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3. Traffic Modelling

3.1 Background

The A38 in Bromsgrove is an important corridor on the Major Road Network (MRN). It acts as a key strategic link, providing access to the Strategic Road Network (SRN), as well as offering an important local function as an eastern bypass to Bromsgrove and providing access to housing, services and employment frontages.

This OBC seeks funding to deliver a major upgrade of the A38 corridor, between M5 Junction 4 to the north and the junction of the A38 with Worcester Road to the south which is approximately 7.5 miles (12 km) long. This corridor forms part of the strategic north south spine through Worcestershire, connecting Worcester, Droitwich, Bromsgrove to Birmingham to the North and Gloucester and Bristol to the south as an alternative to the M5 route. The study area is shown in as shown on Figure 3.1.

The A38 corridor is a multi-functional route serving a range of users which contributes to the problems and issues discussed later in this chapter. The key characteristics are:

- The route performs a range of different functions, acting as a link to the Strategic Road Network, as a bypass to Bromsgrove town centre, a distributor road for journeys that have an origin and/or destination in Bromsgrove and a local access route for residents and businesses that have direct frontages on to the corridor.
- The corridor comprises sections with differing speed limits, levels of frontage and access points in addition to varying levels of pedestrian and cyclist provision. In addition, the driving experience along the route varies due to the differing land uses along sections of the A38 from residential, open field to employment and retail.
- Congested corridor due to high levels of car dependency across Bromsgrove.

The A38 Bromsgrove Route Enhancement Programme (A38 BREP Package) comprises a package of schemes delivering targeted improvements to junctions and significant enhancement of facilities for active modes.

Figure 3.1: Scheme location

This situation is projected to worsen in the future as new housing and employment planned for the local area are delivered. The planned growth in housing will increase the demand for travel. The following points summarise the planned developments in the area:

- The Bromsgrove District Plan (adopted in 2017) includes major residential development sites around the edge of Bromsgrove, with Perryfields Road and Whitford Road being particularly relevant to the A38. Smaller residential allocations are also found in surrounding areas. In total the Local Plan identifies a need for 7,000 dwellings and 28 Hectares of employment land in the period 2011-2030. However, the adopted local plan only allocated land for 4,700 dwellings to 2023, noting that the remaining 2,300 would be subject to a Green Belt review and then allocated within a Local Plan Review. Subject to the ongoing Local Plan review, the scheme may further support delivery of additional homes and employment land. This review is intended to be completed by 2023.
- The Local Plan review will also identify development allocations for growth targets beyond 2030 and in its Issues and Options consultation put forward various scenarios. The consultation documents published in September 2019 proposed that the new Plan will have a likely start date of 2023 and an end date of 2040. Over this period the Plan will be required to provide for at least 6,443 dwellings and up to 90 Hectares of employment land.
- Within close proximity of the A38 corridor area there are significant cross-boundary allocations within the adopted Local Plan for Redditch. This includes an additional 3,400 dwellings on the border with Redditch but located within Bromsgrove District, to meet Redditch's housing need, as identified in their own Local Plan. The allocation at Foxlyidate is particularly relevant to the A38.
- In addition there are further allocations within the Redditch Local Plan (and sited within Redditch itself).

Table 2.29 of the Strategic Case shows key development sites in the vicinity of the A38 identified within the adopted 2017 plans. The quantum of proposed development (housing and employment) within the adopted

plans requires enhancements to transport infrastructure, including the A38. Whilst no individual development site currently has obligations that restrict development in advance of delivery of the A38 schemes, there are planning linkages between the A38 BREP and the delivery of allocations identified in existing Local Plans and this is reflected in the requirement for S106 contributions to the BREP scheme. Worcestershire County Council has identified that the A38 in its current form is a key constraint to additional future development allocations through the District Plan review process. Therefore, in summary, the A38 BREP supports the delivery of 5310 homes and 13.45 Hectares of employment land based on the current plan. Subject to the ongoing District Plan review, the scheme may further support delivery of additional homes.

To effectively support the future development of Bromsgrove and to deliver economic growth, significant improvements are required to the corridor itself, supported by targeted improvements for other modes.

The scheme for which funding is sought through this MRN bid is an important part of the overall approach to transport in Bromsgrove. It would support ongoing work that is aiming to enhance both the major and local road network, as well as encouraging walking, cycling and the use of public transport.

