.30
Investment Costs	£102.74
Developer and Other Contributions	£0
Grant/Subsidy Payments	£0
Net Impact	**£104.22**
Central Government Funding: Non-Transport	
Indirect Tax Revenues	-£1.41
Totals	
Broad Transport Budget	**£107.72**
Wider Public Finances	**-£1.41**

Note: All monetary values are in 2010 market prices discounted to 2010

5.12 Analysis of Monetised Costs and Benefits

Table 5-19 - Analysis of Monetised Costs and benefits (AMCB) Table (£m)

Item	Core Scenario
Noise	£3.17
Local Air Quality	-£3.77
Greenhouse Gases	-£17.45
Journey Quality	Not assessed
Physical Activity	Not assessed
Accident Savings	-£7.33
Delays During Construction	-£1.04[12]
Economic Efficiency: Consumer Users (Commuting)	£42.15
Economic Efficiency: Consumer Users (Others)	£28.37
Economic Efficiency: Business Users and Providers	£110.72
Wider Public Finances (Indirect Taxation Revenues)	£1.41[13]
Present Value of Benefits (PVB)	**£156.23**
Broad Transport Budget	£107.72
Present Value of Costs (PVC)	**£107.72**
Overall Impacts	
Net Present Value (NPV)	**£48.52**
Benefit to Cost Ratio (BCR)	**1.45**

Note: All monetary values are in 2010 market prices discounted to 2010

5.12.1 This excludes the values of reliability and wider economic impacts, the effect of which on the BCR is considered below.

5.13 Adjusted BCR

5.13.1 Inclusion of journey time reliability benefits and wider economic impacts increases the PVB from £156.23m to £264.20m. With the PVC of £107.72m, this gives an adjusted NPV of £156.49m and an adjusted BCR of 2.45.

[12] Delays During Construction include PVB from Greenhouse Gases, Economic Efficiency for Consumer Users (Commuting and Other), Economic Efficiency for Business Users & Providers and Wider Public Finances (Indirect Taxation Revenues).
[13] Excludes £58,000 of increased indirect tax generated during the construction period, to avoid double counting.

Table 5-20 - Analysis of Monetised Costs and benefits (AMCB) Table (£m)

Item	Core Scenario
Initial PVB	**£156.23**
Reliability	£10.72
Wider Economic Impacts	
Agglomeration	£85.56
Increased Output in Imperfectly Competitive Markets	£11.69
Adjusted PVB	**£264.20**
Broad Transport Budget	£107.72
Present Value of Costs (PVC)	**£107.72**
Overall Impacts	
Net Present Value (NPV)	**£156.49**
Benefit to Cost Ratio (BCR)	**2.45**

Note: All monetary values are in 2010 market prices discounted to 2010

6. Sensitivity Testing

6.1 Overview

6.1.1 The core scenario described in the previous sections is viewed as the 'most likely' future scenario. However, forecasting into the future is inherently uncertain, as unforeseen changes to key underlying assumptions can have implications for future levels of demand and supply. The DfT recommend, therefore, that scenario analysis be undertaken to allow for future uncertainty.

6.1.2 Four sensitivity tests have been undertaken considering changes to traffic growth and uncertainty of assumptions as agreed with Highways England.

6.1.3 The demand-side sensitivity tests utilise transport schemes as for the core scenario but apply adjustment factors to take into account low and high traffic growth, as set out in TAG Unit M4 and the Traffic Forecasting Report. These tests include:

- Low growth scenario: incorporating land-use uncertainty assumptions as for the core scenario (i.e. Near Certain and More Than Likely developments) with low traffic growth; and
- Optimistic scenario: The local uncertainty threshold was lowered so that all the 'Reasonably Foreseeable' developments from the uncertainty log were also included. Overall demand was then constrained to the national uncertainty associated with the optimistic growth scenario, at the trip end level. High traffic growth was then applied.

6.1.4 The low and high[14] traffic growth are represented in the modelled years by starting with the core scenario demand for that year and subtracting or adding a proportion of the base year demand. This proportion increases over time up to a maximum of 15% by the 36th year after the base year.

6.1.5 This testing of low and optimistic growth impacts has not considered the full range of impacts which have been assessed for the core scenario. Only the impact on benefits assessed through the TUBA software for the operational period of the scheme have been re-assessed to provide an indication of the scale of change.

6.1.6 A further sensitivity test has been presented in which the central carbon values used for calculation of the impact of greenhouse gas emissions have been replaced with high carbon values, to indicate the potential impact on economic performance of the scheme of potential increases in the monetary value attached to CO2e emissions.

6.1.7 Finally, a test of the sensitivity of the overall scheme performance to the geographic extent of the Wider Economic Impact assessment has been performed. As has been described, a range of tests were performed considering a balance between geographic coverage and robustness of assessment. The core assumption has been based on the mid-point of this range. Sensitivity tests have been set out examining the impact on the Adjusted BCR of each of the alternatives.

6.1.8 In all cases the scheme investment costs, and maintenance costs are held constant at the core scenario level.

6.1.9 The results of the sensitivity tests are summarised in the following sections and detailed in Appendix F.

[14] "High" growth here refers specifically to the difference in assumed growth rate relative to the Core scenario. The Optimistic scenario is generated through application of both this High growth and changes to future schemes and developments based on the uncertainty log.

6.2 Results from Low/Optimistic Growth Scenarios

6.2.1 Table 6-1 summarises the results of the demand-side sensitivity tests. Environmental and safety elements of the benefit assessment and to a lesser extent delays during the construction period would all be affected by alternative demand assumptions but for the purposes of these sensitivity tests these benefit groups have been retained at the same level as for the core scenario. Results produced from this analysis show that the BCRs are in the range from 1.20 to 1.72.

Table 6-1 - Summary for Demand-Side Sensitivity Tests (£m)

Item	Low	Core	Optimistic
Economic Efficiency: Consumer Users (Commuting)	£28.84	£42.15	£50.53
Economic Efficiency: Consumer Users (Others)	£26.45	£28.38	£35.88
Economic Efficiency: Business Users and Providers	£98.15	£110.72	£123.78
Wider Public Finances (Indirect Taxation Revenues)	£1.90	£1.14	£1.79
Other benefit groups (not reassessed)[15]	-£26.42	-£26.42	-£26.42
Present Value of Benefits (PVB)	**£128.92**	**£156.23**	**£185.55**
Broad Transport Budget	£107.72	£107.72	£107.72
Present Value of Costs (PVC)	**£107.72**	**£107.72**	**£107.72**
Net Present Value (NPV)	**£21.20**	**£48.52**	**£77.84**
Benefit to Cost Ratio (BCR)	**1.20**	**1.45**	**1.72**
Difference from Core BCR	**-17%**		**+19%**

Note: All monetary values are in 2010 market prices discounted to 2010

6.2.2 While it has not been considered proportionate to re-assess all elements of benefits in the assessment of Low and Optimistic scenarios, it is recognised that the wider economic impacts contribute a large value to the Adjusted BCR. An assessment has therefore been performed to identify to what extent these benefits would need to fall for the adjusted BCR to drop below 2.

6.2.3 However, it must be stressed that this is an indicator only of how much variation would be needed from the Core WEI forecast for the Low Growth Adjusted BCR to reach this level. There is no evidence base indicating how much change would actually be expected, or what factors leading to traffic levels falling to those forecast in the Low growth scenario would drive the necessary change in WEIs.

[15] Includes greenhouse gas emissions, air quality, noise, accidents and delays during construction. Values have not been reassessed for Low and Optimistic scenarios and so are assumed constant for the purpose of this sensitivity test.

6.2.4 The wider economic impacts in the Core scenario provide a benefit of £97.3m. This value would need to fall to £76m (a reduction of 22%) when combined with the Low Growth Initial PVB for the Adjusted BCR of the Low Growth scenario to fall to 2.

6.3 Output of High Carbon Assessment

6.3.1 For the High Carbon value sensitivity test, all elements of benefit and cost have been maintained at the same level as the core assessment, with the exception of the values placed on carbon emissions. There is no change to the assumed level of emissions, only to their economic value. The result of this assessment is set out in Table 6-2.

Table 6-2 – Summary of Greenhouse Gas Outputs over 60 Years (£m)

Greenhouse Gas Output	Value
Change in CO_2e emissions (tonnes)	399,867
Greenhouse Gas (NPV) Central Carbon Values	-£17.4
Greenhouse Gas (NPV) High Carbon Values	-£27.0

Note: All monetary values are in 2010 market prices discounted to 2010

The impact of this change on the overall economic performance is set out in Table 6-3.

Table 6-3 - Summary for Carbon Valuation Sensitivity Tests (£m)

Item	Central	High Carbon
Time savings, vehicle operating costs and user charges	£181.25	£181.25
Accidents	-£7.33	-£7.33
Greenhouse gas emissions	-£17.45	-£26.96
Air Quality	-£3.77	-£3.77
Noise	£3.17	£3.17
Delays during construction	-£1.04	-£1.04
Indirect tax	£1.41	£1.41
Present Value of Benefits (PVB)	**£156.23**	**£146.72**
Present Value of Costs (PVC)	**£107.72**	**£107.72**
Net Present Value (NPV)	**£48.52**	**£39.00**
Benefit to Cost Ratio (BCR)	**1.45**	**1.36**

Note: All monetary values are in 2010 market prices discounted to 2010

6.4 Alternative View of Wider Economic Impacts

6.4.1 As described in Section 5.7 the scale of agglomeration has been measured over a range of geographical coverage, including:

- Option A which provides the highest level of robustness but excludes potential impacts across much of the country;
- Option B which brings in Manchester and Sheffield; and
- Option C which assesses impacts across the whole country but is considered less robust.

6.4.2 Table 6-2 sets out the range of potential impacts of the WEIs on the Adjusted BCR for the Core scenario.

Table 6-4 – Uncertainty in Wider Economic Impacts (£m)

	Option A	Option B	Option C
Initial PVB	£156	£156	£156
Reliability	£11	£11	£11
Output in Imperfectly Competitive Markets	£12	£12	£12
Agglomeration	£60	£86	£130
Adjusted PVB	£239	£264	£309
PVC	£108	£108	£108
Adjusted BCR	2.22	2.45	2.87

Note: All monetary values are in 2010 market prices discounted to 2010

6.4.3 These results indicate a level of uncertainty only around the inclusion of WEIs from different regions within the assessment. Uncertainty around various assumptions used in the WITA assessment and in the precision of modelling input used in the forecasts are not captured within this range.

7. Summary

7.1 Approach

7.1.1 This Economic Appraisal Package documents the details of the approach adopted for the estimation of economic benefits arising from the scheme and summarises the results of the assessments, as part of the Project Control Framework (PCF) Stage 3.

7.1.2 This report also seeks to establish the extent to which the scheme provides good value for money in relation to impacts on public accounts by improving transport economic efficiency for all users, contributing to the wider economy and allowing for impacts on the environment.

7.1.3 The economic assessment compares the monetised costs and benefits of the proposed scheme (the Do Something or DS) against the alternative without scheme scenario (the Do Minimum or DM).

7.1.4 The costs of the scheme used in the assessment comprise the scheme construction costs provided by the Highways England Commercial team plus maintenance costs over the appraisal period. These costs are considered further in Section 3.

7.1.5 The benefits of the scheme are calculated from a number of sources, which are:

- User benefits during normal operation[16] (savings relating to travel times and vehicle operating costs) have been assessed using TUBA;
- User disbenefits during construction have also been assessed using TUBA (user disbenefits during maintenance assumed to be negligible); and
- Accident savings have been forecast using COBALT.

7.1.6 In addition, estimates have been made of the monetised greenhouse gas, air quality and noise impacts of the scheme.

7.1.7 Supplementary assessments have been undertaken to quantify benefits due to journey time reliability, wider economic impacts and social and distributional impacts.

7.1.8 An initial Benefit Cost Ratio (BCR) has been calculated over the 60-year appraisal period that excludes the outputs of the journey time reliability assessment and wider economic impacts, with an adjusted BCR also reported that includes these impacts.

7.1.9 The economic appraisal has been undertaken for the core scenario of the identified single option and is supplemented with sensitivity tests.

7.1.10 All benefits and costs were calculated in monetary terms and expressed as present values (PV) in 2010 market prices, discounted to 2010. This enables direct economic comparison with other schemes which may have different timescales.

7.2 Outputs

7.2.1 The scheme is forecast to produce benefits of £156m (PV) over the 60-year appraisal period. These benefits are generated by:

- Travel time savings and vehicle operating cost benefits of £180m;
- Safety disbenefits of -£7m;
- An environmental disbenefit of -£18m; and
- An indirect tax increase of £1m.

[16] These benefits currently reflect only the weekday peak and interpeak periods, in line with the forecasting prepared in the transport model. Subsequent stages of assessment may seek to also capture benefits during off peak and weekend periods.

7.2.2 The total scheme costs at the time of compiling this report are £108m (PV).

7.2.3 With consideration of these costs and benefits, the initial BCR is 1.45.

7.2.4 The scheme is forecast to generate additional benefits which have not been included in the Initial BCR. These include:

- Improved reliability worth £11m; and
- Wider economic impacts of £97m, composed of:
  - Agglomeration benefits of £86m; and
  - Increased output in imperfectly competitive markets of £12m.

Note: All monetary values are in 2010 market prices discounted to 2010

7.2.5 The addition of these elements of benefit result in an Adjusted BCR of 2.45 which represents Good Value for Money.

7.3 Performance Against Objectives

7.3.1 As set out in Section 1, a series of Scheme Objectives listed in the CSR have been defined for the scheme which have been used to inform the design. The economic assessment described above has been focussed on the overall impacts in line with TAG methodologies, which allow comparison of performance against other investments.

7.3.2 In parallel to this, reviews have been performed of the extent to which the proposed scheme will achieve its KPIs:

- **Connectivity** – reducing congestion and improve the reliability of people's journeys between the Manchester and Sheffield city regions.
  - As demonstrated by the time saving benefits and their spatial distribution, congestion through Mottram, Hattersley and Wooley Bridge will be relieved, improving journey times for trips on the SRN between Manchester and Sheffield, as well as for trips using the local road network in this area.
  - This impact benefits traffic not only between Manchester and Sheffield but also helps trips in other directions through the areas of Mottram, Hollingworth, Glossop and Hattersley, by providing additional network capacity.
  - Congestion on the de-trunked section of the A57 is also relieved, making improving connectivity for local traffic.
- **Environmental** – improving air quality and reducing noise levels in certain areas, through reduced congestion and removal of traffic from residential areas. The scheme is also being designed to avoid unacceptable impacts on the natural environment and landscape in the Peak District National Park.
  - It is recognised that, when measured across the whole study area, there is an overall increase in emissions. However, the outcomes of the air quality assessment undertaken using dispersion modelling to assess changes in concentrations at receptors, indicated there would be significant improvement in terms of annual mean NO2 concentrations at sensitive human health receptors within the air quality study area.
  - There is forecast to be an adverse noise impact during the construction phase, but with no night-time disturbance. Once operational the scheme will displace large volumes of traffic from a route immediately in front of properties through Mottram and Wooley Bridge, such that despite increases in flow the noise impacts will be positive.
- **Societal** – re-connect local communities along the Trans-Pennine route.
  - Reduced journey time and improved reliability will help to make use of this route more accessible. User benefits and affordability impacts of the scheme spread across all income groups, with the most deprived scoring most strongly in these areas.

  - However, collision rates are expected to be adversely impacted by the scheme, with cyclist, motorcyclists and young males identified as being most at risk. Additional traffic flow using the A57 Snake Pass is forecast to lead to an overall increase in accidents and consideration of mitigation measures may be required.
- **Capacity** – reduce delays and queues that occur during busy periods and improve the performance of junctions on the route.
  - Transport modelling forecasts delays in excess of 5 minutes along the A57(T) in both directions in the DM scenario by the scheme design year of 2040 during the busy PM peak period. Due to the congestion this creates, traffic crossing the A57(T) will also experience delays of several minutes per trip. With the scheme in place delays through the same section of network or using the new links are all forecast to be less than 1 minute during the same time period and forecast year.
  - Improved design at the Gun Inn junction will benefit NMUs by making crossing easier and safety at the junction will also be improved.
  - At Hattersley Roundabout signalisation will improve safety and smoothness of flow, while the cut-through of the roundabout will provide more direct access between the M67 and the new Mottram bypass.
  - A reliability assessment has been performed which shows that, particularly for local movements in the vicinity of the scheme, journey times will become more consistent on a day-to-day basis.

7.4 Uncertainty

7.4.1 The core scenario is viewed as the ‘most likely’ future scenario. However, forecasting into the future is inherently uncertain, as unforeseen changes to key underlying assumptions can have implications for future levels of demand and supply. The DfT recommends, therefore, that scenario analysis be undertaken to allow for future uncertainty.

7.4.2 Two sensitivity tests have been undertaken considering changes to traffic growth and uncertainty of assumptions as agreed with Highways England.

7.4.3 The case for the scheme shows a moderate[17] level of sensitivity to variations in traffic growth with the optimistic growth scenario increasing the initial BCR to 1.72 (from 1.45 in the Core) while the low growth scenario reduces the initial BCR to 1.20.

7.4.4 A sensitivity test of the impact of using high, rather than central, carbon values adds £9.5m to the economic cost of emissions generated as a result of the scheme, reducing the BCR to 1.36.

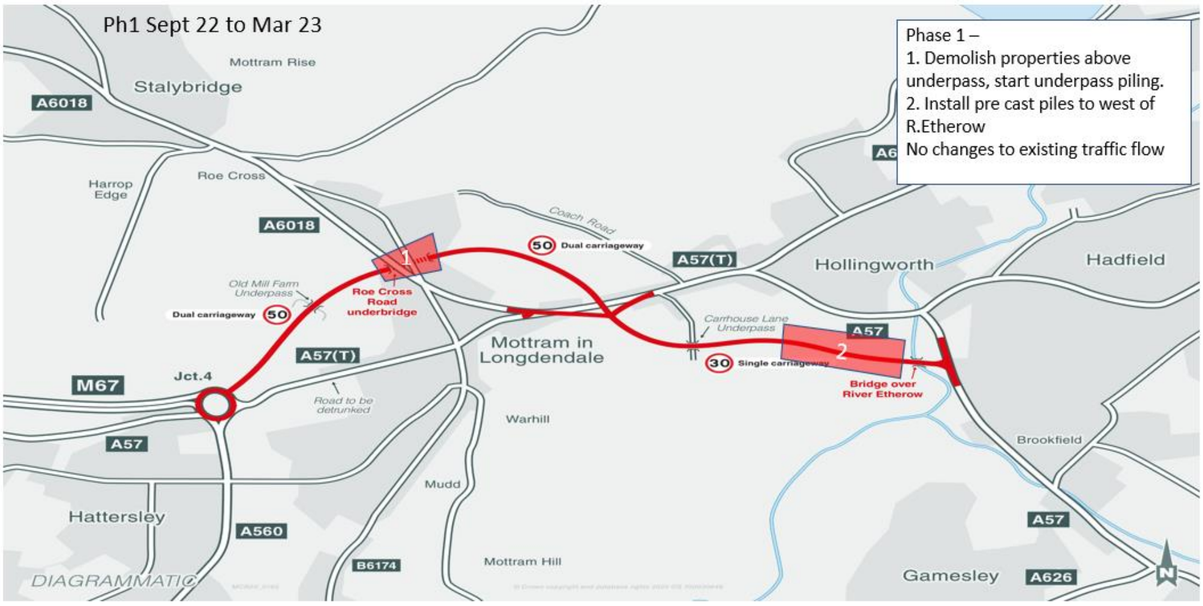
7.4.5 Finally, sensitivity tests around the potential area of impact of agglomeration indicates a range of BCRs from 2.22 to 2.87 could be returned based on this area of uncertainty.

[17] While this suggests a high range of BCRs, it must be recognised that the high and low growth parameters represent a range of +/-15% to growth in trip numbers and would suggest more fundamental changes to travel behaviour and long term economic growth. Where network capacity and rerouting options are more constrained it’s not unusual for high growth scenarios in particular to demonstrate significantly greater impacts on performance.

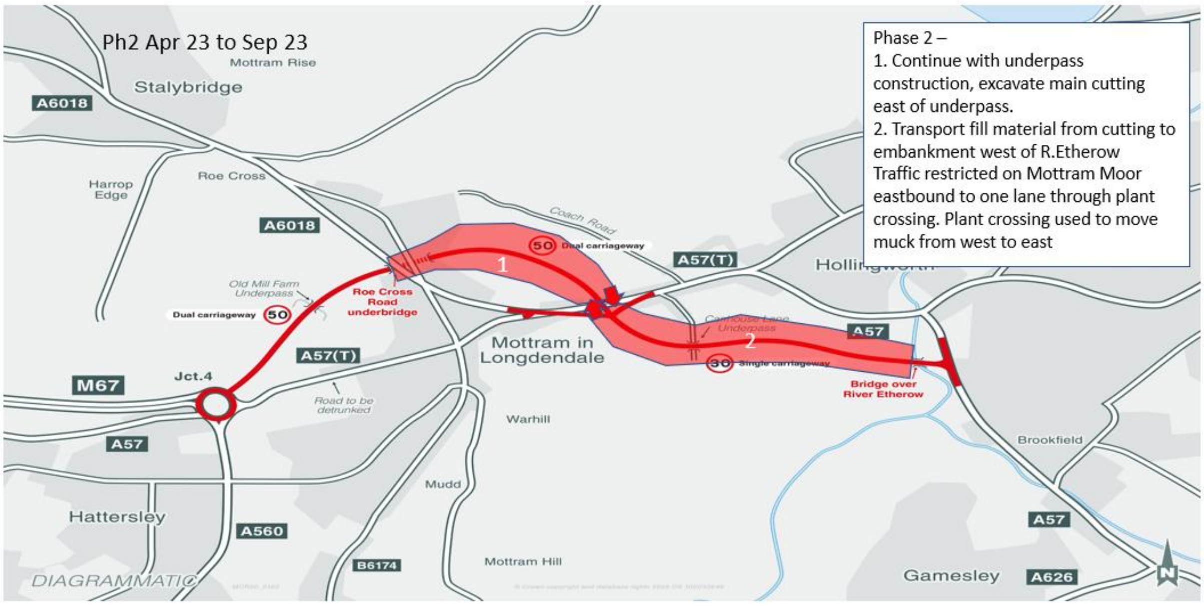
Appendices

Appendix A. Traffic Management Phases

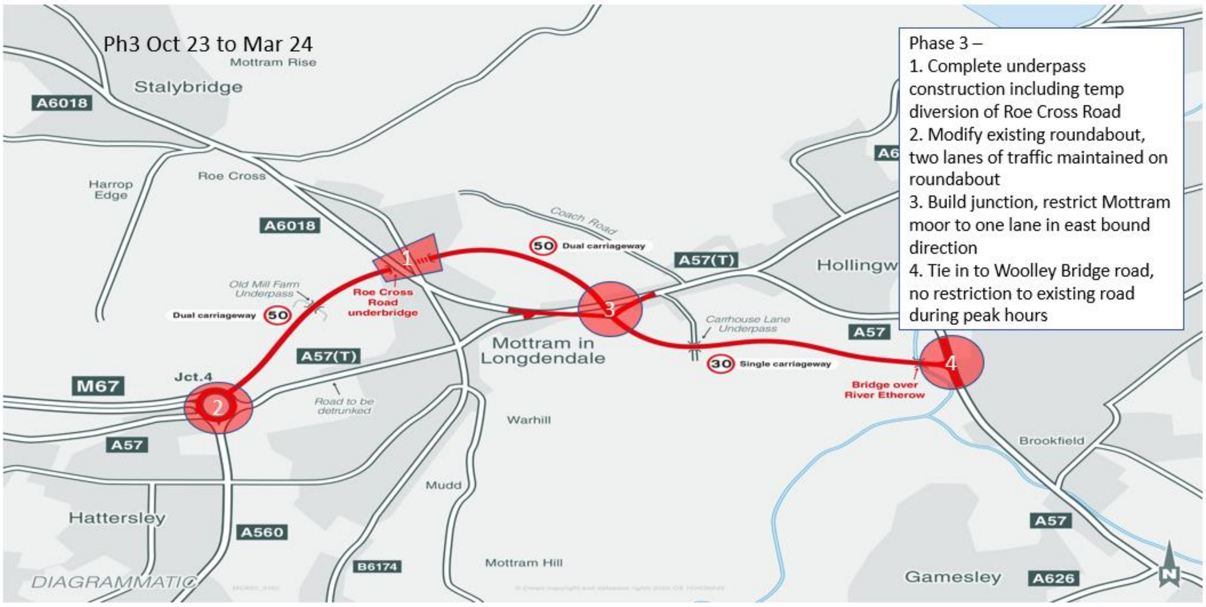
A.1. Traffic Management Phase 1



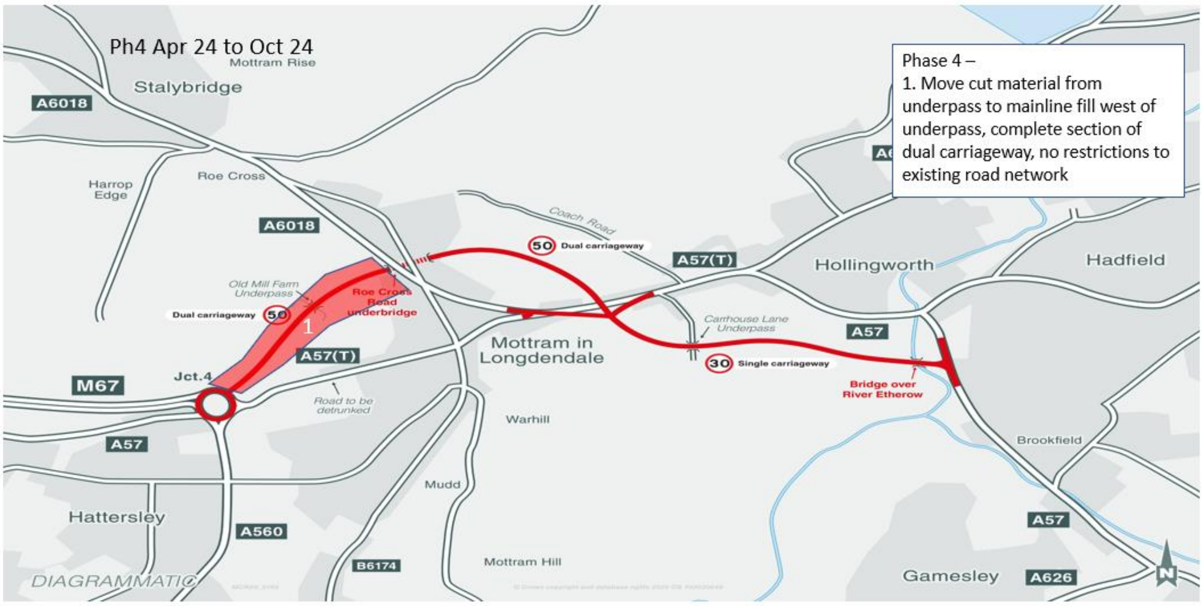
A.2. Traffic Management Phase 2



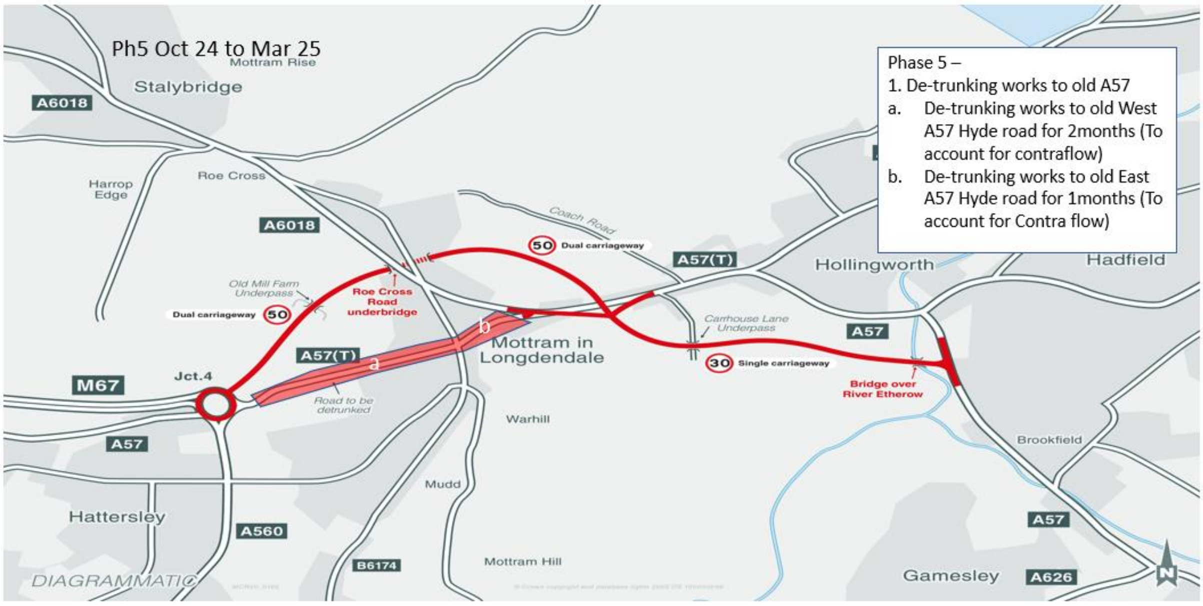
A.3. Traffic Management Phase 3



A.4. Traffic Management Phase 4



A.4.1. Traffic Management Phase 5



Appendix B. Scheme Cost Estimates

Highways England

Commercial Services Division

Economics Information for the whole package - Most Likely Cost

Funding Directorate	Major Projects (MP)
Project / Scheme Name	A57/ A628 Trans Pennine Upgrade
Option Name	Option A
Estimate Release Date	05/03/2021
Current PCF Stage	Developing
Type of Estimate	3. Development - Preliminary Design
Lead Cost Engineer	Matt Syddall

Estimate Release Notes

- If you have any questions regarding the information provided please contact CommercialServicesDivision@highwaysengland.co.uk
- Rebased 2010 calendar year profiles for Economic Calculations - All costs are in the factor cost unit of account.
- The expenditure profiles are based upon cost estimates for each financial year prepared at a base date and then inflated to outturn costs using HE projected construction related inflation.

These costs have then been rebased to 2010 calendar year profiles for economic calculations, using the GDP-deflator series as published in the WebTAG Databook.
- The costs exclude all VAT. All historic costs have been removed - previous years and an approximate of this years spend that occurs in the past.

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	Total (Excl Hist)
PREPARATION EXPENDITURE PROFILE	£0	£7,293,875	£9,746,975	£2,713	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£17,043,562
SUPERVISION EXPENDITURE PROFILE	£0	£0	£0	£1,076,005	£1,554,439	£1,025,624	£60,511	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£3,716,578
WORKS EXPENDITURE PROFILE	£0	£83,655	£102,129	£55,028,024	£47,619,850	£1,189,209	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£104,022,867
LANDS EXPENDITURE PROFILE	£0	£2,349,788	£978,083	£4,399,456	£1,233,704	£1,047,951	£900,881	£172,594	£59,604	£55,891	£28,533	£18,612	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£11,245,099
TOTAL EXPENDITURE FORECAST	£0	£9,727,317	£10,827,187	£60,506,198	£50,407,993	£3,262,783	£961,391	£172,594	£59,604	£55,891	£28,533	£18,612	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£136,028,106

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	Total (Excl Hist)
PREPARATION EXPENDITURE PROFILE	0%	75%	90%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	13%
SUPERVISION EXPENDITURE PROFILE	0%	0%	0%	2%	3%	31%	6%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	3%
WORKS EXPENDITURE PROFILE	0%	1%	1%	91%	94%	36%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	76%
LANDS EXPENDITURE PROFILE	0%	24%	9%	7%	2%	32%	94%	100%	100%	100%	100%	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	8%
TOTAL EXPENDITURE FORECAST (ALL COSTS INCLUDED)	0.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
2010 PVC Market Price	£0	£7,928,594	£8,526,649	£46,038,618	£37,057,957	£2,317,554	£659,784	£114,443	£38,186	£34,596	£17,064	£10,755	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£102,744,200

This table sets out only the capital cost element of the PVC. As illustrated in Section 3, additional costs will be incurred over the appraisal period of the scheme to maintain the assets. Spend profiles for the maintenance of the carriageway surface and the structures are set out in Table 3-4. The total PVC including both capital investment and maintenance is £107.72m.

Appendix C. Sector Definitions

As noted in Section 4 the study area covered by the model has been divided into 25 sectors to facilitate further analysis of TUBA outputs and to support the masking of these outputs. Details of the geography of the sectors is illustrated in Figure 4-1. The definitions of these areas are listed below:

The internal sectors are:

- Sector 1 -Study Area within Mottram
- Sector 2 - Rest of Tameside
- Sector 3 - Oldham
- Sector 4 - Kirklees
- Sector 5 - Barnsley
- Sector 6 - Sheffield
- Sector 7 - Rest of High Peak
- Sector 8 - Stockport

The buffer sectors are:

- Sector 9 - Manchester (North west Region)
- Sector 10 - Rochdale
- Sector 11 - Rest of York and Humber Region
- Sector 12 - Wakefield
- Sector 13 - Rotherham
- Sector 14 - Chesterfield
- Sector 15 - South West of Pennines
- Sector 16 - West of Pennines
- Sector 17 - North West of Pennines
- Sector 18 - East of Pennines (York and Humber)
- Sector 19 - East of Pennines, Lincoln, Doncaster, Scunthorpe

The external sectors are:

- Sector 20 - Rest of East
- Sector 21 - South East, South West and London Region
- Sector 22 - Rest of West Midlands and Wales
- Sector 23 - Rest of North West Region
- Sector 24 - North East Region
- Sector 25 - Scotland

Appendix D. Benefit Distribution

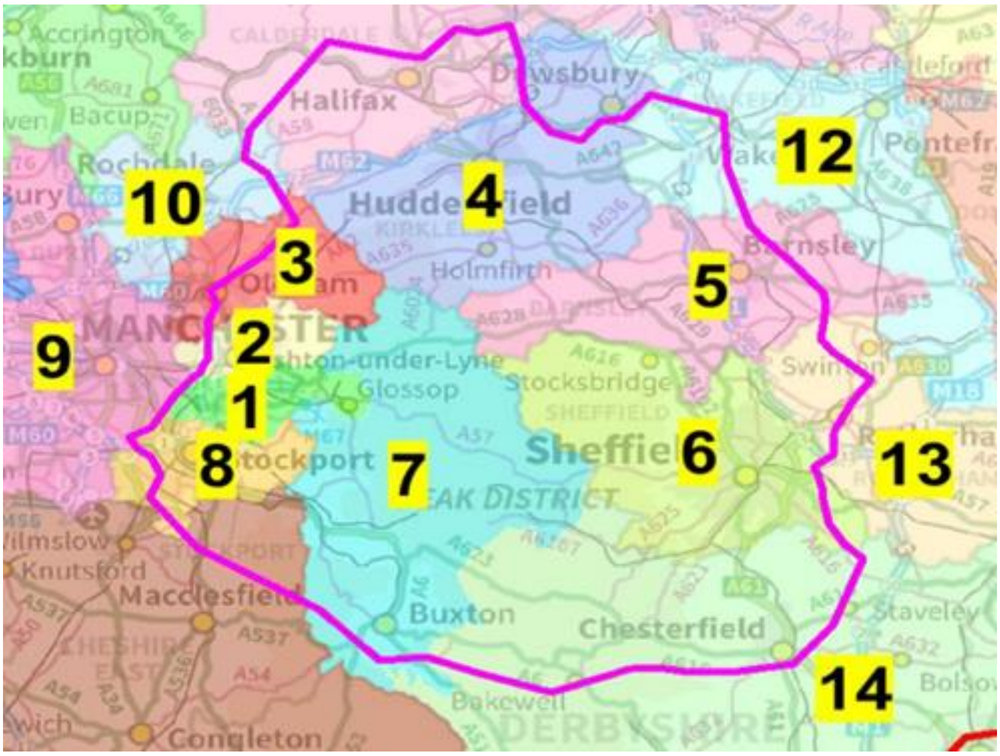
To understand the spatial distribution of benefits from the scheme, sector analysis was carried out. The traffic model zones were aggregated into twenty-five sectors as set out in Figure D-1

Sectors 1 to 8 are internal sectors, sectors 9 to 19 are buffer sectors, while sectors 20 to 25 are external sectors for the Trans-Pennine Upgrade scheme

Figure D-1 indicates the sectoring applied in the vicinity of the Trans-Pennine Upgrade scheme. Based on the size of the modelled area relative to the scale of scheme all external-external movements have been masked within the matrix skimming process.

The sector analysis of the transport user benefits for all the movements captured over the 60year appraisal period and is presented in Figure D-1.

Figure D-1 - A57 Link Roads Scheme Simulation Area Sectors



The sector analysis of the journey time benefits over the 60-year appraisal period post masking is presented in Table D-1.

Distributions of benefits per trip in the forecast years of 2025, 2040 and 2051 are set out in Table D-2 to Table D-4.
These tables indicate that the majority of benefits generated by the A57 Link Roads Scheme relate to trips either to or from the central sector 1, with the large number of trips to and from Manchester also resulting in moderate levels of benefits accruing to these movements.

The distributions of benefits per trip show a more dispersed pattern, as trips passing through the scheme will experience more comparable levels of benefit even if few trips make that journey. The masking process means that, though sector to sector demand levels may be high, only the trips which are affected by the scheme are retained for the benefit calculations. The benefit per trip distribution shows that the highest values are obtained by movements travelling from one side of the buffer area of the model to the other, on an east to west or west to east trajectory. These movements are largely from the areas west of Manchester to Sheffield, or from areas to the East of Sheffield towards Manchester. This demonstrates the improved connectivity along this corridor, preventing the need for potentially long diversions which may be required in the DM scenario to avoid the congested area around the A57 Link Roads Scheme.

Table D-1 – Sector Benefit Summary – Core Scenario – all 60 years (£m)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	Grand Total
1	28.0	4.8	1.5	0.2	0.1	0.7	1.5	3.0	6.7	0.8	0.1	0.1	0.1	0.2	1.8	2.7	1.7	-0.1	0.3	0.1	0.0	0.6	0.1	0.0	0.1	55.1
2	11.9	0.0	0.0	0.0	0.0	0.2	1.8	1.2	0.2	0.0	0.0	0.0	-0.1	0.1	0.3	0.0	0.0	0.0	0.0	0.3	0.1	0.1	0.0	0.0	0.0	16.3
3	1.9	0.0	0.0	0.0	0.0	0.3	0.8	0.5	0.1	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.1	0.1	-0.1	0.0	0.0	0.0	4.1
4	0.1	0.0	0.0			0.0	0.1	0.1	-0.1	0.0				0.0	0.0	0.0	0.0			0.0	0.0	0.0	0.0		0.0	0.2
5	0.0	0.0	0.0					0.1	0.8	0.0					0.4	0.0	0.0					0.1	0.0		0.0	1.5
6	0.1	0.1	0.1	0.0			0.0	0.6	4.0	0.1	0.0				0.8	1.7	1.6					0.3	0.1	0.0	0.0	9.5
7	0.3	0.7	0.3	0.0	0.0	0.0	-0.2	0.5	1.9	0.2	0.1	0.0	0.0	0.0	0.0	0.4	0.7	0.0	0.0	0.0	-0.1	0.0	0.1	0.0	0.0	4.9
8	6.2	1.1	0.6	0.2	0.3	0.9	1.3	0.6	1.2	0.1	0.1	0.1	0.1	0.1	0.1	0.5	0.2	0.1	0.3	0.1	0.1	0.0	0.0	0.1	0.0	14.1
9	10.2	0.3	0.2	0.5	3.3	5.8	2.3	0.8			-0.3	1.3	1.9	1.3	0.0			-0.7	3.7	1.1	0.2	0.0		-0.4		31.5
10	0.6				0.0	0.2	0.2	0.0				0.0	0.0	0.0	0.0				0.0	0.0	0.0	0.0				1.1
11	0.1	0.0				0.0	0.1	0.0	-0.6					0.0	0.0	0.0				0.0	0.0	0.0				-0.5
12	0.0	0.0	0.0				0.0	0.0	0.0	0.0				0.0	0.1	0.0	0.0			0.0		0.0	0.0			0.2
13	0.0	0.0	0.0					0.0	0.5	0.0					0.2	-0.2	0.0					0.1	0.0			0.5
14	0.1	0.0	0.0	0.0			0.0	0.0	0.6	0.0	0.0	0.0			0.0	0.0	0.1					0.0	0.1	0.0	0.0	1.1
15	1.8	0.2	0.2	0.1	0.7	0.6	0.3	0.0	0.0	0.0	-0.1	0.4	0.3	0.1		0.0	0.0	-0.1	0.7	0.0			0.0	0.0	0.0	5.2
16	4.4	0.1	0.0	0.1	1.5	2.9	0.8	0.1			0.0	0.5	1.2	0.4	0.0			0.0	0.5	0.1	0.0	0.0		0.0		12.7
17	2.2	0.0		0.0	0.1	2.3	0.4	0.1				0.0	0.1	0.1	0.0				0.0	0.1	-0.2	0.0				5.2
18	-0.1	0.0					0.0	0.0	-0.7						0.0	0.0						0.0				-0.7
19	0.0	0.0	0.0					0.1	0.3	0.0					0.1	-0.2	0.0					0.0	0.0			0.4
20	0.2	0.2	0.1	0.0			0.0	0.0	1.3	0.1	0.0	0.0			0.0	0.0	0.2					0.0	0.0	0.0	0.0	2.3
21	0.1	0.0	0.0	0.0			0.1	0.0	0.5	0.0	0.0	0.0				0.0	-0.6						0.0			0.0
22	0.1	0.0	0.0	0.0	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0		0.0	0.0	0.0	0.2	0.0			0.0	0.0	0.0	0.7
23	0.3				0.0	0.1	0.1	0.0						0.0						0.0						0.5
24	0.0	0.0				0.0	0.0	0.0	-0.5					0.0	0.0	0.0				0.0		0.0				-0.6
25	0.3				0.0	0.0	0.1	0.0	0.0					0.0												0.4
Grand Total	**68.9**	**7.5**	**3.0**	**1.0**	**6.2**	**14.3**	**9.4**	**7.7**	**16.4**	**1.3**	**0.0**	**2.5**	**3.7**	**2.4**	**4.0**	**5.0**	**4.0**	**-0.7**	**5.7**	**1.8**	**0.3**	**1.2**	**0.4**	**-0.3**	**0.1**	**165.6**

All values are in £million in 2010 market prices discounted to 2010.

Table D-2 – Sector Benefit Summary – Time Benefit per Trip, 2025 (£m)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	Total
1	0.05	0.02	0.03	0.06	0.03	0.13	0.06	0.02	0.03	0.03	0.03	0.05	0.08	0.11	0.05	0.05	0.06	-0.08	0.16	0.08	0.04	0.09	0.10	0.03	0.02	0.05
2	0.06	0.00	0.01	0.09	-0.05	0.22	0.35	0.06	0.00	0.00	0.01	0.06	-0.26	0.10	0.00	-0.01	-0.01	0.03	0.07	0.27	0.00	0.01	-0.01	0.02	-0.01	0.04
3	0.06	-0.01	0.00	0.06	0.22	0.44	0.41	0.14	-0.01	0.01	0.06	0.09	0.48	0.17	0.00	-0.02	-0.03	0.08	0.12	0.09	0.07	-0.01	-0.05	0.07	-0.07	0.09
4	0.05	-0.01	0.03			0.03	0.42	0.12	0.02	0.01				0.42	0.03	0.00	0.00			0.09	0.01	0.03	-0.02		-0.03	0.07
5	0.01	0.01	0.10					0.16	0.23	0.03					0.26	0.01	0.04					0.23	-0.01		-0.01	0.09
6	0.03	0.11	0.23	-0.03			-0.12	0.30	0.41	0.45	0.01				0.34	0.37	0.85					0.37	0.59	0.16	0.16	0.26
7	0.00	0.08	0.14	0.19	-0.11	-0.12	-0.22	0.14	0.15	0.14	0.13	-0.06	-0.09	-0.32	0.14	0.13	0.24	-0.07	-0.25	-0.27	-0.38	0.14	0.26	-0.20	0.26	0.00
8	0.03	0.03	0.07	0.11	0.49	0.42	0.21	0.08	0.04	0.05	0.04	0.10	0.41	0.29	0.05	0.04	0.06	0.02	0.43	0.10	0.28	0.05	0.04	0.07	0.07	0.14
9	0.08	0.01	0.01	0.11	0.62	0.74	0.23	0.09			0.00	0.14	0.54	0.39	0.06			0.01	0.39	0.14	-0.02	-0.01		0.02		0.19
10	0.08				0.02	0.55	0.16	0.04				0.03	0.03	0.03	-0.02				0.06	0.02	0.00	-0.04				0.08
11	0.05	0.01				0.45	0.15	0.03	0.02					0.19	-0.02	-0.05				0.02	-0.38	-0.03				0.04
12	0.04	0.01	0.02				-0.09	0.08	0.06	-0.04				0.39	0.04	-0.02	0.01			0.01		0.11	0.01			0.04
13	-0.03	-0.07	0.20					0.18	0.24	0.03					0.24	-0.30	0.03					0.29	0.02			0.08
14	0.05	0.07	0.06	0.19			0.07	0.21	0.22	0.03	0.16	0.02			0.16	0.01	0.14					0.13	0.22	0.32	0.07	0.12
15	0.10	0.01	0.01	0.06	0.67	0.54	0.57	0.04	-0.01	0.00	0.04	0.21	0.69	0.31		0.01	0.03	0.04	0.34	0.02			0.00	0.01	0.00	0.17
16	0.14	-0.03	-0.01	0.05	0.49	0.81	0.42	0.05			0.04	0.11	0.53	0.24	0.02			0.04	0.07	0.02	0.00	0.00		0.03		0.16
17	0.17	-0.17		0.01	0.05	0.91	0.13	0.12				0.15	0.04	0.03	0.01				0.07	0.01	0.00	-0.02				0.10
18	-0.02	0.04					-0.07	0.00	0.05						-0.02	-0.06						-0.04				-0.01
19	0.00	-0.06	0.00					0.11	-0.02	-0.04					0.11	0.00	0.00					0.17	0.00			0.02
20	0.08	0.10	0.03	0.02			-0.08	0.12	0.12	0.03	0.03	0.01			0.03	0.01	0.01					0.02	0.01	0.07	0.00	0.03
21	0.07	-0.20	-0.06	-0.05			-0.09	0.08	0.09	0.00	0.01	0.00				-0.02	0.00						0.00			-0.01
22	0.05	-0.06	-0.04	0.04	0.38	1.17	0.52	0.05	-0.01	-0.05	0.02	0.18	0.79	0.31		-0.01	-0.05	0.01	0.34	0.03			0.00	0.00	0.00	0.17
23	0.29				0.00	0.52	0.13	0.09						0.00						-0.01						0.15
24	-0.04	-0.05				0.10	-0.03	0.01	0.05					0.02	0.00	-0.05				0.01		-0.01				0.00
25	0.21				0.00	0.00	0.18	0.06	-0.15					0.00												0.04
Total	0.06	-0.01	0.05	0.07	0.22	0.43	0.15	0.10	0.08	0.04	0.04	0.08	0.30	0.16	0.07	0.00	0.09	0.01	0.16	0.04	-0.03	0.07	0.07	0.05	0.04	0.09

Table D-3 – Sector Benefit Summary – Time Benefit per Trip, 2040 (£m)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	Total
1	0.08	0.04	0.05	0.08	0.05	0.27	0.10	0.03	0.04	0.07	0.04	0.08	0.10	0.12	0.04	0.07	0.11	-0.10	0.25	0.11	0.04	0.11	0.17	-0.07	0.05	0.08
2	0.09	0.01	0.03	0.15	-0.06	0.45	0.55	0.15	0.01	0.04	0.03	0.10	-0.29	0.16	0.05	0.02	0.02	0.05	0.03	0.43	0.13	0.05	-0.01	0.07	-0.01	0.09
3	0.08	0.03	0.02	0.09	0.29	0.73	0.63	0.28	0.02	0.04	0.08	0.23	0.45	0.28	0.05	0.01	0.04	0.10	0.20	0.15	0.04	-0.02	0.04	0.12	0.06	0.16
4	0.07	0.01	0.05			0.07	0.54	0.09	0.00	0.00				0.50	0.03	0.00	0.00			0.11	-0.03	-0.05	-0.16		-0.04	0.07
5	0.02	-0.02	0.04					0.18	0.24	0.04					0.20	0.01	0.04					0.20	0.00		-0.05	0.08
6	0.02	0.16	0.27	0.03			-0.16	0.37	0.47	0.39	0.13				0.46	0.66	1.14					0.56	0.60	0.17	0.07	0.33
7	0.02	0.20	0.24	-0.02	-0.18	-0.19	-0.33	0.15	0.25	0.42	0.26	-0.11	-0.18	-0.43	0.06	0.24	0.50	-0.17	-0.06	-0.45	-0.57	0.18	0.57	-0.36	0.58	0.02
8	0.06	0.12	0.17	0.19	0.69	0.66	0.32	0.11	0.06	0.12	0.12	0.24	0.58	0.41	0.06	0.10	0.14	0.12	0.56	0.17	0.33	0.05	0.06	0.13	0.10	0.23
9	0.08	0.03	0.02	0.08	0.76	0.79	0.34	0.20			-0.06	0.24	0.65	0.53	0.09			-0.09	0.42	0.22	0.05	0.03		-0.08		0.23
10	0.09				0.08	0.66	0.28	0.17				0.08	-0.06	0.09	0.03				0.05	0.13	0.06	0.01				0.13
11	0.06	0.00				0.32	0.13	0.03	-0.02					0.14	0.03	0.06				0.05	-0.01	0.04				0.07
12	0.07	0.05	0.08				0.00	0.09	0.02	0.03				-0.02	0.09	0.00	0.02			-0.03		0.10	0.04			0.04
13	-0.02	-0.04	0.21					0.22	0.27	0.04					0.27	-0.21	0.04					0.30	0.03			0.10
14	0.10	0.16	0.11	0.08			-0.14	0.26	0.30	0.06	0.29	0.03			0.15	0.04	0.21					0.08	0.39	0.63	0.12	0.17
15	0.13	0.06	0.05	0.01	0.74	0.55	0.71	0.10	-0.02	0.02	-0.10	0.21	0.64	0.28		-0.01	0.08	-0.08	0.40	-0.04			0.00	0.01	0.00	0.17
16	0.17	0.02	0.00	0.01	0.44	1.08	0.70	0.11			-0.08	0.06	0.50	0.22	0.03			-0.10	0.02	0.03	-0.04	0.02		0.03		0.17
17	0.24	0.09		0.01	0.07	1.19	0.35	0.22				0.09	0.08	0.10	0.05				0.04	0.04	-0.11	-0.05				0.16
18	-0.10	0.01					-0.04	-0.01	-0.06						0.01	0.02						0.02				-0.02
19	0.04	-0.06	-0.01					0.14	0.11	0.01					0.12	0.00	0.03					0.09	0.02			0.05
20	0.18	0.25	0.11	0.03			0.30	0.21	0.21	0.17	0.06	0.03			0.01	0.01	0.07					0.00	0.03	-0.61	0.02	0.06
21	0.01	-0.04	-0.03	-0.08			-0.05	0.02	0.02	-0.01	0.01	0.01				0.01	-0.06						0.02			-0.01
22	0.00	0.01	-0.11	-0.11	0.42	1.19	0.56	0.10	-0.06	-0.06	-0.04	0.19	0.98	0.25		-0.05	-0.03	-0.10	0.43	0.02			0.02	0.02	0.02	0.17
23	0.42				0.02	0.47	0.32	0.14						0.06						0.03						0.21
24	-0.07	-0.01				0.26	0.00	0.00	-0.06					0.16	0.00	-0.01				0.02		0.02				0.03
25	0.41				0.01	0.03	0.42	0.14	-0.06					0.02												0.14
Total	0.09	0.05	0.07	0.04	0.26	0.53	0.25	0.14	0.09	0.09	0.06	0.11	0.31	0.17	0.09	0.05	0.15	-0.04	0.21	0.06	-0.01	0.09	0.11	0.00	0.08	0.123

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Table D-4 – Sector Benefit Summary – Time Benefit per Trip, 2051 (£m)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	Total
1	0.09	0.04	0.10	0.13	0.13	0.34	0.12	0.02	0.07	0.22	0.15	0.14	0.18	0.17	0.10	0.18	0.35	-0.09	0.32	0.11	-0.05	0.13	0.31	0.09	0.25	0.14
2	0.09	0.03	0.05	0.21	-0.05	0.59	0.64	0.18	0.02	0.06	0.01	0.14	-0.31	0.21	0.06	0.03	0.07	0.00	-0.06	0.48	0.19	0.06	0.01	0.04	0.02	0.11
3	0.10	0.05	0.03	0.14	0.47	1.01	0.71	0.34	0.04	0.04	0.05	0.48	0.60	0.40	0.07	0.00	0.09	0.07	0.15	0.15	0.07	-0.05	0.03	0.07	0.03	0.21
4	0.07	0.07	0.02			0.14	0.55	0.04	-0.03	0.01				0.43	0.01	0.00	0.01			0.03	-0.03	-0.04	0.08		0.13	0.09
5	0.02	0.00	0.06					0.25	0.32	0.04					0.24	0.02	0.04					0.25	0.04		-0.04	0.10
6	0.01	0.16	0.34	0.01			-0.18	0.40	0.53	0.50	0.11				0.50	0.70	1.38					0.57	0.68	0.47	-0.03	0.38
7	0.03	0.26	0.34	0.10	-0.06	-0.19	-0.23	0.03	0.25	0.48	0.28	0.03	-0.17	-0.53	0.05	0.23	0.60	-0.09	-0.09	-0.50	-0.64	0.13	0.70	-0.22	0.70	0.06
8	0.06	0.14	0.23	0.29	0.95	0.84	0.45	0.08	0.05	0.03	0.10	0.28	0.79	0.52	0.00	0.04	0.10	0.13	0.71	0.20	0.32	-0.03	0.08	0.14	0.07	0.26
9	0.08	0.10	0.08	0.11	0.92	0.95	0.41	0.30			-0.06	0.25	0.74	0.61	0.11			-0.08	0.45	0.24	0.04	0.02		-0.07		0.27
10	0.09				0.08	0.82	0.38	0.25				0.10	-0.19	0.07	0.06				0.03	0.07	-0.03	-0.01				0.13
11	0.03	-0.03				0.77	0.12	0.01	-0.14					0.18	-0.01	0.00				-0.07	0.09	0.03				0.08
12	0.05	0.07	0.04				-0.04	0.09	-0.03	0.04				-0.03	0.07	-0.01	0.02			-0.05		0.12	-0.08			0.02
13	-0.02	-0.07	0.23					0.27	0.32	0.05					0.31	-0.20	0.05					0.40	-0.06			0.12
14	0.13	0.24	0.15	0.42			-0.21	0.23	0.33	0.07	0.35	0.03			0.19	0.05	0.26					0.13	0.32	0.74	0.11	0.21
15	0.12	0.13	0.13	0.06	0.85	0.58	0.85	0.11	-0.02	0.03	-0.01	0.19	0.70	0.05		0.02	0.11	0.00	0.50	0.02			0.04	-0.02	0.04	0.20
16	0.20	0.12	0.02	0.06	0.43	1.11	0.84	0.23			0.05	0.14	0.56	0.22	0.02			0.05	0.06	0.05	0.04	0.02		0.03		0.22
17	0.26	0.40		0.01	0.09	1.38	0.44	0.29				0.10	0.08	0.09	0.09				0.05	0.05	-0.03	0.04				0.22
18	-0.15	-0.01					-0.07	-0.01	-0.13						0.01	0.01						0.00				-0.04
19	0.06	-0.13	0.00					0.17	0.04	0.01					0.04	-0.06	-0.05					0.04	-0.06			0.01
20	0.27	0.43	0.13	0.00			0.23	0.03	0.28	0.21	0.06	-0.01			0.01	0.02	0.06					0.00	-0.01	-0.12	-0.01	0.09
21	0.09	0.04	0.00	0.03			0.46	-0.07	0.15	-0.02	0.00	0.00				-0.02	-0.33						-0.05			0.02
22	0.04	0.11	-0.01	0.04	0.48	1.07	0.71	0.06	0.02	0.02	0.00	0.19	0.98	0.09		-0.04	-0.01	0.02	0.31	0.00			-0.03	0.01	-0.04	0.18
23	0.48				0.03	0.52	0.39	0.23						0.12						0.08						0.26
24	-0.11	0.00				0.32	0.00	0.00	-0.17					0.16	-0.02	0.01				0.01		0.00				0.02
25	0.46				0.01	-0.01	0.47	0.23	-0.06					0.05												0.16
Total	0.10	0.10	0.11	0.12	0.33	0.64	0.32	0.15	0.09	0.11	0.08	0.15	0.36	0.17	0.10	0.05	0.17	0.00	0.22	0.05	0.00	0.09	0.13	0.10	0.10	0.15

Appendix E. TUBA Warnings

All scenarios assessed in TUBA have had output files reviewed to check warning messages for any possible indications of problems. A record of the review undertaken for the Core Scenario is set out below.

E.1. Warnings and Logic checking

Annualised total trip matrix numbers that were fed as an input to TUBA were cross checked for different peak periods, user classes and forecast years by deriving them independently from SATURN matrices and comparing them to TUBA outputs. All comparisons showed the results to be internally consistent.

Warnings on the Core Scenario TUBA (Masked) output file, such as the ratio of DM to DS travel distance or travel time being outside the defined range, were investigated. The number of warnings of each type is summarised in Table E-1 – TUBA Warnings for Core Scenario TUBA run (Masked)

Table E-1 – TUBA Warnings for Core Scenario TUBA run (Masked)

TUBA Warning	Number of types of warning	Comment
Warning: Ratio of DM to DS travel time lower than limit	1,013 (Serious 42)	Longer travel times forecasted for a small number of short distance movements. 42 of such warnings are serious. [18]
Warning: Ratio of DM to DS travel time higher than limit	15,298 (Serious 113)	Indicates relatively high journey time savings but impacting only very small number of short distance movements. 113 of such warnings are serious. [11]
Warning: Ratio of DM to DS travel distance lower than limit	1,857 (Serious 193)	Longer travel distances forecasted for few small numbers of inter zonal trips (majority of those are of short distance movements). 193 of such warnings are serious. [11]
Warning: Ratio of DM to DS travel distance higher than limit	1,326 (Serious 86)	Shorter travel distances forecasted for a small number of movements. 86 of such warnings are serious. [11]
Warning: DM speeds less than limit	157,722	Warnings relate to DM trips having speeds lower than the minimum threshold speed of 5km/h as specified in TUBA. Few DM trips experience network delay and most of them are of short distance trips to town centre. [11]
Warning: DM speeds greater than limit	1,513,762	Warnings relate to DM trips having speed higher than the maximum threshold speed of 130km/h as specified in TUBA. These movements are happening outside of model simulation area. [11]
Warning: DS speeds less than limit	157,834	Warnings relate to DS trips having speeds lower than the minimum threshold speed of 5km/h as specified in TUBA. Few DS trips experience network delay and most of them are of short distance trips to town centre. [11]
Warning: DS speeds greater than limit	1,513,002	Warnings relate to DS trips having speed higher than the maximum threshold speed of 130km/h as specified in TUBA. These movements are happening outside of model simulation area. [11]
Warning: DM time greater than limit	49	Warnings relate to few DM trips where travel time exceeds the maximum limit of 10 hrs as specified in TUBA. Due to large size of this model, few OD

[18] Warnings of this type tend to occur for adjacent zones which are connected directly by centroid connectors meaning that traffic does not need to enter the modelled network.

TUBA Warning	Number of types of warning	Comment
		pairs particularly for HGVs experience such a high travel time.
Warning: DS time greater than limit	47	Warnings relate to few DS trips where travel time exceeds the maximum limit of 10 hrs as specified in TUBA. Due to large size of this model, few OD pairs particularly for HGVs experience such a high travel time.
Serious Warning: Possible introduction of new mode one of DM and DS time is zero, but not both	96 (Serious 96)	Warnings relate to OD pairs in which either DM or DS (but not both) time is zero. These warnings have been checked and relate to movements which have zero time associated due to demand for that movement being zero in one scenario or the other. Very small variations in trip numbers across the network result in some movements fluctuating between zero and marginally above zero between scenarios. In all cases the demand reported for the relevant movements have been confirmed to be zero due to the rounding processes employed within TUBA, so these variations have no impact on the calculated benefits.
Serious Warning: Possible introduction of new mode one of DM and DS distance is zero, but not both	211 (Serious 211)	Warnings relate to OD pairs in which either DM or DS (but not both) distance is zero. As above the zero distances relate to demands for these movements varying between zero and a very small non-zero number. Checks have been performed showing the non-zero distances have very low demands associated and so will not impact on the reported benefits.
Total	3,362,217	Total Number of Warnings

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Appendix F. Observed Accident Data

Table F-1 – STATS19 accident data for "Combined Link and Junction" approach

Accident Location		Accident Year					
Road/Junction	Link Name	2014	2015	2016	2017	2018	Total
Sheffiel Road	Silk Street/Sheffield Rd to Shirebrook Drive/Kings Edward Avenue	0	0	0	0	0	0
High Street	Shirebrook Drive/Kings Edward Avenue to Smithy Fold/Elison St	0	0	2	0	1	3
	Smithy Fold/Elison St to Victoria St/Norfolk St	0	1	0	2	0	3
	Victoria St/Norfolk St to Market St/Railway St/High St	1	1	2	1	1	6
	Market St/Railway St to Arundel st/Chapel St	2	0	1	0	0	3
	Arundel st/Chapel St/High St E to Brook St/High St E	2	1	1	0	0	4
	Brook St/High St E to Queen St/Glossop Brook Rd	0	2	0	0	1	3
	Queen St/Glossop Brook Rd to Spring St/High St E	0	0	0	1	1	2
	Spring St/High St E to Primrose Ln/Brookfield/High St Rbt	0	0	0	1	1	2
Brookfield	Primrose Ln/Brookfield/High St Rbt to Dinting Ln/Brookfield	0	1	0	1	1	3
	Dinting Ln/Brookfield to Brookfield/Glossop Rd	0	1	1	0	0	2
	Brookfield/Glossop Rd to Shaw Ln/Brookfield	0	0	0	2	0	2
	Shaw Ln/Brookfield to Tavern Rd/Brookfield	4	2	0	3	1	10
Woolley Lane	Woolley Bridge Rbt to Woolley Ln/Earnshaw St	0	1	1	0	1	3
A57 Mottram	A57 Mottram Carrhouse to A57 Mottram Moor/Fern Cottages	0	0	0	0	0	0
A57 Mottram	Mottram Moor Fern Cottages Ln to A57 Mottram Bus Stop	0	0	0	0	0	0
	A57 Mottram Bus Stop to Mottoram Moor/Back Moor bypass	0	0	0	0	0	0
	A57 Mottram Moor/Fern Cottages to Mottram Moor/BackMoor Pass	0	0	0	0	0	0
Back Moor Junction	Mottram Moor/BackMoor Pass to Roe Cross Rd	1	0	0	0	1	2
	Mottram Moor/BackMoor Pass to Roe Cross Rd	1	0	0	0	1	2
A628	Flouch Roundabout to A628/A6024 Woodhead Rd	14	5	11	11	9	50
	A628/A6024 Woodhead Rd to A628/B6105 bypass	2	2	0	0	1	5
	A628/B6105 bypass to Woodhead Rd/Valehouse Reservoir	0	2	1	2	2	7
	Woodhead Rd /Valehouse Reservoir to New Rd/Church St	1	0	1	1	1	4
	Market St/Water Ln to Church St/Manchester Rd/New Rd	3	0	2	1	1	7
	Market St/Water Ln to Market St/Taylor St	1	2	2	1	1	7
B6105	A628/B6105 bypass to Woodhead Rd/Cementery Rd	2	3	0	2	1	8

Table F-2 – STATS19 accident data for "Link Only" approach

Accident Location		Accident Year					
Junction	Link Name	2014	2015	2016	2017	2018	Total
Hattersley Roundabout	M67 Approach to Hattersley Roundabout in DS (Link 1)	0	0	0	2	0	2
Gun Inn Junction	Approach arm to Gunn Inn junction, along Mottram Moor in DS (Link 2)	0	0	0	2	0	2
Woolley lane Junction	Approach to Woolley Lane junction – Proposed Link (Link 5)	0	0	0	2	0	2
Gun Inn Junction	Approach arm to Gunn Inn junction, along Mottram Moor in DM (Link 7)	0	0	0	2	0	2

Table F-3 – STATS19 accident data for "Junction Only" approach

Accident Location		Accident Year					
Junction	Junction no.	2014	2015	2016	2017	2018	Total
Hattersley Roundabout	Junction 1	3	1	0	0	3	7
Hattersley Roundabout	Junction 2	1	0	0	0	1	2
Gun Inn Junction	Junction 3	0	0	0	1	0	1
Gun Inn Junction	Junction 4	0	0	0	1	0	1

Table F-4 – STATS19 accident data for Snake Pass Link

Accident Location		Accident Year					
Road/Junction	Link Name	2015	2016	2017	2018	2019	Total
Snake Road	Onksley Lane to A6013/Manchester Rd	3	12	3	5	6	29
Snake Road	A6013/Manchester to A57 Snake Rd near Longley Barn	4	2	5	1	0	12
Snake Road	A57 Snake Rd near Longley Barn to Silk Street/Sheffield Rd	12	10	5	13	5	45

Appendix G. Agglomeration Impacts Assessment in WITA

G.1. Purpose

The definition of Level 2 WEBs is set out in TAG A2 series, within which the most notable impact is productivity uplift from urban agglomeration (static clustering). This technical note outlines the methodology and findings from an agglomeration impact assessment undertaken for the proposed A57 Trans-Pennine Upgrade scheme. The remainder of this document outlines the specification of the assessments, data used, key assumptions and findings.

G.2. Scope and Specification of the assessment

G.2.1. Scope of assessment

TAG Unit A2.1 (July 2020) sets out approaches for estimating a range of wider economic impacts that can be considered to be supplementary to the welfare economic benefits captured through conventional appraisal described in the previous sections (termed Level 1 appraisal), and occur as individuals and businesses change their behaviour and / or economic activities in response to the transport change[19].

The WEI identified in TAG are categorised into two levels:

- Level 2 WEI based on connectivity improvements only, without explicit land use change, including: static agglomeration, more people working and increased output in imperfectly competitive markets
- Level 3 WEI involving explicit land use change and/or additional economic modelling, including: dynamic agglomeration, move to more productive jobs and dependent development

For the purposes of this assessment:

- Static agglomeration was quantified as it was deemed to account for a significant part of the WEIs and align well with the nature of the intervention
- Benefits associated with increased output in imperfectly competitive markets were quantified as 10% of the conventional impacts on business users, in line with TAG Unit A2.2 (July 2020)
- Other Level 2 impacts such as labour market effects (more people working) were only looked at qualitatively and deemed to be beneficial
- Dependent development impacts or move to more productive jobs were deemed less significant or relevant to the nature of the scheme and therefore not assessed

This document is focused on the methodology adopted for assessing static agglomeration impacts, which represent GVA impacts from productivity uplift as a result of enhanced access to economic mass (ATEM) brought by transport investment. There is clear economic evidence showing a causal relationship between agglomeration and productivity as documented and referenced in relevant guidance. Agglomeration benefits represent the uplift in business productivity as a result of improvement in ATEM, which is a metric to measure agglomeration, and also termed effective density (ED) in TAG. The calculation of agglomeration impacts is mainly influenced by the following three factors:

- the uplift in productivity per worker (derived from comparing ATEM with and without the proposed intervention)
- the quantum of employment (i.e. number of jobs)
- the average GDP per worker

Therefore, the value of agglomeration benefits is informed by a combination of the three factors above. High agglomeration benefit could be the result of a marginal increase in connectivity that is linked with locations with high number of jobs and average productivity, or a significant journey cost saving linked with locations with modest quantum of employment.

[19] Conventional appraisal is based on the assumption that transport markets behave in a theoretical 'perfect' manner. However, in reality markets are imperfect and wider economic impacts occur as the impacts of the transport scheme transmit from the transport markets to other markets as businesses and individuals change their behaviour.

G.2.2. Overview of the approach

Overall, the methodology adopted in this assessment is based on an understanding of the similar assessment undertaken previously in a former iteration of the scheme assessment. A review of similar work was undertaken in Jun 2020, findings from the review of the previous work (which was proportionate for the relevant stage of work at the time) were fed into the formulation of the new methodology so the observations and limitations were addressed appropriately. A summary of this process is outlined in Table 5, where observations in the previous assessment against a systematic review of the process are presented, along with mitigations proposed in the new approach.

Table 5 – Formulation of the technical approach to address observations and limitations in previous assessment

Areas of Observations		Observations in the previous forecasts	Mitigations in the new approach
Data	Transport connectivity	Unable to check / bespoke process	Improved transparency and assurance through the use of WITA
	Economic data	Observations on the discrepancies with DfT dataset (jobs and GVA)	Latest DfT wider impacts dataset used
	Other economic parameters	Consistent with the guidance in TAG	No changes but need to check consistency with the latest databook and wider impacts dataset (standard and sensitivity test versions)
Calculation	Step 1 – GTC	See "Transport connectivity"	Python scripts developed to consolidate input from transport models
	Step 2 – ATEM	PT travel costs appears to be unrealistic for certain movements	Use of Atkins dataset applied elsewhere based on timetable and fare
	Step 3 – Annual impacts	Constrained to a selection of sectors excluding Manchester and Sheffield	Manchester and Sheffield included in one of the options
	Step 4 – Profiling over 60 years	VoT growth and discounting need update in new forecast	Incorporated in WITA

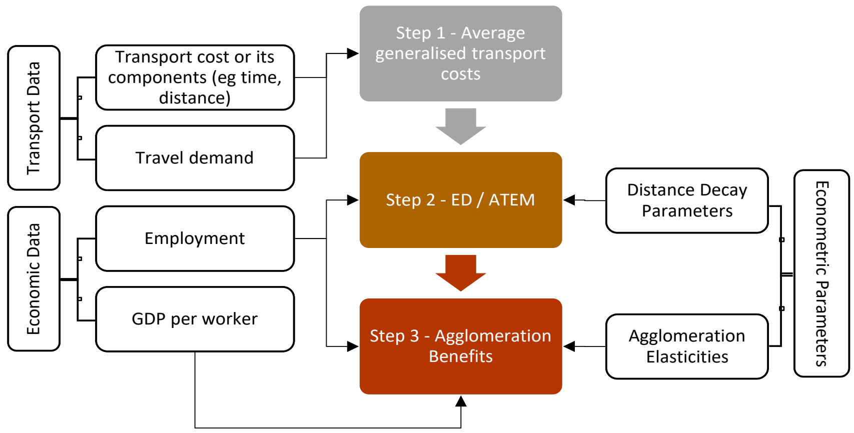
Details of the technical approach formulated are presented in the next sub-section.

G.2.3. Tools and specification

Software tool

The calculation of agglomeration impact is based on DfT's WITA Beta 2.0 so the technical approach and its implementation are in line with TAG Unit A2.4. Key input and steps in agglomeration assessment are illustrated in the diagram in Figure 5 below.

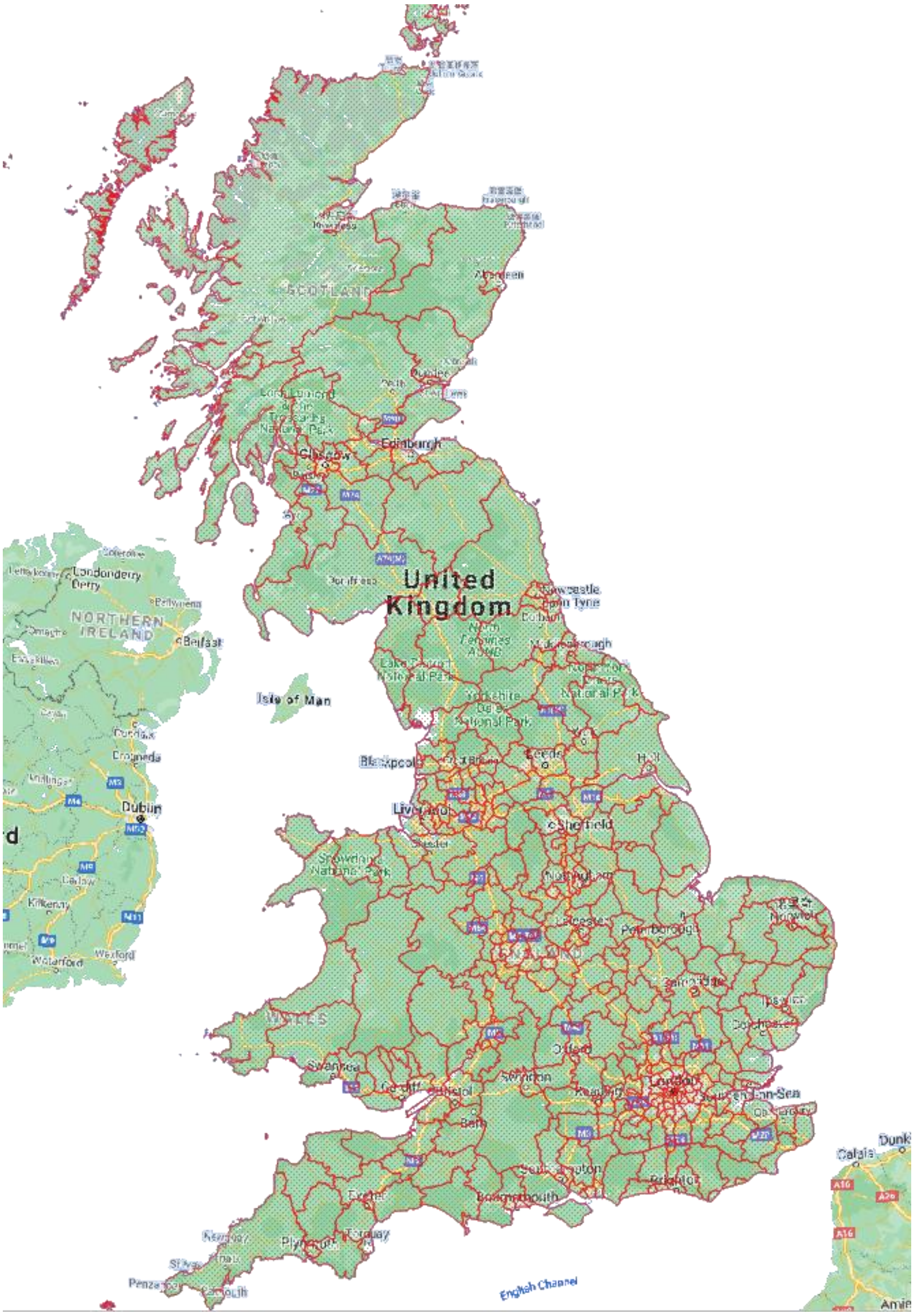
Figure 5 – Illustration of the process for WITA assessment



Geographical extent and detail

The nature of agglomeration impacts requires a nationwide geographical extent. Zoning system of the WITA model is based on the Local Authority District (LAD) definition used in the latest Wider Impacts Dataset published by the DfT. There are 380 LAD zones in the current dataset that covers the entirety of the UK. The LAD-based zoning structure is illustrated in Figure 6.

Figure 6 – Illustration of zoning structure for WITA assessment



Profiling and discounting

The agglomeration assessment covers a 60-year appraisal period starting from an assumed opening year of 2025. Transport model forecasts for year 2025, 2040 and 2051 were used.

Profiling and discounting over the appraisal period follows the guidance in TAG and are undertaken by WITA. Output monetary forecasts in this document are expressed in 2010 prices and values.

G.3. Data for agglomeration assessment

As illustrated in Figure 5, the agglomeration assessment used a range of economic and transport connectivity data.

The economic data (mainly jobs, GVA and other parameters used in the calculation as set out in TAG) came from DfT's wider impacts dataset, which has a compatible geographical resolution with the zoning system of the WITA model. The current sensitivity test version of the wider impacts dataset (issued by DfT) was used for consistency purpose as the transport model output (and TUBA assessment) was based on DfT's Databook v1.14 (sensitivity test).

A representation of the future baseline rail travel cost was also used for completeness purpose as agglomeration assessment requires a representation of travel costs by both highway and rail. Omission of this will usually lead to significant overestimation of agglomeration benefits.

Rail travel costs were based on a dataset developed by Atkins during the course of delivering similar studies elsewhere. Information fed into the rail travel costs involves data like timetables, fare, NRTS survey on average access/egress time and information from automated online journey planning queries. It is noted that the focus on the particular assessment is highway intervention, so rail travel costs were assumed to remain unchanged in any tests.

Highway travel costs that fed into the WITA model were based on the same highway model output that was used for user impacts assessment in TUBA. A main challenge in this process is the consolidation of the detailed transport model zoning system to the WITA model of 380 zones. This was carried out with the help of a GIS tool that derived the correspondence between the two sets of zoning systems. The consolidation of any output from the transport model (such as time and distance) was demand-weighted during data processing. Overall, transport model output in forecasting year 2025, 2040 and 2051 for the future reference case and Do Something scenario was used.

G.4. Findings from the assessment

The WITA model outputs the forecast total agglomeration benefits for the 60-year appraisal period and also provides separate forecasts for individual zones modelled, i.e. LADs in this model. These forecast agglomeration benefits reflect the increased productivity caused by firms being closer in physical or travel time terms to other firms and potential employees.

Due to the varying level of details in the transport model, modelling noise present and masking applied to mitigate such noises, the robustness of agglomeration forecasts by LAD also varies.

In light of the varying level of robustness in the forecasts, alterative perspectives of interpreting the output were established. This involves three different areas in which agglomeration benefits may be claimed, as illustrated in options A, B and C in Figure 8.

Figure 7 – Three different perspectives for interpreting the forecast agglomeration benefits

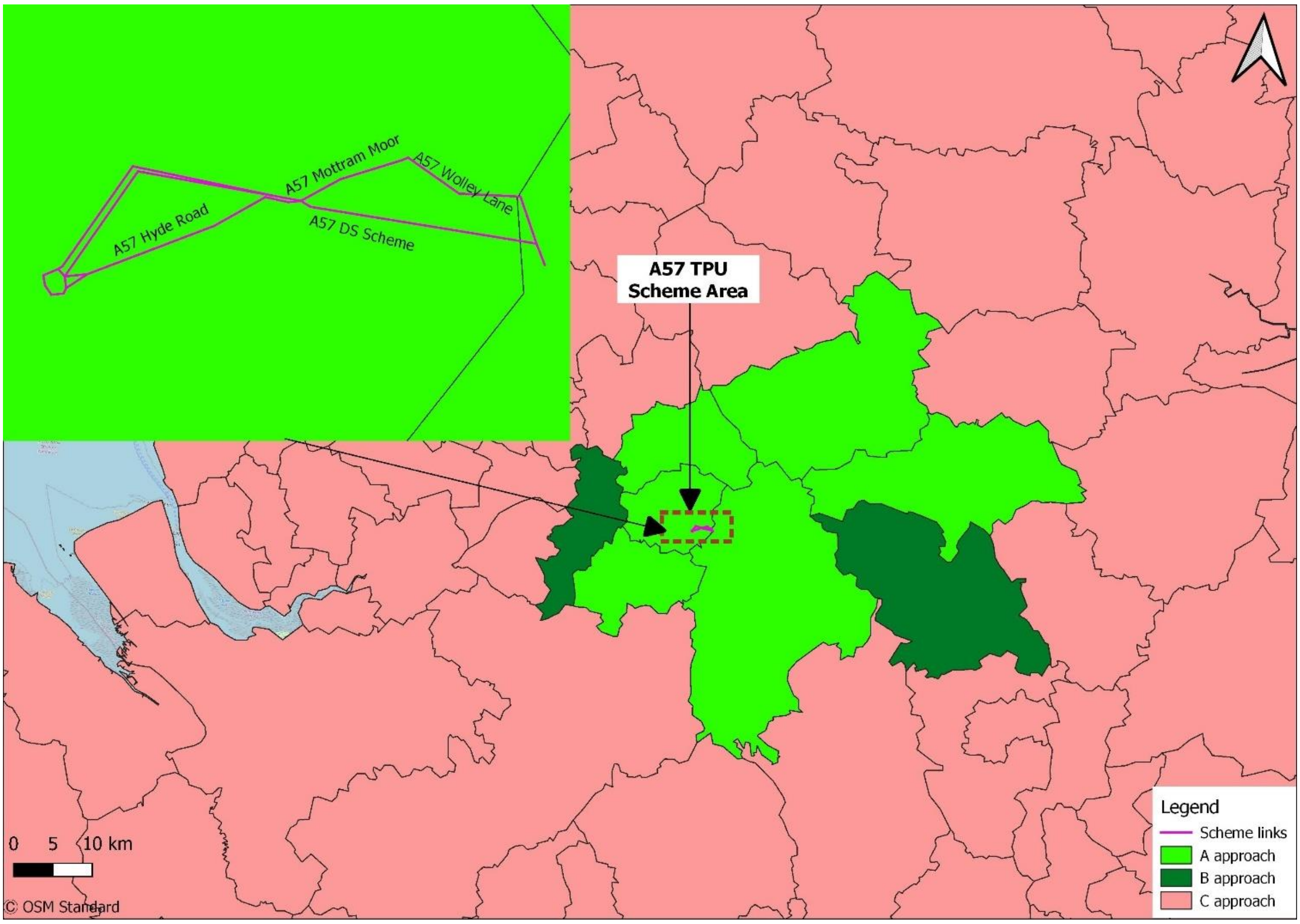


Table 6 – Formulation of the technical approach to address observations and limitations in previous assessment

Perspective	Observations in the previous forecasts	Mitigations in the new approach
Option A – benefits from High Peak, Oldham, Stockport, Tameside, Barnsley, Kirklees	£60m	Areas located mostly within the ADM and are directly relevant to the geography of the scheme. Reasonable consistency in the forecast benefits between the masked and unmasked runs, which implies robustness.
Option B – Option A plus impacts from Manchester and Sheffield	£86m	Including two clusters of economic activities at either side of the Pennine. Sensible (positive) forecasts obtained for Manchester and Sheffield when the masked transport model output was used (less noise).
Option C – Option B plus the rest of the country	£130m	Significantly higher benefit when modelling 'noise' was dealt with by masking. Generally lower level of robustness for agglomeration forecasts with significant level of masking but it demonstrates the scope for additional benefits (vs Option A).

Table 5-11 also outlines the reasons behind the choice of the three different approaches for interpreting agglomeration forecasts. Option A brings higher robustness and consistency although maybe on the conservative side. Option C is less reliable but certainly demonstrate the scope for potential legitimate benefits on a national stage but the exact figure is to be refined. Option B appears to bring a reasonable balance between robustness and representation of the scheme's potential. Option B forecast is built upon the benefits claimed through Option A but captures further productivity uplift in Manchester and Sheffield which is deemed to be in line with expectation. The additional benefits in Option B were derived through the masking of potential 'noise' in the transport model output (in consistent with the approach for conventional user impacts) and therefore are slightly less robust compared with Option A.

Furthermore, Table 5-12 also presents the top 10 LADs with the highest agglomeration benefits, along with an indication of the total employment present and which option each LAD falls into. It is clear from this that the top

10 locations are generally sensible in relation to the geography and nature of the intervention, and both Options A and B are well represented in these top locations (Option C is expected to cover all location by default).

Table 7 – Formulation of the technical approach to address observations and limitations in previous assessment

	LADs	Benefits		Employment	Option A	Option B	Option C
1	Tameside	£	23,506,770	87,327	y	y	y
2	High Peak	£	16,779,946	41,325	y	y	y
3	Stockport	£	14,740,932	138,789	y	y	y
4	Sheffield	£	13,080,189	297,476		y	y
5	Manchester	£	12,596,494	350,836		y	y
6	Trafford	£	5,607,028	142,976			y
7	Oldham	£	4,853,746	97,431	y	y	y
8	Salford	£	4,204,621	125,197			y
9	Bury	£	2,676,751	80,299			y
10	Derbyshire Dales	£	1,925,050	41,594			y

Appendix H. Change in Travel Time and Trip Numbers

H.1. Purpose

This appendix provides a summary of the distribution of benefits generated by the scheme, disaggregated by:

- The change in time savings per trip as a percentage of the DM travel time; and
- The change in trip numbers resulting from the scheme, as a percentage of the DM trips.

Table H-1 to Table H-3 present time benefits broken down by the change in travel time and trip numbers for the model year 2025, 2040 and 2051 respectively.

Table H-1 – Monetised change in travel time with respect to change in trip numbers for the model year 2025 (£000s)

	Change in travel time			
Change in trip numbers	<-30%	-30% to 0%	0% to 30%	>30%
<-30%	0	0	0	0
-30% to 0%	66	2141	-1432	-42
0% to 30%	142	2444	-150	0
>30%	61	320	0	0

Table H-2 – Monetised change in travel time with respect to change in trip numbers for the model year 2040 (£000s)

	Change in travel time			
Change in trip numbers	<-30%	-30% to 0%	0% to 30%	>30%
<-30%	0	0	0	0
-30% to 0%	64	1821	-1353	-56
0% to 30%	158	2399	-116	0
>30%	121	380	0	0

Table H-3 – Monetised change in travel time with respect to change in trip numbers for the model year 2051 (£000s)

	Change in travel time			
Change in trip numbers	<-30%	-30% to 0%	0% to 30%	>30%
<-30%	0	1	0	0
-30% to 0%	212	1689	-1530	-73
0% to 30%	205	2124	-176	-49
>30%	127	392	0	0

It can be observed from these tables that majority of the time benefits occur when DS trips increase by less than 30% and DS travel time reduces by less than 30% compared to DM. If large proportions of trips experienced changes in journey times or trip numbers above this level it could suggest a moderate level of error in the rule of a half calculations performed by TUBA and indicate that an intermediate cost point should be used to mitigate this effect.

The benefits which relate to the largest changes in costs and trips are those in 2051 which experience larger time savings and moderate to large increases in trip numbers. Further analysis shows that more than half of these benefits fall into the range of 30% to 40% changes in costs and trips and only 2% of the total relate to changes in either cost or trips of more than 50%. This breakdown suggests use of intermediate cost points could improve accuracy of benefit calculations, but the difference would be expected a be a fraction of 1% of the total and is therefore not considered to be proportionate.

The scheme is expected to generate a large proportion of its benefit through time savings for trips involving east west movement and vice versa using M67, A57 Mottram road and Hyde road, along the Manchester to Sheffield corridor. This will result in time saving benefits for the trips travelling longer distance and passing through the scheme area. Therefore, although time savings per trip will be moderately high, as indicated in Table 5-1, in many cases this will be as part of a longer distance journey and so the saving may not be a high percentage of the total journey time.

Appendix I. Social and Distributional Impact Assessment Report

Document reference: HE551473-BBA-GWE-A57_AL_SCHEME-RP-TB-000001

[redacted]

Routes to Market – Delivery Integration Partnership

A57 TPU

A57 Transport Modelling Package

HE551473-BBA-GEN-A57_AL_SCHEME-AS-TR-000002
12/11/21
S4

HE551473-BBA-GEN-A57_AL_SCHEME-AS-TR-000002

Notice

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This document has 79 pages including the cover.

Document history

Revision	Suitability	Purpose description	Originated	Checked	Reviewed	Authorised	Date
[redacted]							

Contents

Tables

Figures

1. Introduction

1.1. Purpose of the Transport Model Package

1.1.1. The purpose of the Transport Model Package is to provide details of the 2015 base year transport model developed for PCF Stage 3 of the Trans-Pennine Upgrade (TPU) A57 link road scheme.

1.2. Background

1.2.1. The base model at PCF Stage 2 of the TPU scheme was developed from the 2015 Trans-Pennine South Regional Transport Model (TPS RTM). Details of the validated base model developed at PCF Stage 2 are provided in the corresponding Local Model Validation Report (LMVR)[1].

1.2.2. The validated base model developed during PCF Stage 2 has been used as a starting point for the development of the PCF Stage 3 TPU strategic model. Comprehensive details regarding the TPU model specification are outlined in the PCF Stage 2 LMVR, and therefore have not been repeated in the PCF Stage 3 Transport Model Package.

1.2.3. An initial PCF Stage 3 Transport Model Package was produced by Arcadis in November 2018[2]. However, following refinements to the PCF Stage 3 TPU model by Atkins, this has been superseded by this document.

1.2.4. An extensive data collection exercise was not deemed necessary as part of the transport modelling at PCF Stage 3. However, a series of ad-hoc traffic surveys was commissioned to assist with model development. Full details of the data used to inform the development of the 2015 base year TPU model are documented in the PCF Stage 3 Supplementary Data Collection Package[3].

1.3. Need for modelling refinement

1.3.1. Initial air quality (AQ) modelling undertaken by Arcadis in July 2018 indicated that an unmitigated TPU scheme could have significant AQ effects and jeopardise the application for development consent. Changes in traffic flow and speed as a result of the scheme were predicted to cause exceedances of the AQ strategy objectives for annual mean nitrogen dioxide (NO2). The primary locations where a negative AQ impact was reported were the village of Tintwistle (A628) and the specific locations on the A57 route through Dinting Vale and Glossop High Street, as shown in Figure 1-1.

1.3.2. Atkins was commissioned by HE to undertake a review of the work done by consultants Arcadis at PCF Stage 3 for the proposed TPU scheme. The aim of this process was to strengthen the robustness of the modelling, under high levels of scrutiny for the Development Consent Order (DCO). Following the presentation of the review findings in the summer of 2019, Atkins was commissioned to implement its recommendations and finalise PCF Stage 3.

1.3.3. As such, details of how the base model has been developed during the finalisation of PCF Stage 3 are provided in section 2, resulting model metrics are shown in section 3 and a summary is presented in section 4.

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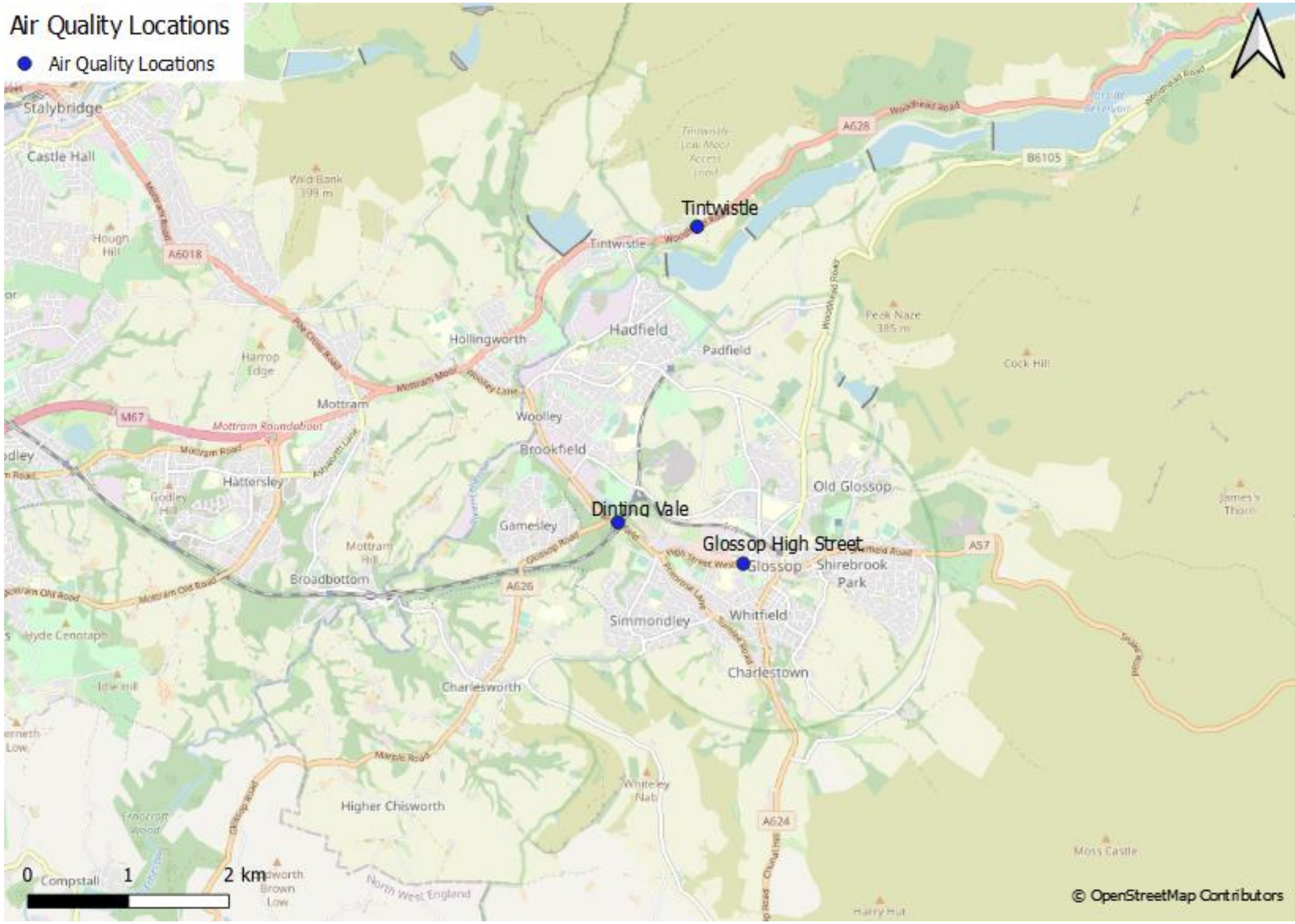
[1] Stage 2 TPU LMVR (August 2017): HE551473-ARC-GEN-ZZZ-RP-TR-2017

[2] Stage 3 TPU Transport Model Package (Arcadis, 2018) (superseded): HE551473-ARC-TTM-TPU-RP-TR-3177

[3] Stage 3 TPU Supplementary Data Collection Package (November 2020): HE551473-BBA-GEN-A57_AL_SCHEME-AS-TR-000001

Figure 1-1 - Air quality issue locations



2. Model development

2.1.1. This section provides details of the base model developments undertaken by Atkins during the finalisation of PCF Stage 3. The changes made to the base year model focus on the known AQ issues in Tintwistle and on Dinting Vale and Glossop High Street (as noted in section 1.3).

2.2. Model Specification

2.2.1. No changes to the model specification have been made since PCF Stage 2. Full details of the model specification are provided in the PCF Stage 2 LMVR (see section 1.2.1).

2.2.2. The TPU model is developed from the TPS RTM, which includes a SATURN (v11.3.12) Highway Assignment Model (HAM) combined with a DIADEM Variable Demand Model (VDM) (DIADEM v6.3.4). Software versions were retained for consistency with the TPS RTM donor model and previous PCF stages.

2.2.3. The TPU base model year is 2015, with average hour peak time periods (AM: 07:00-10:00, IP: 10:00-16:00 and PM: 16:00-19:00).

2.2.4. As shown in Table 2-1, demand for the TPU model is segmented into 10 categories. These are aggregated into five user classifications for the Highway Assignment Model (HAM).

Table 2-1 - TPU base model - user classes

HAM User Class	Demand Segment	Trip Purpose
UC1: Car Business	Home Based Employers' business	HB Employers' business
	Non-Home-Based Employers' business	NHB Employers' business
	Fixed – Employers' business	Employers' business
UC2: Car Commute	Home Based Commute	HB Commute
	Fixed – Commute	Commute
UC3: Car Other	Home Based Other	HB Shopping
		HB Personal business
		HB Recreation/Social
		HB Visiting Friends and Relatives
		HB Holiday/Day Trip
		HB Education
	Non-Home Based Other	NHB Work
		NHB Education
		NHB Shopping
		NHB Personal business
		NHB Recreation/Social
		NHB Holiday/Day Trip
	Fixed – Other	Others
UC4: LGV	Light Goods Vehicles	Light Goods Vehicles
UC5: HGV	Heavy Goods Vehicles	Heavy Goods Vehicles

2.2.5. The simulation boundary of the TPS RTM has been retained, but the focus of the TPU model is concentrated on the Area of Detailed Modelling (ADM) highlighted in Figure 2-1.

Figure 2-1 – Area of Detailed Modelling (ADM) – TPU PCF Stage 3

2.3. Prior matrices

2.3.1. The prior matrices developed during PCF Stage 2 have been retained as a starting point for PCF Stage 3. Full details of the prior matrices are provided in the PCF Stage 2 LMVR.

2.3.2. However, the granularity and network connectivity of certain zones in and around Glossop has been improved to give a more accurate reflection of vehicle loading in the local area.

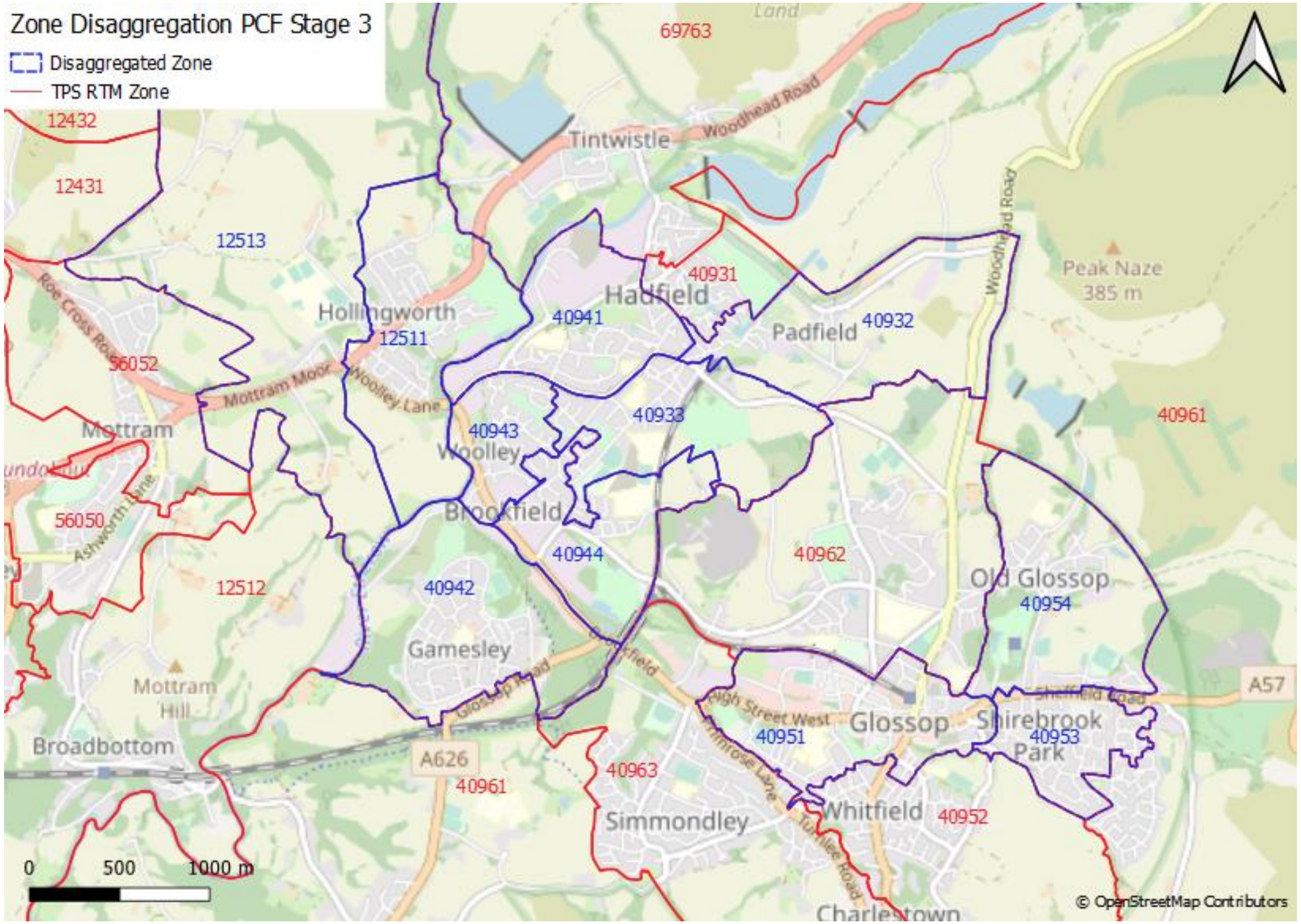
2.3.3. The zoning system for TPS RTM is derived through an aggregation of Office for National Statistics (ONS) Output Areas (OAs). Several zones in Stage 3 have been disaggregated into smaller sets of OAs to form new zones using the ONS 2011 Census population data (KS101EW: usual resident population) obtained at OA level. Origin and destination trip end totals of existing zones (Stage 2) have been applied a factor based on the proportional population split of the disaggregated zones (Stage 3). Therefore the disaggregated zones (Stage 3) fit seamlessly within the existing zones (Stage 2) as all follow OA boundaries.

2.3.4. Table 2-2 provides details of the zones disaggregated in the local area, whilst Figure 2-2 provides a visual representation.

Table 2-2 - Zone disaggregation - PCF Stage 3

Existing Zone – Stage 2	Disaggregated Zone – Stage 3	Location	Description
40951	40951, 40953, 40954	Glossop	Glossop has been split into three zones: old Glossop, east Glossop and central Glossop.
40941	40941, 40943	Hadfield	Hadfield has been split into two zones: north Hadfield and south Hadfield.
40942	40942, 40944	Gamesley	This zone has been split into two zones: one represents Gamesley village, whilst the other represents Brookfield and the area surrounding the Carpenter industrial site.
40932	40932, 40933	Padfield	This zone has been split into two zones: one represents Padfield north of Park Road, whilst the other represents the area adjacent to Newshaw Lane.
12511	12511, 12513	Hollingworth	Hollingworth has been split into two zones: Hollingworth village and Hollingworth rural

Figure 2-2 - Zone disaggregation - PCF Stage 3



2.4. Highway network

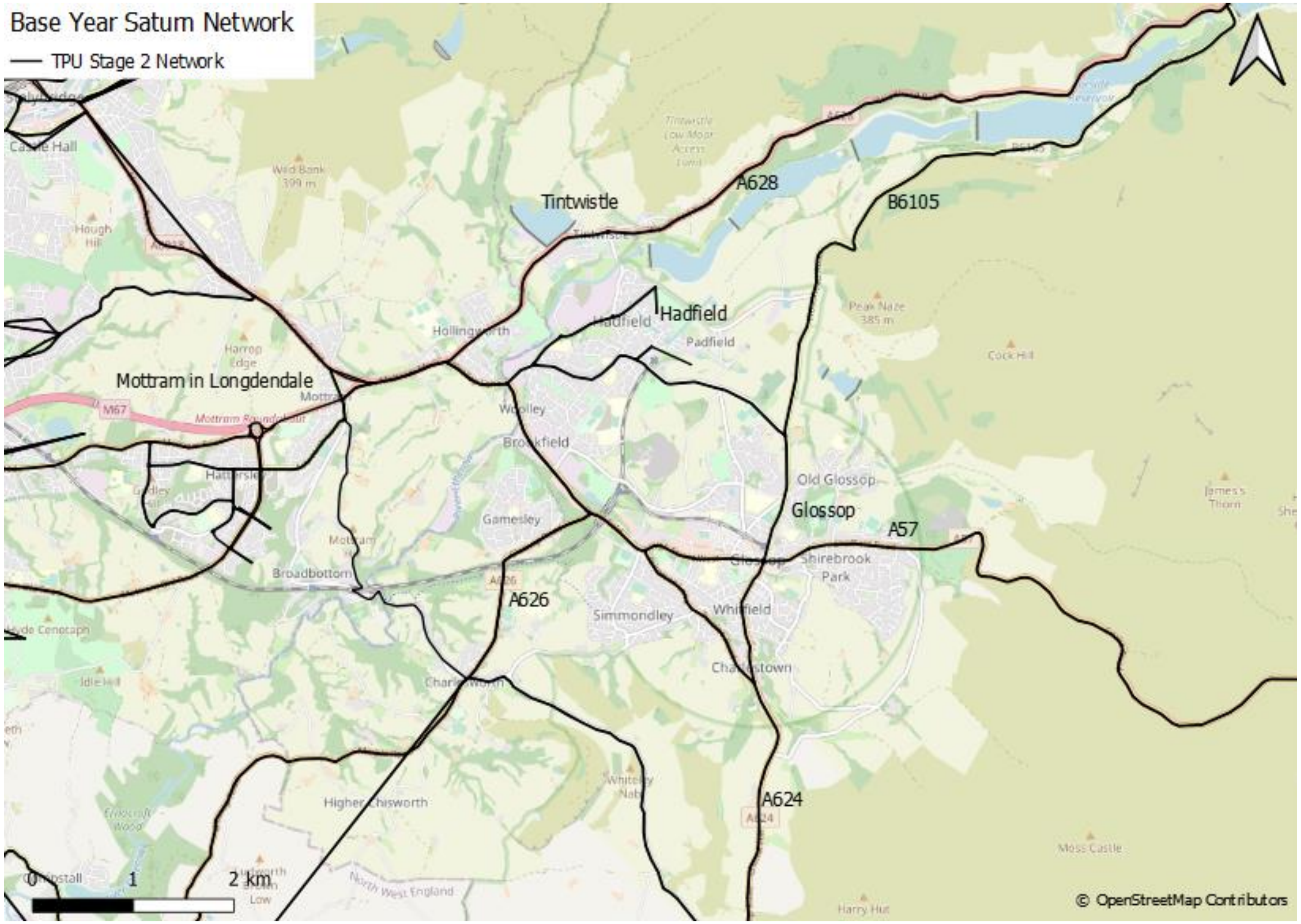
2.4.1. Improvements to the highway network coding around Mottram and Glossop have been made during PCF Stage 3.

2.4.2. Figure 2-3 highlights the section of the TPU Stage 2 model that has been the focus of the highway network enhancements.

2.4.3. Details of the changes to the highway network implemented during PCF Stage 3 are summarised below. This includes increasing the level of detail, ensuring coding consistency and adherence to best practice guidance.

2.4.4. Full details of the network audit process undertaken prior to PCF Stage 3 are provided in the PCF Stage 2 LMVR.

Figure 2-3 - Base year SATURN network in the Mottram and Glossop area – PCF Stage 2



Network checks

2.4.5. At PCF Stage 3, a thorough network checking exercise was undertaken in the Mottram and Glossop area (Figure 2-3). The network audit procedure involved conducting checks at the junction level for all nodes included in the Mottram and Glossop area. The RTM manual was used to check the following network properties:

- Junction type;
- Number of approach arms;
- Number of lanes;
- Link length;
- Free-flow speeds and speed-flow curves;
- Lane allocation;
- Turn saturation flows;
- Stacking capacity;
- Circulating capacity at roundabouts;
- GAP values;
- Priority markers; and
- Flare markers.

2.4.6. The audit procedure informed a range of enhancements to the PCF Stage 3 TPU transport model, including the following:

- Modification of saturation flows at junctions that were not consistent with RTM coding. Turning capacities at various junctions were modified to accurately reflect the infrastructure on the ground.
- Accurate representation of flare capacities to avoid a misrepresentation of junction capacity.
- Modification of free-flow speeds where they were shown to be in excess of the posted speed limit.
- There were numerous pedestrian crossings and signalised junctions on the A57 between Glossop Road and Glossop Crossroads that were not taken account of in the model, which contributed to the underrepresentation of congestion in the base year model. A review was undertaken to identify those which were most likely to impact congestion, and code them into the model.

Network detail

2.4.7. The highway network detail representative of Glossop has been increased during PCF Stage 3. The coded network inherited by Atkins consisted of key routes through the Mottram and Glossop area (A57, A624, A626, A628 and B6105), yet there was scope to better replicate alternative routes through the local area. Consideration was given to avoid the inclusion of disproportionate detail, whilst additional data was collected to inform the additional network coding.

2.4.8. To provide a more accurate reflection of base year network performance in the local area, the following network detail has been included in the PCF Stage 3 TPU model. The locations of these changes are highlighted in Figure 2-4.

- Ellison Street between the B6105 and the High Street East (A57).
  - Vehicles on the B6105 (SB) travelling towards Sheffield Road (A57) (and vice versa) can bypass the signalised junction at Glossop Crossroads by travelling via Ellison Street. Ellison Street effectively acts as a rat-run to avoid peak period congestion at the Glossop Crossroads signals.
- Shaw Lane / Newshaw Lane / Green Lane

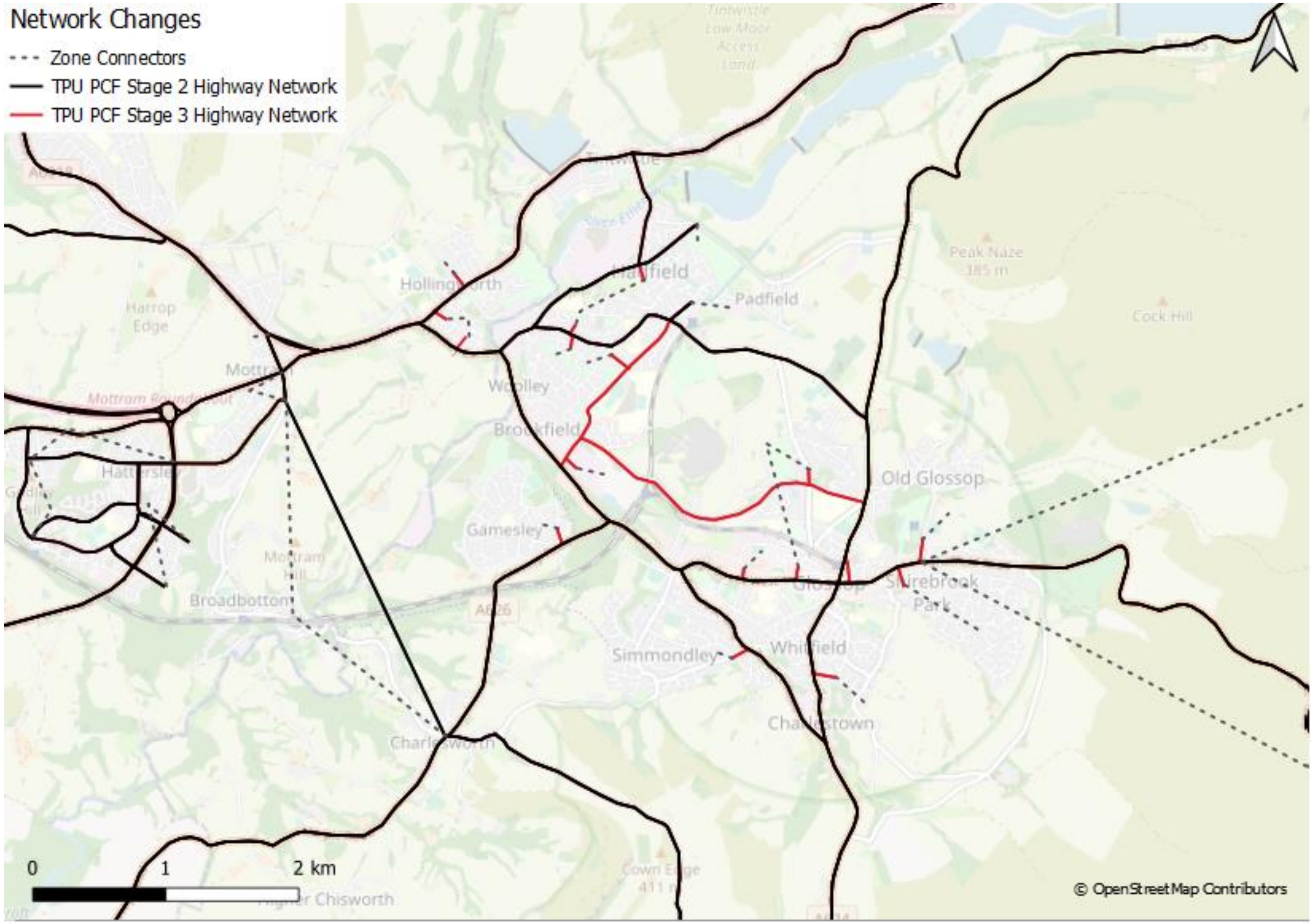
  - Offers vehicles access between the A57 and Hadfield Road, in addition to Dinting Road. This link road is important to ensure the level of demand replicated on the A57 is comparable to observed data.
- Dinting Road
  - In conjunction with Shaw Lane, Dinting Road is an alternative route to the A57. It is important to capture possible alternative routes when assessing the impact of the TPU scheme.

2.4.9. In addition to the enhanced network detail, several structural changes have been made to support the zone disaggregation specified in Table 2-2. To ensure the model better reflects observed data in the local area, zones that connected directly to the highway network by straddling links, were converted to stub connectors. Details are outlined in Table 2-3.

Table 2-3 – Zone connectors – PCF Stage 3

Zone	Location	Description
40951	Glossop	Stub connector located on High Street West (A57) near the Glossop Brook Road junction.
40962	Glossop	Two stub connectors: one located on High Street West (A57) near the Arundel Street junction, the other on Dinting Road near the North Street junction.
40963	Glossop	Stub connector located on Primrose Lane near the Simmondley New Road junction.
40952	Glossop	Stub connector located on Victoria Street (A624) near the Whitfield Avenue junction.
40953	Glossop	Stub connector located on High Street East (A57) near the Shirebrook Drive junction.
40954	Glossop	Stub connector located on High Street East (A57) near the Manor Park Road junction.
40942	Gamesley	Stub connector located on the A626 (Glossop Road) at the entrance of Gamesley village.
40944	Brookfield	Stub connector located on Shaw Lane at the entrance of the Carpenter industrial site.
40933	Hadfield	Stub connector located on Newshaw Lane near the Lower Barn Road junction.
40941	Hadfield	Two stub connectors: one located on Hadfield Road near the Carriage Drive junction, the other on Woolley Bridge Road near the Waterside junction.
40943	Hadfield	Stub connector located on Hadfield Road near the Higher Barn Road junction.
12511	Hollingworth	Two stub connectors: one located on Woolley Lane (A57) near the Earnshaw Street junction, the other on Market Street (A628) at the Taylor Street junction.
12513	Hollingworth	Stub connector located on Market Street near the Green Lane junction.

Figure 2-4 - Base year highway network detail – PCF Stage 3



2.5. Data

2.5.1. Additional classified turning counts (CTC) were undertaken in September 2019 to help improve model validation and support the inclusion of the network enhancements presented in Figure 2-4. The locations of the additional counts are shown in Figure 2-5. Further details are provided in the aforementioned 'Supplementary Data Collection Package' (PCF Stage 3) issued in November 2020.

2.5.2. The enhancements of the model focused on replicating observed journey times on the key sections of the A57 and A628 in the localised study area. As such, an additional journey time validation route has been included, which is described as the 'Hadfield Alternative'. Figure 2-6 presents the journey time routes used to validate the TPU Stage 3 base model.

Figure 2-5 - Survey Locations in Glossop (2019)

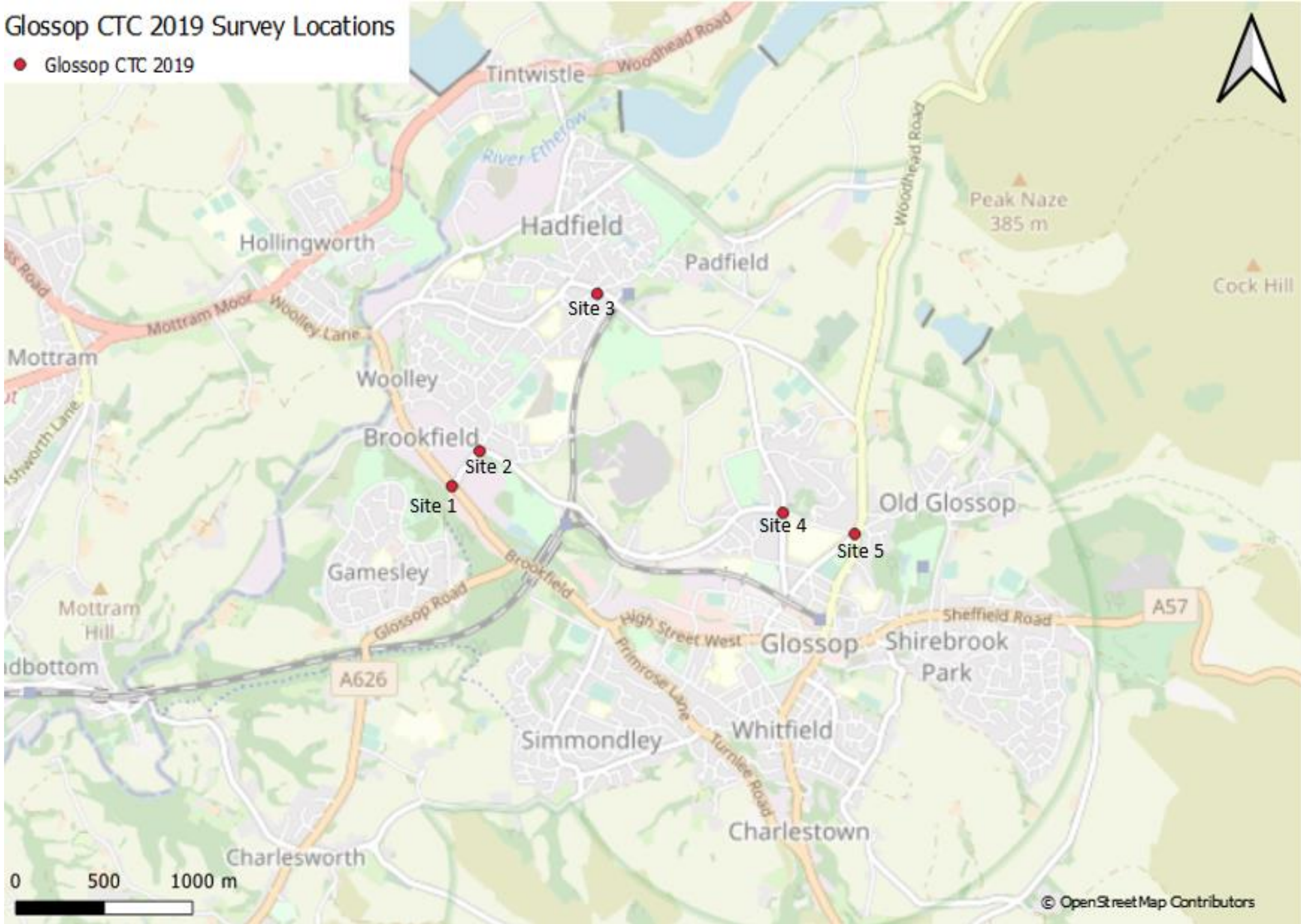
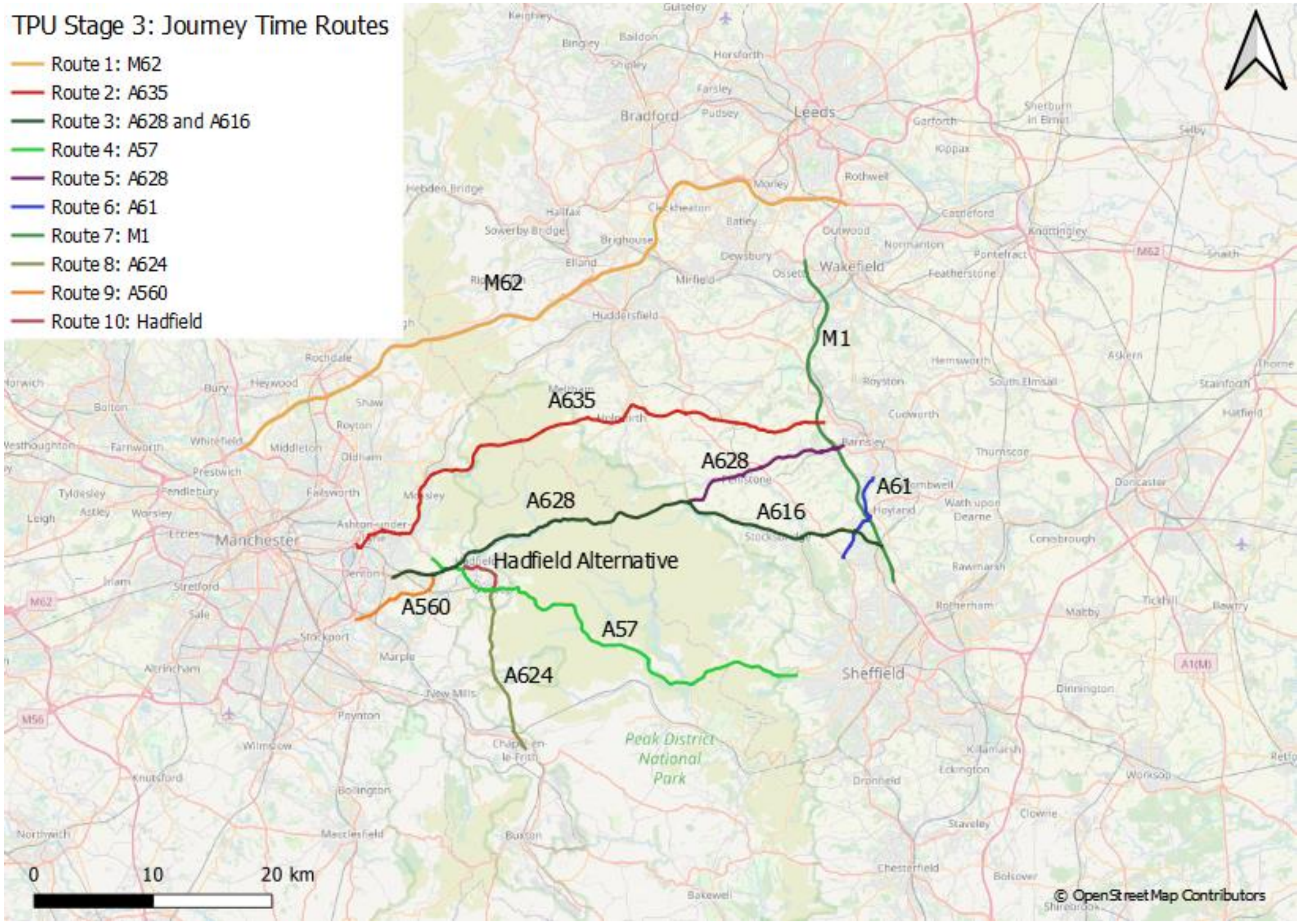


Figure 2-6 - Journey Time Validation Routes - PCF Stage 3



2.6. Value of Time (VoT) and Vehicle Operating Costs (VOC)

2.6.1. The base year Vehicle Operating Costs (VOC) and Value of Time (VoT) were updated using the then latest available TAG Databook v1.12, May 2019.

3. Model results

3.1.1. This section provides details of the base model results that were submitted for approval. A summary of the following is provided in the main body, whilst full details are provided in the appendices:

- Trip Ends
- Highway matrices – impact of Matrix Estimation (ME)
- Screenline flow calibration
- Link flow calibration
- Journey time validation
- Convergence
- Demand model parameters
- Demand model matrices
- Realism tests (highway and Public Transport (PT))

3.1.2. No changes to the modelling methodology have been made since PCF Stage 2. Full details of the methodology are provided in the PCF Stage 2 LMVR (see section 1.2.1).

3.2. Trip ends

3.2.1. The prior matrices used in PCF Stage 3 were mainly retained from PCF Stage 2 (which were derived from the TPS RTM prior matrices), with some additional zone disaggregation. Details of the prior matrices and disaggregation are provided in section 2.3.

3.3. Highway matrices – Matrix Estimation

3.3.1. This section provides a summary of the changes induced by Matrix Estimation (ME) between the prior demand matrices and the post-ME demand matrices. Table 3-1 provides an overview of the standards used to assess the change in demand induced by ME, as specified in unit M3.1 of the TAG guidance.

Table 3-1 – Significance of matrix estimation changes criteria (TAG unit M3.1)

Measure	Criteria
Matrix zonal cell values	Slope within 0.98 and 1.02 Intercept near zero R^2 in excess of 0.95
Matrix zonal trip ends	Slope within 0.99 and 1.01 Intercept near zero R^2 in excess of 0.98
Trip length distributions	Means within 5% Standard deviations within 5%
Sector to sector level matrices	Differences within 5%

Matrix totals

3.3.2. Table 3-2 to Table 3-4 compare matrix totals by user class between the prior and post-ME matrices. ME has induced a change in matrix totals of 0.7% in the AM peak, 1.0% in the IP and 0.6% in the PM peak.

3.3.3. ME was undertaken individually for each vehicle type (i.e. car, LGV and HGV), as specified in the PCF Stage 2 LMVR (see section 1.2.1). The percentage change between the prior and post-ME matrices for Car Business and HGV user classes is between 2.5% to 3.9% for all time periods. For all other user classes, the change is less than 1.0% across all time periods.

Table 3-2 – Comparison of matrix totals: prior vs. post-ME – TPU PCF Stage 3 (AM peak)

User Class	Prior	Post-ME	Difference	Difference (%)
UC1: Car Business	311,344	323,497	12,153	3.9%
UC2: Car Commute	2,368,169	2,379,531	11,362	0.5%
UC3: Car Other	2,134,824	2,138,375	3,551	0.2%
UC4: LGV	602,498	607,454	4,956	0.8%
UC5: HGV	315,974	326,182	10,208	3.2%
Total	5,732,809	5,775,038	42,229	0.7%

Table 3-3 – Comparison of matrix totals: prior vs. post-ME – TPU PCF Stage 3 (IP)

User Class	Prior	Post-ME	Difference	Difference (%)
UC1: Car Business	335,075	345,966	10,891	3.3%
UC2: Car Commute	904,759	912,475	7,717	0.9%
UC3: Car Other	2,705,499	2,723,031	17,532	0.6%
UC4: LGV	553,396	557,004	3,609	0.7%
UC5: HGV	328,663	337,965	9,302	2.8%
Total	4,827,391	4,876,442	49,052	1.0%

Table 3-4 – Comparison of matrix totals: prior vs. post-ME – TPU PCF Stage 3 (PM peak)

User Class	Prior	Post-ME	Difference	Difference (%)
UC1: Car Business	335,290	343,553	8,263	2.5%
UC2: Car Commute	2,229,458	2,238,061	8,603	0.4%
UC3: Car Other	3,044,206	3,052,442	8,236	0.3%
UC4: LGV	585,689	590,202	4,513	0.8%
UC5: HGV	231,703	237,607	5,904	2.5%
Total	6,426,347	6,461,866	35,519	0.6%

Regression analysis

3.3.4. Regression analysis of the prior and post-ME matrices is undertaken for individual cells (i.e. ij pairs) and trip ends (i.e. origin and destination zone totals). Table 3-5 compares the TPU PCF Stage 3 prior and post-ME matrices for all trips across the model, whilst Table 3-6 only includes ij pairs with less than 500 trips.

3.3.5. All values adhere to TAG guidance except the intercept values for trip ends. Defining 'near zero' as up to 5.0 trips, the intercept values satisfy the TAG criteria except for the destination trip ends in the AM and PM peak periods. Therefore, a comparison of the prior and post-ME matrices from the TPS RTM have also been provided (Table 3-7 and Table 3-8).

3.3.6. The regression analysis presented for TPU PCF Stage 3 is comparable to the TPS RTM. The intercepts of the destination trip ends in the TPS RTM are also not near to zero. However, the values presented for TPU PCF Stage 3 are a slightly better fit compared to the TPS RTM. This suggests that the ME process adopted for TPU has induced a level of change comparable to the TPS RTM donor model.

Table 3-5 - Comparison of matrix cell values and trip ends (all trips) – TPU PCF Stage 3

	Measures	TAG Criteria (M3.1)	AM	IP	PM
Zonal cell values – ij pairs	Slope	Between 0.98 to 1.02	1.00	1.00	1.00
	Intercept	Near to Zero	0.00	0.00	0.00
	R^2	>0.95	1.00	1.00	1.00
Trip ends - origin	Slope	Between 0.99 to 1.01	1.00	1.00	1.00
	Intercept	Near to Zero	4.09	4.77	3.44
	R^2	>0.98	1.00	1.00	1.00
Trip ends - destination	Slope	Between 0.99 to 1.01	1.00	1.00	1.00
	Intercept	Near to Zero	20.22	3.67	6.74
	R^2	>0.98	1.00	1.00	1.00

Table 3-6 - Comparison of matrix cell values and trip ends (less than 500 trips) – TPU PCF Stage 3

	Measures	TAG Criteria (M3.1)	AM	IP	PM
Zonal cell values – ij pairs	Slope	Between 0.98 to 1.02	1.00	1.00	1.00
	Intercept	Near to Zero	0.00	0.00	0.00
	R^2	>0.95	0.99	1.00	1.00
Trip ends - origin	Slope	Between 0.99 to 1.01	1.01	1.02	1.00
	Intercept	Near to Zero	2.55	2.26	3.89
	R^2	>0.98	0.99	1.00	0.99
Trip ends - destination	Slope	Between 0.99 to 1.01	1.00	1.02	1.01
	Intercept	Near to Zero	9.24	4.41	9.15
	R^2	>0.98	0.99	1.00	1.00

Table 3-7 - Comparison of matrix cell values and trip ends (all trips) – TPS RTM

	Measures	TAG Criteria (M3.1)	AM	IP	PM
Zonal cell values – ij pairs	Slope	Between 0.98 to 1.02	1.00	1.00	1.00
	Intercept	Near to Zero	0.00	0.00	0.00
	R^2	>0.95	1.00	1.00	1.00
Trip ends - origin	Slope	Between 0.99 to 1.01	1.00	1.00	1.00
	Intercept	Near to Zero	3.94	4.52	3.25
	R^2	>0.98	1.00	1.00	1.00
Trip ends - destination	Slope	Between 0.99 to 1.01	1.00	1.00	1.00
	Intercept	Near to Zero	19.44	22.38	15.84
	R^2	>0.98	1.00	1.00	1.00

Table 3-8 - Comparison of matrix cell values and trip ends (less than 500 trips) – TPS RTM

	Measures	TAG Criteria (M3.1)	AM	IP	PM

Zonal cell values – ij pairs	Slope	Between 0.98 to 1.02	1.00	1.00	1.00
	Intercept	Near to Zero	0.00	0.00	0.00
	R^2	>0.95	1.00	1.00	1.00
Trip ends - origin	Slope	Between 0.99 to 1.01	1.01	1.02	1.00
	Intercept	Near to Zero	2.26	2.00	3.42
	R^2	>0.98	0.99	1.00	1.00
Trip ends - destination	Slope	Between 0.99 to 1.01	1.01	1.02	1.01
	Intercept	Near to Zero	15.85	12.65	8.53
	R^2	>0.98	0.99	1.00	1.00

Sectored matrices

3.3.7. In considering the changes induced by ME at a sector to sector level it is important to avoid highlighting large percentage differences which represent only a small number of trips. As such, sector to sector movements with less than 100 trips in the prior matrix have been excluded from the analysis. In line with the TPS RTM donor model, the GEH statistic has also been assessed, along with the proportion of movements with less than ±10% change. The GEH statistic assessment does not exclude movements with less than 100 trips, as the purpose of the statistic is to provide a method to compare traffic flow changes regardless of flow volume scale.

3.3.8. The TPU PCF Stage 3 prior and post-ME matrices have been aggregated into 17 sectors for comparison. The 17-sector system is presented in Figure 3-1.

3.3.9. Table 3-9 provides a summary of the changes induced by ME in the TPU PCF Stage 3 model at a sector level, whilst sectored tabulations of percentage change and GEH are presented in A.1 to A.6. The sectoral analysis for TPU Stage 3 shows that most of the sectors are within a GEH range of 5 (~80%) across all time periods.

3.3.10. The equivalent analysis for the TPS RTM has also been undertaken to identify whether a similar scale of change was recorded (Table 3-10) (sectored tabulations of percentage change and GEH are presented in A.7 to A.12).

3.3.11. The sectored analysis presented suggests that the ME process adopted for TPU has induced a level of change comparable to the TPS RTM donor model.

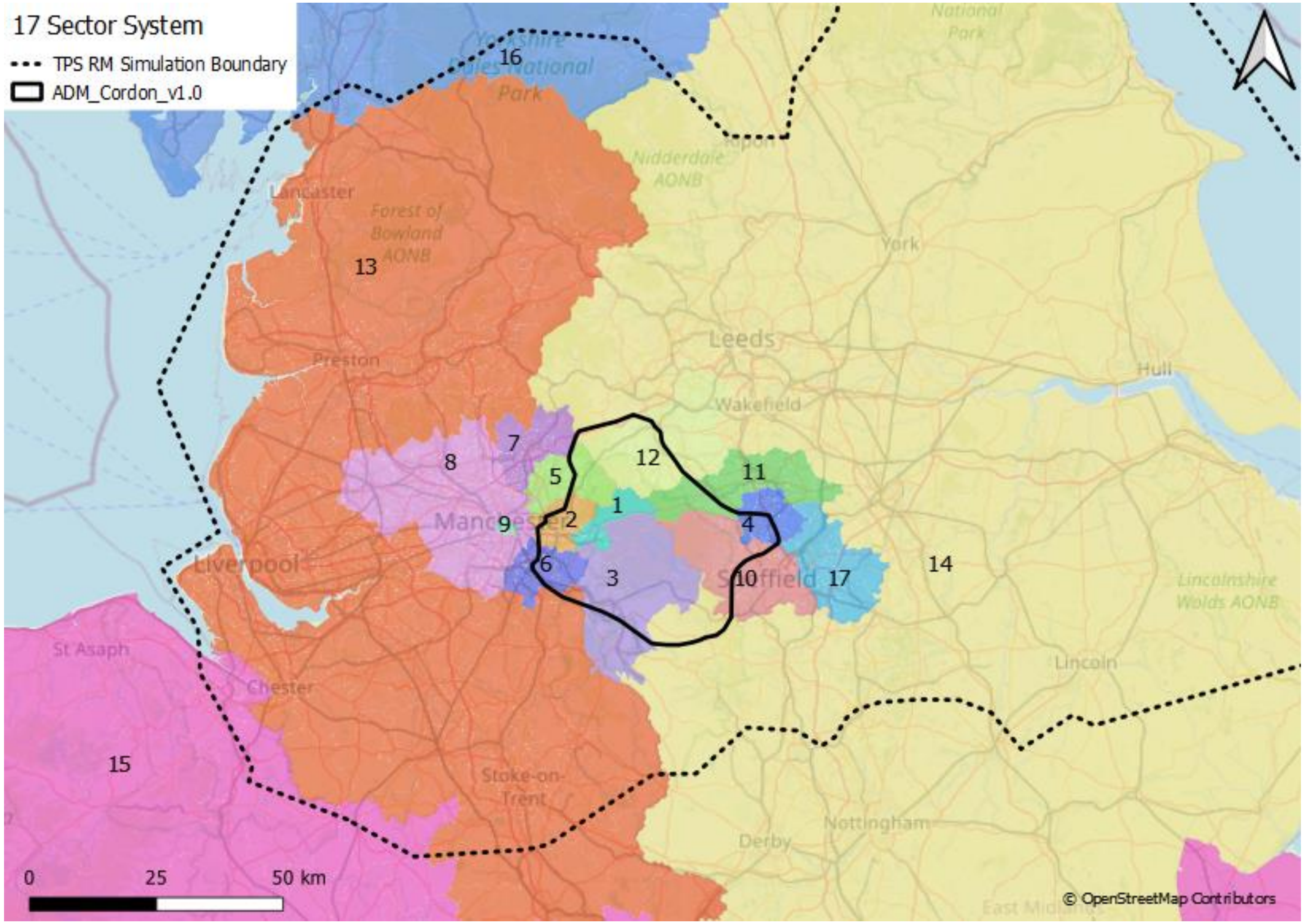
Table 3-9 - Comparison of sectored trip matrices: prior vs. post-ME – TPU PCF Stage 3

Time Period	No. Cells with >100 Trips	% Cells with <5% change	% Cells with <10% change	% Cells with GEH <5 change
AM	134	33%	54%	78%
IP	136	33%	49%	80%
PM	130	33%	53%	78%

Table 3-10 - Comparison of sectored trip matrices: prior vs. post-ME – TPS RTM

Time Period	No. Cells with >100 Trips	% Cells with <5% change	% Cells with <10% change	% Cells with GEH <5 change
AM	133	35%	56%	80%
IP	136	37%	58%	83%
PM	133	34%	59%	79%

Figure 3-1 – 17-sector system



Trip Length Distribution (TLD)

3.3.12. The trip length distribution of post-ME matrices has been compared with the corresponding prior matrices to ensure that trip lengths haven't been significantly modified by ME. The TLD analysis has been presented following two different methodologies:

- The TAG compliant methodology that considers all ij pairs that are permitted to change as a result of running ME; and
- An alternative methodology which involves the exclusion of external trips between zones in the model buffer area. With this method, in separately considering the matrix elements that have an origin trip end in the internal area and a destination trip end in the internal model area will in practice double count the internal-internal trips within the model simulation area.

3.3.13. Table 3-11 to Table 3-13 provide the TAG compliant comparison of trip length distributions between the TPU PCF Stage 3 prior and post-ME matrices across all ij pairs, by vehicle type. This shows that all values adhere to TAG guidance (Table 3-1).

Table 3-11 - TAG compliant comparison of mean and standard deviation TLD: prior vs. post-ME – TPU PCF Stage 3 (AM peak)

	Prior Distance (kms)		Post Distance (kms)		Change (%)	
Vehicle Type	Mean	Std	mean	std	mean	Std
1 Car	13.5	39.4	13.7	39.8	1.9%	1.1%
2 LGV	16.6	44.5	16.9	44.8	1.9%	0.7%
3 HGV	55.2	87.0	55.1	86.1	0.0%	-1.0%
Total	16.1	44.9	16.4	45.3	1.9%	0.8%

Table 3-12 - TAG compliant comparison of mean and standard deviation TLD: prior vs. post-ME – TPU PCF Stage 3 (IP)

	Prior Distance (kms)		Post Distance (kms)		Change (%)	
Vehicle Type	Mean	Std	mean	std	mean	std
1 Car	9.5	34.4	9.7	34.6	2.2%	0.6%
2 LGV	15.1	43.6	15.2	43.7	0.8%	0.3%
3 HGV	55.0	88.2	54.9	87.2	-0.2%	-1.1%
All	13.3	42.9	13.5	43.0	1.7%	0.2%

Table 3-13 - TAG compliant comparison of mean and standard deviation TLD: prior vs. post-ME – TPU PCF Stage 3 (PM peak)

	Prior Distance (kms)		Post Distance (kms)		Change (%)	
Vehicle Type	Mean	Std	mean	std	mean	std
1 Car	12.3	38.1	12.5	38.5	2.0%	1.1%
2 LGV	15.8	43.8	16.4	44.5	3.6%	1.6%
3 HGV	54.5	86.8	54.7	86.5	0.4%	-0.3%
All	14.1	42.1	14.4	42.5	2.1%	1.1%

3.3.14. Table 3-14 to Table 3-16 provide the alternative comparison of trip length distributions between the TPU PCF Stage 3 prior and post-ME matrices, by vehicle type. As aforementioned, this process excludes external trips between zones in the model buffer area and doubles internal trips within the model simulation area.

3.3.15. In comparison to the TAG compliant methodology that considers all ij pairs in the matrices, mean and standard deviation trip lengths are lower for all vehicle types. This is attributable to the exclusion of longer distance trips between larger external zones and the doubling of shorter distance internal trips.

3.3.16. This alternative approach to calculating the TLD does not meet TAG criteria, with mean trip length changes for all vehicle types ranging between 8-11% (AM: 9.1%, IP: 8.1%, PM: 10.6%).

Table 3-14 - Alternative comparison of mean and standard deviation TLD: prior vs. post-ME – TPU PCF Stage 3 (AM peak)

	Prior Distance (kms)		Post Distance (kms)		Change (%)	
Vehicle Type	Mean	std	mean	std	mean	Std
1 Car	9.2	19.7	10.0	21.6	7.7%	9.6%
2 LGV	13.6	25.4	15.3	26.7	12.8%	5.4%
3 HGV	48.7	57.0	47.1	55.0	-3.3%	-3.5%
All	11.3	24.5	12.3	26.3	9.1%	7.3%

Table 3-15 - Alternative comparison of mean and standard deviation TLD: prior vs. post-ME – TPU PCF Stage 3 (IP)

	Prior Distance (kms)		Post Distance (kms)		Change (%)	
Vehicle Type	Mean	std	mean	std	mean	Std
1 Car	7.5	19.8	8.2	21.0	8.2%	6.0%
2 LGV	12.5	26.5	13.0	26.9	4.4%	1.5%
3 HGV	48.6	59.7	47.2	57.6	-3.0%	-3.6%
All	9.8	25.4	10.6	26.4	8.1%	4.2%

Table 3-16 - Alternative comparison of mean and standard deviation TLD: prior vs. post-ME – TPU PCF Stage 3 (PM peak)

	Prior Distance (kms)		Post Distance (kms)		Change (%)	
Vehicle Type	Mean	std	mean	std	mean	Std
1 Car	8.3	18.7	9.0	20.9	9.3%	11.4%
2 LGV	12.6	25.1	15.8	28.6	25.9%	13.8%
3 HGV	44.1	54.7	43.6	54.8	-1.2%	0.2%
All	9.6	22.0	10.6	24.2	10.6%	9.9%

3.3.17. This analysis shows the TAG method of assessing the impact of matrix estimation on TLD is within criteria across the whole model area, whilst the analysis of the subset within the simulation area shows greater change beyond the prescribed 5%, particularly for the LGV movements in the PM peak. It is likely the prior data for more localised LGV in this (and the other) time period is taken from a small sample and hence liable to need additional matrix estimation.

3.4. Screenline flow calibration

3.4.1. As part of the matrix calibration process for TPU PCF Stage 3, 10 screenlines have been defined within the ADM (Figure 2-1). Figure 3-2 identifies the location of the flow screenlines used to calibrate the model.

3.4.2. To improve the fit between modelled and observed data in the localised area, all screenlines and additional count data have been included in the matrix estimation process as calibration counts. As specified in TAG unit M3.1, it is possible to include data that would otherwise form independent validation data, into the calibration to further refine the model.

3.4.3. Table 3-17 describes the screenline flow calibration criterion and acceptability guidelines provided by TAG unit M3.1.

Table 3-17 - Screenline flow calibration criterion (TAG unit M3.1)

Criteria	Guideline
Differences between modelled flows and counts should be less than 5% of the counts	All or nearly all screen-lines (95%)

3.4.4. Table 3-18 and Table 3-19 present a high-level summary of the number of screenlines that meet TAG criteria (unit M3.1) in the prior and post-ME assignments, by vehicle type. For indicative purposes only, and to maintain consistency with the Stage 2 LMVR, the former DMRB GEH criteria has also been included (GEH <4). Note that the DMRB is no longer relevant in this context, and the source of model development guidance is now TAG.

3.4.5. The results indicate that the calibration screenlines correlate well with observed data, with 100% of screenlines meeting TAG criteria across all screenlines and time periods (all vehicles) in the post-ME assignment.

3.4.6. Full details of individual screenlines are presented in Appendix B.

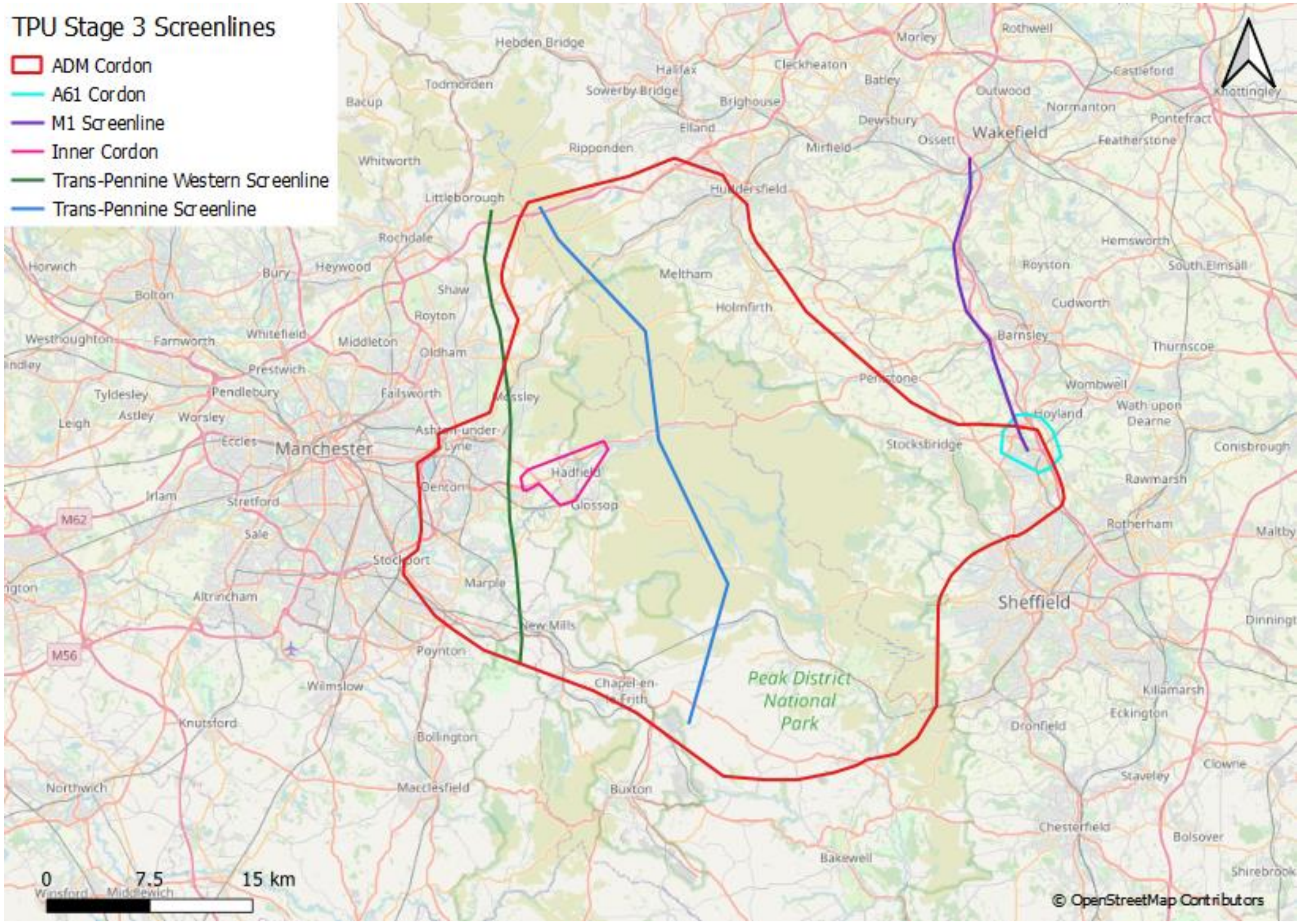
Table 3-18 - TPU PCF Stage 3 calibration screenline summary: prior

Time Period	Screenlines	% of screenlines pass TAG criteria (within 5% difference in flow)				% of screenlines pass DMRB criteria (GEH <4)			
		Car	LGV	HGV	All	Car	LGV	HGV	All
AM	10	0%	0%	0%	10%	10%	40%	60%	20%
IP	10	30%	0%	10%	10%	30%	30%	20%	0%
PM	10	10%	10%	30%	20%	10%	50%	40%	30%

Table 3-19 - TPU PCF Stage 3 calibration screenline summary: post-ME

Time Period	Screenlines	% of screenlines pass TAG criteria (within 5% difference in flow)				% of screenlines pass DMRB criteria (GEH <4)			
		Car	LGV	HGV	All	Car	LGV	HGV	All
AM	10	100%	60%	70%	100%	100%	90%	100%	90%
IP	10	90%	90%	70%	100%	100%	100%	80%	100%
PM	10	100%	70%	50%	100%	100%	100%	90%	100%

Figure 3-2 – Flow calibration screenlines and cordons – TPU PCF Stage 3



3.5. Link flow calibration

3.5.1. In addition to an evaluation at a screenline level, modelled flows have been compared against observed data at an individual link level.

3.5.2. Table 3-20 describes the link flow calibration criteria and acceptability guidelines provided by TAG unit M3.1.

Table 3-20 – Link flow and turning movement calibration criteria (TAG unit M3.1)

Criteria	Description of Criteria	Guideline
1	Individual flows within 100 veh/h of counts for flows less than 700 veh/h	> 85% of cases
	Individual flows within 15% of counts for flows from 700 to 2,700 veh/h	
	Individual flows within 400 veh/h of counts for flows more than 2,700 veh/h	
2	GEH < 5 for individual flows	> 85% of cases

3.5.3. Table 3-21 to Table 3-26 present a high-level summary of the number of links that meet TAG criteria in the prior and post-ME assignments.

3.5.4. Links have been split into those that form the calibration screenlines (Figure 3-2), link counts derived from classified turning counts undertaken in Glossop during September 2019 (Figure 2-5) and all 'other' counts that were used in model calibration. Full details of the data used to inform the development of the 2015 base year TPU model are documented in the PCF Stage 3 Supplementary Data Collection Package (see section 1.2.4).

3.5.5. In comparing observed and modelled link flow data, TAG (unit M3.1) states that the model is required to meet either the flow or GEH criteria.

3.5.6. As such, the results indicate that the calibration counts correlate well with observed data at the individual link level, with at least 84% of counts meeting TAG criteria across each modelled time period of the post-ME assignments.

3.5.7. Full details of the individual link flows are included in Appendix B.

Table 3-21 - TPU PCF Stage 3 calibration link flow summary: prior (AM peak)

Link Type	Number of Links	Flow		GEH		Either (Flow or GEH)	
		Total	%	Total	%	Total	%
All screenline counts	106	78	74%	70	66%	79	75%
Additional Glossop counts	28	19	68%	12	43%	19	68%
All other counts	136	91	67%	83	61%	94	69%
Total	270	188	70%	165	61%	192	71%

Table 3-22 - TPU PCF Stage 3 calibration link flow summary: prior (IP)

Link Type	Number of Links	Flow		GEH		Either (Flow or GEH)	
		Total	%	Total	%	Total	%
All screenline counts	106	64	60%	54	51%	67	63%
Additional Glossop counts	28	23	82%	21	75%	23	82%
All other counts	136	86	63%	72	53%	88	65%
Total	270	173	64%	147	54%	178	66%

Table 3-23 - TPU PCF Stage 3 calibration link flow summary: prior (PM peak)

Link Type	Number of Links	Flow		GEH		Either (Flow or GEH)	
		Total	%	Total	%	Total	%
All screenline counts	106	67	63%	58	55%	69	65%
Additional Glossop counts	28	24	86%	19	68%	24	86%
All other counts	136	89	65%	78	57%	90	66%
Total	270	180	67%	155	57%	183	68%

Table 3-24 - TPU PCF Stage 3 calibration link flow summary: post-ME (AM peak)

Link Type	Number of Links	Flow		GEH		Either (Flow or GEH)	
		Total	%	Total	%	Total	%
All screenline counts	106	90	85%	86	81%	92	87%
Additional Glossop counts	28	26	93%	24	86%	26	93%
All other counts	136	117	86%	117	86%	119	88%
Total	270	233	86%	227	84%	237	88%

Table 3-25 - TPU PCF Stage 3 calibration link flow summary: post-ME (IP)

Link Type	Number of Links	Flow		GEH		Either (Flow or GEH)	
		Total	%	Total	%	Total	%
All screenline counts	106	92	87%	87	82%	95	90%
Additional Glossop counts	28	28	100%	26	93%	28	100%
All other counts	136	126	93%	123	90%	128	94%
Total	270	246	91%	236	87%	251	93%

Table 3-26 - TPU PCF Stage 3 calibration link flow summary: post-ME (PM peak)

Link Type	Number of Links	Flow		GEH		Either (Flow or GEH)	
		Total	%	Total	%	Total	%
All screenline counts	106	84	79%	83	78%	86	81%
Additional Glossop counts	28	27	96%	23	82%	27	96%
All other counts	136	114	84%	108	79%	115	85%
Total	270	225	83%	214	79%	228	84%

3.6. Journey time validation

3.6.1. The purpose of journey time validation is to show that the model is able to replicate observed journey times on key routes through the ADM (Figure 2-1). Observed journey times have been compared against modelled data along 20 journey time routes, as shown in Figure 2-6.

3.6.2. Table 3-27 describes the journey time validation criterion and acceptability guidelines provided by TAG unit M3.1.

Table 3-27 - Journey time validation criterion (TAG unit M3.1)

Criterion	Acceptability Guideline
Modelled times along routes should be within 15% (or 1 minute, if higher)	> 85% of routes

3.6.3. Table 3-28 summarises the number of journey time routes that meet TAG criteria (unit M3.1) (i.e. modelled times along routes should be within 15% of surveyed times (or 1 minute, if higher) for over 85% of routes).

3.6.4. The results indicate that the model can replicate observed journey times, achieving TAG criteria across all time periods.

3.6.5. Full details of the individual journey time validation routes are presented in Appendix C, including a graphical breakdown by timing point.

Table 3-28 - TPU PCF Stage 3 journey time validation summary: post-ME

Time Period	Total Journey Time Routes (directional)	Total Number Passing TAG criteria	% Passing TAG criteria
AM	20	19	95%
IP	20	20	100%
PM	20	20	100%

3.7. Convergence

Highway Assignment Model (HAM)

3.7.1. The convergence parameters adopted for TPU have been retained from the TPS RTM. The advice on model convergence is set out in TAG unit M3.1 (Table 4) and is reproduced below in Table 3-29.

Table 3-29 - TAG (unit 3.1) convergence criteria

Convergence Measures	Type	Base Model Acceptable Values
Delta & %GAP	Proximity	Less than 0.1% or at least stable with convergence fully documented and all other criteria met
Percentage of links with flow change (P1) < 1%	Stability	Four consecutive iterations greater than 98%

Source: TAG Unit M 3.1 Table 4

3.7.2. Table 3-30 provides a summary of the convergence statistics for the TPU PCF Stage 3 post-ME model.

3.7.3. The results indicate that all modelled time periods achieve a level of convergence that complies with the recommended TAG criteria. In terms of percentage flow change and gap acceptance the TPU PCF Stage 3 model meets TAG criteria within 69 loops in the AM peak, 54 loops in the IP and 82 loops in the PM peak.

3.7.4. Full details of the HAM convergence statistics are presented in Appendix D.

Table 3-30 - TPU PCF Stage 3 HAM convergence statistics: post-ME

AM			Inter Peak			PM		
Iteration	%Flow	%Gap	Iteration	%Flow	%Gap	Iteration	%Flow	%Gap
66	98.4	0.013	51	98.0	0.009	79	98.2	0.012
67	98.2	0.016	52	98.4	0.011	80	98.3	0.013
68	98.5	0.016	53	98.1	0.007	81	98.3	0.014
69	98.6	0.016	54	98.7	0.012	82	98.3	0.012

Variable Demand Model (VDM)

3.7.5. The TPS RTM demand model setup has been retained for the variable demand modelling (VDM) for the TPU PCF Stage 3 model, details of which are summarised in section 2.2 (full details to be provided in the model forecasting package).

3.7.6. It important that the VDM converges to a satisfactory degree in order to have confidence that the model results are as free from error and noise as possible. In line with TAG guidance, target %GAP values of 0.1% for the full model area and 0.2% for the subset area have been achieved (Table 3-31).

3.7.7. Full details of the VDM convergence statistics are presented in Appendix E.

Table 3-31 - TPU PCF Stage 3 VDM convergence statistics: post-ME

Best Loop	% GAP Full Model Area	%GAP Subset Area (ADM)
3	0.09%	0.17%

3.8. Demand model parameters

Destination choice and main mode choice

3.8.1. Destination choice values (referred to as lambda values) are provided in TAG unit M2.1 (Table 5.1). TAG states that “revised lambdas and thetas which were within ±25% of the median illustrative values would be regarded as acceptable.” Table 3-32 and Table 3-33 present the destination and mode choice parameters used in TPU PCF Stage 3 and the TPS RTM. These show that the parameter values adhere to TAG guidance. The values adopted for the TPS RTM are the median parameters specified in TAG unit M2.1 (Table 5.1), whilst car trip purposes were modified for TPU PCF Stage 3.

Table 3-32 - Destination choice parameters used in TPS RTM and TPU PCF Stage 3

Trip Purpose and Mode	TPS RTM	TPU Stage 3
Car		
Home-based work	-0.065	-0.080
Home-based employer’s business	-0.067	-0.050
Home-based other	-0.090	-0.067
Non-home-based employer’s business	-0.081	-0.060
Non-home-based other	-0.077	-0.057
Public Transport		
Home-based work	-0.033	-0.033
Home-based employer’s business	-0.036	-0.036
Home-based other	-0.036	-0.036
Non-home-based employer’s business	-0.042	-0.042
Non-home-based other	-0.033	-0.033

Table 3-33 - Main mode choice scaling parameters used in TPS RTM and TPU PCF Stage 3

Trip Purpose and Mode	TPS RTM	TPU Stage 3
Car		
Home-based work	0.68	0.68
Home-based employer’s business	0.45	0.45
Home-based other	0.53	0.53
Non-home-based employer’s business	0.73	0.73
Non-home-based other	0.81	0.81

3.9. Demand model matrices

3.9.1. The base PA matrices used in the DIADEM VDM were retained from the TPS RTM, as detailed in the TPS RTM LMVR[4].

3.9.2. Off-peak demand (19:00-07:00) is a required input of the VDM, however the TPU base model does not have an off-peak component. Therefore, demand has been adopted from the TPS RTM. It should be noted that while the off-peak model was not validated in either the TPS RTM or the TPU base model, its outputs are not used directly in the scheme appraisal or business case.

3.9.3. The demand model matrices used for the base year VDM have been presented at a 25-sector and 3-sector level. Figure 3-3 shows the 25 sectors that have been used to summarise the demand matrices. The 25-sector system is referenced in the legend, whilst the 3-sector system comprises of the ADM, the TPS RTM simulation area and the TPS RTM buffer area.

3.9.4. Demand model matrices from the VDM are presented by mode, time period and purpose at both sector levels in Appendix F.1. Table 3-34 provides an overview of the demand segmentation used in the TPU base year DIADEM VDM.

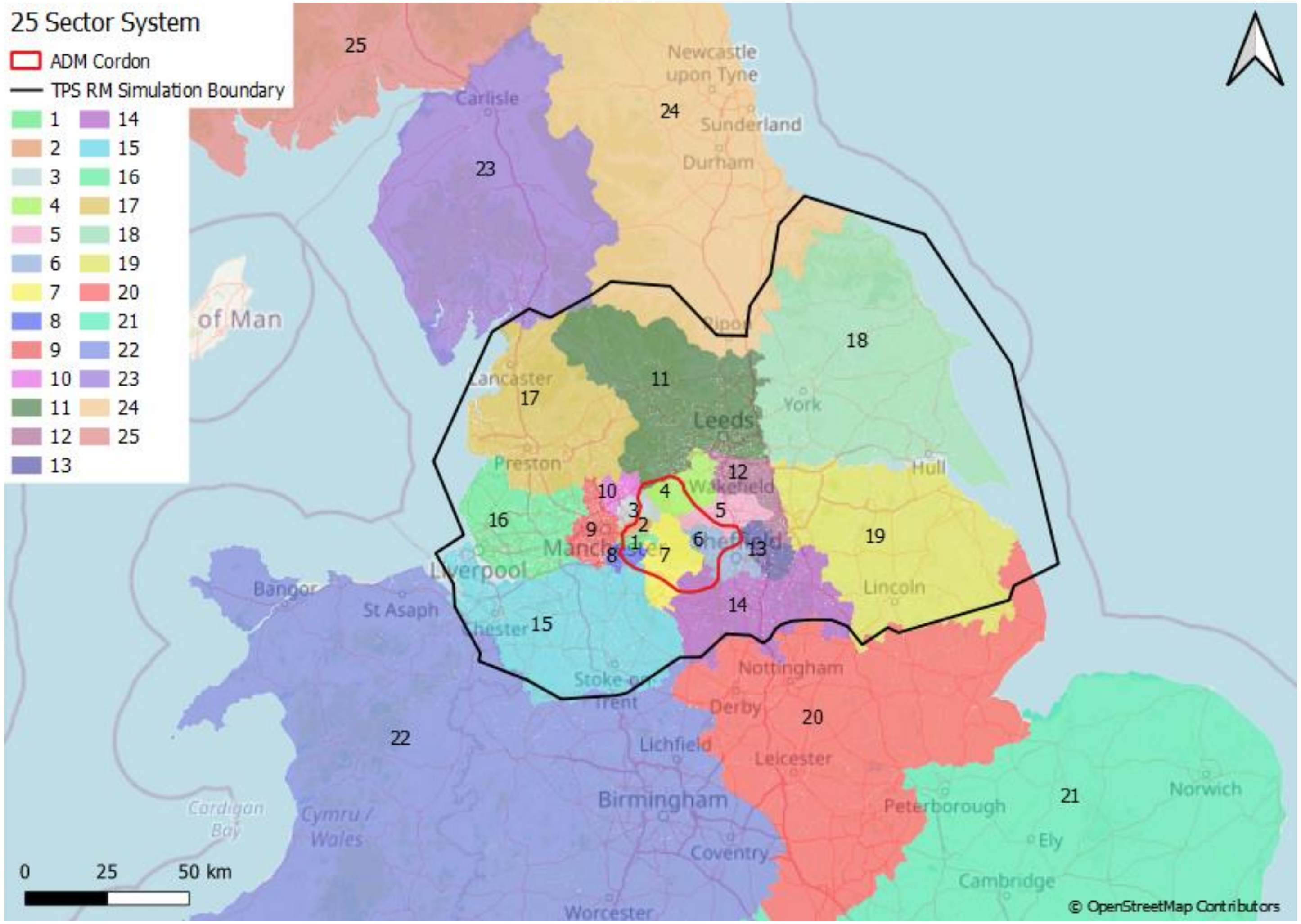
Table 3-34 - TPU PCF Stage 3 demand segmentation

Demand Segment	Purpose	Form of Matrices	Demand Response
1	Home Based Employer Business	24 hr - PA	Variable
2	Home Based Commute	24 hr - PA	Variable
3	Home Based Others	24 hr - PA	Variable
4	Non-Home-Based Employer Business	All time slice - OD	Variable
5	Non – Home Based Others	All time slice - OD	Variable
6	Fixed Demand - Employers Business	All time slice - OD	Fixed
7	Fixed Demand - Work	All time slice - OD	Fixed
8	Fixed Demand - Other	All time slice - OD	Fixed
9	Fixed Demand - LGV	All time slice - OD	Fixed
10	Fixed Demand - HGV	All time slice - OD	Fixed

3.9.5. The base matrices used in the HAM differ to the base year matrices from the VDM. The structure of the TPU model is specified in the PCF Stage 2 LMVR (see section 1.2.1). This explains how the model specification allows for different base matrices in the HAM and VDM (which in turn facilitates detailed calibration of the base HAM, without affecting the VDM). The discrepancies between the HAM and VDM matrices are accommodated through the use of 'fitting on factors', which are explained in the PCF Stage 3 model forecasting package. For this reason, the TPU base matrices from the HAM are presented in Appendix F.2, following the VDM matrices in Appendix F.1.

[4] TPS RTM LMVR (March 2017): TPS Model Validation Report - V1.9

Figure 3-3 - 25-sector system



3.10. Realism tests

3.10.1. Realism testing has been undertaken to ensure that the TPU PCF Stage 3 model realistically responds to changes in travel costs. This section summarises the realism tests for car fuel cost elasticity, car journey time elasticity and Public Transport (PT) fare elasticity, as specified in TAG unit M2.1 (section 6.4).

Car fuel cost elasticity

3.10.2. As recommended in TAG unit M2.1, car fuel cost elasticity values have been calculated using both the matrix-based and network-based methods. The car fuel cost elasticity was carried out with a 10% increase in vehicle operating costs (VOC).

3.10.3. The Pence per Kilometre (PPK) values adopted for the car fuel realism test are given in Table 3-35. The base year HAM was used for realism testing.

Table 3-35 - PPK Values adopted for the car fuel realism test run.

User Class	Purpose	Base	Realism Test
UC1	Business	12.59	13.10
UC2	Commuting	6.15	6.77
UC3	Others	6.15	6.77

3.10.4. Table 3-36 presents the fuel cost elasticity values calculated for each car purpose by time period, using the matrix-based methodology. To derive the total number of vehicle kilometres travelled, the demand matrices from the realism test VDM were multiplied with the distance skim matrices from the validated base year HAM.

3.10.5. The vehicle kilometre matrices were categorised based on whether the trip ends of each ij pair were inside or outside of the TPS RTM simulation area. All ij pairs except external to external movements were considered for the fuel cost elasticity calculation.

3.10.6. Table 3-37 presents the fuel cost elasticity values calculated for each car purpose by time period, using the network-based methodology. The total number of vehicle kilometres travelled were extracted from SATURN for all links within the simulated area.

3.10.7. The annual average elasticity for all purpose trips is within the TAG specified range of -0.25 to -0.35.

Table 3-36 - TPU PCF Stage 3 fuel cost elasticity: matrix-based

Purpose	AM	IP	PM	OP	Annual Average	Desired Value
Business	-0.18	-0.23	-0.22	-0.18	-0.21	-0.10
Commuting	-0.22	-0.25	-0.23	-0.31	-0.24	-0.25
Others	-0.49	-0.48	-0.42	-0.49	-0.47	-0.40
All Purpose	-0.25	-0.35	-0.29	-0.32	-0.31	-0.30

Table 3-37 - TPU PCF Stage 3 fuel cost elasticity: network-based

Purpose	AM	IP	PM	OP	Annual Average	Desired Value
Business	-0.14	-0.21	-0.19	-0.18	-0.18	-0.10
Commuting	-0.19	-0.24	-0.20	-0.31	-0.22	-0.25
Others	-0.45	-0.46	-0.40	-0.48	-0.45	-0.40
All Purpose	-0.22	-0.33	-0.26	-0.32	-0.29	-0.30

3.10.8. Table 3-38 shows the car fuel cost elasticity values presented in the TPS RTM model validation report, as a comparison and consistency check. This shows that the car fuel cost elasticity values calculated for TPU PCF Stage 3 are comparable to the TPS RTM.

Table 3-38 - TPS RTM Stage 3 fuel cost elasticity

Purpose	AM	IP	PM	OP	Annual Average	Desired Value
Business	-0.18	-0.19	-0.16	-0.26	-0.20	-0.10
Commuting	-0.19	-0.20	-0.17	-0.24	-0.19	-0.25
Others	-0.48	-0.49	-0.48	-0.57	-0.50	-0.40
All Purpose	-0.25	-0.31	-0.27	-0.37	-0.30	-0.30

Car journey time elasticity

3.10.9. Car journey time elasticity was derived from the car fuel cost elasticity using the following equation:

$$Etime = Efuel\ aT/bK$$

Where,

Etime = Car journey time elasticity

Efuel = Car fuel cost elasticity

a = Pence per hour

b = Pence per km

T = Total veh-hrs

K = Total veh-kms

3.10.10. Table 3-39 presents car journey time elasticity values calculated for each car purpose by time period. As specified in TAG unit M2.1, car journey time elasticity values are shown to be no stronger than -2.0.

Table 3-39 - TPU PCF Stage 3 car journey time elasticity

Purpose	AM	IP	PM	OP	Desired Value
Business	-0.38	-0.47	-0.44	-0.34	<-2.0
Commuting	-0.60	-0.68	-0.63	-0.80	<-2.0
Others	-0.97	-0.99	-0.88	-0.93	<-2.0

Public transport fare elasticity

3.10.11. As recommended in TAG unit M2.1, PT fare elasticity values have been calculated by implementing a 10% fare increase. The updated PT cost files were input in to the TPU base year VDM.

3.10.12. The public transport demand matrices produced by the realism test were categorised based on whether the trip ends of each ij pair were inside or outside of the TPS RTM simulation area. All ij pairs except external to external movements were considered for the PT fare elasticity calculation.

3.10.13. Table 3-40 presents the public transport fare elasticity values calculated for the variable demand segments (as shown previously in Table 3-34).

Table 3-40 - TPU PCF Stage 3 public transport fare elasticity

Demand Segment	Purpose	Time Period	Reference PT Trips	Realism PT Trips	Elasticity
1	Home based Employers Business	PA all day	44,758	44,102	-0.15
2	Home based Commute	PA all day	116,461	114,351	-0.19
3	Home based Others	PA all day	56,484	51,979	-0.87
4	Non-Home-based Employers	AM	444	432	-0.29
		IP	265	258	-0.29
		PM	431	420	-0.29
		OP	172	167	-0.29
		24-hr	6,274	6,104	-0.29
5	Non-Home-based Others	AM	309	278	-1.09
		IP	229	207	-1.06
		PM	665	603	-1.03
		OP	217	196	-1.03
		24-hr	6,896	6,242	-1.05

3.10.14. As specified in TAG unit M2.1, PT fare elasticities are expected to lie in the range of -0.2 to -0.9 at a total trip level (all purpose). Table 3-41 compares 24-hour PT fare elasticities for TPU PCF Stage 3 with the TPS RTM. This shows that the elasticity value for all purpose trips achieves the TAG criteria (-0.37). The values provided for all the purposes (business, commuting and other) are shown to have slightly higher elasticity than TPS RTM, but are still comparable and well within the prescribed TAG range.

Table 3-41 – Comparison of 24-hour PT fare elasticity by purpose: TPS RTM vs. TPU PCF Stage 3

Purpose	TPS RTM	TPU Stage 3
Business	-0.15	-0.16
Commuting	-0.17	-0.19
Others	-0.78	-0.88
All Purpose	-0.29	-0.37

4. Summary

4.1.1. The transport modelling package summarises the development of the TPU PCF Stage 3 2015 base year transport model.

4.1.2. The calibration, validation and realism test results that are presented show that the model meets the TAG criteria and is suitable for developing traffic forecasts used to inform economic, environmental, and operational appraisal of the TPU scheme.

Appendices

Appendix A. ME: sectored matrices (prior vs. post)

For full details please see the attached folder ‘Appendix A’ (filename: ME_Sector_Comparison_v0.2_TPU_CC.xlsm) and (filename: ME_Sector_Comparison_v0.2_TPS_CC.xlsm)

The red highlighted cells in the sectored percentage change tables indicate changes greater than ±5%

The colour coding in the sectored GEH tables are based on the following criteria:

GEH>5	GEH>7.5	GEH>10	GEH>15	GEH>20

A.1. TPU PCF Stage 3: Percentage change (AM peak)

Sector From\To	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Total
1	10%	3%	2%			20%		-19%	-83%				38%					4%
2	43%	0%			7%	-1%	40%	4%	-38%				55%	-9%				4%
3	-24%	-15%	-4%			-6%		-16%	-68%	-44%			-5%	-27%				-11%
4				-1%						-22%	8%			22%			10%	-1%
5		-2%			3%	-22%	6%	10%	-9%			-29%	33%	-15%	15%			4%
6	28%	-3%	3%		8%	2%	36%	17%	-23%				48%	-38%	23%			9%
7		10%			10%	8%	2%	4%	-26%			-46%	-9%	3%		-33%		1%
8		30%	43%		43%	25%	21%	4%	-5%			-25%	12%	40%	0%	-11%		7%
9		24%				1%		4%	0%				29%					5%
10				7%						-2%	9%	-3%	-28%	9%	-2%	5%	-5%	-1%
11				-5%						-20%	4%	-6%		17%	32%		15%	5%
12					-7%			-28%		4%	17%	1%	-29%	9%	57%		37%	3%
13		39%	12%		45%	16%	6%	4%	-3%	-29%		-13%	2%	6%	15%	-8%		3%
14		19%	-9%	28%	-12%	-16%	-10%	10%	-50%	-15%	32%	18%	1%	2%	1%	10%	8%	2%
15		13%			37%	10%		23%	-22%	22%		44%	0%	4%	0%	22%	13%	0%
16								17%					10%	6%	-3%	0%		0%
17				2%						-27%	15%			3%	-34%		-3%	-6%
Total	21%	5%	-1%	5%	10%	7%	6%	5%	-11%	-7%	10%	3%	3%	3%	0%	0%	1%	1%

A.2. TPU PCF Stage 3: GEH (AM peak)

Sector From\To	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Total
1	4.10	0.94	0.24	2.91	0.28	3.91	2.15	3.14	11.86	3.93	0.84	2.96	4.37	2.65	1.03	0.37	2.59	2.44
2	9.09	0.45	2.27	0.36	3.02	0.31	5.98	2.32	15.65	3.32	0.39	2.05	14.83	1.00	6.97	1.10	1.37	5.02
3	2.99	1.70	2.20	1.05	1.12	1.54	0.43	2.45	8.70	8.04	2.04	2.68	1.41	5.99	2.38	0.88	2.42	8.61
4	0.53	0.41	1.78	0.25	0.01	0.47	0.09	1.14	1.91	10.52	2.36	0.94	0.59	5.47	4.90	1.32	3.11	1.27
5	3.12	1.06	1.06	0.19	3.07	4.44	2.81	5.36	3.27	0.06	0.61	3.93	9.31	3.38	1.50	1.61	0.67	5.27
6	3.74	1.18	0.54	0.98	0.94	1.90	3.77	14.24	11.95	2.78	0.23	3.26	27.67	5.75	3.18	1.43	0.10	16.22
7	1.14	1.37	0.64	0.07	3.99	1.06	1.39	2.35	6.79	0.44	0.28	6.29	3.31	0.94	1.60	3.75	0.59	0.88
8	6.09	11.20	4.36	1.69	16.19	15.92	10.21	14.18	5.92	5.51	1.19	4.26	15.43	16.10	0.16	2.45	5.23	25.03
9	2.10	2.70	0.94	0.21	0.62	0.09	1.67	2.39	0.00	2.09	0.47	1.20	5.67	0.83	0.36	0.86	1.24	3.54
10	0.78	0.18	2.58	2.57	0.16	1.18	0.25	1.95	4.71	3.81	2.15	0.38	3.28	6.31	0.39	0.51	2.74	1.86
11	1.20	0.54	2.73	1.55	0.18	1.42	1.07	2.25	3.80	6.14	4.37	1.30	1.48	9.07	3.05	2.63	5.20	6.89
12	1.04	0.35	1.76	0.05	1.01	0.53	4.94	4.52	6.11	0.58	4.02	0.85	5.40	9.46	5.86	2.97	3.69	5.89
13	5.67	8.66	2.52	2.66	10.75	8.85	2.25	5.09	1.67	3.78	2.77	2.32	12.96	5.28	17.88	3.81	6.86	18.86
14	2.02	1.91	1.89	6.24	2.25	2.20	2.67	4.01	10.61	13.37	13.07	13.92	0.79	15.01	2.05	6.56	4.73	16.64
15	1.35	1.39	0.39	8.47	3.53	1.48	6.82	7.65	2.56	3.69	11.34	4.04	0.29	5.41	0.07	8.46	1.57	0.91
16	2.33	5.24	1.27	0.95	1.38	2.23	2.03	3.43	2.85	1.82	2.90	5.33	4.13	3.83	1.23	0.05	1.03	0.68
17	0.56	0.82	2.28	0.49	0.08	0.59	0.00	1.31	2.40	20.20	4.21	2.13	2.78	1.65	4.66	1.12	3.75	10.26
Total	10.95	6.26	0.54	3.64	12.49	11.12	7.71	19.70	17.04	17.10	12.50	5.75	19.57	19.61	1.42	0.79	0.93	17.60

A.3. TPU PCF Stage 3: Percentage change (IP peak)

Sector From\To	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Total
1	4%	12%	12%			37%		67%										11%
2	21%	4%			12%	12%	67%	38%	4%				58%					13%
3	-14%		-4%			24%		61%		0%			14%	-10%				1%
4				4%						4%	14%			42%			25%	12%
5		10%			6%	17%	13%	49%	27%			-21%	66%	-24%				13%
6	8%	-9%	12%		20%	1%	5%	19%	-2%				21%	-29%	5%			6%
7		24%			10%	52%	2%	20%	1%			-43%	11%	-12%				6%
8	35%	14%	79%		35%	7%	14%	5%	2%			-15%	7%	17%	-1%	-10%		6%
9		7%			1%	1%	-16%	4%	0%				26%	-44%	25%			4%
10				4%						1%	31%	3%	-1%	3%	-5%	-5%	5%	1%
11				4%						20%	6%	4%		34%			19%	11%
12					-18%			6%		6%	10%	1%	3%	14%	30%			4%
13	79%	9%	15%		41%	11%	17%	6%	17%	-32%		1%	3%	7%	10%	1%		3%
14		-37%	-22%	42%	-42%	-34%	-12%	21%	-24%	1%	28%	9%	5%	2%	0%	13%	10%	2%
15		-2%			17%	-11%		19%	26%	8%		44%	6%	2%	0%	1%	7%	0%
16								-16%		-17%			5%	10%	-2%	0%		0%
17				20%						-1%	26%			2%	-30%		1%	3%
Total	11%	5%	0%	10%	10%	4%	6%	7%	2%	1%	12%	2%	3%	2%	0%	0%	5%	1%

A.4. TPU PCF Stage 3: GEH (IP peak)

Sector From\To	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Total
1	1.95	2.86	1.33	3.72	3.11	4.68	4.50	6.44	2.89	2.23	1.26	1.58	6.54	1.81	2.86	0.70	1.16	6.45
2	4.95	3.46	1.73	0.80	4.71	4.68	7.19	15.40	0.74	1.53	0.67	0.23	12.31	1.23	5.79	2.66	1.26	16.25
3	1.62	0.33	2.09	0.06	1.12	3.46	0.96	5.83	0.73	0.01	0.81	1.14	2.67	1.70	0.51	0.50	1.49	0.41
4	1.29	0.21	1.23	1.84	0.70	0.43	0.36	3.83	0.85	1.32	4.47	0.34	4.78	7.96	5.27	2.08	6.68	9.29
5	3.24	4.09	0.74	0.06	5.49	2.08	4.99	17.96	4.18	0.36	0.13	2.37	14.31	5.52	5.73	0.67	0.68	16.61
6	1.16	3.79	1.91	0.07	2.68	1.60	0.47	12.07	0.59	1.43	0.42	1.82	10.29	4.04	0.58	2.39	1.64	9.28
7	1.82	2.96	1.24	0.22	4.23	4.68	2.27	9.41	0.13	0.01	0.52	5.00	3.73	4.02	0.64	2.70	0.12	7.35
8	3.84	6.27	7.15	1.06	13.07	4.41	6.80	16.79	1.19	5.01	1.38	2.25	7.39	7.43	0.23	2.14	3.37	22.16
9	0.10	1.43	2.22	0.63	0.11	0.34	2.28	3.11	0.00	2.90	1.06	3.06	7.10	7.22	2.84	1.34	1.57	3.80
10	2.73	0.80	4.04	1.48	0.35	0.94	0.61	1.04	2.70	1.52	6.04	0.28	0.07	1.80	0.92	0.58	2.91	3.17
11	1.16	0.46	1.75	1.21	0.60	0.54	0.97	2.28	0.60	4.02	6.86	0.77	3.56	13.50	3.19	3.42	5.28	13.38
12	1.97	0.89	2.20	0.08	2.29	1.13	2.86	0.81	0.41	0.67	2.11	1.35	0.46	12.12	2.92	2.79	1.53	7.18
13	7.23	2.22	2.78	3.07	9.49	5.48	5.54	7.39	4.71	4.05	1.79	0.10	16.31	6.00	11.04	0.42	4.34	21.37
14	1.91	4.72	3.69	8.45	9.16	4.92	3.55	7.55	2.98	0.66	11.85	7.99	3.77	13.46	0.32	7.86	5.32	16.21
15	2.20	0.19	0.03	9.99	1.74	1.67	1.33	5.97	2.43	1.43	8.16	4.94	6.26	2.50	0.03	0.23	0.95	0.93
16	3.21	3.41	0.79	0.90	0.53	2.14	2.75	3.79	1.65	1.83	3.72	1.22	2.21	6.11	0.77	0.06	1.30	0.55
17	0.82	0.75	2.01	5.34	0.13	0.83	0.53	3.65	0.02	0.75	7.32	0.42	4.76	0.85	4.19	1.28	1.71	4.03
Total	6.03	6.31	0.25	8.10	12.64	6.83	7.37	26.90	2.45	1.50	15.26	4.76	21.49	17.10	0.84	0.70	7.41	22.27

A.5. TPU PCF Stage 3: Percentage change (PM peak)

Sector From\To	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Total
1	3%	37%	1%			29%		25%										14%
2	0%	1%	-23%		9%	12%	36%	32%	3%				98%					10%
3	-25%	12%	-6%			30%		9%		6%			12%	-10%				-2%
4				2%						-3%	10%	5%		34%			4%	4%
5		12%			6%	34%	16%	32%	-2%			-4%	85%	-1%				13%
6	-14%	-18%	-13%		15%	-3%	20%	11%	-2%				17%	4%	77%			1%
7		12%			3%	24%	2%	22%	-6%			-35%	15%	-5%				6%
8	36%	5%	-22%		33%	-8%	16%	2%	-1%	-25%		0%	10%	40%	34%	19%		4%
9	-9%	-10%	-49%		5%	-22%	-20%	-2%	0%				-6%	-17%	41%			-5%
10	-42%		-50%	-13%				-46%		-2%	1%	-4%	-37%	-9%	-12%		-24%	-5%
11				7%						20%	5%	8%		29%			16%	9%
12					-11%			24%		2%	-8%	0%	24%	10%				2%
13	71%	12%	-3%		40%	-1%	12%	9%	5%	-15%		12%	1%	9%	4%	0%		2%
14		-13%	-31%	48%	-19%	-13%	-10%	43%	-30%	-9%	23%	3%	7%	1%	2%	14%	10%	1%
15		-10%				-1%		9%		-16%	139%	67%	8%	2%	0%	18%	2%	0%
16								41%					13%	11%	15%	0%		0%
17				20%						-16%	27%	18%		5%	-28%		-1%	-1%
Total	1%	2%	-11%	7%	10%	-3%	6%	5%	-1%	-3%	9%	1%	2%	1%	0%	0%	-2%	1%

A.6. TPU PCF Stage 3: GEH (PM peak)

Sector From\To	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Total
1	1.46	9.03	0.12	0.25	2.85	4.50	1.18	2.80	1.54	0.34	0.53	0.34	4.08	0.59	3.18	0.22	0.99	8.46
2	0.08	0.96	3.02	0.40	4.17	5.40	4.94	14.15	0.64	2.86	0.51	0.39	18.53	1.25	11.27	2.96	0.35	13.65
3	3.95	1.23	3.11	1.08	1.19	4.70	0.49	1.00	1.44	0.69	1.37	1.48	2.54	1.83	0.53	0.34	2.28	1.37
4	3.87	0.02	0.85	1.06	0.23	0.32	0.15	0.30	0.35	1.40	3.32	0.52	0.45	6.89	4.95	2.66	1.20	3.81
5	3.03	5.46	0.00	0.72	6.58	4.17	7.32	13.97	0.22	0.59	0.33	0.54	18.91	0.29	10.77	0.41	1.65	19.07
6	3.01	9.16	3.46	1.34	2.92	4.43	2.55	8.04	0.44	2.38	1.26	1.16	9.63	0.46	8.06	2.10	0.92	1.20
7	2.82	1.91	0.04	0.63	1.63	2.84	1.78	11.72	0.69	0.19	0.77	4.75	5.43	1.46	0.73	0.23	2.05	8.23
8	5.23	3.01	3.35	1.27	16.32	6.67	9.23	8.51	0.41	2.72	1.64	0.02	12.86	15.60	11.15	3.47	1.16	17.02
9	1.00	3.48	5.84	0.33	1.62	10.64	4.69	2.32	0.00	4.21	0.71	3.74	3.03	3.36	5.03	1.33	0.12	7.50
10	4.88	1.63	7.01	6.14	0.52	3.08	0.20	5.32	4.09	3.86	0.41	0.65	5.10	7.56	1.97	3.01	18.38	12.84
11	0.78	0.18	1.11	2.47	0.63	0.09	1.26	2.49	0.63	4.79	5.59	2.08	3.91	12.71	5.23	3.39	4.90	12.81
12	2.32	0.68	1.28	0.83	1.64	0.01	2.19	3.08	0.21	0.21	1.96	0.58	3.09	8.49	4.90	3.73	0.79	3.58
13	7.14	3.22	0.94	0.49	9.79	0.95	3.87	12.07	1.28	1.76	0.48	1.85	7.95	7.83	4.66	0.06	4.71	12.60
14	2.70	1.55	6.57	11.98	4.05	1.83	3.10	14.36	3.51	6.99	12.52	2.92	5.97	8.61	2.70	9.18	6.52	11.88
15	1.45	1.09	1.78	9.53	2.90	0.08	3.26	2.98	0.05	2.96	10.83	7.16	9.60	3.20	0.19	6.26	0.26	1.38
16	4.50	2.61	0.54	1.76	1.66	0.09	0.50	7.47	0.18	0.77	1.83	1.97	5.85	6.97	5.39	0.04	1.86	1.32
17	1.95	0.02	2.93	6.45	0.57	0.29	1.17	0.11	0.69	11.06	9.11	1.76	1.64	3.01	3.39	2.04	1.55	0.99
Total	0.82	2.62	8.72	6.06	14.98	6.44	8.47	19.21	0.64	8.55	13.40	1.53	15.33	12.35	1.29	1.14	4.22	13.99

A.7. TPS RTM: Percentage change (AM peak)

Sector From\To	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Total
1	-5%	-6%	-12%			-24%		5%	-46%				35%					-8%
2	-18%	-1%			-3%	-5%	5%	4%	-12%				53%	-39%				0%
3	-7%		1%			-30%		-33%	-45%	-38%			-10%	-23%				-11%
4				-3%						-27%	1%			10%			-6%	-9%
5		-2%			-1%	-4%	3%	4%	-15%			-37%	33%	-17%	6%			0%
6	-1%	-4%	-4%		12%	-1%	5%	16%	-13%				58%	-48%	26%			9%
7		14%			7%	38%	1%	4%	-19%			-41%	-9%	14%		-18%		1%
8	37%	28%	4%		39%	26%	19%	4%	-6%	-37%		-17%	13%	43%	4%	-3%		6%
9		-6%				-12%		4%	0%				34%					3%
10				10%				-57%		-2%	12%	-28%	-49%	10%	-3%		-3%	-1%
11				5%						-16%	4%	-9%		14%	19%		6%	4%
12					-19%			6%		-13%	15%	0%	-10%	9%	73%		46%	3%
13	74%	60%	9%		51%	14%	6%	3%	1%	-19%		-2%	2%	9%	15%	-8%		3%
14		15%	6%	37%	14%	-3%	-2%	46%	-36%	-16%	26%	15%	2%	2%	1%	9%	5%	2%
15					61%	-16%		24%	-20%	19%		63%	0%	4%	0%	23%	11%	0%
16								8%					7%	7%	0%	0%		0%
17				1%						-24%	12%			2%	-35%		-4%	-7%
Total	-3%	4%	1%	6%	6%	4%	5%	5%	-8%	-7%	8%	2%	3%	3%	0%	0%	-2%	1%

A.8. TPS RTM: GEH (AM peak)

Sector From\To	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Total
1	2.21	1.98	1.55	3.53	0.14	5.28	0.64	0.95	7.71	4.73	1.72	0.32	4.59	0.78	0.93	0.66	0.29	5.26
2	4.62	1.26	0.93	1.34	1.14	2.36	0.84	2.46	4.71	2.67	1.65	2.27	14.27	4.98	5.15	0.04	0.67	0.51
3	0.73	2.80	0.26	0.40	1.67	7.91	1.52	5.17	5.39	6.85	0.82	0.07	2.97	4.99	2.38	0.29	1.44	8.68
4	2.22	1.49	1.24	1.42	1.02	1.69	0.58	3.69	2.26	13.13	0.19	1.66	3.52	2.52	3.11	1.09	1.83	7.67
5	2.20	0.66	1.42	1.29	0.90	0.83	1.25	2.22	5.30	3.28	1.90	5.16	9.28	3.75	0.62	1.35	0.70	0.04
6	0.12	1.72	0.75	1.60	1.43	1.85	0.52	12.98	6.39	3.17	1.34	2.65	32.38	7.66	3.58	3.21	1.17	15.66
7	0.03	1.89	0.27	0.91	2.74	4.55	1.11	2.28	4.82	2.01	1.36	5.54	3.50	4.15	2.49	1.93	0.42	1.72
8	3.85	10.56	0.41	1.86	14.54	16.63	9.32	12.35	6.21	4.78	0.88	2.93	17.21	17.24	1.41	0.63	0.37	23.89
9	0.23	0.72	1.32	0.56	1.20	1.85	2.13	2.29	0.00	2.80	0.27	1.58	6.52	2.77	0.87	0.29	0.50	2.42
10	0.31	2.87	1.58	3.61	1.55	3.06	1.00	7.57	7.72	3.66	2.53	3.64	6.69	6.67	0.50	0.87	1.91	2.00
11	1.82	2.05	1.03	1.54	1.08	2.47	0.49	4.39	3.04	4.86	3.63	2.25	3.10	7.20	1.88	0.92	2.03	4.94
12	1.59	1.20	1.25	1.22	2.83	0.24	1.66	0.93	3.57	1.97	3.71	0.75	1.72	9.55	7.37	2.24	4.53	6.56
13	6.67	12.91	1.94	0.46	12.12	7.50	2.22	4.18	0.37	2.79	1.82	0.31	13.40	7.38	17.85	3.54	1.21	19.60
14	0.91	1.61	1.22	8.13	2.41	0.43	0.59	17.30	7.40	14.29	10.65	11.78	2.01	15.48	1.54	6.34	3.11	17.65
15	1.94	3.55	0.15	7.95	5.53	2.50	4.69	8.12	2.28	3.13	10.61	5.58	0.47	5.15	0.08	8.95	1.34	0.94
16	3.94	5.29	1.14	2.26	1.54	2.83	2.68	1.54	3.17	2.22	2.43	1.20	2.83	4.84	0.10	0.05	1.07	0.70
17	2.29	1.62	1.43	0.17	0.74	2.38	0.57	4.23	2.80	17.66	3.26	2.03	5.18	1.29	4.85	1.32	5.46	11.38
Total	1.79	4.58	0.37	4.81	8.18	6.01	5.72	18.67	12.15	17.01	9.86	4.58	21.04	20.26	1.39	0.85	3.16	16.81

A.9. TPS RTM: Percentage change (IP peak)

Sector From\To	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Total
1	5%	20%				0%		41%					69%					10%
2	-15%	1%			2%	3%	21%	22%	10%				29%					4%
3			0%			6%		35%		-13%			8%	-8%				1%
4				1%						0%	6%			25%			10%	4%
5		7%			1%	28%	8%	43%	25%			-38%	64%	-39%				8%
6	-12%	-1%	1%		-3%	1%	-13%	20%	5%				33%	-30%	13%			7%
7		20%			6%	40%	2%	22%	3%			-29%	11%	0%				6%
8	-2%	19%	2%		23%	10%	12%	5%	1%			-5%	6%	24%	1%	-10%		6%
9		12%			0%	-1%	-17%	3%	0%				24%	-41%	21%			3%
10				4%				-41%		1%	23%	-12%	-26%	5%	-6%	2%	6%	1%
11				8%						20%	5%	3%		27%			19%	9%
12					-40%			14%		6%	1%	0%	14%	14%	40%			3%
13	12%	27%	6%		50%	17%	17%	7%	17%	-18%		10%	3%	7%	10%	2%		4%
14		-37%	-2%	32%	-39%	-26%	-9%	32%	-19%	-1%	23%	8%	8%	2%	0%	13%	8%	2%
15		13%			44%	-12%		17%	3%	2%		59%	6%	2%	0%	1%	9%	0%
16								-13%		-6%			5%	10%	-1%	0%		0%
17				15%						4%	22%			1%	-36%		0%	2%
Total	-1%	6%	0%	7%	4%	4%	4%	7%	3%	1%	8%	2%	4%	2%	0%	0%	3%	1%

A.10. TPS RTM: GEH (IP peak)

Sector From\To	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Total
1	2.21	5.01	0.44	4.44	0.90	0.07	0.26	4.92	0.19	0.44	1.38	0.51	6.19	1.28	0.64	1.42	1.22	5.93
2	4.08	1.17	0.60	1.29	0.87	1.29	2.46	9.24	1.95	1.17	1.42	2.25	6.56	4.51	2.60	1.22	0.93	5.69
3	0.48	0.57	0.13	0.26	0.46	0.94	0.57	3.45	0.13	1.60	0.38	0.43	1.52	1.32	0.09	0.71	1.05	0.85
4	1.74	1.40	1.11	0.38	1.27	1.43	0.80	2.56	1.18	0.07	1.95	0.53	2.87	4.84	3.44	1.47	2.60	3.16
5	1.26	2.96	0.03	1.04	0.88	3.33	3.40	15.97	3.79	1.19	1.30	4.60	14.05	9.23	5.59	0.90	0.99	10.63
6	1.77	0.49	0.22	1.36	0.41	1.13	1.38	12.72	1.15	0.59	1.57	2.15	15.57	4.27	1.57	3.50	1.56	11.32
7	0.64	2.42	0.16	1.03	2.46	3.72	2.22	10.52	0.48	1.32	0.74	3.21	3.84	0.00	0.59	2.48	0.78	8.01
8	0.25	8.32	0.18	2.67	8.85	6.35	5.67	16.13	0.99	2.94	2.51	0.78	6.86	10.27	0.43	2.04	2.24	21.33
9	0.11	2.39	0.98	1.06	0.01	0.26	2.36	2.53	0.00	0.32	0.45	2.45	6.61	6.74	2.45	1.32	0.62	3.10
10	0.52	2.54	2.02	1.54	2.45	0.96	2.04	4.86	3.55	1.53	4.56	1.31	3.21	3.04	0.97	0.23	3.13	3.09
11	1.37	1.28	0.42	2.46	0.97	0.90	0.91	1.17	0.79	4.12	5.04	0.64	0.88	10.78	2.55	1.80	5.42	10.69
12	1.84	2.08	1.69	0.03	5.56	0.36	3.01	1.67	0.50	0.63	0.12	0.71	1.94	11.49	3.83	2.80	1.92	6.27
13	1.36	6.39	1.08	2.99	11.31	8.48	5.38	7.71	4.56	2.25	2.39	1.62	16.58	5.78	11.10	0.90	2.86	21.89
14	0.15	4.79	0.28	6.63	8.47	3.75	2.66	11.32	2.41	0.70	9.76	6.65	6.44	13.73	0.31	7.68	4.32	16.55
15	0.40	1.33	0.11	7.74	4.22	1.83	0.31	5.45	0.35	0.26	7.72	6.39	6.14	2.17	0.05	0.55	1.20	0.85
16	2.08	3.52	0.17	0.23	0.39	1.30	1.88	3.02	1.48	0.62	1.22	1.61	2.10	6.19	0.29	0.06	1.13	0.58
17	1.50	1.06	1.20	4.23	0.81	1.38	0.70	2.59	1.32	2.10	6.26	1.26	2.50	0.62	5.19	1.24	0.04	2.54
Total	0.41	7.41	0.00	5.59	5.79	6.82	5.49	25.50	2.80	1.73	10.77	3.84	21.88	17.28	0.82	0.73	4.28	20.92

A.11. TPS RTM: Percentage change (PM peak)

Sector From\To	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Total
1	0%	14%	-11%			-6%		20%					72%					5%
2	-29%	-1%			-1%	0%	10%	14%	-6%				79%					1%
3	-4%		-2%			-4%		-1%		-8%			1%	-7%				-3%
4				-3%						-10%	3%	-10%		24%			-7%	-3%
5		3%			2%	38%	12%	39%	0%			-13%	105%	8%				11%
6	-9%	-8%	-15%		-18%	-4%	1%	11%	-4%				25%	-5%	79%			1%
7		7%			3%	26%	2%	25%	-2%			-16%	16%	1%				7%
8	21%	8%	-18%		19%	-2%	16%	2%	-1%			18%	9%	40%	34%	16%		4%
9	17%	6%			12%	-27%	-15%	-2%	0%				-2%	-9%	31%			-3%
10	-35%		-35%	-17%				-57%		-2%	-12%	-21%	-38%	-9%	-15%		-22%	-5%
11				7%						4%	4%	10%		25%			5%	7%
12					-36%			33%		9%	-9%	0%	32%	11%				2%
13	50%	27%	-4%		30%	9%	13%	9%	9%	-11%		40%	1%	8%	3%	1%		2%
14		-33%	-15%	43%	-31%	-20%	-8%	48%	-26%	-11%	24%	3%	9%	1%	2%	14%	7%	1%
15		3%				0%		5%		-18%	125%	98%	8%	2%	0%	19%	7%	0%
16								56%					13%	10%	20%	0%		0%
17				17%						-10%	24%	20%		3%	-21%		-2%	-1%
Total	-6%	2%	-8%	3%	4%	-3%	6%	4%	-1%	-3%	8%	1%	2%	2%	0%	0%	-4%	1%

A.12. TPS RTM: GEH (PM peak)

Sector From\To	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Total
1	0.03	3.97	1.17	0.54	0.38	1.10	0.25	2.52	2.90	0.69	2.16	1.52	6.24	0.36	3.59	0.89	0.61	2.98
2	10.44	1.28	2.62	1.28	0.70	0.14	1.51	6.25	1.19	2.10	2.93	1.81	15.34	3.09	9.93	1.68	0.98	1.88
3	0.50	0.13	1.00	0.25	0.55	0.63	0.15	0.10	0.48	1.07	1.15	0.54	0.24	1.40	0.73	0.38	1.60	1.77
4	6.76	1.16	0.87	1.61	1.55	1.19	0.77	2.31	0.98	3.91	0.88	1.02	1.71	4.96	4.44	1.94	2.08	2.47
5	0.67	1.24	0.30	0.23	2.04	4.62	5.44	16.77	0.06	0.17	0.91	1.93	22.57	1.64	10.63	0.25	0.01	15.51
6	1.91	3.95	3.71	0.88	3.64	5.31	0.07	8.19	0.81	1.21	2.04	1.71	13.64	0.66	8.24	2.55	1.40	2.38
7	0.07	1.18	0.13	0.66	1.65	3.03	2.06	13.34	0.29	0.17	0.52	2.02	5.81	0.41	0.11	0.31	0.38	9.64
8	3.63	4.52	2.63	1.61	9.59	2.13	9.23	7.61	0.57	2.17	2.94	2.85	12.38	15.65	11.16	2.93	0.33	16.26
9	2.02	2.15	5.65	0.92	3.56	13.21	3.58	1.90	0.00	0.32	1.84	2.37	0.81	1.65	3.88	1.32	0.48	4.80
10	4.26	3.37	4.49	7.92	2.97	4.11	1.98	7.08	4.84	3.72	3.50	3.55	5.27	7.56	2.48	3.62	16.94	13.32
11	1.76	1.43	0.92	2.30	1.50	1.23	1.14	1.87	1.22	0.92	4.77	2.43	1.12	11.14	4.46	3.16	1.76	9.58
12	3.35	2.02	1.25	0.67	5.89	0.73	3.20	4.17	0.83	1.09	2.24	0.79	4.14	9.63	5.70	3.78	0.18	3.91
13	5.75	6.95	1.11	0.32	7.52	5.59	4.27	12.68	2.55	1.22	0.40	5.73	7.93	7.70	4.17	0.31	0.26	13.33
14	1.68	4.38	3.01	10.87	6.72	2.84	2.41	15.66	3.00	8.78	13.07	3.55	7.33	9.41	2.68	9.24	4.35	12.61
15	0.91	0.35	1.60	8.86	1.73	0.07	2.13	1.79	0.01	3.17	9.95	9.82	9.41	2.83	0.17	6.76	1.05	1.33
16	0.96	0.71	0.44	1.18	1.10	0.58	0.81	9.82	0.50	0.40	0.53	0.77	5.86	6.65	6.85	0.04	1.45	1.37
17	2.59	1.49	2.05	5.50	0.89	1.73	0.62	3.34	1.51	6.81	8.10	1.98	2.23	1.93	2.51	1.99	2.14	1.01
Total	4.31	2.29	5.81	2.73	5.75	5.71	7.53	18.45	0.80	8.61	11.03	2.15	15.82	13.00	1.24	1.17	6.61	13.16

Appendix B. Calibration / Validation: flow screenlines

For full details please see the attached folder ‘Appendix C’ (filename: ‘TPUP3_Base_Cal_Val_v3.5_CC.xlsm’) and (filename: ‘TPUP3_Base_Cal_Val_v3.0.xlsm’). This includes a breakdown by vehicle type at both a screenline level and an individual link level.