3.2 Introduction

The A38 BREP Package is being delivered in three parts as described below:

- Part 1 (funded by WLEP, Greater Birmingham and Solihull Local Economic Partnership (GBSLEP) and Highways England's Growth and Housing Fund (GHF)), provided for capacity upgrades at M5 Junction 4, M42 Junction 1 (completed in 2020/21) and the Barley Mow Lane junction with the A38 (completed in 2019). (Historically, this has been referred to as A38 Package 1, for this OBC submission, this will now be referred to as Part 1).
- Part 2 comprises of the early delivery elements of the A38 BREP Package presented at SOBC stage and submitted in November 2020. The early delivery schemes have been delivered using WLEP local contribution funding, and are referred to as Schemes 2a, 2b and 4. These works are an important part of the overall A38 BREP Package, contributing to the improvement of active mode facilities on the corridor. They have been delivered early to take advantage of the local funding availability.
    - Scheme 2a was identified in the SOBC as Scheme 2 and provides an active mode corridor between Harvington Road and Charford Road, the new scheme 2a also includes the connecting bridge to Charford Road that in the SOBC was included in Scheme C leading to an enhanced scheme 2a at an earlier stage.
    - Scheme 2b is a shared active mode corridor along the northern side of Charford Road, to connect scheme 2a to South Bromsgrove High School. This scheme was added further to public engagement in early 2020, and after the SOBC submission.
    - Scheme 4 is a new toucan crossing as outlined in the SOBC, over the A448 Stratford Road and localised path improvements to facilitate walking and cycling.

    Schemes have been developed as part of the overall strategic active modes upgrade as part of the A38 BREP Package.
- Part 3 includes a number of active mode, local public transport and highways improvement schemes which were originally included in the SOBC submission to DfT in 2019.

Part 2 and Part 3 form the overall BREP package, with Part 2 being delivered using local contribution, and Part 3 to be delivered with local and MRN funding contributions. The scheme comprises interventions which target all modes, including highway, sustainable mode schemes and public transport schemes. In brief the A38 BREP Package includes:

- Highways schemes, notated as Schemes A to G, targeting key junctions.
- Sustainable/active mode schemes, notated as Schemes 1 to 6.