B.1. TPU PCF Stage 3: AM peak (all vehicles)

		Prior-ME					Post-ME				
Screenline	Direction	Obs.	Mod.	Diff.	Diff. (%)	GEH	Obs.	Mod.	Diff.	Diff. (%)	GEH
A61 Cordon	A61 Cordon Inbound	11,428	9,569	-1,859	-16.3%	18.1	11,428	11,540	112	1.0%	1.0
A61 Cordon	A61 Cordon Outbound	12,175	9,196	-2,979	-24.5%	28.8	12,175	11,665	-510	-4.2%	4.7
Inner Study Cordon	Inner Study Cordon Inbound	4,091	3,608	-483	-11.8%	7.8	4,091	3,933	-158	-3.9%	2.5
Inner Study Cordon	Inner Study Cordon Outbound	4,472	4,237	-234	-5.2%	3.6	4,472	4,396	-76	-1.7%	1.1
M1 Screenline	M1 Screenline EB	5,965	5,421	-545	-9.1%	7.2	5,965	6,019	54	0.9%	0.7
M1 Screenline	M1 Screenline WB	4,041	3,673	-368	-9.1%	5.9	4,041	4,094	54	1.3%	0.8
Trans-Pennine Western Screenline	Trans-Pennine Western Screenline EB	8,474	7,666	-808	-9.5%	9.0	8,474	8,460	-13	-0.2%	0.1
Trans-Pennine Western Screenline	Trans-Pennine Western Screenline WB	9,568	9,806	238	2.5%	2.4	9,568	9,502	-65	-0.7%	0.7
Trans-Pennine Eastern Screenline	Trans-Pennine Eastern Screenline EB	4,660	4,969	309	6.6%	4.5	4,660	4,600	-59	-1.3%	0.9
Trans-Pennine Eastern Screenline	Trans-Pennine Eastern Screenline WB	4,425	5,312	887	20.0%	12.7	4,425	4,382	-43	-1.0%	0.7
Glossop / Hadfield Counts	Glossop-Hadfield_Links	1,402	1,557	155	11.1%	4.0	1,402	1,416	14	1.0%	0.4
All Other Counts	Other Link Counts	177,146	173,950	-3,196	-1.8%	7.6	177,146	175,528	-1,618	-0.9%	3.9

B.2. TPU PCF Stage 3: IP (all vehicles)

		Prior-ME					Post-ME				
Screenline	Direction	Obs.	Mod.	Diff.	Diff. (%)	GEH	Obs.	Mod.	Diff.	Diff. (%)	GEH
A61 Cordon	A61 Cordon Inbound	10,014	7,117	-2,897	-28.9%	31.3	10,014	9,979	-35	-0.4%	0.4
A61 Cordon	A61 Cordon Outbound	10,215	6,987	-3,228	-31.6%	34.8	10,215	10,164	-52	-0.5%	0.5
Inner Study Cordon	Inner Study Cordon Inbound	3,898	3,417	-481	-12.4%	8.0	3,898	3,922	24	0.6%	0.4
Inner Study Cordon	Inner Study Cordon Outbound	3,795	3,348	-447	-11.8%	7.5	3,795	3,839	44	1.2%	0.7
M1 Screenline	M1 Screenline EB	4,271	3,648	-623	-14.6%	9.9	4,271	4,280	9	0.2%	0.1
M1 Screenline	M1 Screenline WB	4,177	3,690	-487	-11.7%	7.8	4,177	4,152	-25	-0.6%	0.4
Trans-Pennine Western Screenline	Trans-Pennine Western Screenline EB	8,138	7,746	-392	-4.8%	4.4	8,138	8,270	132	1.6%	1.5
Trans-Pennine Western Screenline	Trans-Pennine Western Screenline WB	8,311	7,317	-994	-12.0%	11.2	8,311	8,325	14	0.2%	0.2
Trans-Pennine Eastern Screenline	Trans-Pennine Eastern Screenline EB	4,316	4,845	529	12.2%	7.8	4,316	4,354	39	0.9%	0.6
Trans-Pennine Eastern Screenline	Trans-Pennine Eastern Screenline WB	4,413	4,813	400	9.1%	5.9	4,413	4,263	-150	-3.4%	2.3
Glossop / Hadfield Counts	Glossop-Hadfield_Links	1,396	1,377	-19	-1.3%	0.5	1,396	1,378	-18	-1.3%	0.5
All Other Counts	Other Link Counts	153,288	140,863	-12,425	-8.1%	32.4	153,288	154,882	1,594	1.0%	4.1

B.3. TPU PCF Stage 3: PM peak (all vehicles)

		Prior-ME					Post-ME				
Screenline	Direction	Obs.	Mod.	Diff.	Diff. (%)	GEH	Obs.	Mod.	Diff.	Diff. (%)	GEH
A61 Cordon	A61 Cordon Inbound	12,748	9,254	-3,495	-27.4%	33.3	12,748	12,731	-17	-0.1%	0.2
A61 Cordon	A61 Cordon Outbound	12,909	9,176	-3,733	-28.9%	35.5	12,909	12,869	-40	-0.3%	0.4
Inner Study Cordon	Inner Study Cordon Inbound	4,439	4,639	200	4.5%	3.0	4,439	4,432	-7	-0.2%	0.1
Inner Study Cordon	Inner Study Cordon Outbound	4,197	3,958	-240	-5.7%	3.8	4,197	4,237	40	1.0%	0.6
M1 Screenline	M1 Screenline EB	4,499	4,035	-464	-10.3%	7.1	4,499	4,525	26	0.6%	0.4
M1 Screenline	M1 Screenline WB	5,801	5,459	-341	-5.9%	4.5	5,801	5,778	-23	-0.4%	0.3
Trans-Pennine Western Screenline	Trans-Pennine Western Screenline EB	10,191	9,136	-1,054	-10.3%	10.7	10,191	10,131	-60	-0.6%	0.6
Trans-Pennine Western Screenline	Trans-Pennine Western Screenline WB	9,932	7,900	-2,032	-20.5%	21.5	9,932	9,893	-40	-0.4%	0.4
Trans-Pennine Eastern Screenline	Trans-Pennine Eastern Screenline EB	4,739	4,289	-450	-9.5%	6.7	4,739	4,712	-27	-0.6%	0.4
Trans-Pennine Eastern Screenline	Trans-Pennine Eastern Screenline WB	4,934	5,097	163	3.3%	2.3	4,934	4,901	-33	-0.7%	0.5
Glossop / Hadfield Counts	Glossop-Hadfield_Links	1,570	1,680	110	7.0%	2.7	1,570	1,631	61	3.9%	1.5
All Other Counts	Other Link Counts	190,891	175,408	-15,483	-8.1%	36.2	190,891	194,171	3,280	1.7%	7.5

Appendix C. Calibration / Validation: journey time routes

For full details please see the attached folder 'Appendix D' (filename: 'Journey_Time.html'). This includes journey time profiles for all routes by timing point and time period.

C.1. Journey time screenline summary (modelled vs. observed)

C.1.1. AM peak

Route Name	Route Direction	Distance (km)	Observed	Modelled	Diff	% Diff	Pass/Fail
A560	NB	8.2	00:12:32	00:11:43	-00:00:48	-6.50%	Pass
A560	SB	8.2	00:19:43	00:20:05	00:00:22	1.90%	Pass
A57	EB	38.2	00:39:16	00:42:26	00:03:09	8.10%	Pass
A57	WB	38.2	00:41:23	00:40:38	-00:00:44	-1.80%	Pass
A61	NB	8.1	00:09:21	00:09:49	00:00:28	5.00%	Pass
A61	SB	8.2	00:10:02	00:08:51	-00:01:11	-11.80%	Pass
A624	NB	13.8	00:14:55	00:15:21	00:00:25	2.90%	Pass
A624	SB	13.8	00:14:38	00:13:52	-00:00:45	-5.20%	Pass
A628	EB	14.8	00:16:20	00:17:37	00:01:17	7.90%	Pass
A628	WB	14.8	00:15:49	00:15:41	-00:00:07	-0.80%	Pass
A628&A616	EB	48.2	00:55:15	00:58:56	00:03:41	6.70%	Pass
A628&A616	WB	49.4	00:55:15	00:55:44	00:00:29	0.90%	Pass
A635	EB	44.1	00:56:04	00:55:33	-00:00:30	-0.90%	Pass
A635	WB	47.4	00:58:12	01:00:59	00:02:46	4.80%	Pass
Hadfield Alternative	EB	4.5	00:07:34	00:07:53	00:00:18	4.10%	Pass
Hadfield Alternative	WB	4.5	00:09:20	00:07:18	-00:02:01	-21.70%	Fail
M1	NB	28.7	00:20:53	00:18:23	-00:02:30	-12.00%	Pass
M1	SB	27.5	00:19:50	00:17:21	-00:02:29	-12.50%	Pass
M62	EB	60.1	00:53:00	00:51:11	-00:01:49	-3.40%	Pass
M62	WB	59.3	00:45:44	00:40:32	-00:05:12	-11.40%	Pass

C.1.2. IP

Route Name	Route Direction	Distance (km)	Observed	Modelled	Diff	% Diff	Pass/Fail
A560	NB	8.2	00:12:24	00:11:47	-00:00:36	-4.90%	Pass
A560	SB	8.2	00:16:13	00:14:49	-00:01:23	-8.60%	Pass
A57	EB	38.2	00:41:55	00:43:52	00:01:57	4.70%	Pass
A57	WB	38.2	00:42:02	00:42:17	00:00:15	0.60%	Pass
A61	NB	8.1	00:08:49	00:09:40	00:00:50	9.50%	Pass
A61	SB	8.2	00:09:12	00:08:39	-00:00:32	-5.80%	Pass
A624	NB	13.8	00:15:16	00:14:40	-00:00:36	-4.00%	Pass
A624	SB	13.8	00:14:55	00:13:09	-00:01:46	-11.90%	Pass
A628	EB	14.8	00:16:07	00:18:07	00:02:00	12.40%	Pass
A628	WB	14.8	00:15:41	00:17:10	00:01:29	9.50%	Pass
A628&A616	EB	48.2	00:55:09	01:00:40	00:05:30	10.00%	Pass
A628&A616	WB	49.4	00:52:13	00:58:31	00:06:17	12.10%	Pass
A635	EB	44.1	00:55:59	00:54:42	-00:01:17	-2.30%	Pass
A635	WB	47.4	00:56:01	00:56:06	00:00:05	0.20%	Pass
Hadfield Alternative	EB	4.5	00:07:42	00:07:51	00:00:08	1.80%	Pass
Hadfield Alternative	WB	4.5	00:07:28	00:07:20	-00:00:08	-1.90%	Pass
M1	NB	28.7	00:20:21	00:17:33	-00:02:48	-13.80%	Pass
M1	SB	27.5	00:19:27	00:16:49	-00:02:38	-13.60%	Pass
M62	EB	60.1	00:48:09	00:43:16	-00:04:52	-10.10%	Pass
M62	WB	59.3	00:42:51	00:41:14	-00:01:36	-3.80%	Pass

C.1.3. PM peak

Route Name	Route Direction	Distance (km)	Observed	Modelled	Diff	% Diff	Pass/Fail
A560	NB	8.2	00:13:04	00:13:30	00:00:26	3.40%	Pass
A560	SB	8.2	00:15:07	00:14:32	-00:00:35	-3.90%	Pass
A57	EB	38.2	00:41:47	00:44:36	00:02:48	6.70%	Pass
A57	WB	38.2	00:41:06	00:41:43	00:00:37	1.50%	Pass
A61	NB	8.1	00:09:28	00:10:17	00:00:48	8.50%	Pass
A61	SB	8.2	00:10:34	00:09:20	-00:01:14	-11.80%	Pass
A624	NB	13.8	00:15:07	00:15:43	00:00:36	4.00%	Pass
A624	SB	13.8	00:14:11	00:13:20	-00:00:50	-6.00%	Pass
A628	EB	14.8	00:15:47	00:16:33	00:00:45	4.80%	Pass
A628	WB	14.8	00:15:42	00:16:12	00:00:29	3.20%	Pass
A628&A616	EB	48.2	00:57:50	00:57:54	00:00:03	0.10%	Pass
A628&A616	WB	49.4	00:54:50	00:55:43	00:00:53	1.60%	Pass
A635	EB	44.1	00:57:17	01:00:16	00:02:59	5.20%	Pass
A635	WB	47.4	00:57:23	01:00:25	00:03:01	5.30%	Pass
Hadfield Alternative	EB	4.5	00:07:59	00:08:19	00:00:19	4.10%	Pass
Hadfield Alternative	WB	4.5	00:08:03	00:07:36	-00:00:27	-5.70%	Pass
M1	NB	28.7	00:20:03	00:18:01	-00:02:01	-10.10%	Pass
M1	SB	27.5	00:20:12	00:17:33	-00:02:38	-13.10%	Pass
M62	EB	60.1	00:48:45	00:43:10	-00:05:34	-11.40%	Pass
M62	WB	59.3	00:47:22	00:45:13	-00:02:08	-4.50%	Pass

Appendix D. HAM convergence

D.1. TPU PCF Stage 3: AM peak

Loop	% Flow	% Delay	% Gap	Ass.	Sim.	A/S Step	%V.I.
1	0.0	49.4	3.506	0.364	0.057	1.000	0.00000
2	28.0	82.5	1.286	0.428	0.021	1.000	0.17700
3	41.1	89.1	0.749	0.197	0.027	0.933	0.00810
4	53.1	91.8	0.451	0.165	0.044	1.000	0.00410
5	63.2	93.1	0.268	0.140	0.027	0.867	0.00061
6	69.1	94.0	0.218	0.075	0.027	1.000	0.00110
7	73.5	94.8	0.137	0.071	0.036	0.478	0.00340
8	80.6	95.7	0.107	0.073	0.019	1.000	0.01200
9	81.9	95.7	0.113	0.065	0.022	1.000	0.00400
10	83.3	96.1	0.081	0.040	0.023	0.270	0.00120
11	86.7	96.3	0.083	0.039	0.020	1.000	0.00280
12	87.4	96.6	0.074	0.044	0.015	0.114	0.00140
13	88.7	96.6	0.071	0.035	0.028	1.000	0.00230
14	88.9	96.8	0.053	0.042	0.016	0.185	0.00049
15	90.8	96.9	0.062	0.029	0.022	1.000	0.00150
16	90.4	97.0	0.044	0.028	0.014	0.536	0.00190
17	92.4	97.1	0.063	0.025	0.019	1.000	0.00080
18	92.2	97.1	0.039	0.021	0.017	0.373	0.00004
19	93.8	97.3	0.054	0.021	0.022	1.000	0.00019
20	93.0	97.4	0.039	0.018	0.016	0.273	0.00000

Loop	% Flow	% Delay	% Gap	Ass.	Sim.	A/S Step	%V.I.
21	93.5	97.4	0.049	0.021	0.013	0.646	0.00059
22	94.0	97.6	0.031	0.019	0.006	0.247	0.00020
23	95.1	97.6	0.060	0.022	0.014	1.000	0.00040
24	93.1	97.5	0.038	0.023	0.015	0.135	0.00092
25	94.7	97.7	0.031	0.017	0.011	0.566	0.00002
26	95.3	97.7	0.030	0.014	0.016	0.489	0.00100
27	94.9	97.5	0.074	0.015	0.013	1.000	0.00011
28	93.1	97.4	0.036	0.025	0.016	0.231	0.00008
29	95.4	97.7	0.034	0.015	0.022	0.543	0.00032
30	96.2	98.0	0.027	0.017	0.008	0.170	0.00070
31	97.1	98.1	0.020	0.012	0.017	0.531	0.00021
32	96.9	98.1	0.030	0.013	0.008	0.538	0.00001
33	96.3	98.1	0.019	0.011	0.005	0.205	0.00005
34	97.3	98.3	0.027	0.016	0.011	0.626	0.00022
35	96.4	98.2	0.018	0.011	0.010	0.214	0.00000
36	97.4	98.3	0.025	0.014	0.010	0.506	0.00001
37	97.1	98.4	0.021	0.014	0.006	0.130	0.00065
38	97.7	98.5	0.018	0.011	0.006	0.246	0.00004
39	97.3	98.5	0.022	0.011	0.004	0.454	0.00010
40	97.2	98.4	0.017	0.010	0.003	0.200	0.00002
41	97.7	98.4	0.021	0.012	0.005	0.363	0.00002
42	98.1	98.6	0.016	0.008	0.007	0.182	0.00005
43	97.8	98.6	0.022	0.010	0.013	0.367	0.00002
44	97.4	98.5	0.015	0.015	0.006	0.146	0.00011

Loop	% Flow	% Delay	% Gap	Ass.	Sim.	A/S Step	%V.I.
45	97.8	98.5	0.025	0.010	0.008	0.491	0.00003
46	97.4	98.5	0.020	0.008	0.007	0.128	0.00052
47	97.9	98.6	0.014	0.012	0.012	0.326	0.00002
48	98.0	98.6	0.022	0.011	0.007	0.453	0.00007
49	97.8	98.6	0.015	0.013	0.007	0.125	0.00003
50	98.3	98.7	0.020	0.010	0.005	0.262	0.00007
51	97.6	98.5	0.017	0.010	0.012	0.108	0.00041
52	98.4	98.6	0.012	0.007	0.011	0.101	0.00002
53	98.5	98.8	0.022	0.011	0.011	0.346	0.00003
54	98.0	98.7	0.019	0.010	0.004	0.096	0.00045
55	98.5	98.8	0.012	0.007	0.003	0.134	0.00004
56	98.5	98.8	0.024	0.011	0.010	0.502	0.00007
57	97.6	98.5	0.020	0.008	0.014	0.190	0.00022
58	97.4	98.1	0.039	0.010	0.008	1.000	0.00011
59	95.9	98.0	0.022	0.010	0.008	0.177	0.00014
60	97.1	98.3	0.019	0.009	0.010	0.341	0.00021
61	97.8	98.6	0.013	0.007	0.010	0.310	0.00000
62	98.0	98.6	0.021	0.008	0.008	0.354	0.00008
63	97.9	98.7	0.012	0.010	0.004	0.084	0.00002
64	98.1	98.6	0.022	0.007	0.007	0.401	0.00003
65	97.7	98.7	0.018	0.007	0.007	0.127	0.00053
66	98.4	98.9	0.013	0.008	0.004	0.100	0.00002
67	98.2	98.8	0.016	0.009	0.009	0.116	0.00001
68	98.5	98.9	0.016	0.007	0.005	0.054	0.00033

Loop	% Flow	% Delay	% Gap	Ass.	Sim.	A/S Step	%V.I.
69	98.6	98.9	0.016	0.006	0.007	0.023	0.00053

D.2. TPU PCF Stage 3: IP

Loop	% Flow	% Delay	% Gap	Ass.	Sim.	A/S Step	%V.I.
1	0.0	50.6	1.816	0.147	0.045	1.000	0.00000
2	35.4	89.3	0.580	0.234	0.018	1.000	0.12100
3	54.3	94.6	0.415	0.145	0.014	0.771	0.00500
4	66.4	96.1	0.264	0.112	0.018	1.000	0.04000
5	74.3	96.6	0.207	0.103	0.009	0.756	0.00210
6	79.4	97.1	0.124	0.047	0.008	0.489	0.00340
7	83.9	97.5	0.105	0.056	0.015	1.000	0.01700
8	86.7	97.7	0.094	0.037	0.012	1.000	0.00430
9	88.2	98.0	0.073	0.031	0.006	0.243	0.00085
10	90.3	98.1	0.080	0.030	0.011	1.000	0.00073
11	91.5	98.2	0.053	0.023	0.006	0.190	0.00078
12	93.4	98.4	0.047	0.024	0.014	0.631	0.00240
13	94.2	98.5	0.080	0.023	0.008	1.000	0.00160
14	93.2	98.3	0.051	0.022	0.018	0.705	0.00190
15	94.4	98.5	0.043	0.023	0.013	0.420	0.00008
16	93.6	98.5	0.052	0.024	0.008	1.000	0.00250
17	94.4	98.6	0.051	0.021	0.010	0.166	0.00097
18	95.2	98.7	0.044	0.019	0.013	0.691	0.00110
19	95.8	98.8	0.036	0.019	0.017	0.267	0.00012
20	96.0	98.8	0.031	0.024	0.007	1.000	0.00020
21	94.2	98.7	0.023	0.015	0.013	0.109	0.00074
22	95.7	98.7	0.038	0.014	0.015	1.000	0.00120
23	94.6	98.7	0.029	0.019	0.015	0.119	0.00160

Loop	% Flow	% Delay	% Gap	Ass.	Sim.	A/S Step	%V.I.
24	96.1	98.8	0.023	0.011	0.007	0.679	0.00053
25	96.1	98.8	0.017	0.011	0.013	0.372	0.00110
26	96.5	98.9	0.023	0.011	0.007	0.681	0.00036
27	95.6	98.8	0.015	0.010	0.016	0.121	0.00037
28	97.0	98.9	0.032	0.010	0.010	1.000	0.00016
29	95.2	98.8	0.020	0.021	0.023	0.099	0.00120
30	96.6	98.8	0.025	0.010	0.012	1.000	0.00013
31	95.6	98.8	0.015	0.013	0.029	0.175	0.00098
32	96.8	99.0	0.032	0.014	0.017	0.442	0.00110
33	96.2	98.9	0.014	0.012	0.010	0.165	0.00013
34	97.5	99.1	0.013	0.009	0.016	0.315	0.00060
35	97.8	99.2	0.016	0.007	0.012	0.113	0.00076
36	97.6	99.1	0.012	0.010	0.008	0.551	0.00003
37	97.5	99.0	0.016	0.008	0.012	1.000	0.00002
38	97.2	99.0	0.015	0.008	0.016	0.586	0.00019
39	97.6	99.2	0.012	0.007	0.017	0.178	0.00007
40	97.9	99.1	0.037	0.009	0.007	1.000	0.00005
41	95.3	98.9	0.012	0.014	0.015	0.073	0.00018
42	97.4	98.9	0.014	0.005	0.006	0.487	0.00022
43	97.5	99.0	0.013	0.006	0.010	0.485	0.00010
44	98.0	99.1	0.013	0.006	0.010	0.457	0.00011
45	97.7	99.1	0.009	0.006	0.006	0.139	0.00007
46	98.1	99.1	0.017	0.006	0.003	1.000	0.00006
47	97.2	99.1	0.009	0.007	0.012	0.148	0.00037

Loop	% Flow	% Delay	% Gap	Ass.	Sim.	A/S Step	%V.I.
48	97.9	99.2	0.007	0.006	0.010	0.326	0.00022
49	98.4	99.2	0.013	0.004	0.004	1.000	0.00001
50	97.6	99.1	0.012	0.006	0.008	0.463	0.00007
51	98.0	99.2	0.009	0.006	0.009	0.189	0.00023
52	98.4	99.2	0.011	0.007	0.007	0.442	0.00009
53	98.1	99.3	0.007	0.006	0.007	0.100	0.00006
54	98.7	99.3	0.012	0.004	0.005	0.569	0.00004

D.3. TPU PCF Stage 3: PM peak

Loop	% Flow	% Delay	% Gap	Ass.	Sim.	A/S Step	%V.I.
1	0.0	49.5	4.204	0.443	0.045	1.000	0.00000
2	28.0	81.3	1.644	0.397	0.024	1.000	0.18700
3	41.2	88.3	0.931	0.264	0.023	0.898	0.01200
4	52.7	90.9	0.582	0.189	0.021	1.000	0.01000
5	61.6	92.1	0.316	0.116	0.037	0.670	0.01900
6	69.3	93.6	0.320	0.090	0.024	1.000	0.01400
7	73.5	93.9	0.223	0.089	0.019	0.667	0.00190
8	78.8	94.6	0.199	0.069	0.029	0.922	0.00240
9	81.8	95.2	0.126	0.073	0.022	0.589	0.00430
10	85.3	95.7	0.159	0.055	0.026	1.000	0.00160
11	85.8	95.8	0.089	0.048	0.010	0.582	0.00034
12	88.8	96.3	0.135	0.036	0.031	1.000	0.00240
13	87.6	96.2	0.081	0.044	0.012	0.639	0.00025
14	89.9	96.6	0.078	0.042	0.027	0.639	0.00570
15	91.0	96.7	0.089	0.035	0.014	0.901	0.00100
16	90.0	96.6	0.056	0.029	0.030	0.528	0.00230
17	93.1	97.0	0.090	0.024	0.025	1.000	0.00047
18	91.2	96.7	0.046	0.031	0.013	0.582	0.00025
19	94.3	97.1	0.059	0.022	0.019	0.822	0.00074
20	93.5	97.1	0.087	0.021	0.020	0.530	0.00022
21	91.8	96.6	0.100	0.037	0.037	0.883	0.00150

Loop	% Flow	% Delay	% Gap	Ass.	Sim.	A/S Step	%V.I.
22	91.5	96.8	0.068	0.030	0.040	0.628	0.00070
23	92.9	97.0	0.055	0.039	0.032	0.891	0.00083
24	93.9	97.1	0.044	0.022	0.031	0.857	0.00033
25	94.5	97.2	0.075	0.021	0.018	0.759	0.00005
26	93.6	97.2	0.047	0.026	0.015	0.568	0.00054
27	95.5	97.4	0.042	0.029	0.014	0.692	0.00001
28	95.0	97.4	0.058	0.023	0.012	1.000	0.00003
29	93.1	97.2	0.054	0.026	0.017	0.475	0.00021
30	94.5	97.2	0.083	0.030	0.045	1.000	0.00230
31	91.6	97.1	0.048	0.039	0.021	0.446	0.00043
32	94.3	97.3	0.059	0.037	0.024	1.000	0.00054
33	93.5	97.2	0.052	0.026	0.041	0.392	0.00089
34	94.6	97.4	0.040	0.020	0.045	0.602	0.00012
35	95.4	97.7	0.039	0.022	0.032	0.653	0.00022
36	95.6	97.7	0.036	0.018	0.050	0.778	0.00020
37	95.7	97.7	0.027	0.022	0.041	0.678	0.00040
38	96.0	97.8	0.027	0.020	0.033	0.506	0.00051
39	96.7	97.9	0.028	0.017	0.043	0.806	0.00019
40	95.6	97.8	0.023	0.022	0.039	0.506	0.00003
41	97.2	98.0	0.030	0.015	0.038	0.874	0.00008
42	96.1	98.0	0.038	0.019	0.025	0.519	0.00007
43	96.0	97.9	0.026	0.026	0.018	0.437	0.00039
44	96.7	98.1	0.030	0.014	0.013	0.749	0.00008
45	96.2	97.9	0.027	0.014	0.015	0.510	0.00003

Loop	% Flow	% Delay	% Gap	Ass.	Sim.	A/S Step	%V.I.
46	96.2	97.6	0.036	0.016	0.023	1.000	0.00044
47	94.5	97.6	0.028	0.016	0.015	0.320	0.00010
48	96.0	97.8	0.027	0.014	0.027	0.578	0.00016
49	96.6	98.1	0.021	0.014	0.015	0.552	0.00028
50	96.9	98.0	0.038	0.019	0.026	1.000	0.00021
51	94.6	97.7	0.026	0.026	0.016	0.256	0.00087
52	96.2	97.9	0.037	0.014	0.028	0.454	0.00005
53	95.6	97.9	0.027	0.022	0.020	0.063	0.00150
54	96.7	98.1	0.031	0.020	0.016	0.647	0.00004
55	95.7	98.1	0.025	0.015	0.028	0.239	0.00016
56	96.9	97.9	0.022	0.011	0.020	0.405	0.00008
57	97.3	98.4	0.019	0.011	0.024	0.403	0.00015
58	97.4	98.4	0.017	0.011	0.013	0.487	0.00008
59	97.7	98.3	0.026	0.011	0.039	0.635	0.00015
60	96.8	98.0	0.044	0.013	0.042	0.765	0.00026
61	96.0	98.0	0.032	0.028	0.034	0.332	0.00008
62	96.5	97.9	0.023	0.014	0.028	0.605	0.00004
63	96.7	98.1	0.017	0.010	0.025	0.352	0.00025
64	97.7	98.4	0.020	0.011	0.030	0.546	0.00008
65	97.3	98.2	0.018	0.010	0.026	0.464	0.00022
66	97.8	98.3	0.016	0.008	0.028	0.433	0.00019
67	97.6	98.4	0.034	0.008	0.017	0.270	0.00003
68	96.5	98.2	0.014	0.022	0.023	0.061	0.00012
69	98.2	98.6	0.016	0.007	0.025	0.341	0.00005

Loop	% Flow	% Delay	% Gap	Ass.	Sim.	A/S Step	%V.I.
70	97.7	98.5	0.016	0.009	0.009	0.194	0.00005
71	98.2	98.6	0.025	0.008	0.046	0.651	0.00007
72	96.5	98.2	0.023	0.012	0.040	0.148	0.00001
73	97.4	98.4	0.017	0.016	0.028	0.205	0.00007
74	97.9	98.4	0.019	0.010	0.026	0.311	0.00001
75	97.5	98.4	0.014	0.008	0.026	0.165	0.00004
76	98.2	98.6	0.019	0.008	0.031	0.427	0.00006
77	97.7	98.6	0.019	0.010	0.038	0.156	0.00017
78	97.8	98.5	0.015	0.015	0.028	0.180	0.00005
79	98.2	98.6	0.012	0.012	0.024	0.237	0.00005
80	98.3	98.7	0.013	0.007	0.031	0.301	0.00009
81	98.3	98.7	0.014	0.008	0.024	0.119	0.00003
82	98.3	98.5	0.012	0.007	0.040	0.183	0.00002

Appendix E. VDM convergence

Iteration	Gap	Full Model %GAP	Subset Area %GAP	Cost Stability				Flow Stability				Totals	
Main	Abs			RAAD	AAD	RMS	%<5%	RAAD	AAD	RMS	%<5%	Trips	Cost (000s)
1	25929548	1.50%	1.64%	0	0	0	0%	0	0	0	0%	70,266,573	1,733,240.7
2	5350757.5	0.31%	0.38%	0.004	0.144	0.225	99.83%	0.030	0.009	1.527	76.11%	70,266,573	1,724,142.3
3	1514443.7	0.09%	0.17%	0.001	0.042	0.121	99.88%	0.005	0.002	0.305	99.76%	70,266,573	1,722,876.3

Appendix F. Sectored demand matrices

F.1. TPU PCF Stage 3: VDM

For full details please see the attached folder ‘Appendix F’ (filename: ‘TPU_VDM_Demand_Summary_Base_v3.5_CC.xlsm’).

F.2. TPU PCF Stage 3: HAM

For full details please see the attached folder ‘Appendix F’ (filename: ‘TPU_HAM_Demand_Summary_Base_v3.5_CC.xlsm’).

[redacted]

Routes to Market – Delivery Integration Partnership

A57 TPU

A57 Transport Modelling Package

HE551473-BBA-GEN-A57_AL_SCHEME-AS-TR-000002
12/11/21
S4

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This document has 79 pages including the cover.

Document history

Revision	Suitability	Purpose description	Originated	Checked	Reviewed	Authorised	Date
[redacted]							

DRIVING OUTCOMES

Contents

Tables

Figures

1. Introduction

1.1. Purpose of the Transport Model Package

1.1.1. The purpose of the Transport Model Package is to provide details of the 2015 base year transport model developed for PCF Stage 3 of the Trans-Pennine Upgrade (TPU) A57 link road scheme.

1.2. Background

1.2.1. The base model at PCF Stage 2 of the TPU scheme was developed from the 2015 Trans-Pennine South Regional Transport Model (TPS RTM). Details of the validated base model developed at PCF Stage 2 are provided in the corresponding Local Model Validation Report (LMVR)[1].

1.2.2. The validated base model developed during PCF Stage 2 has been used as a starting point for the development of the PCF Stage 3 TPU strategic model. Comprehensive details regarding the TPU model specification are outlined in the PCF Stage 2 LMVR, and therefore have not been repeated in the PCF Stage 3 Transport Model Package.

1.2.3. An initial PCF Stage 3 Transport Model Package was produced by Arcadis in November 2018[2]. However, following refinements to the PCF Stage 3 TPU model by Atkins, this has been superseded by this document.

1.2.4. An extensive data collection exercise was not deemed necessary as part of the transport modelling at PCF Stage 3. However, a series of ad-hoc traffic surveys was commissioned to assist with model development. Full details of the data used to inform the development of the 2015 base year TPU model are documented in the PCF Stage 3 Supplementary Data Collection Package[3].

1.3. Need for modelling refinement

1.3.1. Initial air quality (AQ) modelling undertaken by Arcadis in July 2018 indicated that an unmitigated TPU scheme could have significant AQ effects and jeopardise the application for development consent. Changes in traffic flow and speed as a result of the scheme were predicted to cause exceedances of the AQ strategy objectives for annual mean nitrogen dioxide (NO2). The primary locations where a negative AQ impact was reported were the village of Tintwistle (A628) and the specific locations on the A57 route through Dinting Vale and Glossop High Street, as shown in Figure 1-1.

1.3.2. Atkins was commissioned by HE to undertake a review of the work done by consultants Arcadis at PCF Stage 3 for the proposed TPU scheme. The aim of this process was to strengthen the robustness of the modelling, under high levels of scrutiny for the Development Consent Order (DCO). Following the presentation of the review findings in the summer of 2019, Atkins was commissioned to implement its recommendations and finalise PCF Stage 3.

1.3.3. As such, details of how the base model has been developed during the finalisation of PCF Stage 3 are provided in section 2, resulting model metrics are shown in section 3 and a summary is presented in section 4.

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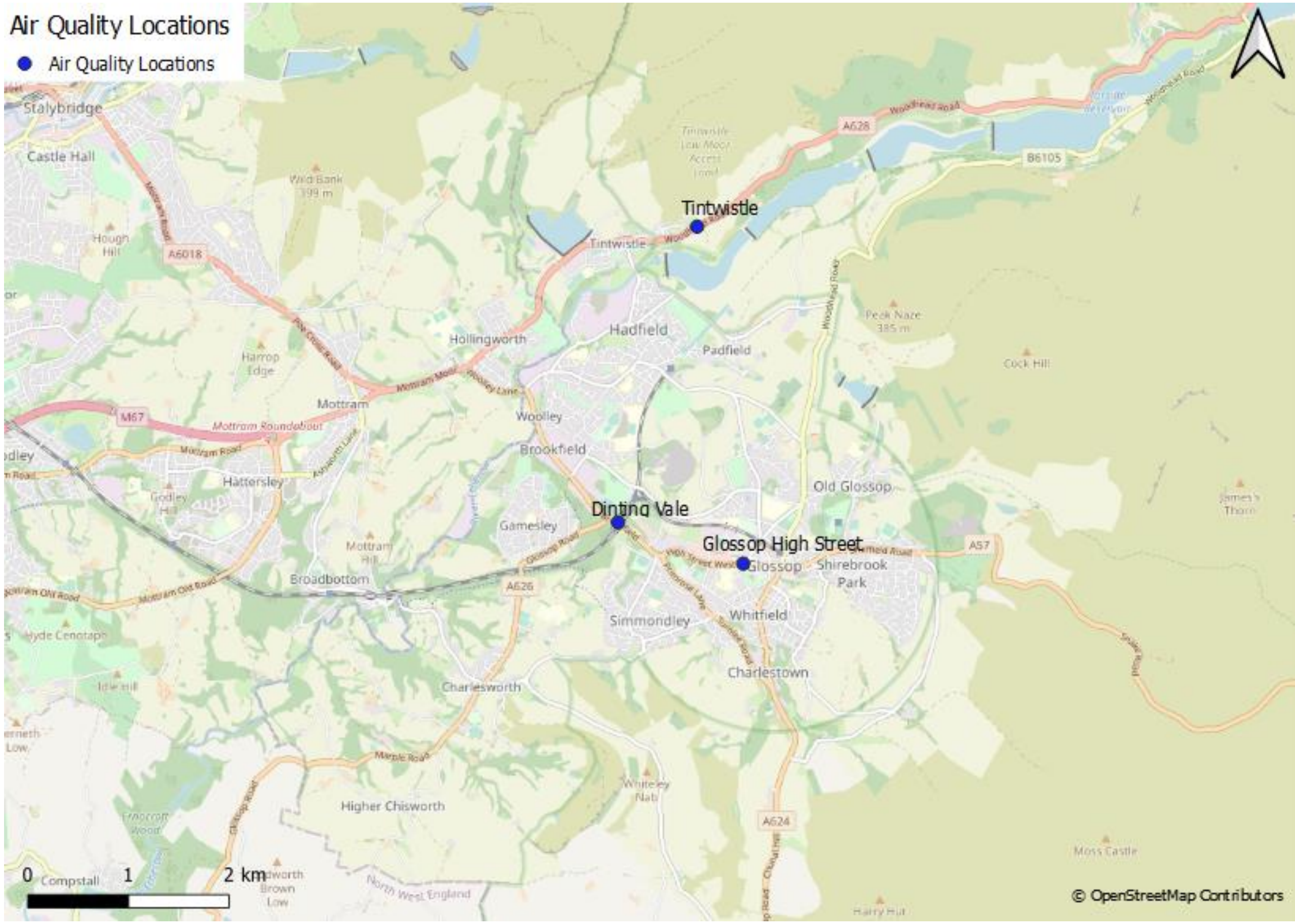
[1] Stage 2 TPU LMVR (August 2017): HE551473-ARC-GEN-ZZZ-RP-TR-2017
[2] Stage 3 TPU Transport Model Package (Arcadis, 2018) (superseded): HE551473-ARC-TTM-TPU-RP-TR-3177
[3] Stage 3 TPU Supplementary Data Collection Package (November 2020): HE551473-BBA-GEN-A57_AL_SCHEME-AS-TR-000001

Figure 1-1 - Air quality issue locations



2. Model development

2.1.1. This section provides details of the base model developments undertaken by Atkins during the finalisation of PCF Stage 3. The changes made to the base year model focus on the known AQ issues in Tintwistle and on Dinting Vale and Glossop High Street (as noted in section 1.3).

2.2. Model Specification

2.2.1. No changes to the model specification have been made since PCF Stage 2. Full details of the model specification are provided in the PCF Stage 2 LMVR (see section 1.2.1).

2.2.2. The TPU model is developed from the TPS RTM, which includes a SATURN (v11.3.12) Highway Assignment Model (HAM) combined with a DIADEM Variable Demand Model (VDM) (DIADEM v6.3.4). Software versions were retained for consistency with the TPS RTM donor model and previous PCF stages.

2.2.3. The TPU base model year is 2015, with average hour peak time periods (AM: 07:00-10:00, IP: 10:00-16:00 and PM: 16:00-19:00).

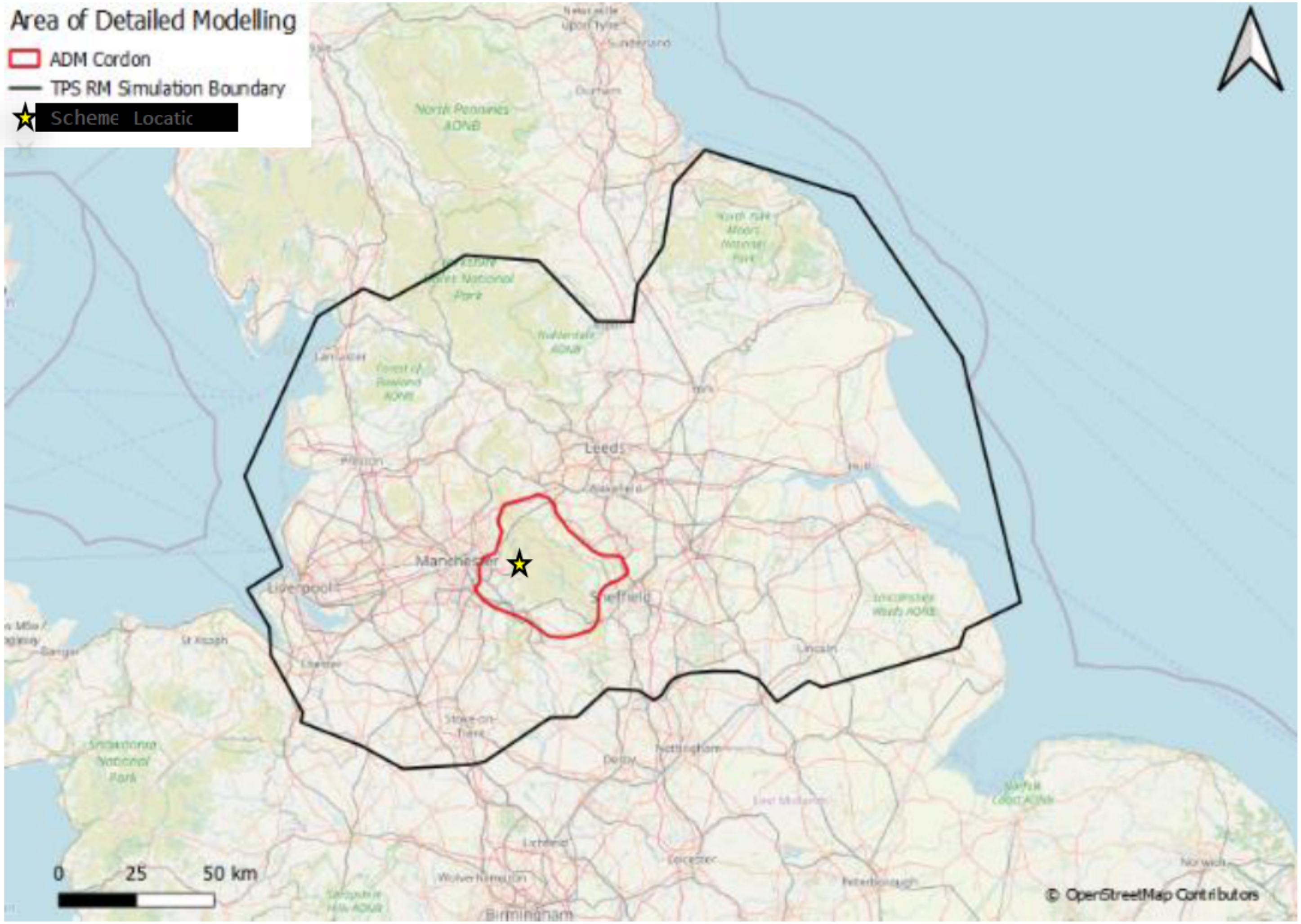
2.2.4. As shown in Table 2-1, demand for the TPU model is segmented into 10 categories. These are aggregated into five user classifications for the Highway Assignment Model (HAM).

Table 2-1 - TPU base model - user classes

HAM User Class	Demand Segment	Trip Purpose
UC1: Car Business	Home Based Employers' business	HB Employers' business
	Non-Home-Based Employers' business	NHB Employers' business
	Fixed – Employers' business	Employers' business
UC2: Car Commute	Home Based Commute	HB Commute
	Fixed – Commute	Commute
UC3: Car Other	Home Based Other	HB Shopping
		HB Personal business
		HB Recreation/Social
		HB Visiting Friends and Relatives
		HB Holiday/Day Trip
		HB Education
	Non-Home Based Other	NHB Work
		NHB Education
		NHB Shopping
		NHB Personal business
		NHB Recreation/Social
		NHB Holiday/Day Trip
	Fixed – Other	Others
UC4: LGV	Light Goods Vehicles	Light Goods Vehicles
UC5: HGV	Heavy Goods Vehicles	Heavy Goods Vehicles

2.2.5. The simulation boundary of the TPS RTM has been retained, but the focus of the TPU model is concentrated on the Area of Detailed Modelling (ADM) highlighted in Figure 2-1.

Figure 2-1 – Area of Detailed Modelling (ADM) – TPU PCF Stage 3



2.3. Prior matrices

2.3.1. The prior matrices developed during PCF Stage 2 have been retained as a starting point for PCF Stage 3. Full details of the prior matrices are provided in the PCF Stage 2 LMVR.

2.3.2. However, the granularity and network connectivity of certain zones in and around Glossop has been improved to give a more accurate reflection of vehicle loading in the local area.

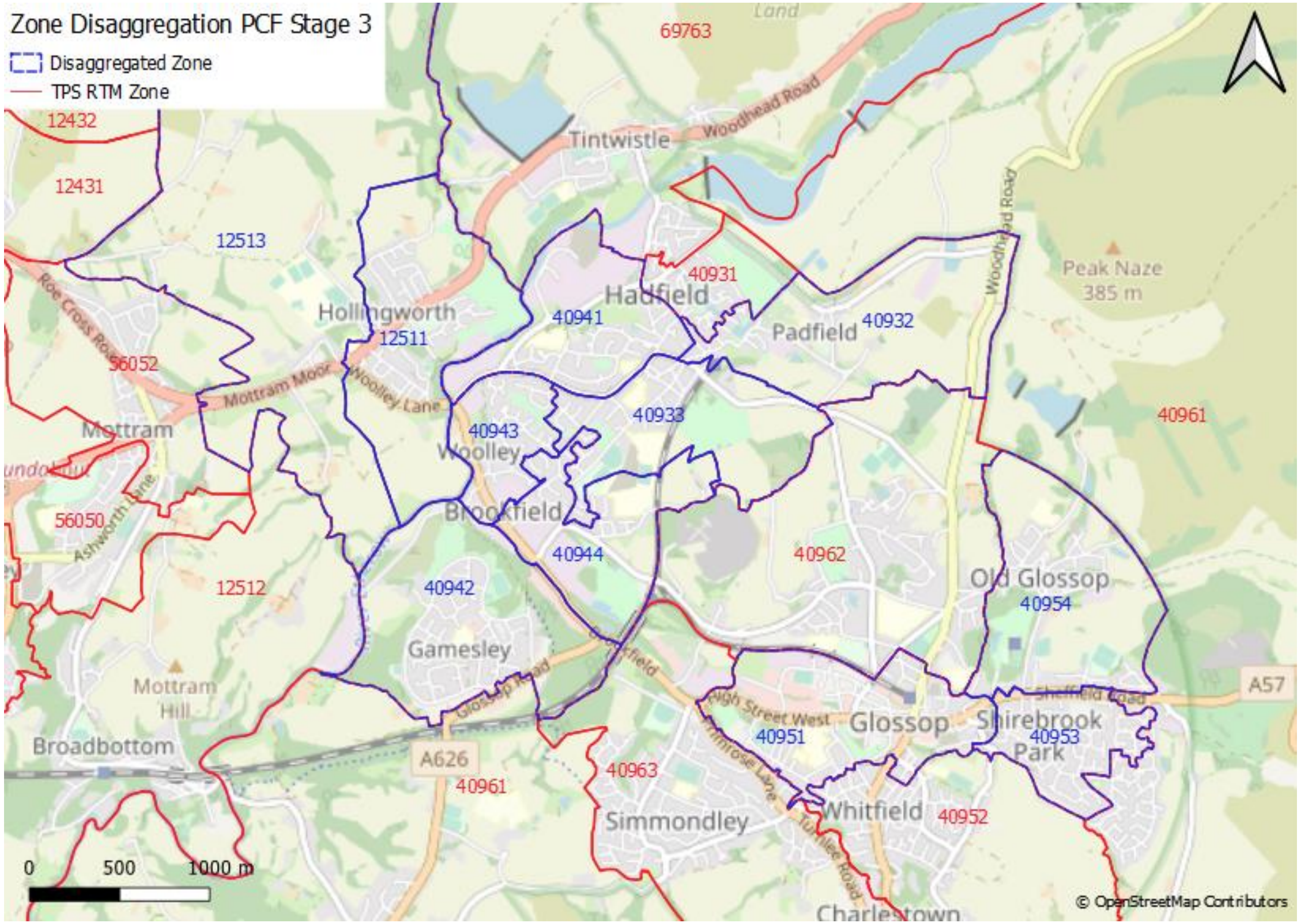
2.3.3. The zoning system for TPS RTM is derived through an aggregation of Office for National Statistics (ONS) Output Areas (OAs). Several zones in Stage 3 have been disaggregated into smaller sets of OAs to form new zones using the ONS 2011 Census population data (KS101EW: usual resident population) obtained at OA level. Origin and destination trip end totals of existing zones (Stage 2) have been applied a factor based on the proportional population split of the disaggregated zones (Stage 3). Therefore the disaggregated zones (Stage 3) fit seamlessly within the existing zones (Stage 2) as all follow OA boundaries.

2.3.4. Table 2-2 provides details of the zones disaggregated in the local area, whilst Figure 2-2 provides a visual representation.

Table 2-2 - Zone disaggregation - PCF Stage 3

Existing Zone – Stage 2	Disaggregated Zone – Stage 3	Location	Description
40951	40951, 40953, 40954	Glossop	Glossop has been split into three zones: old Glossop, east Glossop and central Glossop.
40941	40941, 40943	Hadfield	Hadfield has been split into two zones: north Hadfield and south Hadfield.
40942	40942, 40944	Gamesley	This zone has been split into two zones: one represents Gamesley village, whilst the other represents Brookfield and the area surrounding the Carpenter industrial site.
40932	40932, 40933	Padfield	This zone has been split into two zones: one represents Padfield north of Park Road, whilst the other represents the area adjacent to Newshaw Lane.
12511	12511, 12513	Hollingworth	Hollingworth has been split into two zones: Hollingworth village and Hollingworth rural

Figure 2-2 - Zone disaggregation - PCF Stage 3



2.4. Highway network

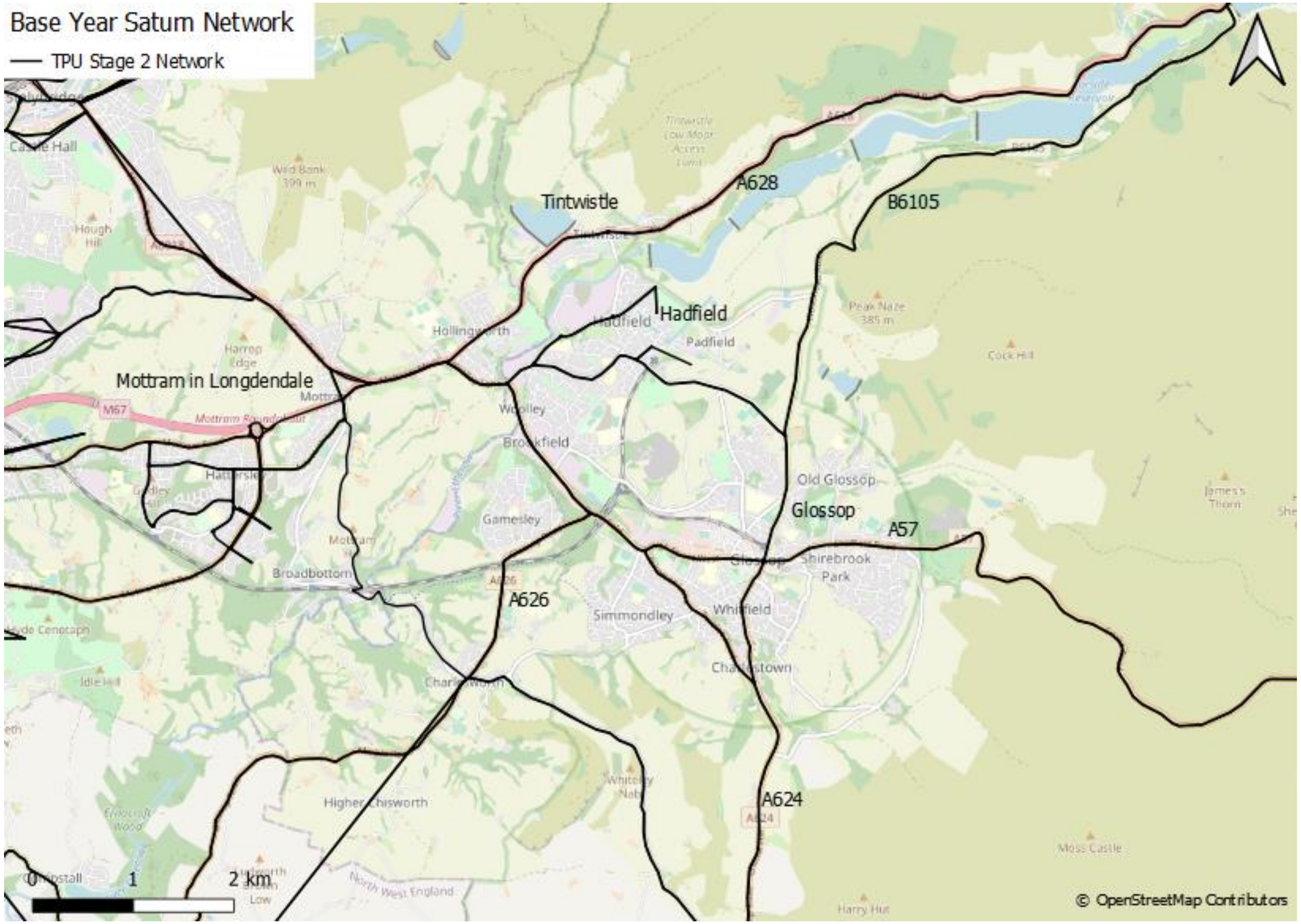
2.4.1. Improvements to the highway network coding around Mottram and Glossop have been made during PCF Stage 3.

2.4.2. Figure 2-3 highlights the section of the TPU Stage 2 model that has been the focus of the highway network enhancements.

2.4.3. Details of the changes to the highway network implemented during PCF Stage 3 are summarised below. This includes increasing the level of detail, ensuring coding consistency and adherence to best practice guidance.

2.4.4. Full details of the network audit process undertaken prior to PCF Stage 3 are provided in the PCF Stage 2 LMVR.

Figure 2-3 - Base year SATURN network in the Mottram and Glossop area – PCF Stage 2



Network checks

2.4.5. At PCF Stage 3, a thorough network checking exercise was undertaken in the Mottram and Glossop area (Figure 2-3). The network audit procedure involved conducting checks at the junction level for all nodes included in the Mottram and Glossop area. The RTM manual was used to check the following network properties:

- Junction type;
- Number of approach arms;
- Number of lanes;
- Link length;
- Free-flow speeds and speed-flow curves;
- Lane allocation;
- Turn saturation flows;
- Stacking capacity;
- Circulating capacity at roundabouts;
- GAP values;
- Priority markers; and
- Flare markers.

2.4.6. The audit procedure informed a range of enhancements to the PCF Stage 3 TPU transport model, including the following:

- Modification of saturation flows at junctions that were not consistent with RTM coding. Turning capacities at various junctions were modified to accurately reflect the infrastructure on the ground.
- Accurate representation of flare capacities to avoid a misrepresentation of junction capacity.
- Modification of free-flow speeds where they were shown to be in excess of the posted speed limit.
- There were numerous pedestrian crossings and signalised junctions on the A57 between Glossop Road and Glossop Crossroads that were not taken account of in the model, which contributed to the underrepresentation of congestion in the base year model. A review was undertaken to identify those which were most likely to impact congestion, and code them into the model.

Network detail

2.4.7. The highway network detail representative of Glossop has been increased during PCF Stage 3. The coded network inherited by Atkins consisted of key routes through the Mottram and Glossop area (A57, A624, A626, A628 and B6105), yet there was scope to better replicate alternative routes through the local area. Consideration was given to avoid the inclusion of disproportionate detail, whilst additional data was collected to inform the additional network coding.

2.4.8. To provide a more accurate reflection of base year network performance in the local area, the following network detail has been included in the PCF Stage 3 TPU model. The locations of these changes are highlighted in Figure 2-4.

- Ellison Street between the B6105 and the High Street East (A57).
  - Vehicles on the B6105 (SB) travelling towards Sheffield Road (A57) (and vice versa) can bypass the signalised junction at Glossop Crossroads by travelling via Ellison Street. Ellison Street effectively acts as a rat-run to avoid peak period congestion at the Glossop Crossroads signals.
- Shaw Lane / Newshaw Lane / Green Lane

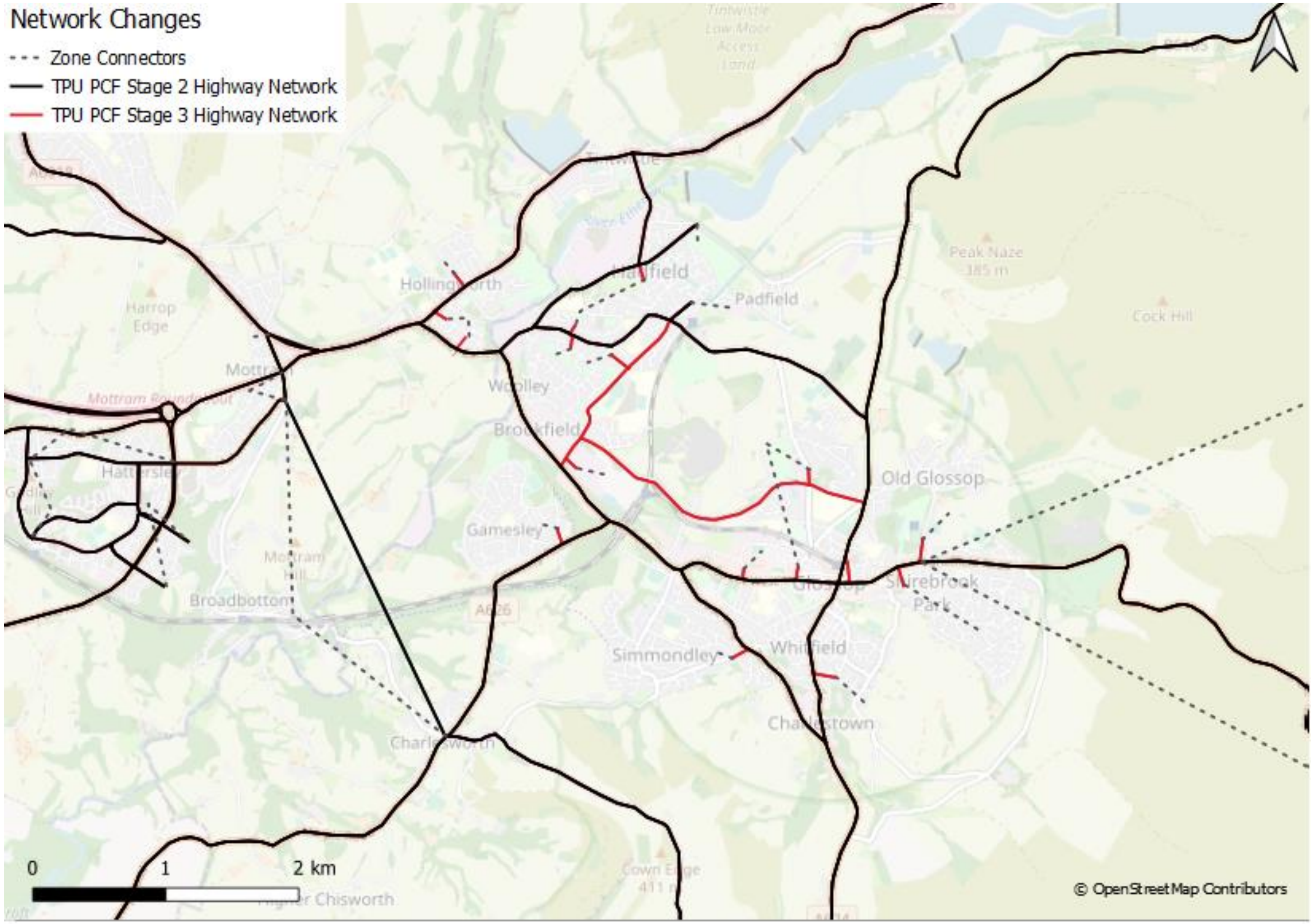
  - Offers vehicles access between the A57 and Hadfield Road, in addition to Dinting Road. This link road is important to ensure the level of demand replicated on the A57 is comparable to observed data.
- Dinting Road
  - In conjunction with Shaw Lane, Dinting Road is an alternative route to the A57. It is important to capture possible alternative routes when assessing the impact of the TPU scheme.

2.4.9. In addition to the enhanced network detail, several structural changes have been made to support the zone disaggregation specified in Table 2-2. To ensure the model better reflects observed data in the local area, zones that connected directly to the highway network by straddling links, were converted to stub connectors. Details are outlined in Table 2-3.

Table 2-3 – Zone connectors – PCF Stage 3

Zone	Location	Description
40951	Glossop	Stub connector located on High Street West (A57) near the Glossop Brook Road junction.
40962	Glossop	Two stub connectors: one located on High Street West (A57) near the Arundel Street junction, the other on Dinting Road near the North Street junction.
40963	Glossop	Stub connector located on Primrose Lane near the Simmondley New Road junction.
40952	Glossop	Stub connector located on Victoria Street (A624) near the Whitfield Avenue junction.
40953	Glossop	Stub connector located on High Street East (A57) near the Shirebrook Drive junction.
40954	Glossop	Stub connector located on High Street East (A57) near the Manor Park Road junction.
40942	Gamesley	Stub connector located on the A626 (Glossop Road) at the entrance of Gamesley village.
40944	Brookfield	Stub connector located on Shaw Lane at the entrance of the Carpenter industrial site.
40933	Hadfield	Stub connector located on Newshaw Lane near the Lower Barn Road junction.
40941	Hadfield	Two stub connectors: one located on Hadfield Road near the Carriage Drive junction, the other on Woolley Bridge Road near the Waterside junction.
40943	Hadfield	Stub connector located on Hadfield Road near the Higher Barn Road junction.
12511	Hollingworth	Two stub connectors: one located on Woolley Lane (A57) near the Earnshaw Street junction, the other on Market Street (A628) at the Taylor Street junction.
12513	Hollingworth	Stub connector located on Market Street near the Green Lane junction.

Figure 2-4 - Base year highway network detail – PCF Stage 3



2.5. Data

2.5.1. Additional classified turning counts (CTC) were undertaken in September 2019 to help improve model validation and support the inclusion of the network enhancements presented in Figure 2-4. The locations of the additional counts are shown in Figure 2-5. Further details are provided in the aforementioned ‘Supplementary Data Collection Package’ (PCF Stage 3) issued in November 2020.

2.5.2. The enhancements of the model focused on replicating observed journey times on the key sections of the A57 and A628 in the localised study area. As such, an additional journey time validation route has been included, which is described as the ‘Hadfield Alternative’. Figure 2-6 presents the journey time routes used to validate the TPU Stage 3 base model.

Figure 2-5 - Survey Locations in Glossop (2019)

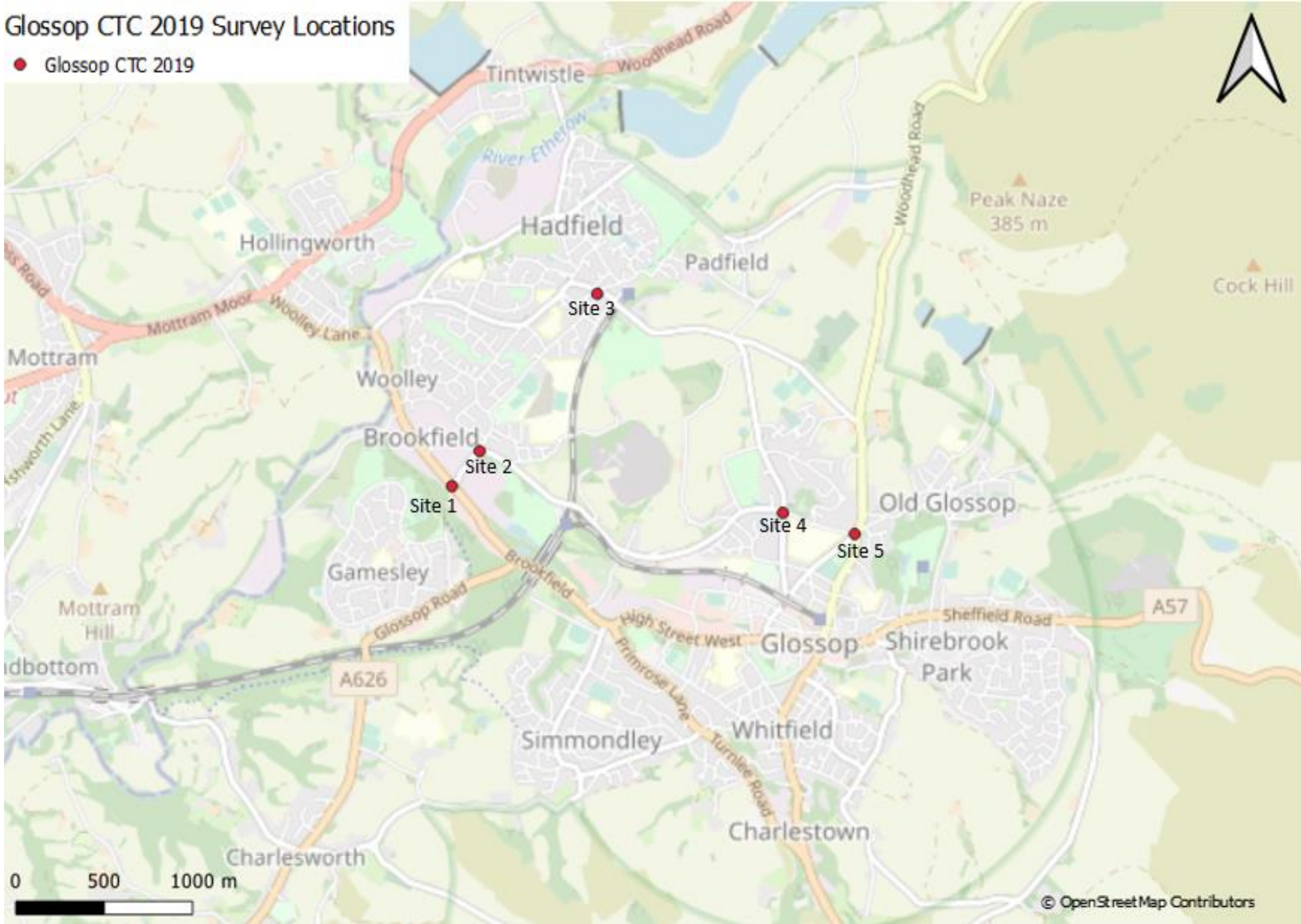
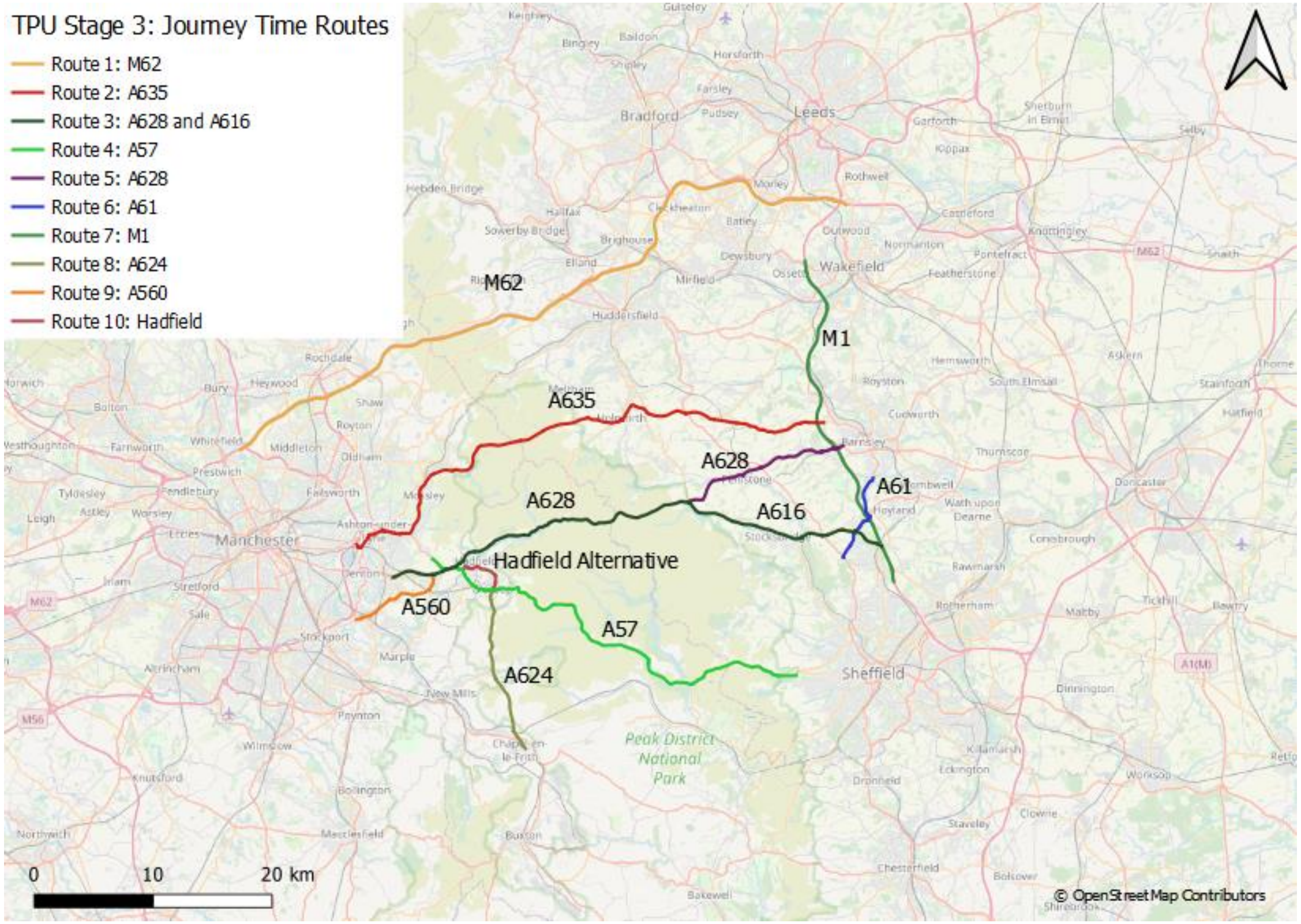


Figure 2-6 - Journey Time Validation Routes - PCF Stage 3



2.6. Value of Time (VoT) and Vehicle Operating Costs (VOC)

2.6.1. The base year Vehicle Operating Costs (VOC) and Value of Time (VoT) were updated using the then latest available TAG Databook v1.12, May 2019.

3. Model results

3.1.1. This section provides details of the base model results that were submitted for approval. A summary of the following is provided in the main body, whilst full details are provided in the appendices:

- Trip Ends
- Highway matrices – impact of Matrix Estimation (ME)
- Screenline flow calibration
- Link flow calibration
- Journey time validation
- Convergence
- Demand model parameters
- Demand model matrices
- Realism tests (highway and Public Transport (PT))

3.1.2. No changes to the modelling methodology have been made since PCF Stage 2. Full details of the methodology are provided in the PCF Stage 2 LMVR (see section 1.2.1).

3.2. Trip ends

3.2.1. The prior matrices used in PCF Stage 3 were mainly retained from PCF Stage 2 (which were derived from the TPS RTM prior matrices), with some additional zone disaggregation. Details of the prior matrices and disaggregation are provided in section 2.3.

3.3. Highway matrices – Matrix Estimation

3.3.1. This section provides a summary of the changes induced by Matrix Estimation (ME) between the prior demand matrices and the post-ME demand matrices. Table 3-1 provides an overview of the standards used to assess the change in demand induced by ME, as specified in unit M3.1 of the TAG guidance.

Table 3-1 – Significance of matrix estimation changes criteria (TAG unit M3.1)

Measure	Criteria
Matrix zonal cell values	Slope within 0.98 and 1.02 Intercept near zero R^2 in excess of 0.95
Matrix zonal trip ends	Slope within 0.99 and 1.01 Intercept near zero R^2 in excess of 0.98
Trip length distributions	Means within 5% Standard deviations within 5%
Sector to sector level matrices	Differences within 5%

Matrix totals

3.3.2. Table 3-2 to Table 3-4 compare matrix totals by user class between the prior and post-ME matrices. ME has induced a change in matrix totals of 0.7% in the AM peak, 1.0% in the IP and 0.6% in the PM peak.

3.3.3. ME was undertaken individually for each vehicle type (i.e. car, LGV and HGV), as specified in the PCF Stage 2 LMVR (see section 1.2.1). The percentage change between the prior and post-ME matrices for Car Business and HGV user classes is between 2.5% to 3.9% for all time periods. For all other user classes, the change is less than 1.0% across all time periods.

Table 3-2 – Comparison of matrix totals: prior vs. post-ME – TPU PCF Stage 3 (AM peak)

User Class	Prior	Post-ME	Difference	Difference (%)
UC1: Car Business	311,344	323,497	12,153	3.9%
UC2: Car Commute	2,368,169	2,379,531	11,362	0.5%
UC3: Car Other	2,134,824	2,138,375	3,551	0.2%
UC4: LGV	602,498	607,454	4,956	0.8%
UC5: HGV	315,974	326,182	10,208	3.2%
Total	5,732,809	5,775,038	42,229	0.7%

Table 3-3 – Comparison of matrix totals: prior vs. post-ME – TPU PCF Stage 3 (IP)

User Class	Prior	Post-ME	Difference	Difference (%)
UC1: Car Business	335,075	345,966	10,891	3.3%
UC2: Car Commute	904,759	912,475	7,717	0.9%
UC3: Car Other	2,705,499	2,723,031	17,532	0.6%
UC4: LGV	553,396	557,004	3,609	0.7%
UC5: HGV	328,663	337,965	9,302	2.8%
Total	4,827,391	4,876,442	49,052	1.0%

Table 3-4 – Comparison of matrix totals: prior vs. post-ME – TPU PCF Stage 3 (PM peak)

User Class	Prior	Post-ME	Difference	Difference (%)
UC1: Car Business	335,290	343,553	8,263	2.5%
UC2: Car Commute	2,229,458	2,238,061	8,603	0.4%
UC3: Car Other	3,044,206	3,052,442	8,236	0.3%
UC4: LGV	585,689	590,202	4,513	0.8%
UC5: HGV	231,703	237,607	5,904	2.5%
Total	6,426,347	6,461,866	35,519	0.6%

Regression analysis

3.3.4. Regression analysis of the prior and post-ME matrices is undertaken for individual cells (i.e. ij pairs) and trip ends (i.e. origin and destination zone totals). Table 3-5 compares the TPU PCF Stage 3 prior and post-ME matrices for all trips across the model, whilst Table 3-6 only includes ij pairs with less than 500 trips.

3.3.5. All values adhere to TAG guidance except the intercept values for trip ends. Defining ‘near zero’ as up to 5.0 trips, the intercept values satisfy the TAG criteria except for the destination trip ends in the AM and PM peak periods. Therefore, a comparison of the prior and post-ME matrices from the TPS RTM have also been provided (Table 3-7 and Table 3-8).

3.3.6. The regression analysis presented for TPU PCF Stage 3 is comparable to the TPS RTM. The intercepts of the destination trip ends in the TPS RTM are also not near to zero. However, the values presented for TPU PCF Stage 3 are a slightly better fit compared to the TPS RTM. This suggests that the ME process adopted for TPU has induced a level of change comparable to the TPS RTM donor model.

Table 3-5 - Comparison of matrix cell values and trip ends (all trips) – TPU PCF Stage 3

	Measures	TAG Criteria (M3.1)	AM	IP	PM
Zonal cell values – ij pairs	Slope	Between 0.98 to 1.02	1.00	1.00	1.00
	Intercept	Near to Zero	0.00	0.00	0.00
	R^2	>0.95	1.00	1.00	1.00
Trip ends - origin	Slope	Between 0.99 to 1.01	1.00	1.00	1.00
	Intercept	Near to Zero	4.09	4.77	3.44
	R^2	>0.98	1.00	1.00	1.00
Trip ends - destination	Slope	Between 0.99 to 1.01	1.00	1.00	1.00
	Intercept	Near to Zero	20.22	3.67	6.74
	R^2	>0.98	1.00	1.00	1.00

Table 3-6 - Comparison of matrix cell values and trip ends (less than 500 trips) – TPU PCF Stage 3

	Measures	TAG Criteria (M3.1)	AM	IP	PM
Zonal cell values – ij pairs	Slope	Between 0.98 to 1.02	1.00	1.00	1.00
	Intercept	Near to Zero	0.00	0.00	0.00
	R^2	>0.95	0.99	1.00	1.00
Trip ends - origin	Slope	Between 0.99 to 1.01	1.01	1.02	1.00
	Intercept	Near to Zero	2.55	2.26	3.89
	R^2	>0.98	0.99	1.00	0.99
Trip ends - destination	Slope	Between 0.99 to 1.01	1.00	1.02	1.01
	Intercept	Near to Zero	9.24	4.41	9.15
	R^2	>0.98	0.99	1.00	1.00

Table 3-7 - Comparison of matrix cell values and trip ends (all trips) – TPS RTM

	Measures	TAG Criteria (M3.1)	AM	IP	PM
Zonal cell values – ij pairs	Slope	Between 0.98 to 1.02	1.00	1.00	1.00
	Intercept	Near to Zero	0.00	0.00	0.00
	R^2	>0.95	1.00	1.00	1.00
Trip ends - origin	Slope	Between 0.99 to 1.01	1.00	1.00	1.00
	Intercept	Near to Zero	3.94	4.52	3.25
	R^2	>0.98	1.00	1.00	1.00
Trip ends - destination	Slope	Between 0.99 to 1.01	1.00	1.00	1.00
	Intercept	Near to Zero	19.44	22.38	15.84
	R^2	>0.98	1.00	1.00	1.00

Table 3-8 - Comparison of matrix cell values and trip ends (less than 500 trips) – TPS RTM

	Measures	TAG Criteria (M3.1)	AM	IP	PM

Zonal cell values – ij pairs	Slope	Between 0.98 to 1.02	1.00	1.00	1.00
	Intercept	Near to Zero	0.00	0.00	0.00
	R^2	>0.95	1.00	1.00	1.00
Trip ends - origin	Slope	Between 0.99 to 1.01	1.01	1.02	1.00
	Intercept	Near to Zero	2.26	2.00	3.42
	R^2	>0.98	0.99	1.00	1.00
Trip ends - destination	Slope	Between 0.99 to 1.01	1.01	1.02	1.01
	Intercept	Near to Zero	15.85	12.65	8.53
	R^2	>0.98	0.99	1.00	1.00

Sectored matrices

3.3.7. In considering the changes induced by ME at a sector to sector level it is important to avoid highlighting large percentage differences which represent only a small number of trips. As such, sector to sector movements with less than 100 trips in the prior matrix have been excluded from the analysis. In line with the TPS RTM donor model, the GEH statistic has also been assessed, along with the proportion of movements with less than ±10% change. The GEH statistic assessment does not exclude movements with less than 100 trips, as the purpose of the statistic is to provide a method to compare traffic flow changes regardless of flow volume scale.

3.3.8. The TPU PCF Stage 3 prior and post-ME matrices have been aggregated into 17 sectors for comparison. The 17-sector system is presented in Figure 3-1.

3.3.9. Table 3-9 provides a summary of the changes induced by ME in the TPU PCF Stage 3 model at a sector level, whilst sectored tabulations of percentage change and GEH are presented in A.1 to A.6. The sectoral analysis for TPU Stage 3 shows that most of the sectors are within a GEH range of 5 (~80%) across all time periods.

3.3.10. The equivalent analysis for the TPS RTM has also been undertaken to identify whether a similar scale of change was recorded (Table 3-10) (sectored tabulations of percentage change and GEH are presented in A.7 to A.12).

3.3.11. The sectored analysis presented suggests that the ME process adopted for TPU has induced a level of change comparable to the TPS RTM donor model.

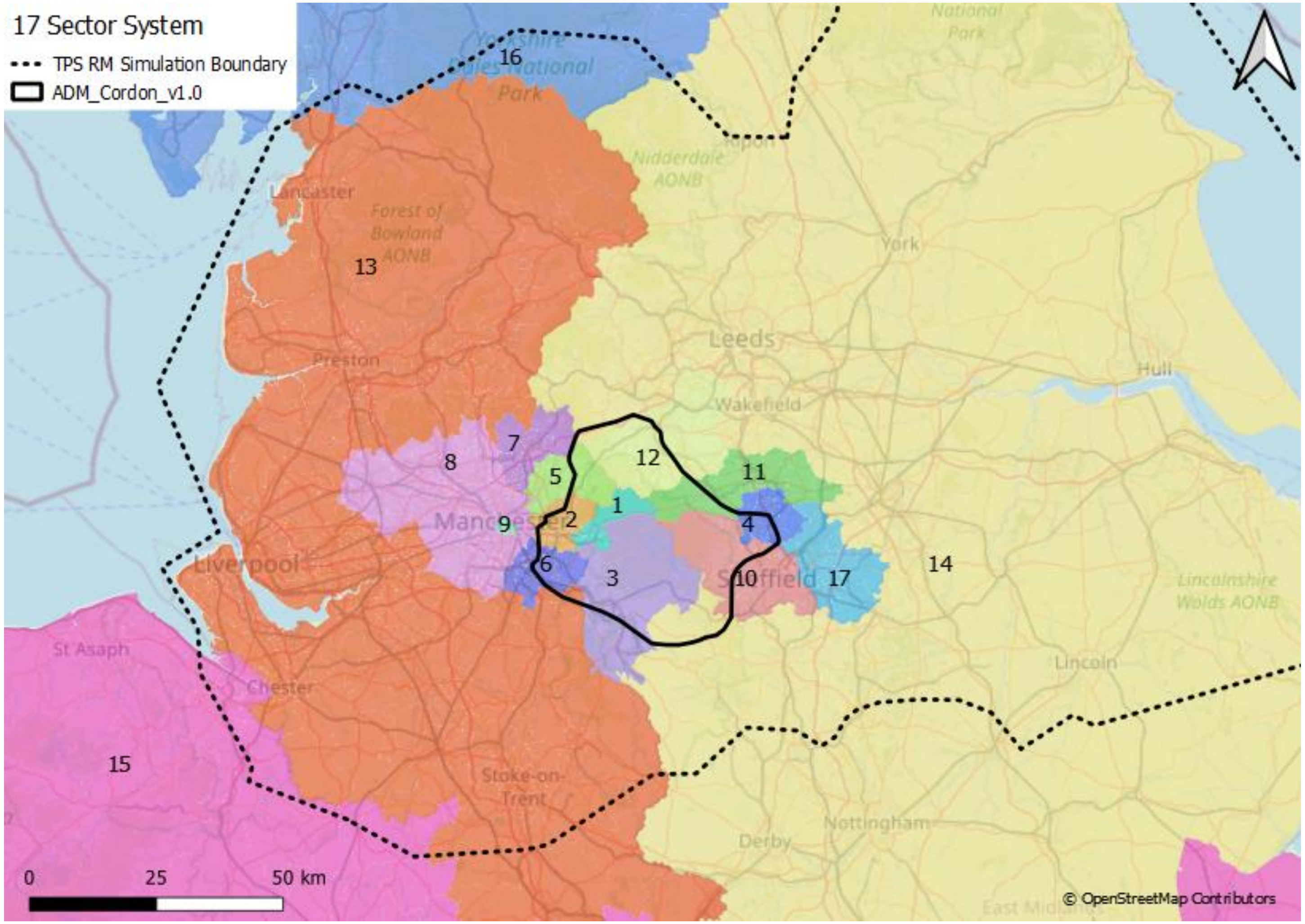
Table 3-9 - Comparison of sectored trip matrices: prior vs. post-ME – TPU PCF Stage 3

Time Period	No. Cells with >100 Trips	% Cells with <5% change	% Cells with <10% change	% Cells with GEH <5 change
AM	134	33%	54%	78%
IP	136	33%	49%	80%
PM	130	33%	53%	78%

Table 3-10 - Comparison of sectored trip matrices: prior vs. post-ME – TPS RTM

Time Period	No. Cells with >100 Trips	% Cells with <5% change	% Cells with <10% change	% Cells with GEH <5 change
AM	133	35%	56%	80%
IP	136	37%	58%	83%
PM	133	34%	59%	79%

Figure 3-1 – 17-sector system



Trip Length Distribution (TLD)

3.3.12. The trip length distribution of post-ME matrices has been compared with the corresponding prior matrices to ensure that trip lengths haven't been significantly modified by ME. The TLD analysis has been presented following two different methodologies:

- The TAG compliant methodology that considers all ij pairs that are permitted to change as a result of running ME; and
- An alternative methodology which involves the exclusion of external trips between zones in the model buffer area. With this method, in separately considering the matrix elements that have an origin trip end in the internal area and a destination trip end in the internal model area will in practice double count the internal-internal trips within the model simulation area.

3.3.13. Table 3-11 to Table 3-13 provide the TAG compliant comparison of trip length distributions between the TPU PCF Stage 3 prior and post-ME matrices across all ij pairs, by vehicle type. This shows that all values adhere to TAG guidance (Table 3-1).

Table 3-11 - TAG compliant comparison of mean and standard deviation TLD: prior vs. post-ME – TPU PCF Stage 3 (AM peak)

	Prior Distance (kms)		Post Distance (kms)		Change (%)	
Vehicle Type	Mean	Std	mean	std	mean	Std
1 Car	13.5	39.4	13.7	39.8	1.9%	1.1%
2 LGV	16.6	44.5	16.9	44.8	1.9%	0.7%
3 HGV	55.2	87.0	55.1	86.1	0.0%	-1.0%
Total	16.1	44.9	16.4	45.3	1.9%	0.8%

Table 3-12 - TAG compliant comparison of mean and standard deviation TLD: prior vs. post-ME – TPU PCF Stage 3 (IP)

	Prior Distance (kms)		Post Distance (kms)		Change (%)	
Vehicle Type	Mean	Std	mean	std	mean	std
1 Car	9.5	34.4	9.7	34.6	2.2%	0.6%
2 LGV	15.1	43.6	15.2	43.7	0.8%	0.3%
3 HGV	55.0	88.2	54.9	87.2	-0.2%	-1.1%
All	13.3	42.9	13.5	43.0	1.7%	0.2%

Table 3-13 - TAG compliant comparison of mean and standard deviation TLD: prior vs. post-ME – TPU PCF Stage 3 (PM peak)

	Prior Distance (kms)		Post Distance (kms)		Change (%)	
Vehicle Type	Mean	Std	mean	std	mean	std
1 Car	12.3	38.1	12.5	38.5	2.0%	1.1%
2 LGV	15.8	43.8	16.4	44.5	3.6%	1.6%
3 HGV	54.5	86.8	54.7	86.5	0.4%	-0.3%
All	14.1	42.1	14.4	42.5	2.1%	1.1%

3.3.14. Table 3-14 to Table 3-16 provide the alternative comparison of trip length distributions between the TPU PCF Stage 3 prior and post-ME matrices, by vehicle type. As aforementioned, this process excludes external trips between zones in the model buffer area and doubles internal trips within the model simulation area.

3.3.15. In comparison to the TAG compliant methodology that considers all ij pairs in the matrices, mean and standard deviation trip lengths are lower for all vehicle types. This is attributable to the exclusion of longer distance trips between larger external zones and the doubling of shorter distance internal trips.

3.3.16. This alternative approach to calculating the TLD does not meet TAG criteria, with mean trip length changes for all vehicle types ranging between 8-11% (AM: 9.1%, IP: 8.1%, PM: 10.6%).

Table 3-14 - Alternative comparison of mean and standard deviation TLD: prior vs. post-ME – TPU PCF Stage 3 (AM peak)

	Prior Distance (kms)		Post Distance (kms)		Change (%)	
Vehicle Type	Mean	std	mean	std	mean	Std
1 Car	9.2	19.7	10.0	21.6	7.7%	9.6%
2 LGV	13.6	25.4	15.3	26.7	12.8%	5.4%
3 HGV	48.7	57.0	47.1	55.0	-3.3%	-3.5%
All	11.3	24.5	12.3	26.3	9.1%	7.3%

Table 3-15 - Alternative comparison of mean and standard deviation TLD: prior vs. post-ME – TPU PCF Stage 3 (IP)

	Prior Distance (kms)		Post Distance (kms)		Change (%)	
Vehicle Type	Mean	std	mean	std	mean	Std
1 Car	7.5	19.8	8.2	21.0	8.2%	6.0%
2 LGV	12.5	26.5	13.0	26.9	4.4%	1.5%
3 HGV	48.6	59.7	47.2	57.6	-3.0%	-3.6%
All	9.8	25.4	10.6	26.4	8.1%	4.2%

Table 3-16 - Alternative comparison of mean and standard deviation TLD: prior vs. post-ME – TPU PCF Stage 3 (PM peak)

	Prior Distance (kms)		Post Distance (kms)		Change (%)	
Vehicle Type	Mean	std	mean	std	mean	Std
1 Car	8.3	18.7	9.0	20.9	9.3%	11.4%
2 LGV	12.6	25.1	15.8	28.6	25.9%	13.8%
3 HGV	44.1	54.7	43.6	54.8	-1.2%	0.2%
All	9.6	22.0	10.6	24.2	10.6%	9.9%

3.3.17. This analysis shows the TAG method of assessing the impact of matrix estimation on TLD is within criteria across the whole model area, whilst the analysis of the subset within the simulation area shows greater change beyond the prescribed 5%, particularly for the LGV movements in the PM peak. It is likely the prior data for more localised LGV in this (and the other) time period is taken from a small sample and hence liable to need additional matrix estimation.

3.4. Screenline flow calibration

3.4.1. As part of the matrix calibration process for TPU PCF Stage 3, 10 screenlines have been defined within the ADM (Figure 2-1). Figure 3-2 identifies the location of the flow screenlines used to calibrate the model.

3.4.2. To improve the fit between modelled and observed data in the localised area, all screenlines and additional count data have been included in the matrix estimation process as calibration counts. As specified in TAG unit M3.1, it is possible to include data that would otherwise form independent validation data, into the calibration to further refine the model.

3.4.3. Table 3-17 describes the screenline flow calibration criterion and acceptability guidelines provided by TAG unit M3.1.

Table 3-17 - Screenline flow calibration criterion (TAG unit M3.1)

Criteria	Guideline
Differences between modelled flows and counts should be less than 5% of the counts	All or nearly all screen-lines (95%)

3.4.4. Table 3-18 and Table 3-19 present a high-level summary of the number of screenlines that meet TAG criteria (unit M3.1) in the prior and post-ME assignments, by vehicle type. For indicative purposes only, and to maintain consistency with the Stage 2 LMVR, the former DMRB GEH criteria has also been included (GEH <4). Note that the DMRB is no longer relevant in this context, and the source of model development guidance is now TAG.

3.4.5. The results indicate that the calibration screenlines correlate well with observed data, with 100% of screenlines meeting TAG criteria across all screenlines and time periods (all vehicles) in the post-ME assignment.

3.4.6. Full details of individual screenlines are presented in Appendix B.

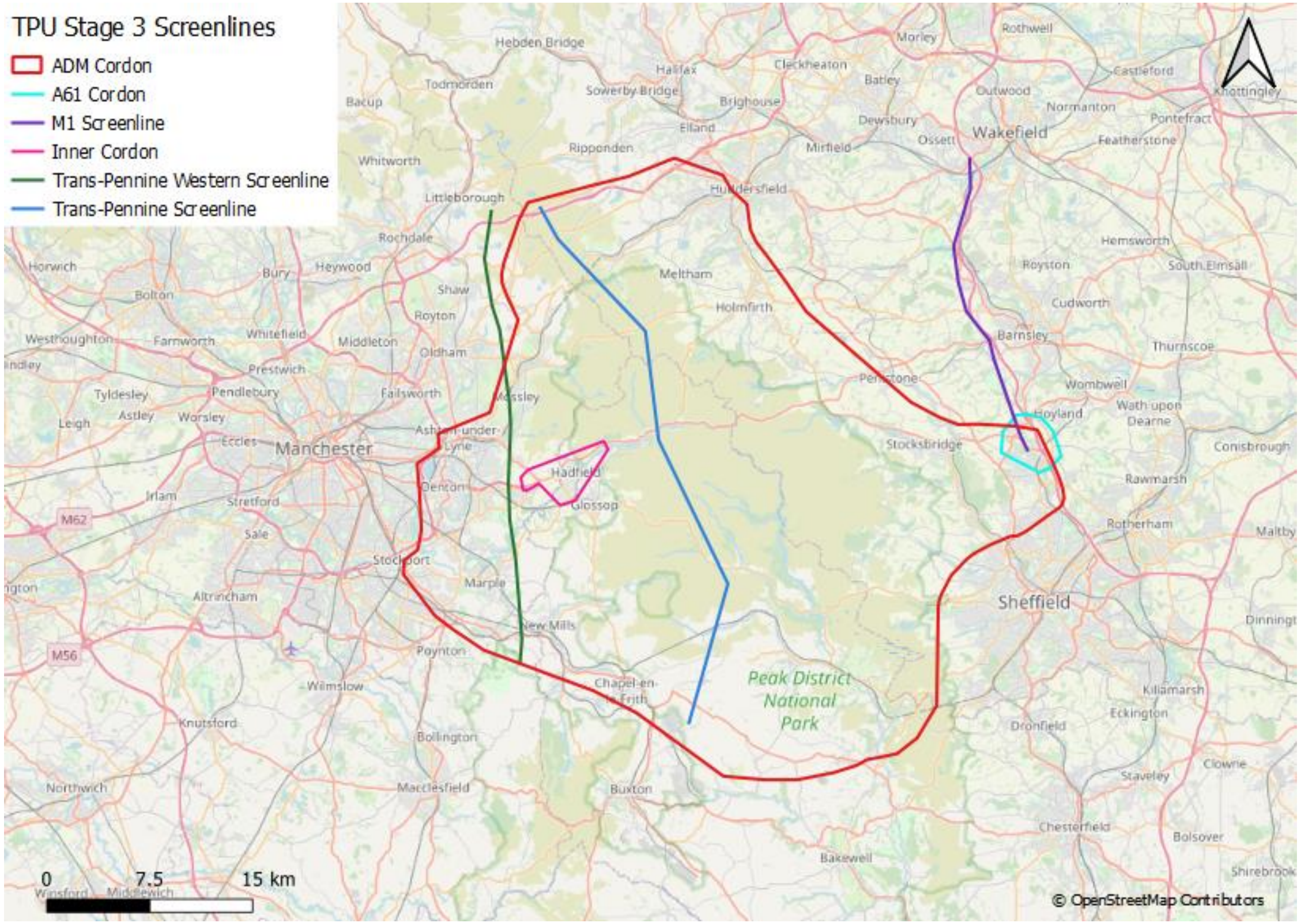
Table 3-18 - TPU PCF Stage 3 calibration screenline summary: prior

Time Period	Screenlines	% of screenlines pass TAG criteria (within 5% difference in flow)				% of screenlines pass DMRB criteria (GEH <4)			
		Car	LGV	HGV	All	Car	LGV	HGV	All
AM	10	0%	0%	0%	10%	10%	40%	60%	20%
IP	10	30%	0%	10%	10%	30%	30%	20%	0%
PM	10	10%	10%	30%	20%	10%	50%	40%	30%

Table 3-19 - TPU PCF Stage 3 calibration screenline summary: post-ME

Time Period	Screenlines	% of screenlines pass TAG criteria (within 5% difference in flow)				% of screenlines pass DMRB criteria (GEH <4)			
		Car	LGV	HGV	All	Car	LGV	HGV	All
AM	10	100%	60%	70%	100%	100%	90%	100%	90%
IP	10	90%	90%	70%	100%	100%	100%	80%	100%
PM	10	100%	70%	50%	100%	100%	100%	90%	100%

Figure 3-2 – Flow calibration screenlines and cordons – TPU PCF Stage 3



3.5. Link flow calibration

3.5.1. In addition to an evaluation at a screenline level, modelled flows have been compared against observed data at an individual link level.

3.5.2. Table 3-20 describes the link flow calibration criteria and acceptability guidelines provided by TAG unit M3.1.

Table 3-20 – Link flow and turning movement calibration criteria (TAG unit M3.1)

Criteria	Description of Criteria	Guideline
1	Individual flows within 100 veh/h of counts for flows less than 700 veh/h	> 85% of cases
	Individual flows within 15% of counts for flows from 700 to 2,700 veh/h	
	Individual flows within 400 veh/h of counts for flows more than 2,700 veh/h	
2	GEH < 5 for individual flows	> 85% of cases

3.5.3. Table 3-21 to Table 3-26 present a high-level summary of the number of links that meet TAG criteria in the prior and post-ME assignments.

3.5.4. Links have been split into those that form the calibration screenlines (Figure 3-2), link counts derived from classified turning counts undertaken in Glossop during September 2019 (Figure 2-5) and all 'other' counts that were used in model calibration. Full details of the data used to inform the development of the 2015 base year TPU model are documented in the PCF Stage 3 Supplementary Data Collection Package (see section 1.2.4).

3.5.5. In comparing observed and modelled link flow data, TAG (unit M3.1) states that the model is required to meet either the flow or GEH criteria.

3.5.6. As such, the results indicate that the calibration counts correlate well with observed data at the individual link level, with at least 84% of counts meeting TAG criteria across each modelled time period of the post-ME assignments.

3.5.7. Full details of the individual link flows are included in Appendix B.

Table 3-21 - TPU PCF Stage 3 calibration link flow summary: prior (AM peak)

Link Type	Number of Links	Flow		GEH		Either (Flow or GEH)	
		Total	%	Total	%	Total	%
All screenline counts	106	78	74%	70	66%	79	75%
Additional Glossop counts	28	19	68%	12	43%	19	68%
All other counts	136	91	67%	83	61%	94	69%
Total	270	188	70%	165	61%	192	71%

Table 3-22 - TPU PCF Stage 3 calibration link flow summary: prior (IP)

Link Type	Number of Links	Flow		GEH		Either (Flow or GEH)	
		Total	%	Total	%	Total	%
All screenline counts	106	64	60%	54	51%	67	63%
Additional Glossop counts	28	23	82%	21	75%	23	82%
All other counts	136	86	63%	72	53%	88	65%
Total	270	173	64%	147	54%	178	66%

Table 3-23 - TPU PCF Stage 3 calibration link flow summary: prior (PM peak)

Link Type	Number of Links	Flow		GEH		Either (Flow or GEH)	
		Total	%	Total	%	Total	%
All screenline counts	106	67	63%	58	55%	69	65%
Additional Glossop counts	28	24	86%	19	68%	24	86%
All other counts	136	89	65%	78	57%	90	66%
Total	270	180	67%	155	57%	183	68%

Table 3-24 - TPU PCF Stage 3 calibration link flow summary: post-ME (AM peak)

Link Type	Number of Links	Flow		GEH		Either (Flow or GEH)	
		Total	%	Total	%	Total	%
All screenline counts	106	90	85%	86	81%	92	87%
Additional Glossop counts	28	26	93%	24	86%	26	93%
All other counts	136	117	86%	117	86%	119	88%
Total	270	233	86%	227	84%	237	88%

Table 3-25 - TPU PCF Stage 3 calibration link flow summary: post-ME (IP)

Link Type	Number of Links	Flow		GEH		Either (Flow or GEH)	
		Total	%	Total	%	Total	%
All screenline counts	106	92	87%	87	82%	95	90%
Additional Glossop counts	28	28	100%	26	93%	28	100%
All other counts	136	126	93%	123	90%	128	94%
Total	270	246	91%	236	87%	251	93%

Table 3-26 - TPU PCF Stage 3 calibration link flow summary: post-ME (PM peak)

Link Type	Number of Links	Flow		GEH		Either (Flow or GEH)	
		Total	%	Total	%	Total	%
All screenline counts	106	84	79%	83	78%	86	81%
Additional Glossop counts	28	27	96%	23	82%	27	96%
All other counts	136	114	84%	108	79%	115	85%
Total	270	225	83%	214	79%	228	84%

3.6. Journey time validation

3.6.1. The purpose of journey time validation is to show that the model is able to replicate observed journey times on key routes through the ADM (Figure 2-1). Observed journey times have been compared against modelled data along 20 journey time routes, as shown in Figure 2-6.

3.6.2. Table 3-27 describes the journey time validation criterion and acceptability guidelines provided by TAG unit M3.1.

Table 3-27 - Journey time validation criterion (TAG unit M3.1)

Criterion	Acceptability Guideline
Modelled times along routes should be within 15% (or 1 minute, if higher)	> 85% of routes

3.6.3. Table 3-28 summarises the number of journey time routes that meet TAG criteria (unit M3.1) (i.e. modelled times along routes should be within 15% of surveyed times (or 1 minute, if higher) for over 85% of routes).

3.6.4. The results indicate that the model can replicate observed journey times, achieving TAG criteria across all time periods.

3.6.5. Full details of the individual journey time validation routes are presented in Appendix C, including a graphical breakdown by timing point.

Table 3-28 - TPU PCF Stage 3 journey time validation summary: post-ME

Time Period	Total Journey Time Routes (directional)	Total Number Passing TAG criteria	% Passing TAG criteria
AM	20	19	95%
IP	20	20	100%
PM	20	20	100%

3.7. Convergence

Highway Assignment Model (HAM)

3.7.1. The convergence parameters adopted for TPU have been retained from the TPS RTM. The advice on model convergence is set out in TAG unit M3.1 (Table 4) and is reproduced below in Table 3-29.

Table 3-29 - TAG (unit 3.1) convergence criteria

Convergence Measures	Type	Base Model Acceptable Values
Delta & %GAP	Proximity	Less than 0.1% or at least stable with convergence fully documented and all other criteria met
Percentage of links with flow change (P1) < 1%	Stability	Four consecutive iterations greater than 98%

Source: TAG Unit M 3.1 Table 4

3.7.2. Table 3-30 provides a summary of the convergence statistics for the TPU PCF Stage 3 post-ME model.

3.7.3. The results indicate that all modelled time periods achieve a level of convergence that complies with the recommended TAG criteria. In terms of percentage flow change and gap acceptance the TPU PCF Stage 3 model meets TAG criteria within 69 loops in the AM peak, 54 loops in the IP and 82 loops in the PM peak.

3.7.4. Full details of the HAM convergence statistics are presented in Appendix D.

Table 3-30 - TPU PCF Stage 3 HAM convergence statistics: post-ME

AM			Inter Peak			PM		
Iteration	%Flow	%Gap	Iteration	%Flow	%Gap	Iteration	%Flow	%Gap
66	98.4	0.013	51	98.0	0.009	79	98.2	0.012
67	98.2	0.016	52	98.4	0.011	80	98.3	0.013
68	98.5	0.016	53	98.1	0.007	81	98.3	0.014
69	98.6	0.016	54	98.7	0.012	82	98.3	0.012

Variable Demand Model (VDM)

3.7.5. The TPS RTM demand model setup has been retained for the variable demand modelling (VDM) for the TPU PCF Stage 3 model, details of which are summarised in section 2.2 (full details to be provided in the model forecasting package).

3.7.6. It important that the VDM converges to a satisfactory degree in order to have confidence that the model results are as free from error and noise as possible. In line with TAG guidance, target %GAP values of 0.1% for the full model area and 0.2% for the subset area have been achieved (Table 3-31).

3.7.7. Full details of the VDM convergence statistics are presented in Appendix E.

Table 3-31 - TPU PCF Stage 3 VDM convergence statistics: post-ME

Best Loop	% GAP Full Model Area	%GAP Subset Area (ADM)
3	0.09%	0.17%

3.8. Demand model parameters

Destination choice and main mode choice

3.8.1. Destination choice values (referred to as lambda values) are provided in TAG unit M2.1 (Table 5.1). TAG states that "revised lambdas and thetas which were within ±25% of the median illustrative values would be regarded as acceptable." Table 3-32 and Table 3-33 present the destination and mode choice parameters used in TPU PCF Stage 3 and the TPS RTM. These show that the parameter values adhere to TAG guidance. The values adopted for the TPS RTM are the median parameters specified in TAG unit M2.1 (Table 5.1), whilst car trip purposes were modified for TPU PCF Stage 3.

Table 3-32 - Destination choice parameters used in TPS RTM and TPU PCF Stage 3

Trip Purpose and Mode	TPS RTM	TPU Stage 3
Car		
Home-based work	-0.065	-0.080
Home-based employer's business	-0.067	-0.050
Home-based other	-0.090	-0.067
Non-home-based employer's business	-0.081	-0.060
Non-home-based other	-0.077	-0.057
Public Transport		
Home-based work	-0.033	-0.033
Home-based employer's business	-0.036	-0.036
Home-based other	-0.036	-0.036
Non-home-based employer's business	-0.042	-0.042
Non-home-based other	-0.033	-0.033

Table 3-33 - Main mode choice scaling parameters used in TPS RTM and TPU PCF Stage 3

Trip Purpose and Mode	TPS RTM	TPU Stage 3
Car		
Home-based work	0.68	0.68
Home-based employer's business	0.45	0.45
Home-based other	0.53	0.53
Non-home-based employer's business	0.73	0.73
Non-home-based other	0.81	0.81

3.9. Demand model matrices

3.9.1. The base PA matrices used in the DIADEM VDM were retained from the TPS RTM, as detailed in the TPS RTM LMVR[4].

3.9.2. Off-peak demand (19:00-07:00) is a required input of the VDM, however the TPU base model does not have an off-peak component. Therefore, demand has been adopted from the TPS RTM. It should be noted that while the off-peak model was not validated in either the TPS RTM or the TPU base model, its outputs are not used directly in the scheme appraisal or business case.

3.9.3. The demand model matrices used for the base year VDM have been presented at a 25-sector and 3-sector level. Figure 3-3 shows the 25 sectors that have been used to summarise the demand matrices. The 25-sector system is referenced in the legend, whilst the 3-sector system comprises of the ADM, the TPS RTM simulation area and the TPS RTM buffer area.

3.9.4. Demand model matrices from the VDM are presented by mode, time period and purpose at both sector levels in Appendix F.1. Table 3-34 provides an overview of the demand segmentation used in the TPU base year DIADEM VDM.

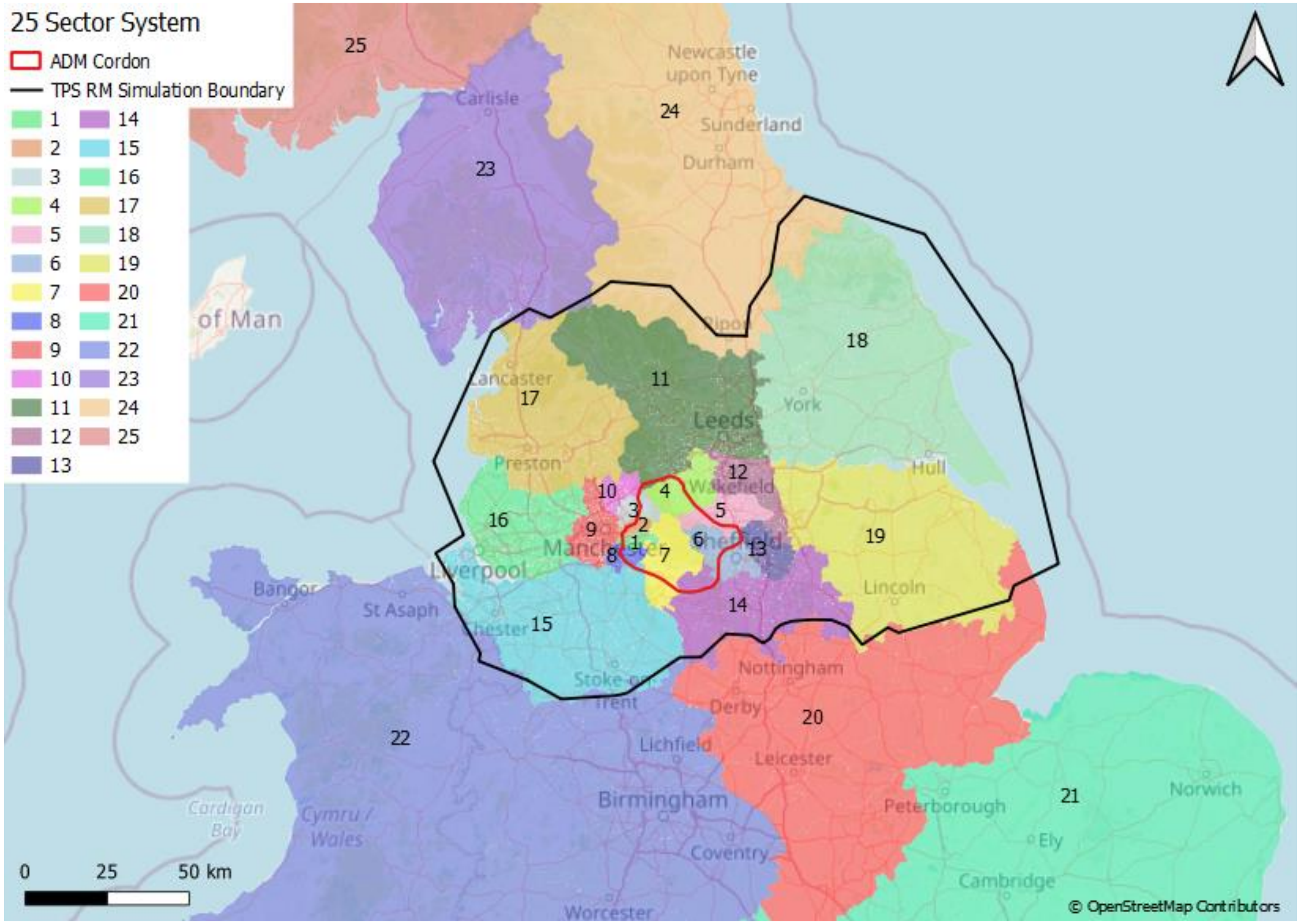
Table 3-34 - TPU PCF Stage 3 demand segmentation

Demand Segment	Purpose	Form of Matrices	Demand Response
1	Home Based Employer Business	24 hr - PA	Variable
2	Home Based Commute	24 hr - PA	Variable
3	Home Based Others	24 hr - PA	Variable
4	Non-Home-Based Employer Business	All time slice - OD	Variable
5	Non – Home Based Others	All time slice - OD	Variable
6	Fixed Demand - Employers Business	All time slice - OD	Fixed
7	Fixed Demand - Work	All time slice - OD	Fixed
8	Fixed Demand - Other	All time slice - OD	Fixed
9	Fixed Demand - LGV	All time slice - OD	Fixed
10	Fixed Demand - HGV	All time slice - OD	Fixed

3.9.5. The base matrices used in the HAM differ to the base year matrices from the VDM. The structure of the TPU model is specified in the PCF Stage 2 LMVR (see section 1.2.1). This explains how the model specification allows for different base matrices in the HAM and VDM (which in turn facilitates detailed calibration of the base HAM, without affecting the VDM). The discrepancies between the HAM and VDM matrices are accommodated through the use of 'fitting on factors', which are explained in the PCF Stage 3 model forecasting package. For this reason, the TPU base matrices from the HAM are presented in Appendix F.2, following the VDM matrices in Appendix F.1.

[4] TPS RTM LMVR (March 2017): TPS Model Validation Report - V1.9

Figure 3-3 - 25-sector system



3.10. Realism tests

3.10.1. Realism testing has been undertaken to ensure that the TPU PCF Stage 3 model realistically responds to changes in travel costs. This section summarises the realism tests for car fuel cost elasticity, car journey time elasticity and Public Transport (PT) fare elasticity, as specified in TAG unit M2.1 (section 6.4).

Car fuel cost elasticity

3.10.2. As recommended in TAG unit M2.1, car fuel cost elasticity values have been calculated using both the matrix-based and network-based methods. The car fuel cost elasticity was carried out with a 10% increase in vehicle operating costs (VOC).

3.10.3. The Pence per Kilometre (PPK) values adopted for the car fuel realism test are given in Table 3-35. The base year HAM was used for realism testing.

Table 3-35 - PPK Values adopted for the car fuel realism test run.

User Class	Purpose	Base	Realism Test
UC1	Business	12.59	13.10
UC2	Commuting	6.15	6.77
UC3	Others	6.15	6.77

3.10.4. Table 3-36 presents the fuel cost elasticity values calculated for each car purpose by time period, using the matrix-based methodology. To derive the total number of vehicle kilometres travelled, the demand matrices from the realism test VDM were multiplied with the distance skim matrices from the validated base year HAM.

3.10.5. The vehicle kilometre matrices were categorised based on whether the trip ends of each ij pair were inside or outside of the TPS RTM simulation area. All ij pairs except external to external movements were considered for the fuel cost elasticity calculation.

3.10.6. Table 3-37 presents the fuel cost elasticity values calculated for each car purpose by time period, using the network-based methodology. The total number of vehicle kilometres travelled were extracted from SATURN for all links within the simulated area.

3.10.7. The annual average elasticity for all purpose trips is within the TAG specified range of -0.25 to -0.35.

Table 3-36 - TPU PCF Stage 3 fuel cost elasticity: matrix-based

Purpose	AM	IP	PM	OP	Annual Average	Desired Value
Business	-0.18	-0.23	-0.22	-0.18	-0.21	-0.10
Commuting	-0.22	-0.25	-0.23	-0.31	-0.24	-0.25
Others	-0.49	-0.48	-0.42	-0.49	-0.47	-0.40
All Purpose	-0.25	-0.35	-0.29	-0.32	-0.31	-0.30

Table 3-37 - TPU PCF Stage 3 fuel cost elasticity: network-based

Purpose	AM	IP	PM	OP	Annual Average	Desired Value
Business	-0.14	-0.21	-0.19	-0.18	-0.18	-0.10
Commuting	-0.19	-0.24	-0.20	-0.31	-0.22	-0.25
Others	-0.45	-0.46	-0.40	-0.48	-0.45	-0.40
All Purpose	-0.22	-0.33	-0.26	-0.32	-0.29	-0.30

3.10.8. Table 3-38 shows the car fuel cost elasticity values presented in the TPS RTM model validation report, as a comparison and consistency check. This shows that the car fuel cost elasticity values calculated for TPU PCF Stage 3 are comparable to the TPS RTM.

Table 3-38 - TPS RTM Stage 3 fuel cost elasticity

Purpose	AM	IP	PM	OP	Annual Average	Desired Value
Business	-0.18	-0.19	-0.16	-0.26	-0.20	-0.10
Commuting	-0.19	-0.20	-0.17	-0.24	-0.19	-0.25
Others	-0.48	-0.49	-0.48	-0.57	-0.50	-0.40
All Purpose	-0.25	-0.31	-0.27	-0.37	-0.30	-0.30

Car journey time elasticity

3.10.9. Car journey time elasticity was derived from the car fuel cost elasticity using the following equation:

$$Etime = Efuel\ aT/bK$$

Where,

Etime = Car journey time elasticity

Efuel = Car fuel cost elasticity

a = Pence per hour

b = Pence per km

T = Total veh-hrs

K = Total veh-kms

3.10.10. Table 3-39 presents car journey time elasticity values calculated for each car purpose by time period. As specified in TAG unit M2.1, car journey time elasticity values are shown to be no stronger than -2.0.

Table 3-39 - TPU PCF Stage 3 car journey time elasticity

Purpose	AM	IP	PM	OP	Desired Value
Business	-0.38	-0.47	-0.44	-0.34	<-2.0
Commuting	-0.60	-0.68	-0.63	-0.80	<-2.0
Others	-0.97	-0.99	-0.88	-0.93	<-2.0

Public transport fare elasticity

3.10.11. As recommended in TAG unit M2.1, PT fare elasticity values have been calculated by implementing a 10% fare increase. The updated PT cost files were input in to the TPU base year VDM.

3.10.12. The public transport demand matrices produced by the realism test were categorised based on whether the trip ends of each ij pair were inside or outside of the TPS RTM simulation area. All ij pairs except external to external movements were considered for the PT fare elasticity calculation.

3.10.13. Table 3-40 presents the public transport fare elasticity values calculated for the variable demand segments (as shown previously in Table 3-34).

Table 3-40 - TPU PCF Stage 3 public transport fare elasticity

Demand Segment	Purpose	Time Period	Reference PT Trips	Realism PT Trips	Elasticity
1	Home based Employers Business	PA all day	44,758	44,102	-0.15
2	Home based Commute	PA all day	116,461	114,351	-0.19
3	Home based Others	PA all day	56,484	51,979	-0.87
4	Non-Home-based Employers	AM	444	432	-0.29
		IP	265	258	-0.29
		PM	431	420	-0.29
		OP	172	167	-0.29
		24-hr	6,274	6,104	-0.29
5	Non-Home-based Others	AM	309	278	-1.09
		IP	229	207	-1.06
		PM	665	603	-1.03
		OP	217	196	-1.03
		24-hr	6,896	6,242	-1.05

3.10.14. As specified in TAG unit M2.1, PT fare elasticities are expected to lie in the range of -0.2 to -0.9 at a total trip level (all purpose). Table 3-41 compares 24-hour PT fare elasticities for TPU PCF Stage 3 with the TPS RTM. This shows that the elasticity value for all purpose trips achieves the TAG criteria (-0.37). The values provided for all the purposes (business, commuting and other) are shown to have slightly higher elasticity than TPS RTM, but are still comparable and well within the prescribed TAG range.

Table 3-41 – Comparison of 24-hour PT fare elasticity by purpose: TPS RTM vs. TPU PCF Stage 3

Purpose	TPS RTM	TPU Stage 3
Business	-0.15	-0.16
Commuting	-0.17	-0.19
Others	-0.78	-0.88
All Purpose	-0.29	-0.37

4. Summary

4.1.1. The transport modelling package summarises the development of the TPU PCF Stage 3 2015 base year transport model.

4.1.2. The calibration, validation and realism test results that are presented show that the model meets the TAG criteria and is suitable for developing traffic forecasts used to inform economic, environmental, and operational appraisal of the TPU scheme.

Appendices

Appendix A. ME: sectored matrices (prior vs. post)

For full details please see the attached folder 'Appendix A' (filename: ME_Sector_Comparison_v0.2_TPU_CC.xlsm) and (filename: ME_Sector_Comparison_v0.2_TPS_CC.xlsm)

The red highlighted cells in the sectored percentage change tables indicate changes greater than ±5%

The colour coding in the sectored GEH tables are based on the following criteria:

GEH>5	GEH>7.5	GEH>10	GEH>15	GEH>20

A.1. TPU PCF Stage 3: Percentage change (AM peak)

Sector From\To	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Total
1	10%	3%	2%			20%		-19%	-83%				38%					4%
2	43%	0%			7%	-1%	40%	4%	-38%				55%	-9%				4%
3	-24%	-15%	-4%			-6%		-16%	-68%	-44%			-5%	-27%				-11%
4				-1%						-22%	8%			22%			10%	-1%
5		-2%			3%	-22%	6%	10%	-9%			-29%	33%	-15%	15%			4%
6	28%	-3%	3%		8%	2%	36%	17%	-23%				48%	-38%	23%			9%
7		10%			10%	8%	2%	4%	-26%			-46%	-9%	3%		-33%		1%
8		30%	43%		43%	25%	21%	4%	-5%			-25%	12%	40%	0%	-11%		7%
9		24%				1%		4%	0%				29%					5%
10				7%						-2%	9%	-3%	-28%	9%	-2%	5%	-5%	-1%
11				-5%						-20%	4%	-6%		17%	32%		15%	5%
12					-7%			-28%		4%	17%	1%	-29%	9%	57%		37%	3%
13		39%	12%		45%	16%	6%	4%	-3%	-29%		-13%	2%	6%	15%	-8%		3%
14		19%	-9%	28%	-12%	-16%	-10%	10%	-50%	-15%	32%	18%	1%	2%	1%	10%	8%	2%
15		13%			37%	10%		23%	-22%	22%		44%	0%	4%	0%	22%	13%	0%
16								17%					10%	6%	-3%	0%		0%
17				2%						-27%	15%			3%	-34%		-3%	-6%
Total	21%	5%	-1%	5%	10%	7%	6%	5%	-11%	-7%	10%	3%	3%	3%	0%	0%	1%	1%

DRIVING OUTCOMES

A.2. TPU PCF Stage 3: GEH (AM peak)

Sector From\To	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Total
1	4.10	0.94	0.24	2.91	0.28	3.91	2.15	3.14	11.86	3.93	0.84	2.96	4.37	2.65	1.03	0.37	2.59	2.44
2	9.09	0.45	2.27	0.36	3.02	0.31	5.98	2.32	15.65	3.32	0.39	2.05	14.83	1.00	6.97	1.10	1.37	5.02
3	2.99	1.70	2.20	1.05	1.12	1.54	0.43	2.45	8.70	8.04	2.04	2.68	1.41	5.99	2.38	0.88	2.42	8.61
4	0.53	0.41	1.78	0.25	0.01	0.47	0.09	1.14	1.91	10.52	2.36	0.94	0.59	5.47	4.90	1.32	3.11	1.27
5	3.12	1.06	1.06	0.19	3.07	4.44	2.81	5.36	3.27	0.06	0.61	3.93	9.31	3.38	1.50	1.61	0.67	5.27
6	3.74	1.18	0.54	0.98	0.94	1.90	3.77	14.24	11.95	2.78	0.23	3.26	27.67	5.75	3.18	1.43	0.10	16.22
7	1.14	1.37	0.64	0.07	3.99	1.06	1.39	2.35	6.79	0.44	0.28	6.29	3.31	0.94	1.60	3.75	0.59	0.88
8	6.09	11.20	4.36	1.69	16.19	15.92	10.21	14.18	5.92	5.51	1.19	4.26	15.43	16.10	0.16	2.45	5.23	25.03
9	2.10	2.70	0.94	0.21	0.62	0.09	1.67	2.39	0.00	2.09	0.47	1.20	5.67	0.83	0.36	0.86	1.24	3.54
10	0.78	0.18	2.58	2.57	0.16	1.18	0.25	1.95	4.71	3.81	2.15	0.38	3.28	6.31	0.39	0.51	2.74	1.86
11	1.20	0.54	2.73	1.55	0.18	1.42	1.07	2.25	3.80	6.14	4.37	1.30	1.48	9.07	3.05	2.63	5.20	6.89
12	1.04	0.35	1.76	0.05	1.01	0.53	4.94	4.52	6.11	0.58	4.02	0.85	5.40	9.46	5.86	2.97	3.69	5.89
13	5.67	8.66	2.52	2.66	10.75	8.85	2.25	5.09	1.67	3.78	2.77	2.32	12.96	5.28	17.88	3.81	6.86	18.86
14	2.02	1.91	1.89	6.24	2.25	2.20	2.67	4.01	10.61	13.37	13.07	13.92	0.79	15.01	2.05	6.56	4.73	16.64
15	1.35	1.39	0.39	8.47	3.53	1.48	6.82	7.65	2.56	3.69	11.34	4.04	0.29	5.41	0.07	8.46	1.57	0.91
16	2.33	5.24	1.27	0.95	1.38	2.23	2.03	3.43	2.85	1.82	2.90	5.33	4.13	3.83	1.23	0.05	1.03	0.68
17	0.56	0.82	2.28	0.49	0.08	0.59	0.00	1.31	2.40	20.20	4.21	2.13	2.78	1.65	4.66	1.12	3.75	10.26
Total	10.95	6.26	0.54	3.64	12.49	11.12	7.71	19.70	17.04	17.10	12.50	5.75	19.57	19.61	1.42	0.79	0.93	17.60

DRIVING OUTCOMES

A.3. TPU PCF Stage 3: Percentage change (IP peak)

Sector From\To	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Total
1	4%	12%	12%			37%		67%										11%
2	21%	4%			12%	12%	67%	38%	4%				58%					13%
3	-14%		-4%			24%		61%		0%			14%	-10%				1%
4				4%						4%	14%			42%			25%	12%
5		10%			6%	17%	13%	49%	27%			-21%	66%	-24%				13%
6	8%	-9%	12%		20%	1%	5%	19%	-2%				21%	-29%	5%			6%
7		24%			10%	52%	2%	20%	1%			-43%	11%	-12%				6%
8	35%	14%	79%		35%	7%	14%	5%	2%			-15%	7%	17%	-1%	-10%		6%
9		7%			1%	1%	-16%	4%	0%				26%	-44%	25%			4%
10				4%						1%	31%	3%	-1%	3%	-5%	-5%	5%	1%
11				4%						20%	6%	4%		34%			19%	11%
12					-18%			6%		6%	10%	1%	3%	14%	30%			4%
13	79%	9%	15%		41%	11%	17%	6%	17%	-32%		1%	3%	7%	10%	1%		3%
14		-37%	-22%	42%	-42%	-34%	-12%	21%	-24%	1%	28%	9%	5%	2%	0%	13%	10%	2%
15		-2%			17%	-11%		19%	26%	8%		44%	6%	2%	0%	1%	7%	0%
16								-16%		-17%			5%	10%	-2%	0%		0%
17				20%						-1%	26%			2%	-30%		1%	3%
Total	11%	5%	0%	10%	10%	4%	6%	7%	2%	1%	12%	2%	3%	2%	0%	0%	5%	1%

DRIVING OUTCOMES

A.4. TPU PCF Stage 3: GEH (IP peak)

Sector From\To	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Total
1	1.95	2.86	1.33	3.72	3.11	4.68	4.50	6.44	2.89	2.23	1.26	1.58	6.54	1.81	2.86	0.70	1.16	6.45
2	4.95	3.46	1.73	0.80	4.71	4.68	7.19	15.40	0.74	1.53	0.67	0.23	12.31	1.23	5.79	2.66	1.26	16.25
3	1.62	0.33	2.09	0.06	1.12	3.46	0.96	5.83	0.73	0.01	0.81	1.14	2.67	1.70	0.51	0.50	1.49	0.41
4	1.29	0.21	1.23	1.84	0.70	0.43	0.36	3.83	0.85	1.32	4.47	0.34	4.78	7.96	5.27	2.08	6.68	9.29
5	3.24	4.09	0.74	0.06	5.49	2.08	4.99	17.96	4.18	0.36	0.13	2.37	14.31	5.52	5.73	0.67	0.68	16.61
6	1.16	3.79	1.91	0.07	2.68	1.60	0.47	12.07	0.59	1.43	0.42	1.82	10.29	4.04	0.58	2.39	1.64	9.28
7	1.82	2.96	1.24	0.22	4.23	4.68	2.27	9.41	0.13	0.01	0.52	5.00	3.73	4.02	0.64	2.70	0.12	7.35
8	3.84	6.27	7.15	1.06	13.07	4.41	6.80	16.79	1.19	5.01	1.38	2.25	7.39	7.43	0.23	2.14	3.37	22.16
9	0.10	1.43	2.22	0.63	0.11	0.34	2.28	3.11	0.00	2.90	1.06	3.06	7.10	7.22	2.84	1.34	1.57	3.80
10	2.73	0.80	4.04	1.48	0.35	0.94	0.61	1.04	2.70	1.52	6.04	0.28	0.07	1.80	0.92	0.58	2.91	3.17
11	1.16	0.46	1.75	1.21	0.60	0.54	0.97	2.28	0.60	4.02	6.86	0.77	3.56	13.50	3.19	3.42	5.28	13.38
12	1.97	0.89	2.20	0.08	2.29	1.13	2.86	0.81	0.41	0.67	2.11	1.35	0.46	12.12	2.92	2.79	1.53	7.18
13	7.23	2.22	2.78	3.07	9.49	5.48	5.54	7.39	4.71	4.05	1.79	0.10	16.31	6.00	11.04	0.42	4.34	21.37
14	1.91	4.72	3.69	8.45	9.16	4.92	3.55	7.55	2.98	0.66	11.85	7.99	3.77	13.46	0.32	7.86	5.32	16.21
15	2.20	0.19	0.03	9.99	1.74	1.67	1.33	5.97	2.43	1.43	8.16	4.94	6.26	2.50	0.03	0.23	0.95	0.93
16	3.21	3.41	0.79	0.90	0.53	2.14	2.75	3.79	1.65	1.83	3.72	1.22	2.21	6.11	0.77	0.06	1.30	0.55
17	0.82	0.75	2.01	5.34	0.13	0.83	0.53	3.65	0.02	0.75	7.32	0.42	4.76	0.85	4.19	1.28	1.71	4.03
Total	6.03	6.31	0.25	8.10	12.64	6.83	7.37	26.90	2.45	1.50	15.26	4.76	21.49	17.10	0.84	0.70	7.41	22.27

A.5. TPU PCF Stage 3: Percentage change (PM peak)

Sector From\To	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Total
1	3%	37%	1%			29%		25%										14%
2	0%	1%	-23%		9%	12%	36%	32%	3%				98%					10%
3	-25%	12%	-6%			30%		9%		6%			12%	-10%				-2%
4				2%						-3%	10%	5%		34%			4%	4%
5		12%			6%	34%	16%	32%	-2%			-4%	85%	-1%				13%
6	-14%	-18%	-13%		15%	-3%	20%	11%	-2%				17%	4%	77%			1%
7		12%			3%	24%	2%	22%	-6%			-35%	15%	-5%				6%
8	36%	5%	-22%		33%	-8%	16%	2%	-1%	-25%		0%	10%	40%	34%	19%		4%
9	-9%	-10%	-49%		5%	-22%	-20%	-2%	0%				-6%	-17%	41%			-5%
10	-42%		-50%	-13%				-46%		-2%	1%	-4%	-37%	-9%	-12%		-24%	-5%
11				7%						20%	5%	8%		29%			16%	9%
12					-11%			24%		2%	-8%	0%	24%	10%				2%
13	71%	12%	-3%		40%	-1%	12%	9%	5%	-15%		12%	1%	9%	4%	0%		2%
14		-13%	-31%	48%	-19%	-13%	-10%	43%	-30%	-9%	23%	3%	7%	1%	2%	14%	10%	1%
15		-10%				-1%		9%		-16%	139%	67%	8%	2%	0%	18%	2%	0%
16								41%					13%	11%	15%	0%		0%
17				20%						-16%	27%	18%		5%	-28%		-1%	-1%
Total	1%	2%	-11%	7%	10%	-3%	6%	5%	-1%	-3%	9%	1%	2%	1%	0%	0%	-2%	1%

DRIVING OUTCOMES

A.6. TPU PCF Stage 3: GEH (PM peak)

Sector From\To	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Total
1	1.46	9.03	0.12	0.25	2.85	4.50	1.18	2.80	1.54	0.34	0.53	0.34	4.08	0.59	3.18	0.22	0.99	8.46
2	0.08	0.96	3.02	0.40	4.17	5.40	4.94	14.15	0.64	2.86	0.51	0.39	18.53	1.25	11.27	2.96	0.35	13.65
3	3.95	1.23	3.11	1.08	1.19	4.70	0.49	1.00	1.44	0.69	1.37	1.48	2.54	1.83	0.53	0.34	2.28	1.37
4	3.87	0.02	0.85	1.06	0.23	0.32	0.15	0.30	0.35	1.40	3.32	0.52	0.45	6.89	4.95	2.66	1.20	3.81
5	3.03	5.46	0.00	0.72	6.58	4.17	7.32	13.97	0.22	0.59	0.33	0.54	18.91	0.29	10.77	0.41	1.65	19.07
6	3.01	9.16	3.46	1.34	2.92	4.43	2.55	8.04	0.44	2.38	1.26	1.16	9.63	0.46	8.06	2.10	0.92	1.20
7	2.82	1.91	0.04	0.63	1.63	2.84	1.78	11.72	0.69	0.19	0.77	4.75	5.43	1.46	0.73	0.23	2.05	8.23
8	5.23	3.01	3.35	1.27	16.32	6.67	9.23	8.51	0.41	2.72	1.64	0.02	12.86	15.60	11.15	3.47	1.16	17.02
9	1.00	3.48	5.84	0.33	1.62	10.64	4.69	2.32	0.00	4.21	0.71	3.74	3.03	3.36	5.03	1.33	0.12	7.50
10	4.88	1.63	7.01	6.14	0.52	3.08	0.20	5.32	4.09	3.86	0.41	0.65	5.10	7.56	1.97	3.01	18.38	12.84
11	0.78	0.18	1.11	2.47	0.63	0.09	1.26	2.49	0.63	4.79	5.59	2.08	3.91	12.71	5.23	3.39	4.90	12.81
12	2.32	0.68	1.28	0.83	1.64	0.01	2.19	3.08	0.21	0.21	1.96	0.58	3.09	8.49	4.90	3.73	0.79	3.58
13	7.14	3.22	0.94	0.49	9.79	0.95	3.87	12.07	1.28	1.76	0.48	1.85	7.95	7.83	4.66	0.06	4.71	12.60
14	2.70	1.55	6.57	11.98	4.05	1.83	3.10	14.36	3.51	6.99	12.52	2.92	5.97	8.61	2.70	9.18	6.52	11.88
15	1.45	1.09	1.78	9.53	2.90	0.08	3.26	2.98	0.05	2.96	10.83	7.16	9.60	3.20	0.19	6.26	0.26	1.38
16	4.50	2.61	0.54	1.76	1.66	0.09	0.50	7.47	0.18	0.77	1.83	1.97	5.85	6.97	5.39	0.04	1.86	1.32
17	1.95	0.02	2.93	6.45	0.57	0.29	1.17	0.11	0.69	11.06	9.11	1.76	1.64	3.01	3.39	2.04	1.55	0.99
Total	0.82	2.62	8.72	6.06	14.98	6.44	8.47	19.21	0.64	8.55	13.40	1.53	15.33	12.35	1.29	1.14	4.22	13.99

A.7. TPS RTM: Percentage change (AM peak)

Sector From\To	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Total
1	-5%	-6%	-12%			-24%		5%	-46%				35%					-8%
2	-18%	-1%			-3%	-5%	5%	4%	-12%				53%	-39%				0%
3	-7%		1%			-30%		-33%	-45%	-38%			-10%	-23%				-11%
4				-3%						-27%	1%			10%			-6%	-9%
5		-2%			-1%	-4%	3%	4%	-15%			-37%	33%	-17%	6%			0%
6	-1%	-4%	-4%		12%	-1%	5%	16%	-13%				58%	-48%	26%			9%
7		14%			7%	38%	1%	4%	-19%			-41%	-9%	14%		-18%		1%
8	37%	28%	4%		39%	26%	19%	4%	-6%	-37%		-17%	13%	43%	4%	-3%		6%
9		-6%				-12%		4%	0%				34%					3%
10				10%				-57%		-2%	12%	-28%	-49%	10%	-3%		-3%	-1%
11				5%						-16%	4%	-9%		14%	19%		6%	4%
12					-19%			6%		-13%	15%	0%	-10%	9%	73%		46%	3%
13	74%	60%	9%		51%	14%	6%	3%	1%	-19%		-2%	2%	9%	15%	-8%		3%
14		15%	6%	37%	14%	-3%	-2%	46%	-36%	-16%	26%	15%	2%	2%	1%	9%	5%	2%
15					61%	-16%		24%	-20%	19%		63%	0%	4%	0%	23%	11%	0%
16								8%					7%	7%	0%	0%		0%
17				1%						-24%	12%			2%	-35%		-4%	-7%
Total	-3%	4%	1%	6%	6%	4%	5%	5%	-8%	-7%	8%	2%	3%	3%	0%	0%	-2%	1%

A.8. TPS RTM: GEH (AM peak)

Sector From\To	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Total
1	2.21	1.98	1.55	3.53	0.14	5.28	0.64	0.95	7.71	4.73	1.72	0.32	4.59	0.78	0.93	0.66	0.29	5.26
2	4.62	1.26	0.93	1.34	1.14	2.36	0.84	2.46	4.71	2.67	1.65	2.27	14.27	4.98	5.15	0.04	0.67	0.51
3	0.73	2.80	0.26	0.40	1.67	7.91	1.52	5.17	5.39	6.85	0.82	0.07	2.97	4.99	2.38	0.29	1.44	8.68
4	2.22	1.49	1.24	1.42	1.02	1.69	0.58	3.69	2.26	13.13	0.19	1.66	3.52	2.52	3.11	1.09	1.83	7.67
5	2.20	0.66	1.42	1.29	0.90	0.83	1.25	2.22	5.30	3.28	1.90	5.16	9.28	3.75	0.62	1.35	0.70	0.04
6	0.12	1.72	0.75	1.60	1.43	1.85	0.52	12.98	6.39	3.17	1.34	2.65	32.38	7.66	3.58	3.21	1.17	15.66
7	0.03	1.89	0.27	0.91	2.74	4.55	1.11	2.28	4.82	2.01	1.36	5.54	3.50	4.15	2.49	1.93	0.42	1.72
8	3.85	10.56	0.41	1.86	14.54	16.63	9.32	12.35	6.21	4.78	0.88	2.93	17.21	17.24	1.41	0.63	0.37	23.89
9	0.23	0.72	1.32	0.56	1.20	1.85	2.13	2.29	0.00	2.80	0.27	1.58	6.52	2.77	0.87	0.29	0.50	2.42
10	0.31	2.87	1.58	3.61	1.55	3.06	1.00	7.57	7.72	3.66	2.53	3.64	6.69	6.67	0.50	0.87	1.91	2.00
11	1.82	2.05	1.03	1.54	1.08	2.47	0.49	4.39	3.04	4.86	3.63	2.25	3.10	7.20	1.88	0.92	2.03	4.94
12	1.59	1.20	1.25	1.22	2.83	0.24	1.66	0.93	3.57	1.97	3.71	0.75	1.72	9.55	7.37	2.24	4.53	6.56
13	6.67	12.91	1.94	0.46	12.12	7.50	2.22	4.18	0.37	2.79	1.82	0.31	13.40	7.38	17.85	3.54	1.21	19.60
14	0.91	1.61	1.22	8.13	2.41	0.43	0.59	17.30	7.40	14.29	10.65	11.78	2.01	15.48	1.54	6.34	3.11	17.65
15	1.94	3.55	0.15	7.95	5.53	2.50	4.69	8.12	2.28	3.13	10.61	5.58	0.47	5.15	0.08	8.95	1.34	0.94
16	3.94	5.29	1.14	2.26	1.54	2.83	2.68	1.54	3.17	2.22	2.43	1.20	2.83	4.84	0.10	0.05	1.07	0.70
17	2.29	1.62	1.43	0.17	0.74	2.38	0.57	4.23	2.80	17.66	3.26	2.03	5.18	1.29	4.85	1.32	5.46	11.38
Total	1.79	4.58	0.37	4.81	8.18	6.01	5.72	18.67	12.15	17.01	9.86	4.58	21.04	20.26	1.39	0.85	3.16	16.81

A.9. TPS RTM: Percentage change (IP peak)

Sector From\To	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Total
1	5%	20%				0%		41%					69%					10%
2	-15%	1%			2%	3%	21%	22%	10%				29%					4%
3			0%			6%		35%		-13%			8%	-8%				1%
4				1%						0%	6%			25%			10%	4%
5		7%			1%	28%	8%	43%	25%			-38%	64%	-39%				8%
6	-12%	-1%	1%		-3%	1%	-13%	20%	5%				33%	-30%	13%			7%
7		20%			6%	40%	2%	22%	3%			-29%	11%	0%				6%
8	-2%	19%	2%		23%	10%	12%	5%	1%			-5%	6%	24%	1%	-10%		6%
9		12%			0%	-1%	-17%	3%	0%				24%	-41%	21%			3%
10				4%				-41%		1%	23%	-12%	-26%	5%	-6%	2%	6%	1%
11				8%						20%	5%	3%		27%			19%	9%
12					-40%			14%		6%	1%	0%	14%	14%	40%			3%
13	12%	27%	6%		50%	17%	17%	7%	17%	-18%		10%	3%	7%	10%	2%		4%
14		-37%	-2%	32%	-39%	-26%	-9%	32%	-19%	-1%	23%	8%	8%	2%	0%	13%	8%	2%
15		13%			44%	-12%		17%	3%	2%		59%	6%	2%	0%	1%	9%	0%
16								-13%		-6%			5%	10%	-1%	0%		0%
17				15%						4%	22%			1%	-36%		0%	2%
Total	-1%	6%	0%	7%	4%	4%	4%	7%	3%	1%	8%	2%	4%	2%	0%	0%	3%	1%

A.10. TPS RTM: GEH (IP peak)

Sector From\To	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Total
1	2.21	5.01	0.44	4.44	0.90	0.07	0.26	4.92	0.19	0.44	1.38	0.51	6.19	1.28	0.64	1.42	1.22	5.93
2	4.08	1.17	0.60	1.29	0.87	1.29	2.46	9.24	1.95	1.17	1.42	2.25	6.56	4.51	2.60	1.22	0.93	5.69
3	0.48	0.57	0.13	0.26	0.46	0.94	0.57	3.45	0.13	1.60	0.38	0.43	1.52	1.32	0.09	0.71	1.05	0.85
4	1.74	1.40	1.11	0.38	1.27	1.43	0.80	2.56	1.18	0.07	1.95	0.53	2.87	4.84	3.44	1.47	2.60	3.16
5	1.26	2.96	0.03	1.04	0.88	3.33	3.40	15.97	3.79	1.19	1.30	4.60	14.05	9.23	5.59	0.90	0.99	10.63
6	1.77	0.49	0.22	1.36	0.41	1.13	1.38	12.72	1.15	0.59	1.57	2.15	15.57	4.27	1.57	3.50	1.56	11.32
7	0.64	2.42	0.16	1.03	2.46	3.72	2.22	10.52	0.48	1.32	0.74	3.21	3.84	0.00	0.59	2.48	0.78	8.01
8	0.25	8.32	0.18	2.67	8.85	6.35	5.67	16.13	0.99	2.94	2.51	0.78	6.86	10.27	0.43	2.04	2.24	21.33
9	0.11	2.39	0.98	1.06	0.01	0.26	2.36	2.53	0.00	0.32	0.45	2.45	6.61	6.74	2.45	1.32	0.62	3.10
10	0.52	2.54	2.02	1.54	2.45	0.96	2.04	4.86	3.55	1.53	4.56	1.31	3.21	3.04	0.97	0.23	3.13	3.09
11	1.37	1.28	0.42	2.46	0.97	0.90	0.91	1.17	0.79	4.12	5.04	0.64	0.88	10.78	2.55	1.80	5.42	10.69
12	1.84	2.08	1.69	0.03	5.56	0.36	3.01	1.67	0.50	0.63	0.12	0.71	1.94	11.49	3.83	2.80	1.92	6.27
13	1.36	6.39	1.08	2.99	11.31	8.48	5.38	7.71	4.56	2.25	2.39	1.62	16.58	5.78	11.10	0.90	2.86	21.89
14	0.15	4.79	0.28	6.63	8.47	3.75	2.66	11.32	2.41	0.70	9.76	6.65	6.44	13.73	0.31	7.68	4.32	16.55
15	0.40	1.33	0.11	7.74	4.22	1.83	0.31	5.45	0.35	0.26	7.72	6.39	6.14	2.17	0.05	0.55	1.20	0.85
16	2.08	3.52	0.17	0.23	0.39	1.30	1.88	3.02	1.48	0.62	1.22	1.61	2.10	6.19	0.29	0.06	1.13	0.58
17	1.50	1.06	1.20	4.23	0.81	1.38	0.70	2.59	1.32	2.10	6.26	1.26	2.50	0.62	5.19	1.24	0.04	2.54
Total	0.41	7.41	0.00	5.59	5.79	6.82	5.49	25.50	2.80	1.73	10.77	3.84	21.88	17.28	0.82	0.73	4.28	20.92

A.11. TPS RTM: Percentage change (PM peak)

Sector From\To	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Total
1	0%	14%	-11%			-6%		20%					72%					5%
2	-29%	-1%			-1%	0%	10%	14%	-6%				79%					1%
3	-4%		-2%			-4%		-1%		-8%			1%	-7%				-3%
4				-3%						-10%	3%	-10%		24%			-7%	-3%
5		3%			2%	38%	12%	39%	0%			-13%	105%	8%				11%
6	-9%	-8%	-15%		-18%	-4%	1%	11%	-4%				25%	-5%	79%			1%
7		7%			3%	26%	2%	25%	-2%			-16%	16%	1%				7%
8	21%	8%	-18%		19%	-2%	16%	2%	-1%			18%	9%	40%	34%	16%		4%
9	17%	6%			12%	-27%	-15%	-2%	0%				-2%	-9%	31%			-3%
10	-35%		-35%	-17%				-57%		-2%	-12%	-21%	-38%	-9%	-15%		-22%	-5%
11				7%						4%	4%	10%		25%			5%	7%
12					-36%			33%		9%	-9%	0%	32%	11%				2%
13	50%	27%	-4%		30%	9%	13%	9%	9%	-11%		40%	1%	8%	3%	1%		2%
14		-33%	-15%	43%	-31%	-20%	-8%	48%	-26%	-11%	24%	3%	9%	1%	2%	14%	7%	1%
15		3%				0%		5%		-18%	125%	98%	8%	2%	0%	19%	7%	0%
16								56%					13%	10%	20%	0%		0%
17				17%						-10%	24%	20%		3%	-21%		-2%	-1%
Total	-6%	2%	-8%	3%	4%	-3%	6%	4%	-1%	-3%	8%	1%	2%	2%	0%	0%	-4%	1%

A.12. TPS RTM: GEH (PM peak)

Sector From\To	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Total
1	0.03	3.97	1.17	0.54	0.38	1.10	0.25	2.52	2.90	0.69	2.16	1.52	6.24	0.36	3.59	0.89	0.61	2.98
2	10.44	1.28	2.62	1.28	0.70	0.14	1.51	6.25	1.19	2.10	2.93	1.81	15.34	3.09	9.93	1.68	0.98	1.88
3	0.50	0.13	1.00	0.25	0.55	0.63	0.15	0.10	0.48	1.07	1.15	0.54	0.24	1.40	0.73	0.38	1.60	1.77
4	6.76	1.16	0.87	1.61	1.55	1.19	0.77	2.31	0.98	3.91	0.88	1.02	1.71	4.96	4.44	1.94	2.08	2.47
5	0.67	1.24	0.30	0.23	2.04	4.62	5.44	16.77	0.06	0.17	0.91	1.93	22.57	1.64	10.63	0.25	0.01	15.51
6	1.91	3.95	3.71	0.88	3.64	5.31	0.07	8.19	0.81	1.21	2.04	1.71	13.64	0.66	8.24	2.55	1.40	2.38
7	0.07	1.18	0.13	0.66	1.65	3.03	2.06	13.34	0.29	0.17	0.52	2.02	5.81	0.41	0.11	0.31	0.38	9.64
8	3.63	4.52	2.63	1.61	9.59	2.13	9.23	7.61	0.57	2.17	2.94	2.85	12.38	15.65	11.16	2.93	0.33	16.26
9	2.02	2.15	5.65	0.92	3.56	13.21	3.58	1.90	0.00	0.32	1.84	2.37	0.81	1.65	3.88	1.32	0.48	4.80
10	4.26	3.37	4.49	7.92	2.97	4.11	1.98	7.08	4.84	3.72	3.50	3.55	5.27	7.56	2.48	3.62	16.94	13.32
11	1.76	1.43	0.92	2.30	1.50	1.23	1.14	1.87	1.22	0.92	4.77	2.43	1.12	11.14	4.46	3.16	1.76	9.58
12	3.35	2.02	1.25	0.67	5.89	0.73	3.20	4.17	0.83	1.09	2.24	0.79	4.14	9.63	5.70	3.78	0.18	3.91
13	5.75	6.95	1.11	0.32	7.52	5.59	4.27	12.68	2.55	1.22	0.40	5.73	7.93	7.70	4.17	0.31	0.26	13.33
14	1.68	4.38	3.01	10.87	6.72	2.84	2.41	15.66	3.00	8.78	13.07	3.55	7.33	9.41	2.68	9.24	4.35	12.61
15	0.91	0.35	1.60	8.86	1.73	0.07	2.13	1.79	0.01	3.17	9.95	9.82	9.41	2.83	0.17	6.76	1.05	1.33
16	0.96	0.71	0.44	1.18	1.10	0.58	0.81	9.82	0.50	0.40	0.53	0.77	5.86	6.65	6.85	0.04	1.45	1.37
17	2.59	1.49	2.05	5.50	0.89	1.73	0.62	3.34	1.51	6.81	8.10	1.98	2.23	1.93	2.51	1.99	2.14	1.01
Total	4.31	2.29	5.81	2.73	5.75	5.71	7.53	18.45	0.80	8.61	11.03	2.15	15.82	13.00	1.24	1.17	6.61	13.16

Appendix B. Calibration / Validation: flow screenlines

For full details please see the attached folder ‘Appendix C’ (filename: ‘TPUP3_Base_Cal_Val_v3.5_CC.xlsm’) and (filename: ‘TPUP3_Base_Cal_Val_v3.0.xlsm’). This includes a breakdown by vehicle type at both a screenline level and an individual link level.

B.1. TPU PCF Stage 3: AM peak (all vehicles)

		Prior-ME					Post-ME				
Screenline	Direction	Obs.	Mod.	Diff.	Diff. (%)	GEH	Obs.	Mod.	Diff.	Diff. (%)	GEH
A61 Cordon	A61 Cordon Inbound	11,428	9,569	-1,859	-16.3%	18.1	11,428	11,540	112	1.0%	1.0
A61 Cordon	A61 Cordon Outbound	12,175	9,196	-2,979	-24.5%	28.8	12,175	11,665	-510	-4.2%	4.7
Inner Study Cordon	Inner Study Cordon Inbound	4,091	3,608	-483	-11.8%	7.8	4,091	3,933	-158	-3.9%	2.5
Inner Study Cordon	Inner Study Cordon Outbound	4,472	4,237	-234	-5.2%	3.6	4,472	4,396	-76	-1.7%	1.1
M1 Screenline	M1 Screenline EB	5,965	5,421	-545	-9.1%	7.2	5,965	6,019	54	0.9%	0.7
M1 Screenline	M1 Screenline WB	4,041	3,673	-368	-9.1%	5.9	4,041	4,094	54	1.3%	0.8
Trans-Pennine Western Screenline	Trans-Pennine Western Screenline EB	8,474	7,666	-808	-9.5%	9.0	8,474	8,460	-13	-0.2%	0.1
Trans-Pennine Western Screenline	Trans-Pennine Western Screenline WB	9,568	9,806	238	2.5%	2.4	9,568	9,502	-65	-0.7%	0.7
Trans-Pennine Eastern Screenline	Trans-Pennine Eastern Screenline EB	4,660	4,969	309	6.6%	4.5	4,660	4,600	-59	-1.3%	0.9
Trans-Pennine Eastern Screenline	Trans-Pennine Eastern Screenline WB	4,425	5,312	887	20.0%	12.7	4,425	4,382	-43	-1.0%	0.7
Glossop / Hadfield Counts	Glossop-Hadfield_Links	1,402	1,557	155	11.1%	4.0	1,402	1,416	14	1.0%	0.4
All Other Counts	Other Link Counts	177,146	173,950	-3,196	-1.8%	7.6	177,146	175,528	-1,618	-0.9%	3.9

B.2. TPU PCF Stage 3: IP (all vehicles)

		Prior-ME					Post-ME				
Screenline	Direction	Obs.	Mod.	Diff.	Diff. (%)	GEH	Obs.	Mod.	Diff.	Diff. (%)	GEH
A61 Cordon	A61 Cordon Inbound	10,014	7,117	-2,897	-28.9%	31.3	10,014	9,979	-35	-0.4%	0.4
A61 Cordon	A61 Cordon Outbound	10,215	6,987	-3,228	-31.6%	34.8	10,215	10,164	-52	-0.5%	0.5
Inner Study Cordon	Inner Study Cordon Inbound	3,898	3,417	-481	-12.4%	8.0	3,898	3,922	24	0.6%	0.4
Inner Study Cordon	Inner Study Cordon Outbound	3,795	3,348	-447	-11.8%	7.5	3,795	3,839	44	1.2%	0.7
M1 Screenline	M1 Screenline EB	4,271	3,648	-623	-14.6%	9.9	4,271	4,280	9	0.2%	0.1
M1 Screenline	M1 Screenline WB	4,177	3,690	-487	-11.7%	7.8	4,177	4,152	-25	-0.6%	0.4
Trans-Pennine Western Screenline	Trans-Pennine Western Screenline EB	8,138	7,746	-392	-4.8%	4.4	8,138	8,270	132	1.6%	1.5
Trans-Pennine Western Screenline	Trans-Pennine Western Screenline WB	8,311	7,317	-994	-12.0%	11.2	8,311	8,325	14	0.2%	0.2
Trans-Pennine Eastern Screenline	Trans-Pennine Eastern Screenline EB	4,316	4,845	529	12.2%	7.8	4,316	4,354	39	0.9%	0.6
Trans-Pennine Eastern Screenline	Trans-Pennine Eastern Screenline WB	4,413	4,813	400	9.1%	5.9	4,413	4,263	-150	-3.4%	2.3
Glossop / Hadfield Counts	Glossop-Hadfield_Links	1,396	1,377	-19	-1.3%	0.5	1,396	1,378	-18	-1.3%	0.5
All Other Counts	Other Link Counts	153,288	140,863	-12,425	-8.1%	32.4	153,288	154,882	1,594	1.0%	4.1

B.3. TPU PCF Stage 3: PM peak (all vehicles)

		Prior-ME					Post-ME				
Screenline	Direction	Obs.	Mod.	Diff.	Diff. (%)	GEH	Obs.	Mod.	Diff.	Diff. (%)	GEH
A61 Cordon	A61 Cordon Inbound	12,748	9,254	-3,495	-27.4%	33.3	12,748	12,731	-17	-0.1%	0.2
A61 Cordon	A61 Cordon Outbound	12,909	9,176	-3,733	-28.9%	35.5	12,909	12,869	-40	-0.3%	0.4
Inner Study Cordon	Inner Study Cordon Inbound	4,439	4,639	200	4.5%	3.0	4,439	4,432	-7	-0.2%	0.1
Inner Study Cordon	Inner Study Cordon Outbound	4,197	3,958	-240	-5.7%	3.8	4,197	4,237	40	1.0%	0.6
M1 Screenline	M1 Screenline EB	4,499	4,035	-464	-10.3%	7.1	4,499	4,525	26	0.6%	0.4
M1 Screenline	M1 Screenline WB	5,801	5,459	-341	-5.9%	4.5	5,801	5,778	-23	-0.4%	0.3
Trans-Pennine Western Screenline	Trans-Pennine Western Screenline EB	10,191	9,136	-1,054	-10.3%	10.7	10,191	10,131	-60	-0.6%	0.6
Trans-Pennine Western Screenline	Trans-Pennine Western Screenline WB	9,932	7,900	-2,032	-20.5%	21.5	9,932	9,893	-40	-0.4%	0.4
Trans-Pennine Eastern Screenline	Trans-Pennine Eastern Screenline EB	4,739	4,289	-450	-9.5%	6.7	4,739	4,712	-27	-0.6%	0.4
Trans-Pennine Eastern Screenline	Trans-Pennine Eastern Screenline WB	4,934	5,097	163	3.3%	2.3	4,934	4,901	-33	-0.7%	0.5
Glossop / Hadfield Counts	Glossop-Hadfield_Links	1,570	1,680	110	7.0%	2.7	1,570	1,631	61	3.9%	1.5
All Other Counts	Other Link Counts	190,891	175,408	-15,483	-8.1%	36.2	190,891	194,171	3,280	1.7%	7.5

Appendix C. Calibration / Validation: journey time routes

For full details please see the attached folder ‘Appendix D’ (filename: ‘Journey_Time.html‘). This includes journey time profiles for all routes by timing point and time period.

C.1. Journey time screenline summary (modelled vs. observed)

C.1.1. AM peak

Route Name	Route Direction	Distance (km)	Observed	Modelled	Diff	% Diff	Pass/Fail
A560	NB	8.2	00:12:32	00:11:43	-00:00:48	-6.50%	Pass
A560	SB	8.2	00:19:43	00:20:05	00:00:22	1.90%	Pass
A57	EB	38.2	00:39:16	00:42:26	00:03:09	8.10%	Pass
A57	WB	38.2	00:41:23	00:40:38	-00:00:44	-1.80%	Pass
A61	NB	8.1	00:09:21	00:09:49	00:00:28	5.00%	Pass
A61	SB	8.2	00:10:02	00:08:51	-00:01:11	-11.80%	Pass
A624	NB	13.8	00:14:55	00:15:21	00:00:25	2.90%	Pass
A624	SB	13.8	00:14:38	00:13:52	-00:00:45	-5.20%	Pass
A628	EB	14.8	00:16:20	00:17:37	00:01:17	7.90%	Pass
A628	WB	14.8	00:15:49	00:15:41	-00:00:07	-0.80%	Pass
A628&A616	EB	48.2	00:55:15	00:58:56	00:03:41	6.70%	Pass
A628&A616	WB	49.4	00:55:15	00:55:44	00:00:29	0.90%	Pass
A635	EB	44.1	00:56:04	00:55:33	-00:00:30	-0.90%	Pass
A635	WB	47.4	00:58:12	01:00:59	00:02:46	4.80%	Pass
Hadfield Alternative	EB	4.5	00:07:34	00:07:53	00:00:18	4.10%	Pass
Hadfield Alternative	WB	4.5	00:09:20	00:07:18	-00:02:01	-21.70%	Fail
M1	NB	28.7	00:20:53	00:18:23	-00:02:30	-12.00%	Pass
M1	SB	27.5	00:19:50	00:17:21	-00:02:29	-12.50%	Pass
M62	EB	60.1	00:53:00	00:51:11	-00:01:49	-3.40%	Pass
M62	WB	59.3	00:45:44	00:40:32	-00:05:12	-11.40%	Pass

C.1.2. IP

Route Name	Route Direction	Distance (km)	Observed	Modelled	Diff	% Diff	Pass/Fail
A560	NB	8.2	00:12:24	00:11:47	-00:00:36	-4.90%	Pass
A560	SB	8.2	00:16:13	00:14:49	-00:01:23	-8.60%	Pass
A57	EB	38.2	00:41:55	00:43:52	00:01:57	4.70%	Pass
A57	WB	38.2	00:42:02	00:42:17	00:00:15	0.60%	Pass
A61	NB	8.1	00:08:49	00:09:40	00:00:50	9.50%	Pass
A61	SB	8.2	00:09:12	00:08:39	-00:00:32	-5.80%	Pass
A624	NB	13.8	00:15:16	00:14:40	-00:00:36	-4.00%	Pass
A624	SB	13.8	00:14:55	00:13:09	-00:01:46	-11.90%	Pass
A628	EB	14.8	00:16:07	00:18:07	00:02:00	12.40%	Pass
A628	WB	14.8	00:15:41	00:17:10	00:01:29	9.50%	Pass
A628&A616	EB	48.2	00:55:09	01:00:40	00:05:30	10.00%	Pass
A628&A616	WB	49.4	00:52:13	00:58:31	00:06:17	12.10%	Pass
A635	EB	44.1	00:55:59	00:54:42	-00:01:17	-2.30%	Pass
A635	WB	47.4	00:56:01	00:56:06	00:00:05	0.20%	Pass
Hadfield Alternative	EB	4.5	00:07:42	00:07:51	00:00:08	1.80%	Pass
Hadfield Alternative	WB	4.5	00:07:28	00:07:20	-00:00:08	-1.90%	Pass
M1	NB	28.7	00:20:21	00:17:33	-00:02:48	-13.80%	Pass
M1	SB	27.5	00:19:27	00:16:49	-00:02:38	-13.60%	Pass
M62	EB	60.1	00:48:09	00:43:16	-00:04:52	-10.10%	Pass
M62	WB	59.3	00:42:51	00:41:14	-00:01:36	-3.80%	Pass

C.1.3. PM peak

Route Name	Route Direction	Distance (km)	Observed	Modelled	Diff	% Diff	Pass/Fail
A560	NB	8.2	00:13:04	00:13:30	00:00:26	3.40%	Pass
A560	SB	8.2	00:15:07	00:14:32	-00:00:35	-3.90%	Pass
A57	EB	38.2	00:41:47	00:44:36	00:02:48	6.70%	Pass
A57	WB	38.2	00:41:06	00:41:43	00:00:37	1.50%	Pass
A61	NB	8.1	00:09:28	00:10:17	00:00:48	8.50%	Pass
A61	SB	8.2	00:10:34	00:09:20	-00:01:14	-11.80%	Pass
A624	NB	13.8	00:15:07	00:15:43	00:00:36	4.00%	Pass
A624	SB	13.8	00:14:11	00:13:20	-00:00:50	-6.00%	Pass
A628	EB	14.8	00:15:47	00:16:33	00:00:45	4.80%	Pass
A628	WB	14.8	00:15:42	00:16:12	00:00:29	3.20%	Pass
A628&A616	EB	48.2	00:57:50	00:57:54	00:00:03	0.10%	Pass
A628&A616	WB	49.4	00:54:50	00:55:43	00:00:53	1.60%	Pass
A635	EB	44.1	00:57:17	01:00:16	00:02:59	5.20%	Pass
A635	WB	47.4	00:57:23	01:00:25	00:03:01	5.30%	Pass
Hadfield Alternative	EB	4.5	00:07:59	00:08:19	00:00:19	4.10%	Pass
Hadfield Alternative	WB	4.5	00:08:03	00:07:36	-00:00:27	-5.70%	Pass
M1	NB	28.7	00:20:03	00:18:01	-00:02:01	-10.10%	Pass
M1	SB	27.5	00:20:12	00:17:33	-00:02:38	-13.10%	Pass
M62	EB	60.1	00:48:45	00:43:10	-00:05:34	-11.40%	Pass
M62	WB	59.3	00:47:22	00:45:13	-00:02:08	-4.50%	Pass

Appendix D. HAM convergence

D.1. TPU PCF Stage 3: AM peak

Loop	% Flow	% Delay	% Gap	Ass.	Sim.	A/S Step	%V.I.
1	0.0	49.4	3.506	0.364	0.057	1.000	0.00000
2	28.0	82.5	1.286	0.428	0.021	1.000	0.17700
3	41.1	89.1	0.749	0.197	0.027	0.933	0.00810
4	53.1	91.8	0.451	0.165	0.044	1.000	0.00410
5	63.2	93.1	0.268	0.140	0.027	0.867	0.00061
6	69.1	94.0	0.218	0.075	0.027	1.000	0.00110
7	73.5	94.8	0.137	0.071	0.036	0.478	0.00340
8	80.6	95.7	0.107	0.073	0.019	1.000	0.01200
9	81.9	95.7	0.113	0.065	0.022	1.000	0.00400
10	83.3	96.1	0.081	0.040	0.023	0.270	0.00120
11	86.7	96.3	0.083	0.039	0.020	1.000	0.00280
12	87.4	96.6	0.074	0.044	0.015	0.114	0.00140
13	88.7	96.6	0.071	0.035	0.028	1.000	0.00230
14	88.9	96.8	0.053	0.042	0.016	0.185	0.00049
15	90.8	96.9	0.062	0.029	0.022	1.000	0.00150
16	90.4	97.0	0.044	0.028	0.014	0.536	0.00190
17	92.4	97.1	0.063	0.025	0.019	1.000	0.00080
18	92.2	97.1	0.039	0.021	0.017	0.373	0.00004
19	93.8	97.3	0.054	0.021	0.022	1.000	0.00019
20	93.0	97.4	0.039	0.018	0.016	0.273	0.00000

Loop	% Flow	% Delay	% Gap	Ass.	Sim.	A/S Step	%V.I.
21	93.5	97.4	0.049	0.021	0.013	0.646	0.00059
22	94.0	97.6	0.031	0.019	0.006	0.247	0.00020
23	95.1	97.6	0.060	0.022	0.014	1.000	0.00040
24	93.1	97.5	0.038	0.023	0.015	0.135	0.00092
25	94.7	97.7	0.031	0.017	0.011	0.566	0.00002
26	95.3	97.7	0.030	0.014	0.016	0.489	0.00100
27	94.9	97.5	0.074	0.015	0.013	1.000	0.00011
28	93.1	97.4	0.036	0.025	0.016	0.231	0.00008
29	95.4	97.7	0.034	0.015	0.022	0.543	0.00032
30	96.2	98.0	0.027	0.017	0.008	0.170	0.00070
31	97.1	98.1	0.020	0.012	0.017	0.531	0.00021
32	96.9	98.1	0.030	0.013	0.008	0.538	0.00001
33	96.3	98.1	0.019	0.011	0.005	0.205	0.00005
34	97.3	98.3	0.027	0.016	0.011	0.626	0.00022
35	96.4	98.2	0.018	0.011	0.010	0.214	0.00000
36	97.4	98.3	0.025	0.014	0.010	0.506	0.00001
37	97.1	98.4	0.021	0.014	0.006	0.130	0.00065
38	97.7	98.5	0.018	0.011	0.006	0.246	0.00004
39	97.3	98.5	0.022	0.011	0.004	0.454	0.00010
40	97.2	98.4	0.017	0.010	0.003	0.200	0.00002
41	97.7	98.4	0.021	0.012	0.005	0.363	0.00002
42	98.1	98.6	0.016	0.008	0.007	0.182	0.00005
43	97.8	98.6	0.022	0.010	0.013	0.367	0.00002
44	97.4	98.5	0.015	0.015	0.006	0.146	0.00011

Loop	% Flow	% Delay	% Gap	Ass.	Sim.	A/S Step	%V.I.
45	97.8	98.5	0.025	0.010	0.008	0.491	0.00003
46	97.4	98.5	0.020	0.008	0.007	0.128	0.00052
47	97.9	98.6	0.014	0.012	0.012	0.326	0.00002
48	98.0	98.6	0.022	0.011	0.007	0.453	0.00007
49	97.8	98.6	0.015	0.013	0.007	0.125	0.00003
50	98.3	98.7	0.020	0.010	0.005	0.262	0.00007
51	97.6	98.5	0.017	0.010	0.012	0.108	0.00041
52	98.4	98.6	0.012	0.007	0.011	0.101	0.00002
53	98.5	98.8	0.022	0.011	0.011	0.346	0.00003
54	98.0	98.7	0.019	0.010	0.004	0.096	0.00045
55	98.5	98.8	0.012	0.007	0.003	0.134	0.00004
56	98.5	98.8	0.024	0.011	0.010	0.502	0.00007
57	97.6	98.5	0.020	0.008	0.014	0.190	0.00022
58	97.4	98.1	0.039	0.010	0.008	1.000	0.00011
59	95.9	98.0	0.022	0.010	0.008	0.177	0.00014
60	97.1	98.3	0.019	0.009	0.010	0.341	0.00021
61	97.8	98.6	0.013	0.007	0.010	0.310	0.00000
62	98.0	98.6	0.021	0.008	0.008	0.354	0.00008
63	97.9	98.7	0.012	0.010	0.004	0.084	0.00002
64	98.1	98.6	0.022	0.007	0.007	0.401	0.00003
65	97.7	98.7	0.018	0.007	0.007	0.127	0.00053
66	98.4	98.9	0.013	0.008	0.004	0.100	0.00002
67	98.2	98.8	0.016	0.009	0.009	0.116	0.00001
68	98.5	98.9	0.016	0.007	0.005	0.054	0.00033

Loop	% Flow	% Delay	% Gap	Ass.	Sim.	A/S Step	%V.I.
69	98.6	98.9	0.016	0.006	0.007	0.023	0.00053

D.2. TPU PCF Stage 3: IP

Loop	% Flow	% Delay	% Gap	Ass.	Sim.	A/S Step	%V.I.
1	0.0	50.6	1.816	0.147	0.045	1.000	0.00000
2	35.4	89.3	0.580	0.234	0.018	1.000	0.12100
3	54.3	94.6	0.415	0.145	0.014	0.771	0.00500
4	66.4	96.1	0.264	0.112	0.018	1.000	0.04000
5	74.3	96.6	0.207	0.103	0.009	0.756	0.00210
6	79.4	97.1	0.124	0.047	0.008	0.489	0.00340
7	83.9	97.5	0.105	0.056	0.015	1.000	0.01700
8	86.7	97.7	0.094	0.037	0.012	1.000	0.00430
9	88.2	98.0	0.073	0.031	0.006	0.243	0.00085
10	90.3	98.1	0.080	0.030	0.011	1.000	0.00073
11	91.5	98.2	0.053	0.023	0.006	0.190	0.00078
12	93.4	98.4	0.047	0.024	0.014	0.631	0.00240
13	94.2	98.5	0.080	0.023	0.008	1.000	0.00160
14	93.2	98.3	0.051	0.022	0.018	0.705	0.00190
15	94.4	98.5	0.043	0.023	0.013	0.420	0.00008
16	93.6	98.5	0.052	0.024	0.008	1.000	0.00250
17	94.4	98.6	0.051	0.021	0.010	0.166	0.00097
18	95.2	98.7	0.044	0.019	0.013	0.691	0.00110
19	95.8	98.8	0.036	0.019	0.017	0.267	0.00012
20	96.0	98.8	0.031	0.024	0.007	1.000	0.00020
21	94.2	98.7	0.023	0.015	0.013	0.109	0.00074
22	95.7	98.7	0.038	0.014	0.015	1.000	0.00120
23	94.6	98.7	0.029	0.019	0.015	0.119	0.00160

Loop	% Flow	% Delay	% Gap	Ass.	Sim.	A/S Step	%V.I.
24	96.1	98.8	0.023	0.011	0.007	0.679	0.00053
25	96.1	98.8	0.017	0.011	0.013	0.372	0.00110
26	96.5	98.9	0.023	0.011	0.007	0.681	0.00036
27	95.6	98.8	0.015	0.010	0.016	0.121	0.00037
28	97.0	98.9	0.032	0.010	0.010	1.000	0.00016
29	95.2	98.8	0.020	0.021	0.023	0.099	0.00120
30	96.6	98.8	0.025	0.010	0.012	1.000	0.00013
31	95.6	98.8	0.015	0.013	0.029	0.175	0.00098
32	96.8	99.0	0.032	0.014	0.017	0.442	0.00110
33	96.2	98.9	0.014	0.012	0.010	0.165	0.00013
34	97.5	99.1	0.013	0.009	0.016	0.315	0.00060
35	97.8	99.2	0.016	0.007	0.012	0.113	0.00076
36	97.6	99.1	0.012	0.010	0.008	0.551	0.00003
37	97.5	99.0	0.016	0.008	0.012	1.000	0.00002
38	97.2	99.0	0.015	0.008	0.016	0.586	0.00019
39	97.6	99.2	0.012	0.007	0.017	0.178	0.00007
40	97.9	99.1	0.037	0.009	0.007	1.000	0.00005
41	95.3	98.9	0.012	0.014	0.015	0.073	0.00018
42	97.4	98.9	0.014	0.005	0.006	0.487	0.00022
43	97.5	99.0	0.013	0.006	0.010	0.485	0.00010
44	98.0	99.1	0.013	0.006	0.010	0.457	0.00011
45	97.7	99.1	0.009	0.006	0.006	0.139	0.00007
46	98.1	99.1	0.017	0.006	0.003	1.000	0.00006
47	97.2	99.1	0.009	0.007	0.012	0.148	0.00037

Loop	% Flow	% Delay	% Gap	Ass.	Sim.	A/S Step	%V.I.
48	97.9	99.2	0.007	0.006	0.010	0.326	0.00022
49	98.4	99.2	0.013	0.004	0.004	1.000	0.00001
50	97.6	99.1	0.012	0.006	0.008	0.463	0.00007
51	98.0	99.2	0.009	0.006	0.009	0.189	0.00023
52	98.4	99.2	0.011	0.007	0.007	0.442	0.00009
53	98.1	99.3	0.007	0.006	0.007	0.100	0.00006
54	98.7	99.3	0.012	0.004	0.005	0.569	0.00004

D.3. TPU PCF Stage 3: PM peak

Loop	% Flow	% Delay	% Gap	Ass.	Sim.	A/S Step	%V.I.
1	0.0	49.5	4.204	0.443	0.045	1.000	0.00000
2	28.0	81.3	1.644	0.397	0.024	1.000	0.18700
3	41.2	88.3	0.931	0.264	0.023	0.898	0.01200
4	52.7	90.9	0.582	0.189	0.021	1.000	0.01000
5	61.6	92.1	0.316	0.116	0.037	0.670	0.01900
6	69.3	93.6	0.320	0.090	0.024	1.000	0.01400
7	73.5	93.9	0.223	0.089	0.019	0.667	0.00190
8	78.8	94.6	0.199	0.069	0.029	0.922	0.00240
9	81.8	95.2	0.126	0.073	0.022	0.589	0.00430
10	85.3	95.7	0.159	0.055	0.026	1.000	0.00160
11	85.8	95.8	0.089	0.048	0.010	0.582	0.00034
12	88.8	96.3	0.135	0.036	0.031	1.000	0.00240
13	87.6	96.2	0.081	0.044	0.012	0.639	0.00025
14	89.9	96.6	0.078	0.042	0.027	0.639	0.00570
15	91.0	96.7	0.089	0.035	0.014	0.901	0.00100
16	90.0	96.6	0.056	0.029	0.030	0.528	0.00230
17	93.1	97.0	0.090	0.024	0.025	1.000	0.00047
18	91.2	96.7	0.046	0.031	0.013	0.582	0.00025
19	94.3	97.1	0.059	0.022	0.019	0.822	0.00074
20	93.5	97.1	0.087	0.021	0.020	0.530	0.00022
21	91.8	96.6	0.100	0.037	0.037	0.883	0.00150

Loop	% Flow	% Delay	% Gap	Ass.	Sim.	A/S Step	%V.I.
22	91.5	96.8	0.068	0.030	0.040	0.628	0.00070
23	92.9	97.0	0.055	0.039	0.032	0.891	0.00083
24	93.9	97.1	0.044	0.022	0.031	0.857	0.00033
25	94.5	97.2	0.075	0.021	0.018	0.759	0.00005
26	93.6	97.2	0.047	0.026	0.015	0.568	0.00054
27	95.5	97.4	0.042	0.029	0.014	0.692	0.00001
28	95.0	97.4	0.058	0.023	0.012	1.000	0.00003
29	93.1	97.2	0.054	0.026	0.017	0.475	0.00021
30	94.5	97.2	0.083	0.030	0.045	1.000	0.00230
31	91.6	97.1	0.048	0.039	0.021	0.446	0.00043
32	94.3	97.3	0.059	0.037	0.024	1.000	0.00054
33	93.5	97.2	0.052	0.026	0.041	0.392	0.00089
34	94.6	97.4	0.040	0.020	0.045	0.602	0.00012
35	95.4	97.7	0.039	0.022	0.032	0.653	0.00022
36	95.6	97.7	0.036	0.018	0.050	0.778	0.00020
37	95.7	97.7	0.027	0.022	0.041	0.678	0.00040
38	96.0	97.8	0.027	0.020	0.033	0.506	0.00051
39	96.7	97.9	0.028	0.017	0.043	0.806	0.00019
40	95.6	97.8	0.023	0.022	0.039	0.506	0.00003
41	97.2	98.0	0.030	0.015	0.038	0.874	0.00008
42	96.1	98.0	0.038	0.019	0.025	0.519	0.00007
43	96.0	97.9	0.026	0.026	0.018	0.437	0.00039
44	96.7	98.1	0.030	0.014	0.013	0.749	0.00008
45	96.2	97.9	0.027	0.014	0.015	0.510	0.00003

Loop	% Flow	% Delay	% Gap	Ass.	Sim.	A/S Step	%V.I.
46	96.2	97.6	0.036	0.016	0.023	1.000	0.00044
47	94.5	97.6	0.028	0.016	0.015	0.320	0.00010
48	96.0	97.8	0.027	0.014	0.027	0.578	0.00016
49	96.6	98.1	0.021	0.014	0.015	0.552	0.00028
50	96.9	98.0	0.038	0.019	0.026	1.000	0.00021
51	94.6	97.7	0.026	0.026	0.016	0.256	0.00087
52	96.2	97.9	0.037	0.014	0.028	0.454	0.00005
53	95.6	97.9	0.027	0.022	0.020	0.063	0.00150
54	96.7	98.1	0.031	0.020	0.016	0.647	0.00004
55	95.7	98.1	0.025	0.015	0.028	0.239	0.00016
56	96.9	97.9	0.022	0.011	0.020	0.405	0.00008
57	97.3	98.4	0.019	0.011	0.024	0.403	0.00015
58	97.4	98.4	0.017	0.011	0.013	0.487	0.00008
59	97.7	98.3	0.026	0.011	0.039	0.635	0.00015
60	96.8	98.0	0.044	0.013	0.042	0.765	0.00026
61	96.0	98.0	0.032	0.028	0.034	0.332	0.00008
62	96.5	97.9	0.023	0.014	0.028	0.605	0.00004
63	96.7	98.1	0.017	0.010	0.025	0.352	0.00025
64	97.7	98.4	0.020	0.011	0.030	0.546	0.00008
65	97.3	98.2	0.018	0.010	0.026	0.464	0.00022
66	97.8	98.3	0.016	0.008	0.028	0.433	0.00019
67	97.6	98.4	0.034	0.008	0.017	0.270	0.00003
68	96.5	98.2	0.014	0.022	0.023	0.061	0.00012
69	98.2	98.6	0.016	0.007	0.025	0.341	0.00005

Loop	% Flow	% Delay	% Gap	Ass.	Sim.	A/S Step	%V.I.
70	97.7	98.5	0.016	0.009	0.009	0.194	0.00005
71	98.2	98.6	0.025	0.008	0.046	0.651	0.00007
72	96.5	98.2	0.023	0.012	0.040	0.148	0.00001
73	97.4	98.4	0.017	0.016	0.028	0.205	0.00007
74	97.9	98.4	0.019	0.010	0.026	0.311	0.00001
75	97.5	98.4	0.014	0.008	0.026	0.165	0.00004
76	98.2	98.6	0.019	0.008	0.031	0.427	0.00006
77	97.7	98.6	0.019	0.010	0.038	0.156	0.00017
78	97.8	98.5	0.015	0.015	0.028	0.180	0.00005
79	98.2	98.6	0.012	0.012	0.024	0.237	0.00005
80	98.3	98.7	0.013	0.007	0.031	0.301	0.00009
81	98.3	98.7	0.014	0.008	0.024	0.119	0.00003
82	98.3	98.5	0.012	0.007	0.040	0.183	0.00002

Appendix E. VDM convergence

Iteration	Gap	Full Model %GAP	Subset Area %GAP	Cost Stability				Flow Stability				Totals	
Main	Abs			RAAD	AAD	RMS	%<5%	RAAD	AAD	RMS	%<5%	Trips	Cost (000s)
1	25929548	1.50%	1.64%	0	0	0	0%	0	0	0	0%	70,266,573	1,733,240.7
2	5350757.5	0.31%	0.38%	0.004	0.144	0.225	99.83%	0.030	0.009	1.527	76.11%	70,266,573	1,724,142.3
3	1514443.7	0.09%	0.17%	0.001	0.042	0.121	99.88%	0.005	0.002	0.305	99.76%	70,266,573	1,722,876.3

Appendix F. Sectored demand matrices

F.1. TPU PCF Stage 3: VDM

For full details please see the attached folder ‘Appendix F’ (filename: ‘TPU_VDM_Demand_Summary_Base_v3.5_CC.xlsm’).

F.2. TPU PCF Stage 3: HAM

For full details please see the attached folder ‘Appendix F’ (filename: ‘TPU_HAM_Demand_Summary_Base_v3.5_CC.xlsm’).

[redacted]

Routes to Market – Delivery Integration Partnership

A57 TPU

A57 Transport Forecasting Package

HE551473-BBA-GEN-A57_AL_SCHEME-AS-TR-000003
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This document has 191 pages including the cover.

Document history

Revision	Suitability	Purpose description	Originated	Checked	Reviewed	Authorised	Date
[redacted]							

DRIVING OUTCOMES

Contents

Tables

Figures

1. Introduction

1.1. Purpose of the Transport Forecasting Package

1.1.1. The purpose of the Transport Forecasting Package is to provide details of the forecast transport models developed for Project Control Framework (PCF) Stage 3 of the Trans-Pennine Upgrade (TPU) A57 link road scheme.

1.2. Background

1.2.1. The validated base model developed during PCF Stage 3 has been used as a starting point for the development of the PCF Stage 3 TPU forecasting scenarios. Comprehensive details regarding the TPU model specification are outlined in the PCF Stage 2 LMVR[1], whilst details of the base model developments undertaken by Atkins during the finalisation of PCF Stage 3 are provided in the Transport Model Package[2], including results extracted from the validated base model.

1.2.2. The forecasting process adopted for PCF Stage 3 of the TPU A57 link road scheme is derived from the Trans-Pennine South Regional Traffic Model (TPS RTM). Comprehensive details of the TPS RTM forecasting setup are outlined in the relevant forecasting report[3] and are therefore not repeated in this document. Forecasting assumptions are consistent with the TPS RTM, unless otherwise stated.

1.2.3. An initial PCF Stage 3 Combined Modelling and Appraisal (ComMA) report was produced by Arcadis in May 2019[4], without the production of a separate Transport Forecasting Package. Following refinements to the PCF Stage 3 TPU model by Atkins, details relating to the forecasting assumptions and results included in the ComMA (Arcadis, May 2019) have been superseded by this Transport Forecasting Package.

1.3. Need for modelling refinement

1.3.1. Initial air quality (AQ) modelling undertaken by Arcadis in July 2018 indicated that an unmitigated TPU scheme could have significant AQ effects and jeopardise the application for development consent. Changes in traffic flow and speed as a result of the scheme were predicted to cause exceedances of the AQ strategy objectives for annual mean nitrogen dioxide (NO2). The primary locations where a negative AQ impact was reported were the village of Tintwistle (A628) and the roads Dinting Vale and Glossop High Street, as shown in Figure 1-1.

1.3.2. Atkins was commissioned by HE to undertake a review of the work done by consultants Arcadis at PCF Stage 3 for the proposed TPU scheme. The aim of this process was to strengthen the robustness of the modelling, under high levels of scrutiny for the Development Consent Order (DCO). Following the presentation of the review findings in the summer of 2019, Atkins was commissioned to implement its recommendations and finalise PCF Stage 3.

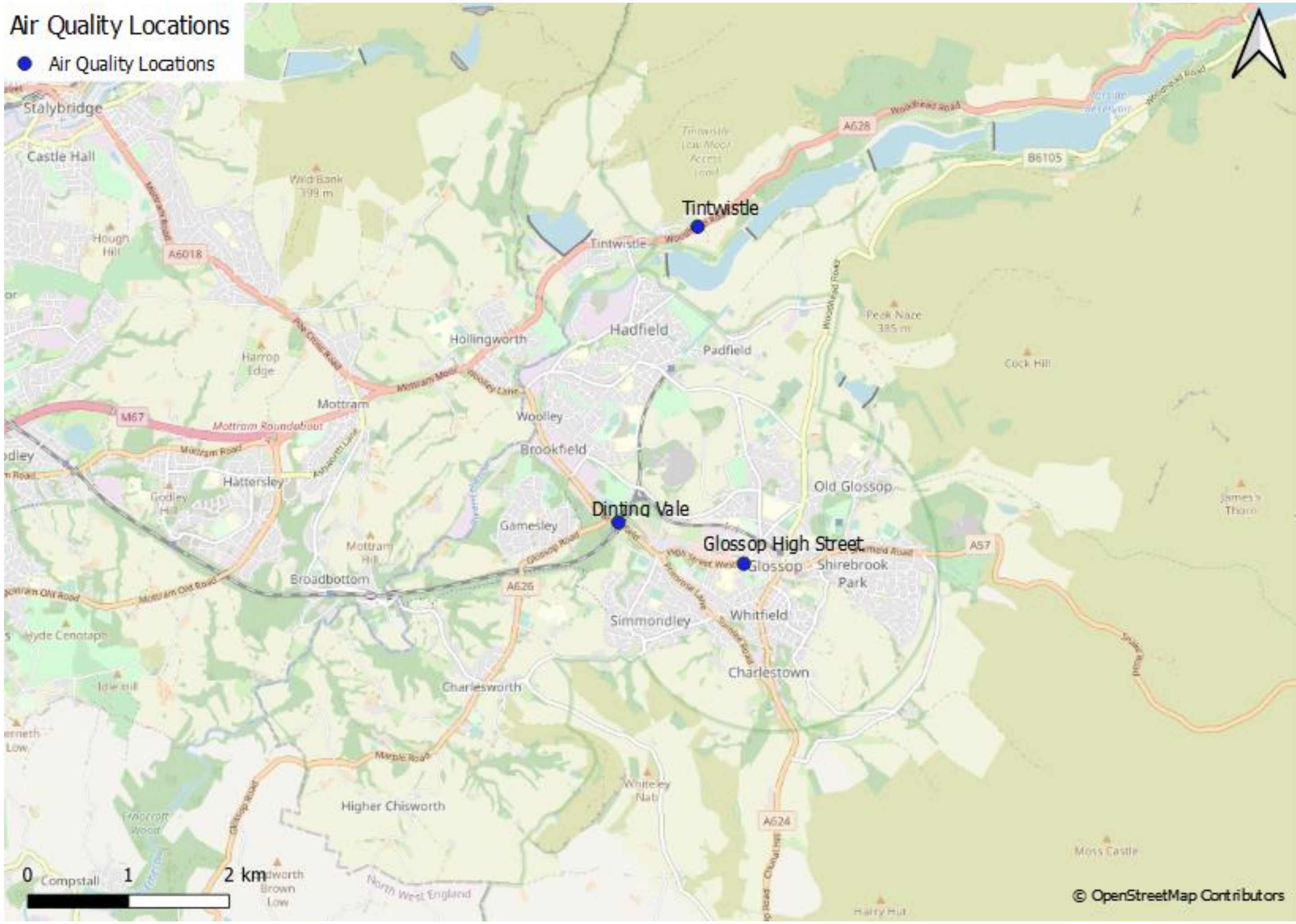
[1] Stage 2 TPU LMVR (August 2017): HE551473-ARC-GEN-ZZZ-RP-TR-2017

[2] Stage 3 TPU Transport Model Package (April 2021): HE551473-BBA-GEN-A57_AL_SCHEME-AS-TR-000002

[3] TPS RTM Transport Forecasting Package (January 2020): TPSRTM_TFP_Rev7.0

[4] Stage 3 TPU ComMA (May 2019) (superseded): HE551473-ARC-HGN-TPU-RP-D-3061

Figure 1-1 - Air quality issue locations



1.3.3. Details of the TPU A57 link road scheme are presented in chapter 2, the forecasting assumptions are provided in section 3, and resulting model forecast metrics are shown in sections 4 (core) and 5 (alternative growth).

2. Scheme background

2.1. Need for scheme

2.1.1. The Trans-Pennine route is part of Highways England's Strategic Road Network (SRN), connecting the city regions of Manchester and Sheffield via the A57, A628, A616 and A61. This connects the M67 J4 to the east of Manchester with the M1 J35A / J36 to the north of Sheffield.

2.1.2. The TPU comprises of a series of transport infrastructure measures announced as part of the Department for Transport's (DfT) Road Investment Strategy (RIS) for the 2015-2020 period. The aim of the TPU was to address longstanding issues of connectivity, congestion, reliability, and safety of the SRN between the M67 and the M1.

2.1.3. The key objectives of the TPU Scheme are:

- Connectivity: reducing congestion and improving the reliability of people's journeys between the Manchester and Sheffield city regions.
- Environmental: improving air quality and reducing noise levels in certain areas, through reduced congestion and removal of traffic from residential areas. The scheme is also being designed to avoid unacceptable impacts on the natural environment and landscape in the Peak District National Park.
- Societal: re-connecting local communities along the Trans-Pennine route.
- Capacity: reducing delays and queues that occur during busy periods and improving the performance of junctions on the route.
- Reliability: reducing the number of incidents and using technology to advise drivers of incidents along the route.
- Safety: reducing the number of accidents along the route through targeted improvement measures.

2.2. Description of scheme

2.2.1. Figure 2-1 provides an overview of the proposed TPU scheme aimed at improving the performance of the SRN between Manchester and Sheffield, whilst Figure 2-2 gives a detailed breakdown of the scheme elements specific to the A57 link road (detailed scheme design is included in Appendix A).

2.2.2. The Trans-Pennine Upgrade scheme taken forward as part of PCF Stage 3 comprises of the following scheme elements:

- **Mottram Moor link road**: a new dual-carriageway link road from the M67 J4 to a new junction at A57(T) Mottram Moor.
  - A57 / B6174 junction (Mottram crossroads): separate signal staging for Stalybridge Road and Market Street (run together in the same stage in the without scheme scenario), which permits additional green time for pedestrian movements, plus the reduction of right-turning vehicles blocking the junction whilst waiting for gaps in the traffic.
- **A57(T) to A57 link road**: a new single carriageway link from the A57(T) at Mottram Moor to a new junction on the A57 at Brookfield, bypassing the existing A628 / A57 and A57 Woolley Lane / Hadfield Road junctions.
  - M67 J4 roundabout improvements: the addition of traffic signals, carriageway widening and a cut-through link between the M67 and the Mottram Moor link road.
  - A57 / A628 junction (Gun Inn junction): greater green time for pedestrian movements, reflective of improved pedestrian facilities at the Gun Inn junction.
  - A57 (Mottram Moor): a reduction in lane provision of the existing A57 between Mottram and the Gun Inn junction to provide parking and improved non-motorised users (NMU) facilities.

- **Westwood roundabout improvements**: the addition of traffic signals and lane widening to address peak time traffic congestion.
- **Safety and technology improvements**: safety measures focused on addressing accident clusters and the provision of traffic light cameras, speed cameras and message signs to allow drivers to make informed decisions.

2.2.3. The A57 link road scheme is a specific combination of elements of the wider TPU package of measures to improve the Trans-Pennine corridor between Manchester and Sheffield. As such, the focus of this documentation is concentrated on the A57 link road scheme only (i.e. 'Mottram Moor Link Road' and 'A57(T) to A57 Link Road'). The other elements of the wider TPU scheme are being delivered separately (i.e. 'Westwood roundabout improvements' and 'safety and technology improvements').

2.2.4. It should be noted that the scheme design accommodates the recommendations arising out of public consultation in December 2020.

Figure 2-1 – Location of Proposed Scheme

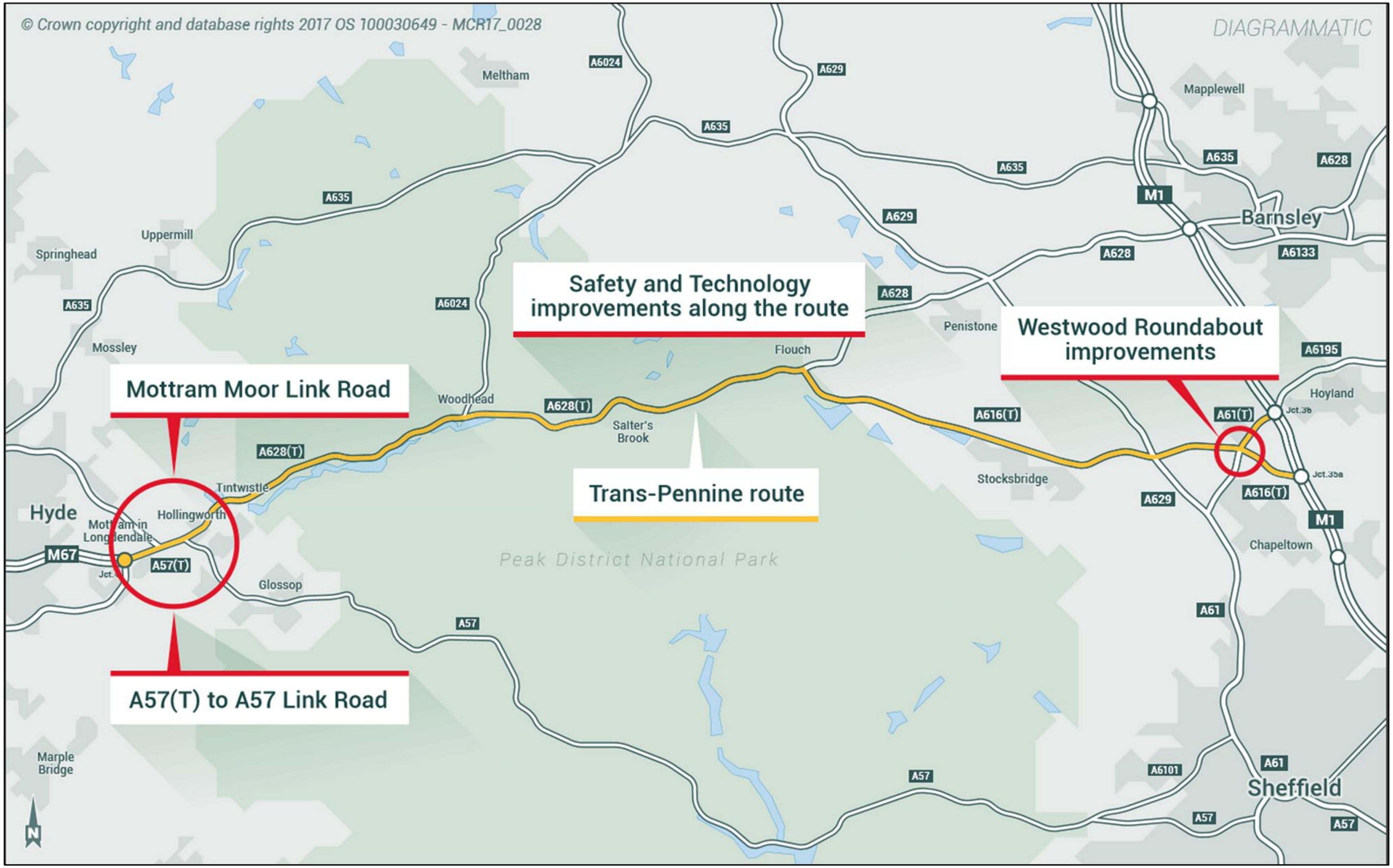
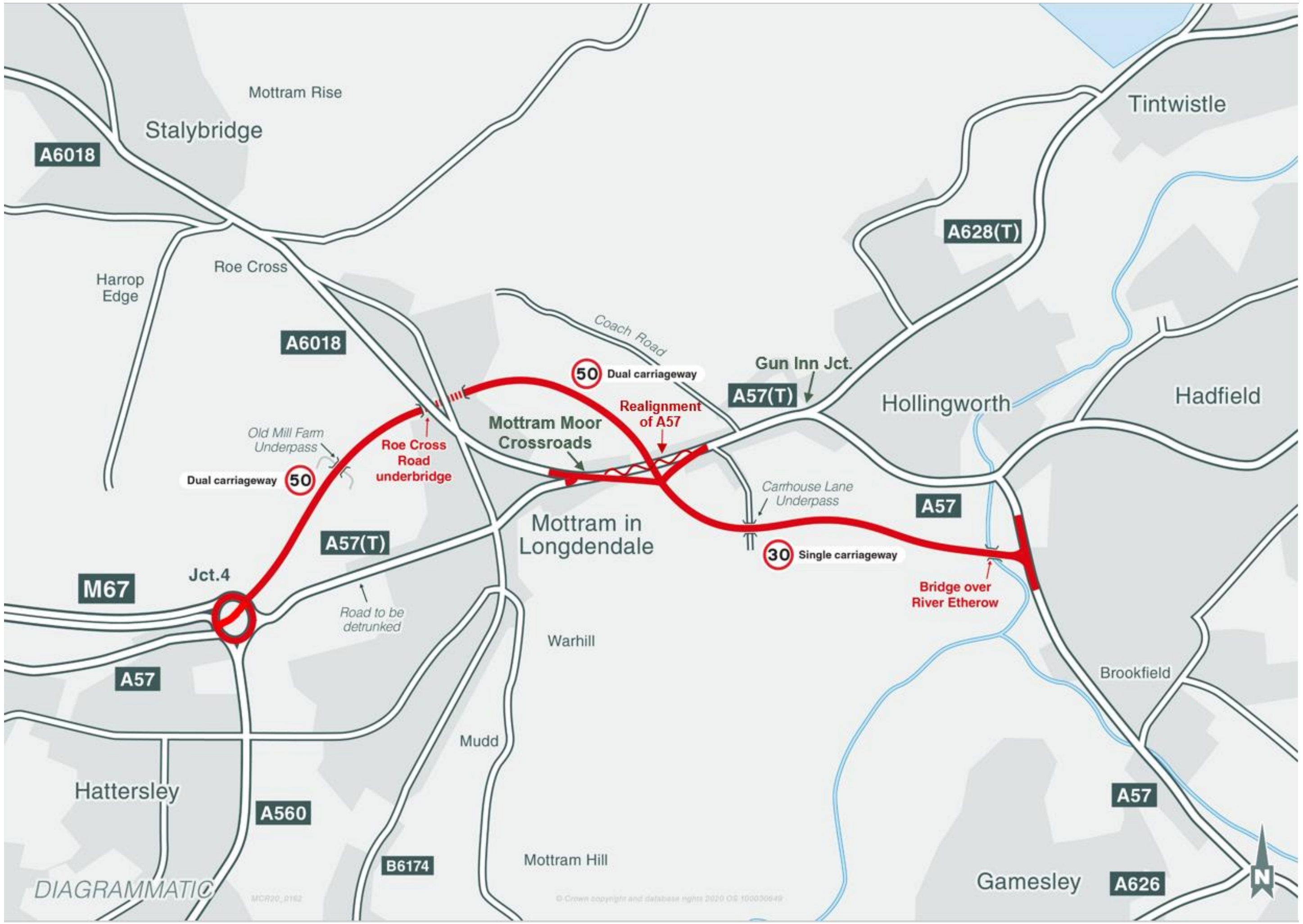


Figure 2-2 – A57 link road scheme alignment



3. Forecast assumptions

3.1. Introduction

3.1.1. This chapter provides the assumptions and inputs regarding the development of the PCF Stage 3 forecast year transport model, based on the guidance from TAG unit M2 (Variable demand modelling) & M4 (Forecasting & Uncertainty).

3.1.2. The basis for model forecasting is the 2015 validated PCF Stage 3 TPU transport model, details of which are provided in the Transport Model Package[5]. Model parameters are consistent with the validated base model, unless explicitly stated in this report.

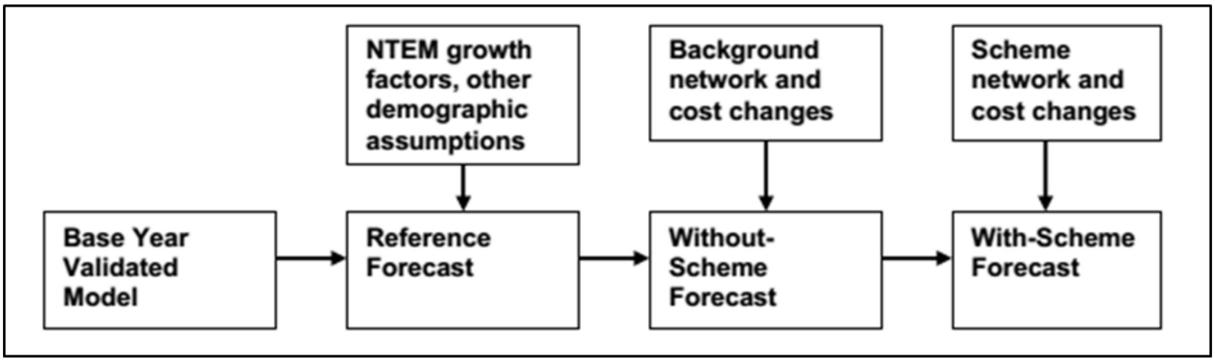
3.1.3. The growth in demand between the validated base year and the model forecast years is derived from three sources:

- National long-term population, employment and transport forecasts published by the DfT in the National Trip End Model (NTEM) dataset (v7.2).
- Local planning data summarised in the Uncertainty Log (UL) provided by the relevant Local Authorities.
- Light Goods Vehicles (LGV) and Heavy Good Vehicles (HGV) growth rates derived from the DfT Road Traffic Forecasts (RTF18).

3.1.4. The overall forecasting approach is summarised below in Figure 3-1. The first step of the forecasting process is to derive Reference Case demand matrices which reflect changes in population, employment, car ownership and other demographic and economic factors. The Reference Case demand matrices utilise the validated base year demand matrices as a basis. The transport supply element of the model is also updated for each forecast year which includes network changes and generalised cost assumptions (i.e. value of time (pence per minute: PPM) and vehicle operating costs (pence per kilometre: PPK), both by vehicle type and purpose). This is to derive the most likely 'without scheme' scenario against which the impact of the 'with scheme' scenario can be tested.

3.1.5. The Reference Case forecasts do not account for induced changes in travel demand in response to changes in future traffic conditions. Therefore, the Variable Demand Model (VDM) modifies the Reference Case forecasts to reflect the impact on demand, of changes in congestion on the road network.

Figure 3-1 - Overview of forecasting process



[5] Stage 3 TPU Transport Model Package (April 2021): HE551473-BBA-GEN-A57_AL_SCHEME-AS-TR-000002

3.1.6. This chapter provides the following information:

- Details and justification of all the assumptions undertaken in the forecasting process, including the sensitivity of forecasts to planning and network assumptions.
- Description of uncertainty in forecasting is presented and the core, low and optimistic (high) growth scenarios are described.
- Development of the Reference Case demand matrices for the core and alternate growth scenarios. The development of the forecast year highway networks and the generalised cost assumptions are also discussed.

3.1.7. Forecasting assumptions are consistent with the TPS RTM, unless otherwise stated.

3.2. Model specification

3.2.1. No changes to the model specification have been made since PCF Stage 2. Full details of the model specification are provided in the PCF Stage 2 LMVR (Chapter 2)[6].

3.2.2. The TPU model is developed from the TPS RTM, which includes a SATURN (v11.3.12) Highway Assignment Model (HAM) combined with a DIADEM (VDM) (DIADEM v6.3.4). Software versions were retained for consistency with the TPS RTM donor model and previous PCF stages.

3.2.3. As shown in Table 3-1, demand for the TPU model is segmented into 10 demand segments, which are aggregated into five user classifications (UC) for the Highway Assignment Model (HAM) including Light Goods Vehicles (LGV) and Heavy Goods Vehicles (HGV) . Table 3-2 provides further details of the demand segmentation utilised in the VDM setup including modes available by demand segment covering Highway (HW) and Public Transport (PT).

[6] Stage 2 TPU LMVR (August 2017): HE551473-ARC-GEN-ZZZ-RP-TR-2017

Table 3-1 - TPU HAM: user classes

HAM user class	Demand segment	Trip purpose
UC1: Car Business	DS1: Home Based Employers' business	HB Employers' business
	DS4: Non-Home-Based Employers' business	NHB Employers' business
	DS6: Fixed – Employers' business	Employers' business
UC2: Car Commute	DS2: Home Based Commute	HB Commute
	DS7: Fixed – Commute	Commute
UC3: Car Other	DS3: Home Based Other	HB Shopping
		HB Personal business
		HB Recreation/Social
		HB Visiting Friends and Relatives
		HB Holiday/Day Trip
		HB Education
	DS5: Non-Home Based Other	NHB Work
		NHB Education
		NHB Shopping
		NHB Personal business
		NHB Recreation/Social
		NHB Holiday/Day Trip
	DS8: Fixed – Other	Others
UC4: LGV	DS9: LGV	Light Goods Vehicles
UC5: HGV	DS10: HGV	Heavy Goods Vehicles

Table 3-2 - TPU VDM: demand segments

Demand segment	Purpose	Form of matrices	Modes (Highway/PT)	Demand response
DS1	Home Based Employer Business	24 hr - PA	HW & PT	Variable
DS2	Home Based Commute	24 hr - PA	HW & PT	Variable
DS3	Home Based Others	24 hr - PA	HW & PT	Variable
DS4	Non- Home-Based Employer Business	All time slice - OD	HW & PT	Variable
DS5	Non - Home Based Others	All time slice - OD	HW & PT	Variable
DS6	Fixed Demand - Employers Business	All time slice - OD	HW & PT	Fixed
DS7	Fixed Demand - Commute	All time slice - OD	HW & PT	Fixed
DS8	Fixed Demand - Other	All time slice - OD	HW & PT	Fixed
DS9	Fixed Demand - LGV	All time slice - OD	HW	Fixed
DS10	Fixed Demand - HGV	All time slice - OD	HW	Fixed

3.2.4. The simulation boundary of the TPS RTM has been retained, but the focus of the TPU model is concentrated on the Area of Detailed Modelling (ADM) highlighted in Figure 3-2.

Figure 3-2 - Area of Detailed Modelling (ADM) – TPU PCF Stage 3

3.3. Modelled forecast years and time periods

3.3.1. The opening and design year of the scheme have been revised since the previous iteration of the Stage 3 TPU transport modelling undertaken by the incumbent consultants.

3.3.2. The PCF Stage 3 TPU transport model has been developed to represent a 2015 base year and three forecast years:

- 2025: scheme opening year (previously 2023 in Stage 2).
- 2040: scheme design year, 15 years after scheme opening (previously 2038 in Stage 2).
- 2051: horizon year for the economic assessment.

3.3.3. The TPU model is an average peak hour model reflective of the following time periods:

- AM: 07:00-10:00
- IP: 10:00-16:00
- PM: 16:00-19:00
- OP: 19:00-07:00

3.4. Uncertainty Log (UL)

3.4.1. TAG recommends that all known assumptions and uncertainties in the modelling and forecasting approach should be set out in an uncertainty log. The purpose of the uncertainty log is to record the central forecasting assumptions that underpin the core scenario and record the degree of uncertainty around these central assumptions. These assumptions are the basis for developing a set of alternative scenarios.

3.4.2. Three scenarios have been modelled for each forecast year: Core, Low and Optimistic growth. As identified in Table 3-3, the following uncertainty status assumptions have been made for each scenario:

- Core: ‘near certain’ and ‘more than likely’ infrastructure schemes and developments, constrained to TEMPro (NTEM 7.2).
- Low growth: ‘near certain’ and ‘more than likely’ infrastructure schemes and developments, constrained to low growth national uncertainty.
- Optimistic: ‘near certain’, ‘more than likely’ and ‘reasonably foreseeable’ infrastructure schemes and developments, constrained to high growth national uncertainty. The developments with status of “hypothetical” were considered to carry too much uncertainty and were deemed outside the scope of the Optimistic scenario.

Table 3-3 - Uncertainty Log – classification of future inputs

Probability of input	Status	Core	Low	Optimistic
Near certain: The outcome will happen or there is a high probability that it will happen	Intent announced by proponent to regulatory agencies. Approved development proposals. Projects under construction.	✓	✓	✓
More than likely: The outcome is likely to happen but there is some uncertainty	Submission of planning or consent application imminent. Development application within the consent process	✓	✓	✓
Reasonably foreseeable: The outcome may happen, but there is significant uncertainty	Identified within a development plan. Not directly associated with the transport strategy/scheme but may occur if the strategy/scheme is implemented. Development conditional upon the transport strategy/scheme proceeding. Or, a committed policy goal, subject to tests (e.g. of deliverability) whose outcomes are subject to significant uncertainty.	✗	✗	✓
Hypothetical: There is considerable uncertainty whether the outcome will ever happen	Conjecture based upon currently available information. Discussed on a conceptual basis. One of several possible inputs in an initial consultation process. Or a policy aspiration	✗	✗	✗

3.4.3. The initial version of the UL was provided by the incumbent consultants in early 2019, and was based on the following information:

- The Road Investment Strategy (RIS) and Local Authority highway schemes included in the TPS RTM; and
- The housing and employment developments within the Area of Detailed Modelling (ADM) boundary (Figure 3-2).

3.4.4. The UL received from the incumbent consultant was subsequently revised in line with current understanding of development certainty (December 2019). A review of all infrastructure schemes and developments was undertaken by each of the Local Authority districts shown in Figure 3-3.

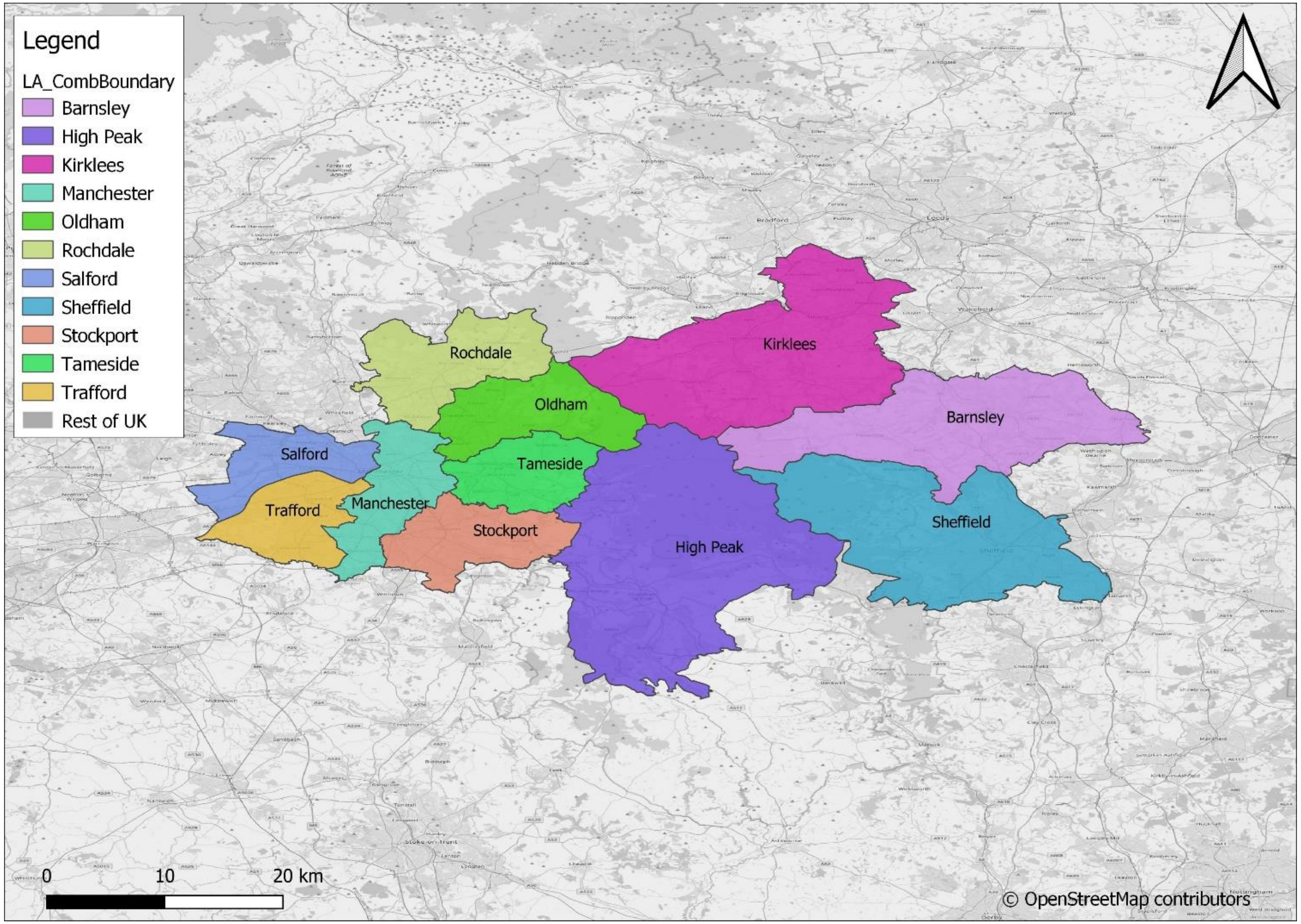
3.4.5. In December 2020, the Greater Manchester Spatial Framework (GMSF) further revised the information included in the UL for Tameside, Manchester, Trafford and Stockport, whilst updated data was also provided for High Peak. The following changes have been made to the UL received from the incumbent consultants in early 2019:

- No significant changes were observed within the immediate vicinity of the scheme (i.e. in Tameside and High Peak) for developments with an uncertainty status of 'near certain' or 'more than likely' (i.e. core growth scenario).
- However, there have been changes in the status and/or size of developments with an uncertainty status of 'reasonably foreseeable' (i.e. optimistic growth scenario).

3.4.6. The list of highway infrastructure schemes included in PCF Stage 3 has been retained from the incumbent consultant. No changes were specified during the review of the uncertainty log in December 2019 and December 2020.

3.4.7. The development site UL used in the PCF Stage 3 forecast year scenarios is presented in Appendix B, whilst a list of the transport infrastructure schemes included in all growth scenarios is presented in Appendix C.

Figure 3-3 - Uncertainty Log: Local Authority districts



3.5. Development of trip rates

3.5.1. The trip rates derived by the incumbent consultants were retained for the PCF Stage 3 forecast year transport model. Their derivation is described below.

3.5.2. TRICS (v7.4.4) was used to calculate future trips associated with the proposed new developments. TRICS is a large database system containing traffic counts for individual developments across a wide range of land-use categories. TRICS analyses individual or selected sets of survey counts to produce trip rate information.

3.5.3. Table 3-4 summarises the trip rates used for Cars, whilst the trip rates for all other vehicle types are presented in Appendix D.

3.5.4. TRICS does not provide purpose breakdowns for proposed development trips. As such, Car trips associated with each development were allocated to one of the three car user classes (UC1: Car Employers Business, UC2: Car Commute and UC3: Car Others) in accordance with the distribution pattern of zonal trip ends in the validated base model.

Table 3-4 - TRICS car trip rate summary (per hour)

	Arrivals			Departures		
Land Use	AM	IP	PM	AM	IP	PM
Office (per 100 sqm GFA)	0.2867	0.0843	0.0347	0.0383	0.1005	0.2437
Business park (per 100 sqm GFA)	0.4603	0.1620	0.0670	0.0770	0.1785	0.4130
Warehousing B8 (per 100 sqm GFA)	0.0480	0.0142	0.0120	0.0053	0.0213	0.0477
Industrial unit (per 100 sqm GFA) B1 B2	0.1680	0.0442	0.0163	0.0240	0.0577	0.1857
Mixed/ Affordable housing (per no. of dwells)	0.0307	0.0542	0.0833	0.0887	0.0500	0.0617
Mixed private houses (per no. of dwells)	0.0660	0.1213	0.1767	0.1343	0.1122	0.1353
Retail Park excluding food (per 100 sqm GFA)	0.3423	1.3222	0.7437	0.1970	1.2120	1.0500
Leisure Centre (per hec GFA)	3.5117	4.9500	10.5097	2.2923	4.7548	8.8027
Retail mixed shopping (per 100 sqm GFA)	0.4250	1.2548	0.2940	0.0910	1.2082	0.9870
Industrial estate (per 100sqm GFA) B1 or B2	0.0657	0.0340	0.0113	0.0213	0.0432	0.0450

3.6. Reference Case matrices

3.6.1. The Reference Case was developed from the PCF Stage 3 base model by considering the growth in demand arising from changes in demographics and macro-economic factors from the validated 2015 base year to 2025, 2040 and 2051 forecast years.

3.6.2. To develop the Reference Case forecast matrices, growth factors have been derived using the following sources:

- For cars, growth rates have been derived from NTEM 7.2.
- For LGVs and HGVs, the growth rates have been derived from RTF18.

3.6.3. In summary the Reference Case matrices were derived by undertaking the following steps:

- Determine the growth in the forecast car trip ends projected by TEMPro between the validated base and the forecast years, at the LA district level which are outlined in Figure 3-3
- Apply the TEMPro Alternative Assumptions growth to the base year trip ends.
- Create the “Base + Background Growth” matrix by furnessing the trip ends at LA level.

- The development trip ends are used to form the development matrix as described in para 3.6.7 below. Add the development matrix to "Base + Background Growth" Matrix.
- The resulting demand matrices are furnessed to the unadjusted TEMPro growth by trip ends at LA district level to ensure consistency with the national forecasts.
- Determine the growth in commercial vehicle (LGV and HGV) trip ends using RTF18.
- Apply RTF18 growth factors to the LGV and HGV base matrices to derive the forecast year matrices.

3.6.4. The following section provides further detail on the forecasting methodology used for developing Reference Case Origin Destination (OD) and Production Attraction (PA) matrices for the core scenario.

Development matrix

3.6.5. All developments identified in the UL (Appendix B) were assigned an appropriate model zone based on their geographical location.

3.6.6. The inclusion of individual sites in the development matrices for the core scenario were based on the following criteria:

- Uncertainty status of 'near certain' or 'more than likely', as specified in the UL.
- All developments located within the immediate vicinity of the scheme (i.e. Tameside and High Peak) were automatically included.
- However, developments located in all other Local Authorities included in the UL (Figure 3-3) that are not within the immediate vicinity of the scheme (i.e. not Tameside and High Peak) were only included if certain thresholds were met:
  - Residential development of more than 200 dwellings.
  - Commercial development type B1> 10,000 sqm, B2 > 1,500 sqm, and B8> 5,000 sqm. All other commercial development types were included without the application of a threshold.

3.6.7. For each development that met the criteria for inclusion, trip generation was prepared by using the appropriate TRICS rates (Section 3.5). As aforementioned, TRICS does not provide purpose breakdowns for proposed development trips, therefore car trips were split by purpose (Employers Business, Commute and Other) using the same donor zones from the validated base model.

Background growth

NTEM v7.2

3.6.8. Alternative growth assumptions derived from NTEM v7.2 were used to calculate background growth factors for car trips, by subtracting the proposed developments included in the UL from NTEM planning information.

3.6.9. NTEM alternative growth assumptions were obtained for each Local Authority included in the UL at the LA district level. Car Driver trips were used to calculate background growth between the 2015 base year and all forecast years. Development information from 2040 was used for the 2051 horizon year as planning details beyond 2040 were not provided in the UL.

3.6.10. For the individual Local Authorities where total development growth exceeded NTEM (v7.2) growth at the LA district level, growth forecasts were adjusted down to match NTEM (v7.2) growth.

3.6.11. Appendix E summarises the growth factors derived from NTEM v7.2 that have been used to constrain car trip ends.

RTF18

3.6.12. RTF18 was used to constrain the overall growth of commercial traffic (LGV and HGV) in a similar way to how growth in car trips is constrained to NTEM v7.2. Growth factors have been derived using the 'traffic in billions of miles' data from scenario 1 of RTF18.

3.6.13. Table 3-5 summarises the RTF18 growth factors that have been used to constrain LGV and HGV trip ends. These are based on all road types in England and Wales.

3.6.14. Data is provided in 5 yearly intervals starting in 2010, which have been interpolated to fit with the TPU forecast years (2025, 2040 and 2051). The data is not disaggregated by time of day, therefore uniform growth factors have been applied to all time periods.

Table 3-5 - RTF18 growth factors from 2015

Vehicle Type	2025	2040	2051
LGV	16.0%	39.3%	53.2%
HGV	0.2%	5.0%	9.2%

Fixed demand - ports

3.6.15. Trips originating or terminating from airports and seaports are fixed in the PCF Stage 3 TPU transport model and are therefore not subject to VDM.

3.6.16. NTEM v7.2 and RTF18 have been used to derive growth factors for car, LGV and HGV trips, however neither data source takes account of change in passenger demand at airports and seaports.

3.6.17. Fixed demand data representative of airports and seaports across Great Britain was provided by the incumbent consultants, based on the TPS RTM demand matrices. Airport passenger growth was derived based on the DfT's National Air Passenger Allocation Model (NAPALM), whilst seaport passenger growth was derived from historic seaport road traffic data provided by the DfT (see aforementioned TPS RTM forecasting report for full details).

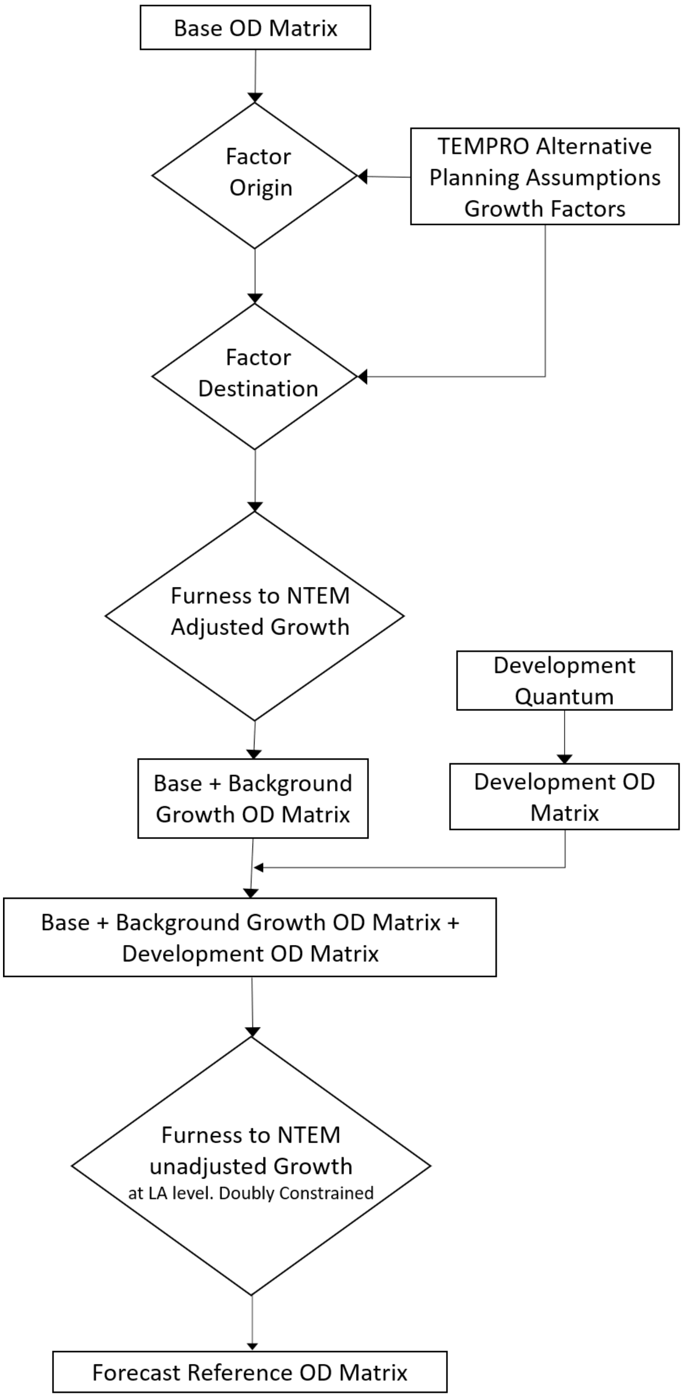
3.6.18. In line with the previous scheme opening and design years, the fixed demand matrices provided by the incumbent consultants were supplied for forecast years 2023, 2038 and 2051. As agreed with Highways England, linear interpolation has been assumed to adjust the opening and design forecast years to 2025 and 2040, from 2023 and 2038. The 2051 horizon year remained unchanged.

Origin-Destination (OD) Reference Case matrices

3.6.19. Figure 3-4 provides an overview of the process adopted to derive the forecast year Reference Case OD matrices.

3.6.20. The 2015 'Base OD Matrix' was obtained from the PCF Stage 3 validated base year transport model, as described in the Transport Model Package (see section 1.2.1).

Figure 3-4 - Derivation of forecast year OD matrices



3.6.21. Table 3-6 to Table 3-8 compare OD matrix totals between the validated base year and the Reference Case matrices for all forecast years.

Table 3-6 - Reference Case OD matrix totals: Core scenario (AM Peak)

Year / Time Period	Matrix Totals (PCU/hr)					Total	Growth from 2015
	UC1	UC2	UC3	UC4	UC5		
	Car Business	Car Commute	Car Others	LGV	HGV		
2015	323,497	2,379,531	2,138,375	607,454	326,182	5,775,040	-
2025	361,436	2,543,733	2,366,387	699,686	326,511	6,297,753	9%
2040	398,801	2,761,581	2,668,312	840,717	339,235	7,008,645	21%
2051	426,244	2,947,340	2,886,287	924,699	352,039	7,536,609	31%

Table 3-7 - Reference Case OD matrix totals: Core scenario (IP)

Year / Time Period	Matrix Totals (PCU/hr)					Total	Growth from 2015
	UC1	UC2	UC3	UC4	UC5		
	Car Business	Car Commute	Car Others	LGV	HGV		
2015	345,966	912,475	2,723,032	557,004	337,965	4,876,443	-
2025	379,358	965,932	3,022,259	642,513	338,329	5,348,390	10%
2040	414,754	1,039,365	3,415,054	772,013	351,918	5,993,104	23%
2051	441,941	1,100,280	3,681,441	849,052	365,336	6,438,050	32%

Table 3-8 - Reference Case OD matrix totals: Core scenario (PM peak)

Year / Time Period	Matrix Totals (PCU/hr)					Total	Growth from 2015
	UC1	UC2	UC3	UC4	UC5		
	Car Business	Car Commute	Car Others	LGV	HGV		
2015	343,553	2,238,061	3,052,443	590,202	237,608	6,461,866	-
2025	379,647	2,375,279	3,348,037	680,064	237,868	7,020,896	9%
2040	416,152	2,559,381	3,743,095	817,151	247,514	7,783,294	20%
2051	443,971	2,714,908	4,025,477	898,766	256,991	8,340,114	29%

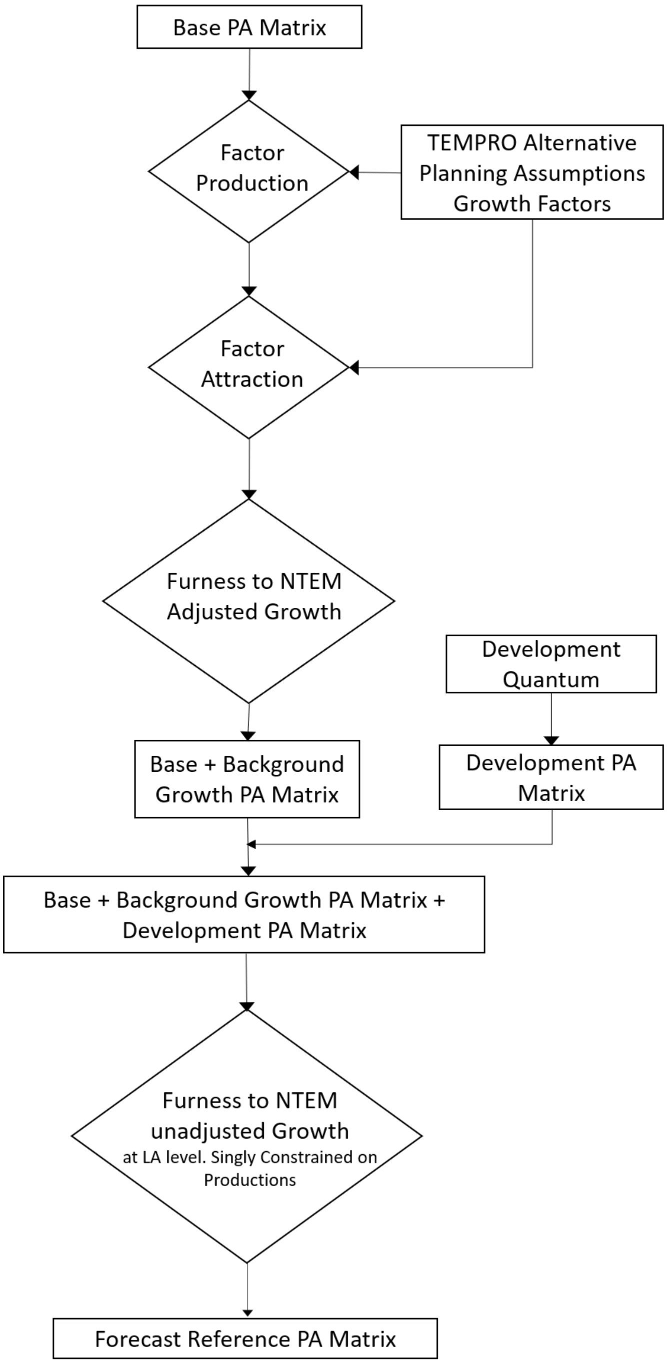
Production-Attraction (PA) Reference Case matrices

3.6.22. Figure 3-5 provides an overview of the process adopted to derive the forecast year Reference Case PA matrices.

3.6.23. The 2015 ‘Base PA Matrix’ was obtained from the TPS RTM, as described in the TPS RTM LMVR[7].

[7] TPS RTM LMVR (March 2017): TPS Model Validation Report - V1.9

Figure 3-5 - Derivation of forecast year PA matrices



3.6.24. In deriving the development PA matrices, development zones were separated into three categories (residential, commercial, and mixed use) based on the land use type specified in the UL.

3.6.25. The development matrices developed from the UL and TRICS were only available in OD format. To convert the OD development trip matrices into PA format, the following factors were calculated between the base year OD and PA matrices by trip end:

- 12-hour origin totals to 24-hour production totals.
- 12-hour destination totals to 24-hour attractions totals.

3.6.26. These factors were generated for the three 24-hour PA demand segments (DS1: HBEB, DS2: HBW, DS3: HBO), as specified in Table 3-2.

3.6.27. Development zones that only include residential sites were assumed to generate trip productions, whilst development zones that only include commercial sites were assumed to generate trip attractions. For zones including both residential and commercial sites, residential sites were assumed to generate trip productions, whilst commercial sites were assumed to generate trip attractions.

3.6.28. Table 3-9 compares PA matrix totals between the validated base year and the Reference Case matrices for all forecast years.

Table 3-9 - Reference Case PA matrix totals: Core scenario (24 hours)

Year / Time Period	Matrix Totals (PCU/hr)			Total	Overall Growth from 2015
	Demand Segment 1	Demand Segment 2	Demand Segment 3		
	HBEB	HBC	HBO		
2015	1,668,183	11,455,038	16,600,193	29,723,415	-
2025	1,764,174	12,129,194	18,367,973	32,261,341	9%
2040	1,924,361	13,057,003	20,726,398	35,707,762	20%
2051	2,065,086	13,846,352	22,354,083	38,265,521	29%

Fitting on Factors (FoF)

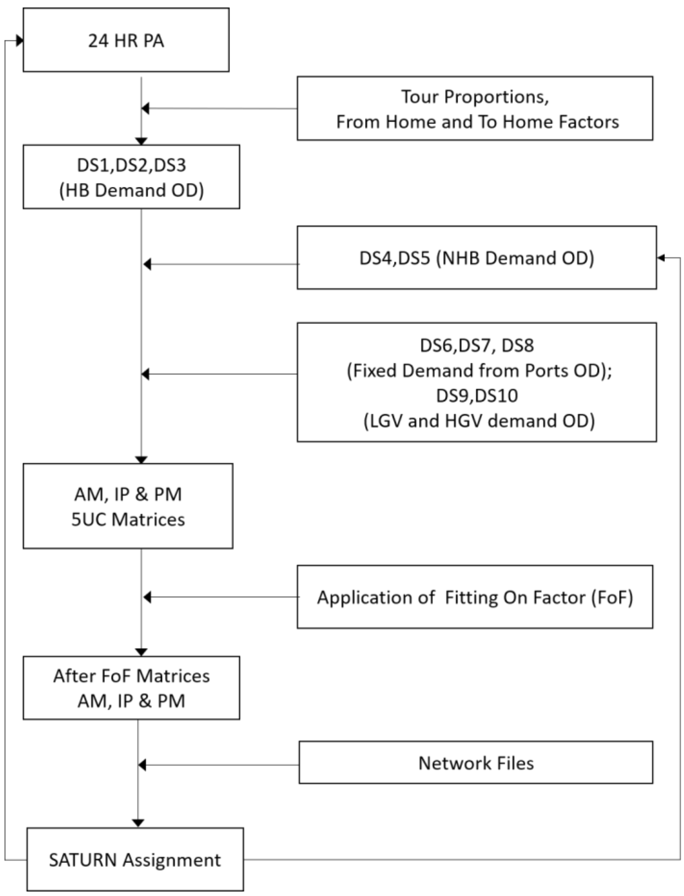
3.6.29. The resultant OD matrices (essentially synthetic) produced after the first iteration of DIADEM (and part of the inherent PA to OD conversion process) do not precisely match the OD matrices as derived from the scaled highway assignment model. Consequently, a set of Fitting on Factors (FoF) has been used to ensure that in both the realism tests and forecasting the Reference Case OD matrices produced in the preliminary iteration of DIADEM are made consistent with the Forecast Highway OD matrices prior to assignment. The fitting on factors applied are held fixed and the resultant assignment cost skims used to drive the variable demand response through all subsequent DIADEM loops.

3.6.30. The FoF used in the TPS RTM were derived from the difference between the first iteration of the base year DIADEM UFMs and the validated base year SATURN UFMs. However, due to the inclusion of local developments in the forecast year scenarios, the set of FoF derived from the base were distorting trip patterns in the study area. Therefore, the derivation of modified FoF for each forecast year was deemed necessary.

3.6.31. Figure 3-6 presents the PA to OD conversion process for each iteration of DIADEM, illustrating how the FoFs have been applied. Explanation of the HAM user classes (e.g. UC1, UC2 etc.) are provided in Table 3-1, whilst details of the VDM demand segments (e.g. DS1, DS2 etc.) are provided in Table 3-2.

3.6.32. The FoFs are applied to the HAM matrices after the VDM demand segments have been converted to OD format. The cost skims produced at the end of each iteration are used as an input to the next iteration of DIADEM.

Figure 3-6 - PA to OD procedure for each iteration of DIADEM



3.7. Forecast networks

Generalised cost parameters

3.7.1. Generalised cost is as a measure of disutility for a journey between an origin and destination across the transport network. DIADEM estimates the change in car travel demand (UC1-3) based on the change in generalised cost caused by the change in network costs.

3.7.2. Values of time and distance are used to reflect the relative preference of time and distance, forming part of the process by which highway users will choose routes. The generalised cost of travel represents travellers' value of time (pence per minute: PPM) and the vehicle operating cost (pence per kilometre: PPK), both by vehicle type and purpose.

3.7.3. The forecast generalised travel costs are derived from TAG Databook v1.14 (July 2020) and are shown in Table 3-10 (Value of Time, PPM) and Table 3-11 (Vehicle Operating Costs, PPK). An average network speed of 54kph was used for all scenarios.

Table 3-10 - Value of Time (in pence per minute) by user: 2025, 2040 & 2051

User Class	2025			2040			2051		
	AM	IP	PM	AM	IP	PM	AM	IP	PM
Car Business	31.98	32.77	32.44	39.61	40.58	40.18	45.76	46.89	46.42
Car Commute	21.45	21.80	21.52	26.56	26.99	26.65	30.69	31.19	30.79
Car Other	14.80	15.76	15.50	18.32	19.52	19.19	21.17	22.55	22.17
LGV	23.18	23.18	23.18	28.70	28.70	28.70	33.16	33.16	33.16
HGV	46.17	46.17	46.17	57.17	57.17	57.17	66.05	66.05	66.05

Table 3-11 - Vehicle Operating Costs (pence per kilometre) by user: 2025, 2040 & 2051

User Class	2025	2040	2051
Car Business	11.80	8.96	8.28
Car Commute	5.64	4.17	3.82
Car Other	5.64	4.17	3.82
LGV	13.47	11.81	11.23
HGV	39.73	36.46	36.66

Values are the same for all time periods

Do-Minimum (DM) scenario

3.7.4. The PCF Stage 3 TPU DM network coding has been adopted from the TPS RTM forecast year models, which include relevant LA and RIS highway schemes across the modelled simulation area (Figure 3-2). The forecast year DM networks include all infrastructure schemes and improvements specified in the uncertainty log (Appendix C).

3.7.5. The validated PCF Stage 3 TPU 2015 base year model network was used as a basis for the forecast year DM scenario. The network coding for the LA and RIS schemes specified in Appendix C were coded into the validated base year network to create DM networks representative of 2025, 2040 and 2051.

3.7.6. The TPS RTM includes forecast years of 2021 and 2041. Therefore, schemes predicted to be completed by 2021 are included in the TPU 2025 opening year, whilst schemes predicted to be completed by 2041 are included in the TPU 2040 design year. The highway infrastructure schemes included in the 2051 horizon year are identical to 2040.

3.7.7. The model coding of the proposed schemes is based on the RTM coding manual, consistent with the validated base model (see section 1.2.1). Scheme coding checks were undertaken in terms of junction characteristics, turn saturation flows, free-flow speed, and link length.

Do-Something (DS) scenario

3.7.8. The PCF Stage 3 TPU DS network coding incorporates the TPU A57 link road scheme, in addition to the schemes present in the DM network. The latest DS scheme alignment is presented in Figure 2-2, and was coded based on the RTM coding manual.

3.7.9. For determining an initial set of signal timings to be used in the SATURN model, a set of LinSig models were produced for all scheme junctions (see section 2.2). Details of the LinSig models developed are provided in the Operational Model Report in Appendix L.

3.7.10. Signal timing and phasing were reviewed for junctions with high levels of delay. Existing timings that were found to be unreasonable for the assigned flow were optimised based on observation and judgment.

3.8. Fixed Cost Function (FCF)

3.8.1. A cordon of the full RTM was proposed to reduce the area of influence to a more localised study area, relevant for the TPU A57 link road scheme.

3.8.2. In consideration of other cordoning techniques (i.e. a conventional cordon and Simulation Buffer Transformation) and the requirement to retain the demand response of the VDM, the FCF approach was deemed to be the most appropriate method for the PCF Stage 3 TPU transport model. The benefits of adopting the FCF are as follows:

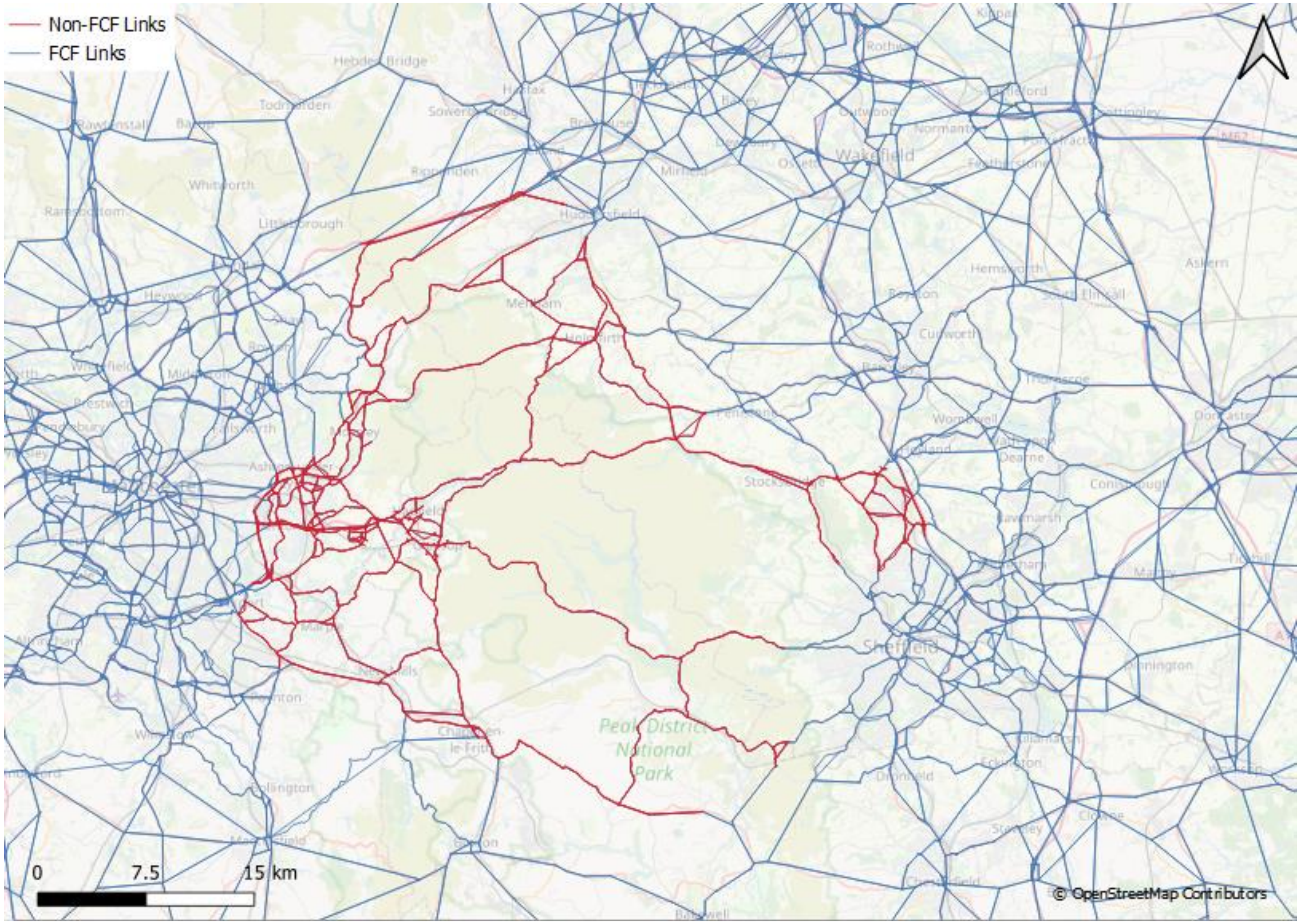
- Reduced run times: a full DIADEM VDM run time ranges from 30 to 38 hours
- Improved model convergence.
- Reduced model noise: large geographic areas and convergence issues tend to result in greater levels of model ‘noise’ that may result in spurious economic assessment results.

3.8.3. The Fixed Cost Function (FCF) methodology involves the importation of individual turn flow-delay curves from a previously converged network assignment, rather than calculating individual turn flow-delay curves based on current network flows and vehicle interactions. For example, the Do-Something network would use the (previously calculated) turn-flow delay curves from the Do-Minimum network. This approximation would only be applied to simulated turns *outside* the area of interest. Nearer to the scheme, the full SATURN simulation approach would be retained, for optimal accuracy.

3.8.4. Figure **3-7** shows the extent of the FCF network, which has been defined as the area outside the Affected Road Network (ARN). Consistent with the DMRB LA105 air quality guidance (November 2019), the ARN is defined at the link level by calculating the difference between the Do-Minimum and Do-Something scenarios, based on the following criteria:

- Change in annual average daily traffic (AADT) >= ±1,000 (two-way link values combined); or
- Change in heavy duty vehicles (HDV) AADT >= ± 200 (two-way link values combined); or
- A step change in speed band for the daily average and modelled hour speeds (AM, IP, PM, OP):
  - Heavy congestion (5-20 kph);
  - Light congestion (20-45 kph);
  - Free flow (45-80 kph); and
  - High speed (80+ kph).

Figure 3-7 **– Fixed Cost Function (FCF) area**



3.9. Alternate growth scenarios

3.9.1. TAG unit M4 states that the core scenario is intended to be the best basis for decision-making given current evidence. However, there is no guarantee that the outturn will match the assumptions. A single core scenario cannot reflect the uncertainty in national trends such as GDP and demographic growth, fuel price trends and vehicle efficiency changes.

3.9.2. Therefore, it is suggested to test the impact of this uncertainty through sensitivity tests. Two alternative growth scenarios have been run as sensitivity tests, using the PCF Stage 3 TPU core growth scenario as a basis.

3.9.3. As identified in Table 3-3, the following uncertainty status assumptions have been made for the two alternative growth scenarios:

- Low growth: 'near certain' and 'more than likely' developments, constrained to low growth national uncertainty.
- Optimistic growth: 'near certain', 'more than likely' and 'reasonably foreseeable' developments, constrained to high growth national uncertainty.

3.9.4. National uncertainty has been considered by following the guidance provided in TAG Unit M4, which states that the alternative growth scenarios should consist of forecasts based on a proportion of the base year demand being added to (optimistic growth) or subtracted from (low growth) the core growth scenario.

3.9.5. The proportion of base year demand to be added (or subtracted) is based on a parameter 'p' which varies by mode. The proportion is calculated as follows:

- For 1 year after the base year, proportion p of base year demand added (or subtracted) to the core scenario.
- For 36 or more years after the base year, proportion 6*p of base year demand added to the core scenario.
- Between 1 and 36 years after the base year, the proportion of base year demand should rise from p to 6*p in proportion with the square root of the years. For example, 16 years after the base year, the proportion is 4*p.

3.9.6. For highway demand at the national level, the value of p is 2.5%, reflecting uncertainty around annual forecasts from the National Transport Model (NTM), based on the macro-economic variables that influence the main drivers of travel demand. The indicative TAG value of p for rail travel is 2%, which has been adopted for the PT demand.

Low growth scenario

3.9.7. The local uncertainty for the low growth scenario was retained for consistency with the core scenario (i.e. 'near certain' and 'more than likely' developments).

3.9.8. Since the development matrices for the low growth scenario are identical to the core scenario, there was no further requirement for demand constraining. The Reference Case demand matrices for the low growth scenario were calculated by subtracting the relevant proportion of the validated base matrices (dependent on forecast year, see paragraph 3.9.5) from the core post-VDM demand matrices. This process was followed individually for each forecast year.

Optimistic growth scenario

3.9.9. The local uncertainty threshold for the optimistic growth scenario was lowered so that all the ‘reasonably foreseeable’ developments from the uncertainty log were included. These were in addition to the ‘near certain’ and ‘more than likely’ developments already present in the core scenario.

3.9.10. The additional trip ends associated with the ‘reasonably foreseeable’ developments were included in the development trip matrix, which were then added to the optimistic growth scenario trip matrix (i.e. core post-VDM demand plus the relevant proportion of the validated base matrices, dependent on forecast year). Overall demand was then furnessed to the level of uncertainty associated with the national high growth scenario, by trip end at the Local Authority district level. This process was followed individually for each forecast year.

4. Forecast results: core scenario

4.1.1. This section provides details of the core model forecast results that were submitted for approval. A summary of the following model results is provided in the main body, whilst full details are provided in the appendices:

- Model convergence
- Highway demand matrices
- Trip Length Distribution
- Link flow
- Journey times

4.2. Model convergence

Variable Demand Model (VDM)

4.2.1. It is important that the VDM converges to a satisfactory degree to have confidence that the model results are as free from error and noise as possible. Paragraph 6.3.8 of TAG Unit M2 provides guidance on desired convergence of VDM. The guidance states: “tests indicate that gap values of less than 0.1% can be achieved in many cases, although in more problematic systems this may be nearer to 0.2%. Where the convergence level, as measured by the %GAP, is over 0.2% remedial steps should be taken to improve the convergence, by increasing the assignment accuracy.”

4.2.2. In accordance with TAG guidance, Table 4-1 shows that %GAP values of 0.1% for the full model area and 0.2% for the subset area are very good for all Core forecast year scenarios. This provides a robust basis for economic appraisal which otherwise may be distorted by spurious model convergence ‘noise’.

4.2.3. Full details of the VDM convergence statistics are presented in Appendix G.

Table 4-1 - TPU PCF Stage 3 VDM convergence statistics: Core scenario

Scenario	Best Loop	Full Model Gap	Subset Area Gap
DM 2025	15	0.01%	0.03%
DS 2025	19	0.01%	0.03%
DM 2040	20	0.01%	0.03%
DS 2040	19	0.01%	0.03%
DM 2051	17	0.02%	0.05%
DS 2051	19	0.02%	0.06%

Highway Assignment Model (HAM)

4.2.4. The convergence parameters adopted for TPU have been retained from the TPS RTM. The advice on model convergence is set out in TAG unit M3.1 (Table 4) and is reproduced below in Table 4-2.

Table 4-2 - TAG (unit 3.1) convergence criteria

Convergence Measures	Type	Base Model Acceptable Values
Delta & %GAP	Proximity	Less than 0.1% or at least stable with convergence fully documented and all other criteria met
Percentage of links with flow change (P1) < 1%	Stability	Four consecutive iterations greater than 98%

Source: TAG Unit M 3.1 Table 4

4.2.5. Table 4-3 and Table 4-4 show TAG convergence criteria have been met for all core forecast year scenarios.

4.2.6. However, the %GAP for TPU has been tightened to 0.05% as a target figure in accordance with the TPS RTM, hence the high number of assignment-simulation loop iterations. Based on these criteria, all Core forecast year scenarios are achieving the target figure, except the AM peak of the 2051 DM and DS scenarios. The convergence statistics indicate a reduction in model stability in the 2051 horizon year forecast scenarios during the morning and evening peaks. This is reflective of the predicted increase in network congestion as a result of an increase in demand assigned to the networks. It is noted that 0.062% gap in the DM and 0.052% gap in the DS are still well below the 0.1% specified in TAG.

4.2.7. Full details of the HAM convergence statistics are presented in Appendix H.

Table 4-3 - TPU PCF Stage 3 HAM convergence statistics: DM Core scenario

Time Period	Year	Assignment Simulation Loops	P (%)	Gap%
AM	2025	11	99.1%	0.039%
	2040	105	100.0%	0.050%
	2051	120	99.6%	0.062%
IP	2025	10	99.5%	0.020%
	2040	10	98.7%	0.042%
	2051	11	99.9%	0.047%
PM	2025	12	98.9%	0.034%
	2040	25	99.9%	0.050%
	2051	107	100.0%	0.049%

Table 4-4 - TPU PCF Stage 3 HAM convergence statistics: DS Core scenario

Time Period	Year	Assignment Simulation Loops	P (%)	Gap%
AM	2025	10	98.6%	0.041%
	2040	58	99.9%	0.049%
	2051	120	99.8%	0.052%
IP	2025	10	98.8%	0.020%
	2040	9	99.1%	0.043%
	2051	11	99.3%	0.046%
PM	2025	10	98.6%	0.038%
	2040	26	99.9%	0.049%
	2051	118	100.0%	0.050%

4.3. Demand

4.3.1. Trip matrix totals and sectored demand matrices from the VDM and HAM have been analysed to identify the demand response as a result of implementing the TPU scheme.

Matrix Totals

4.3.2. Table 4-5 to Table 4-7 summarise matrix totals for the Reference Case, post-VDM DM and post-VDM DS, by forecast year and user class. The tabulations show that DIADEM induces minimal change in matrix totals between the Reference Case and the post-VDM DM, and even less still between the post-VDM DM and DS scenarios.

Table 4-5 - Matrix total comparison by user class (2025): Core scenario

Time Period	User Class	Reference case	DM	DS	Abs Diff (DM-Ref)	% Diff (DM-Ref)	Abs Diff (DS-DM)	% Diff (DS-DM)
AM	1 - Car Business	361,436	360,632	360,588	-804	-0.22%	-44	-0.01%
	2 - Car Commute	2,543,733	2,536,185	2,536,130	-7,548	-0.30%	-55	0.00%
	3 - Car Other	2,366,387	2,353,150	2,353,111	-13,237	-0.56%	-39	0.00%
	4 - LGV Fixed	699,686	699,686	699,686	0	0.00%	0	0.00%
	5 - HGV Fixed	326,511	326,511	326,511	0	0.00%	0	0.00%
IP	1 - Car Business	379,358	379,360	379,364	3	0.00%	3	0.00%
	2 - Car Commute	965,932	966,163	966,174	231	0.02%	11	0.00%
	3 - Car Other	3,022,259	3,025,347	3,025,395	3,088	0.10%	48	0.00%
	4 - LGV Fixed	642,513	642,513	642,513	0	0.00%	0	0.00%
	5 - HGV Fixed	338,329	338,329	338,329	0	0.00%	0	0.00%
PM	1 - Car Business	379,647	379,435	379,418	-213	-0.06%	-16	0.00%
	2 - Car Commute	2,375,279	2,375,428	2,375,457	149	0.01%	29	0.00%
	3 - Car Other	3,348,037	3,349,949	3,349,927	1,912	0.06%	-23	0.00%
	4 - LGV Fixed	680,064	680,064	680,064	0	0.00%	0	0.00%
	5 - HGV Fixed	237,868	237,868	237,868	0	0.00%	0	0.00%

Table 4-6 - Matrix total comparison by user class (2040): Core scenario

Time Period	User Class	Reference case	DM	DS	Abs Diff (DM-Ref)	% Diff (DM-Ref)	Abs Diff (DS-DM)	% Diff (DS-DM)
AM	1 - Car Business	398,801	396,088	396,044	-2,713	-0.68%	-44	-0.01%
	2 - Car Commute	2,761,581	2,735,968	2,735,924	-25,613	-0.93%	-44	0.00%
	3 - Car Other	2,668,312	2,631,333	2,631,303	-36,978	-1.39%	-30	0.00%
	4 - LGV Fixed	840,717	840,717	840,717	0	0.00%	0	0.00%
	5 - HGV Fixed	339,235	339,235	339,235	0	0.00%	0	0.00%
IP	1 - Car Business	414,754	416,591	416,586	1,837	0.44%	-5	0.00%
	2 - Car Commute	1,039,365	1,042,355	1,042,358	2,990	0.29%	4	0.00%
	3 - Car Other	3,415,054	3,442,228	3,442,258	27,174	0.80%	29	0.00%
	4 - LGV Fixed	772,013	772,013	772,013	0	0.00%	0	0.00%
	5 - HGV Fixed	351,918	351,918	351,918	0	0.00%	0	0.00%
PM	1 - Car Business	416,152	409,421	409,405	-6,732	-1.62%	-15	0.00%
	2 - Car Commute	2,559,381	2,535,899	2,535,963	-23,483	-0.92%	64	0.00%
	3 - Car Other	3,743,095	3,694,162	3,694,170	-48,933	-1.31%	8	0.00%
	4 - LGV Fixed	817,151	817,151	817,151	0	0.00%	0	0.00%
	5 - HGV Fixed	247,514	247,514	247,514	0	0.00%	0	0.00%

Table 4-7 - Matrix total comparison by user class (2051): Core scenario

Time Period	User Class	Reference case	DM	DS	Abs Diff (DM-Ref)	% Diff (DM-Ref)	Abs Diff (DS-DM)	% Diff (DS-DM)
AM	1 - Car Business	426,244	422,931	422,870	-3,313	-0.78%	-61	-0.01%
	2 - Car Commute	2,947,340	2,917,893	2,917,882	-29,447	-1.00%	-11	0.00%
	3 - Car Other	2,886,287	2,845,698	2,845,636	-40,588	-1.41%	-62	0.00%
	4 - LGV Fixed	924,699	924,699	924,699	0	0.00%	0	0.00%
	5 - HGV Fixed	352,039	352,039	352,039	0	0.00%	0	0.00%
IP	1 - Car Business	441,941	443,582	443,586	1,641	0.37%	4	0.00%
	2 - Car Commute	1,100,280	1,101,418	1,101,431	1,138	0.10%	13	0.00%
	3 - Car Other	3,681,441	3,709,654	3,709,705	28,213	0.77%	51	0.00%
	4 - LGV Fixed	849,052	849,052	849,052	0	0.00%	0	0.00%
	5 - HGV Fixed	365,336	365,336	365,336	0	0.00%	0	0.00%
PM	1 - Car Business	443,971	436,096	436,071	-7,875	-1.77%	-25	-0.01%
	2 - Car Commute	2,714,908	2,688,263	2,688,312	-26,645	-0.98%	50	0.00%
	3 - Car Other	4,025,477	3,969,849	3,969,857	-55,629	-1.38%	9	0.00%
	4 - LGV Fixed	898,766	898,766	898,766	0	0.00%	0	0.00%
	5 - HGV Fixed	256,991	256,991	256,991	0	0.00%	0	0.00%

Sectored Matrices

4.3.3. Figure 4-1 presents the 25-sector system that has been utilised to compare the demand matrices, whilst Figure 3-2 shows the extent of the 3-sector system. The sector systems are defined as follows:

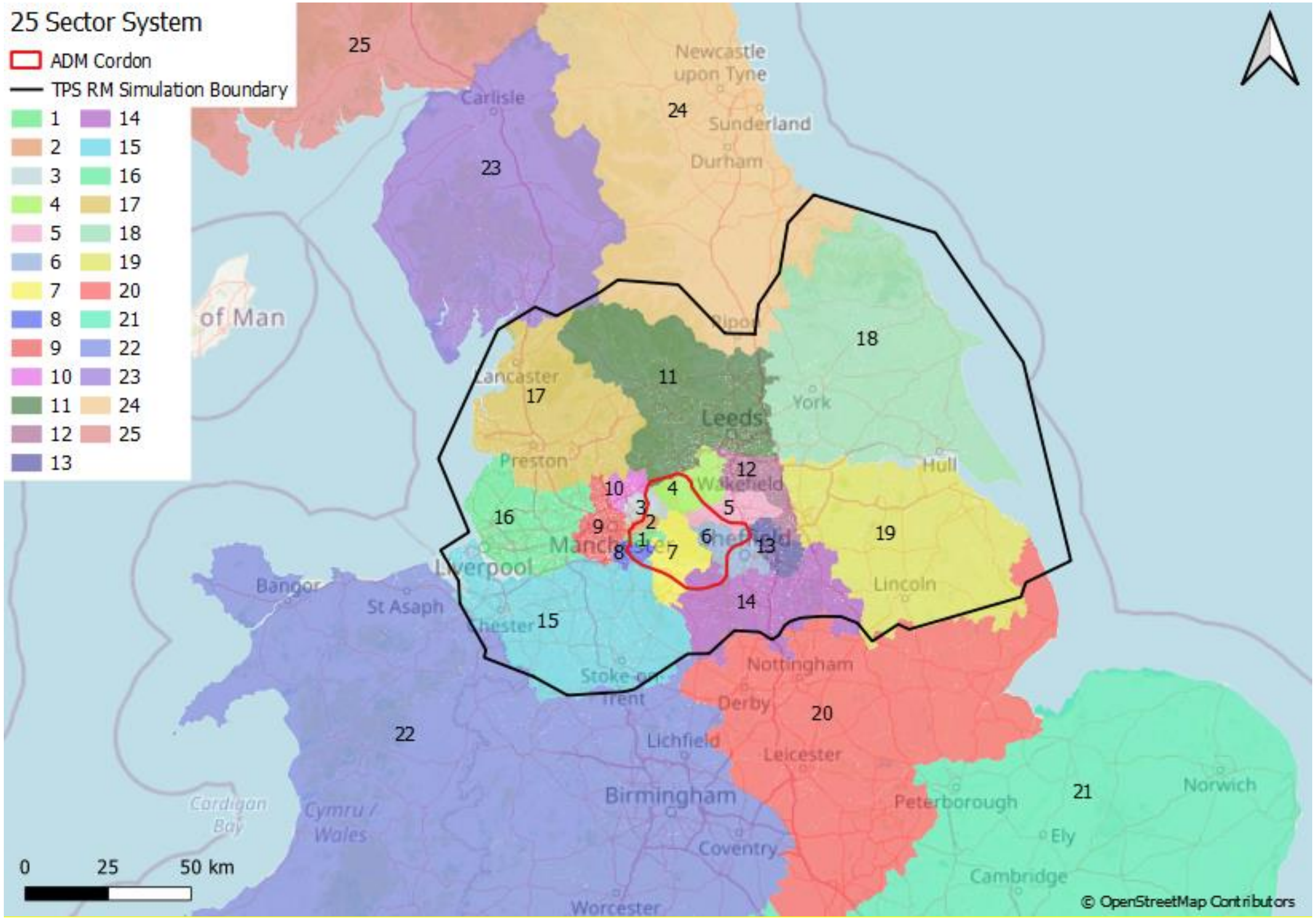
- 25-sector system: administrative boundaries (varying levels of aggregation dependent on proximity to the scheme).
- 3-sector system: internal simulation (simulation network in TPS RTM, inside TPU Area of Detailed Modelling), external simulation (simulation network in TPS RTM, outside TPU ADM) and external (buffer network in TPS RTM).

4.3.4. Full details of the sectored analysis are included in Appendix I as an accompanying spreadsheet.

4.3.5. Key observations regarding the demand response induced by the scheme are listed below. These observations focus on the 3-sector system, but the points raised regarding the demand response of the scheme are also reflected in the 25-sector system.

- There is no change in LGV and HGV trips as they are fixed in DIADEM.
- The trends apparent in the sectored demand analysis show that the introduction of the scheme has had minimal impact on the absolute distribution of forecast trips across the model. However, there are some specific sector to sector movements with low levels of flow, which have a more significant percentage change (e.g. rest of Tameside to rest of High Peak).
- As such, the analysis suggests that the scheme would likely have limited demand response.

Figure 4-1 - TPU sector system (25)



4.4. Trip Length Distribution (TLD)

4.4.1. Analysis has been undertaken to identify the impact of the scheme on Trip Length Distribution (TLD). Figure 4-2 to Figure 4-4 compare 12-hour (07:00-19:00) Annual Average Weekday Traffic (AAWT) trip length distributions for cars between the Base, Reference Case, post-VDM DM and post-VDM DS. There is no change in the distribution of LGV and HGV trip lengths as they are not included in DIADEM. However, detailed analysis of all user classes in is presented in Appendix F.

4.4.2. The TLD analysis has been produced using an alternate method which involves the exclusion of external trips between zones in the model buffer area, whilst separately considering matrix elements that have an origin or destination trip end in the model simulation area, which in practice double counts the internal-internal trips within the model simulation area.

4.4.3. Key observations regarding the impact of the VDM on TLDs are listed below:

- It is evident that the VDM induces an increase in the number of longer distance trips between the Reference Case and the post-VDM DM scenario.
  - For car trips in 2025, this equates to a 7% increase in 50-100km trips, a 7% increase in 100-200km trips and an 8% increase in trips over 200km.
  - For car trips in 2040, this equates to a 14% increase in 50-100km trips, an 18% increase in 100-200km trips and a 26% increase in trips over 200km.
  - For car trips in 2051, this equates to a 15% increase in 50-100km trips, an 21% increase in 100-200km trips and a 33% increase in trips over 200km.
  - It is worth noting that although the percentage change seems high, as a proportion of the entire matrix these changes involve a very small number of trips.
- The difference in trip lengths between the DM and DS scenarios is immaterial, which is consistent with the demand analysis that suggests the introduction of the scheme has had minimal impact on the distribution of trips across the model.

Figure 4-2 - TLD Analysis 12-hour (07:00-19:00) Car AAWT (2025): Core scenario

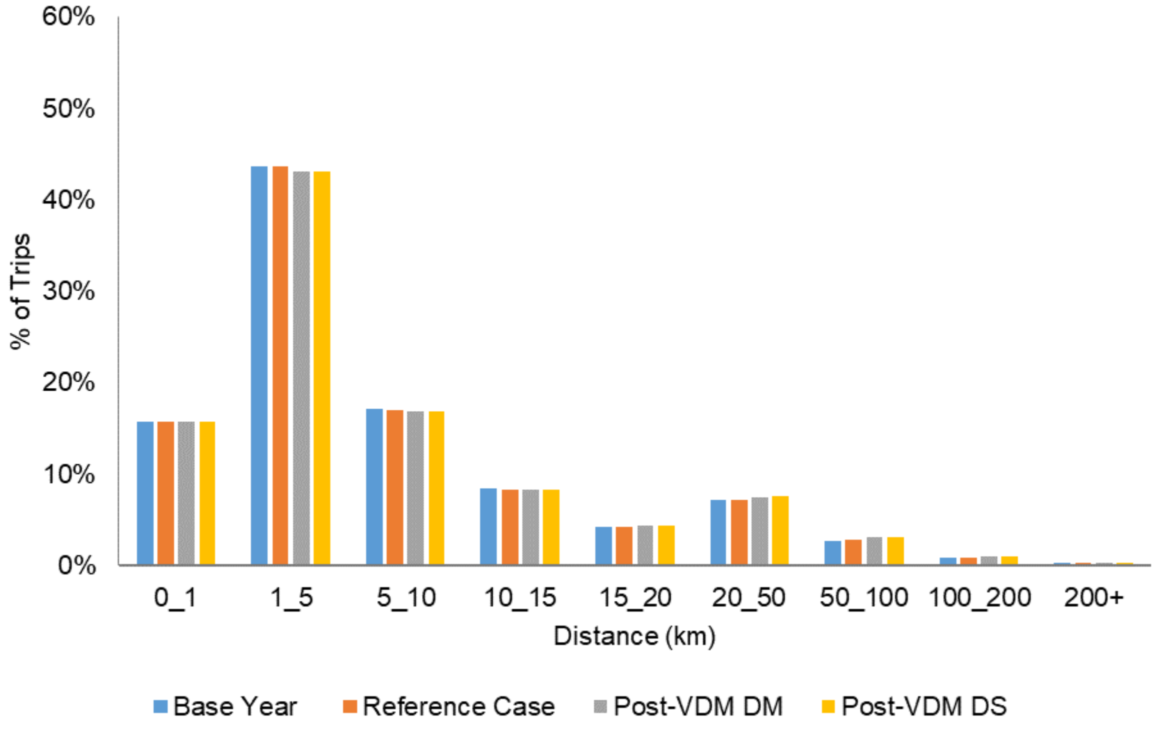


Figure 4-3 - TLD Analysis 12-hour (07:00-19:00) Car AAWT (2040): Core scenario

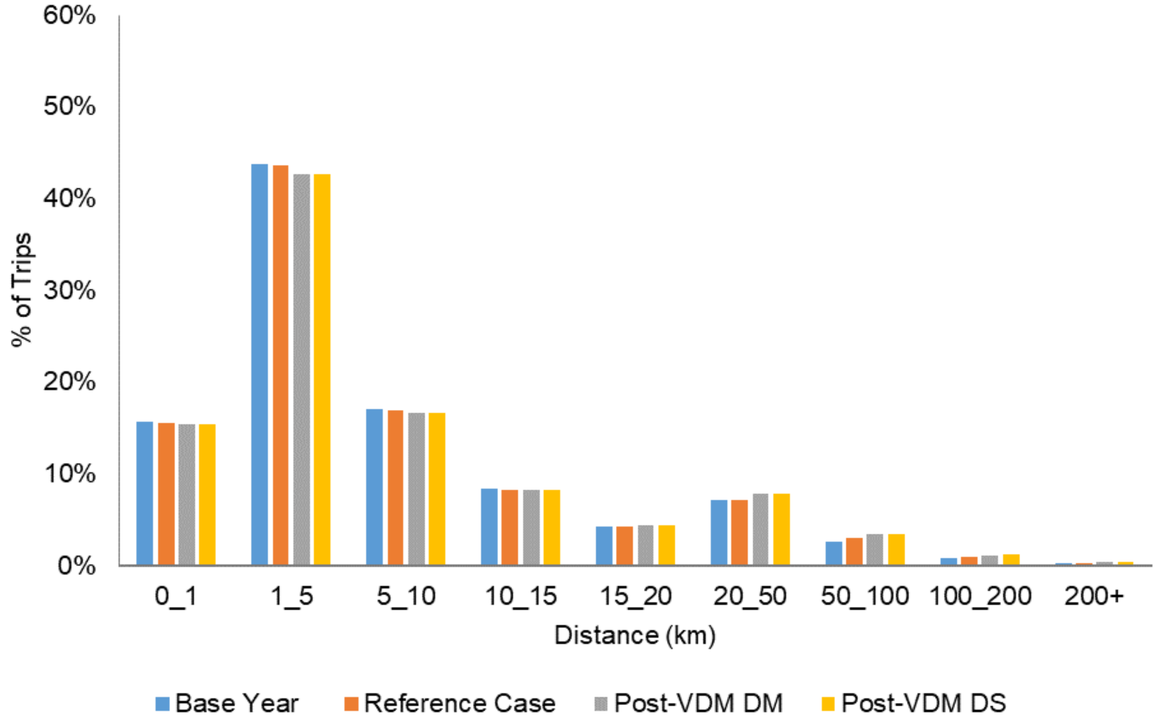
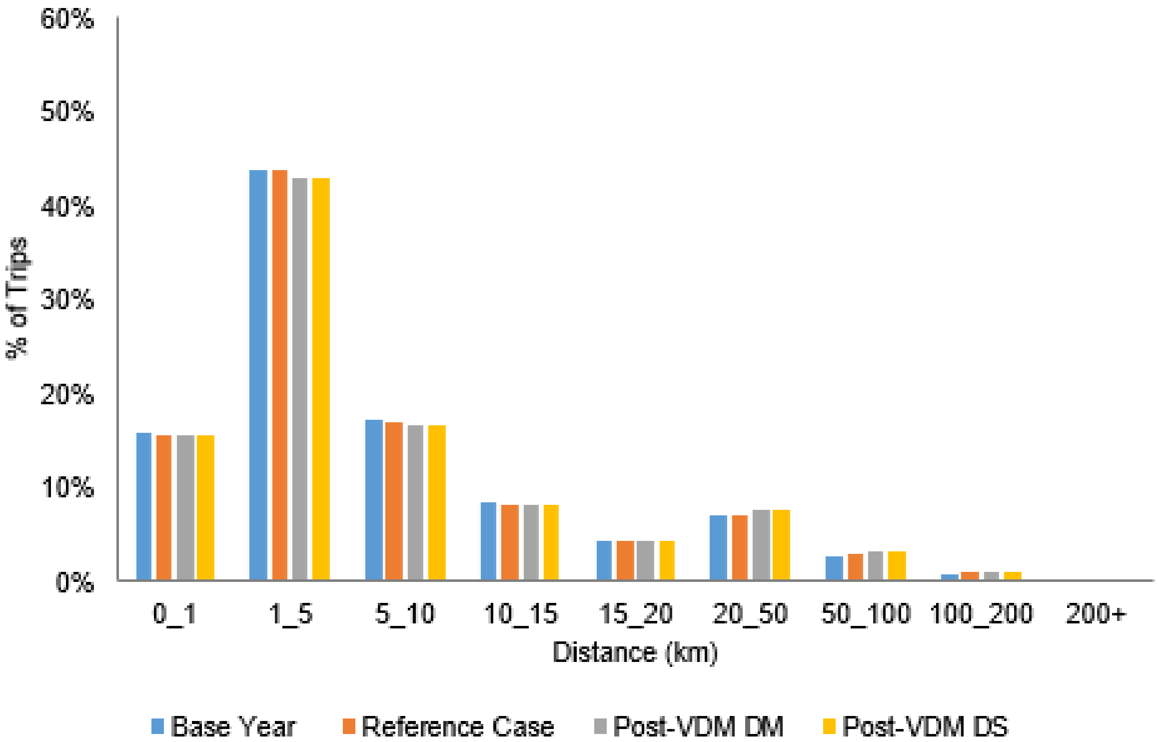


Figure 4-4 - TLD Analysis 12-hour (07:00-19:00) Car AAWT (2051): Core scenario



4.5. Link flow

4.5.1. Link flows have been compared between the DM and DS scenarios to understand the impact of the scheme on the localised highway network.

4.5.2. 12-hour (07:00-19:00) AAWT flow comparisons between the core DM and DS scenarios are presented in Table 4-8, for all forecast years. Figure 4-5 shows the locations of the links that have been included in the analysis.

4.5.3. The following observations are based on the change in 12-hour AAWT values between the DM and DS scenarios. All values quoted in the text are two-way 12-hour AAWT vehicle volumes, rounded to the nearest 100. The reference IDs attached to the road names in the text refer to Figure 4-5.

4.5.4. As a result of introducing the A57 TPU scheme, the model predicts the following changes in two-way link flow in the scheme opening and design year:

Mottram

- There is a reduction in flow on the existing A57 along Hyde Road (12) (2025: -13,600 and 2040: -14,600) and Mottram Moor (13) (2025: -13,800 and 2040: -14,100), as vehicles are reassigned onto the new A57 alignment.
- As vehicles no longer seek alternative routes to avoid congestion on the A57 along Hyde Road and Mottram Moor, there is also a reduction in flow on Roe Cross Road (11) (2025: -1,300 and 2040: -900), Back Moor (14) (2025: -2,000 and 2040: -1,700) and Ashworth Lane (4) (2025: -3,300 and 2040: -2,300).
- Consequently, with the reduction in re-routing, vehicle volumes on the M67 between J3 and J4 (1) have increased (2025: +6,100 and 2040: +7,000).
- There is a slight increase in northbound / southbound movements at Mottram Crossroads on Stalybridge Road (15) (2025: +300 and 2040: +900) and Market Street (B6174) (6) (2025: +2,100 and 2040: +3,000).
  - This has been enabled by the considerable reduction in vehicle volumes on the A57, increasing the spare capacity of the Mottram Crossroads junction. It is noted the north-south movements across the Mottram village Crossroads following the reduction in flow on the A57 have been modified, with the Stalybridge Road and Market Street approach arms modelled as separate signal stages (see section 2.2.4) to also improve pedestrian crossing facilities.

Hollingworth

- There is a reduction in trips on the A57 along Mottram Moor (16) (2025: -10,300 and 2040: -11,200) and Woolley Lane (9) (2025: -10,400 and 2040: -10,900), as vehicles are diverted onto the new A57 alignment.
- There is minimal change in vehicles on Market Street (A628) (10) (2025: -0 and 2040: -300) due to improved pedestrian facilities at the Gun Inn junction. The reduction in green time in favour of pedestrians has increased delay at the junction and subsequently reduced the number of vehicles travelling between the A57 and A628.
- There is an increase in flow on the A57 (Brookfield) (7) between the scheme junction and Shaw Lane (2025: +3,800 and 2040: +4,100). This increase in vehicles is reflective of vehicles utilising the scheme and no longer seeking alternative routes to avoid congestion on the A57 along Hyde Road and Mottram Moor.

4.5.5. More detailed link flow analysis is included in Appendix J as an accompanying spreadsheet.

Figure 4-5 - Link flow comparison locations

Table 4-8 - Link flow comparison (12-hour AAWT, 07:00-19:00): Core scenario

			2025				2040				2051			
ID	Description	Dir.	DM	DS	Diff.	Diff. %	DM	DS	Diff.	Diff. %	DM	DS	Diff.	Diff. %
1	M67 J3 - J4	EB	10,965	14,094	3,130	29%	11,949	14,789	2,840	24%	12,069	15,205	3,137	26%
1	M67 J3 - J4	WB	12,581	15,567	2,986	24%	14,145	18,340	4,195	30%	15,028	19,511	4,484	30%
2	Mottram Road	EB	1,562	1,392	-170	-11%	1,708	1,660	-49	-3%	1,786	1,679	-107	-6%
2	Mottram Road	WB	1,271	1,202	-70	-5%	1,578	1,310	-269	-17%	1,580	1,361	-219	-14%
3	Stockport Road	NB	949	1,098	148	16%	1,015	1,382	367	36%	1,412	1,613	201	14%
3	Stockport Road	SB	952	1,273	321	34%	961	1,384	423	44%	1,000	1,524	524	52%
4	Ashworth Lane	EB	5,022	1,608	-3,413	-68%	5,091	1,878	-3,213	-63%	5,001	1,789	-3,212	-64%
4	Ashworth Lane	WB	4,301	4,423	122	3%	4,590	5,524	934	20%	4,616	6,084	1,468	32%
5	Broadbottom Road	NB	3,972	3,410	-562	-14%	4,679	4,402	-276	-6%	4,864	4,768	-95	-2%
5	Broadbottom Road	SB	3,524	2,875	-649	-18%	3,576	3,403	-174	-5%	3,542	3,646	103	3%
6	B6174	NB	2,178	1,833	-345	-16%	2,003	1,911	-92	-5%	2,003	2,021	18	1%
6	B6174	SB	895	3,341	2,446	273%	642	3,712	3,070	478%	596	4,168	3,572	599%
7	Brookfield	NB	5,982	7,663	1,682	28%	6,314	8,529	2,215	35%	6,612	8,855	2,243	34%
7	Brookfield	SB	6,460	8,585	2,126	33%	7,044	8,934	1,890	27%	7,282	8,833	1,552	21%
8	Woolley Bridge Road	EB	3,122	3,361	239	8%	3,316	3,828	513	15%	3,518	4,254	736	21%
8	Woolley Bridge Road	WB	3,683	3,934	251	7%	4,286	4,429	143	3%	4,584	4,542	-42	-1%
9	Woolley Lane	EB	6,788	637	-6,151	-91%	7,237	666	-6,571	-91%	7,431	677	-6,754	-91%
9	Woolley Lane	WB	6,858	2,572	-4,286	-62%	7,457	3,135	-4,322	-58%	7,804	3,343	-4,461	-57%
10	Market Street	EB	6,620	6,777	157	2%	6,763	6,719	-44	-1%	6,880	6,861	-19	0%
10	Market Street	WB	6,603	6,422	-181	-3%	7,023	6,742	-280	-4%	7,300	7,012	-289	-4%
11	Roe Cross Road	NB	6,102	5,540	-562	-9%	6,880	6,361	-519	-8%	7,447	7,067	-380	-5%

ID	Description	Dir.	2025				2040				2051			
			DM	DS	Diff.	Diff. %	DM	DS	Diff.	Diff. %	DM	DS	Diff.	Diff. %
11	Roe Cross Road	SB	6,387	5,608	-779	-12%	6,976	6,596	-380	-5%	7,482	7,327	-154	-2%
12	Hyde Road	EB	7,469	2,053	-5,416	-73%	7,824	2,054	-5,770	-74%	7,951	2,059	-5,892	-74%
12	Hyde Road	WB	8,464	281	-8,183	-97%	9,175	321	-8,854	-96%	9,409	337	-9,072	-96%
13	Mottram Moor (Between Stalybridge/Backmoor)	EB	7,530	823	-6,707	-89%	7,562	796	-6,766	-89%	7,433	801	-6,632	-89%
13	Mottram Moor (Between Stalybridge/Backmoor)	WB	7,728	598	-7,130	-92%	7,932	621	-7,311	-92%	8,033	674	-7,359	-92%
14	Back Moor	EB	5,037	3,953	-1,084	-22%	5,610	4,740	-870	-16%	6,083	5,043	-1,040	-17%
14	Back Moor	WB	3,879	3,009	-870	-22%	4,524	3,718	-806	-18%	4,878	4,291	-587	-12%
15	Stalybridge Road	NB	2,203	2,368	165	7%	2,031	2,402	371	18%	2,059	2,505	446	22%
15	Stalybridge Road	SB	2,173	2,319	146	7%	2,017	2,573	556	28%	1,972	3,074	1,102	56%
16	Mottram Moor (Carhouse Lane and Woolley Lane)	EB	12,490	6,937	-5,553	-44%	13,102	7,014	-6,088	-46%	13,438	7,004	-6,434	-48%
16	Mottram Moor (Carhouse Lane and Woolley Lane)	WB	11,606	6,851	-4,755	-41%	12,483	7,357	-5,126	-41%	12,986	7,667	-5,319	-41%
17	A57 Link Road	EB	-	13,037	-	-	-	14,068	-	-	-	14,701	-	-
17	A57 Link Road	WB	-	11,810	-	-	-	13,287	-	-	-	13,830	-	-
18	A57 Spur	EB	-	9,821	-	-	-	10,842	-	-	-	11,322	-	-
18	A57 Spur	WB	-	7,534	-	-	-	8,562	-	-	-	8,959	-	-
19	Mottram Moor link road	EB	-	4,769	-	-	-	5,516	-	-	-	5,840	-	-
19	Mottram Moor link road	WB	-	3,600	-	-	-	4,319	-	-	-	4,961	-	-
20	Woolley Bridge	NB	5,982	4,439	-1,543	-26%	6,314	5,070	-1,244	-20%	6,612	5,541	-1,070	-16%
20	Woolley Bridge	SB	6,459	3,076	-3,384	-52%	7,044	3,200	-3,844	-55%	7,282	3,162	-4,120	-57%

4.6. Journey times

4.6.1. Journey times have been compared between the core DM and DS scenarios to understand the impact of the scheme on the localised highway network.

4.6.2. Table 4-9 to Table 4-11 compare journey times between the core DM and DS scenarios, for all forecast years. Figure 4-6 highlights the extent of the journey time routes that have been included in the analysis.

4.6.3. As a result of introducing the A57 TPU scheme, the model predicts the following changes in journey times in the scheme opening and design years:

M67 J3 to Glossop Crossroads

- Journey times between the M67 J3 and Glossop Crossroads are predicted to improve in both directions across all modelled time periods and forecast years.
  - The greatest journey time savings occur in the eastbound direction in the IP and PM peak, with improvements of ~8-10 minutes predicted in all forecast years.
- However, journey time savings are not as great for vehicles travelling westbound, with the greatest reduction predicted in the IP in all forecast years (~5-6 minutes).
  - This is attributable to the lower levels of congestion in the westbound direction between Glossop Crossroads and the M67 J3 in the DM scenario, especially at the Gun Inn junction (A57 / A628).
  - Delay is predicted on the Mottram Moor (A57) (eastbound) approach arm at the Gun Inn junction in all time periods, but delay is not reflected to the same extent on the Woolley Lane approach arm (i.e. equivalent westbound journey time route).
- Vehicles travelling east-west (in both directions) can utilise the TPU link scheme in its entirety, which is predicted to offer considerable journey time savings in comparison to journey times on the existing A57 route in the DM scenario.

M67 J3 to Woodhead (A628)

- Journey times are predicted to improve in both directions on the A628 between the M67 J3 and Woodhead Reservoir, across all time periods and forecast years, through the alleviation of congestion on the A57, following the implementation of the TPU A57 link scheme.
  - The greatest journey time savings are predicted to occur in the eastbound direction in the PM peak, with improvements of around 5 minutes predicted in all forecast years. (The savings in the IP are only marginally less).
- Journey time improvements are not predicted to be as great for vehicles travelling westbound on the A628 due to the re-prioritisation of signal timings at the Gun Inn junction (A57 / A628), plus lower levels of congestion in the DM scenario.
  - As part of the TPU scheme proposal, greater improvements for non-motorised users (NMU) have been considered at the Gun Inn junction. This includes increasing green time for pedestrians which will be at the expense of motorised road users.
  - Consequently, journey time savings for vehicles travelling westbound between the M67 J3 and Woodhead are not as great, at ~1-2 minutes.
  - Although the re-distribution of green time is predicted to affect all approach arms of the Gun Inn junction, it has a greater impact on journey times on the A628 (Market Street) compared to the A57 (Mottram Moor). This is because the introduction of the scheme is predicted to significantly reduce congestion on Mottram Moor, which outweighs the loss of journey times associated with the re-distribution of green time at Gun inn in favour of pedestrians.

Roe Cross to Glossop Crossroads (A57)

- Journey time savings are predicted on the A57 route between Roe Cross Road and Glossop Crossroads across all modelled time periods and forecast years, except westbound in the 2025 PM peak and 2051 AM peak.
- The greatest time savings, of ~2 minutes, are predicted eastbound in the IP in all forecast years.
- A small increase in journey times is predicted on the A57 westbound during the PM peak in 2025 (~25 seconds) and the AM peak in 2051 (~1 minute).
  - The model predicts a small increase in journey times on the A57 between the Woolley Lane scheme junction and Glossop Crossroads, as a result of increased demand following the implementation of the TPU link scheme.
  - In comparison to the M67 J3 to Glossop Crossroads route, vehicles travelling north-south (in both directions) via Back Moor (A6018) only benefit from a single section of the scheme (i.e. A57(T) to A57 link road). Consequently, journey time savings are not predicted to be as great as those predicted for vehicles travelling east-west (in both directions) between the M67 J3 and Glossop Crossroads.
  - It is also worth noting that Back Moor (A6018) is not a major arm of the signalised scheme junction at Mottram.

4.6.4. More detailed link flow analysis is included in Appendix K as an accompanying spreadsheet.

Figure 4-6 – Journey Time Routes - With Scheme

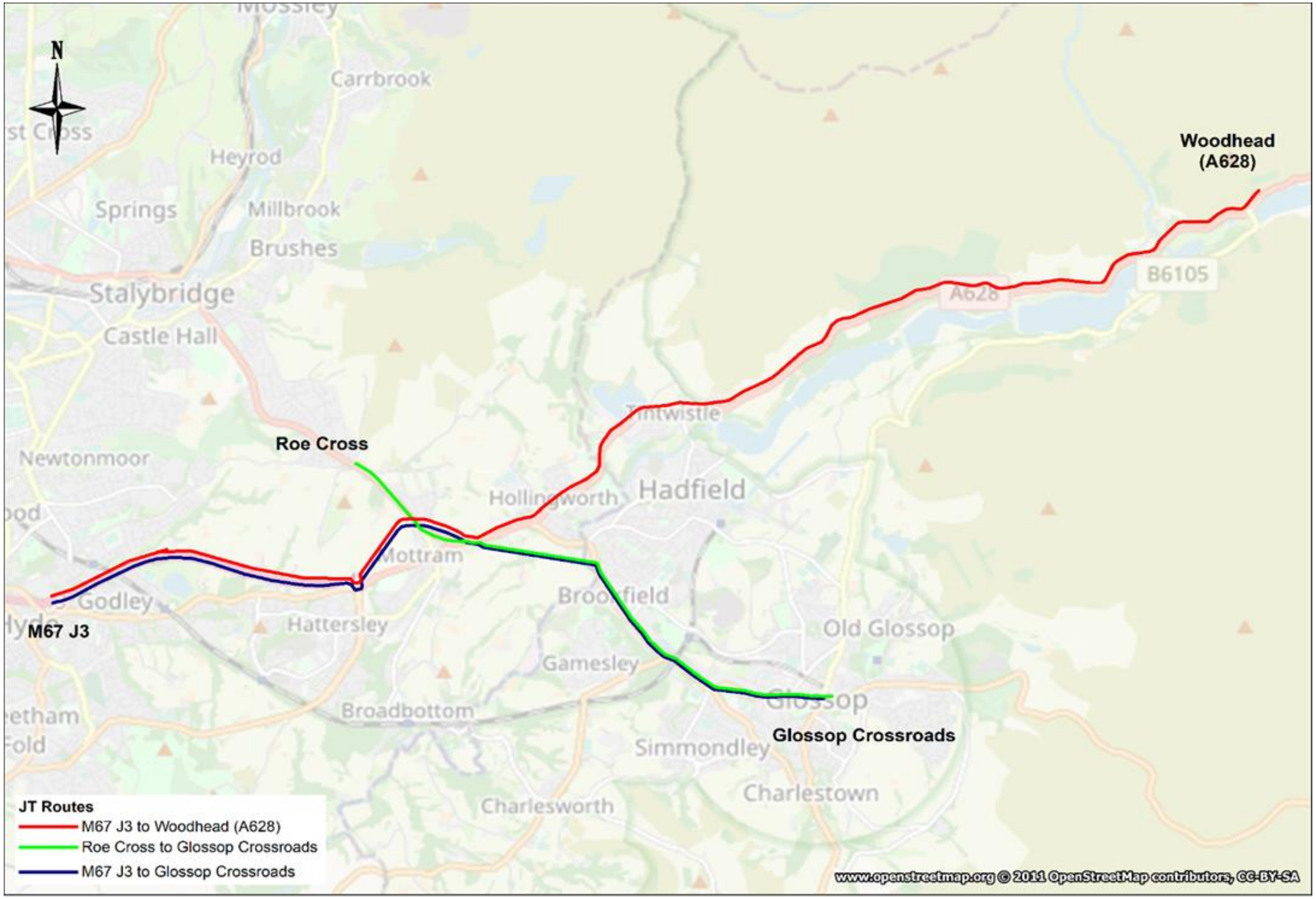


Table 4-9 - Journey time (mm:ss) route comparison (2025): Core scenario

JT Route	Dir.	AM				IP				PM			
		DM	DS	Diff.	% Diff.	DM	DS	Diff.	% Diff.	DM	DS	Diff.	% Diff.
M67 J3 to Glossop Crossroads	EB	19:15	15:07	-04:09	-22%	23:20	14:51	-08:29	-36%	24:21	16:25	-07:55	-33%
	WB	16:14	13:30	-02:44	-17%	19:12	14:05	-05:07	-27%	16:33	15:21	-01:12	-7%
M67 J3 to Woodhead (A628)	EB	21:49	20:14	-01:35	-7%	26:32	22:24	-04:08	-16%	24:55	20:08	-04:46	-19%
	WB	20:25	18:58	-01:27	-7%	22:10	19:50	-02:19	-10%	19:21	18:47	-00:34	-3%
Roe Cross to Glossop Crossroads (A57)	EB	14:38	13:54	-00:43	-5%	15:22	13:37	-01:45	-11%	15:41	15:09	-00:32	-3%
	WB	12:15	12:03	-00:12	-2%	13:17	12:29	-00:48	-6%	13:37	14:03	00:25	3%

Table 4-10 - Journey time (mm:ss) route comparison (2040): Core scenario

JT Route	Dir.	AM				IP				PM			
		DM	DS	Diff.	% Diff.	DM	DS	Diff.	% Diff.	DM	DS	Diff.	% Diff.
M67 J3 to Glossop Crossroads	EB	21:54	16:30	-05:24	-25%	24:52	16:01	-08:52	-36%	25:59	16:55	-09:03	-35%
	WB	16:53	13:59	-02:54	-17%	20:40	14:42	-05:59	-29%	18:08	15:13	-02:54	-16%
M67 J3 to Woodhead (A628)	EB	23:28	20:51	-02:37	-11%	27:33	22:49	-04:44	-17%	25:50	20:50	-05:00	-19%
	WB	20:58	19:34	-01:23	-7%	23:04	20:39	-02:26	-11%	20:01	18:44	-01:17	-6%
Roe Cross to Glossop Crossroads (A57)	EB	16:13	15:26	-00:47	-5%	16:38	14:43	-01:55	-12%	16:30	15:38	-00:53	-5%
	WB	12:36	12:30	-00:06	-1%	14:07	13:11	-00:56	-7%	14:50	14:27	-00:23	-3%

Table 4-11 - Journey time (mm:ss) route comparison (2051): Core scenario

JT Route	Dir.	AM				IP				PM			
		DM	DS	Diff.	% Diff.	DM	DS	Diff.	% Diff.	DM	DS	Diff.	% Diff.
M67 J3 to Glossop Crossroads	EB	23:37	17:36	-06:00	-25%	25:49	16:37	-09:11	-36%	27:15	17:34	-09:40	-35%
	WB	17:20	15:29	-01:51	-11%	21:37	14:50	-06:48	-31%	19:11	14:56	-04:15	-22%
M67 J3 to Woodhead (A628)	EB	24:15	20:51	-03:24	-14%	28:06	23:09	-04:57	-18%	26:11	20:47	-05:25	-21%
	WB	21:19	20:00	-01:19	-6%	23:26	20:33	-02:54	-12%	20:38	19:15	-01:23	-7%
Roe Cross to Glossop Crossroads (A57)	EB	17:30	16:37	-00:53	-5%	17:23	15:23	-02:01	-12%	17:24	16:12	-01:12	-7%
	WB	12:48	13:58	01:09	9%	15:00	13:19	-01:41	-11%	15:38	14:29	-01:09	-7%

5. Forecast results: alternative growth scenarios

5.1.1. This section provides details of the forecast model results for the alternative growth scenarios that were submitted for approval. A summary of the following model results is provided in the main body, whilst full details are provided in the appendices as explained in the sections below:

- Model convergence
- Highway demand matrices
- Trip Length Distribution
- Link flow
- Journey times

5.1.2. Comparisons are drawn between the core scenario and the alternative growth scenarios (low and optimistic). Details of the low and optimistic growth scenarios are provided in section 3.9.

5.2. Model convergence

Variable Demand Model (VDM)

5.2.1. In accordance with TAG guidance (see section 4.2.1), the target %GAP value is 0.1%. In this context, Table 5-1 shows that %GAP values for the full model area and for the subset area are very good for the alternative growth scenarios.

5.2.2. Full details of the VDM convergence statistics are presented in Appendix G.

Table 5-1 - TPU PCF Stage 3 VDM convergence statistics: Low, Core and Optimistic scenario

Scenario	Low			Core			Optimistic		
	Best Loop	Full Model Gap	Subset Area Gap	Best Loop	Full Model Gap	Subset Area Gap	Best Loop	Full Model Gap	Subset Area Gap
DM 2025	15	0.01%	0.03%	15	0.01%	0.03%	10	0.01%	0.03%
DS 2025	17	0.01%	0.03%	19	0.01%	0.03%	13	0.01%	0.03%
DM 2040	18	0.01%	0.04%	20	0.01%	0.03%	20	0.01%	0.03%
DS 2040	19	0.01%	0.04%	19	0.01%	0.03%	13	0.02%	0.05%
DM 2051	11	0.01%	0.04%	17	0.02%	0.05%	14	0.01%	0.03%
DS 2051	20	0.01%	0.04%	19	0.02%	0.06%	17	0.02%	0.05%

Highway Assignment Model (HAM)

5.2.3. Table 5-2 to Table 5-3 show TAG convergence criteria (Table 4-2) have been met for all alternative growth scenarios.

5.2.4. However, the assignment %GAP for TPU has been tightened to 0.05% as a target figure in accordance with the TPS RTM, hence the high number of assignment-simulation loop iterations. Based on these criteria, the following alternative growth scenarios are not achieving the target figure:

- Low growth 2051 AM peak (DM and DS)
- Optimistic growth 2051 AM and PM peak (DM and DS)

5.2.5. Nevertheless, it should be noted that the assignment %GAP for all forecast year scenarios is well below the 0.1% criteria specified in TAG.

5.2.6. The convergence statistics indicate a reduction in model stability in the later forecast years of the optimistic scenario. This is reflective of the predicted increase in network congestion as a result of an increase in demand assigned to the network.

5.2.7. The low growth scenarios typically converge after a lower number of assignment loops when compared to the core scenario, which is reflective of the lower levels of demand assigned to the network.

5.2.8. Full details of the HAM convergence statistics are presented in Appendix H.

Table 5-2 - TPU PCF Stage 3 HAM convergence statistics: Low, Core and Optimistic DM scenario

Time Period	Year	Low			Core			Optimistic		
		Ass. Sim. Loops	P (%)	Gap%	Ass. Sim. Loops	P (%)	Gap%	Ass. Sim. Loops	P (%)	Gap%
AM	2025	10	98.2	0.034%	11	99.1%	0.039%	11	99.2	0.044%
	2040	57	99.9	0.050%	105	100.0%	0.050%	103	99.9	0.050%
	2051	120	99.9	0.053%	120	99.6%	0.062%	120	99.9	0.055%
IP	2025	12	99.3	0.014%	10	99.5%	0.020%	10	98.9	0.020%
	2040	9	99.2	0.033%	10	98.7%	0.042%	11	99.1	0.044%
	2051	11	99.3	0.042%	11	99.9%	0.047%	20	100.0	0.048%
PM	2025	9	98.9	0.031%	12	98.9%	0.034%	11	99.9	0.034%
	2040	11	99.1	0.048%	25	99.9%	0.050%	51	99.9	0.049%
	2051	60	99.9	0.049%	107	100.0%	0.049%	120	99.9	0.052%

Table 5-3 - TPU PCF Stage 3 HAM convergence statistics: Low, Core and Optimistic DS scenario

Time Period	Year	Low			Core			Optimistic		
		Ass. Sim. Loops	P (%)	Gap%	Ass. Sim. Loops	P (%)	Gap%	Ass. Sim. Loops	P (%)	Gap%
AM	2025	10	98.4	0.038%	10	98.6%	0.041%	11	99.1	0.045%
	2040	57	99.9	0.050%	58	99.9%	0.049%	80	99.9	0.050%
	2051	120	99.9	0.060%	120	99.8%	0.052%	120	99.9	0.063%
IP	2025	11	99.2	0.015%	10	98.8%	0.020%	12	99.5	0.021%
	2040	11	98.9	0.036%	9	99.1%	0.043%	15	99.2	0.043%
	2051	9	98.8	0.045%	11	99.3%	0.046%	30	99.9	0.049%
PM	2025	9	98.5	0.029%	10	98.6%	0.038%	10	98.7	0.034%
	2040	16	99.1	0.046%	26	99.9%	0.049%	54	99.9	0.049%
	2051	58	99.9	0.050%	118	100.0%	0.050%	120	100.0	0.051%

5.3. Demand

5.3.1. Table 5-4 to Table 5-12 compare matrix totals for the Reference Case, post-VDM DM and post-VDM DS, by forecast year and growth scenario. More detailed tabulations by user class are provided for the alternative growth scenarios in Appendix I (see section 4.3 for the core scenario).

5.3.2. The tabulations show the following trends in relation to the alternative growth scenarios:

- DIADEM induces minimal change in matrix totals between the Reference Case and the post-VDM DM, and even less between the post-VDM DM and DS scenarios.
- The difference in matrix totals between low and core, and optimistic and core are of a similar scale, which increases in the later forecast years.

5.3.3. To maintain consistency with the analysis provided for the core scenario (section 4.3), sectored demand matrices from the VDM and HAM have also been provided for the alternative growth scenario in Appendix I, as an accompanying spreadsheet.

Table 5-4 - Matrix Trip total comparison by growth scenario: Reference Case (2025)

Time Period	Low	Core	Optimistic	Abs. Diff. (Low -Core)	% Diff. (Low -Core)	Abs. Diff. (Opt. - Core)	% Diff. (Opt. - Core)
AM	5,819,974	6,297,753	6,732,341	-477,778	-7.59%	434,588	6.90%
IP	4,966,524	5,348,390	5,736,876	-381,865	-7.14%	388,486	7.26%
PM	6,512,306	7,020,896	7,533,160	-508,590	-7.24%	512,264	7.30%

Table 5-5 – Matrix Trip total comparison by growth scenario: Reference Case (2040)

Time Period	Low	Core	Optimistic	Abs. Diff. (Low -Core)	% Diff. (Low -Core)	Abs. Diff. (Opt. - Core)	% Diff. (Opt. - Core)
AM	6,221,524	7,008,645	7,665,121	-787,121	-11.23%	656,476	9.37%
IP	5,415,637	5,993,104	6,634,459	-577,467	-9.64%	641,355	10.70%
PM	6,896,501	7,783,294	8,511,739	-886,793	-11.39%	728,446	9.36%

Table 5-6 - Matrix Trip total comparison by growth scenario: Reference Case (2051)

Time Period	Low	Core	Optimistic	Abs. Diff. (Low -Core)	% Diff. (Low -Core)	Abs. Diff. (Opt. - Core)	% Diff. (Opt. - Core)
AM	6,597,078	7,536,609	8,329,400	-939,531	-12.47%	792,791	10.52%
IP	5,737,674	6,438,050	7,200,325	-700,376	-10.88%	762,274	11.84%
PM	7,280,799	8,340,114	9,219,088	-1,059,315	-12.70%	878,974	10.54%

Table 5-7 - Matrix Trip total comparison by growth scenario: post-VDM DM (2025)

Time Period	Low	Core	Optimistic	Abs. Diff. (Low -Core)	% Diff. (Low -Core)	Abs. Diff. (Opt. - Core)	% Diff. (Opt. - Core)
AM	5,822,063	6,276,164	6,728,307	-454,101	-7.24%	452,143	7.20%
IP	4,966,277	5,351,711	5,736,178	-385,434	-7.20%	384,466	7.18%
PM	6,515,817	7,022,744	7,526,871	-506,926	-7.22%	504,127	7.18%

Table 5-8 - Matrix Trip total comparison by growth scenario: post-VDM DM (2040)

Time Period	Low	Core	Optimistic	Abs. Diff. (Low -Core)	% Diff. (Low -Core)	Abs. Diff. (Opt. - Core)	% Diff. (Opt. - Core)
AM	6,224,377	6,943,341	7,661,027	-718,965	-10.35%	717,686	10.34%
IP	5,415,659	6,025,105	6,633,985	-609,446	-10.12%	608,880	10.11%
PM	6,902,796	7,704,147	8,503,824	-801,351	-10.40%	799,678	10.38%

Table 5-9 - Matrix Trip total comparison by growth scenario: post-VDM DM (2051)

Time Period	Low	Core	Optimistic	Abs. Diff. (Low -Core)	% Diff. (Low -Core)	Abs. Diff. (Opt. - Core)	% Diff. (Opt. - Core)
AM	6,599,959	7,463,261	8,325,790	-863,302	-11.57%	862,530	11.56%
IP	5,736,146	6,469,042	7,198,902	-732,895	-11.33%	729,860	11.28%
PM	7,288,215	8,249,964	9,211,463	-961,749	-11.66%	961,498	11.65%

Table 5-10 - Matrix Trip total comparison by growth scenario: post-VDM DS (2025)

Time Period	Low	Core	Optimistic	Abs. Diff. (Low -Core)	% Diff. (Low -Core)	Abs. Diff. (Opt. - Core)	% Diff. (Opt. - Core)
AM	5,821,984	6,276,026	6,728,171	-454,041	-7.23%	452,146	7.20%
IP	4,966,317	5,351,774	5,736,199	-385,457	-7.20%	384,425	7.18%
PM	6,515,798	7,022,733	7,526,877	-506,935	-7.22%	504,144	7.18%

Table 5-11 - Matrix Trip total comparison by growth scenario: post-VDM DS (2040)

Time Period	Low	Core	Optimistic	Abs. Diff. (Low -Core)	% Diff. (Low -Core)	Abs. Diff. (Opt. - Core)	% Diff. (Opt. - Core)
AM	6,224,259	6,943,224	7,660,921	-718,964	-10.35%	717,698	10.34%
IP	5,415,707	6,025,133	6,633,989	-609,426	-10.11%	608,856	10.11%
PM	6,902,803	7,704,204	8,503,933	-801,400	-10.40%	799,729	10.38%

Table 5-12 - Matrix Trip total comparison by growth scenario: post-VDM DS (2051)

Time Period	Low	Core	Optimistic	Abs. Diff. (Low -Core)	% Diff. (Low -Core)	Abs. Diff. (Opt. - Core)	% Diff. (Opt. - Core)
AM	6,599,866	7,463,127	8,325,652	-863,261	-11.57%	862,525	11.56%
IP	5,738,118	6,469,110	7,198,961	-730,991	-11.30%	729,852	11.28%
PM	7,288,250	8,249,997	9,209,534	-961,747	-11.66%	959,536	11.63%

5.4. Trip Length Distribution (TLD)

5.4.1. Figure 5-1 to Figure 5-6 compare 12-hour (07:00-19:00) AAWT trip length distributions for cars between the Base, Reference Case, post-VDM DM and post-VDM DS, by forecast year and growth scenario (Figure 4-2 to Figure 4-4 show the Core results). There is minimal change in the Low/Optimistic scenarios in the distribution of LGV and HGV trip lengths as they are not included in the VDM. However, detailed analysis of all user classes is presented in Appendix F.

5.4.2. Table 5-13 and Table 5-14 show the forecast proportion of 0-20 km and 20+ km car trips in the post-VDM matrices of each growth scenario. The following model observations are relevant for both the post-VDM DM and DS assignments as the difference in trip length distribution is insignificant:

- In the low growth scenario, there is a slightly lower proportion of short distance trips compared to the core growth scenario. This is reflective of a less congested network, permitting people to travel further without increasing their journey times.
- In the optimistic growth scenario, there is a slightly higher proportion of shorter distance trips compared to the core scenario. This is reflective of a more congested network, resulting in the VDM inducing a change in distribution patterns as people seek to mitigate the impact of increased journey times. Furthermore, there is an increase in the number of local developments included in the optimistic growth scenario, which may have a greater impact on the proportion of short distance trips.
- Uniform growth factors derived from RTF18 (see Table 3-5) are applied to all trips in the LGV and HGV matrices, and they are fixed in the VDM. Therefore, the proportional split between TLD bands for these two vehicle types is consistent across all model scenarios.

Figure 5-1 - TLD Analysis 12-hour (07:00-19:00) Car AAWT (2025): Low scenario

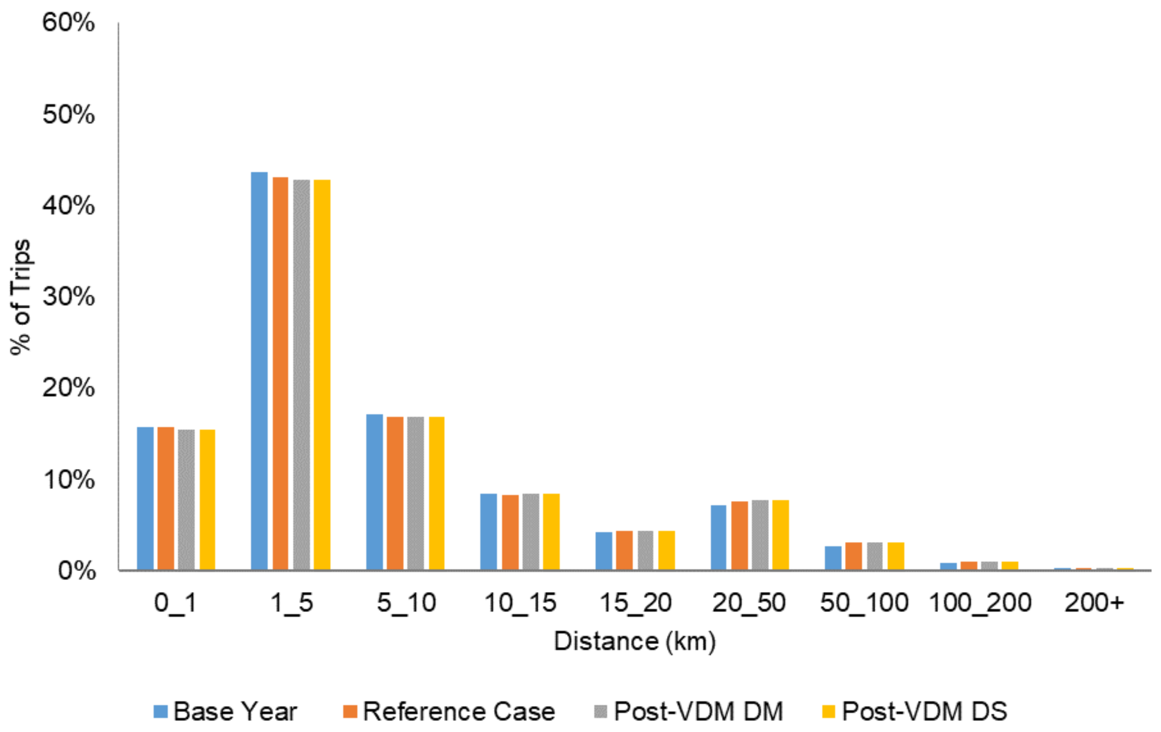


Figure 5-2 - TLD Analysis 12-hour (07:00-19:00) Car AAWT (2040): Low scenario

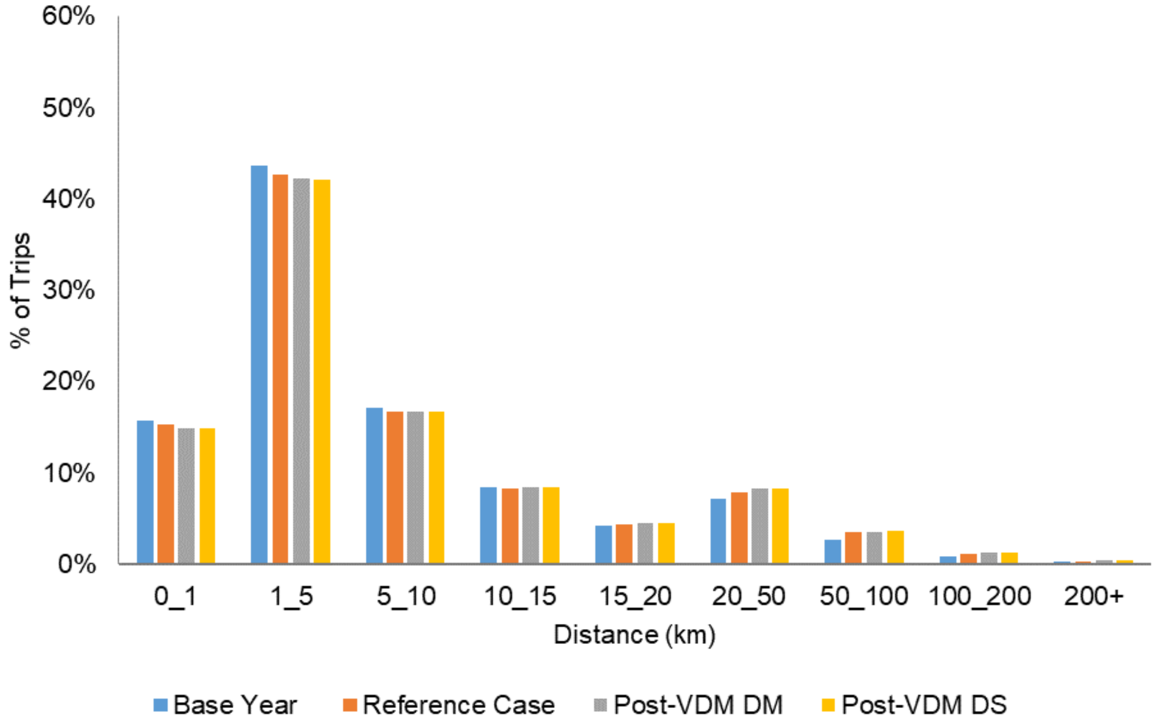


Figure 5-3 - TLD Analysis 12-hour (07:00-19:00) Car AAWT (2051): Low scenario

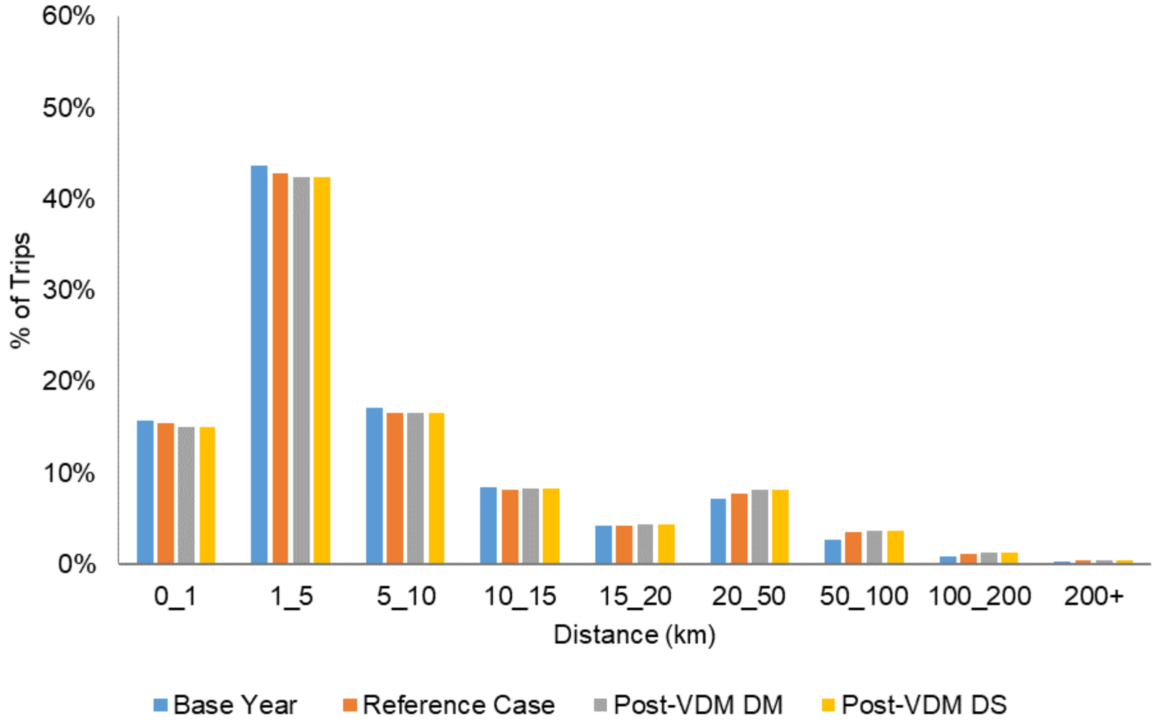


Figure 5-4 - TLD Analysis 12-hour (07:00-19:00) Car AAWT (2025): Optimistic scenario

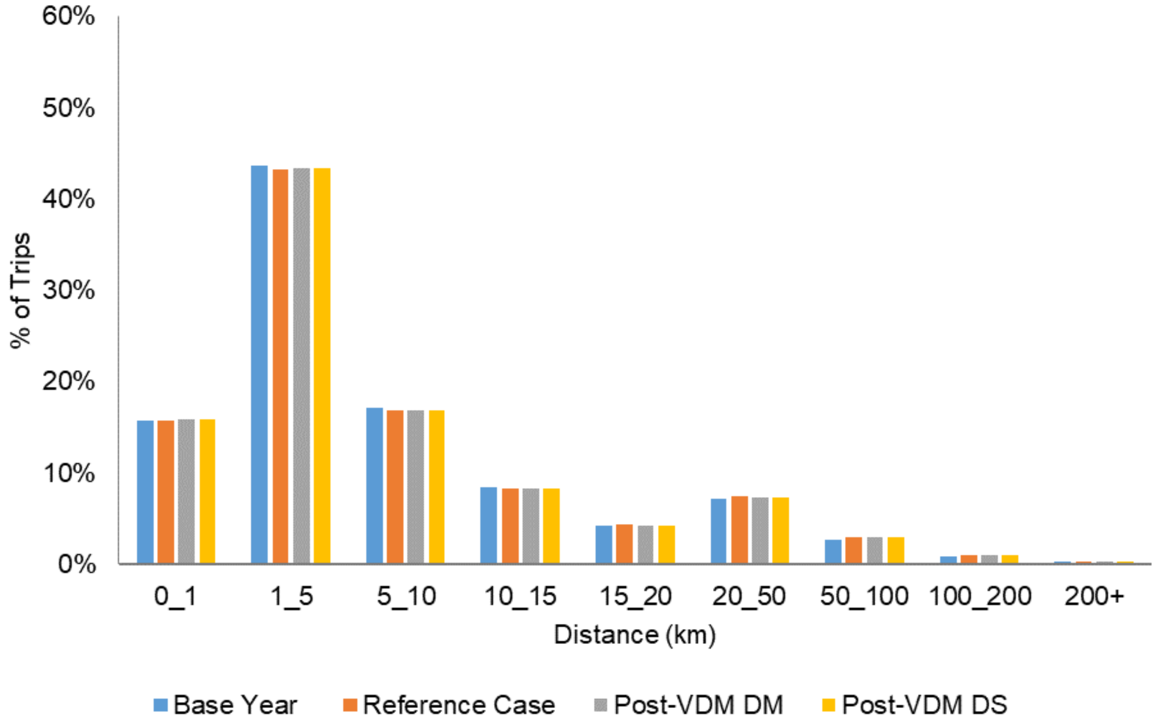


Figure 5-5 - TLD Analysis 12-hour (07:00-19:00) Car AAWT (2040): Optimistic scenario

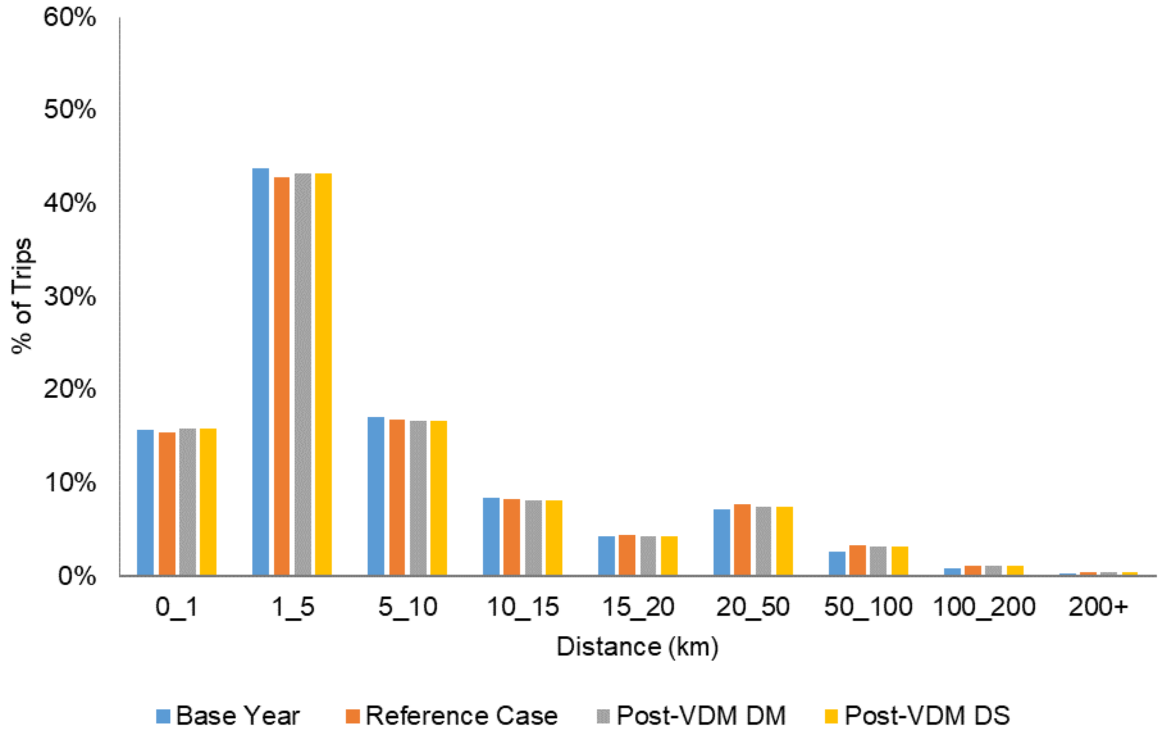


Figure 5-6 - TLD Analysis 12-hour (07:00-19:00) Car AAWT (2051): Optimistic scenario

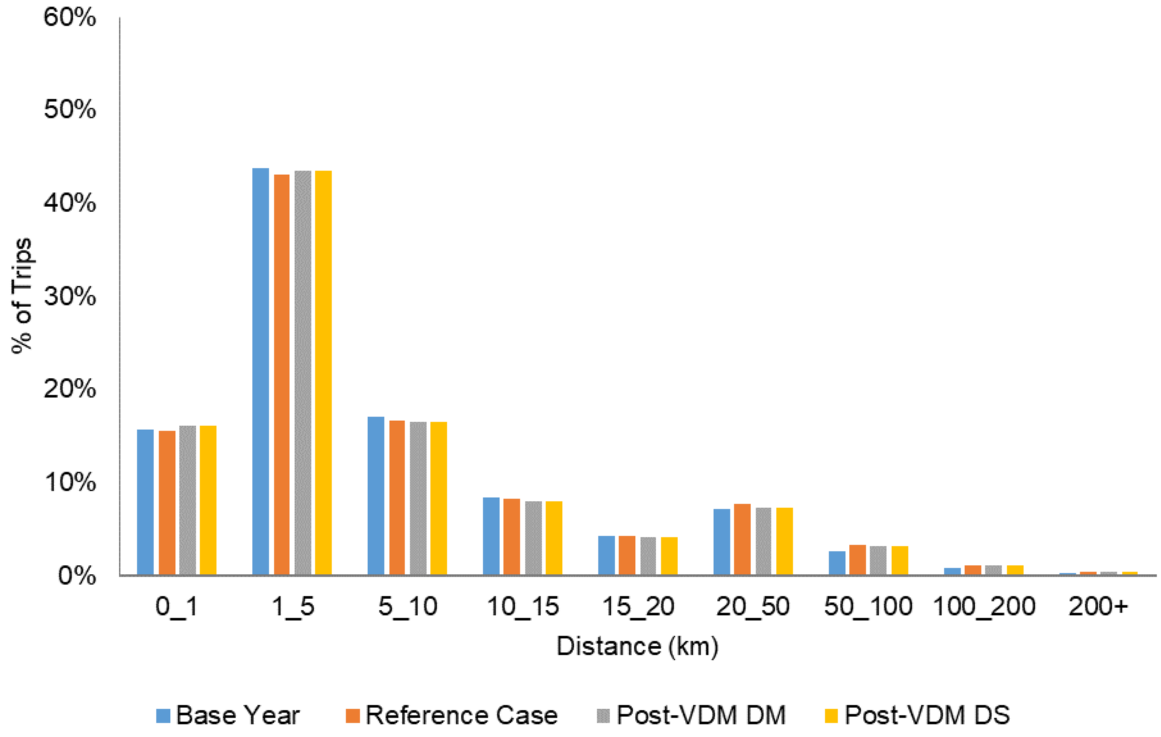


Table 5-13 - Trip length comparison by growth scenario and forecast year: post-VDM DM

Growth scenario	2025		2040		2051	
	0-20 km	20+ km	0-20 km	20+ km	0-20 km	20+ km
Low	87.9%	12.1%	86.6%	13.4%	86.7%	13.3%
Core	88.3%	11.7%	87.3%	12.7%	87.5%	12.5%
High	88.6%	11.4%	88.0%	12.0%	88.2%	11.8%

Table 5-14 - Trip length comparison by growth scenario and forecast year: post-VDM DS

Growth scenario	2025		2040		2051	
	0-20 km	20+ km	0-20 km	20+ km	0-20 km	20+ km
Low	87.9%	12.1%	86.6%	13.4%	86.6%	13.4%
Core	88.2%	11.8%	87.3%	12.7%	87.5%	12.5%
High	88.6%	11.4%	87.9%	12.1%	88.2%	11.8%

5.5. Link flow

5.5.1. Appendix J compare link flows between the DM and DS scenarios, by forecast year and growth scenario. 12-hour (07:00-19:00) two-way AAWT link flows are provided for the locations shown in Figure 4-5.

5.5.2. In general, the difference in individual link flows between the low and core, and optimistic and core are of a similar scale. Link flows in the low growth scenario are lower than the core, whilst link flows in the high growth scenario are higher than the core.

5.5.3. However, there are instances where this generic trend is not apparent, particularly where the assigned link flows are small and small changes in route choice will therefore have a disproportionate effect. In all cases where the low growth scenario is greater than the core or the high growth scenario is less than the core, the difference in 12-hour two-way AAWT link flows is less than 200 vehicles.

5.5.4. More detailed link flow analysis for the alternative growth scenarios is presented in Appendix J as an accompanying spreadsheet.

5.6. Journey times

5.6.1. Table 5-15 to Table 5-23 compare journey times between the DM and DS scenarios, by forecast year and growth scenario. Figure 4-6 highlights the extent of the journey time routes that have been included in the analysis.

5.6.2. In comparison to the core scenario, journey times are mostly greater in the optimistic growth scenario and lower in the low growth scenario, for all forecast years and scheme scenarios. The higher level of demand in the optimistic scenario is predicted to result in higher levels of congestion, whilst the opposite effect is predicted in the low growth scenario.

5.6.3. There are three instances on the monitored routes where journey times do not follow the positive trend of increasing between the low, core and optimistic scenarios. However, in these cases the difference is minimal, and across all routes, journey time savings increase between the low, core and optimistic growth scenarios as a result of introducing the scheme.

- M67 J3 to Glossop Crossroads westbound
  - Journey times in the low growth scenario are one second longer than the core in the 2025 DS PM peak.
- M67 J3 to Woodhead (A628) eastbound
  - Journey times in the optimistic growth scenario are 12 seconds shorter than the core in the 2040 DS PM peak, and six seconds shorter in the 2051 DS PM peak.

5.6.4. More detailed journey time analysis is included in Appendix K as an accompanying spreadsheet.

DRIVING OUTCOMES

Table 5-15 - Journey time (mm:ss) route comparison: 2025 (AM peak)

JT Route	Dir.	Low				Core				Optimistic			
		DM	DS	Diff.	% Diff.	DM	DS	Diff.	% Diff.	DM	DS	Diff.	% Diff.
M67 J3 to Glossop Crossroads	EB	18:32	14:50	-03:42	-20%	19:15	15:07	-04:09	-22%	20:11	15:36	-04:35	-23%
	WB	15:23	13:17	-02:06	-14%	16:14	13:30	-02:44	-17%	16:47	13:42	-03:05	-18%
M67 J3 to Woodhead (A628)	EB	21:20	19:50	-01:30	-7%	21:49	20:14	-01:35	-7%	22:28	20:52	-01:36	-7%
	WB	19:40	18:41	-00:58	-5%	20:25	18:58	-01:27	-7%	20:59	19:24	-01:36	-8%
Roe Cross to Glossop Crossroads (A57)	EB	14:04	13:36	-00:28	-3%	14:38	13:54	-00:43	-5%	15:16	14:30	-00:46	-5%
	WB	12:02	11:49	-00:12	-2%	12:15	12:03	-00:12	-2%	12:27	12:16	-00:12	-2%

Table 5-16 - Journey time (mm:ss) route comparison: 2025 (IP)

JT Route	Dir.	Low				Core				Optimistic			
		DM	DS	Diff.	% Diff.	DM	DS	Diff.	% Diff.	DM	DS	Diff.	% Diff.
M67 J3 to Glossop Crossroads	EB	22:26	14:32	-07:55	-35%	23:20	14:51	-08:29	-36%	24:14	15:09	-09:05	-37%
	WB	18:41	13:48	-04:53	-26%	19:12	14:05	-05:07	-27%	20:24	14:25	-05:59	-29%
M67 J3 to Woodhead (A628)	EB	25:48	21:43	-04:05	-16%	26:32	22:24	-04:08	-16%	27:16	22:45	-04:31	-17%
	WB	21:34	19:39	-01:55	-9%	22:10	19:50	-02:19	-10%	22:41	20:29	-02:12	-10%
Roe Cross to Glossop Crossroads (A57)	EB	14:45	13:19	-01:25	-10%	15:22	13:37	-01:45	-11%	16:06	13:56	-02:10	-13%
	WB	13:08	12:11	-00:57	-7%	13:17	12:29	-00:48	-6%	14:08	12:52	-01:16	-9%

Table 5-17 - Journey time (mm:ss) route comparison: 2025 (PM peak)

JT Route	Dir.	Low				Core				Optimistic			
		DM	DS	Diff.	% Diff.	DM	DS	Diff.	% Diff.	DM	DS	Diff.	% Diff.
M67 J3 to Glossop Crossroads	EB	22:42	16:00	-06:42	-30%	24:21	16:25	-07:55	-33%	25:38	16:51	-08:47	-34%
	WB	15:54	15:22	-00:32	-3%	16:33	15:21	-01:12	-7%	17:25	15:43	-01:43	-10%
M67 J3 to Woodhead (A628)	EB	23:43	19:27	-04:16	-18%	24:55	20:08	-04:46	-19%	25:52	20:23	-05:29	-21%
	WB	19:00	18:28	-00:32	-3%	19:21	18:47	-00:34	-3%	19:48	19:21	-00:27	-2%
Roe Cross to Glossop Crossroads (A57)	EB	15:03	14:41	-00:22	-2%	15:41	15:09	-00:32	-3%	16:10	15:38	-00:32	-3%
	WB	13:05	13:58	00:53	7%	13:37	14:03	00:25	3%	14:16	14:34	00:18	2%

Journey times that are greater than the core in the low growth scenario are highlighted in red, whilst journey times less than the core in the optimistic growth scenario are highlighted in blue.

Table 5-18 - Journey time (mm:ss) route comparison: 2040 (AM peak)

JT Route	Dir.	Low				Core				Optimistic			
		DM	DS	Diff.	% Diff.	DM	DS	Diff.	% Diff.	DM	DS	Diff.	% Diff.
M67 J3 to Glossop Crossroads	EB	19:37	15:15	-04:23	-22%	21:54	16:30	-05:24	-25%	23:59	17:53	-06:06	-25%
	WB	16:03	13:32	-02:31	-16%	16:53	13:59	-02:54	-17%	18:02	15:37	-02:25	-13%
M67 J3 to Woodhead (A628)	EB	22:06	20:22	-01:43	-8%	23:28	20:51	-02:37	-11%	24:33	20:57	-03:36	-15%
	WB	20:15	19:12	-01:03	-5%	20:58	19:34	-01:23	-7%	21:58	20:19	-01:39	-8%
Roe Cross to Glossop Crossroads (A57)	EB	14:49	14:05	-00:45	-5%	16:13	15:26	-00:47	-5%	17:33	16:56	-00:37	-3%
	WB	12:14	12:03	-00:11	-2%	12:36	12:30	-00:06	-1%	12:59	14:08	01:09	9%

Table 5-19 - Journey time (mm:ss) route comparison: 2040 (IP)

JT Route	Dir.	Low				Core				Optimistic			
		DM	DS	Diff.	% Diff.	DM	DS	Diff.	% Diff.	DM	DS	Diff.	% Diff.
M67 J3 to Glossop Crossroads	EB	23:28	15:09	-08:18	-35%	24:52	16:01	-08:52	-36%	26:32	16:46	-09:47	-37%
	WB	19:38	14:12	-05:26	-28%	20:40	14:42	-05:59	-29%	21:49	15:15	-06:34	-30%
M67 J3 to Woodhead (A628)	EB	26:29	22:34	-03:55	-15%	27:33	22:49	-04:44	-17%	28:38	23:18	-05:19	-19%
	WB	22:17	19:37	-02:40	-12%	23:04	20:39	-02:26	-11%	23:37	21:26	-02:11	-9%
Roe Cross to Glossop Crossroads (A57)	EB	15:35	13:51	-01:44	-11%	16:38	14:43	-01:55	-12%	17:50	15:29	-02:22	-13%
	WB	13:36	12:37	-00:59	-7%	14:07	13:11	-00:56	-7%	15:10	13:48	-01:21	-9%

Table 5-20 - Journey time (mm:ss) route comparison: 2040 (PM peak)

JT Route	Dir.	Low				Core				Optimistic			
		DM	DS	Diff.	% Diff.	DM	DS	Diff.	% Diff.	DM	DS	Diff.	% Diff.
M67 J3 to Glossop Crossroads	EB	23:47	16:15	-07:32	-32%	25:59	16:55	-09:03	-35%	28:00	17:50	-10:10	-36%
	WB	17:09	14:18	-02:52	-17%	18:08	15:13	-02:54	-16%	19:21	15:24	-03:57	-20%
M67 J3 to Woodhead (A628)	EB	24:28	20:24	-04:04	-17%	25:50	20:50	-05:00	-19%	26:32	20:38	-05:54	-22%
	WB	19:29	18:34	-00:55	-5%	20:01	18:44	-01:17	-6%	20:47	19:26	-01:22	-7%
Roe Cross to Glossop Crossroads (A57)	EB	15:37	14:54	-00:43	-5%	16:30	15:38	-00:53	-5%	17:49	16:30	-01:19	-7%
	WB	14:05	13:12	-00:53	-6%	14:50	14:27	-00:23	-3%	15:42	15:02	-00:41	-4%

Journey times that are greater than the core in the low growth scenario are highlighted in red, whilst journey times less than the core in the optimistic growth scenario are highlighted in blue.

Table 5-21 - Journey time (mm:ss) route comparison: 2051 (AM peak)

JT Route	Dir.	Low				Core				Optimistic			
		DM	DS	Diff.	% Diff.	DM	DS	Diff.	% Diff.	DM	DS	Diff.	% Diff.
M67 J3 to Glossop Crossroads	EB	20:55	15:53	-05:02	-24%	23:37	17:36	-06:00	-25%	25:44	18:56	-06:48	-26%
	WB	16:12	13:41	-02:31	-16%	17:20	15:29	-01:51	-11%	18:49	16:43	-02:05	-11%
M67 J3 to Woodhead (A628)	EB	22:51	20:33	-02:18	-10%	24:15	20:51	-03:24	-14%	25:23	21:11	-04:11	-17%
	WB	20:21	19:01	-01:20	-7%	21:19	20:00	-01:19	-6%	22:34	20:25	-02:09	-10%
Roe Cross to Glossop Crossroads (A57)	EB	15:38	14:45	-00:53	-6%	17:30	16:37	-00:53	-5%	19:07	18:08	-00:59	-5%
	WB	12:20	12:13	-00:08	-1%	12:48	13:58	01:09	9%	13:17	14:47	01:30	11%

Table 5-22 - Journey time (mm:ss) route comparison: 2051 (IP)

JT Route	Dir.	Low				Core				Optimistic			
		DM	DS	Diff.	% Diff.	DM	DS	Diff.	% Diff.	DM	DS	Diff.	% Diff.
M67 J3 to Glossop Crossroads	EB	23:57	15:48	-08:09	-34%	25:49	16:37	-09:11	-36%	28:14	17:46	-10:28	-37%
	WB	20:20	14:21	-05:59	-29%	21:37	14:50	-06:48	-31%	23:05	16:22	-06:43	-29%
M67 J3 to Woodhead (A628)	EB	26:47	22:31	-04:17	-16%	28:06	23:09	-04:57	-18%	29:49	24:00	-05:50	-20%
	WB	22:51	20:09	-02:41	-12%	23:26	20:33	-02:54	-12%	24:07	22:51	-01:16	-5%
Roe Cross to Glossop Crossroads (A57)	EB	15:58	14:35	-01:23	-9%	17:23	15:23	-02:01	-12%	18:56	16:35	-02:21	-12%
	WB	13:49	12:47	-01:02	-8%	15:00	13:19	-01:41	-11%	16:18	14:15	-02:03	-13%

Table 5-23 - Journey time (mm:ss) route comparison: 2051 (PM peak)

JT Route	Dir.	Low				Core				Optimistic			
		DM	DS	Diff.	% Diff.	DM	DS	Diff.	% Diff.	DM	DS	Diff.	% Diff.
M67 J3 to Glossop Crossroads	EB	24:56	16:38	-08:18	-33%	27:15	17:34	-09:40	-35%	29:42	18:44	-10:58	-37%
	WB	17:40	14:54	-02:45	-16%	19:11	14:56	-04:15	-22%	20:40	16:03	-04:37	-22%
M67 J3 to Woodhead (A628)	EB	25:12	20:43	-04:29	-18%	26:11	20:47	-05:25	-21%	26:48	20:41	-06:07	-23%
	WB	19:43	18:45	-00:58	-5%	20:38	19:15	-01:23	-7%	21:00	19:53	-01:06	-5%
Roe Cross to Glossop Crossroads (A57)	EB	16:08	15:18	-00:50	-5%	17:24	16:12	-01:12	-7%	19:15	17:28	-01:47	-9%
	WB	14:33	14:00	-00:33	-4%	15:38	14:29	-01:09	-7%	17:08	16:03	-01:06	-6%

Journey times that are greater than the core in the low growth scenario are highlighted in red, whilst journey times less than the core in the optimistic growth scenario are highlighted in blue.

6. Summary

6.1.1. The Transport Forecasting Package summarises the development of the TPU PCF Stage 3 forecast year transport model used to undertake an assessment of the TPU A57 link road scheme.

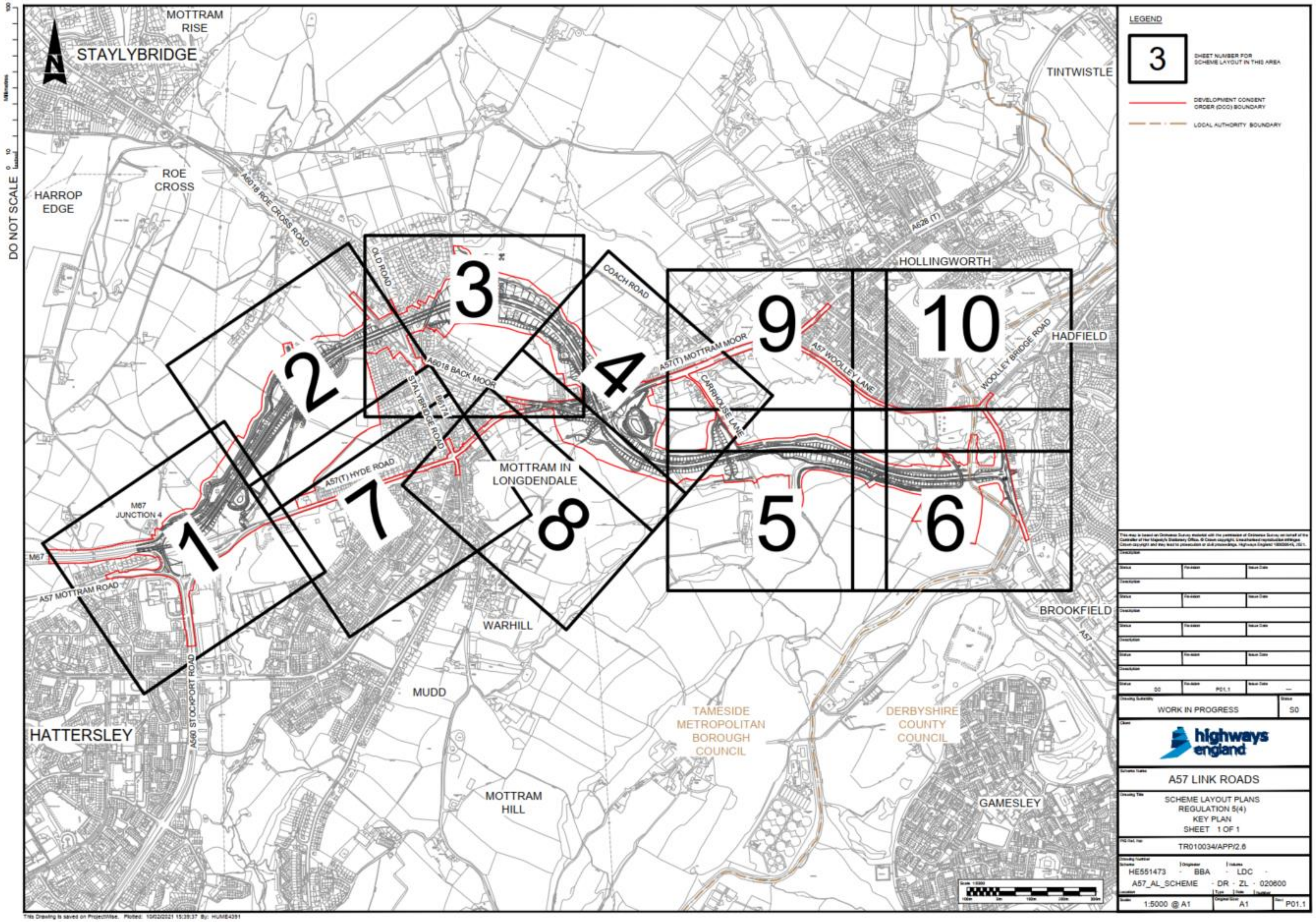
6.1.2. The forecasting results presented in this report suggest that the introduction of the A57 link road is likely to meet many of the high-level scheme objectives of TPU. The model predicts that connectivity between the Manchester and Sheffield city regions will be improved through the reduction in congestion on the A57. The introduction of the A57 link road scheme is shown to divert vehicles from the existing A57, reducing traffic volumes through residential areas and improving the capacity of existing junctions (e.g. Mottram Crossroads). As fewer vehicles are likely to seek alternative routes to avoid congestion on the A57 along Hyde Road and Mottram Moor, there is also a reduction in flow on local alternative routes (e.g. Roe Cross Road and Ashworth Lane), with vehicles more inclined to remain on the SRN.

6.1.3. The forecasts are considered fit for the purposes of informing the economic, environmental and operational appraisal of the scheme.