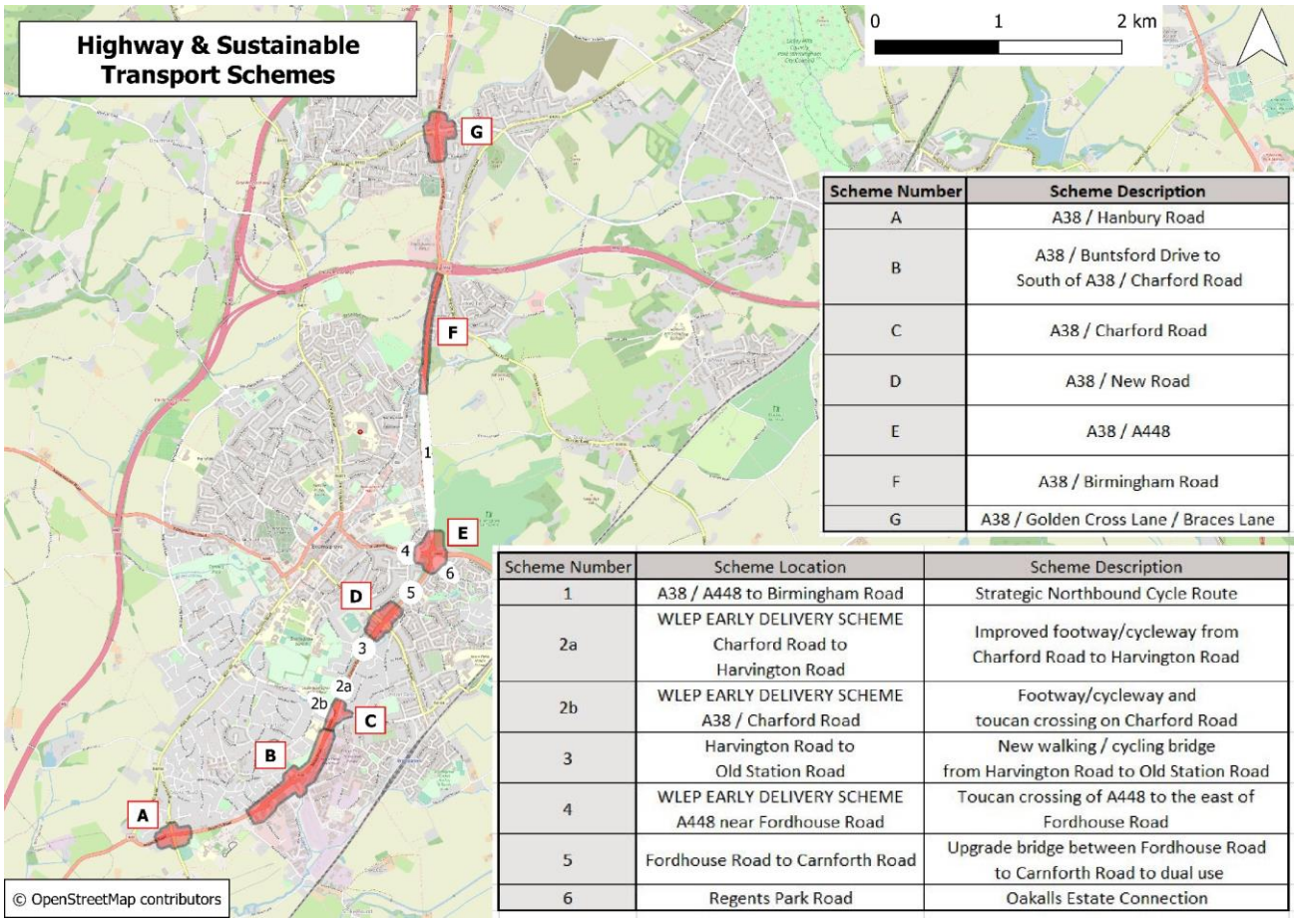
    As indicated above, of these, 3 schemes (schemes 2a, 2b and 4) have been taken forward as early delivery schemes, funded by WLEP which has its own FBC. Hence, the early delivery schemes are reflected in the Without Scheme (WoS) scenario, and their impacts are therefore not assessed as part of the modelling and economic assessment work carried out as part of this OBC (which is considered to be aligned with the TAG requirements).

Construction of these schemes began on site at the end of 2020 and now have been completed. Schemes 1, 3, 5 and 6 are included within this OBC for MRN funding.

- Local public transport improvements, notated as schemes 7 (Real time information (RTI)) and 8 (the provision of select vehicle detection at New Road and Charford Road junctions to support buses in crossing the A38 corridor, on the primary routes between the Town Centre and Railway station). This scheme is accommodated within the works of the highway interventions hence not discussed separately.

Figure 3.2 provides an overview of the highway and sustainable elements of the A38 scheme while Figure 3.3 presents the locations of the RTI interventions included in scheme 7.