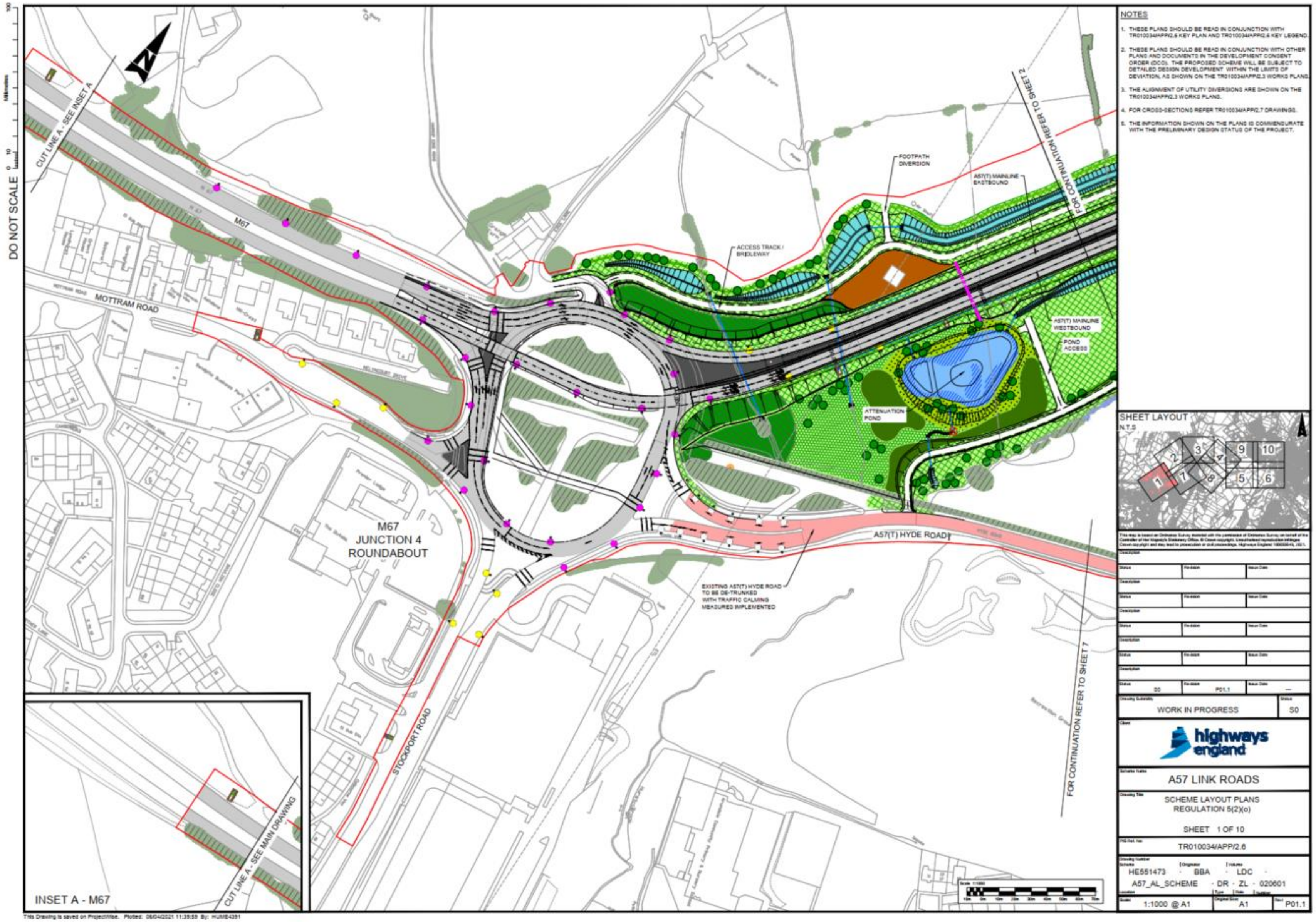
Appendices

Appendix A. Scheme design: A57 link road

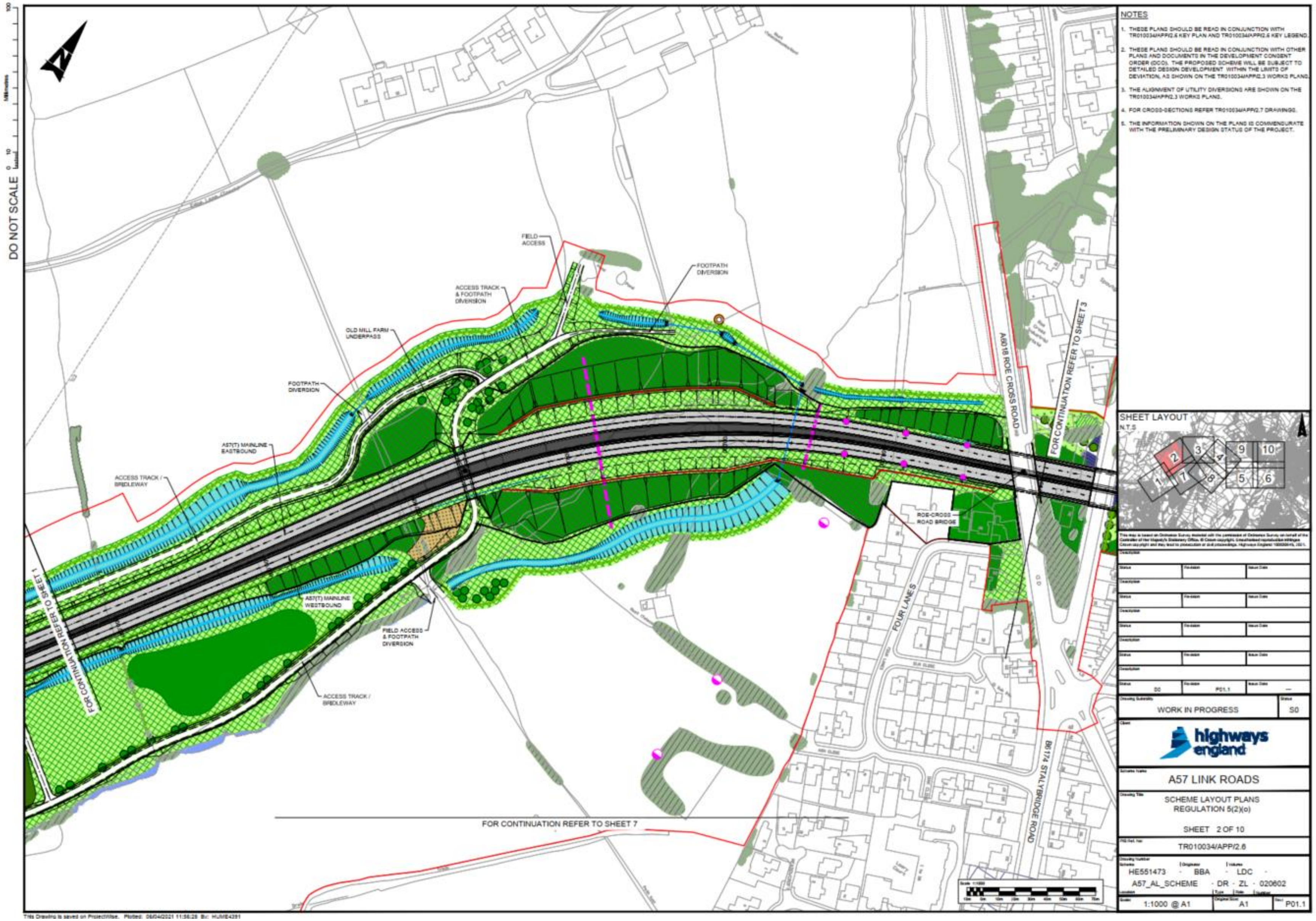
DRIVING OUTCOMES

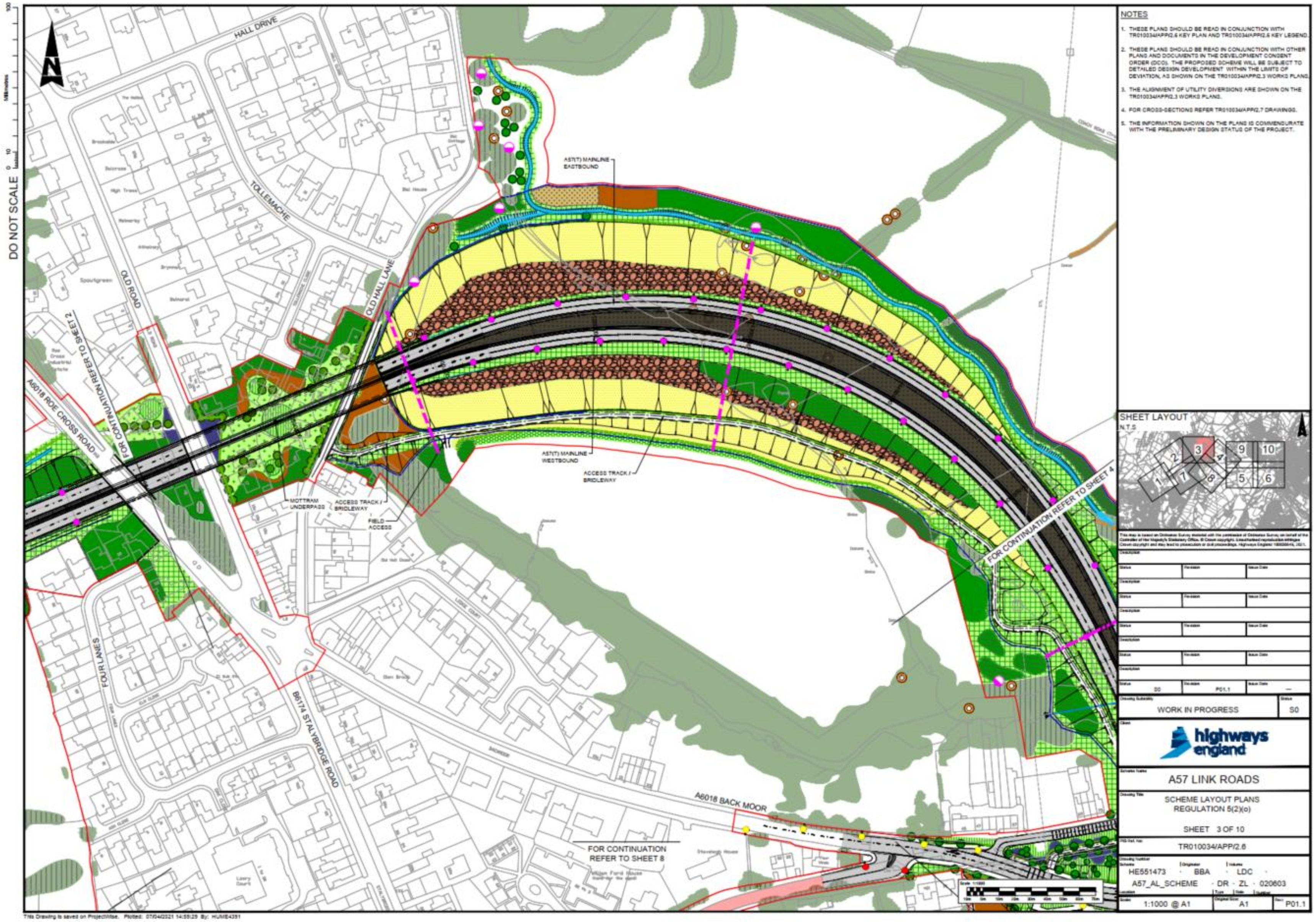


DRIVING OUTCOMES

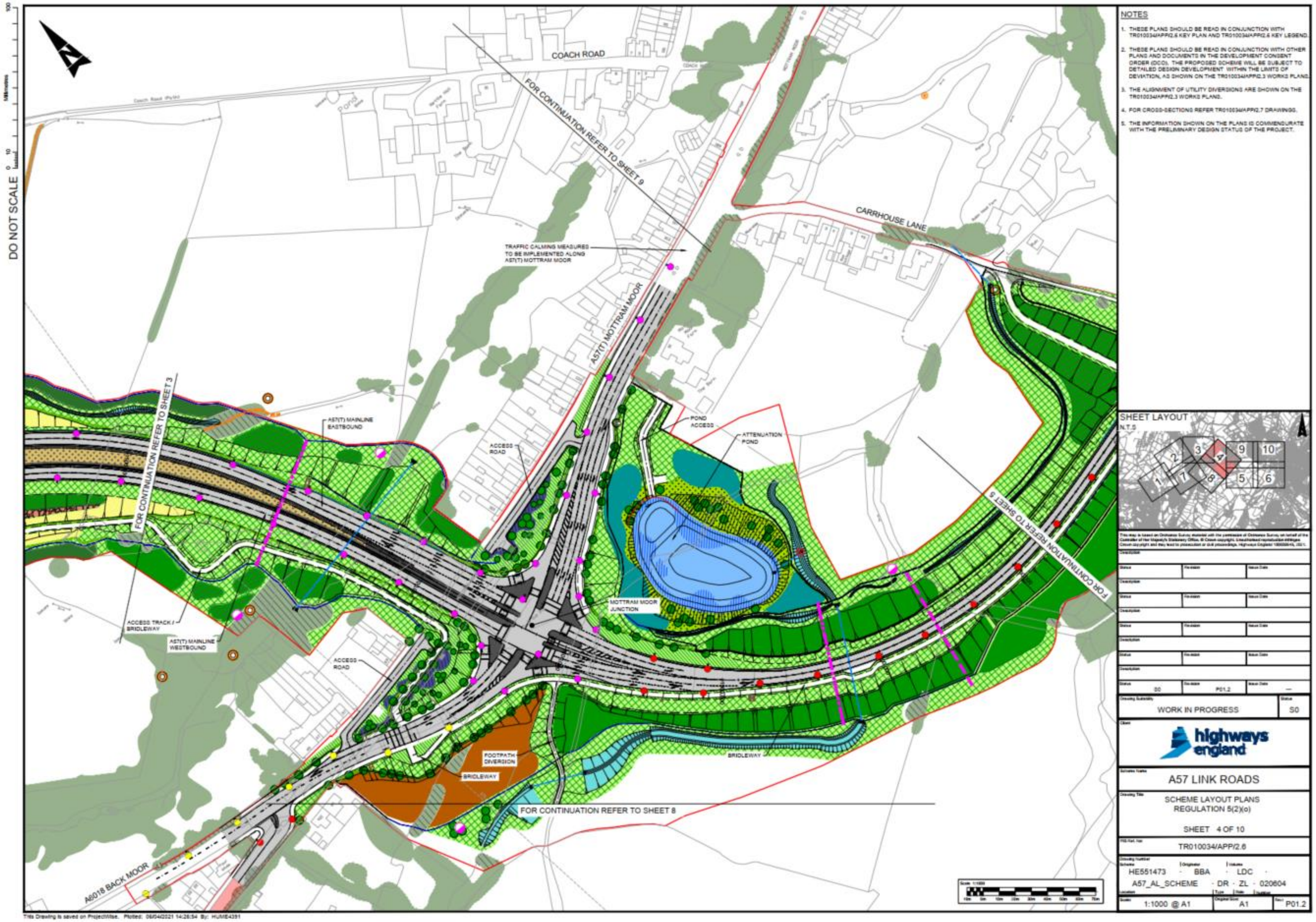


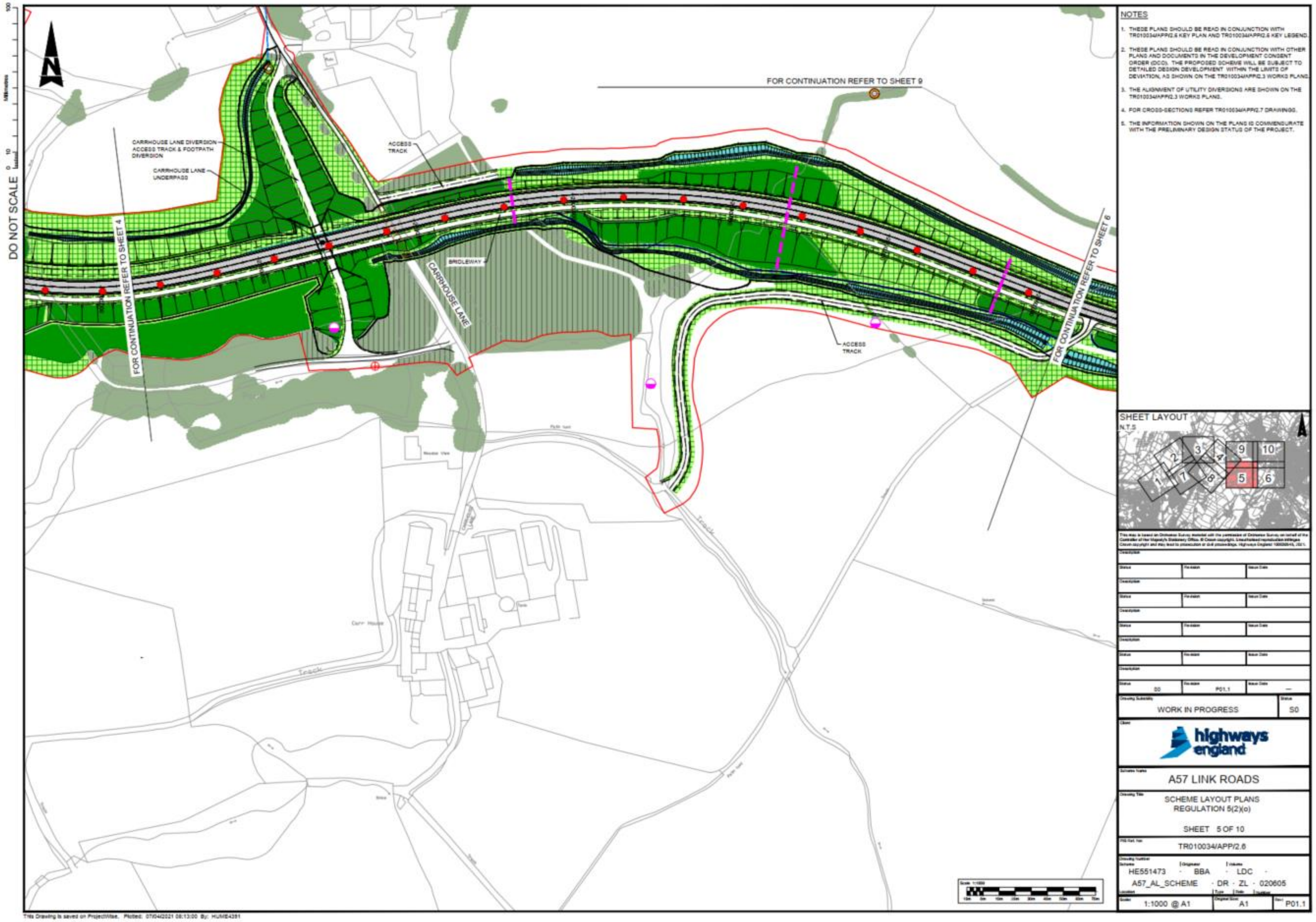
DRIVING OUTCOMES




DO NOT SCALE
HALL DRIVE
TOLLEMACHE
OLD HALL LANE
OLD ROAD
A6018 ROE CROSS ROAD
FOR CONTINUATION REFER TO SHEET 2
A57(T) MAINLINE EASTBOUND
A57(T) MAINLINE WESTBOUND
ACCESS TRACK / BRIDLEWAY
MOTTRAM UNDERPASS
FIELD ACCESS
FOR CONTINUATION REFER TO SHEET 4
FOUR LANES
B6174 STALYBRIDGE ROAD
A6018 BACK MOOR
FOR CONTINUATION REFER TO SHEET 8
NOTES
1. THESE PLANS SHOULD BE READ IN CONJUNCTION WITH TR010034/APP/2.6 KEY PLAN AND TR010034/APP/2.6 KEY LEGEND.
2. THESE PLANS SHOULD BE READ IN CONJUNCTION WITH OTHER PLANS AND DOCUMENTS IN THE DEVELOPMENT CONSENT ORDER (DCO). THE PROPOSED SCHEME WILL BE SUBJECT TO DETAILED DESIGN DEVELOPMENT WITHIN THE LIMITS OF DEVIATION, AS SHOWN ON THE TR010034/APP/2.3 WORKS PLANS.
3. THE ALIGNMENT OF UTILITY DIVERSIONS ARE SHOWN ON THE TR010034/APP/2.3 WORKS PLANS.
4. FOR CROSS-SECTIONS REFER TR010034/APP/2.7 DRAWINGS.
5. THE INFORMATION SHOWN ON THE PLANS IS COMMENSURATE WITH THE PRELIMINARY DESIGN STATUS OF THE PROJECT.
SHEET LAYOUT
N.T.S
S0
P01.1
WORK IN PROGRESS
S0
A57 LINK ROADS
SCHEME LAYOUT PLANS
REGULATION 5(2)(o)
SHEET 3 OF 10
TR010034/APP/2.6
HE551473 - BBA - LDC -
A57_AL_SCHEME - DR - ZL - 020603
1:1000 @ A1
A1
P01.1

DRIVING OUTCOMES




DO NOT SCALE
FOR CONTINUATION REFER TO SHEET 9
FOR CONTINUATION REFER TO SHEET 4
FOR CONTINUATION REFER TO SHEET 6
CARRHOUSE LANE DIVERSION ACCESS TRACK & FOOTPATH DIVERSION
CARRHOUSE LANE UNDERPASS
ACCESS TRACK
BRIDLEWAY
CARRHOUSE LANE
ACCESS TRACK
NOTES
1. THESE PLANS SHOULD BE READ IN CONJUNCTION WITH TR010034/APP/2.6 KEY PLAN AND TR010034/APP/2.6 KEY LEGEND.
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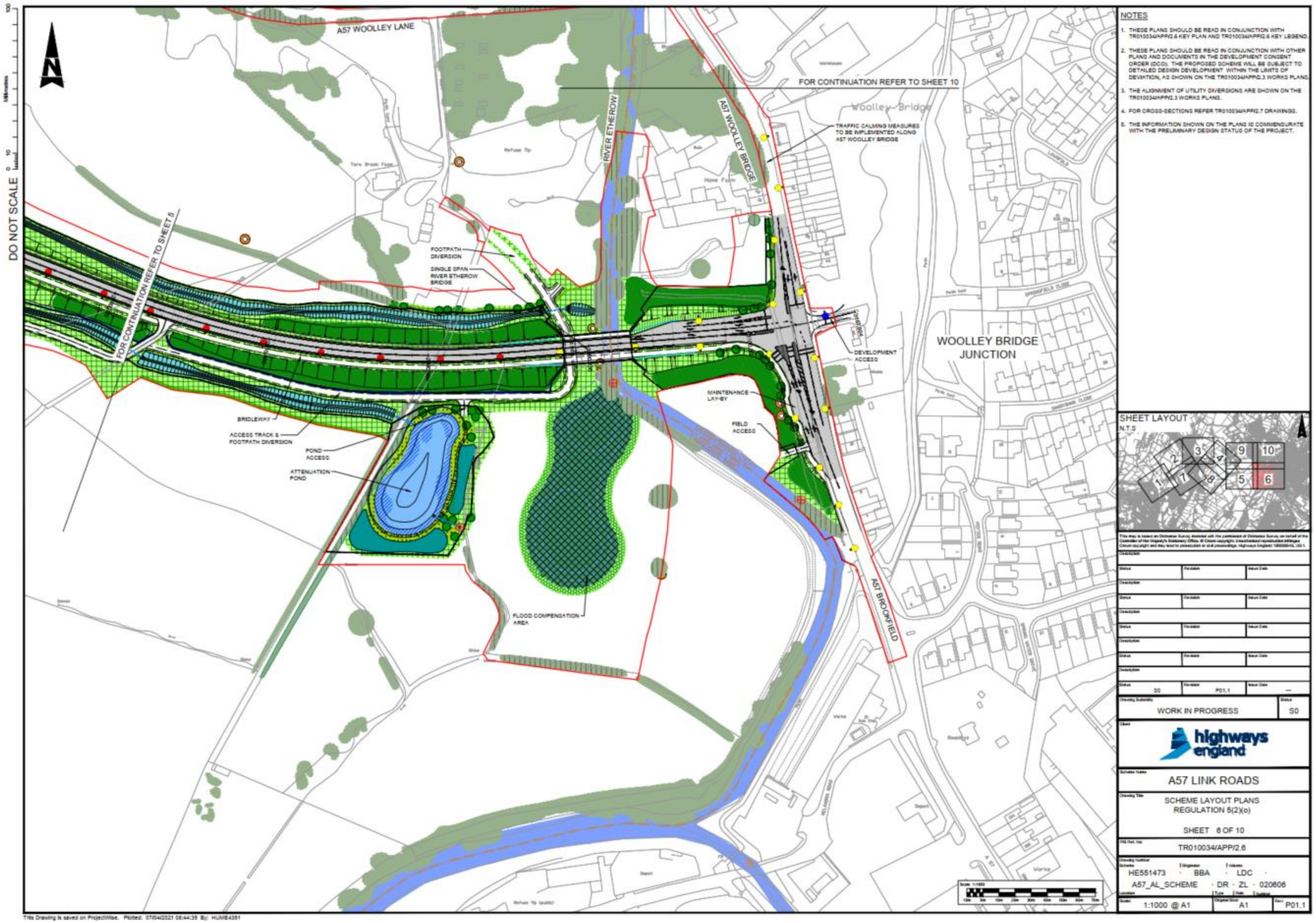
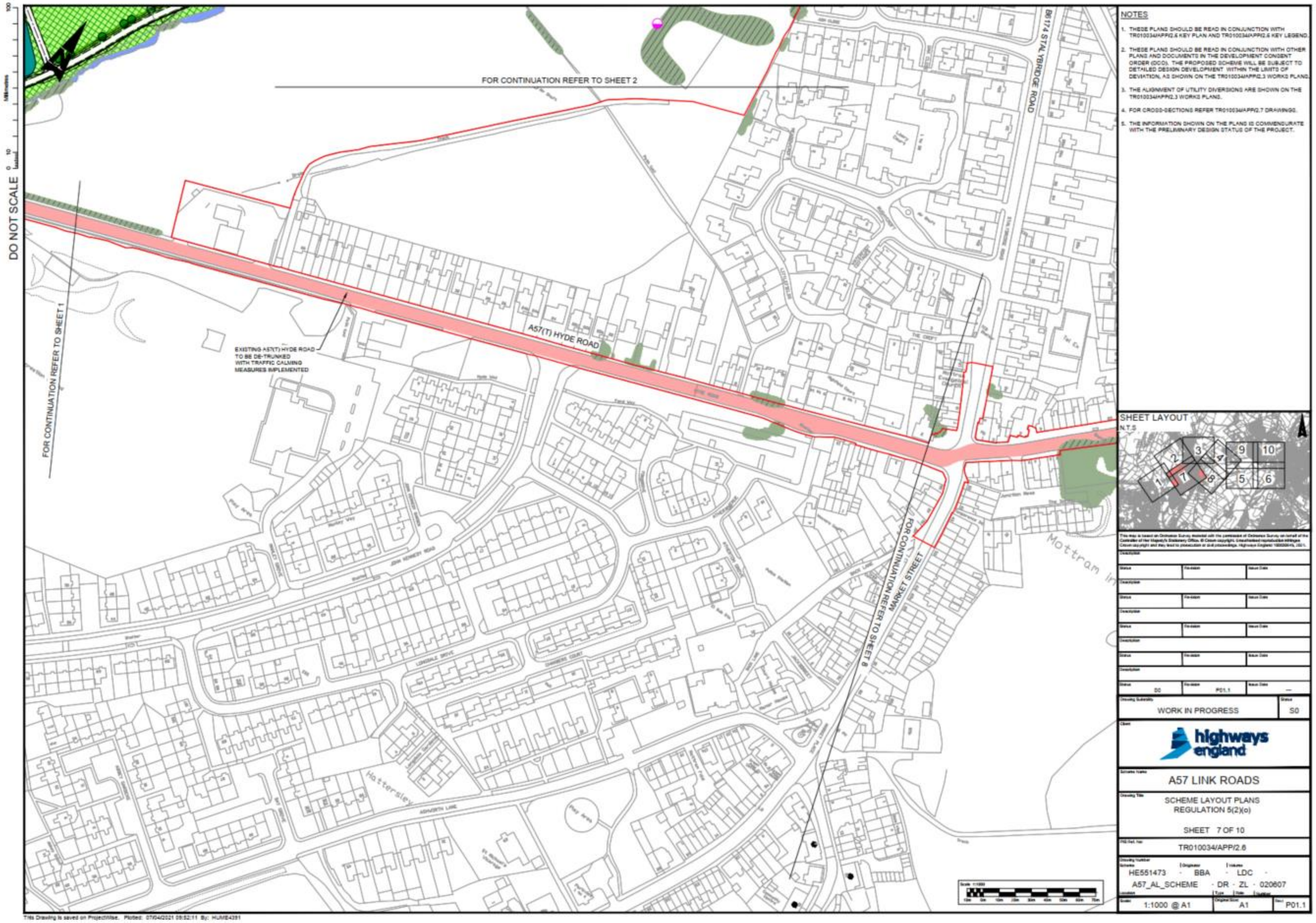
3. THE ALIGNMENT OF UTILITY DIVERSIONS ARE SHOWN ON THE TR010034/APP/2.3 WORKS PLANS.
4. FOR CROSS-SECTIONS REFER TR010034/APP/2.7 DRAWINGS.
5. THE INFORMATION SHOWN ON THE PLANS IS COMMENSURATE WITH THE PRELIMINARY DESIGN STATUS OF THE PROJECT.
SHEET LAYOUT
N.T.S
WORK IN PROGRESS
S0
highways england
A57 LINK ROADS
SCHEME LAYOUT PLANS
REGULATION 5(2)(o)
SHEET 5 OF 10
TR010034/APP/2.6
HE551473 - BBA - LDC -
A57_AL_SCHEME - DR - ZL - 020605
1:1000 @ A1
A1
P01.1

DRIVING OUTCOMES




DO NOT SCALE
FOR CONTINUATION REFER TO SHEET 2
FOR CONTINUATION REFER TO SHEET 1
FOR CONTINUATION REFER TO SHEET 8
EXISTING A57(T) HYDE ROAD TO BE DE-TRUNKED WITH TRAFFIC CALMING MEASURES IMPLEMENTED
A57(T) HYDE ROAD
B6174 STALYBRIDGE ROAD
MARKET STREET
Mottram
Hattersley
NOTES
1. THESE PLANS SHOULD BE READ IN CONJUNCTION WITH TR010034/APP/2.6 KEY PLAN AND TR010034/APP/2.6 KEY LEGEND.
2. THESE PLANS SHOULD BE READ IN CONJUNCTION WITH OTHER PLANS AND DOCUMENTS IN THE DEVELOPMENT CONSENT ORDER (DCO). THE PROPOSED SCHEME WILL BE SUBJECT TO DETAILED DESIGN DEVELOPMENT WITHIN THE LIMITS OF DEVIATION, AS SHOWN ON THE TR010034/APP/2.3 WORKS PLANS.
3. THE ALIGNMENT OF UTILITY DIVERSIONS ARE SHOWN ON THE TR010034/APP/2.3 WORKS PLANS.
4. FOR CROSS-SECTIONS REFER TR010034/APP/2.7 DRAWINGS.
5. THE INFORMATION SHOWN ON THE PLANS IS COMMENSURATE WITH THE PRELIMINARY DESIGN STATUS OF THE PROJECT.
SHEET LAYOUT
N.T.S
1
2
3
4
5
6
7
8
9
10
S0
P01.1
WORK IN PROGRESS
S0
A57 LINK ROADS
SCHEME LAYOUT PLANS
REGULATION 5(2)(o)
SHEET 7 OF 10
TR010034/APP/2.6
HE551473 - BBA - LDC -
A57_AL_SCHEME - DR - ZL - 020607
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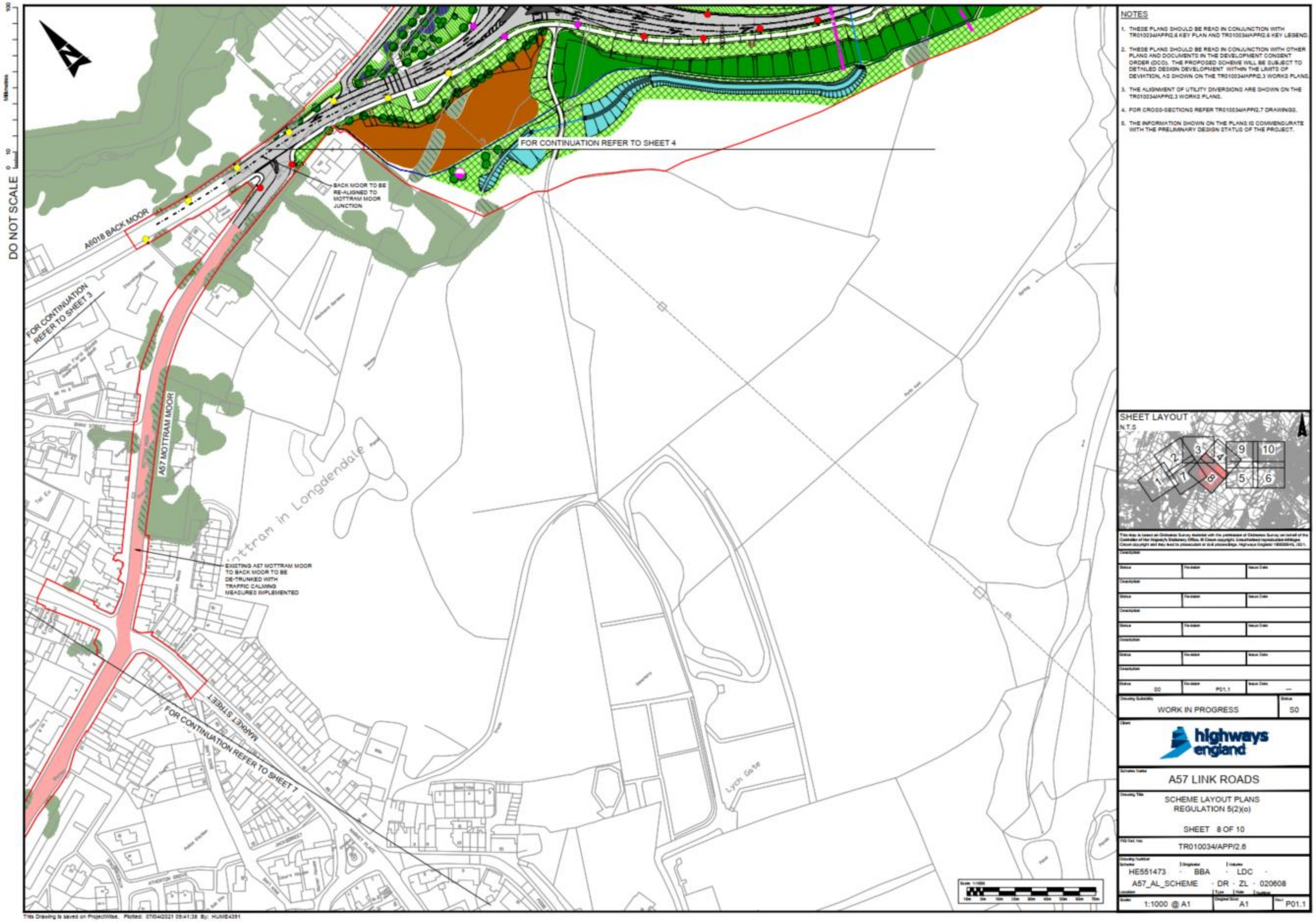
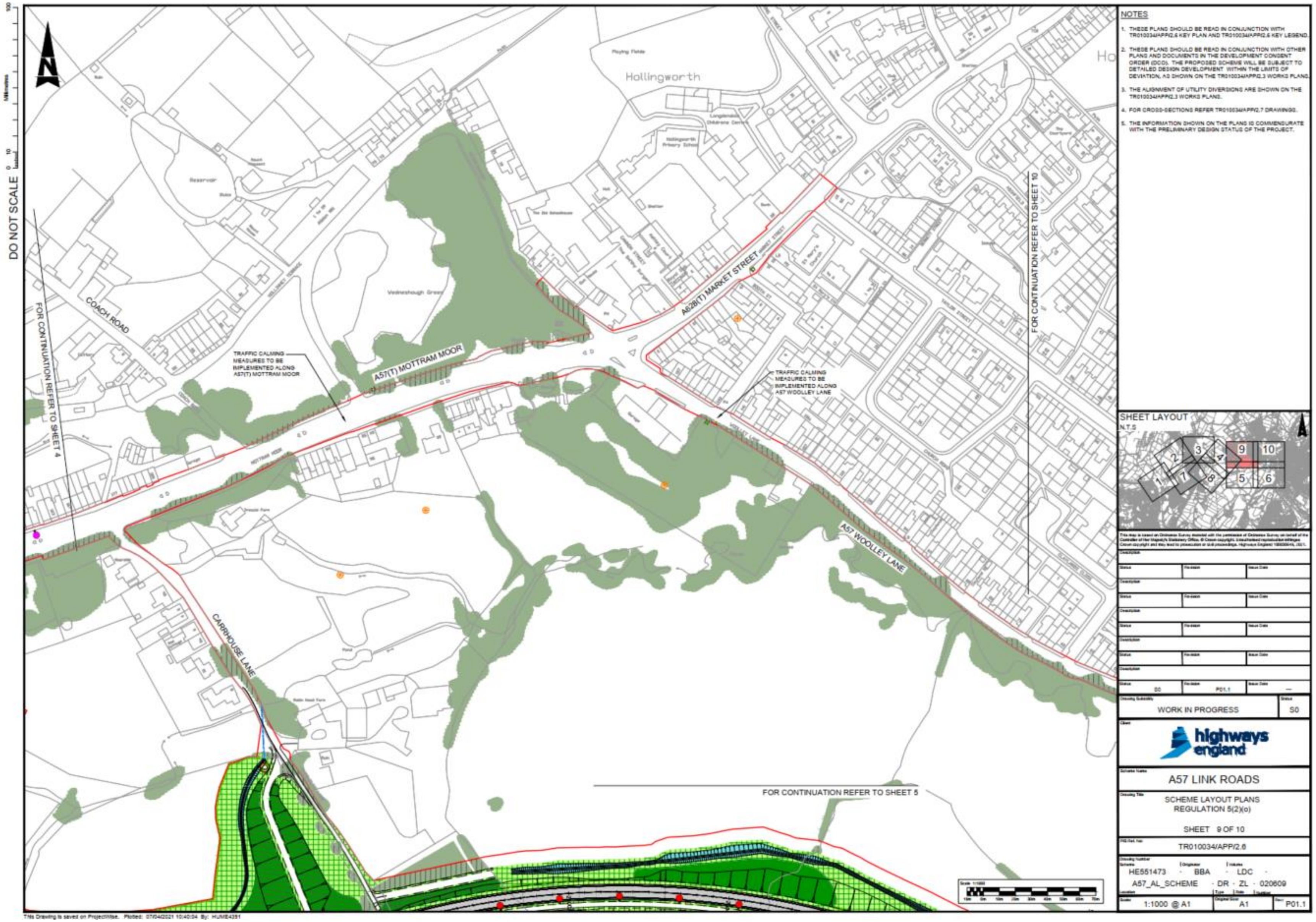
A1
P01.1

DRIVING OUTCOMES




DO NOT SCALE
Hollingworth
COACH ROAD
A57(T) MOTTRAM MOOR
A628(T) MARKET STREET
TRAFFIC CALMING MEASURES TO BE IMPLEMENTED ALONG A57(T) MOTTRAM MOOR
TRAFFIC CALMING MEASURES TO BE IMPLEMENTED ALONG A57 WOOLLEY LANE
A57 WOOLLEY LANE
CARRHOUSE LANE
FOR CONTINUATION REFER TO SHEET 4
FOR CONTINUATION REFER TO SHEET 10
FOR CONTINUATION REFER TO SHEET 5
NOTES
1. THESE PLANS SHOULD BE READ IN CONJUNCTION WITH TR010034/APP/2.6 KEY PLAN AND TR010034/APP/2.6 KEY LEGEND.
2. THESE PLANS SHOULD BE READ IN CONJUNCTION WITH OTHER PLANS AND DOCUMENTS IN THE DEVELOPMENT CONSENT ORDER (DCO). THE PROPOSED SCHEME WILL BE SUBJECT TO DETAILED DESIGN DEVELOPMENT WITHIN THE LIMITS OF DEVIATION, AS SHOWN ON THE TR010034/APP/2.3 WORKS PLANS.
3. THE ALIGNMENT OF UTILITY DIVERSIONS ARE SHOWN ON THE TR010034/APP/2.3 WORKS PLANS.
4. FOR CROSS-SECTIONS REFER TR010034/APP/2.7 DRAWINGS.
5. THE INFORMATION SHOWN ON THE PLANS IS COMMENSURATE WITH THE PRELIMINARY DESIGN STATUS OF THE PROJECT.
SHEET LAYOUT
N.T.S
1 2 3 4 5 6 7 8 9 10
S0
P01.1
WORK IN PROGRESS
S0
highways england
A57 LINK ROADS
SCHEME LAYOUT PLANS
REGULATION 5(2)(o)
SHEET 9 OF 10
TR010034/APP/2.6
HE551473 - BBA - LDC -
A57_AL_SCHEME - DR - ZL - 020609
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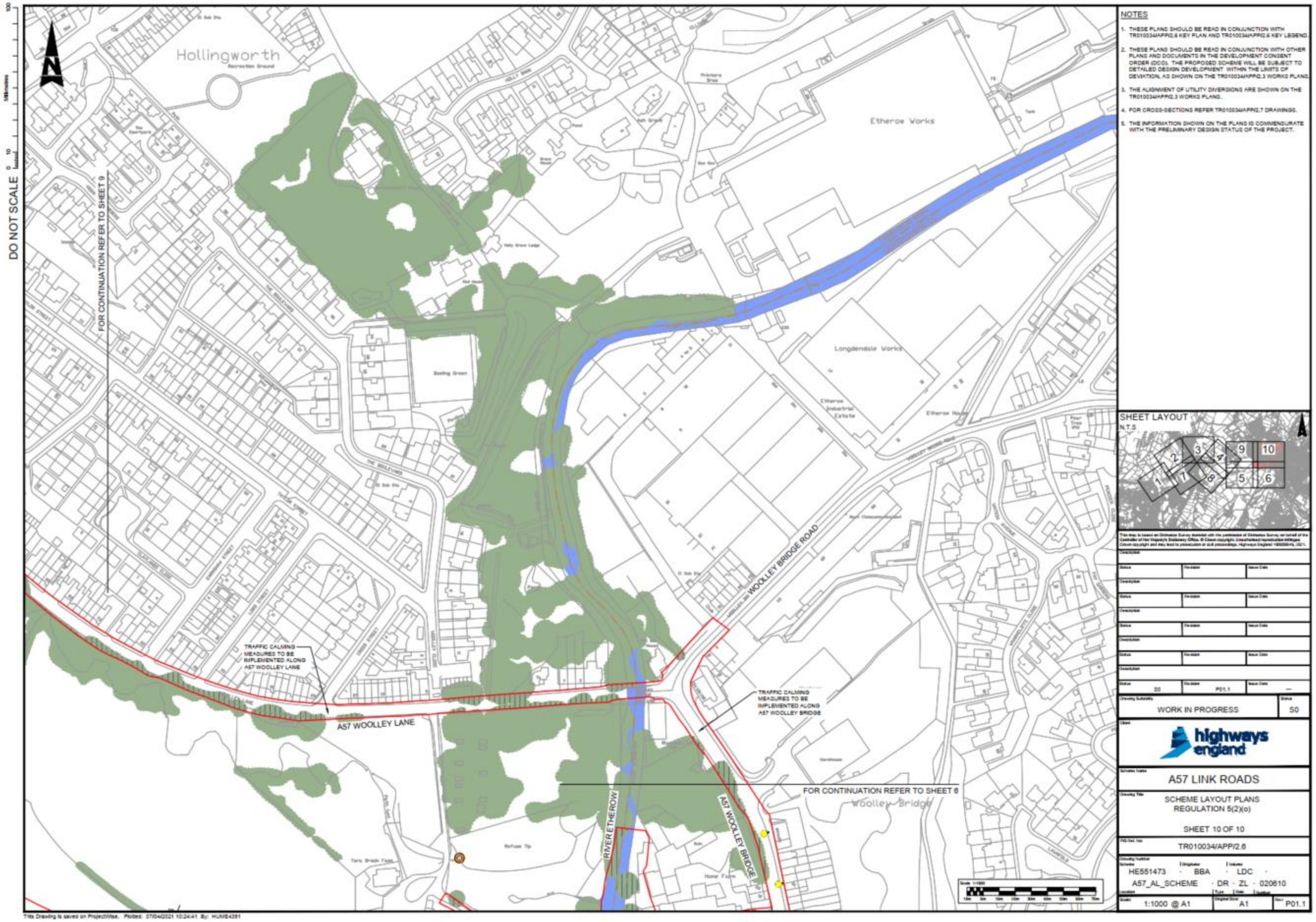
A1
P01.1


DO NOT SCALE
Hollingworth
Etherow Works
Longdendale Works
FOR CONTINUATION REFER TO SHEET 9
WOOLLEY BRIDGE ROAD
TRAFFIC CALMING MEASURES TO BE IMPLEMENTED ALONG A57 WOOLLEY LANE
A57 WOOLLEY LANE
TRAFFIC CALMING MEASURES TO BE IMPLEMENTED ALONG A57 WOOLLEY BRIDGE
FOR CONTINUATION REFER TO SHEET 8
Woolley Bridge
RIVER ETHEROW
A57 WOOLLEY BRIDGE
NOTES
1. THESE PLANS SHOULD BE READ IN CONJUNCTION WITH TR010034/APP/2.6 KEY PLAN AND TR010034/APP/2.6 KEY LEGEND.
2. THESE PLANS SHOULD BE READ IN CONJUNCTION WITH OTHER PLANS AND DOCUMENTS IN THE DEVELOPMENT CONSENT ORDER (DCO). THE PROPOSED SCHEME WILL BE SUBJECT TO DETAILED DESIGN DEVELOPMENT WITHIN THE LIMITS OF DEVIATION, AS SHOWN ON THE TR010034/APP/2.3 WORKS PLANS.
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4. FOR CROSS-SECTIONS REFER TR010034/APP/2.7 DRAWINGS.
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SHEET LAYOUT
N.T.S
WORK IN PROGRESS
S0
P01.1
highways england
A57 LINK ROADS
SCHEME LAYOUT PLANS
REGULATION 5(2)(o)
SHEET 10 OF 10
TR010034/APP/2.6
HE551473 - BBA - LDC -
A57_AL_SCHEME - DR - ZL - 020610
1:1000 @ A1
A1
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Appendix B. Uncertainty Log: developments

Table B-1 - Uncertainty Log-Developments

S. No for TFP	ID	Ref	Local authority	Scheme	Certainty criteria	Forecast developments for 2015 - 2025	Forecast developments for 2015 - 2040	Land-use Type
1	1	H-HURST-021	Tameside	Former Hartshead High School, Greenhurst Road	Near Certain	200	200	Housing
2	3	H-MOSSLE-133	Tameside	Brookfields land to the rear of houses on Stamford road and Carrhill Road	More Than Likely	0	50	Housing
3	6	H-MOSSLE-021	Tameside	Remainder of Land Between Hey Farm and Micklehurst Estate	More Than Likely	100	100	Housing
4	7	H-MOSSLE-096	Tameside	Former Mossley Hollins High School, Huddersfield	Near Certain	41	41	Housing
5	9	H-STMICH-054	Tameside	Stamford High School, Mossley Road	Near Certain	102	102	Housing
6	11	H-STMICH-060	Tameside	Ashton Foods LTD Mackeson Road	Near Certain	86	86	Housing
7	12	H-STASTH-023	Tameside	Brushes Quarry Land South of 69 to 83 Brushes Road	Near Certain	66	66	Housing
8	17	H-DROEST-033	Tameside	Droylsden Marina Main Site/ Phase 2	Near Certain	137	137	Housing
9	18	H-AUDENS-020	Tameside	Hawthorns community school corporation road	Near Certain	90	90	Housing
10	19	H-HYDNEW-047	Tameside	Findel Former Senior Service Site, Ashton Road	Near Certain	9	9	Housing
11	22	H-HYDGOD-029	Tameside	Cleared land east of Honiton Avenue (Regn Site 10)	Near Certain	53	53	Housing
12	23	H-HYDGOD-031	Tameside	Site of Hattersley High school and waterside court	Near Certain	209	209	Housing

S. No for TFP	ID	Ref	Local authority	Scheme	Certainty criteria	Forecast developments for 2015 - 2025	Forecast developments for 2015 - 2040	Land-use Type
13	24	Multiple Site Refs	Tameside	Hattersley Regeneration Sites 12 13 14 15 16 17 and 19	Near Certain	160	160	Housing
14	25	H-HYDGOD-042	Tameside	Land at Milverton Avenue Hattersley regeneration site 11	Near Certain	37	37	Housing
15	33	Policy DS 7 Policy H2 (G2)	High Peak (Glossopdale)	Land Adjacent Paradise Street Hadfield Glossop	Near Certain	12	12	Housing
16	35	Policy DS 1	High Peak (Glossopdale)	Woods Mill, Milltown, Glossop, Derbyshire, SK13 8DJ	Near Certain	57	57	Housing
17	36	Policy DS 8 Policy H2 (G13)	High Peak (Glossopdale)	Hawkshead Mill, Hawkshead Road, Glossop Derbyshire, SK13 7SS	More Than Likely	31	31	Housing
18	37	Policy DS 4	High Peak (Glossopdale)	Land off Surrey Street, Glossop, Derbyshire, SK13 7AJ	Near Certain	51	51	Housing
19	38	Policy DS 9	High Peak (Glossopdale)	Land North of Shepley Street, Glossop, Derbyshire	Near Certain	44	44	Housing
20	39	Policy DS7 & Policy H2 (G6)	High Peak (Glossopdale)	Land off North Road, Glossop, Derbyshire	Near Certain	150	150	Housing
21	40	Policy DS 2	High Peak (Glossopdale)	Dinting Lane, Glossop, Derbyshire, SK13 7DY	Near Certain	20	20	Housing
22	41	Policy DS 3 & H2 (G31)	High Peak (Glossopdale)	Charlestown Works, Charlestown, Glossop, SK13 8LJ	Near Certain	97	97	Housing
23	42	H-AUDENS-119	Tameside	Land Adjacent M60 Motorway off Audenshaw Road	Near Certain	208	208	Housing

S. No for TFP	ID	Ref	Local authority	Scheme	Certainty criteria	Forecast developments for 2015 - 2025	Forecast developments for 2015 - 2040	Land-use Type
24	43	H-DENTNE-002	Tameside	Land and buildings on the east side of Edward Street	Near Certain	55	55	Housing
25	47	H-HYDGOD-062	Tameside	Land Bounded by Wardlebrook Avenue and Underwood Road	Near Certain	41	41	Housing
26	48	H-HYDNEW-054	Tameside	Former Burma Castrol Alma works site Furnace Street, Hyde	Near Certain	60	60	Housing
27	49	H-HYDNEW-053 and H-HYDNEW-066	Tameside	Former Toray Textiles Former Wharf Mill Dukinfield Road	Near Certain	95	95	Housing
28	50	H-LONGDE-111	Tameside	Hattersley District Centre	More Than Likely	0	137	Housing
29	52	Policy DS 10	High Peak (Glossopdale)	Former Bridge Mills, New Road, Tintwistle, Derbyshire, SK13 1JN	Near Certain	82	165	Housing
30	54	AS529	Tameside	Industrial site, Langham Street, Ashton-under-Lyne	Near Certain	4178	4178	Employment
31	62	AU500	Tameside	Shepley industrial estate extension, Shepley Road	More Than Likely	3750	7500	Employment
32	64	HY509	Tameside	Site 2 Hattersley IE, Longdendale	More Than Likely	1000	1000	Employment
33	65	HY508	Tameside	Site 1 Hattersley IE, Longdendale	More Than Likely	3600	3600	Employment
34	71	Policy DS 1 & Policy H2 (G16)	High Peak	Woods Mill, Milltown, Glossop, Derbyshire, SK13 8DJ	Near Certain	1609	3219	Employment

S. No for TFP	ID	Ref	Local authority	Scheme	Certainty criteria	Forecast developments for 2015 - 2025	Forecast developments for 2015 - 2040	Land-use Type
35	72	Policy DS 3	High Peak	Charlestown Works, Charlestown, Glossop, SK13 8LJ	Near Certain	1660	1660	Employment
36	76	DE506E	Tameside	Remaining land at Eastern Approach, Denton Hall Farm Road	Near Certain	2950	2950	Employment
37	79	HY545	Tameside	Broadway 67, Broadway, Hyde	Near Certain	3300	3300	Employment
38	82	HY519	Tameside	Land adjacent to Sports and social club, Manchester Rd, Hyde	Near Certain	1388	1388	Employment
39	86	59b	Manchester	Land between Hyde Rd/Potter Lane/Bennett St	Near Certain	360	367	Housing
40	87	59h	Manchester	Edge Lane Business Centre, Fairfield Rd	More Than Likely	162	162	Housing
41	88	32	Stockport	Former Fir Tree Primary School, Browning Road Reddish SK5 6JW	Near Certain	51	51	Housing
42	89	25	Stockport	Site A- Phase 2 (Former Bridgehall Sidings), Bridgehall SK3 8NH	Near Certain	168	168	Housing
43	91	23	Stockport	MAN Diesel and Turbo UK Ltd, Mirless Drive, Hazel Grove SK7 5BP	Near Certain	203	203	Housing
44	92	26	Stockport	Cherry Tree Hospital, Cherry Tree Lane Great Moor	Near Certain	65	65	Housing
45	93	27	Stockport	Dialstone Centre, Lisburne Lane, Offerton SK2 7LL	Near Certain	94	94	Housing

S. No for TFP	ID	Ref	Local authority	Scheme	Certainty criteria	Forecast developments for 2015 - 2025	Forecast developments for 2015 - 2040	Land-use Type
46	96	22	Stockport	Mallard Court, 107 Finney Lane, Heald Green SK8 3PT	Near Certain	55	55	Housing
47	102	MU5	Barnsley	Land off Lee Lane, Royston, S71 4RT	More Than Likely	256	994	Housing
48	111	HS3	Barnsley	Former William Freeman Site, Wakefield	More Than Likely	91	102	Housing
49	116	HS35	Barnsley	Land adjacent to Carrs Lane / Summerdale Road, Cudworth	Near Certain	198	278	Housing
50	121	HS21	Barnsley	Monk Bretton Reservoir and land to the east of Cross Street, S71 2EP	Near Certain	95	174	Housing
51	122	HS13	Barnsley	Former Priory School/ Land off Rotherham Road, Cundy Cross, S71 5RG	Near Certain	208	248	Housing
52	125	HS18	Barnsley	Site of former Kingstone High School, S70 6RB	Near Certain	163	163	Housing
53	126	HS19	Barnsley	Land North of Wilthorpe Road,	Near Certain	326	326	Housing
54	127	HS4	Barnsley	Longcar PDC, Longcar Lane, S70 6BB	Near Certain	32	32	Housing
55	136	HS82	Barnsley	Land off Newsome Avenue, Wombwell S73 8LH	Near Certain	43	43	Housing
56	137	HS55	Barnsley	Former Highgate Social Centre, S63 9AR	Near Certain	35	35	Housing
57	146	HS47	Barnsley	Land to the north of the Dearne Advanced Learning Centre, Goltho rpe	More Than Likely	86	86	Housing

S. No for TFP	ID	Ref	Local authority	Scheme	Certainty criteria	Forecast developments for 2015 - 2025	Forecast developments for 2015 - 2040	Land-use Type
58	149	HS43	Barnsley	Former Reema Estate and adjoining land, off School Street, Thurnscoe	More Than Likely	140	480	Housing
59	150	HS50	Barnsley	Site at Brunswick Street	Near Certain	0	45	Housing
60	151	HS64	Barnsley	Land North of Hoyland Road, Hoyland	More Than Likely	270	615	Housing
61	152	HS66	Barnsley	Land west of Upper Hoyland Road	More Than Likely	0	70	Housing
62	153	HS56	Barnsley	Land off Shortwood Roundabout, Hoyland	More Than Likely	0	80	Housing
63	162	S00002	Sheffield	Land at Station Road, Manchester Road, Deepcar	Near Certain	100	396	Housing
64	167	S00180	Sheffield	Land Adjacent to 237a Main Road, Wharncliffe Side, Sheffield	Near Certain	13	13	Housing
65	172	S00781	Sheffield	Parson Cross College (SW) - Remington Rd/ Monteney Rd, New Parson Cross Masterplan Area	Near Certain	94.5	189	Housing
66	183	S00682	Sheffield	Falstaff Rd/ Symons Cres/ Murdoch Rd, Parson Cross Masterplan Area (SHC Falstaff Phase 1)	Near Certain	15	15	Housing
67	184	S01590	Sheffield	Woolley Wood School	Near Certain	46	46	Housing
68	185	S01875	Sheffield	Paper Mill Road	Near Certain	10	10	Housing

DRIVING OUTCOMES

S. No for TFP	ID	Ref	Local authority	Scheme	Certainty criteria	Forecast developments for 2015 - 2025	Forecast developments for 2015 - 2040	Land-use Type
69	186	S01593	Sheffield	Parson Cross College (NE) - Remington Rd/ Monteney Rd New Parson Cross Masterplan Area	Near Certain	85	85	Housing
70	195	S00684	Sheffield	Flower Estate (5 Roads)	Near Certain	38	38	Housing
71	196	S01581	Sheffield	Land Adjoining 6 Woodbury Road, Sheffield	Near Certain	21	21	Housing
72	197	S02153	Sheffield	Scattergood and Johnson Ltd, 91 Holywell Road	Near Certain	14	14	Housing
73	198	S02310	Sheffield	Phoenix and Davian Houses Centurion Office Park 2 Julian Way, Sheffield S9 1GD	Near Certain	12	12	Housing
74	199	S02733	Sheffield	Bowlan The Old Chapel Studio 301 Holywell Road, Sheffield S9 1BE	Near Certain	12	12	Housing
75	203	S02242	Sheffield	Site of Sevenfields Residential Home 239 Ben Lane, Sheffield S6 4SB	Near Certain	29	29	Housing
76	204	S02621	Sheffield	Meade House 96 - 100 Middlewood Road Sheffield S6 4HA	Near Certain	12	12	Housing
77	205	S02309	Sheffield	Wynstay House 148 Bradfield Road Sheffield S6 2BQ	Near Certain	12	12	Housing
78	206	S02694	Sheffield	United Reformed Church Wadsley 83 Carlton Road Sheffield S6 1WR	Near Certain	10	10	Housing
79	207	S00215	Sheffield	Land adjoining 434-652 Grimesthorpe Road	Near Certain	19	19	Housing

S. No for TFP	ID	Ref	Local authority	Scheme	Certainty criteria	Forecast developments for 2015 - 2025	Forecast developments for 2015 - 2040	Land-use Type
80	208	S00182	Sheffield	Land Adjacent to 130 Owler Lane	Near Certain	12	12	Housing
81	209	S00688	Sheffield	Catherine Street / Brotherton Street	Near Certain	16	16	Housing
82	210	S02284	Sheffield	Old Coroners Court Business Centre 14 - 38 Nursery Street Sheffield S3 8GG	Near Certain	42	42	Housing
83	242	S02246	Sheffield	Land Between Phillips Road and Lee Road and Land Between 1 And 9 Lee Road, Sheffield S6 6SF	Near Certain	11	11	Housing
84	243	S01263	Sheffield	Griff Works, Stopes Road, Stannington, S6 6BW	Near Certain	88	88	Housing
85	244	S02641	Sheffield	Site Of 252 Deer Park Road Sheffield S6 5NH	Near Certain	14	14	Housing
86	245	S00695	Sheffield	Land at Junction with Ouse Road Ouseburn Road Sheffield S9 3AD	Near Certain	33	33	Housing
87	246	S00703	Sheffield	Seaton Crescent (Phase 2)	Near Certain	28	28	Housing
88	247	S01448	Sheffield	Site Of 2 To 54 And 75 To 91 Scotia Drive Sheffield S2 1HN	Near Certain	18	18	Housing
89	248	S02610	Sheffield	Land at Junction with Finchwell Road Quarry Road Handsworth Sheffield S13 9AZ	Near Certain	14	14	Housing
90	249	S02858	Sheffield	Land at Main Road Ross Street and Whitwell Street Sheffield S9 4QL	Near Certain	28	28	Housing

S. No for TFP	ID	Ref	Local authority	Scheme	Certainty criteria	Forecast developments for 2015 - 2025	Forecast developments for 2015 - 2040	Land-use Type
91	277	S01702	Sheffield	335 And 337 Ecclesall Road South Sheffield S11 9PW	Near Certain	10	10	Housing
92	278	S01747	Sheffield	Former Abbeydale Grange School, Abbeydale Road	Near Certain	58	58	Housing
93	279	S02057	Sheffield	Bannerdale Centre & Park Site, Cater Knowle Road	Near Certain	57	57	Housing
94	280	S02187	Sheffield	Garage Site at Rear Of 33 To 35 Daisy Walk, adjoining 49 - 65 Lilac Road and Sevenairs Road Beighton Sheffield S20 1FT	Near Certain	20	20	Housing
95	291	S00731	Sheffield	Site of King Ecberts Upper School, Furniss Avenue, Dore	Near Certain	64	64	Housing
96	292	S00092	Sheffield	Site of Green Oak View Nursing Home, Green Oak Avenue, Lemont Road	Near Certain	30	30	Housing
97	293	S01969	Sheffield	Site Of 3 Ryecroft Glen Road, Sheffield, S17 3NG	Near Certain	10	10	Housing
98	294	S02606	Sheffield	Fleur De Lys Hotel Totley Hall Lane Sheffield S17 4AA	Near Certain	11	11	Housing
99	295	S02707	Sheffield	Whirlow Grange Conference Centre Whirlow Grange Drive Sheffield S11 9RX	Near Certain	14	14	Housing
100	296	S00108	Sheffield	Site of Vernons the Bakers and Bankside Works, Archer Road, Sheffield S8 0JT	Near Certain	33	33	Housing
101	297	S01361	Sheffield	Site of TTS Car Sales Ltd, Archer Road, Sheffield	Near Certain	19	19	Housing

S. No for TFP	ID	Ref	Local authority	Scheme	Certainty criteria	Forecast developments for 2015 - 2025	Forecast developments for 2015 - 2040	Land-use Type
102	298	S01592	Sheffield	Former Oakes Park School	Near Certain	49	49	Housing
103	299	S02269	Sheffield	Hazlehurst Residential Home, 1 Dyche Drive	Near Certain	42	42	Housing
104	306	S00821	Sheffield	Oxclose Farm, Halfway	Near Certain	100	200	Housing
105	307	S00842	Sheffield	Land Opposite 2 To 6, Portland Road Off Byron Road, Beighton, Sheffield (numbered Apts 1-12, 5 Portland Road)	Near Certain	12	12	Housing
106	308	S00112	Sheffield	Land at Blagden Street, Park Hill, Sheffield	Near Certain	50	50	Housing
107	309	S00782	Sheffield	Park Hill Flats, Duke Street, Sheffield (PHASE 1)	Near Certain	100	151	Housing
108	310	S00709	Sheffield	Castle College North Site, Granville Road	Near Certain	43	43	Housing
109	311	S00729	Sheffield	Former Nursery School, Denby Street	Near Certain	100	186	Housing
110	312	S00723	Sheffield	Park Spring Drive B, Norfolk Park (part of Norfolk Park site 5)	Near Certain	45	45	Housing
111	313	S00825	Sheffield	Sheffield United FC, Bramall Lane, Sheffield	Near Certain	52	52	Housing
112	314	S00013	Sheffield	New retail quarter - land and buildings at Barkers Pool, Burgess Street, Cambridge Street, Carver Street, Charles Street, Charter Square, Cross	Near Certain	100	150	Housing

S. No for TFP	ID	Ref	Local authority	Scheme	Certainty criteria	Forecast developments for 2015 - 2025	Forecast developments for 2015 - 2040	Land-use Type
				Burgess Street, Furnivall Gate, Pinstone Street, Rockingham Street, Trafalgar Street, Wellington Street				
113	315	S00056	Sheffield	Site of 85-95 Headford Street and Site of Beckett and Garner Works, Hodgson Street, Sheffield S3 7WQ	Near Certain	100	135	Housing
114	316	S00017	Sheffield	Land at Napier Street Site Of 1 Pomona Street and Summerfield St. Former Gordon Lamb	Near Certain	100	120	Housing
115	317	S00192	Sheffield	Abbey Glen Laundry Co Ltd Coniston Road Sheffield S8 0UW	Near Certain	46	46	Housing
116	318	S00040	Sheffield	Development at Bernard Works Site, Sylvester Gardens, Sheffield S1 4RP	Near Certain	96	96	Housing
117	319	S01417	Sheffield	Lynthorpe House, 86 Charlotte Road, Sheffield, S1 4TL	Near Certain	16	16	Housing
118	320	S00059	Sheffield	Development at Industry Works, Site B, Sylvester Gardens, Sheffield S1 4RP	Near Certain	64	64	Housing
119	321	S00018	Sheffield	75 Milton Street, 83 Headford Street and Land at Milton Lane, Thomas Street and Hodgson Street, Sheffield, S3 7WG	Near Certain	100	191	Housing

S. No for TFP	ID	Ref	Local authority	Scheme	Certainty criteria	Forecast developments for 2015 - 2025	Forecast developments for 2015 - 2040	Land-use Type
120	322	S01521	Sheffield	2 Haymarket and 5-7 Commercial Street, Sheffield S1 1PF	Near Certain	11	11	Housing
121	323	S01609	Sheffield	Land and Buildings at Boston Street Bramall Lane And Arley Street Boston Street Sheffield	Near Certain	100	445	Housing
122	324	S01608	Sheffield	Yorkshire Co Op Society Car Park Beeley Street Sheffield S2 4LP	Near Certain	10	10	Housing
123	325	S01837	Sheffield	Land and Buildings at Sidney Street, Matilda Street, Arundel Street and Sylvester Street, Sheffield, S1 3RA	Near Certain	100	116	Housing
124	326	S01916	Sheffield	Site of 45 Stalker Lees Road	Near Certain	12	12	Housing
125	327	S02062	Sheffield	W Laycock Building 33 - 41 Suffolk Road Sheffield	Near Certain	100	138	Housing
126	328	S02046	Sheffield	The Tower, 2 Furnival Square, S1 2QL	Near Certain	17	17	Housing
127	329	S02061	Sheffield	Matilda Tavern 100 Matilda Street Sheffield S1 4QF	Near Certain	10	10	Housing
128	330	S02005	Sheffield	Site of Pearl Works, 17 - 21 Eyre Lane, Sheffield S1 2NP	Near Certain	53	53	Housing
129	331	S02259	Sheffield	RJ Stokes, 20 Egerton Street	Near Certain	39	39	Housing
130	332	S02278	Sheffield	Site of former Gatecrasher, 112 Arundel Street, S1 4RE	Near Certain	100	128	Housing

S. No for TFP	ID	Ref	Local authority	Scheme	Certainty criteria	Forecast developments for 2015 - 2025	Forecast developments for 2015 - 2040	Land-use Type
131	333	S02120	Sheffield	Friends Meeting House, 12 Hartshead, Sheffield, S1 2EL	Near Certain	10	10	Housing
132	334	S02180	Sheffield	Former Head Post Office Fitzalan Square Sheffield S1 1AB	Near Certain	52	52	Housing
133	335	S02199	Sheffield	Sheffield United Football Club Car Park Cherry Street and Shoreham Street Highfield Sheffield S2 4RD	Near Certain	39	39	Housing
134	336	S02202	Sheffield	Car Park at Site Of 117 Fitzwilliam Street Sheffield S1 4JP	Near Certain	26	26	Housing
135	337	S02217	Sheffield	Blenheim Reach 861 Ecclesall Road Sheffield S11 8TH	Near Certain	13	13	Housing
136	338	S02225	Sheffield	Watsons Chambers Business Centre 5 - 15 Market Place City Centre Sheffield S1 2GH	Near Certain	62	62	Housing
137	339	S00750	Sheffield	Former Eon Works Earl Street Sheffield S1 4PY	Near Certain	100	129	Housing
138	340	S02254	Sheffield	Telephone House Charter Square Sheffield S1 4HS	Near Certain	168	336	Housing
139	341	S02270	Sheffield	Land between Maltravers Place and Whites Lane, Cricket Inn Road Sheffield S2 5AN	Near Certain	41	41	Housing
140	342	S02299	Sheffield	Globe II Business Centre 128 Maltravers Road Sheffield S2 5AZ	Near Certain	185	370	Housing

S. No for TFP	ID	Ref	Local authority	Scheme	Certainty criteria	Forecast developments for 2015 - 2025	Forecast developments for 2015 - 2040	Land-use Type
141	343	S02170	Sheffield	St Mary's House, 11 London Road, Sheffield S2 4LA	Near Certain	12	12	Housing
142	344	S02304	Sheffield	Bells Court Bells Square Sheffield S1 2FY	Near Certain	32	32	Housing
143	345	S02655	Sheffield	Deacon House 192 Eyre Street Sheffield S1 3GQ	Near Certain	68	68	Housing
144	346	S02582	Sheffield	Knowle House 4 Norfolk Park Road Sheffield S2 3QE	Near Certain	14	14	Housing
145	347	S02585	Sheffield	Wharncliffe House 44 Bank Street Sheffield S1 2DS	Near Certain	16	16	Housing
146	348	S02587	Sheffield	Sportsman Inn 10 Denby Street Sheffield S2 4QH	Near Certain	11	11	Housing
147	349	S02575	Sheffield	Peel House 1-3 West Bar Sheffield S3 8PQ	Near Certain	48	48	Housing
148	350	S02316	Sheffield	Former Manor Lodge Primary School Manor Lane Sheffield S2 1TR	Near Certain	19	19	Housing
149	351	S02699	Sheffield	Redvers House Union Street Sheffield S1 2JQ	Near Certain	175	175	Housing
150	352	S02656	Sheffield	Land and Buildings at Junction with Dyson Place Gordon Road Sheffield S11 8XU	Near Certain	23	23	Housing
151	353	S02688	Sheffield	Department for Work and Pensions Mayfield Court 56 West Street City Centre Sheffield S1 4EP	Near Certain	43	43	Housing

S. No for TFP	ID	Ref	Local authority	Scheme	Certainty criteria	Forecast developments for 2015 - 2025	Forecast developments for 2015 - 2040	Land-use Type
152	354	S02686	Sheffield	Part First, Second and Third Floor Offices Midcity House 17 Furnival Gate Sheffield S1 4QR	Near Certain	19	19	Housing
153	355	S02770	Sheffield	Birch Hall 87 Trippet Lane Sheffield S1 4EL	Near Certain	50	50	Housing
154	356	S02811	Sheffield	Park Gardeners Club and Institute Cricket Inn Road Sheffield S2 5AT	Near Certain	38	38	Housing
155	357	S02767	Sheffield	Department for Work and Pensions Porterbrook House 7 Pear Street Sheffield S11 8JF	Near Certain	105	105	Housing
156	358	S02761	Sheffield	Unit C Centenary Works 150 Little London Road Sheffield S8 0UJ	Near Certain	10	10	Housing
157	359	S02846	Sheffield	The Gateway 1 Blast Lane Sheffield S2 5TN	Near Certain	38	38	Housing
158	360	S02705	Sheffield	Site of ARC Car Wash and Site Of 500 Queens Road Highfield Sheffield S2 4DU	Near Certain	20	20	Housing
159	361	S02722	Sheffield	35 - 45 Church Street And 8 - 10 Orchard Street City Centre Sheffield S1 2GL	Near Certain	14	14	Housing
160	362	S02859	Sheffield	Baldwins Omega Ltd Brincliffe Hill Sheffield S11 9DF	Near Certain	38	38	Housing
161	417	S00162	Sheffield	Birley Depot Thornbridge Lane Sheffield S12 3BJ	Near Certain	14	14	Housing

S. No for TFP	ID	Ref	Local authority	Scheme	Certainty criteria	Forecast developments for 2015 - 2025	Forecast developments for 2015 - 2040	Land-use Type
162	431	58	Manchester	Milliner's wharf Phase 2, Munday Street	Near Certain	144	144	Housing
163	432	123	Manchester	Land Known as Holt Town Waterfront, bounded by Ash	Near Certain	800	1800	Housing
164	433	55	Manchester	60 Units are Extra Care Brunswick Neighbourhood	Near Certain	296	296	Housing
165	440	HS73	Barnsley	Land off Hartcliff Road, Penistone, Barnsley/Site South, East of Schole Hill Lane	Near Certain	139	139	Housing
166	443	24	Stockport	Former Barnes Hospital, Kingsway Cheadle	Near Certain	300	300	Housing
167	445	S02857	Sheffield	The Market Inn 18 Wortley Road High Green Sheffield S35 4LU	Near Certain	14	14	Housing
168	448	S00090	Sheffield	Adjacent to 45 Spring Close Mount, Gleadless Valley	Near Certain	57	57	Housing
169	449	S01353	Sheffield	800 Gleadless Road, Sheffield	Near Certain	12	12	Housing
170	450	S01549	Sheffield	Curtilage Of 649-651, Gleadless Road, Sheffield, S2 2BT	Near Certain	29	29	Housing
171	451	S02808	Sheffield	Site of Arbourthorne Hotel 6 Errington Road Sheffield S2 2EG	Near Certain	18	18	Housing
172	452	S02810	Sheffield	Heeley and Sheffield 781 Gleadless Road Sheffield S12 2QD	Near Certain	13	13	Housing

S. No for TFP	ID	Ref	Local authority	Scheme	Certainty criteria	Forecast developments for 2015 - 2025	Forecast developments for 2015 - 2040	Land-use Type
173	460	S01259	Sheffield	Former Outo Kumpu Steelworks off Ford Lane, North of Manchester Road, Stocksbridge	Near Certain	114	114	Housing
174	465	S00147	Sheffield	72 Russell Street Sheffield S3 8RW	Near Certain	52	52	Housing
175	466	S00006	Sheffield	Land and Buildings at Kelham Riverside, Alma Street and Green Lane	Near Certain	104	104	Housing
176	467	S00730	Sheffield	Holiday Inn, Manchester Road	Near Certain	133	133	Housing
177	468	S00178	Sheffield	Weston House And Western Tower West Bar Green Sheffield S1 2DA	Near Certain	18	18	Housing
178	469	S02100	Sheffield	Twigg Bros 51 Toyne Street	Near Certain	12	12	Housing
179	470	S00727	Sheffield	Tapton Halls of Residence, University of Sheffield (student accommodation)	Near Certain	107	107	Housing
180	471	S00353	Sheffield	9-13 Ashgate Road, Sheffield S10	Near Certain	10	10	Housing
181	472	S00759	Sheffield	St. Phillip's Social Club, Radford Street / Daisy Walk	Near Certain	192	192	Housing
182	473	S00110	Sheffield	Land at Bamforth Street Junction Cuthbert Bank Road Sheffield S6 2HP	Near Certain	45	45	Housing
183	474	S00107	Sheffield	Site of Cornish Steel Works Land Between Dun Street and	Near Certain	33	33	Housing

S. No for TFP	ID	Ref	Local authority	Scheme	Certainty criteria	Forecast developments for 2015 - 2025	Forecast developments for 2015 - 2040	Land-use Type
				Dunfields, Green Lane, Sheffield				
184	475	S00079	Sheffield	137 West Bar, Sheffield S3 8PU	Near Certain	89	89	Housing
185	476	S00029	Sheffield	Site at 29 to 65 Garden Street, Sheffield	Near Certain	153	153	Housing
186	477	S00919	Sheffield	Site Of 152 - 158 Langsett Road, Sheffield, S6 2UB	Near Certain	11	11	Housing
187	478	S00023	Sheffield	Site of Richardsons Cutlery Works, 60 Russell Street, Cotton Street and Alma Street, Sheffield S3 8RW	Near Certain	98	98	Housing
188	479	S01972	Sheffield	Sovereign House, 110 Queen Street	Near Certain	100	250	Housing
189	480	S02141	Sheffield	Portobello House 3 Portobello Street S1 4ND	Near Certain	100	128	Housing
190	481	S02156	Sheffield	Site of 1-7 Allen Street, 7, 9, 11, 13 and 15 Smithfield and Snow Lane, Sheffield	Near Certain	36	36	Housing
191	482	S02207	Sheffield	Site of Barkers Furniture Centre, E Barker & Son (Hillsboro) Ltd Garage And 44 Trickett Road, Dodd Street Sheffield S6 2NR	Near Certain	13	13	Housing
192	483	S02260	Sheffield	3 St Peter's Close Sheffield S1 2EJ	Near Certain	24	24	Housing
193	484	S02586	Sheffield	287 - 289 Glossop Road Sheffield S10 2HB	Near Certain	10	10	Housing

S. No for TFP	ID	Ref	Local authority	Scheme	Certainty criteria	Forecast developments for 2015 - 2025	Forecast developments for 2015 - 2040	Land-use Type
194	485	S02639	Sheffield	162-170 Devonshire Street Sheffield S3 7SG	Near Certain	12	12	Housing
195	486	S02695	Sheffield	Provincial House, Solly Street and 90 Garden Street Sheffield	Near Certain	107	107	Housing
196	487	S02771	Sheffield	305 Glossop Road Sheffield S10 2HL	Near Certain	12	12	Housing
197	488	S02779	Sheffield	Willis House Peel Street Sheffield S10 2PQ	Near Certain	24	24	Housing
198	489	S02768	Sheffield	Acorn House 288 - 292 Shalesmoor Sheffield S3 8UL	Near Certain	13	13	Housing
199	490	S02729	Sheffield	First to Eighth floors 125 Queen Street City Centre Sheffield S1 2DU	Near Certain	32	32	Housing
200	491	S02711	Sheffield	Minalloy House 10-16 Regent Street and 2 Pitt St Sheffield S1	Near Certain	73	73	Housing
201	520	41	Manchester	Princess Ltd, Lord North Street, Miles Platting, Manchester M40 2HJ	Near Certain	6663	6663	Employment
202	532	Barnsley Town Centre	Barnsley	Barnsley Regeneration	Near Certain	19050	38100	Employment
203	533	HS27	Barnsley	Bleachcroft Way Industrial Estate	More Than Likely	110	230	Housing
204	544	0	Sheffield	'Victory Park' - Former Gas Site, Upwell Street / Colliery Road - Warehouse extension to Unit 2	Near Certain	0	7660	Employment

DRIVING OUTCOMES

S. No for TFP	ID	Ref	Local authority	Scheme	Certainty criteria	Forecast developments for 2015 - 2025	Forecast developments for 2015 - 2040	Land-use Type
205	545	0	Sheffield	Land to the east of Shepcote Office Village	Near Certain	0	2050	Employment
206	546	0	Sheffield	Howco Whitham, Carbrook Street / Weedon Street / Dunlop Street	Near Certain	0	2160	Employment
207	547	0	Sheffield	Kilner Way Retail Park	Near Certain	0	8900	Employment
208	553	0	Sheffield	Hartwell Site, Savile Street / Spital Hill / Carlisle Street	More Than Likely	0	5330	Employment
209	554	0	Sheffield	Land at Rear of 2 Hunsley Street	Near Certain	0	1450	Employment
210	555	0	Sheffield	University Technical College, Worksop Road	Near Certain	0	5240	Employment
211	556	0	Sheffield	Ancon Building Products, 9 President Way	More Than Likely	0	2650	Employment
212	557	0	Sheffield	Newhall Road Business Park and Former Attercliffe Steel Works, 58 Newhall Road	More Than Likely	0	20100	Employment
213	558	0	Sheffield	Olympic Legacy Park, Lower Don Valley	Near Certain	0	20000	Employment
214	562	0	Sheffield	Rivelin Water Treatment Works, Manchester Road, Crosspool	Near Certain	0	2805	Employment
215	563	0	Sheffield	Sheffield Business Park Phase 2, Europa Link	Near Certain	0	84000	Employment
216	564	0	Sheffield	Tinsley Bridge (Holdings) Ltd, Shepcote Lane	Near Certain	0	19700	Employment

S. No for TFP	ID	Ref	Local authority	Scheme	Certainty criteria	Forecast developments for 2015 - 2025	Forecast developments for 2015 - 2040	Land-use Type
217	565	0	Sheffield	Alison Crescent	Near Certain	0	1560	Employment
218	566	0	Sheffield	Parkway Retail Park, Cricket Inn Road	Near Certain	0	1140	Employment
219	567	0	Sheffield	Ferraris Piston Services Ltd, 5 Parkway Rise	Near Certain	0	1500	Employment
220	568	0	Sheffield	Unit 1 Drakehouse Retail Park, Drakehouse Way	More Than Likely	1330	1330	Employment
221	569	0	Sheffield	Drake House Crescent / Eckington Way / Drake House Way	More Than Likely	3700	3700	Employment
222	570	0	Sheffield	Pennine Foods Ltd, Drake House Crescent	Near Certain	2985	2985	Employment
223	571	0	Sheffield	North West Of 11 And 13 Archer Drive	Near Certain	2760	2760	Employment
224	572	0	Sheffield	Graves Tennis & Leisure Centre, Bochum Parkway	Near Certain	9200	9200	Employment
225	573	0	Sheffield	'St. James Retail Park', Former Norton College Campus, Dyche Lane	More Than Likely	13643	13643	Employment
226	574	0	Sheffield	Land at Rear of Hadee Engineering Co Ltd, Rother Valley Way	Near Certain	3650	3650	Employment
227	575	0	Sheffield	Curtilage of BOC Ltd, Rother Valley Way	Near Certain	3600	3600	Employment
228	576	0	Sheffield	Land at the junction of Rother Valley Way and Station Road, Holbrook	Near Certain	1612	1612	Employment

S. No for TFP	ID	Ref	Local authority	Scheme	Certainty criteria	Forecast developments for 2015 - 2025	Forecast developments for 2015 - 2040	Land-use Type
229	586	0	Sheffield	Castlegate ('The Square') Phase 3 - Remaining Offices (Nos. 2, 3 and 5).	Near Certain	14200	14200	Employment
230	587	0	Sheffield	Nunnery Square Phase 3, Bernard Road / Sheffield Parkway	Near Certain	6800	6800	Employment
231	588	0	Sheffield	Pomona Street / Summerfield Street	Near Certain	5000	5000	Employment
232	589	0	Sheffield	1-15 The Moor, 12-24 Furnival Gate (known as Block 8)	Near Certain	5160	5160	Employment
233	590	0	Sheffield	75 Milton Street, 83 Headford Street / Milton Lane / Thomas Street / Hodgson Street	Near Certain	2230	2230	Employment
234	591	0	Sheffield	The Moor Redevelopment Phase 2 - Charter Row / Rockingham Gate / The Moor / Charter Square / Rockingham Way (Block 1)	Near Certain	11475	22950	Employment
235	592	0	Sheffield	Former Central Post Office, Fitzalan Square	Near Certain	5110	5110	Employment
236	593	0	Sheffield	Heart of the City - Offices Phase 3 (3 St. Paul's Place) - Charles Street / Arundel Gate / Norfolk Street	Near Certain	9950	9950	Employment
237	594	0	Sheffield	Sheffield Digital Campus Phase 2, Pond Hill / Sheaf Street - Building 2 (Vidrio House)	Near Certain	6840	6840	Employment

S. No for TFP	ID	Ref	Local authority	Scheme	Certainty criteria	Forecast developments for 2015 - 2025	Forecast developments for 2015 - 2040	Land-use Type
238	595	0	Sheffield	Sheffield United Football Club, Highfield - South Stand, Cherry Street	Near Certain	7000	7000	Employment
239	596	0	Sheffield	Site of Carpetright And Furniture for Less, Woodside Retail Park, Chesterfield Road	Near Certain	1600	1600	Employment
240	597	0	Sheffield	Former NUM Headquarters, Holly Street	Near Certain	3063	3063	Employment
241	598	0	Sheffield	'New Era Square', London Road / St. Mary's Gate / Shoreham Street	Near Certain	6300	6300	Employment
242	599	0	Sheffield	'Ecclesall Junction', Former Peugeot Garage, 127 Ecclesall Road	More Than Likely	3482	3482	Employment
243	600	0	Sheffield	The Old Dairy, Broadfield Road	Near Certain	1230	1230	Employment
244	601	0	Sheffield	Sheffield Retail Quarter, Barker's Pool	More Than Likely	116800	116800	Employment
245	611	15	Stockport	Gorsey Bank	Near Certain	10522	10522	Employment
246	615	126	Stockport	Gorsey Bank Road	Near Certain	2993	2993	Employment
247	620	ES4	Barnsley	Capitol Park Extension	Near Certain	0	16200	Employment
248	621	ES5	Barnsley	Capitol Park	Near Certain	8100	27300	Employment

S. No for TFP	ID	Ref	Local authority	Scheme	Certainty criteria	Forecast developments for 2015 - 2025	Forecast developments for 2015 - 2040	Land-use Type
249	624	0	Sheffield	Land at Thorncliffe Recreation Ground, Mortomley Close	Near Certain	2700	2700	Employment
250	625	0	Sheffield	River Don District, Meadowhall	More Than Likely	71000	142000	Employment
251	626	0	Sheffield	Ikea, former Betafence Wire Factory, Lock House Road / Shepcote Lane	Near Certain	36500	36500	Employment
252	633	0	Sheffield	Site of former Green Lane Works, Green Lane	Near Certain	2400	2400	Employment
253	634	0	Sheffield	W A Tyzack & Co Ltd, Green Lane Works, Green Lane, Shalesmoor	Near Certain	1060	1060	Employment
254	640	53	Trafford	LCCC Strategic Location and applications	Near Certain	277	393	Housing
255	644	0	Kirklees	MX1905 - Land east of 932-1110 Leeds Road, Shaw Cross/ Woodkirk, Dewsbury	More Than Likely	0	1535	Housing
256	645	0	Kirklees	H2098 - Land to the south of, Ravensthorpe Road/ Lees Hall Road, Dewsbury	More Than Likely	0	2310	Housing
257	646	0	Kirklees	MX1930 - Land north of Blackmoorfoot Road, Crosland Moor, Huddersfield	More Than Likely	0	441	Housing
258	656	0	Kirklees	H69- Merchant Fields, Hunsworth Lane, Cleckheaton	More Than Likely	0	413	Housing
259	657	0	Kirklees	H1747- Land north of Bradley Road, Bradley, Huddersfield	More Than Likely	0	1577	Housing

S. No for TFP	ID	Ref	Local authority	Scheme	Certainty criteria	Forecast developments for 2015 - 2025	Forecast developments for 2015 - 2040	Land-use Type
260	658	0	Kirklees	MX1911-Land south of Lindley Moor Road, Lindley, Huddersfield	More Than Likely	0	533	Housing
261	665	H-LONGDE-027	Tameside	Court House Farm Stockport Road	Near Certain	19	19	Housing
262	666	H-STASTH-025	Tameside	The Woodlands and Adjoining Property, Mottram Road	Near Certain	23	23	Housing
263	667	H-HYDGOD-022	Tameside	Former Globe Works Brook Street	More Than Likely	43	43	Housing
264	669	HY518	Tameside	Former Highbank Works, Halton Street, Hyde	Near Certain	1000	1000	Employment
265	670	0	High Peak (Glossopdale)	Land north of Dinting Road, Glossop, Derbyshire, SK13 7UU	Near Certain	29	29	Housing
266	671	0	High Peak (Glossopdale)	Land off Ellison Street, Glossop, Derbyshire, SK13 8BY	Near Certain	22	22	Housing
267	672	0	High Peak (Glossopdale)	Land north of Dinting Road, Glossop	More Than Likely	108	108	Housing
268	673	0	High Peak (Glossopdale)	Land at Woolley Bridge, East of A57, Hadfield, Glossop, Derbyshire	More Than Likely	31	31	Housing
269	674	Policy H2 (G19)	High Peak (Glossopdale)	Land at, Dinting Road, Glossop, Derbyshire	Near Certain	65	65	Housing
270	675	Policy DS20 & Policy H2 (B20, B2, B22)	High Peak (Buxton)	Foxlow Farm, Harpur Hill Road, Harpur Hill, Buxton, Derbyshire, SK17 9LE	Near Certain	395	395	Housing

S. No for TFP	ID	Ref	Local authority	Scheme	Certainty criteria	Forecast developments for 2015 - 2025	Forecast developments for 2015 - 2040	Land-use Type
271	676	0	Trafford	Trafford Waters	More Than Likely	0	3000	Housing
272	677	0	Trafford	Trafford Waters	More Than Likely	0	80000	Employment
273	678	0	Tameside	Proposed District Centre, Hattersely (Land bounded by Ashworth Lane and Chain Bar Lane)	Near Certain	6750	6750	Employment
274	679	H-LONGDE-207	Tameside	Hattersley Regeneration Site 23: Cleared site and land off Bunkers Hill Road	More Than Likely	22	22	Housing
275	680	H-LONGDE-208	Tameside	Hattersley Regeneration Site 24: Land east of Dawlish Close	More Than Likely	40	40	Housing
276	684	HS15	Barnsley	Site to the west of Smithy Wood Lane, Gilroyd	Near Certain	36	36	Housing
277	685	HS20	Barnsley	Land off High Street, Dodworth	Near Certain	6	6	Housing
278	692	HS31	Barnsley	Land off High Street, Shafton	Near Certain	38	38	Housing
279	693	HS41	Barnsley	Willowgarth High, Grimethorpe, Barnsley	Near Certain	97	97	Housing
280	704	HS70	Barnsley	Land north of Barnsley Road, Penistone	Near Certain	32	32	Housing
281	709	HS83	Barnsley	Former Kings Road School Site, Wombwell	Near Certain	34	34	Housing

S. No for TFP	ID	Ref	Local authority	Scheme	Certainty criteria	Forecast developments for 2015 - 2025	Forecast developments for 2015 - 2040	Land-use Type
282	711	HS88	Barnsley	Oughtibridge Paper Mill (houses count to Sheffield as straddles boundary)	Near Certain	0	0	Housing
283	718	HS94	Barnsley	Land off New Road, Pilley	Near Certain	26	26	Housing
284	720	MU1 (Employment)	Barnsley	Land south of Barugh Green Road, Barugh Green	More Than Likely	24382	121068	Employment
285	721	MU1 (Housing)	Barnsley	Land south of Barugh Green Road, Barugh Green	More Than Likely	0	0	Housing
286	725	MU6	Barnsley	Former Wombwell High School, Wombwell	More Than Likely	0	0	Housing
287	729	Policy H2 (G26)	High Peak (Glossopdale)	Samas Roneo, Glossop Road	Near Certain	137	137	Housing
288	730	0	High Peak (Glossopdale)	Land at Chapel Lane, Hadfield	More Than Likely	10	10	Housing
289	738	0	High Peak (Buxton)	Burlow Road, Buxton	Near Certain	225	275	Housing
290	739	0	High Peak (Buxton)	Waterswallows Road, Buxton	More Than Likely	96	330	Housing
291	740	0	High Peak (Buxton)	Corbar House, Buxton	More Than Likely	15	15	Housing
292	741	0	High Peak (Buxton)	Artisan Quarter, Spring Gardens, Buxton	Near Certain	13	13	Housing
293	742	Policy H2 (B1)	High Peak (Buxton)	Batham Gate, Peak Dale	Near Certain	27	27	Housing
294	743	Policy DS17 & Policy H2 (B3, B3)	High Peak (Buxton)	Land at Hogshaws, Buxton	More Than Likely	25	124	Housing

S. No for TFP	ID	Ref	Local authority	Scheme	Certainty criteria	Forecast developments for 2015 - 2025	Forecast developments for 2015 - 2040	Land-use Type
295	744	Policy H2 (B6)	High Peak (Buxton)	Hardwick Square South, Buxton	Near Certain	28	28	Housing
296	745	Policy H2 (B7)	High Peak (Buxton)	Market Street, Buxton	More Than Likely	24	24	Housing
297	748	Policy H2 (B27)	High Peak (Buxton)	Harpur Hill College campus	More Than Likely	153	153	Housing
298	749	Policy DS22 & Policy H2 (B31)	High Peak (Buxton)	Station Road, Buxton	More Than Likely	30	30	Housing
299	751	HPK/2017/0087	High Peak (Buxton)	Staden Business Park, Staden Lane, Buxton, Derbyshire, SK17 9RZ	Near Certain	1439	1439	employment
300	752	Policy E2 (Waterswallows extension)	High Peak (Buxton)	Waterswallows Lane, Buxton	Near Certain	52000	52000	employment
301	754	HPK/2017/0213	High Peak (Buxton)	Unit 15, Tongue Lane Industrial Estate, Dew Pond Lane, Fairfield, Buxton, Derbyshire, SK17 7LF	Near Certain	4780	4780	employment
302	755	HPK/2017/0632	High Peak (Buxton)	Land adjacent Unit 28, Harpur Hill Business Park, Harpur Hill, Buxton, Derbyshire,	Near Certain	2945	2945	employment
303	756	HPK/2018/0334	High Peak (Buxton)	Site above Swains Go-Kart Track and opposite The Skills Base Centre, Harpur Hill Business Park, Harpur Hill, Buxton, Derbyshire,	Near Certain	2430	2430	employment
304	757	Policy H2 (C13)	High Peak (Central Area)	Land opposite Alders Meadow, Buxton Road, Chinley	Near Certain	25	25	Housing

S. No for TFP	ID	Ref	Local authority	Scheme	Certainty criteria	Forecast developments for 2015 - 2025	Forecast developments for 2015 - 2040	Land-use Type
305	758	0	High Peak (Central Area)	Forge Works, Chinley	Near Certain	63	63	Housing
306	759	0	High Peak (Central Area)	Land at 152a Albion Road, New Mills	Near Certain	10	10	Housing
307	760	0	High Peak (Central Area)	Old vicarage Marsh Lane, New Mills	Near Certain	29	29	Housing
308	761	0	High Peak (Central Area)	Land adjacent to the rear of Buxton Rd, Bridgemont, Whaley Bridge	Near Certain	13	13	Housing
309	762	Policy H2 (C9)	High Peak (Central Area)	South of Macclesfield Road, Linglongs Road, Whaley Bridge	More Than Likely	107	107	Housing
310	763	0	High Peak (Central Area)	Hallsteads Dove Holes	More Than Likely	91	91	Housing
311	771	0	High Peak (Glossopdale)	Small site allowance Glossopdale Area 1/4/19 - 31/3/31 35 per annum	More Than Likely	140	420	Housing
312	772	0	High Peak (Central Area)	Small site allowance Central Area 1/4/19 - 31/3/31 35 per annum	More Than Likely	140	420	Housing
313	773	0	High Peak (Buxton)	Small site allowance Buxton Area 1/4/19 - 31/3/31 35 per annum	More Than Likely	140	420	Housing
314	886	0	Stockport	Stockport Exchange	Near Certain	5700	5700	Employment
315	887	0	Stockport	Kings Reach Business Park	Near Certain	8143	8143	Employment

S. No for TFP	ID	Ref	Local authority	Scheme	Certainty criteria	Forecast developments for 2015 - 2025	Forecast developments for 2015 - 2040	Land-use Type
316	892	H-AUDENS-110	Tameside	Former Robertson's 'Golden Shred' Works Williamson Lane, Droylsden	Near Certain	0	330	Housing
317	894	H-HURST-021	Tameside	Former Mono Pumps, Martin Street, Ashton-under-Lyne, M34 5JA	Near Certain	183	183	Housing
318	895	0	Trafford	Pomona Island - application within Pomona Strategic Location	Near Certain	526	526	Housing
319	896	0	Trafford	Pomona Island - application within Pomona Strategic Location	Near Certain	216	216	Housing
320	897	0	Trafford	Carrington Village - application within New Carrington and Carrington Strategic Location	Near Certain	277	725	Housing
321	898	0	Trafford	Heath Farm Lane, Partington - application within New Carrington and Carrington Strategic Location	Near Certain	80	600	Housing
322	899	0	Trafford	Trafford Wharf Road - application within Wharfside Strategic Location	Near Certain	354	354	Housing
323	900	0	Trafford	Land bounded by Bridgewater Way, Chester Road, Virgil Street and Princess Street	Near Certain	363	363	Housing
324	901	0	Trafford	The Square, Sale	Near Certain	202	202	Housing

S. No for TFP	ID	Ref	Local authority	Scheme	Certainty criteria	Forecast developments for 2015 - 2025	Forecast developments for 2015 - 2040	Land-use Type
325	902	0	Trafford	Former Itron Site, Talbot Road	Near Certain	282	282	Housing
326	903	0	Trafford	Land at Lock Lane, Partington	Near Certain	210	450	Housing
327	904	0	Trafford	Land off Barton Bridge	Near Certain	17000	17000	Employment
328	905	0	Trafford	Land off Common Lane	Near Certain	7500	43873	Employment
329	906	0	Trafford	Carrington Village	Near Certain	46450	46450	Employment
330	907	0	Trafford	Sawfield Nurseries	Near Certain	11813	11813	Employment
331	908	0	Trafford	F and G Commercials	Near Certain	2338	2338	Employment
332	909	0	Trafford	Evams Halshaw Commercials	Near Certain	0	20898	Employment
333	910	0	Tameside	Organ Inn, 81 Market Street, Hollingworth	Near Certain	57	57	Housing
334	2	H-MOSSLE-012	Tameside	Plevins Cheshire Street	Reasonably Foreseeable	0	155	Housing
335	10	H-STANTH-032	Tameside	West Stalybridge Market Street and Caroline Street	Reasonably Foreseeable	0	247	Housing
336	13	H-STASTH-021	Tameside	Oakwood Mill and Land around Stayley Cricket Club, Millbrook	Reasonably Foreseeable	0	126	Housing
337	26	H-DENSTH-022	Tameside	Two Trees school 101 Two Trees Lane	Reasonably Foreseeable	0	274	Housing

S. No for TFP	ID	Ref	Local authority	Scheme	Certainty criteria	Forecast developments for 2015 - 2025	Forecast developments for 2015 - 2040	Land-use Type
338	27	GMA44	Tameside	GMA44 south of Hyde	Reasonably Foreseeable	0	442	Housing
339	28	H-DUKSTB-023	Tameside	Castle Street Car Park West of restaurant	Reasonably Foreseeable	51	51	Housing
340	32	GMA43	Tameside	Godley Green	Reasonably Foreseeable	0	2350	Housing
341	58	Multiple Site Refs	Tameside	St. Petersfield Buildings	Reasonably Foreseeable	9946	27588	Employment
342	60	DU510	Tameside	Cleared Land, Ashton St/ Gate St, Dukinfield	Reasonably Foreseeable	0	3967	Employment
343	68	ST551	Tameside	Former Total Petrochemicals site, Globe house, Bayley Street	Reasonably Foreseeable	10626	13283	Employment
344	69	HY502	Tameside	The Thorns, Hattersley, Hyde	Reasonably Foreseeable	0	12655	Employment
345	70	HY522	Tameside	Tract of land, Talbot Rd/ Victoria St, Hyde	Reasonably Foreseeable	0	1716	Employment
346	73	AS526	Tameside	Ashton Moss Plot 3000, Lord Sheldon Way, Ashton-under-Lyne	Reasonably Foreseeable	0	37161	Employment
347	74	AU506	Tameside	Moss Way/ Audenshaw Road, Groby Road North/ Hanover Street	Reasonably Foreseeable	0	17058	Employment
348	78	GMA42	Tameside	GMA42 Ashton Moss West	Reasonably Foreseeable	0	160000	Employment
349	84	125	Manchester	Jacksons Brickworks Briscoe Lane	Reasonably Foreseeable	200	200	Housing

S. No for TFP	ID	Ref	Local authority	Scheme	Certainty criteria	Forecast developments for 2015 - 2025	Forecast developments for 2015 - 2040	Land-use Type
350	85	59f	Manchester	Hyde Road	Reasonably Foreseeable	55	272	Housing
351	90	85	Stockport	Adswood Road / Siddington Avenue SK3 8LF	Reasonably Foreseeable	67	67	Housing
352	95	28.8.21	Stockport	GM Allocation High Lane	Reasonably Foreseeable	0	500	Housing
353	98	28.8.22	Stockport	Stanley Green - GM Allocation	Reasonably Foreseeable	0	850	Housing
354	99	OA23	Stockport	Heald Green - GM Allocation	Reasonably Foreseeable	0	850	Housing
355	100	21	Stockport	Woodford Aerodrome, Chester Road, Woodford, SK7 1QR	Reasonably Foreseeable	520	920	Housing
356	101	28.8.20	Stockport	Woodford - GM Allocation	Reasonably Foreseeable	0	750	Housing
357	103	HS38	Barnsley	Land off Cudworth Bypass	Reasonably Foreseeable	0	192	Housing
358	104	HS37	Barnsley	Land north of Sidcop Road, Cudworth	Reasonably Foreseeable	0	18	Housing
359	105	HS40	Barnsley	Land north of Oak Tree Avenue	Reasonably Foreseeable	0	38	Housing
360	106	HS32	Barnsley	Land off Pontefract Road	Reasonably Foreseeable	40	147	Housing
361	107	HS36	Barnsley	Land at Weetshaw Lane, Cudworth	Reasonably Foreseeable	0	144	Housing
362	108	HS39	Barnsley	Land west of Three Nooks Lane, Cudworth	Reasonably Foreseeable	20	41	Housing

S. No for TFP	ID	Ref	Local authority	Scheme	Certainty criteria	Forecast developments for 2015 - 2025	Forecast developments for 2015 - 2040	Land-use Type
363	109	HS34	Barnsley	Land north of Blacker Lane, Shafton	Reasonably Foreseeable	0	169	Housing
364	110	HS8	Barnsley	Site West of Wakefield Road, Mapplewell	Reasonably Foreseeable	224	374	Housing
365	112	HS2	Barnsley	Land south of Darton Lane, Staincross	Reasonably Foreseeable	86	86	Housing
366	113	HS11	Barnsley	Land South of Bloomhouse Lane, Darton	Reasonably Foreseeable	94	214	Housing
367	114	HS25	Barnsley	Land to the east of Woolley Colliery Road	Reasonably Foreseeable	0	118	Housing
368	115	HS1	Barnsley	Former Woolley Colliery	Reasonably Foreseeable	0	90	Housing
369	117	HS33	Barnsley	Land west of Brierley Road, Grimethorpe	Reasonably Foreseeable	0	61	Housing
370	118	HS17	Barnsley	Land west of Wakefield Road	Reasonably Foreseeable	112	232	Housing
371	119	HS12	Barnsley	Site north of Carlton Road	Reasonably Foreseeable	86	86	Housing
372	120	HS16	Barnsley	Site to the east of St Helens Avenue	Reasonably Foreseeable	96	96	Housing
373	123	HS7	Barnsley	Land east of Burton Road, Monk Bretton	Reasonably Foreseeable	98	218	Housing
374	129	HS75	Barnsley	Land south of Halifax Road, Penistone	Reasonably Foreseeable	120	414	Housing
375	130	HS74	Barnsley	Land south of Well House Lane	Reasonably Foreseeable	80	132	Housing

S. No for TFP	ID	Ref	Local authority	Scheme	Certainty criteria	Forecast developments for 2015 - 2025	Forecast developments for 2015 - 2040	Land-use Type
376	131	HS78	Barnsley	Land to the south of Doncaster Road, Darfield	Reasonably Foreseeable	121	441	Housing
377	132	HS79	Barnsley	Former Foulstone School Playing Fields	Reasonably Foreseeable	69	189	Housing
378	133	HS85	Barnsley	Land at Hill Street/ Snape Hill Road, Darfield	Reasonably Foreseeable	30	30	Housing
379	134	HS86	Barnsley	Land at New Street, Wombwell	Reasonably Foreseeable	2	35	Housing
380	135	HS80	Barnsley	The Former Foulstone School	Reasonably Foreseeable	41	41	Housing
381	140	HS51	Barnsley	Site to the east of Broadwater Estate	Reasonably Foreseeable	0	279	Housing
382	141	HS44	Barnsley	Bolton House Farm, Goldthorpe	Reasonably Foreseeable	0	194	Housing
383	142	HS52	Barnsley	Land west of Thurnscoe Bridge Lane and south of Derry Grove, Thurnscoe	Reasonably Foreseeable	0	308	Housing
384	143	HS46	Barnsley	Land north of East Street, Goldthorpe	Reasonably Foreseeable	0	125	Housing
385	144	HS49	Barnsley	Land to the south of Beever Street Goldthorpe	Reasonably Foreseeable	125	179	Housing
386	145	HS48	Barnsley	Land north of Barnburgh Lane, Goldthorpe	Reasonably Foreseeable	0	109	Housing
387	147	HS45	Barnsley	Land south of Barnburgh Lane	Reasonably Foreseeable	130	130	Housing
388	148	HS54	Barnsley	Land of Gooseacre Avenue, Thurnscoe	Reasonably Foreseeable	0	80	Housing

DRIVING OUTCOMES

S. No for TFP	ID	Ref	Local authority	Scheme	Certainty criteria	Forecast developments for 2015 - 2025	Forecast developments for 2015 - 2040	Land-use Type
389	155	HS24	Barnsley	Land between Mount Vernon Road and Upper Sheffield Road	Reasonably Foreseeable	42	42	Housing
390	156	HS5	Barnsley	Land south of West Street, Worsbrough	Reasonably Foreseeable	70	70	Housing
391	158	HS65	Barnsley	Land North of Stead Lane, Hoyland	Reasonably Foreseeable	146	524	Housing
392	159	HS61	Barnsley	Land off Clough Fields Road, Hoyland	Reasonably Foreseeable	74	74	Housing
393	160	HS62	Barnsley	Land off Meadowfield Drive	Reasonably Foreseeable	0	74	Housing
394	161	HS58	Barnsley	Land at Broad Carr Road, Hoyland	Reasonably Foreseeable	0	131	Housing
395	163	S01465	Sheffield	Sewage works, Manchester Road, Deepcar	Reasonably Foreseeable	0	142	Housing
396	164	S00789	Sheffield	Land between Rookery Vale and Manchester Road, Deepcar	Reasonably Foreseeable	0	52	Housing
397	165	S00148	Sheffield	Former Occupational Training Centre, Westwood Road, High Green	Reasonably Foreseeable	18	18	Housing
398	166	S01203	Sheffield	Land off Norfolk Hill, Grenoside, Sheffield	Reasonably Foreseeable	38	38	Housing
399	168	S01179	Sheffield	Wiggan Farm, Towngate Road, Worral, Sheffield	Reasonably Foreseeable	45	45	Housing
400	169	S01223	Sheffield	Former Silica Brick Works, Land off Platts Lane, Oughtibridge, Sheffield	Reasonably Foreseeable	98	98	Housing

S. No for TFP	ID	Ref	Local authority	Scheme	Certainty criteria	Forecast developments for 2015 - 2025	Forecast developments for 2015 - 2040	Land-use Type
401	170	S01184	Sheffield	Land off Platts Lane/ Oughtibridge Lane, Oughtibridge, Sheffield	Reasonably Foreseeable	34	34	Housing
402	171	S01594	Sheffield	Site surrounding Worrall Hall Farm, Kirk Edge Road, Worrall	Reasonably Foreseeable	25	25	Housing
403	173	S00764	Sheffield	Margetson Crescent, Parson Cross	Reasonably Foreseeable	30	30	Housing
404	174	S01453	Sheffield	Mansel Crescent / Mansel Road (Malthouses)	Reasonably Foreseeable	40	92	Housing
405	175	S01589	Sheffield	Chaucer School Site - Parson Cross Masterplan Area	Reasonably Foreseeable	31	31	Housing
406	176	S00674	Sheffield	Lytton Rd / Buchanan Rd / Wordsworth Ave (B2) Parson Cross Masterplan Area (Lytton A and B)	Reasonably Foreseeable	35	35	Housing
407	177	S02296	Sheffield	Land at Fox Hill Place, South Plot of Fox Hill Recreation Ground, S6 1GE (Site A, B, C)	Reasonably Foreseeable	25	25	Housing
408	178	S00016	Sheffield	Fox Hill Place Sheffield S6 1GE	Reasonably Foreseeable	70	156	Housing
409	179	S01458	Sheffield	Remington Youth Club Site, Remington Road	Reasonably Foreseeable	34	34	Housing
410	180	S01750	Sheffield	Knutton Rise	Reasonably Foreseeable	40	40	Housing
411	181	P00444	Sheffield	Chaucer Road / Mansell Avenue	Reasonably Foreseeable	36	36	Housing

S. No for TFP	ID	Ref	Local authority	Scheme	Certainty criteria	Forecast developments for 2015 - 2025	Forecast developments for 2015 - 2040	Land-use Type
412	182	P00307	Sheffield	Former 200-262 (evens) Deerlands Avenue	Reasonably Foreseeable	29	29	Housing
413	187	S00675	Sheffield	Buchanan Crescent / Adlington Rd (C1 & C2) Parson Cross Masterplan Area (Adlington)	Reasonably Foreseeable	60	120	Housing
414	188	S00677	Sheffield	Falstaff Sites CDEF OPQR Buchanan Road	Reasonably Foreseeable	60	122	Housing
415	189	S01046	Sheffield	Former 354-384 (Evens) Deerlands Avenue [Part 1 (of 2) of Deerland Avenue 1] (Deerlands A)	Reasonably Foreseeable	48	48	Housing
416	190	S01459	Sheffield	St Paul's, Wordsworth Avenue	Reasonably Foreseeable	40	40	Housing
417	191	S01461	Sheffield	Steel City (Tennis Courts) Bellhouse Road, Firth Park	Reasonably Foreseeable	22	22	Housing
418	192	S02089	Sheffield	Wordsworth Avenue/Buchanan Road/Deerlands Avenue, Parson Cross	Reasonably Foreseeable	10	10	Housing
419	193	S00153	Sheffield	Parson Cross Hotel, Deerlands Avenue, Sheffield S5 8AA	Reasonably Foreseeable	20	20	Housing
420	194	P00306	Sheffield	Former 179-229 (odds) Deerlands Avenue	Reasonably Foreseeable	24	24	Housing
421	200	S01140	Sheffield	Land to the north of Fife Street, Wincobank	Reasonably Foreseeable	40	81	Housing
422	201	S01241	Sheffield	Land to the south of Fife Street, Wincobank	Reasonably Foreseeable	10	10	Housing

S. No for TFP	ID	Ref	Local authority	Scheme	Certainty criteria	Forecast developments for 2015 - 2025	Forecast developments for 2015 - 2040	Land-use Type
423	202	S00774	Sheffield	Pic Toys, Off Darnall Road	Reasonably Foreseeable	107	214	Housing
424	211	S00672	Sheffield	Musgrave Road Housing Clearance Site (E3 and E4), (Shirecliffe 2)	Reasonably Foreseeable	42	42	Housing
425	212	S00690	Sheffield	Earl Marshall	Reasonably Foreseeable	59	59	Housing
426	213	S00679	Sheffield	Falstaff Rd / Adrian Crescent (Falstaff Sites GHIJKLMN)	Reasonably Foreseeable	103	103	Housing
427	214	S00063	Sheffield	Land between Spital Hill Brunswick Road and Handley Street, Spital Hill, Sheffield S4 7LD	Reasonably Foreseeable	31	31	Housing
428	215	S00743	Sheffield	Pitsmoor Road / Chatham Street/Swinton Street	Reasonably Foreseeable	90	190	Housing
429	216	S00769	Sheffield	Fitzalan Works, Effingham Road, Attercliffe	Reasonably Foreseeable	33	33	Housing
430	217	S00772	Sheffield	Spartan Works, Attercliffe	Reasonably Foreseeable	22	22	Housing
431	218	S00775	Sheffield	Site adj. to Fitzalan Works, Attercliffe Road	Reasonably Foreseeable	15	15	Housing
432	219	S02092	Sheffield	Land at Somerset Road / Richmond Street	Reasonably Foreseeable	24	24	Housing
433	220	S00766	Sheffield	Stanley Tools, Rutland Road, S3 9PT	Reasonably Foreseeable	45	45	Housing
434	221	S01136	Sheffield	Land between Pitsmoor Road and Woodside Lane, Woodside	Reasonably Foreseeable	100	100	Housing

S. No for TFP	ID	Ref	Local authority	Scheme	Certainty criteria	Forecast developments for 2015 - 2025	Forecast developments for 2015 - 2040	Land-use Type
435	222	S00685	Sheffield	Cannon Brewery, Rutland Road	Reasonably Foreseeable	13	13	Housing
436	223	S00692	Sheffield	Upwell Street	Reasonably Foreseeable	41	41	Housing
437	224	S00741	Sheffield	Victoria Station Road	Reasonably Foreseeable	27	27	Housing
438	225	S01694	Sheffield	Land at the Junction of Abbeyfield Road and Holtwood Road including 11 Holtwood Road Sheffield S4 7AY	Reasonably Foreseeable	15	15	Housing
439	226	S01754	Sheffield	Nursery Street	Reasonably Foreseeable	57	57	Housing
440	227	S01789	Sheffield	Site of Longley Old People's Home, Longley Hall Road	Reasonably Foreseeable	18	18	Housing
441	228	S02053	Sheffield	Rutland Road/ Rugby Road	Reasonably Foreseeable	13	13	Housing
442	229	S02054	Sheffield	Part of Saxon Works Rutland Road Sheffield	Reasonably Foreseeable	22	22	Housing
443	230	S02060	Sheffield	Nursery Lane / Stanley Street	Reasonably Foreseeable	100	100	Housing
444	231	S02271	Sheffield	Titterton Close, Darnall	Reasonably Foreseeable	20	20	Housing
445	232	S02276	Sheffield	Mowbray Street / Pitsmoor Road	Reasonably Foreseeable	33	33	Housing
446	233	S02281	Sheffield	Harvest Lane, S3 8EQ	Reasonably Foreseeable	45	45	Housing

S. No for TFP	ID	Ref	Local authority	Scheme	Certainty criteria	Forecast developments for 2015 - 2025	Forecast developments for 2015 - 2040	Land-use Type
447	234	S02282	Sheffield	Stanley Street, S3 8G	Reasonably Foreseeable	99	99	Housing
448	235	S02283	Sheffield	Wicker/ Wicker Lane, S3 8H (flats above shops on the Wicker)	Reasonably Foreseeable	81	81	Housing
449	236	S02284	Sheffield	Old Coroners Court Business Centre 14 - 38 Nursery Street Sheffield S3 8GG	Reasonably Foreseeable	30	30	Housing
450	237	S02596	Sheffield	Sheffield City Council Rutland Hostel 275 - 279 Rutland Road Sheffield S3 9PZ	Reasonably Foreseeable	24	24	Housing
451	238	P00312	Sheffield	Launce Rd / Collinson Rd, Parson Cross	Reasonably Foreseeable	20	20	Housing
452	239	P00302	Sheffield	Collinson Road / Adrian Cres, Parson Cross	Reasonably Foreseeable	20	20	Housing
453	240	P00323	Sheffield	Former 16-42 Buchanan Road	Reasonably Foreseeable	18	18	Housing
454	241	P00029	Sheffield	Woodside clearance site	Reasonably Foreseeable	90	190	Housing
455	250	S00768	Sheffield	Attercliffe Canalside - Rippon Street Rec	Reasonably Foreseeable	100	213	Housing
456	251	S00776	Sheffield	Darnall Works (formerly Sanderson Kaysers), Wilfrid Road	Reasonably Foreseeable	100	169	Housing
457	252	S00826	Sheffield	Prince of Wales Road, Darnall	Reasonably Foreseeable	32	32	Housing
458	253	S00696	Sheffield	Staniforth Canalside	Reasonably Foreseeable	100	150	Housing

S. No for TFP	ID	Ref	Local authority	Scheme	Certainty criteria	Forecast developments for 2015 - 2025	Forecast developments for 2015 - 2040	Land-use Type
459	254	S00693	Sheffield	Ardmore Street, Shirland Lane	Reasonably Foreseeable	50	50	Housing
460	255	S00701	Sheffield	Manor Site 8	Reasonably Foreseeable	100	124	Housing
461	256	S00707	Sheffield	Mixed Development Site, Wulfric Road/ Windy House Road (Fairleigh) (Manor 5 & 9)	Reasonably Foreseeable	32	32	Housing
462	257	S00710	Sheffield	Harborough Road / Harborough Rise, Manor Park (Corker Bottom / Harborough Rise)	Reasonably Foreseeable	49	49	Housing
463	258	S00711	Sheffield	Manor Boot Houses (Manor Gateway)	Reasonably Foreseeable	100	226	Housing
464	259	S00700	Sheffield	Harborough Ave/ Viking Lea Drive Manor (part of Fairfax) (Manor 14)	Reasonably Foreseeable	95	95	Housing
465	260	S00702	Sheffield	Phase D, Stonecliffe Rd, Manor (The Circle, Upper) Harborough Avenue (Manor 10 and 11)	Reasonably Foreseeable	100	181	Housing
466	261	S00706	Sheffield	Manor Community Centre (Part of Fairfax)	Reasonably Foreseeable	39	39	Housing
467	262	S00715	Sheffield	Manor Park Avenue (Pennine Village)	Reasonably Foreseeable	92	92	Housing
468	263	S00069	Sheffield	Land, Site of Handsworth First School, St. Josephs Road and Fitzalan Road Sheffield	Reasonably Foreseeable	20	20	Housing

S. No for TFP	ID	Ref	Local authority	Scheme	Certainty criteria	Forecast developments for 2015 - 2025	Forecast developments for 2015 - 2040	Land-use Type
469	264	S00777	Sheffield	Pinfold Works, Staniforth Road	Reasonably Foreseeable	40	40	Housing
470	265	S00778	Sheffield	Westaways, Bacon Lane, Attercliffe	Reasonably Foreseeable	36	36	Housing
471	266	S01443	Sheffield	Infield Lane / Britannia Road	Reasonably Foreseeable	36	36	Housing
472	267	S01108	Sheffield	Land to the north of Ravencarr Road, Manor (Fretson) (Manor 13)	Reasonably Foreseeable	22	22	Housing
473	268	S00699	Sheffield	Fretson Road / Motehall Road, Manor (the Circle Lower) (Manor 12)	Reasonably Foreseeable	100	122	Housing
474	269	S02415	Sheffield	Land at Infield Lane, Darnall, S9 5JH	Reasonably Foreseeable	37	37	Housing
475	270	S01112	Sheffield	Land off Corker Bottoms Lane, Wybourn	Reasonably Foreseeable	79	79	Housing
476	271	S00708	Sheffield	Pipworth School	Reasonably Foreseeable	42	42	Housing
477	272	S00697	Sheffield	Car Park, Kvaerner Site, Prince of Wales Road	Reasonably Foreseeable	46	46	Housing
478	273	S01475	Sheffield	Rear of White Rose PH, Handsworth Road	Reasonably Foreseeable	42	42	Housing
479	274	S02097	Sheffield	Portland Business Park, Richmond Park Road, Handsworth, Sheffield	Reasonably Foreseeable	43	43	Housing
480	275	S02273	Sheffield	Former Darnall Fire Station, Darnall Road, S9 5AF	Reasonably Foreseeable	28	28	Housing

S. No for TFP	ID	Ref	Local authority	Scheme	Certainty criteria	Forecast developments for 2015 - 2025	Forecast developments for 2015 - 2040	Land-use Type
481	276	S02401	Sheffield	Fulwood House, Old Fulwood road, S10 3TH	Reasonably Foreseeable	69	69	Housing
482	281	S01068	Sheffield	Land to the South of Beighton Road, Woodhouse	Reasonably Foreseeable	95	95	Housing
483	282	S00806	Sheffield	Woodhouse East (farmland area)	Reasonably Foreseeable	100	220	Housing
484	283	S00738	Sheffield	Owlthorpe D	Reasonably Foreseeable	71	71	Housing
485	284	S00736	Sheffield	Owlthorpe C	Reasonably Foreseeable	94	94	Housing
486	285	S00737	Sheffield	Owlthorpe E	Reasonably Foreseeable	92	92	Housing
487	286	S00785	Sheffield	Scrapyard and vacant land at Junction Road, Woodhouse (scrapyard)	Reasonably Foreseeable	60	60	Housing
488	287	S00159	Sheffield	Land Adjacent 53 Beighton Road, Woodhouse, Sheffield	Reasonably Foreseeable	14	14	Housing
489	288	S01060	Sheffield	Land to the west of Moorthorpe Rise, Owlthorpe	Reasonably Foreseeable	73	73	Housing
490	289	S01697	Sheffield	Curtilage of Basforth House 471 Stradbroke Road Sheffield S13 7GE	Reasonably Foreseeable	21	21	Housing
491	290	S01795	Sheffield	Site of Tannery Lodge, 520 Stradbroke Road	Reasonably Foreseeable	28	28	Housing
492	300	S00799	Sheffield	Former Sheffield Hallam University Playing Fields at Hemsworth Road, Norton Woodseats	Reasonably Foreseeable	40	40	Housing

S. No for TFP	ID	Ref	Local authority	Scheme	Certainty criteria	Forecast developments for 2015 - 2025	Forecast developments for 2015 - 2040	Land-use Type
493	301	S00735	Sheffield	Former Hazlebarrow School, Hazlebarrow Crescent	Reasonably Foreseeable	30	30	Housing
494	302	S01097	Sheffield	Land off Matthews Lane, Norton	Reasonably Foreseeable	16	16	Housing
495	303	S01096	Sheffield	Land at Norton Lane, Oakes, Norton	Reasonably Foreseeable	21	21	Housing
496	304	S01898	Sheffield	Land Between 5 and 21 Holmhirst Road	Reasonably Foreseeable	10	10	Housing
497	305	S02441	Sheffield	Norton College Dyche Lane, Sheffield, South Yorkshire, S8 8BR	Reasonably Foreseeable	42	42	Housing
498	363	S00811	Sheffield	Beldon B, Norfolk Park (Norfolk Park site 11a)	Reasonably Foreseeable	32	32	Housing
499	364	S00740	Sheffield	Castle Markets	Reasonably Foreseeable	100	200	Housing
500	365	S00705	Sheffield	St Johns School, Manor Oaks Road	Reasonably Foreseeable	25	25	Housing
501	366	S00712	Sheffield	Skye Edge Avenue A (Skye Edge)	Reasonably Foreseeable	83	83	Housing
502	367	S00719	Sheffield	Kenninghall Drive, Norfolk Park (Norfolk Park Site 10)	Reasonably Foreseeable	95	95	Housing
503	368	S00718	Sheffield	Park Spring Drive, Norfolk Park site 5b	Reasonably Foreseeable	12	12	Housing
504	369	S00724	Sheffield	S R Gents factory, East Bank Road, Norfolk Park	Reasonably Foreseeable	17	17	Housing
505	370	S00783	Sheffield	Park Hill Flats, Duke Street, Sheffield (PHASES 2, 3 and 4]	Reasonably Foreseeable	300	628	Housing

S. No for TFP	ID	Ref	Local authority	Scheme	Certainty criteria	Forecast developments for 2015 - 2025	Forecast developments for 2015 - 2040	Land-use Type
506	371	S00717	Sheffield	Norfolk Park 4 and Bluestones (Land between Park Grange Road and Beeches Drive extending to Samuel Drive Park Grange Drive Sheffield S2 3SF)	Reasonably Foreseeable	92	92	Housing
507	372	S00746	Sheffield	West Bar Triangle	Reasonably Foreseeable	100	200	Housing
508	373	S01447	Sheffield	Claywood	Reasonably Foreseeable	80	80	Housing
509	374	S00758	Sheffield	Klausners Site, Sylvester Street / Mary Street	Reasonably Foreseeable	100	126	Housing
510	375	S02063	Sheffield	Norfolk Park 5c, Land next to Park Grange Road / Queens Gardens (SHC)	Reasonably Foreseeable	24	24	Housing
511	376	S02093	Sheffield	Sheaf Square	Reasonably Foreseeable	65	65	Housing
512	377	S02098	Sheffield	Carver Lane/ Holly Street	Reasonably Foreseeable	45	45	Housing
513	378	S02095	Sheffield	Sheaf Street/ Pond Street	Reasonably Foreseeable	60	60	Housing
514	379	S02474	Sheffield	The Square, Land off Broad Street West	Reasonably Foreseeable	40	40	Housing
515	380	S00824	Sheffield	Gilders car showroom, 1 Ecclesall Road South, Sheffield	Reasonably Foreseeable	25	25	Housing
516	381	S00739	Sheffield	Cross Turner Street / Fornham Street	Reasonably Foreseeable	105	105	Housing

S. No for TFP	ID	Ref	Local authority	Scheme	Certainty criteria	Forecast developments for 2015 - 2025	Forecast developments for 2015 - 2040	Land-use Type
517	382	S00752	Sheffield	Arundel Gate / Esperanto Place / High Street, inc. Former Roxy Nightclub	Reasonably Foreseeable	100	225	Housing
518	383	S00725	Sheffield	Heeley Bank Centre	Reasonably Foreseeable	15	15	Housing
519	384	S00742	Sheffield	Court House, Waingate	Reasonably Foreseeable	18	18	Housing
520	385	S00756	Sheffield	Moore Street / Fitzwilliam Street	Reasonably Foreseeable	100	168	Housing
521	386	S00748	Sheffield	St Mary's Road / Suffolk Road / Fornham Street	Reasonably Foreseeable	100	135	Housing
522	387	S00747	Sheffield	Between Shoreham Street and Sidney Street	Reasonably Foreseeable	100	117	Housing
523	388	S00749	Sheffield	Car Park at Arundel Street/Charles Street	Reasonably Foreseeable	54	54	Housing
524	389	S00823	Sheffield	Somerfield, Banner Cross, Shopping Centre, Ecclesall Road	Reasonably Foreseeable	38	38	Housing
525	390	S00838	Sheffield	Site of Former 169 Upper Hanover Street and Land Rear of 194-198, Broomhall Street, Sheffield	Reasonably Foreseeable	18	18	Housing
526	391	S00843	Sheffield	Site of Flockton House/Flockton Court, Rockingham Street, Division Street and Westfield Terrace	Reasonably Foreseeable	100	144	Housing
527	392	S00164	Sheffield	121 Duke Street, S2 5QL	Reasonably Foreseeable	10	10	Housing

S. No for TFP	ID	Ref	Local authority	Scheme	Certainty criteria	Forecast developments for 2015 - 2025	Forecast developments for 2015 - 2040	Land-use Type
528	393	S01113	Sheffield	Land to the east of Maltravers Terrace, Wybourn	Reasonably Foreseeable	104	104	Housing
529	394	S00093	Sheffield	Charter Works, 20 Hodgson Street, Sheffield S3 7WQ	Reasonably Foreseeable	18	18	Housing
530	395	S00133	Sheffield	Land at Rockingham Street, Rockingham Lane and West Street, Sheffield	Reasonably Foreseeable	51	51	Housing
531	396	S00119	Sheffield	17 Broomgrove Road Sheffield S10 2LZ	Reasonably Foreseeable	15	15	Housing
532	397	S00044	Sheffield	149-155 Pinstone Street and 23 Furnival Gate	Reasonably Foreseeable	48	48	Housing
533	398	S00174	Sheffield	Land adjoining 112 London Road Sheffield S2 4LR	Reasonably Foreseeable	15	15	Housing
534	399	S01415	Sheffield	Waitrose Supermarket, 123 Ecclesall Road, Sheffield, S11 8HY	Reasonably Foreseeable	25	25	Housing
535	400	S01403	Sheffield	Sheaf Quay, 1 North Quay Drive, Victoria Quay, Sheffield, S2 5SW	Reasonably Foreseeable	90	90	Housing
536	401	S01337	Sheffield	Bailey House, 5-11 Bailey Street, Sheffield, S1 4EH	Reasonably Foreseeable	17	17	Housing
537	402	S01773	Sheffield	Tritec, Milton Street	Reasonably Foreseeable	45	45	Housing
538	403	S02078	Sheffield	Eye Witness Works, Milton St	Reasonably Foreseeable	87	87	Housing
539	404	S02277	Sheffield	83 to 87 Fitzwilliam Street, S1 4JP	Reasonably Foreseeable	36	36	Housing

S. No for TFP	ID	Ref	Local authority	Scheme	Certainty criteria	Forecast developments for 2015 - 2025	Forecast developments for 2015 - 2040	Land-use Type
540	405	S02279	Sheffield	The Tramsheds, Leadmill Road, S1 4SJ	Reasonably Foreseeable	24	24	Housing
541	406	S02704	Sheffield	Land at 48 Suffolk Road, Sheffield, S2 4AF	Reasonably Foreseeable	48	48	Housing
542	407	S01266	Sheffield	Land at Banner Cross Hall, Carterknowle Road and Ecclesall Road, S11 9PD	Reasonably Foreseeable	59	59	Housing
543	408	S02466	Sheffield	Sextons Yard, Eccleshall Road South, Sheffield, S11 9QL	Reasonably Foreseeable	22	22	Housing
544	409	S02471	Sheffield	Springvale Gospel Hall, Carter Knowle Road, Sheffield, S7 2EB	Reasonably Foreseeable	22	22	Housing
545	410	S02598	Sheffield	MAST Old Sharrow Junior School South View Road Sheffield S7 1DB	Reasonably Foreseeable	13	13	Housing
546	411	S02599	Sheffield	Former East Hill Primary/ Secondary School East Bank Road Sheffield S2 3PX	Reasonably Foreseeable	51	51	Housing
547	412	S02744	Sheffield	51 - 65 High Street, City Centre, Sheffield S1 2GD (former Primark store)	Reasonably Foreseeable	18	18	Housing
548	413	S02745	Sheffield	Car Park, Eyre Lane, Sheffield S1 4RB (on Furnival Square roundabout)	Reasonably Foreseeable	12	12	Housing
549	414	S00744	Sheffield	Headford Street/Egerton Street	Reasonably Foreseeable	30	30	Housing
550	415	S00753	Sheffield	Egerton Street / Hanover Way	Reasonably Foreseeable	100	175	Housing

S. No for TFP	ID	Ref	Local authority	Scheme	Certainty criteria	Forecast developments for 2015 - 2025	Forecast developments for 2015 - 2040	Land-use Type
551	416	S02750	Sheffield	Former Norfolk Park Primary Special School Park Grange Road Sheffield S2 3QF	Reasonably Foreseeable	24	24	Housing
552	418	S01360	Sheffield	Site of 2A and 2B Birley Moor Road and Birley Vale Avenue, Sheffield, S12 4WD	Reasonably Foreseeable	19	19	Housing
553	419	S01467	Sheffield	Site of properties at Scowerdons Drive, Silkstone Road, Spa Brook Drive, Wickfield Close (Scowerdons Phases 1b, 1c, 2, 4,5, 6)	Reasonably Foreseeable	100	265	Housing
554	420	S01478	Sheffield	Weakland Drive, Weakland Crescent	Reasonably Foreseeable	38	38	Housing
555	421	S01748	Sheffield	Former Ravencroft, Smelter Wood Road	Reasonably Foreseeable	22	22	Housing
556	422	S00014	Sheffield	Site of properties Birley Moor Ave, Newstead Ave, Newstead Grove, Newstead Pl, Newstead Rise, Newstead Way, Newstead Rd (remainder of Newstead development (excluding phase A))	Reasonably Foreseeable	100	165	Housing
557	423	S00794	Sheffield	TA Centre, Hurlfield Road, Manor Top	Reasonably Foreseeable	100	120	Housing
558	424	S01749	Sheffield	Former Foxwood, Ridgeway Road	Reasonably Foreseeable	39	39	Housing
559	425	S02275	Sheffield	Fire Station, Mansfield Road, S12 2AE	Reasonably Foreseeable	20	20	Housing

S. No for TFP	ID	Ref	Local authority	Scheme	Certainty criteria	Forecast developments for 2015 - 2025	Forecast developments for 2015 - 2040	Land-use Type
560	426	S02703	Sheffield	Land off Jaunty Avenue, Base Green, S12 3DQ	Reasonably Foreseeable	66	66	Housing
561	427	56	Manchester	Adjacent to 275 Great Ancoats Street	Reasonably Foreseeable	100	111	Housing
562	428	57	Manchester	Millhead Ave / Manstead Wk, Miles Platting N'hood, M40	Reasonably Foreseeable	621	894	Housing
563	429	121	Manchester	Lower Medlock	Reasonably Foreseeable	357	357	Housing
564	430	177	Manchester	Peary Street	Reasonably Foreseeable	39	239	Housing
565	434	120	Manchester	West Gorton	Reasonably Foreseeable	107	535	Housing
566	435	175	Manchester	Collyhurst Road	Reasonably Foreseeable	43	243	Housing
567	436	176	Manchester	Lower Irk Valley, Carriage Sidings and N of Dantzic St	Reasonably Foreseeable	375	700	Housing
568	437	178	Manchester	Lower Irk Valley, land to the N and S of Roger street	Reasonably Foreseeable	700	1100	Housing
569	438	179	Manchester	Collyhurst Road	Reasonably Foreseeable	500	900	Housing
570	439	59	Manchester	St John's Qtr	Reasonably Foreseeable	450	2850	Housing
571	442	30	Stockport	Brinnington Development	Reasonably Foreseeable	265	265	Housing
572	444	HS10	Barnsley	Land North of Keresforth Road, Dodworth	Reasonably Foreseeable	135	175	Housing

S. No for TFP	ID	Ref	Local authority	Scheme	Certainty criteria	Forecast developments for 2015 - 2025	Forecast developments for 2015 - 2040	Land-use Type
573	446	S00767	Sheffield	River Don District, Weedon Street	Reasonably Foreseeable	300	800	Housing
574	447	S02464	Sheffield	Meadowhall and the surrounding lands- M1 Distribution centre and The Source, Vulcan Road, S9 1EW	Reasonably Foreseeable	43	43	Housing
575	453	S01451	Sheffield	Algar Place/ Algar Road (Arbourthorne Fields Phase 3)	Reasonably Foreseeable	100	142	Housing
576	454	S00733	Sheffield	Gaunt Road (previously numbered 95 - 381)	Reasonably Foreseeable	18	18	Housing
577	455	S00721	Sheffield	Land between East Bank Way East Bank Road and Daresbury Drive, Sheffield (Daresbury - Sheffield Housing Company Phase 2)	Reasonably Foreseeable	43	43	Housing
578	456	S01450	Sheffield	Berners Road / Berners Place (Arbourthorne Fields Phase 2 - Berners Road)	Reasonably Foreseeable	73	73	Housing
579	457	S01347	Sheffield	Site of Park & Arbourthorne Labour Club, Eastern Avenue/City Road, Sheffield, S2 2GG	Reasonably Foreseeable	10	10	Housing
580	458	S01463	Sheffield	Hurlfield Service Reservoir, Hurlfield Road	Reasonably Foreseeable	12	12	Housing
581	459	S02529	Sheffield	Former Cradock School Site, Sheffield S2 2JZ	Reasonably Foreseeable	29	29	Housing

S. No for TFP	ID	Ref	Local authority	Scheme	Certainty criteria	Forecast developments for 2015 - 2025	Forecast developments for 2015 - 2040	Land-use Type
582	461	S00671	Sheffield	Site A Stocksbridge Steelworks, off Manchester Road, Stocksbridge	Reasonably Foreseeable	235	235	Housing
583	462	S00788	Sheffield	Hawthorn Avenue/ Coppice Close, Stocksbridge	Reasonably Foreseeable	52	52	Housing
584	463	HS81	Barnsley	Land rear of Kings Oak Primary School, Wombwell	Reasonably Foreseeable	60	60	Housing
585	464	HS84	Barnsley	Land east of Lundhill Road, Wombwell	Reasonably Foreseeable	150	150	Housing
586	492	S00831	Sheffield	Land off Ash Street/Langsett Road	Reasonably Foreseeable	25	25	Housing
587	493	S00050	Sheffield	Former British Glass Laboratories Northumberland Road	Reasonably Foreseeable	18	18	Housing
588	494	S01039	Sheffield	Site of Hillfoot Mitsubishi, 101 Scotland Street, Sheffield S3 7BX	Reasonably Foreseeable	12	12	Housing
589	495	S00046	Sheffield	Land Adjacent to and Rear of 85 Scotland Street, Sheffield	Reasonably Foreseeable	81	81	Housing
590	496	S00755	Sheffield	St Vincent´s Church, Solly Street	Reasonably Foreseeable	100	224	Housing
591	497	S00754	Sheffield	Rockingham Street / Bailey Lane / Boden Lane	Reasonably Foreseeable	100	144	Housing
592	498	S00065	Sheffield	Land at Acorn Street, Green Lane and Dunfields	Reasonably Foreseeable	56	56	Housing
593	499	S00757	Sheffield	Upper Allen Street, Craven Street, Morpeth Street & Well Meadow Street	Reasonably Foreseeable	100	111	Housing

S. No for TFP	ID	Ref	Local authority	Scheme	Certainty criteria	Forecast developments for 2015 - 2025	Forecast developments for 2015 - 2040	Land-use Type
594	500	S00759	Sheffield	St. Phillip's Social Club, Radford Street / Daisy Walk	Reasonably Foreseeable	106	106	Housing
595	501	S00101	Sheffield	Wharncliffe Works and 86-88 Green Lane	Reasonably Foreseeable	18	18	Housing
596	502	S00102	Sheffield	Car Park Next to Steel City Plaza, Townhead Street, Sheffield S1 2EB	Reasonably Foreseeable	21	21	Housing
597	503	S00053	Sheffield	Land at Junction of West Bar/Lambert Street and 117-119 West Bar Sheffield S3 8PT	Reasonably Foreseeable	45	45	Housing
598	504	S00041	Sheffield	Land Opposite 134 to 180 St Georges Close Sheffield	Reasonably Foreseeable	33	33	Housing
599	505	S00852	Sheffield	Site At 31 Acorn Street/Dunfields/Green Lane (Site 4), Sheffield, S3 8SQ	Reasonably Foreseeable	20	20	Housing
600	506	S01225	Sheffield	Lydgate Service Reservoir, off Ryegate Crescent, Crookes	Reasonably Foreseeable	21	21	Housing
601	507	S01345	Sheffield	Toledo Works, 79-81 Hollis Croft, Sheffield, S1 4BG	Reasonably Foreseeable	33	33	Housing
602	508	S01338	Sheffield	Site of 55 Russell Street and Bowling Green Street, Sheffield, S3 8RW	Reasonably Foreseeable	48	48	Housing
603	509	S01390	Sheffield	Walkley House, Burnaby Crescent, Sheffield, S6 2TS	Reasonably Foreseeable	10	10	Housing
604	510	S01226	Sheffield	Hadfield Service Reservoir, off Glebe Road/ Blakeney Road, Crookes	Reasonably Foreseeable	45	45	Housing

S. No for TFP	ID	Ref	Local authority	Scheme	Certainty criteria	Forecast developments for 2015 - 2025	Forecast developments for 2015 - 2040	Land-use Type
605	511	S01753	Sheffield	Hoyle Street Development Site	Reasonably Foreseeable	43	43	Housing
606	512	S01751	Sheffield	Whitehouse Lane, 158 Primrose View	Reasonably Foreseeable	12	12	Housing
607	513	S02052	Sheffield	Brass Founders Sheffield Ltd Princess Works Scotland Street Sheffield S3 7BX	Reasonably Foreseeable	48	48	Housing
608	514	S02267	Sheffield	Former Bole Hill Residential Home, Bole Hill View, S10 1QL	Reasonably Foreseeable	20	20	Housing
609	515	S02285	Sheffield	Former Footprint Tools, Hollis Croft	Reasonably Foreseeable	100	130	Housing
610	516	S02297	Sheffield	Don Cutlery Works, Doncaster Street	Reasonably Foreseeable	15	15	Housing
611	517	S02298	Sheffield	7 to 15 St James Row	Reasonably Foreseeable	21	21	Housing
612	518	S02458	Sheffield	Northumberland Road Car Park	Reasonably Foreseeable	22	22	Housing
613	519	S02508	Sheffield	Sport Sheffield (Goodwin Sports Centre), Northumberland Road, S10 2TY	Reasonably Foreseeable	76	76	Housing
614	524	28.1.2	Manchester	Roundthorn Medipark Extension	Reasonably Foreseeable	0	86000	Employment
615	525	87	Stockport	Factory off Pepper Road	Reasonably Foreseeable	4500	9000	Employment
616	527	ES8	Barnsley	Land off Ferrymoor Way	Reasonably Foreseeable	0	5100	Employment

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617	528	ES9	Barnsley	Land west of Springvale Road	Reasonably Foreseeable	1800	3600	Employment
618	529	ES6	Barnsley	Bromcliffe Business Park	Reasonably Foreseeable	0	2100	Employment
619	530	ES2	Barnsley	Claycliffe Business Park	Reasonably Foreseeable	0	4500	Employment
620	531	ES3	Barnsley	Zenith Business Park	Reasonably Foreseeable	0	1200	Employment
621	534	ES7	Barnsley	Oaks Business Park	Reasonably Foreseeable	1350	2700	Employment
622	535	ES22	Barnsley	Park Springs, Houghton	Reasonably Foreseeable	0	10200	Employment
623	536	ES23	Barnsley	Land South of Park Springs	Reasonably Foreseeable	0	24900	Employment
624	537	ES10	Barnsley	Land South of Dearne Valley Parkway	Reasonably Foreseeable	0	218700	Employment
625	538	ES11	Barnsley	Fields End Business Park	Reasonably Foreseeable	0	6000	Employment
626	539	ES12	Barnsley	Thurnscoe Business Park	Reasonably Foreseeable	0	18000	Employment
627	540	ES15	Barnsley	Shortwood Extension	Reasonably Foreseeable	35400	35400	Employment
628	541	ES16	Barnsley	Shortwood Business Park	Reasonably Foreseeable	0	11400	Employment
629	542	ES17	Barnsley	Land South of Dearne Valley Parkway	Reasonably Foreseeable	0	84600	Employment

S. No for TFP	ID	Ref	Local authority	Scheme	Certainty criteria	Forecast developments for 2015 - 2025	Forecast developments for 2015 - 2040	Land-use Type
630	543	ES18	Barnsley	Ashroyd	Reasonably Foreseeable	0	25500	Employment
631	548	0	Sheffield	Sheffield Wednesday Football Club Training Ground, Middlewood Road	Reasonably Foreseeable	0	3900	Employment
632	550	0	Sheffield	Jubilee House and Adjoining Land, Clay Wheels Lane	Reasonably Foreseeable	0	4300	Employment
633	551	0	Sheffield	Central Works, Herries Road	Reasonably Foreseeable	0	2600	Employment
634	552	0	Sheffield	Site of Riverdale Works (Former Harold Moore Factory), Rawson Spring Road	Reasonably Foreseeable	0	2510	Employment
635	559	0	Sheffield	Sheffield United FC Academy, Shirecliffe Road	Reasonably Foreseeable	0	2000	Employment
636	560	0	Sheffield	Salmon Pastures, Warren Street	Reasonably Foreseeable	0	1000	Employment
637	561	0	Sheffield	Clough Bank Works, 1 Downgate Drive	Reasonably Foreseeable	0	1080	Employment
638	577	0	Sheffield	West Bar Square	Reasonably Foreseeable	0	56900	Employment
639	578	0	Sheffield	Sheffield United Football Club, Highfield - The Kop Stand, Shoreham Street	Reasonably Foreseeable	0	11900	Employment
640	579	0	Sheffield	121 Eyre Street	Reasonably Foreseeable	0	6700	Employment

S. No for TFP	ID	Ref	Local authority	Scheme	Certainty criteria	Forecast developments for 2015 - 2025	Forecast developments for 2015 - 2040	Land-use Type
641	580	0	Sheffield	Sidney Street / Matilda Street / Arundel Street / Sylvester Street	Reasonably Foreseeable	0	1860	Employment
642	581	0	Sheffield	Sheaf Quay, 1 North Quay Drive, Victoria Quays	Reasonably Foreseeable	0	1840	Employment
643	582	0	Sheffield	Castle House, Angel Street	Reasonably Foreseeable	0	1770	Employment
644	583	0	Sheffield	Site of Sheffield MDC Car Park at Rear of Bristol Hotel, Blonk Street	Reasonably Foreseeable	0	11800	Employment
645	584	0	Sheffield	The Old Dairy, Broadfield Road	Reasonably Foreseeable	0	2045	Employment
646	585	0	Sheffield	Former Office World Site, Furnival Square, Eyre Street / Furnival Street	Reasonably Foreseeable	0	14200	Employment
647	610	28.1	Manchester	Airport City South	Reasonably Foreseeable	0	40000	Employment
648	616	28.4.2	Stockport	Bredbury Park Extension	Reasonably Foreseeable	0	90000	Employment
649	619	ES1	Barnsley	Birthwaite Business Park	Reasonably Foreseeable	0	10500	Employment
650	622	ES13	Barnsley	Hoyland - Masterplanning site	Reasonably Foreseeable	0	148200	Employment
651	623	ES21	Barnsley	Wentworth Industrial Park, Tankersley	Reasonably Foreseeable	0	12900	Employment
652	627	0	Sheffield	Former Smithywood Colliery, Cowley Hill / Nether Lane	Reasonably Foreseeable	0	53000	Employment

S. No for TFP	ID	Ref	Local authority	Scheme	Certainty criteria	Forecast developments for 2015 - 2025	Forecast developments for 2015 - 2040	Land-use Type
653	628	ES20	Barnsley	Everill Gate Lane	Reasonably Foreseeable	5400	10800	Employment
654	629	0	Sheffield	The Nichols Building, Shalesmoor	Reasonably Foreseeable	0	2000	Employment
655	630	0	Sheffield	Clarkson Osborn International Ltd, 100 Penistone Road	Reasonably Foreseeable	0	10250	Employment
656	631	0	Sheffield	Pennine Centre, Tenter Street / Hawley Street / Silver Street Head / Lee Croft / Sims Street	Reasonably Foreseeable	0	9200	Employment
657	632	0	Sheffield	Site of former Presto International UK Ltd, Penistone Road	Reasonably Foreseeable	0	11100	Employment
658	635	28.8.9	Oldham	OA9 Cowlishaw	Reasonably Foreseeable	124	465	Housing
659	636	28.8.11	Oldham	OA11 Beal Valley	Reasonably Foreseeable	0	482	Housing
660	637	28.8.8	Oldham	OA8 Broadbent Moss	Reasonably Foreseeable	0	1198	Housing
661	638	28.8.12	Oldham	OA12 Robert Fletchers	Reasonably Foreseeable	0	170	Housing
662	639	51	Trafford	Pomona Island Strategic Location	Reasonably Foreseeable	0	358	Housing
663	642	28.2.1	Trafford	New Carrington - GMSF allocation	Reasonably Foreseeable	0	4775	Housing
664	643	52	Trafford	Carrington Strategic Location	Reasonably Foreseeable	0	235	Housing
665	647	28.1.3	Trafford	Timpereley Wedge - GMSF allocation	Reasonably Foreseeable	0	2400	Housing

S. No for TFP	ID	Ref	Local authority	Scheme	Certainty criteria	Forecast developments for 2015 - 2025	Forecast developments for 2015 - 2040	Land-use Type
666	649	28.8.10	Oldham	Hanging Chadder	Reasonably Foreseeable	0	260	Housing
667	650	28.3.4	Oldham and Rochdale	Stakehill	Reasonably Foreseeable	0	1700	Housing
668	651	28.3.5	Oldham and Rochdale	Kingsway South	Reasonably Foreseeable	0	700	Housing
669	652	28.2.2	Salford	Western Cadishead and Irlam	Reasonably Foreseeable	0	2250	Housing
670	654	54	Trafford	Wharfside Strategic Location	Reasonably Foreseeable	0	546	Housing
671	659	28.1.3	Trafford	Timpereley Wedge, Davenport Green	Reasonably Foreseeable	0	60000	Employment
672	660	28.2.1	Trafford	New Carrington	Reasonably Foreseeable	0	410000	Employment
673	661	28.2.3	Salford	Port Salford Extension	Reasonably Foreseeable	0	320000	Employment
674	662	28.3.4	Oldham and Rochdale	Stakehill	Reasonably Foreseeable	0	250000	Employment
675	663	28.3.5	Oldham and Rochdale	Kingsway South	Reasonably Foreseeable	0	310000	Employment
676	664	28.8.8	Oldham	OA8 Broadbent Moss	Reasonably Foreseeable	21720	21720	Employment
677	681	ES14	Barnsley	Rockingham	Reasonably Foreseeable	0	25800	Employment
678	682	ES19	Barnsley	Land North of Sheffield Road	Reasonably Foreseeable	0	9900	Employment

S. No for TFP	ID	Ref	Local authority	Scheme	Certainty criteria	Forecast developments for 2015 - 2025	Forecast developments for 2015 - 2040	Land-use Type
679	683	HS14	Barnsley	Site at Garden House Farm, Monk Bretton	Reasonably Foreseeable	70	70	Housing
680	686	HS22	Barnsley	Land at St Michael's Avenue, Carlton	Reasonably Foreseeable	0	38	Housing
681	687	HS23	Barnsley	Land off Highstone Lane, Worsbrough Common	Reasonably Foreseeable	18	18	Housing
682	688	HS26	Barnsley	Zenith Extension	Reasonably Foreseeable	0	143	Housing
683	689	HS28	Barnsley	Land south west of Priory Road, Lundwood	Reasonably Foreseeable	18	36	Housing
684	690	HS29	Barnsley	Land off Mount Vernon Road, Barnsley	Reasonably Foreseeable	74	74	Housing
685	691	HS30	Barnsley	Land off Leighton Close	Reasonably Foreseeable	18	18	Housing
686	694	HS42	Barnsley	Land south of Lowfield Road, Bolton Upon Dearne	Reasonably Foreseeable	86	86	Housing
687	695	HS53	Barnsley	Site South of King Street, Thurnscoe	Reasonably Foreseeable	0	25	Housing
688	696	HS57	Barnsley	Land at Tankersley Lane, Hoyland Common	Reasonably Foreseeable	46	97	Housing
689	697	HS59	Barnsley	Land south of Hay Green Lane, Birdwell	Reasonably Foreseeable	118	118	Housing
690	698	HS6	Barnsley	Site south of Coniston Avenue, Darton	Reasonably Foreseeable	40	40	Housing
691	699	HS60	Barnsley	Greenside Lane, Hoyland	Reasonably Foreseeable	22	22	Housing

S. No for TFP	ID	Ref	Local authority	Scheme	Certainty criteria	Forecast developments for 2015 - 2025	Forecast developments for 2015 - 2040	Land-use Type
692	700	HS63	Barnsley	Land off Welland Crescent, Elsecar	Reasonably Foreseeable	0	29	Housing
693	701	HS67	Barnsley	Land at Sheffield Road, Birdwell	Reasonably Foreseeable	17	17	Housing
694	702	HS68	Barnsley	Land east of Sheffield Road, Hoyland Common	Reasonably Foreseeable	220	237	Housing
695	703	HS69	Barnsley	Land North of Wood Walk, Hoyland	Reasonably Foreseeable	112	112	Housing
696	705	HS71	Barnsley	Land at Talbot Road, Penistone	Reasonably Foreseeable	40	40	Housing
697	706	HS72	Barnsley	Land East of Saunderson Avenue, Penistone	Reasonably Foreseeable	28	28	Housing
698	707	HS76	Barnsley	Land at end of Melton Way, Royston	Reasonably Foreseeable	0	58	Housing
699	708	HS77	Barnsley	Land North of Pitt Street, Wombwell	Reasonably Foreseeable	0	109	Housing
700	710	HS87	Barnsley	Land East of Wortley Street, Wombwell	Reasonably Foreseeable	40	40	Housing
701	712	HS89	Barnsley	Land off Roughbirchworth Lane, Oxspring	Reasonably Foreseeable	22	22	Housing
702	713	HS9	Barnsley	Site East of Smithy Wood Lane, Gilroyd	Reasonably Foreseeable	0	144	Housing
703	714	HS90	Barnsley	Land off High Street, Great Houghton	Reasonably Foreseeable	27	67	Housing
704	715	HS91	Barnsley	Land off Cote Lane, Thurgoland	Reasonably Foreseeable	0	22	Housing

S. No for TFP	ID	Ref	Local authority	Scheme	Certainty criteria	Forecast developments for 2015 - 2025	Forecast developments for 2015 - 2040	Land-use Type
705	716	HS92	Barnsley	Everill Gate Farm, Broomhill	Reasonably Foreseeable	0	26	Housing
706	717	HS93	Barnsley	Site north of Halifax Road, Thurgoland	Reasonably Foreseeable	25	25	Housing
707	719	HS95	Barnsley	Land at Hall Farm, Brierley	Reasonably Foreseeable	29	29	Housing
708	722	MU2	Barnsley	Land between Fish Dam Lane & Carlton Road, Carlton	Reasonably Foreseeable	94	294	Housing
709	723	MU3	Barnsley	Land between Shaw Lane & West Green Link Road, Royston	Reasonably Foreseeable	80	1683	Housing
710	724	MU4	Barnsley	Land off Broadway, Barnsley	Reasonably Foreseeable	70	150	Housing
711	726	Town Centre Development Site 2	Barnsley	Southern Fringe Development Site, Barnsley Town Centre	Reasonably Foreseeable	0	88	Housing
712	727	Town Centre Development Site 3	Barnsley	Courthouse Campus, Barnsley Town Centre	Reasonably Foreseeable	98	138	Housing
713	731	Policy H2 (G3)	High Peak (Glossopdale)	Roughfields, Hadfield	Reasonably Foreseeable	51	102	Housing
714	732	Policy H2 (G12)	High Peak (Glossopdale)	Bute Street, Glossop	Reasonably Foreseeable	0	30	Housing
715	733	Policy H2 (G20)	High Peak (Glossopdale)	Dinting Lane, Glossop	Reasonably Foreseeable	0	50	Housing
716	734	Policy H2 (G23)	High Peak (Glossopdale)	Former Railway Museum, Glossop	Reasonably Foreseeable	0	89	Housing

S. No for TFP	ID	Ref	Local authority	Scheme	Certainty criteria	Forecast developments for 2015 - 2025	Forecast developments for 2015 - 2040	Land-use Type
717	735	Policy H2 (G25)	High Peak (Glossopdale)	Land off Melandra Castle Road	Reasonably Foreseeable	15	35	Housing
718	736	Policy DS4 & Policy H2 (G34)	High Peak (Glossopdale)	Adderley Place	Reasonably Foreseeable	65	130	Housing
719	737	Policy E2 (Land off Wren Nest Road, Glossop)	High Peak (Glossopdale)	Land off Wren Nest Road, Glossop	Reasonably Foreseeable	0	25000	employment
720	746	Policy DS18 & Policy H2 (B8)	High Peak (Buxton)	West of Tongue Lane, Buxton	Reasonably Foreseeable	0	139	Housing
721	747	Policy DS19 & Policy H2 (B10)	High Peak (Buxton)	Land off Dukes Drive, Buxton	Reasonably Foreseeable	169	338	Housing
722	749	Policy DS22 & Policy H2 (B31)	High Peak (Buxton)	Station Road, Buxton	Reasonably Foreseeable	30	30	Housing
723	750	Policy E2 (Staden Lane extension)	High Peak (Buxton)	Staden Lane, Buxton	Reasonably Foreseeable	0	13600	employment
724	753	Policy E2 (Tongue Lane extension)	High Peak (Buxton)	Tongue Lane, Buxton	Reasonably Foreseeable	0	20000	employment
725	764	Policy DSC10 Policy H2(C15)	High Peak (Central Area)	Britannia Mill, Buxworth	Reasonably Foreseeable	0	50	Housing
726	765	Policy DS8 & Policy H2 (C3)	High Peak (Central Area)	Derby Road, New Mills	Reasonably Foreseeable	54	107	Housing
727	766	Policy DS9 & Policy H2 (C5, C6, C17, C18)	High Peak (Central Area)	Ollerset Lane, New Mills	Reasonably Foreseeable	120	239	Housing
728	767	Policy H2 (C7)	High Peak (Central Area)	Woodside Street, New Mills	Reasonably Foreseeable	0	25	Housing

S. No for TFP	ID	Ref	Local authority	Scheme	Certainty criteria	Forecast developments for 2015 - 2025	Forecast developments for 2015 - 2040	Land-use Type
729	768	Policy H2 (C16)	High Peak (Central Area)	Furness Vale A6	Reasonably Foreseeable	0	39	Housing
730	769	Policy DSC12 & Policy H2 (C20)	High Peak (Central Area)	Furness Vale Business Park	Reasonably Foreseeable	0	32500	Employment
731	770	Policy DS15 & Policy H2 (C21)	High Peak (Central Area)	Birch Vale Industrial Estate	Reasonably Foreseeable	0	9000	Employment
732	777	Policy DS14 (C20)	High Peak (Central Area)	Newtown Industrial Legacy site	Reasonably Foreseeable	0	11000	Employment
733	778	Policy DS11	High Peak (Central Area)	Bingswood, Whaley Bridge	Reasonably Foreseeable	0	43000	Employment
734	779	Policy DS13	High Peak (Central Area)	Torr Vale Mill, New Mills	Reasonably Foreseeable	0	4000	Employment
735	888	0	Stockport	Cheadle Royal Business Park	Reasonably Foreseeable	5500	11000	Employment
736	889	0	Stockport	Land off Ashurst Drive, Cheadle	Reasonably Foreseeable	3345	3345	Employment
737	890	0	Stockport	Land off Duke Avenue, Cheadle Hulme	Reasonably Foreseeable	4482	4482	Employment
738	891	0	Stockport	Ajax Works, Whitehill Road, Reddish	Reasonably Foreseeable	1246	1246	Employment
739	893	H-HYDNEW-003	Tameside	Former Newton Printworks (ABC Wax), Clarendon Road, Hyde, SK14 2LJ	Reasonably Foreseeable	0	155	Housing
740	914	H/E14	High Peak	Street Crane	Reasonably Foreseeable	1958	1958	Employment
741	926	0	Tameside	H-DROEST-055 Seamark	Reasonably Foreseeable	77	225	Housing

S. No for TFP	ID	Ref	Local authority	Scheme	Certainty criteria	Forecast developments for 2015 - 2025	Forecast developments for 2015 - 2040	Land-use Type
742	927	0	Tameside	H-STANTH-032 Harrop Street and Shepley Street, UDP Allocation E2(9)	Reasonably Foreseeable	0	277	Housing
743	928	0	Tameside	H-STPETE-164 Ashton town centre	Reasonably Foreseeable	0	600	Housing
744	929	0	Tameside	E-DENWST-003 - Former Gasworks	Reasonably Foreseeable	3164	3955	Employment
745	930	0	Tameside	E-MOSSLE-001 - Metal Brite Ltd	Reasonably Foreseeable	0	1578	Employment
746	931	0	Tameside	E-STANTH-002 - Site of Former Ray Mill	Reasonably Foreseeable	1839	2299	Employment
747	932	0	Tameside	E-STMICH-001 - Unit 2	Reasonably Foreseeable	0	1799	Employment
748	934	0	Tameside	E-STPETE-008 - Goldgem Site	Reasonably Foreseeable	0	1900	Employment
749	936	S/H7	Stockport	Compstall Mills, Andrew Street, Compstall	Reasonably Foreseeable	61	121	Housing
750	937	S/H10	Stockport	Greenhale House site, Piccadilly, Town Centre	Reasonably Foreseeable	78	155	Housing
751	939	S/H19	Stockport	Piccadilly / Fletcher Street Car Park, Town Centre	Reasonably Foreseeable	63	125	Housing
752	941	S/H22	Stockport	Broadstone Mill, Broadstone Road, Reddish	Reasonably Foreseeable	50	100	Housing
753	942	S/H5	Stockport	Land at Midland Rd / Geneva Rd, Bramhall	Reasonably Foreseeable	82	163	Housing
754	943	S/E14	Stockport	Melford Road Employment Area, Melford Road, Hazel Grove	Reasonably Foreseeable	4750	9500	Employment

S. No for TFP	ID	Ref	Local authority	Scheme	Certainty criteria	Forecast developments for 2015 - 2025	Forecast developments for 2015 - 2040	Land-use Type
755	944	S/E12	Stockport	Woodford, Former BAE site	Reasonably Foreseeable	4181	8361	Employment
756	945	S/E12	Stockport	Woodford, Former BAE site	Reasonably Foreseeable	475	950	Housing
757	946	S/E10	Stockport	Stockport Town Centre, Town Centre Area	Reasonably Foreseeable	60000	120000	Employment
758	948	S/E19	Stockport	Compstall Mills, Andrew Street	Reasonably Foreseeable	1229	2458	Employment
759	949	S/E7	Stockport	Kings Reach, Yew Street, Yew Street, Stockport	Reasonably Foreseeable	6278	12555	Employment
760	951	S/R39	Stockport	DC/050476, Blackstone, Blackstone Field, Lisburne Lane, Offerton Estate, Stockport, SK2 5NA	Reasonably Foreseeable	245	490	Employment
761	952	S/R40	Stockport	DC/051676, Water Street, Land at Water Street, Stockport, Sk1 2bt	Reasonably Foreseeable	2787	5574	Employment
762	954		Stockport	Unit 6, Peel Centre (DC/052216), Unit 6 (Toys R Us) Peel Centre, Great Portwood Street Stockport, SK1 2HH	Reasonably Foreseeable	2697	5393	Employment
763	955	0	Manchester	EW9b Styal Road/ Irvin Drive	Reasonably Foreseeable	0	15300	Employment
764	956	M/E8	Manchester	1.16ha Office Allocation with vacant plots remaining undeveloped at Simons Way / Shadowmoss Road	Reasonably Foreseeable	11600	11600	Employment

Appendix C. Uncertainty Log: infrastructure

Table C-1 and Table C-2 provide a comprehensive record of all transport infrastructure schemes that are included in the core, low and high growth scenarios. The networks for all forecast growth scenarios are identical, the only differences relate to the model forecast year.

Table C-1 - TPS RTM forecasting Uncertainty Log: Road Investment Strategy (RIS) schemes

Item	Scheme name	Road	Scheme description	Model Year
1	M62 Jct 19 Improvement	M62	All the approaches of the gyratory are signalised	2025
2	M1 Jct 45 Improvement	M1	NA	2025
3	M621 Jcts 1-7 Improvements	M621	Improvements to junction 45 of the M1, to the east of Leeds near the Aire Valley enterprise zone, through signalisation and improved slip road.	2040
4	M62/M606 Chain Bar	M62/M606	Provision of a direct link from the M62 westbound to the M606 northbound and removing significant congestion from the main part of the existing junction.	2025
5	M62 Jcts 20-25: Smart Motorway	M62	Upgrading the M62 to Smart Motorway between junction 20 (Rochdale) and junction 25 (Brighouse) across the Pennines. Together with other Smart Motorways already under construction in Greater Manchester and existing Smart Motorways in Yorkshire, this will provide a full four lane Smart Motorway link between Leeds and Manchester.	2040
6	A1 Leeming to Barton	A1	Upgrading the A1 between Leeming and Barton to three-lane motorway standard; connecting together the two sections of the A1(M) in the north of England and completing the motorway link from the Teesside and Tyne and Wear to the rest of England.	2025
9	M1/M62 Lofthouse Interchange	M1/M62	Reconstruction of the junction between the M1 and the M62 as an all-direction free-flowing interchange.	2025
11	M1 Jcts 32-35a: Smart Motorway	M1	Upgrading the M1 to Smart Motorway, including the use of hard-shoulder running, between junction 32 (M18) and junction 35A (A616) around Sheffield and Rotherham.	2025
15	M1 Jcts 39 - 42	M1	Upgrading the M1 to Smart Motorway, including the use of hard-shoulder running, between junction 39 (Derby Dale) and junction 42 (M62) near Wakefield.	2025
16	A63 Castle Street	A63	Grade separation of the A1079 Mytongate junction in Hull and improvements to the surrounding roads, including the provision of improved pedestrian and cyclist access across the A63. Along with the Connecting the City Bridge, funded through the Humber Growth Deal, this will improve cyclists' and pedestrians' access to and from Hull Marina and road access to and from the port of Hull.	2025

Item	Scheme name	Road	Scheme description	Model Year
17	A160/A180 Immingham	A160/A180	Improvements to the junction between the A180 and A160 near Immingham port, plus upgrading the A160 to a full dual carriageway between the A180 and the port itself.	2025
18	M60 Jcts 8 – M62 J20 (MMM)	M60	Installation of Smart Motorway technology on the M60 between junction 8 and junction 18, plus the introduction of Smart Motorway with all-lane running between M62 junction 18 and junction 20.	2025
20	M6 Jct 22 upgrade	M6	Improvements to junction 22 near Warrington, improving access to nearby developments.	2025
22	M56 new Jct 11A	M56	A new junction to link the M56 to the A533 at Runcorn, creating an improved link to the new Mersey Gateway bridge from the south.	2025
23	M6 Jct 19 Improvement	M6	Major improvements to the junction between the M6 and the A556 in Cheshire. Together with improvements to the A556, M6 and M56, this forms part of a comprehensive upgrade of Manchester's southern access.	2025
24	M55 Jct 2	M55	This new junction will link the recently-approved Preston Western Distributor Road to the strategic road network.	2025
27	A556 Knutsford to Bowdon	A556	Online and offline widening of the A556 between the M56 and the M6 with grade-separated dual carriageway, including a bypass around Mere. This improves the A-road that serves as the main southern access to Manchester to Expressway standard.	2025
28	M6 Jcts 21a-26: Smart Motorways	M6	Upgrading the M6 to Smart Motorway between junction 21A (M62) and junction 26 (Wigan) in southern Lancashire. This links to the M62 junctions 20-12 scheme to the east.	2025
29	M62 Jcts 10-12: Smart Motorways	M62	Upgrading the M62 to Smart Motorway between junction 10 (M6) and junction 12 (M60) west of Manchester. This links to the M60 Smart Motorway schemes to the east and the M6 junctions 21A-26 schemes to the north.	2025
31	M56 Jcts 6-8: Smart Motorways	M56	Upgrading the M56 to Smart Motorway between junction 6 (Manchester Airport) and junction 8 (A556). Together with improvements to the A556, the M6 junction 19 and Smart Motorways on the M6, this forms part of a comprehensive upgrade to Manchester's southern access.	2025
32	M6 Jcts 16-19: Smart Motorways	M6	Upgrading the M6 to Smart Motorway between junction 16 (Stoke) and junction 19 (Knutsford). coupled with other improvements to the M6 and M1, this forms the northern end of the 'smart spine' linking the North West and London.	2025
33	A585 Windy Harbour - Skippool	A585	A new offline bypass of the village of Little Singleton, reducing the impact of traffic on the local community and removing a major bottleneck on the main road to Fleetwood.	2040

Item	Scheme name	Road	Scheme description	Model Year
34	A5036 Princess Way - Access to Port of Liverpool	A5036	Comprehensive upgrade to improve traffic conditions on the main link between the Port of Liverpool and the motorway network. This scheme was identified as a central element of the Liverpool Local Growth Deal.	2040
35	M1 Jcts 35A-39: Smart Motorway	M1	Upgrade the M1 to Smart Motorway between junction 35A (A616) and junction 39 (Denby Dale) near Barnsley. Together with other Smart Motorways already under construction in Yorkshire, this will provide a full Smart Motorway link between Sheffield and Leeds; and together with improvements in the East Midlands will provide a fully upgraded link between Leeds and London.	2025
37	M1 Jcts 28-31: Managed Motorways	M1	NA	2025
38	M18 Jcts 2-3: Main Line Widening	M18	NA	2025

Table C-2 - TPS RTM forecasting Uncertainty Log: Local Authority (LA) schemes

Item	Scheme name	Road	Model Year
1	FARRRS (Great Yorkshire Way)	A6182	2025
2	Hatfield Link Road	M18	2025
3	Waverly Link Road	B6200	2025
4	A630 Parkway Widening	A630	2025
5	Harrogate Road / New Line Junction	A658/A657	2025
6	A650 Hard Ings Road Improvement	A650	2025
7	A650 Tong Street (Phase 1)	A650	2040
8	M62 J24a	M62/A641	2040
9	TF5 - Wakefield Eastern Relief Road	A638/A642	2025
10	Western Gateway Infrastructure Scheme (Full)	M60/A57	2040
11	Mersey Gateway	A533/A562	2025
12	A6 MARR (Manchester Airport Relief Road)	A555	2025
13	Poynton Relief Road	A555/A523	2025
14	Congleton Link Road	A54/A34	2025
15	Middlewich Eastern Bypass	A533	2025
16	A59 Penwortham Bypass Completion	A59	2025
17	A6 Broughton Bypass	A6	2025
18	Heysham to M6 Link	A683	2025
19	A582 South Ribble Widening	A582	2025
20	Preston Western Distributor and East-West Link Road	A583	2025
21	M58 Link Road	M58/M6/A49	2025
22	Westwood Park A49 Link Road and Marus Bridge Roundabout	A49	2025
23	Phoenix Way to Seaman Way Link	A58	2025
24	Knowsley Expressway and Speke Road Junction	A5300	2025
25	Denton Link Road	A57	2025
26	A565 Dualling	A565	2025
27	Etruria Valley Highway and Connectivity Improvement	A500/A527	2025
28	A5758 Broom's Cross Road	A5758	2025
29	M58 Junction 1 Improvement	M58	#N/A
30	A580 / A570 Windle Island Improvement	A580/A570	2025
31	A570 Corridor Improvements	A570	2025
32	M181	M181	2025
33	A18/A180 Link Road	A18/A180	2025
34	Glasshoughton Southern Link Road	A6539/A639	2025
35	TF23 - New Access Road to Leeds Bradford Airport	A65/A658	2040
36	TF24 - A6110 Outer Ring Road, Leeds	A6110	2025
37	Barnetby Top	A18	2025

Appendix D. Trip rate summary

Table D-1 - Trip rate summary – Taxi

Land Use		Taxi					
		Arrival			Departure		
		AM	IP	PM	AM	IP	PM
office (per 100 sqm GFA)	101	0.0103	0.0063	0.0067	0.0107	0.0063	0.0067
business park (per 100 sqm GFA)	102	0.0117	0.0052	0.0027	0.0043	0.0048	0.0103
Warehousing B8 (per 100 sqm GFA)	103	0.0000	0.0002	0.0003	0.0000	0.0002	0.0003
industrial unit (per 100 sqm GFA) B1 B2	104	0.0000	0.0005	0.0000	0.0000	0.0005	0.0000
mixed/ affordable housing (no. of dwells)	105	0.0047	0.0043	0.0047	0.0053	0.0043	0.0057
mixed private houses (no. of dwells)	106	0.0133	0.0102	0.0143	0.0120	0.0097	0.0120
Retail Park excluding food (per 100 sqm GFA)	107	0.0033	0.0125	0.0057	0.0023	0.0120	0.0070
Leisure Centre (per hec GFA)	108	0.0487	0.0243	0.0487	0.0487	0.0243	0.0487
RETAIL_MIXED SHOPPING (per 100 sqm GFA)	109	0.0200	0.0903	0.0100	0.0150	0.0853	0.0460
industrial estate (per 100sqm GFA) B1 or B2	110	0.0010	0.0008	0.0003	0.0010	0.0008	0.0003

Table D-2 - Trip rate summary – LGV

Land Use		LGV					
		Arrival			Departure		
		AM	IP	PM	AM	IP	PM
office (per 100 sqm GFA)	101	0.0333	0.0175	0.0197	0.0317	0.0167	0.0220
business park (per 100 sqm GFA)	102	0.0783	0.0715	0.0220	0.0653	0.0710	0.0320
Warehousing B8 (per 100 sqm GFA)	103	0.0090	0.0103	0.0040	0.0063	0.0102	0.0050
industrial unit (per 100 sqm GFA) B1 B2	104	0.0230	0.0343	0.0040	0.0157	0.0338	0.0153
mixed/ affordable housing (no. of dwells)	105	0.0163	0.0130	0.0117	0.0093	0.0147	0.0100
mixed private houses (no. of dwells)	106	0.0190	0.0277	0.0153	0.0130	0.0290	0.0133
Retail Park excluding food (per 100 sqm GFA)	107	0.0347	0.0610	0.0337	0.0273	0.0590	0.0437
Leisure Centre (per hec GFA)	108	0.4390	0.5242	0.4390	0.3170	0.5120	0.3170
RETAIL_MIXED SHOPPING (per 100 sqm GFA)	109	0.0150	0.0380	0.0050	0.0150	0.0312	0.0460
industrial estate (per 100sqm GFA) B1 or B2	110	0.0657	0.0552	0.0260	0.0597	0.0540	0.0387

Table D-3 - Trip rate summary - OGV

Land Use		OGV					
		Arrival			Departure		
		AM	IP	PM	AM	IP	PM
office (per 100 sqm GFA)	101	0.0013	0.0015	0.0007	0.0013	0.0012	0.0013
business park (per 100 sqm GFA)	102	0.0140	0.0095	0.0073	0.0097	0.0107	0.0097
Warehousing B8 (per 100 sqm GFA)	103	0.0443	0.0453	0.0290	0.0413	0.0368	0.0347
industrial unit (per 100 sqm GFA) B1 B2	104	0.0183	0.0170	0.0030	0.0137	0.0143	0.0057
mixed/ affordable housing (no. of dwells)	105	0.0020	0.0027	0.0000	0.0033	0.0023	0.0000
mixed private houses (no. of dwells)	106	0.0060	0.0035	0.0000	0.0050	0.0037	0.0000
Retail Park excluding food (per 100 sqm GFA)	107	0.0070	0.0028	0.0023	0.0057	0.0028	0.0033
Leisure Centre (per hec GFA)	108	0.0977	0.0122	0.0000	0.0973	0.0122	0.0000
RETAIL_MIXED SHOPPING(per 100 sqm GFA)	109	0.0150	0.0083	0.0000	0.0350	0.0033	0.0200
industrial estate (per 100sqm GFA) B1 or B2	110	0.0167	0.0178	0.0087	0.0170	0.0178	0.0110

Table D-4 - Trip rate summary - PSV

Land Use		PSV					
		Arrival			Departure		
		AM	IP	PM	AM	IP	PM
office (per 100 sqm GFA)	101	0.0010	0.0000	0.0000	0.0000	0.0000	0.0003
business park (per 100 sqm GFA)	102	0.0000	0.0002	0.0000	0.0000	0.0002	0.0000
Warehousing B8 (per 100 sqm GFA)	103	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
industrial unit (per 100 sqm GFA) B1 B2	104	0.0010	0.0010	0.0000	0.0010	0.0010	0.0000
mixed/ affordable housing (no. of dwells)	105	0.0007	0.0007	0.0000	0.0007	0.0007	0.0000
mixed private houses (no. of dwells)	106	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Retail Park excluding food (per 100 sqm GFA)	107	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Leisure Centre (per hec GFA)	108	0.0487	0.1583	0.0000	0.0487	0.1583	0.0000
RETAIL_MIXED SHOPPING (per 100 sqm GFA)	109	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
industrial estate (per 100sqm GFA) B1 or B2	110	0.0023	0.0015	0.0010	0.0030	0.0013	0.0000

Table D-5 - Trip rate summary - Motorcycle

Land Use		Motorcycle					
		Arrival			Departure		
		AM	IP	PM	AM	IP	PM
office (per 100 sqm GFA)	101	0.0043	0.0007	0.0003	0.0010	0.0007	0.0040
business park (per 100 sqm GFA)	102	0.0010	0.0010	0.0003	0.0003	0.0010	0.0013
Warehousing B8 (per 100 sqm GFA)	103	0.0007	0.0010	0.0003	0.0000	0.0002	0.0007
industrial unit (per 100 sqm GFA) B1 B2	104	0.0030	0.0020	0.0000	0.0010	0.0015	0.0060
mixed/ affordable housing (no. of dwells)	105	0.0000	0.0003	0.0017	0.0000	0.0003	0.0000
mixed private houses (no. of dwells)	106	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Retail Park excluding food (per 100 sqm GFA)	107	0.0003	0.0035	0.0030	0.0000	0.0027	0.0050
Leisure Centre (per hec GFA)	108	0.0487	0.0365	0.0730	0.0243	0.0608	0.0487
RETAIL_MIXED SHOPPING (per 100 sqm GFA)	109	0.0000	0.0050	0.0000	0.0000	0.0042	0.0100
industrial estate (per 100sqm GFA) B1 or B2	110	0.0033	0.0018	0.0027	0.0013	0.0017	0.0033

Table D-6 - Trip rate summary – All vehicles

Land Use		Vehicles					
		Arrival			Departure		
		AM	IP	PM	AM	IP	PM
office (per 100 sqm GFA)	101	0.8613	0.2323	0.1103	0.1780	0.2510	0.6933
business park (per 100 sqm GFA)	102	0.7033	0.3377	0.1247	0.1860	0.3567	0.6003
Warehousing B8 (per 100 sqm GFA)	103	0.1113	0.0762	0.0517	0.0597	0.0732	0.1030
industrial unit (per 100 sqm GFA) B1 B2	104	0.2243	0.1050	0.0267	0.0570	0.1163	0.2250
mixed/ affordable housing (no. of dwells)	105	0.0767	0.1183	0.1777	0.1633	0.1120	0.1317
mixed private houses (no. of dwells)	106	0.1190	0.1925	0.2543	0.1977	0.1803	0.2040
Retail Park excluding food (per 100 sqm GFA)	107	0.4173	1.5207	0.8440	0.2527	1.4023	1.1820
Leisure Centre (per hec GFA)	108	7.6080	8.2053	15.4597	4.7063	7.9982	13.8990
RETAIL_MIXED SHOPPING (per 100 sqm GFA)	109	0.4760	1.3965	0.3090	0.1570	1.3325	1.1090
industrial estate (per 100sqm GFA) B1 or B2	110	0.2787	0.1770	0.0980	0.1330	0.1848	0.2300

Appendix E. NTEM v7.2 growth factors

Table E-1 - NTEM v7.2 growth factors between 2015 to 2025: OD

Authority	AM						IP						PM					
	UC1		UC2		UC3		UC1		UC2		UC3		UC1		UC2		UC3	
	O	D	O	D	O	D	O	D	O	D	O	D	O	D	O	D	O	D
Rest of UK	1.09	1.09	1.07	1.07	1.11	1.11	1.08	1.08	1.06	1.06	1.11	1.11	1.08	1.08	1.06	1.06	1.10	1.10
High Peak	1.06	1.07	1.03	1.05	1.09	1.10	1.06	1.06	1.04	1.03	1.10	1.10	1.07	1.05	1.04	1.03	1.08	1.08
Manchester	1.18	1.09	1.20	1.08	1.16	1.11	1.09	1.10	1.11	1.13	1.13	1.13	1.09	1.16	1.08	1.20	1.12	1.14
Oldham	1.10	1.09	1.09	1.07	1.09	1.09	1.08	1.08	1.06	1.07	1.10	1.10	1.08	1.09	1.07	1.08	1.09	1.09
Rochdale	1.09	1.09	1.07	1.08	1.09	1.10	1.08	1.08	1.06	1.06	1.09	1.09	1.08	1.08	1.07	1.06	1.08	1.08
Salford	1.16	1.09	1.16	1.08	1.14	1.10	1.09	1.09	1.09	1.11	1.12	1.12	1.09	1.14	1.08	1.15	1.11	1.13
Stockport	1.06	1.09	1.04	1.08	1.07	1.09	1.07	1.07	1.05	1.04	1.08	1.08	1.08	1.06	1.06	1.03	1.08	1.07
Tameside	1.10	1.09	1.08	1.08	1.10	1.10	1.08	1.08	1.06	1.06	1.10	1.10	1.08	1.09	1.07	1.07	1.09	1.09
Trafford	1.09	1.09	1.07	1.08	1.10	1.10	1.08	1.08	1.06	1.06	1.10	1.10	1.08	1.08	1.07	1.06	1.09	1.09
Barnsley	1.10	1.09	1.08	1.07	1.11	1.09	1.08	1.08	1.06	1.06	1.10	1.10	1.08	1.09	1.06	1.07	1.09	1.10
Sheffield	1.11	1.10	1.10	1.08	1.10	1.10	1.09	1.09	1.07	1.08	1.10	1.10	1.09	1.10	1.07	1.09	1.10	1.10
Kirklees	1.05	1.06	1.03	1.04	1.09	1.09	1.05	1.05	1.03	1.03	1.10	1.10	1.05	1.05	1.03	1.02	1.08	1.08

Table E-2 - NTEM v7.2 growth factors between 2015 to 2040: OD

Authority	AM						IP						PM					
	UC1		UC2		UC3		UC1		UC2		UC3		UC1		UC2		UC3	
	O	D	O	D	O	D	O	D	O	D	O	D	O	D	O	D	O	D
Rest of UK	1.18	1.18	1.16	1.16	1.25	1.25	1.17	1.17	1.14	1.14	1.25	1.25	1.17	1.17	1.14	1.14	1.23	1.23
High Peak	1.11	1.17	1.07	1.14	1.19	1.22	1.14	1.14	1.09	1.08	1.21	1.21	1.15	1.11	1.12	1.05	1.18	1.17
Manchester	1.39	1.20	1.44	1.18	1.37	1.25	1.21	1.22	1.24	1.28	1.31	1.32	1.19	1.34	1.18	1.43	1.28	1.33
Oldham	1.20	1.19	1.18	1.17	1.21	1.22	1.17	1.17	1.15	1.15	1.23	1.22	1.18	1.18	1.15	1.16	1.21	1.21
Rochdale	1.18	1.19	1.16	1.17	1.20	1.22	1.17	1.17	1.14	1.13	1.22	1.21	1.18	1.16	1.15	1.13	1.20	1.19
Salford	1.32	1.20	1.34	1.18	1.31	1.24	1.20	1.20	1.21	1.24	1.28	1.29	1.19	1.29	1.17	1.32	1.26	1.29
Stockport	1.14	1.19	1.11	1.17	1.17	1.21	1.16	1.16	1.12	1.11	1.20	1.20	1.17	1.13	1.15	1.09	1.19	1.17
Tameside	1.21	1.19	1.19	1.17	1.25	1.23	1.18	1.18	1.15	1.15	1.25	1.25	1.18	1.19	1.15	1.17	1.22	1.23
Trafford	1.20	1.19	1.18	1.17	1.24	1.23	1.17	1.17	1.15	1.15	1.24	1.24	1.18	1.18	1.16	1.16	1.22	1.22
Barnsley	1.21	1.19	1.19	1.17	1.25	1.23	1.18	1.18	1.15	1.16	1.25	1.25	1.19	1.20	1.16	1.17	1.22	1.23
Sheffield	1.23	1.20	1.23	1.18	1.25	1.23	1.19	1.19	1.17	1.18	1.25	1.25	1.19	1.22	1.17	1.21	1.23	1.24
Kirklees	1.15	1.16	1.12	1.14	1.23	1.24	1.14	1.14	1.11	1.11	1.25	1.25	1.15	1.14	1.12	1.10	1.22	1.21

Table E-3 - NTEM v7.2 growth factors between 2015 to 2051: OD

Authority	AM						IP						PM					
	UC1		UC2		UC3		UC1		UC2		UC3		UC1		UC2		UC3	
	O	D	O	D	O	D	O	D	O	D	O	D	O	D	O	D	O	D
Rest of UK	1.27	1.27	1.24	1.24	1.35	1.35	1.25	1.25	1.20	1.20	1.35	1.35	1.25	1.25	1.21	1.21	1.32	1.32
High Peak	1.18	1.25	1.12	1.22	1.28	1.32	1.21	1.21	1.15	1.13	1.30	1.30	1.23	1.18	1.18	1.10	1.27	1.25
Manchester	1.55	1.29	1.62	1.27	1.56	1.38	1.30	1.31	1.34	1.40	1.45	1.47	1.28	1.48	1.26	1.60	1.42	1.49
Oldham	1.28	1.27	1.25	1.25	1.31	1.32	1.25	1.24	1.21	1.21	1.32	1.32	1.26	1.25	1.22	1.22	1.30	1.29
Rochdale	1.26	1.28	1.23	1.26	1.30	1.33	1.25	1.24	1.20	1.20	1.32	1.32	1.26	1.24	1.22	1.20	1.29	1.29
Salford	1.45	1.29	1.46	1.27	1.46	1.36	1.29	1.29	1.29	1.33	1.41	1.42	1.27	1.40	1.25	1.43	1.38	1.42
Stockport	1.19	1.28	1.16	1.25	1.25	1.31	1.23	1.23	1.17	1.15	1.29	1.29	1.25	1.19	1.22	1.13	1.27	1.25
Tameside	1.31	1.28	1.29	1.26	1.37	1.35	1.26	1.26	1.22	1.23	1.37	1.36	1.26	1.28	1.23	1.26	1.33	1.34
Trafford	1.28	1.28	1.26	1.26	1.34	1.34	1.25	1.25	1.22	1.21	1.34	1.34	1.26	1.26	1.23	1.23	1.31	1.32
Barnsley	1.31	1.29	1.27	1.26	1.37	1.35	1.27	1.27	1.22	1.23	1.36	1.36	1.27	1.29	1.23	1.25	1.33	1.34
Sheffield	1.34	1.30	1.33	1.27	1.37	1.35	1.27	1.28	1.25	1.26	1.36	1.36	1.28	1.31	1.25	1.30	1.34	1.35
Kirklees	1.23	1.25	1.20	1.22	1.34	1.35	1.22	1.22	1.18	1.17	1.37	1.37	1.23	1.22	1.19	1.17	1.32	1.32

Table E-4 - NTEM v7.2 growth factors between 2015 to 2025: PA

Authority	DS1		DS2		DS3	
	P	A	P	A	P	A
Rest of UK	1.090	1.090	1.059	1.059	1.106	1.106
High Peak	1.054	1.077	1.021	1.045	1.089	1.098
Manchester	1.246	1.090	1.220	1.066	1.206	1.102
Oldham	1.104	1.088	1.080	1.064	1.100	1.089
Rochdale	1.084	1.092	1.057	1.068	1.086	1.091
Salford	1.192	1.090	1.165	1.067	1.156	1.097
Stockport	1.054	1.093	1.029	1.069	1.062	1.094
Tameside	1.099	1.092	1.069	1.067	1.101	1.095
Trafford	1.090	1.090	1.063	1.066	1.093	1.098
Barnsley	1.106	1.091	1.071	1.062	1.109	1.094
Sheffield	1.118	1.099	1.092	1.069	1.104	1.097
Kirklees	1.051	1.062	1.019	1.032	1.089	1.098

Table E-5 - NTEM v7.2 growth factors between 2015 to 2040: PA

Authority	DS1		DS2		DS3	
	P	A	P	A	P	A
Rest of UK	1.187	1.187	1.138	1.138	1.247	1.247
High Peak	1.093	1.178	1.041	1.127	1.176	1.222
Manchester	1.524	1.190	1.470	1.152	1.477	1.242
Oldham	1.202	1.188	1.162	1.150	1.221	1.216
Rochdale	1.170	1.192	1.129	1.154	1.195	1.216
Salford	1.387	1.190	1.339	1.153	1.353	1.233
Stockport	1.118	1.193	1.081	1.155	1.159	1.222
Tameside	1.215	1.192	1.165	1.154	1.257	1.228
Trafford	1.200	1.190	1.159	1.152	1.238	1.234
Barnsley	1.223	1.199	1.167	1.153	1.258	1.233
Sheffield	1.255	1.208	1.211	1.161	1.262	1.235
Kirklees	1.143	1.163	1.096	1.116	1.232	1.248

Table E-6 - NTEM v7.2 growth factors between 2015 to 2051: PA

Authority	DS1		DS2		DS3	
	P	A	P	A	P	A
Rest of UK	1.272	1.272	1.206	1.206	1.344	1.344
High Peak	1.157	1.263	1.087	1.195	1.253	1.318
Manchester	1.736	1.276	1.651	1.224	1.705	1.356
Oldham	1.273	1.274	1.219	1.222	1.313	1.315
Rochdale	1.251	1.278	1.195	1.226	1.296	1.320
Salford	1.529	1.277	1.457	1.225	1.509	1.343
Stockport	1.162	1.280	1.115	1.227	1.223	1.321
Tameside	1.319	1.278	1.251	1.225	1.380	1.336
Trafford	1.284	1.276	1.228	1.224	1.341	1.340
Barnsley	1.320	1.290	1.243	1.227	1.371	1.343
Sheffield	1.361	1.300	1.302	1.235	1.386	1.344
Kirklees	1.224	1.248	1.162	1.186	1.343	1.363

Appendix F. Trip Length Distribution

For full details please see the attached folder ‘Appendix G’ filenames below:

Core 2b Core forecast:

- “TLD_2025_v2.0_CC.xlsm”
- “TLD_2040_v2.0_CC.xlsm”
- “TLD_2051_v2.0_CC.xlsm”

Core 2b Low forecast:

- “TLD_2025_v2.0_Low_CC.xlsm”
- “TLD_2040_v2.0_Low_CC.xlsm”
- “TLD_2051_v2.0_Low_CC.xlsm”

Core 2b Optimistic forecast:

- “TLD_2025_v2.0_Optimistic_CC.xlsm”
- “TLD_2040_v2.0_Optimistic_CC.xlsm”
- “TLD_2051_v2.0_Optimistic_CC.xlsm”

Appendix G. VDM convergence

For full details please see the attached folder ‘Appendix G’ filenames below:

Core 2b Core forecast:

- “VDM_Convergence_Summary_v4.0_Core2b_CC.xlsm”

Core 2b Low forecast:

- “VDM_Convergence_Summary_v4.0_Core2b_Low_CC.xlsm”

Core 2b Optimistic forecast:

- “VDM_Convergence_Summary_v4.0_Core2b_Optimistic_CC.xlsm”

Appendix H. HAM convergence

For full details please see the attached folder ‘Appendix H’ filenames below:

Core 2b Core forecast:

- “HAM_Convergence_Summary_v5.0_Core2b_CC.xlsm”

Core 2b Low forecast:

- “HAM_Convergence_Summary_v5.0_Core2b_Low_CC.xlsm”

Core 2b Optimistic forecast:

- “HAM_Convergence_Summary_v5.0_Core2b_Optimistic_CC.xlsm”

Appendix I. Demand

I.1. Core growth

For full details please see the attached folder ‘Appendix I’ filenames below:

Core 2b Core forecast:

- “VDM_Demand_Summary_3_3_v3.0_CC.xlsm”
- “VDM_Demand_Summary_25_25_v3.0_CC.xlsm”
- “HAM_Demand_Summary_v5.0_Core2b_CC.xlsm”

I.2. Low growth

For full details please see the attached folder ‘Appendix I’ filenames below:

- “VDM_Demand_Summary_Low_3_3_v1.8_CC.xlsm”
- “VDM_Demand_Summary_Low_25_25_v1.8_CC.xlsm”
- “HAM_Demand_Summary_v5.0_Core2b_Low_CC.xlsm””

Table I-1 - Matrix total comparison by user class Low Scenario: 2025

Time Period	User Class	Reference	DM	DS	Abs Diff (DM-Ref)	% Diff (DM-Ref)	Abs Diff (DS-DM)	% Diff (DS-DM)
AM	1 - Car Business	335,086	335,818	335,790	732	0.22%	-29	-0.01%
	2 - Car Commute	2,348,224	2,349,420	2,349,388	1,195	0.05%	-32	0.00%
	3 - Car Other	2,184,224	2,184,385	2,184,366	161	0.01%	-18	0.00%
	4 - LGV Fixed	651,697	651,697	651,697	0	0.00%	0	0.00%
	5 - HGV Fixed	300,743	300,743	300,743	0	0.00%	0	0.00%
IP	1 - Car Business	352,054	351,889	351,889	-166	-0.05%	0	0.00%
	2 - Car Commute	894,085	893,838	893,845	-246	-0.03%	6	0.00%
	3 - Car Other	2,810,246	2,810,411	2,810,445	165	0.01%	34	0.00%
	4 - LGV Fixed	598,509	598,509	598,509	0	0.00%	0	0.00%
	5 - HGV Fixed	311,630	311,630	311,630	0	0.00%	0	0.00%
PM	1 - Car Business	352,304	352,539	352,525	235	0.07%	-14	0.00%
	2 - Car Commute	2,198,640	2,200,371	2,200,387	1,732	0.08%	16	0.00%
	3 - Car Other	3,108,827	3,110,371	3,110,351	1,544	0.05%	-20	0.00%
	4 - LGV Fixed	633,438	633,438	633,438	0	0.00%	0	0.00%
	5 - HGV Fixed	219,097	219,097	219,097	0	0.00%	0	0.00%

Table I-2 - Matrix total comparison by user class Low Scenario: 2040

Time Period	User Class	Reference	DM	DS	Abs Diff (DM-Ref)	% Diff (DM-Ref)	Abs Diff (DS-DM)	% Diff (DS-DM)
AM	1 - Car Business	355,664	356,817	356,776	1,153	0.32%	-41	-0.01%
	2 - Car Commute	2,438,559	2,440,314	2,440,271	1,755	0.07%	-43	0.00%
	3 - Car Other	2,364,052	2,363,996	2,363,962	-56	0.00%	-34	0.00%
	4 - LGV Fixed	764,785	764,785	764,785	0	0.00%	0	0.00%
	5 - HGV Fixed	298,464	298,464	298,464	0	0.00%	0	0.00%
IP	1 - Car Business	373,388	373,201	373,201	-187	-0.05%	0	0.00%
	2 - Car Commute	928,307	927,930	927,939	-377	-0.04%	9	0.00%
	3 - Car Other	3,101,881	3,102,467	3,102,505	586	0.02%	39	0.00%
	4 - LGV Fixed	702,387	702,387	702,387	0	0.00%	0	0.00%
	5 - HGV Fixed	309,674	309,674	309,674	0	0.00%	0	0.00%
PM	1 - Car Business	366,489	366,893	366,878	404	0.11%	-15	0.00%
	2 - Car Commute	2,256,183	2,259,098	2,259,133	2,915	0.13%	35	0.00%
	3 - Car Other	3,312,638	3,315,614	3,315,601	2,976	0.09%	-13	0.00%
	4 - LGV Fixed	743,377	743,377	743,377	0	0.00%	0	0.00%
	5 - HGV Fixed	217,815	217,815	217,815	0	0.00%	0	0.00%

DRIVING OUTCOMES

Table I-3 - Matrix total comparison by user class Low Scenario: 2051

Time Period	User Class	Reference	DM	DS	Abs Diff (DM-Ref)	% Diff (DM-Ref)	Abs Diff (DS-DM)	% Diff (DS-DM)
AM	1 - Car Business	374,426	375,771	375,734	1,346	0.36%	-38	-0.01%
	2 - Car Commute	2,561,003	2,562,825	2,562,795	1,822	0.07%	-30	0.00%
	3 - Car Other	2,524,956	2,524,669	2,524,643	-286	-0.01%	-26	0.00%
	4 - LGV Fixed	833,581	833,581	833,581	0	0.00%	0	0.00%
	5 - HGV Fixed	303,112	303,112	303,112	0	0.00%	0	0.00%
IP	1 - Car Business	391,736	389,608	391,546	-2,129	-0.54%	1,938	0.50%
	2 - Car Commute	964,560	964,138	964,139	-422	-0.04%	1	0.00%
	3 - Car Other	3,301,234	3,302,257	3,302,289	1,023	0.03%	32	0.00%
	4 - LGV Fixed	765,502	765,502	765,502	0	0.00%	0	0.00%
	5 - HGV Fixed	314,642	314,642	314,642	0	0.00%	0	0.00%
PM	1 - Car Business	384,581	385,057	385,038	476	0.12%	-19	0.00%
	2 - Car Commute	2,352,613	2,355,980	2,356,034	3,368	0.14%	54	0.00%
	3 - Car Other	3,512,019	3,515,592	3,515,591	3,572	0.10%	0	0.00%
	4 - LGV Fixed	810,236	810,236	810,236	0	0.00%	0	0.00%
	5 - HGV Fixed	221,350	221,350	221,350	0	0.00%	0	0.00%

I.3. Optimistic growth

For full details please see the attached folder ‘Appendix I’ filenames below:

- “VDM_Demand_Summary_Optimistic_3_3_v1.9_CC.xlsm”
- “VDM_Demand_Summary_Optimistic_25_25_v1.9_CC.xlsm”
- “HAM_Demand_Summary_v5.0_Core2b_Optimistic_CC.xlsm””

Table I-4 - Matrix total comparison by user class Optimistic Scenario: 2025

Time Period	User Class	Reference	DM	DS	Abs Diff (DM-Ref)	% Diff (DM-Ref)	Abs Diff (DS-DM)	% Diff (DS-DM)
AM	1 - Car Business	386,171	385,185	385,141	-986	-0.26%	-44	-0.01%
	2 - Car Commute	2,724,147	2,721,438	2,721,376	-2,709	-0.10%	-62	0.00%
	3 - Car Other	2,522,069	2,521,730	2,521,701	-339	-0.01%	-30	0.00%
	4 - LGV Fixed	747,675	747,675	747,675	0	0.00%	0	0.00%
	5 - HGV Fixed	352,278	352,278	352,278	0	0.00%	0	0.00%
IP	1 - Car Business	406,654	406,625	406,623	-29	-0.01%	-2	0.00%
	2 - Car Commute	1,038,238	1,038,005	1,038,007	-233	-0.02%	2	0.00%
	3 - Car Other	3,240,440	3,240,004	3,240,025	-436	-0.01%	22	0.00%
	4 - LGV Fixed	686,516	686,516	686,516	0	0.00%	0	0.00%
	5 - HGV Fixed	365,027	365,027	365,027	0	0.00%	0	0.00%
PM	1 - Car Business	406,548	405,972	405,954	-576	-0.14%	-18	0.00%
	2 - Car Commute	2,552,214	2,548,867	2,548,898	-3,347	-0.13%	31	0.00%
	3 - Car Other	3,591,069	3,588,703	3,588,697	-2,366	-0.07%	-6	0.00%
	4 - LGV Fixed	726,690	726,690	726,690	0	0.00%	0	0.00%
	5 - HGV Fixed	256,639	256,639	256,639	0	0.00%	0	0.00%

Table I-5 - Matrix total comparison by user class Optimistic Scenario: 2040

Time Period	User Class	Reference	DM	DS	Abs Diff (DM-Ref)	% Diff (DM-Ref)	Abs Diff (DS-DM)	% Diff (DS-DM)
AM	1 - Car Business	436,483	435,080	435,040	-1,403	-0.32%	-41	-0.01%
	2 - Car Commute	3,033,372	3,030,511	3,030,477	-2,861	-0.09%	-34	0.00%
	3 - Car Other	2,898,609	2,898,777	2,898,746	169	0.01%	-31	0.00%
	4 - LGV Fixed	916,649	916,649	916,649	0	0.00%	0	0.00%
	5 - HGV Fixed	380,009	380,009	380,009	0	0.00%	0	0.00%
IP	1 - Car Business	459,711	459,771	459,762	59	0.01%	-9	0.00%
	2 - Car Commute	1,156,395	1,156,427	1,156,430	32	0.00%	3	0.00%
	3 - Car Other	3,782,549	3,781,984	3,781,993	-566	-0.01%	9	0.00%
	4 - LGV Fixed	841,639	841,639	841,639	0	0.00%	0	0.00%
	5 - HGV Fixed	394,165	394,165	394,165	0	0.00%	0	0.00%
PM	1 - Car Business	452,304	451,644	451,629	-660	-0.15%	-14	0.00%
	2 - Car Commute	2,815,617	2,811,482	2,811,567	-4,135	-0.15%	84	0.00%
	3 - Car Other	4,075,675	4,072,556	4,072,594	-3,120	-0.08%	38	0.00%
	4 - LGV Fixed	890,927	890,927	890,927	0	0.00%	0	0.00%
	5 - HGV Fixed	277,216	277,216	277,216	0	0.00%	0	0.00%

Table I-6 - Matrix total comparison by user class Optimistic Scenario: 2051

Time Period	User Class	Reference	DM	DS	Abs Diff (DM-Ref)	% Diff (DM-Ref)	Abs Diff (DS-DM)	% Diff (DS-DM)
AM	1 - Car Business	471,412	469,877	469,815	-1,534	-0.33%	-62	-0.01%
	2 - Car Commute	3,274,776	3,272,095	3,272,057	-2,680	-0.08%	-38	0.00%
	3 - Car Other	3,166,429	3,167,034	3,166,996	605	0.02%	-38	0.00%
	4 - LGV Fixed	1,015,818	1,015,818	1,015,818	0	0.00%	0	0.00%
	5 - HGV Fixed	400,966	400,966	400,966	0	0.00%	0	0.00%
IP	1 - Car Business	495,374	495,356	495,354	-18	0.00%	-2	0.00%
	2 - Car Commute	1,238,268	1,238,346	1,238,354	78	0.01%	8	0.00%
	3 - Car Other	4,118,049	4,116,566	4,116,619	-1,483	-0.04%	53	0.00%
	4 - LGV Fixed	932,603	932,603	932,603	0	0.00%	0	0.00%
	5 - HGV Fixed	416,031	416,031	416,031	0	0.00%	0	0.00%
PM	1 - Car Business	487,563	486,992	484,979	-570	-0.12%	-2,013	-0.41%
	2 - Car Commute	3,023,926	3,019,706	3,019,783	-4,220	-0.14%	77	0.00%
	3 - Car Other	4,427,670	4,424,835	4,424,843	-2,835	-0.06%	7	0.00%
	4 - LGV Fixed	987,296	987,296	987,296	0	0.00%	0	0.00%
	5 - HGV Fixed	292,632	292,632	292,632	0	0.00%	0	0.00%

Appendix J. Link information

For full details please see the attached folder ‘Appendix J’ filenames below:

Core 2b Core forecast:

- “TPUP3_Link_Flow_Information_v5.0_Core2b_CC.xlsm”

Core 2b Low forecast:

- “TPUP3_Link_Flow_Information_v5.0_Core2b_Low_CC.xlsm”

Core 2b Optimistic forecast:

- “TPUP3_Link_Flow_Information_v5.0_Core2b_Optimistic_ CC.xlsm”

Table J-1 - Link flow comparison (12-hour AAWT, 07:00-19:00): 2025-DM

ID	Description	Dir	Low-2025	Core-2025	Optimistic-2025	Abs Diff (Low-Core)	% Diff (Low-Core)	Abs Diff (Opt. -Core)	% Diff (Opt. -Core)
1	M67 J3 - J4	EB	10,914	10,965	11,039	-51	0%	75	1%
1	M67 J3 - J4	WB	12,252	12,581	12,822	-330	-3%	241	2%
2	Mottram Road	EB	1,468	1,562	1,687	-94	-6%	125	8%
2	Mottram Road	WB	1,249	1,271	1,363	-22	-2%	91	7%
3	Stockport Road	NB	909	949	962	-40	-4%	13	1%
3	Stockport Road	SB	939	952	983	-13	-1%	31	3%
4	Ashworth Lane	EB	4,986	5,022	5,062	-36	-1%	40	1%
4	Ashworth Lane	WB	4,046	4,301	4,408	-254	-6%	107	2%
5	Broadbottom Road	NB	3,747	3,972	4,131	-226	-6%	159	4%
5	Broadbottom Road	SB	3,397	3,524	3,544	-126	-4%	21	1%
6	B6174	NB	2,199	2,178	2,085	21	1%	-93	-4%
6	B6174	SB	821	895	881	-74	-8%	-14	-2%
7	Brookfield	NB	5,746	5,982	6,222	-235	-4%	241	4%
7	Brookfield	SB	6,219	6,460	6,670	-241	-4%	211	3%
8	Woolley Bridge Road	EB	2,928	3,122	3,277	-194	-6%	155	5%
8	Woolley Bridge Road	WB	3,425	3,683	3,931	-258	-7%	248	7%
9	Woolley Lane	EB	6,593	6,788	6,944	-195	-3%	156	2%
9	Woolley Lane	WB	6,608	6,858	7,131	-250	-4%	274	4%
10	Market Street	EB	6,575	6,620	6,670	-46	-1%	50	1%
10	Market Street	WB	6,326	6,603	6,852	-277	-4%	250	4%
11	Roe Cross Road	NB	5,584	6,102	6,592	-517	-8%	490	8%
11	Roe Cross Road	SB	5,889	6,387	6,728	-498	-8%	341	5%
12	Hyde Road	EB	7,406	7,469	7,551	-63	-1%	82	1%

ID	Description	Dir	Low-2025	Core-2025	Optimistic-2025	Abs Diff (Low-Core)	% Diff (Low-Core)	Abs Diff (Opt. -Core)	% Diff (Opt. -Core)
12	Hyde Road	WB	8,523	8,464	8,513	60	1%	50	1%
13	Mottram Moor (Between Stalybridge/Backmoor)	EB	7,575	7,530	7,517	45	1%	-12	0%
13	Mottram Moor (Between Stalybridge/Backmoor)	WB	7,689	7,728	7,744	-39	-1%	15	0%
14	Back Moor	EB	4,690	5,037	5,302	-347	-7%	265	5%
14	Back Moor	WB	3,497	3,879	4,272	-382	-10%	392	10%
15	Stalybridge Road	NB	2,222	2,203	2,157	19	1%	-47	-2%
15	Stalybridge Road	SB	2,109	2,173	2,173	-64	-3%	0	0%
16	Mottram Moor (Carhouse Lane and Woolley Lane)	EB	12,201	12,490	12,735	-289	-2%	244	2%
16	Mottram Moor (Carhouse Lane and Woolley Lane)	WB	11,184	11,606	12,013	-422	-4%	407	4%
17	A57 Link Road	EB	-	-	-	-	-	-	-
17	A57 Link Road	WB	-	-	-	-	-	-	-
18	A57 Spur	EB	-	-	-	-	-	-	-
18	A57 Spur	WB	-	-	-	-	-	-	-
19	Mottram Moor link road	EB	-	-	-	-	-	-	-
19	Mottram Moor link road	WB	-	-	-	-	-	-	-
20	Woolley Bridge	NB	5,746	5,982	6,222	-235	-4%	241	4%
20	Woolley Bridge	SB	6,219	6,459	6,670	-241	-4%	211	3%

Table J-2 - Link flow comparison (12-hour AAWT, 07:00-19:00): 2025-DS

ID	Description	Dir	Low-2025	Core-2025	Optimistic-2025	Abs Diff (Low-Core)	% Diff (Low-Core)	Abs Diff (Opt. -Core)	% Diff (Opt. -Core)
1	M67 J3 - J4	EB	13,701	14,094	14,178	-393	-3%	83	1%
1	M67 J3 - J4	WB	14,701	15,567	16,276	-866	-6%	709	5%
2	Mottram Road	EB	1,266	1,392	1,560	-126	-9%	168	12%
2	Mottram Road	WB	1,085	1,202	1,246	-116	-10%	44	4%
3	Stockport Road	NB	1,003	1,098	1,216	-95	-9%	118	11%
3	Stockport Road	SB	1,220	1,273	1,340	-53	-4%	67	5%
4	Ashworth Lane	EB	1,527	1,608	1,713	-82	-5%	104	6%
4	Ashworth Lane	WB	4,012	4,423	4,828	-410	-9%	406	9%
5	Broadbottom Road	NB	2,972	3,410	3,812	-439	-13%	402	12%
5	Broadbottom Road	SB	2,601	2,875	3,018	-274	-10%	143	5%
6	B6174	NB	1,674	1,833	1,858	-159	-9%	24	1%
6	B6174	SB	3,076	3,341	3,393	-264	-8%	52	2%
7	Brookfield	NB	7,499	7,663	7,911	-165	-2%	248	3%
7	Brookfield	SB	8,222	8,585	8,796	-363	-4%	211	2%
8	Woolley Bridge Road	EB	3,022	3,361	3,633	-339	-10%	272	8%
8	Woolley Bridge Road	WB	3,548	3,934	4,290	-386	-10%	356	9%
9	Woolley Lane	EB	610	637	688	-27	-4%	51	8%
9	Woolley Lane	WB	2,420	2,572	2,806	-152	-6%	234	9%
10	Market Street	EB	7,010	6,777	6,615	233	3%	-162	-2%
10	Market Street	WB	6,175	6,422	6,560	-247	-4%	138	2%
11	Roe Cross Road	NB	5,086	5,540	6,005	-454	-8%	465	8%
11	Roe Cross Road	SB	5,124	5,608	6,003	-484	-9%	395	7%
12	Hyde Road	EB	1,969	2,053	2,096	-83	-4%	44	2%

ID	Description	Dir	Low-2025	Core-2025	Optimistic-2025	Abs Diff (Low-Core)	% Diff (Low-Core)	Abs Diff (Opt. -Core)	% Diff (Opt. -Core)
12	Hyde Road	WB	258	281	364	-23	-8%	83	30%
13	Mottram Moor (Between Stalybridge/Backmoor)	EB	796	823	854	-28	-3%	31	4%
13	Mottram Moor (Between Stalybridge/Backmoor)	WB	554	598	642	-43	-7%	45	7%
14	Back Moor	EB	3,597	3,953	4,270	-357	-9%	317	8%
14	Back Moor	WB	2,710	3,009	3,334	-300	-10%	324	11%
15	Stalybridge Road	NB	2,229	2,368	2,462	-139	-6%	94	4%
15	Stalybridge Road	SB	2,144	2,319	2,418	-176	-8%	99	4%
16	Mottram Moor (Carhouse Lane and Woolley Lane)	EB	6,936	6,937	6,923	-1	0%	-14	0%
16	Mottram Moor (Carhouse Lane and Woolley Lane)	WB	6,603	6,851	6,926	-248	-4%	75	1%
17	A57 Link Road	EB	12,559	13,037	13,302	-478	-4%	265	2%
17	A57 Link Road	WB	11,300	11,810	12,072	-511	-4%	261	2%
18	A57 Spur	EB	9,210	9,821	10,271	-611	-6%	450	5%
18	A57 Spur	WB	7,171	7,534	7,922	-363	-5%	388	5%
19	Mottram Moor link road	EB	4,384	4,769	5,116	-385	-8%	347	7%
19	Mottram Moor link road	WB	3,256	3,600	3,968	-344	-10%	368	10%
20	Woolley Bridge	NB	4,045	4,439	4,817	-393	-9%	379	9%
20	Woolley Bridge	SB	2,761	3,076	3,356	-315	-10%	280	9%

Table J-3 - Link flow comparison (12-hour AAWT, 07:00-19:00): 2040-DM

ID	Description	Dir	Low-2025	Core-2025	Optimistic-2025	Abs Diff (Low-Core)	% Diff (Low-Core)	Abs Diff (Opt. - Core)	% Diff (Opt. - Core)
1	M67 J3 - J4	EB	11,972	11,949	11,849	23	0%	-100	-1%
1	M67 J3 - J4	WB	13,870	14,145	14,370	-274	-2%	226	2%
2	Mottram Road	EB	1,536	1,708	1,831	-172	-10%	122	7%
2	Mottram Road	WB	1,377	1,578	1,648	-201	-13%	69	4%
3	Stockport Road	NB	904	1,015	1,080	-111	-11%	65	6%
3	Stockport Road	SB	927	961	1,005	-34	-4%	44	5%
4	Ashworth Lane	EB	5,188	5,091	4,934	97	2%	-157	-3%
4	Ashworth Lane	WB	4,458	4,590	4,588	-132	-3%	-1	0%
5	Broadbottom Road	NB	4,425	4,679	4,834	-253	-5%	156	3%
5	Broadbottom Road	SB	3,610	3,576	3,461	34	1%	-115	-3%
6	B6174	NB	2,020	2,003	2,011	17	1%	8	0%
6	B6174	SB	692	642	613	50	8%	-30	-5%
7	Brookfield	NB	5,995	6,314	6,715	-319	-5%	401	6%
7	Brookfield	SB	6,706	7,044	7,300	-338	-5%	256	4%
8	Woolley Bridge Road	EB	3,060	3,316	3,512	-256	-8%	196	6%
8	Woolley Bridge Road	WB	3,863	4,286	4,724	-422	-10%	439	10%
9	Woolley Lane	EB	7,028	7,237	7,388	-209	-3%	152	2%
9	Woolley Lane	WB	7,108	7,457	7,987	-349	-5%	530	7%
10	Market Street	EB	6,766	6,763	6,784	3	0%	21	0%
10	Market Street	WB	6,700	7,023	7,263	-323	-5%	240	3%
11	Roe Cross Road	NB	6,154	6,880	7,696	-726	-11%	816	12%
11	Roe Cross Road	SB	6,375	6,976	7,516	-601	-9%	541	8%
12	Hyde Road	EB	7,715	7,824	7,944	-109	-1%	120	2%

ID	Description	Dir	Low-2025	Core-2025	Optimistic-2025	Abs Diff (Low-Core)	% Diff (Low-Core)	Abs Diff (Opt. - Core)	% Diff (Opt. - Core)
12	Hyde Road	WB	9,126	9,175	9,238	-50	-1%	63	1%
13	Mottram Moor (Between Stalybridge/Backmoor)	EB	7,705	7,562	7,342	143	2%	-220	-3%
13	Mottram Moor (Between Stalybridge/Backmoor)	WB	7,934	7,932	7,958	1	0%	26	0%
14	Back Moor	EB	5,146	5,610	6,116	-464	-8%	507	9%
14	Back Moor	WB	4,032	4,524	5,072	-491	-11%	549	12%
15	Stalybridge Road	NB	2,037	2,031	2,114	7	0%	83	4%
15	Stalybridge Road	SB	2,018	2,017	1,978	1	0%	-39	-2%
16	Mottram Moor (Carhouse Lane and Woolley Lane)	EB	12,803	13,102	13,372	-298	-2%	271	2%
16	Mottram Moor (Carhouse Lane and Woolley Lane)	WB	11,964	12,483	13,145	-519	-4%	662	5%
17	A57 Link Road	EB	-	-	-	-	-	-	-
17	A57 Link Road	WB	-	-	-	-	-	-	-
18	A57 Spur	EB	-	-	-	-	-	-	-
18	A57 Spur	WB	-	-	-	-	-	-	-
19	Mottram Moor link road	EB	-	-	-	-	-	-	-
19	Mottram Moor link road	WB	-	-	-	-	-	-	-
20	Woolley Bridge	NB	5,995	6,314	6,715	-319	-5%	401	6%
20	Woolley Bridge	SB	6,706	7,044	7,300	-338	-5%	256	4%

Table J-4 - Link flow comparison (12-hour AAWT, 07:00-19:00): 2040-DS

ID	Description	Dir	Low-2025	Core-2025	Optimistic-2025	Abs Diff (Low-Core)	% Diff (Low-Core)	Abs Diff (Opt. -Core)	% Diff (Opt. -Core)
1	M67 J3 - J4	EB	14,781	14,789	15,150	-9	0%	360	2%
1	M67 J3 - J4	WB	17,275	18,340	19,109	-1064	-6%	769	4%
2	Mottram Road	EB	1,489	1,660	1,701	-171	-10%	41	2%
2	Mottram Road	WB	1,157	1,310	1,421	-152	-12%	112	9%
3	Stockport Road	NB	1,139	1,382	1,570	-243	-18%	188	14%
3	Stockport Road	SB	1,271	1,384	1,527	-113	-8%	143	10%
4	Ashworth Lane	EB	1,649	1,878	1,843	-229	-12%	-35	-2%
4	Ashworth Lane	WB	4,967	5,524	6,163	-556	-10%	640	12%
5	Broadbottom Road	NB	3,894	4,402	4,814	-508	-12%	411	9%
5	Broadbottom Road	SB	3,134	3,403	3,482	-268	-8%	80	2%
6	B6174	NB	1,854	1,911	2,011	-57	-3%	100	5%
6	B6174	SB	3,585	3,712	3,985	-127	-3%	273	7%
7	Brookfield	NB	8,385	8,529	8,677	-144	-2%	148	2%
7	Brookfield	SB	8,787	8,934	9,028	-146	-2%	94	1%
8	Woolley Bridge Road	EB	3,363	3,828	4,263	-466	-12%	435	11%
8	Woolley Bridge Road	WB	3,793	4,429	4,831	-636	-14%	402	9%
9	Woolley Lane	EB	618	666	670	-48	-7%	4	1%
9	Woolley Lane	WB	2,588	3,135	3,377	-547	-17%	242	8%
10	Market Street	EB	6,932	6,719	6,793	213	3%	74	1%
10	Market Street	WB	6,479	6,742	6,860	-263	-4%	118	2%
11	Roe Cross Road	NB	5,560	6,361	7,244	-801	-13%	883	14%
11	Roe Cross Road	SB	5,741	6,596	7,393	-854	-13%	797	12%
12	Hyde Road	EB	2,072	2,054	2,082	18	1%	28	1%

ID	Description	Dir	Low-2025	Core-2025	Optimistic-2025	Abs Diff (Low-Core)	% Diff (Low-Core)	Abs Diff (Opt. -Core)	% Diff (Opt. -Core)
12	Hyde Road	WB	168	321	408	-153	-48%	86	27%
13	Mottram Moor (Between Stalybridge/Backmoor)	EB	797	796	831	1	0%	35	4%
13	Mottram Moor (Between Stalybridge/Backmoor)	WB	531	621	702	-90	-14%	81	13%
14	Back Moor	EB	4,085	4,740	5,196	-655	-14%	456	10%
14	Back Moor	WB	3,126	3,718	4,389	-591	-16%	672	18%
15	Stalybridge Road	NB	2,272	2,402	2,547	-129	-5%	146	6%
15	Stalybridge Road	SB	2,353	2,573	2,968	-220	-9%	396	15%
16	Mottram Moor (Carhouse Lane and Woolley Lane)	EB	7,137	7,014	7,009	124	2%	-4	0%
16	Mottram Moor (Carhouse Lane and Woolley Lane)	WB	7,017	7,357	7,451	-340	-5%	94	1%
17	A57 Link Road	EB	13,688	14,068	14,707	-379	-3%	640	5%
17	A57 Link Road	WB	12,777	13,287	13,498	-510	-4%	210	2%
18	A57 Spur	EB	10,066	10,842	11,513	-775	-7%	671	6%
18	A57 Spur	WB	8,073	8,562	8,988	-489	-6%	426	5%
19	Mottram Moor link road	EB	4,875	5,516	6,020	-641	-12%	504	9%
19	Mottram Moor link road	WB	3,651	4,319	5,085	-669	-15%	766	18%
20	Woolley Bridge	NB	4,387	5,070	5,554	-684	-13%	483	10%
20	Woolley Bridge	SB	2,845	3,200	3,413	-354	-11%	213	7%

Table J-5 - Link flow comparison (12-hour AAWT, 07:00-19:00): 2051-DM

ID	Description	Dir	Low-2025	Core-2025	Optimistic-2025	Abs Diff (Low-Core)	% Diff (Low-Core)	Abs Diff (Opt. -Core)	% Diff (Opt. - Core)
1	M67 J3 - J4	EB	12,274	12,069	12,058	206	2%	-11	0%
1	M67 J3 - J4	WB	14,518	15,028	14,842	-510	-3%	-185	-1%
2	Mottram Road	EB	1,622	1,786	1,954	-164	-9%	168	9%
2	Mottram Road	WB	1,532	1,580	1,731	-49	-3%	150	10%
3	Stockport Road	NB	1,061	1,412	1,432	-350	-25%	20	1%
3	Stockport Road	SB	941	1,000	1,034	-59	-6%	34	3%
4	Ashworth Lane	EB	5,147	5,001	4,900	146	3%	-101	-2%
4	Ashworth Lane	WB	4,465	4,616	4,643	-150	-3%	27	1%
5	Broadbottom Road	NB	4,629	4,864	4,908	-235	-5%	45	1%
5	Broadbottom Road	SB	3,631	3,542	3,383	88	2%	-160	-5%
6	B6174	NB	2,025	2,003	2,084	22	1%	81	4%
6	B6174	SB	629	596	592	33	6%	-4	-1%
7	Brookfield	NB	6,178	6,612	7,014	-434	-7%	402	6%
7	Brookfield	SB	6,941	7,282	7,411	-341	-5%	129	2%
8	Woolley Bridge Road	EB	3,205	3,518	3,742	-313	-9%	225	6%
8	Woolley Bridge Road	WB	4,085	4,584	4,903	-499	-11%	319	7%
9	Woolley Lane	EB	7,214	7,431	7,585	-218	-3%	154	2%
9	Woolley Lane	WB	7,317	7,804	8,317	-487	-6%	513	7%
10	Market Street	EB	6,859	6,880	6,909	-22	0%	29	0%
10	Market Street	WB	6,896	7,300	7,571	-404	-6%	270	4%
11	Roe Cross Road	NB	6,552	7,447	8,269	-896	-12%	822	11%
11	Roe Cross Road	SB	6,781	7,482	8,008	-700	-9%	526	7%
12	Hyde Road	EB	7,889	7,951	8,088	-62	-1%	137	2%

ID	Description	Dir	Low-2025	Core-2025	Optimistic-2025	Abs Diff (Low-Core)	% Diff (Low-Core)	Abs Diff (Opt. -Core)	% Diff (Opt. - Core)
12	Hyde Road	WB	9,400	9,409	9,243	-9	0%	-166	-2%
13	Mottram Moor (Between Stalybridge/Backmoor)	EB	7,683	7,433	7,251	249	3%	-183	-2%
13	Mottram Moor (Between Stalybridge/Backmoor)	WB	8,038	8,033	8,024	5	0%	-9	0%
14	Back Moor	EB	5,469	6,083	6,603	-614	-10%	520	9%
14	Back Moor	WB	4,253	4,878	5,351	-625	-13%	473	10%
15	Stalybridge Road	NB	2,025	2,059	2,309	-34	-2%	250	12%
15	Stalybridge Road	SB	1,994	1,972	2,025	22	1%	53	3%
16	Mottram Moor (Carhouse Lane and Woolley Lane)	EB	13,094	13,438	13,751	-344	-3%	313	2%
16	Mottram Moor (Carhouse Lane and Woolley Lane)	WB	12,299	12,986	13,565	-687	-5%	578	4%
17	A57 Link Road	EB	-	-	-	-	-	-	-
17	A57 Link Road	WB	-	-	-	-	-	-	-
18	A57 Spur	EB	-	-	-	-	-	-	-
18	A57 Spur	WB	-	-	-	-	-	-	-
19	Mottram Moor link road	EB	-	-	-	-	-	-	-
19	Mottram Moor link road	WB	-	-	-	-	-	-	-
20	Woolley Bridge	NB	6,178	6,612	7,014	-434	-7%	403	6%
20	Woolley Bridge	SB	6,941	7,282	7,410	-341	-5%	128	2%

Table J-6 - Link flow comparison (12-hour AAWT, 07:00-19:00): 2051-DS

ID	Description	Dir	Low-2025	Core-2025	Optimistic-2025	Abs Diff (Low-Core)	% Diff (Low-Core)	Abs Diff (Opt. -Core)	% Diff (Opt. -Core)
1	M67 J3 - J4	EB	15,018	15,205	15,832	-187	-1%	627	4%
1	M67 J3 - J4	WB	18,210	19,511	20,767	-1301	-7%	1256	6%
2	Mottram Road	EB	1,598	1,679	1,780	-81	-5%	101	6%
2	Mottram Road	WB	1,261	1,361	1,579	-100	-7%	218	16%
3	Stockport Road	NB	1,277	1,613	1,963	-336	-21%	351	22%
3	Stockport Road	SB	1,343	1,524	1,754	-181	-12%	230	15%
4	Ashworth Lane	EB	1,860	1,789	1,814	71	4%	25	1%
4	Ashworth Lane	WB	5,382	6,084	6,767	-701	-12%	683	11%
5	Broadbottom Road	NB	4,262	4,768	5,225	-506	-11%	457	10%
5	Broadbottom Road	SB	3,428	3,646	3,662	-218	-6%	16	0%
6	B6174	NB	1,862	2,021	2,109	-159	-8%	88	4%
6	B6174	SB	3,731	4,168	4,323	-438	-10%	154	4%
7	Brookfield	NB	8,635	8,855	9,095	-220	-2%	241	3%
7	Brookfield	SB	8,820	8,833	8,872	-13	0%	38	0%
8	Woolley Bridge Road	EB	3,687	4,254	5,064	-567	-13%	810	19%
8	Woolley Bridge Road	WB	4,053	4,542	5,257	-488	-11%	716	16%
9	Woolley Lane	EB	643	677	736	-34	-5%	59	9%
9	Woolley Lane	WB	2,772	3,343	3,819	-571	-17%	476	14%
10	Market Street	EB	6,940	6,861	6,886	79	1%	25	0%
10	Market Street	WB	6,653	7,012	7,197	-359	-5%	185	3%
11	Roe Cross Road	NB	6,017	7,067	8,033	-1050	-15%	966	14%
11	Roe Cross Road	SB	6,256	7,327	8,313	-1072	-15%	986	13%
12	Hyde Road	EB	2,012	2,059	2,120	-47	-2%	61	3%

ID	Description	Dir	Low-2025	Core-2025	Optimistic-2025	Abs Diff (Low-Core)	% Diff (Low-Core)	Abs Diff (Opt. -Core)	% Diff (Opt. -Core)
12	Hyde Road	WB	257	337	383	-80	-24%	46	14%
13	Mottram Moor (Between Stalybridge/Backmoor)	EB	760	801	893	-41	-5%	92	11%
13	Mottram Moor (Between Stalybridge/Backmoor)	WB	537	674	851	-136	-20%	178	26%
14	Back Moor	EB	4,454	5,043	5,883	-590	-12%	840	17%
14	Back Moor	WB	3,521	4,291	4,987	-770	-18%	696	16%
15	Stalybridge Road	NB	2,281	2,505	2,730	-224	-9%	225	9%
15	Stalybridge Road	SB	2,544	3,074	3,304	-530	-17%	231	8%
16	Mottram Moor (Carhouse Lane and Woolley Lane)	EB	7,177	7,004	6,961	173	2%	-42	-1%
16	Mottram Moor (Carhouse Lane and Woolley Lane)	WB	7,200	7,667	7,793	-467	-6%	125	2%
17	A57 Link Road	EB	14,161	14,701	15,462	-540	-4%	761	5%
17	A57 Link Road	WB	13,306	13,830	14,476	-524	-4%	646	5%
18	A57 Spur	EB	10,506	11,322	12,267	-816	-7%	944	8%
18	A57 Spur	WB	8,505	8,959	9,590	-455	-5%	630	7%
19	Mottram Moor link road	EB	5,207	5,840	6,630	-634	-11%	789	14%
19	Mottram Moor link road	WB	4,052	4,961	5,692	-908	-18%	731	15%
20	Woolley Bridge	NB	4,751	5,541	6,554	-790	-14%	1013	18%
20	Woolley Bridge	SB	2,987	3,162	3,664	-175	-6%	503	16%

Appendix K. Journey Time

For full details please see the attached folder ‘Appendix K’ filenames below:

Core 2b Core forecast:

- “TPUP3_FY_2025_JT_Analysis_v10.1_Core2b_CC.xlsm”
- “TPUP3_FY_2040_JT_Analysis_v10.1_Core2b_CC.xlsm”
- “TPUP3_FY_2051_JT_Analysis_v1.0_Core2b_CC.xlsm”

Core 2b Low forecast:

- “TPUP3_FY_2025_JT_Analysis_v10.1_Core2b_Low_CC.xlsm”
- “TPUP3_FY_2040_JT_Analysis_v10.1_Core2b_Low_CC.xlsm”
- “TPUP3_FY_2051_JT_Analysis_v1.0_Core2b_Low_CC.xlsm”

Core 2b Optimistic forecast:

- “TPUP3_FY_2025_JT_Analysis_v10.1_Core2b_Optimsitic_CC.xlsm”
- “TPUP3_FY_2040_JT_Analysis_v10.1_Core2b_Optimsitic_CC.xlsm”
- “TPUP3_FY_2051_JT_Analysis_v1.0_Core2b_Optimsitic_CC.xlsm”

Appendix L. Operational model report

The operational model report (‘HE551473-BBA-GEN-A57_AL_SCHEME-RP-TR-000003’) is in the attached folder: Appendix_L-Operational_Model_Report

[redacted]

DRIVING OUTCOMES

Routes to Market – Delivery Integration Partnership

A57 TPU

Trans-Pennine Upgrade: Stage 3 Combined Modelling and Appraisal Report

HE551473-BBA-GEB-A57_AL_SCHEME-AS-TB-000001

S4

Balfour Beatty ATKINS Member of the SNC-Lavalin Group

Notice

This document and its contents have been prepared and are intended solely as information for and use in relation to A57 TPU. Balfour Beatty assumes no responsibility to any other party in respect of or arising out of or in connection with this document and/or its contents.