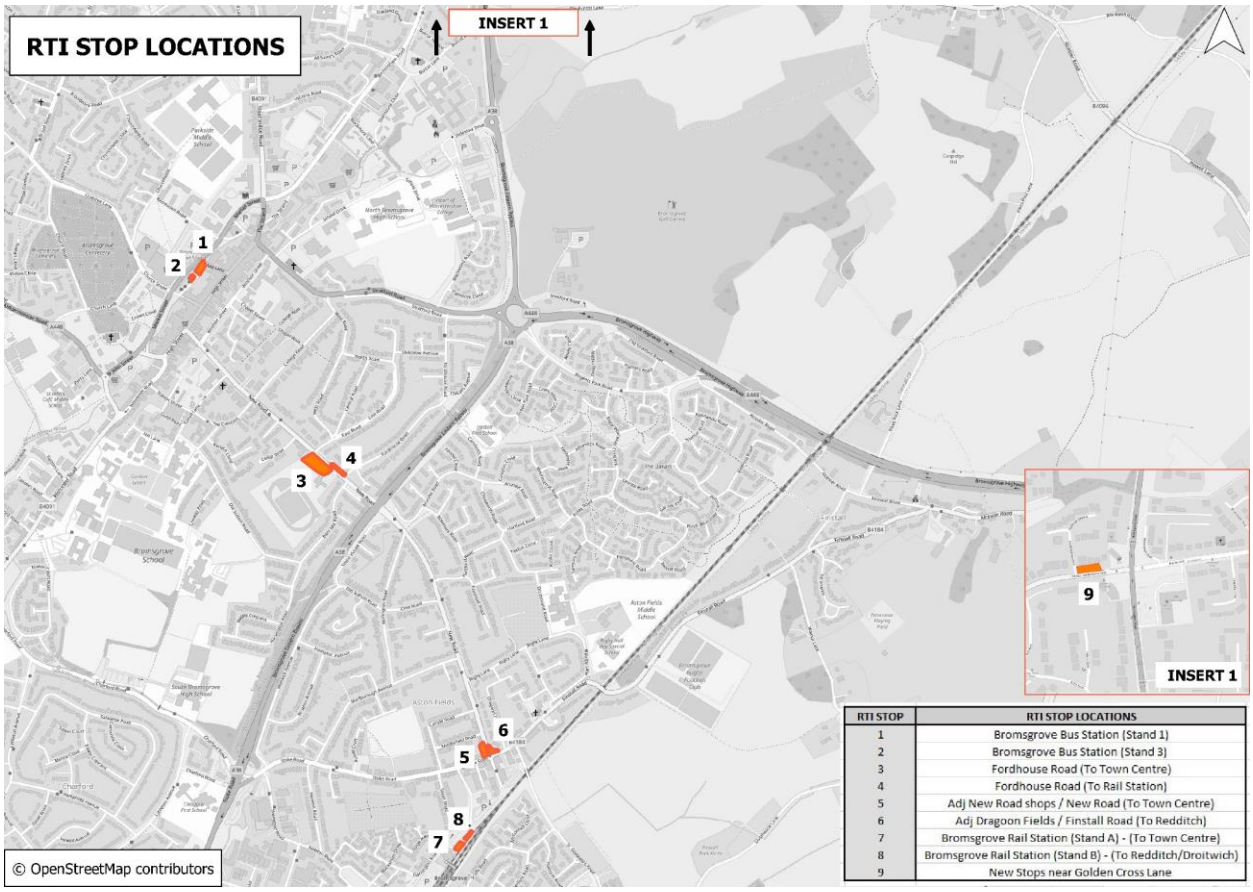
Figure 3.2: Highway and sustainable transport schemes



Scheme Number	Scheme Description
A	A38 / Hanbury Road
B	A38 / Buntsford Drive to South of A38 / Charford Road
C	A38 / Charford Road
D	A38 / New Road
E	A38 / A448
F	A38 / Birmingham Road
G	A38 / Golden Cross Lane / Braces Lane

Scheme Number	Scheme Location	Scheme Description
1	A38 / A448 to Birmingham Road	Strategic Northbound Cycle Route
2a	WLEP EARLY DELIVERY SCHEME Charford Road to Harvington Road	Improved footway/cycleway from Charford Road to Harvington Road
2b	WLEP EARLY DELIVERY SCHEME A38 / Charford Road	Footway/cycleway and toucan crossing on Charford Road
3	Harvington Road to Old Station Road	New walking / cycling bridge from Harvington Road to Old Station Road
4	WLEP EARLY DELIVERY SCHEME A448 near Fordhouse Road	Toucan crossing of A448 to the east of Fordhouse Road
5	Fordhouse Road to Carnforth Road	Upgrade bridge between Fordhouse Road to Carnforth Road to dual use
6	Regents Park Road	Oakalls Estate Connection

Figure 3.3: Scheme 7/ RTIs stop locations



RTI STOP	RTI STOP LOCATIONS
1	Bromsgrove Bus Station (Stand 1)
2	Bromsgrove Bus Station (Stand 3)
3	Fordhouse Road (To Town Centre)
4	Fordhouse Road (To Rail Station)
5	Adj New Road shops / New Road (To Town Centre)
6	Adj Dragoon Fields / Finstall Road (To Redditch)
7	Bromsgrove Rail Station (Stand A) - (To Town Centre)
8	Bromsgrove Rail Station (Stand B) - (To Redditch/Droitwich)
9	New Stops near Golden Cross Lane

3.3 Traffic Modelling

The A38 BREP OBC model consists of:

- A Highway Assignment Model (HAM); and
- A Variable Demand Model (VDM).

Traffic modelling was undertaken using VISUM version 21.0, which is a strategic macroscopic assignment modelling software. These models were purpose built for the assessment of this scheme and based upon traffic data collected in June 2017.

VISUM allows junctions to be modelled in detail including signals, priorities and roundabouts; enabling an estimation of delays experienced along the A38 and other junctions in the Area of Detailed Modelling (AoDM). Additionally, this package allows for wide area re-routing impacts to be considered as part of the economic assessment.

The SOBC used a Variable Demand VISUM model based on an Origin – Destination (OD) method. However, following feedback from DfT the SOBC model has been converted to a Production – Attraction (PA) method for use at OBC stage. The methodology for the conversion of the OD matrices to PA matrices was documented in the ASR which was shared with DfT in summer 2020 and then discussed at subsequent meetings. The Demand Model Report provides full details of the modelling process.

For each modelled year, three time periods have been considered. These are:

- Morning peak hour (AM): 08:00 – 09:00;
- Interpeak period (IP): Average hour from 09:00 – 15:00; and
- Afternoon peak hour (PM):17:00 – 18:00.

This Chapter provides an overview of the traffic model used for the OBC stage appraisal.

3.4 Base scenario

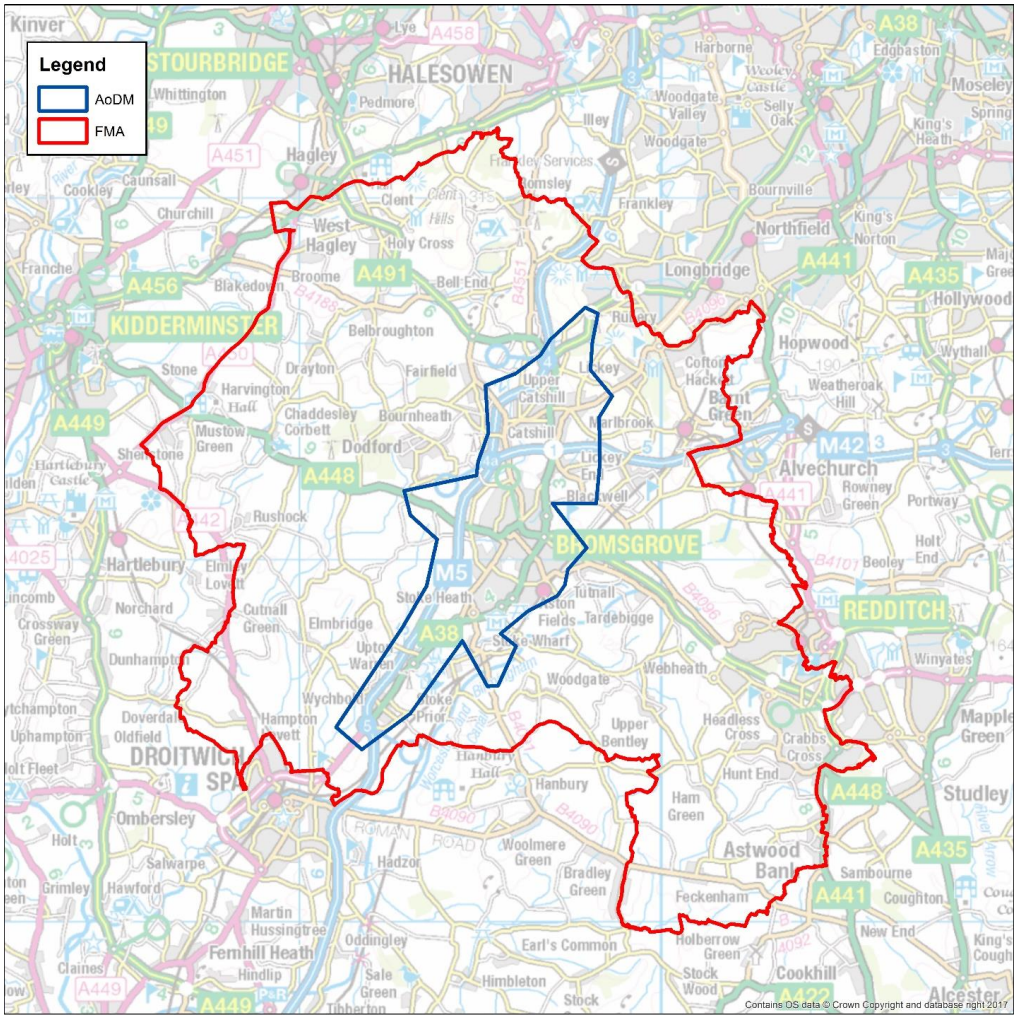
The base year for the transport model is 2017 (defined by the data collection). Traffic data used to calibrate and validate the model was from 2017, and included the following data:

- Junction Turning Counts (JTC);
- Automatic Traffic Counts (ATC);
- Road Side Interviews (RSI);
- Journey Time surveys;
- Queue length surveys; and
- Car park surveys.

Full details of data collection can be found in the Traffic Data Collection Report, Appendix TM.2.

The study area of the model was defined for the purpose of testing the impacts of improvements schemes on the A38 in Bromsgrove. The AoDM includes the detailed network, such as the smaller residential roads within Bromsgrove. The AoDM covers the urban area of Bromsgrove, Catshill and the north Marlbrook neighbourhood area, and includes the key junctions linking the A38 to the M5. The wider Fully Modelled Area (FMA) includes key routing options from Birmingham, Redditch, Droitwich and Kidderminster. These boundaries are illustrated in Figure 3.4. There has been no change to the extent of the modelled area since SOBC stage.

Figure 3.4: Extent of Fully Modelled Area (FMA)



3.5 Highway Assignment Model

Model demand was predominantly based upon the National Trip End Model (NTEM) trip ends and smoothened with observed Roadside Interview (RSI) data. The demand was developed in a PA form representing a 12-hr period consistent with the temporal coverage of the RSI and car park surveys.

The demand matrices were segmented into Home-Based Work (HBW), Home-Based Employers Business (HBEB), Home-Based Others (HBO), Non-Home based Employers Business (NHBEB) and Non-Home based Other (NHBO) purpose trips. Matrices for LGV and HGV from the SOBC model were retained for the model peak hours as they are fixed demand segments not subjected to VDM.

The NTEM 12-hour trip end data at Mid-Level Super Output Area (MSOA) and aggregate spatial boundaries was converted to the A38 model zones using zonal population and employment data obtained from Office of National Statistics (ONS), Business Register Employment Survey (BRES) data and Postcode point data.

The distance skims from the SOBC model was used to develop a gravity model for each demand segment. The peak hour cost skims are used to inform the HBW and HBEB segments, whilst the IP cost skims are used to inform the HBO, NHBEB and NHBO demand segments. This process resulted in deriving 12-hour synthetic PA matrices for each demand segment.

The validity of the synthetic prior matrices was verified by comparing the goodness of fit of the modelled TLD against the target TLD. The 12-hour synthetic matrices for Home-based and Non-home based purposes were allocated to model time period and converted to OD matrices for assignment based on time of day factors derived from RSI data and TAG car occupancy factors.

The out-turn matrices (Prior matrices) were assigned to the HAM networks and model flows compared with observed flows along cordons and screenlines. Further refinements were undertaken of the prior matrices including trip rate adjustment and smoothening with observed data to arrive at the final set of prior matrices. Generalised cost parameters were taken from TAG databook 'v1.15 May 2021 Forthcoming change'.

Matrix estimation was undertaken on the prior matrix so that assigned demand matches observed link counts. Matrix estimation was undertaken for three model hours (AM, IP and PM). The base scenario was validated against the Journey Time data along nine routes.

The model results achieved various TAG criteria for changes to matrices brought about by matrix estimation, flow calibration and validation along the A38 and its approaches, as well as across the full model area; and journey time validation. It can be concluded that the model robustly reflects observed flows and delays along key routes in the modelled area.

Across all model time periods, 13 out of 14 screenlines/cordons passed the TAG criteria. A summary of the flow calibration and validation is given in Table 3.1 that shows the model passes the flow criteria across all time periods.