This document has 249 pages including the cover.

Document history

Revision	Suitability	Purpose description	Originated	Checked	Reviewed	Authorised	Date
[redacted]							

Contents

Tables

Figures

1. Introduction

1.1. Document Purpose

1.1.1. This Combined Modelling and Appraisal Report (ComMA) presents a summary of the evidence assembled to inform the options assessment stage three Business Case for the A57 Link Road Scheme, covering:

- Identification of the underlying problem;
- Collection of data;
- Production of the base transport model;
- Preparation of future year forecasts;
- Modelling of the impacts of the alternative options;
- Appraisal of the impacts of the alternative options; and
- Preparation of the Business Case.

1.1.2. This Combined Modelling and Appraisal (ComMA) report will act as the end of stage report for PCF Stage 3. It will signpost and summarise previous PCF products and the analysis they have provided.

1.1.3. The ComMA summarises the contents of the following PCF products for the A57 Link Road:

- Transport Data Package;
- Transport Model Package;
- Transport Forecasting Package; and
- Economic Appraisal Package.

1.2. Report Structure and Contents

1.2.1. This ComMA follows the structure indicated in the Highways England PCF product guidance; the main part of the document summarises the contents of the relevant PCF products which were prepared during the development of the transport model and the economic appraisal of the scheme.

1.2.2. The remainder of this report is structured as follows:

- Chapter 2: Local Transport Situation
- Chapter 3: Summary
- Chapter 4: Summary and Review of Existing Data
- Chapter 5: Data Collection
- Chapter 6: Final Datasets
- Chapter 7: Context for Model Development
- Chapter 8: Model development
- Chapter 9: Model Calibration / Validation
- Chapter 10: Data Collection: Summary
- Chapter 11: Forecast assumptions
- Chapter 12: Forecast results: core scenario
- Chapter 13: Economic Appraisal Overview
- Chapter 14: Economic appraisal results

- Chapter 15: Sensitivity Tests
- Chapter 16: Data Annex

The supporting data is provided in the appendices as:

- Appendix A – The Data Collection Package
- Appendix B – The Transport Modelling Package
- Appendix C – Transport Forecasting Package
- Appendix D – Economic Appraisal Package
- Appendix E - Data Annex

1.3. Proposed scheme

1.3.1. Figure 1-1 provides an overview of the proposed TPU scheme aimed at improving the performance of the SRN between Manchester and Sheffield, whilst Figure 1-2 gives a detailed breakdown of the scheme elements specific to the A57 link road (detailed scheme design is included in Appendix A.

1.3.2. The Trans-Pennine Upgrade scheme taken forward as part of PCF Stage 3 comprises of the following scheme elements:

- **Mottram Moor link road**: a new dual-carriageway link road from the M67 J4 to a new junction at A57(T) Mottram Moor.
  - A57 / B6174 junction (Mottram crossroads): separate signal staging for Stalybridge Road and Market Street (run together in the same stage in the without scheme scenario), which permits additional green time for pedestrian movements, plus the reduction of right-turning vehicles blocking the junction whilst waiting for gaps in the traffic.
  - M67 J4 roundabout improvements: the addition of traffic signals, carriageway widening and a cut-through link between the M67 and the Mottram Moor link road.
- **A57(T) to A57 link road**: a new single carriageway link from the A57(T) at Mottram Moor to a new junction on the A57 at Brookfield, bypassing the existing A628 / A57 and A57 Woolley Lane / Hadfield Road junctions.
  - A57 / A628 junction (Gun Inn junction): greater green time for pedestrian movements, reflective of improved pedestrian facilities at the Gun Inn junction.
  - A57 (Mottram Moor): a reduction in lane provision of the existing A57 between Mottram and the Gun Inn junction to provide parking and improved non-motorised users (NMU) facilities.
- **Westwood roundabout improvements**: the addition of traffic signals and lane widening to address peak time traffic congestion.
- **Safety and technology improvements**: safety measures focused on addressing accident clusters and the provision of traffic light cameras, speed cameras and message signs to allow drivers to make informed decisions.

1.3.3. The A57 link road scheme is a specific combination of elements of the wider TPU package of measures to improve the Trans-Pennine corridor between Manchester and Sheffield. As such, the focus of this documentation is concentrated on the A57 link road scheme only (i.e. 'Mottram Moor Link Road', 'M67 J4 roundabout improvements' and 'A57(T) to A57 Link Road'). The other elements of the wider TPU scheme ('Westwood roundabout improvements' and 'Safety and technology' improvements) are being delivered separately.

1.3.4. It should be noted that the scheme design accommodates the recommendations arising out of A57 Link Roads public consultation held in November / December 2020.

Figure 1-1 - Proposed Scheme Location

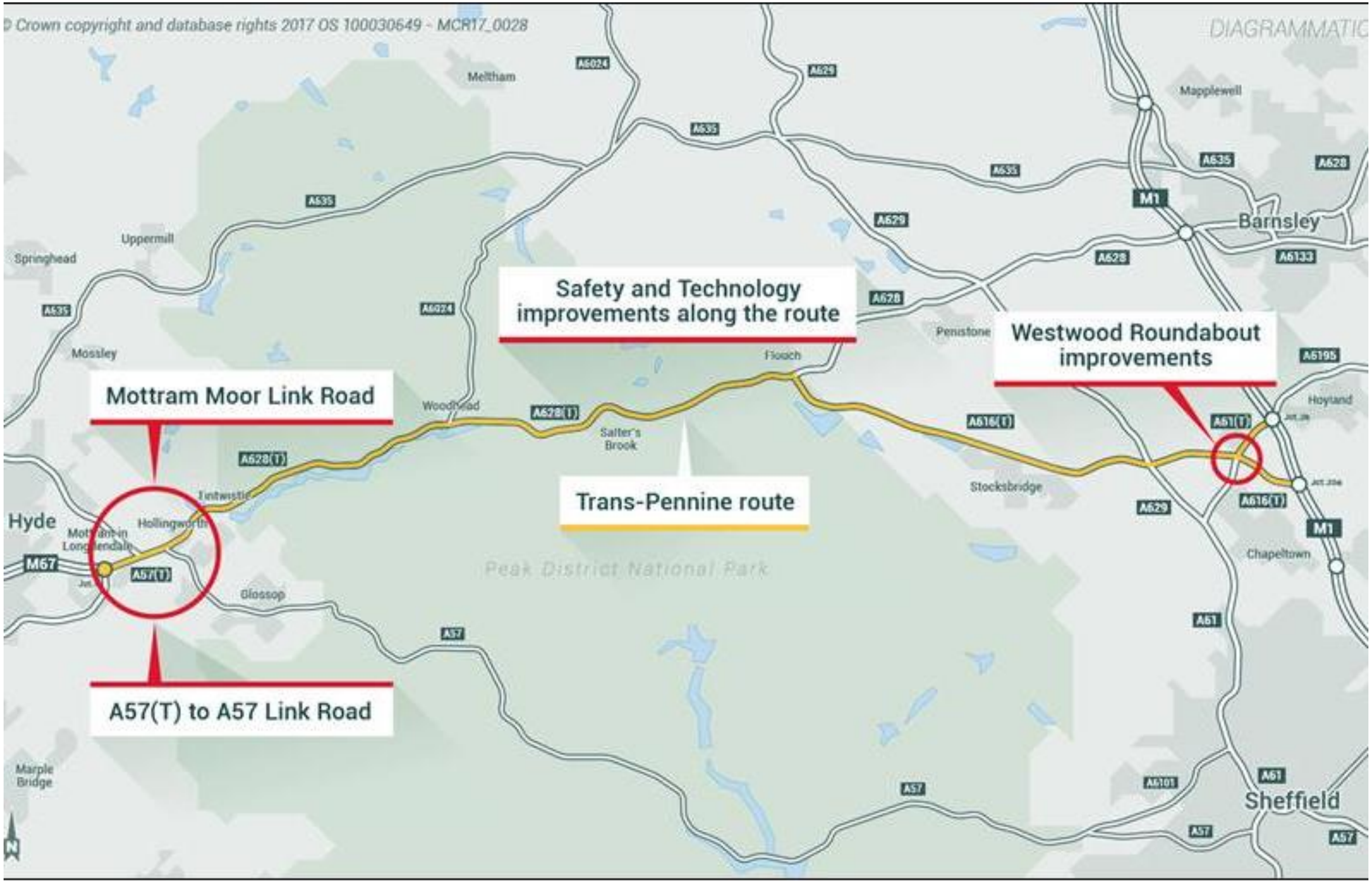
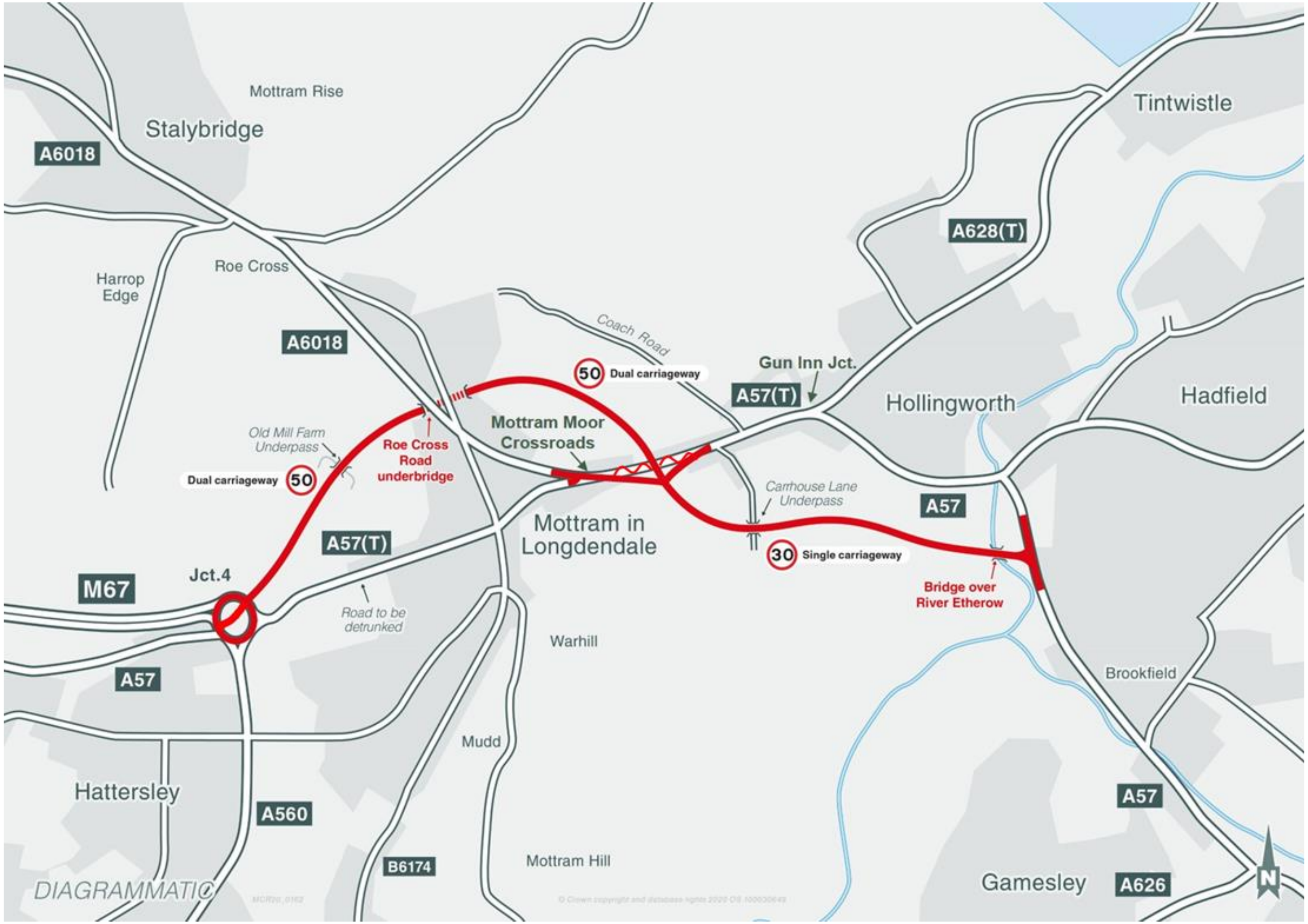


Figure 1-2 – A57 link road scheme alignment



1.4. Scheme Objectives

1.4.1. The Trans-Pennine route is one part of Highways England's Strategic Road Network (SRN), connecting the city regions of Manchester and Sheffield via the A57, A628, A616 and A61. This connects the M67 J4 to the east of Manchester, with the M1 J35A / J36 to the north of Sheffield.

1.4.2. The TPU comprises of a series of transport infrastructure measures announced as part of the Department for Transport's (DfT) Road Investment Strategy (RIS) for the 2015-2020 period. The aim of the TPU was to address longstanding issues of connectivity, congestion, reliability, and safety of the SRN between the M67 and the M1.

1.4.3. Atkins was commissioned by HE to undertake a review of the work done by consultants Arcadis at PCF Stage 3 for the proposed TPU scheme. The aim of this process was to strengthen the robustness of the modelling to ensure high levels of scrutiny for the Development Consent Order (DCO). Following the presentation of the review findings in the summer of 2019, Atkins was commissioned to implement their recommendations and finalise PCF Stage 3.

1.4.4. The key objectives of the TPU Scheme are:

- Connectivity: reducing congestion and improving the reliability of people's journeys between the Manchester and Sheffield city regions.
- Environment: improving air quality and reducing noise levels in certain areas, through reduced congestion and removal of traffic from residential areas.
- Society: re-connecting local communities along the Trans-Pennine route.
- Capacity: reducing delays and queues that occur during busy periods and improving the performance of junctions on the route.
- Reliability: reducing the number of incidents and using technology to advise drivers of incidents along the route.
- Safety: reducing the number of accidents along the route through targeted improvement measures.

1.4.5. Each of these overarching objectives includes sub-objectives and indicators for measuring success. A Benefits Register has been developed which records details of these and the specific performance of the scheme in each area. This register is maintained and updated as the TPU scheme progresses through each stage of development. Key findings of the A57 Link Road Benefits Register are presented in the Appraisal Summary Table, which is presented in the Business Case.

1.5. Previous Analysis and Economic Assessments

Previous Studies

1.5.1. Proposals for Trans-Pennine route improvements have been investigated in a number of studies over recent years. These include:

- Mottram-Tintwistle Bypass Study (2009)
- Derbyshire County Council, Trans-Pennine Connectivity Study, URS (2012)
- Department for Transport/ Northern Way: Trans-Pennine Connectivity Study (2010-11)
- Manchester (M60/ M62) Managed/ Smart Motorway Study
- SWAMM (HE M1 Managed Motorway) Study
- Trans-Pennine Tunnel Study (2017)
- Trans Pennine South Regional Model

1.5.2. Further detail regarding these studies can be found in the Appraisal Specification Report[1].

Previous Scheme Analysis

1.5.3. At PCF Stage 1, various options were developed and a first sift was undertaken, which included the development of a long list of options followed by a high-level economic assessment and ranking of four strategic scheme options for the TPU scheme.

1.5.4. A second sift was then undertaken which included a further economic assessment and ranking of four more detailed scheme options. The four options were identified for further assessment at PCF Stage 2.

1.5.5. In PCF Stage 2, the following scheme elements were considered for the A57 Link Road scheme:

- **Option A:** A new dual carriageway link road from the M67/ A560 terminal roundabout, to a new junction at the A57(T) at Mottram Moor. It then continues as a new single carriageway link, bypassing the existing A628/ A57 and the A57 Woolley Lane/ Woolley Bridge Road/ Woolley Bridge junctions to connect to the existing A57 with a junction at Brookfield.
- **Option B:** Similar to Option A, the main difference between Option A and Option B is the location and alignment of the new junction at Mottram Moor; for Option B it is located closer to the A628/A57 Woolley Lane junction (and for Option A, it is located close to the A57 Mottram Moor/ A6018 Back Moor junction).

1.5.6. Also, in PCF Stage 2, the following scheme elements were assessed as part of the wider TPU scheme.

- **A628 Climbing Lanes**: Consideration of the provision of two overtaking lanes on the A628 near Woodhead Bridge and near Salter's Brook Bridge.
- **A61 Dualling Option 2**: The A61 between the Westwood Roundabout (A616/A61) and M1 J36 was considered for an upgrade to dual carriageway standard.
- **Safety and Technology:** Measures were focused on addressing accident clusters and the provision of traffic light cameras, speed cameras and message signs to allow drivers to make informed decisions.
- **Westwood Roundabout**: An improvement was considered for the existing 5-arm Westwood Roundabout, to provide a signalised cut-through (hamburger) roundabout junction. The cut-through lanes would link the A61 (eastbound and westbound) arms of the roundabout which would enable the traffic to pass through the junction without negotiating the roundabout.

1.5.7. At PCF Stage 2, the scheme options outlined above were grouped into seven different packages of options as described in Table 1-1.

1.5.8. Each option was assessed for a core growth scenario for the forecast years of 2023 (the opening year) and 2038 (the design year).

1.5.9. These were then processed for economic assessment to obtain the monetised costs and benefits of each scheme packages.

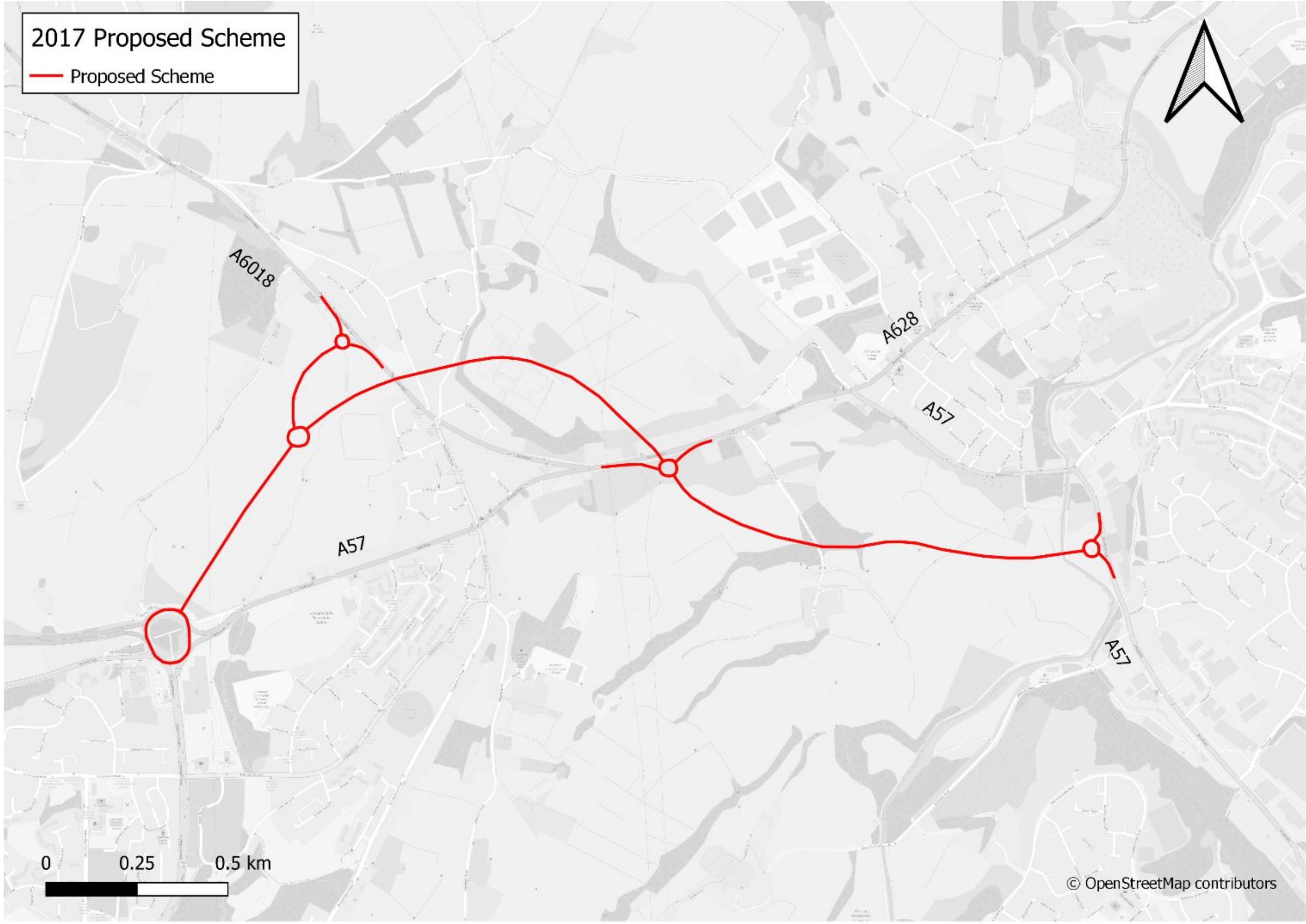
[1](Document reference: HE551473-ARC-HGN-ZZZ-PCF-TR-3008_Appraisal Specification Report V2.0).

Table 1-1 - Packages of Options Considered During Stage 2

Package of Options	Package Contents
Package A	Mottram Moor Link Road and A57(T) to A57 Link Road Option A A628 Climbing Lanes Safety and Technology Improvements A61 Dualling
Package B	Mottram Moor Link Road and A57(T) to A57 Link Road Option B A628 Climbing Lanes Safety and Technology Improvements A61 Dualling
Package C	Mottram Moor Link Road and A57(T) to A57 Link Road Option A A628 Climbing Lanes Safety and Technology Improvements
Package D	Mottram Moor Link Road and A57(T) to A57 Link Road Option B A628 Climbing Lanes Safety and Technology Improvements
Package E	Mottram Moor Link Road and A57(T) to A57 Link Road Option A A628 Climbing Lanes Safety and Technology Improvements Westwood Roundabout Improvements
Package F	Mottram Moor Link Road and A57(T) to A57 Link Road Option B A628 Climbing Lanes Safety and Technology Improvements Westwood Roundabout Improvements
Package G	Mottram Moor Link Road and A57(T) to A57 Link Road Option A Safety and Technology Improvements Westwood Roundabout Improvements

1.5.10. Package G was selected and formed the proposal in the Preferred Route Announcement (PRA) in November 2017.

Figure 1-3 - Package G (as announced in the November 2017 PRA)



1.6. Development and Refinement of the Preferred Scheme

1.6.1. Since the PRA in November 2017, there have been further developments to the scheme during PCF Stage 3. Refinements to the PRA were first put forward in a non-statutory public consultation in 2018, then updated again in the 2020 consultation. The majority of the refinements have been associated with the junctions on the route: the M67 roundabout; the Mottram Moor Junction; the A57 Woolley Bridge junction; and the Roe Cross Road junction. The changes to the route are illustrated in Figure 1-4.

2018 Public Consultation[2]

1.6.2. The first round of changes and developments to the PRA were put forward in the 2018 Public Consultation. It is worth noting that many of the following proposals were later superseded in the 2020 public consultation:

M67 Junction 4

- A number of options for improving the junction were identified; and,
- Partial signalisation and widening of the northern part of the roundabout, as well as widening of its approaches were progressed.

Junctions

- A6018 Roe Cross Road Junction and the junction of the A57 link at Brookfield were changed to signalised 'T' junctions.

Mottram Tunnel

- The proposed length of Mottram Tunnel was reduced by 40 metres on the eastern side. As such, the tunnel was then categorised as an underpass due to the length of the structure.

Facilities for cyclists, pedestrians and equestrians

- Improved crossing facilities on the existing A57 from the M67 Junction 4;
- Shared user path on new A57 link towards Roe Cross; and,
- Combined cycle path and footpath between Mottram Moor and Woolley Bridge on the new A57 link road.

Improvements on existing roads

- The existing A57(T) would no longer be part of the trunk road network and ownership would pass to the Local Highway Authority, Tameside MB; and,
- Proposals to turn the existing A57(T) into a local road included:
  - A 20mph speed limit and speed reduction measures;
  - Local junction improvements;
  - Provision of additional parking bays; and,
  - Identification of areas where improvements could be made for cyclists and pedestrians.

2020 Public Consultation[3]

1.6.3. Further refinements to the scheme were announced in the 2020 Public Consultation. Many of these refinements and developments built upon ones that were proposed in the 2018 consultation.

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[2] 2018 consultation brochure https://highwaysengland.citizenspace.com/he/trans-pennine-upgrade/supporting_documents/Trans%20Pennine%20Upgrade%20Consultation%20Document%20Only_Web.pdf

[3] 2020 consultation brochure https://highwaysengland.citizenspace.com/he/a57-link-roads/supporting_documents/WEBacc%20MCR20_0179%20%20A57%20TransPennine%20Upgrade%20Consultation%20Brochure.pdf

Improvements to M67 Junction 4

1.6.4. Improvements to M67 Junction 4 announced at the 2020 Public Consultation included the following:

- Partial signalisation of the roundabout;
- Adding an extra lane to the roundabout; and
- Widening of its approaches from the M67.

Mottram Underpass

1.6.5. Improvements to the Mottram Underpass announced at the 2020 Public Consultation included the following:

- The location of the underpass was moved due to a geological faultline; and
- Due to the relocation, the underpass could be simplified and is now proposed to comprise earthworks instead of concrete.

Removal of the Roe Cross Road Link

1.6.6. Updated traffic modelling suggested that the Roe Cross link road, junction and Cricket Ground roundabout could be removed from the scheme, without compromising the benefits to traffic flows which the scheme will provide. This avoids the need for a new road, 7m high embankment and signal-controlled junction. Environmental benefits include reduced impacts of the scheme on wildlife, watercourses and views from neighbouring properties and it would also make construction cheaper, quicker and less disruptive.

Replacement of the proposed roundabout at Mottram Moor with a signal-controlled junction

1.6.7. Revisions to the proposed roundabout at Mottram Moor announced at the 2020 Public Consultation consisted of replacing the roundabout with a signal-controlled junction. It is considered that this will still allow the junction to operate efficiently, but will reduce the amount of land required, the impacts on wildlife and impacts on views from neighbouring properties.

Improving the River Etherow Crossing

1.6.8. Revisions to the River Etherow crossing announced at the 2020 Public Consultation consisted of shortening the bridge length, reducing construction time and costs.

Updated design of the junction with the A57 at Brookfield

1.6.9. Improvements to the Brookfield junction announced at the 2020 Public Consultation included the following:

- Updated junction design to reduce land take; and
- The route of the road from Mottram Moor has been slightly altered.

Carrhouse Lane Underpass

1.6.10. Improvements to the Carrhouse Lane Underpass announced at the 2020 Public Consultation included moving the underpass closer to the existing road, to improve ease of access for farmers.

Facilities for cyclists, pedestrians and horse riders

1.6.11. Improvements to facilities for cyclists, pedestrians and horse riders announced at the 2020 Public Consultation comprised the following:

- Replacement connections for the existing footpaths severed by the Scheme;
- A combined footway and cycleway along the new A57 Link Road between Mottram Moor and Brookfield, creating a route to link Mottram to the Trans Pennine Trail (National Cycle Network route 62); and
- Easier crossing at Mottram Moor Junction compared to the previous roundabout option.

1.6.12. The Scheme will provide cycling and pedestrian crossings facilities at all new junctions.

Figure 1-4 - Changes to the preferred scheme since 2017

2021 Revised Scheme

1.6.13. Since the 2020 consultation, there have been further revisions to the proposed layout of the M67 Junction 4 roundabout. The westbound lanes of the link roads will route through the centre of the J4 roundabout and directly merge with the M67. The proposed new layout is shown in Figure 1-5.

Figure 1-5 - 2021 Revised Layout of M67 J4 Roundabout

Previous Economic Assessments

1.6.14. At PCF Stage 0 (Feasibility Study) an economic assessment of four primary packages of the TPU scheme options was produced in February 2015 by Mouchel Group consultants (now WSP). (Reference – 'Trans-Pennine Routes Feasibility Study Stage 3 Report', 2015).

1.6.15. At PCF Stage 1 (Options Development and First Sift), a long list of options was developed as part of the TPU scheme followed by the economic assessment and ranking of four strategic scheme options[4]. A second sift at PCF Stage 1 led to further economic assessment and ranking of four strategic TPU scheme options[5].

1.6.16. Economic assessments for Packages A to G were carried out in PCF Stage 2 for the TPU scheme. The economic assessment was undertaken over the standard 60-year appraisal period with 2023 as the scheme opening year. The economic assessment used the following software packages:

- Transport User Benefit Appraisal (TUBA, version 1.9.8)
- Cost and Benefit to Accidents – Light Touch (COBALT, version 2013.2)
- Queues and Delays at Roadworks (QUADRO version 4.12.1.124)

1.6.17. A summary of the benefits, costs and Benefits to Cost Ratio (BCR) is presented in Table 1-2 for TPU schemes, Packages A to D with Climbing lanes, Greenhouse gases and Noise assessment. At the time, the assessment for Greenhouse gases and Noise was not undertaken for Packages E and F. Additionally, the Safety and Technology scheme costs were included in the Present Value of Cost (PVC), however the corresponding benefits were not considered the Present Value of Benefits (PVB)

Table 1-2 - Total Road User Benefit (£m), Cost and BCR for TPU schemes[6]

Package	TUBA	Accident	Green House Gases	Noise	Climbing Lanes	PVB	PVC	BCR
Package A	✓	✓	✓	✓	✓	524.89	170.87	3.07
Package B	✓	✓	✓	✓	✓	460.96	196.93	2.34
Package C	✓	✓	✓	✓	✓	398.10	155.45	2.56
Package D	✓	✓	✓	✓	✓	586.37	181.57	3.23
Package E	✓	✓	x	x	✓	640.47	163.65	3.91
Package F	✓	✓	x	x	✓	516.01	190.99	2.70
Package G	✓	✓	x	x	x	587.69	148.21	3.97

[4] (Report Reference: HE550691-HYD-GEN-TP01-TN-PM-1033).
[5] (Report Reference: HE550691-HYD-GEN-TP01-TN-1049).
[6] Monetised values are in 2010 market prices, discounted to 2010.

1.6.18. Details relating to economic analyses are documented within the Economic Assessment Report[7].

1.6.19. At PCF Stage 3 (Preliminary design), in 2019 an economic assessment, based on TUBA version 1.9.10, was undertaken over the standard 60-year appraisal period with 2023 as the scheme opening year. From the analysis, the TPU scheme was expected to generate user benefits of approximately £264million (in 2010 prices, discounted to 2010) for the core growth scenario. The scheme has an initial BCR[8] of 1.7 without reliability and wider economic benefits and an adjusted BCR of 2.4 including the reliability and wider economic benefits.

1.6.20. A TUBA user benefit assessment was carried out using the AM, IP, and PM periods for the core growth scenario. The total benefits after accounting for operator revenue and indirect tax revenue, generated by the scheme was £277.07 million. In terms of user benefit by time period, the PM Peak period accounted for the largest proportion of benefits of approx. 42%, closely followed by the Inter-Peak period (41%).

1.6.21. Details relating to PCF Stage 3 economic analyses are documented within the Stage 3 Combined Modelling and Appraisal Report[9].

1.6.22. Subsequent to this assessment, revisions have been made to the scheme design with modelling and economic assessment being updated.

1.6.23. Improvements to Westwood Roundabout, at the intersection between the A61 and A616 have been removed, to be assessed independently, while addition of technology schemes along the A628(T) have been excluded, focussing the scheme on the A57 Link Road. This area is shown in Figure 1-2.

1.6.24. In addition, safety improvements have been included in this area, to provide non-motorised users (NMUs) improved access by upgrading the design and including additional pedestrian phases for signals at the A57/A628 junction at Gun Inn. Further, a cut-through of Hattersley Roundabout has been included to improve efficiency of this junction.

1.6.25. Scheme costs and benefits have been updated to reflect these design changes and also to capture impacts of updates to the transport model, changes in guidance and variations to forecasts of economic growth which have occurred over this period. Details of theses updated assessments are set out in Economic Appraisal Package[10] and in the supporting Traffic Forecasting Report[11].

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[7] Document reference: HE551473-ARC-GEN-ZZZ-TP-TR-2030 version 3.0.
[8] An initial Benefit Cost Ratio (BCR) has been calculated over the 60-year appraisal period that excludes the outputs of the journey time reliability assessment and wider economic impacts, with an adjusted BCR also reported that includes these impacts
[9] Document reference: HE551473-ARC-HGN-TPU-RP-D-3061 (17 May 2019).
[10] Document reference: HE551473-BBA-GEN-A57_AL_SCHEME-AS-TB-000001.
[11] Document reference: HE551473-BBA-GEN-A57_AL_SCHEME-AS-TR-000003.

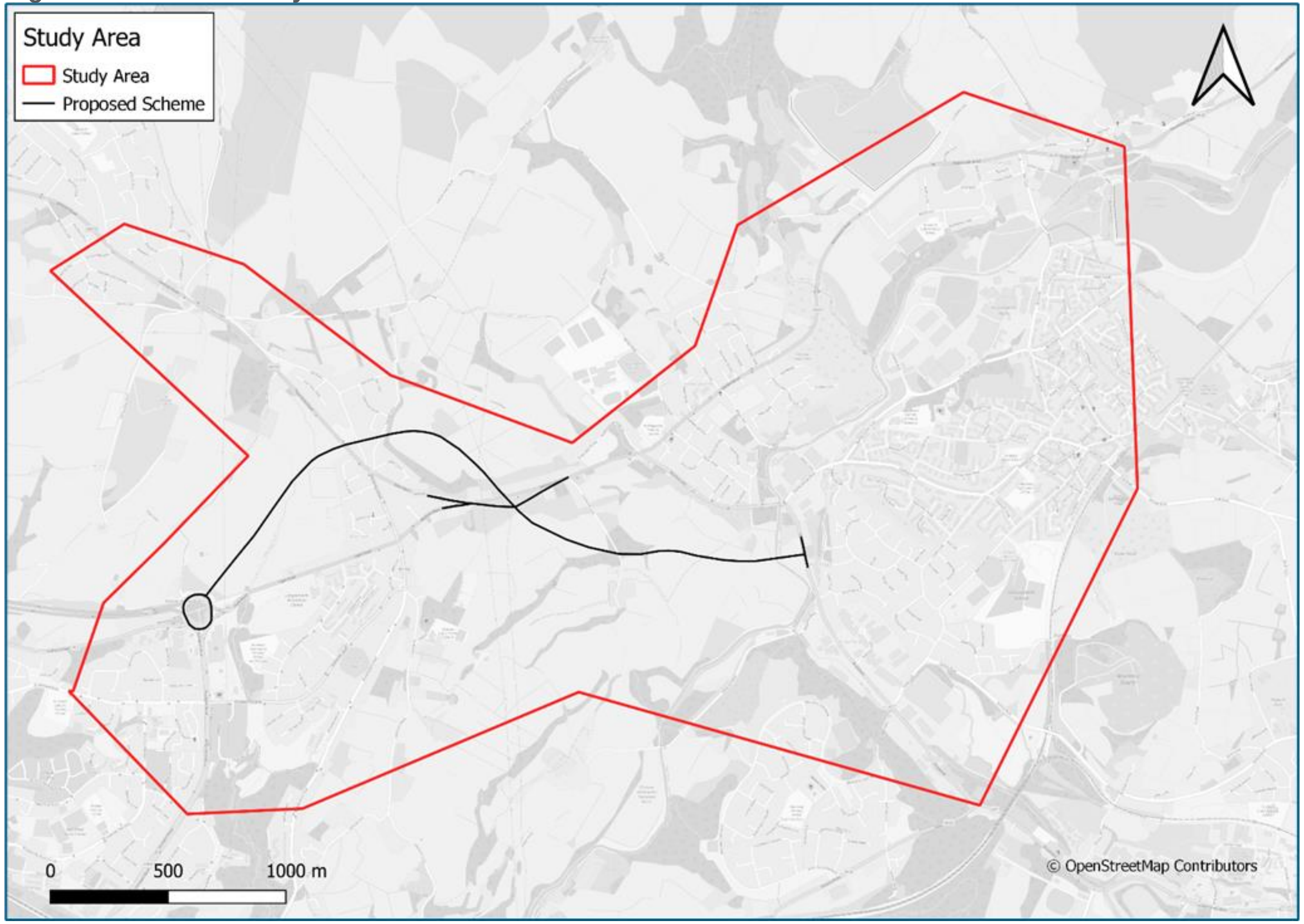
2. Local Transport Situation

2.1. Description of the Local Transport System

Existing Road Network

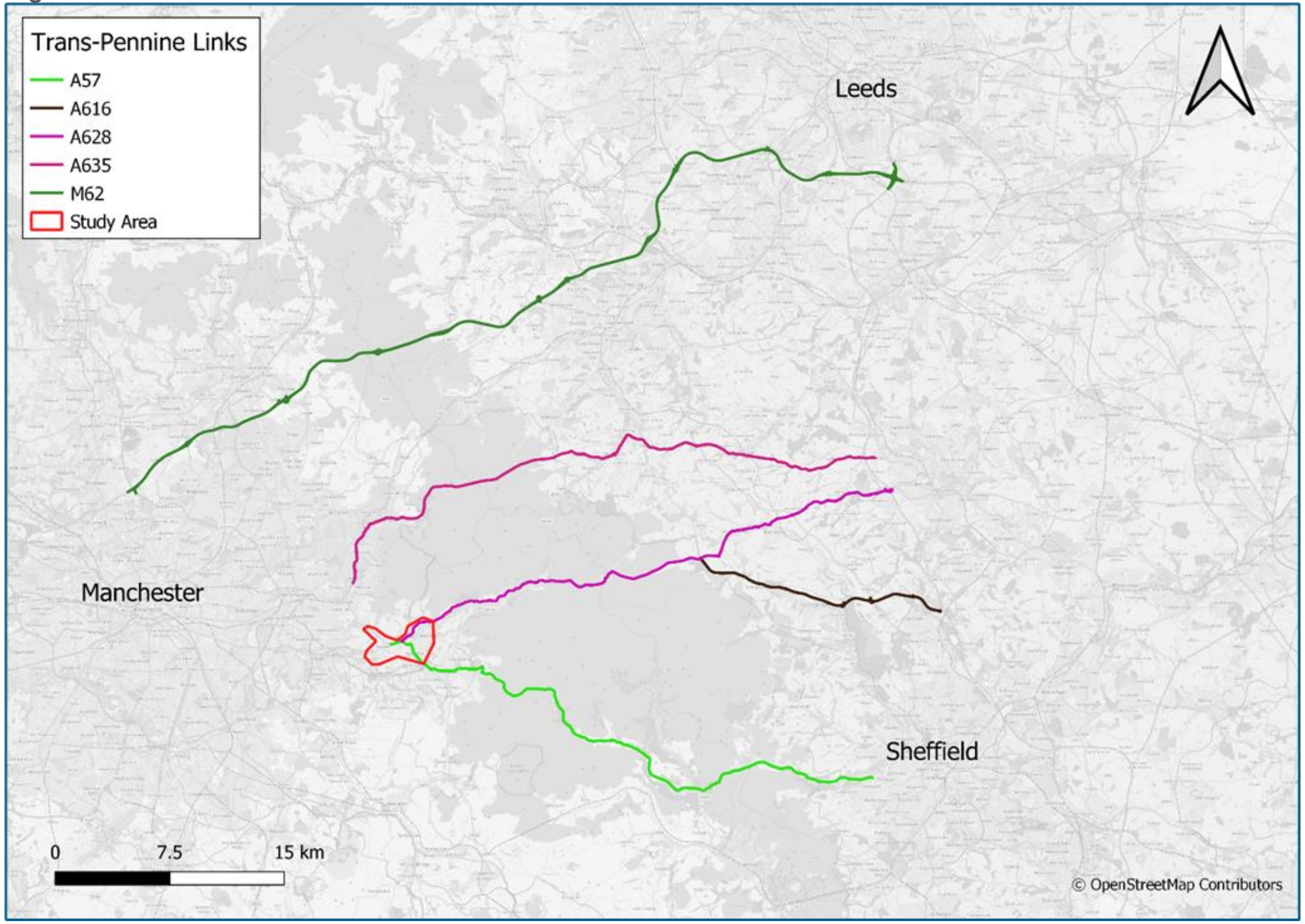
2.1.1. The wider scheme assessment takes into consideration the area encompassed by the Area of Detailed Modelling (ADM), shown in Figure 8-1. However, for the purposes of the baseline network conditions review, a local study area has been defined as shown below in Figure 2-1.

Figure 2-1 – Local Study Area



2.1.2. The local study area for this TAR forms a key part of multiple Trans-Pennine routes between Sheffield and Manchester. As shown in Figure 2-2. Two of the four main routes between Manchester and South Yorkshire pass through the local study area.

Figure 2-2 – Trans-Pennine Links



2.1.3. The local study area encompasses the proposed Scheme, which lies between the M67 Junction 4 and the proposed junction location at Woolley Bridge. The local study area also captures the western end of the A628, a major road in this area, as well as the A57 through Glossop and alternative routes, such as Hadfield Road.

M67 Junction 4 (Hattersley Roundabout)

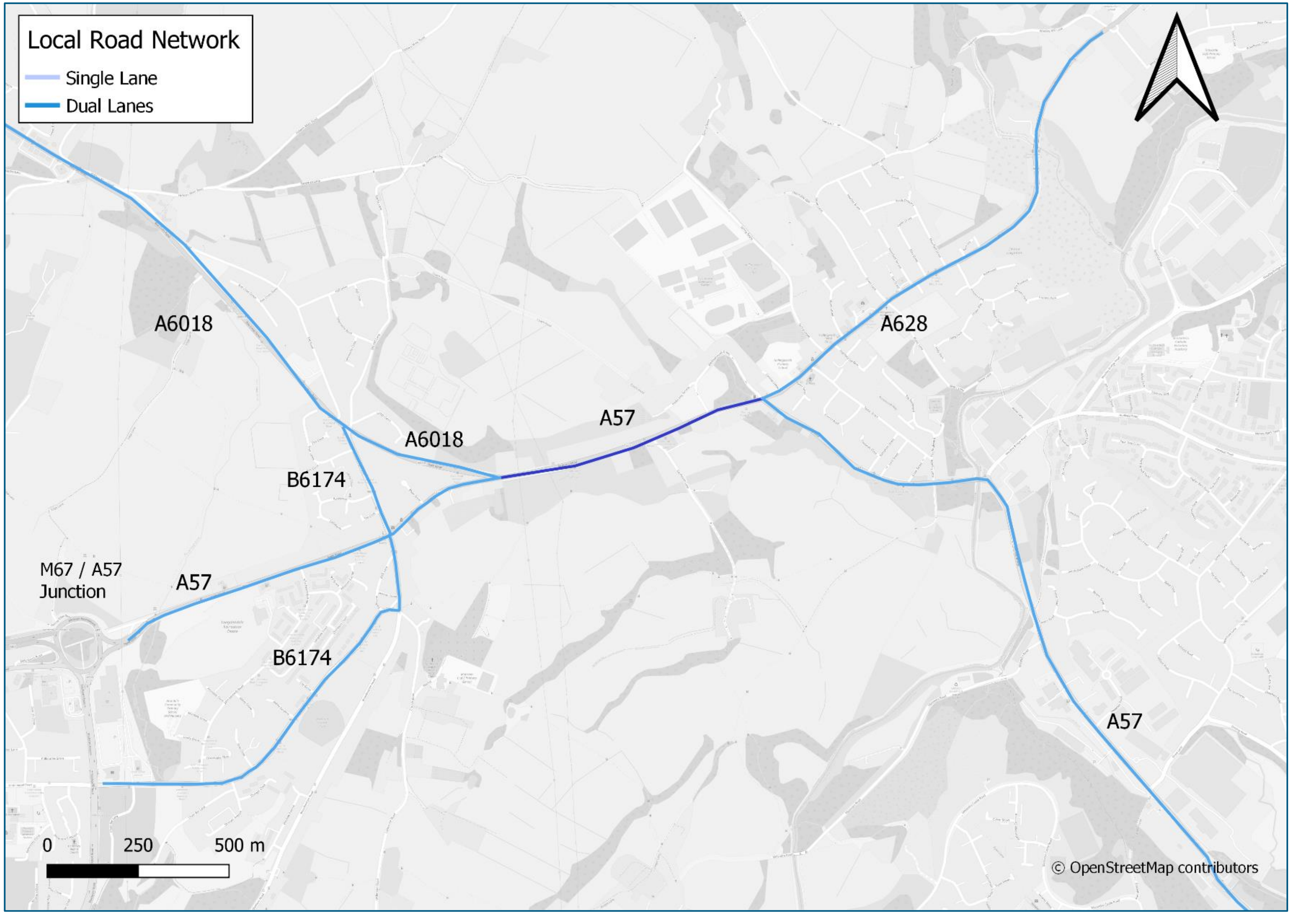
2.1.4. This large four-arm roundabout forms a nodal point for the M67, A57 Hyde Road, A57 Mottram Road and the A560 Stockport Road, and forms the eastern terminus of the M67. The roundabout and approach lanes are dualled with the exception of the southwestern approach from the A57 Mottram Road. The roundabout is subject to a 40mph speed limit. Although pedestrian/cycle crossing points are provided on each arm of the junction, these are currently uncontrolled crossings provided with tactile paving only.

A57

2.1.5. The A57 runs between the M67 to the west and Sheffield to the east and is predominantly a two-way single carriageway road. The A57 connects with the M67 in the form of a roundabout to the west of Mottram. The route uses the A57 for 1.3 miles, passing through the village of Mottram until its junction with the A628 in Hollingworth where it diverges south onto Woolley Lane before reaching the junction at Woolley Bridge, and heads south to Glossop. The A57 transects Glossop and runs east through the Peak District to Sheffield.

2.1.6. The A57 passes through two signalised junctions within Mottram, one with the B6174 Market Street, and one with the A6018 Back Moor. The A57 between the M67 and A6018 Back Moor is a two-way single carriageway road and becomes a single carriageway with two lanes in each direction between its junctions with the A6018 Back Moor and A57/A628 (Gun Inn). Figure 2-3 below shows the existing local road network within the vicinity of Mottram.

Figure 2-3 – Existing Local Road Network Through Mottram



A628

2.1.7. The western terminus of the A628 connects with the A57 at the Gun Inn in Hollingworth in the form of a signalised junction. Within the study area, the A628 (Market Street/Manchester Road/Woodhead Road) is a two-way single carriageway road and provides local links to Tintwistle, continuing across the Pennines to Penistone and Barnsley. Through the villages of Hollingworth and Tintwistle, the A628 is subject to a 30mph speed limit. Between the two villages and also on the eastern edge of Tintwistle, the speed limit rises to 40mph, before rising to 60mph for the rural route across the Pennines.

A6018

2.1.8. The A6018 (Back Moor/Roe Cross Road) provides a local link between Mottram and Stalybridge to the north in the form of a two-way single carriageway road. From the Matley Lane junction travelling south towards Mottram, the speed limit is 40mph. In Mottram, just before the Old Road junction, this decreases to 30mph. Within the study area, it intersects with the B6174 (Stalybridge Road) at a roundabout and, to the southeast, joins the A57 at a signalised junction.

B6174

2.1.9. The B6174 (Stalybridge Road/Market Street) is a two-way single carriageway road running north to south and is intersected by the A57 trunk road at a signalised junction. To the south of this junction, it is known as Market Street, and as Stalybridge Road to the north where it terminates at the roundabout with the A6018. The B6174 is served by multiple residential side roads and is subject to a 30mph speed limit.

Existing Public Transport Network

Trans Pennine Railway Links

2.1.10. The main railway link between Manchester and Sheffield is the Hope Valley Line, this line is served by three services:

- Manchester Airport to Cleethorpes – Trans-Pennine Express;
- Liverpool to Norwich – East Midlands Trains; and,
- Manchester to Sheffield – Arriva/Northern

2.1.11. The frequencies of each service and the times they run between are summarised in Table 2-1.

Table 2-1 - Trans-Pennine Rail Timetable Information

	Eastbound			Westbound		
Operator	First Service (hh:mm)	Last Service (hh:mm)	Trains per Hour (tph)	First Service (hh:mm)	Last Service (hh:mm)	Trains per Hour (tph)
Trans Pennine	06:15	22:17	1	03:25	22:11	1
East Midlands	07:38	20:38	1	06:18	20:39	1
Arriva	05:46	20:49	1	07:10	22:47	1

Source: Service Operator Websites (Trans-Pennine Express; East Midlands Trains; Arriva/Northern). Information correct as of January 2021.

2.1.12. Rail journey times between Manchester and Sheffield for the current services are shown in the table below. The Trans Pennine services offer the fastest service with journey times of 53 minutes on average, the East Midlands service, Liverpool to Norwich, offers journey times of 55 minutes on average whereas the Arriva services, all stopping service, provides average journey times of 77 minutes.

2.1.13. **Table 2-2** below shows the current journey times by rail between Manchester and Sheffield.

Table 2-2 - Indicative Journey Times By Rail between Manchester and Sheffield

Operator/Route (2020)	Eastbound (hh:mm)		Westbound (hh:mm)	
	Off-Peak	Peak	Off-Peak	Peak
Arriva	1:17	1:17	1:20	1:20
TransPennine	0:53	0:53	0:53	0:53
East Midlands	0:55	0:52	0:56	0:52

Source: thetrainline.com

Local Rail Services

2.1.14. The local area surrounding the Scheme is served by several train stations, which form part of the eastern end of the Manchester – Glossop line. The locations of these stations are presented in Figure 2-4.

Figure 2-4 - Local Railway Stations

2.1.15. The frequency of services through these stations is 4 tph; 2tph to Manchester Piccadilly and 2tph to Hadfield via Glossop. Of these stations, Glossop experiences the highest passenger flows, followed by Hadfield. The patronage figures for these stations in the two most recently recorded years are shown in Table 2-3.

Table 2-3 - Station Patronage 2018 - 2020

Station	2018/2019 Patronage	2019/2020 Patronage
Glossop	1,114,454	1,129,132
Hadfield	400,912	397,128
Broadbottom	197,316	202,140
Dinting	171,004	163,604
Hattersley	111,354	110,646

Source: ORR Annual Station Usage 2018/19 & 2019/20.
It should be noted that the estimates of station usage from the Office of Rail and Road (ORR) are based on the financial year, with each financial year running from 1 April to 31 March. Therefore, for FY 2019-20, the effects of the COVID-19 pandemic on travel and station patronages would be very limited given that the Government lockdown restrictions came into effect in mid-March 2020.

2.1.16. Local Bus Services

2.1.17. The local area is well served by bus services; there are 13 different services that run through the study area. Table 2-4 outlines the services that run through the area, their destinations, and their frequencies.

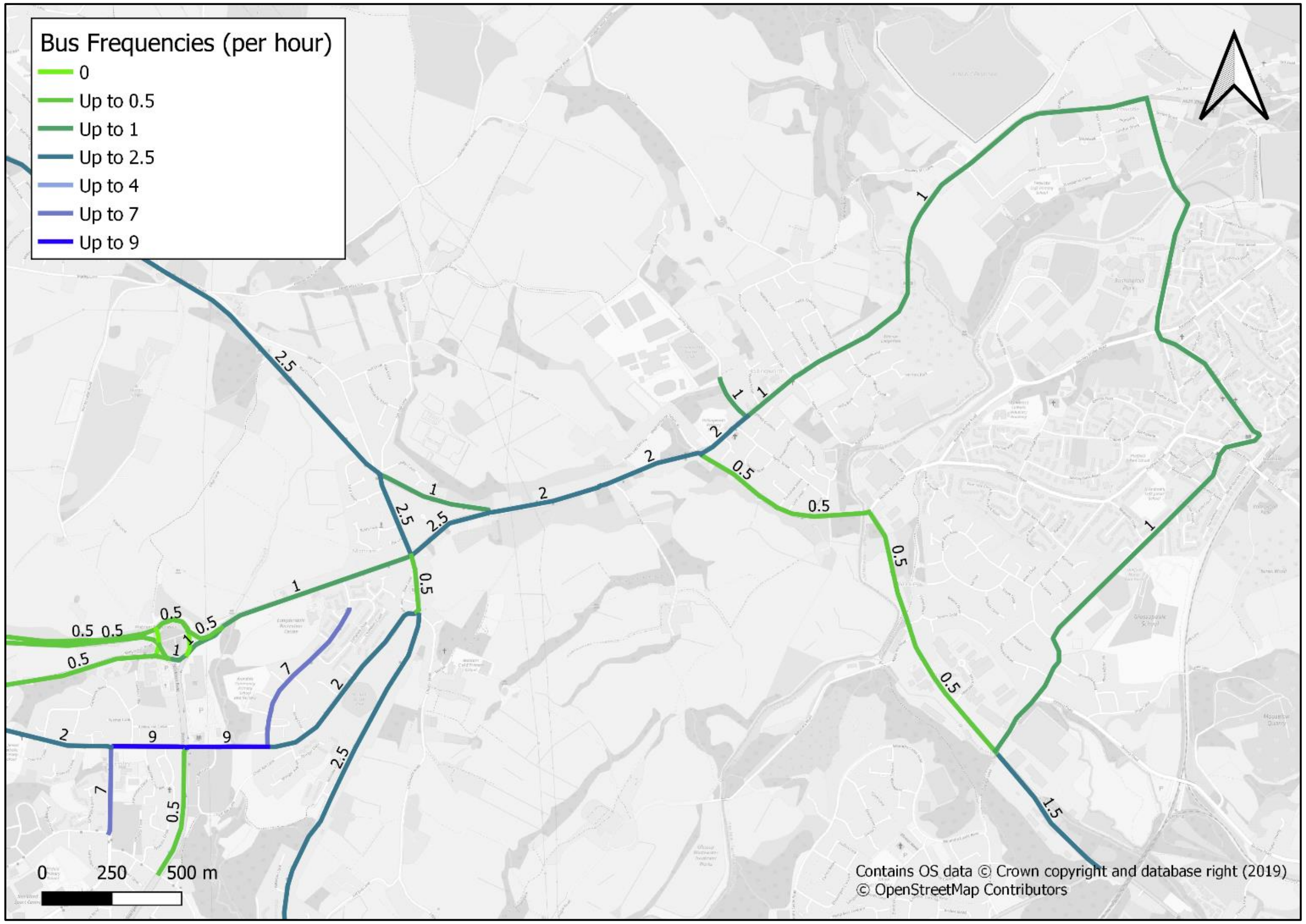
Table 2-4 - Local Bus Services

Service	Route	Frequency (each way)[12]
125	Mottram – Oldham Mumps	1 per day
201	Hattersley to Manchester City Centre	Up to 6 per hour
219	Glossop to Manchester City Centre	1 per day
237	Glossop to Ashton-under-Lyne	3 per hour
341	Glossop to Hyde	1 per hour
387	Ashton-under-Lyne to Hyde	1 per hour
837	Tameside Hospital to Hyde	1 every 2 hours between 11:00 – 18:00
838	Hollingworth to Ridge Hill	1 per day
841	Hattersley to Dukinfield	1 per day
842	Hollingworth to Broadbottom	1 per day
X57	Sheffield – Glossop - Manchester	1 every 2 hours

2.1.18. Data from TRACC, an industry-standard public transport analysis software tool, with the addition of the X57 service supplemented by timetable information from Transport for Greater Manchester (TfGM), was used to assess the current bus service flows through the study area shown in Figure 2-5. These flows are one-way and based on a Monday AM peak period.

[12] https://tfgm.com/bus/timetables Frequency based on weekday timetables, correct as of April 2021. COVID may have affected these services

Figure 2-5 - Bus Frequencies in the Study Area in each Direction



2.1.19. As shown in Figure 2-5 the roads that are most frequently served by buses are John Kennedy Road and Ashworth Lane. There are also relatively frequent services (2 – 2.5 ph) using the A57 around Mottram Moor and Back Moor.

2.1.20. It is expected that bus services running through the study area will benefit from improved journey times and reduced congestion.

2.2. Trans-Pennine Route – Existing Users

2.2.1. The current strength of travel links between Greater Manchester, South Yorkshire and West Yorkshire can be interpreted from existing data, including 2011 census data. The existing users of the Trans-Pennine routes are discussed within this section.

2.2.2. Table 2-5 below shows the inter-peak hour road-based business trips between the Greater Manchester, South Yorkshire and West Yorkshire areas. The table also shows travel to 'other' areas and total inter-peak hourly movements. The table shows that the linkages between the two conurbations and West Yorkshire are significantly stronger in terms of business trips.

Table 2-5 - Trans-Pennine Inter-Peak Hour Highway Business Trips

Origin	Destination				Total
	Greater Manchester	South Yorkshire	West Yorkshire	Other	
Greater Manchester	-	78 (2%)	533 (12%)	3,889 (86%)	4,511 (100%)
South Yorkshire	126 (7%)	-	604 (32%)	1,157 (61%)	1,887 (100%)
West Yorkshire	399 (15%)	669 (26%)	-	1,548 (59%)	2,615 (100%)

Source: Trans-Pennine Connectivity Study Phase 1 Report

2.2.3. Table 2-6 below shows the inter-peak hour road-based freight trips between the Greater Manchester, South Yorkshire and West Yorkshire areas. The table also shows freight travel to 'other' areas and total inter-peak hourly movements.

Table 2-6 - Trans-Pennine Inter-Peak Hour Highway Freight Trips

Origin	Destination				Total
	Greater Manchester	South Yorkshire	West Yorkshire	Other	
Greater Manchester	-	47 (1%)	492 (10%)	4,219 (89%)	4,758 (100%)
South Yorkshire	165 (8%)	-	691 (32%)	1,278 (60%)	2,135 (100%)
West Yorkshire	305 (14%)	398 (19%)	-	1,431 (67%)	2,133 (100%)

Source: Trans-Pennine Connectivity Study Phase 1 Report

2.2.4. The data presented relating to freight and business trips indicates weaker links between Greater Manchester and South Yorkshire. The freight figures in Table 2-6 above illustrate that the scale of total traffic from South Yorkshire and West Yorkshire is essentially the same, yet their attractiveness as a destination from Greater Manchester is highly unbalanced, with a much higher level of freight traffic to West Yorkshire compared to South Yorkshire. The reason for this lower level of trip making could be due to factors relating to high journey time or other factors; these are discussed later in this TAR.

2011 Census Travel to Work Data

2.2.5. Analysis of 2011 Census Travel to Work data, presented in Table 2-7, shows a significant variation in the strength of employment links between Greater Manchester, South Yorkshire and West Yorkshire. The strongest links between the three are between the two Yorkshire metropolitan areas, with a total of over 41,500 commuting trips made between the two areas. This compares to a total of 20,600 between Greater Manchester and West Yorkshire, and only 5,000 between Greater Manchester and South Yorkshire.

Table 2-7 – Daily Commuters between Metropolitan Areas – All Journeys

Metropolitan Area	Greater Manchester	South Yorkshire	West Yorkshire
Greater Manchester	904,361 (41.4%)	1,374 (0.1%)	8,916 (0.4%)
South Yorkshire	3,677 (0.1%)	426,951 (19.6%)	26,420 (0.2%)
West Yorkshire	11,692 (0.5%)	15,116 (0.7%)	783,428 (35.9%)

Source: Trans-Pennine Connectivity Study Phase 1 Report

3. Summary

3.1. Approach to Modelling and Economic Appraisal

3.1.1. The Stage 3 assessment of the A57 Link Road Scheme has been conducted in line with the TAG requirements and is considered to be acceptable for PCF Stage 3 analysis.

3.1.2. The TPU Stage 3 base year traffic model was developed using the SATURN version 11.3.12W highway modelling suite. The realism tests and variable demand modelling were carried out using DIADEM version 6.3.4.

3.2. Summary: Assumptions

3.2.1. The economic appraisal is primarily based on the outputs from the transport model and therefore the assumptions and caveats relating to the transport modelling would also affect the appraisal

3.2.2. The main assumptions for modelling and appraisal are summarised below:

- Modelled forecast years - 2025, 2040 and 2051
- The scheme is to be delivered by the opening year of 2025
- Appraisal period is set to 60 years from the opening year
- Economic assessment is based on TUBA version 1.9.14
- Cost and Benefit to Accidents Light Touch (COBALT) v2013.2 assesses the accident savings resulting from the TPU scheme
- Environmental Impact Appraisal - The effects of the TPU scheme on the greenhouse gases, air quality and noise levels have been monetised in line with TAG Unit A3
- User impacts during construction and maintenance have been assessed by modelling relevant scenarios for phases of construction in SATURN and capturing benefits through TUBA
- Assessment of Journey Time Reliability (JTR) has been undertaken in line with TAG Unit A1.3
- Assessment of Wider Economic Benefits follows guidance presented in TAG Unit A2.1

3.3. Summary: High Level BCR

3.3.1. Table 3-1 presents the results of the TPU scheme appraisal, showing the initial BCR. The rest of the tables of the ComMA Summary are provided at the end of this report.

Table 3-1 - TPU Scheme Appraisal Results (2010 prices and discounted to 2010)

Item	Low	Core	Optimistic
Present Value of Benefits (PVB)	£128.92m	£156.23m	£185.55m
Broad Transport Budget	£107.72m	£107.72m	£107.72m
Present Value of Costs (PVC)	£107.72m	£107.72m	£107.72m
Net Present Value (NPV)	£21.20m	£48.52m	£77.84m
Benefit to Cost Ratio (BCR)	1.20	1.45	1.72
Difference from Core BCR	-17%	-	+19%

3.3.2. Over the 60-year appraisal period, the TPU scheme is expected to generate user benefits of approximately £156 million (in 2010 prices, discounted to 2010) for the core growth scenario. The scheme has an initial BCR of 1.45 without reliability and wider economic benefits. Overall, the scheme delivers a net positive economic outcome.

Adjusted BCR

3.3.3. Inclusion of journey time reliability benefits and wider economic impacts increases the PVB from £156.23m to £264.20m. With the PVC of £107.72m, this gives an adjusted NPV of £156.49m and an adjusted BCR of 2.45.

Table 3-2 - Analysis of Montetised Costs and Benefits (AMCB) Table (£m)

Item	Core Scenario
Initial PVB	**£156.23**
Reliability	£10.72
Wider Economic Impacts	
Agglomeration	£85.56
Increased Output in Imperfectly Competitive Markets	£11.69
Adjusted PVB	**£264.20**
Broad Transport Budget	£107.72
Present Value of Costs (PVC)	**£107.72**
Overall Impacts	
Net Present Value (NPV)	**£156.49**
Benefit to Cost Ratio (BCR)	**2.45**

Note: All monetary values are in 2010 market prices discounted to 2010

3.4. Sources of Costs

- The preparation of scheme costs for the TPU scheme has been carried out following the principles set out in TAG Unit A1.1 Scheme Costs and provided by Highways England.

3.4.1. Table 3-3 sets out the estimated Present Value of Costs (PVC) for the TPU scheme for a standard base year of 2010. The costs were converted to market prices and discounted using standard Treasury discount rates. The following assumptions were made:

- The PVC was estimated based on the base cost estimated by Highways England Commercial Services Division in 2016
- All PVC of Scheme costs are present values discounted to 2010, in 2010 prices
- The scheme cost includes Safety and Technology element of the scheme.

Table 3-3 - Scheme Costs – 2010 discounted cost at Market Price

Cost Item	PVC (£m, 2010 market prices)
Capital Investment	102.7
Carriageway Maintenance	1.3
Structure Maintenance	3.5
Toll Revenue	0.2
Total Cost	**107.7**

3.5. Sources of Benefits

3.5.1. The sources of benefits for the scheme include the following, each of which is presented in greater detail in section 14 of this ComMA Report:

- Transport User Benefits (time and vehicle operating cost savings)
- Accident cost savings
- Air quality and noise
- Greenhouse gases
- Journey time reliability
- Wider economic impact
- Construction Delay Assessment

3.5.2. Impacts on users during maintenance of the new network have been considered but have not been monetised. It has been assumed that delays during maintenance of the DM network will have a greater adverse impact than maintenance of the DS network. The newly introduced links add resilience to the existing network by adding capacity and providing alternative route options for use when traffic management measures are in place. This will reduce the need for lengthy diversions while maintenance is carried out.

3.5.3. The Analysis of Monetised Costs and Benefits (AMCB) table summarises all of the monetised impacts of a scheme. A summary of the AMCB table for all growth scenarios has been presented as Table 3-4. The TUBA benefits have been assessed for the Core as well as Low and Optimistic growth scenarios, whereas, the accident benefits and greenhouse gas, air quality and noise assessments have been carried out for the Core scenario only. Accident benefits reported below are the accident savings from the operational period of the scheme assessed using COBALT.

3.5.4. A TUBA user benefit assessment of construction delays was only carried out for the core growth scenario. The dis-benefits for users from delays during construction are valued at -£1.04 million.

Table 3-4 - Summary of Economic Benefits – (2010 prices and discounted to 2010).

Benefit Type	Low Growth	Core Growth	Optimistic Growth
User benefits (TEE)	£153.44m	£181.25m	£210.19m
Accident benefits	-£7.33m	-£7.33m	-£7.33m
Indirect Taxation	£1.90m	£1.41m	£1.79m
Greenhouse gas benefits	-£17.45m	-£17.45m	-£17.45m
Air quality	-£3.77m	-£3.77m	-£3.77m
Noise	£3.17m	£3.17m	£3.17m
Delays during construction	£1.04m	£1.04m	£1.04m
Total (PVB)	£128.92m	£156.23m	£185.55m

3.5.5. In this table accident benefits, greenhouse gas emissions, noise, air quality and delays during construction have not been reassessed for the low or optimistic scenarios. These values are assumed constant for the purpose of calculating a PVB for this sensitivity test.

3.5.6. The wider economic impacts and journey time reliability benefits for the TPU scheme were carried out for the Core scenario only as summarised in Table 3-5. These benefits are not included in the Initial BCR summarised in Table 3-1 but form part of the Adjusted BCR presented at the end of section 14.

Table 3-5 - Journey Time Reliability & Wider Economic Benefits for Core Scenario (in 2010 prices and discounted to 2010).

Item	Benefits
Journey Time Reliability Benefits	£10.72m
Wider Economic Benefits	£97.25m

3.6. Assessment of Alternative Schemes

3.6.1. Alternatives scheme options were assessed at PCF Stage 2 and one scheme option was selected for assessment in Stage 3. Therefore, no other scheme options were assessed in PCF Stage 3.

4. Summary and Review of Existing Data

4.1. Introduction

4.1.1. The following sections have been taken from the Data Collection Report which was submitted to HE on the 04/11/2020. The document reference is HE551473-BBA-GEN-A57_AL_Scheme_AS-TR-000001.

4.1.2. This Data Collection Report provides a summary of existing and newly collected data used to inform the development of the A57/A628 Trans-Pennine Upgrade (TPU) Stage 3 transport model.

4.1.3. The information provided in this document is derived from the initial PCF Stage 3 Transport Data package produced by Arcadis, supplemented with details of data subsequently collected by Atkins to assist with model refinement in the latter stages of PCF Stage 3.

4.1.4. The aim of this section is to summarise existing traffic data used in the development of the A57 TPU Stage 3 transport model.

4.1.5. The information provided in this section has been compiled from the PCF Stage 3 Transport Data Package[13].

4.2. Use of Existing Traffic Survey Data

4.2.1. Traffic surveys were undertaken during PCF Stages 1 and 2. The counts comprised of Automatic Traffic Counts (ATCs), Classified Turning Counts (CTCs) and Roadside Interviews (RSIs) undertaken in 2015 and 2016. These surveys were undertaken by specialised survey companies. Additionally, ATC data used in the development of the Trans-Pennine South Regional Traffic Model (TPS RTM) was also collated. Unless otherwise stated, traffic survey data is included in the PCF Stage 3 Transport Data Package produced by Arcadis.

4.2.2. Details relating to traffic surveys undertaken in PCF Stages 1 and 2 were documented in the relevant Traffic Data Collection Reports (TDCR)[14]. The TDCRs for Stages 1 and 2 are included in the Transport Data Package.

4.2.3. The datasets used for calibration and validation during PCF Stage 2 have been considered suitable for PCF Stage 3. The TPS RTM, which was calibrated and validated during PCF Stage 2, has been used as a starting point for the development of the PCF Stage 3 TPU strategic model.

4.2.4. An extensive data collection exercise was not deemed necessary as part of the transport modelling at PCF Stage 3. However, a series of ad-hoc traffic surveys was commissioned to assist with the following aspects of model development. These are discussed in greater detail in the subsequent chapter.

- To verify vehicle volumes on the A57 for air quality assessment purposes.
- To increase the level of network coverage and improve model validity in the immediate study area.
- To inform the development of the operational model (VISSIM).

[13] Stage 3 Transport Data Package: HE551473-ARC-TTM-TPU-RP-TR-3176
[14] Stage 1 Transport Data Collection Report: HE550691-HYD-GEN-TP01-RP-TP-1012 V0.2, and Stage 2 Transport Data Collection Report: HE551473-ARC-GEN-ZZZ-RP-TR-2016

4.3. Existing Accident Data

4.3.1. In PCF Stage 2, local observed accident data (STATS19) for the TPU Scheme was obtained from the government's database website (www.data.gov.uk) for the most recent five-year period (2011-2015) at that time. However, in PCF Stage 3, the most recent five year period for the local observed accident data (STATS19) had advanced forward to the more recent period 2014-2018. Therefore, the recent published accident records were extracted and used.

4.3.2. The more recent accident record data collected for the TPU scheme area was used to inform the accident analysis.

4.4. Additional Data Requirements and Survey Approach

4.4.1. The following outlines the requirement for additional data collected during Stage 3. Specific details of the survey programme are provided in section 5.2.

- Operational assessment
  - Additional data was required to expand the extent of the Stage 1 VISSIM model.
  - ATC, CTC, queue and signal data was collected in Mottram.
- Environmental assessment
  - Additional data was required to verify vehicle volumes on the A57 for environmental assessment purposes.
  - ATC and MCC data were collected on the A57 between the Woolley Bridge Road junction and Shaw Lane to provide more detailed vehicle type classification.
- Glossop turning counts
  - Seven classified turning counts at various junctions on the A57 were commissioned by Arcadis.
  - Five further counts in Glossop were commissioned by Atkins to facilitate the improvement of the network detail of the immediate local area.
- TomTom journey time data
  - Independent and additional observed journey time data was required for selected routes to compare against observed Trafficmaster data used by Arcadis in the development of the Stage 3 transport model.

5. Data Collection

5.1. Introduction

5.1.1. Model development involves an extensive data collection and processing exercise. To develop and enhance the Stage 2 models, further data collection was required in Stage 3.

5.1.2. The information provided in this section is derived from the Stage 3 Transport Data Package produced by Arcadis, supplemented with details of data subsequently collected by Atkins to assist with model refinement during Stage 3.

5.2. Details of the Survey Programme

Operational Assessment

5.2.1. The Stage 1 VISSIM model has been expanded to include Mottram Road (A57) and Stockport Road (A560) to the south-west, the A6018 to the north and the A57 towards Glossop to the south-east.

5.2.2. To increase the extent of the VISSIM model in Stage 3, additional ATC, CTC, queue and signal information surveys were carried out in December 2017.

5.2.3. The details of the additional traffic surveys are as follows:

- ATC data: Thursday 7th December 2017 to Wednesday 13th December 2017 (ATC 10, 11, 12, 13, 14 and 15).
- CTC data: Thursday 7th December 2017 (CTC 10, 11, 12 and 13).
- Queue data: Thursday 7th December 2017 (CTC 10, 11, 12 and 13).
- Signal information: Thursday 7th December 2017 for the following junctions:
    - (SJT 1) A57 Mottram Moor / A57 Hyde Road / B6174 Broadbottom Road / Stalybridge Road
    - (SJT 2) A57 Mottram Moor / A6018 Back Moor
    - (SJT 3) A628 Market Street / A57 Woolley Lane / A57 Mottram Moor / Gun Inn
    - (SJT 4) A57 Brookfield / A57 Dinting Vale / Shaw Lane

5.2.4. The surveys were undertaken over 24 hours, from which the required data for the modelled peak periods was extracted (07:00-10:00 for AM and 16:00-19:00 for PM).

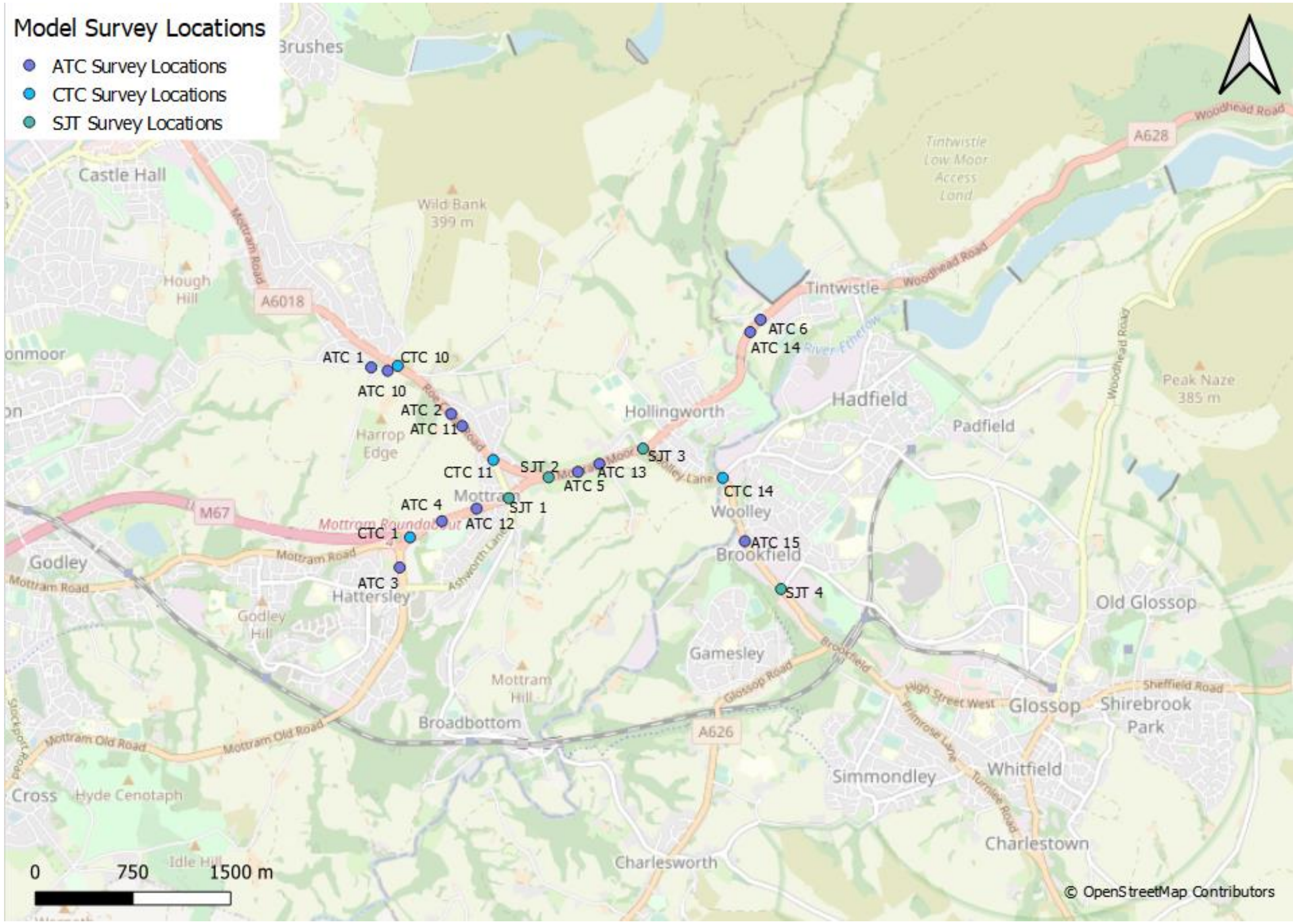
- To supplement the signal information surveys, UTC and MOVA data was provided by Traffic for Greater Manchester (TfGM) for the following signal-controlled junctions:
- A560 Stockport Road / Ashworth Lane / Underwood Road
- A57 Hyde Road / B6174 Stalybridge / A57 Mottram Moor / B6174 Broadbottom Road
- A57 Mottram Moor / A6018 Back Moor

5.2.5. Due to signal data outputs being regularly overwritten, the data that was provided by TfGM was the most up to date at the time of request (January 2018).

5.2.6. A controller specification for the A57 Brookfield / A57 Dinting Vale / Shaw Lane junction was obtained from Derbyshire County Council to provide additional signalling information.

5.2.7. Counts collected to inform the operational assessment are provided as appendices in the PCF Stage 3 Transport Data Package produced by Arcadis.

Figure 5-1 - Survey Locations for Operational Assessment



5.2.8. The first set of ATC surveys conducted in June / July 2015 experienced some operational issues on site that meant a complete dataset was not obtained. Table 5-1 summarises the impacts on the survey data collected.

Table 5-1 - Survey Data Issues

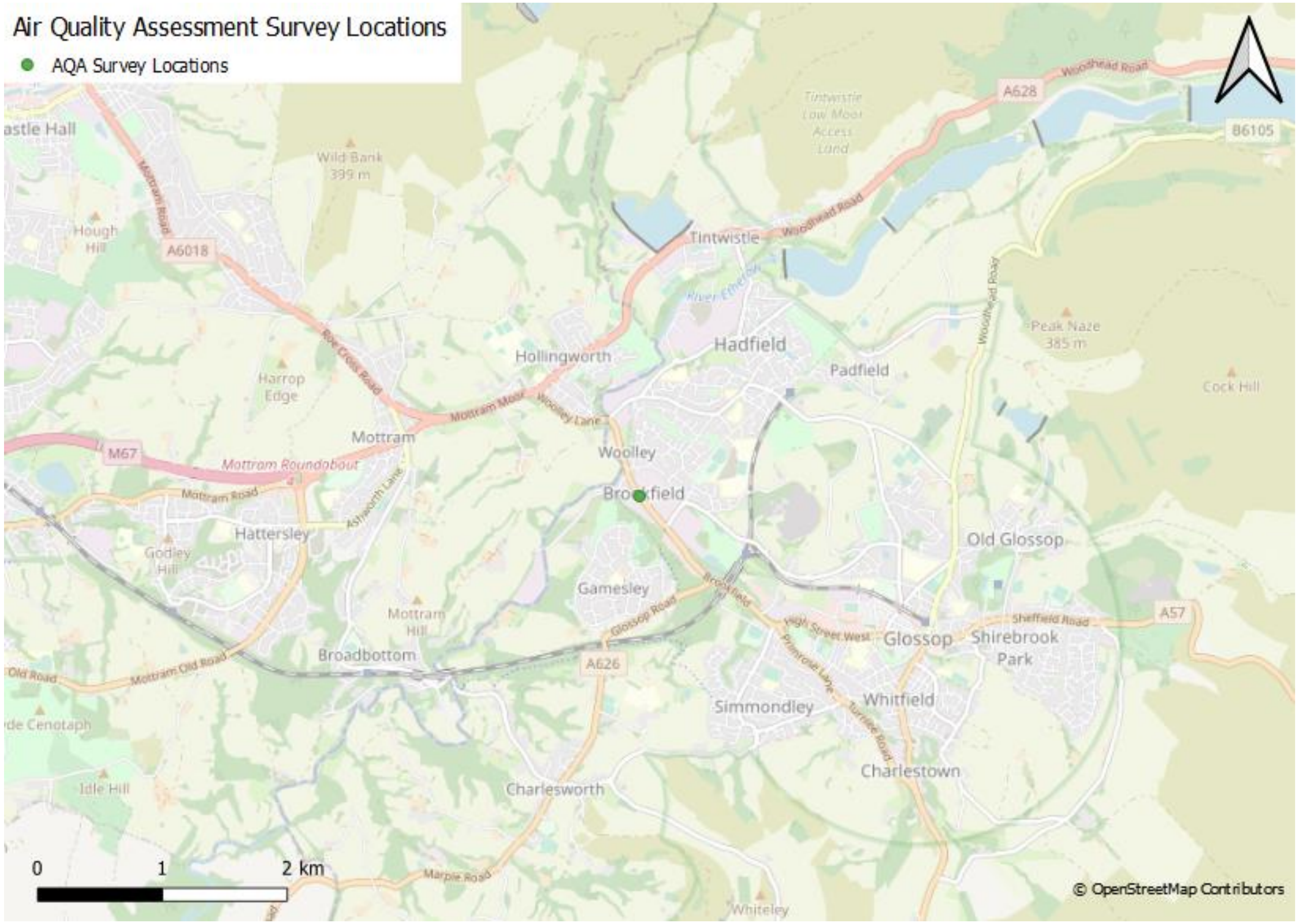
ATC Number	Location	Issue
4	A57 Hyde Road to M67 J4	Week 1 data loss 08:15 30/06 - 07:00 01/07. No data after 14:00 on 02/07 due to tube damage. ATC re-installed on 13/07. Week 2 data collected between 14/07-19/07.
5	A57 Eastbound between Mottram Moor and Back Moor Road	Data loss 12:00 30/06 - 06:30 01/07 & 09:00 07/07 - 07:00 09/07.
	A57 Westbound between Mottram Moor and Back Moor Road	Week 2 starts 10/07 due to re-installation at site.
6	A628 Manchester Road between Hollingworth and Tintwistle	Data loss 12:00-16:00 30/06.

Environmental Assessment

5.2.9. For air quality environmental assessment purposes, classified directional ATCs were undertaken along the A57 between the Woolley Bridge junction and Shaw Lane for two weeks during July 2018. 24-hour directional Manual Classified Counts (MCC) were undertaken over a two-day period whilst the ATCs were in operation. The location of the traffic survey site is shown in Figure 5-2.

5.2.10. Counts collected to inform the environmental assessment are provided as an Appendix A in the PCF Stage 3 Transport Data Package produced by Arcadis.

Figure 5-2 - Survey Location for Environmental Assessment



Classified Turning Counts – A57 Corridor

5.2.11. Classified turning counts were undertaken on the A57 corridor at the following junctions, as shown in Figure 5-3.

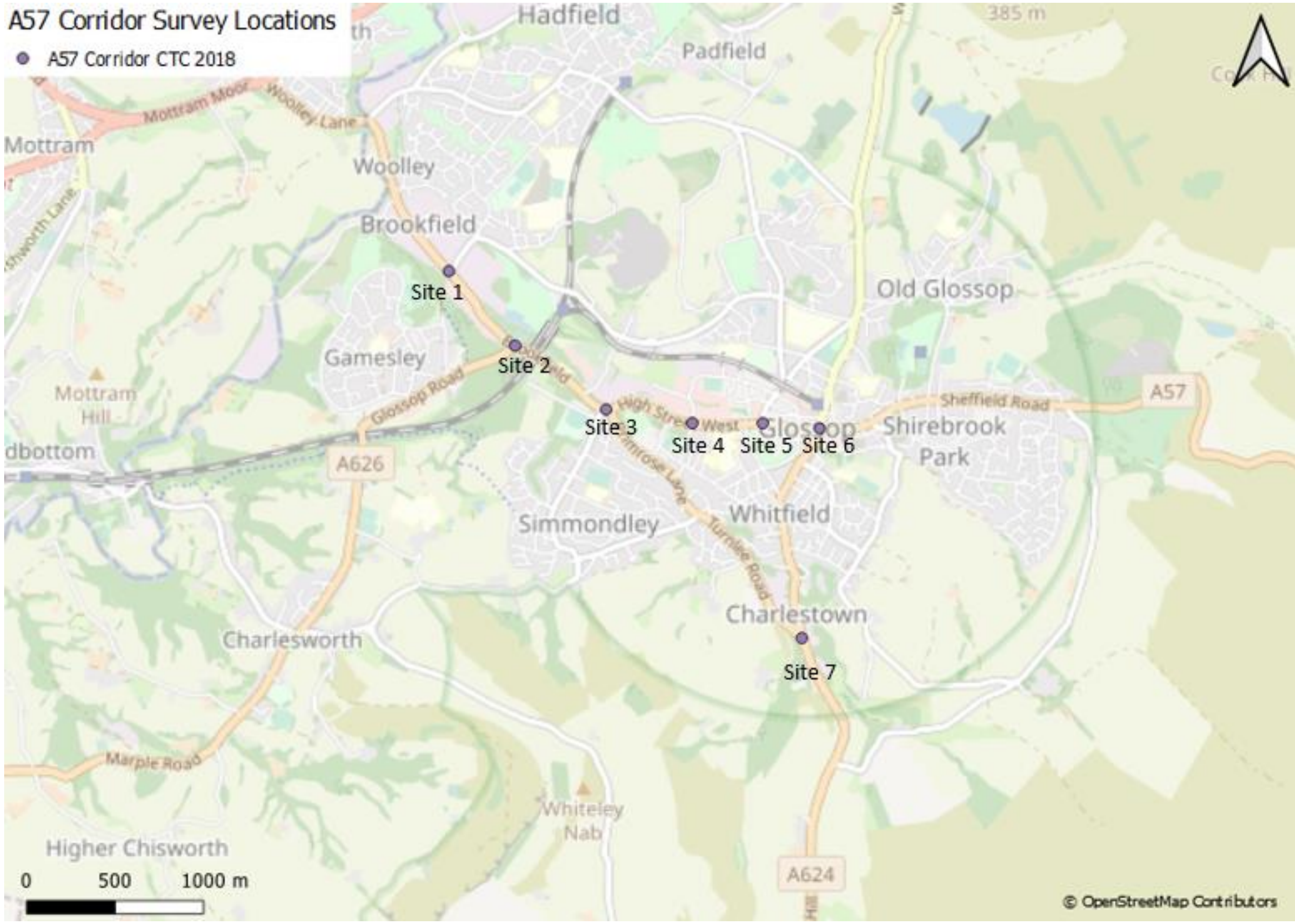
- Site 1: A57 Brookfield / A57 Dinting Vale / Shaw Lane
- Site 2: A57 Dinting Vale / A626 Glossop Road
- Site 3: A57 Dinting Vale / A57 High Street West / Primrose Lane / Simmondley Lane
- Site 4: A57 High Street West / Glossop Brook Road / Queen Street
- Site 5: A57 High Street West / Chapel Street / Arundel Street
- Site 6: A57 High Street West / A57 High Street East / B6105 Norfolk Square / A624 Victoria Street
- Site 7: A624 Charlestown Road / A626 Chunal Lane / Turnlee Road

5.2.12. The surveys were carried out on Tuesday 20th March 2018, between 07:00–10:00 and 16:00- 19:00. Over the same time period, the queue lengths of each arm of the above junctions were also recorded.

5.2.13. The weather on the survey day was mostly dry and cloudy, with no significant events or incidents recorded.

5.2.14. CTC data collected on the A57 corridor during 2018 is provided in Appendix A within the PCF Stage 3 Transport Data Package produced by Arcadis

Figure 5-3 - Survey Locations on A57 corridor (2018)



Classified Turning Counts – Glossop

5.2.15. A further five classified junction turning counts were undertaken in the Glossop area to help improve model validation. These five sites are shown in Figure 5-4 and are described below:

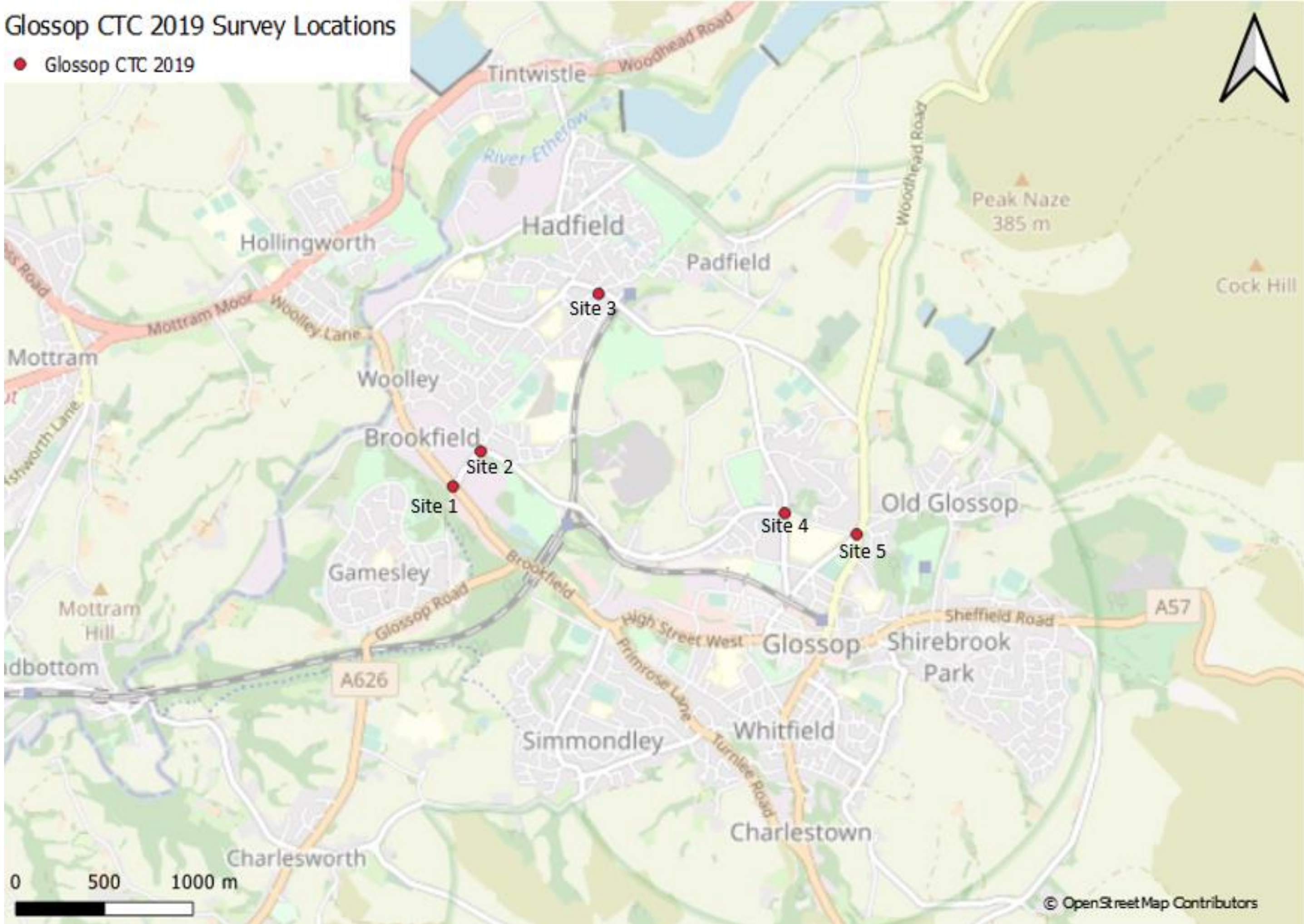
- Site 1: A57 Brookfield / Shaw Lane / A57 Dinting Vale / Cottage Lane
- Site 2: Newshaw Lane / Shaw Lane (SE) / Shaw Lane (SW)
- Site 3: Railway Street / Hadfield Road (ESE) / Church Street / Stanyforth Street / Hadfield Road (WNW)
- Site 4: North Road (N) / Talbot Road / North Road (S) / Dinting Road
- Site 5: B6105 Woodhead Road / Norfolk Street / Fauvel Road / Talbot Road

5.2.16. The surveys took place across three days from Tuesday 10th September 2019 to Thursday 12th September 2019 between 07:00–19:00.

5.2.17. The weather across the three days was reported as follows:

- Tues 10/09 - AM: wet and overcast, PM: mainly overcast with some clear spells.
- Wed 11/09 - AM: wet and rainy, PM: overcast.
- Thurs 12/09 - AM: overcast with some showers, PM: overcast with some showers.

Figure 5-4 - Survey Locations in Glossop (2019)



TomTom Journey Time Data

5.2.18. Prior to completion of Stage 3, Atkins were initially commissioned to undertake a review of the strategic TPU model developed by Arcadis. As part of the Stage 3 model review process, Atkins collected independent TomTom journey time data to compare against the observed Trafficmaster data used by Arcadis in the development of the Stage 3 transport model.

5.2.19. Atkins requested TomTom journey time data for three routes as detailed in Table 5-2 and shown in Figure 5-5.

Table 5-2 - Journey Time Route Information

Route Name	Description	Length (km)
A57	Matley Lane - Glossop Crossroads	6.4
Hadfield Alternative	Matley Lane - Glossop Crossroads, via Hadfield	7.4
A628	M67 J4 - A628/B6105 junction	11.2

5.2.20. Data was collected between the 7th of September 2015 and the 24th of October 2015, for Tuesdays, Wednesdays and Thursdays only.

5.2.21. Across these dates, data was collected between 07:00-10:00, 10:00-16:00 and 16:00-19:00. During the morning and evening peak periods data was recorded on an hourly basis, whereas for the IP it was collected as an average six-hour period.

5.2.22. TomTom journey time data is provided in Appendix A.

Figure 5-5 - TomTom Journey Time Routes

5.3. The Representative Basis of the Surveys

5.3.1. The ATC and CTC surveys conducted in 2017 and 2018 only present a snapshot of traffic conditions over a short period. This was one day (12 hours) for the classified turning counts, and a two-week period for the automatic traffic counts. It was important therefore that the results produced could be shown as being typical of normal network operating conditions, and broadly unaffected by incidents which would render the results atypical.

5.4. Outcome of the Surveys

5.4.1. The surveys were undertaken successfully during the survey window. An exercise was undertaken to assess the robustness of the additional survey data collected to inform the operational assessment, given that surveys were conducted at the beginning of December 2017, which is not a TAG neutral period. It was determined that the traffic data received was not materially different from traffic flows during a more typical month, and therefore approved by Highways England for use in the study.

6. Final Datasets

6.1.1. This aim of this section is to provide a summary of the final datasets used for PCF Stage 3 in relation to highway model development, forecasting and economic appraisal.

6.1.2. The information provided in this section is derived from the Stage 3 Transport Data Package produced by Arcadis, supplemented with details of data subsequently collected by Atkins to assist with model refinement during Stage 3.

6.2. Overview of Datasets

Temporary Highway Count Sites

6.2.1. The traffic count programme included a variety of data that was collected at temporary roadside locations, including ATCs, CTCs, queue counts, signal information surveys and a Road Survey Interview (RSI).

Strategic Model

6.2.2. To identify possible inconsistencies, count data used to develop the TPS RTM was compared against traffic count data collected during TPU model development. For consistency, data acquired from the development of the TPS RTM was retained where it originally formed part of a TPS RTM screenline or cordon. However, data collected during the development of the TPU strategic model (Stage 1 to Stage 3) has been used to inform the immediate localised study area of the scheme.

6.2.3. The following datasets were utilised to inform the TPU strategic model:

- Automatic Traffic Counts (ATCs)
  - ATCs were undertaken during June, July, September and October 2015 (Stage 1) and June and July 2016 (Stage 2).
  - ATC data used in the development of the TPS RTM was also acquired. This data was collected during March 2015, November 2015 and February 2016.
  - The location of ATC data collected prior to Stage 3 is presented in Figure 6-1. No new ATC data was collected at Stage 3 to inform the development of the TPU strategic model.
- Classified Turning Counts (CTC)
  - CTCs were undertaken during September 2015 (Stage 1), June 2016 (Stage 2), March 2018 (Stage 3) and September 2019 (Stage 3).
  - The location of CTC data collected prior to Stage 3 is presented in Figure 6-2, whilst CTC data collected during Stage 3 is presented in Figure 5-3 and Figure 5-4.
- Road Survey Interviews (RSI)
  - An RSI was undertaken on Mottram Moor (A57) on the 14th June 2016 (Stage 2).
  - The location of the single RSI is presented in Figure 6-3.

Operational Model

To increase the extent of the VISSIM model in Stage 3, additional ATC, CTC, queue and signal information surveys were carried out in December 2017. The locations of the survey sites are shown in Figure 5-1.

Figure 6-1 - Survey Locations for ATCs Collected Prior to Stage 3

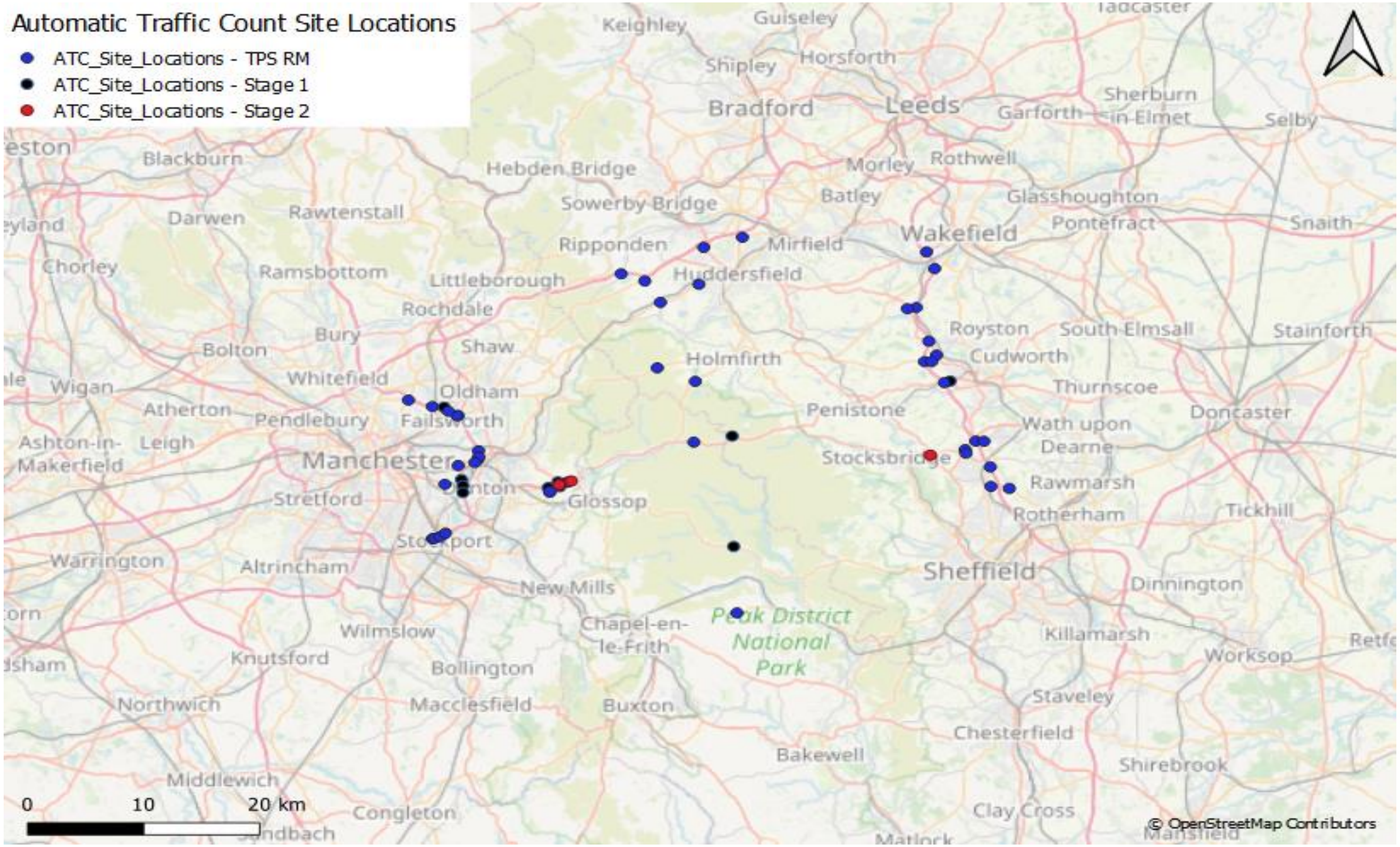


Figure 6-2 - Survey Locations for CTCs Collected Prior to Stage 3

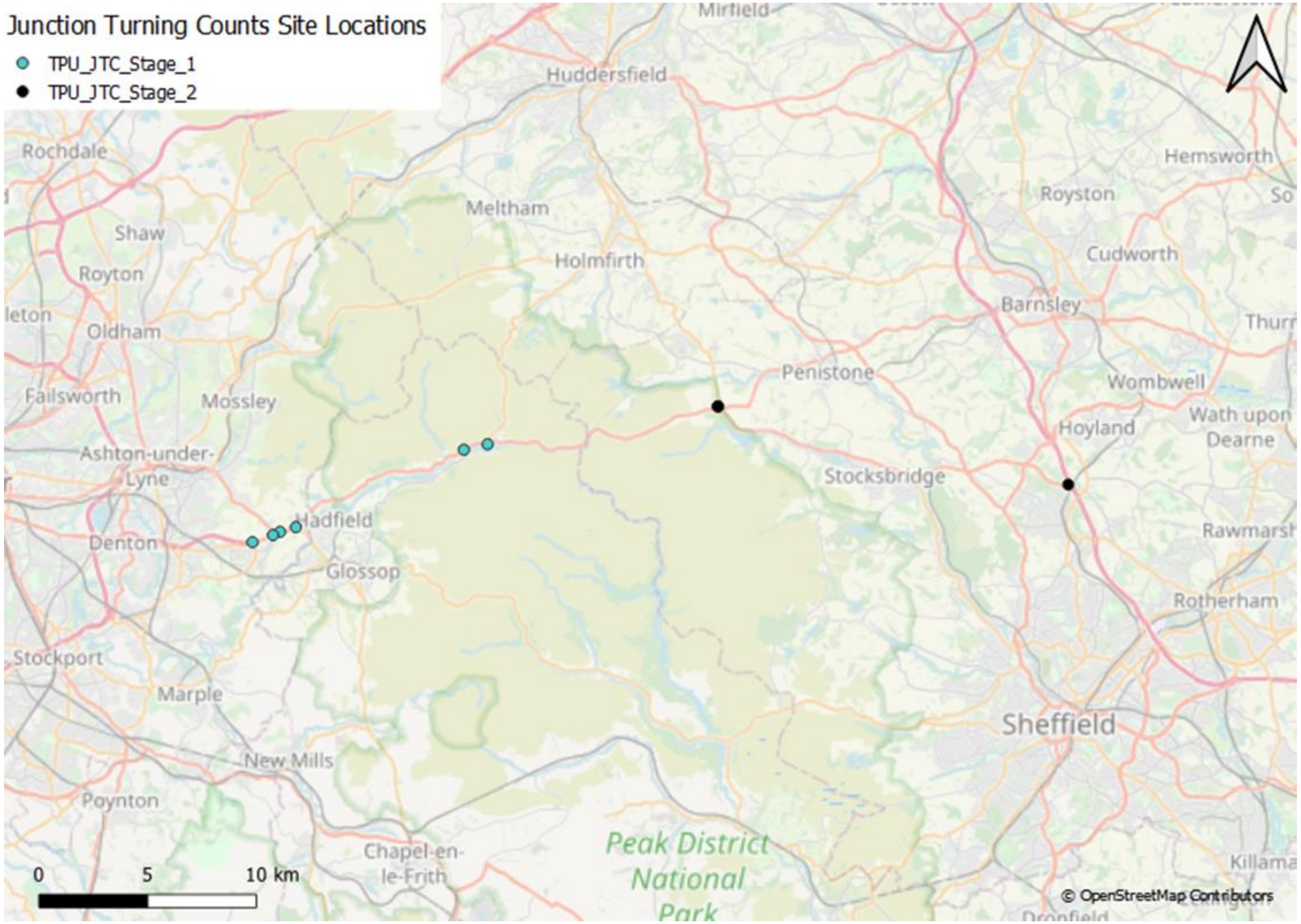
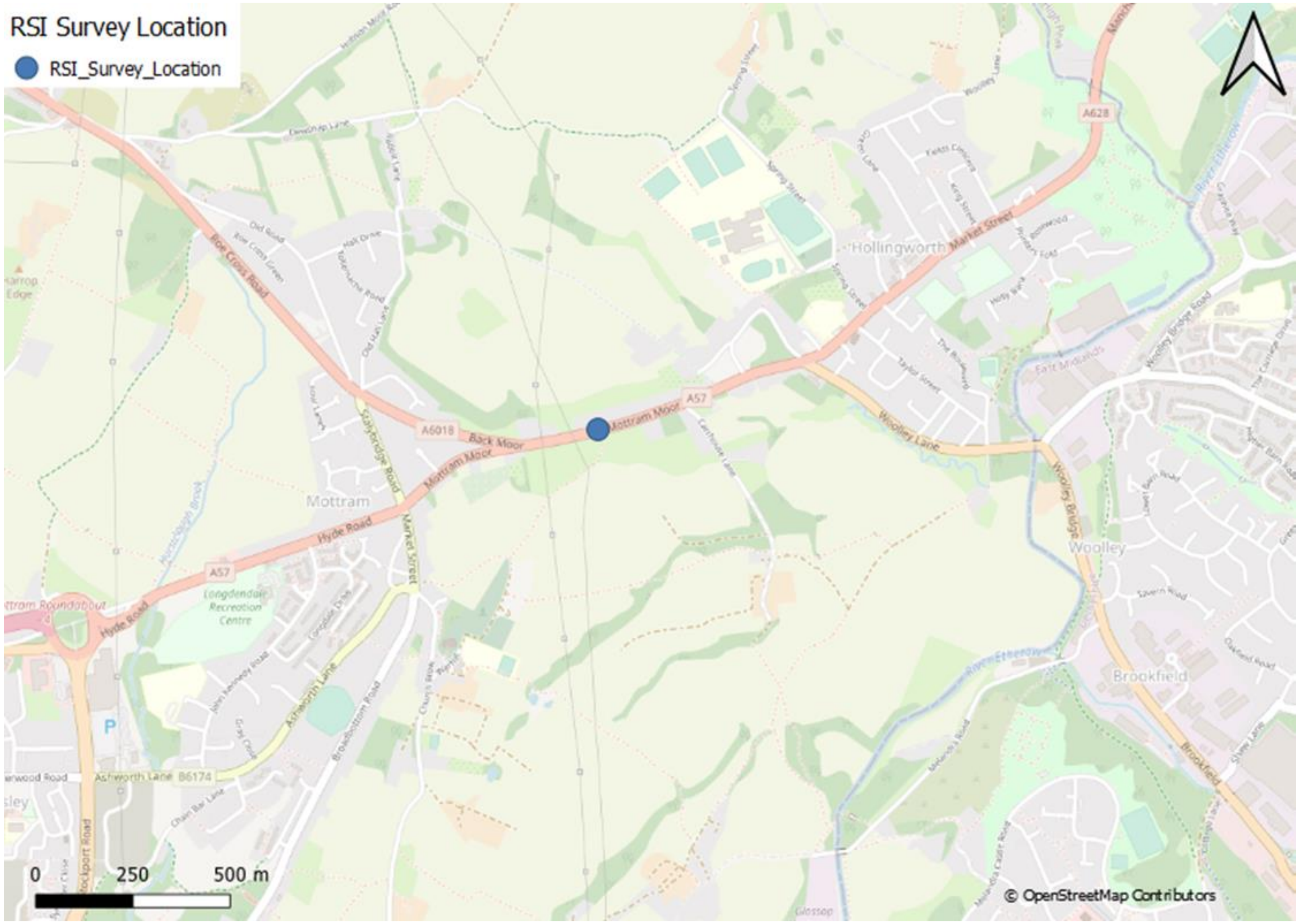


Figure 6-3 - Survey Location of RSI (2016)

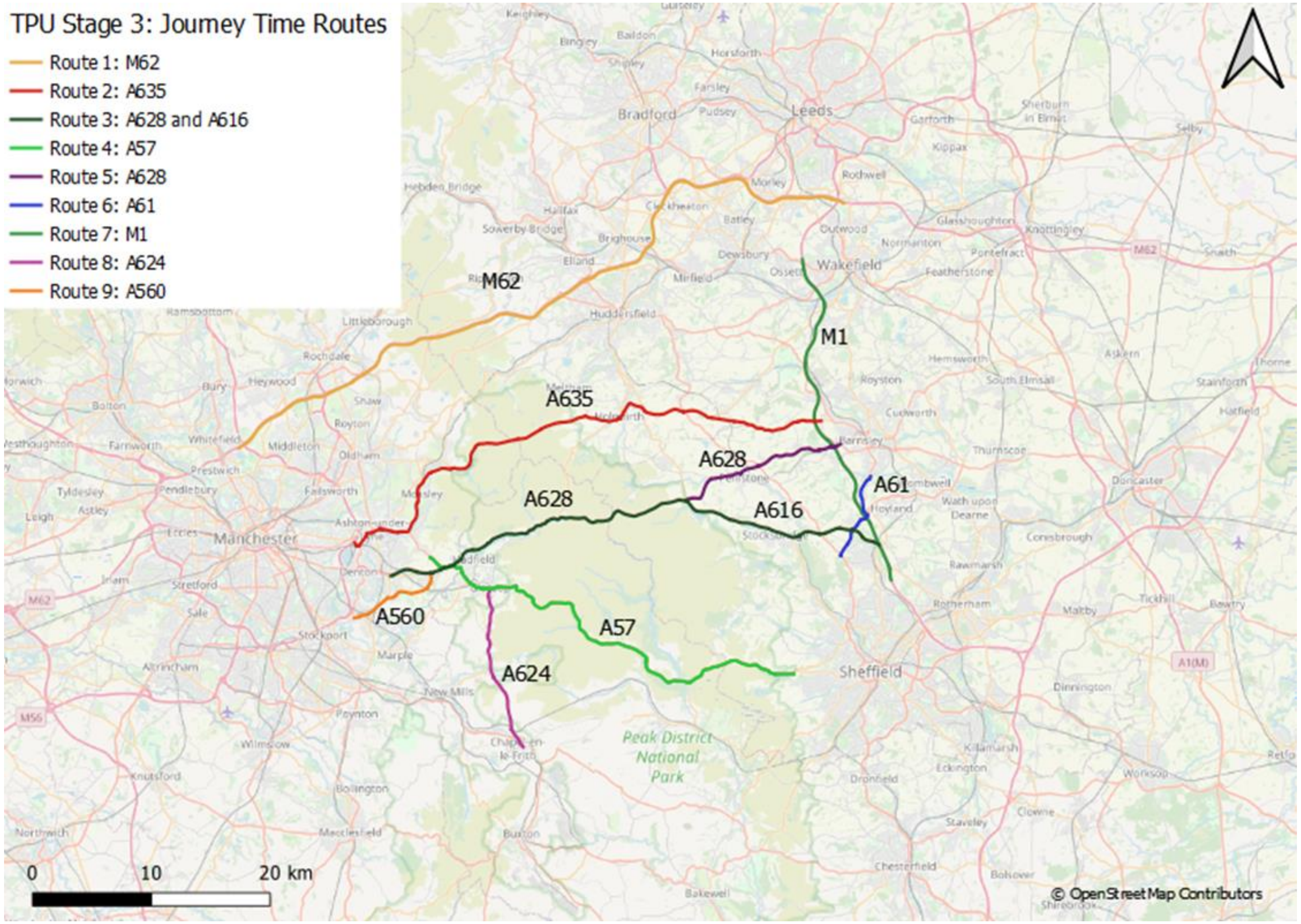


Journey Time Data

6.2.4. Figure 6-4 presents the journey time routes for which Trafficmaster data has been collected.

6.2.5. Trafficmaster journey time data from September and October 2015 has been used to validate the TPU strategic model, whilst data from March, September and October 2015 has been used to validate the operational model. The same 2015 dataset used to validate the TPU strategic model has been used to inform the speed banding and pivoting process for the environmental assessment.

Figure 6-4 - Stage 3 Journey Time Routes (2015)



WebTRIS Data

6.2.6. 2015 count data from the Highways England's Traffic Information System (WebTRIS) has also been utilised in the development of the TPU strategic model. Table 6-1 provides details of the 2015 WebTRIS count sites, whilst Figure 6-5 shows their location.

6.2.7. To inform the economic and environmental assessments, 2016 WebTRIS data has also been obtained to derive AADT / AAWT factors. Table 6-2 provides details of the 2016 WebTRIS count sites, whilst Figure 6-6 and Figure 6-7 show their location.

Table 6-1 - WebTRIS Sites Used for TPU Model Development (2015)

SL No	Site	Site location	Direction
1	TRIS_M60_17	M60 Between J20-21	Anti-clockwise
2	TRIS_M60_18	M60 Between J20-21	Clockwise
3	TRIS_M60_21	M60 Between J24-25	Anti-clockwise
4	TRIS_M60_22	M60 Between J24-25	Clockwise
5	TRIS_M60_11	M60 J25 exit	Anti-clockwise
6	TRIS_M60_26	M60 After J 24	Clockwise
7	TRIS_M62_4	M62 J21 access	Eastbound
8	TRIS_M67_1	M67 between J2 and J3	Eastbound
9	TRIS_M67_11	M67 between J3 and J4	Westbound
10	TRIS_M67_10	M67 between J3 and J4	Eastbound
11	TRIS_M60_15	M60 Between J18-19	Anti-clockwise
12	TRIS_M60_16	M60 Between J18-19	Clockwise
13	TRIS_M60_19	M60 Between J22-23	Anti-clockwise
14	TRIS_M60_20	M60 Between J22-23	Clockwise
15	TRIS_M60_23	M60 Between J26-27	Anti-clockwise
16	TRIS_M60_24	M60 Between J26-27	Clockwise
17	TRIS_M67_4	M67 between J1 and J1A	Eastbound
18	TRIS_M67_5	M67 between J1 and M60	Westbound
19	TRIS_M67_2	M67 between J2 and J1A	Westbound
20	TRIS_M67_3	M67 between J1A and J2	Eastbound
21	TRIS_M60_3	M60 within J24	Clockwise
22	TRIS_M60_27	M60 JN 24 Slip SB	Clockwise
23	TRIS_M60_4	M60 J24 exit	Anti-clockwise
24	TRIS_M60_5	M60 within J24	Anti-clockwise
25	TRIS_M60_6	M60 J24 access	Anti-clockwise

Table 6-2 - WebTRIS Data Used for the Environmental Assessment (2016)

Road Name	Easting	Northing	Site No.
M67	391717	395536	8417A
M67	391717	395519	8417B
M67	392071	395537	8420B
M67	392515	395751	8425A
M67	392541	395741	8425B
M67	393035	395670	8431B
M67	394329	395296	8444A
M67	394740	395172	8448A
M67	395134	395124	8453B
M67	397276	395458	8475A
M67	397338	395423	8476B
M67	398359	395351	8486B
A616	431703	398873	8302-1
A616	431705	398868	8302-2
A61	434004	399312	8303-1
A61	434008	399308	8303-2
A616	434224	398883	8304-1
A616	434221	398879	8304-2
M60	392425	398402	9458A
M60	392195	398032	9462B
M60	391737	397617	9468A
M60	390866	396440	9484A
M60	390865	396445	9484J
M60	391004	395943	9489A
M60	391063	395667	9492A
M60	391045	395606	9493B
M60	391074	395366	9495A
M60	391191	394446	9505A
M60	391249	394138	9508B
M60	391331	393924	9510A
M60	391430	393613	9513A
M60	390981	395865	9490M
M60	391041	395312	9496L
M1	435245	399555	4701A
M1	435219	399567	4701B
M1	435055	399932	4705B
M1	434951	400004	4706A

Road Name	Easting	Northing	Site No.
M1	434832	400161	4708B
M1	434733	400234	4709A
M1	434516	400529	4713A
M1	435087	399804	4704J
M1	435040	399921	4705M
M1	434718	400303	4710K
M1	434668	400276	4710L

Figure 6-5 - Survey Location of WebTRIS Sites (2015)

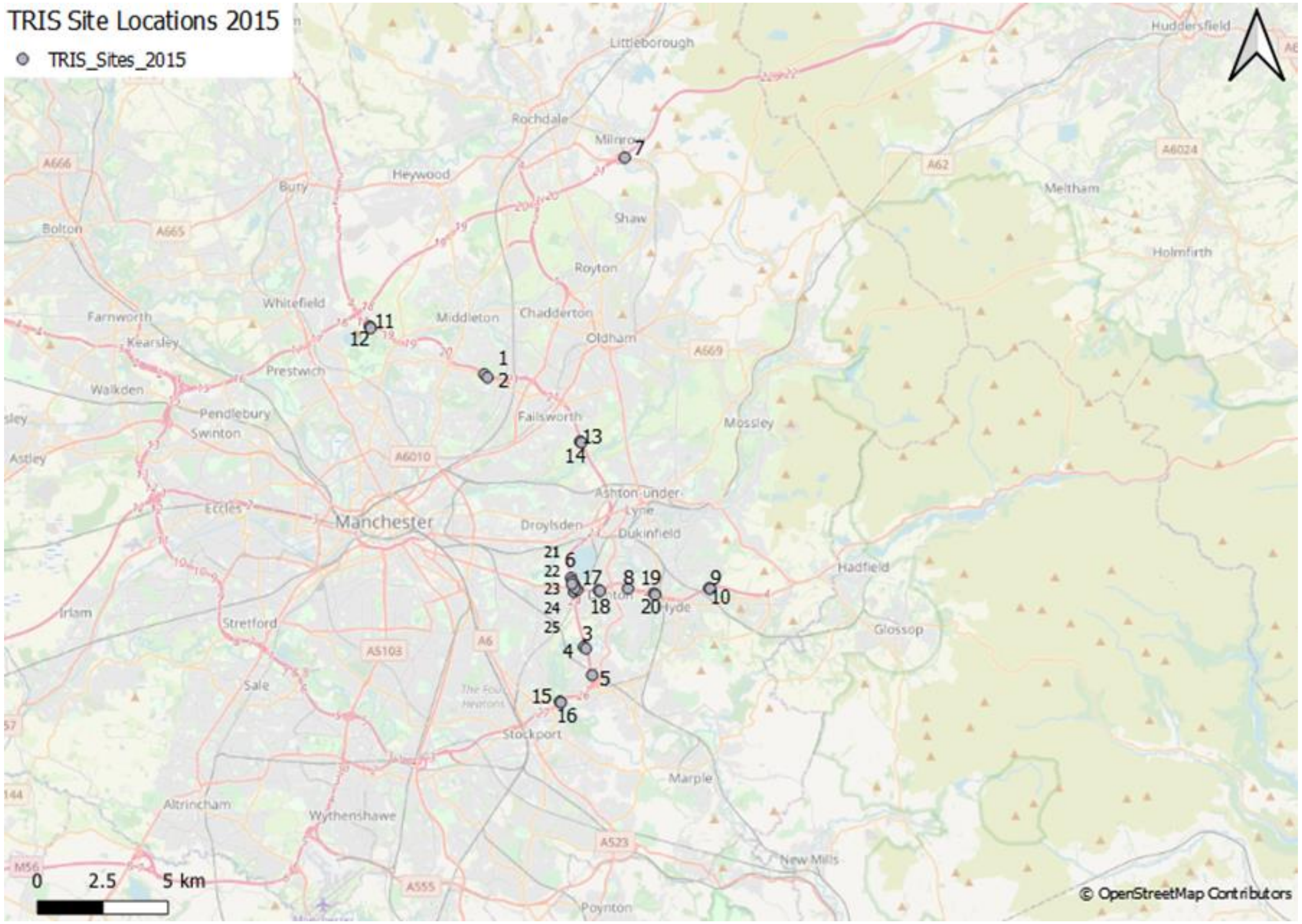


Figure 6-6 - Survey Location of WebTRIS Sites on A61/A616/M1 (2016)

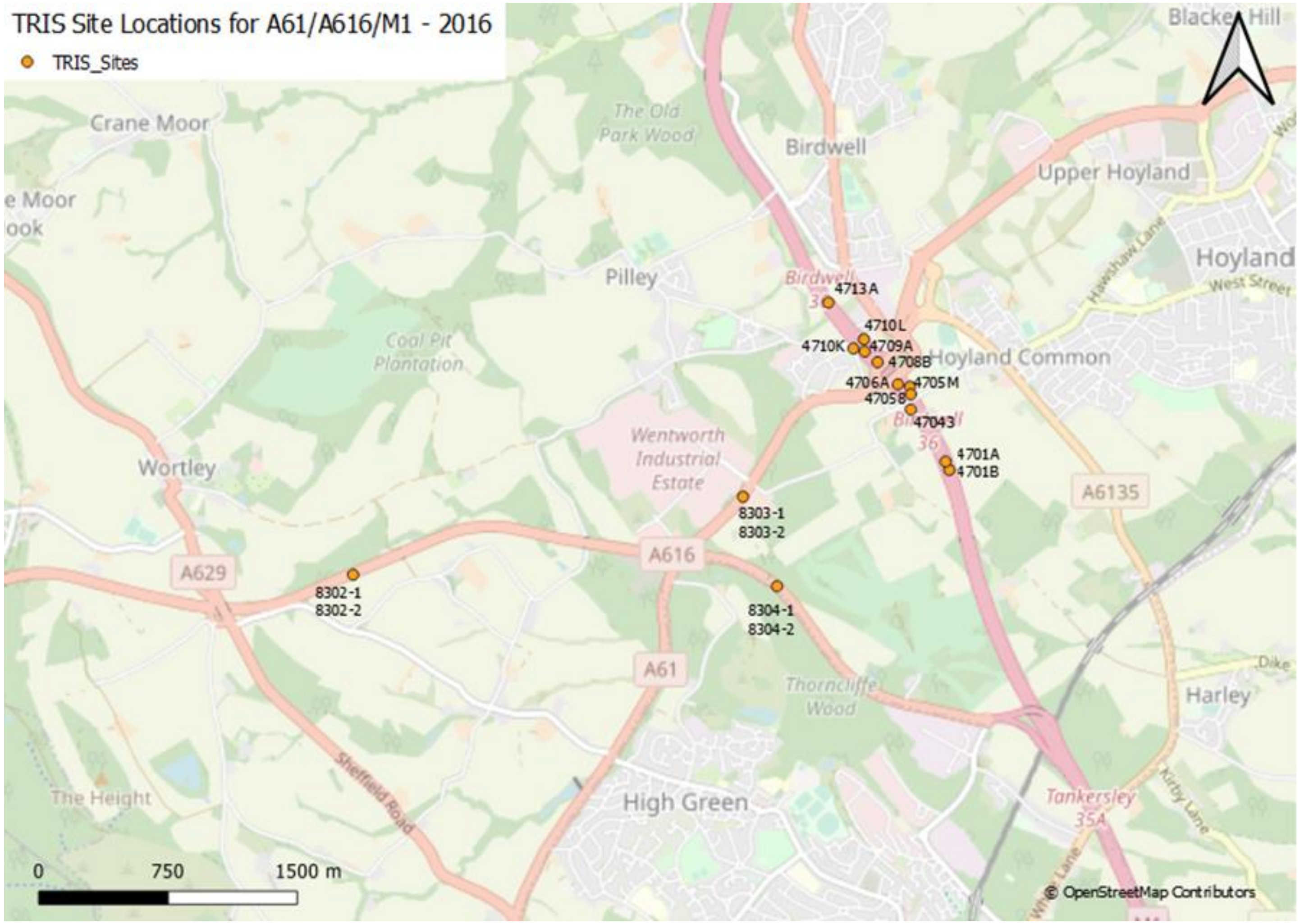
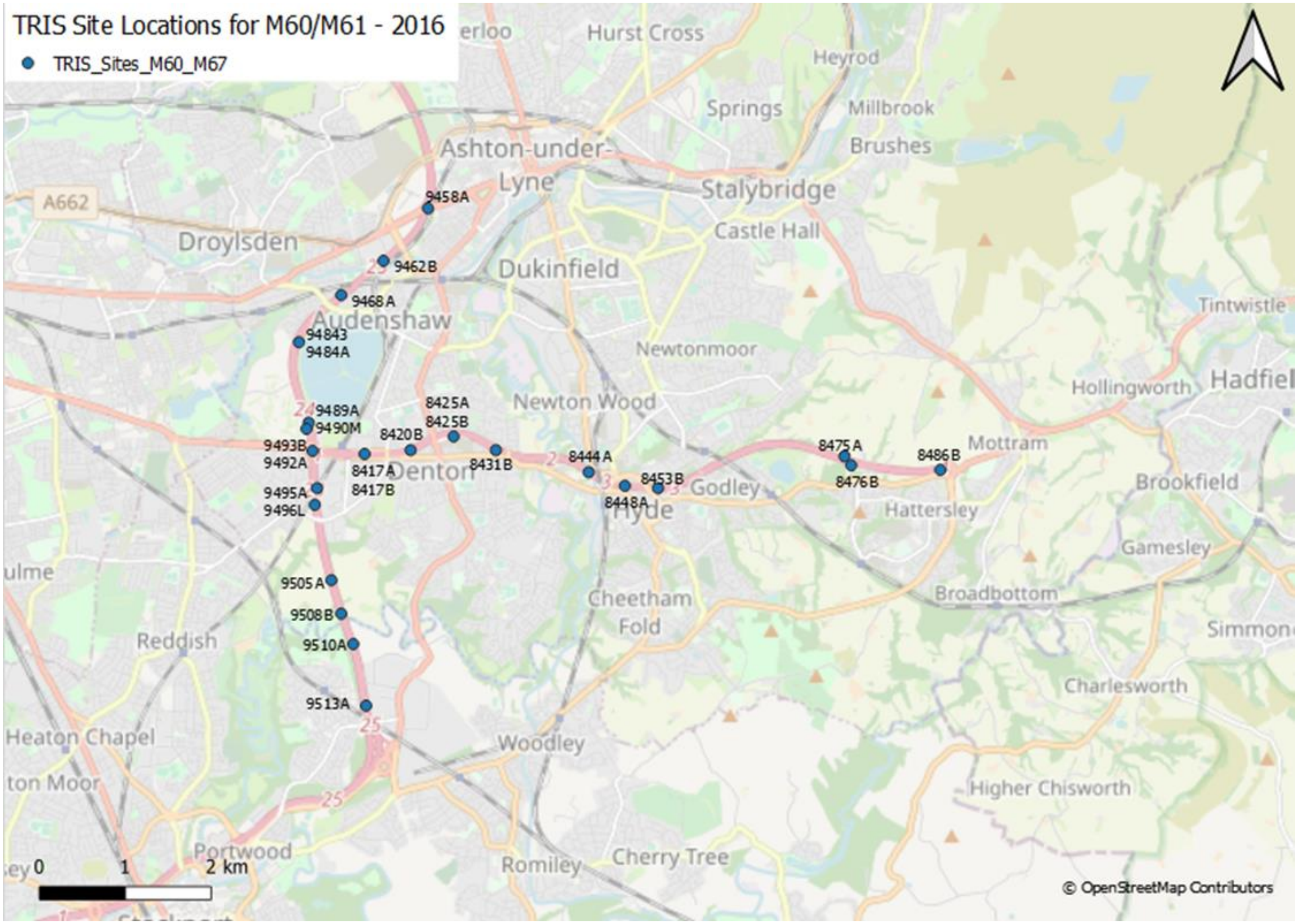


Figure 6-7 - Survey Location of WebTRIS Sites on M60/M67 (2016)



Data Used for Forecasting

6.2.8. An uncertainty log was produced at Stage 2, details of which are provided in the PCF Stage 2 Traffic Forecasting Report[15]. The uncertainty log includes residential and employment development sites, plus transport infrastructure schemes. The original Stage 2 uncertainty log has been revisited and updated to create a 2020 uncertainty log. The revised 2020 uncertainty log has been used to update the core scenario.

6.2.9. The NTEM v7.2 dataset has been used to provide suitable targets for all local growth to be constrained.

6.2.10. For LGV and HGV growth, revised Road Traffic Forecast (RTF) projections published in September 2018 have been used to replace earlier published RTF projections (from 2015).

6.2.11. TAG Databook v1.14 (July 2020) has been used to project changes in value of time and vehicle operating cost for the three forecast years adopted (2025, 2040 and 2051).

TPS Regional Highway Model

6.2.12. 2015 and 2016 count data used in the development of the TPS RTM has been utilised to assist with the development of the TPU strategic model.

TPS Variable Demand Model

6.2.13. The TPS RTM VDM setup files for the 2015 base year were used as the starting point for model calibration and validation.

6.2.14. The TPS RTM VDM forecasting setup (2021, 2031 and 2041) was used as a basis to inform the TPU VDM process (revised forecast years: 2025, 2040 and 2051).

Data Used for Economic Analysis

6.2.15. As stated in section 6.2.5, WebTRIS data has been used to derive factors for AADT and AAWT flows.

6.2.16. In PCF Stage 2, local observed accident data (STATS19) for the TPU Scheme was obtained from the government's database website (www.data.gov.uk) for the most recent six-year period (2011-2015) at that time. However, in PCF Stage 3, the most recent six-year period for the local observed accident data (STATS19) had advanced forward to the more recent period 2013-2018. Therefore, the recent published accident records were extracted and used for COBALT and distributional impact assessments.

6.2.17. If required the Wider Impact (WI) assessment would be carried out using the Department for Transport's Wider Impacts dataset, which conforms with NTEM v7.2.

6.2.18. The Delays During Construction assessment used the Traffic Management and Construction plan provided by the construction team.

6.2.19. TAG Databook 1.14 (July 2020) has been used to project changes in appraisal values for the three forecast years adopted (2025, 2040 and 2051). In the first instance, all sensitivity tests will also use Databook 1.14.

Summary of the Adequacy of the Datasets

6.2.20. The datasets used for the development of the transport model, forecasting and economic appraisal were considered fit for use for the Trans-Pennine Upgrade Scheme.

6.2.21. All data received from the traffic survey companies was checked to ensure that the data was suitable for model development. Various types of checks such as outlier removal, range checks and logic checks were undertaken to ensure that the data was fit for purpose.

6.2.22. The external datasets (e.g. WebTRIS and Trafficmaster) were derived from reliable sources and deemed suitable for use in the scheme assessment.

[15] Stage 2 Traffic Forecasting Report: HE551473-ARC-GEN-ZZZ-RP-TR-2029 v02

7. Context for Model Development

7.1. Purpose of the Transport Model Package

7.1.1. The following sections have been taken from the Transport Model Package which was submitted to HE and approved as of 28th May 2021. The document reference is HE551473-BBA-GEN-A57_AL_Scheme_AS-TR-000002.

7.1.2. The purpose of the Transport Model Package is to provide details of the 2015 base year transport model developed for PCF Stage 3 of the Trans-Pennine Upgrade (TPU) A57 link road scheme.

7.2. Background

7.2.1. The base model at PCF Stage 2 of the TPU scheme was developed from the 2015 Trans-Pennine South Regional Traffic Model (TPS RTM). Details of the validated base model developed at PCF Stage 2 are provided in the corresponding Local Model Validation Report (LMVR)[16].

7.2.2. The validated base model developed during PCF Stage 2 has been used as a starting point for the development of the PCF Stage 3 TPU strategic model. Comprehensive details regarding the TPU model specification are outlined in the PCF Stage 2 LMVR, and therefore have not been repeated in the PCF Stage 3 Transport Model Package.

7.2.3. An initial PCF Stage 3 Transport Model Package was produced by Arcadis in November 2018[17]. However, following refinements to the PCF Stage 3 TPU model by Atkins, this has been superseded by the Stage 3 Atkins Traffic Modelling report.

7.2.4. An extensive data collection exercise was not deemed necessary as part of the transport modelling at PCF Stage 3. However, a series of ad-hoc traffic surveys was commissioned to assist with model development as summarised in section 5. Full details of the data used to inform the development of the 2015 base year TPU model are documented in the PCF Stage 3 Supplementary Data Collection Package[18].

7.3. Need for modelling refinement

7.3.1. Initial air quality (AQ) modelling undertaken by Arcadis in July 2018 indicated that an unmitigated TPU scheme could have significant AQ effects and jeopardise the application for development consent. Changes in traffic flow and speed as a result of the scheme were predicted to cause exceedances of the AQ strategy objectives for annual mean nitrogen dioxide (NO2). The primary locations where a negative AQ impact was reported were the village of Tintwistle (A628) and the specific locations on the A57 route through Dinting Vale and Glossop High Street, as shown in Figure 7-1.

[16] Stage 2 TPU LMVR (August 2017): HE551473-ARC-GEN-ZZZ-RP-TR-2017

[17] Stage 3 TPU Transport Model Package (Arcadis, 2018) (superseded): HE551473-ARC-TTM-TPU-RP-TR-3177

[18] Stage 3 TPU Supplementary Data Collection Package (November 2020): HE551473-BBA-GEN-A57_AL_SCHEME-AS-TR-000001

7.3.2. Atkins was commissioned by Highways England to undertake a review of the work done by consultants Arcadis at PCF Stage 3 for the proposed TPU scheme. The aim of this process was to strengthen the robustness of the modelling, under high levels of scrutiny for the Development Consent Order (DCO). Following the presentation of the review findings in the summer of 2019, Atkins was commissioned to implement its recommendations and finalise PCF Stage 3.

7.3.3. As such, details of how the base model has been developed during the finalisation of PCF Stage 3 are provided in section 8, resulting model metrics are shown in section 9 and a summary is presented in section 10.

Figure 7-1 - Air quality issue locations

8. Model development

8.1. Introduction

8.1.1. This section provides details of the base model developments undertaken by Atkins during the finalisation of PCF Stage 3. The changes made to the base year model focus on the known AQ issues in Tintwistle and on Dinting Vale and Glossop High Street (as noted in section 7.3).

8.2. Model Specification

8.2.1. No changes to the model specification have been made since PCF Stage 2. Full details of the model specification are provided in the PCF Stage 2 LMVR (see section 7.2.1).

8.2.2. The TPU model is developed from the TPS RTM, which includes a SATURN (v11.3.12) Highway Assignment Model (HAM) combined with a DIADEM Variable Demand Model (VDM) (DIADEM v6.3.4). Software versions were retained for consistency with the TPS RTM donor model and previous PCF stages.

8.2.3. The TPU base model year is 2015, with average hour peak time periods (AM: 07:00-10:00, IP: 10:00-16:00 and PM: 16:00-19:00).

8.2.4. As shown in Table 8-1, demand for the TPU model is segmented into 10 categories. These are aggregated into five user classifications for the Highway Assignment Model (HAM).

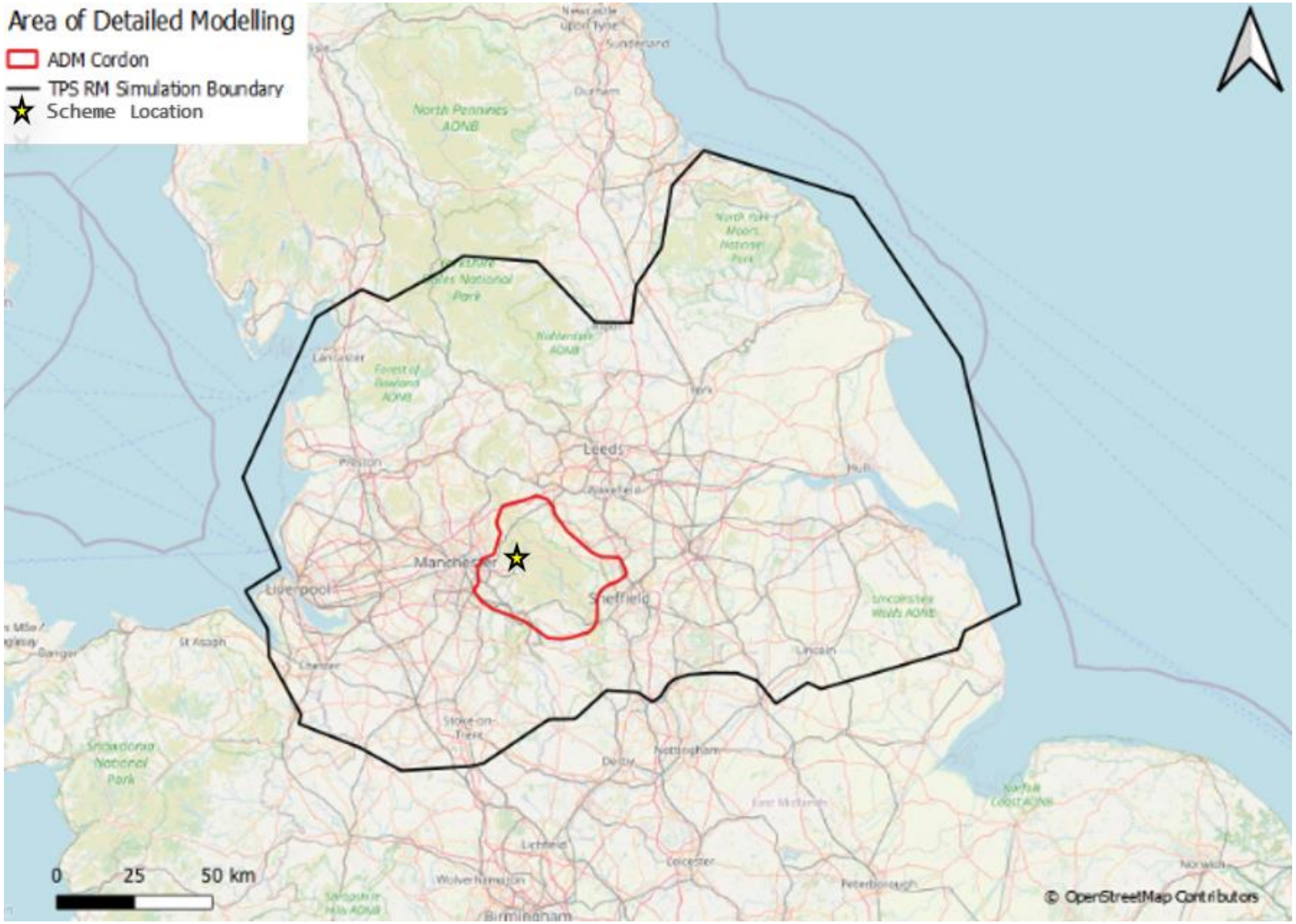
Table 8-1 - TPU base model - user classes

HAM User Class	Demand Segment	Trip Purpose
UC1: Car Business	Home Based Employers' business	HB Employers' business
	Non-Home-Based Employers' business	NHB Employers' business
	Fixed – Employers' business	Employers' business
UC2: Car Commute	Home Based Commute	HB Commute
	Fixed – Commute	Commute
UC3: Car Other	Home Based Other	HB Shopping
		HB Personal business
		HB Recreation/Social
		HB Visiting Friends and Relatives
		HB Holiday/Day Trip
		HB Education
	Non-Home Based Other	NHB Work
		NHB Education
		NHB Shopping

HAM User Class	Demand Segment	Trip Purpose
		NHB Personal business
		NHB Recreation/Social
		NHB Holiday/Day Trip
	Fixed – Other	Others
UC4: LGV	Light Goods Vehicles	Light Goods Vehicles
UC5: HGV	Heavy Goods Vehicles	Heavy Goods Vehicles

8.2.5. The simulation boundary of the TPS RTM has been retained, but the focus of the TPU model is concentrated on the Area of Detailed Modelling (ADM) highlighted in Figure 8-1.

Figure 8-1 - Area of Detailed Modelling (ADM) - TPU PCF Stage 3



8.3. Prior matrices

8.3.1. The prior matrices developed during PCF Stage 2 have been retained as a starting point for PCF Stage 3. Full details of the prior matrices are provided in the PCF Stage 2 LMVR.

8.3.2. However, the granularity and network connectivity of certain zones in and around Glossop has been improved to give a more accurate reflection of vehicle loading in the local area.

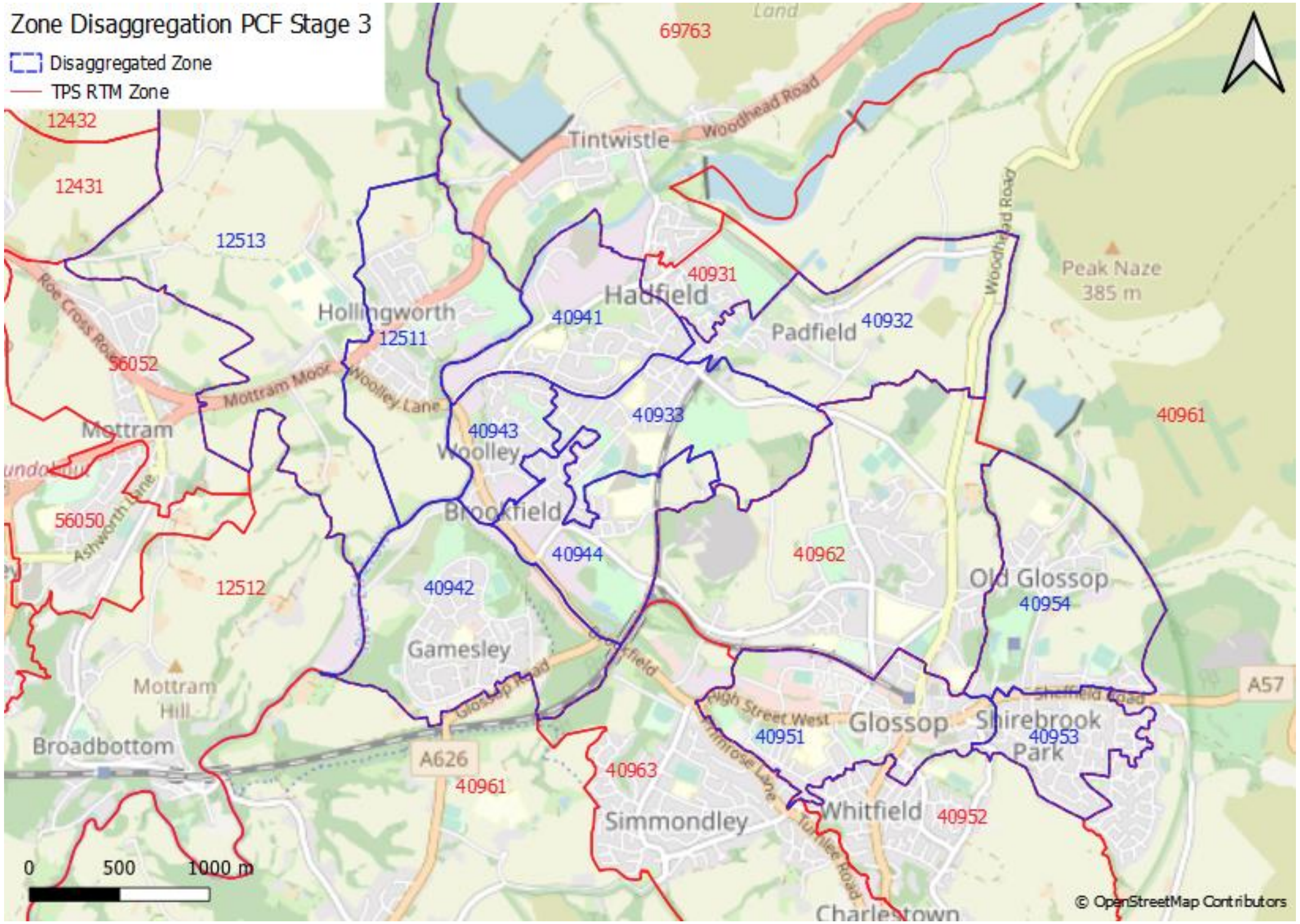
8.3.3. The zoning system for TPS RTM is derived through an aggregation of Office for National Statistics (ONS) Output Areas (OAs). Several zones in Stage 3 have been disaggregated into smaller sets of OAs to form new zones using the ONS 2011 Census population data (KS101EW: usual resident population) obtained at OA level. Origin and destination trip end totals of existing zones (Stage 2) have been applied a factor based on the proportional population split of the disaggregated zones (Stage 3). Therefore, the disaggregated zones (Stage 3) fit seamlessly within the existing zones (Stage 2) as all follow OA boundaries.

8.3.4. Table 8-2 provides details of the zones disaggregated in the local area, whilst Figure 8-2 provides a visual representation.

Table 8-2 - Zone disaggregation - PCF Stage 3

Existing Zone – Stage 2	Disaggregated Zone – Stage 3	Location	Description
40951	40951, 40953, 40954	Glossop	Glossop has been split into three zones: old Glossop, east Glossop and central Glossop.
40941	40941, 40943	Hadfield	Hadfield has been split into two zones: north Hadfield and south Hadfield.
40942	40942, 40944	Gamesley	This zone has been split into two zones: one represents Gamesley village, whilst the other represents Brookfield and the area surrounding the Carpenter industrial site.
40932	40932, 40933	Padfield	This zone has been split into two zones: one represents Padfield north of Park Road, whilst the other represents the area adjacent to Newshaw Lane.
12511	12511, 12513	Hollingworth	Hollingworth has been split into two zones: Hollingworth village and Hollingworth rural

Figure 8-2 - Zone disaggregation



8.4. Highway network

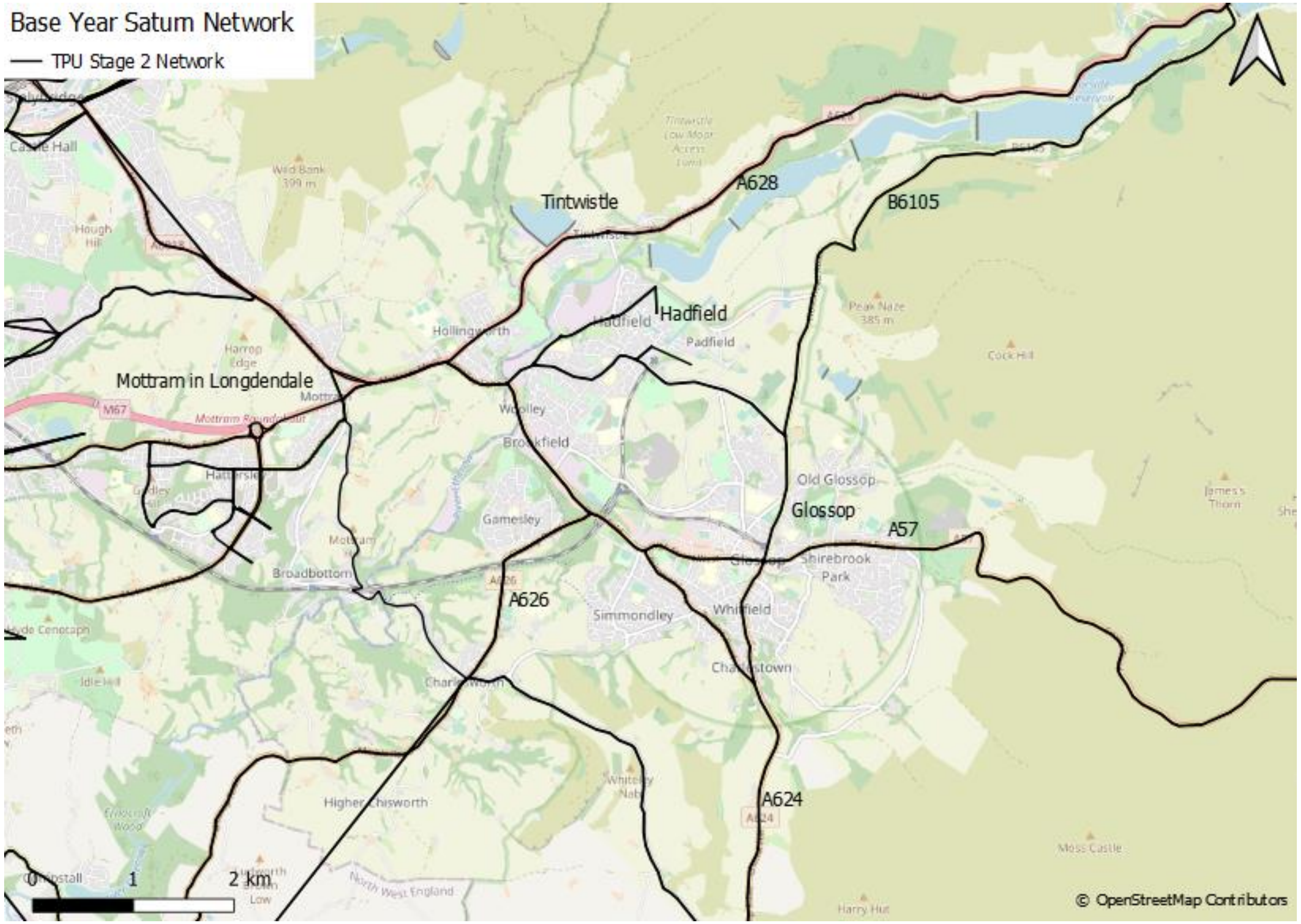
8.4.1. Improvements to the highway network coding around Mottram and Glossop have been made during PCF Stage 3.

8.4.2. Figure 8-3 highlights the section of the TPU Stage 2 model that has been the focus of the highway network enhancements.

8.4.3. Details of the changes to the highway network implemented during PCF Stage 3 are summarised below. This includes increasing the level of detail, ensuring coding consistency and adherence to best practice guidance.

8.4.4. Full details of the network audit process undertaken prior to PCF Stage 3 are provided in the PCF Stage 2 LMVR.

Figure 8-3 - Base year SATURN network in the Mottram and Glossop area – PCF Stage 2



Network checks

8.4.5. At PCF Stage 3, a thorough network checking exercise was undertaken in the Mottram and Glossop area (Figure 8-2). The network audit procedure involved conducting checks at the junction level for all nodes included in the Mottram and Glossop area. Highways England's Regional Traffic Models' coding manual was used to check the following network properties:

- Junction type;
- Number of approach arms;
- Number of lanes;
- Link length;
- Free-flow speeds and speed-flow curves;
- Lane allocation;
- Turn saturation flows;
- Stacking capacity;
- Circulating capacity at roundabouts;
- GAP values;
- Priority markers; and
- Flare markers.

8.4.6. The audit procedure informed a range of enhancements to the PCF Stage 3 TPU transport model, including the following:

- Modification of saturation flows at junctions that were not consistent with RTM coding. Turning capacities at various junctions were modified to accurately reflect the infrastructure on the ground.
- Accurate representation of flare capacities to avoid a misrepresentation of junction capacity.
- Modification of free-flow speeds where they were shown to be in excess of the posted speed limit.
- There were numerous pedestrian crossings and signalised junctions on the A57 between A626 Glossop Road and A624/B6105 Glossop Crossroads that were not taken account of in the model, which contributed to the underrepresentation of congestion in the base year model. A review was undertaken to identify those which were most likely to impact congestion, and code them into the model.

Network detail

8.4.7. The highway network detail representative of Glossop has been increased during PCF Stage 3. The coded network inherited by Atkins consisted of key routes through the Mottram and Glossop area (A57, A624, A626, A628 and B6105), yet there was scope to better replicate alternative routes through the local area. Consideration was given to avoid the inclusion of disproportionate detail, whilst additional data was collected to inform the additional network coding.

8.4.8. To provide a more accurate reflection of base year network performance in the local area, the following network detail has been included in the PCF Stage 3 TPU model. The locations of these changes are highlighted in Figure 8-4.

- Ellison Street between the B6105 and the High Street East (A57).
  - Vehicles on the B6105 (SB) travelling towards Sheffield Road (A57) (and vice versa) can bypass the signalised junction at Glossop Crossroads by travelling via Ellison Street. Ellison Street effectively acts as a rat-run to avoid peak period congestion at the Glossop Crossroads signals.
- Shaw Lane / Newshaw Lane / Green Lane
  - Offers vehicles access between the A57 and Hadfield Road, in addition to Dinting Road. This link road is important to ensure the level of demand replicated on the A57 is comparable to observed data.

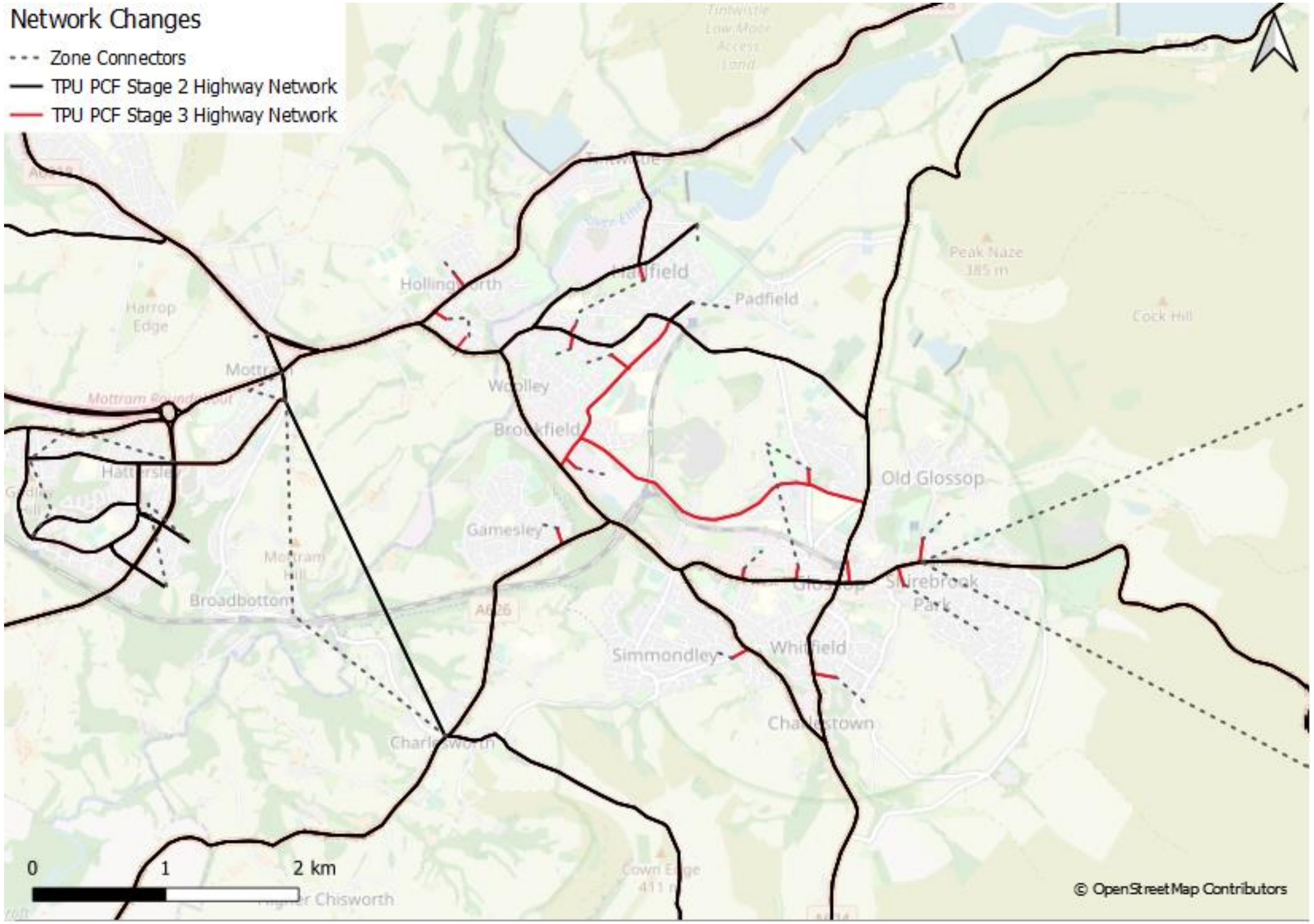
- Dinting Road
  - In conjunction with Shaw Lane, Dinting Road is an alternative route to the A57. It is important to capture possible alternative routes when assessing the impact of the TPU scheme.

8.4.9. In addition to the enhanced network detail, several structural changes have been made to support the zone disaggregation specified in Table 8-2. To ensure the model better reflects observed data in the local area, zones that connected directly to the highway network by straddling links, were converted to stub connectors. Details are outlined in Table 8-3.

Table 8-3 – Zone connectors – PCF Stage 3

Zone	Location	Description
40951	Glossop	Stub connector located on High Street West (A57) near the Glossop Brook Road junction.
40962	Glossop	Two stub connectors: one located on High Street West (A57) near the Arundel Street junction, the other on Dinting Road near the North Street junction.
40963	Glossop	Stub connector located on Primrose Lane near the Simmondley New Road junction.
40952	Glossop	Stub connector located on Victoria Street (A624) near the Whitfield Avenue junction.
40953	Glossop	Stub connector located on High Street East (A57) near the Shirebrook Drive junction.
40954	Glossop	Stub connector located on High Street East (A57) near the Manor Park Road junction.
40942	Gamesley	Stub connector located on the A626 (Glossop Road) at the entrance of Gamesley village.
40944	Brookfield	Stub connector located on Shaw Lane at the entrance of the Carpenter industrial site.
40933	Hadfield	Stub connector located on Newshaw Lane near the Lower Barn Road junction.
40941	Hadfield	Two stub connectors: one located on Hadfield Road near the Carriage Drive junction, the other on Woolley Bridge Road near the Waterside junction.
40943	Hadfield	Stub connector located on Hadfield Road near the Higher Barn Road junction.
12511	Hollingworth	Two stub connectors: one located on Woolley Lane (A57) near the Earnshaw Street junction, the other on Market Street (A628) at the Taylor Street junction.
12513	Hollingworth	Stub connector located on Market Street near the Green Lane junction.

Figure 8-4 - Base year highway network detail – PCF Stage 3



8.5. Data

8.5.1. Additional classified turning counts (CTC) were undertaken in September 2019 to help improve model validation and support the inclusion of the network enhancements presented in Figure 8-4. The locations of the additional counts are shown in Figure 8-5. Further details are provided in the aforementioned 'Supplementary Data Collection Package' (PCF Stage 3) issued in November 2020.

8.5.2. The enhancements of the model were focused on replicating observed journey times on the key sections of the A57 and A628 in the localised study area. As such, an additional journey time validation route has been included, which is described as the 'Hadfield Alternative'. Figure 8-6 presents the journey time routes used to validate the TPU Stage 3 base model.

Figure 8-5 - Survey Locations in Glossop (2019)

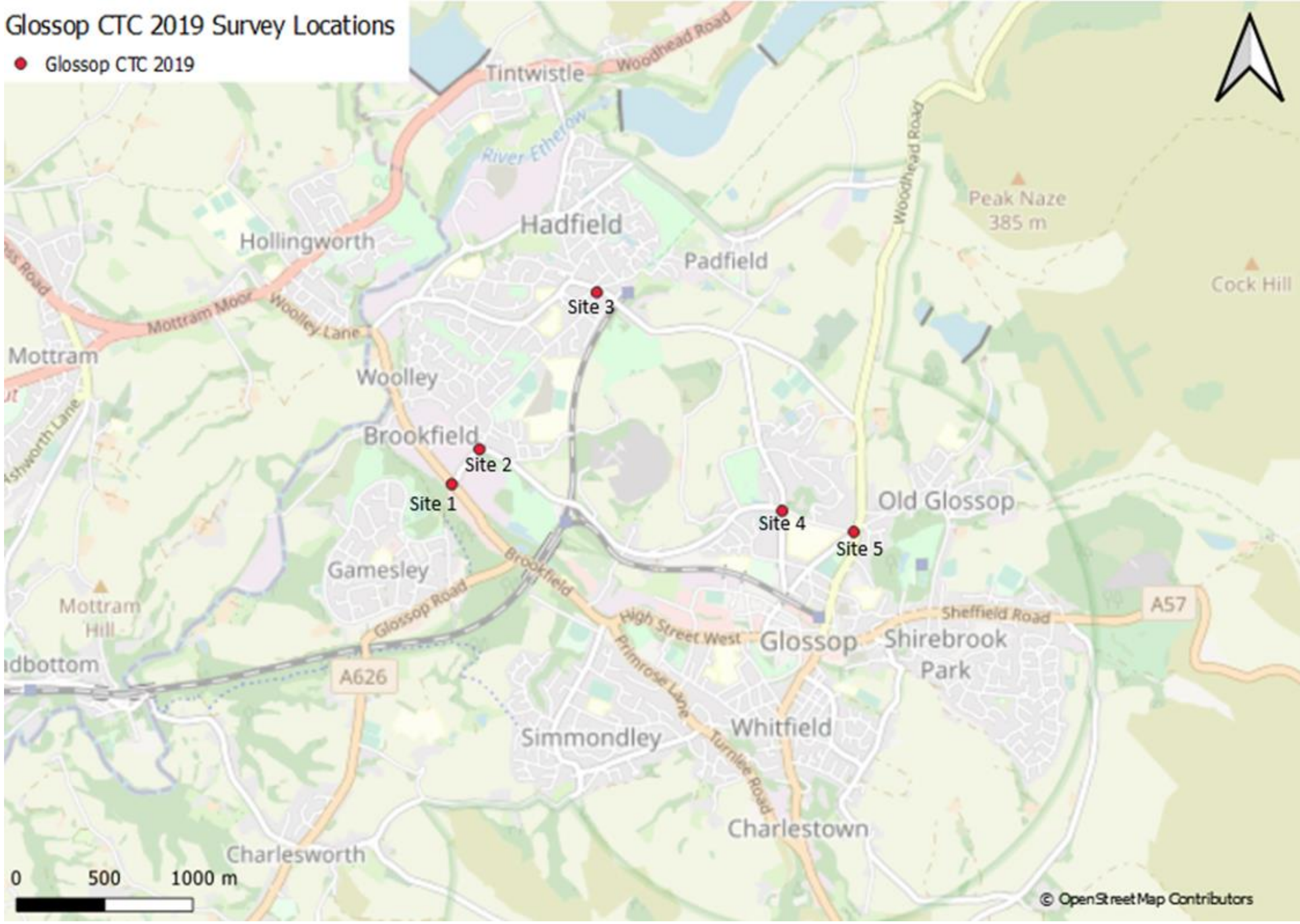
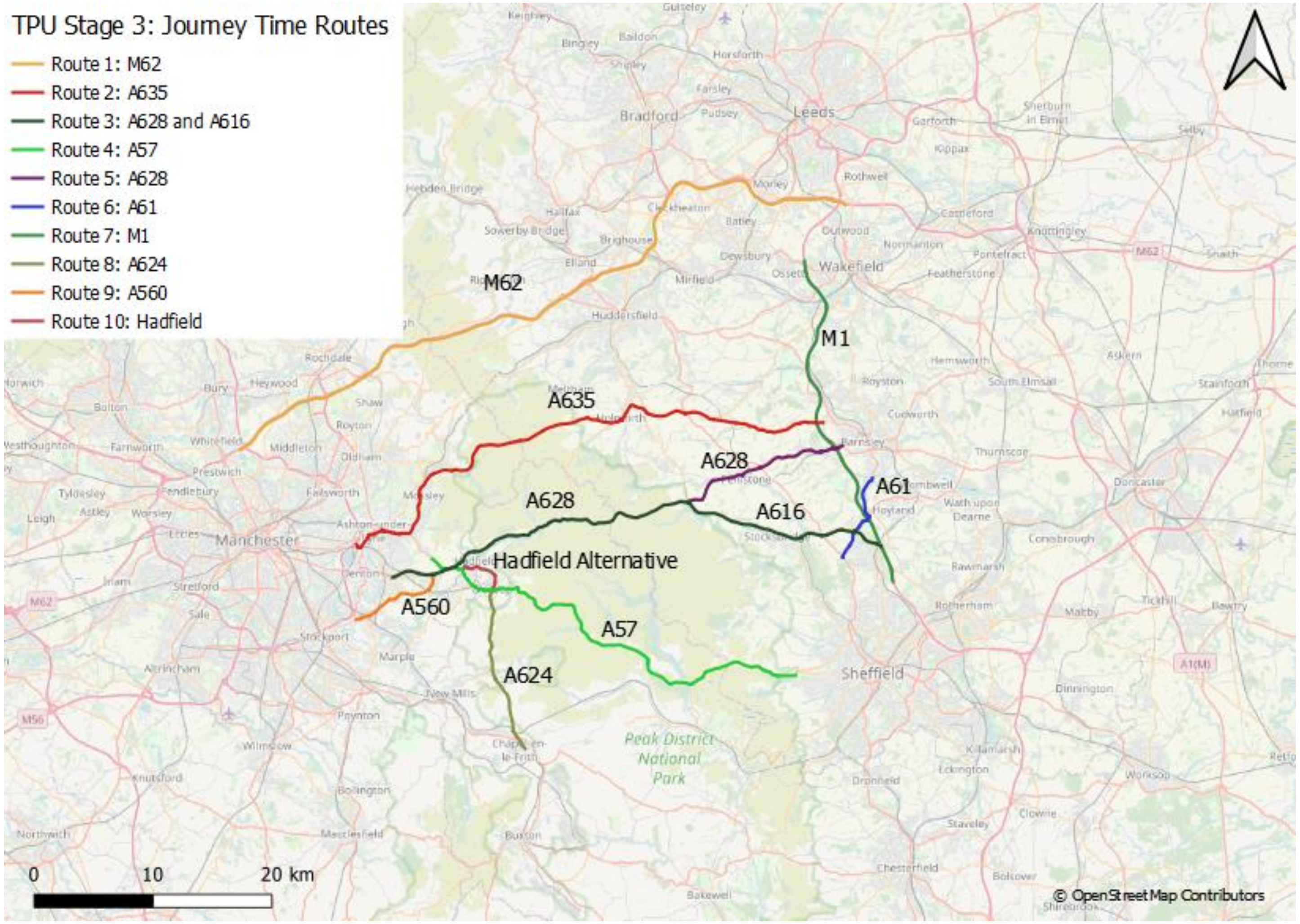


Figure 8-6 - Journey Time Validation Routes - PCF Stage 3



8.6. Value of Time (VoT) and Vehicle Operating Costs (VOC)

8.6.1. The base year Vehicle Operating Costs (VOC) and Value of Time (VoT) were updated using the then latest available TAG Databook v1.12, May 2019.