Table 3.1: Summary of model performance – link flow calibration

Time period	Vehicle Type	Description	Direction	No of sites	Flow Criteria	GEH<5	Overall Pass	% Overall Pass
AM	Light Vehicles	Non-Screenline	All	119	101	102	107	90%
		All Calibration	All	139	120	121	127	91%
	Total Vehicles	Non-Screenline	All	119	101	102	107	90%
		All Calibration	All	139	120	121	127	91%
IP	Light Vehicles	Non-Screenline	All	111	104	100	106	95%
		All Calibration	All	131	122	118	125	95%
	Total Vehicles	Non-Screenline	All	111	102	100	106	95%
		All Calibration	All	131	119	118	125	95%
PM	Light Vehicles	Non-Screenline	All	119	104	98	105	88%
		All Calibration	All	139	122	114	124	89%
	Total Vehicles	Non-Screenline	All	119	102	101	105	88%

Time period	Vehicle Type	Description	Direction	No of sites	Flow Criteria	GEH<5	Overall Pass	% Overall Pass
		All Calibration	All	139	119	118	123	88%

A summary of the flow calibration on A38 mainline and approaches to junctions on A38 is given in Table 3.2 shows the model passes the flow criteria across all time periods.

Table 3.2: Calibration summary of count data on A38 and approaches to junctions on A38

Time period	Direction	No of sites	Flow Criteria	GEH<5	Overall Pass	% Overall Pass
AM	All	62	57	54	58	94%
IP	All	62	58	58	60	97%
PM	All	62	55	55	56	90%

Similarly, the link flow validation across all time periods pass the TAG criteria as shown in Table 3.3.

Table 3.3: Summary of model performance – link flow validation

Time period	Vehicle Type	Direction	No of sites	Flow Criteria	GEH<5	Overall Pass	% Overall Pass
AM	Light Vehicles	All	33	28	27	29	88%
AM	Total Vehicles	All	33	28	26	28	85%
IP	Light Vehicles	All	33	32	30	32	97%
IP	Total Vehicles	All	33	32	30	32	97%
PM	Light Vehicles	All	33	29	24	30	91%
PM	Total Vehicles	All	33	30	26	31	94%

Of the 18 journey time routes by direction (9 routes), 15 routes (83%) pass the TAG criteria across all three model periods.

Full details of the highway assignment model build process can be found in the Local Model Validation Report (LMVR), see Appendix TM.3.

3.6 Variable Demand Model

The VDM was built using Visum 21, consistent with the version used for the HAM. The VDM developed was for a 12-hour period with demand in a PA format. The person trip demand was segmented into HBW, HBEB, HBO, NHBEB and NHBO purpose trips, consistent with the segments used in the HAM. The VDM was developed only for car-available trips. No income segmentation was used within the VDM. LGV and HGV were excluded from demand response changes. In forecast years, growth for goods vehicles (LGV, HGV) were based on DfT's Road Traffic Forecasts (RTF, Sep 2018). No public transport model was validated. However, to better reflect the mode choice response within the demand model, a representation of the detailed PT supply network was incorporated within the HAM to produce the required PT skims for each demand alternatives.

The A38 BREP VDM incorporates Model choice, followed by Destination choice. It does not include time of day choice but incorporates a Trip frequency component. The model adopts an incremental approach to absolute estimates.

The parameters used in the VDM were defined from values in TAG databook 1.15 May 2021 Forthcoming release. Starting values for the VDM parameters lambda (λ) and scaling factors (θ) for each demand response were taken as the median value from Table 5.1 and Table 5.2 of TAG unit M2.1, then adjusted during model calibration. Cost damping was required as part of the VDM calibration process.

Realism tests were undertaken to test model response to changes in travel costs for the following elasticity tests:

- Car fuel cost increase by 10%; and
- Car journey time increase by 10%.

The results of the realism tests on the model elasticities are shown in Table 3.4 and Table 3.5. They show that the model elasticities are in line with the TAG specified values for both the fuel cost changes and journey time changes.