9. Model Calibration / Validation

9.1.1. This section provides details of the base model results that were submitted for approval. A summary of the following is provided in the main body, whilst full details are provided in Appendix B.

- Trip Ends
- Highway matrices – impact of Matrix Estimation (ME)
- Screenline flow calibration
- Link flow calibration
- Journey time validation
- Convergence
- Demand model parameters
- Demand model matrices
- Realism tests (highway and Public Transport (PT))

9.1.2. No changes to the modelling methodology have been made since PCF Stage 2. Full details of the methodology are provided in the PCF Stage 2 LMVR (see section 1.2.1).

9.2. Trip ends

9.2.1. The prior matrices used in PCF Stage 3 were mainly retained from PCF Stage 2 (which were derived from the TPS RTM prior matrices), with some additional zone disaggregation. Details of the prior matrices and disaggregation are provided in section 8.3.

9.3. Highway matrices – Matrix Estimation

9.3.1. This section provides a summary of the changes induced by Matrix Estimation (ME) between the prior demand matrices and the post-ME demand matrices. Table 9-1 provides an overview of the standards used to assess the change in demand induced by ME, as specified in unit M3.1 of the TAG guidance.

Table 9-1 – Significance of matrix estimation changes criteria (TAG unit M3.1)

Measure	Criteria
Matrix zonal cell values	Slope within 0.98 and 1.02 Intercept near zero R^2 in excess of 0.95
Matrix zonal trip ends	Slope within 0.99 and 1.01 Intercept near zero R^2 in excess of 0.98
Trip length distributions	Means within 5% Standard deviations within 5%
Sector to sector level matrices	Differences within 5%

Matrix totals

9.3.2. Table 9-2 to Table 9-4 compare matrix totals by user class between the prior and post-ME matrices. ME has induced a change in matrix totals of 0.7% in the AM peak, 1.0% in the IP and 0.6% in the PM peak.

9.3.3. ME was undertaken individually for each vehicle type (i.e. car, LGV and HGV), as specified in the PCF Stage 2 LMVR (see section 7.2.1). The percentage change between the prior and post-ME matrices for Car Business and HGV user classes is between 2.5% to 3.9% for all time periods. For all other user classes, the change is less than 1.0% across all time periods.

Table 9-2 – Comparison of matrix totals: prior vs. post-ME – TPU PCF Stage 3 (AM peak)

User Class	Prior	Post-ME	Difference	Difference (%)
UC1: Car Business	311,344	323,497	12,153	3.9%
UC2: Car Commute	2,368,169	2,379,531	11,362	0.5%
UC3: Car Other	2,134,824	2,138,375	3,551	0.2%
UC4: LGV	602,498	607,454	4,956	0.8%
UC5: HGV	315,974	326,182	10,208	3.2%
Total	5,732,809	5,775,038	42,229	0.7%

Table 9-3 – Comparison of matrix totals: prior vs. post-ME – TPU PCF Stage 3 (IP)

User Class	Prior	Post-ME	Difference	Difference (%)
UC1: Car Business	335,075	345,966	10,891	3.3%
UC2: Car Commute	904,759	912,475	7,717	0.9%
UC3: Car Other	2,705,499	2,723,031	17,532	0.6%
UC4: LGV	553,396	557,004	3,609	0.7%
UC5: HGV	328,663	337,965	9,302	2.8%
Total	4,827,391	4,876,442	49,052	1.0%

Table 9-4 – Comparison of matrix totals: prior vs. post-ME – TPU PCF Stage 3 (PM peak)

User Class	Prior	Post-ME	Difference	Difference (%)
UC1: Car Business	335,290	343,553	8,263	2.5%
UC2: Car Commute	2,229,458	2,238,061	8,603	0.4%
UC3: Car Other	3,044,206	3,052,442	8,236	0.3%
UC4: LGV	585,689	590,202	4,513	0.8%
UC5: HGV	231,703	237,607	5,904	2.5%
Total	6,426,347	6,461,866	35,519	0.6%

Regression analysis

9.3.4. Regression analysis of the prior and post-ME matrices is undertaken for individual cells (i.e. ij pairs) and trip ends (i.e. origin and destination zone totals). Table 9-5 compares the TPU PCF Stage 3 prior and post-ME matrices for all trips across the model, whilst Table 9-6 only includes ij pairs with less than 500 trips.

9.3.5. All values adhere to TAG guidance except the intercept values for trip ends. Defining 'near zero' as up to 5.0 trips, the intercept values satisfy the TAG criteria except for the destination trip ends in the AM and PM peak periods. Therefore, a comparison of the prior and post-ME matrices from the TPS RTM have also been provided (Table 9-7 and Table 9-8).

9.3.6. The regression analysis presented for TPU PCF Stage 3 is comparable to the TPS RTM. The intercepts of the destination trip ends in the TPS RTM are also not near to zero. However, the values presented for TPU PCF Stage 3 are a slightly better fit compared to the TPS RTM. This suggests that the ME process adopted for TPU has induced a level of change comparable to the TPS RTM donor model.

Table 9-5 - Comparison of matrix cell values and trip ends (all trips) – TPU PCF Stage 3

	Measures	TAG Criteria (M3.1)	AM	IP	PM
Zonal cell values – ij pairs	Slope	Between 0.98 to 1.02	1.00	1.00	1.00
	Intercept	Near to Zero	0.00	0.00	0.00
	R^2	>0.95	1.00	1.00	1.00
Trip ends - origin	Slope	Between 0.99 to 1.01	1.00	1.00	1.00
	Intercept	Near to Zero	4.09	4.77	3.44
	R^2	>0.98	1.00	1.00	1.00
Trip ends - destination	Slope	Between 0.99 to 1.01	1.00	1.00	1.00
	Intercept	Near to Zero	20.22	3.67	6.74
	R^2	>0.98	1.00	1.00	1.00

Table 9-6 - Comparison of matrix cell values and trip ends (less than 500 trips) – TPU PCF Stage 3

	Measures	TAG Criteria (M3.1)	AM	IP	PM
Zonal cell values – ij pairs	Slope	Between 0.98 to 1.02	1.00	1.00	1.00
	Intercept	Near to Zero	0.00	0.00	0.00
	R^2	>0.95	0.99	1.00	1.00
Trip ends - origin	Slope	Between 0.99 to 1.01	1.01	1.02	1.00
	Intercept	Near to Zero	2.55	2.26	3.89
	R^2	>0.98	0.99	1.00	0.99
Trip ends - destination	Slope	Between 0.99 to 1.01	1.00	1.02	1.01
	Intercept	Near to Zero	9.24	4.41	9.15
	R^2	>0.98	0.99	1.00	1.00

Table 9-7 - Comparison of matrix cell values and trip ends (all trips) – TPS RTM

	Measures	TAG Criteria (M3.1)	AM	IP	PM
Zonal cell values – ij pairs	Slope	Between 0.98 to 1.02	1.00	1.00	1.00
	Intercept	Near to Zero	0.00	0.00	0.00
	R^2	>0.95	1.00	1.00	1.00
Trip ends - origin	Slope	Between 0.99 to 1.01	1.00	1.00	1.00
	Intercept	Near to Zero	3.94	4.52	3.25
	R^2	>0.98	1.00	1.00	1.00
Trip ends - destination	Slope	Between 0.99 to 1.01	1.00	1.00	1.00
	Intercept	Near to Zero	19.44	22.38	15.84
	R^2	>0.98	1.00	1.00	1.00

Table 9-8 - Comparison of matrix cell values and trip ends (less than 500 trips) – TPS RTM

	Measures	TAG Criteria (M3.1)	AM	IP	PM
Zonal cell values – ij pairs	Slope	Between 0.98 to 1.02	1.00	1.00	1.00
	Intercept	Near to Zero	0.00	0.00	0.00
	R^2	>0.95	1.00	1.00	1.00
Trip ends - origin	Slope	Between 0.99 to 1.01	1.01	1.02	1.00
	Intercept	Near to Zero	2.26	2.00	3.42
	R^2	>0.98	0.99	1.00	1.00
Trip ends - destination	Slope	Between 0.99 to 1.01	1.01	1.02	1.01
	Intercept	Near to Zero	15.85	12.65	8.53
	R^2	>0.98	0.99	1.00	1.00

Sectored matrices

9.3.7. In considering the changes induced by ME at a sector to sector level it is important to avoid highlighting large percentage differences which represent only a small number of trips. As such, sector to sector movements with less than 100 trips in the prior matrix have been excluded from the analysis. In line with the TPS RTM donor model, the GEH statistic has also been assessed, along with the proportion of movements with less than ±10% change. The GEH statistic assessment does not exclude movements with less than 100 trips, as the purpose of the statistic is to provide a method to compare traffic flow changes regardless of flow volume scale.

9.3.8. The TPU PCF Stage 3 prior and post-ME matrices have been aggregated into 17 sectors for comparison. The 17-sector system is presented in Figure 9-1.

9.3.9. Table 9-9 provides a summary of the changes induced by ME in the TPU PCF Stage 3 model at a sector level, whilst sectored tabulations of percentage change and GEH are presented in Appendix B The sectoral analysis for TPU Stage 3 shows that most of the sectors are within a GEH range of 5 (~80%) across all time periods.

9.3.10. The equivalent analysis for the TPS RTM has also been undertaken to identify whether a similar scale of change was recorded (Table 9-10) (sectored tabulations of percentage change and GEH are presented in Appendix B.

9.3.11. The sectored analysis presented suggests that the ME process adopted for TPU has induced a level of change comparable to the TPS RTM donor model.

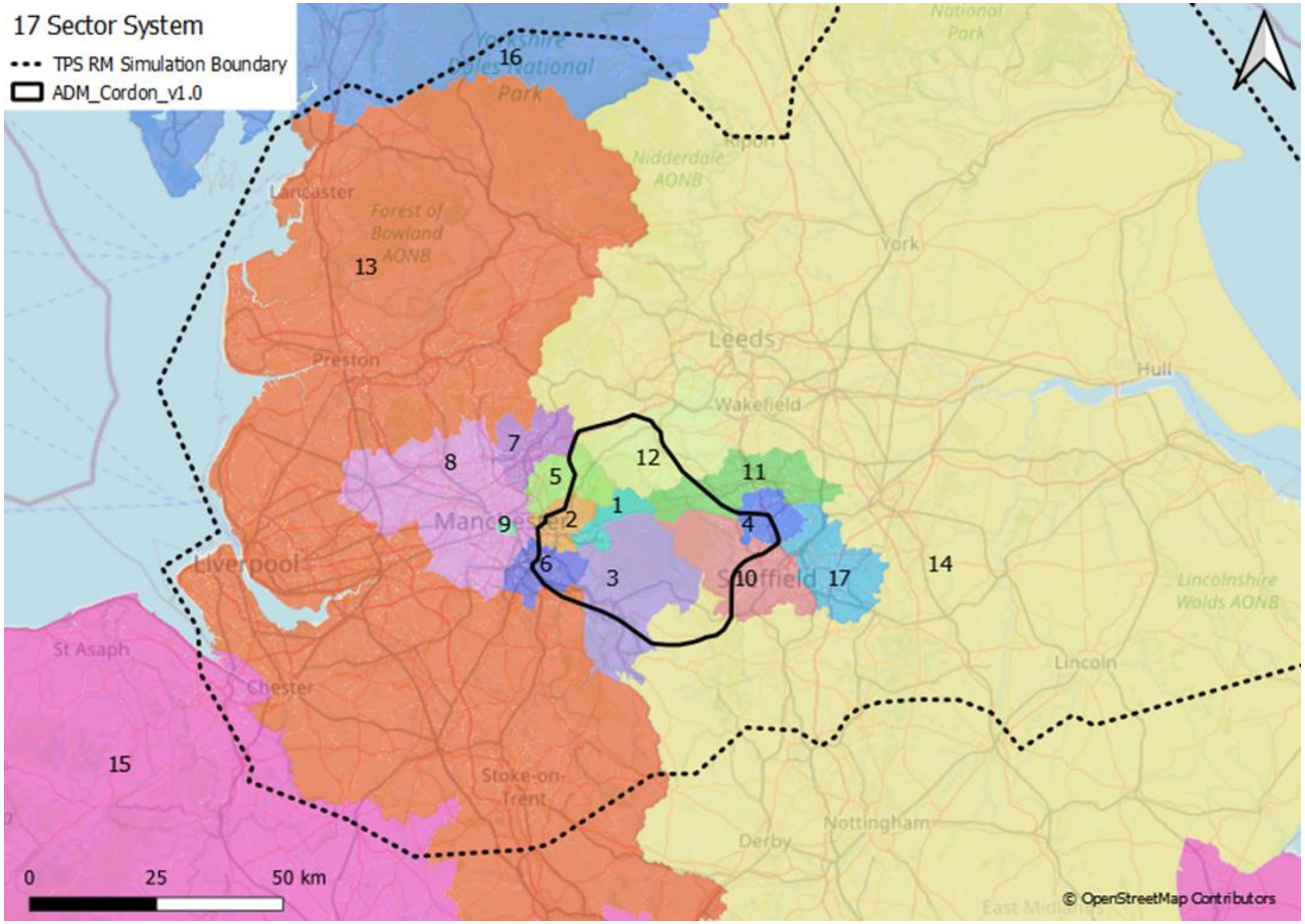
Table 9-9 - Comparison of sectored trip matrices: prior vs. post-ME – TPU PCF Stage 3

Time Period	No. Cells with >100 Trips	% Cells with <5% change	% Cells with <10% change	% Cells with GEH <5 change
AM	134	33%	54%	78%
IP	136	33%	49%	80%
PM	130	33%	53%	78%

Table 9-10 - Comparison of sectored trip matrices: prior vs. post-ME – TPS RTM

Time Period	No. Cells with >100 Trips	% Cells with <5% change	% Cells with <10% change	% Cells with GEH <5 change
AM	133	35%	56%	80%
IP	136	37%	58%	83%
PM	133	34%	59%	79%

Figure 9-1 - 17-sector system



Trip Length Distribution (TLD)

9.3.12. The trip length distribution of post-ME matrices has been compared with the corresponding prior matrices to ensure that trip lengths haven't been significantly modified by ME. The TLD analysis has been presented following two different methodologies:

- The TAG compliant methodology that considers all ij pairs that are permitted to change as a result of running ME; and
- An alternative methodology, which involves the exclusion of external trips between zones in the model buffer area. With this method, in separately considering the matrix elements that have an origin trip end in the internal area and a destination trip end in the internal model area will in practice double count the internal-internal trips within the model simulation area.

9.3.13. Table 9-11 to Table 9-13 provide the TAG compliant comparison of trip length distributions between the TPU PCF Stage 3 prior and post-ME matrices across all ij pairs, by vehicle type. This shows that all values adhere to TAG guidance (Table 9-1).

Table 9-11 - TAG compliant comparison of mean and standard deviation (Std) TLD: prior vs. post-ME – TPU PCF Stage 3 (AM peak)

	Prior Distance (kms)		Post Distance (kms)		Change (%)	
Vehicle Type	Mean	Std	Mean	Std	Mean	Std
1 Car	13.5	39.4	13.7	39.8	1.9%	1.1%
2 LGV	16.6	44.5	16.9	44.8	1.9%	0.7%
3 HGV	55.2	87.0	55.1	86.1	0.0%	-1.0%
Total	16.1	44.9	16.4	45.3	1.9%	0.8%

Table 9-12 - TAG compliant comparison of mean and standard deviation (Std) TLD: prior vs. post-ME – TPU PCF Stage 3 (IP)

	Prior Distance (kms)		Post Distance (kms)		Change (%)	
Vehicle Type	Mean	Std	Mean	Std	Mean	Std
1 Car	9.5	34.4	9.7	34.6	2.2%	0.6%
2 LGV	15.1	43.6	15.2	43.7	0.8%	0.3%
3 HGV	55.0	88.2	54.9	87.2	-0.2%	-1.1%
All	13.3	42.9	13.5	43.0	1.7%	0.2%

Table 9-13 - TAG compliant comparison of mean and standard deviation (Std) TLD: prior vs. post-ME – TPU PCF Stage 3 (PM peak)

	Prior Distance (kms)		Post Distance (kms)		Change (%)	
Vehicle Type	Mean	Std	Mean	Std	Mean	Std
1 Car	12.3	38.1	12.5	38.5	2.0%	1.1%
2 LGV	15.8	43.8	16.4	44.5	3.6%	1.6%
3 HGV	54.5	86.8	54.7	86.5	0.4%	-0.3%
All	14.1	42.1	14.4	42.5	2.1%	1.1%

9.3.14. Table 9-14 to Table 9-16 provide the alternative comparison of trip length distributions between the TPU PCF Stage 3 prior and post-ME matrices, by vehicle type. As aforementioned, this process excludes external trips between zones in the model buffer area and doubles internal trips within the model simulation area.

9.3.15. In comparison to the TAG compliant methodology that considers all ij pairs in the matrices, mean and standard deviation trip lengths are lower for all vehicle types. This is attributable to the exclusion of longer distance trips between larger external zones and the doubling of shorter distance internal trips.

9.3.16. This alternative approach to calculating the TLD does not meet TAG criteria, with mean trip length changes for all vehicle types ranging between 8-11% (AM: 9.1%, IP: 8.1%, PM: 10.6%).

Table 9-14 - Alternative comparison of mean and standard deviation (Std) TLD: prior vs. post-ME – TPU PCF Stage 3 (AM peak)

	Prior Distance (kms)		Post Distance (kms)		Change (%)	
Vehicle Type	Mean	Std	Mean	Std	Mean	Std
1 Car	9.2	19.7	10.0	21.6	7.7%	9.6%
2 LGV	13.6	25.4	15.3	26.7	12.8%	5.4%
3 HGV	48.7	57.0	47.1	55.0	-3.3%	-3.5%
All	11.3	24.5	12.3	26.3	9.1%	7.3%

Table 9-15 - Alternative comparison of mean and standard deviation (Std) TLD: prior vs. post-ME – TPU PCF Stage 3 (IP)

	Prior Distance (kms)		Post Distance (kms)		Change (%)	
Vehicle Type	Mean	Std	Mean	Std	Mean	Std
1 Car	7.5	19.8	8.2	21.0	8.2%	6.0%
2 LGV	12.5	26.5	13.0	26.9	4.4%	1.5%
3 HGV	48.6	59.7	47.2	57.6	-3.0%	-3.6%
All	9.8	25.4	10.6	26.4	8.1%	4.2%

Table 9-16 - Alternative comparison of mean and standard deviation (Std) TLD: prior vs. post-ME – TPU PCF Stage 3 (PM peak)

	Prior Distance (kms)		Post Distance (kms)		Change (%)	
Vehicle Type	Mean	Std	Mean	Std	Mean	Std
1 Car	8.3	18.7	9.0	20.9	9.3%	11.4%
2 LGV	12.6	25.1	15.8	28.6	25.9%	13.8%
3 HGV	44.1	54.7	43.6	54.8	-1.2%	0.2%
All	9.6	22.0	10.6	24.2	10.6%	9.9%

9.3.17. This analysis shows the TAG method of assessing the impact of matrix estimation on TLD is within criteria across the whole model area, whilst the analysis of the subset within the simulation area shows greater change beyond the prescribed 5%, particularly for the LGV movements in the PM peak. It is likely the prior data for more localised LGV in this (and the other) time period is taken from a small sample and hence liable to need additional matrix estimation.

9.4. Screenline flow calibration

9.4.1. As part of the matrix calibration process for TPU PCF Stage 3, 10 screenlines have been defined within the ADM (Figure 8-1). Figure 9-2 identifies the location of the flow screenlines used to calibrate the model.

9.4.2. To improve the fit between modelled and observed data in the localised area, all screenlines and additional count data have been included in the matrix estimation process as calibration counts. As specified in TAG unit M3.1, it is possible to include data that would otherwise form independent validation data, into the calibration to further refine the model.

9.4.3. Table 9-17 describes the screenline flow calibration criterion and acceptability guidelines provided by TAG unit M3.1.

Table 9-17 - Screenline flow calibration criterion (TAG unit M3.1)

Criteria	Guideline
Differences between modelled flows and counts should be less than 5% of the counts	All or nearly all screen-lines (95%)

9.4.4. Table 9-18 and Table 9-19 present a high-level summary of the number of screenlines that meet TAG criteria (unit M3.1) in the prior and post-ME assignments, by vehicle type. For indicative purposes only, and to maintain consistency with the Stage 2 LMVR, the former DMRB GEH criteria has also been included (GEH <4). Note that the DMRB is no longer relevant in this context, and the source of model development guidance is now TAG.

9.4.5. The results indicate that the calibration screenlines correlate well with observed data, with 100% of screenlines meeting TAG criteria across all screenlines and time periods (all vehicles) in the post-ME assignment.

9.4.6. Full details of individual screenlines are presented in Appendix B.

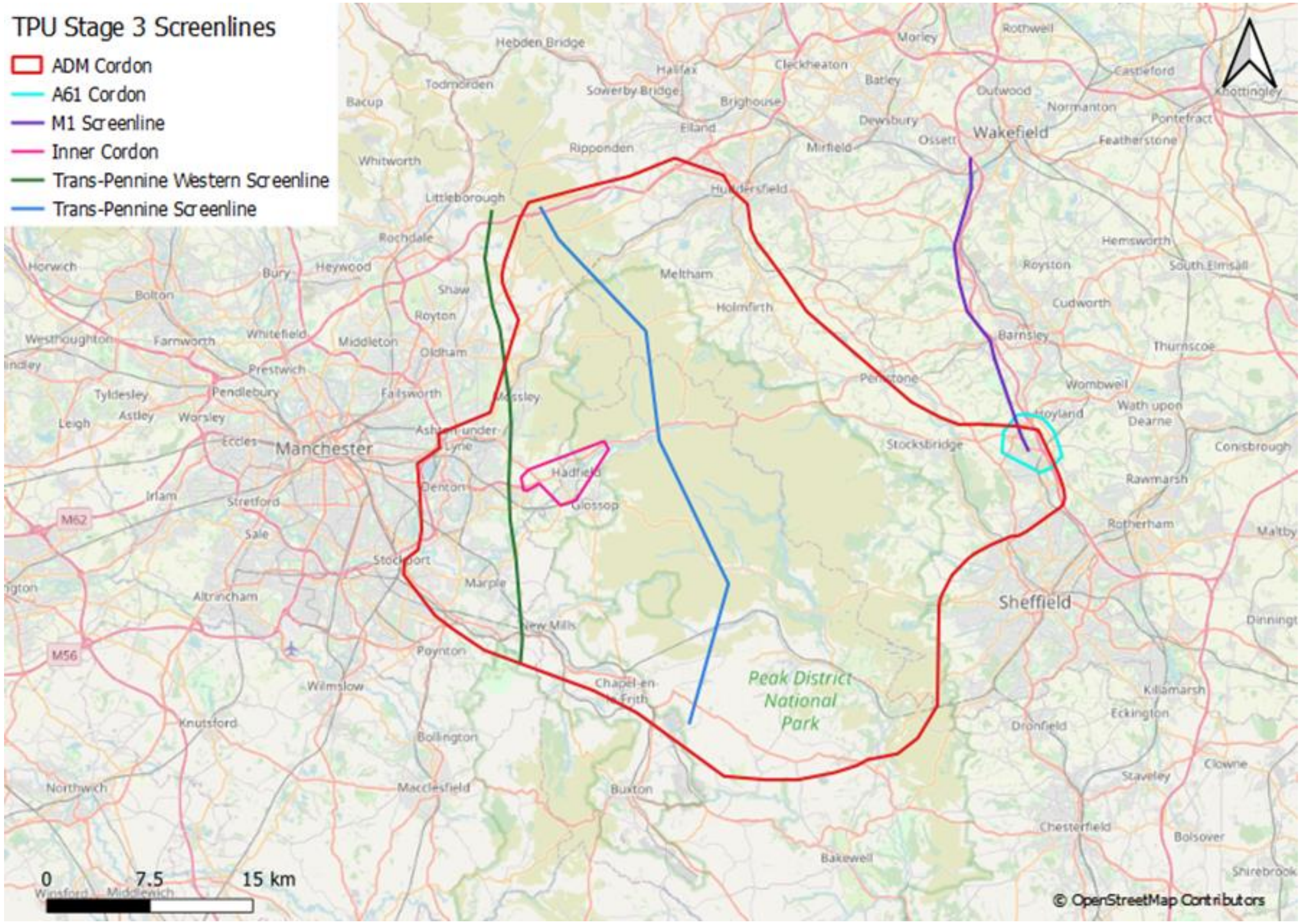
Table 9-18 - TPU PCF Stage 3 calibration screenline summary: prior

Time Period	Screenlines	% of screenlines pass TAG criteria (within 5% difference in flow)				% of screenlines pass DMRB criteria (GEH <4)			
		Car	LGV	HGV	All	Car	LGV	HGV	All
AM	10	0%	0%	0%	10%	10%	40%	60%	20%
IP	10	30%	0%	10%	10%	30%	30%	20%	0%
PM	10	10%	10%	30%	20%	10%	50%	40%	30%

Table 9-19 - TPU PCF Stage 3 calibration screenline summary: post-ME

Time Period	Screenlines	% of screenlines pass TAG criteria (within 5% difference in flow)				% of screenlines pass DMRB criteria (GEH <4)			
		Car	LGV	HGV	All	Car	LGV	HGV	All
AM	10	100%	60%	70%	100%	100%	90%	100%	90%
IP	10	90%	90%	70%	100%	100%	100%	80%	100%
PM	10	100%	70%	50%	100%	100%	100%	90%	100%

Figure 9-2 - Flow calibration screenlines and cordons – TPU PCF Stage 3



9.5. Link flow calibration

9.5.1. In addition to an evaluation at a screenline level, modelled flows have been compared against observed data at an individual link level.

9.5.2. Table 9-20 describes the link flow calibration criteria and acceptability guidelines provided by TAG unit M3.1.

Table 9-20 – Link flow and turning movement calibration criteria (TAG unit M3.1)

Criteria	Description of Criteria	Guideline
1	Individual flows within 100 veh/h of counts for flows less than 700 veh/h	> 85% of cases
	Individual flows within 15% of counts for flows from 700 to 2,700 veh/h	
	Individual flows within 400 veh/h of counts for flows more than 2,700 veh/h	
2	GEH < 5 for individual flows	> 85% of cases

9.5.3. Table 9-21 to Table 9-26 present a high-level summary of the number of links that meet TAG criteria in the prior and post-ME assignments.

9.5.4. Links have been split into those that form the calibration screenlines (Figure 9-2), link counts derived from classified turning counts undertaken in Glossop during September 2019 (Figure 5-4) and all 'other' counts that were used in model calibration. Full details of the data used to inform the development of the 2015 base year TPU model are documented in the PCF Stage 3 Supplementary Data Collection Package (see section 7.2.4).

9.5.5. In comparing observed and modelled link flow data, TAG (unit M3.1) states that the model is required to meet either the flow or GEH criteria.

9.5.6. As such, the results indicate that the calibration counts correlate well with observed data at the individual link level, with at least 84% of counts meeting TAG criteria across each modelled time period of the post-ME assignments.

9.5.7. Full details of the individual link flows are included in Appendix B.

Table 9-21 - TPU PCF Stage 3 calibration link flow summary: prior (AM peak)

Link Type	Number of Links	Flow		GEH		Either (Flow or GEH)	
		Total	%	Total	%	Total	%
All screenline counts	106	78	74%	70	66%	79	75%
Additional Glossop counts	28	19	68%	12	43%	19	68%
All other counts	136	91	67%	83	61%	94	69%
Total	270	188	70%	165	61%	192	71%

Table 9-22 - TPU PCF Stage 3 calibration link flow summary: prior (IP)

Link Type	Number of Links	Flow		GEH		Either (Flow or GEH)	
		Total	%	Total	%	Total	%
All screenline counts	106	64	60%	54	51%	67	63%
Additional Glossop counts	28	23	82%	21	75%	23	82%
All other counts	136	86	63%	72	53%	88	65%
Total	270	173	64%	147	54%	178	66%

Table 9-23 - TPU PCF Stage 3 calibration link flow summary: prior (PM peak)

Link Type	Number of Links	Flow		GEH		Either (Flow or GEH)	
		Total	%	Total	%	Total	%
All screenline counts	106	67	63%	58	55%	69	65%
Additional Glossop counts	28	24	86%	19	68%	24	86%
All other counts	136	89	65%	78	57%	90	66%
Total	270	180	67%	155	57%	183	68%

Table 9-24 - TPU PCF Stage 3 calibration link flow summary: post-ME (AM peak)

Link Type	Number of Links	Flow		GEH		Either (Flow or GEH)	
		Total	%	Total	%	Total	%
All screenline counts	106	90	85%	86	81%	92	87%
Additional Glossop counts	28	26	93%	24	86%	26	93%
All other counts	136	117	86%	117	86%	119	88%
Total	270	233	86%	227	84%	237	88%

Table 9-25 - TPU PCF Stage 3 calibration link flow summary: post-ME (IP)

Link Type	Number of Links	Flow		GEH		Either (Flow or GEH)	
		Total	%	Total	%	Total	%
All screenline counts	106	92	87%	87	82%	95	90%
Additional Glossop counts	28	28	100%	26	93%	28	100%
All other counts	136	126	93%	123	90%	128	94%
Total	270	246	91%	236	87%	251	93%

Table 9-26 - TPU PCF Stage 3 calibration link flow summary: post-ME (PM peak)

Link Type	Number of Links	Flow		GEH		Either (Flow or GEH)	
		Total	%	Total	%	Total	%
All screenline counts	106	84	79%	83	78%	86	81%
Additional Glossop counts	28	27	96%	23	82%	27	96%
All other counts	136	114	84%	108	79%	115	85%
Total	270	225	83%	214	79%	228	84%

9.6. Journey time validation

9.6.1. The purpose of journey time validation is to show that the model is able to replicate observed journey times on key routes through the ADM (Figure 8-1). Observed journey times have been compared against modelled data along 20 journey time routes, as shown in Figure 8-6.

9.6.2. Table 9-27 describes the journey time validation criterion and acceptability guidelines provided by TAG unit M3.1.

Table 9-27 - Journey time validation criterion (TAG unit M3.1)

Criterion	Acceptability Guideline
Modelled times along routes should be within 15% (or 1 minute, if higher)	> 85% of routes

9.6.3. Table 9-28 summarises the number of journey time routes that meet TAG criteria (unit M3.1) (i.e. modelled times along routes should be within 15% of surveyed times (or 1 minute, if higher) for over 85% of routes).

9.6.4. The results indicate that the model can replicate observed journey times, achieving TAG criteria across all time periods.

9.6.5. Full details of the individual journey time validation routes are presented in Appendix B including a graphical breakdown by timing point.

Table 9-28 - TPU PCF Stage 3 journey time validation summary: post-ME

Time Period	Total Journey Time Routes (directional)	Total Number Passing TAG criteria	% Passing TAG criteria
AM	20	19	95%
IP	20	20	100%
PM	20	20	100%

9.7. Convergence

Highway Assignment Model (HAM)

9.7.1. The convergence parameters adopted for TPU have been retained from the TPS RTM. The advice on model convergence is set out in TAG unit M3.1 (Table 4) and is reproduced below in Table 9-29.

Table 9-29 - TAG (unit 3.1) convergence criteria

Convergence Measures	Type	Base Model Acceptable Values
Delta & %GAP	Proximity	Less than 0.1% or at least stable with convergence fully documented and all other criteria met
Percentage of links with flow change (P1) < 1%	Stability	Four consecutive iterations greater than 98%

Source: TAG Unit M 3.1 Table 4

9.7.2. Table 9-30 provides a summary of the convergence statistics for the TPU PCF Stage 3 post-ME model.

9.7.3. The results indicate that all modelled time periods achieve a level of convergence that complies with the recommended TAG criteria. In terms of percentage flow change and gap acceptance the TPU PCF Stage 3 model meets TAG criteria within 69 loops in the AM peak, 54 loops in the IP and 82 loops in the PM peak.

9.7.4. Full details of the HAM convergence statistics are presented in Appendix B.

Table 9-30 - TPU PCF Stage 3 HAM convergence statistics: post-ME

AM			Inter Peak			PM		
Iteration	%Flow	%Gap	Iteration	%Flow	%Gap	Iteration	%Flow	%Gap
66	98.4	0.013	51	98.0	0.009	79	98.2	0.012
67	98.2	0.016	52	98.4	0.011	80	98.3	0.013
68	98.5	0.016	53	98.1	0.007	81	98.3	0.014
69	98.6	0.016	54	98.7	0.012	82	98.3	0.012

Variable Demand Model (VDM)

9.7.5. The TPS RTM demand model setup has been retained for the variable demand modelling (VDM) for the TPU PCF Stage 3 model, details of which are summarised in section 8.2 (full details to be provided in the model forecasting package).

9.7.6. It important that the VDM converges to a satisfactory degree in order to have confidence that the model results are as free from error and noise as possible. In line with TAG guidance, target %GAP values of 0.1% for the full model area and 0.2% for the subset area have been achieved (Table 9-31).

9.7.7. Full details of the VDM convergence statistics are presented in Appendix B.

Table 9-31 - TPU PCF Stage 3 VDM convergence statistics: post-ME

Best Loop	% GAP Full Model Area	%GAP Subset Area (ADM)
3	0.09%	0.17%

9.8. Demand model parameters

Destination choice and main mode choice

9.8.1. Destination choice values (referred to as lambda values) are provided in TAG unit M2.1 (Table 5.1). TAG states that “revised lambdas and thetas which were within ±25% of the median illustrative values would be regarded as acceptable.” Table 9-32 and Table 9-33 present the destination and mode choice parameters used in TPU PCF Stage 3 and the TPS RTM. These show that the parameter values adhere to TAG guidance. The values adopted for the TPS RTM are the median parameters specified in TAG unit M2.1 (Table 5.1), whilst car trip purposes were modified for TPU PCF Stage 3.

Table 9-32 - Destination choice parameters used in TPS RTM and TPU PCF Stage 3

Trip Purpose and Mode	TPS RTM	TPU Stage 3
Car		
Home-based work	-0.065	-0.080
Home-based employer’s business	-0.067	-0.050
Home-based other	-0.090	-0.067
Non-home-based employer’s business	-0.081	-0.060
Non-home-based other	-0.077	-0.057
Public Transport		
Home-based work	-0.033	-0.033
Home-based employer’s business	-0.036	-0.036
Home-based other	-0.036	-0.036
Non-home-based employer’s business	-0.042	-0.042
Non-home-based other	-0.033	-0.033

Table 9-33 - Main mode choice scaling parameters used in TPS RTM and TPU PCF Stage 3

Trip Purpose and Mode	TPS RTM	TPU Stage 3
Car		
Home-based work	0.68	0.68
Home-based employer's business	0.45	0.45
Home-based other	0.53	0.53
Non-home-based employer's business	0.73	0.73
Non-home-based other	0.81	0.81

9.9. Demand model matrices

9.9.1. The base PA matrices used in the DIADEM VDM were retained from the TPS RTM, as detailed in the TPS RTM LMVR19.

9.9.2. Off-peak demand (19:00-07:00) is a required input of the VDM, however the TPU base model does not have an off-peak component. Therefore, demand has been adopted from the TPS RTM. It should be noted that while the off-peak model was not validated in either the TPS RTM or the TPU base model, its outputs are not used directly in the scheme appraisal or business case.

9.9.3. The demand model matrices used for the base year VDM have been presented at a 25-sector and 3-sector level in Appendix B shows the 25 sectors that have been used to summarise the demand matrices. The 25-sector system is referenced in the legend, whilst the 3-sector system comprises of the ADM, the TPS RTM simulation area and the TPS RTM buffer area.

9.9.4. Demand model matrices from the VDM are presented by mode, time period and purpose at both sector levels in Appendix B. Table 9-34 provides an overview of the demand segmentation used in the TPU base year DIADEM VDM.

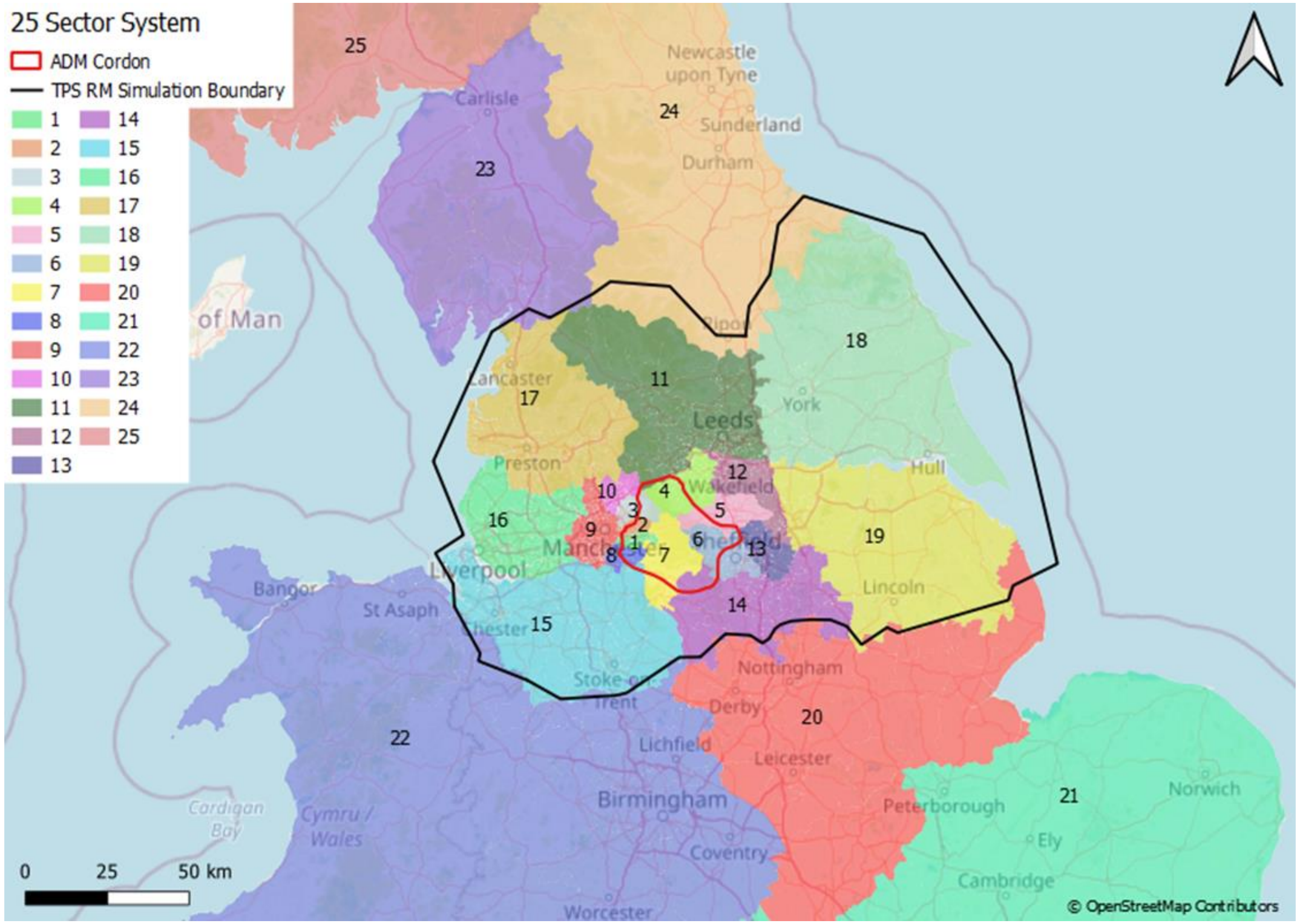
Table 9-34 - TPU PCF Stage 3 demand segmentation

Demand Segment	Purpose	Form of Matrices	Demand Response
1	Home Based Employer Business	24 hr - PA	Variable
2	Home Based Commute	24 hr - PA	Variable
3	Home Based Others	24 hr - PA	Variable
4	Non-Home-Based Employer Business	All time slice - OD	Variable
5	Non – Home Based Others	All time slice - OD	Variable
6	Fixed Demand - Employers Business	All time slice - OD	Fixed
7	Fixed Demand - Work	All time slice - OD	Fixed
8	Fixed Demand - Other	All time slice - OD	Fixed
9	Fixed Demand - LGV	All time slice - OD	Fixed
10	Fixed Demand - HGV	All time slice - OD	Fixed

19 TPS RTM LMVR (March 2017): TPS Model Validation Report - V1.9

9.9.5. The base matrices used in the HAM differ to the base year matrices from the VDM. The structure of the TPU model is specified in the PCF Stage 2 LMVR (see section 7.2.1). This explains how the model specification allows for different base matrices in the HAM and VDM (which in turn facilitates detailed calibration of the base HAM, without affecting the VDM). The discrepancies between the HAM and VDM matrices are accommodated through the use of 'fitting on factors', which are explained in the PCF Stage 3 model forecasting package. For this reason, the TPU base matrices from the HAM are presented in Appendix B, following the VDM matrices in Appendix B.

Figure 9-3 - 25-sector system



9.10. Realism tests

9.10.1. Realism testing has been undertaken to ensure that the TPU PCF Stage 3 model realistically responds to changes in travel costs. This section summarises the realism tests for car fuel cost elasticity, car journey time elasticity and Public Transport (PT) fare elasticity, as specified in TAG unit M2.1 (section 6.4).

Car fuel cost elasticity

9.10.2. As recommended in TAG unit M2.1, car fuel cost elasticity values have been calculated using both the matrix-based and network-based methods. The car fuel cost elasticity was carried out with a 10% increase in vehicle operating costs (VOC).

9.10.3. The Pence per Kilometre (PPK) values adopted for the car fuel realism test are given in Table 9-35. The base year HAM was used for realism testing.

Table 9-35 - PPK Values adopted for the car fuel realism test run.

User Class	Purpose	Base	Realism Test
UC1	Business	12.59	13.10
UC2	Commuting	6.15	6.77
UC3	Others	6.15	6.77

9.10.4. Table 9-36 presents the fuel cost elasticity values calculated for each car purpose by time period, using the matrix-based methodology. To derive the total number of vehicle kilometres travelled, the demand matrices from the realism test VDM were multiplied with the distance skim matrices from the validated base year HAM.

9.10.5. The vehicle kilometre matrices were categorised based on whether the trip ends of each ij pair were inside or outside of the TPS RTM simulation area. All ij pairs except external to external movements were considered for the fuel cost elasticity calculation.

9.10.6. Table 9-37 presents the fuel cost elasticity values calculated for each car purpose by time period, using the network-based methodology. The total number of vehicle kilometres travelled were extracted from SATURN for all links within the simulated area.

9.10.7. The annual average elasticity for all purpose trips is within the TAG specified range of -0.25 to -0.35.

Table 9-36 - TPU PCF Stage 3 fuel cost elasticity: matrix-based

Purpose	AM	IP	PM	OP	Annual Average	Desired Value
Business	-0.18	-0.23	-0.22	-0.18	-0.21	-0.10
Commuting	-0.22	-0.25	-0.23	-0.31	-0.24	-0.25
Others	-0.49	-0.48	-0.42	-0.49	-0.47	-0.40
All Purpose	-0.25	-0.35	-0.29	-0.32	-0.31	-0.30

Table 9-37 - TPU PCF Stage 3 fuel cost elasticity: network-based

Purpose	AM	IP	PM	OP	Annual Average	Desired Value
Business	-0.14	-0.21	-0.19	-0.18	-0.18	-0.10
Commuting	-0.19	-0.24	-0.20	-0.31	-0.22	-0.25
Others	-0.45	-0.46	-0.40	-0.48	-0.45	-0.40
All Purpose	-0.22	-0.33	-0.26	-0.32	-0.29	-0.30

9.10.8. Table 9-38 shows the car fuel cost elasticity values presented in the TPS RTM model validation report, as a comparison and consistency check. This shows that the car fuel cost elasticity values calculated for TPU PCF Stage 3 are comparable to the TPS RTM.

Table 9-38 - TPS RTM Stage 3 fuel cost elasticity

Purpose	AM	IP	PM	OP	Annual Average	Desired Value
Business	-0.18	-0.19	-0.16	-0.26	-0.20	-0.10
Commuting	-0.19	-0.20	-0.17	-0.24	-0.19	-0.25
Others	-0.48	-0.49	-0.48	-0.57	-0.50	-0.40
All Purpose	-0.25	-0.31	-0.27	-0.37	-0.30	-0.30

Car journey time elasticity

9.10.9. Car journey time elasticity was derived from the car fuel cost elasticity using the following equation:

$$Etime = Efuel\ aT/bK$$

Where,

Etime = Car journey time elasticity

Efuel = Car fuel cost elasticity

a = Pence per hour

b = Pence per km

T = Total veh-hrs

K = Total veh-kms

9.10.10. Table 9-39 presents car journey time elasticity values calculated for each car purpose by time period. As specified in TAG unit M2.1, car journey time elasticity values are shown to be no stronger than -2.0.

Table 9-39 - TPU PCF Stage 3 car journey time elasticity

Purpose	AM	IP	PM	OP	Desired Value
Business	-0.38	-0.47	-0.44	-0.34	<-2.0
Commuting	-0.60	-0.68	-0.63	-0.80	<-2.0
Others	-0.97	-0.99	-0.88	-0.93	<-2.0

Public transport fare elasticity

9.10.11. As recommended in TAG unit M2.1, PT fare elasticity values have been calculated by implementing a 10% fare increase. The updated PT cost files were input in to the TPU base year VDM.

9.10.12. The public transport demand matrices produced by the realism test were categorised based on whether the trip ends of each ij pair were inside or outside of the TPS RTM simulation area. All ij pairs except external to external movements were considered for the PT fare elasticity calculation.

9.10.13. Table 9-40 presents the public transport fare elasticity values calculated for the variable demand segments (as shown previously in Table 9-34).

Table 9-40 - TPU PCF Stage 3 public transport fare elasticity

Demand Segment	Purpose	Time Period	Reference PT Trips	Realism PT Trips	Elasticity
1	Home based Employers Business	PA all day	44,758	44,102	-0.15
2	Home based Commute	PA all day	116,461	114,351	-0.19
3	Home based Others	PA all day	56,484	51,979	-0.87
4	Non-Home-based Employers	AM	444	432	-0.29
		IP	265	258	-0.29
		PM	431	420	-0.29
		OP	172	167	-0.29
		24-hr	6,274	6,104	-0.29
5	Non-Home-based Others	AM	309	278	-1.09
		IP	229	207	-1.06
		PM	665	603	-1.03
		OP	217	196	-1.03
		24-hr	6,896	6,242	-1.05

9.10.14. As specified in TAG unit M2.1, PT fare elasticities are expected to lie in the range of -0.2 to -0.9 at a total trip level (all purpose). Table 9-41 compares 24-hour PT fare elasticities for TPU PCF Stage 3 with the TPS RTM. This shows that the elasticity value for all purpose trips achieves the TAG criteria (-0.37). The values provided for all the purposes (business, commuting and other) are shown to have slightly higher elasticity than TPS RTM, but are still comparable and well within the prescribed TAG range.

Table 9-41 – Comparison of 24-hour PT fare elasticity by purpose: TPS RTM vs. TPU PCF Stage 3

Purpose	TPS RTM	TPU Stage 3
Business	-0.15	-0.16
Commuting	-0.17	-0.19
Others	-0.78	-0.88
All Purpose	-0.29	-0.37

10. Transport Modelling Package Summary

10.1.1. The transport modelling package summarises the development of the TPU PCF Stage 3 2015 base year transport model.

10.1.2. The calibration, validation and realism test results that are presented show that the model meets the TAG criteria and is suitable for developing traffic forecasts used to inform economic, environmental, and operational appraisal of the TPU scheme.

11. Forecast assumptions

11.1. Introduction

11.1.1. This chapter provides the assumptions and inputs regarding the development of the PCF Stage 3 forecast year transport model, based on the guidance from TAG unit M2 (Variable demand modelling) & M4 (Forecasting & Uncertainty).

11.1.2. The basis for model forecasting is the 2015 validated PCF Stage 3 TPU transport model, details of which are provided in the Transport Model Package[20]. Model parameters are consistent with the validated base model, unless explicitly stated in this report.

11.1.3. The growth in demand between the validated base year and the model forecast years is derived from three sources:

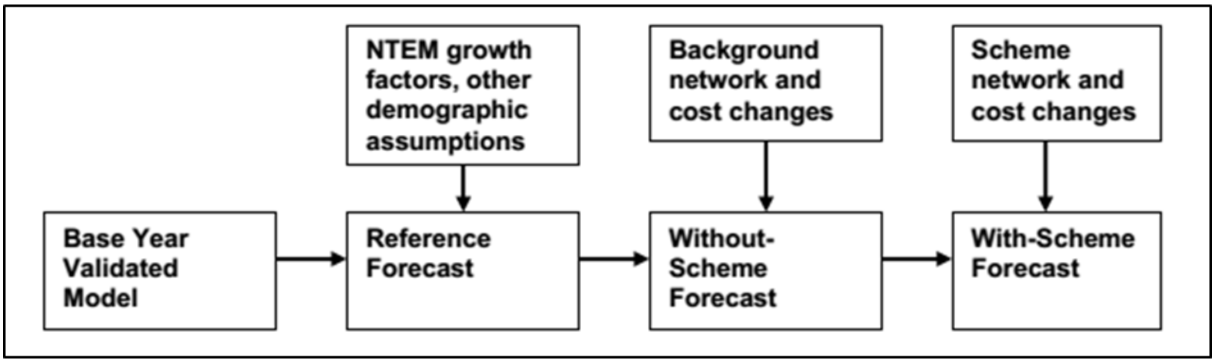
- National long-term population, employment and transport forecasts published by the DfT in the National Trip End Model (NTEM) dataset (v7.2).
- Local planning data summarised in the Uncertainty Log (UL) provided by the relevant Local Authorities.
- Light Goods Vehicles (LGV) and Heavy Good Vehicles (HGV) growth rates derived from the DfT Road Traffic Forecasts (RTF18).

11.1.4. The overall forecasting approach is summarised below in Figure 11-1. The first step of the forecasting process is to derive Reference Case demand matrices which reflect changes in population, employment, car ownership and other demographic and economic factors. The Reference Case demand matrices utilise the validated base year demand matrices as a basis. The transport supply element of the model is also updated for each forecast year which includes network changes and generalised cost assumptions (i.e. value of time (pence per minute: PPM) and vehicle operating costs (pence per kilometre: PPK), both by vehicle type and purpose). This is to derive the most likely 'without scheme' scenario against which the impact of the 'with scheme' scenario can be tested.

11.1.5. The Reference Case forecasts do not account for induced changes in travel demand in response to changes in future traffic conditions. Therefore, the Variable Demand Model (VDM) modifies the Reference Case forecasts to reflect the impact on demand, of changes in congestion on the road network.

[20] Stage 3 TPU Transport Model Package (April 2021): HE551473-BBA-GEN-A57_AL_SCHEME-AS-TR-000002

Figure 11-1 - Overview of forecasting process



11.1.6. This chapter provides the following information:

- Details and justification of all the assumptions undertaken in the forecasting process, including the sensitivity of forecasts to planning and network assumptions.
- Description of uncertainty in forecasting is presented and the core, low and high growth scenarios are described.
- Development of the Reference Case demand matrices for the core and alternate growth scenarios. The development of the forecast year highway networks and the generalised cost assumptions are also discussed.

11.1.7. Forecasting assumptions are consistent with the TPS RTM, unless otherwise stated (See Appendix C).

11.2. Model specification

11.2.1. No changes to the model specification have been made since PCF Stage 2. Full details of the model specification are provided in the PCF Stage 2 LMVR (Chapter 2)[21].

11.2.2. The TPU model is developed from the TPS RTM, which includes a SATURN (v11.3.12) Highway Assignment Model (HAM) combined with a DIADEM (VDM) (DIADEM v6.3.4). Software versions were retained for consistency with the TPS RTM donor model and previous PCF stages.

11.2.3. As shown in Table 11-1, demand for the TPU model is segmented into 10 demand segments, which are aggregated into five user classifications for the Highway Assignment Model (HAM). Table 11-2 provides further details of the demand segmentation utilised in the VDM setup.

[21] Stage 2 TPU LMVR (August 2017): HE551473-ARC-GEN-ZZZ-RP-TR-2017

Table 11-1 - TPU HAM: user classes

HAM user class	Demand segment	Trip purpose
UC1: Car Business	DS1: Home Based Employers' business	HB Employers' business
	DS4: Non-Home-Based Employers' business	NHB Employers' business
	DS6: Fixed – Employers' business	Employers' business
UC2: Car Commute	DS2: Home Based Commute	HB Commute
	DS7: Fixed – Commute	Commute
UC3: Car Other	DS3: Home Based Other	HB Shopping
		HB Personal business
		HB Recreation/Social
		HB Visiting Friends and Relatives
		HB Holiday/Day Trip
		HB Education
	DS5: Non-Home Based Other	NHB Work
		NHB Education
		NHB Shopping
		NHB Personal business
		NHB Recreation/Social
		NHB Holiday/Day Trip
	DS8: Fixed – Other	Others
UC4: LGV	DS9: LGV	Light Goods Vehicles
UC5: HGV	DS10: HGV	Heavy Goods Vehicles

Table 11-2 - TPU VDM: demand segments

Demand segment	Purpose	Form of matrices	Modes (Highway/PT)	Demand response
DS1	Home Based Employer Business	24 hr - PA	HW & PT	Variable
DS2	Home Based Commute	24 hr - PA	HW & PT	Variable
DS3	Home Based Others	24 hr - PA	HW & PT	Variable
DS4	Non- Home-Based Employer Business	All time slice - OD	HW & PT	Variable
DS5	Non - Home Based Others	All time slice - OD	HW & PT	Variable
DS6	Fixed Demand - Employers Business	All time slice - OD	HW & PT	Fixed
DS7	Fixed Demand - Commute	All time slice - OD	HW & PT	Fixed
DS8	Fixed Demand - Other	All time slice - OD	HW & PT	Fixed
DS9	Fixed Demand - LGV	All time slice - OD	HW	Fixed
DS10	Fixed Demand - HGV	All time slice - OD	HW	Fixed

11.2.4. The simulation boundary of the TPS RTM has been retained, but the focus of the TPU model is concentrated on the Area of Detailed Modelling (ADM) highlighted in Figure 8-1.

11.3. Modelled forecast years and time periods

11.3.1. The opening and design year of the scheme have been revised since the previous iteration of the Stage 3 TPU transport modelling undertaken by the incumbent consultants.

11.3.2. The PCF Stage 3 TPU transport model has been developed to represent a 2015 base year and three forecast years:

- 2025: scheme opening year (previously 2023 in Stage 2).
- 2040: scheme design year, 15 years after scheme opening (previously 2038 in Stage 2).
- 2051: horizon year for the economic assessment.

11.3.3. The TPU model is an average peak hour model reflective of the following time periods:

- AM: 07:00-10:00
- IP: 10:00-16:00
- PM: 16:00-19:00
- OP: 19:00-07:00

11.4. Uncertainty Log (UL)

11.4.1. TAG recommends that all known assumptions and uncertainties in the modelling and forecasting approach should be set out in an uncertainty log. The purpose of the uncertainty log is to record the central forecasting assumptions that underpin the core scenario and record the degree of uncertainty around these central assumptions. These assumptions are the basis for developing a set of alternative scenarios.

11.4.2. Three scenarios have been modelled for each forecast year: Core, Low growth and Optimistic. As identified in Table 11-3, the following uncertainty status assumptions have been made for each scenario:

- Core: 'near certain' and 'more than likely' infrastructure schemes and developments, constrained to TEMPro (NTEM 7.2).
- Low growth: 'near certain' and 'more than likely' infrastructure schemes and developments, constrained to low growth national uncertainty.
- Optimistic: 'near certain', 'more than likely' and 'reasonably foreseeable' infrastructure schemes and developments, constrained to high growth national uncertainty.

Table 11-3 - Uncertainty Log – classification of future inputs

Probability of input	Status	Core	Low	High
Near certain: The outcome will happen or there is a high probability that it will happen	Intent announced by proponent to regulatory agencies. Approved development proposals. Projects under construction.	✓	✓	✓
More than likely: The outcome is likely to happen but there is some uncertainty	Submission of planning or consent application imminent. Development application within the consent process	✓	✓	✓
Reasonably foreseeable: The outcome may happen, but there is significant uncertainty	Identified within a development plan. Not directly associated with the transport strategy/scheme but may occur if the strategy/scheme is implemented. Development conditional upon the transport strategy/scheme proceeding. Or, a committed policy goal, subject to tests (e.g. of deliverability) whose outcomes are subject to significant uncertainty.	✗	✗	✓
Hypothetical: There is considerable uncertainty whether the outcome will ever happen	Conjecture based upon currently available information. Discussed on a conceptual basis. One of several possible inputs in an initial consultation process. Or a policy aspiration	✗	✗	✗

11.4.3. The initial version of the UL was provided by the incumbent consultants in early 2019, and was based on the following information:

- The Road Investment Strategy (RIS) and Local Authority highway schemes included in the TPS RTM; and
- The housing and employment developments within the Area of Detailed Modelling (ADM) boundary (Figure 8-1).

11.4.4. The UL received from the incumbent consultant was subsequently revised in line with current understanding of development certainty (December 2019). A review of all infrastructure schemes and developments was undertaken by each of the Local Authority districts shown in Figure 11-2.

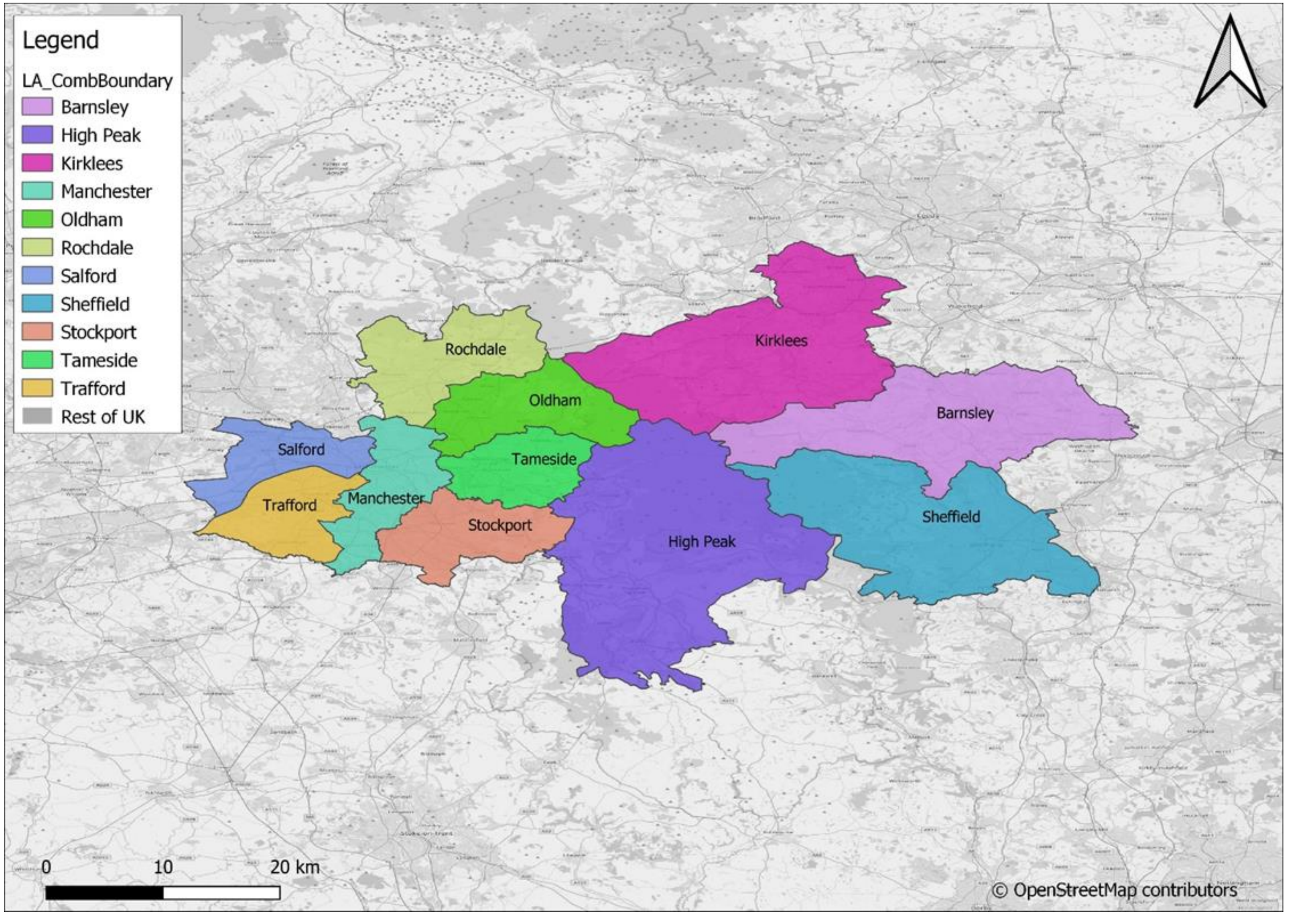
11.4.5. In December 2020, the Greater Manchester Spatial Framework (GMSF) further revised the information included in the UL for Tameside, Manchester, Trafford and Stockport, whilst updated data was also provided for High Peak. The following changes have been made to the UL received from the incumbent consultants in early 2019:

- No significant changes were observed within the immediate vicinity of the scheme (i.e. in Tameside and High Peak) for developments with an uncertainty status of ‘near certain’ or ‘more than likely’ (i.e. core growth scenario).
- However, there have been changes in the status and/or size of developments with an uncertainty status of ‘reasonably foreseeable’ (i.e. High growth scenario).

11.4.6. The list of highway infrastructure schemes included in PCF Stage 3 has been retained from the incumbent consultant. No changes were specified during the review of the uncertainty log in December 2019 and December 2020.

11.4.7. The development site UL used in the PCF Stage 3 forecast year scenarios is presented and a list of the transport infrastructure schemes included in all growth scenarios is presented in Appendix C.

Figure 11-2 - Uncertainty Log: Local Authority districts



11.5. Development of trip rates

11.5.1. The trip rates derived by the incumbent consultants were retained for the PCF Stage 3 forecast year transport model. Their derivation is described below.

11.5.2. TRICS (v7.4.4) was used to calculate future trips associated with the proposed new developments. TRICS is a large database system containing traffic counts for individual developments across a wide range of land-use categories. TRICS analyses individual or selected sets of survey counts to produce trip rate information.

11.5.3. Table 11-4 summarises the trip rates used for Cars, whilst the trip rates for all other vehicle types are presented in Appendix C.

11.5.4. TRICS does not provide purpose breakdowns for proposed development trips. As such, Car trips associated with each development were allocated to one of the three car user classes (UC1: Car Employers Business, UC2: Car Commute and UC3: Car Others) in accordance with the distribution pattern of zonal trip ends in the validated base model.

Table 11-4 - TRICS car trip rate summary (per hour)

Land Use	Arrivals			Departures		
	AM	IP	PM	AM	IP	PM
Office (per 100 sqm GFA)	0.2867	0.0843	0.0347	0.0383	0.1005	0.2437
Business park (per 100 sqm GFA)	0.4603	0.1620	0.0670	0.0770	0.1785	0.4130
Warehousing B8 (per 100 sqm GFA)	0.0480	0.0142	0.0120	0.0053	0.0213	0.0477
Industrial unit (per 100 sqm GFA) B1 B2	0.1680	0.0442	0.0163	0.0240	0.0577	0.1857
Mixed/ Affordable housing (per no. of dwells)	0.0307	0.0542	0.0833	0.0887	0.0500	0.0617
Mixed private houses (per no. of dwells)	0.0660	0.1213	0.1767	0.1343	0.1122	0.1353
Retail Park excluding food (per 100 sqm GFA)	0.3423	1.3222	0.7437	0.1970	1.2120	1.0500
Leisure Centre (per hec GFA)	3.5117	4.9500	10.5097	2.2923	4.7548	8.8027
Retail mixed shopping (per 100 sqm GFA)	0.4250	1.2548	0.2940	0.0910	1.2082	0.9870
Industrial estate (per 100sqm GFA) B1 or B2	0.0657	0.0340	0.0113	0.0213	0.0432	0.0450

11.6. Reference Case matrices

11.6.1. The Reference Case was developed from the PCF Stage 3 base model by considering the growth in demand arising from changes in demographics and macro-economic factors from the validated 2015 base year to 2025, 2040 and 2051 forecast years.

11.6.2. To develop the Reference Case forecast matrices, growth factors have been derived using the following sources:

- For cars, growth rates have been derived from NTEM 7.2.
- For LGVs and HGVs, the growth rates have been derived from RTF18.

11.6.3. In summary the Reference Case matrices were derived by undertaking the following steps:

- Determine the growth in the forecast car trip ends projected by TEMPro between the validated base and the forecast years.
- Apply the TEMPro alternative assumptions growth to the base year trip ends.
- Create the "Base + Background Growth" matrix by furnessing the trip ends at LA level.
- The development trip ends are used to form the development matrix as described in para 11.6.7 below. Add the development matrix to "Base + Background Growth" Matrix.
- The resulting demand matrices are furnessed to the unadjusted TEMPro growth by trip ends at LA district level to ensure consistency with the national forecasts.
- Determine the growth in commercial vehicle (LGV and HGV) trip ends using RTF18.
- Apply RTF18 growth factors on the LGV and HGV base matrices to derive the forecast year matrices.

11.6.4. The following section provides further detail on the forecasting methodology used for developing Reference Case Origin Destination (OD) and Production Attraction (PA) matrices for the core scenario.

Development matrix

11.6.5. All developments identified in the UL (Appendix C) were assigned an appropriate model zone based on their geographical location.

11.6.6. The inclusion of individual sites in the development matrices for the core scenario were based on the following criteria:

- Uncertainty status of 'near certain' or 'more than likely', as specified in the UL.
- All developments located within the immediate vicinity of the scheme (i.e. Tameside and High Peak) were automatically included.
- However, developments located in all other Local Authorities included in the UL (Figure 11-2) that are not within the immediate vicinity of the scheme (i.e. not Tameside and High Peak) were only included if certain thresholds were met:

- Residential development of more than 200 dwellings.
- Commercial development type B1> 10,000 sqm, B2 > 1,500 sqm, and B8> 5,000 sqm. All other commercial development types were included without the application of a threshold.

11.6.7. For each development that met the criteria for inclusion, trip generation was prepared by using the appropriate TRICS rates (Section 3.5). As aforementioned, TRICS does not provide purpose breakdowns for proposed development trips, therefore car trips were split by purpose (Employers Business, Commute and Other) using the same donor zones from the validated base model.

Background growth

NTEM v7.2

11.6.8. Alternative growth assumptions derived from NTEM v7.2 were used to calculate background growth factors for car trips, by subtracting the proposed developments included in the UL from NTEM planning information.

11.6.9. NTEM alternative growth assumptions were obtained for each Local Authority included in the UL at the LA district level. Car Driver trips were used to calculate background growth between the 2015 base year and all forecast years. Development information from 2040 was used for the 2051 horizon year as planning details beyond 2040 were not provided in the UL.

11.6.10. For the individual Local Authorities where total development growth exceeded NTEM (v7.2) growth at LA district level, the growth forecasts were adjusted down to match NTEM (v7.2) growth.

11.6.11. Appendix C summarises the growth factors derived from NTEM v7.2 that have been used to constrain car trip ends.

RTF18

11.6.12. RTF18 was used to constrain the overall growth of freight traffic (LGV and HGV) in a similar way to how growth in car trips is constrained to NTEM v7.2. Growth factors have been derived using the 'traffic in billions of miles' data from scenario 1 of RTF18.

11.6.13. Table 11-5 summarises the RTF18 growth factors that have been used to constrain LGV and HGV trip ends. These are based on all road types in England and Wales.

11.6.14. Data is provided in 5 yearly intervals starting in 2010, which have been interpolated to fit with the TPU forecast years (2025, 2040 and 2051). The data is not disaggregated by time of day, therefore uniform growth factors have been applied to all time periods.

Table 11-5 - RTF18 growth factors from 2015

Vehicle Type	2025	2040	2051
LGV	16.0%	39.3%	53.2%
HGV	0.2%	5.0%	9.2%

Fixed demand - ports

11.6.15. Trips originating or terminating from airports and seaports are fixed in the PCF Stage 3 TPU transport model and are therefore not subject to VDM.

11.6.16. NTEM v7.2 and RTF18 have been used to derive growth factors for car and freight trips, however neither data source takes account of change in passenger demand at airports and seaports.

11.6.17. Fixed demand data representative of airports and seaports across Great Britain was provided by the incumbent consultants, based on the TPS RTM demand matrices. Airport passenger growth was derived based on the DfTs National Air Passenger Allocation Model (NAPALM), whilst seaport passenger growth was derived from historic seaport road traffic data provided by the DfT (see aforementioned TPS RTM forecasting report for full details).

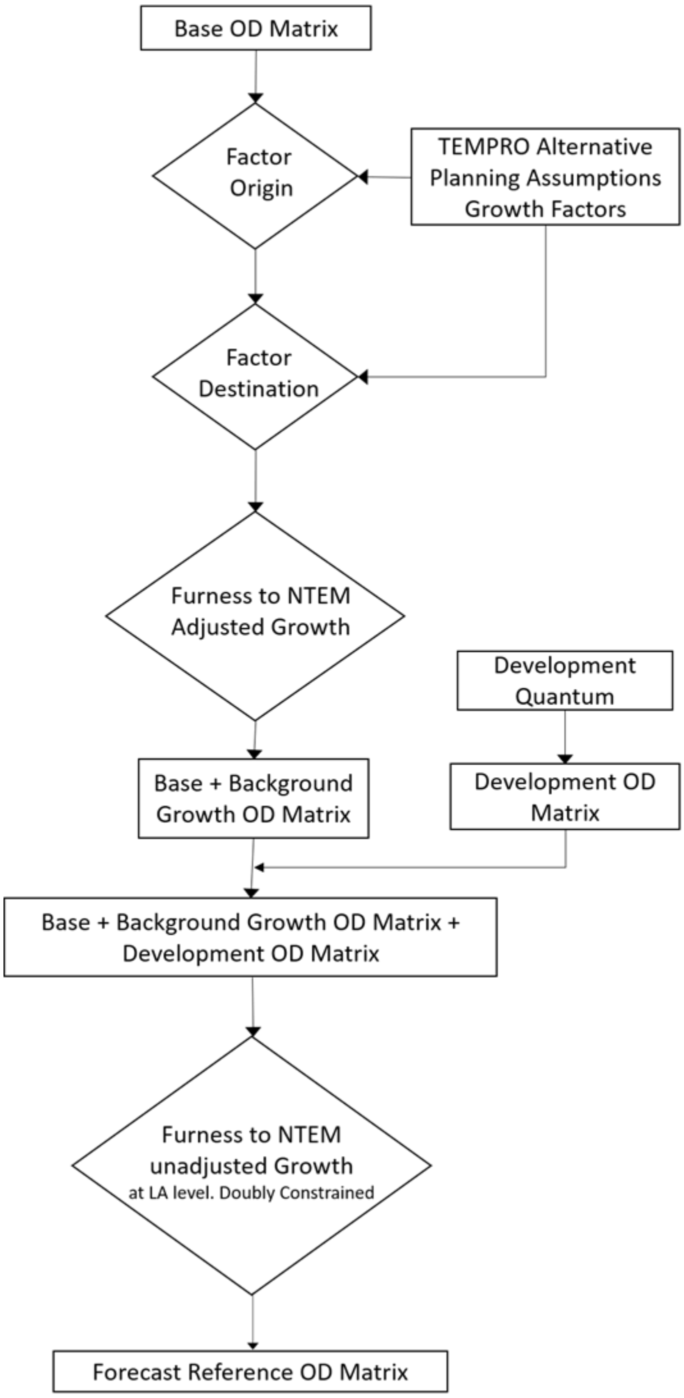
11.6.18. In line with the previous scheme opening and design years, the fixed demand matrices provided by the incumbent consultants were supplied for forecast years 2023, 2038 and 2051. As agreed with Highways England, linear interpolation has been assumed to adjust the opening and design forecast years to 2025 and 2040, from 2023 and 2038. The 2051 horizon year remained unchanged.

Origin-Destination (OD) Reference Case matrices

11.6.19. Figure 11-3 provides an overview of the process adopted to derive the forecast year Reference Case OD matrices.

11.6.20. The 2015 ‘Base OD Matrix’ was obtained from the PCF Stage 3 validated base year transport model, as described in the Transport Model Package (Appendix B).

Figure 11-3 - Derivation of forecast year OD matrices



11.6.21. Table 11-6 to Table 11-8 compare OD matrix totals between the validated base year and the Reference Case matrices for all forecast years.

Table 11-6 - Reference Case OD matrix totals: Core scenario (AM Peak)

Year / Time Period	Matrix Totals (PCU/hr)					Total	Growth from 2015
	UC1	UC2	UC3	UC4	UC5		
	Car Business	Car Commute	Car Others	LGV	HGV		
2015	323,497	2,379,531	2,138,375	607,454	326,182	5,775,040	-
2025	361,436	2,543,733	2,366,387	699,686	326,511	6,297,753	9%
2040	398,801	2,761,581	2,668,312	840,717	339,235	7,008,645	21%
2051	426,244	2,947,340	2,886,287	924,699	352,039	7,536,609	31%

Table 11-7 - Reference Case OD matrix totals: Core scenario (IP)

Year / Time Period	Matrix Totals (PCU/hr)					Total	Growth from 2015
	UC1	UC2	UC3	UC4	UC5		
	Car Business	Car Commute	Car Others	LGV	HGV		
2015	345,966	912,475	2,723,032	557,004	337,965	4,876,443	-
2025	379,358	965,932	3,022,259	642,513	338,329	5,348,390	10%
2040	414,754	1,039,365	3,415,054	772,013	351,918	5,993,104	23%
2051	441,941	1,100,280	3,681,441	849,052	365,336	6,438,050	32%

Table 11-8 - Reference Case OD matrix totals: Core scenario (PM peak)

Year / Time Period	Matrix Totals (PCU/hr)					Total	Growth from 2015
	UC1	UC2	UC3	UC4	UC5		
	Car Business	Car Commute	Car Others	LGV	HGV		
2015	343,553	2,238,061	3,052,443	590,202	237,608	6,461,866	-
2025	379,647	2,375,279	3,348,037	680,064	237,868	7,020,896	9%
2040	416,152	2,559,381	3,743,095	817,151	247,514	7,783,294	20%
2051	443,971	2,714,908	4,025,477	898,766	256,991	8,340,114	29%

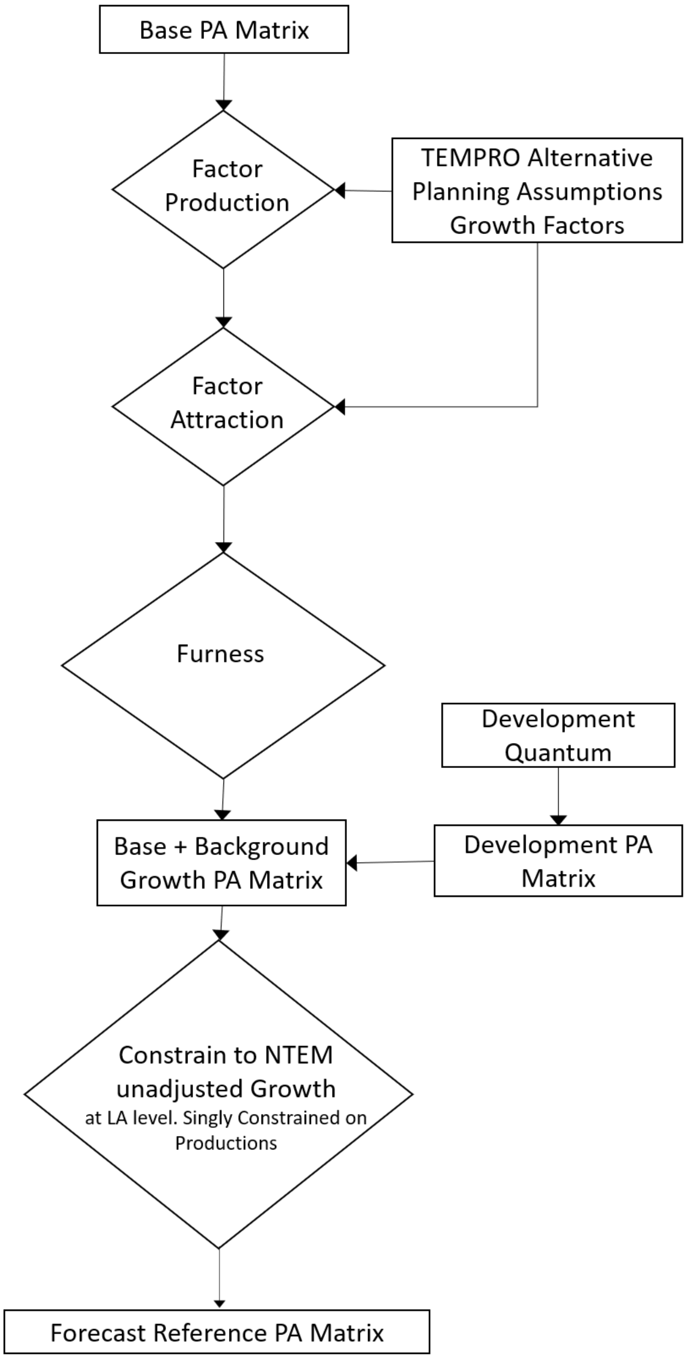
Production-Attraction (PA) Reference Case matrices

11.6.22. Figure 11-4 provides an overview of the process adopted to derive the forecast year Reference Case PA matrices.

11.6.23. The 2015 'Base PA Matrix' was obtained from the TPS RTM, as described in the TPS RTM LMVR[22].

[22] TPS RTM LMVR (March 2017): TPS Model Validation Report - V1.9

Figure 11-4 - Derivation of forecast year PA matrices



11.6.24. In deriving the development PA matrices, development zones were separated into three categories (residential, commercial, and mixed use) based on the land use type specified in the UL.

11.6.25. The development matrices developed from the UL and TRICS were only available in OD format. To convert the OD development trip matrices into PA format, the following factors were calculated between the base year OD and PA matrices by trip end:

- 12-hour origin totals to 24-hour production totals.
- 12-hour destination totals to 24-hour attractions totals.

11.6.26. These factors were generated for the three 24-hour PA demand segments (DS1: HBEB, DS2: HBW, DS3: HBO), as specified in Table 11-2.

11.6.27. Development zones that only include residential sites were assumed to generate trip productions, whilst development zones that only include commercial sites were assumed to generate trip attractions. For zones including both residential and commercial sites, residential sites were assumed to generate trip productions, whilst commercial sites were assumed to generate trip attractions.

11.6.28. Table 11-9 compares PA matrix totals between the validated base year and the Reference Case matrices for all forecast years.

Table 11-9 - Reference Case PA matrix totals: Core scenario (24 hours)

Year / Time Period	Matrix Totals (PCU/hr)			Total	Growth from 2015
	DS1	DS2	DS3		
	HBEB	HBC	HBO		
2015	1,668,183	11,455,038	16,600,193	29,723,415	-
2025	1,764,174	12,129,194	18,367,973	32,261,341	9%
2040	1,924,361	13,057,003	20,726,398	35,707,762	20%
2051	2,065,086	13,846,352	22,354,083	38,265,521	29%

11.7. Fitting on Factors (FoF)

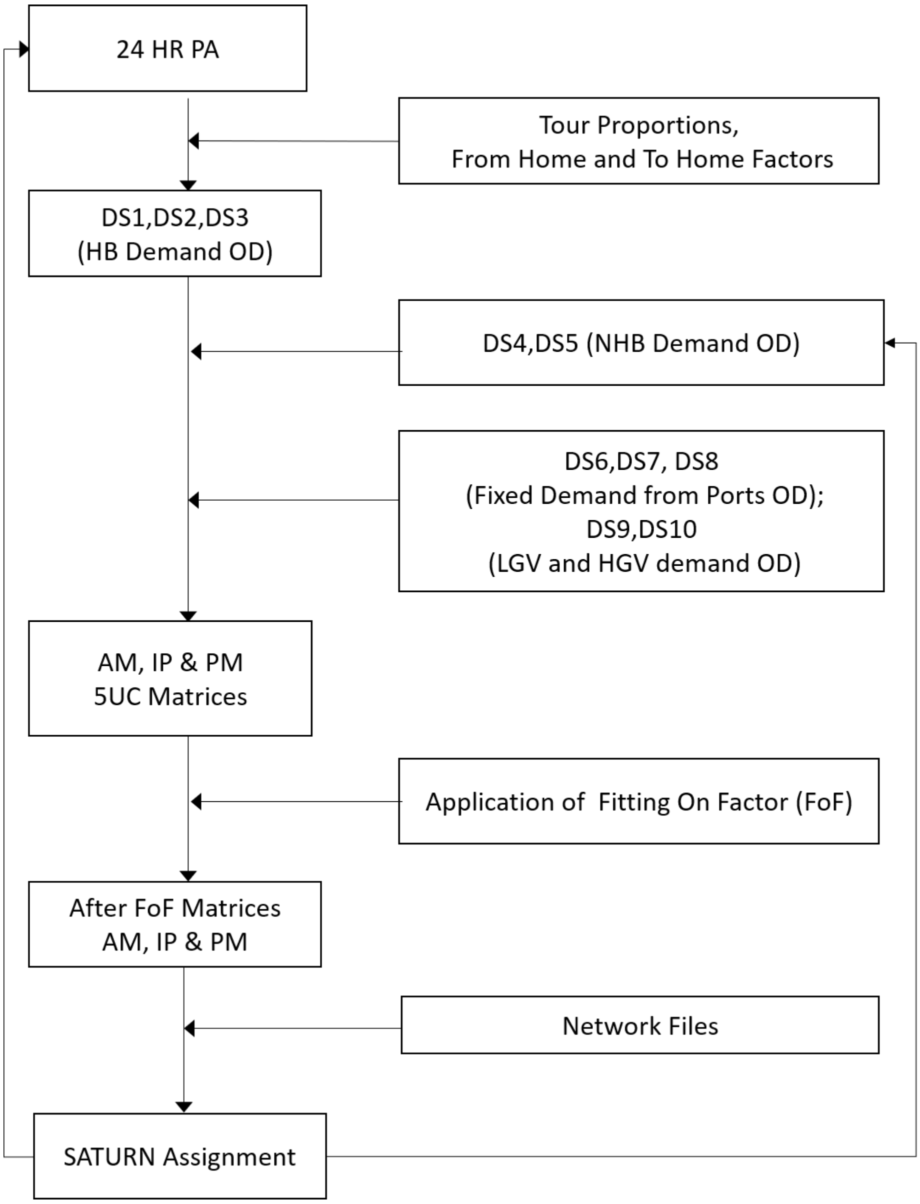
11.7.1. The resultant OD matrices (essentially synthetic) produced after the first iteration of DIADEM (and part of the inherent PA to OD conversion process) do not precisely match the OD matrices as derived from the scaled highway assignment model. Consequently, a set of Fitting on Factors (FoF) has been used to ensure that in both the realism tests and forecasting the Reference Case OD matrices produced in the preliminary iteration of DIADEM are made consistent with the Forecast Highway OD matrices prior to assignment. The fitting on factors applied are held fixed and the resultant assignment cost skims used to drive the variable demand response through all subsequent DIADEM loops.

11.7.2. The FoF used in the TPS RTM were derived from the difference between the first iteration of the base year DIADEM UFMs and the validated base year SATURN UFMs. However, due to the inclusion of local developments in the forecast year scenarios, the set of FoF derived from the base were distorting trip patterns in the study area. Therefore, the derivation of modified FoF for each forecast year was deemed necessary.

11.7.3. Appendix C presents the PA to OD conversion process for each iteration of DIADEM, illustrating how the FoFs have been applied. Explanation of the HAM user classes (e.g. UC1, UC2 etc.) are provided in Table 11-1, whilst details of the VDM demand segments (e.g. DS1, DS2 etc.) are provided in Table 11-2.

11.7.4. The FoFs are applied to the HAM matrices after the VDM demand segments have been converted to OD format. The cost skims produced at the end of each iteration are used as an input to the next iteration of DIADEM.

Figure 11-5 - PA to OD procedure for each iteration of DIADEM



11.8. Forecast networks

Generalised cost parameters

11.8.1. Generalised cost is as a measure of disutility for a journey between an origin and destination across the transport network. DIADEM estimates the change in car travel demand (UC1-3) based on the change in generalised cost caused by the change in network costs.

11.8.2. Values of time and distance are used to reflect the relative preference of time and distance, forming part of the process by which highway users will choose routes. The generalised cost of travel represents travellers' value of time (pence per minute: PPM) and the vehicle operating cost (pence per kilometre: PPK), both by vehicle type and purpose.

11.8.3. The forecast generalised travel costs are derived from TAG Databook v1.14 (July 2020) and are shown in Table 11-10 (Value of Time, PPM) and Table 11-11 (Vehicle Operating Costs, PPK). An average network speed of 54kph was used for all scenarios.

Table 11-10 - Value of Time (in pence per minute) by user: 2025, 2040 & 2051

User Class	2025			2040			2051		
	AM	IP	PM	AM	IP	PM	AM	IP	PM
Car Business	31.98	32.77	32.44	39.61	40.58	40.18	45.76	46.89	46.42
Car Commute	21.45	21.80	21.52	26.56	26.99	26.65	30.69	31.19	30.79
Car Other	14.80	15.76	15.50	18.32	19.52	19.19	21.17	22.55	22.17
LGV	23.18	23.18	23.18	28.70	28.70	28.70	33.16	33.16	33.16
HGV	46.17	46.17	46.17	57.17	57.17	57.17	66.05	66.05	66.05

Table 11-11 - Vehicle Operating Costs (pence per kilometre) by user: 2025, 2040 & 2051

User Class	2025	2040	2051
Car Business	11.80	8.96	8.28
Car Commute	5.64	4.17	3.82
Car Other	5.64	4.17	3.82
LGV	13.47	11.81	11.23
HGV	39.73	36.46	36.66

Values are the same for all time periods

Do-Minimum (DM) scenario

11.8.4. The PCF Stage 3 TPU DM network coding has been adopted from the TPS RTM forecast year models, which include relevant LA and RIS highway schemes across the modelled simulation area (Figure 8-1). The forecast year DM networks include all infrastructure schemes and improvements specified in the uncertainty log (Appendix C).

11.8.5. The validated PCF Stage 3 TPU 2015 base year model network was used as a basis for the forecast year DM scenario. The network coding for the LA and RIS schemes specified in Appendix C were coded into the validated base year network to create DM networks representative of 2025, 2040 and 2051.

11.8.6. The TPS RTM includes forecast years of 2021 and 2041. Therefore, schemes predicted to be completed by 2021 are included in the TPU 2025 opening year, whilst schemes predicted to be completed by 2041 are included in the TPU 2040 design year. The highway infrastructure schemes included in the 2051 horizon year are identical to 2040.

11.8.7. The model coding of the proposed schemes is based on the RTM coding manual, consistent with the validated base model. Scheme coding checks were undertaken in terms of junction characteristics, turn saturation flows, free-flow speed, and link length.

Do-Something (DS) scenario

11.8.8. The PCF Stage 3 TPU DS network coding incorporates the TPU A57 link road scheme, in addition to the schemes present in the DM network. The latest DS scheme alignment is presented in Figure 1-2.

11.8.9. For determining an initial set of signal timings to be used in the SATURN model, a set of LinSig models were produced for all scheme junctions. Details of the LinSig models developed are provided in the Operational Model Report in Appendix C.

11.8.10. Signal timing and phasing were reviewed for junctions with high levels of delay. Existing timings that were found to be unreasonable for the assigned flow were optimised based on observation and judgment.

11.9. Fixed Cost Function (FCF)

11.9.1. A cordon of the full RTM was proposed to reduce the area of influence to a more localised study area, relevant for the TPU A57 link road scheme.

11.9.2. In consideration of other cordoning techniques (i.e. a conventional cordon and Simulation Buffer Transformation) and the requirement to retain the demand response of the VDM, the FCF approach was deemed to be the most appropriate method for the PCF Stage 3 TPU transport model. The benefits of adopting the FCF are as follows:

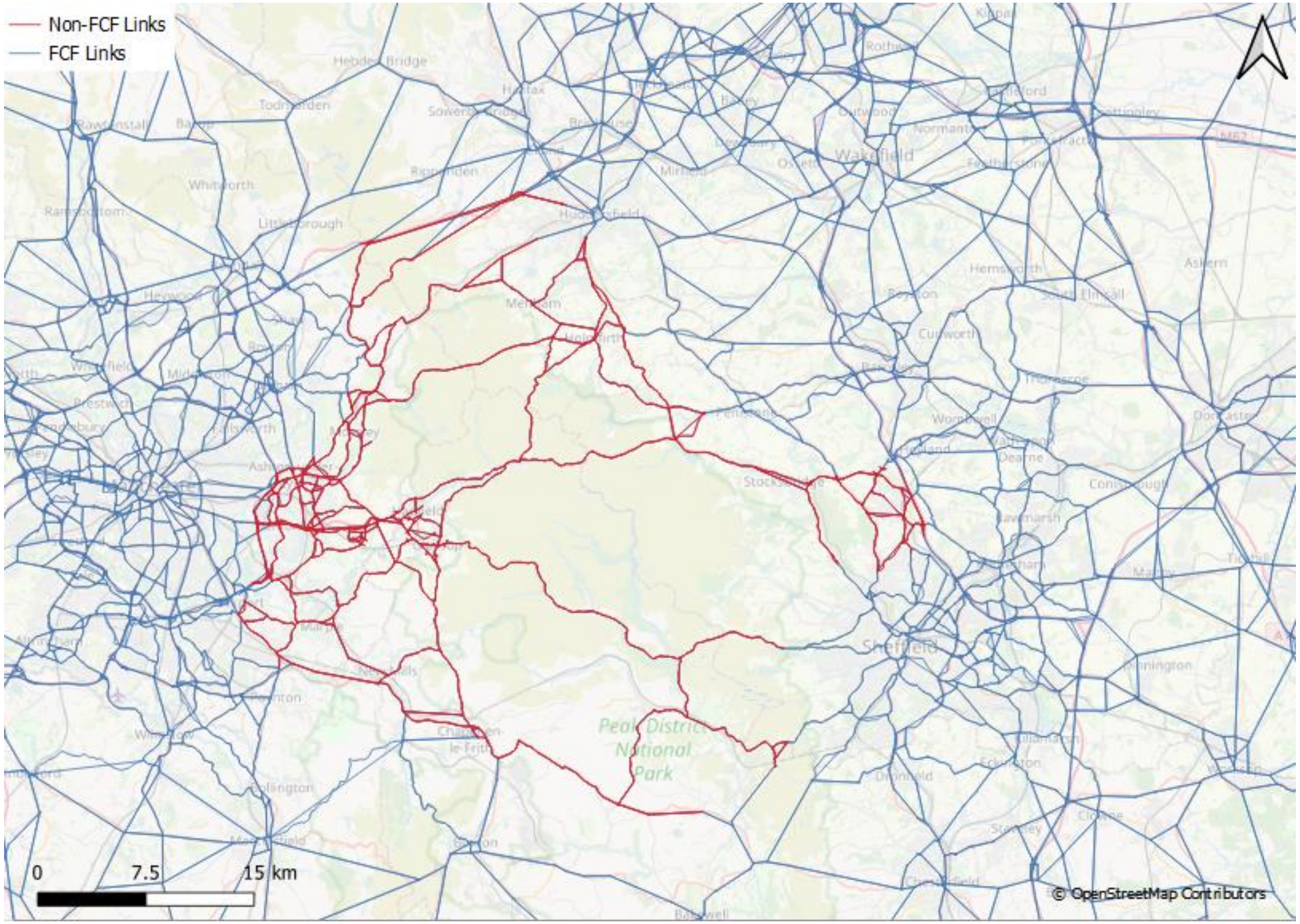
- Reduced run times: a full DIADEM VDM run time ranges from 30 to 38 hours
- Improved model convergence.
- Reduced model noise: large geographic areas and convergence issues tend to result in greater levels of model ‘noise’ that may result in spurious economic assessment results.

11.9.3. The Fixed Cost Function (FCF) methodology involves the importation of individual turn flow-delay curves from a previously converged network assignment, rather than calculating individual turn flow-delay curves based on current network flows and vehicle interactions. For example, the Do-Something network would use the (previously calculated) turn-flow delay curves from the Do-Minimum network. This approximation would only be applied to simulated turns *outside* the area of interest. Nearer to the scheme, the full SATURN simulation approach would be retained, for optimal accuracy.

11.9.4. Figure 11-6 shows the extent of the FCF network, which has been defined as the area outside the Affected Road Network (ARN). Consistent with the DMRB LA105 air quality guidance (November 2019), the ARN is defined at the link level by calculating the difference between the Do-Minimum and Do-Something scenarios, based on the following criteria:

- Change in annual average daily traffic (AADT) >=1,000 (two-way link values combined); or
- Change in heavy duty vehicles (HDV) AADT >=200 (two-way link values combined); or
- A step change in speed band for the daily average and modelled hour speeds (AM, IP, PM, OP).
  - Heavy congestion (5-20 kph).
  - Light congestion (20-45 kph).
  - Free flow (45-80 kph).
  - High speed (80+ kph).

Figure 11-6 - Fixed Cost Function (FCF) area



11.10. Alternate growth scenarios

11.10.1. TAG unit M4 states that the core scenario is intended to be the best basis for decision-making given current evidence. However, there is no guarantee that the outturn will match the assumptions. A single core scenario cannot reflect the uncertainty in national trends such as GDP and demographic growth, fuel price trends and vehicle efficiency changes.

11.10.2. Therefore, it is suggested to test the impact of this uncertainty through sensitivity tests. Two alternative growth scenarios have been run as sensitivity tests, using the PCF Stage 3 TPU core growth scenario as a basis.

11.10.3. As identified in Table 11-3, the following uncertainty status assumptions have been made for the two alternative growth scenarios:

- Low growth: ‘near certain’ and ‘more than likely’ developments, constrained to low growth national uncertainty.
- Optimistic growth: ‘near certain’, ‘more than likely’ and ‘reasonably foreseeable’ developments, constrained to high growth national uncertainty.

11.10.4. National uncertainty has been considered by following the guidance provided in TAG Unit M4, which states that the alternative growth scenarios should consist of forecasts based on a proportion of the base year demand being added to (optimistic growth) or subtracted from (low growth) the core growth scenario.

11.10.5. The proportion of base year demand to be added (or subtracted) is based on a parameter ‘p’ which varies by mode. The proportion is calculated as follows:

- For 1 year after the base year, proportion p of base year demand added (or subtracted) to the core scenario.
- For 36 or more years after the base year, proportion 6*p of base year demand added to the core scenario.
- Between 1 and 36 years after the base year, the proportion of base year demand should rise from p to 6*p in proportion with the square root of the years. For example, 16 years after the base year, the proportion is 4*p.

11.10.6. For highway demand at the national level, the value of p is 2.5%, reflecting uncertainty around annual forecasts from the National Transport Model (NTM), based on the macro-economic variables that influence the main drivers of travel demand. The indicative TAG value of p for rail travel is 2%, which has been adopted for the PT demand.

Low growth scenario

11.10.7. The local uncertainty for the low growth scenario was retained for consistency with the core scenario (i.e. ‘near certain’ and ‘more than likely’ developments).

11.10.8. Since the development matrices for the low growth scenario are identical to the core scenario, there was no further requirement for demand constraining. The Reference Case demand matrices for the low growth scenario were calculated by subtracting the relevant proportion of the validated base matrices (dependent on forecast year, see paragraph 11.10.5) from the core post-VDM demand matrices. This process was followed individually for each forecast year.

Optimistic growth scenario

11.10.9. The local uncertainty threshold for the optimistic growth scenario was lowered so that all the ‘reasonably foreseeable’ developments from the uncertainty log were included. These were in addition to the ‘near certain’ and ‘more than likely’ developments already present in the core scenario.

11.10.10. The additional trips ends associated with the ‘reasonably foreseeable’ developments were included in the development trip matrix, which were then added to the optimistic growth scenario trip matrix (i.e. core post-VDM demand plus the relevant proportion of the validated base matrices, dependent on forecast year). Overall demand was then finessed to the level of uncertainty associated with the national high growth scenario, by trip end at the Local Authority district level. This process was followed individually for each forecast year.

12. Forecast results: core scenario

12.1.1. This section provides details of the core model forecast results that were submitted for approval. A summary of the following model results is provided in the main body, whilst full details are provided in the appendices:

- Model convergence
- Highway demand matrices
- Trip Length Distribution
- Link flow
- Journey times

12.2. Model convergence

Variable Demand Model (VDM)

12.2.1. It is important that the VDM converges to a satisfactory degree to have confidence that the model results are as free from error and noise as possible. Paragraph 6.3.8 of TAG Unit M2 provides guidance on desired convergence of VDM. The guidance states: "tests indicate that gap values of less than 0.1% can be achieved in many cases, although in more problematic systems this may be nearer to 0.2%. Where the convergence level, as measured by the %GAP, is over 0.2% remedial steps should be taken to improve the convergence, by increasing the assignment accuracy."

12.2.2. In accordance with TAG guidance, Table 12-1 shows that %GAP values of 0.1% for the full model area and 0.2% for the subset area are very good for all Core forecast year scenarios. This provides a robust basis for economic appraisal which otherwise may be distorted by spurious model convergence 'noise'.

12.2.3. Full details of the VDM convergence statistics are presented in Appendix C.

Table 12-1 - TPU PCF Stage 3 VDM convergence statistics: Core scenario

Scenario	Best Loop	Full Model Gap	Subset Area Gap
DM 2025	15	0.01%	0.03%
DS 2025	19	0.01%	0.03%
DM 2040	20	0.01%	0.03%
DS 2040	19	0.01%	0.03%
DM 2051	17	0.02%	0.05%
DS 2051	19	0.02%	0.06%

Highway Assignment Model (HAM)

12.2.4. The convergence parameters adopted for TPU have been retained from the TPS RTM. The advice on model convergence is set out in TAG unit M3.1 (Table 4) and is reproduced below in Table 12-2.

Table 12-2 - TAG (unit 3.1) convergence criteria

Convergence Measures	Type	Base Model Acceptable Values
Delta & %GAP	Proximity	Less than 0.1% or at least stable with convergence fully documented and all other criteria met
Percentage of links with flow change (P1) < 1%	Stability	Four consecutive iterations greater than 98%

Source: TAG Unit M 3.1 Table 4

12.2.5. Table 12-3 and Table 12-4 show TAG convergence criteria have been met for all core forecast year scenarios.

12.2.6. However, the %GAP for TPU has been tightened to 0.05% as a target figure in accordance with the TPS RTM, hence the high number of assignment-simulation loop iterations. Based on these criteria, all Core forecast year scenarios are achieving the target figure, except the AM peak of the 2051 DM and DS scenarios. The convergence statistics indicate a reduction in model stability in the 2051 horizon year forecast scenarios during the morning and evening peaks. This is reflective of the predicted increase in network congestion as a result of an increase in demand assigned to the networks. It is noted that 0.062% gap in the DM and 0.052% gap in the DS are still well below the 0.1% specified in TAG.

12.2.7. Full details of the HAM convergence statistics are presented in Appendix C.

Table 12-3 - TPU PCF Stage 3 HAM convergence statistics: DM Core scenario

Time Period	Year	Assignment Simulation Loops	P (%)	Gap%
AM	2025	11	99.1%	0.039%
	2040	105	100.0%	0.050%
	2051	120	99.6%	0.062%
IP	2025	10	99.5%	0.020%
	2040	10	98.7%	0.042%
	2051	11	99.9%	0.047%
PM	2025	12	98.9%	0.034%
	2040	25	99.9%	0.050%
	2051	107	100.0%	0.049%

Table 12-4 - TPU PCF Stage 3 HAM convergence statistics: DS Core scenario

Time Period	Year	Assignment Simulation Loops	P (%)	Gap%
AM	2025	10	98.6%	0.041%
	2040	58	99.9%	0.049%
	2051	120	99.8%	0.052%
IP	2025	10	98.8%	0.020%
	2040	9	99.1%	0.043%
	2051	11	99.3%	0.046%
PM	2025	10	98.6%	0.038%
	2040	26	99.9%	0.049%
	2051	118	100.0%	0.050%

12.3. Demand

12.3.1. Trip matrix totals and sectored demand matrices from the VDM and HAM have been analysed to identify the demand response as a result of implementing the TPU scheme.

Matrix Totals

12.3.2. Table 12-5 to Table 12-7 summarise matrix totals for the Reference Case, post-VDM DM and post-VDM DS, by forecast year and user class. The tabulations show that DIADEM induces minimal change in matrix totals between the Reference Case and the post-VDM DM, and even less still between the post-VDM DM and DS scenarios.

Table 12-5 - Matrix total comparison by user class (2025): Core scenario

Time Period	User Class	Reference case	DM	DS	Abs Diff (DM-Ref)	% Diff (DM-Ref)	Abs Diff(DS-DM)	% Diff (DS-DM)
AM	1 - Car Business	361,436	360,632	360,588	-804	-0.22%	-44	-0.01%
	2 - Car Commute	2,543,733	2,536,185	2,536,130	-7,548	-0.30%	-55	0.00%
	3 - Car Other	2,366,387	2,353,150	2,353,111	-13,237	-0.56%	-39	0.00%
	4 - LGV Fixed	699,686	699,686	699,686	0	0.00%	0	0.00%
	5 - HGV Fixed	326,511	326,511	326,511	0	0.00%	0	0.00%
IP	1 - Car Business	379,358	379,360	379,364	3	0.00%	3	0.00%
	2 - Car Commute	965,932	966,163	966,174	231	0.02%	11	0.00%
	3 - Car Other	3,022,259	3,025,347	3,025,395	3,088	0.10%	48	0.00%
	4 - LGV Fixed	642,513	642,513	642,513	0	0.00%	0	0.00%
	5 - HGV Fixed	338,329	338,329	338,329	0	0.00%	0	0.00%
PM	1 - Car Business	379,647	379,435	379,418	-213	-0.06%	-16	0.00%
	2 - Car Commute	2,375,279	2,375,428	2,375,457	149	0.01%	29	0.00%
	3 - Car Other	3,348,037	3,349,949	3,349,927	1,912	0.06%	-23	0.00%
	4 - LGV Fixed	680,064	680,064	680,064	0	0.00%	0	0.00%
	5 - HGV Fixed	237,868	237,868	237,868	0	0.00%	0	0.00%

Table 12-6 - Matrix total comparison by user class (2040): Core scenario

Time Period	User Class	Reference case	DM	DS	Abs Diff (DM-Ref)	% Diff (DM-Ref)	Abs Diff(DS-DM)	% Diff (DS-DM)
AM	1 - Car Business	398,801	396,088	396,044	-2,713	-0.68%	-44	-0.01%
	2 - Car Commute	2,761,581	2,735,968	2,735,924	-25,613	-0.93%	-44	0.00%
	3 - Car Other	2,668,312	2,631,333	2,631,303	-36,978	-1.39%	-30	0.00%
	4 - LGV Fixed	840,717	840,717	840,717	0	0.00%	0	0.00%
	5 - HGV Fixed	339,235	339,235	339,235	0	0.00%	0	0.00%
IP	1 - Car Business	414,754	416,591	416,586	1,837	0.44%	-5	0.00%
	2 - Car Commute	1,039,365	1,042,355	1,042,358	2,990	0.29%	4	0.00%
	3 - Car Other	3,415,054	3,442,228	3,442,258	27,174	0.80%	29	0.00%
	4 - LGV Fixed	772,013	772,013	772,013	0	0.00%	0	0.00%
	5 - HGV Fixed	351,918	351,918	351,918	0	0.00%	0	0.00%
PM	1 - Car Business	416,152	409,421	409,405	-6,732	-1.62%	-15	0.00%
	2 - Car Commute	2,559,381	2,535,899	2,535,963	-23,483	-0.92%	64	0.00%
	3 - Car Other	3,743,095	3,694,162	3,694,170	-48,933	-1.31%	8	0.00%
	4 - LGV Fixed	817,151	817,151	817,151	0	0.00%	0	0.00%
	5 - HGV Fixed	247,514	247,514	247,514	0	0.00%	0	0.00%

Table 12-7 - Matrix total comparison by user class (2051): Core scenario

Time Period	User Class	Reference case	DM	DS	Abs Diff (DM-Ref)	% Diff (DM-Ref)	Abs Diff(DS-DM)	% Diff (DS-DM)
AM	1 - Car Business	426,244	422,931	422,870	-3,313	-0.78%	-61	-0.01%
	2 - Car Commute	2,947,340	2,917,893	2,917,882	-29,447	-1.00%	-11	0.00%
	3 - Car Other	2,886,287	2,845,698	2,845,636	-40,588	-1.41%	-62	0.00%
	4 - LGV Fixed	924,699	924,699	924,699	0	0.00%	0	0.00%
	5 - HGV Fixed	352,039	352,039	352,039	0	0.00%	0	0.00%
IP	1 - Car Business	441,941	443,582	443,586	1,641	0.37%	4	0.00%
	2 - Car Commute	1,100,280	1,101,418	1,101,431	1,138	0.10%	13	0.00%
	3 - Car Other	3,681,441	3,709,654	3,709,705	28,213	0.77%	51	0.00%
	4 - LGV Fixed	849,052	849,052	849,052	0	0.00%	0	0.00%
	5 - HGV Fixed	365,336	365,336	365,336	0	0.00%	0	0.00%
PM	1 - Car Business	443,971	436,096	436,071	-7,875	-1.77%	-25	-0.01%
	2 - Car Commute	2,714,908	2,688,263	2,688,312	-26,645	-0.98%	50	0.00%
	3 - Car Other	4,025,477	3,969,849	3,969,857	-55,629	-1.38%	9	0.00%
	4 - LGV Fixed	898,766	898,766	898,766	0	0.00%	0	0.00%
	5 - HGV Fixed	256,991	256,991	256,991	0	0.00%	0	0.00%

Sectored Matrices

12.3.3. Figure 12-1 presents the 25-sector system that has been utilised to compare the demand matrices, whilst Figure 8-1 shows the extent of the 3-sector system. The sector systems are defined as follows:

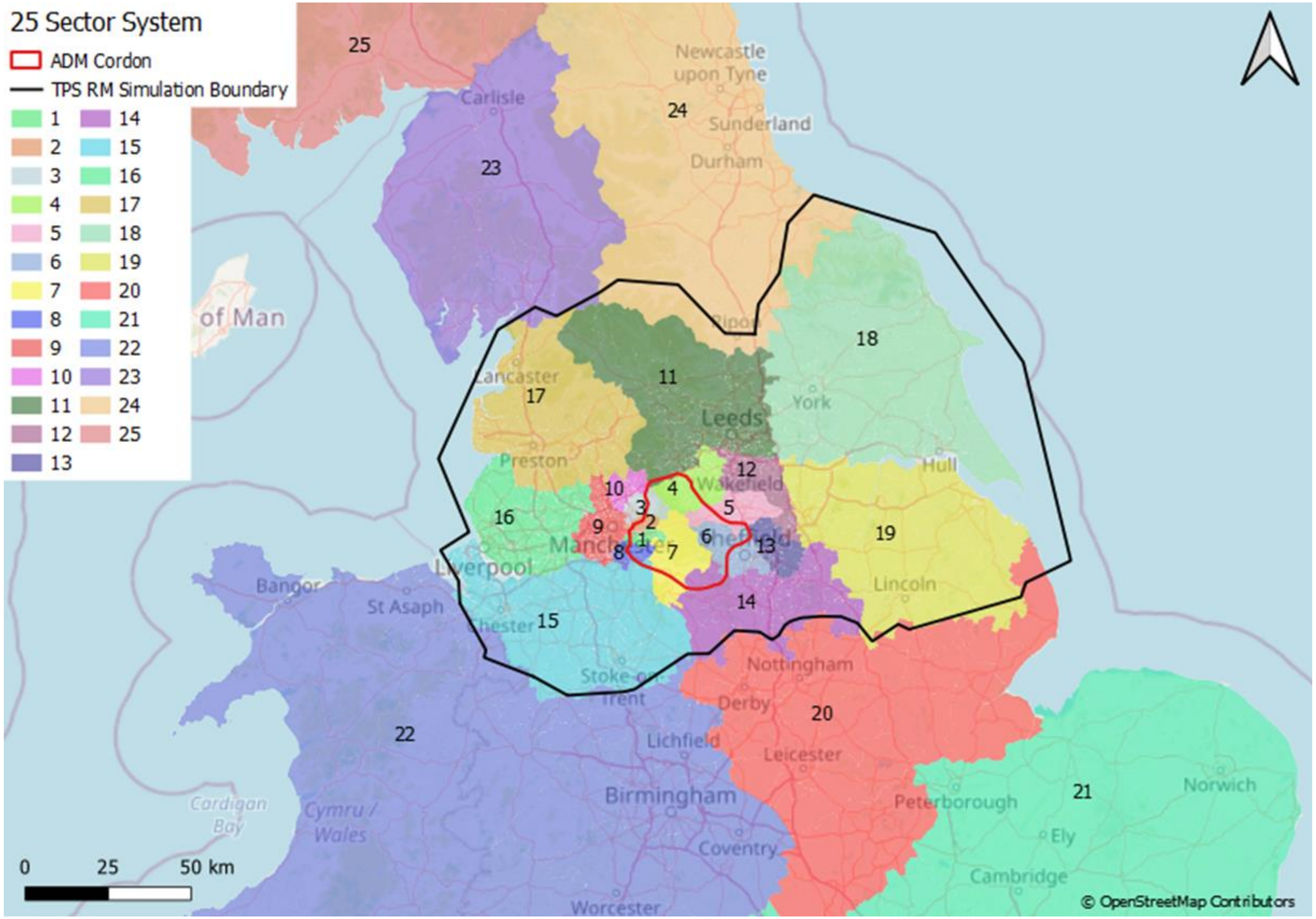
- 25-sector system: administrative boundaries (varying levels of aggregation dependent on proximity to the scheme).
- 3-sector system: internal simulation (simulation network in TPS RTM, inside TPU Area of Detailed Modelling), external simulation (simulation network in TPS RTM, outside TPU ADM) and external (buffer network in TPS RTM).

12.3.4. Full details of the sectored analysis are included in Appendix C as an accompanying spreadsheet.

12.3.5. Key observations regarding the demand response induced by the scheme are listed below. These observations focus on the 3-sector system, but the points raised regarding the demand response of the scheme are also reflected in the 25-sector system.

- There is no change in LGV and HGV trips as they are fixed in DIADEM.
- The trends apparent in the sectored demand analysis show that the introduction of the scheme has had minimal impact on the absolute distribution of forecast trips across the model. However, there are some specific sector to sector movements with low levels of flow, which have a more significant percentage change (e.g. rest of Tameside to rest of High Peak).
- As such, the analysis suggests that the scheme would likely have limited demand response.

Figure 12-1 - TPU sector system



12.4. Trip Length Distribution (TLD)

12.4.1. Analysis has been undertaken to identify the impact of the scheme on Trip Length Distribution (TLD). Figure 12-2 to Figure 12-4 compare 12-hour (07:00-19:00) Annual Average Weekday Traffic (AAWT) trip length distributions for cars between the Base, Reference Case, post-VDM DM and post-VDM DS. There is no change in the distribution of LGV and HGV trip lengths as they are not included in DIADEM. However, detailed analysis of all user classes is presented in Appendix C.

12.4.2. The TLD analysis has been produced using the alternative TLD method which involves the exclusion of external trips between zones in the model buffer area, whilst separately considering matrix elements that have an origin or destination trip end in the model simulation area, which in practice double counts the internal-internal trips within the model simulation area.

12.4.3. Key observations regarding the impact of the VDM on TLDs are listed below:

- It is evident that the VDM induces an increase in the number of longer distance trips between the Reference Case and the post-VDM DM scenario.
  - For car trips in 2025, this equates to a 7% increase in 50-100km trips, a 7% increase in 100-200km trips and an 8% increase in trips over 200km.
  - For car trips in 2040, this equates to a 14% increase in 50-100km trips, an 18% increase in 100-200km trips and a 26% increase in trips over 200km.
  - For car trips in 2051, this equates to a 15% increase in 50-100km trips, an 21% increase in 100-200km trips and a 33% increase in trips over 200km.
  - It is worth noting that although the percentage change seems high, as a proportion of the entire matrix these changes involve a very small number of trips.
- The difference in trip lengths between the DM and DS scenarios is immaterial, which is consistent with the demand analysis that suggests the introduction of the scheme has had minimal impact on the distribution of trips across the model.

Figure 12-2 - TLD Analysis 12-hour (07:00-19:00) Car AAWT (2025): Core scenario

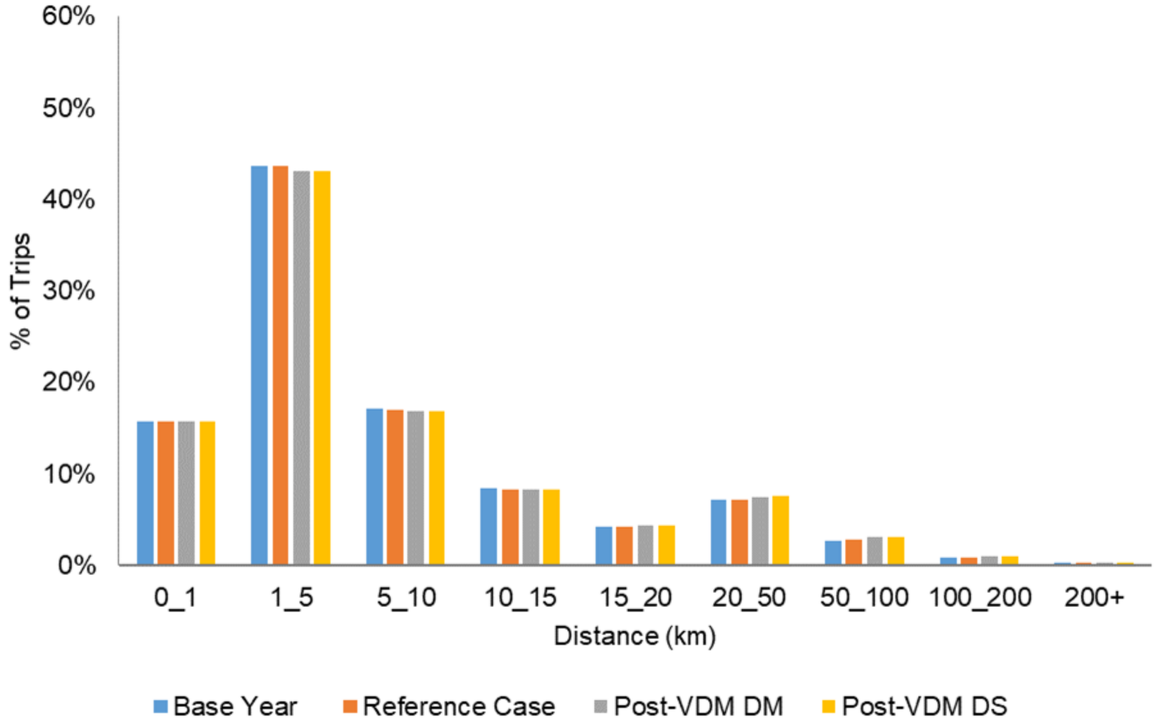


Figure 12-3 - TLD Analysis 12-hour (07:00-19:00) Car AAWT (2040): Core scenario

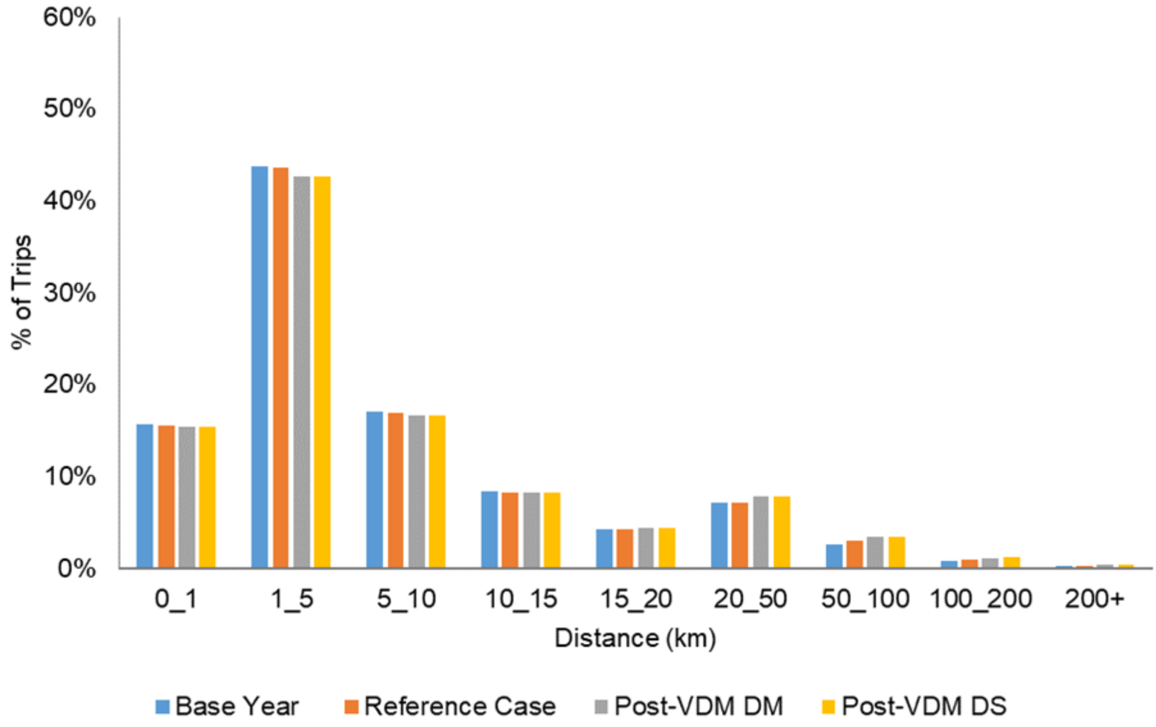
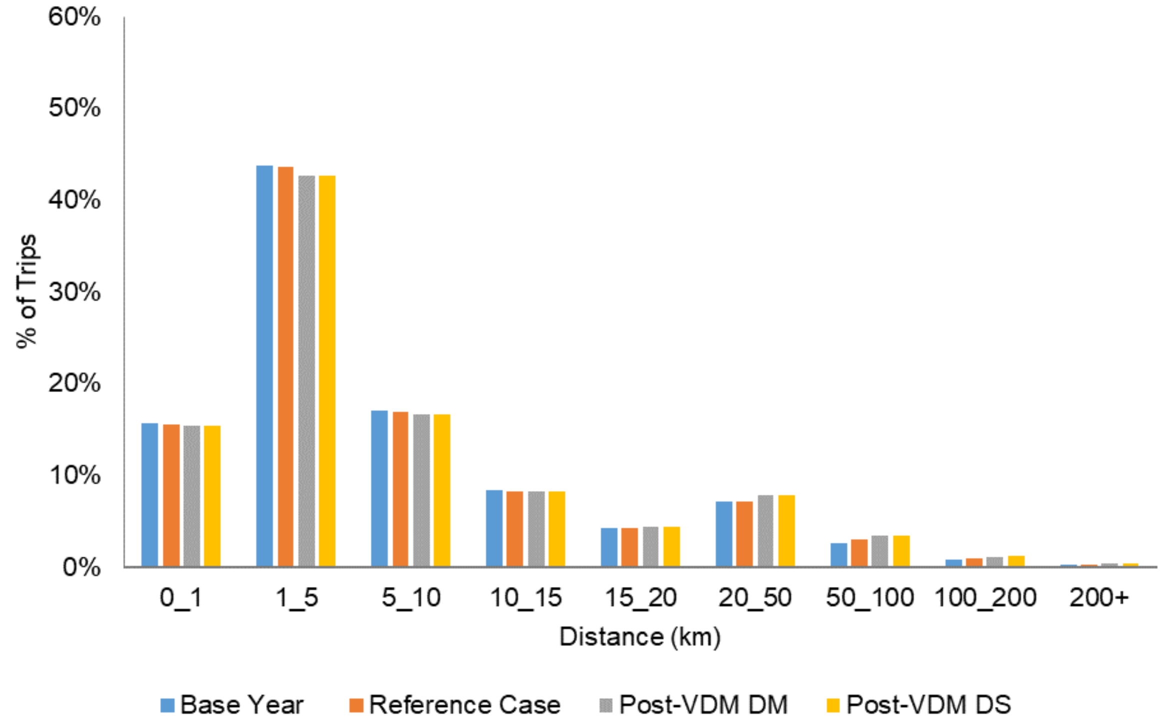


Figure 12-4 - TLD Analysis 12-hour (07:00-19:00) Car AAWT (2051): Core scenario



12.5. Link flow

12.5.1. Link flows have been compared between the DM and DS scenarios to understand the impact of the scheme on the localised highway network.

12.5.2. 12-hour (07:00-19:00) AAWT flow comparisons between the core DM and DS scenarios are presented in Table 12-8, for all forecast years. Figure 12-5 shows the locations of the links that have been included in the analysis.

12.5.3. The following observations are based on the change in 12-hour AAWT values between the DM and DS scenarios. All values quoted in the text are two-way 12-hour AAWT vehicle volumes, rounded to the nearest 100. The reference IDs attached to the road names in the text refer to Figure 12-5.

12.5.4. As a result of introducing the A57 TPU scheme, the model predicts the following changes in two-way link flow in the scheme opening and design year:

Mottram

- There is a reduction in flow on the existing A57 along Hyde Road (12) (2025: -13,600 and 2040: -14,600) and Mottram Moor (13) (2025: -13,900 and 2040: -14,000), as vehicles are reassigned onto the new A57 alignment.
- As vehicles no longer seek alternative routes to avoid congestion on the A57 along Hyde Road and Mottram Moor, there is also a reduction in flow on Roe Cross Road (11) (2025: -1,300 and 2040: -900), Back Moor (14) (2025: -2,000 and 2040: -1,700) and Ashworth Lane (4) (2025: -3,300 and 2040: -2,300).
- Consequently, with the reduction in re-routing, vehicle volumes on the M67 between J3 and J4 (1) have increased (2025: +6,100 and 2040: +7,000).
- There is a slight increase in northbound / southbound movements at Mottram Crossroads on Stalybridge Road (15) (2025: +300 and 2040: +900) and Market Street (B6174) (6) (2025: +2,100 and 2040: +3,000).
  - This has been enabled by the considerable reduction in vehicle volumes on the A57, increasing the spare capacity of the Mottram Crossroads junction. It is noted the north-south movements across the Mottram village Crossroads following the reduction in flow on the A57 have been modified, with the Stalybridge Road and Market Street approach arms modelled as separate signal stages (see section 2.2.4) to also improve pedestrian crossing facilities.

Hollingworth

- There is a reduction in trips on the A57 along Mottram Moor (16) (2025: -10,300 and 2040: -11,200) and Woolley Lane (9) (2025: -10,400 and 2040: -10,900), as vehicles are diverted onto the new A57 alignment.
- There is also a slight reduction in vehicles on Market Street (A628) (10) (2025: -0 and 2040: -300) due to improved pedestrian facilities at the Gun Inn junction. The reduction in green time in favour of pedestrians has increased delay at the junction and subsequently reduced the number of vehicles travelling between the A57 and A628.
- There is an increase in flow on the A57 (Brookfield) (7) between the scheme junction and Shaw Lane (2025: +3,800 and 2040: +4,100). This increase in vehicles is reflective of vehicles utilising the scheme and no longer seeking alternative routes to avoid congestion on the A57 along Hyde Road and Mottram Moor.

12.5.5. More detailed link flow analysis is included in Appendix C as an accompanying spreadsheet.

Figure 12-5 - Link flow comparison

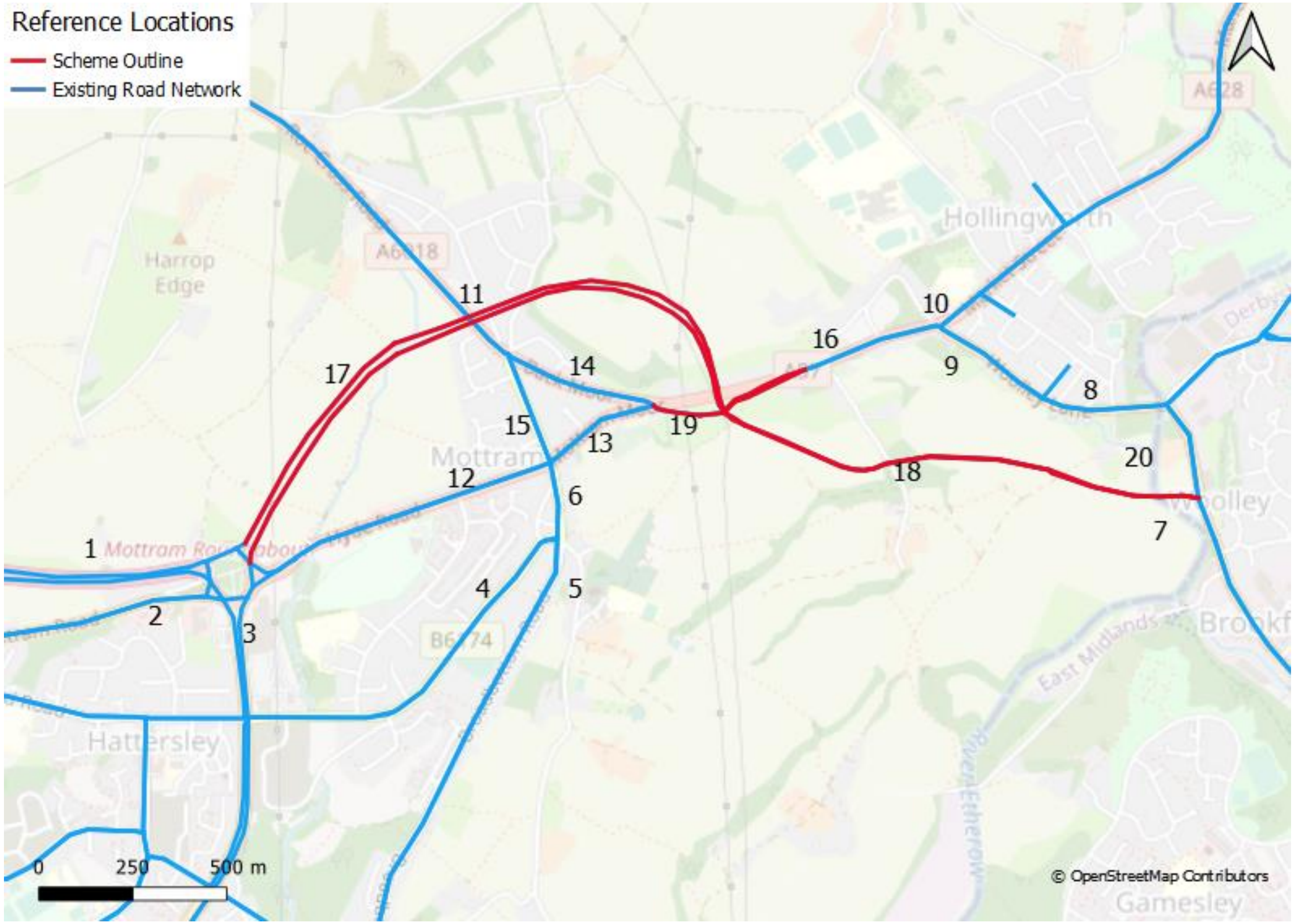


Table 12-8 - Link flow comparison (12-hour AAWT, 07:00-19:00): Core Scenario (in vehicles)

ID	Description	Dir.	2025				2040				2051			
			DM	DS	Diff.	Diff. %	DM	DS	Diff.	Diff. %	DM	DS	Diff.	Diff. %
1	M67 J3 - J4	EB	10,965	14,094	3,130	29%	11,949	14,789	2,840	24%	12,069	15,205	3,137	26%
1	M67 J3 - J4	WB	12,581	15,567	2,986	24%	14,145	18,340	4,195	30%	15,028	19,511	4,484	30%
2	Mottram Road	EB	1,562	1,392	-170	-11%	1,708	1,660	-49	-3%	1,786	1,679	-107	-6%
2	Mottram Road	WB	1,271	1,202	-70	-5%	1,578	1,310	-269	-17%	1,580	1,361	-219	-14%
3	Stockport Road	NB	949	1,098	148	16%	1,015	1,382	367	36%	1,412	1,613	201	14%
3	Stockport Road	SB	952	1,273	321	34%	961	1,384	423	44%	1,000	1,524	524	52%
4	Ashworth Lane	EB	5,022	1,608	-3,413	-68%	5,091	1,878	-3,213	-63%	5,001	1,789	-3,212	-64%
4	Ashworth Lane	WB	4,301	4,423	122	3%	4,590	5,524	934	20%	4,616	6,084	1,468	32%
5	Broadbottom Road	NB	3,972	3,410	-562	-14%	4,679	4,402	-276	-6%	4,864	4,768	-95	-2%
5	Broadbottom Road	SB	3,524	2,875	-649	-18%	3,576	3,403	-174	-5%	3,542	3,646	103	3%
6	B6174	NB	2,178	1,833	-345	-16%	2,003	1,911	-92	-5%	2,003	2,021	18	1%
6	B6174	SB	895	3,341	2,446	273%	642	3,712	3,070	478%	596	4,168	3,572	599%
7	Brookfield	NB	5,982	7,663	1,682	28%	6,314	8,529	2,215	35%	6,612	8,855	2,243	34%
7	Brookfield	SB	6,460	8,585	2,126	33%	7,044	8,934	1,890	27%	7,282	8,833	1,552	21%
8	Woolley Bridge Road	EB	3,122	3,361	239	8%	3,316	3,828	513	15%	3,518	4,254	736	21%
8	Woolley Bridge Road	WB	3,683	3,934	251	7%	4,286	4,429	143	3%	4,584	4,542	-42	-1%
9	Woolley Lane	EB	6,788	637	-6,151	-91%	7,237	666	-6,571	-91%	7,431	677	-6,754	-91%
9	Woolley Lane	WB	6,858	2,572	-4,286	-62%	7,457	3,135	-4,322	-58%	7,804	3,343	-4,461	-57%
10	Market Street	EB	6,620	6,777	157	2%	6,763	6,719	-44	-1%	6,880	6,861	-19	0%
10	Market Street	WB	6,603	6,422	-181	-3%	7,023	6,742	-280	-4%	7,300	7,012	-289	-4%
11	Roe Cross Road	NB	6,102	5,540	-562	-9%	6,880	6,361	-519	-8%	7,447	7,067	-380	-5%
11	Roe Cross Road	SB	6,387	5,608	-779	-12%	6,976	6,596	-380	-5%	7,482	7,327	-154	-2%

ID	Description	Dir.	2025				2040				2051			
			DM	DS	Diff.	Diff. %	DM	DS	Diff.	Diff. %	DM	DS	Diff.	Diff. %
12	Hyde Road	EB	7,469	2,053	-5,416	-73%	7,824	2,054	-5,770	-74%	7,951	2,059	-5,892	-74%
12	Hyde Road	WB	8,464	281	-8,183	-97%	9,175	321	-8,854	-96%	9,409	337	-9,072	-96%
13	Mottram Moor (Between Stalybridge/Backmoor)	EB	7,530	823	-6,707	-89%	7,562	796	-6,766	-89%	7,433	801	-6,632	-89%
13	Mottram Moor (Between Stalybridge/Backmoor)	WB	7,728	598	-7,130	-92%	7,932	621	-7,311	-92%	8,033	674	-7,359	-92%
14	Back Moor	EB	5,037	3,953	-1,084	-22%	5,610	4,740	-870	-16%	6,083	5,043	-1,040	-17%
14	Back Moor	WB	3,879	3,009	-870	-22%	4,524	3,718	-806	-18%	4,878	4,291	-587	-12%
15	Stalybridge Road	NB	2,203	2,368	165	7%	2,031	2,402	371	18%	2,059	2,505	446	22%
15	Stalybridge Road	SB	2,173	2,319	146	7%	2,017	2,573	556	28%	1,972	3,074	1,102	56%
16	Mottram Moor (Carhouse Lane and Woolley Lane)	EB	12,490	6,937	-5,553	-44%	13,102	7,014	-6,088	-46%	13,438	7,004	-6,434	-48%
16	Mottram Moor (Carhouse Lane and Woolley Lane)	WB	11,606	6,851	-4,755	-41%	12,483	7,357	-5,126	-41%	12,986	7,667	-5,319	-41%
17	A57 Link Road	EB	-	13,037	-	-	-	14,068	-	-	-	14,701	-	-
17	A57 Link Road	WB	-	11,810	-	-	-	13,287	-	-	-	13,830	-	-
18	A57 Spur	EB	-	9,821	-	-	-	10,842	-	-	-	11,322	-	-
18	A57 Spur	WB	-	7,534	-	-	-	8,562	-	-	-	8,959	-	-
19	Mottram Moor link road	EB	-	4,769	-	-	-	5,516	-	-	-	5,840	-	-
19	Mottram Moor link road	WB	-	3,600	-	-	-	4,319	-	-	-	4,961	-	-
20	Woolley Bridge	NB	5,982	4,439	-1,543	-26%	6,314	5,070	-1,244	-20%	6,612	5,541	-1,070	-16%
20	Woolley Bridge	SB	6,459	3,076	-3,384	-52%	7,044	3,200	-3,844	-55%	7,282	3,162	-4,120	-57%

12.6. Journey times

12.6.1. Journey times have been compared between the core DM and DS scenarios to understand the impact of the scheme on the localised highway network.

12.6.2. Table 12-9 to Table 12-11 compare journey times between the core DM and DS scenarios, for all forecast years. Figure 12-6 highlights the extent of the journey time routes that have been included in the analysis.

12.6.3. As a result of introducing the A57 TPU scheme, the model predicts the following changes in journey times in the scheme opening and design years:

M67 J3 to Glossop Crossroads

- Journey times between the M67 J3 and Glossop Crossroads are predicted to improve in both directions across all modelled time periods and forecast years.
  - The greatest journey time savings occur in the eastbound direction in the IP and PM peak, with improvements of ~8-10 minutes predicted in all forecast years.
- However, journey time savings are not as great for vehicles travelling westbound, with the greatest reduction predicted in the IP in all forecast years (~5-6 minutes).
  - This is attributable to the lower levels of congestion in the westbound direction between Glossop Crossroads and the M67 J3 in the DM scenario, especially at the Gun Inn junction (A57 / A628).
  - Delay is predicted on the Mottram Moor (A57) (eastbound) approach arm at the Gun Inn junction in all time periods, but delay is not reflected to the same extent on the Woolley Lane approach arm (i.e. equivalent westbound journey time route).
- Vehicles travelling east-west (in both directions) can utilise the TPU link scheme in its entirety, which is predicted to offer considerable journey time savings in comparison to journey times on the existing A57 route in the DM scenario.

M67 J3 to Woodhead (A628)

- Journey times are predicted to improve in both directions on the A628 between the M67 J3 and Woodhead Reservoir, across all time periods and forecast years, through the alleviation of congestion on the A57, following the implementation of the TPU A57 link scheme.
  - The greatest journey time savings are predicted to occur in the eastbound direction in the PM peak, with improvements of around 5 minutes predicted in all forecast years. (The savings in the IP are only marginally less).
- Journey time improvements are not predicted to be as great for vehicles travelling westbound on the A628 due to the re-prioritisation of signal timings at the Gun Inn junction (A57 / A628), plus lower levels of congestion in the DM scenario.
  - As part of the TPU scheme proposal, greater improvements for non-motorised users (NMU) have been considered at the Gun Inn junction. This includes increasing green time for pedestrians which will be at the expense of motorised road users.
  - Consequently, journey time savings for vehicles travelling westbound between the M67 J3 and Woodhead are not as great, at ~1-2 minutes.
  - Although the re-distribution of green time is predicted to affect all approach arms of the Gun Inn junction, it has a greater impact on journey times on the A628 (Market Street) compared to the A57 (Mottram Moor). This is because the introduction of the scheme is predicted to significantly reduce congestion on Mottram Moor, which outweighs the loss of journey times associated with the re-distribution of green time at Gun inn in favour of pedestrians.

Roe Cross to Glossop Crossroads (A57)

- Journey time savings are predicted on the A57 route between Roe Cross Road and Glossop Crossroads across all modelled time periods and forecast years, except westbound in the 2025 PM peak and 2051 AM peak.
- The greatest time savings, of ~2 minutes, are predicted eastbound in the IP in all forecast years.

- A small increase in journey times is predicted on the A57 westbound during the PM peak in 2025 (~25 seconds) and the AM peak in 2051 (~1 minute).
    - The model predicts a small increase in journey times on the A57 between the Woolley Lane scheme junction and Glossop Crossroads, as a result of increased demand following the implementation of the TPU link scheme.
    - In comparison to the M67 J3 to Glossop Crossroads route, vehicles travelling north-south (in both directions) via Back Moor (A6018) only benefit from a single section of the scheme (i.e. A57(T) to A57 link road). Consequently, journey time savings are not predicted to be as great as those predicted for vehicles travelling east-west (in both directions) between the M67 J3 and Glossop Crossroads.

Figure 12-6 - Journey Time Routes - With Scheme

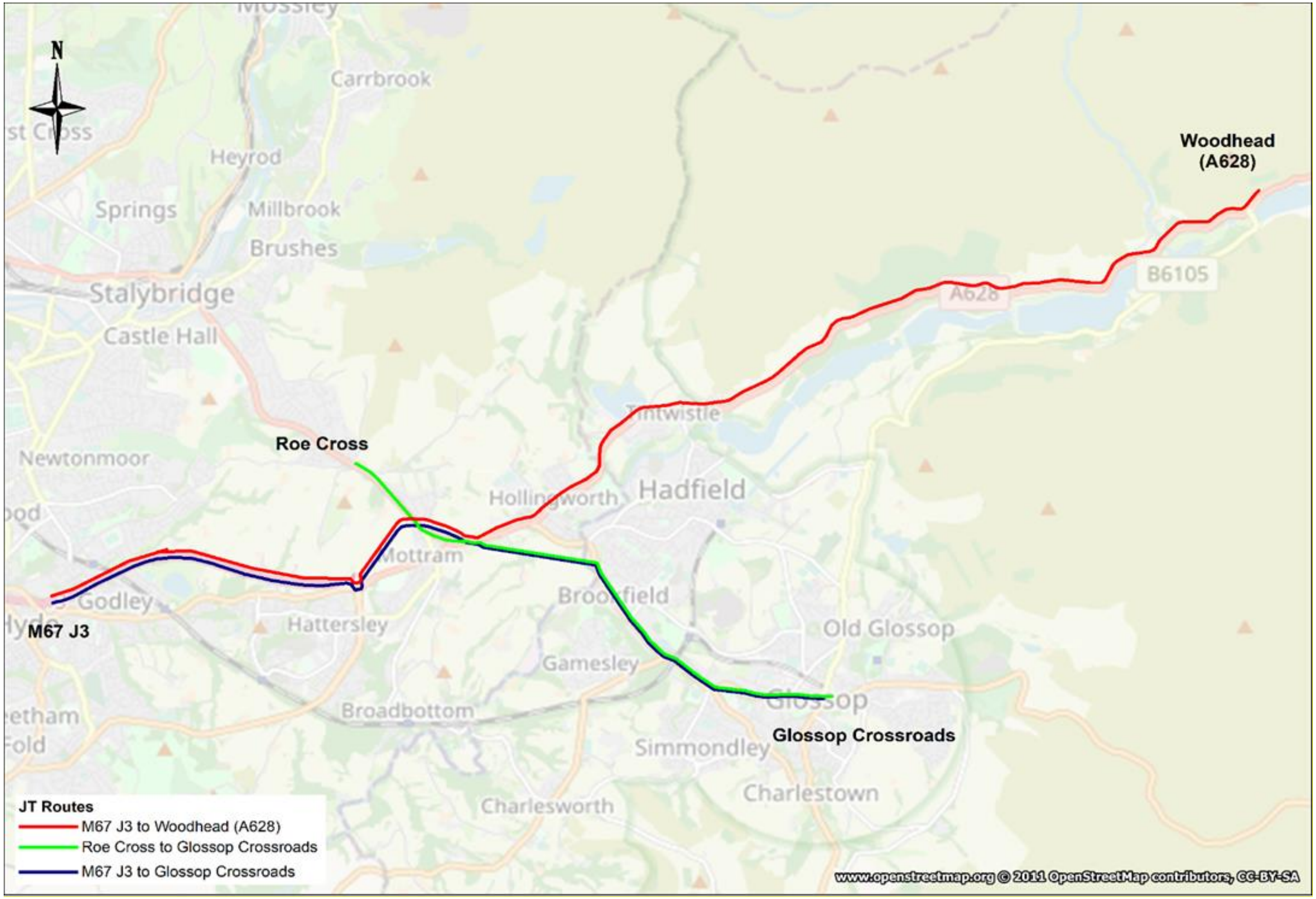


Table 12-9 - Journey time (mm:ss) route comparison (2025): Core scenario

JT Route	Dir.	AM				IP				PM			
		DM	DS	Diff.	% Diff.	DM	DS	Diff.	% Diff.	DM	DS	Diff.	% Diff.
M67 J3 to Glossop Crossroads	EB	19:15	15:07	-04:09	-22%	23:20	14:51	-08:29	-36%	24:21	16:25	-07:55	-33%
	WB	16:14	13:30	-02:44	-17%	19:12	14:05	-05:07	-27%	16:33	15:21	-01:12	-7%
M67 J3 to Woodhead (A628)	EB	21:49	20:14	-01:35	-7%	26:32	22:24	-04:08	-16%	24:55	20:08	-04:46	-19%
	WB	20:25	18:58	-01:27	-7%	22:10	19:50	-02:19	-10%	19:21	18:47	-00:34	-3%
Roe Cross to Glossop Crossroads (A57)	EB	14:38	13:54	-00:43	-5%	15:22	13:37	-01:45	-11%	15:41	15:09	-00:32	-3%
	WB	12:15	12:03	-00:12	-2%	13:17	12:29	-00:48	-6%	13:37	14:03	00:25	3%

Table 12-10 - Journey time (mm:ss) route comparison (2040): Core scenario

JT Route	Dir.	AM				IP				PM			
		DM	DS	Diff.	% Diff.	DM	DS	Diff.	% Diff.	DM	DS	Diff.	% Diff.
M67 J3 to Glossop Crossroads	EB	21:54	16:30	-05:24	-25%	24:52	16:01	-08:52	-36%	25:59	16:55	-09:03	-35%
	WB	16:53	13:59	-02:54	-17%	20:40	14:42	-05:59	-29%	18:08	15:13	-02:54	-16%
M67 J3 to Woodhead (A628)	EB	23:28	20:51	-02:37	-11%	27:33	22:49	-04:44	-17%	25:50	20:50	-05:00	-19%
	WB	20:58	19:34	-01:23	-7%	23:04	20:39	-02:26	-11%	20:01	18:44	-01:17	-6%
Roe Cross to Glossop Crossroads (A57)	EB	16:13	15:26	-00:47	-5%	16:38	14:43	-01:55	-12%	16:30	15:38	-00:53	-5%
	WB	12:36	12:30	-00:06	-1%	14:07	13:11	-00:56	-7%	14:50	14:27	-00:23	-3%

Table 12-11 - Journey time (mm:ss) route comparison (2051): Core scenario

JT Route	Dir.	AM				IP				PM			
		DM	DS	Diff.	% Diff.	DM	DS	Diff.	% Diff.	DM	DS	Diff.	% Diff.
M67 J3 to Glossop Crossroads	EB	23:37	17:36	-06:00	-25%	25:49	16:37	-09:11	-36%	27:15	17:34	-09:40	-35%
	WB	17:20	15:29	-01:51	-11%	21:37	14:50	-06:48	-31%	19:11	14:56	-04:15	-22%
M67 J3 to Woodhead (A628)	EB	24:15	20:51	-03:24	-14%	28:06	23:09	-04:57	-18%	26:11	20:47	-05:25	-21%
	WB	21:19	20:00	-01:19	-6%	23:26	20:33	-02:54	-12%	20:38	19:15	-01:23	-7%
Roe Cross to Glossop Crossroads (A57)	EB	17:30	16:37	-00:53	-5%	17:23	15:23	-02:01	-12%	17:24	16:12	-01:12	-7%
	WB	12:48	13:58	01:09	9%	15:00	13:19	-01:41	-11%	15:38	14:29	-01:09	-7%

13. Economic Appraisal Overview

13.1.1. This section contains an outline of the components of the economic appraisal of the A57. It identifies the elements for which quantitative and qualitative assessments have been undertaken, the assumptions made, the values of parameters adopted, and the sources of input values. Each of the key components of the economic appraisal is considered in turn.

13.1.2. The results of the economic appraisal of the options identified are shown in Chapter 13 and are summarised in Chapter 14.

13.1.3. The economic appraisal identifies and estimates all the associated expenditures and the benefits over the lifetime of the project to determine to what extent value for money would be delivered as a return on taxpayer investment. As per the TAG Unit A1.2, an economic assessment is undertaken with an objective to facilitate the quantification and monetisation, where possible, of scheme costs and benefits.

13.1.4. The economic assessment, undertaken over a 60-year period from the date of the scheme becoming operational, compares the monetised costs and benefits of the proposed scheme against the alternative without scheme scenario.

13.1.5. The costs of the scheme used in the assessment comprise the scheme construction costs (provided by the Highways England Commercial team), Land Cost, preparation cost, operating and maintenance costs. These costs are considered further later in this section.

13.1.6. The benefits of the scheme are the net benefit experienced by the road user and wider society with and without the scheme, which has been calculated from a number of sources, such as:

- User benefits during normal operation (savings relating to travel times, vehicle operating costs and user charges) have been assessed using TUBA version 1.9.14 with economics file "Economics_TAG_db1_14_0.txt" based on TAG 1.14. This included sensitivity tests of low growth/optimistic scenarios;
- Reliability impact due to changes in Journey time variability;
- Accident savings have been forecast using COBALT version 2013.2 with economic parameters file version 2020.2;
- Wider economic impacts have been assessed in line with TAG Unit A2.2 using WITA Beta 2.0 for static agglomeration benefits;
- Environmental impacts have been assessed in line with TAG A.3; and
- Social and distributional impacts have been assessed in line with TAG A4.1 and A4.2.

13.1.7. An initial Benefit Cost Ratio (BCR) has been calculated over the 60-year appraisal period that excludes the outputs of the journey time reliability assessment and wider economic impacts, with an adjusted BCR also reported that includes these impacts.

13.1.8. To ensure consistency of outputs across all elements of assessment, both costs and benefits from each of the above analyses have been output in 2010 market prices, discounted to 2010.

13.1.9. The results of the assessment are presented in the following tables:

- The Transport Economy Efficiency (TEE) table;
- The Public Accounts (PA) table; and

- The Analysis of Monetised Costs and Benefits (AMCB) table.

13.1.10. The methodology for the quantification of scheme benefits is presented in Chapter 4 and the results are presented in Chapter 5 of this report.

13.1.11. The economic appraisal has been undertaken for the core scenario of the identified single option and is supplemented with sensitivity tests.

13.2. Estimation of scheme costs

Approach

13.2.1. To ensure value for public money and secure funding, the project requires precise estimation of the costs of the transport scheme.

13.2.2. Costs of the proposed scheme have been developed by Highways England and prepared for inclusion in the cost-benefits analysis based on the TAG Unit A1.2 which provides specific guidance on presentation of the costs associated with the scheme, predominantly construction, operating and maintenance costs. Any unrealistic cost estimates could adversely affect the robustness of the assessment of affordability and value for money of a scheme.

13.2.3. The costs have been estimated under two broad categories – construction costs and operating and maintenance costs

Construction Costs

13.2.4. Scheme construction costs have been estimated by and received from the Highways England Commercial team. These include the results of a quantified risk assessment (rather than Optimism Bias) and the effects of real-terms construction price inflation. The costs have been provided on a year by year basis as factor costs in 2010 prices.

13.2.5. A summary of the costs, along with their respective cost profiles, are provided in Table 13-1 and Table 13-2. The full Scheme Cost Estimates can be found in Appendix D. These figures were correct at the time of compiling this report. Any significant changes in cost may require the calculations to be reviewed.

Table 13-1 - Total Scheme Construction Cost (£m PVC, 2010 prices)

Cost Type	Core Scenario
Preparation	£13.62
Supervision	£2.73
Works	£77.87
Lands	£8.52
Total	**£102.74**

Note: all monetary values are in 2010 market prices discounted to 2010

Table 13-2 - Scheme Construction cost profiles (£m)

Year	Capital Expenditure, by Year and Component (£m)				
	Preparation	Supervision	Works	Land	Total
2021	£5.95	-	£0.07	£1.92	£7.93
2022	£7.68	-	£0.08	£0.77	£8.53
2023	£2.06	£0.82	£41.87	£3.35	£46.04
2024	-	£1.43	£35.01	£0.91	£37.06
2025	-	£0.73	£0.84	£0.74	£2.32
2026	-	£0.04	-	£0.62	£0.66
2027	-	-	-	£0.11	£0.11
2028	-	-	-	£0.04	£0.04
2029	-	-	-	£0.03	£0.03
2030	-	-	-	£0.02	£0.02
2031	-	-	-	£0.01	£0.01
Total	**£13.62**	**£2.73**	**£77.87**	**£8.52**	**£102.74**

Note: all monetary values are in 2010 market prices discounted to 2010

13.2.6. To convert the costs to Present Value Costs (PVC), the following calculations have been performed:

- Conversion to market prices (using a factor for the average rate of indirect taxation in the economy of 1.19).
- Discounting to 2010 at 3.5% per annum.

Maintenance Costs

13.2.7. The capital cost of maintenance is the cost of people, machinery, and materials to maintain the network and its assets.

13.2.8. The cost of periodic repairs and replacement of the new sections of carriageway have been calculated in line with QUADRO data, setting out typical repair and spend profiles and costs for each phase of repair for the relevant network sections.

13.2.9. For the dual carriageway sections it is proposed to use a Long Life Flexible Pavement (LLP) and for the Single Carriageway section a Determinate Life Flexible Pavement (DLP) is proposed. The maintenance profiles and spend for these surfaces are set out in Table 13-3.

Table 13-3 – Maintenance Profiles (Costs in £000s per km)[23]

DLP (single 2 lane)					LLP (Dual 2 lane)			
Year	Works	Cost	Duration (days)		Year	Works	Cost	Duration (days)
0	New	0	0		0	New	0	0
11	TS	66	4		11	TS	168	6
22	Ov	240	12		22	In	354	7
32	TS	66	4		32	In	576	12
42	Ov	252	12		42	In	354	7
52	TS	66	4		52	In	354	7

Note: all monetary values are in 2010 market prices discounted to 2010

Costs in £000s per km of road (both directions) in 2010 prices. Includes cost of traffic management

Traffic management assumes day working for single and dual

TS = Thin Surfacing (typically 30mm)

Ov = Overlay (height 50/100mm)

In = Inlay (depths 50/100mm)

13.2.10. Assessed over the 60 year appraisal period this cost profile returns a PVC of £1.3m in 2010 market prices.

13.2.11. In addition to this cost of maintaining the carriageways themselves, bridges and underpasses constructed at crossing points will also incur maintenance and renewal costs over the appraisal period.

13.2.12. Estimates of costs for the individual structures have been prepared and whole life costs of maintaining each asset assessed. Maintenance has been assumed to be carried out periodically, with major investment required 25 years after scheme opening and at 15-year periods thereafter. A summary of these costs is set out in Table 13-4.

Table 13-4 – Maintenance Costs for Structures

Structure	Total Maintenance	
	Cost in 2020 factor costs	PVC in 2010 market prices
Roe Cross Road Bridge	0.8	0.3
River Etherow Bridge	1.5	0.6
Carrhouse Lane Underpass	0.35	0.1
Old Mill Farm Underpass	0.35	0.1
Mottram Underpass	6.0	2.3
Total	**9.0**	**3.5**

Note: all monetary values are in 2010 market prices discounted to 2010

[23] Maintenance profiles, phasing and costs set out in this table are based on Table 4/1 of Part 2 of the QUADRO Manual, July 2020

Total Costs

13.2.13. Table 13-5 sets out the total cost of the scheme over the appraisal period, bringing together the elements described above.

13.2.14. In addition to the scheme related costs a small change in value of revenue is forecast to be generated by the scheme. This will occur at locations including Dunham bridge, Humber bridge, Kingsway tunnel, M6 mainline, M6 ramp, Queensway tunnel and Warburton Bridge Road. These impacts are calculated through the transport model and TUBA assessment which are described later in this document, but the output is reported here to provide a full overview of the Present Value of Cost of the scheme. The impact on revenue collection is a reduction of £0.2m over the appraisal period, which is presented here as an addition to the PVC, giving a total value of £107.7m.

Table 13-5 – Total Cost

Cost Item	PVC (£m)
Capital Investment	102.7
Carriageway Maintenance	1.3
Structure Maintenance	3.5
Toll Revenue	0.2
Total Cost	**107.7**

Note: all monetary values are in 2010 market prices discounted to 2010

13.3. Methodology for Assessing Benefits

13.3.1. For monetising the proposed scheme impact, the overall benefit of the scheme can be estimated in terms of net travel time saving (DS compared against DM), reduced vehicle operating costs, impacts during the construction phase, road user safety impact, reliability, environmental impacts and wider economic impacts. In addition to monetised benefits, social impacts and distributional impacts have been assessed.

13.3.2. The results of the assessment can be presented in terms of following parameters.

13.4. Transport Economy Efficiency (TEE)

13.4.1. Transport Economic Efficiency (TEE) benefits have been captured in accordance with TAG Unit A1.3 (July 2020). Impacts on transport users and providers typically make up the majority of benefits for transport business cases. This TAG unit provides specific guidance on how impacts on transport users and providers (including travel time and vehicle operating cost savings) should be estimated, valued and reported in transport appraisal.

Software Used for the Appraisal

13.4.2. The calculation of main economic benefits to road users incorporates use of the DfT's Transport Users Benefit Appraisal (TUBA) program.

13.4.3. TUBA is a software package developed for the appraisal of highway and public transport schemes. TUBA compares the users economic costs for the Do Something (DS) situation with the user costs for the Do Minimum (DM) situation to establish the value of forecast savings in travel time and vehicle operating costs. A BCR is calculated by comparing these values, together with those of other relevant costs and benefits, with the construction and operation costs, over a 60-year period for the scheme. TUBA version 1.9.14 has been used in the appraisal.

Economic Parameters

13.4.4. TUBA version 1.9.14 provides a complete set of default economic parameters in its 'Standard Economics File[24]'. This contains values of time, vehicle operating cost data, tax rates, economic growth rates and formally adopts the variation in the value of time by distance for car and rail business trips within the default economic parameters file. TUBA reports economic values in 2010 prices, discounted to a present value of 2010.

Modelled Forecast Year

13.4.5. Traffic forecasts were prepared for the following years:

- Opening year - 2025
- Design Year,15 years after opening – 2040
- Horizon Year - 2051

Appraisal Period

13.4.6. A 60-year appraisal period was used from the Scheme opening year of 2025 therefore providing a final appraisal year of 2084.

Time slice and Annualisation Factors

13.4.7. The annualisation factors adopted for the TPU PCF-Stage 3 assessment are presented in Table 13-6. The appraisal has been based on AM peak, interpeak and PM peak modelled periods. The annualisation approach therefore assumes 253 weekdays per year excluding the weekends and the bank holidays. For each period an average hour is modelled so the factors applied to each period are derived by multiplying either 3 or 6 hours by 253.

Table 13-6 - Annualisation factors

Time Period	Period Length	Annualisation Factor
AM Peak Period (0700-1000)	3	3 x 253 = 759
Inter-peak Period (1000-1600)	6	6 x 253 = 1518
PM Peak Period (1600-1900)	3	3 x 253 = 759

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[24] "Economics_TAG_db1_14_0.txt" dated 28/08/2020, based on the Sensitivity Test TAG Data Book v1.14.

13.4.8. Off peak and weekend flows have not been captured in the modelling and no benefits have been represented for these times in the TUBA assessment. Congestion in the DM scenario will be more limited during these periods and so both trip numbers and benefits per trip will be reduced compared to the modelled hours.

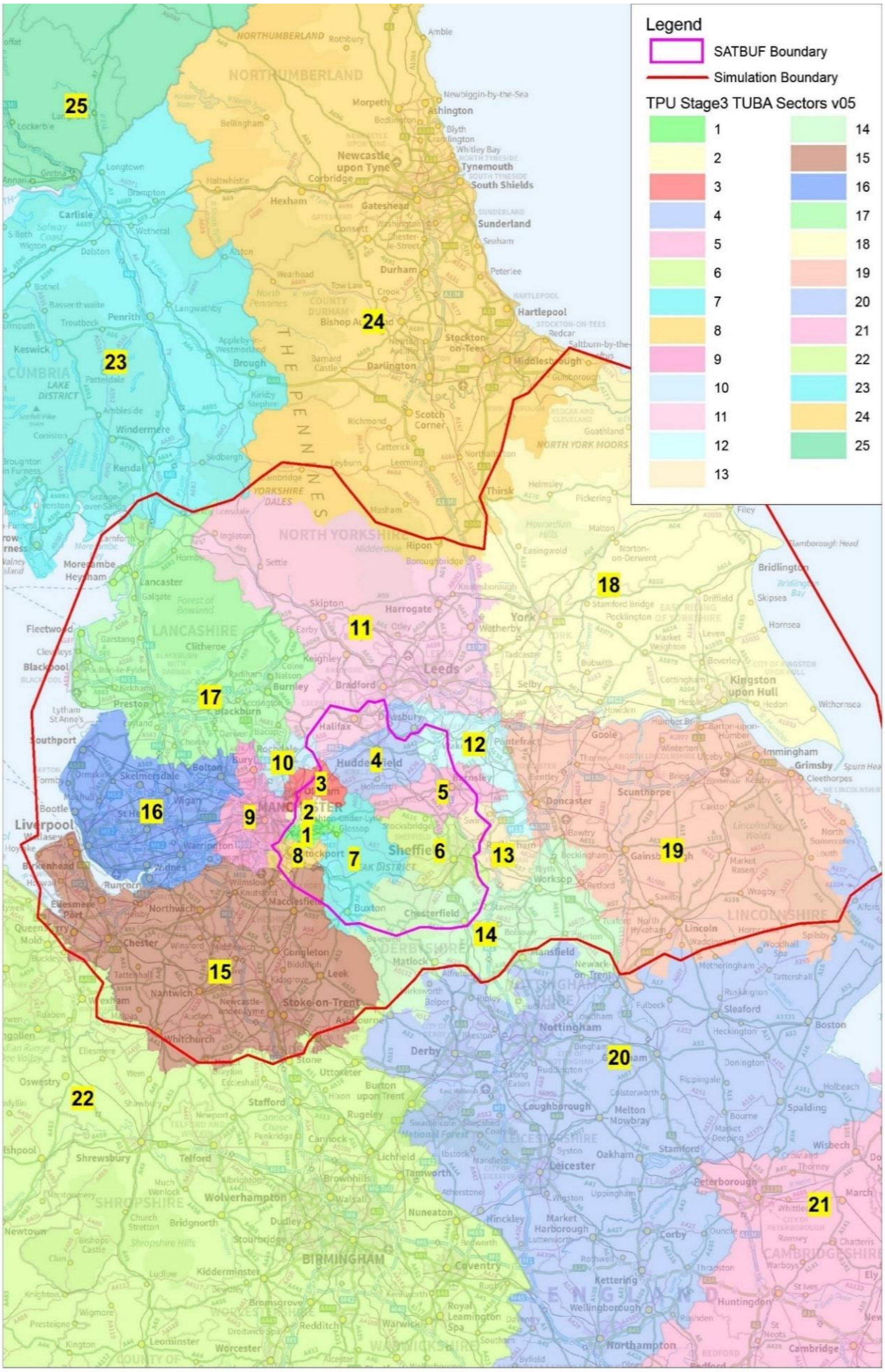
13.4.9. RIS schemes typically consider impact over weekends, so for consistency consideration of these impacts should be made during the next stage of assessment, which represents an upside opportunity for the PVB.

TUBA Sectors

13.4.10. The study area comprises model zones, which have been aggregated to sectors to enable more detailed analysis of the TUBA outputs. These sectors are listed below.

13.4.11. The sectors are indicated in Figure 13-1, which also shows the division of sectors between “internal”, “buffer” and “external”. Further specifications of the sectors are set out in Appendix D.

Figure 13-1 - Sector definitions



13.5. User Classes and Journey Purposes

13.5.1. The TPU Traffic Model comprises five user classes. The modelled user classes were split into seven user classes as required for the TUBA economic appraisal, as shown in Table 13-7 below:

Table 13-7 - Correspondence of Modelled User Classes to TUBA User Classes -Weekday

Modelled User Class	TUBA User Class	Factors
Car Business	Car Business	1.000
Car Commute	Car Commute	1.000
Car Other	Car Other	1.000
LGV	LGV Personal	0.120
	LGV Freight	0.880
HGV	OGV1	0.192*
	OGV2	0.208*

* Includes conversion from Passenger Car Units, or PCUs (the traffic model's unit of traffic flow) to vehicles as required for input to TUBA. The model represents an HGV as 2.5 PCUs. The two HGV factors therefore need to sum to 0.4 (the inverse of 2.5).

13.5.2. The LGV user class was disaggregated into LGV Personal and LGV Freight using the TAG Data Book Table A1.3.4 (July 2020), giving a default proportional split of 12 % for LGV Personal and 88 % for LGV Freight. HGVs were split into OGV1 (48%) and OGV2 (52%) calculated from Highways England's WebTRIS database. Accordingly, the factors for the OGV1 and OGV2 were 0.192 and 0.208 respectively in TUBA, taking into account the PCU factor for HGV as 2.5. The above-mentioned factors and splits were retained against the TPU Stage 3 ComMA report (17 May 2019) produced by Arcadis.

13.6. User Benefits

Travel Time Savings

13.6.1. Travel time savings are calculated in TUBA using the 'rule of a half' applied to generalised time skims from the TPU Traffic Model. The 'rule of a half' relates to the change in the consumer surplus resulting from a reduction in travel costs such that existing users receive the full benefit while new users receive half of the benefit.

13.6.2. Travel times in the traffic model are represented in seconds. These are converted to vehicle hours and annualised for each time period, so that annual travel time savings can be calculated.

13.6.3. Annual time savings are calculated for each modelled year. Benefits for non-modelled years are calculated via linear interpolation between modelled years, and flat-line extrapolation beyond the final modelled year. However, the impact of discounting and growth in values of time on estimated benefits means that the benefits 'curve' does not represent a straight line through the appraisal period.

13.6.4. Default economic assumptions have been applied, as contained in the TUBA software (v1.9.14) and Economic parameter file "Economics_TAG_db1_14_0.txt".

Vehicle Operating Cost Savings

13.6.5. Vehicle operating costs (VOCs) are calculated for both fuel and non-fuel elements of the journey, based on formulae set out in the DfT's TAG guidance. The 'rule of a half' formula is broadly applied as for travel times, but with vehicle operating costs being based on distance travelled (vehicle-kilometres) and average vehicle speeds.

13.6.6. All assumptions relating to fuel costs, duty and vehicle efficiency are those contained in the default TUBA economics file. The same annualisation factors as defined above are applied to derive VOC benefits.

13.7. Masking of Impacts

Masking approach

13.7.1. A relatively large transport model (PCF Stage 3 TPU model) was developed on behalf of Highways England and has been used for appraisal of the A57 Trans-Pennine Upgrade (TPU) scheme.

13.7.2. While every effort has been made to refined and update this model to best represent the impacts of the scheme, it has been necessary for focus to be been placed on validation of performance around the scheme area. The model contains large cities including Manchester and Sheffield which, as part of a strategic model, can be particularly sensitive in terms of variations to traffic flow and congestion at busy junctions.

13.7.3. Furthermore, the scope of the model, whose simulation area extends as far as the east and west coasts of England, contains a very high number of trips and hence a large overall cost of travel, making relatively small fluctuations in modelled behaviour, potentially influential on overall performance.

13.7.4. To minimise this effect a fixed cost function (FCF) has been applied, whereby a cordon is set within the model and costs outside of this cordon fixed to ensure uniform behaviour between the DM and DS scenarios. Further detail on this approach and the cordon used are set out in the Transport Forecasting Package.

13.7.5. Despite use of the FCF it was observed that the value of TUBA Sensitivity in the initial TUBA runs was much weaker than TAG would recommend to indicate a reliable assessment[25].

13.7.6. In order to reduce the model noise and improve the value of TUBA Sensitivity in line with TAG recommendation, a masking approach was adopted.

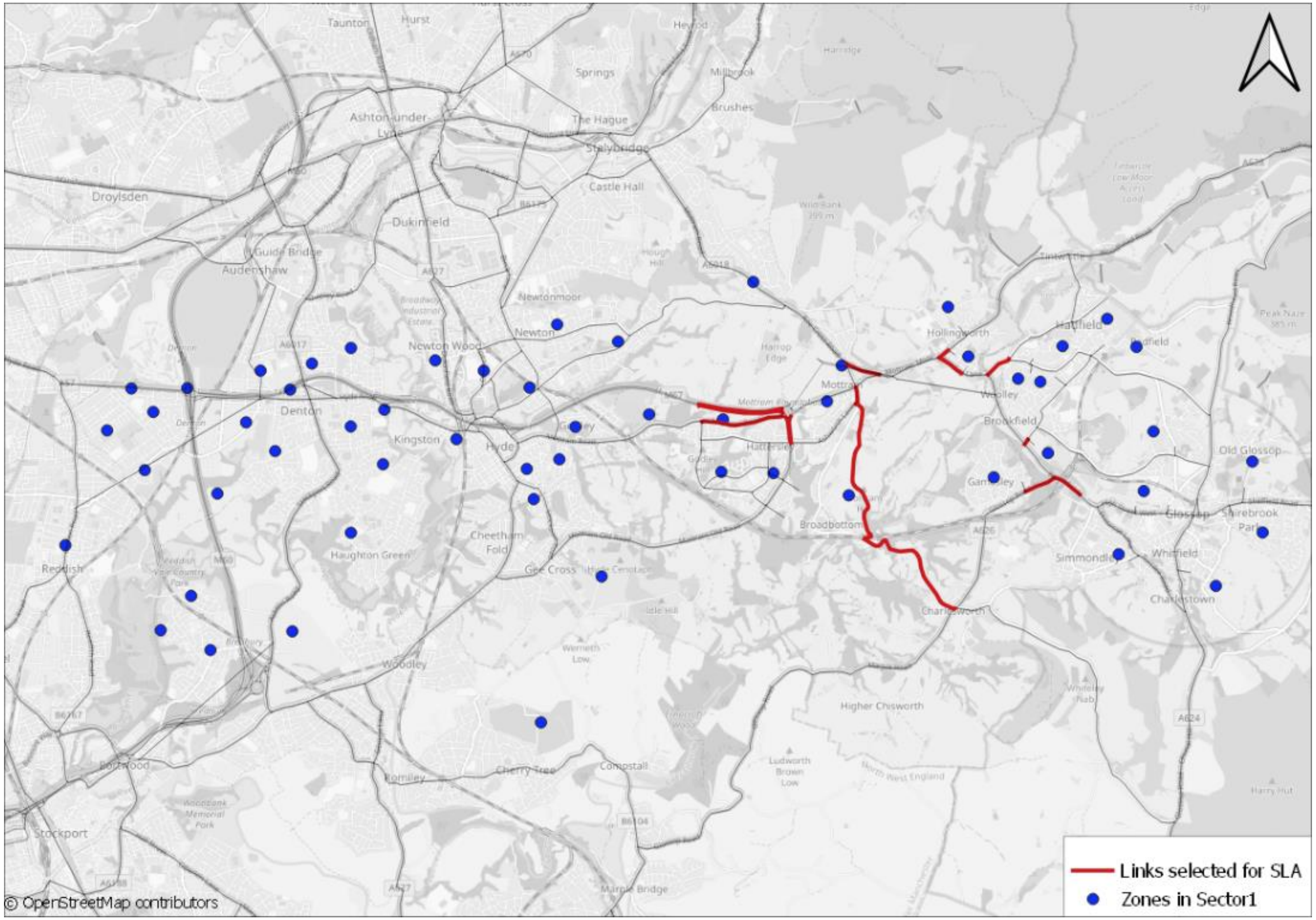
13.7.7. This was based on analysis which focussed on identifying the OD pairs which are directly impacted by the scheme and those which can reasonably be understood to experience an indirect impact.

[25] The TUBA Sensitivity value is a ratio between
- the change in total network cost between DM and DS scenarios; and
- the total network cost in the DM scenario.

This indicates how sensitive the results are to convergence in the transport model and should be no less than around 10 times the corresponding convergence %GAP values reported for the transport model. The smaller the TUBA Sensitivity value, the more susceptible TUBA results will be to convergence noise.

13.7.8. This was achieved by performing select link analysis (SLA) on a selection of links, illustrated in Figure 13-2 which are either part of the scheme directly or are used to enter or exit the scheme. The extraction of this information from DM and DS scenarios provided all the OD pairs which are definitely impacted by the scheme. The SLA had captured every OD pair using the scheme or passing through a small scheme area in any scenario during any peak modelled hour. In addition all movements to or from Sector 1 zones were retained as these are in the immediate vicinity of the scheme and changes in flows through this region, whether passing through the scheme or not, can be reasonably expected to be influenced by changes to resulting traffic patterns.

Figure 13-2 - Enhanced Masking version 2 (SLA + Sector 1)



13.7.9. This two-streamed approach ensured that:

- Local impacts, whether positive or negative are retained;
- Movements across the scheme area which will be affected are retained; but
- Other movements which won't experience either direct or indirect impacts are excluded.

13.8. User costs during construction and maintenance

13.8.1. The delays during construction have been estimated using the strategic model and TUBA runs to represent the impacts of different phases of construction. As diversionary impacts could, potentially contribute significantly to the total delay, this approach has been considered to provide a better representation of wider network effects within the cordoned model area than use of the QUADRO tool which is more focussed on the immediate area of effect. Each construction stage has been modelled in a single-year assignment run using the 2025 demand matrix in a fixed matrix assignment for the cordoning as illustrated in Figure 12-3 below.

13.8.2. The outputs from the modelling assignment have been compared against the DM 2025 model in TUBA in order to monetise the disbenefits during construction phases of the scheme.

13.8.3.

13.8.4. Table 13-8 below summarises the traffic management (TM) information that was provided by Balfour Beatty on 25th November 2020.

Table 13-8 - Traffic Management Phases

TM Phase	Work	Expected Duration
1	During Traffic Management Phase 1, properties above the underpass demolished, underpass pilings started, pre-casted piles to the west of River Etherow installed, and Traffic Outcome: no changes made to the existing traffic flow.	Sept 22 to Mar 23 (182 days)
2	During Traffic Management Phase 2, Underpass construction continued, along with excavation of main cutting to the east of the underpass; Fill materials from cutting transported to the west of River Etherow embankment; Traffic restricted on Mottram Moor eastbound to one lane through plant crossing; Plant crossing used to move muck from west to east. Traffic Outcome: Addition of a traffic signal junction on Mottram moor road with suitable inter green time.	Apr 23 to Sep 23 (183 days)
3	Traffic management Phase 3 primarily comprised of Complete underpass construction including temporary diversion of the Roe Cross Road;	Oct 23 to Mar 24 (182 days)

TM Phase	Work	Expected Duration
	Modification of the existing roundabout, and two lanes of traffic maintained on the roundabout Construction of Mottram Moor junction and restricting Mottram Moor to one lane in the eastbound direction. Tie into the Woolley Bridge road with no restriction to existing road network during peak hours Traffic Outcome: Mottram Moor reduced to one lane in eastbound direction	
4	During Traffic Management Phase 4, cut material from underpass moved to the mainline to fill west of underpass. a complete dual carriageway throughout the section, and Traffic Outcome: no restrictions to the existing road network	Apr 24 to Oct 24 (184 days)
5	Traffic Management Phase 5 comprised of de-trunking work to old A57. The entire phase was divided into two sub-phases, namely Phase 5_1 and Phase 5_2, to account for contraflow. Phase 5_1: De-trunking works confined to old West Hyde road for the duration of 2 months Traffic Outcome: West Hyde Road signalised to allow just one direction at a time to account for contra-flow. Phase 5_2: De-trunking works to old East Mottram moor road for a duration of 1 month. Traffic Outcome: East Hyde Road signalised to allow just one direction at a time to account for contra-flow.	Oct 24 to Dec 24 (5_1: 61 days, 5_2: 31 days)

13.8.5. A detailed breakdown of the sequence of the traffic management phases is provided in Appendix D.

13.9. Accident Savings

13.9.1. A safety assessment has been carried out using DfT's COBALT software to analyse the impact of the scheme on road traffic accidents, providing a monetised impact. It estimates the number of accidents for each road link over the 60-year appraisal period, based on the product of:

- the accident rate per million vehicle kilometres;
- the road length; and
- the forecast annual traffic flow.

13.9.2. Accidents at junctions can also be separately assessed based on junction design and through-flow, or link and junction accidents can be assessed in combination.

13.9.3. Personal injury accidents (PIAs) are considered, split between fatal, serious and slight injuries, with national average rates of accidents and severities by link or junction type applied. The calculation uses relationships contained in the program to take account of changes in accident and casualty rates over time.

13.9.4. The current version of the COBALT software (2013.02) and economic parameters file (2020.2) were used for the appraisal.

Study Area

13.9.5. The geographical coverage of the COBALT assessment includes only the Affected Road Network (ARN) rather than the whole model area. The extent of the network for the assessment has been identified through review of the modelling to identify where significant changes in flow[26] are generated by the scheme which could induce a change in accident numbers. The ARN is confined to Huddersfield in the North, Sheffield in the East, Buxton in the South, and Whitefield in the West adjacent to Manchester area. The ARN includes strategic road networks mainly M60, M62, M67, A57, and the A629.

13.9.6. The central Manchester and Sheffield areas have been excluded as these are highly sensitive to model noise. This sensitivity could result in traffic using alternative routes for reasons unrelated to the TPU scheme, which could distort the assessment. The geographic extent of the affected road network is presented in Figure 13-3.

13.9.7. This area is broadly comparable to the Area of Detailed Modelling, but with certain strategic links added at the periphery, where flow changes resulting from the TPU scheme are forecast to be significant enough to warrant examination of the impacts on safety. A comparison between the two areas is illustrated in Figure 13-4.

[26] There is not a precise definition of what change in flow is considered "significant", as this will vary from scheme to scheme based on the scale of impacts created. Professional judgement has been used through review of flow difference plots from the SATURN model to identify the area over which flows are most impacted by the scheme.

Figure 13-3 - COBALT Study Area

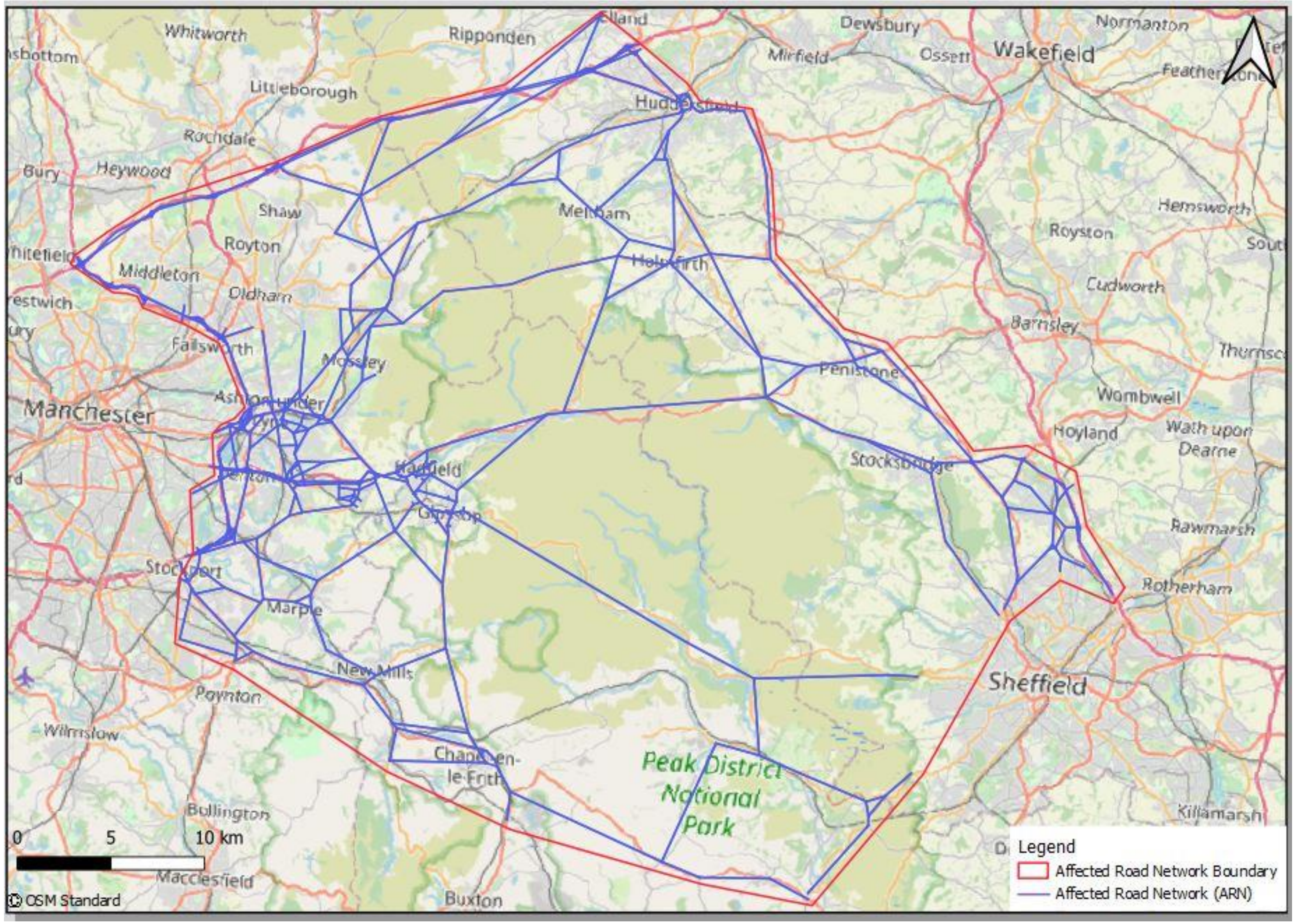
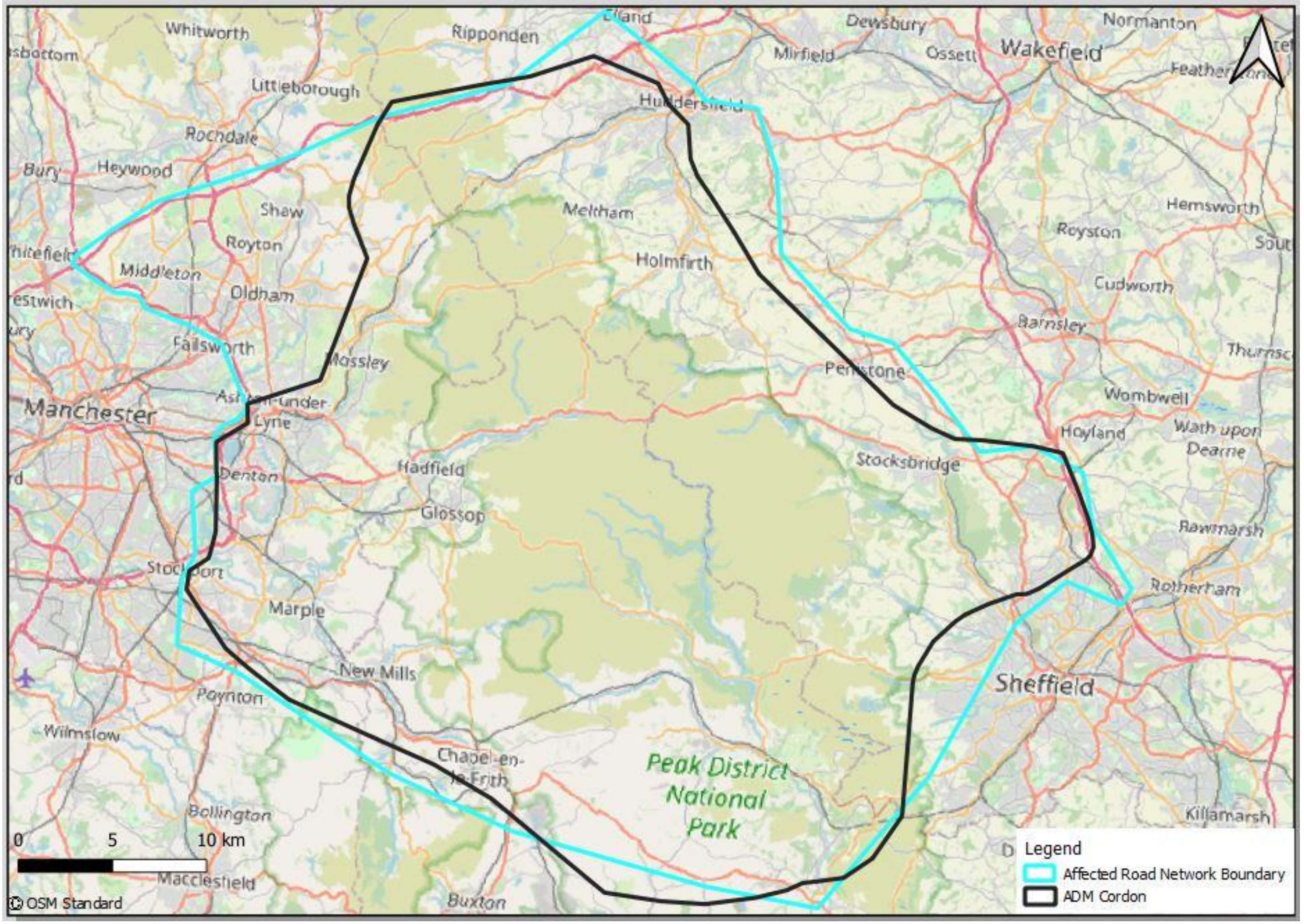


Figure 13-4 - COBALT Study Area Relative to the Area of Detailed Modelling



13.9.8. For assessing the accident benefits generated by the scheme, the entire ARN has been divided into three different categories based on the assessment approach, namely:

- Junction Only
- Link Only
- Combined Link and Junction

13.9.9. These three methods are provided within COBALT to enable detailed disaggregate assessments of network sections which may have specific properties or layouts, or which vary between scenarios, while providing a more generic assessment approach to cover larger sections of the network.

13.9.10. Within the proposal, the junctions which will be significantly altered in design as a part of the scheme, or which exist in one scenario but not the other, are assessed under the “Junction Only” approach. It has been identified that Hattersley Roundabout and Gun Inn junctions will undergo significant changes in DS compared to DM in terms of geometric design once the scheme has been implemented. Specific treatment of these junctions is discussed further below. In addition to this, a new junction will be constructed at Woolley Bridge as part of the DS proposed scheme. Each of these junctions have been assessed using the “Junction Only” approach.

13.9.11. Within COBALT junctions are defined to include the network section 50m in each direction from the junction. Any newly introduced links adjacent to the junctions described above, excluding these 50m sections have been captured within the “Link Only” approach. This ensures no double counting of accidents related to the junctions.

13.9.12. Certain variations to the modelled network have also been introduced whereby modelled links do not connect to physical junctions, but represent separate sections of a single stretch of carriageway. In such cases “junction only” and “link only” assessments have been used to deliver the most representative outcome.

13.9.13. For the rest of the links and the junctions in the ARN, the “Combined Link and Junction” approach has been adopted.

13.9.14. The required inputs for COBALT are summarised below, along with their source, and are discussed in detail in the subsequent sections.

- 24 Hour Annual Average Daily Traffic (AADT) flows for all links in the study area for the Base, DM and DS scenarios have been provided from the Trans-Pennine Upgrade (TPU) model;
- Link details, including link length, speed limit, link and junction type, etc have been determined from the TPU Traffic Model network details;
- Junction details, including number of arms, junction layout and inflow from each arm have been extracted from the TPU Traffic Model and informed by the scheme design; and
- Observed accidents for specific network sections have been taken from DfT STATS19 accident data.

Network Details

13.9.15. For the "Combined link and Junction" and "Link only" approach, the main input parameters for COBALT include link length, speed limit and COBALT link type for each link. Whereas for "Junction only" assessment, the input includes COBALT junction type, speed limit, Major Arm type and Highest carriageway standard.

13.9.16. The objectives behind these data requirements was to allow the lookup of relevant national average accident rates for the new/improved links and existing links. The definition of each link type can be found in the COBALT user manual (2013.2). For junctions the input details determine the formula applied to calculate the relationship between flow and accidents.

13.9.17. Within the COBALT assessment some links and junctions vary in structure between DM and DS scenarios. These network sections have been coded twice, with and without the scheme, for COBALT to evaluate the impact of the scheme.

13.9.18. The COBALT output file returns details of errors or warnings. There were 7 warnings in the output file for the TPU COBALT assessment. One was related to the lower limit of flow for the minor arm of Hattersley Roundabout, where traffic levels in DS are significantly reduced and the rest of the warnings were related to the higher observed accident rates which have been checked and found consistent with the high number of accidents observed.

Traffic Flows

13.9.19. 24 Hour AADT flows for all links in the study area for the Base, DM and DS scenarios have been provided from the TPU Traffic Model. The model forecasts are based on average flows over the respective peak periods for a neutral month (i.e. a month not distorted by holiday periods) and cover only the 12-hour peak period during weekdays. Therefore, observed data used to develop the base year model is used to pro-rate the modelled link flows in order to estimate the annual number of trips expected on each[27].

13.9.20. The Development of the annual average daily traffic (AADT) forecasts followed the approach set out below:

- The Base, DM and DS hourly traffic flows were extracted from the TPU model for each modelled time period and forecast year.
- These were converted to peak period flows using the factors of 3, 6 and 3 for AM, IP and PM respectively to calculate the 12-hour average weekday traffic (AWT).
- 12-hour AWT was converted into 12-hour average annual weekday traffic (AAWT) to account for seasonality of flow.
- 12-hour AAWT calculated in the previous step was then converted into 24-hour AAWT.
- 24-hour AAWT was then converted to the annual average daily traffic (AADT) which also includes weekend flows.

13.9.21. The individual factors are as shown in Table 13-9.

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27 While off-peak and weekend flow data has been used to calculate the annual traffic flow, the same data has not been used at this stage to estimate off-peak journey time savings. This is because the relationship between flow and benefits is more complex, with benefits per trip also increasing as trip numbers increase due to congestion rising in both DM and DS scenarios.

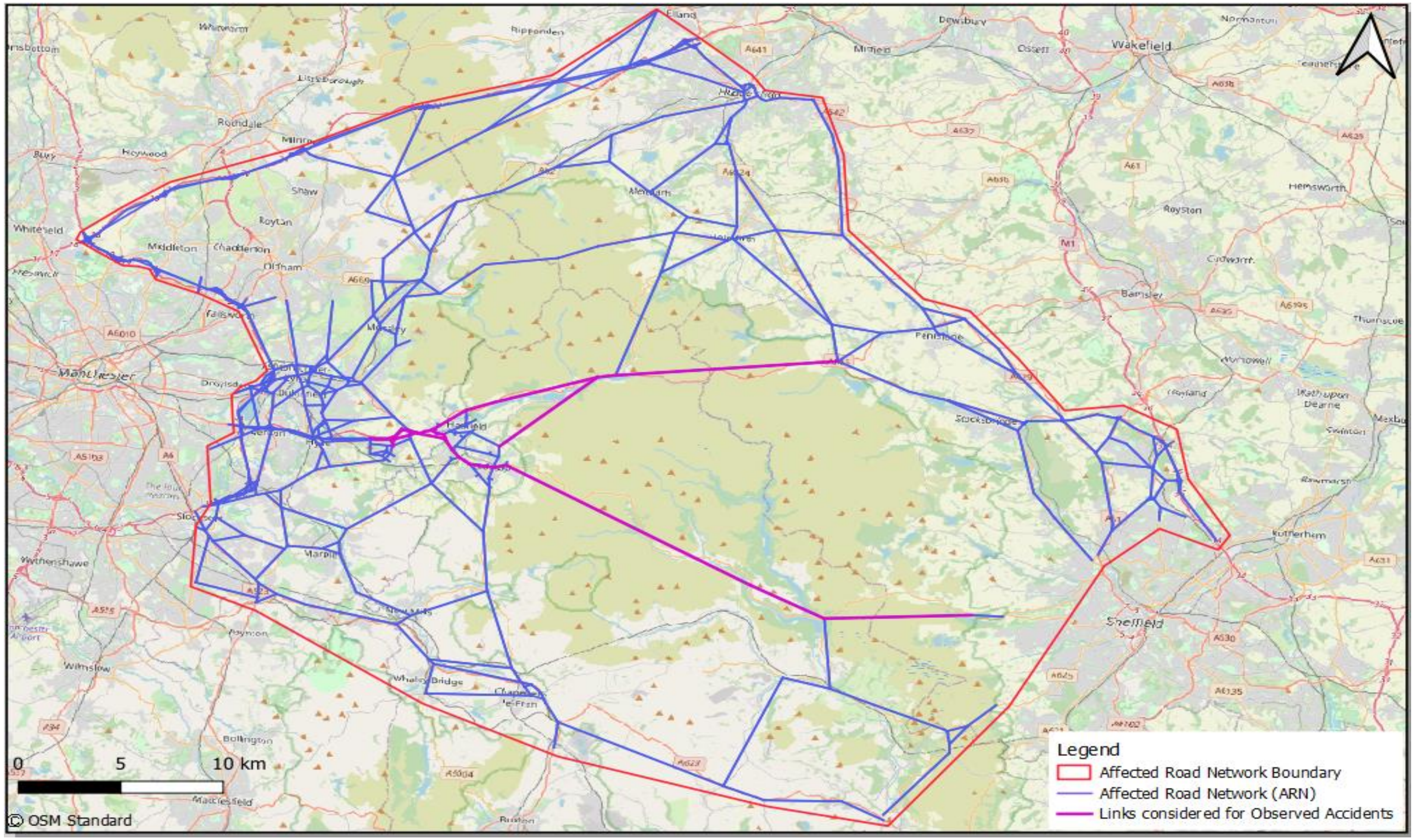
Table 13-9 - Traffic flow conversion factors

Traffic Flow	Conversion Factor	Lights	Heavies
AM	Average Hour to Period	3	3
IP	Average Hour to Period	6	6
PM	Average Hour to Period	3	3
AM AAWT	AM Peak-AWT to AAWT	0.88	0.87
IP AAWT	IP Peak-AWT to AAWT	0.90	0.88
PM AAWT	PM Peak-AWT to AAWT	0.89	0.87
24Hr AAWT	12Hr AAWT to 24Hr AAWT	1.30	1.29
24Hr AADT	24Hr AAWT to 24Hr AADT	0.95	0.79

Observed Accidents

13.9.22. Accidents over last five-years between January 2014 and December 2018 (the most recent five calendar years available across the network) were extracted from Statement of Administrative Sources (STATS19) Road Safety Database for the links within the study area. Details of these records are shown in Appendix D. The locations of links which used observed data to define accident rates are illustrated in Figure 13-6. These links have been selected as being those on which traffic flows are forecast to be most affected by the scheme.

Figure 13-5– Observed Accident Data



13.9.23. Elements of this observed accident data applied to network sections captured within the "Combined Link and Junction", "Link Only" and "Junction Only "approaches as shown in Appendix D.

Hattersley Roundabout

13.9.24. Observed accidents have been used to assess the accident saving analysis for Hattersley roundabout and Gun Inn junction. In the case of Hattersley roundabout, while actual observed accident data was used for the DM scenario, for the DS scenario an adjustment has been applied. The upgraded junction has been designed to improve safety. However, default accident rates for this type of junction, which would normally be applied, indicate a significant increase in accident rates as these do not take into account the local behaviour of traffic and actual speeds of travel.

13.9.25. To better reflect the safety impacts of the scheme at this junction an adjustment has been applied whereby a proportional change between the default rates for the DM and DS junction designs has been calculated. This proportion has then been applied to the observed accident numbers to generate an adjusted rate for the junction in the DS scenario.

13.9.26. This adjustment to the observed accident data has been calculated as a reduction to about 20% of the current observed rates to capture the geometric design changes and signalisation in the DS scenario. The rate has been applied through a factoring of the observed accident data as shown in Appendix D.

Gun Inn Junction

13.9.27. As part of the scheme design Gun Inn junction on the intersection between the A628 and A57 has been upgraded. This upgrade has considered geometric safety improvements for traffic and the addition of more frequent pedestrian phases to make crossing safer.

13.9.28. However, the changes to design do not change the type of junction as considered by the COBALT tool and so would not result in any change to the output of accident numbers. In addition COBALT does not take account of pedestrian facilities when considering accident rates. Therefore, while it is recognised qualitatively that this junction is forecast to experience a reduction in accidents as a result of the scheme, the approach used for assessment of safety benefits is not sufficiently sensitive to monetise these benefits.

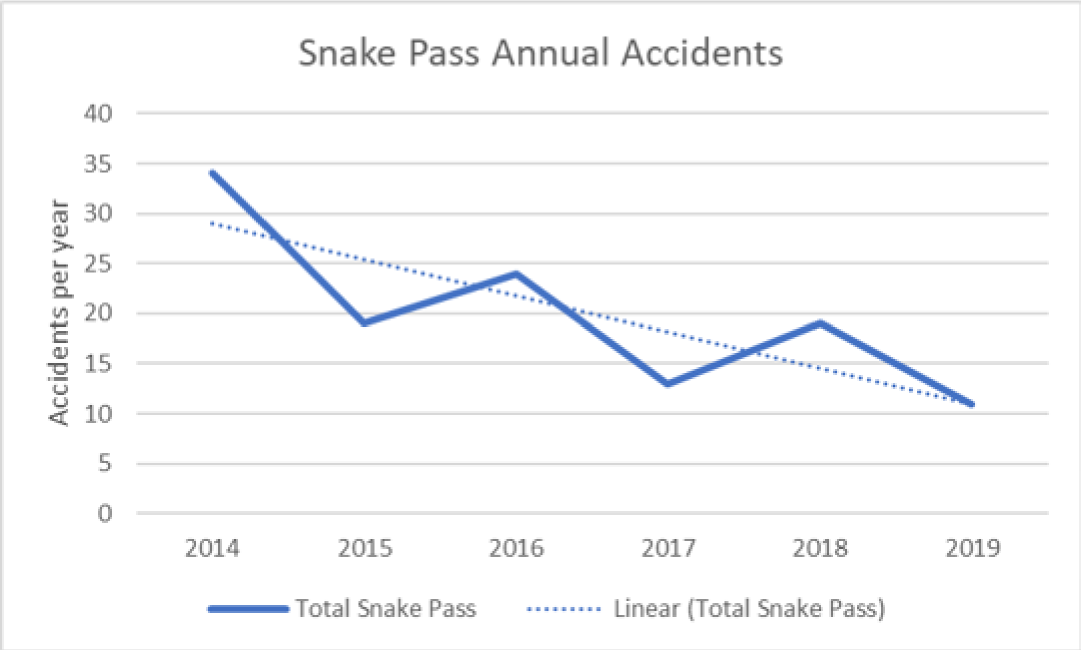
13.9.29. This junction has been treated within the COBALT assessment as "junction only", but the purpose for this is not related to the junction itself. It is rather that adjacent links vary and are split between DM and DS scenarios requiring "link only" assessment. Therefore, Gun Inn junction has been treated this way to avoid double counting of junction related accident costs.

Snake Pass

13.9.30. Although Snake Pass road is comparatively far away from the scheme area, considering the historical accident hotspot record of the Snake Pass, observed accidents have been used to assess the accident saving benefits on the Snake Pass road. It is understood that measures have been taken in recent years to address this historically high accident rate and it was observed that post 2014, the number of accidents that occurred along Snake Pass shows a declining trend as shown in Figure 13-6 which suggests a measure of success having been achieved in bringing accident rates down.

13.9.31. It has therefore been considered that a refined analysis period for Snake road alone as 2015-2019, unlike 2014-2018 used for the rest of the links in the network, would be more representative of the present accident rates on this route. Observed accidents along Snake Pass from 2015-19 are shown in Appendix D.

Figure 13-6 – Accident trend along Snake Pass



13.9.32. In addition, as the contribution of the Snake Pass route to the total effect of the scheme on accident numbers is significant, further analysis of the flows on these links was conducted. As a rural area within a large-scale model the level of detail of modelling at this location is low, having used large zones to cover wide areas of dispersed population and very long links with few access/egress points. The result is that traffic modelled as using these links behaves consistently between DM and DS scenarios, but may not be entirely representative of reality. To ensure the most accurate relationship between accidents and flow, the observed accident data on these links has been matched with observed flow data using most recent counts. This observed flow data has been used in place of the modelled base year flow data in the COBALT assessment.

13.9.33. These two observed inputs generate an accurate accident rate per vehicle km, which is then used with the modelled change in flow between DM and DS scenarios to calculate the impact of the scheme on the accident numbers. It has been recognised that the forecast year DM and DS flows on these links will have the same limitations as the base year flow. However, the change in flow between DM and DS is driven by changes in behaviour across the much wider network, with only a negligible affect from the few zones directly connected to the Snake Pass links.

13.9.34. For the rest of the network in the study area, COBALT default accident rates have been applied.

Environmental impacts

13.9.35. This section discusses the methodologies and results for assessing the monetised air quality, noise and greenhouse gas impacts of the link road elements of the TPU scheme.

13.9.36. The scheme has been assessed in accordance with the DfT's Transport Analysis Guidance (TAG) , Unit A3 Environmental Impact Assessment (May 2019) and associated worksheets (updated July 2020), with reference to methodologies within the Highways Agency Design Manual for Roads and Bridges (DMRB), Air Quality, revision November 2019 (DMRB LA105).

13.9.37. The TAG monetised assessment of environmental impacts includes:

- Air Quality
  - An assessment of the overall change in mass emissions of NOx and fine particulate matter (PM2.5) in tonnes over the 60-year appraisal period; and
  - Monetisation of changes in air quality.
- Greenhouse Gas Emissions
- An assessment of the change in mass emissions of total carbon dioxide equivalent (CO2e) in tonnes for the opening year;
- An assessment of the change in mass emissions of CO2e in tonnes over the 60-year appraisal period; and
- Monetisation of changes in CO2e emissions.

Air Quality Assessment

13.9.38. The assessment of local air quality has been undertaken using traffic flows, the proportion of heavy duty vehicles (HDV), speed band data, and road link lengths for the opening year (2025) and a future year (2040), for both the without scheme (do-minimum) and with scheme (do-something) scenario.

13.9.39. The change in total emissions of NOx and PM10 for the traffic reliability area (TRA) were calculated (using Highways England speed band emissions factors version 3.1 derived from EFT V10.1). PM10 emissions were converted to PM2.5 using the conversion factor included in TAG databook version 1.14 table A 3.2.4. A factor of 0.673 (road transport) was applied to the total PM10 emissions.

13.9.40. The change in NOx and PM2.5 emissions were then monetised as documented in the TAG guidance which considers an appraisal period of 60 years from the opening year of the scheme. The change in NOx and PM2.5 emissions over time is calculated by linear interpolation between the opening year and future year and then assumed to be constant for the remainder of the 60-year appraisal period in the absence of any other data.

13.9.41. Where there are areas where NO2 and PM legal limits for human health are expected to be exceeded, the economic valuation is determined using the Marginal Abatement Cost (MAC) approach[28]. Where the scheme is unlikely to affect legal limits and the NPV is not greater than £50 million, the damage cost approach is followed for the economic valuation of NOx and PM emissions.

[28]Details of this approach are discussed in the Environmental Statement.

13.9.42. The costs are derived from analysis by the Inter Departmental Group on Costs and Benefits (Air Quality) (IGCB(A)) of the typical health impacts arising from changes in air pollution.

13.9.43. There are no exceedances of legal air quality limits expected either with or without the scheme and consequently the damage cost approach has been followed throughout. This was determined on the basis of Defra Pollution Climate Model (PCM) concentrations for relevant road links in the scheme opening year and scheme specific air quality modelling undertaken for compliance risk assessment purposes.

13.9.44. The values calculated for the 60 years of the appraisal period were discounted at standard HM Treasury rates to give a present value for that particular year. This was then summed over the appraisal period, to give the net present value (NPV) of the change in air quality using the latest version of the TAG Air Quality Sensitivity Workbook which is aligned with TAG data book v1.14 (July 2020).

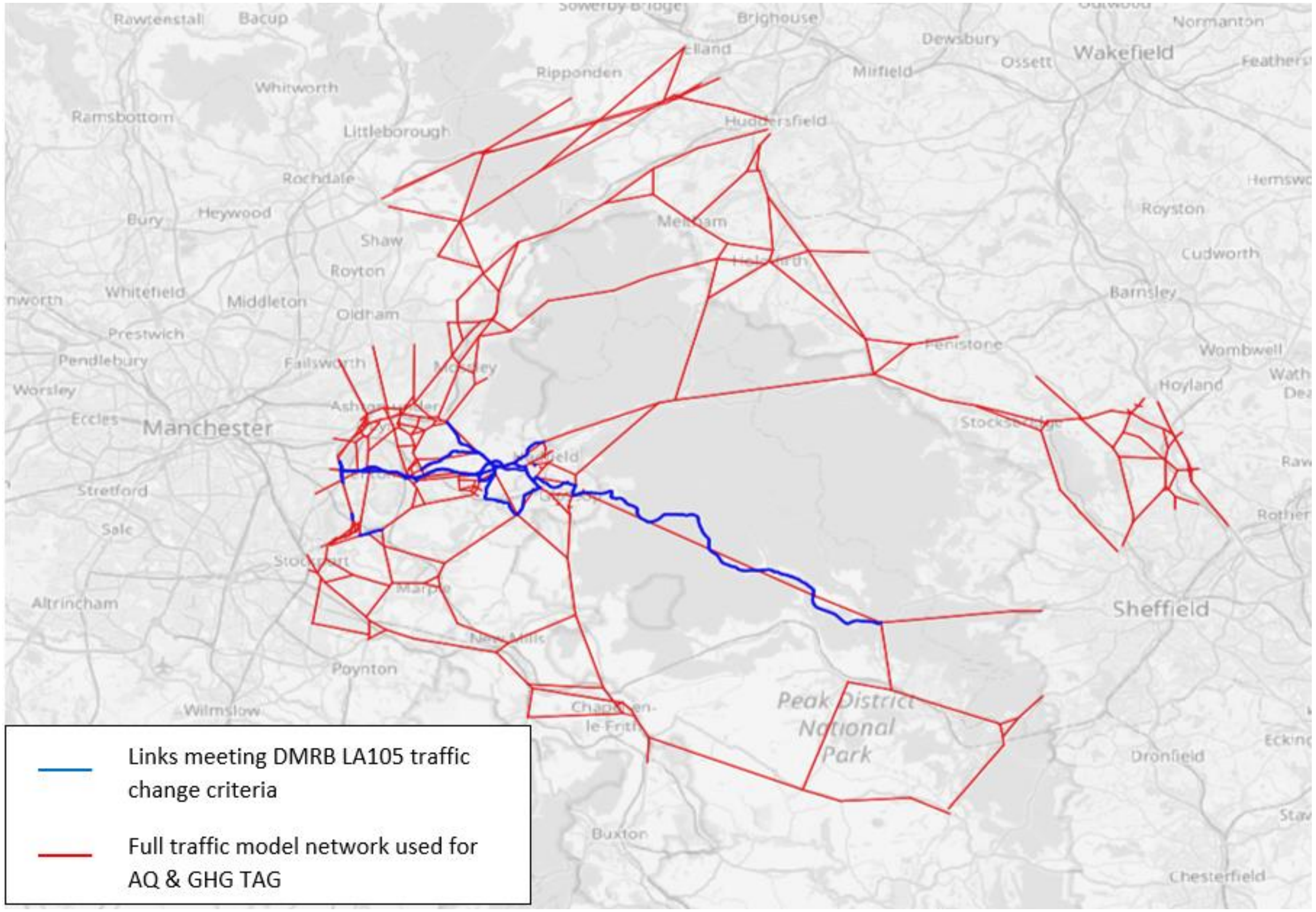
Greenhouse Gases

13.9.45. The change in total emissions of CO2e for the TRA were calculated using Highways England speed band emissions factors version 3.1 derived from EFT V10.1.

13.9.46. Greenhouse gas impacts to determine the carbon dioxide equivalent (CO2e) emissions over the 60-year appraisal period were computed using the standard TAG Greenhouse Gases Workbook. The value of these benefits over the 60-year appraisal period was calculated using valuations presented in TAG data book v1.14 (July 2020) based on the approach set out in TAG Unit A3.4. In addition to this a sensitivity is presented based on the upper estimate NPV which uses high carbon values.

13.9.47. Both greenhouse gas impacts and air quality have been assessed over the area illustrated in Figure 13-7.

Figure 13-7 – Area of Network Considered for Air Quality and Greenhouse Gas Assessments



Noise Assessment

13.9.48. TAG Unit A3 outlines the approach for the assessment of traffic related noise and the valuation of noise level in monetary term, which follows guidance set out in DMRB Volume 11 concerning noise and vibration. This captures noise impacts during the construction period, including impacts of traffic diversions and during the 60 year operational period based on data from the opening and design year transport modelling. The assessment has been based on the inclusion of embedded noise and mitigation measures which have been incorporated into the design. Full details of the approach are set out in the Environmental Statement.

13.9.49. The results of this assessment are provided in the Appendix D.

Estimation of Journey Reliability Benefits

13.9.50. The reliability impacts of the scheme were estimated using the approach set out in TAG Unit A1.3 on reliability for urban roads. This provides an estimate of the change in the level of journey time variability depending on the change in average journey time for each origin/destination pair due to the scheme and the demand and distance between each pair. The process uses the same input parameters and assumptions as the TUBA assessment. Only weekday impacts are included, and no benefits are counted for journeys of less than 0.5km in length as the method becomes increasingly sensitivity for shorter distance trips and journeys of shorter distance than this are not considered to be sufficiently accurately represented by the strategic model.

13.9.51. The TAG ‘Urban Roads’ method was considered the most appropriate approach to assessing reliability for the appraisal of the TPU scheme. Whilst the Highways England MyRIAD software for assessing the Journey Time Variability impacts of dual-carriageway schemes was considered, MyRIAD focuses on capturing the impacts of motorway widening and technology schemes along defined links and cannot represent junction changes or new links, so it was deemed not to be suitable for this scheme.

13.9.52. While the urban roads approach was developed using empirical data from studies of traffic in cities, the behaviour can be broadly translated to networks for which a range of alternative route choices are available while passing through smaller urban areas. Longer trips are less well represented using this method, but the calculation of reliability benefits includes an inverse relationship with journey distance, meaning that for longer distance journeys the calculated reliability benefits are increasingly reduced. Therefore, these longer trips outside of the core urban areas will have little impact on the calculated reliability benefits.

13.9.53. As this method for assessment of reliability impacts is not as well established as that used for measuring other monetised benefits, the value captured has not been included as part of the Level 1 benefits which contribute to the Initial BCR, but is included as a Level 2 benefit and represented within the Adjusted BCR.

Wider economic impacts (WEIs)

13.9.54. TAG Unit A2.1 (July 2020) sets out approaches for estimating a range of wider economic impacts relating to benefits/disbenefits realised outside of the transport market where there is a particular market failure at present. These can be considered to be supplementary to the welfare economic benefits captured through conventional appraisal described in the previous sections (termed Level 1 appraisal), and occur as individuals and businesses change their behaviour and / or economic activities in response to the transport change[27].

13.9.55. The WEI identified in TAG are categorised into two levels:

- Level 2 WEI based on connectivity improvements only, without explicit land use change, including: static agglomeration, more people working and increased output in imperfectly competitive markets; and
- Level 3 WEI involving explicit land use change and/or additional economic modelling, including: dynamic agglomeration, move to more productive jobs and dependent development.

13.9.56. For the purposes of this assessment:

- Static agglomeration was quantified as it was deemed to account for a significant part of the WEIs and align well with the nature of the intervention;
- Benefits associated with increased output in imperfectly competitive markets were quantified as 10% of the conventional impacts on business users, in line with TAG Unit A2.2 (July 2020); Other Level 2 impacts such as labour market effects (more people working) were only looked at qualitatively and deemed to be beneficial; and
- Dependent development impacts or move to more productive jobs were deemed less significant or relevant to the nature of the scheme and therefore not assessed.

13.9.57. The remainder of this sub-section is focused on the methodology adopted for assessing static agglomeration impacts, which represent GVA impacts from productivity uplift as a result of enhanced access to economic mass (ATEM) brought by transport investment. There is clear economic evidence showing a causal relationship between agglomeration and productivity as documented and referenced in relevant guidance. Agglomeration benefits represent the uplift in business productivity as a result of improvement in ATEM, which is a metric to measure agglomeration. The calculation of agglomeration is mainly determined by the product of the following three factors:

- the uplift in productivity per worker (derived from comparing ATEM with and without the proposed intervention)
- the quantum of employment (i.e. number of jobs)
- the average GDP per worker

13.9.58. Therefore, the value of agglomeration benefits is informed by a combination of the three factors above. High agglomeration benefit could be the result of a marginal increase in connectivity that is linked with locations with high number of jobs and average productivity, or a significant journey cost saving linked with locations with modest quantum of employment

13.9.59. The calculation of agglomeration impact is based on DfT’s WITA Beta 2.0 so the assessment process and its implementation are in line with TAG Unit A2.4.

13.9.60. The zoning system of the agglomeration model in WITA has a national coverage and is based on the 380 Local Authority Districts (LAD) as shown in Figure 13-8, which are also compatible with the spatial resolution of the economic data (jobs and GVA) in DfT’s wider impacts dataset. Information from the latter is also fed into the WITA model as required for agglomeration assessment. The current sensitivity test version of the wider impacts dataset (issued by DfT) was used for consistency purpose as the transport model output (and TUBA assessment) was based on DfT’s Databook v1.14 (sensitivity test version).

Figure 13-8 – WITA model zoning system

13.9.61. The WITA model used the same highway model output as that used for TUBA. This involves the consolidation of the more detailed transport model zoning system to the WITA model of 380 zones with the help of a GIS tool. Any output used (such as time and distance) was demand-weighted during the consolidation process. Overall, transport model output in forecasting year 2025, 2040 and 2051 was used (opening year 2025).

13.9.62. A representation of the future baseline rail travel cost was also used for completeness purpose as agglomeration assessment requires a representation of travel costs by both highway and rail. Omission of this will usually lead to significant overestimation of agglomeration benefits. This was based on a dataset developed by Atkins during the course of delivering similar studies elsewhere. Information fed into the rail travel costs involves data like timetables, fare, NRTS survey on average access/egress time and information from automated online journey planning queries. It is noted that the focus on the particular assessment is highway intervention, so rail travel costs were assumed to remain unchanged in any tests.

13.9.63. Overall, the aforementioned methodology in this assessment was based on a review of similar work that was undertaken in a previous iteration of the study (with a bespoke spreadsheet). Mitigations were proposed in the latest approach in order to address potential limitations in the previous exercise in every aspect of the assessment, as summarised in Table 13-10 below.

Table 13-10 – A demonstration of key considerations informing our methodology

Area of observations		Observations in the previous forecasts	Mitigations in the new approach
Data	Transport connectivity	Unable to check / bespoke process	Improved transparency and assurance through the use of WITA
	Economic data	Observations on the discrepancies with DfT dataset (jobs and GVA)	Latest DfT wider impacts dataset used
	Other economic parameters	Consistent with the latest guidance in TAG	No changes
Calculation	Step 1 – GTC	See “Transport connectivity”	Python scripts developed to consolidate input from transport models
	Step 2 – ATEM	PT travel costs appears to be unrealistic for certain movements	Use of Atkins dataset applied elsewhere based on timetable and fare
	Step 3 – Annual impacts	Constrained to a selection of sectors excluding Manchester and Sheffield	Manchester and Sheffield included in one of the options
	Step 4 – Profiling over 60 years	VoT growth and discounting need update in new forecast	Incorporated in WITA

13.10. Social and distributional impacts (SIs and DIs)

13.10.1. Social impacts (SIs) consider the human experience of the transport system and its impact on social factors, where not considered as part of economic or environmental impacts. SIs include the impacts of accidents, physical activity, security, severance, journey quality, option and non-use values, accessibility and personal affordability.

13.10.2. For SIs, the appraisal has been carried out in accordance with TAG Unit A4.1 Social Impact Appraisal (May 2020). A qualitative approach was deemed suitable for most indicators, although a quantitative assessment was undertaken where evidence was available. The results are presented using a seven-point scale of beneficial, neutral or adverse.

13.10.3. Distributional impacts (DIs) consider the variance of impacts across different social groups and are assessed as part of the appraisal and an assessment entered into the Appraisal Summary Table (AST). The DI assessment has followed guidance set out in TAG Unit A4.2 Distributional Impact Appraisal (May 2020).

13.10.4. The distributional analysis aims to evaluate whether the preferred route unduly favours or disadvantages any particular social or vulnerable groups within the study area.

13.10.5. Both beneficial and/or adverse SDIs of transport interventions are considered, along with the identification of social groups within the geographical area which are likely to be affected. The indicators considered for social and distributional impacts are shown in Table 13-11. Where indicators have been assessed elsewhere in the Economic Appraisal Package these have not been considered within the SI assessment to avoid duplication.

Table 13-11 Indicators considered for social and distributional impacts

Indicator	Social Impact	Distributional Impact
User Benefits		✓
Air Quality		✓
Noise		✓
Personal Security	✓	✓
Severance	✓	✓
Accessibility	✓	✓
Personal Affordability	✓	✓
Collisions	✓	✓
Physical Activity	✓	
Journey Quality	✓	
Option Values and Non-Use Values	✓	

13.10.6. Full detail on the methodologies and results can be found in the Social and Distributional Impact Assessment Report.

14. Economic appraisal results

14.1. Introduction

14.1.1. This chapter sets out the results of the economic appraisal for the core scenario in line with the assessment methodologies set out in section 13. The economic appraisal identifies and estimates all the associated expenditures and the benefits over the lifetime of the project to determine to what extent value for money would be delivered as a return on taxpayer investment. As per the TAG Unit A1.2, an economic assessment is undertaken with an objective to facilitate the quantification and monetisation, where possible, of scheme costs and benefits (See section 13.1.3).

14.2. Transport Economic Efficiency (TEE)

14.2.1. All benefits and costs were calculated in monetary terms and expressed as present values (PV) in 2010 market prices, discounted to 2010.This enables direct economic comparison with other schemes which may have very different timescales.

14.2.2. The scheme is forecast to produce user benefits derived through TUBA for the operational period of £181.2m (PV) over the 60-year appraisal period. These benefits are generated by travel time savings of £165.64m, vehicle operating cost benefits of £14.2m due to the proposed scheme generating reductions in congestion which requires less fuel to be consumed and an increase in user charges of £1.4m resulting from rerouting on the wider network.

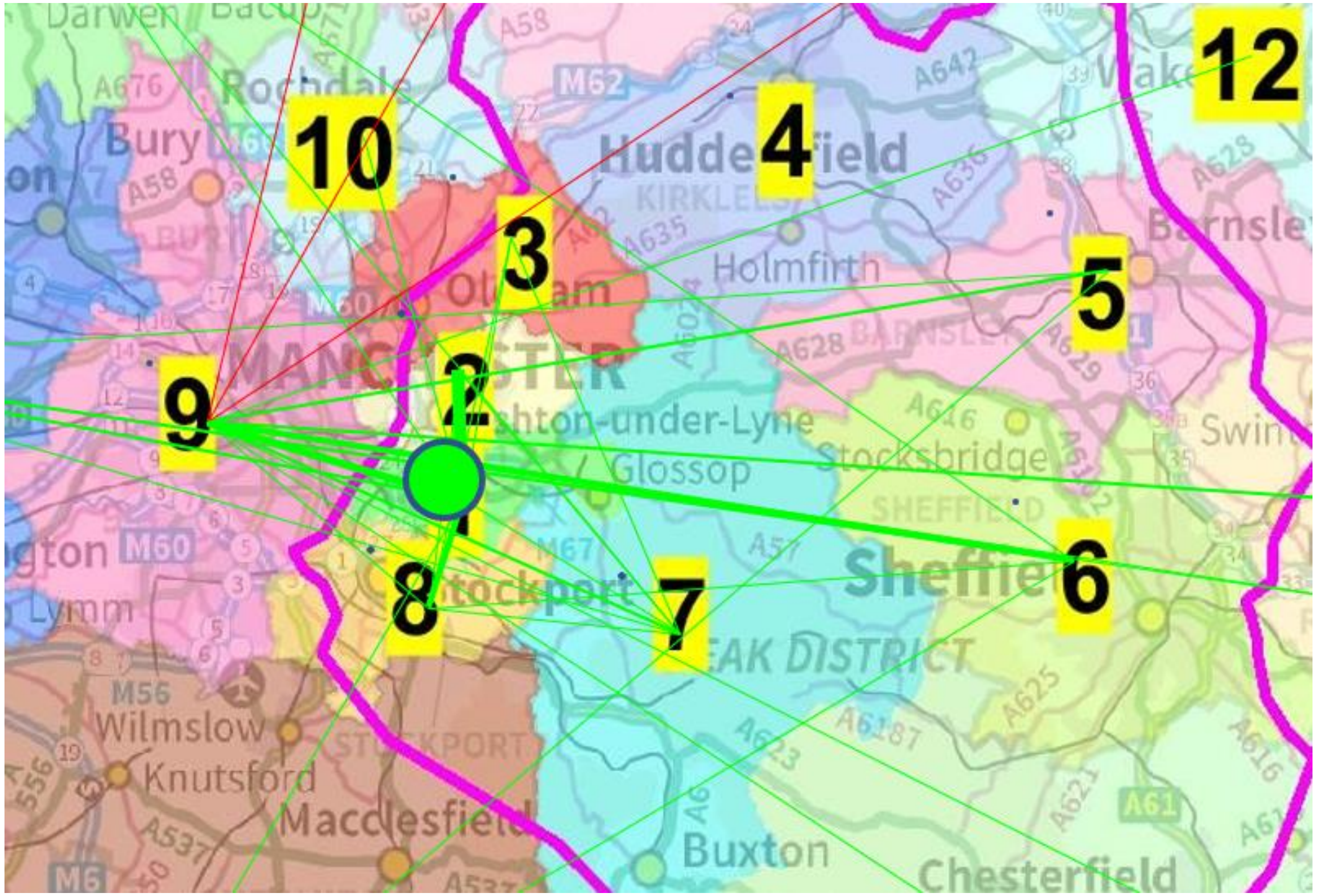
14.2.3. A number of detailed analyses were undertaken on the TUBA user benefit outputs to ensure that the results are logical and in line with expectations, as reported subsequent section. Table 14-3 shows the user travel time benefits over the 60-year appraisal.

Spatial analysis of benefits

14.2.4. To understand the spatial distribution of benefits from the scheme, sector analysis was carried out. The Traffic Model zones were aggregated into twenty-five sectors as set out in Figure 13-1

14.2.5. Figure 14-1 indicates the benefit distribution across the sectors in the vicinity of the Trans-Pennine Upgrade scheme.

Figure 14-1 - TPU Benefit Distribution



Thickness of bands represents scale of 2-directional benefits for inter-sector movements

Size of circles represent scale of benefits for intra-sector movements

Green = benefit, Red = disbenefit

14.2.6. This shows a dominant source of benefits being movements within the central area of sector 1, with the majority of remaining benefits being generated on east to west and west to east movements across the scheme and shorter north to south and south to north movements also experience benefits as congestion is eased at key junctions. The movements which would be anticipated to have the greatest benefits would be:

- Sector 1 to Sector 1 = £27.98m;
- Sector 2 to Sector 1 = £11.92m;
- Sector 9 to Sector 1 = £10.24m;
- Sector 1 to Sector 9 = £6.73m; and
- Sector 8 to Sector 1 = £6.24m.

14.2.7. Some sector-to-sector movements are forecast to experience a dis-benefit, and the movements with the highest dis-benefits are:

- Sector 9 to Sector 18 = -£0.70m;
- Sector 18 to Sector 9 = -£0.65m;
- Sector 11 to Sector 9 = -£0.64m;
- Sector 21 to Sector 17 = -£0.61m; and
- Sector 24 to Sector 9 = -£0.53m.

14.2.8. A summary of how journey time benefits break down by scale of time saving per trip is set out in Table 14-1. Values indicated are the net position of benefits and disbenefits within each range. This shows the scheme will generate the majority of the time savings for trips which experience a change in journey time of more than 5 minutes. A similar scale of benefits for trips with savings between 2 and 5 minutes will be generated. Changes in journey times of less than 2 minutes largely balance out between benefits and disbenefits, resulting in only a small net benefit.

Table 14-1 Time benefits (£000s) by size of time saving

User	0 to 2 mins	2 to 5 mins	>5 mins
Business	10,975	40,610	42,907
Non business	-1,835	34,800	38,186

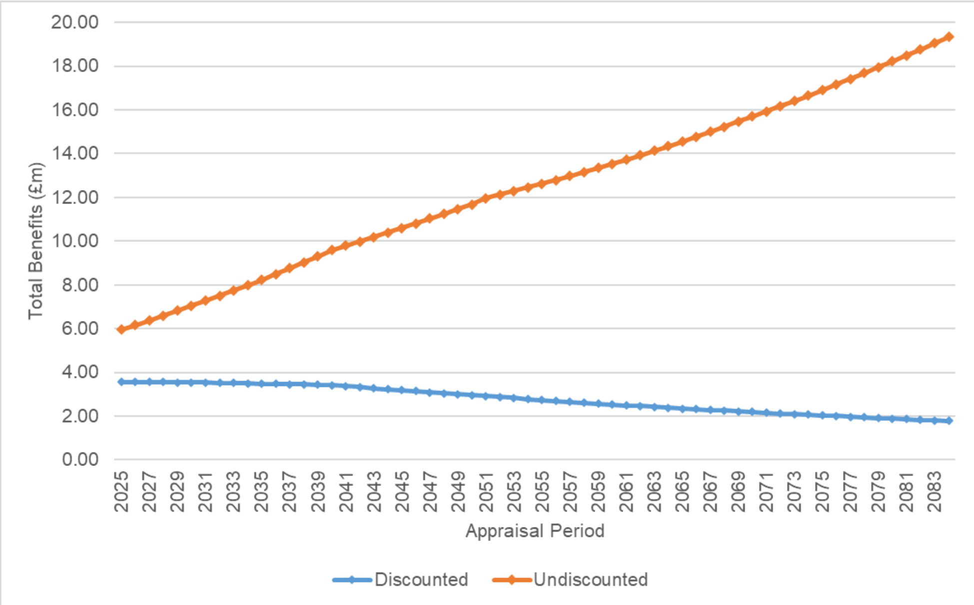
Note: all monetary values are in 2010 market prices discounted to 2010

14.2.9. Further detail on this distribution of benefits is set out in Appendix D.

Profile of benefits over 60-year Appraisal Period

14.2.10. Figure 14-2 shows the profile of the user journey time benefits across the 60-year appraisal period. The figure shows that although benefits rise through the forecast years from 2025 to 2051 as demand and hence congestion levels increase, once discounting has been applied this increase is largely levelled out. After 2051 the continued rate of discounting exceeds the rate of growth in values of time and so benefits decline afterwards until the end of the appraisal period in 2084.

Figure 14-2 - Profile of User masked benefits over Appraisal Period



Note: all monetary values are in 2010 market prices discounted to 2010

User Benefits by Journey Purpose

14.2.11. Table 14-2 below provides a summary of the user benefits disaggregated by journey purpose over the 60-year appraisal period.

Table 14-2 - User Benefits by Journey Purpose (£m)

Purpose	Travel Time	Vehicle Operating Cost	Total	Proportion
Business	£94.49	£17.47	£111.96	62.3%
Commute	£42.16	-£0.58	£41.58	23.1%
Other	£29.00	-£2.69	£26.31	14.6%
Total	£165.64	£14.20	£179.85	100%

Note: all monetary values are in 2010 market prices discounted to 2010

14.2.12. Analysis of user benefits show that more of the scheme benefits are attributed to business trips than commuting and other trips. As can be seen, the user benefits claimed by business purpose trips account for approx. 62% of the total user benefits, with 23% and 15% for commuting and other trips respectively. The significantly higher proportion of benefits attributed to business trips compared to commuting and others is expected as the scheme serves as part of a key inter-urban route and connects many businesses in the region and the value of time for business trips are higher than commuting and other trips. Movements such as Glossop to Manchester, Hyde and Stockport all benefit as do longer distance trips between Manchester and Sheffield, which are more frequently made for business purposes.

14.2.13. Some vehicle operating cost benefits are achieved for business trips, relating primarily to avoiding the need for lengthy diversions when making trans-Pennine movements. Modelling indicates rerouting of trips, which use the M62 and M1 in the DM scenario for travelling between Manchester and Sheffield, but which transfer onto the A62 and A57 in the DS scenario due to reduced congestion levels in the vicinity of the TPU scheme. This is a much shorter journey, resulting in reduced operating costs.

14.2.14. User Benefits by Time Period Table 14-3 provides a summary of the user benefits in terms of time savings and vehicle operating cost benefits by time period, for each forecast year and also for the 60-year appraisal period. To enable direct comparison a summary is also provided showing only a single annualised hour per day, rather than the usual 3 hour peak periods and 6 hour interpeak.

Table 14-3 - User Benefits by Forecast Year and Period (£000)

	Type	2025	2040	2051	60 Years
AM Peak	Total	455	550	478	25,938
Interpeak	Total	2,744	2,080	1,600	98,600
PM Peak	Total	896	1,070	1,074	55,309
Total	Total	4,095	3,700	3,153	179,847
AM Peak	per Hour	152	183	159	8,646
Interpeak	per Hour	457	347	267	16,433
PM Peak	per Hour	299	357	358	18,436

Note: all monetary values are in 2010 market prices discounted to 2010

14.2.15. The benefits show a similar level of impact during the Interpeak and PM peak hours, with a lower level of benefit during the AM peak. This highlights the directional nature of the congestion in the DM scenario. Delays on the A57(T) through Mottram in the PM peak by the design year of 2040 are forecast to be approximately double the length of those in the AM peak and considerably higher in the eastbound direction for flows all the way from Hattersley Roundabout to the A628(T).

14.2.16. These delays will be relieved through implementation of the TPU scheme, leading to a larger reduction in journey time, and therefore increase in benefit, for those trips experiencing the greatest delay in the DM scenario.

14.2.17. There are some fluctuations in how benefits by time period develop over the modelled years. The AM peak shows a reasonably stable level of benefit across the forecast years having been discounted to 2010, as does the PM peak. The interpeak period however shows a reduction over time in discounted benefits reflecting a relatively low rate of growth.

14.3. User Costs During Construction

14.3.1. The results of the TUBA analysis of the construction impacts are shown in Table 14-4 (2010 prices, discounted to 2010):

Table 14-4 - Traffic Management (TM) User Disbenefits (£000) Unmasked

TM Phase	Construction Duration (days)	Commuting	Other	Business	Indirect Tax	Total
1	182	No Impact during construction				
2	183	-£55	-£99	-£13	£16	**-£155**
3	182	-£226	-£265	-£136	£29	**-£605**
4	184	No Impact during construction				
5_1	61	-£47	-£68	-£82	£10	**-£189**
5_2	31	-£25	-£38	-£34	£3	**-£95**
Total		**-£353**	**-£470**	**-£265**	**£58**	**-£1,044**

Note: all monetary values are in 2010 market prices discounted to 2010

14.3.2. The total net disbenefit during construction is -£1.04m occurring mainly during Traffic Management Phase 2, phase 3, and phase 5. Of these, phase 3 is the most detrimental, representing a 6 month period during which Mottram Moor will be reduced to a single lane in the eastbound direction.

14.3.3. It has been noted that the construction impact during Traffic Management phase 1 and phase 4 does not have any disbenefits as there was no restriction to the existing network during these construction periods.

14.3.4. Impacts on users during maintenance of the new network have been considered but have not been monetised. It has been assumed that delays during maintenance of the DM network will have a greater adverse impact than maintenance of the DS network. The newly introduced links add resilience to the existing network by adding capacity and providing alternative route options for use when traffic management measures are in place. This will reduce the need for lengthy diversions while maintenance is carried out.

14.4. COBALT: Accident Savings

14.4.1. Results of the COBALT assessment the TPU scheme's impact on the frequency and cost of traffic accidents is set out below. Table 14-5 summarises the accident impact of the scheme over the 60-year appraisal period.

Table 14-5 - Accidents and Casualties over Appraisal Period (Whole Network)

Scenario	Accident Summary (PIAs)	Casualty Summary (Casualties, by Severity)			Economic Impact
		Fatal	Serious	Slight	
Do-Minimum	34,884	431	4,691	43,599	£1,304m
Do-Something	34,986	438	4,718	43,755	£1,311m
Scheme Impact	-102	-6	-28	-156	-£7.33m

Note: all monetary values are in 2010 market prices discounted to 2010

14.4.2. The results show an increase in accident numbers on the assessed area of the modelled network, resulting in a monetised cost of accidents which is higher in the DS scenarios than the DM scenario. This means that the scheme provides an accident disbenefit. The accident impact from the proposed scheme is -£7.33m. This relates to a forecast increase of 102 accidents over the appraisal period, or an average of 1.7 accidents per year. This would lead to an estimated additional 6 fatal casualties, 28 serious casualties, and 156 slight casualties over 60 years.

14.4.3. A more detailed analysis of impacts across the network shows that the A57 Snake Pass, which is known to have a high accident rate, is forecast to experience an increase of more than 160 accidents. This alone exceeds the total impact across the rest of the network combined. Small increases in accidents are also expected through Glossop and along the A628. The scheme does not make any of these roads intrinsically less safe but increases traffic flow, leading to a higher potential for accidents to occur. Flow is reduced elsewhere on the network, such as along the M62, but motorways are safer than other road types and so the net impact of the combined rerouting is negative.

14.4.4. As Snake Pass is a known accident hotspot which will see flow increased as a result of the TPU scheme, measures should be pursued to minimise these negative impacts.

Impact on Strategic Road Network (SRN)

14.4.5. Within the COBALT assessment analysis has been performed of the impact of the scheme on the SRN in isolation. Table 14-6 below indicates the network sections which have been included in this analysis. The existing A57 through Mottram has been included as part of the SRN in the DM scenario, but following de-trunking it is not included in the DS scenario, with the new link road replacing it as part of the SRN. Table 14-6 sets out the results of this analysis.

Table 14-6 - Accidents and Casualties over Appraisal Period (SRN only)

Scenario	Accident Summary (PIAs)	Casualty Summary (Casualties, by Severity)			Economic Impact
		Fatal	Serious	Slight	
Do-Minimum	3,561	66	482	4,880	£143.2m
Do-Something	3,511	67	482	4819	£143.0m
Scheme Impact	50	-1	0	61	£0.2m

Note: all monetary values are in 2010 market prices discounted to 2010

14.4.6. This shows a small benefit of £0.2m on the SRN, arising from a reduction of 61 slight injuries and the related damage caused by these accidents. The forecast show part of this saving to be offset by an increase of 1 fatality on the SRN over the 60 year period. This marginally higher fatality rate is driven by the increased flow on the A628 which has a slightly higher risk of this type of accident than other parts of the SRN.

14.4.7. The reduction in overall accident numbers is largely achieved through the junction improvements at Hattersley Roundabout and Gun Inn.

Spatial Distribution of Benefits

14.4.8. The spatial distribution of safety benefits by link, as forecast through the COBALT assessment, is set out in Figure 14-3. This shows that the most significant negative impacts will be on the A57 Snake Pass and the A628. These are both long distance routes which will see increases in flow. As a result, the vehicle-kilometres will be increased leading to a forecast growth in accident numbers.

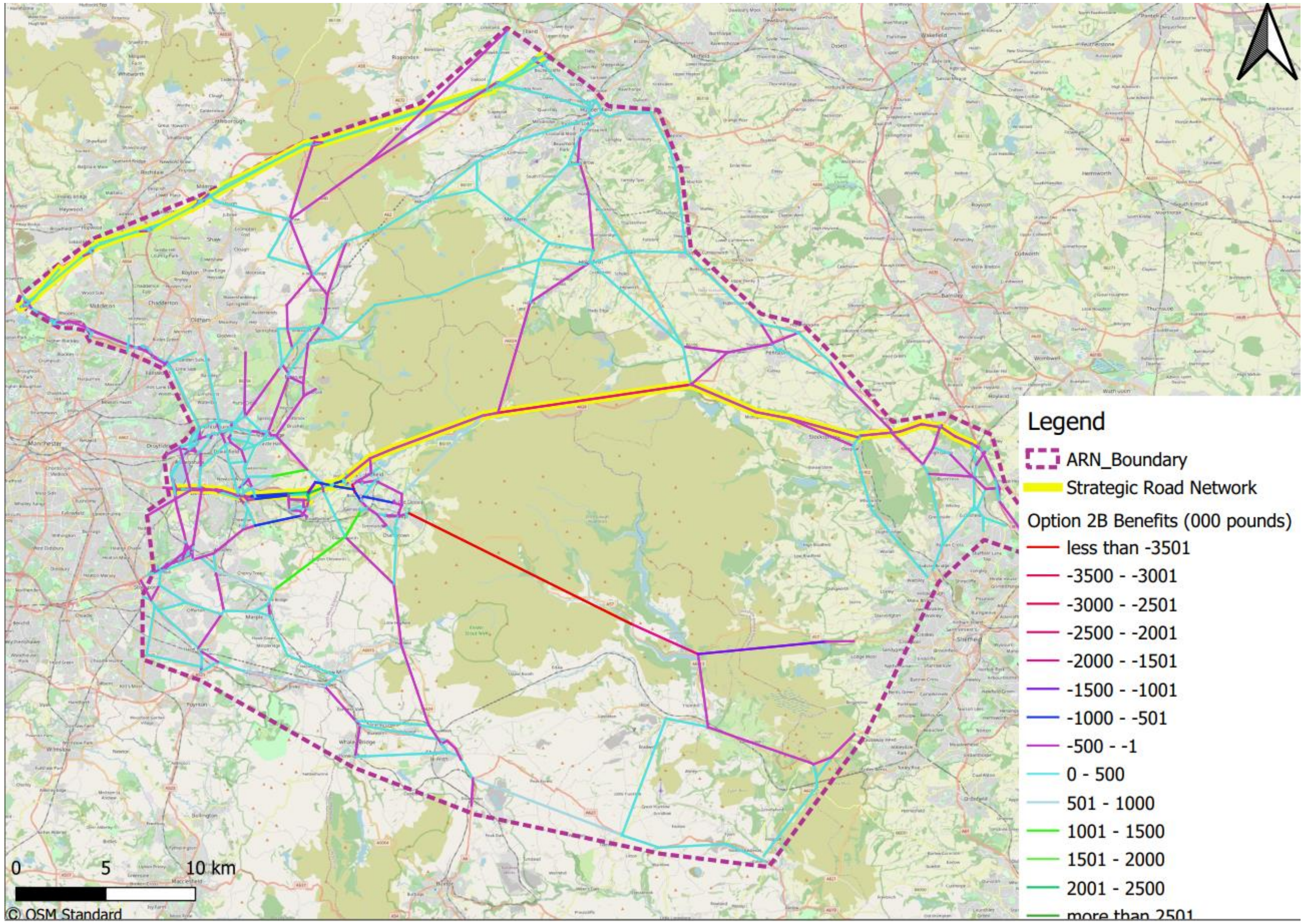
14.4.9. Similarly, the M67 and A560 will experience increases in flow, as the scheme makes these routes more desirable, leading to increases in accident numbers.

14.4.10. The links seeing the greatest improvements will be the A57 through Mottram, as traffic diverts onto the new link road and the A626 which will experience a reduction in flow as traffic diverts onto the A560.

14.4.11. Additional benefits which are not indicated in this figure will occur at Hattersley Roundabout and Gun Inn, as these junctions are upgraded to provide improved safety.

14.4.12. The SRN sections which have been assessed are indicated in the figure. The M60 Ring Road, the A627(M) and A663 have not been considered in this part of the analysis, as flow changes resulting from the scheme are negligible and within the range of model noise. Impacts at Hattersley Roundabout and Gun Inn junctions have been included within the SRN analysis.

Figure 14-3 – Spatial Distribution of Safety Impacts



14.5. Environmental Impacts

Air Quality Assessment

14.5.1. Air quality benefits over the 60-year appraisal period were computed as part of the Environmental Assessment using the standard TAG Air Quality Workbook. The value of these benefits over 60 years, is set out in Table 14-7.

Table 14-7 – Summary of Air Quality Outputs over 60 Years

Air Quality Output	Value
Increase in NOx emissions (tonnes)	284
Value of change in NOx emissions (NPV)	-£1.14m
Increase in $PM_{2.5}$ emissions (tonnes)	37
Value of change in $PM_{2.5}$ emissions (NPV)	-£2.63m
Total Air Quality (NPV)	-£3.77

Greenhouse Gases

14.5.2. Greenhouse gas benefits over the 60-year appraisal period were computed as part of the Environmental Assessment using the standard TAG Greenhouse Gases Workbook. The value of these benefits over 60 years is set out in Table 14-8.

Table 14-8 – Summary of Greenhouse Gas Outputs over 60 Years

Greenhouse Gas Output	Value
Change in CO_2e emissions (tonnes)	399,867
Greenhouse Gas (NPV) Central Carbon Values	-£17.4m

Note: all monetary values are in 2010 market prices discounted to 2010

Noise Assessment

14.5.3. Noise benefits over the 60-year appraisal period were computed as set out in Chapter 4. The value of these benefits over 60 years, in 2010 prices discounted to 2010 is £3.17m.

14.5.4. Although some significant adverse impacts are predicted during the construction phase, none of these are predicted during the night-time.

14.5.5. The scheme routes traffic away from an existing Noise Important Area, which is where most of the reductions in daytime and night-time noise will occur. The traffic is routed along a new route through areas that already affected by road traffic noise, however the dominant noise source changes. This is particularly evident around Mottram Moor junction where the existing A57 is relocated further from the front facades of receptors, but the new route of the A57 would introduce noise predominantly affecting the rear facades of the same receptors.

14.5.6. There are forecast to be 1619 perceptible adverse changes and 416 perceptible beneficial changes from the Scheme by the design year. However, the variation in scale of these impacts is such the overall result is a net positive value of benefit related to changes in noise levels.

14.5.7. Monetised benefits related to noise impacts are set out in Table 14-9 The anticipated non-monetised impacts, which cannot be reflected in the cost-benefit analysis above, are:

Table 14-9 - Noise benefits (£m)

Economic parameters	Present value of reliability impact (2010 prices and values)
Sleep disturbance	£1.42m
Amenity	£1.08m
AMI	£0.64m
Stroke	£0.01m
Dementia	£0.02m
Total	£3.17m

Note: all monetary values are in 2010 market prices discounted to 2010

Non-monetised Impacts

- A slight adverse impact on landscape features is expected at the point of scheme opening, but within 15 years these will be been remedied.
- A slight adverse impact on townscape features at a small number of receptors has been identified during both the construction and operational phases.
- A slight adverse impact on the historic environment.
- A slight adverse impact on biodiversity has been predicated as a result of the scheme.
- A slight adverse impact on the water environment at the River Etherow is expected during the construction period. No further significant effects are anticipated during the operational period.

14.5.8. These are described more fully in the Appraisal Summary Table, which may differ from the Environmental Statement results due to being assessed against different criteria.

14.6. Journey Time Reliability

14.6.1. The overall results of the application of the TAG 'Urban Roads' reliability benefits calculation are summarised in Table 14-10,

Table 14-10 - Reliability benefits (£m)

Trip Purpose	Scheme Impacts
Business	£6.2
Commute	£2.4
Other	£2.1
Total	**£10.7**

Note: All monetary values are in 2010 market prices discounted to 2010

14.6.2. The reliability benefits were reviewed at the sector level, allowing the key impacts on the individual sector to sector movements to be identified with their geographical context. The largest impacts were:

- Within Sector 1 (Mottram): this sector alone gives a reliability benefit of around £3.6m.
- Movements from Sector 2 (Rest of Tameside) to Sector 1 produces the second largest benefit of around £1.10m followed by movements from Sector 8 (Stockport) to Sector 1 £0.6m.
- Sector 7 (Rest of High Peak) to sector 1 is having some reliability disbenefits at -£0.1m

14.6.3. Table 14-11 provides a further breakdown of the reliability benefits by vehicle type. This shows that cars account for the largest benefit of the impact at around £8.4m (79%). LGV and HGV account for roughly of around £1.5m (14%) and £0.7m (7%) respectively.

Table 14-11 - Reliability benefits by vehicle type (£m)

Vehicle type	Standard parameters
Car	£8.4m
LGV	£1.5m
HGV	£0.7m
Total	£10.7m

Note: All monetary values are in 2010 market prices discounted to 2010

14.7. Wider Economic Impacts (WEIs)

14.7.1. The following sections outline headline findings from the WEI assessment.

Agglomeration

14.7.2. Agglomeration reflects the increased productivity caused by firms being closer in physical or travel time terms to other firms and potential employees.

14.7.3. The WITA model outputs a total agglomeration forecast for the 60-year appraisal period and also provides separate forecasts for individual LADs. It is noted that due to the varying level of details in the transport model and the level of modelling noise present and masking applied, the robustness of agglomeration forecast by LAD also varies.

14.7.4. In light of the varying level of robustness in the forecasts, alterative perspectives of interpreting the output were established. This involves three different areas in which agglomeration benefits may be claimed, as illustrated in options A, B and C in Figure 14-4 and Table 14-12

Figure 14-4 - Agglomeration Impact Areas

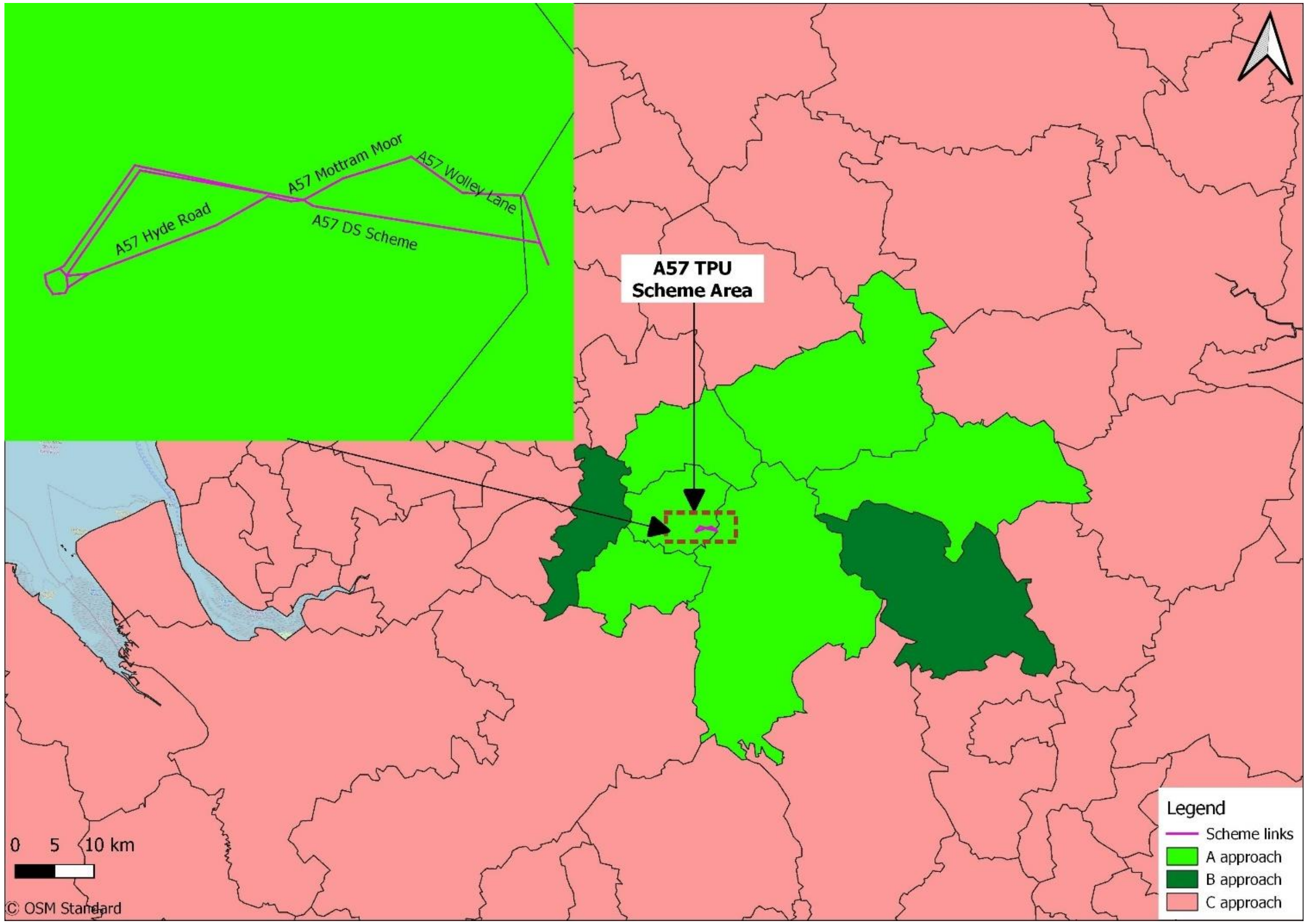


Table 14-12 – Agglomeration benefits forecasts from three different geographic perspectives (£m)

Perspective	Benefits	Commentary
Option A – benefits from High Peak, Oldham, Stockport, Tameside, Barnsley, Kirklees	£60m	Areas located mostly within the ADM and are directly relevant to the geography of the scheme. Reasonable consistency in the forecast benefits between the masked and unmasked runs, which implies robustness.
Option B – Option A plus impacts from Manchester and Sheffield	£86m	Including two clusters of economic activities at either side of the Pennine. Sensible (positive) forecasts obtained for Manchester and Sheffield with the masked transport model output
Option C – Option B plus the rest of the country	£130m	Significantly higher benefit when modelling 'noise' was dealt with by masking. Generally lower level of robustness for agglomeration forecasts with significant level of masking but it demonstrates the scope for additional benefits (vs Option A)

14.7.5. Table 14-12 also outlines the reasons behind the choice of the three different approaches for interpreting agglomeration forecasts. Option A brings higher robustness and consistency although maybe on the conservative side. Option C is less reliable but certainly demonstrate the scope for potential legitimate benefits on a national stage but the exact figure is to be refined. Option B appears to bring a reasonable balance between robustness and representation of the scheme's real benefit in this context so it is the recommended figure to take forward for further assessment in the appraisal.

14.7.6. Furthermore, Table 14-13 also presents the top 10 LAD with the highest agglomeration benefits, along with an indication of the total employment present and which option each LAD falls into. It is clear from this that the top 10 locations are generally sensible in relation to the geography and nature of the intervention, and Option B captures these top locations reasonably well, hence offering a good blend of capturing the benefits whilst maintaining the robustness of the assessment.

Table 14-13 – Agglomeration benefits forecasts top 10 breakdown (by LAD on a national stage)

	LADs	Benefits		Employment	Option A	Option B	Option C
1	Tameside	£	23,506,770	87,327	y	y	y
2	High Peak	£	16,779,946	41,325	y	y	y
3	Stockport	£	14,740,932	138,789	y	y	y
4	Sheffield	£	13,080,189	297,476		y	y
5	Manchester	£	12,596,494	350,836		y	y
6	Trafford	£	5,607,028	142,976			y
7	Oldham	£	4,853,746	97,431	y	y	y
8	Salford	£	4,204,621	125,197			y
9	Bury	£	2,676,751	80,299			y
10	Derbyshire Dales	£	1,925,050	41,594			y

Increased Output in Imperfectly Competitive Markets

14.7.7. This reflects the additional margin firms make on each unit of output they produce, and these impacts are anticipated to be modest.

14.7.8. The estimated value of this impact is driven directly by the value of business user benefits generated by the scheme and therefore has been calculated as outlined above in section giving an additional contribution of £11.7m.

Labour Market

14.7.9. Labour Market impacts reflect the tax revenue from additional people joining the labour market or employment relocating to more productive locations and these impacts are anticipated to be insignificant. For this reasoning, Labour Market impacts have been excluded from the assessment.

14.7.10. It is expected to be beneficial as there is an overall reduction in journey time and cost, but due to the Trans-Pennine nature of the intervention, the direct impacts on (potential) commuters who are making this journey are likely to be small.

Overall Wider Economic Impact Assessment

14.7.11. Therefore, the overall figure for the WEI assessment is £97.7 million. This is derived from the sum of the agglomeration benefits and the increased benefits in imperfectly competitive markets, which are £86million and £11.7million respectively.

14.8. Social and Distributional Impacts (SIs and DIs)

14.8.1. Based on the approaches described in Section 13.10 this section sets out the identified Social and Distributional Impacts of the TPU scheme.

14.8.2. A summary of the findings of the analysis undertaken for the SI assessment accompanied with a brief conclusion is presented in Table 14-14.

Table 14-14 – Summary of Social Impacts

Indicator	Assessment	Conclusion
Collisions	Moderate Adverse	There is a relatively small increase in the number of casualties and associated collision costs as a result of the Scheme.
Physical Activity	Neutral	Small increases in active mode trips are to some extent counter-balanced by some walking and cycling trips moving to private modes. As a result, no impact to physical activity is expected as a result of the scheme.
Security	Neutral	The scheme is unlikely to affect significantly the security of drivers, but it will provide new and replacement street lighting which will enable some users to be more secure, especially pedestrians and cyclists.
Severance	Slight Beneficial	The detrunking of a section of the existing A57 will help to decrease the severance of the communities close to this road as the speed limit is decreased and the volume of traffic decreases leading to improvements in traffic flow. All new and improved junctions will be provided with upgraded WCH facilities (Gun Inn Junction, Mottram Moor, Wooley Bridge and M67 Junction 4) making crossing easier and improving safety. Consultation with landowners has been on-going throughout the Scheme's design to reduce severance on agricultural holdings. However, increases in traffic flow in Glossop will have slight adverse impact on access to amenities, and therefore the overall impact is expected to be slight beneficial.
Journey Quality	Slight Beneficial	Reduced congestion will reduce traveller stress along the Trans-Pennine route. The proposed scheme improvements are also expected to improve facilities and the environment for motorists. Overall, a positive impact on the quality of journeys is expected for motorists, pedestrians and cyclists.
Option and Non-Use Values	Not Assessed	No changes to public transport services or routes are proposed the scheme, so this indicator was not assessed.
Accessibility	Neutral	The scheme will not directly affect the accessibility of services and activities for non-car users, since it does not change any public transport routes, service frequencies or passenger facilities and does not impact upon disadvantaged communities. Nevertheless, it may allow some small opportunity for public transport improvements and hence better access on some local roads for which the scheme provides traffic relief. Overall the impact is assessed as neutral.
Personal Affordability	Neutral	The scheme will cause a slight increase in vehicle operating costs likely as a result of increased vehicle speeds in the area. However, there is a slight benefit for low income groups. The overall impact is assessed as neutral.

14.8.3. A summary of findings for the eight distributional impact indicators is provided in Table 14-15.

Table 14-15 – Summary of Distributional Impacts

DI indicators	Assessment	Conclusion
Accessibility	Not Assessed	This indicator was screened out of the DI assessment.
Severance	Slight Beneficial	The detrunking of a section of the existing A57 will help to decrease the severance of the communities close to this road as the speed limit is decreased and the volume of traffic decreases. These decreases in flows and traffic speeds are expected to lead to a reduced perception of severance for children, no car households and DLA claimants. Therefore, the impact is expected to be slight beneficial.
Security	Not Assessed	This indicator was screened out of the DI assessment.
Collisions	Moderate Adverse	Collision rates are expected to increase for income deprived residents and slightly for motorcyclists and young male drivers and very slightly for cyclists as a result of the TPU scheme. Mitigation in the form of improved crossings and signalisation at Hattersley Roundabout has been introduced which will reduce the negative impact of accidents on cyclists.
Air quality	Slight Beneficial	Air quality is expected to improve for the most income deprived residents as a result of the scheme. Both beneficial and adverse impacts to air quality for children are expected. It is however noted that the air quality assessment presented within the Environmental Statement focuses on areas of poor air quality used to inform the judgement of significant air quality effects and limit value compliance where as DfT's TAG appraisal considers the changes in air quality across the entire study area irrespective of whether there are areas exceeding government air quality thresholds i.e. it is a representation of overall changes of emissions, which may lead to a total increase but still see benefits in areas of poor air quality, as is the case for this scheme.
Noise	Slight Beneficial	Noise levels are expected to decrease for the most income deprived residents. However, there is an adverse noise impact for income quintiles 3 and 5.
User benefits	Moderate Beneficial	A proportionate beneficial impact to user benefits is expected for the 20% most income deprived residents.
Personal affordability	Slight Beneficial	There is a large beneficial impact to affordability for income quintile 1, but a moderate adverse impact for income quintile 2. Hence, the affordability assessment is considered slight beneficial.

14.8.4. The variance of impacts across quintiles of income deprivation is shown in Table 14-16.

Table 14-16 Distribution of measures across income quintiles

	Distributional impact of income deprivation (0-20% = most deprived)					Are the impacts evenly distributed?	Key impacts – Qualitative statements
	0-20%	20-40%	40-60%	60-80%	80-100%		
Accessibility	-						This indicator was screened out of the assessment.
Air Quality	✓	✓✓✓	✓	×	×	**No**	There are beneficial impacts to air quality for income quintiles 1-3, but adverse impacts for income quintiles 4 and 5.
Noise	✓	✓	×××	0	×××	**No**	There are beneficial impacts to noise for income quintiles 1 and 2, but adverse impacts for income quintiles 3 and 5.
User Benefits	✓✓✓	✓	✓✓✓	✓	✓✓	**No**	There are beneficial user benefits for all income quintiles, however, these vary in magnitude from slight to large.
Affordability	✓✓✓	××	✓✓✓	××	××	**No**	There are beneficial impacts to affordability for income quintiles 1 and 3, but adverse impacts for income quintiles 2, 4 and 5.

14.9. Reporting the Economic Assessment Results

Transport Economic Efficiency (TEE) Table

14.9.1. The TEE table brings together the benefits to transport users and providers derived from the TUBA runs. The TEE table is a key component in the reporting of the economic assessment impacts and is set out in section 14.10.

Public Accounts (PA) Table

14.9.2. The PA table brings together the costs of the scheme and the revenue and tax changes which would result. The revenue and tax changes which follow from changes in traffic routes and speeds are derived from the TUBA output, while the capital and operating costs have been prepared as described in Chapter 13.2. The PA table is set out in Section 14.11.

Analysis of Monetised Costs and Benefits (AMCB) Table

14.9.3. The AMCB table brings together all quantified scheme costs and benefits to help determine the economic worth of the Trans-Pennine Upgrade (TPU) transport scheme. This table is based on those elements of the economic appraisal which are considered to produce robust monetised estimates of the impacts. The AMCB table includes:

- User benefits, such as time savings and vehicle operating cost saving, over the 60-year appraisal period;
- Effects of delays during construction;
- Changes in user charge revenues;
- Indirect taxation benefits;
- Accident benefits;

- Monetised environment impacts; and
- Costs of construction and maintenance.

14.9.4. The benefits less costs provide an initial estimate of the Net Present Value (NPV) of the scheme. The ratio of these benefits to costs is referred to as the Initial BCR.

14.9.5. In the AMCB table, four critical values are presented:

- The Present Value of Benefits (PVB) is the summation of the stream of discounted initial benefits over the appraisal period, reduced by the discounted value of the developer contribution.
- The Present Value of Costs (PVC) is the summation of the stream of discounted costs from the current year forward through the 60-year appraisal period, less the discounted value of the developer contribution, although the majority of investment costs are likely to occur before the scheme opening year. The PVC indicates the total cost of the scheme which will be considered against the benefits.
- The Net Present Value (NPV) is the PVB less the PVC and indicates whether there are positive or negative benefits, and their scale, from a scheme.
- The Benefit-Cost Ratio (BCR) is the ratio of the PVB and the PVC.

14.9.6. A BCR greater than 1.0 indicates that the benefits outweigh the costs.

14.9.7. The AMCB table is set out in section 5.13. Following the production of the AMCB table, the relevant values in the TEE/PA/AMCB tables are then transcribed to the AST.

Adjusted BCR

14.9.8. Following calculation of the Initial BCR other benefits whose estimation methods are less well established are added to the appraisal, as explained in DfT's Value for Money Assessment Advice Note (December 2013). These are benefits from changes in journey time reliability and wider economic impacts (WEIs) arising from implementation of the scheme.

14.9.9. The results of these calculations were used to derive an Adjusted PVB and an Adjusted BCR. The same PVC is used to generate the Initial and Adjusted BCRs.

14.10. Transport Economic Efficiency

14.10.1. The final Transport Economic Efficiency, Public Accounts and Analysis of Monetised Costs and Benefits tables are presented below in Table 14-17 ,Table 14-18 and Table 14-19 respectively.

Table 14-17 - Transport Economic Efficiency (TEE) Table (£m)

Non-Business: Commuting	
Travel Time	£42.16
Vehicle Operating Costs	-£0.58
User Charges	£0.58
Net Non-Business Benefits: Commuting	**£42.15**
Non-Business: Other	
Travel Time	£29.00
Vehicle Operating Costs	-£2.69
User Charges	£2.06
Net Non-Business Benefits: Other	**£28.37**
Business User Benefits	
Travel Time	£94.49
Vehicle Operating Costs	£17.47
User Charges	-£1.24
Net Business Benefits	**£110.72**
Total	
Present Value of Transport Economic Efficiency	**£181.25**

Note: All monetary values are in 2010 market prices discounted to 2010

14.11. Public Accounts

Table 14-18 - Public Accounts (PA) Table (£m)

Local Government Funding	
Revenue	£0
Operating Costs	£3.49
Investment Costs	£0
Developer and Other Contributions	£0
Grant/Subsidy Payments	£0
Net Impact	**£3.49**
Central Government Funding: Transport	
Revenue	£0.18
Operating Costs	£1.30
Investment Costs	£102.74
Developer and Other Contributions	£0
Grant/Subsidy Payments	£0
Net Impact	**£104.22**
Central Government Funding: Non-Transport	
Indirect Tax Revenues	-£1.41
Totals	
Broad Transport Budget	**£107.72**
Wider Public Finances	**-£1.41**

Note: All monetary values are in 2010 market prices discounted to 2010

14.12. Analysis of Monetised Costs and Benefits

Table 14-19 - Analysis of Monetised Costs and benefits (AMCB) Table (£m)

Item	Core Scenario
Noise	£3.17
Local Air Quality	-£3.77
Greenhouse Gases	-£17.45
Accident Savings	-£7.33
Delays During Construction	-£1.04
Economic Efficiency: Consumer Users (Commuting)	£42.15
Economic Efficiency: Consumer Users (Others)	£28.37
Economic Efficiency: Business Users and Providers	£110.72
Wider Public Finances (Indirect Taxation Revenues)	£1.41
Present Value of Benefits (PVB)	**£156.23**
Broad Transport Budget	£107.72
Present Value of Costs (PVC)	**£107.72**
Overall Impacts	
Net Present Value (NPV)	**£48.52**
Benefit to Cost Ratio (BCR)	**1.45**

Note: All monetary values are in 2010 market prices discounted to 2010

14.12.1. This excludes the values of reliability and wider economic impacts, the effect of which on the BCR is considered below.

14.13. Adjusted BCR

14.13.1. Inclusion of journey time reliability benefits and wider economic impacts increases the PVB from £156.23m to £264.20m. With the PVC of £107.72m, this gives an adjusted NPV of £156.49m and an adjusted BCR of 2.45.

Table 14-20 - Analysis of Monetised Costs and benefits (AMCB) Table (£m)

Item	Core Scenario
Initial PVB	**£156.23**
Reliability	£10.72
Wider Economic Impacts	
Agglomeration	£85.56
Increased Output in Imperfectly Competitive Markets	£11.69
Adjusted PVB	**£264.20**
Broad Transport Budget	£107.72
Present Value of Costs (PVC)	**£107.72**
Overall Impacts	
Net Present Value (NPV)	**£156.49**
Benefit to Cost Ratio (BCR)	**2.45**

Note: All costs and benefits are £m in 2010 market prices discounted to 2010

15. Sensitivity Tests

15.1. Introduction

15.1.1. This section provides details of the forecast model results for the alternative growth scenarios that were submitted for approval. A summary of the following model results is provided in the main body, whilst full details are provided in the appendices:

- Model convergence
- Highway demand matrices
- Trip Length Distribution
- Link flow
- Journey times
- High carbon valuation

15.1.2. Comparisons are drawn between the core scenario and the alternative growth scenarios (low and optimistic). Details of the low and optimistic growth scenarios are provided in section 11.10.

15.2. Model convergence

Variable Demand Model (VDM)

15.2.1. In accordance with TAG guidance (see section 12.1.1), the target %GAP value is 0.1%. In this context, Table 15-1 shows that %GAP values for the full model area and for the subset area are very good for the alternative growth scenarios.

15.2.2. Full details of the VDM convergence statistics are presented in Appendix C.

Table 15-1 - TPU PCF Stage 3 VDM convergence statistics: Low, Core and Optimistic scenario

Scenario	Low			Core			Optimistic		
	Best Loop	Full Model Gap	Subset Area Gap	Best Loop	Full Model Gap	Subset Area Gap	Best Loop	Full Model Gap	Subset Area Gap
DM 2025	15	0.01%	0.03%	15	0.01%	0.03%	10	0.01%	0.03%
DS 2025	17	0.01%	0.03%	19	0.01%	0.03%	13	0.01%	0.03%
DM 2040	18	0.01%	0.04%	20	0.01%	0.03%	20	0.01%	0.03%
DS 2040	19	0.01%	0.04%	19	0.01%	0.03%	13	0.02%	0.05%
DM 2051	11	0.01%	0.04%	17	0.02%	0.05%	14	0.01%	0.03%
DS 2051	20	0.01%	0.04%	19	0.02%	0.06%	17	0.02%	0.05%

Highway Assignment Model (HAM)

15.2.3. Table 15-2 to Table 15-3 show that TAG convergence criteria (presented in Table 12-2) have been met for all alternative growth scenarios.

15.2.4. However, the %GAP for TPU has been tightened to 0.05% as a target figure in accordance with the TPS RTM, hence the high number of assignment-simulation loop iterations. Based on these criteria, the following alternative growth scenarios are not achieving the target figure:

- Low growth 2051 AM peak (DM and DS)
- Optimistic growth 2051 AM and PM peak (DM and DS)

15.2.5. Nevertheless, it should be noted that the %GAP for all forecast year scenarios is well below the 0.1% criteria specified in TAG.

15.2.6. The convergence statistics indicate a reduction in model stability in the later forecast years of the optimistic scenario. This is reflective of the predicted increase in network congestion as a result of an increase in demand assigned to the network.

15.2.7. The low growth scenarios typically converge after a lower number of assignment loops when compared to the core scenario, which is reflective of the lower levels of demand assigned to the network.

15.2.8. Full details of the HAM convergence statistics are presented in Appendix C.

Table 15-2 - TPU PCF Stage 3 HAM convergence statistics: Low, Core and Optimistic DM scenario

Time Period	Year	Low			Core			Optimistic		
		Ass. Sim. Loops	P (%)	Gap%	Ass. Sim. Loops	P (%)	Gap%	Ass. Sim. Loops	P (%)	Gap%
AM	2025	10	98.2	0.034%	11	99.1%	0.039%	11	99.2	0.044%
	2040	57	99.9	0.050%	105	100.0%	0.050%	103	99.9	0.050%
	2051	120	99.9	0.053%	120	99.6%	0.062%	120	99.9	0.055%
IP	2025	12	99.3	0.014%	10	99.5%	0.020%	10	98.9	0.020%
	2040	9	99.2	0.033%	10	98.7%	0.042%	11	99.1	0.044%
	2051	11	99.3	0.042%	11	99.9%	0.047%	20	100.0	0.048%
PM	2025	9	98.9	0.031%	12	98.9%	0.034%	11	99.9	0.034%
	2040	11	99.1	0.048%	25	99.9%	0.050%	51	99.9	0.049%
	2051	60	99.9	0.049%	107	100.0%	0.049%	120	99.9	0.052%

Table 15-3 - TPU PCF Stage 3 HAM convergence statistics: Low, Core and Optimistic DS scenario

Time Period	Year	Low			Core			Optimistic		
		Ass. Sim. Loops	P (%)	Gap%	Ass. Sim. Loops	P (%)	Gap%	Ass. Sim. Loops	P (%)	Gap%
AM	2025	10	98.4	0.038%	10	98.6%	0.041%	11	99.1	0.045%
	2040	57	99.9	0.050%	58	99.9%	0.049%	80	99.9	0.050%
	2051	120	99.9	0.060%	120	99.8%	0.052%	120	99.9	0.063%
IP	2025	11	99.2	0.015%	10	98.8%	0.020%	12	99.5	0.021%
	2040	11	98.9	0.036%	9	99.1%	0.043%	15	99.2	0.043%
	2051	9	98.8	0.045%	11	99.3%	0.046%	30	99.9	0.049%
PM	2025	9	98.5	0.029%	10	98.6%	0.038%	10	98.7	0.034%
	2040	16	99.1	0.046%	26	99.9%	0.049%	54	99.9	0.049%
	2051	58	99.9	0.050%	118	100.0%	0.050%	120	100	0.051%

15.3. Demand

15.3.1. Table 15-4 to Table 15-12 compare matrix totals for the Reference Case, post-VDM DM and post-VDM DS, by forecast year and growth scenario. More detailed tabulations by user class are provided for the alternative growth scenarios in 16.5.Appendix B (see section 12.3 for the core scenario).

15.3.2. The tabulations show the following trends in relation to the alternative growth scenarios:

- DIADEM induces minimal change in matrix totals between the Reference Case and the post-VDM DM, and even less still between the post-VDM DM and DS scenarios.
- The difference in matrix totals between low and core, and optimistic and core are of a similar scale, which increases in the latter forecast years.

15.3.3. To maintain consistency with the analysis provided for the core scenario (section 12.3), sectored demand matrices from the VDM and HAM have also been provided for the alternative growth scenario in 16.5.Appendix B, as an accompanying spreadsheet.

Table 15-4 - Matrix Trip total comparison by growth scenario: Reference Case (2025)

Time Period	Low	Core	Optimistic	Abs. Diff. (Low -Core)	% Diff. (Low -Core)	Abs. Diff. (Opt. - Core)	% Diff. (Opt. - Core)
AM	5,819,974	6,297,753	6,732,341	-477,778	-7.59%	434,588	6.90%
IP	4,966,524	5,348,390	5,736,876	-381,865	-7.14%	388,486	7.26%
PM	6,512,306	7,020,896	7,533,160	-508,590	-7.24%	512,264	7.30%

Table 15-5 – Matrix Trip total comparison by growth scenario: Reference Case (2040)

Time Period	Low	Core	Optimistic	Abs. Diff. (Low -Core)	% Diff. (Low -Core)	Abs. Diff. (Opt. - Core)	% Diff. (Opt. - Core)
AM	6,221,524	7,008,645	7,665,121	-787,121	-11.23%	656,476	9.37%
IP	5,415,637	5,993,104	6,634,459	-577,467	-9.64%	641,355	10.70%
PM	6,896,501	7,783,294	8,511,739	-886,793	-11.39%	728,446	9.36%

Table 15-6 - Matrix Trip total comparison by growth scenario: Reference Case (2051)

Time Period	Low	Core	Optimistic	Abs. Diff. (Low -Core)	% Diff. (Low -Core)	Abs. Diff. (Opt. - Core)	% Diff. (Opt. - Core)
AM	6,597,078	7,536,609	8,329,400	-939,531	-12.47%	792,791	10.52%
IP	5,737,674	6,438,050	7,200,325	-700,376	-10.88%	762,274	11.84%
PM	7,280,799	8,340,114	9,219,088	-1,059,315	-12.70%	878,974	10.54%

Table 15-7 - Matrix Trip total comparison by growth scenario: post-VDM DM (2025)

Time Period	Low	Core	Optimistic	Abs. Diff. (Low -Core)	% Diff. (Low -Core)	Abs. Diff. (Opt. - Core)	% Diff. (Opt. - Core)
AM	5,822,063	6,276,164	6,728,307	-454,101	-7.24%	452,143	7.20%
IP	4,966,277	5,351,711	5,736,178	-385,434	-7.20%	384,466	7.18%
PM	6,515,817	7,022,744	7,526,871	-506,926	-7.22%	504,127	7.18%

Table 15-8 - Matrix Trip total comparison by growth scenario: post-VDM DM (2040)

Time Period	Low	Core	Optimistic	Abs. Diff. (Low -Core)	% Diff. (Low -Core)	Abs. Diff. (Opt. - Core)	% Diff. (Opt. - Core)
AM	6,224,377	6,943,341	7,661,027	-718,965	-10.35%	717,686	10.34%
IP	5,415,659	6,025,105	6,633,985	-609,446	-10.12%	608,880	10.11%
PM	6,902,796	7,704,147	8,503,824	-801,351	-10.40%	799,678	10.38%

Table 15-9 - Matrix Trip total comparison by growth scenario: post-VDM DM (2051)

Time Period	Low	Core	Optimistic	Abs. Diff. (Low -Core)	% Diff. (Low -Core)	Abs. Diff. (Opt. - Core)	% Diff. (Opt. - Core)
AM	6,599,959	7,463,261	8,325,790	-863,302	-11.57%	862,530	11.56%
IP	5,736,146	6,469,042	7,198,902	-732,895	-11.33%	729,860	11.28%
PM	7,288,215	8,249,964	9,211,463	-961,749	-11.66%	961,498	11.65%

Table 15-10 - Matrix Trip total comparison by growth scenario: post-VDM DS (2025)

Time Period	Low	Core	Optimistic	Abs. Diff. (Low -Core)	% Diff. (Low -Core)	Abs. Diff. (Opt. - Core)	% Diff. (Opt. - Core)
AM	5,821,984	6,276,026	6,728,171	-454,041	-7.23%	452,146	7.20%
IP	4,966,317	5,351,774	5,736,199	-385,457	-7.20%	384,425	7.18%
PM	6,515,798	7,022,733	7,526,877	-506,935	-7.22%	504,144	7.18%

Table 15-11 - Matrix Trip total comparison by growth scenario: post-VDM DS (2040)

Time Period	Low	Core	Optimistic	Abs. Diff. (Low -Core)	% Diff. (Low -Core)	Abs. Diff. (Opt. - Core)	% Diff. (Opt. - Core)
AM	6,224,259	6,943,224	7,660,921	-718,964	-10.35%	717,698	10.34%
IP	5,415,707	6,025,133	6,633,989	-609,426	-10.11%	608,856	10.11%
PM	6,902,803	7,704,204	8,503,933	-801,400	-10.40%	799,729	10.38%

Table 15-12 - Matrix Trip total comparison by growth scenario: post-VDM DS (2051)

Time Period	Low	Core	Optimistic	Abs. Diff. (Low -Core)	% Diff. (Low -Core)	Abs. Diff. (Opt. - Core)	% Diff. (Opt. - Core)
AM	6,599,866	7,463,127	8,325,652	-863,261	-11.57%	862,525	11.56%
IP	5,738,118	6,469,110	7,198,961	-730,991	-11.30%	729,852	11.28%
PM	7,288,250	8,249,997	9,209,534	-961,747	-11.66%	959,536	11.63%

15.4. Trip Length Distribution (TLD)

15.4.1. Figure 15-1 to Figure 15-6 compare 12-hour (07:00-19:00) AAWT trip length distributions for cars between the Base, Reference Case, post-VDM DM and post-VDM DS, by forecast year and growth scenario. (Figure 12-2 to Figure 12-4 show the Core Results). There is minimal change in the distribution of LGV and HGV trip lengths as they are not included in the VDM. However, detailed analysis of all user classes is presented in Appendix C.

15.4.2. As aforementioned in section 12.4.2, the TLD analysis has been produced in accordance with TAG and the alternative method.

15.4.3. Table 15-13 and Table 15-14 show the proportion of 0-20 km and 20+ km car trips in the post-VDM matrices of each growth scenario. The following model predictions are relevant for both the post-VDM DM and DS assignments as the difference in trip length distribution is immaterial:

- In the low growth scenario, there is a slightly lower proportion of short distance trips compared to the core growth scenario. This is reflective of a less congested network, permitting people to travel further without increasing their journey times.
- In the optimistic growth scenario, there is a slightly higher proportion of shorter distance trips compared to the core scenario. This is reflective of a more congested network, resulting in the VDM inducing a change in distribution patterns as people seek to mitigate the impact of increased journey times. Furthermore, there is an increase in the number of local developments included in the optimistic growth scenario, which may have a greater impact on the proportion of short distance trips.
- Uniform growth factors derived from RTF18 (see Table 11-5) are applied to all trips in the LGV and HGV matrices, and they are fixed in the VDM. Therefore, the proportional split between TLD bands for these two vehicle types is consistent across all model scenarios.

Figure 15-1 - TLD Analysis 12-hour (07:00-19:00) Car AAWT (2025): Low scenario

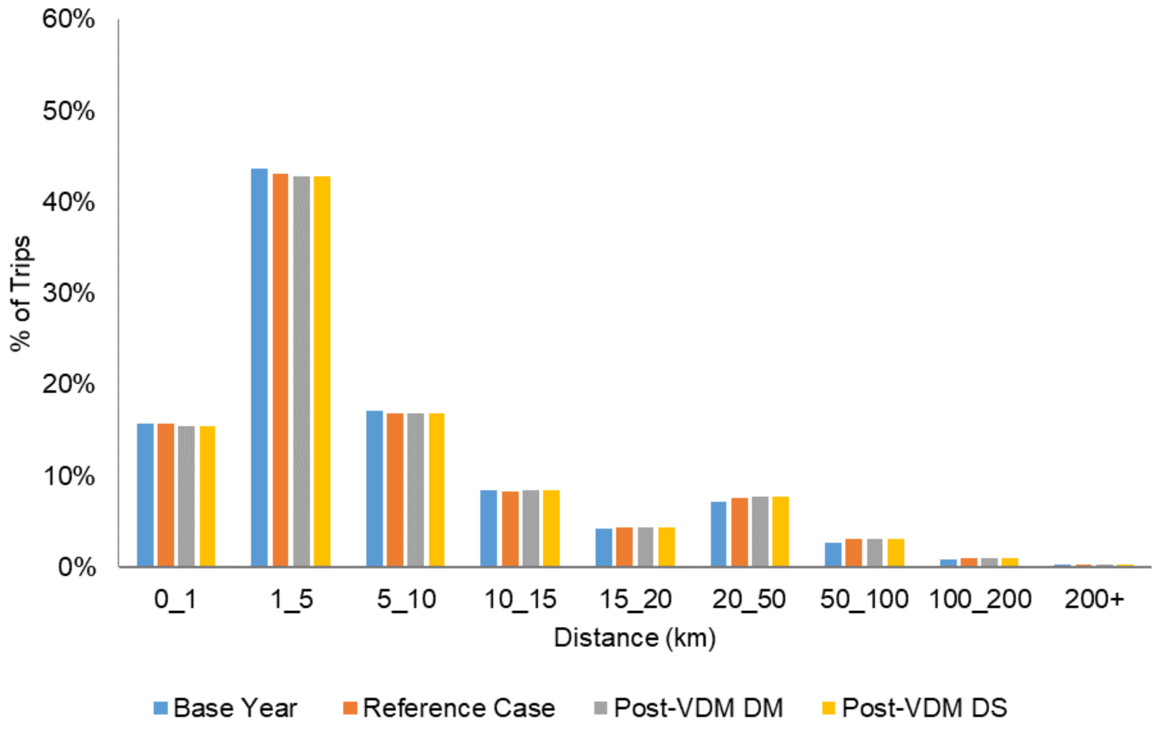


Figure 15-2 - TLD Analysis 12-hour (07:00-19:00) Car AAWT (2040): Low scenario

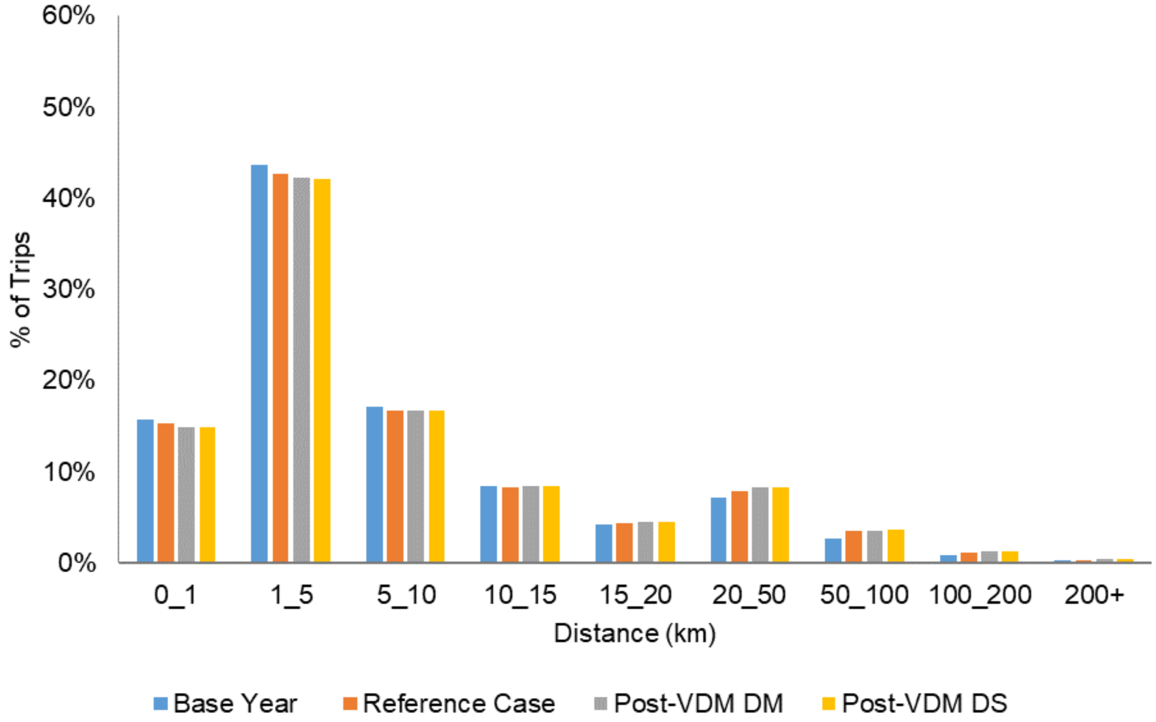


Figure 15-3 - TLD Analysis 12-hour (07:00-19:00) Car AAWT (2051): Low scenario

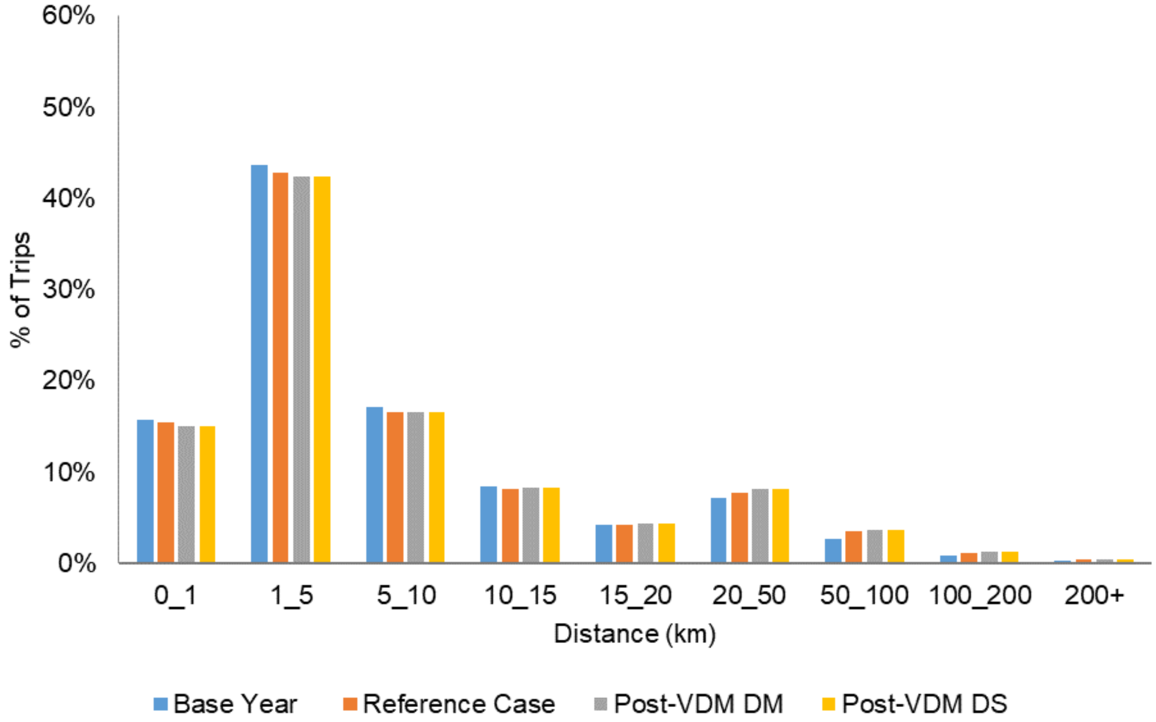


Figure 15-4 - TLD Analysis 12-hour (07:00-19:00) Car AAWT (2025): Optimistic scenario

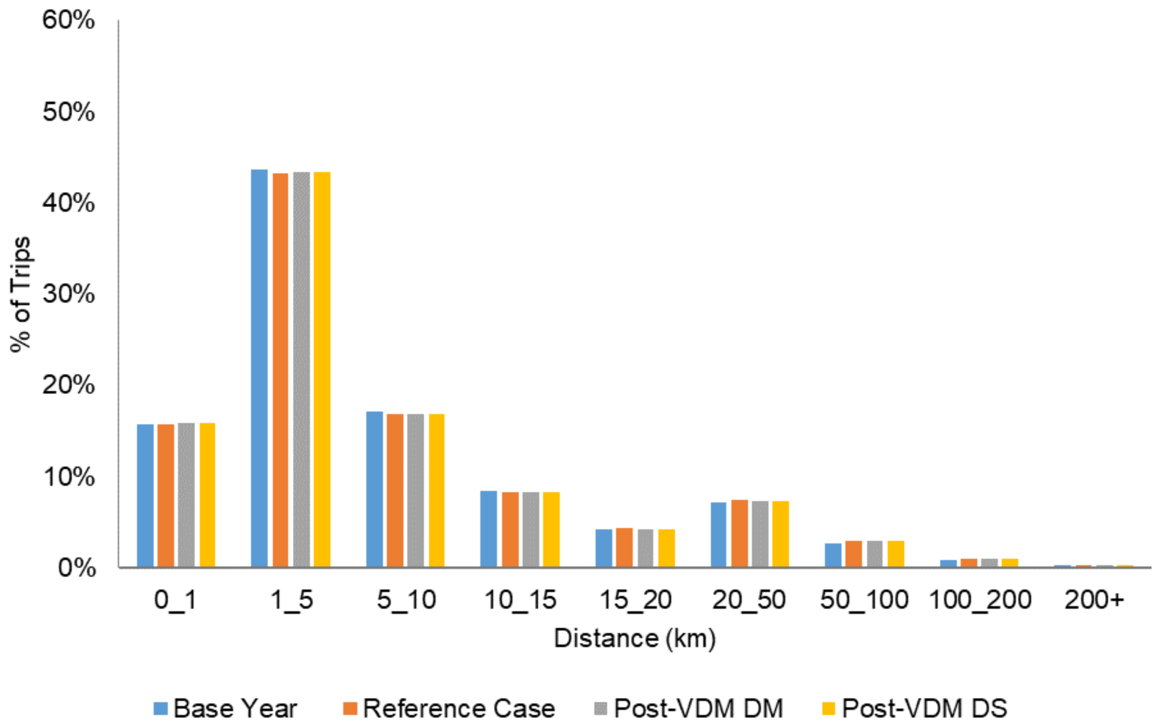


Figure 15-5 - TLD Analysis 12-hour (07:00-19:00) Car AAWT (2040): Optimistic scenario

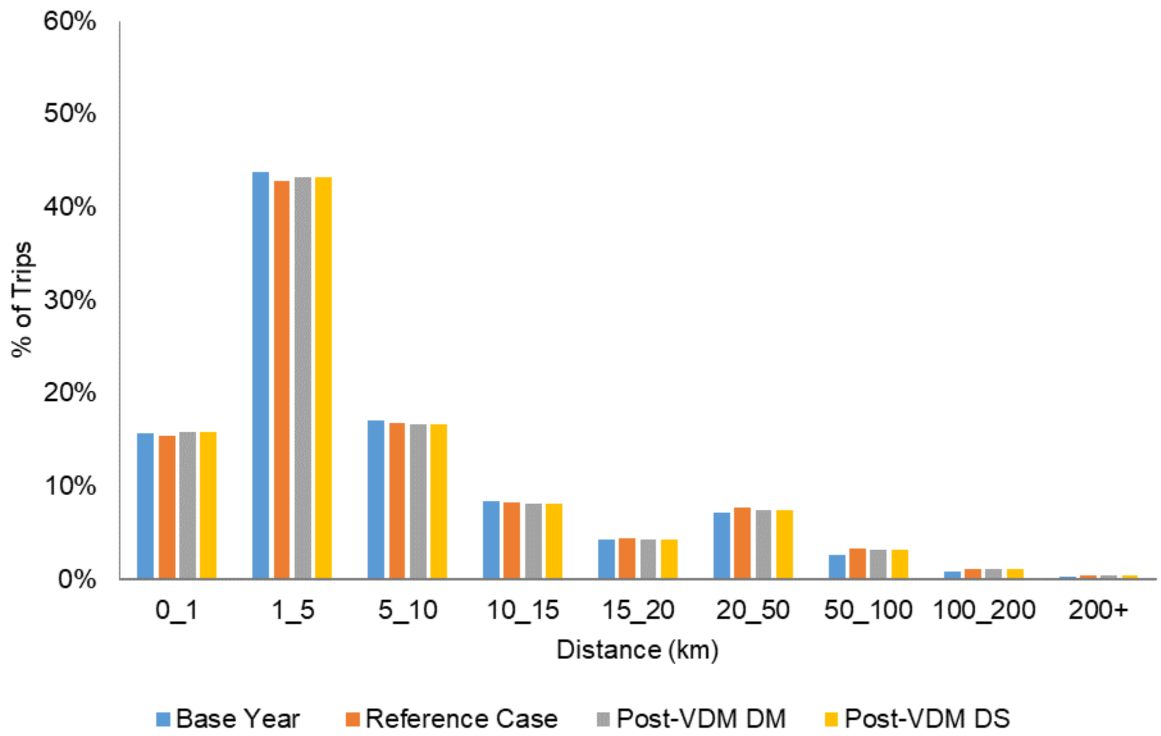


Figure 15-6 - TLD Analysis 12-hour (07:00-19:00) Car AAWT (2051): Optimistic scenario

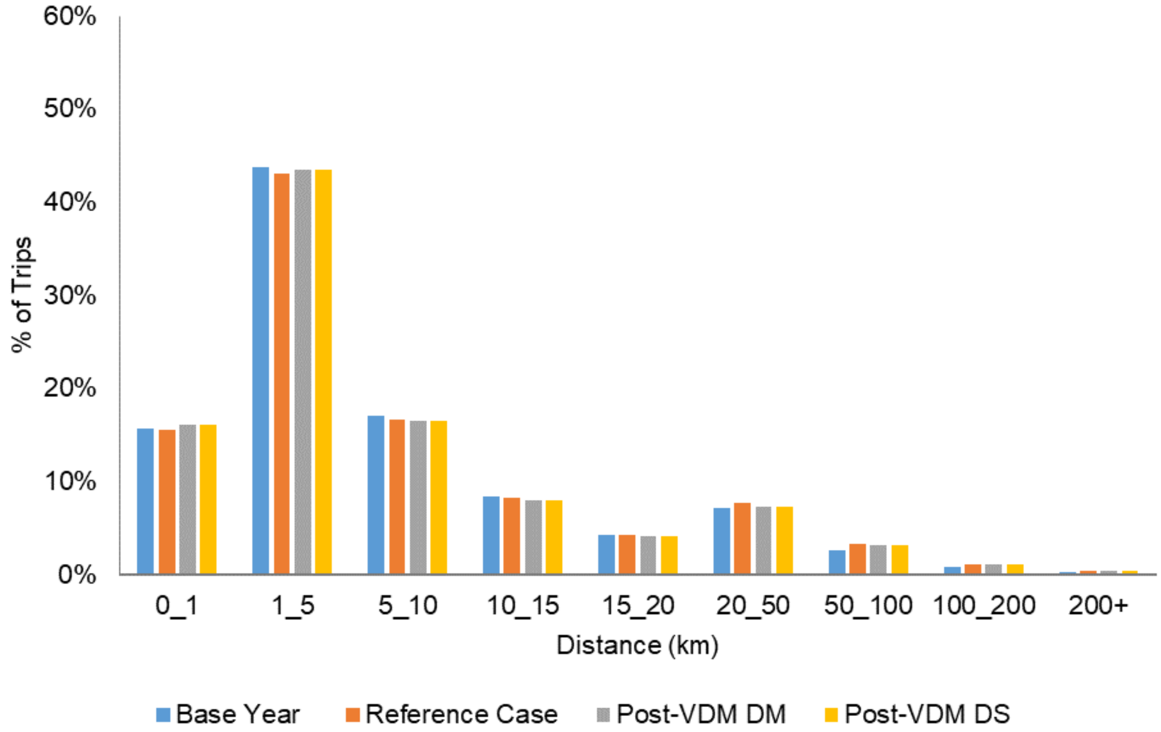


Table 15-13 - Trip length comparison by growth scenario and forecast year: post-VDM DM

Growth scenario	2025		2040		2051	
	0-20 km	20+ km	0-20 km	20+ km	0-20 km	20+ km
Low	87.9%	12.1%	86.6%	13.4%	86.7%	13.3%
Core	88.3%	11.7%	87.3%	12.7%	87.5%	12.5%
High	88.6%	11.4%	88.0%	12.0%	88.2%	11.8%

Table 15-14 - Trip length comparison by growth scenario and forecast year: post-VDM DS

Growth scenario	2025		2040		2051	
	0-20 km	20+ km	0-20 km	20+ km	0-20 km	20+ km
Low	87.9%	12.1%	86.6%	13.4%	86.6%	13.4%
Core	88.2%	11.8%	87.3%	12.7%	87.5%	12.5%
High	88.6%	11.4%	87.9%	12.1%	88.2%	11.8%

15.5. Link flow

15.5.1. Appendix C compares link flows between the DM and DS scenarios, by forecast year and growth scenario. 12-hour (07:00-19:00) two-way AAWT link flows are provided for the locations shown in Table 12-5.

15.5.2. In general, the difference in individual link flows between the low and core, and optimistic and core are of a similar scale. Link flows in the low growth scenario are lower than the core, whilst link flows in the high growth scenario are higher than the core.

15.5.3. However, there are instances where this generic trend is not apparent. In all cases where the low growth scenario is greater than the core or the high growth scenario is less than the core, the difference in 12-hour two-way AAWT link flows is less than 200 vehicles.

15.5.4. More detailed link flow analysis for the alternative growth scenarios is presented in Appendix C as an accompanying spreadsheet.

15.6. Journey times

15.6.1. Table 15-15 to Table 15-23 compare journey times between the DM and DS scenarios, by forecast year and growth scenario. Figure 12-6 highlights the extent of the journey time routes that have been included in the analysis.

15.6.2. In comparison to the core scenario, journey times are mostly greater in the optimistic growth scenario and lower in the low growth scenario, for all forecast years and scheme scenarios. The higher level of demand in the optimistic scenario is predicted to result in higher levels of congestion, whilst the opposite effect is predicted in the low growth scenario.

15.6.3. There are three instances on the monitored routes where journey times do not follow the positive trend of increasing between the low, core and optimistic scenarios. However, in these cases the difference is minimal, and journey time savings increase between the low, core and optimistic growth scenarios as a result of introducing the scheme.

- M67 J3 to Glossop Crossroads westbound
  - Journey times in the low growth scenario are one second slower than the core in the 2025 DS PM peak.
- M67 J3 to Woodhead (A628) eastbound
  - Journey times in the optimistic growth scenario are 12 seconds quicker than the core in the 2040 DS PM peak, and six seconds quicker in the 2051 DS PM peak.

15.6.4. More detailed link flow analysis is included in Appendix C as an accompanying spreadsheet.

Table 15-15 - Journey time (mm:ss) route comparison: 2025 (AM peak)

JT Route	Dir.	Low				Core				Optimistic			
		DM	DS	Diff.	% Diff.	DM	DS	Diff.	% Diff.	DM	DS	Diff.	% Diff.
M67 J3 to Glossop Crossroads	EB	18:32	14:50	-03:42	-20%	19:15	15:07	-04:09	-22%	20:11	15:36	-04:35	-23%
	WB	15:23	13:17	-02:06	-14%	16:14	13:30	-02:44	-17%	16:47	13:42	-03:05	-18%
M67 J3 to Woodhead (A628)	EB	21:20	19:50	-01:30	-7%	21:49	20:14	-01:35	-7%	22:28	20:52	-01:36	-7%
	WB	19:40	18:41	-00:58	-5%	20:25	18:58	-01:27	-7%	20:59	19:24	-01:36	-8%
Roe Cross to Glossop Crossroads (A57)	EB	14:04	13:36	-00:28	-3%	14:38	13:54	-00:43	-5%	15:16	14:30	-00:46	-5%
	WB	12:02	11:49	-00:12	-2%	12:15	12:03	-00:12	-2%	12:27	12:16	-00:12	-2%

Table 15-16 - Journey time (mm:ss) route comparison: 2025 (IP)

JT Route	Dir.	Low				Core				Optimistic			
		DM	DS	Diff.	% Diff.	DM	DS	Diff.	% Diff.	DM	DS	Diff.	% Diff.
M67 J3 to Glossop Crossroads	EB	22:26	14:32	-07:55	-35%	23:20	14:51	-08:29	-36%	24:14	15:09	-09:05	-37%
	WB	18:41	13:48	-04:53	-26%	19:12	14:05	-05:07	-27%	20:24	14:25	-05:59	-29%
M67 J3 to Woodhead (A628)	EB	25:48	21:43	-04:05	-16%	26:32	22:24	-04:08	-16%	27:16	22:45	-04:31	-17%
	WB	21:34	19:39	-01:55	-9%	22:10	19:50	-02:19	-10%	22:41	20:29	-02:12	-10%
Roe Cross to Glossop Crossroads (A57)	EB	14:45	13:19	-01:25	-10%	15:22	13:37	-01:45	-11%	16:06	13:56	-02:10	-13%
	WB	13:08	12:11	-00:57	-7%	13:17	12:29	-00:48	-6%	14:08	12:52	-01:16	-9%

Table 15-17 - Journey time (mm:ss) route comparison: 2025 (PM peak)

JT Route	Dir.	Low				Core				Optimistic			
		DM	DS	Diff.	% Diff.	DM	DS	Diff.	% Diff.	DM	DS	Diff.	% Diff.
M67 J3 to Glossop Crossroads	EB	22:42	16:00	-06:42	-30%	24:21	16:25	-07:55	-33%	25:38	16:51	-08:47	-34%
	WB	15:54	15:22	-00:32	-3%	16:33	15:21	-01:12	-7%	17:25	15:43	-01:43	-10%
M67 J3 to Woodhead (A628)	EB	23:43	19:27	-04:16	-18%	24:55	20:08	-04:46	-19%	25:52	20:23	-05:29	-21%
	WB	19:00	18:28	-00:32	-3%	19:21	18:47	-00:34	-3%	19:48	19:21	-00:27	-2%
Roe Cross to Glossop Crossroads (A57)	EB	15:03	14:41	-00:22	-2%	15:41	15:09	-00:32	-3%	16:10	15:38	-00:32	-3%
	WB	13:05	13:58	00:53	7%	13:37	14:03	00:25	3%	14:16	14:34	00:18	2%

Journey times that are greater than the core in the low growth scenario are highlighted in red, whilst journey times less than the core in the high growth scenario are highlighted in blue.

Table 15-18 - Journey time (mm:ss) route comparison: 2040 (AM peak)

JT Route	Dir.	Low				Core				Optimistic			
		DM	DS	Diff.	% Diff.	DM	DS	Diff.	% Diff.	DM	DS	Diff.	% Diff.
M67 J3 to Glossop Crossroads	EB	19:37	15:15	-04:23	-22%	21:54	16:30	-05:24	-25%	23:59	17:53	-06:06	-25%
	WB	16:03	13:32	-02:31	-16%	16:53	13:59	-02:54	-17%	18:02	15:37	-02:25	-13%
M67 J3 to Woodhead (A628)	EB	22:06	20:22	-01:43	-8%	23:28	20:51	-02:37	-11%	24:33	20:57	-03:36	-15%
	WB	20:15	19:12	-01:03	-5%	20:58	19:34	-01:23	-7%	21:58	20:19	-01:39	-8%
Roe Cross to Glossop Crossroads (A57)	EB	14:49	14:05	-00:45	-5%	16:13	15:26	-00:47	-5%	17:33	16:56	-00:37	-3%
	WB	12:14	12:03	-00:11	-2%	12:36	12:30	-00:06	-1%	12:59	14:08	01:09	9%

Table 15-19 - Journey time (mm:ss) route comparison: 2040 (IP)

JT Route	Dir.	Low				Core				Optimistic			
		DM	DS	Diff.	% Diff.	DM	DS	Diff.	% Diff.	DM	DS	Diff.	% Diff.
M67 J3 to Glossop Crossroads	EB	23:28	15:09	-08:18	-35%	24:52	16:01	-08:52	-36%	26:32	16:46	-09:47	-37%
	WB	19:38	14:12	-05:26	-28%	20:40	14:42	-05:59	-29%	21:49	15:15	-06:34	-30%
M67 J3 to Woodhead (A628)	EB	26:29	22:34	-03:55	-15%	27:33	22:49	-04:44	-17%	28:38	23:18	-05:19	-19%
	WB	22:17	19:37	-02:40	-12%	23:04	20:39	-02:26	-11%	23:37	21:26	-02:11	-9%
Roe Cross to Glossop Crossroads (A57)	EB	15:35	13:51	-01:44	-11%	16:38	14:43	-01:55	-12%	17:50	15:29	-02:22	-13%
	WB	13:36	12:37	-00:59	-7%	14:07	13:11	-00:56	-7%	15:10	13:48	-01:21	-9%

Table 15-20 - Journey time (mm:ss) route comparison: 2040 (PM peak)

JT Route	Dir.	Low				Core				Optimistic			
		DM	DS	Diff.	% Diff.	DM	DS	Diff.	% Diff.	DM	DS	Diff.	% Diff.
M67 J3 to Glossop Crossroads	EB	23:47	16:15	-07:32	-32%	25:59	16:55	-09:03	-35%	28:00	17:50	-10:10	-36%
	WB	17:09	14:18	-02:52	-17%	18:08	15:13	-02:54	-16%	19:21	15:24	-03:57	-20%
M67 J3 to Woodhead (A628)	EB	24:28	20:24	-04:04	-17%	25:50	20:50	-05:00	-19%	26:32	20:38	-05:54	-22%
	WB	19:29	18:34	-00:55	-5%	20:01	18:44	-01:17	-6%	20:47	19:26	-01:22	-7%
Roe Cross to Glossop Crossroads (A57)	EB	15:37	14:54	-00:43	-5%	16:30	15:38	-00:53	-5%	17:49	16:30	-01:19	-7%
	WB	14:05	13:12	-00:53	-6%	14:50	14:27	-00:23	-3%	15:42	15:02	-00:41	-4%

Journey times that are greater than the core in the low growth scenario are highlighted in red, whilst journey times less than the core in the high growth scenario are highlighted in blue.

Table 15-21 - Journey time (mm:ss) route comparison: 2051 (AM peak)

JT Route	Dir.	Low				Core				Optimistic			
		DM	DS	Diff.	% Diff.	DM	DS	Diff.	% Diff.	DM	DS	Diff.	% Diff.
M67 J3 to Glossop Crossroads	EB	20:55	15:53	-05:02	-24%	23:37	17:36	-06:00	-25%	25:44	18:56	-06:48	-26%
	WB	16:12	13:41	-02:31	-16%	17:20	15:29	-01:51	-11%	18:49	16:43	-02:05	-11%
M67 J3 to Woodhead (A628)	EB	22:51	20:33	-02:18	-10%	24:15	20:51	-03:24	-14%	25:23	21:11	-04:11	-17%
	WB	20:21	19:01	-01:20	-7%	21:19	20:00	-01:19	-6%	22:34	20:25	-02:09	-10%
Roe Cross to Glossop Crossroads (A57)	EB	15:38	14:45	-00:53	-6%	17:30	16:37	-00:53	-5%	19:07	18:08	-00:59	-5%
	WB	12:20	12:13	-00:08	-1%	12:48	13:58	01:09	9%	13:17	14:47	01:30	11%

Table 15-22 - Journey time (mm:ss) route comparison: 2051 (IP)

JT Route	Dir.	Low				Core				Optimistic			
		DM	DS	Diff.	% Diff.	DM	DS	Diff.	% Diff.	DM	DS	Diff.	% Diff.
M67 J3 to Glossop Crossroads	EB	23:57	15:48	-08:09	-34%	25:49	16:37	-09:11	-36%	28:14	17:46	-10:28	-37%
	WB	20:20	14:21	-05:59	-29%	21:37	14:50	-06:48	-31%	23:05	16:22	-06:43	-29%
M67 J3 to Woodhead (A628)	EB	26:47	22:31	-04:17	-16%	28:06	23:09	-04:57	-18%	29:49	24:00	-05:50	-20%
	WB	22:51	20:09	-02:41	-12%	23:26	20:33	-02:54	-12%	24:07	22:51	-01:16	-5%
Roe Cross to Glossop Crossroads (A57)	EB	15:58	14:35	-01:23	-9%	17:23	15:23	-02:01	-12%	18:56	16:35	-02:21	-12%
	WB	13:49	12:47	-01:02	-8%	15:00	13:19	-01:41	-11%	16:18	14:15	-02:03	-13%

Table 15-23 - Journey time (mm:ss) route comparison: 2051 (PM peak)

JT Route	Dir.	Low				Core				Optimistic			
		DM	DS	Diff.	% Diff.	DM	DS	Diff.	% Diff.	DM	DS	Diff.	% Diff.
M67 J3 to Glossop Crossroads	EB	24:56	16:38	-08:18	-33%	27:15	17:34	-09:40	-35%	29:42	18:44	-10:58	-37%
	WB	17:40	14:54	-02:45	-16%	19:11	14:56	-04:15	-22%	20:40	16:03	-04:37	-22%
M67 J3 to Woodhead (A628)	EB	25:12	20:43	-04:29	-18%	26:11	20:47	-05:25	-21%	26:48	20:41	-06:07	-23%
	WB	19:43	18:45	-00:58	-5%	20:38	19:15	-01:23	-7%	21:00	19:53	-01:06	-5%
Roe Cross to Glossop Crossroads (A57)	EB	16:08	15:18	-00:50	-5%	17:24	16:12	-01:12	-7%	19:15	17:28	-01:47	-9%
	WB	14:33	14:00	-00:33	-4%	15:38	14:29	-01:09	-7%	17:08	16:03	-01:06	-6%

Journey times that are greater than the core in the low growth scenario are highlighted in red, whilst journey times less than the core in the high growth scenario are highlighted in blue

15.7. Output of High Carbon

15.7.1. For the High Carbon value sensitivity test, all elements of benefit and cost have been maintained at the same level as the core assessment, with the exception of the values placed on carbon emissions. There is no change to the assumed level of emissions, only to their economic value. The result of this assessment is set out in Table 15-24.

Table 15-24 – Summary of Greenhouse Gas Outputs over 60 Years (£m)

Greenhouse Gas Output	Value
Change in CO_2e emissions (tonnes)	399,867
Greenhouse Gas (NPV) Central Carbon Values	-£17.4
Greenhouse Gas (NPV) High Carbon Values	-£27.0

Note: All monetary values are in 2010 market prices discounted to 2010

The impact of this change on the overall economic performance is set out in Table 15-25.

Table 15-25 - Summary for Carbon Valuation Sensitivity Tests (£m)

Item	Central	High Carbon
Time savings, vehicle operating costs and user charges	£181.25	£181.25
Accidents	-£7.33	-£7.33
Greenhouse gas emissions	-£17.45	-£26.96
Air Quality	-£3.77	-£3.77
Noise	£3.17	£3.17
Delays during construction	-£1.04	-£1.04
Indirect tax	£1.41	£1.41
Present Value of Benefits (PVB)	**£156.23**	**£146.72**
Present Value of Costs (PVC)	**£107.72**	**£107.72**
Net Present Value (NPV)	**£48.52**	**£39.00**
Benefit to Cost Ratio (BCR)	**1.45**	**1.36**

Note: All monetary values are in 2010 market prices discounted to 2010

16. Data Annex

16.1.1. This section provides elements of the standard data annex which forms part of the requirements for the ComMA. This section includes:

- Scheme investment, operations and maintenance cost profiles;
- Scheme benefit and disbenefit characteristic profiles:
- Journey times for journeys along the route,
- Profile of accidents over time – total, fatal, serious and slight,
- Environment - profile of NOx, PM10 and greenhouse gas

16.2. Scheme costs

Table 16-1 - Scheme investment cost profile in 2010 prices (£m)

Year	2010 factor prices (not discounted)	2010 market prices (discounted)
2025	9.73	7.93
2026	10.83	8.53
2027	60.51	46.04
2028	50.41	37.06
2029	3.26	2.32
2030	0.96	0.76
2031	0.17	0.11
2032	0.06	0.04
2033	0.06	0.03
2034	0.03	0.02
2035	0.02	0.01

Table 16-2 - Scheme O&M cost profile in 2010 prices (£000s)

Year	2010 factor prices (not discounted)	2010 market prices (discounted)
Opening year	0	0
Years 2-10	0	0
Year 11	408	205
Years 12-21	0	0
Year 22	1,177	406
Years 23-24	0	0
Year 25	6	2
Years 26-31	0	0
Year 32	1,205	302
Years 33-39	0	0
Year 40	3	1
Year 41	0	0
Year 42	1,383	258
Years 43-51	0	0
Year 52	925	128
Years 53-54	0	0
Year 55	3	1
Years 56-60	0	0

16.3. Scheme benefits / disbenefits

Journey times

Table 16-3 - Average journey times during construction period along route by phase (minutes)

	Phase 2	Phase 3	Phase 5-1	Phase 5-2
Without scheme	11.5	11.5	11.5	11.5
With scheme	11.6	11.4	6.3	6.3

Route between M67 J4 and Shaw Lane (A57).

16.3.1. Phases 1 & 4 will have no impact on traffic. By phase 5 the new link will be operational and works will be undertaken to de-trunk the existing section of A57. Values are averaged across modelled time periods of AM, IP and PM and over both directions.

Table 16-4 - Average journey times along route (minutes)

	Opening year	Design year	Change (%)
Without scheme	11.5	6.5	-43%
With scheme	12.9	6.9	-47%

Route between M67 J4 and Shaw Lane (A57).Values are averaged across modelled time periods of AM, IP and PM and over both directions.

16.4. Safety

Table 16-5 - Number of accidents by year

Year	Without scheme (DM)	With scheme (DS)	Difference (DM-DS)
Opening year	586.80	587.00	-0.20
Year 2	579.00	579.20	-0.20
Year 3	571.20	571.60	-0.40
Year 4	563.50	564.00	-0.50
Year 5	555.80	556.50	-0.70
Year 6	554.00	554.80	-0.80
Year 7	552.20	553.10	-0.90
Year 8	550.30	551.40	-1.10
Year 9	548.50	549.60	-1.10
Year 10	546.60	547.80	-1.20
Year 11	544.70	546.10	-1.40
Year 12	542.80	544.30	-1.50
Year 13	540.90	542.40	-1.50
Year 14	538.90	540.60	-1.70
Year 15	536.90	538.70	-1.80
Year 16	559.90	561.70	-1.80
Year 17	563.10	564.90	-1.80
Year 18	566.30	568.10	-1.80
Year 19	569.50	571.30	-1.80
Year 20	572.70	574.60	-1.90
Year 21	575.90	577.80	-1.90
Year 22	579.10	581.00	-1.90
Year 23	582.40	584.20	-1.80
Year 24	585.60	587.50	-1.90
Year 25	588.80	590.70	-1.90
Year 26	592.00	593.90	-1.90
Year 27	595.20	597.20	-2.00

Year	Without scheme (DM)	With scheme (DS)	Difference (DM-DS)
Year 28	595.20	597.20	-2.00
Year 29	595.20	597.20	-2.00
Year 30	595.20	597.20	-2.00
Year 31	595.20	597.20	-2.00
Year 32	595.20	597.20	-2.00
Year 33	595.20	597.20	-2.00
Year 34	595.20	597.20	-2.00
Year 35	595.20	597.20	-2.00
Year 36	595.20	597.20	-2.00
Year 37	595.20	597.20	-2.00
Year 38	595.20	597.20	-2.00
Year 39	595.20	597.20	-2.00
Year 40	595.20	597.20	-2.00
Year 41	595.20	597.20	-2.00
Year 42	595.20	597.20	-2.00
Year 43	595.20	597.20	-2.00
Year 44	595.20	597.20	-2.00
Year 45	595.20	597.20	-2.00
Year 46	595.20	597.20	-2.00
Year 47	595.20	597.20	-2.00
Year 48	595.20	597.20	-2.00
Year 49	595.20	597.20	-2.00
Year 50	595.20	597.20	-2.00
Year 51	595.20	597.20	-2.00
Year 52	595.20	597.20	-2.00
Year 53	595.20	597.20	-2.00
Year 54	595.20	597.20	-2.00
Year 55	595.20	597.20	-2.00
Year 56	595.20	597.20	-2.00
Year 57	595.20	597.20	-2.00
Year 58	595.20	597.20	-2.00
Year 59	595.20	597.20	-2.00
Year 60	595.20	597.20	-2.00

Table 16-6 - Number of Fatal casualties by year

Year	Without scheme (DM)	With scheme (DS)	Difference (DM-DS)
Opening year	7.20	7.30	-0.10
Year 2	7.10	7.20	-0.10
Year 3	7.00	7.10	-0.10
Year 4	6.90	7.00	-0.10
Year 5	6.80	6.90	-0.10
Year 6	6.80	6.90	-0.10
Year 7	6.80	6.80	0.00
Year 8	6.70	6.80	-0.10
Year 9	6.70	6.80	-0.10
Year 10	6.70	6.80	-0.10
Year 11	6.70	6.80	-0.10
Year 12	6.60	6.70	-0.10
Year 13	6.60	6.70	-0.10
Year 14	6.60	6.70	-0.10
Year 15	6.60	6.70	-0.10
Year 16	6.90	7.00	-0.10
Year 17	7.00	7.10	-0.10
Year 18	7.00	7.10	-0.10
Year 19	7.10	7.20	-0.10
Year 20	7.10	7.20	-0.10
Year 21	7.10	7.20	-0.10
Year 22	7.20	7.30	-0.10
Year 23	7.20	7.30	-0.10
Year 24	7.30	7.40	-0.10
Year 25	7.30	7.40	-0.10
Year 26	7.30	7.50	-0.20
Year 27	7.40	7.50	-0.10
Year 28	7.40	7.50	-0.10
Year 29	7.40	7.50	-0.10
Year 30	7.40	7.50	-0.10
Year 31	7.40	7.50	-0.10
Year 32	7.40	7.50	-0.10
Year 33	7.40	7.50	-0.10
Year 34	7.40	7.50	-0.10
Year 35	7.40	7.50	-0.10

Year	Without scheme (DM)	With scheme (DS)	Difference (DM-DS)
Year 36	7.40	7.50	-0.10
Year 37	7.40	7.50	-0.10
Year 38	7.40	7.50	-0.10
Year 39	7.40	7.50	-0.10
Year 40	7.40	7.50	-0.10
Year 41	7.40	7.50	-0.10
Year 42	7.40	7.50	-0.10
Year 43	7.40	7.50	-0.10
Year 44	7.40	7.50	-0.10
Year 45	7.40	7.50	-0.10
Year 46	7.40	7.50	-0.10
Year 47	7.40	7.50	-0.10
Year 48	7.40	7.50	-0.10
Year 49	7.40	7.50	-0.10
Year 50	7.40	7.50	-0.10
Year 51	7.40	7.50	-0.10
Year 52	7.40	7.50	-0.10
Year 53	7.40	7.50	-0.10
Year 54	7.40	7.50	-0.10
Year 55	7.40	7.50	-0.10
Year 56	7.40	7.50	-0.10
Year 57	7.40	7.50	-0.10
Year 58	7.40	7.50	-0.10
Year 59	7.40	7.50	-0.10
Year 60	7.40	7.50	-0.10

DRIVING OUTCOMES

Table 16-7 - Number of Serious casualties by year

Year	Without scheme (DM)	With scheme (DS)	Difference (DM-DS)
Opening year	78.70	79.00	-0.30
Year 2	77.70	78.00	-0.30
Year 3	76.70	77.00	-0.30
Year 4	75.70	76.00	-0.30
Year 5	74.70	75.00	-0.30
Year 6	74.50	74.90	-0.40
Year 7	74.30	74.70	-0.40
Year 8	74.10	74.50	-0.40
Year 9	73.90	74.30	-0.40
Year 10	73.70	74.10	-0.40
Year 11	73.50	73.90	-0.40
Year 12	73.30	73.70	-0.40
Year 13	73.10	73.50	-0.40
Year 14	72.90	73.30	-0.40
Year 15	72.60	73.10	-0.50
Year 16	75.10	75.60	-0.50
Year 17	75.50	76.00	-0.50
Year 18	76.00	76.50	-0.50
Year 19	76.40	76.90	-0.50
Year 20	76.90	77.40	-0.50
Year 21	77.30	77.80	-0.50
Year 22	77.80	78.30	-0.50
Year 23	78.20	78.70	-0.50
Year 24	78.70	79.20	-0.50
Year 25	79.10	79.60	-0.50
Year 26	79.60	80.10	-0.50
Year 27	80.00	80.50	-0.50
Year 28	80.00	80.50	-0.50
Year 29	80.00	80.50	-0.50
Year 30	80.00	80.50	-0.50
Year 31	80.00	80.50	-0.50
Year 32	80.00	80.50	-0.50
Year 33	80.00	80.50	-0.50
Year 34	80.00	80.50	-0.50
Year 35	80.00	80.50	-0.50

Year	Without scheme (DM)	With scheme (DS)	Difference (DM-DS)
Year 36	80.00	80.50	-0.50
Year 37	80.00	80.50	-0.50
Year 38	80.00	80.50	-0.50
Year 39	80.00	80.50	-0.50
Year 40	80.00	80.50	-0.50
Year 41	80.00	80.50	-0.50
Year 42	80.00	80.50	-0.50
Year 43	80.00	80.50	-0.50
Year 44	80.00	80.50	-0.50
Year 45	80.00	80.50	-0.50
Year 46	80.00	80.50	-0.50
Year 47	80.00	80.50	-0.50
Year 48	80.00	80.50	-0.50
Year 49	80.00	80.50	-0.50
Year 50	80.00	80.50	-0.50
Year 51	80.00	80.50	-0.50
Year 52	80.00	80.50	-0.50
Year 53	80.00	80.50	-0.50
Year 54	80.00	80.50	-0.50
Year 55	80.00	80.50	-0.50
Year 56	80.00	80.50	-0.50
Year 57	80.00	80.50	-0.50
Year 58	80.00	80.50	-0.50
Year 59	80.00	80.50	-0.50
Year 60	80.00	80.50	-0.50

Table 16-8 - Number of Slight casualties by year

Year	Without scheme (DM)	With scheme (DS)	Difference (DM-DS)
Opening year	732.80	733.50	-0.70
Year 2	722.70	723.60	-0.90
Year 3	712.70	713.80	-1.10
Year 4	702.90	704.10	-1.20
Year 5	693.10	694.50	-1.40
Year 6	690.70	692.20	-1.50
Year 7	688.20	689.80	-1.60
Year 8	685.70	687.50	-1.80
Year 9	683.20	685.10	-1.90
Year 10	680.60	682.70	-2.10
Year 11	678.10	680.30	-2.20
Year 12	675.50	677.80	-2.30
Year 13	672.90	675.40	-2.50
Year 14	670.30	672.90	-2.60
Year 15	667.60	670.40	-2.80
Year 16	700.60	703.40	-2.80
Year 17	704.60	707.40	-2.80
Year 18	708.60	711.40	-2.80
Year 19	712.60	715.40	-2.80
Year 20	716.60	719.40	-2.80
Year 21	720.60	723.40	-2.80
Year 22	724.60	727.40	-2.80
Year 23	728.60	731.40	-2.80
Year 24	732.60	735.40	-2.80
Year 25	736.60	739.50	-2.90
Year 26	740.60	743.50	-2.90
Year 27	744.60	747.50	-2.90
Year 28	744.60	747.50	-2.90
Year 29	744.60	747.50	-2.90
Year 30	744.60	747.50	-2.90
Year 31	744.60	747.50	-2.90
Year 32	744.60	747.50	-2.90
Year 33	744.60	747.50	-2.90
Year 34	744.60	747.50	-2.90

Year	Without scheme (DM)	With scheme (DS)	Difference (DM-DS)
Year 35	744.60	747.50	-2.90
Year 36	744.60	747.50	-2.90
Year 37	744.60	747.50	-2.90
Year 38	744.60	747.50	-2.90
Year 39	744.60	747.50	-2.90
Year 40	744.60	747.50	-2.90
Year 41	744.60	747.50	-2.90
Year 42	744.60	747.50	-2.90
Year 43	744.60	747.50	-2.90
Year 44	744.60	747.50	-2.90
Year 45	744.60	747.50	-2.90
Year 46	744.60	747.50	-2.90
Year 47	744.60	747.50	-2.90
Year 48	744.60	747.50	-2.90
Year 49	744.60	747.50	-2.90
Year 50	744.60	747.50	-2.90
Year 51	744.60	747.50	-2.90
Year 52	744.60	747.50	-2.90
Year 53	744.60	747.50	-2.90
Year 54	744.60	747.50	-2.90
Year 55	744.60	747.50	-2.90
Year 56	744.60	747.50	-2.90
Year 57	744.60	747.50	-2.90
Year 58	744.60	747.50	-2.90
Year 59	744.60	747.50	-2.90
Year 60	744.60	747.50	-2.90

16.5. Environment

Table 16-9 - NOx emissions (tonnes)

Year	Without scheme (DM)	With scheme (DS)	Difference (DM-DS)
Opening year	903.72	910.15	-6.43
Year 2	880.48	886.78	-6.30
Year 3	857.25	863.42	-6.17
Year 4	834.01	840.05	-6.04
Year 5	810.78	816.69	-5.91
Year 6	787.54	793.32	-5.78
Year 7	764.31	769.96	-5.65
Year 8	741.08	746.59	-5.52
Year 9	717.84	723.23	-5.39
Year 10	694.61	699.86	-5.26
Year 11	671.37	676.50	-5.13
Year 12	648.14	653.13	-4.99
Year 13	624.90	629.77	-4.86
Year 14	601.67	606.40	-4.73
Year 15	578.44	583.04	-4.60
Year 16	555.20	559.67	-4.47
Year 17	555.20	559.67	-4.47
Year 18	555.20	559.67	-4.47
Year 19	555.20	559.67	-4.47
Year 20	555.20	559.67	-4.47
Year 21	555.20	559.67	-4.47
Year 22	555.20	559.67	-4.47
Year 23	555.20	559.67	-4.47
Year 24	555.20	559.67	-4.47
Year 25	555.20	559.67	-4.47
Year 26	555.20	559.67	-4.47
Year 27	555.20	559.67	-4.47
Year 28	555.20	559.67	-4.47
Year 29	555.20	559.67	-4.47
Year 30	555.20	559.67	-4.47
Year 31	555.20	559.67	-4.47
Year 32	555.20	559.67	-4.47

Year	Without scheme (DM)	With scheme (DS)	Difference (DM-DS)
Year 33	555.20	559.67	-4.47
Year 34	555.20	559.67	-4.47
Year 35	555.20	559.67	-4.47
Year 36	555.20	559.67	-4.47
Year 37	555.20	559.67	-4.47
Year 38	555.20	559.67	-4.47
Year 39	555.20	559.67	-4.47
Year 40	555.20	559.67	-4.47
Year 41	555.20	559.67	-4.47
Year 42	555.20	559.67	-4.47
Year 43	555.20	559.67	-4.47
Year 44	555.20	559.67	-4.47
Year 45	555.20	559.67	-4.47
Year 46	555.20	559.67	-4.47
Year 47	555.20	559.67	-4.47
Year 48	555.20	559.67	-4.47
Year 49	555.20	559.67	-4.47
Year 50	555.20	559.67	-4.47
Year 51	555.20	559.67	-4.47
Year 52	555.20	559.67	-4.47
Year 53	555.20	559.67	-4.47
Year 54	555.20	559.67	-4.47
Year 55	555.20	559.67	-4.47
Year 56	555.20	559.67	-4.47
Year 57	555.20	559.67	-4.47
Year 58	555.20	559.67	-4.47
Year 59	555.20	559.67	-4.47
Year 60	555.20	559.67	-4.47

Table 16-10 - PM10 emissions (tonnes)

Year	Without scheme (DM)	With scheme (DS)	Difference (DM-DS)
Opening year	49.77	50.02	-0.25
Year 2	50.12	50.39	-0.27
Year 3	50.48	50.76	-0.28
Year 4	50.84	51.13	-0.29
Year 5	51.19	51.50	-0.30
Year 6	51.55	51.87	-0.31
Year 7	51.91	52.23	-0.33
Year 8	52.27	52.60	-0.34
Year 9	52.62	52.97	-0.35
Year 10	52.98	53.34	-0.36
Year 11	53.34	53.71	-0.37
Year 12	53.69	54.08	-0.39
Year 13	54.05	54.45	-0.40
Year 14	54.41	54.82	-0.41
Year 15	54.76	55.19	-0.42
Year 16	55.12	55.55	-0.43
Year 17	55.12	55.55	-0.43
Year 18	55.12	55.55	-0.43
Year 19	55.12	55.55	-0.43
Year 20	55.12	55.55	-0.43
Year 21	55.12	55.55	-0.43
Year 22	55.12	55.55	-0.43
Year 23	55.12	55.55	-0.43
Year 24	55.12	55.55	-0.43
Year 25	55.12	55.55	-0.43
Year 26	55.12	55.55	-0.43
Year 27	55.12	55.55	-0.43
Year 28	55.12	55.55	-0.43
Year 29	55.12	55.55	-0.43
Year 30	55.12	55.55	-0.43
Year 31	55.12	55.55	-0.43
Year 32	55.12	55.55	-0.43
Year 33	55.12	55.55	-0.43
Year 34	55.12	55.55	-0.43
Year 35	55.12	55.55	-0.43

Year	Without scheme (DM)	With scheme (DS)	Difference (DM-DS)
Year 36	55.12	55.55	-0.43
Year 37	55.12	55.55	-0.43
Year 38	55.12	55.55	-0.43
Year 39	55.12	55.55	-0.43
Year 40	55.12	55.55	-0.43
Year 41	55.12	55.55	-0.43
Year 42	55.12	55.55	-0.43
Year 43	55.12	55.55	-0.43
Year 44	55.12	55.55	-0.43
Year 45	55.12	55.55	-0.43
Year 46	55.12	55.55	-0.43
Year 47	55.12	55.55	-0.43
Year 48	55.12	55.55	-0.43
Year 49	55.12	55.55	-0.43
Year 50	55.12	55.55	-0.43
Year 51	55.12	55.55	-0.43
Year 52	55.12	55.55	-0.43
Year 53	55.12	55.55	-0.43
Year 54	55.12	55.55	-0.43
Year 55	55.12	55.55	-0.43
Year 56	55.12	55.55	-0.43
Year 57	55.12	55.55	-0.43
Year 58	55.12	55.55	-0.43
Year 59	55.12	55.55	-0.43
Year 60	55.12	55.55	-0.43

Table 16-11 - Greenhouse gas emissions (tonnes CO2e)

Year	Without scheme (DM)	With scheme (DS)	Difference (DM-DS)
Opening year	735,352	740,660	- 5,309
Year 2	738,522	743,935	- 5,413
Year 3	741,692	747,210	- 5,517
Year 4	744,863	750,485	- 5,622
Year 5	748,033	753,759	- 5,726
Year 6	751,204	757,034	- 5,830
Year 7	754,374	760,309	- 5,934
Year 8	757,545	763,584	- 6,039
Year 9	760,715	766,858	- 6,143
Year 10	763,886	770,133	- 6,247
Year 11	767,056	773,408	- 6,352
Year 12	770,227	776,683	- 6,456
Year 13	773,397	779,957	- 6,560
Year 14	776,568	783,232	- 6,664
Year 15	779,738	786,507	- 6,769
Year 16	782,909	789,782	- 6,873
Year 17	782,909	789,782	- 6,873
Year 18	782,909	789,782	- 6,873
Year 19	782,909	789,782	- 6,873
Year 20	782,909	789,782	- 6,873
Year 21	782,909	789,782	- 6,873
Year 22	782,909	789,782	- 6,873
Year 23	782,909	789,782	- 6,873
Year 24	782,909	789,782	- 6,873
Year 25	782,909	789,782	- 6,873
Year 26	782,909	789,782	- 6,873
Year 27	782,909	789,782	- 6,873
Year 28	782,909	789,782	- 6,873
Year 29	782,909	789,782	- 6,873
Year 30	782,909	789,782	- 6,873
Year 31	782,909	789,782	- 6,873
Year 32	782,909	789,782	- 6,873
Year 33	782,909	789,782	- 6,873
Year 34	782,909	789,782	- 6,873
Year 35	782,909	789,782	- 6,873

Year	Without scheme (DM)	With scheme (DS)	Difference (DM-DS)
Year 36	782,909	789,782	- 6,873
Year 37	782,909	789,782	- 6,873
Year 38	782,909	789,782	- 6,873
Year 39	782,909	789,782	- 6,873
Year 40	782,909	789,782	- 6,873
Year 41	782,909	789,782	- 6,873
Year 42	782,909	789,782	- 6,873
Year 43	782,909	789,782	- 6,873
Year 44	782,909	789,782	- 6,873
Year 45	782,909	789,782	- 6,873
Year 46	782,909	789,782	- 6,873
Year 47	782,909	789,782	- 6,873
Year 48	782,909	789,782	- 6,873
Year 49	782,909	789,782	- 6,873
Year 50	782,909	789,782	- 6,873
Year 51	782,909	789,782	- 6,873
Year 52	782,909	789,782	- 6,873
Year 53	782,909	789,782	- 6,873
Year 54	782,909	789,782	- 6,873
Year 55	782,909	789,782	- 6,873
Year 56	782,909	789,782	- 6,873
Year 57	782,909	789,782	- 6,873
Year 58	782,909	789,782	- 6,873
Year 59	782,909	789,782	- 6,873
Year 60	782,909	789,782	- 6,873

Appendix A. Data Collection Package

Appendix B. Transport Modelling Package

Appendix C. Transport Forecasting Package

Appendix D. Economic Appraisal Package

Appendix E. Data Annex

[redacted]

Routes to Market – Delivery Integration Partnership

A57 TPU

A57 Economic Appraisal Package

HE551473-BBA-GEN-A57_AL_SCHEME-AS-TB-000001
26/07/21

Notice

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This document has 93 pages including the cover.

Document history

Revision	Suitability	Purpose description	Originated	Checked	Reviewed	Authorised	Date
[redacted]							

Contents

Tables

Figures

Executive Summary

Scheme Overview

1.1.1. Highways England (the "Applicant") is applying to the Planning Inspectorate ("the Inspectorate") acting on behalf of the Secretary of State for Transport ("SoS"), under Section 37 of the Planning Act 2008 ("the Act") for a Development Consent Order (DCO). If made, the DCO would grant consent for the Applicant to build, operate and maintain the A57 Link Roads project ("the Scheme").

1.1.2. Following feasibility studies, a package of measures referred to here as the Trans-Pennine Upgrade (TPU) was announced in the Road Investment Strategy (RIS), published by the Department for Transport (DfT) in March 2015. Further consideration of benefits related to that scheme have led to additional stages of option identification, sifting, value management, statutory consultation, design and further consultation to arrive at the current proposed scheme which is comprised of:

- Mottram Moor Link Road - a new dual-carriageway link road from M67 Junction 4 to a new junction at A57(T) Mottram Moor and a new single carriageway connecting to the A6018 Roe Cross Road
- A57(T) to A57 Link Road – a new single carriageway link from the A57 at Mottram Moor to a new junction on the A57 at Brookfield, bypassing the existing A628/A57 and A57 Woolley Lane/Woolley Bridge Road junctions
- Upgrades to M67 Junction 4 and the A57/A628 junction to improve safety and optimise flow of traffic.

Purpose

1.1.3. The network section which the A57 Link Roads scheme has been designed to improve lies on the most direct strategic route between Manchester and Sheffield. It has suffered from longstanding connectivity issues, with high levels of congestion leading to low speeds and unreliable journey times, affecting the connection between the M67 and the A628 or A57 routes across the Pennines.

1.1.4. The Client Scheme Requirements (CSR) for the scheme are:

- **Connectivity** - reducing congestion and improve the reliability of people's journeys between the Manchester and Sheffield city regions.
- **Environmental** – improving air quality and reducing noise levels in certain areas, through reduced congestion and removal of traffic from residential areas. The scheme is also being designed to avoid unacceptable impacts on the natural environment and landscape in the Peak District National Park.
- **Societal** – re-connect local communities along the Trans-Pennine route.
- **Capacity** – reduce delays and queues that occur during busy periods and improve the performance of junctions on the route.

Scheme Benefits

1.1.5. The scheme has been forecast to deliver significant economic benefits, with key contributions being derived from journey time savings, particularly for business users making longer distance trips which may otherwise have diverted onto significantly longer distance routes to avoid the congestion and delays in this area. Commuting and other local movements will also benefit from transfer of traffic onto the proposed new links, easing localised congestion on the existing network.

1.1.6. A further significant economic benefit will be derived from improved connectivity leading to agglomeration benefits. The reduced congestion levels and improved journey reliability will effectively bring firms in the area closer together leading to increased productivity. This impact will be felt in the region immediately around the A57 Link Roads scheme but will also affect the cities of Manchester and Sheffield which represent key clusters of economic activity either side of the Pennines.

1.1.7. The bypass around Mottram will divert all but local traffic around the town, making it a safer and quieter place, with improved air quality. The removal of congestion from this area will however have the impact of increasing traffic flows at either end of the scheme and on the network as a whole. This will result in increased emissions, reduced air quality in the wider region and a forecast increase in accidents, as more traffic will use the A57 Snake Pass, which is known to be a high-risk route.

1.1.8. During its construction period impacts on traffic will be relatively limited as much of the work will be offline, while the design has ensured that any adverse environmental impacts will be limited or fully mitigated where feasible.

Value for Money

1.1.9. This document provides a detailed review of the assessment of benefits and disbenefits described above and of the cost which would be involved in building and the maintaining the scheme over its lifetime.

1.1.10. The economic assessment indicates that the scheme would return a BCR above 2, representing an economic net benefit of more than £2 for every £1 invested.

1.1.11. Certain adverse effects on the wider transport network are recognised and measures to mitigate these will be considered. These adverse effects do not however outweigh the benefits and the overall planning balance is therefore in favour of the making of the DCO to enable the Scheme to be delivered.

1. Introduction

1.1. Background

1.1.1 Highways England has been delivering £15 billion of investment to the Strategic Road Network (SRN) set out in the December 2014 Road Investment Strategy (RIS). The Trans-Pennine Upgrade (TPU) is a critical part of this investment to address Trans-Pennine connectivity, particularly between two important Northern cities of Manchester and Sheffield. The existing routes currently suffer from significant congestion, poor journey times, poor reliability, and high accident rates.

1.1.2 The proposed scheme was first identified for delivery as part of the Highways England Road Investment Strategy (RIS1), planned for delivery during the latter part of the period covering 2015 to 2020. Further development work has seen the delivery date amended, with the scheme now included in RIS2, which covers investments in the Strategic Road Network of £27.4 billion between 2020 and 2025.

1.1.3 Atkins were commissioned by HE to undertake a review of the work done by consultants Arcadis at PCF Stage 3 for the proposed A57 Link Roads scheme. The aim of this process was to strengthen the robustness of the modelling to ensure high levels of scrutiny for the Development Consent Order (DCO). Following the presentation of the review findings in the summer of 2019, Atkins were commissioned to implement their recommendations and finalise PCF Stage 3.

1.1.4 This Economic Appraisal Package (EAP) will outline the detailed assumptions and the methodology used to carry out the robust economic assessment which will help to understand the incurred cost, benefits, and the risk associated with this transport scheme in the long run.

1.2 Scheme Objectives

1.2.1 The purpose of the A57 Link Roads is to address longstanding issues of connectivity, congestion, network reliability and safety of strategic Trans-Pennine routes between the M67 at Mottram and the M1 J36 and J35A north of Sheffield.

1.2.2 The strategic objectives of the Trans-Pennine Upgrade Scheme, as set out in the Client Scheme Requirements (CSR) are:

- **Connectivity** – reducing congestion and improve the reliability of people's journeys between the Manchester and Sheffield city regions.
- **Environmental** – improving air quality and reducing noise levels in certain areas, through reduced congestion and removal of traffic from residential areas. The scheme is also being designed to avoid unacceptable impacts on the natural environment and landscape in the Peak District National Park.
- **Societal** – re-connect local communities along the Trans-Pennine route.
- **Capacity** – reduce delays and queues that occur during busy periods and improve the performance of junctions on the route.

1.2.3 In addition to these scheme specific objectives consideration has been made of the performance of the scheme in contributing to the wider RIS2 Key Performance Indicators (KPIs). These KPIs encompass:

- Improving safety for all.
- Providing fast and reliable journeys.
- A well maintained and resilient network.
- Delivering better environmental outcomes.
- Meeting the needs of all road users.
- Achieving efficient delivery.

1.2.4 Each of these overarching objectives includes sub-objectives and indicators for measuring success. A Benefits Register has been developed which records details of these and the specific performance of the scheme in each area. This register is maintained and updated as the scheme progresses through each stage of development. Key findings of this Benefits Register are presented in the Appraisal Summary Table, which is presented in the Business Case.

1.3 Proposed scheme

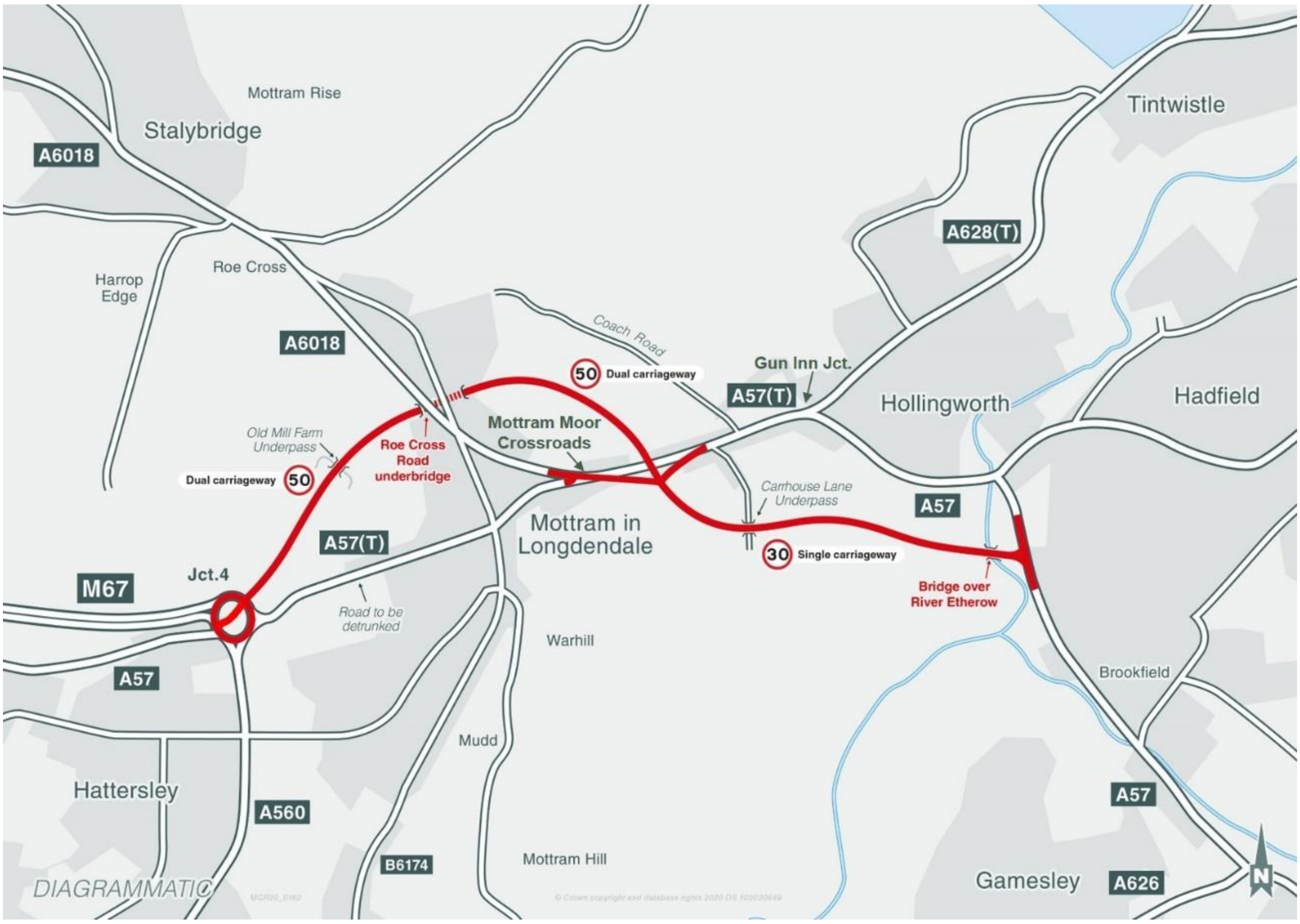
1.3.1 The Trans-Pennine route consists of a road network largely made up of A-roads which crosses the Peak District National Park. The main Trans-Pennine road route between Manchester and Sheffield is a trunk road consisting of the A57, A628, A616 and A61. This route connects the M67 at Mottram in the east of Manchester City Region with the M1 in the north-west of the Sheffield City Region. The other routes that provide connections between Manchester and Sheffield are via the A57, A6187, A623 and other local roads. These routes form the key strategic link between Manchester and Sheffield.

1.3.2 The Trans-Pennine Upgrade scheme taken forward as part of PCF Stage 3 comprises of the following scheme elements described below:

- **Mottram Moor Link Road** - a new dual-carriageway link road from the M67 terminal roundabout to a new junction at A57(T) Mottram Moor.
- The A57 / B6174 junction (Mottram crossroads): separate signal staging for Stalybridge Road and Market Street (run together in the same stage in the without scheme scenario), which permits additional green time for pedestrian movements, plus the reduction of right-turning vehicles blocking the junction whilst waiting for gaps in the traffic.
- **A57(T) to A57 Link Road** - a new single carriageway link from the A57 at Mottram Moor to a new junction on the A57 at Brookfield, bypassing the existing A628/ A57 and A57 Woolley Lane/Hadfield road junctions.
- **M67 Terminal Junction 4 Roundabout Improvements** - the addition of traffic signals, carriageway widening and a cut-through link between the M67 and the Mottram Moor link road.
- **A57 / A628 junction (Gun Inn junction)** - greater green time for pedestrian movements, reflective of improved pedestrian facilities at the Gun Inn junction.
- **A57 (Mottram Moor)** - a reduction in lane provision of the existing A57 between Mottram and the Gun Inn junction to provide parking and improved non-motorised users (NMU) facilities.

1.3.3 The proposed scheme seeks to improve the Trans-Pennine route between two important Northern cities: Manchester and Sheffield. The preferred route for the scheme is shown in Figure 1-1.

Figure 1-1 - Proposed Scheme



1.4 Purpose of the Report

1.4.1 The purpose of this report is to set out the details of the approach adopted for the estimation of economic benefits arising from the scheme and summarises the results of the assessments. This report is accompanied by a Traffic Forecasting Report which has been provided separately.

1.4.2 The report also seeks to establish the extent to which the scheme provides good value for money in relation to the impact on public accounts by considering improvements to transport economic efficiency for all users, environmental impacts, effects on the wider economy and the social and distributional effects of the scheme.

1.5 Previous Economic Assessments

1.5.1 At PCF Stage 0 (Feasibility Study) an economic assessment of four primary packages of the scheme options was produced in February 2015 by Mouchel Group consultants (now WSP). (Reference- Trans-Pennine Routes Feasibility Study Stage 3 Report', 2015).

1.5.2 At PCF Stage 1 (Options Development and First Sift), a long list of options was developed followed by the economic assessment and ranking of four strategic scheme options. (Report Reference: HE550691-HYD-GEN-TP01-TN-PM-1033). A second sift at PCF Stage 1 led to further economic assessment and ranking of four strategic scheme options (Report Reference: HE550691-HYD-GEN-TP01-TN-1049).

1.5.3 Economic assessments for Packages A to G were carried out in PCF Stage 2. The economic assessment was undertaken over the standard 60-year appraisal with 2023 as the scheme opening year. The economic assessment used the following software packages:

- Transport user Benefit Appraisal (TUBA, version 1.9.8)
- Cost and benefit to Accidents – Light Touch (COBALT, version 2013.2)
- Queues and Delays at Roadworks (QUADRO version 4.12.1.124)

1.5.4 A summary of the benefits, costs and Benefits to Cost Ratio (BCR) is presented in Table 1-1 for Trans-Pennine Upgrade (TPU) schemes, Packages A to D with Climbing lanes, Greenhouse gases and Noise assessment. At the time, the assessment for Greenhouse gases and Noise was not undertaken for Packages E and F. Additionally, the Safety and Technology scheme costs were included in the Present Value of Cost (PVC), however the corresponding benefits were not considered the Present Value of Benefits (PVB)

Table 1-1 - Total Road User Benefit (£million), Cost and BCR for TPU schemes (£m)

Package	TUBA	Accident	Green House Gases	Noise	Climbing Lanes	PVB	PVC	BCR
Package A	✓	✓	✓	✓	✓	524.89	170.87	3.07
Package B	✓	✓	✓	✓	✓	460.96	196.93	2.34
Package C	✓	✓	✓	✓	✓	398.10	155.45	2.56
Package D	✓	✓	✓	✓	✓	586.37	181.57	3.23
Package E	✓	✓	x	x	✓	640.47	163.65	3.91
Package F	✓	✓	x	x	✓	516.01	190.99	2.70
Package G	✓	✓	x	x	X	587.69	148.21	3.97

Note: All monetary values are in 2010 market prices discounted to 2010

1.5.5 Details relating to economic analyses are documented within the Economic Assessment Report, document reference: HE551473-ARC-GEN-ZZZ-TP-TR-2030 version 3.0

1.5.6 At PCF Stage 3 (Preliminary design), in 2019 an economic assessment, based on TUBA version 1.9.10, was undertaken over the standard 60-year appraisal with 2023 as the scheme opening year. From the analysis, TPU scheme was expected to generate user benefits of approximately £264million (in 2010 prices, discounted to 2010) for the core growth scenario. The scheme has an initial BCR of 1.7 without reliability and wider economic benefits and an adjusted BCR of 2.4 including the reliability and wider economic benefits.

1.5.7 A TUBA user benefit assessment was carried out using the AM, IP, and PM periods for the core growth scenario. The total benefits after accounting for operator revenue and indirect tax revenue, generated by the scheme was £277.07 million. In terms of user benefit by Time period, the PM Peak was accounted for the largest proportion of benefits of approx. 42% closely followed by Inter-Peak (41%).

1.5.8 Details relating to PCF Stage 3 economic analyses are documented within the Stage 3 Combined Modelling and Appraisal Report, document reference: HE551473-ARC-HGN-TPU-RP-D-3061 (17 May 2019).

1.5.9 Subsequently to this assessment revisions have been made to the scheme design with modelling and economic assessment being updated.[1]

[1] As a result of the specification changes the Trans-Pennine Upgrade (TPU) Scheme has been renamed as the A57 Link Roads Scheme

1.5.10 Improvements to Westwood Roundabout, at the intersection between the A61 and A616 have been removed, to be assessed independently, while addition of technology schemes along the A628(T) have been excluded, focussing the scheme more on the immediate area set out in the figure above.

1.5.11 In addition, safety improvements have been included in this area, to provide non-motorised users (NMUs) improved access by upgrading the design and including additional pedestrian phases for signals at the A57/A628 junction at Gun Inn. Further, a cut-through of Hattersley Roundabout has been included to improve efficiency of this junction.

1.5.12 Scheme costs and benefits have been updated to reflect these design changes and also to capture impacts of updates to the transport model, changes in guidance and variations to forecasts of economic growth which have occurred over this period. Details of the updated assessments are set out in this document and in the supporting Traffic Forecasting Report.

1.6 Structure of the Report

1.6.1 The report is divided into six sections, the brief details of which are as follows:

- **Chapter 2 Economic Appraisal Approach** – provides an overview of the approach used in the economic assessment and the transport modelling used to support it;
- **Chapter 3 Estimation of scheme costs** – explains the derivation of scheme costs;
- **Chapter 4 Estimation of Benefits** - outlines the methodology for the quantification of each element of scheme benefits;
- **Chapter 5 Economic appraisal results** - presents the results of the economic assessments;
- **Chapter 6 Sensitivity Testing** - outlines the assessment of the sensitivity tests; and
- **Chapter 7 Summary** - provides a summary and the overall conclusions of the report.

2. Economic Appraisal Approach

2.1 Introduction

2.1.1 This section provides details on the methodology used to undertake economic assessment based on the output of transport models to access the economic viability of this transport scheme.

2.1.2 The appraisal of the economic elements associated with the scheme has been undertaken in accordance with TAG unit A1-1 Cost-Benefit Analysis. The scope of the economic appraisal comprises the assessment of:

- User benefits during normal operation, using TUBA version 1.9.14 with economics file "Economics_TAG_db1_14_0.txt" based on TAG 1.14. This included sensitivity tests of low growth/optimistic scenarios.
- Construction user dis-benefits (an assessment of delays to travellers during construction and maintenance has been undertaken).
- Accident savings using COBA-LT version 2013.2 with economic parameters file version 2020.2.
- Monetised environmental impacts (the impact of the scheme on Greenhouse gas emissions, Local air quality and noise) in line with TAG.
- Social impacts have been assessed in line with TAG Unit A4-1.
- Distributional impacts have been assessed in line with TAG Unit A4-2.
- Journey time reliability impacts have been assessed in line with TAG Unit A1-3.
- Wider economic impacts have been assessed in line with TAG Unit A2-2.

2.1.3 The aim of economic assessment was to assess the performance of the scheme, in terms of the total benefits generated against the total associated costs of construction, operations and maintenance.

2.1.4 The economic assessment compares the monetised costs and benefits of the proposed scheme (the Do Something or DS) against the alternative without-scheme scenario (the Do Minimum or DM).

2.1.5 The costs of the scheme used in the assessment comprise the overall scheme investment costs (data provided by the Highways England Commercial team) and the cost of maintaining the new network section over the appraisal period.

2.2 TPU Transport Model

2.2.1 **Background**

2.2.2 The 2015 Trans-Pennine South Regional Transport Model (TPS RTM) was calibrated and validated at PCF Stage 2 of the TPU scheme. No changes to the model specification have been made since PCF Stage 2. Details of the validated base model developed at PCF Stage 2 are provided in the corresponding Local Model Validation Report (LMVR).

2.2.3 The validated base model developed during PCF Stage 2 has been used as a starting point for the development of the PCF Stage 3 TPU strategic model. Comprehensive details regarding the TPU model specification are outlined in the PCF Stage 2 LMVR, therefore have not been repeated in the PCF Stage 3 Transport Model Package.

2.2.4 An initial PCF Stage 3 Transport Model Package was produced by Arcadis in November 2018. However, following refinements to the PCF Stage 3 TPU model by Atkins, this has been superseded. Comprehensive details regarding the TPU model specification are outlined in the PCF Stage 2

LMVR[2], whilst details of the base model developments undertaken by Atkins during the finalisation of PCF Stage 3 are provided in the Transport Model Package[3]. The forecasting process adopted for PCF Stage 3 of the A57 Link Roads scheme is derived from the Trans-Pennine South Regional Traffic Model (TPS RTM).

2.2.5 **Need for Model Refinement**

2.2.6 Initial air quality (AQ) modelling undertaken by Arcadis in July 2018 indicated that an unmitigated TPU scheme could have significant AQ effects and jeopardise the application for development consent. Changes in traffic flow and speed as a result of the scheme were predicted to cause exceedances of the AQ strategy objectives for annual mean nitrogen dioxide (NO2). The primary locations where a negative AQ impact was reported were the village of Tintwistle on the A628 and the roads Dinting Vale and Glossop High Street on the A57.

2.2.7 Atkins was commissioned by HE to undertake a review of the work done by consultants Arcadis at PCF Stage 3 for the proposed TPU scheme. The aim of this process was to strengthen the robustness of the modelling, under high levels of scrutiny for the DCO. Following the presentation of the review findings in the summer of 2019, Atkins was commissioned to implement its recommendations and finalise PCF Stage 3.

2.2.8 **Scope of Modelling**

2.2.9 The simulation boundary of the TPS RTM has been retained, but the focus of the TPU model is concentrated on the Area of Detailed Modelling (ADM) highlighted in Figure 2-1.

Figure 2-1 - Area of Detailed Modelling (ADM) – TPU PCF Stage 3

[2] Stage 2 TPU LMVR (August 2017): HE551473-ARC-GEN-ZZZ-RP-TR-2017

[3] Stage 3 TPU Transport Model Package (April 2021): HE551473-BBA-GEN-A57_AL_SCHEME-AS-TR-000002

2.2.10 To help with the analysis and identifying key impacts in their geographical context, a sector system was developed with a total of 25 sectors, of which 8 are internal (in the area of detailed modelling around the scheme), 11 are buffer and 6 are external. Section 4.2.10 sets out the coverage of the 25 defined sectors and identifies the regions within the model defined as “internal”, “buffer” and “external”.

2.2.11 **Demand and Time Periods**

2.2.12 The time periods for forecast years are:

- AM Peak Average Hour: 07:00 – 10:00
- Inter-peak Average Hour: 10:00 – 16:00
- PM Peak Average Hour: 16:00 – 19:00

2.2.13 The traffic model used for forecasting splits the traffic flows into different vehicle categories and different journey purposes. The future year matrices consist of 5 vehicle type and journey purpose combinations (‘User Classes’):

- User Class 1: Car used for Commuting;
- User Class 2: Car used for Employer’s Business;
- User Class 3: Car used for Other Purpose;
- User Class 4: Light Goods Vehicles (LGVs);
- User Class 5: Heavy Goods Vehicles (HGVs).

2.2.14 **Forecast Years**

2.2.15 The TPS RTM (Trans-Pennine Regional Traffic Model) has been developed to represent a validated base year 2015 and three forecast years have been modelled, namely:

- 2025 - opening year
- 2040 - design year, 15 years after opening
- 2051 - horizon year

2.2.16 The growth in demand between the base year and the forecast years is derived from three sources:

- National long-term population, employment and transport forecasts published by the DfT in the National Trip End Model (NTEM) dataset version 7.2.
- Local planning data summarised in the Uncertainty log, provided by the relevant Local Authorities.
- Light Goods Vehicles (LGV) and Heavy Good Vehicles (HGV) growth rates derived from the DfT Road Traffic Forecasts (RTF18).

2.2.17 **Modelling Approach**

2.2.18 The TPU Stage 3 traffic model is developed from the TPS RTM, which includes a SATURN (v11.3.12) Highway Assignment Model (HAM) combined with a DIADEM Variable Demand Model (VDM) (DIADEM v6.3.4 and HEIDI v5.3).

2.2.19 The first step of the forecasting process is to derive Reference Case demand matrices which reflect changes in population, employment, car ownership and other demographic and economic factors. The Reference Case demand matrices utilise the validated base year demand matrices as a basis. The transport supply element of the model is also updated for each forecast year which includes network changes and generalised cost assumptions (i.e. value of time (pence per minute: PPM) and vehicle operating costs (pence per kilometre: PPK), both by vehicle type and purpose). This is to derive the most likely ‘without scheme’ scenario against which the impact of the ‘with scheme’ scenario can be tested.

2.2.20 The Reference Case forecasts do not account for induced changes in travel demand in response to changes in future traffic conditions. Therefore, the Variable Demand Model (VDM) modifies the

Reference Case forecasts to reflect the impact on demand, of changes in congestion on the road network.

2.2.21 **Modelled Scenarios**

2.2.22 Three scenarios have been modelled for each forecast year: Core, Low and Optimistic growth. For each growth scenario, the following assumptions have been made regarding inclusion of future schemes which are under consideration:

- **Core Scenario** - Near Certain and More Than Likely infrastructure schemes and developments, constrained to TEMPro (NTEM 7.2).
- **Optimistic Scenario** - Near Certain, More Than Likely and Reasonably Foreseeable infrastructure schemes and developments, constrained to high growth national uncertainty.
- **Low Growth Scenario** – Near Certain and More Than Likely infrastructure schemes and developments, constrained to low growth national uncertainty.

2.2.23 **Do Minimum (DM) network**

2.2.24 The PCF Stage 3 TPU[4] DM network coding has been adopted from the TPS RTM forecast year models, which include relevant LA and RIS highway schemes across the modelled simulation area.

2.2.25 The validated PCF Stage 3 TPU 2015 base year model network was used as a basis for the forecast year DM scenario. The existing DM road alignment is shown in Figure 1-1.

2.2.26 The TPS RTM includes forecast years of 2021 and 2041. Therefore, schemes predicted to be completed by 2021 are included in the TPU 2025 opening year, whilst schemes predicted to be completed by 2041 are included in the TPU 2040 design year. The highway infrastructure schemes included in the 2051 horizon year are identical to 2040.

2.2.27 **Do Something (DS) Network**

2.2.28 The PCF Stage 3 TPU DS network coding incorporates the A57 Link Roads Scheme, in addition to the schemes present in the DM network. The latest DS scheme alignment is presented in Figure 1-1 and was coded based on the RTM coding manual.

2.2.29 For determining an initial set of signal timings to be used in the SATURN model, a set of LinSig models were produced for all scheme junctions.

2.2.30 Signal timing and phasing were reviewed for junctions with high levels of delay. Existing timings that were found to be unreasonable for the assigned flow were optimised based on observation and judgment.

2.2.31 Further information regarding the modelling methodology, assumptions and scenario specifications can be found in the Transport Forecasting Report.

[4] "PCF Stage 3 TPU" in this context relates to the name of the traffic model, which has been updated for the purpose of assessing the A57 Link Roads Scheme

2.3 Economic Appraisal Overview

2.3.1 The essence of the economic appraisal is the identification and the estimation of all the associated expenditures and the benefits over the lifetime of the project to determine to what extent value for money would be delivered as a return on taxpayer investment. As per the TAG Unit A1.2, an economic assessment is undertaken with an objective to facilitate the quantification and monetisation, where possible, of scheme costs and benefits.

2.3.2 The economic assessment, undertaken over a 60-year period from the date of the scheme becoming operational, compares the monetised costs and benefits of the proposed scheme against the alternative without scheme scenario.

2.3.3 The costs of the scheme used in the assessment comprise the scheme construction costs (provided by the Highways England Commercial team), Land Cost, preparation cost, operating and maintenance costs. These costs are considered further in Section 3.

2.3.4 The benefits of the scheme are the net benefit experienced by the road user and wider society with and without the scheme, which has been calculated from a number of sources, such as:

- User benefits during normal operation (savings relating to travel times, vehicle operating costs and user charges) have been assessed using TUBA;
- Reliability impact due to changes in Journey time variability;
- Accident savings have been forecast using COBALT;
- Wider economic impacts have been assessed using WITA;
- Environmental impacts have been assessed in line with TAG A-3; and
- Social and distributional impacts have been assessed in line with TAG A4-1 and A4-2.

2.3.5 An initial Benefit Cost Ratio (BCR) has been calculated over the 60-year appraisal period that excludes the outputs of the journey time reliability assessment and wider economic impacts, with an adjusted BCR also reported that includes these impacts.

2.3.6 To ensure consistency of outputs across all elements of assessment, both costs and benefits from each of the above analyses have been output in 2010 market prices, discounted to 2010.

2.3.7 The results of the assessment are presented in the following tables:

- The Transport Economy Efficiency (TEE) table;
- The Public Accounts (PA) table; and
- The Analysis of Monetised Costs and Benefits (AMCB) table.

2.3.8 The methodology for the quantification of scheme benefits is presented in Chapter 4 and the results are presented in Chapter 5 of this report.

2.3.9 The economic appraisal has been undertaken for the core scenario of the identified single option and is supplemented with sensitivity tests.

3. Estimation of scheme costs

3.1 Approach

3.1.1 To ensure value for public money and secure funding, the project requires precise estimation of the costs of the transport scheme.

3.1.2 Costs of the proposed scheme have been developed by Highways England and prepared for inclusion in the cost-benefits analysis based on the TAG Unit A1.2 which provides specific guidance on presentation of the costs associated with the scheme, predominantly construction, operating and maintenance costs. Any unrealistic cost estimates could adversely affect the robustness of the assessment of affordability and value for money of a scheme.

3.1.3 The costs have been estimated under two broad categories – construction costs and operating and maintenance costs

3.2 Construction Costs

3.2.1 Scheme construction costs have been estimated by and received from the Highways England Commercial team. These include the results of a quantified risk assessment (rather than Optimism Bias) and the effects of real-terms construction price inflation. The costs have been provided on a year by year basis as factor costs in 2010 prices.

3.2.2 A summary of the costs, along with their respective cost profiles, are provided in Table 3-1 and Table 3-2. The full Scheme Cost Estimates can be found in Appendix B. These figures were correct at the time of compiling this report. Any significant changes in cost may require the calculations to be reviewed.

Table 3-1 - Total Scheme Construction Costs (£m)

Cost Type	Core Scenario
Preparation	£13.62
Supervision	£2.73
Works	£77.87
Lands	£8.52
Total	**£102.74**

Note: All monetary values are in 2010 market prices discounted to 2010

Table 3-2 - Scheme Construction cost profiles (£m)

Year	Capital Expenditure, by Year and Component (£m)				
	Preparation	Supervision	Works	Land	Total
2021	£5.95	-	£0.07	£1.92	£7.93
2022	£7.68	-	£0.08	£0.77	£8.53
2023	£2.06	£0.82	£41.87	£3.35	£46.04
2024	-	£1.43	£35.01	£0.91	£37.06
2025	-	£0.73	£0.84	£0.74	£2.32
2026	-	£0.04	-	£0.62	£0.66
2027	-	-	-	£0.11	£0.11
2028	-	-	-	£0.04	£0.04
2029	-	-	-	£0.03	£0.03
2030	-	-	-	£0.02	£0.02
2031	-	-	-	£0.01	£0.01
Total	**£13.62**	**£2.73**	**£77.87**	**£8.52**	**£102.74**

Note: All monetary values are in 2010 market prices discounted to 2010

3.2.3 To convert the costs to Present Value Costs (PVC), the following calculations have been performed:

- Conversion to market prices (using a factor for the average rate of indirect taxation in the economy of 1.19).
- Discounting to 2010 at 3.5% per annum.

3.3 Maintenance Costs

3.3.1 The capital cost of maintenance is the cost of people, machinery, and materials to maintain the network and its assets.

3.3.2 The cost of periodic repairs and replacement of the new sections of carriageway have been calculated in line with QUADRO data, setting out typical repair and spend profiles and costs for each phase of repair for the relevant network sections.

3.3.3 For the dual carriageway sections it is proposed to use a Long Life Flexible Pavement (LLP) and for the Single Carriageway section a Determinate Life Flexible Pavement (DLP) is proposed. The maintenance profiles and spend for these surfaces are set out in Table 3-3.

Table 3-3 – Maintenance Profiles (£000s per km)[5]

DLP (single 2 lane)					LLP (Dual 2 lane)			
Year	Works	Cost	Duration (days)		Year	Works	Cost	Duration (days)
0	New	0	0		0	New	0	0
11	TS	66	4		11	TS	168	6
22	Ov	240	12		22	In	354	7
32	TS	66	4		32	In	576	12
42	Ov	252	12		42	In	354	7
52	TS	66	4		52	In	354	7

Note: All monetary values are in 2010 market prices discounted to 2010
Costs are total for both directions and include the cost of traffic management
Traffic management assumes day working for single and dual
TS = Thin Surfacing (typically 30mm)
Ov = Overlay (height 50/100mm)
In = Inlay (depths 50/100mm)

3.3.4 Assessed over the 60 year appraisal period this cost profile returns a PVC of **£1.3m** in 2010 market prices.

3.3.5 In addition to this cost of maintaining the carriageways themselves, bridges and underpasses constructed at crossing points will also incur maintenance and renewal costs over the appraisal period.

3.3.6 Estimates of costs for the individual structures have been prepared and whole life costs of maintaining each asset assessed. Maintenance has been assumed to be carried out periodically, with major investment required 25 years after scheme opening and at 15-year periods thereafter. A summary of these costs is set out in Table 3-4.

Table 3-4 – Maintenance Costs for Structures (£m)

Structure	Total Maintenance Cost	
	Cost in 2020 factor prices	PVC in 2010 market prices
Roe Cross Road Bridge	0.8	0.3
River Etherow Bridge	1.5	0.6
Carrhouse Lane Underpass	0.35	0.1
Old Mill Farm Underpass	0.35	0.1
Mottram Underpass	6.0	2.3
Total	**9.0**	**3.5**

Note: All monetary values are in 2010 market prices discounted to 2010 unless otherwise stated

[5] Maintenance profiles, phasing and costs set out in this table are based on Table 4/1 of Part 2 of the QUADRO Manual, July 2020

3.4 Total Costs

3.4.1 Table 3-5 sets out the total cost of the scheme over the appraisal period, bringing together the elements described above.

3.4.2 In addition to the scheme related costs a small change in value of revenue is forecast to be generated by the scheme. This will occur at locations including Dunham bridge, Humber bridge, Kingsway tunnel, M6 mainline, M6 ramp, Queensway tunnel and Warburton Bridge Road. These impacts are calculated through the transport model and TUBA assessment which are described later in this document, but the output is reported here to provide a full overview of the Present Value of Cost of the scheme. The impact on revenue collection is a reduction of £0.2m over the appraisal period, which is presented here as an addition to the PVC, giving a total value of £107.7m.

Table 3-5 – Total Cost (£m)

Cost Item	PVC
Capital Investment	102.7
Carriageway Maintenance	1.3
Structure Maintenance	3.5
Toll Revenue	0.2
Total Cost	**107.7**

Note: All monetary values are in 2010 market prices discounted to 2010

4. Methodology for Assessing Benefits

4.1.1 For monetising the proposed scheme impact, the overall benefit of the scheme can be estimated in terms of net travel time saving (DS compared against DM), reduced vehicle operating costs, impacts during the construction phase, road user safety impact, reliability, environmental impacts and wider economic impacts. In addition to monetised benefits, social impacts and distributional impacts have been assessed.

4.1.2 The results of the assessment can be presented in terms of following parameters.

4.2 Transport Economy Efficiency (TEE)

4.2.1 Transport Economic Efficiency (TEE) benefits have been captured in accordance with TAG Unit A1.3 (July 2020). Impacts on transport users and providers typically make up the majority of benefits for transport business cases. This TAG unit provides specific guidance on how impacts on transport users and providers (including travel time and vehicle operating cost savings) should be estimated, valued and reported in transport appraisal.

Software Used for the Appraisal

4.2.2 The calculation of main economic benefits to road users incorporates use of the DfT's Transport Users Benefit Appraisal (TUBA) program.

4.2.3 TUBA is a software package developed for the appraisal of highway and public transport schemes. TUBA compares the economic costs for the Do Something (DS) situation with the costs for the Do Minimum (DM) situation to establish the value of forecast savings in travel time and vehicle operating costs. A BCR is calculated by comparing these values, together with those of other relevant costs and benefits, with the construction and operation costs, over a 60-year period for the scheme. TUBA version 1.9.14 has been used in the appraisal.

Economic Parameters

4.2.4 TUBA version 1.9.14 provides a complete set of default economic parameters in its 'Standard Economics File[6]'. This contains values of time, vehicle operating cost data, tax rates, economic growth rates and formally adopts the variation in the value of time by distance for car and rail business trips within the default economic parameters file. TUBA reports economic values in 2010 prices, discounted to a present value of 2010.

Modelled Forecast Year

4.2.5 Traffic forecasts were prepared for the following years:

- Opening Year - 2025
- Design Year - 15 years after opening – 2040
- Horizon Year - 2051

Appraisal Period

4.2.6 A 60-year appraisal period was used from the Scheme opening year of 2025 therefore providing a final appraisal year of 2084.

[6] "Economics_TAG_db1_14_0.txt" dated 28/08/2020, based on the Sensitivity Test TAG Data Book v1.14.

Time slice and Annualisation Factors

4.2.7 The annualisation factors adopted for the A57 Link Roads Stage 3 assessment are presented in Table 4-1. The appraisal has been based on AM peak, interpeak and PM peak modelled periods. The annualisation approach therefore assumes 253 weekdays per year excluding the weekends and the bank holidays. For each period an average hour is modelled so the factors applied to each period are derived by multiplying either 3 or 6 hours by 253.

Table 4-1 - Annualisation factors

Time Period	Period Length	Annualisation Factor
AM Peak Period (0700-1000)	3	3 x 253 = 759
Inter-peak Period (1000-1600)	6	6 x 253 = 1518
PM Peak Period (1600-1900)	3	3 x 253 = 759

4.2.8 Off peak and weekend flows have not been captured in the modelling and no benefits have been represented for these times in the TUBA assessment. Congestion in the DM scenario will be more limited during these periods and so both trip numbers and benefits per trip will be reduced compared to the modelled hours.

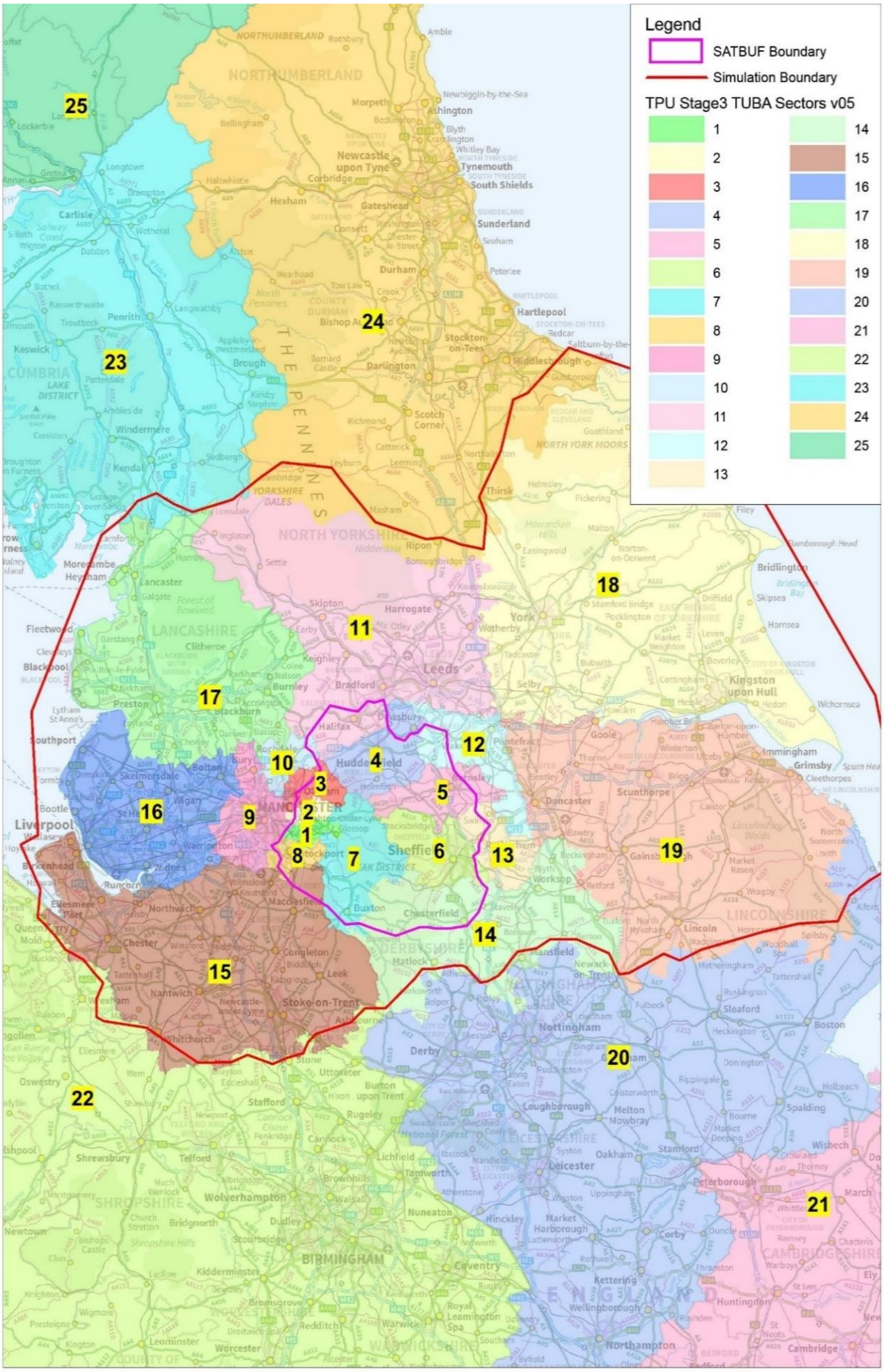
4.2.9 RIS schemes typically consider impact over weekends, so for consistency consideration of these impacts should be made during the next stage of assessment. It is more than likely there will be an upside opportunity for the PVB in the weekend but there is no guarantee of this until the analysis has been undertaken.

TUBA Sectors

4.2.10 The study area comprises model zones, which have been aggregated to sectors to enable more detailed analysis of the TUBA outputs. These sectors are listed below.

4.2.11 The sectors are indicated in Figure 4-1, which also shows the division of sectors between “internal”, “buffer” and “external”. Further specifications of the sectors are set out in Appendix C.

Figure 4-1 - Sectors definitions



4.3 User Classes and Journey Purposes

4.3.1 The TPU Stage 3 traffic model comprises five user classes. The modelled user classes were split into seven user classes as required for the TUBA economic appraisal, as shown in Table 4-2 below:

Table 4-2 - Correspondence of Modelled User Classes to TUBA User Classes -Weekday

Modelled User Class	TUBA User Class	Factors
Car Business	Car Business	1.000
Car Commute	Car Commute	1.000
Car Other	Car Other	1.000
LGV	LGV Personal	0.120
	LGV Freight	0.880
HGV	OGV1	0.192*
	OGV2	0.208*

* Includes conversion from Passenger Car Units, or PCUs (the traffic model's unit of traffic flow) to vehicles as required for input to TUBA. The model represents an HGV as 2.5 PCUs. The two HGV factors therefore need to sum to 0.4 (the inverse of 2.5).

4.3.2 The LGV user class was disaggregated into LGV Personal and LGV Freight using the TAG Data Book Table A1.3.4 (July 2020), giving a default proportional split of 12 % for LGV Personal and 88 % for LGV Freight. HGVs were split into OGV1 (48%) and OGV2 (52%) calculated from Highways England's WebTRIS database. Accordingly, the factors for the OGV1 and OGV2 were 0.192 and 0.208 respectively in TUBA, taking into account the PCU factor for HGV as 2.5. The above-mentioned factors and splits were retained against the TPU Stage 3 ComMA report (17 May 2019) produced by Arcadis.

4.4 User Benefits

Travel Time Savings

4.4.1 Travel time savings are calculated in TUBA using the 'rule of a half' applied to generalised time skims from the TPU Stage 3 traffic model . The 'rule of a half' relates to the change in the consumer surplus resulting from a reduction in travel costs such that existing users receive the full benefit while new users receive half of the benefit.

4.4.2 Travel times in the traffic model are represented in seconds. These are converted to vehicle hours and annualised for each time period, so that annual travel time savings can be calculated.

4.4.3 Annual time savings are calculated for each modelled year. Benefits for non-modelled years are calculated via linear interpolation between modelled years, and flat-line extrapolation beyond the final modelled year. However, the impact of discounting and growth in values of time on estimated benefits means that the benefits 'curve' does not represent a straight line through the appraisal period.

4.4.4 Default economic assumptions have been applied, as contained in the TUBA software (v1.9.14) and Economic parameter file "Economics_TAG_db1_14_0.txt".

Vehicle Operating Cost Savings

4.4.5 Vehicle operating costs (VOCs) are calculated for both fuel and non-fuel elements of the journey, based on formulae set out in the DfT's TAG guidance. The 'rule of a half' formula is broadly applied as for travel times, but with vehicle operating costs being based on distance travelled (vehicle-kilometres) and average vehicle speeds.

4.4.6 All assumptions relating to fuel costs, duty and vehicle efficiency are those contained in the default TUBA economics file. The same annualisation factors as defined above are applied to derive VOC benefits.

4.5 Masking of Impacts

Masking approach

4.5.1 A relatively large transport model (TPU Stage 3 traffic model) was developed on behalf of Highways England and has been used for appraisal of the A57 Link Roads Scheme .

4.5.2 While every effort has been made to refined and update this model to best represent the impacts of the scheme, it has been necessary for focus to be been placed on validation of performance around the scheme area. The model contains large cities including Manchester and Sheffield which, as part of a strategic model, can be particularly sensitive in terms of variations to traffic flow and congestion at busy junctions.

4.5.3 Furthermore, the scope of the model, whose simulation area extends as far as the east and west coasts of England, contains a very high number of trips and hence a large overall cost of travel, making relatively small fluctuations in modelled behaviour, potentially influential on overall performance.

4.5.4 To minimise this effect a fixed cost function (FCF) has been applied, whereby a cordon is set within the model and costs outside of this cordon fixed to ensure uniform behaviour between the DM and DS scenarios. Further detail on this approach and the cordon used are set out in the Transport Forecasting Package.

4.5.5 Despite use of the FCF it was observed that the value of TUBA Sensitivity in the initial TUBA runs was much weaker than TAG would recommend to indicate a reliable assessment[7].

4.5.6 In order to reduce the model noise and improve the value of TUBA Sensitivity in line with TAG recommendation, a masking approach was adopted.

4.5.7 This was based on analysis which focussed on identifying the OD pairs which are directly impacted by the scheme and those which can reasonably be understood to experience an indirect impact.

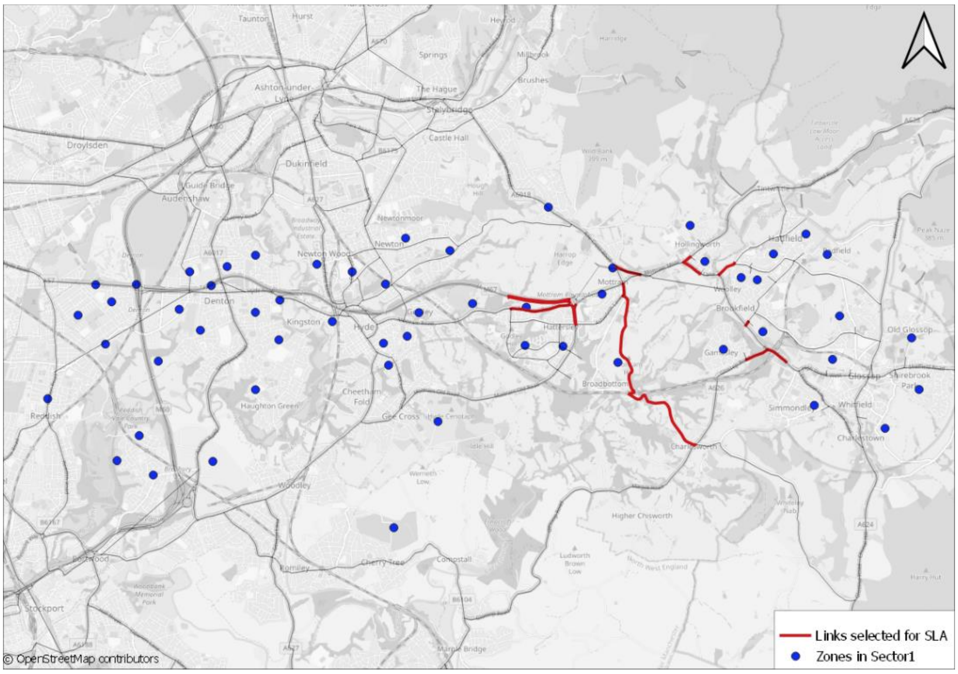
4.5.8 This was achieved by performing select link analysis (SLA) on a selection of links, illustrated in Figure 4-2, which are either part of the scheme directly or are used to enter or exit the scheme. The extraction of this information from DM and DS scenarios provided all the OD pairs which are definitely impacted by the scheme. The SLA had captured every OD pair using the scheme or passing through a small scheme area in any scenario during any peak modelled hour. In addition all movements to or from Sector 1 zones were retained as these are in the immediate vicinity of the scheme and changes in flows through this region, whether passing through the scheme or not, can be reasonably expected to be influenced by changes to resulting traffic patterns.

[7] The TUBA Sensitivity value is a ratio between

- the change in total network cost between DM and DS scenarios; and
- the total network cost in the DM scenario.

This indicates how sensitive the results are to convergence in the transport model and should be no less than around 10 times the corresponding convergence %GAP values reported for the transport model. The smaller the TUBA Sensitivity value, the more susceptible TUBA results will be to convergence noise.

Figure 4-2 - Enhanced Masking version 2 (SLA + Sector 1)



4.5.9 This two-streamed approach ensured that:

- Local impacts, whether positive or negative are retained;
- Movements across the scheme area which will be affected are retained; but
- Other movements which won't experience either direct or indirect impacts are excluded.

4.6 User costs during construction and maintenance

4.6.1 The delays during construction have been estimated using the strategic model and TUBA runs to represent the impacts of different phases of construction. As diversionary impacts could, potentially contribute significantly to the total delay, this approach has been considered to provide a better representation of wider network effects within the cordoned model area than use of the QUADRO tool which is more focussed on the immediate area of effect. Each construction stage has been modelled in a single-year assignment run using the 2025 demand matrix in a fixed matrix assignment for the cordoning as illustrated in Figure 4-3 below.

4.6.2 The outputs from the modelling assignment have been compared against the DM 2025 model in TUBA in order to monetise the disbenefits during construction phases of the scheme.

4.6.3 Table 4-3 below summarises the traffic management (TM) information that was provided by Balfour Beatty on 25th November 2020.

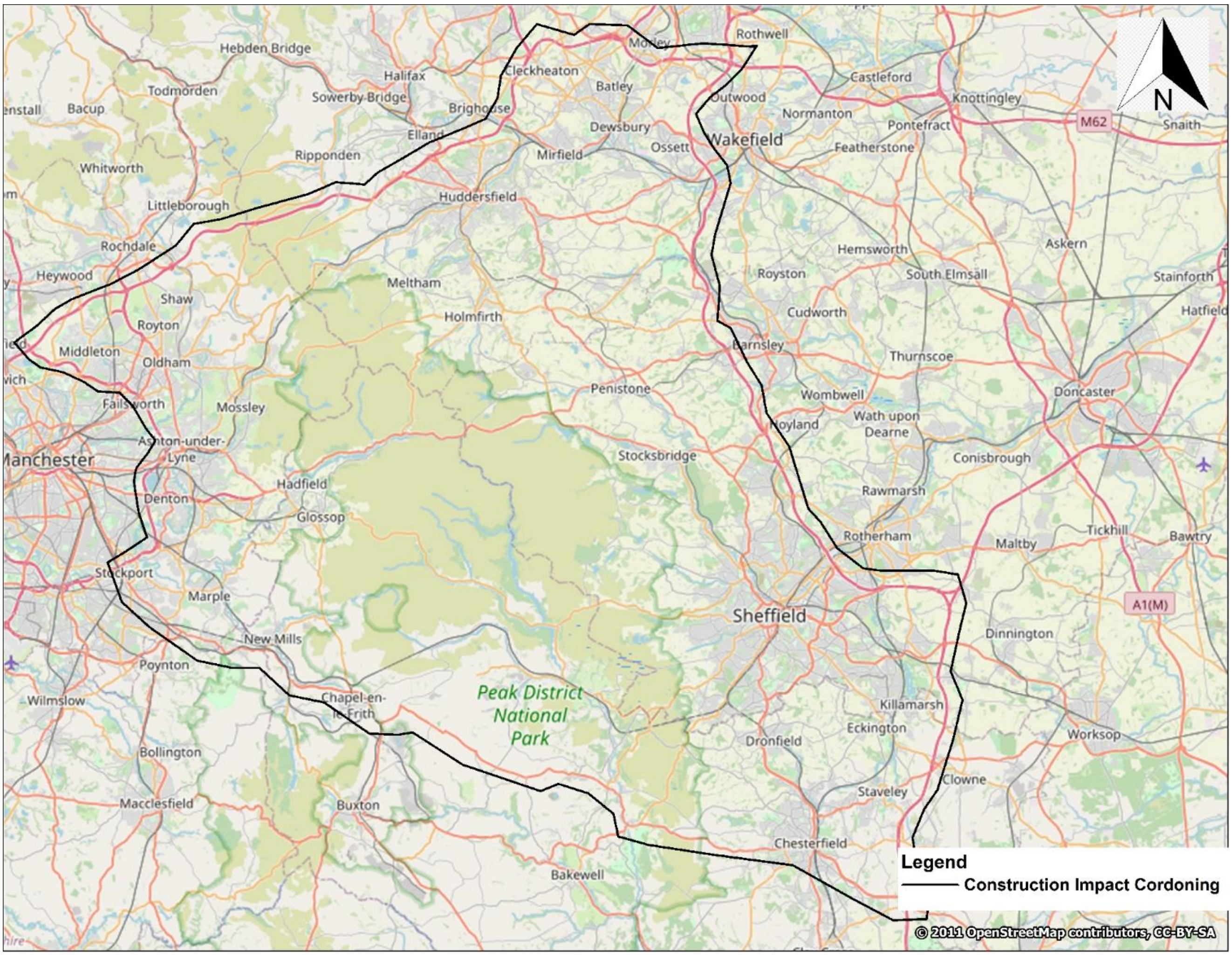
Table 4-3 - Traffic Management Phases

TM Phase	Work	Expected Duration
1	During Traffic Management Phase 1, • properties above the underpass demolished, • underpass pilings started, • pre-casted piles to the west of River Etherow installed, and Traffic Outcome: • no changes made to the existing traffic flow.	Sept 22 to Mar 23 (182 days)

TM Phase	Work	Expected Duration
2	During Traffic Management Phase 2, • Underpass construction continued, along with excavation of main cutting to the east of the underpass; • Fill materials from cutting transported to the west of River Etherow embankment; • Traffic restricted on Mottram Moor eastbound to one lane through plant crossing; • Plant crossing used to move muck from west to east. Traffic Outcome: • Addition of a traffic signal junction on Mottram moor road with suitable inter green time.	Apr 23 to Sep 23 (183 days)
3	Traffic management Phase 3 primarily comprised of • Complete underpass construction including temporary diversion of the Roe Cross Road; • Modification of the existing roundabout, and two lanes of traffic maintained on the roundabout • Construction of Mottram Moor junction and restricting Mottram Moor to one lane in the eastbound direction. • Tie into the Woolley Bridge road with no restriction to existing road network during peak hours Traffic Outcome: • Mottram Moor reduced to one lane in eastbound direction	Oct 23 to Mar 24 (182 days)
4	During Traffic Management Phase 4, • cut material from underpass moved to the mainline to fill west of underpass. • a complete dual carriageway throughout the section, and Traffic Outcome: • no restrictions to the existing road network	Apr 24 to Oct 24 (184 days)
5	Traffic Management Phase 5 comprised of de-trunking work to old A57. The entire phase was divided into two sub-phases, namely Phase 5_1 and Phase 5_2, to account for contraflow. Phase 5_1: • De-trunking works confined to old West Hyde road for the duration of 2 months Traffic Outcome: • West Hyde Road signalised to allow just one direction at a time to account for contra-flow. Phase 5_2: • De-trunking works to old East Mottram moor road for a duration of 1 month. Traffic Outcome: • East Hyde Road signalised to allow just one direction at a time to account for contra-flow.	Oct 24 to Dec 24 (5_1: 61 days, 5_2: 31 days)

4.6.4 A detailed breakdown of the sequence of the traffic management phases is provided in Appendix A.

Figure 4-3 - Construction Impact Cordoning



4.7 Accident Savings

4.7.1 A safety assessment has been carried out using DfT's COBALT software to analyse the impact of the scheme on road traffic accidents, providing a monetised impact. It estimates the number of accidents for each road link over the 60-year appraisal period, based on the product of:

- the accident rate per million vehicle kilometres;
- the road length; and
- the forecast annual traffic flow.

4.7.2 Accidents at junctions can also be separately assessed based on junction design and through-flow, or link and junction accidents can be assessed in combination.

4.7.3 Personal injury accidents (PIAs) are considered, split between fatal, serious and slight injuries, with national average rates of accidents and severities by link or junction type applied. The calculation uses relationships contained in the program to take account of changes in accident and casualty rates over time.

4.7.4 The current version of the COBALT software (2013.02) and economic parameters file (2020.2) were used for the appraisal.

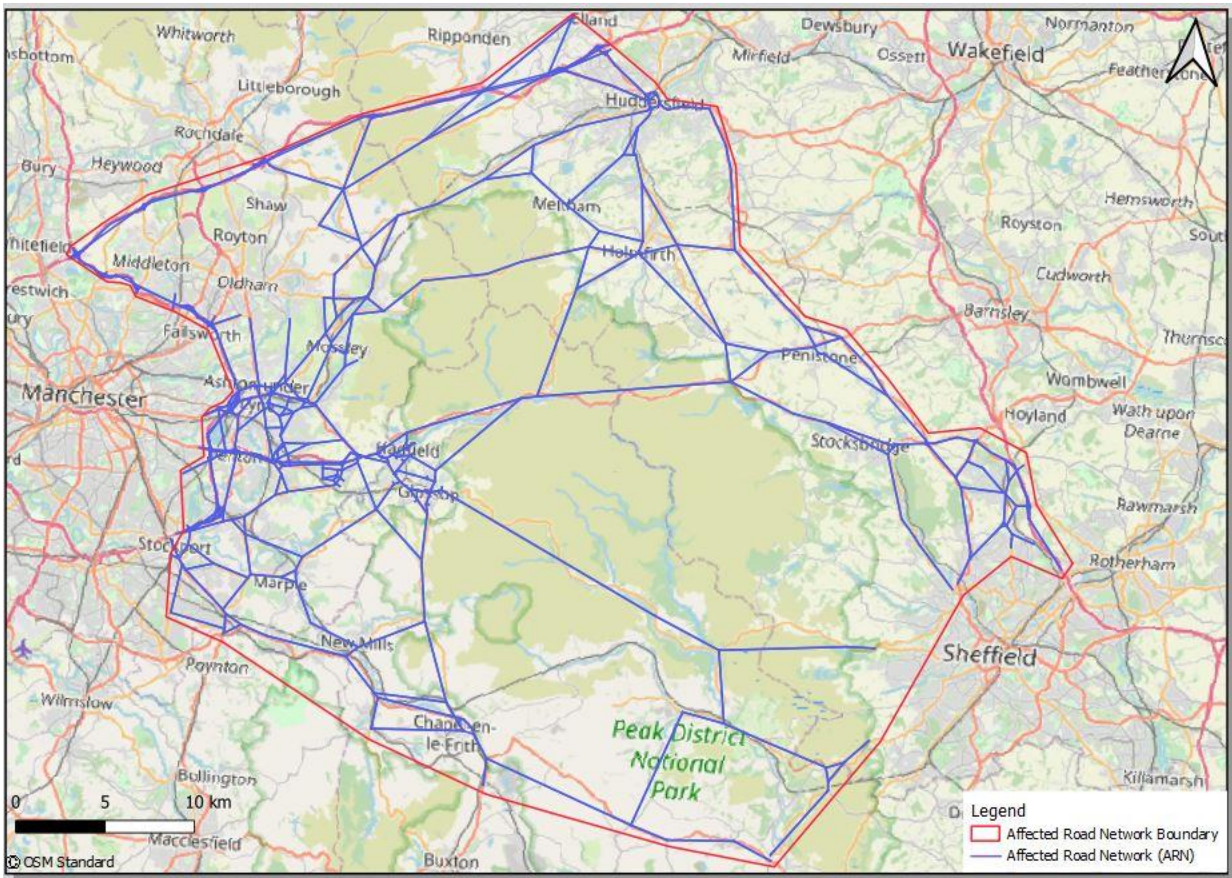
Study Area

4.7.5 The geographical coverage of the COBALT assessment includes only the Affected Road Network (ARN) rather than the whole model area. The extent of the network for the assessment has been identified through review of the modelling to identify where significant changes in flow[8] are generated by the scheme which could induce a change in accident numbers. The ARN is confined to Huddersfield in the North, Sheffield in the East, Buxton in the South, and Whitefield in the West adjacent to Manchester area. The ARN includes strategic road networks mainly M60, M62, M67, A57, and the A629.

4.7.6 The central Manchester and Sheffield areas have been excluded as these are highly sensitive to model noise. This sensitivity could result in traffic using alternative routes for reasons unrelated to the A57 Link Roads Scheme , which could distort the assessment. The geographic extent of the affected road network is presented in Figure 4-4.

4.7.7 This area is broadly comparable to the Area of Detailed Modelling, but with certain strategic links added at the periphery, where flow changes resulting from the A57 Link Roads Scheme are forecast to be significant enough to warrant examination of the impacts on safety. A comparison between the two areas is illustrated in Figure 4-5.

Figure 4-4 - COBALT Study Area



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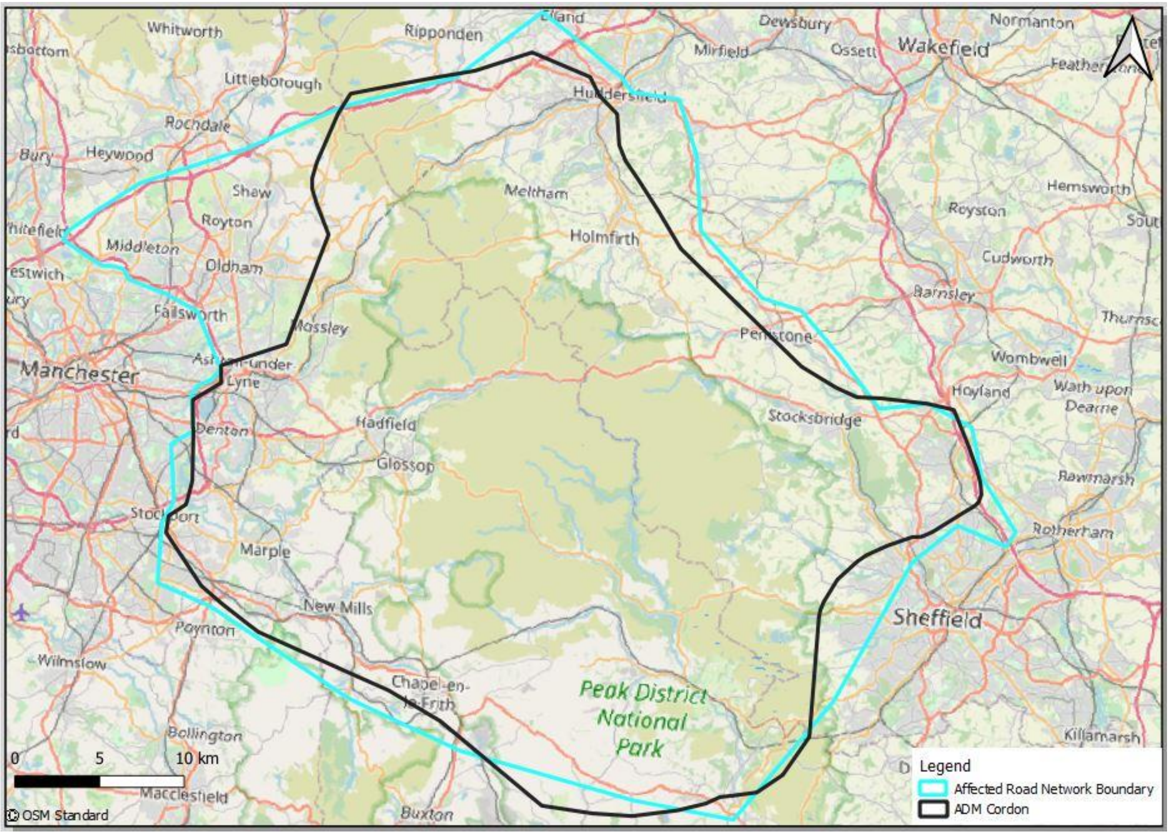
[8] There is not a precise definition of what change in flow is considered "significant", as this will vary from scheme to scheme based on the scale of impacts created. Professional judgement has been used through review of flow difference plots from the SATURN model to identify the area over which flows are most impacted by the scheme.

Figure 4-5 - COBALT Study Area Relative to the Area of Detailed Modelling



4.7.8 For assessing the accident benefits generated by the scheme, the entire ARN has been divided into three different categories based on the assessment approach, namely:

- Junction Only
- Link Only
- Combined Link and Junction

4.7.9 These three methods are provided within COBALT to enable detailed disaggregate assessments of network sections which may have specific properties or layouts, or which vary between scenarios, while providing a more generic assessment approach to cover larger sections of the network.

4.7.10 Within the proposal, the junctions which will be significantly altered in design as a part of the scheme, or which exist in one scenario but not the other, are assessed under the "Junction Only" approach. It has been identified that Hattersley Roundabout and Gun Inn junctions will undergo significant changes in DS compared to DM in terms of geometric design once the scheme has been implemented. Specific treatment of these junctions is discussed further below. In addition to this, a new junction will be constructed at Woolley Bridge as part of the DS proposed scheme. Each of these junctions have been assessed using the "Junction Only" approach.

4.7.11 Within COBALT junctions are defined to include the network section 50m in each direction from the junction. Any newly introduced links adjacent to the junctions described above, excluding these 50m sections have been captured within the "Link Only" approach. This ensures no double counting of accidents related to the junctions.

4.7.12 Certain variations to the modelled network have also been introduced whereby modelled links do not connect to physical junctions, but represent separate sections of a single stretch of carriageway. In such cases "junction only" and "link only" assessments have been used to deliver the most representative outcome.

4.7.13 For the rest of the links and the junctions in the ARN, the “Combined Link and Junction” approach has been adopted.

4.7.14 The required inputs for COBALT are summarised below, along with their source, and are discussed in detail in the subsequent sections.

- 24 Hour Annual Average Daily Traffic (AADT) flows for all links in the study area for the Base, DM and DS scenarios have been provided from the Trans-Pennine Upgrade (TPU) model;
- Link details, including link length, speed limit, link and junction type, etc have been determined from the TPU Stage 3 traffic model network details;
- Junction details, including number of arms, junction layout and inflow from each arm have been extracted from the TPU Stage 3 traffic model and informed by the scheme design; and
- Observed accidents for specific network sections have been taken from DfT STATS19 accident data.

Network Details

4.7.15 For the “Combined link and Junction” and “Link only” approach, the main input parameters for COBALT include link length, speed limit and COBALT link type for each link. Whereas for “Junction only” assessment, the input includes COBALT junction type, speed limit, Major Arm type and Highest carriageway standard.

4.7.16 The objectives behind these data requirements was to allow the lookup of relevant national average accident rates for the new/improved links and existing links. The definition of each link type can be found in the COBALT user manual (2013.2). For junctions the input details determine the formula applied to calculate the relationship between flow and accidents.

4.7.17 Within the COBALT assessment some links and junctions vary in structure between DM and DS scenarios. These network sections have been coded twice, with and without the scheme, for COBALT to evaluate the impact of the scheme.

4.7.18 The COBALT output file returns details of errors or warnings. There were 7 warnings in the output file for the A57 Link Roads Scheme COBALT assessment. One was related to the lower limit of flow for the minor arm of Hattersley Roundabout, where traffic levels in DS are significantly reduced and the rest of the warnings were related to the higher observed accident rates which have been checked and found consistent with the high number of accidents observed.

Traffic Flows

4.7.19 24 Hour AADT flows for all links in the study area for the Base, DM and DS scenarios have been provided from the TPU Stage 3 traffic model. The model forecasts are based on average flows over the respective peak periods for a neutral month (i.e. a month not distorted by holiday periods) and cover only the 12-hour peak period during weekdays. Therefore, observed data used to develop the base year model is used to pro-rate the modelled link flows in order to estimate the annual number of trips expected on each[9].

4.7.20 The Development of the annual average daily traffic (AADT) forecasts followed the approach set out below:

- The Base, DM and DS hourly traffic flows were extracted from the TPU Stage 3 traffic model for each modelled time period and forecast year.

[9] While off-peak and weekend flow data has been used to calculate the annual traffic flow, the same data has not been used at this stage to estimate off-peak journey time savings. This is because the relationship between flow and benefits is more complex, with benefits per trip also increasing as trip numbers increase due to congestion rising in both DM and DS scenarios.

- These were converted to peak period flows using the factors of 3, 6 and 3 for AM, IP and PM respectively to calculate the 12-hour average weekday traffic (AWT).
- 12-hour AWT was converted into 12-hour average annual weekday traffic (AAWT) to account for seasonality of flow.
- 12-hour AAWT calculated in the previous step was then converted into 24-hour AAWT.
- 24-hour AAWT was then converted to the annual average daily traffic (AADT) which also includes weekend flows.

4.7.21 The individual factors are as shown in Table 4-4

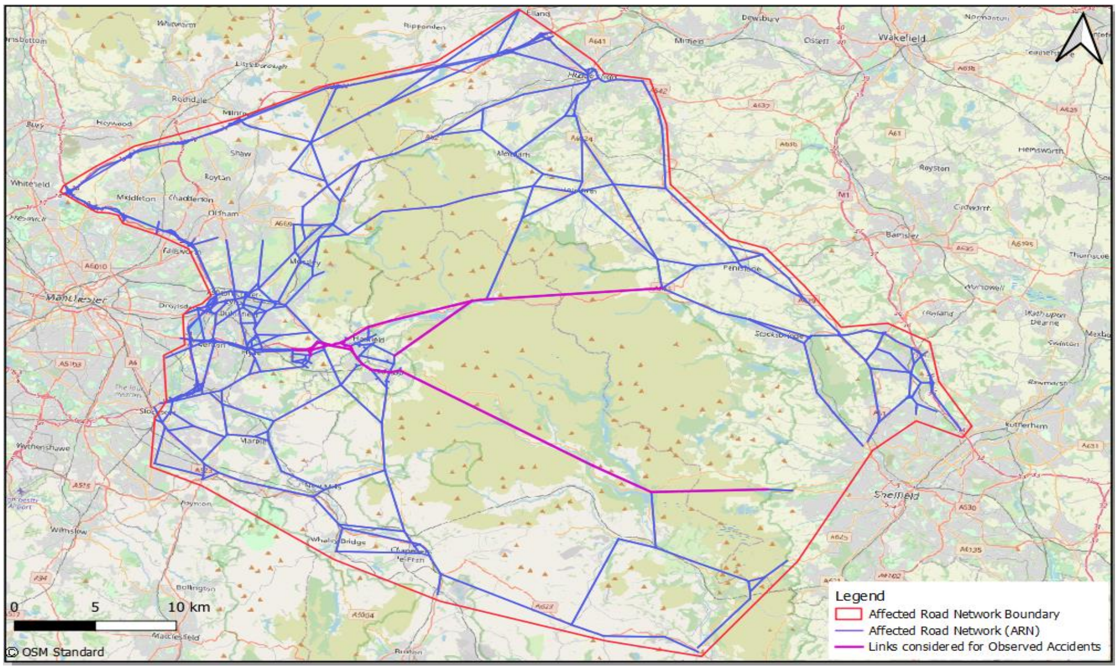
Table 4-4 - Traffic flow conversion factors

Traffic Flow	Conversion Factor	Lights	Heavies
AM	Average Hour to Period	3	3
IP	Average Hour to Period	6	6
PM	Average Hour to Period	3	3
AM AAWT	AM Peak-AWT to AAWT	0.88	0.87
IP AAWT	IP Peak-AWT to AAWT	0.90	0.88
PM AAWT	PM Peak-AWT to AAWT	0.89	0.87
24Hr AAWT	12Hr AAWT to 24Hr AAWT	1.30	1.29
24Hr AADT	24Hr AAWT to 24Hr AADT	0.95	0.79

Observed Accidents

4.7.22 Accidents over last five-years between January 2014 and December 2018 (the most recent five calendar years available across the network) were extracted from Statement of Administrative Sources (STATS19) Road Safety Database for the links within the study area. Details of these records are shown in Appendix F. The locations of links which used observed data to define accident rates are illustrated in Figure 4-6. These links have been selected as being those on which traffic flows are forecast to be most affected by the scheme.

Figure 4-6 – Observed Accident Data



4.7.23 Elements of this observed accident data applied to network sections captured within the “Combined Link and Junction”, “Link Only” and “Junction Only “approaches as shown in Appendix F.

Hattersley Roundabout

4.7.24 Observed accidents have been used to assess the accident saving analysis for Hattersley roundabout and Gun Inn junction. In the case of Hattersley roundabout, while actual observed accident data was used for the DM scenario, for the DS scenario an adjustment has been applied. The upgraded junction has been designed to improve safety. However, default accident rates for this type of junction, which would normally be applied, indicate a significant increase in accident rates as these do not take into account the local behaviour of traffic and actual speeds of travel.

4.7.25 To better reflect the safety impacts of the scheme at this junction an adjustment has been applied whereby a proportional change between the default rates for the DM and DS junction designs has been calculated. This proportion has then been applied to the observed accident numbers to generate an adjusted rate for the junction in the DS scenario.

4.7.26 This adjustment to the observed accident data has been calculated as a reduction to about 20% of the current observed rates to capture the geometric design changes and signalisation in the DS scenario. The rate has been applied through a factoring of the observed accident data as shown in Appendix F.

Gun Inn Junction

4.7.27 As part of the scheme design Gun Inn junction on the intersection between the A628 and A57 has been upgraded. This upgrade has considered geometric safety improvements for traffic and the addition of more frequent pedestrian phases to make crossing safer.

4.7.28 However, the changes to design do not change the type of junction as considered by the COBALT tool and so would not result in any change to the output of accident numbers. In addition COBALT does not take account of pedestrian facilities when considering accident rates. Therefore, while it is recognised qualitatively that this junction is forecast to experience a reduction in accidents as a result of the scheme, the approach used for assessment of safety benefits is not sufficiently sensitive to monetise these benefits.

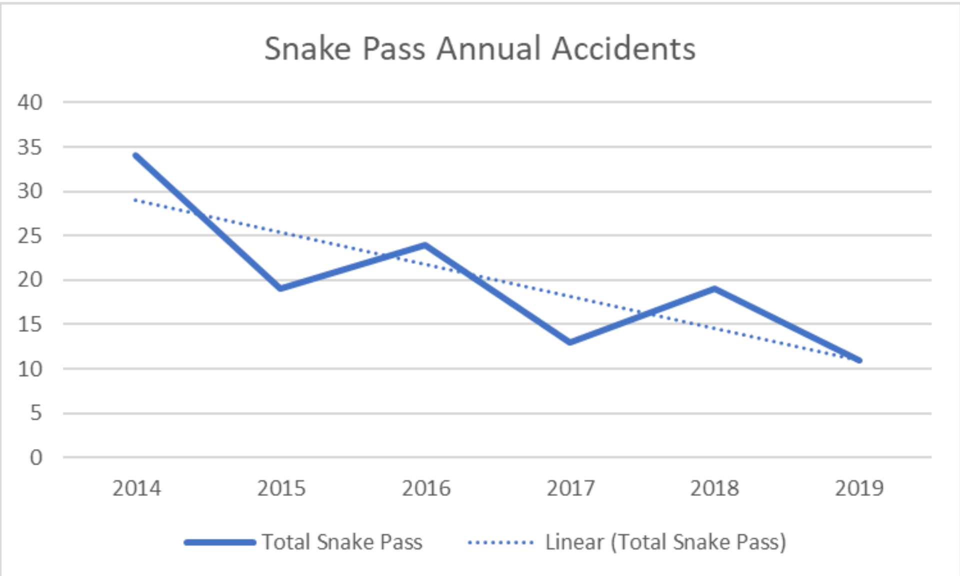
4.7.29 This junction has been treated within the COBALT assessment as "junction only", but the purpose for this is not related to the junction itself. It is rather that adjacent links vary and are split between DM and DS scenarios requiring "link only" assessment. Therefore, Gun Inn junction has been treated this way to avoid double counting of junction related accident costs.

Snake Pass

4.7.30 Although Snake Pass road is comparatively far away from the scheme area, considering the historical accident hotspot record of the Snake Pass, observed accidents have been used to assess the accident saving benefits on the Snake Pass road. It is understood that measures have been taken in recent years to address this historically high accident rate and it was observed that post 2014, the number of accidents that occurred along Snake Pass shows a declining trend as shown in Figure 4-7 which suggests a measure of success having been achieved in bringing accident rates down.

4.7.31 It has therefore been considered that a refined analysis period for Snake road alone as 2015-2019, unlike 2014-2018 used for the rest of the links in the network, would be more representative of the present accident rates on this route. Observed accidents along Snake Pass from 2015-19 are shown in Table F-4.

Figure 4-7 – Accident trend along Snake Pass



4.7.32 In addition, as the contribution of the Snake Pass route to the total effect of the scheme on accident numbers is significant, further analysis of the flows on these links was conducted. As a rural area within a large-scale model the level of detail of modelling at this location is low, having used large zones to cover wide areas of dispersed population and very long links with few access/egress points. The result is that traffic modelled as using these links behaves consistently between DM and DS scenarios, but may not be entirely representative of reality. To ensure the most accurate relationship between accidents and flow, the observed accident data on these links has been matched with observed flow data using most recent counts. This observed flow data has been used in place of the modelled base year flow data in the COBALT assessment.

4.7.33 These two observed inputs generate an accurate accident rate per vehicle km, which is then used with the modelled change in flow between DM and DS scenarios to calculate the impact of the scheme on the accident numbers. It has been recognised that the forecast year DM and DS flows on these links will have the same limitations as the base year flow. However, the change in flow between DM and DS is driven by changes in behaviour across the much wider network, with only a negligible affect from the few zones directly connected to the Snake Pass links.

4.7.34 For the rest of the network in the study area, COBALT default accident rates have been applied.

4.8 Environmental impacts

4.8.1 This section discusses the methodologies and results for assessing the monetised air quality, noise and greenhouse gas impacts of the link road elements of the A57 Link Roads Scheme .

4.8.2 The scheme has been assessed in accordance with the DfT's Transport Analysis Guidance (TAG) , Unit A3 Environmental Impact Assessment (May 2019) and associated worksheets (updated July 2020), with reference to methodologies within the Highways Agency Design Manual for Roads and Bridges (DMRB), Air Quality, revision November 2019 (DMRB LA105).

4.8.3 The TAG monetised assessment of environmental impacts includes:

- Air Quality
  - An assessment of the overall change in mass emissions of NOx and fine particulate matter (PM2.5) in tonnes over the 60-year appraisal period; and
  - Monetisation of changes in air quality.
- Greenhouse Gas Emissions
  - An assessment of the change in mass emissions of total carbon dioxide equivalent (CO2e) in tonnes for the opening year;
  - An assessment of the change in mass emissions of CO2e in tonnes over the 60-year appraisal period; and
  - Monetisation of changes in CO2e emissions.

Air Quality Assessment

4.8.4 The assessment of local air quality has been undertaken using traffic flows, the proportion of heavy duty vehicles (HDV), speed band data, and road link lengths for the opening year (2025) and a future year (2040), for both the without scheme (do-minimum) and with scheme (do-something) scenario.

4.8.5 The change in total emissions of NOx and PM10 for the traffic reliability area (TRA) were calculated (using Highways England speed band emissions factors version 3.1 derived from EFT V10.1). PM10 emissions were converted to PM2.5 using the conversion factor included in TAG Databook version 1.14 table A 3.2.4. A factor of 0.673 (road transport) was applied to the total PM10 emissions.

4.8.6 The change in NOx and PM2.5 emissions were then monetised as documented in the TAG guidance which considers an appraisal period of 60 years from the opening year of the scheme. The change in NOx and PM2.5 emissions over time is calculated by linear interpolation between the opening year and future year and then assumed to be constant for the remainder of the 60-year appraisal period in the absence of any other data.

4.8.7 Where there are areas where NO2 and PM legal limits for human health are expected to be exceeded, the economic valuation is determined using the Marginal Abatement Cost (MAC) approach[10]. Where the scheme is unlikely to affect legal limits and the NPV is not greater than £50 million, the damage cost approach is followed for the economic valuation of NOx and PM emissions.

4.8.8 The costs are derived from analysis by the Inter Departmental Group on Costs and Benefits (Air Quality) (IGCB(A)) of the typical health impacts arising from changes in air pollution.

[10] Details of this approach are discussed in the Environmental Statement.

4.8.9 There are no exceedances of legal air quality limits expected either with or without the scheme and consequently the damage cost approach has been followed throughout. This was determined on the basis of Defra Pollution Climate Model (PCM) concentrations for relevant road links in the scheme opening year and scheme specific air quality modelling undertaken for compliance risk assessment purposes.

4.8.10 The values calculated for the 60 years of the appraisal period were discounted at standard HM Treasury rates to give a present value for that particular year. This was then summed over the appraisal period, to give the net present value (NPV) of the change in air quality using the latest version of the TAG Air Quality Sensitivity Workbook which is aligned with TAG data book v1.14 (July 2020).

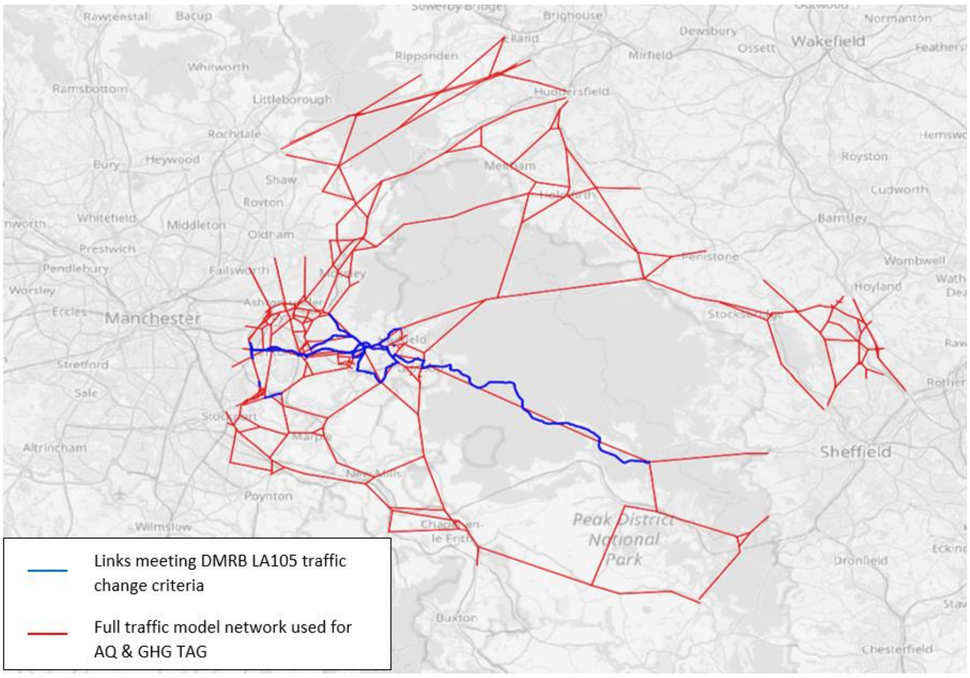
Greenhouse Gases

4.8.11 The change in total emissions of CO2e for the TRA were calculated using Highways England speed band emissions factors version 3.1 derived from EFT V10.1.

4.8.12 Greenhouse gas impacts to determine the carbon dioxide equivalent (CO2e) emissions over the 60-year appraisal period were computed using the standard TAG Greenhouse Gases Workbook. The value of these benefits over the 60-year appraisal period was calculated using valuations presented in TAG data book v1.14 (July 2020) based on the approach set out in TAG Unit A3 Chapter 4. In addition to this a sensitivity is presented based on the upper estimate NPV of greenhouse gas emissions which uses high carbon values.

4.8.13 Both greenhouse gas impacts and air quality have been assessed over the area illustrated in Figure 4-8.

Figure 4-8 – Area of Network Considered for Air Quality and Greenhouse Gas Assessments



Noise Assessment

4.8.14 TAG Unit A3 outlines the approach for the assessment of traffic related noise and the valuation of noise level in monetary term, which follows guidance set out in DMRB Volume 11 concerning noise and vibration. This captures noise impacts during the construction period, including impacts of traffic diversions and during the 60 year operational period based on data from the opening and design year transport modelling. The assessment has been based on the inclusion of embedded noise and mitigation measures which have been incorporated into the design. Full details of the approach are set out in the Environmental Statement.

4.8.15 The results of this assessment are provided in the Section 5.5.

4.9 Estimation of Journey Reliability Benefits

4.9.1 The reliability impacts of the scheme were estimated using the approach set out in TAG Unit A1.3 on reliability for urban roads. This provides an estimate of the change in the level of journey time variability depending on the change in average journey time for each origin/destination pair due to the scheme and the demand and distance between each pair. The process uses the same input parameters and assumptions as the TUBA assessment. Only weekday impacts are included, and no benefits are counted for journeys of less than 0.5km in length as the method becomes increasingly sensitivity for shorter distance trips and journeys of shorter distance than this are not considered to be sufficiently accurately represented by the strategic model.

4.9.2 The TAG 'Urban Roads' method was considered the most appropriate approach to assessing reliability for the appraisal of the A57 Link Roads Scheme. Whilst the Highways England MyRIAD software for assessing the Journey Time Variability impacts of dual-carriageway schemes was considered, MyRIAD focuses on capturing the impacts of motorway widening and technology schemes along defined links and cannot represent junction changes or new links, so it was deemed not to be suitable for this scheme.

4.9.3 While the urban roads approach was developed using empirical data from studies of traffic in cities, the behaviour can be broadly translated to networks for which a range of alternative route choices are available while passing through smaller urban areas. Longer trips are less well represented using this method, but the calculation of reliability benefits includes an inverse relationship with journey distance, meaning that for longer distance journeys the calculated reliability benefits are increasingly reduced. Therefore, these longer trips outside of the core urban areas will have little impact on the calculated reliability benefits.

4.10 Wider economic impacts (WEIs)

4.10.1 TAG Unit A2.1 (July 2020) sets out approaches for estimating a range of wider economic impacts that can be considered to be supplementary to the welfare economic benefits captured through conventional appraisal described in the previous sections (termed Level 1 appraisal), and occur as individuals and businesses change their behaviour and / or economic activities in response to the transport change[11].

4.10.2 The WEI identified in TAG are categorised into two levels:

- **Level 2 WEI** based on connectivity improvements only, without explicit land use change, including: static agglomeration, more people working and increased output in imperfectly competitive markets; and
- **Level 3 WEI** involving explicit land use change and/or additional economic modelling, including: dynamic agglomeration, move to more productive jobs and dependent development.

4.10.3 For the purposes of this assessment:

- Static agglomeration was quantified as it was deemed to account for a significant part of the WEIs and align well with the nature of the intervention;

[11] Conventional appraisal is based on the assumption that transport markets behave in a theoretical 'perfect' manner. However, in reality markets are imperfect and wider economic impacts occur as the impacts of the transport scheme transmit from the transport markets to other markets as businesses and individuals change their behaviour.

- Benefits associated with increased output in imperfectly competitive markets were quantified as 10% of the conventional impacts on business users (inclusive of reliability benefits), in line with TAG Unit A2.2 (July 2020);
- Other Level 2 impacts such as labour market effects (more people working) were only looked at qualitatively and deemed to be beneficial; and
- Dependent development impacts or move to more productive jobs were deemed less significant or relevant to the nature of the scheme and therefore not assessed.

4.10.4 The remainder of this sub-section is focused on the methodology adopted for assessing static agglomeration impacts, which represent GVA impacts from productivity uplift as a result of enhanced access to economic mass (ATEM) brought by transport investment. There is clear economic evidence showing a causal relationship between agglomeration and productivity as documented and referenced in relevant guidance. Agglomeration benefits represent the uplift in business productivity as a result of improvement in ATEM, which is a metric to measure agglomeration. The calculation of agglomeration is mainly determined by the product of the following three factors:

- the uplift in productivity per worker (derived from comparing ATEM with and without the proposed intervention)
- the quantum of employment (i.e. number of jobs)
- the average GDP per worker

4.10.5 Therefore, the value of agglomeration benefits is informed by a combination of the three factors above. High agglomeration benefit could be the result of a marginal increase in connectivity that is linked with locations with high number of jobs and average productivity, or a significant journey cost saving linked with locations with modest quantum of employment.

4.10.6 The calculation of agglomeration impact is based on DfT's WITA Beta 2.0 so the assessment process and its implementation are in line with TAG Unit A2.4.

4.10.7 The zoning system of the agglomeration model in WITA has a national coverage and is based on the 380 Local Authority Districts (LAD), illustrated in Figure G.2 of Appendix G, which are also compatible with the spatial resolution of the economic data (jobs and GVA) in DfT's wider impacts dataset. Information from the latter is also fed into the WITA model as required for agglomeration assessment. The current sensitivity test version of the wider impacts dataset (issued by DfT) was used for consistency purpose as the transport model output (and TUBA assessment) was based on DfT's Databook v1.14 (sensitivity test version)

4.10.8 The WITA model used the same highway model output as that used for TUBA. This involves the consolidation of the more detailed transport model zoning system to the WITA model of 380 zones with the help of a GIS tool. Any output used (such as time and distance) was demand-weighted during the consolidation process. Overall, transport model output in forecasting year 2025, 2040 and 2051 was used (opening year 2025).

4.10.9 A representation of the future baseline rail travel cost was also used for completeness purpose as agglomeration assessment requires a representation of travel costs by both highway and rail. Omission of this will usually lead to significant overestimation of agglomeration benefits. This was based on a dataset developed by Atkins during the course of delivering similar studies elsewhere. Information fed into the rail travel costs involves data like timetables, fare, NRTS survey on average access/egress time and information from automated online journey planning queries. It is noted that the focus on the particular assessment is highway intervention, so rail travel costs were assumed to remain unchanged in any tests.

4.10.10 Overall, the aforementioned methodology in this assessment was based on a review of similar work that was undertaken in a previous iteration of the study (with a bespoke spreadsheet). Mitigations were proposed in the latest approach in order to address potential limitations in the previous exercise in every aspect of the assessment, as summarised in Table 4-5 below.

Table 4-5 – A demonstration of key considerations informing our methodology

Area of observations		**Observations in the previous forecasts**	**Mitigations in the new approach**
Data	Transport connectivity	Unable to check / bespoke process	Improved transparency and assurance through the use of WITA
	Economic data	Observations on the discrepancies with DfT dataset (jobs and GVA)	Latest DfT wider impacts dataset used
	Other economic parameters	Consistent with the latest guidance in TAG	No changes
Calculation	Step 1 – GTC	See "Transport connectivity"	Python scripts developed to consolidate input from transport models
	Step 2 – ATEM	PT travel costs appears to be unrealistic for certain movements	Use of Atkins dataset applied elsewhere based on timetable and fare
	Step 3 – Annual impacts	Constrained to a selection of sectors excluding Manchester and Sheffield	Manchester and Sheffield included in one of the options
	Step 4 – Profiling over 60 years	VoT growth and discounting need update in new forecast	Incorporated in WITA

4.10.11 Additional detail on the method used for assessing agglomeration impacts is set out in Appendix G. Results of the WEI analysis are presented in Section 5.7.

4.11 Social and distributional impacts (SIs and DIs)

4.11.1 Social impacts (SIs) consider the human experience of the transport system and its impact on social factors, where not considered as part of economic or environmental impacts. SIs include the impacts of accidents, physical activity, security, severance, journey quality, option and non-use values, accessibility and personal affordability.

4.11.2 For SIs, the appraisal has been carried out in accordance with TAG Unit A4.1 Social Impact Appraisal (May 2020). A qualitative approach was deemed suitable for most indicators, although a quantitative assessment was undertaken where evidence was available. The results are presented using a seven-point scale of beneficial, neutral or adverse.

4.11.3 Distributional impacts (DIs) consider the variance of impacts across different social groups and are assessed as part of the appraisal and an assessment entered into the Appraisal Summary Table (AST). The DI assessment has followed guidance set out in TAG Unit A4.2 Distributional Impact Appraisal (May 2020). The distributional analysis aims to evaluate whether the preferred route unduly favours or disadvantages any particular social or vulnerable groups within the study area.

4.11.4 Both beneficial and/or adverse SDIs of transport interventions are considered, along with the identification of social groups within the geographical area which are likely to be affected. The indicators considered for social and distributional impacts are shown in Table 4-6. Where indicators have been assessed elsewhere in the Economic Appraisal Package these have not been considered within the SI assessment to avoid duplication.

Table 4-6 Indicators considered for social and distributional impacts

Indicator	Social Impact	Distributional Impact
User Benefits		✓
Air Quality		✓
Noise		✓
Personal Security	✓	✓
Severance	✓	✓
Accessibility	✓	✓
Personal Affordability	✓	✓
Collisions	✓	✓
Physical Activity	✓	
Journey Quality	✓	
Option Values and Non-Use Values	✓	

4.11.5 Full detail on the methodologies and results can be found in the Social and Distributional Impact Assessment Report, the location of which is provided in Appendix I.

5. Economic appraisal results

5.1.1 This chapter sets out the results of the economic appraisal for the core scenario in line with the assessment methodologies set out in chapter 4.

5.2 Transport Economic Efficiency (TEE)

5.2.1 All benefits and costs were calculated in monetary terms and expressed as present values (PV) in 2010 market prices, discounted to 2010.This enables direct economic comparison with other schemes which may have very different timescales.

5.2.2 The scheme is forecast to produce user benefits derived through TUBA for the operational period of £179.8m (PV) over the 60-year appraisal period. These benefits are generated by travel time savings of £165.64m and vehicle operating cost benefits of £14.2m due to the proposed scheme generating reductions in congestion which requires less fuel to be consumed.

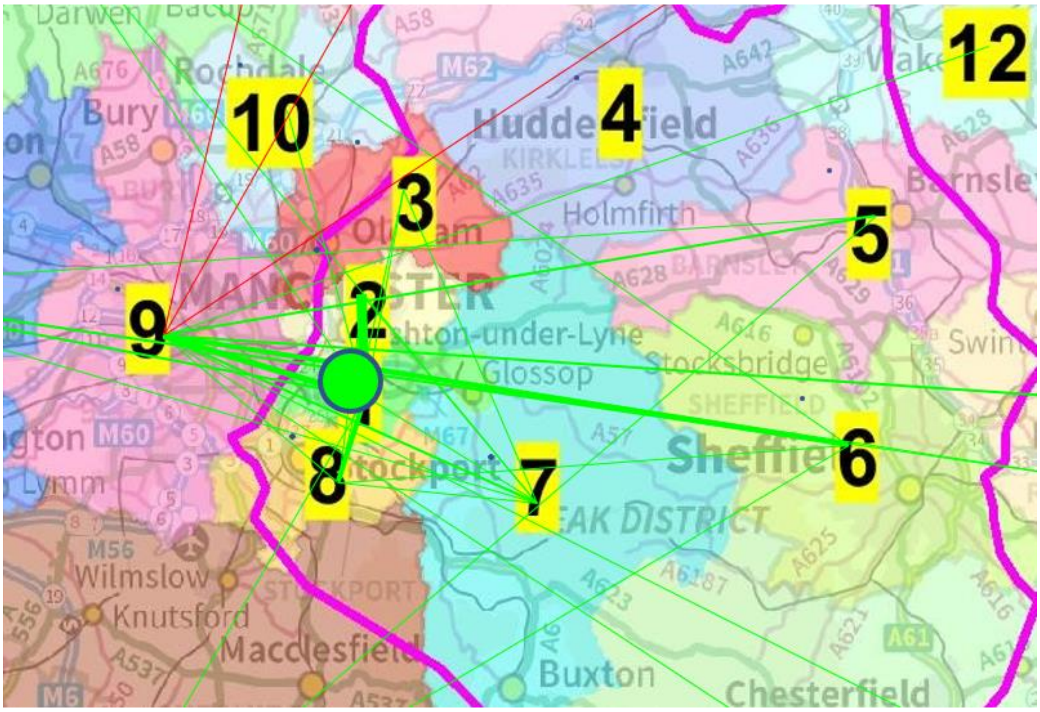
5.2.3 A number of detailed analyses were undertaken on the TUBA user benefit outputs to ensure that the results are logical and in line with expectations, as reported subsequent section. Table 5-3 shows the user travel time benefits over the 60-year appraisal.

Spatial analysis of benefits

5.2.4 To understand the spatial distribution of benefits from the scheme, sector analysis was carried out. The traffic model zones were aggregated into twenty-five sectors as set out in Figure 4-1

5.2.5 Figure 5-1 indicates the benefit distribution across the sectors in the vicinity of the Trans-Pennine Upgrade scheme.

Figure 5-1 - A57 Link Roads Scheme Benefit Distribution



Thickness of bands represents scale of 2-directional benefits for inter-sector movements

Size of circles represent scale of benefits for intra-sector movements

Green = benefit, Red = disbenefit

5.2.6 This shows a dominant source of benefits being movements within the central area of sector 1, with the majority of remaining benefits being generated on east to west and west to east movements across the scheme and shorter north to south and south to north movements also experience benefits as congestion is eased at key junctions. The movements which would be anticipated to have the greatest benefits would be:

- Sector 1 to Sector 1 = £27.98m;
- Sector 2 to Sector 1 = £11.92m;
- Sector 9 to Sector 1 = £10.24m;
- Sector 1 to Sector 9 = £6.73m; and
- Sector 8 to Sector 1 = £6.24m.

Note: All monetary values are in 2010 market prices discounted to 2010

5.2.7 Some sector-to-sector movements are forecast to experience a dis-benefit, and the movements with the highest dis-benefits are:

- Sector 9 to Sector 18 = -£0.70m;
- Sector 18 to Sector 9 = -£0.65m;
- Sector 11 to Sector 9 = -£0.64m;
- Sector 21 to Sector 17 = -£0.61m; and
- Sector 24 to Sector 9 = -£0.53m.

Note: All monetary values are in 2010 market prices discounted to 2010

5.2.8 A summary of how journey time benefits break down by scale of time saving per trip is set out in Table 5-1. Values indicated are the net position of benefits and disbenefits within each range. This shows the scheme will generate the majority of the time savings for trips which experience a change in journey time of more than 5 minutes. A similar scale of benefits for trips with savings between 2 and 5 minutes will be generated. Changes in journey times of less than 2 minutes largely balance out between benefits and disbenefits, resulting in only a small net benefit.

Table 5-1 Time benefits (£000s) by size of time saving

User	0 to 2 mins	2 to 5 mins	>5 mins
Business	10,975	40,610	42,907
Non business	-1,835	34,800	38,186

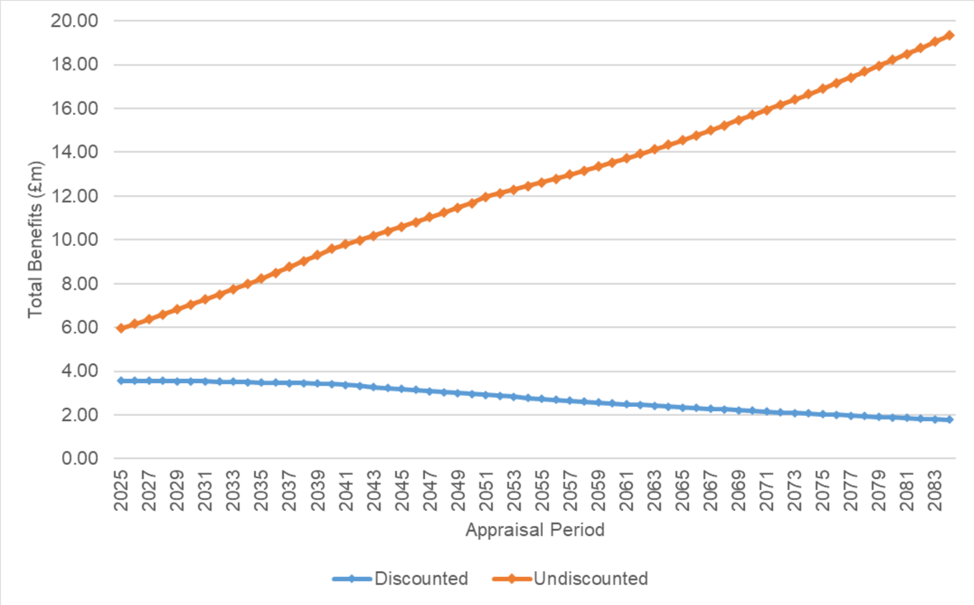
Note: All monetary values are in 2010 market prices discounted to 2010

5.2.9 Further detail on this distribution of benefits is set out in Appendix D.

Profile of benefits over 60-year Appraisal Period

5.2.10 Figure 5-2 shows the profile of the user journey time benefits across the 60-year appraisal period. The figure shows that although benefits rise through the forecast years from 2025 to 2051 as demand and hence congestion levels increase, once discounting has been applied this increase is largely levelled out. After 2051 the continued rate of discounting exceeds the rate of growth in values of time and so benefits decline afterwards until the end of the appraisal period in 2084.

Figure 5-2 - Profile of User masked benefits over Appraisal Period



Note: All monetary values are in 2010 market prices discounted to 2010

User Benefits by Journey Purpose

5.2.11 Table 5-2 below provides a summary of the user benefits disaggregated by journey purpose over the 60-year appraisal period.

Table 5-2 - User Benefits by Journey Purpose (£m)

Purpose	Travel Time	Vehicle Operating Cost	Total	Proportion
Business	£94.49	£17.47	£111.96	62.3%
Commute	£42.16	-£0.58	£41.58	23.1%
Other	£29.00	-£2.69	£26.31	14.6%
Total	£165.64	£14.20	£179.85	100%

Note: All monetary values are in 2010 market prices discounted to 2010

5.2.12 Analysis of user benefits show that more of the scheme benefits are attributed to business trips than commuting and other trips. As can be seen, the user benefits claimed by business purpose trips account for approx. 62% of the total user benefits, with 23% and 15% for commuting and other trips respectively. The significantly higher proportion of benefits attributed to business trips compared to commuting and others is expected as the scheme serves as part of a key inter-urban route and connects many businesses in the region and the value of time for business trips are higher than commuting and other trips. Movements such as Glossop to Manchester, Hyde and Stockport all benefit as do longer distance trips between Manchester and Sheffield, which are more frequently made for business purposes.

5.2.13 Some vehicle operating cost benefits are achieved for business trips, relating primarily to avoiding the need for lengthy diversions when making trans-Pennine movements. Modelling indicates rerouting of trips, which use the M62 and M1 in the DM scenario for travelling between Manchester and Sheffield, but which transfer onto the A628 and A57 in the DS scenario due to reduced congestion levels in the vicinity of the A57 Link Roads Scheme. This is a much shorter journey, resulting in reduced operating costs.

User Benefits by Time Period

5.2.14 Table 5-3 provides a summary of the user benefits in terms of time savings and vehicle operating cost benefits by time period, for each forecast year and also for the 60-year appraisal period. To enable direct comparison a summary is also provided showing only a single annualised hour per day, rather than the usual 3 hour peak periods and 6 hour interpeak.

Table 5-3 - User Benefits by Forecast Year and Period (£000s)

	Type	2025	2040	2051	60 Years
AM Peak	Total	£455	£550	£478	£25,938
Interpeak	Total	£2,744	£2,080	£1,600	£98,600
PM Peak	Total	£896	£1,070	£1,074	£55,309
Total	Total	£4,095	£3,700	£3,153	£179,847
AM Peak	per Hour	£152	£183	£159	£8,646
Interpeak	per Hour	£457	£347	£267	£16,433
PM Peak	per Hour	£299	£357	£358	£18,436

Note: All monetary values are in 2010 market prices discounted to 2010

5.2.15 The benefits show a similar level of impact during the Interpeak and PM peak hours, with a lower level of benefit during the AM peak. This highlights the directional nature of the congestion in the DM scenario. Delays on the A57(T) through Mottram in the PM peak by the design year of 2040 are forecast to be approximately double the length of those in the AM peak and considerably higher in the eastbound direction for flows all the way from Hattersley Roundabout to the A628(T).

5.2.16 These delays will be relieved through implementation of the A57 Link Roads Scheme, leading to a larger reduction in journey time, and therefore increase in benefit, for those trips experiencing the greatest delay in the DM scenario.

5.2.17 There are some fluctuations in how benefits by time period develop over the modelled years. The AM peak shows a reasonably stable level of benefit across the forecast years having been discounted to 2010, as does the PM peak. The interpeak period however shows a reduction over time in discounted benefits reflecting a relatively low rate of growth.

5.2.18 The distribution of time saving benefits by scale of change in journey time and change in trip numbers, measured at an OD pair level and aggregated across the network is set out in Appendix H.

5.3 User Costs During Construction

5.3.1 The results of the TUBA analysis of the construction impacts are shown in Table 5-4 (2010 prices, discounted to 2010):

Table 5-4 - Traffic Management (TM) User Disbenefits (£000) Unmasked

TM Phase	Construction Duration (days)	Commuting	Other	Business	Indirect Tax	Total
1	182	No Impact during construction				
2	183	-£55	-£99	-£13	£16	**-£155**
3	182	-£226	-£265	-£136	£29	**-£605**
4	184	No Impact during construction				
5_1	61	-£47	-£68	-£82	£10	**-£189**
5_2	31	-£25	-£38	-£34	£3	**-£95**
Total		**-£353**	**-£470**	**-£265**	**£58**	**-£1,044**

Note: All monetary values are in 2010 market prices discounted to 2010

5.3.2 The total net disbenefit during construction is -£1.04m occurring mainly during Traffic Management Phase 2, phase 3, and phase 5. Of these, phase 3 is the most detrimental, representing a 6 month period during which Mottram Moor will be reduced to a single lane in the eastbound direction.

5.3.3 It has been noted that the construction impact during Traffic Management phase 1 and phase 4 does not have any disbenefits as there was no restriction to the existing network during these construction periods.

5.3.4 Impacts on users during maintenance of the new network have been considered but have not been monetised. It has been assumed that delays during maintenance of the DM network will have a greater adverse impact than maintenance of the DS network. The newly introduced links add resilience to the existing network by adding capacity and providing alternative route options for use when traffic management measures are in place. This will reduce the need for lengthy diversions while maintenance is carried out.

5.4 COBALT: Accident Savings

5.4.1 Results of the COBALT assessment the A57 Link Roads Scheme's impact on the frequency and cost of traffic accidents is set out below. Table 5-5 summarises the accident impact of the scheme over the 60-year appraisal period.

Table 5-5 - Accidents and Casualties over Appraisal Period (Whole Network) (£m)

Scenario	Accident Summary (PIAs)	Casualty Summary (by Severity)			Economic Impact
		Fatal	Serious	Slight	
Do-Minimum	34,884	431	4,691	43,599	£1,304
Do-Something	34,986	438	4,718	43,755	£1,311
Scheme Impact	-102	-6	-28	-156	-£7.33

Note: All monetary values are in 2010 market prices discounted to 2010

5.4.2 The results show an increase in accident numbers on the assessed area of the modelled network, resulting in a monetised cost of accidents which is higher in the DS scenarios than the DM scenario. This means that the scheme provides an accident disbenefit. The accident impact from the proposed scheme is -£7.33m. This relates to a forecast increase of 102 accidents over the appraisal period, or an average of 1.7 accidents per year. This would lead to an estimated additional 6 fatal casualties, 28 serious casualties, and 156 slight casualties over 60 years.

5.4.3 A more detailed analysis of impacts across the network shows that the A57 Snake Pass, which is known to have a high accident rate, is forecast to experience an increase of more than 160 accidents. This alone exceeds the total impact across the rest of the network combined. Small increases in accidents are also expected through Glossop and along the A628. The scheme does not make any of these roads intrinsically less safe but increases traffic flow, leading to a higher potential for accidents to occur. Flow is reduced elsewhere on the network, such as along the M62, but motorways are safer than other road types and so the net impact of the combined rerouting is negative.

5.4.4 As Snake Pass is a known accident hotspot which will see flow increased as a result of the A57 Link Roads Scheme, measures should be pursued to minimise these negative impacts.

Impact on Strategic Road Network (SRN)

5.4.5 Within the COBALT assessment analysis has been performed of the impact of the scheme on the SRN in isolation. Figure 5-3 below indicates the network sections which have been included in this analysis. The existing A57 through Mottram has been included as part of the SRN in the DM scenario, but following de-trunking it is not included in the DS scenario, with the new link road replacing it as part of the SRN. Table 5-6 sets out the results of this analysis.

Table 5-6 - Accidents and Casualties over Appraisal Period (SRN only) (£m)

Scenario	Accident Summary (PIAs)	Causality Summary (by Severity)			Economic Impact
		Fatal	Serious	Slight	
Do-Minimum	3,561	66	482	4,880	£143.2m
Do-Something	3,511	67	482	4819	£143.0m
Scheme Impact	50	-1	0	61	£0.2m

Note: All monetary values are in 2010 market prices discounted to 2010

5.4.6 This shows a small benefit of £0.2m on the SRN, arising from a reduction of 61 slight injuries and the related damage caused by these accidents. The forecast show part of this saving to be offset by an increase of 1 fatality on the SRN over the 60 year period. This marginally higher fatality rate is driven by the increased flow on the A628 which has a slightly higher risk of this type of accident than other parts of the SRN.

5.4.7 The reduction in overall accident numbers is largely achieved through the junction improvements at Hattersley Roundabout and Gun Inn.

Spatial Distribution of Benefits

5.4.8 The spatial distribution of safety benefits by link, as forecast through the COBALT assessment, is set out in Figure 5-3. This shows that the most significant negative impacts will be on the A57 Snake Pass and the A628. These are both long distance routes which will see increases in flow. As a result, the vehicle-kilometres will be increased leading to a forecast growth in accident numbers.

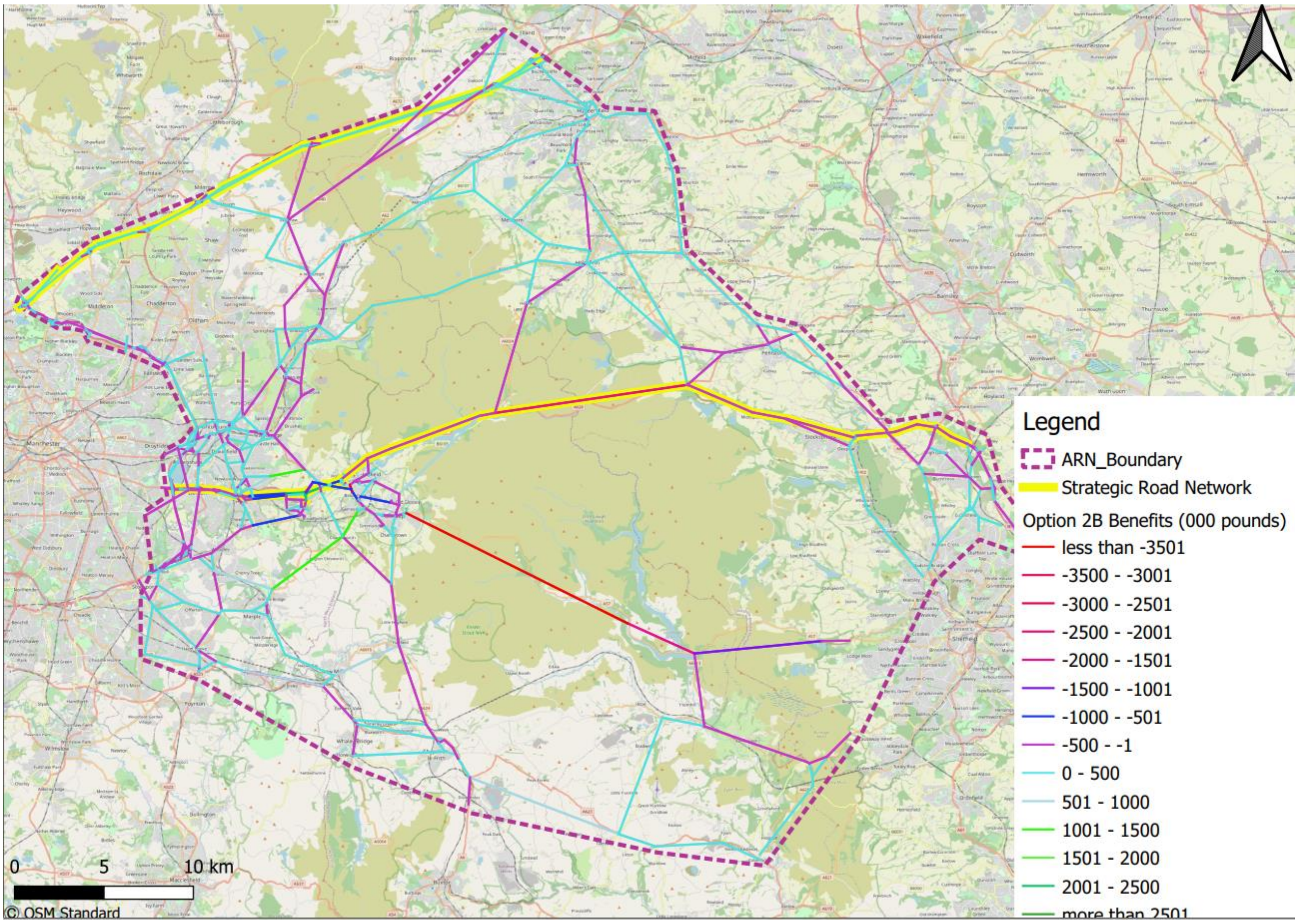
5.4.9 Similarly, the M67 and A560 will experience increases in flow, as the scheme makes these routes more desirable, leading to increases in accident numbers.

5.4.10 The links seeing the greatest improvements will be the A57 through Mottram, as traffic diverts onto the new link road and the A626 which will experience a reduction in flow as traffic diverts onto the A560.

5.4.11 Additional benefits which are not indicated in this figure will occur at Hattersley Roundabout and Gun Inn, as these junctions are upgraded to provide improved safety.

5.4.12 The SRN sections which have been assessed are indicated in the figure. The M60 Ring Road, the A627(M) and A663 have not been considered in this part of the analysis, as flow changes resulting from the scheme are negligible and within the range of model noise. Impacts at Hattersley Roundabout and Gun Inn junctions have been included within the SRN analysis.

Figure 5-3 – Spatial Distribution of Safety Impacts



5.5 Environmental Impacts

Air Quality Assessment

5.5.1 Air quality benefits over the 60-year appraisal period were computed as part of the Environmental Assessment using the standard TAG Air Quality Workbook. The value of these benefits over 60 years, is set out in Table 5-7.

Table 5-7 – Summary of Air Quality Outputs over 60 Years

Air Quality Output	Value
Increase in NOx emissions (tonnes)	284
Value of change in NOx emissions (NPV)	-£1.14m
Increase in $PM_{2.5}$ emissions (tonnes)	37
Value of change in $PM_{2.5}$ emissions (NPV)	-£2.63m
Total Air Quality (NPV)	-£3.77m

Note: All monetary values are in 2010 market prices discounted to 2010

Greenhouse Gases

5.5.2 Greenhouse gas benefits over the 60-year appraisal period were computed as part of the Environmental Assessment using the standard TAG Greenhouse Gases Workbook. The value of these benefits over 60 years is set out in Table 5-8.

Table 5-8 – Summary of Greenhouse Gas Outputs over 60 Years

Greenhouse Gas Output	Value
Change in CO_2e emissions (tonnes)	399,867
Greenhouse Gas (NPV) Central Carbon Values	-£17.4m

Note: All monetary values are in 2010 market prices discounted to 2010

Noise Assessment

5.5.3 Noise benefits over the 60-year appraisal period were computed as set out in Chapter 4. The value of these benefits over 60 years, in 2010 prices discounted to 2010 is £3.17m.

5.5.4 Although some significant adverse impacts are predicted during the construction phase, none of these are predicted during the night-time.

5.5.5 The scheme routes traffic away from an existing Noise Important Area, which is where most of the reductions in daytime and night-time noise will occur. The traffic is routed along a new route through areas that already affected by road traffic noise, however the dominant noise source changes. This is particularly evident around Mottram Moor junction where the existing A57 is relocated further from the front facades of receptors, but the new route of the A57 would introduce noise predominantly affecting the rear facades of the same receptors.

5.5.6 There are forecast to be 1619 perceptible adverse changes and 416 perceptible beneficial changes from the Scheme by the design year. However, the variation in scale of these impacts is such the overall result is a net positive value of benefit related to changes in noise levels.

5.5.7 Monetised benefits related to noise impacts are set out in Table 5-9.

Table 5-9 - Noise benefits (£m)

Economic parameters	Present value of reliability impact
Sleep disturbance	£1.42
Amenity	£1.08
AMI	£0.64
Stroke	£0.01
Dementia	£0.02
Total	**£3.17**

Note: All monetary values are in 2010 market prices discounted to 2010

Non-monetised Impacts

5.5.8 The anticipated non-monetised impacts, which cannot be reflected in the cost-benefit analysis above, are:

- A moderate impact on landscape features is expected at the point of scheme opening, but within 15 years these will be been remedied. Details of the affected receptors are recorded in the Environmental Statement.
- A moderate adverse impact on townscape features at a small number of receptors has been identified during both the construction and operational phases.
- A neutral impact on the historic environment.
- No significant adverse impact on biodiversity have been predicated as a result of the scheme.
- A moderate adverse impact on the water environment at the River Etherow is expected during the construction period. No further significant effects are anticipated during the operational period.

5.5.9 These are described more fully in the Appraisal Summary Table, which may differ from the Environmental Statement results due to being assessed against different criteria.

5.6 Journey Time Reliability

5.6.1 The overall results of the application of the TAG 'Urban Roads' reliability benefits calculation are summarised in Table 5-10,

Table 5-10 - Reliability benefits (£m)

Trip Purpose	Scheme Impacts
Business	£6.2
Commute	£2.4
Other	£2.1
Total	**£10.7**

Note: All monetary values are in 2010 market prices discounted to 2010

5.6.2 The reliability benefits were reviewed at the sector level, allowing the key impacts on the individual sector to sector movements to be identified with their geographical context. The largest impacts were:

- Within Sector 1 (Mottram): this sector alone gives a reliability benefit of around £3.6m.

- Movements from Sector 2 (Rest of Tameside) to Sector 1 produces the second largest benefit of around £1.10m followed by movements from Sector 8 (Stockport) to Sector 1 £0.6m.
- Sector 7 (Rest of High Peak) to sector 1 is having some reliability disbenefits at -£0.1m

5.6.3 Table 5-11 provides a further breakdown of the reliability benefits by vehicle type. This shows that cars account for the largest benefit of the impact at around £8.4m (79%). LGV and HGV account for roughly of around £1.5m (14%) and £0.7m (7%) respectively.

Table 5-11 - Reliability benefits by vehicle type (£m)

Vehicle type	Scheme Impacts
Car	£8.4
LGV	£1.5
HGV	£0.7
Total	£10.7

Note: All monetary values are in 2010 market prices discounted to 2010

5.7 Wider Economic Impacts (WEIs)

5.7.1 The following sections outline headline findings from the WEI assessment.

Agglomeration

5.7.2 Agglomeration reflects the increased productivity caused by firms being closer in physical or travel time terms to other firms and potential employees.

5.7.3 The WITA model outputs a total agglomeration forecast for the 60-year appraisal period and also provides separate forecasts for individual LADs. It is noted that due to the varying level of details in the transport model and the level of modelling noise present and masking applied, the robustness of agglomeration forecast by LAD also varies.

5.7.4 In light of the varying level of robustness in the forecasts, alterative perspectives of interpreting the output were established. This involves three different areas in which agglomeration benefits may be claimed, as illustrated in options A, B and C in Figure 5-4 and Table 5-12.

Figure 5-4 – Three options in interpreting agglomeration forecasts

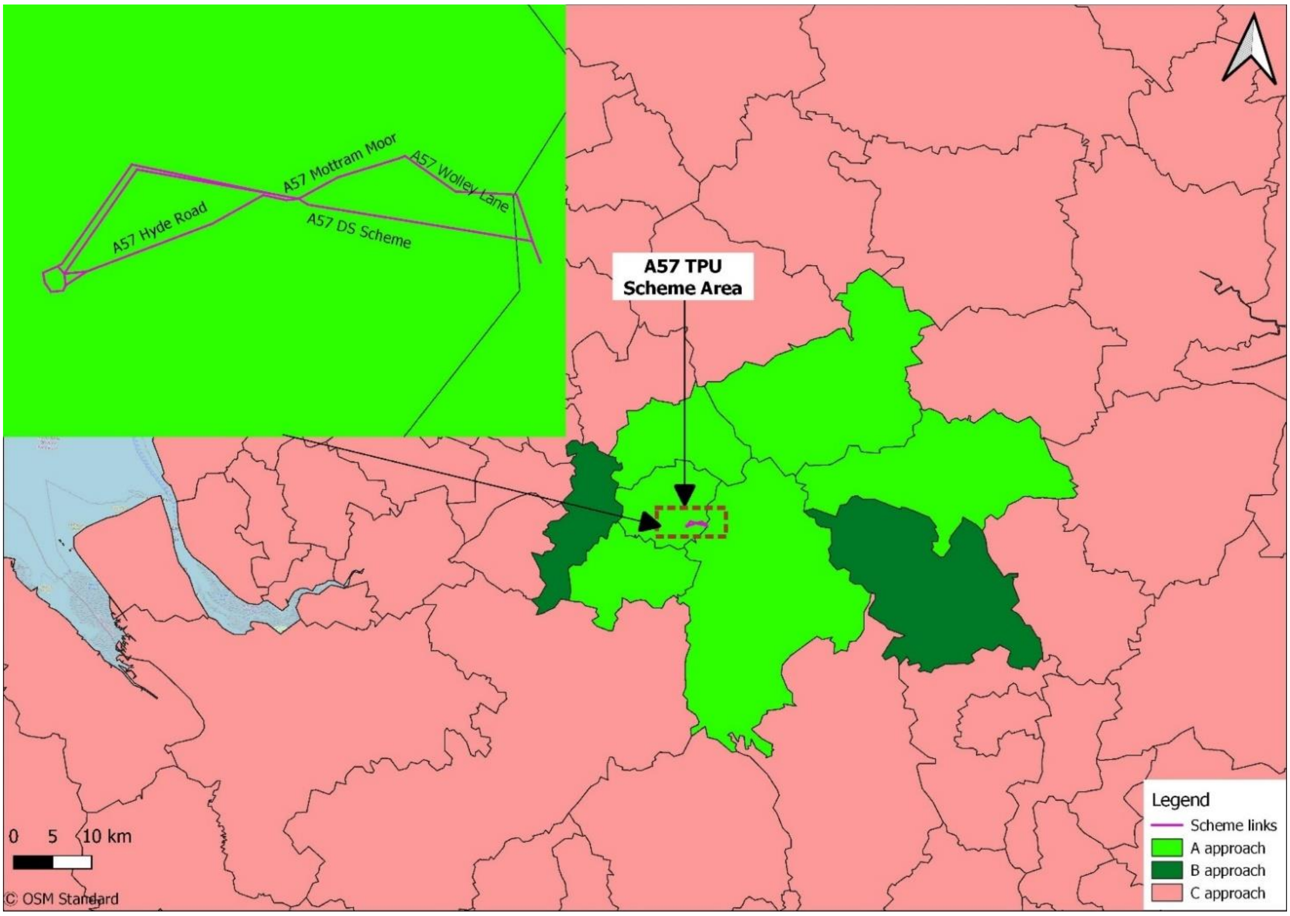


Table 5-12 – Agglomeration benefits forecasts from three different geographic perspectives (£m)

Perspective	Benefits	Commentary
Option A – benefits from High Peak, Oldham, Stockport, Tameside, Barnsley, Kirklees	£60	Areas located mostly within the ADM and are directly relevant to the geography of the scheme. Reasonable consistency in the forecast benefits between the masked and unmasked runs, which implies robustness.
Option B – Option A plus impacts from Manchester and Sheffield	£86	Including two clusters of economic activities at either side of the Pennine. Sensible (positive) forecasts obtained for Manchester and Sheffield when the masked transport model output was used.
Option C – Option B plus the rest of the country	£130	Significantly higher benefit when modelling ‘noise’ was dealt with by masking. Generally lower level of robustness for agglomeration forecasts with significant level of masking but it demonstrates the scope for additional benefits (vs Option A)

Note: All monetary values are in 2010 market prices discounted to 2010

5.7.5 Table 5-12 also outlines the reasons behind the choice of the three different approaches for interpreting agglomeration forecasts. Option A brings higher robustness and consistency although maybe on the conservative side. Option C is less reliable but certainly demonstrate the scope for potential legitimate benefits on a national stage but the exact figure is to be refined. Option B appears to bring a reasonable balance between robustness and representation of the scheme's real benefit in this context so it is the recommended figure to take forward for further assessment in the appraisal.

5.7.6 Furthermore, Table 5-13 also presents the top 10 LAD with the highest agglomeration benefits, along with an indication of the total employment present and which option each LAD falls into. It is clear from this that the top 10 locations are generally sensible in relation to the geography and nature of the intervention, and Option B captures these top locations reasonably well, hence offering a good blend of capturing the benefits whilst maintaining the robustness of the assessment.

Table 5-13 – Agglomeration benefits forecasts top 10 breakdown (by LAD on a national stage)

	LADs	Benefits	Employment	Option A	Option B	Option C
1	Tameside	£23,506,770	87,327	y	y	y
2	High Peak	£16,779,946	41,325	y	y	y
3	Stockport	£14,740,932	138,789	y	y	y
4	Sheffield	£13,080,189	297,476		y	y
5	Manchester	£12,596,494	350,836		y	y
6	Trafford	£5,607,028	142,976			y
7	Oldham	£4,853,746	97,431	y	y	y
8	Salford	£4,204,621	125,197			y
9	Bury	£2,676,751	80,299			y
10	Derbyshire Dales	£1,925,050	41,594			y

Note: All monetary values are in 2010 market prices discounted to 2010

Increased Output in Imperfectly Competitive Markets

5.7.7 This reflects the additional margin firms make on each unit of output they produce, and these impacts are anticipated to be modest.

5.7.8 The estimated value of this impact is driven directly by the value of business user benefits generated by the scheme and therefore has been calculated as outlined above in section 4.10 giving an additional contribution of £11.7m.

Labour Market

5.7.9 Labour Market impacts reflect the tax revenue from additional people joining the labour market or employment relocating to more productive locations and these impacts are anticipated to be insignificant.

5.7.10 It is expected to be beneficial as there is an overall reduction in journey time and cost. Due to the Trans-Pennine nature of the intervention, the direct impacts on (potential) commuters who are making this journey are likely to be small.

5.8 Social and Distributional Impacts (SIs and DIs)

5.8.1 Based on the approaches described in Section 4.11 this section sets out the identified Social and Distributional Impacts of the A57 Link Roads Scheme.

5.8.2 A summary of the findings of the analysis undertaken for the SI assessment accompanied with a brief conclusion is presented in Table 5-14.

Table 5-14 – Summary of Social Impacts

Indicator	Assessment	Conclusion
Collisions	Moderate Adverse	There is a relatively small increase in the number of casualties and associated collision costs as a result of the A57 Link Roads Scheme.
Physical Activity	Neutral	Small increases in active mode trips are to some extent counter-balanced by some walking and cycling trips moving to private modes. As a result, no impact to physical activity is expected as a result of the scheme.
Security	Neutral	The scheme is unlikely to significantly affect the security of drivers, but it will provide new and replacement street lighting which will enable some users to be more secure, especially pedestrians and cyclists.
Severance	Slight Beneficial	The detrunking of a section of the existing A57 will help to decrease the severance of the communities close to this road as the speed limit is decreased and the volume of traffic decreases leading to improvements in traffic flow. All new and improved junctions will be provided with upgraded WCH facilities (Gun Inn Junction, Mottram Moor, Wooley Bridge and M67 Junction 4) making crossing easier and improving safety. Consultation with landowners has been on-going throughout the Scheme's design to reduce severance on agricultural holdings. However, increases in traffic flow in Glossop will have slight adverse impact on access to amenities, and therefore the overall impact is expected to be slight beneficial.
Journey Quality	Slight Beneficial	Reduced congestion will reduce traveller stress along the Trans-Pennine route. The proposed scheme improvements are also expected to improve facilities and the environment for motorists. Overall, a positive impact on the quality of journeys is expected for motorists, pedestrians and cyclists.
Option and Non-Use Values	Not Assessed	No changes to public transport services or routes are proposed the scheme, so this indicator was not assessed.
Accessibility	Neutral	The scheme will not directly affect the accessibility of services and activities for non-car users, since it does not change any public transport routes, service frequencies or passenger facilities and does not impact upon disadvantaged communities. Nevertheless, it may allow some small opportunity for public transport improvements and hence better access on some local roads for which the scheme provides traffic relief. Overall the impact is assessed as neutral.
Personal Affordability	Neutral	The scheme will cause a slight increase in vehicle operating costs likely as a result of increased vehicle speeds in the area. However, there is a slight benefit for low income groups. The overall impact is assessed as neutral.

5.8.3 A summary of findings for the eight distributional impact indicators is provided in Table 5-15.

Table 5-15 – Summary of Distributional Impacts

DI indicators	Assessment	Conclusion
Accessibility	Not Assessed	This indicator was screened out of the DI assessment.
Severance	Slight Beneficial	The detrunking of a section of the existing A57 will help to decrease the severance of the communities close to this road as the speed limit is decreased and the volume of traffic decreases. These decreases in flows and traffic speeds are expected to lead to a reduced perception of severance for children, no car households and DLA claimants. Therefore, the impact is expected to be slight beneficial.
Security	Not Assessed	This indicator was screened out of the DI assessment.
Collisions	Moderate Adverse	Collision rates are expected to increase for income deprived residents and slightly for motorcyclists and young male drivers and very slightly for cyclists as a result of the TPU scheme. Mitigation in the form of improved crossings and signalisation at Hattersley Roundabout has been introduced which will reduce the negative impact of accidents on cyclists.
Air quality	Slight Beneficial	Air quality is expected to improve for the most income deprived residents as a result of the scheme. Both beneficial and adverse impacts to air quality for children are expected. It is however noted that the air quality assessment presented within the Environmental Statement focuses on areas of poor air quality used to inform the judgement of significant air quality effects and limit value compliance where as DfT's TAG appraisal considers the changes in air quality across the entire study area irrespective of whether there are areas exceeding government air quality thresholds i.e. it is a representation of overall changes of emissions, which may lead to a total increase but still see benefits in areas of poor air quality, as is the case for this scheme.
Noise	Slight Beneficial	Noise levels are expected to decrease for the most income deprived residents. However, there is an adverse noise impact for income quintiles 3 and 5.
User benefits	Moderate Beneficial	A proportionate beneficial impact to user benefits is expected for the 20% most income deprived residents.
Personal affordability	Slight Beneficial	There is a large beneficial impact to affordability for income quintile 1, but a moderate adverse impact for income quintile 2. Hence, the affordability assessment is considered slight beneficial.

5.8.4 The variance of impacts across quintiles of income deprivation is shown in Table 5-16.

Table 5-16 Distribution of measures across income quintiles

	Distributional impact of income deprivation (0-20% = most deprived)					Are the impacts evenly distributed?	Key impacts – Qualitative statements
	0-20%	20-40%	40-60%	60-80%	80-100%		
Accessibility	-						This indicator was screened out of the assessment.
Air Quality	✓	✓✓✓	✓	×	×	**No**	There are beneficial impacts to air quality for income quintiles 1-3, but adverse impacts for income quintiles 4 and 5.
Noise	✓	✓	×××	**0**	×××	**No**	There are beneficial impacts to noise for income quintiles 1 and 2, but adverse impacts for income quintiles 3 and 5.
User Benefits	✓✓✓	✓	✓✓✓	✓	✓✓	**No**	There are beneficial user benefits for all income quintiles, however, these vary in magnitude from slight to large.
Affordability	✓✓✓	××	✓✓✓	××	××	**No**	There are beneficial impacts to affordability for income quintiles 1 and 3, but adverse impacts for income quintiles 2, 4 and 5.

5.8.5 A copy of the full SDI report from which these results have been drawn can be found at the location indication in Appendix I.

5.9 Reporting the Economic Assessment Results

5.9.1 **Transport Economic Efficiency (TEE) Table**

5.9.2 The TEE table brings together the benefits to transport users and providers derived from the TUBA runs. The TEE table is a key component in the reporting of the economic assessment impacts and is set out in section 5.10.

Public Accounts (PA) Table

5.9.3 The PA table brings together the costs of the scheme and the revenue and tax changes which would result. The revenue and tax changes which follow from changes in traffic routes and speeds are derived from the TUBA output, while the capital and operating costs have been prepared as described in Chapter 3. The PA table is set out in Section 5.11.

Analysis of Monetised Costs and Benefits (AMCB) Table

5.9.4 The AMCB table brings together all quantified scheme costs and benefits to help determine the economic worth of the A57 Link Roads Scheme. This table is based on those elements of the economic appraisal which are considered to produce robust monetised estimates of the impacts. The AMCB table includes:

- User benefits, such as time savings and vehicle operating cost saving, over the 60-year appraisal period;
- Effects of delays during construction;
- Changes in user charge revenues;
- Indirect taxation benefits;
- Accident benefits;
- Monetised environment impacts; and
- Costs of construction and maintenance.

5.9.5 The benefits less costs provide an initial estimate of the Net Present Value (NPV) of the scheme. The ratio of these benefits to costs is referred to as the Initial BCR.

5.9.6 In the AMCB table, four critical values are presented:

- **The Present Value of Benefits (PVB)** is the summation of the stream of discounted initial benefits over the appraisal period, reduced by the discounted value of the developer contribution.
- **The Present Value of Costs (PVC)** is the summation of the stream of discounted costs from the current year forward through the 60-year appraisal period, less the discounted value of the developer contribution, although the majority of investment costs are likely to occur before the scheme opening year. The PVC indicates the total cost of the scheme which will be considered against the benefits.
- **The Net Present Value (NPV)** is the PVB less the PVC and indicates whether there are positive or negative benefits, and their scale, from a scheme.
- **The Benefit-Cost Ratio (BCR)** is the ratio of the PVB and the PVC.

5.9.7 The AMCB table is set out in section 5.12. Following the production of the AMCB table, the relevant values in the TEE/PA/AMCB tables are then transcribed to the AST.

Adjusted BCR

5.9.8 Following calculation of the Initial BCR other benefits whose estimation are considered to be less robust are added to the appraisal, as explained in DfT's Value for Money Assessment Advice Note (December 2013). These are benefits from changes in journey time reliability and wider economic impacts (WEIs) arising from implementation of the scheme.

5.9.9 The results of these calculations were used to derive an Adjusted PVB and an Adjusted BCR, set out in Table 5-20. The same PVC is used to generate the Initial and Adjusted BCRs.

5.10 Transport Economic Efficiency

The final Transport Economic Efficiency, Public Accounts and Analysis of Monetised Costs and Benefits tables are presented below in Table 5-17, Table 5-18 and Table 5-19 respectively.

Table 5-17 - Transport Economic Efficiency (TEE) Table (£m)

Non-Business: Commuting	
Travel Time	£42.16
Vehicle Operating Costs	-£0.58
User Charges	£0.58
Net Non-Business Benefits: Commuting	**£42.15**
Non-Business: Other	
Travel Time	£29.00
Vehicle Operating Costs	-£2.69
User Charges	£2.06
Net Non-Business Benefits: Other	**£28.37**
Business User Benefits	
Travel Time	£94.49
Vehicle Operating Costs	£17.47
User Charges	-£1.24
Net Business Benefits	**£110.72**
Total	
Present Value of Transport Economic Efficiency	**£181.25**

Note: All monetary values are in 2010 market prices discounted to 2010

5.11 Public Accounts

Table 5-18 - Public Accounts (PA) Table (£m)

Local Government Funding	
Revenue	£0
Operating Costs	£3.49
Investment Costs	£0
Developer and Other Contributions	£0
Grant/Subsidy Payments	£0
Net Impact	**£3.49**
Central Government Funding: Transport	
Revenue	£0.18
Operating Costs	£1.30
Investment Costs	£102.74
Developer and Other Contributions	£0
Grant/Subsidy Payments	£0
Net Impact	**£104.22**
Central Government Funding: Non-Transport	
Indirect Tax Revenues	-£1.41
Totals	
Broad Transport Budget	**£107.72**
Wider Public Finances	**-£1.41**

Note: All monetary values are in 2010 market prices discounted to 2010

5.12 Analysis of Monetised Costs and Benefits

Table 5-19 - Analysis of Monetised Costs and benefits (AMCB) Table (£m)

Item	Core Scenario
Noise	£3.17
Local Air Quality	-£3.77
Greenhouse Gases	-£17.45
Journey Quality	Not assessed
Physical Activity	Not assessed
Accident Savings	-£7.33
Delays During Construction	-£1.04[12]
Economic Efficiency: Consumer Users (Commuting)	£42.15
Economic Efficiency: Consumer Users (Others)	£28.37
Economic Efficiency: Business Users and Providers	£110.72
Wider Public Finances (Indirect Taxation Revenues)	£1.41[13]
Present Value of Benefits (PVB)	**£156.23**
Broad Transport Budget	£107.72
Present Value of Costs (PVC)	**£107.72**
Overall Impacts	
Net Present Value (NPV)	**£48.52**
Benefit to Cost Ratio (BCR)	**1.45**

Note: All monetary values are in 2010 market prices discounted to 2010

5.12.1 This excludes the values of reliability and wider economic impacts, the effect of which on the BCR is considered below.

5.13 Adjusted BCR

5.13.1 Inclusion of journey time reliability benefits and wider economic impacts increases the PVB from £156.23m to £264.20m. With the PVC of £107.72m, this gives an adjusted NPV of £156.49m and an adjusted BCR of 2.45.

[12] Delays During Construction include PVB from Greenhouse Gases, Economic Efficiency for Consumer Users (Commuting and Other), Economic Efficiency for Business Users & Providers and Wider Public Finances (Indirect Taxation Revenues).
[13] Excludes £58,000 of increased indirect tax generated during the construction period, to avoid double counting.

Table 5-20 - Analysis of Monetised Costs and benefits (AMCB) Table (£m)

Item	Core Scenario
Initial PVB	**£156.23**
Reliability	£10.72
Wider Economic Impacts	
Agglomeration	£85.56
Increased Output in Imperfectly Competitive Markets	£11.69
Adjusted PVB	**£264.20**
Broad Transport Budget	£107.72
Present Value of Costs (PVC)	**£107.72**
Overall Impacts	
Net Present Value (NPV)	**£156.49**
Benefit to Cost Ratio (BCR)	**2.45**

Note: All monetary values are in 2010 market prices discounted to 2010

6. Sensitivity Testing

6.1 Overview

6.1.1 The core scenario described in the previous sections is viewed as the ‘most likely’ future scenario. However, forecasting into the future is inherently uncertain, as unforeseen changes to key underlying assumptions can have implications for future levels of demand and supply. The DfT recommend, therefore, that scenario analysis be undertaken to allow for future uncertainty.

6.1.2 Four sensitivity tests have been undertaken considering changes to traffic growth and uncertainty of assumptions as agreed with Highways England.

6.1.3 The demand-side sensitivity tests utilise transport schemes as for the core scenario but apply adjustment factors to take into account low and high traffic growth, as set out in TAG Unit M4 and the Traffic Forecasting Report. These tests include:

- Low growth scenario: incorporating land-use uncertainty assumptions as for the core scenario (i.e. Near Certain and More Than Likely developments) with low traffic growth; and
- Optimistic scenario: The local uncertainty threshold was lowered so that all the ‘Reasonably Foreseeable’ developments from the uncertainty log were also included. Overall demand was then constrained to the national uncertainty associated with the optimistic growth scenario, at the trip end level. High traffic growth was then applied.

6.1.4 The low and high[14] traffic growth are represented in the modelled years by starting with the core scenario demand for that year and subtracting or adding a proportion of the base year demand. This proportion increases over time up to a maximum of 15% by the 36th year after the base year.

6.1.5 This testing of low and optimistic growth impacts has not considered the full range of impacts which have been assessed for the core scenario. Only the impact on benefits assessed through the TUBA software for the operational period of the scheme have been re-assessed to provide an indication of the scale of change.

6.1.6 A further sensitivity test has been presented in which the central carbon values used for calculation of the impact of greenhouse gas emissions have been replaced with high carbon values, to indicate the potential impact on economic performance of the scheme of potential increases in the monetary value attached to CO2e emissions.

6.1.7 Finally, a test of the sensitivity of the overall scheme performance to the geographic extent of the Wider Economic Impact assessment has been performed. As has been described, a range of tests were performed considering a balance between geographic coverage and robustness of assessment. The core assumption has been based on the mid-point of this range. Sensitivity tests have been set out examining the impact on the Adjusted BCR of each of the alternatives.

6.1.8 In all cases the scheme investment costs, and maintenance costs are held constant at the core scenario level.

6.1.9 The results of the sensitivity tests are summarised in the following sections and detailed in Appendix F.

[14] “High” growth here refers specifically to the difference in assumed growth rate relative to the Core scenario. The Optimistic scenario is generated through application of both this High growth and changes to future schemes and developments based on the uncertainty log.

6.2 Results from Low/Optimistic Growth Scenarios

6.2.1 Table 6-1 summarises the results of the demand-side sensitivity tests. Environmental and safety elements of the benefit assessment and to a lesser extent delays during the construction period would all be affected by alternative demand assumptions but for the purposes of these sensitivity tests these benefit groups have been retained at the same level as for the core scenario. Results produced from this analysis show that the BCRs are in the range from 1.20 to 1.72.

Table 6-1 - Summary for Demand-Side Sensitivity Tests (£m)

Item	Low	Core	Optimistic
Economic Efficiency: Consumer Users (Commuting)	£28.84	£42.15	£50.53
Economic Efficiency: Consumer Users (Others)	£26.45	£28.38	£35.88
Economic Efficiency: Business Users and Providers	£98.15	£110.72	£123.78
Wider Public Finances (Indirect Taxation Revenues)	£1.90	£1.14	£1.79
Other benefit groups (not reassessed)[15]	-£26.42	-£26.42	-£26.42
Present Value of Benefits (PVB)	**£128.92**	**£156.23**	**£185.55**
Broad Transport Budget	£107.72	£107.72	£107.72
Present Value of Costs (PVC)	**£107.72**	**£107.72**	**£107.72**
Net Present Value (NPV)	**£21.20**	**£48.52**	**£77.84**
Benefit to Cost Ratio (BCR)	**1.20**	**1.45**	**1.72**
Difference from Core BCR	**-17%**		**+19%**

Note: All monetary values are in 2010 market prices discounted to 2010

6.2.2 While it has not been considered proportionate to re-assess all elements of benefits in the assessment of Low and Optimistic scenarios, it is recognised that the wider economic impacts contribute a large value to the Adjusted BCR. An assessment has therefore been performed to identify to what extent these benefits would need to fall for the adjusted BCR to drop below 2.

6.2.3 However, it must be stressed that this is an indicator only of how much variation would be needed from the Core WEI forecast for the Low Growth Adjusted BCR to reach this level. There is no evidence base indicating how much change would actually be expected, or what factors leading to traffic levels falling to those forecast in the Low growth scenario would drive the necessary change in WEIs.

[15] Includes greenhouse gas emissions, air quality, noise, accidents and delays during construction. Values have not been reassessed for Low and Optimistic scenarios and so are assumed constant for the purpose of this sensitivity test.

6.2.4 The wider economic impacts in the Core scenario provide a benefit of £97.3m. This value would need to fall to £76m (a reduction of 22%) when combined with the Low Growth Initial PVB for the Adjusted BCR of the Low Growth scenario to fall to 2.

6.3 Output of High Carbon Assessment

6.3.1 For the High Carbon value sensitivity test, all elements of benefit and cost have been maintained at the same level as the core assessment, with the exception of the values placed on carbon emissions. There is no change to the assumed level of emissions, only to their economic value. The result of this assessment is set out in Table 6-2.

Table 6-2 – Summary of Greenhouse Gas Outputs over 60 Years (£m)

Greenhouse Gas Output	Value
Change in CO_2e emissions (tonnes)	399,867
Greenhouse Gas (NPV) Central Carbon Values	-£17.4
Greenhouse Gas (NPV) High Carbon Values	-£27.0

Note: All monetary values are in 2010 market prices discounted to 2010

The impact of this change on the overall economic performance is set out in Table 6-3.

Table 6-3 - Summary for Carbon Valuation Sensitivity Tests (£m)

Item	Central	High Carbon
Time savings, vehicle operating costs and user charges	£181.25	£181.25
Accidents	-£7.33	-£7.33
Greenhouse gas emissions	-£17.45	-£26.96
Air Quality	-£3.77	-£3.77
Noise	£3.17	£3.17
Delays during construction	-£1.04	-£1.04
Indirect tax	£1.41	£1.41
Present Value of Benefits (PVB)	**£156.23**	**£146.72**
Present Value of Costs (PVC)	**£107.72**	**£107.72**
Net Present Value (NPV)	**£48.52**	**£39.00**
Benefit to Cost Ratio (BCR)	**1.45**	**1.36**

Note: All monetary values are in 2010 market prices discounted to 2010

6.4 Alternative View of Wider Economic Impacts

6.4.1 As described in Section 5.7 the scale of agglomeration has been measured over a range of geographical coverage, including:

- Option A which provides the highest level of robustness but excludes potential impacts across much of the country;
- Option B which brings in Manchester and Sheffield; and
- Option C which assesses impacts across the whole country but is considered less robust.

6.4.2 Table 6-2 sets out the range of potential impacts of the WEIs on the Adjusted BCR for the Core scenario.

Table 6-4 – Uncertainty in Wider Economic Impacts (£m)

	Option A	Option B	Option C
Initial PVB	£156	£156	£156
Reliability	£11	£11	£11
Output in Imperfectly Competitive Markets	£12	£12	£12
Agglomeration	£60	£86	£130
Adjusted PVB	£239	£264	£309
PVC	£108	£108	£108
Adjusted BCR	2.22	2.45	2.87

Note: All monetary values are in 2010 market prices discounted to 2010

6.4.3 These results indicate a level of uncertainty only around the inclusion of WEIs from different regions within the assessment. Uncertainty around various assumptions used in the WITA assessment and in the precision of modelling input used in the forecasts are not captured within this range.

7. Summary

7.1 Approach

7.1.1 This Economic Appraisal Package documents the details of the approach adopted for the estimation of economic benefits arising from the scheme and summarises the results of the assessments, as part of the Project Control Framework (PCF) Stage 3.

7.1.2 This report also seeks to establish the extent to which the scheme provides good value for money in relation to impacts on public accounts by improving transport economic efficiency for all users, contributing to the wider economy and allowing for impacts on the environment.

7.1.3 The economic assessment compares the monetised costs and benefits of the proposed scheme (the Do Something or DS) against the alternative without scheme scenario (the Do Minimum or DM).

7.1.4 The costs of the scheme used in the assessment comprise the scheme construction costs provided by the Highways England Commercial team plus maintenance costs over the appraisal period. These costs are considered further in Section 3.

7.1.5 The benefits of the scheme are calculated from a number of sources, which are:

- User benefits during normal operation[16] (savings relating to travel times and vehicle operating costs) have been assessed using TUBA;
- User disbenefits during construction have also been assessed using TUBA (user disbenefits during maintenance assumed to be negligible); and
- Accident savings have been forecast using COBALT.

7.1.6 In addition, estimates have been made of the monetised greenhouse gas, air quality and noise impacts of the scheme.

7.1.7 Supplementary assessments have been undertaken to quantify benefits due to journey time reliability, wider economic impacts and social and distributional impacts.

7.1.8 An initial Benefit Cost Ratio (BCR) has been calculated over the 60-year appraisal period that excludes the outputs of the journey time reliability assessment and wider economic impacts, with an adjusted BCR also reported that includes these impacts.

7.1.9 The economic appraisal has been undertaken for the core scenario of the identified single option and is supplemented with sensitivity tests.

7.1.10 All benefits and costs were calculated in monetary terms and expressed as present values (PV) in 2010 market prices, discounted to 2010. This enables direct economic comparison with other schemes which may have different timescales.

7.2 Outputs

7.2.1 The scheme is forecast to produce benefits of £156m (PV) over the 60-year appraisal period. These benefits are generated by:

- Travel time savings and vehicle operating cost benefits of £180m;
- Safety disbenefits of -£7m;
- An environmental disbenefit of -£18m; and
- An indirect tax increase of £1m.

[16] These benefits currently reflect only the weekday peak and interpeak periods, in line with the forecasting prepared in the transport model. Subsequent stages of assessment may seek to also capture benefits during off peak and weekend periods.

7.2.2 The total scheme costs at the time of compiling this report are £108m (PV).

7.2.3 With consideration of these costs and benefits, the initial BCR is 1.45.

7.2.4 The scheme is forecast to generate additional benefits which have not been included in the Initial BCR. These include:

- Improved reliability worth £11m; and
- Wider economic impacts of £97m, composed of:
  - Agglomeration benefits of £86m; and
  - Increased output in imperfectly competitive markets of £12m.

Note: All monetary values are in 2010 market prices discounted to 2010

7.2.5 The addition of these elements of benefit result in an Adjusted BCR of 2.45 which represents Good Value for Money.

7.3 Performance Against Objectives

7.3.1 As set out in Section 1, a series of Scheme Objectives listed in the CSR have been defined for the scheme which have been used to inform the design. The economic assessment described above has been focussed on the overall impacts in line with TAG methodologies, which allow comparison of performance against other investments.

7.3.2 In parallel to this, reviews have been performed of the extent to which the proposed scheme will achieve its KPIs:

- **Connectivity** – reducing congestion and improve the reliability of people's journeys between the Manchester and Sheffield city regions.
  - As demonstrated by the time saving benefits and their spatial distribution, congestion through Mottram, Hattersley and Wooley Bridge will be relieved, improving journey times for trips on the SRN between Manchester and Sheffield, as well as for trips using the local road network in this area.
  - This impact benefits traffic not only between Manchester and Sheffield but also helps trips in other directions through the areas of Mottram, Hollingworth, Glossop and Hattersley, by providing additional network capacity.
  - Congestion on the de-trunked section of the A57 is also relieved, making improving connectivity for local traffic.
- **Environmental** – improving air quality and reducing noise levels in certain areas, through reduced congestion and removal of traffic from residential areas. The scheme is also being designed to avoid unacceptable impacts on the natural environment and landscape in the Peak District National Park.
  - It is recognised that, when measured across the whole study area, there is an overall increase in emissions. However, the outcomes of the air quality assessment undertaken using dispersion modelling to assess changes in concentrations at receptors, indicated there would be significant improvement in terms of annual mean NO2 concentrations at sensitive human health receptors within the air quality study area.
  - There is forecast to be an adverse noise impact during the construction phase, but with no night-time disturbance. Once operational the scheme will displace large volumes of traffic from a route immediately in front of properties through Mottram and Wooley Bridge, such that despite increases in flow the noise impacts will be positive.
- **Societal** – re-connect local communities along the Trans-Pennine route.
  - Reduced journey time and improved reliability will help to make use of this route more accessible. User benefits and affordability impacts of the scheme spread across all income groups, with the most deprived scoring most strongly in these areas.

- However, collision rates are expected to be adversely impacted by the scheme, with cyclist, motorcyclists and young males identified as being most at risk. Additional traffic flow using the A57 Snake Pass is forecast to lead to an overall increase in accidents and consideration of mitigation measures may be required.

- **Capacity** – reduce delays and queues that occur during busy periods and improve the performance of junctions on the route.
  - Transport modelling forecasts delays in excess of 5 minutes along the A57(T) in both directions in the DM scenario by the scheme design year of 2040 during the busy PM peak period. Due to the congestion this creates, traffic crossing the A57(T) will also experience delays of several minutes per trip. With the scheme in place delays through the same section of network or using the new links are all forecast to be less than 1 minute during the same time period and forecast year.
  - Improved design at the Gun Inn junction will benefit NMUs by making crossing easier and safety at the junction will also be improved.
  - At Hattersley Roundabout signalisation will improve safety and smoothness of flow, while the cut-through of the roundabout will provide more direct access between the M67 and the new Mottram bypass.
  - A reliability assessment has been performed which shows that, particularly for local movements in the vicinity of the scheme, journey times will become more consistent on a day-to-day basis.

7.4 Uncertainty

7.4.1 The core scenario is viewed as the 'most likely' future scenario. However, forecasting into the future is inherently uncertain, as unforeseen changes to key underlying assumptions can have implications for future levels of demand and supply. The DfT recommends, therefore, that scenario analysis be undertaken to allow for future uncertainty.

7.4.2 Two sensitivity tests have been undertaken considering changes to traffic growth and uncertainty of assumptions as agreed with Highways England.

7.4.3 The case for the scheme shows a moderate[17] level of sensitivity to variations in traffic growth with the optimistic growth scenario increasing the initial BCR to 1.72 (from 1.45 in the Core) while the low growth scenario reduces the initial BCR to 1.20.

7.4.4 A sensitivity test of the impact of using high, rather than central, carbon values adds £9.5m to the economic cost of emissions generated as a result of the scheme, reducing the BCR to 1.36.

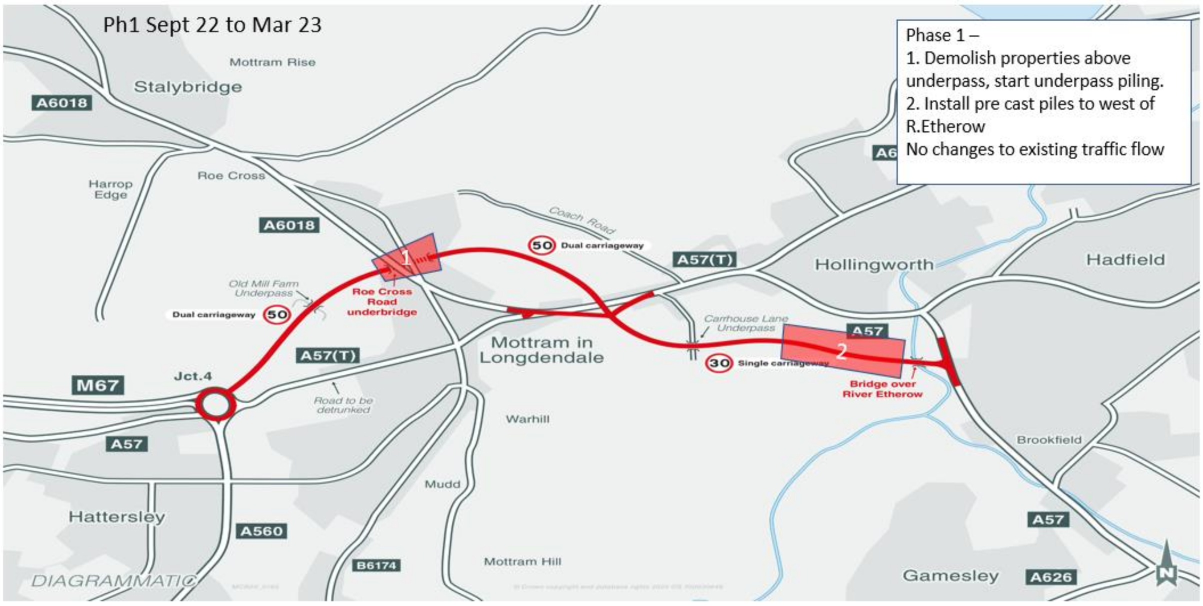
7.4.5 Finally, sensitivity tests around the potential area of impact of agglomeration indicates a range of BCRs from 2.22 to 2.87 could be returned based on this area of uncertainty.

[17] While this suggests a high range of BCRs, it must be recognised that the high and low growth parameters represent a range of +/-15% to growth in trip numbers and would suggest more fundamental changes to travel behaviour and long term economic growth. Where network capacity and rerouting options are more constrained it's not unusual for high growth scenarios in particular to demonstrate significantly greater impacts on performance.

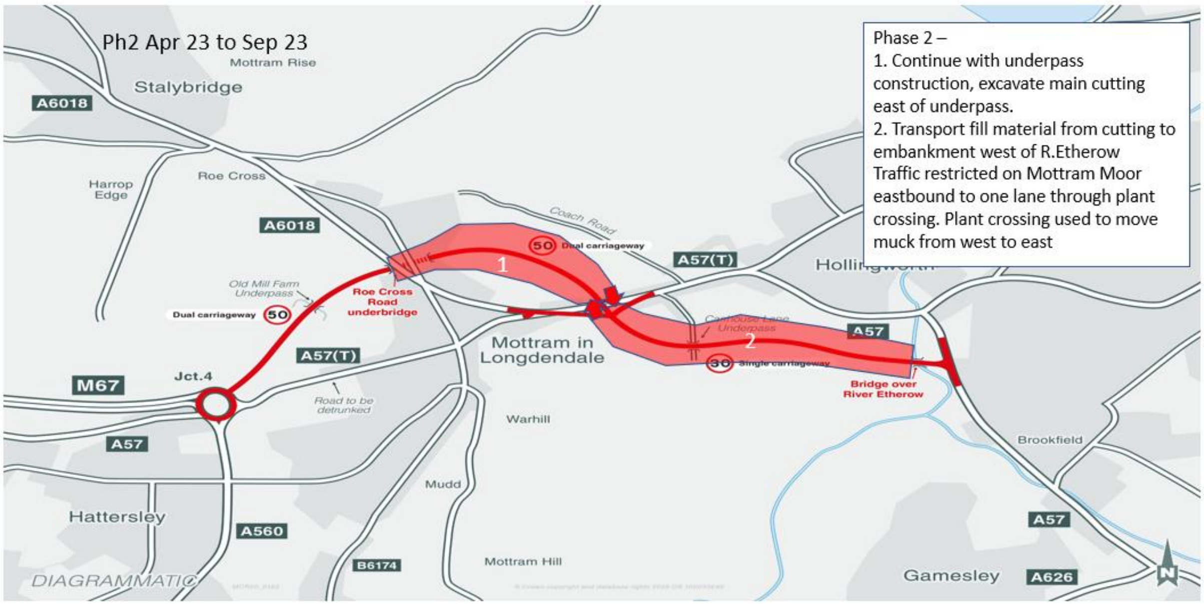
Appendices

Appendix A. Traffic Management Phases

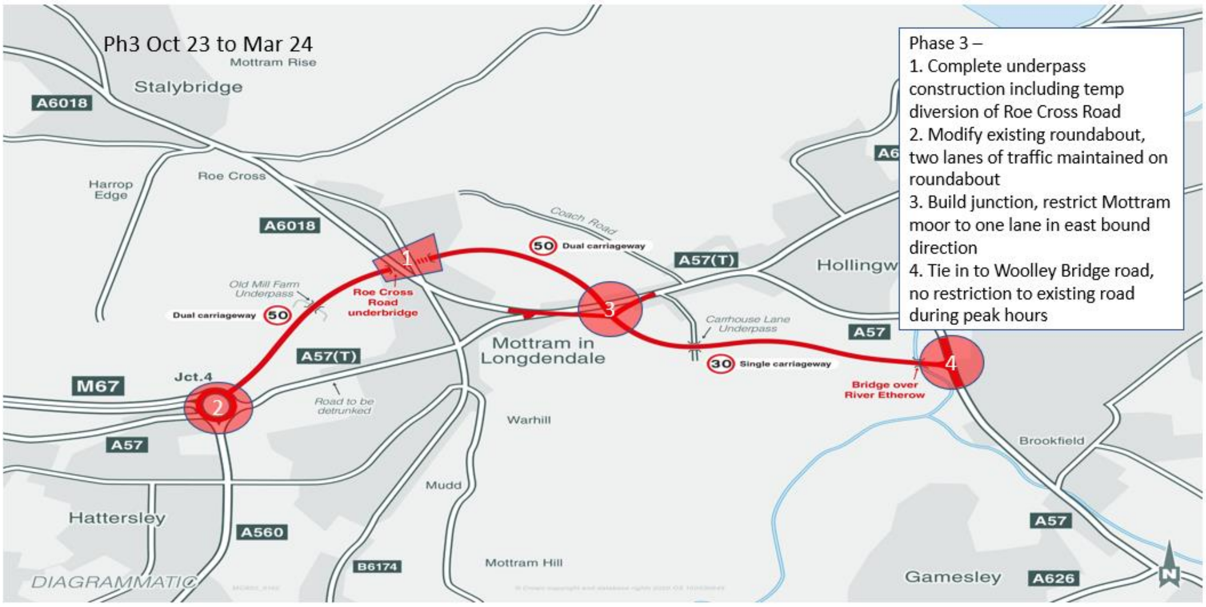
A.1. Traffic Management Phase 1



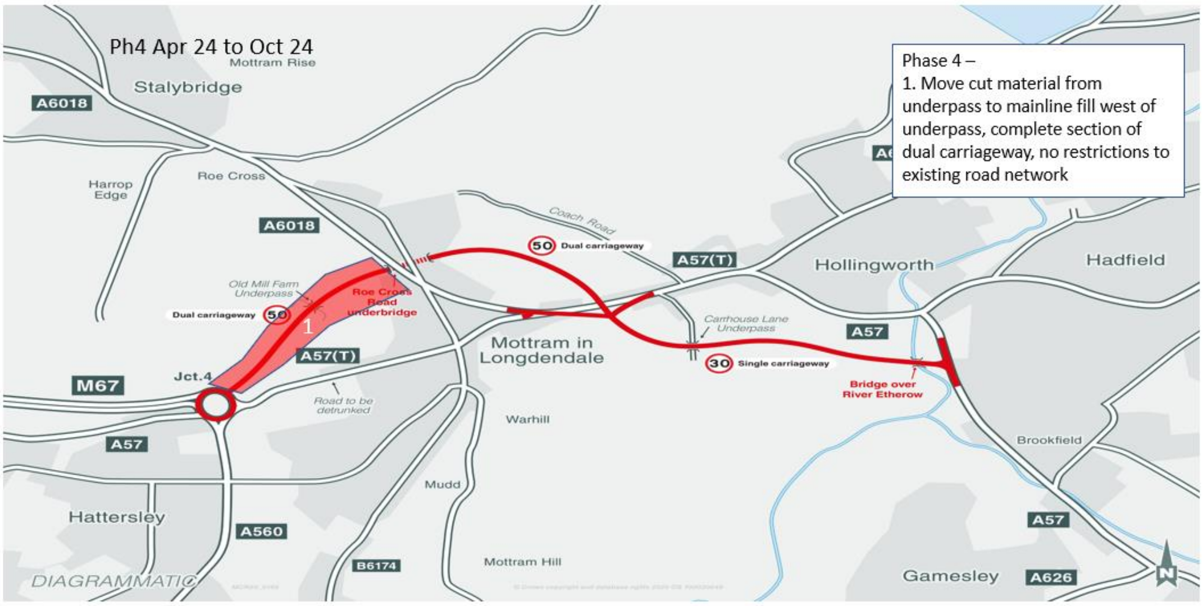
A.2. Traffic Management Phase 2



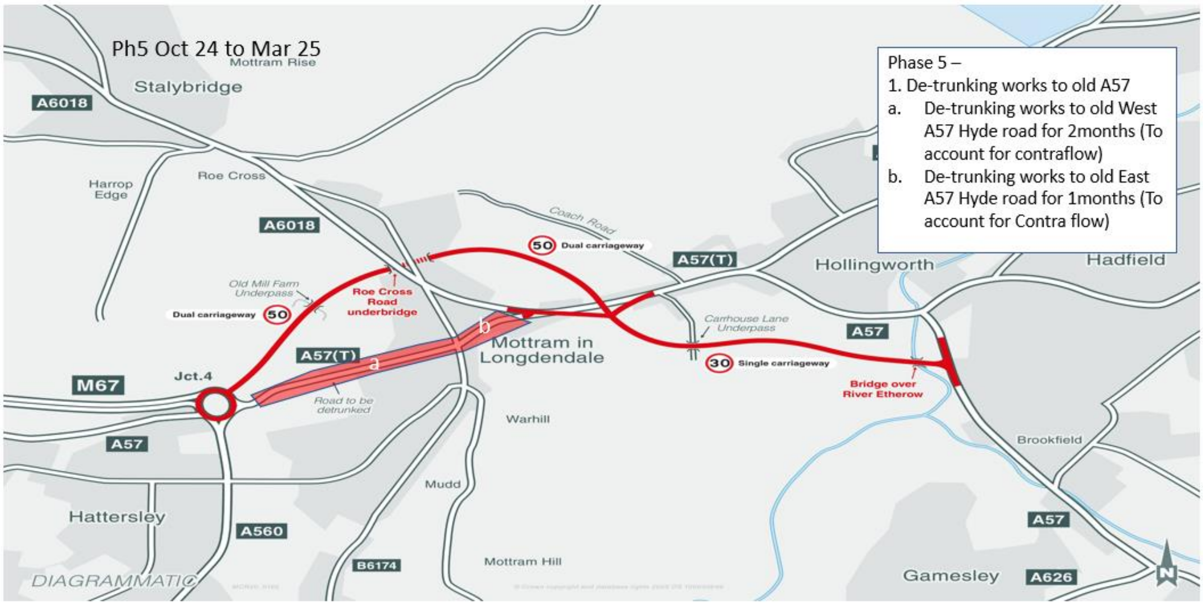
A.3. Traffic Management Phase 3



A.4. Traffic Management Phase 4



A.4.1. Traffic Management Phase 5



Appendix B. Scheme Cost Estimates

Highways England

Commercial Services Division

Economics Information for the whole package - Most Likely Cost

Funding Directorate	Major Projects (MP)
Project / Scheme Name	A57/ A628 Trans Pennine Upgrade
Option Name	Option A
Estimate Release Date	05/03/2021
Current PCF Stage	Developing
Type of Estimate	3. Development - Preliminary Design
Lead Cost Engineer	Matt Syddall

Estimate Release Notes

- If you have any questions regarding the information provided please contact CommercialServicesDivision@highwaysengland.co.uk
- Rebased 2010 calendar year profiles for Economic Calculations - All costs are in the factor cost unit of account.
- The expenditure profiles are based upon cost estimates for each financial year prepared at a base date and then inflated to outturn costs using HE projected construction related inflation.

These costs have then been rebased to 2010 calendar year profiles for economic calculations, using the GDP-deflator series as published in the WebTAG Databook.

- The costs exclude all VAT. All historic costs have been removed - previous years and an approximate of this years spend that occurs in the past.

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
PREPARATION EXPENDITURE PROFILE	£0	£7,293,875	£9,746,975	£2,713	£0	£0	£0	£0	£0	£0	£0	£0	£0
SUPERVISION EXPENDITURE PROFILE	£0	£0	£0	£1,076,005	£1,554,439	£1,025,624	£60,511	£0	£0	£0	£0	£0	£0
WORKS EXPENDITURE PROFILE	£0	£83,655	£102,129	£55,028,024	£47,619,850	£1,189,209	£0	£0	£0	£0	£0	£0	£0
LANDS EXPENDITURE PROFILE	£0	£2,349,788	£978,083	£4,399,456	£1,233,704	£1,047,951	£900,881	£172,594	£59,604	£55,891	£28,533	£18,612	£0
TOTAL EXPENDITURE FORECAST	£0	£9,727,317	£10,827,187	£60,506,198	£50,407,993	£3,262,783	£961,391	£172,594	£59,604	£55,891	£28,533	£18,612	£0

	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	Total (Excl Hist)
PREPARATION EXPENDITURE PROFILE	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£17,043,562
SUPERVISION EXPENDITURE PROFILE	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£3,716,578
WORKS EXPENDITURE PROFILE	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£104,022,867
LANDS EXPENDITURE PROFILE	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£11,245,099
TOTAL EXPENDITURE FORECAST	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£136,028,106

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	Total (Excl Hist)
PREPARATION EXPENDITURE PROFILE	0%	75%	90%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	13%
SUPERVISION EXPENDITURE PROFILE	0%	0%	0%	2%	3%	31%	6%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	3%
WORKS EXPENDITURE PROFILE	0%	1%	1%	91%	94%	36%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	76%
LANDS EXPENDITURE PROFILE	0%	24%	9%	7%	2%	32%	94%	100%	100%	100%	100%	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	8%
TOTAL EXPENDITURE FORECAST (ALL COSTS INCLUDED)	0.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
2010 PVC Market Price	£0	£7,928,594	£8,526,649	£46,038,618	£37,057,957	£2,317,554	£659,784	£114,443	£38,186	£34,596	£17,064	£10,755	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£0	£102,744,200

This table sets out only the capital cost element of the PVC. As illustrated in Section 3, additional costs will be incurred over the appraisal period of the scheme to maintain the assets. Spend profiles for the maintenance of the carriageway surface and the structures are set out in Table 3-4. The total PVC including both capital investment and maintenance is £107.72m.

Appendix C. Sector Definitions

As noted in Section 4 the study area covered by the model has been divided into 25 sectors to facilitate further analysis of TUBA outputs and to support the masking of these outputs. Details of the geography of the sectors is illustrated in Figure 4-1. The definitions of these areas are listed below:

The internal sectors are:

- Sector 1 -Study Area within Mottram
- Sector 2 - Rest of Tameside
- Sector 3 - Oldham
- Sector 4 - Kirklees
- Sector 5 - Barnsley
- Sector 6 - Sheffield
- Sector 7 - Rest of High Peak
- Sector 8 - Stockport

The buffer sectors are:

- Sector 9 - Manchester (North west Region)
- Sector 10 - Rochdale
- Sector 11 - Rest of York and Humber Region
- Sector 12 - Wakefield
- Sector 13 - Rotherham
- Sector 14 - Chesterfield
- Sector 15 - South West of Pennines
- Sector 16 - West of Pennines
- Sector 17 - North West of Pennines
- Sector 18 - East of Pennines (York and Humber)
- Sector 19 - East of Pennines, Lincoln, Doncaster, Scunthorpe

The external sectors are:

- Sector 20 - Rest of East
- Sector 21 - South East, South West and London Region
- Sector 22 - Rest of West Midlands and Wales
- Sector 23 - Rest of North West Region
- Sector 24 - North East Region
- Sector 25 - Scotland

Appendix D. Benefit Distribution

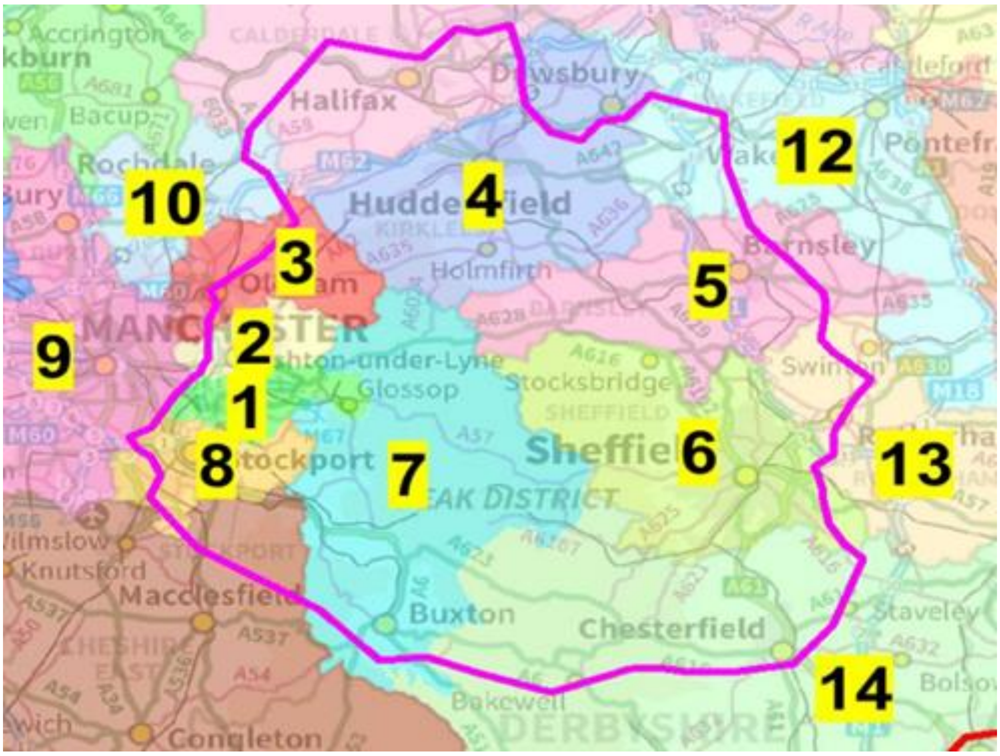
To understand the spatial distribution of benefits from the scheme, sector analysis was carried out. The traffic model zones were aggregated into twenty-five sectors as set out in Figure D-1

Sectors 1 to 8 are internal sectors, sectors 9 to 19 are buffer sectors, while sectors 20 to 25 are external sectors for the Trans-Pennine Upgrade scheme

Figure D-1 indicates the sectoring applied in the vicinity of the Trans-Pennine Upgrade scheme. Based on the size of the modelled area relative to the scale of scheme all external-external movements have been masked within the matrix skimming process.

The sector analysis of the transport user benefits for all the movements captured over the 60year appraisal period and is presented in Figure D-1.

Figure D-1 - A57 Link Roads Scheme Simulation Area Sectors



The sector analysis of the journey time benefits over the 60-year appraisal period post masking is presented in Table D-1.

Distributions of benefits per trip in the forecast years of 2025, 2040 and 2051 are set out in Table D-2 to Table D-4.
These tables indicate that the majority of benefits generated by the A57 Link Roads Scheme relate to trips either to or from the central sector 1, with the large number of trips to and from Manchester also resulting in moderate levels of benefits accruing to these movements.

The distributions of benefits per trip show a more dispersed pattern, as trips passing through the scheme will experience more comparable levels of benefit even if few trips make that journey. The masking process means that, though sector to sector demand levels may be high, only the trips which are affected by the scheme are retained for the benefit calculations. The benefit per trip distribution shows that the highest values are obtained by movements travelling from one side of the buffer area of the model to the other, on an east to west or west to east trajectory. These movements are largely from the areas west of Manchester to Sheffield, or from areas to the East of Sheffield towards Manchester. This demonstrates the improved connectivity along this corridor, preventing the need for potentially long diversions which may be required in the DM scenario to avoid the congested area around the A57 Link Roads Scheme.

Table D-1 – Sector Benefit Summary – Core Scenario – all 60 years (£m)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	Grand Total
1	28.0	4.8	1.5	0.2	0.1	0.7	1.5	3.0	6.7	0.8	0.1	0.1	0.1	0.2	1.8	2.7	1.7	-0.1	0.3	0.1	0.0	0.6	0.1	0.0	0.1	**55.1**
2	11.9	0.0	0.0	0.0	0.0	0.2	1.8	1.2	0.2	0.0	0.0	0.0	-0.1	0.1	0.3	0.0	0.0	0.0	0.0	0.3	0.1	0.1	0.0	0.0	0.0	**16.3**
3	1.9	0.0	0.0	0.0	0.0	0.3	0.8	0.5	0.1	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.1	0.1	-0.1	0.0	0.0	0.0	**4.1**
4	0.1	0.0	0.0			0.0	0.1	0.1	-0.1	0.0				0.0	0.0	0.0	0.0			0.0	0.0	0.0	0.0		0.0	**0.2**
5	0.0	0.0	0.0					0.1	0.8	0.0					0.4	0.0	0.0					0.1	0.0		0.0	**1.5**
6	0.1	0.1	0.1	0.0			0.0	0.6	4.0	0.1	0.0				0.8	1.7	1.6					0.3	0.1	0.0	0.0	**9.5**
7	0.3	0.7	0.3	0.0	0.0	0.0	-0.2	0.5	1.9	0.2	0.1	0.0	0.0	0.0	0.0	0.4	0.7	0.0	0.0	0.0	-0.1	0.0	0.1	0.0	0.0	**4.9**
8	6.2	1.1	0.6	0.2	0.3	0.9	1.3	0.6	1.2	0.1	0.1	0.1	0.1	0.1	0.1	0.5	0.2	0.1	0.3	0.1	0.1	0.0	0.0	0.1	0.0	**14.1**
9	10.2	0.3	0.2	0.5	3.3	5.8	2.3	0.8			-0.3	1.3	1.9	1.3	0.0			-0.7	3.7	1.1	0.2	0.0		-0.4		**31.5**
10	0.6				0.0	0.2	0.2	0.0				0.0	0.0	0.0	0.0				0.0	0.0	0.0	0.0				**1.1**
11	0.1	0.0				0.0	0.1	0.0	-0.6					0.0	0.0	0.0				0.0	0.0	0.0				**-0.5**
12	0.0	0.0	0.0				0.0	0.0	0.0	0.0				0.0	0.1	0.0	0.0			0.0		0.0	0.0			**0.2**
13	0.0	0.0	0.0					0.0	0.5	0.0					0.2	-0.2	0.0					0.1	0.0			**0.5**
14	0.1	0.0	0.0	0.0			0.0	0.0	0.6	0.0	0.0	0.0			0.0	0.0	0.1					0.0	0.1	0.0	0.0	**1.1**
15	1.8	0.2	0.2	0.1	0.7	0.6	0.3	0.0	0.0	0.0	-0.1	0.4	0.3	0.1		0.0	0.0	-0.1	0.7	0.0			0.0	0.0	0.0	**5.2**
16	4.4	0.1	0.0	0.1	1.5	2.9	0.8	0.1			0.0	0.5	1.2	0.4	0.0			0.0	0.5	0.1	0.0	0.0		0.0		**12.7**
17	2.2	0.0		0.0	0.1	2.3	0.4	0.1				0.0	0.1	0.1	0.0				0.0	0.1	-0.2	0.0				**5.2**
18	-0.1	0.0					0.0	0.0	-0.7						0.0	0.0						0.0				**-0.7**
19	0.0	0.0	0.0					0.1	0.3	0.0					0.1	-0.2	0.0					0.0	0.0			**0.4**
20	0.2	0.2	0.1	0.0			0.0	0.0	1.3	0.1	0.0	0.0			0.0	0.0	0.2					0.0	0.0	0.0	0.0	**2.3**
21	0.1	0.0	0.0	0.0			0.1	0.0	0.5	0.0	0.0	0.0				0.0	-0.6						0.0			**0.0**
22	0.1	0.0	0.0	0.0	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0		0.0	0.0	0.0	0.2	0.0			0.0	0.0	0.0	**0.7**
23	0.3				0.0	0.1	0.1	0.0						0.0						0.0						**0.5**
24	0.0	0.0				0.0	0.0	0.0	-0.5					0.0	0.0	0.0				0.0		0.0				**-0.6**
25	0.3				0.0	0.0	0.1	0.0	0.0					0.0												**0.4**
Grand Total	**68.9**	**7.5**	**3.0**	**1.0**	**6.2**	**14.3**	**9.4**	**7.7**	**16.4**	**1.3**	**0.0**	**2.5**	**3.7**	**2.4**	**4.0**	**5.0**	**4.0**	**-0.7**	**5.7**	**1.8**	**0.3**	**1.2**	**0.4**	**-0.3**	**0.1**	**165.6**

All values are in £million in 2010 market prices discounted to 2010.

Table D-2 – Sector Benefit Summary – Time Benefit per Trip, 2025 (£m)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	**Total**
1	0.05	0.02	0.03	0.06	0.03	0.13	0.06	0.02	0.03	0.03	0.03	0.05	0.08	0.11	0.05	0.05	0.06	-0.08	0.16	0.08	0.04	0.09	0.10	0.03	0.02	0.05
2	0.06	0.00	0.01	0.09	-0.05	0.22	0.35	0.06	0.00	0.00	0.01	0.06	-0.26	0.10	0.00	-0.01	-0.01	0.03	0.07	0.27	0.00	0.01	-0.01	0.02	-0.01	0.04
3	0.06	-0.01	0.00	0.06	0.22	0.44	0.41	0.14	-0.01	0.01	0.06	0.09	0.48	0.17	0.00	-0.02	-0.03	0.08	0.12	0.09	0.07	-0.01	-0.05	0.07	-0.07	0.09
4	0.05	-0.01	0.03			0.03	0.42	0.12	0.02	0.01				0.42	0.03	0.00	0.00			0.09	0.01	0.03	-0.02		-0.03	0.07
5	0.01	0.01	0.10					0.16	0.23	0.03					0.26	0.01	0.04					0.23	-0.01		-0.01	0.09
6	0.03	0.11	0.23	-0.03			-0.12	0.30	0.41	0.45	0.01				0.34	0.37	0.85					0.37	0.59	0.16	0.16	0.26
7	0.00	0.08	0.14	0.19	-0.11	-0.12	-0.22	0.14	0.15	0.14	0.13	-0.06	-0.09	-0.32	0.14	0.13	0.24	-0.07	-0.25	-0.27	-0.38	0.14	0.26	-0.20	0.26	0.00
8	0.03	0.03	0.07	0.11	0.49	0.42	0.21	0.08	0.04	0.05	0.04	0.10	0.41	0.29	0.05	0.04	0.06	0.02	0.43	0.10	0.28	0.05	0.04	0.07	0.07	0.14
9	0.08	0.01	0.01	0.11	0.62	0.74	0.23	0.09			0.00	0.14	0.54	0.39	0.06			0.01	0.39	0.14	-0.02	-0.01		0.02		0.19
10	0.08				0.02	0.55	0.16	0.04				0.03	0.03	0.03	-0.02				0.06	0.02	0.00	-0.04				0.08
11	0.05	0.01				0.45	0.15	0.03	0.02					0.19	-0.02	-0.05				0.02	-0.38	-0.03				0.04
12	0.04	0.01	0.02				-0.09	0.08	0.06	-0.04				0.39	0.04	-0.02	0.01			0.01		0.11	0.01			0.04
13	-0.03	-0.07	0.20					0.18	0.24	0.03					0.24	-0.30	0.03					0.29	0.02			0.08
14	0.05	0.07	0.06	0.19			0.07	0.21	0.22	0.03	0.16	0.02			0.16	0.01	0.14					0.13	0.22	0.32	0.07	0.12
15	0.10	0.01	0.01	0.06	0.67	0.54	0.57	0.04	-0.01	0.00	0.04	0.21	0.69	0.31		0.01	0.03	0.04	0.34	0.02			0.00	0.01	0.00	0.17
16	0.14	-0.03	-0.01	0.05	0.49	0.81	0.42	0.05			0.04	0.11	0.53	0.24	0.02			0.04	0.07	0.02	0.00	0.00		0.03		0.16
17	0.17	-0.17		0.01	0.05	0.91	0.13	0.12				0.15	0.04	0.03	0.01				0.07	0.01	0.00	-0.02				0.10
18	-0.02	0.04					-0.07	0.00	0.05						-0.02	-0.06						-0.04				-0.01
19	0.00	-0.06	0.00					0.11	-0.02	-0.04					0.11	0.00	0.00					0.17	0.00			0.02
20	0.08	0.10	0.03	0.02			-0.08	0.12	0.12	0.03	0.03	0.01			0.03	0.01	0.01					0.02	0.01	0.07	0.00	0.03
21	0.07	-0.20	-0.06	-0.05			-0.09	0.08	0.09	0.00	0.01	0.00				-0.02	0.00						0.00			-0.01
22	0.05	-0.06	-0.04	0.04	0.38	1.17	0.52	0.05	-0.01	-0.05	0.02	0.18	0.79	0.31		-0.01	-0.05	0.01	0.34	0.03			0.00	0.00	0.00	0.17
23	0.29				0.00	0.52	0.13	0.09						0.00						-0.01						0.15
24	-0.04	-0.05				0.10	-0.03	0.01	0.05					0.02	0.00	-0.05				0.01		-0.01				0.00
25	0.21				0.00	0.00	0.18	0.06	-0.15					0.00												0.04
Total	0.06	-0.01	0.05	0.07	0.22	0.43	0.15	0.10	0.08	0.04	0.04	0.08	0.30	0.16	0.07	0.00	0.09	0.01	0.16	0.04	-0.03	0.07	0.07	0.05	0.04	0.09

Table D-3 – Sector Benefit Summary – Time Benefit per Trip, 2040 (£m)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	Total
1	0.08	0.04	0.05	0.08	0.05	0.27	0.10	0.03	0.04	0.07	0.04	0.08	0.10	0.12	0.04	0.07	0.11	-0.10	0.25	0.11	0.04	0.11	0.17	-0.07	0.05	0.08
2	0.09	0.01	0.03	0.15	-0.06	0.45	0.55	0.15	0.01	0.04	0.03	0.10	-0.29	0.16	0.05	0.02	0.02	0.05	0.03	0.43	0.13	0.05	-0.01	0.07	-0.01	0.09
3	0.08	0.03	0.02	0.09	0.29	0.73	0.63	0.28	0.02	0.04	0.08	0.23	0.45	0.28	0.05	0.01	0.04	0.10	0.20	0.15	0.04	-0.02	0.04	0.12	0.06	0.16
4	0.07	0.01	0.05			0.07	0.54	0.09	0.00	0.00				0.50	0.03	0.00	0.00			0.11	-0.03	-0.05	-0.16		-0.04	0.07
5	0.02	-0.02	0.04					0.18	0.24	0.04					0.20	0.01	0.04					0.20	0.00		-0.05	0.08
6	0.02	0.16	0.27	0.03			-0.16	0.37	0.47	0.39	0.13				0.46	0.66	1.14					0.56	0.60	0.17	0.07	0.33
7	0.02	0.20	0.24	-0.02	-0.18	-0.19	-0.33	0.15	0.25	0.42	0.26	-0.11	-0.18	-0.43	0.06	0.24	0.50	-0.17	-0.06	-0.45	-0.57	0.18	0.57	-0.36	0.58	0.02
8	0.06	0.12	0.17	0.19	0.69	0.66	0.32	0.11	0.06	0.12	0.12	0.24	0.58	0.41	0.06	0.10	0.14	0.12	0.56	0.17	0.33	0.05	0.06	0.13	0.10	0.23
9	0.08	0.03	0.02	0.08	0.76	0.79	0.34	0.20			-0.06	0.24	0.65	0.53	0.09			-0.09	0.42	0.22	0.05	0.03		-0.08		0.23
10	0.09				0.08	0.66	0.28	0.17				0.08	-0.06	0.09	0.03				0.05	0.13	0.06	0.01				0.13
11	0.06	0.00				0.32	0.13	0.03	-0.02					0.14	0.03	0.06				0.05	-0.01	0.04				0.07
12	0.07	0.05	0.08				0.00	0.09	0.02	0.03				-0.02	0.09	0.00	0.02			-0.03		0.10	0.04			0.04
13	-0.02	-0.04	0.21					0.22	0.27	0.04					0.27	-0.21	0.04					0.30	0.03			0.10
14	0.10	0.16	0.11	0.08			-0.14	0.26	0.30	0.06	0.29	0.03			0.15	0.04	0.21					0.08	0.39	0.63	0.12	0.17
15	0.13	0.06	0.05	0.01	0.74	0.55	0.71	0.10	-0.02	0.02	-0.10	0.21	0.64	0.28		-0.01	0.08	-0.08	0.40	-0.04			0.00	0.01	0.00	0.17
16	0.17	0.02	0.00	0.01	0.44	1.08	0.70	0.11			-0.08	0.06	0.50	0.22	0.03			-0.10	0.02	0.03	-0.04	0.02		0.03		0.17
17	0.24	0.09		0.01	0.07	1.19	0.35	0.22				0.09	0.08	0.10	0.05				0.04	0.04	-0.11	-0.05				0.16
18	-0.10	0.01					-0.04	-0.01	-0.06						0.01	0.02						0.02				-0.02
19	0.04	-0.06	-0.01					0.14	0.11	0.01					0.12	0.00	0.03					0.09	0.02			0.05
20	0.18	0.25	0.11	0.03			0.30	0.21	0.21	0.17	0.06	0.03			0.01	0.01	0.07					0.00	0.03	-0.61	0.02	0.06
21	0.01	-0.04	-0.03	-0.08			-0.05	0.02	0.02	-0.01	0.01	0.01				0.01	-0.06						0.02			-0.01
22	0.00	0.01	-0.11	-0.11	0.42	1.19	0.56	0.10	-0.06	-0.06	-0.04	0.19	0.98	0.25		-0.05	-0.03	-0.10	0.43	0.02			0.02	0.02	0.02	0.17
23	0.42				0.02	0.47	0.32	0.14						0.06						0.03						0.21
24	-0.07	-0.01				0.26	0.00	0.00	-0.06					0.16	0.00	-0.01				0.02		0.02				0.03
25	0.41				0.01	0.03	0.42	0.14	-0.06					0.02												0.14
Total	0.09	0.05	0.07	0.04	0.26	0.53	0.25	0.14	0.09	0.09	0.06	0.11	0.31	0.17	0.09	0.05	0.15	-0.04	0.21	0.06	-0.01	0.09	0.11	0.00	0.08	0.123

Table D-4 – Sector Benefit Summary – Time Benefit per Trip, 2051 (£m)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	Total
1	0.09	0.04	0.10	0.13	0.13	0.34	0.12	0.02	0.07	0.22	0.15	0.14	0.18	0.17	0.10	0.18	0.35	-0.09	0.32	0.11	-0.05	0.13	0.31	0.09	0.25	0.14
2	0.09	0.03	0.05	0.21	-0.05	0.59	0.64	0.18	0.02	0.06	0.01	0.14	-0.31	0.21	0.06	0.03	0.07	0.00	-0.06	0.48	0.19	0.06	0.01	0.04	0.02	0.11
3	0.10	0.05	0.03	0.14	0.47	1.01	0.71	0.34	0.04	0.04	0.05	0.48	0.60	0.40	0.07	0.00	0.09	0.07	0.15	0.15	0.07	-0.05	0.03	0.07	0.03	0.21
4	0.07	0.07	0.02			0.14	0.55	0.04	-0.03	0.01				0.43	0.01	0.00	0.01			0.03	-0.03	-0.04	0.08		0.13	0.09
5	0.02	0.00	0.06					0.25	0.32	0.04					0.24	0.02	0.04					0.25	0.04		-0.04	0.10
6	0.01	0.16	0.34	0.01			-0.18	0.40	0.53	0.50	0.11				0.50	0.70	1.38					0.57	0.68	0.47	-0.03	0.38
7	0.03	0.26	0.34	0.10	-0.06	-0.19	-0.23	0.03	0.25	0.48	0.28	0.03	-0.17	-0.53	0.05	0.23	0.60	-0.09	-0.09	-0.50	-0.64	0.13	0.70	-0.22	0.70	0.06
8	0.06	0.14	0.23	0.29	0.95	0.84	0.45	0.08	0.05	0.03	0.10	0.28	0.79	0.52	0.00	0.04	0.10	0.13	0.71	0.20	0.32	-0.03	0.08	0.14	0.07	0.26
9	0.08	0.10	0.08	0.11	0.92	0.95	0.41	0.30			-0.06	0.25	0.74	0.61	0.11			-0.08	0.45	0.24	0.04	0.02		-0.07		0.27
10	0.09				0.08	0.82	0.38	0.25				0.10	-0.19	0.07	0.06				0.03	0.07	-0.03	-0.01				0.13
11	0.03	-0.03				0.77	0.12	0.01	-0.14					0.18	-0.01	0.00				-0.07	0.09	0.03				0.08
12	0.05	0.07	0.04				-0.04	0.09	-0.03	0.04				-0.03	0.07	-0.01	0.02			-0.05		0.12	-0.08			0.02
13	-0.02	-0.07	0.23					0.27	0.32	0.05					0.31	-0.20	0.05					0.40	-0.06			0.12
14	0.13	0.24	0.15	0.42			-0.21	0.23	0.33	0.07	0.35	0.03			0.19	0.05	0.26					0.13	0.32	0.74	0.11	0.21
15	0.12	0.13	0.13	0.06	0.85	0.58	0.85	0.11	-0.02	0.03	-0.01	0.19	0.70	0.05		0.02	0.11	0.00	0.50	0.02			0.04	-0.02	0.04	0.20
16	0.20	0.12	0.02	0.06	0.43	1.11	0.84	0.23			0.05	0.14	0.56	0.22	0.02			0.05	0.06	0.05	0.04	0.02		0.03		0.22
17	0.26	0.40		0.01	0.09	1.38	0.44	0.29				0.10	0.08	0.09	0.09				0.05	0.05	-0.03	0.04				0.22
18	-0.15	-0.01					-0.07	-0.01	-0.13						0.01	0.01						0.00				-0.04
19	0.06	-0.13	0.00					0.17	0.04	0.01					0.04	-0.06	-0.05					0.04	-0.06			0.01
20	0.27	0.43	0.13	0.00			0.23	0.03	0.28	0.21	0.06	-0.01			0.01	0.02	0.06					0.00	-0.01	-0.12	-0.01	0.09
21	0.09	0.04	0.00	0.03			0.46	-0.07	0.15	-0.02	0.00	0.00				-0.02	-0.33						-0.05			0.02
22	0.04	0.11	-0.01	0.04	0.48	1.07	0.71	0.06	0.02	0.02	0.00	0.19	0.98	0.09		-0.04	-0.01	0.02	0.31	0.00			-0.03	0.01	-0.04	0.18
23	0.48				0.03	0.52	0.39	0.23						0.12						0.08						0.26
24	-0.11	0.00				0.32	0.00	0.00	-0.17					0.16	-0.02	0.01				0.01		0.00				0.02
25	0.46				0.01	-0.01	0.47	0.23	-0.06					0.05												0.16
Total	0.10	0.10	0.11	0.12	0.33	0.64	0.32	0.15	0.09	0.11	0.08	0.15	0.36	0.17	0.10	0.05	0.17	0.00	0.22	0.05	0.00	0.09	0.13	0.10	0.10	0.15

Appendix E. TUBA Warnings

All scenarios assessed in TUBA have had output files reviewed to check warning messages for any possible indications of problems. A record of the review undertaken for the Core Scenario is set out below.

E.1. Warnings and Logic checking

Annualised total trip matrix numbers that were fed as an input to TUBA were cross checked for different peak periods, user classes and forecast years by deriving them independently from SATURN matrices and comparing them to TUBA outputs. All comparisons showed the results to be internally consistent.

Warnings on the Core Scenario TUBA (Masked) output file, such as the ratio of DM to DS travel distance or travel time being outside the defined range, were investigated. The number of warnings of each type is summarised in Table E-1 – TUBA Warnings for Core Scenario TUBA run (Masked)

Table E-1 – TUBA Warnings for Core Scenario TUBA run (Masked)

TUBA Warning	Number of types of warning	Comment
Warning: Ratio of DM to DS travel time lower than limit	1,013 (Serious 42)	Longer travel times forecasted for a small number of short distance movements. 42 of such warnings are serious. [18]
Warning: Ratio of DM to DS travel time higher than limit	15,298 (Serious 113)	Indicates relatively high journey time savings but impacting only very small number of short distance movements. 113 of such warnings are serious. [11]
Warning: Ratio of DM to DS travel distance lower than limit	1,857 (Serious 193)	Longer travel distances forecasted for few small numbers of inter zonal trips (majority of those are of short distance movements). 193 of such warnings are serious. [11]
Warning: Ratio of DM to DS travel distance higher than limit	1,326 (Serious 86)	Shorter travel distances forecasted for a small number of movements. 86 of such warnings are serious. [11]
Warning: DM speeds less than limit	157,722	Warnings relate to DM trips having speeds lower than the minimum threshold speed of 5km/h as specified in TUBA. Few DM trips experience network delay and most of them are of short distance trips to town centre. [11]
Warning: DM speeds greater than limit	1,513,762	Warnings relate to DM trips having speed higher than the maximum threshold speed of 130km/h as specified in TUBA. These movements are happening outside of model simulation area. [11]
Warning: DS speeds less than limit	157,834	Warnings relate to DS trips having speeds lower than the minimum threshold speed of 5km/h as specified in TUBA. Few DS trips experience network delay and most of them are of short distance trips to town centre. [11]
Warning: DS speeds greater than limit	1,513,002	Warnings relate to DS trips having speed higher than the maximum threshold speed of 130km/h as specified in TUBA. These movements are happening outside of model simulation area. [11]
Warning: DM time greater than limit	49	Warnings relate to few DM trips where travel time exceeds the maximum limit of 10 hrs as specified in TUBA. Due to large size of this model, few OD

[18] Warnings of this type tend to occur for adjacent zones which are connected directly by centroid connectors meaning that traffic does not need to enter the modelled network.

TUBA Warning	Number of types of warning	Comment
		pairs particularly for HGVs experience such a high travel time.
Warning: DS time greater than limit	47	Warnings relate to few DS trips where travel time exceeds the maximum limit of 10 hrs as specified in TUBA. Due to large size of this model, few OD pairs particularly for HGVs experience such a high travel time.
Serious Warning: Possible introduction of new mode one of DM and DS time is zero, but not both	96 (Serious 96)	Warnings relate to OD pairs in which either DM or DS (but not both) time is zero. These warnings have been checked and relate to movements which have zero time associated due to demand for that movement being zero in one scenario or the other. Very small variations in trip numbers across the network result in some movements fluctuating between zero and marginally above zero between scenarios. In all cases the demand reported for the relevant movements have been confirmed to be zero due to the rounding processes employed within TUBA, so these variations have no impact on the calculated benefits.
Serious Warning: Possible introduction of new mode one of DM and DS distance is zero, but not both	211 (Serious 211)	Warnings relate to OD pairs in which either DM or DS (but not both) distance is zero. As above the zero distances relate to demands for these movements varying between zero and a very small non-zero number. Checks have been performed showing the non-zero distances have very low demands associated and so will not impact on the reported benefits.
Total	3,362,217	Total Number of Warnings

Appendix F. Observed Accident Data

Table F-1 – STATS19 accident data for "Combined Link and Junction" approach

Accident Location		Accident Year					
Road/Junction	Link Name	2014	2015	2016	2017	2018	Total
Sheffiel Road	Silk Street/Sheffield Rd to Shirebrook Drive/Kings Edward Avenue	0	0	0	0	0	0
High Street	Shirebrook Drive/Kings Edward Avenue to Smithy Fold/Elison St	0	0	2	0	1	3
	Smithy Fold/Elison St to Victoria St/Norfolk St	0	1	0	2	0	3
	Victoria St/Norfolk St to Market St/Railway St/High St	1	1	2	1	1	6
	Market St/Railway St to Arundel st/Chapel St	2	0	1	0	0	3
	Arundel st/Chapel St/High St E to Brook St/High St E	2	1	1	0	0	4
	Brook St/High St E to Queen St/Glossop Brook Rd	0	2	0	0	1	3
	Queen St/Glossop Brook Rd to Spring St/High St E	0	0	0	1	1	2
	Spring St/High St E to Primrose Ln/Brookfield/High St Rbt	0	0	0	1	1	2
Brookfield	Primrose Ln/Brookfield/High St Rbt to Dinting Ln/Brookfield	0	1	0	1	1	3
	Dinting Ln/Brookfield to Brookfield/Glossop Rd	0	1	1	0	0	2
	Brookfield/Glossop Rd to Shaw Ln/Brookfield	0	0	0	2	0	2
	Shaw Ln/Brookfield to Tavern Rd/Brookfield	4	2	0	3	1	10
Woolley Lane	Woolley Bridge Rbt to Woolley Ln/Earnshaw St	0	1	1	0	1	3
A57 Mottram	A57 Mottram Carrhouse to A57 Mottram Moor/Fern Cottages	0	0	0	0	0	0
A57 Mottram	Mottram Moor Fern Cottages Ln to A57 Mottram Bus Stop	0	0	0	0	0	0
	A57 Mottram Bus Stop to Mottoram Moor/Back Moor bypass	0	0	0	0	0	0
	A57 Mottram Moor/Fern Cottages to Mottram Moor/BackMoor Pass	0	0	0	0	0	0
Back Moor Junction	Mottram Moor/BackMoor Pass to Roe Cross Rd	1	0	0	0	1	2
	Mottram Moor/BackMoor Pass to Roe Cross Rd	1	0	0	0	1	2
A628	Flouch Roundabout to A628/A6024 Woodhead Rd	14	5	11	11	9	50
	A628/A6024 Woodhead Rd to A628/B6105 bypass	2	2	0	0	1	5
	A628/B6105 bypass to Woodhead Rd/Valehouse Reservoir	0	2	1	2	2	7
	Woodhead Rd /Valehouse Reservoir to New Rd/Church St	1	0	1	1	1	4
	Market St/Water Ln to Church St/Manchester Rd/New Rd	3	0	2	1	1	7
	Market St/Water Ln to Market St/Taylor St	1	2	2	1	1	7
B6105	A628/B6105 bypass to Woodhead Rd/Cementery Rd	2	3	0	2	1	8

Table F-2 – STATS19 accident data for "Link Only" approach

Accident Location		Accident Year					
Junction	Link Name	2014	2015	2016	2017	2018	Total
Hattersley Roundabout	M67 Approach to Hattersley Roundabout in DS (Link 1)	0	0	0	2	0	2
Gun Inn Junction	Approach arm to Gunn Inn junction, along Mottram Moor in DS (Link 2)	0	0	0	2	0	2
Woolley lane Junction	Approach to Woolley Lane junction – Proposed Link (Link 5)	0	0	0	2	0	2
Gun Inn Junction	Approach arm to Gunn Inn junction, along Mottram Moor in DM (Link 7)	0	0	0	2	0	2

Table F-3 – STATS19 accident data for "Junction Only" approach

Accident Location		Accident Year					
Junction	Junction no.	2014	2015	2016	2017	2018	Total
Hattersley Roundabout	Junction 1	3	1	0	0	3	7
Hattersley Roundabout	Junction 2	1	0	0	0	1	2
Gun Inn Junction	Junction 3	0	0	0	1	0	1
Gun Inn Junction	Junction 4	0	0	0	1	0	1

Table F-4 – STATS19 accident data for Snake Pass Link

Accident Location		Accident Year					
Road/Junction	Link Name	2015	2016	2017	2018	2019	Total
Snake Road	Onksley Lane to A6013/Manchester Rd	3	12	3	5	6	29
Snake Road	A6013/Manchester to A57 Snake Rd near Longley Barn	4	2	5	1	0	12
Snake Road	A57 Snake Rd near Longley Barn to Silk Street/Sheffield Rd	12	10	5	13	5	45

Appendix G. Agglomeration Impacts Assessment in WITA

G.1. Purpose

The definition of Level 2 WEBs is set out in TAG A2 series, within which the most notable impact is productivity uplift from urban agglomeration (static clustering). This technical note outlines the methodology and findings from an agglomeration impact assessment undertaken for the proposed A57 Trans-Pennine Upgrade scheme. The remainder of this document outlines the specification of the assessments, data used, key assumptions and findings.

G.2. Scope and Specification of the assessment

G.2.1. Scope of assessment

TAG Unit A2.1 (July 2020) sets out approaches for estimating a range of wider economic impacts that can be considered to be supplementary to the welfare economic benefits captured through conventional appraisal described in the previous sections (termed Level 1 appraisal), and occur as individuals and businesses change their behaviour and / or economic activities in response to the transport change[19].

The WEI identified in TAG are categorised into two levels:

- Level 2 WEI based on connectivity improvements only, without explicit land use change, including: static agglomeration, more people working and increased output in imperfectly competitive markets
- Level 3 WEI involving explicit land use change and/or additional economic modelling, including: dynamic agglomeration, move to more productive jobs and dependent development

For the purposes of this assessment:

- Static agglomeration was quantified as it was deemed to account for a significant part of the WEIs and align well with the nature of the intervention
- Benefits associated with increased output in imperfectly competitive markets were quantified as 10% of the conventional impacts on business users, in line with TAG Unit A2.2 (July 2020)
- Other Level 2 impacts such as labour market effects (more people working) were only looked at qualitatively and deemed to be beneficial
- Dependent development impacts or move to more productive jobs were deemed less significant or relevant to the nature of the scheme and therefore not assessed

This document is focused on the methodology adopted for assessing static agglomeration impacts, which represent GVA impacts from productivity uplift as a result of enhanced access to economic mass (ATEM) brought by transport investment. There is clear economic evidence showing a causal relationship between agglomeration and productivity as documented and referenced in relevant guidance. Agglomeration benefits represent the uplift in business productivity as a result of improvement in ATEM, which is a metric to measure agglomeration, and also termed effective density (ED) in TAG. The calculation of agglomeration impacts is mainly influenced by the following three factors:

- the uplift in productivity per worker (derived from comparing ATEM with and without the proposed intervention)
- the quantum of employment (i.e. number of jobs)
- the average GDP per worker

Therefore, the value of agglomeration benefits is informed by a combination of the three factors above. High agglomeration benefit could be the result of a marginal increase in connectivity that is linked with locations with high number of jobs and average productivity, or a significant journey cost saving linked with locations with modest quantum of employment.

[19] Conventional appraisal is based on the assumption that transport markets behave in a theoretical 'perfect' manner. However, in reality markets are imperfect and wider economic impacts occur as the impacts of the transport scheme transmit from the transport markets to other markets as businesses and individuals change their behaviour.

G.2.2. Overview of the approach

Overall, the methodology adopted in this assessment is based on an understanding of the similar assessment undertaken previously in a former iteration of the scheme assessment. A review of similar work was undertaken in Jun 2020, findings from the review of the previous work (which was proportionate for the relevant stage of work at the time) were fed into the formulation of the new methodology so the observations and limitations were addressed appropriately. A summary of this process is outlined in Table 5, where observations in the previous assessment against a systematic review of the process are presented, along with mitigations proposed in the new approach.

Table 5 – Formulation of the technical approach to address observations and limitations in previous assessment

Areas of Observations		Observations in the previous forecasts	Mitigations in the new approach
Data	Transport connectivity	Unable to check / bespoke process	Improved transparency and assurance through the use of WITA
	Economic data	Observations on the discrepancies with DfT dataset (jobs and GVA)	Latest DfT wider impacts dataset used
	Other economic parameters	Consistent with the guidance in TAG	No changes but need to check consistency with the latest databook and wider impacts dataset (standard and sensitivity test versions)
Calculation	Step 1 – GTC	See "Transport connectivity"	Python scripts developed to consolidate input from transport models
	Step 2 – ATEM	PT travel costs appears to be unrealistic for certain movements	Use of Atkins dataset applied elsewhere based on timetable and fare
	Step 3 – Annual impacts	Constrained to a selection of sectors excluding Manchester and Sheffield	Manchester and Sheffield included in one of the options
	Step 4 – Profiling over 60 years	VoT growth and discounting need update in new forecast	Incorporated in WITA

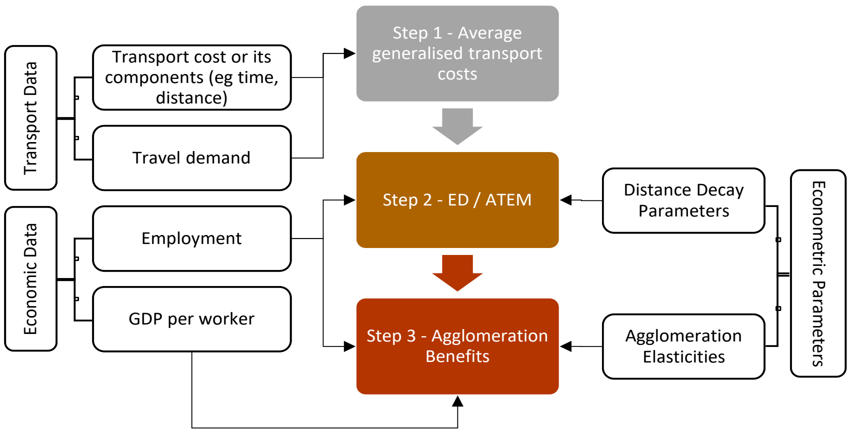
Details of the technical approach formulated are presented in the next sub-section.

G.2.3. Tools and specification

Software tool

The calculation of agglomeration impact is based on DfT's WITA Beta 2.0 so the technical approach and its implementation are in line with TAG Unit A2.4. Key input and steps in agglomeration assessment are illustrated in the diagram in Figure 5 below.

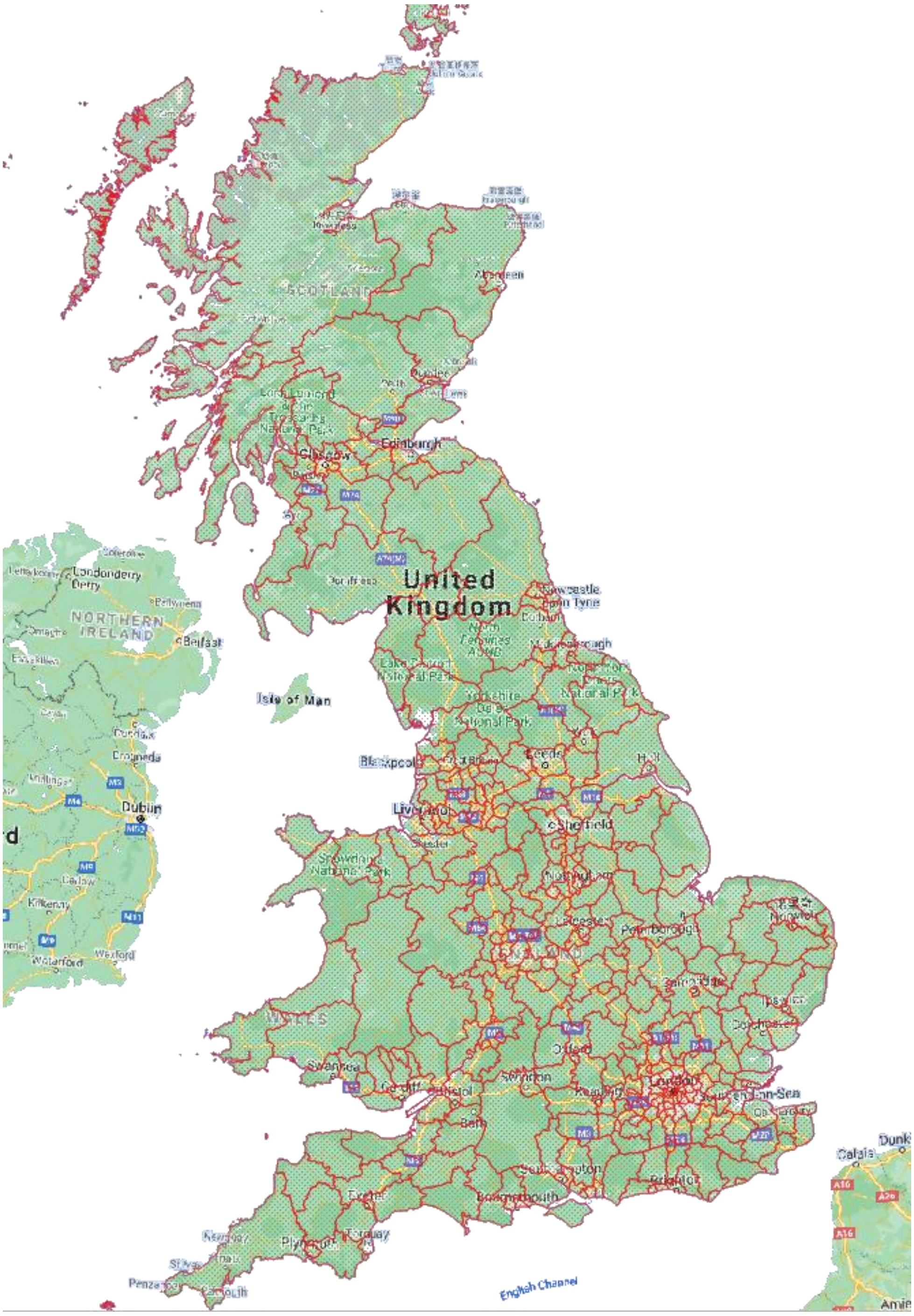
Figure 5 – Illustration of the process for WITA assessment



Geographical extent and detail

The nature of agglomeration impacts requires a nationwide geographical extent. Zoning system of the WITA model is based on the Local Authority District (LAD) definition used in the latest Wider Impacts Dataset published by the DfT. There are 380 LAD zones in the current dataset that covers the entirety of the UK. The LAD-based zoning structure is illustrated in Figure 6.

Figure 6 – Illustration of zoning structure for WITA assessment



Profiling and discounting

The agglomeration assessment covers a 60-year appraisal period starting from an assumed opening year of 2025. Transport model forecasts for year 2025, 2040 and 2051 were used.

Profiling and discounting over the appraisal period follows the guidance in TAG and are undertaken by WITA. Output monetary forecasts in this document are expressed in 2010 prices and values.

G.3. Data for agglomeration assessment

As illustrated in Figure 5, the agglomeration assessment used a range of economic and transport connectivity data.

The economic data (mainly jobs, GVA and other parameters used in the calculation as set out in TAG) came from DfT's wider impacts dataset, which has a compatible geographical resolution with the zoning system of the WITA model. The current sensitivity test version of the wider impacts dataset (issued by DfT) was used for consistency purpose as the transport model output (and TUBA assessment) was based on DfT's Databook v1.14 (sensitivity test).

A representation of the future baseline rail travel cost was also used for completeness purpose as agglomeration assessment requires a representation of travel costs by both highway and rail. Omission of this will usually lead to significant overestimation of agglomeration benefits.

Rail travel costs were based on a dataset developed by Atkins during the course of delivering similar studies elsewhere. Information fed into the rail travel costs involves data like timetables, fare, NRTS survey on average access/egress time and information from automated online journey planning queries. It is noted that the focus on the particular assessment is highway intervention, so rail travel costs were assumed to remain unchanged in any tests.

Highway travel costs that fed into the WITA model were based on the same highway model output that was used for user impacts assessment in TUBA. A main challenge in this process is the consolidation of the detailed transport model zoning system to the WITA model of 380 zones. This was carried out with the help of a GIS tool that derived the correspondence between the two sets of zoning systems. The consolidation of any output from the transport model (such as time and distance) was demand-weighted during data processing. Overall, transport model output in forecasting year 2025, 2040 and 2051 for the future reference case and Do Something scenario was used.

G.4. Findings from the assessment

The WITA model outputs the forecast total agglomeration benefits for the 60-year appraisal period and also provides separate forecasts for individual zones modelled, i.e. LADs in this model. These forecast agglomeration benefits reflect the increased productivity caused by firms being closer in physical or travel time terms to other firms and potential employees.

Due to the varying level of details in the transport model, modelling noise present and masking applied to mitigate such noises, the robustness of agglomeration forecasts by LAD also varies.

In light of the varying level of robustness in the forecasts, alterative perspectives of interpreting the output were established. This involves three different areas in which agglomeration benefits may be claimed, as illustrated in options A, B and C in Figure 8.

Figure 7 – Three different perspectives for interpreting the forecast agglomeration benefits

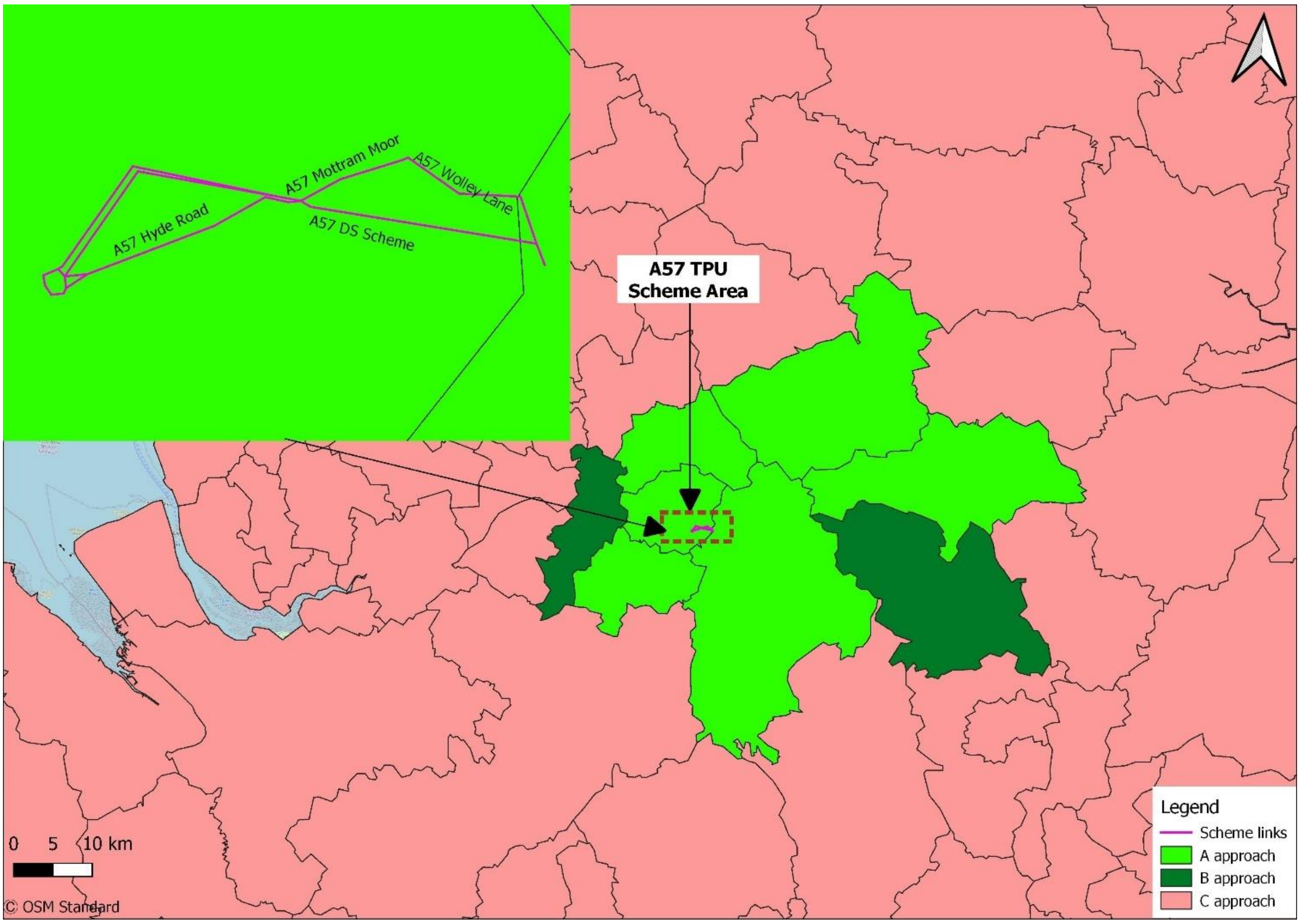


Table 6 – Formulation of the technical approach to address observations and limitations in previous assessment

Perspective	Observations in the previous forecasts	Mitigations in the new approach
Option A – benefits from High Peak, Oldham, Stockport, Tameside, Barnsley, Kirklees	£60m	Areas located mostly within the ADM and are directly relevant to the geography of the scheme. Reasonable consistency in the forecast benefits between the masked and unmasked runs, which implies robustness.
Option B – Option A plus impacts from Manchester and Sheffield	£86m	Including two clusters of economic activities at either side of the Pennine. Sensible (positive) forecasts obtained for Manchester and Sheffield when the masked transport model output was used (less noise).
Option C – Option B plus the rest of the country	£130m	Significantly higher benefit when modelling 'noise' was dealt with by masking. Generally lower level of robustness for agglomeration forecasts with significant level of masking but it demonstrates the scope for additional benefits (vs Option A).

Table 5-11 also outlines the reasons behind the choice of the three different approaches for interpreting agglomeration forecasts. Option A brings higher robustness and consistency although maybe on the conservative side. Option C is less reliable but certainly demonstrate the scope for potential legitimate benefits on a national stage but the exact figure is to be refined. Option B appears to bring a reasonable balance between robustness and representation of the scheme's potential. Option B forecast is built upon the benefits claimed through Option A but captures further productivity uplift in Manchester and Sheffield which is deemed to be in line with expectation. The additional benefits in Option B were derived through the masking of potential 'noise' in the transport model output (in consistent with the approach for conventional user impacts) and therefore are slightly less robust compared with Option A.

Furthermore, Table 5-12 also presents the top 10 LADs with the highest agglomeration benefits, along with an indication of the total employment present and which option each LAD falls into. It is clear from this that the top

10 locations are generally sensible in relation to the geography and nature of the intervention, and both Options A and B are well represented in these top locations (Option C is expected to cover all location by default).

Table 7 – Formulation of the technical approach to address observations and limitations in previous assessment

	LADs	Benefits		Employment	Option A	Option B	Option C
1	Tameside	£	23,506,770	87,327	y	y	y
2	High Peak	£	16,779,946	41,325	y	y	y
3	Stockport	£	14,740,932	138,789	y	y	y
4	Sheffield	£	13,080,189	297,476		y	y
5	Manchester	£	12,596,494	350,836		y	y
6	Trafford	£	5,607,028	142,976			y
7	Oldham	£	4,853,746	97,431	y	y	y
8	Salford	£	4,204,621	125,197			y
9	Bury	£	2,676,751	80,299			y
10	Derbyshire Dales	£	1,925,050	41,594			y

Appendix H. Change in Travel Time and Trip Numbers

H.1. Purpose

This appendix provides a summary of the distribution of benefits generated by the scheme, disaggregated by:

- The change in time savings per trip as a percentage of the DM travel time; and
- The change in trip numbers resulting from the scheme, as a percentage of the DM trips.

Table H-1 to Table H-3 present time benefits broken down by the change in travel time and trip numbers for the model year 2025, 2040 and 2051 respectively.

Table H-1 – Monetised change in travel time with respect to change in trip numbers for the model year 2025 (£000s)

	Change in travel time			
Change in trip numbers	<-30%	-30% to 0%	0% to 30%	>30%
<-30%	0	0	0	0
-30% to 0%	66	2141	-1432	-42
0% to 30%	142	2444	-150	0
>30%	61	320	0	0

Table H-2 – Monetised change in travel time with respect to change in trip numbers for the model year 2040 (£000s)

	Change in travel time			
Change in trip numbers	<-30%	-30% to 0%	0% to 30%	>30%
<-30%	0	0	0	0
-30% to 0%	64	1821	-1353	-56
0% to 30%	158	2399	-116	0
>30%	121	380	0	0

Table H-3 – Monetised change in travel time with respect to change in trip numbers for the model year 2051 (£000s)

	Change in travel time			
Change in trip numbers	<-30%	-30% to 0%	0% to 30%	>30%
<-30%	0	1	0	0
-30% to 0%	212	1689	-1530	-73
0% to 30%	205	2124	-176	-49
>30%	127	392	0	0

It can be observed from these tables that majority of the time benefits occur when DS trips increase by less than 30% and DS travel time reduces by less than 30% compared to DM. If large proportions of trips experienced changes in journey times or trip numbers above this level it could suggest a moderate level of error in the rule of a half calculations performed by TUBA and indicate that an intermediate cost point should be used to mitigate this effect.

The benefits which relate to the largest changes in costs and trips are those in 2051 which experience larger time savings and moderate to large increases in trip numbers. Further analysis shows that more than half of these benefits fall into the range of 30% to 40% changes in costs and trips and only 2% of the total relate to changes in either cost or trips of more than 50%. This breakdown suggests use of intermediate cost points could improve accuracy of benefit calculations, but the difference would be expected a be a fraction of 1% of the total and is therefore not considered to be proportionate.

The scheme is expected to generate a large proportion of its benefit through time savings for trips involving east west movement and vice versa using M67, A57 Mottram road and Hyde road, along the Manchester to Sheffield corridor. This will result in time saving benefits for the trips travelling longer distance and passing through the scheme area. Therefore, although time savings per trip will be moderately high, as indicated in Table 5-1, in many cases this will be as part of a longer distance journey and so the saving may not be a high percentage of the total journey time.

Appendix I. Social and Distributional Impact Assessment Report

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