Table 3.4: Fuel cost elasticities

Fuel cost - 10% increase – 20km Cost Damping - Matrix

Elasticity Values	AM	IP	PM	Annual
Matrix Based elasticities				
Commute	-0.31	-0.20	-0.29	**-0.28**
Employer Business	-0.13	-0.10	-0.09	**-0.10**
Other	-0.40	-0.38	-0.36	**-0.38**
All Purpose	-0.29	-0.28	-0.27	**-0.28**
Network Based elasticities				
Commute	-0.34	-0.23	-0.33	**-0.32**
Employer Business	-0.09	-0.08	-0.09	**-0.08**
Other	-0.34	-0.35	-0.34	**-0.34**
All Purpose	-0.30	-0.27	-0.30	**-0.29**

Table 3.5: Journey time elasticities

Journey time - 10% increase – 20km Cost Damping

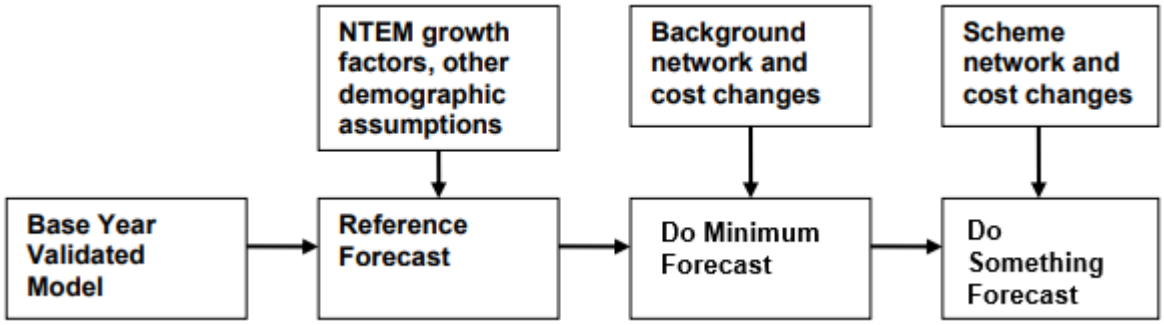
Elasticity Values	AM	IP	PM	Annual
Commute	-0.29	-0.13	-0.40	**-0.30**
Employer Business	-0.06	-0.12	-0.02	**-0.08**
Other	-0.23	-0.36	-0.47	**-0.36**
All Purpose	-0.24	-0.30	-0.40	**-0.31**

Additional information on the VDM can be found in the Demand Model Report (Appendix TM.4).

3.7 Traffic Forecasting

The scheme follows principles set out in the TAG Unit M4 Forecasting and Uncertainty as summarised in Figure 3.5 below.

Figure 3.5: Basic approach to forecasting using a transport model (Source: TAG)



The modelling framework has been developed to represent a 2017 Base Year to which the model has been calibrated and validated. Forecasts for two future years have been produced:

- Opening year - 2025; and
- Design year - 2040.

These years have been chosen to ensure consistency with the scheme opening and design years as well as providing for a phased assessment of the development quantum. The developments are programmed to be completed by 2040.

The forecast scenarios which have been modelled are the Without scheme (WoS) and With scheme (WS) scenarios for 2025 and 2040. The Without scheme scenario consists of the base network with committed highway improvement schemes and demand growth from base to forecast year. The demand growth is based on proposed development allocations in the local plan and their uncertainty classification. The With scheme network include all elements of the Without scheme network and the proposed A38 scheme being appraised. The input demand to the Without scheme and With scheme VDM models are the same.

In addition, the DfT have requested a forecast as far into the future as possible. Therefore, a third forecast year model has been developed for 2050, the last year available within DfT's Road Traffic Forecasts for growth in LGVs and HGVs.

For the purposes of appraisal, only the opening and design year model outputs have been used.

Development and scheme assumptions have been identified through consultation with WCC for the forecast years of 2025 and 2040. In line with TAG guidance (unit M4 Forecasting and Uncertainty), the assumptions have been categorised to identify sites and schemes which are near certain, more than likely, reasonably foreseeable and hypothetical. Only those schemes and developments that are 'Near Certain' or 'More than likely' are considered for the core scenario. The planned HS2 stations in Birmingham central and Birmingham international have not been modelled as part of the PT forecast supply network following discussions with WCC on the assumption that the impact the scheme would have on them will be negligible.

Based on the uncertainty log, the most unbiased and realistic set of assumptions that form the WoS and WS core scenario forecast include only those developments that have been completed since the model base year/are under construction/'near certain'/'more than likely'. The major committed developments proposed in Bromsgrove and Redditch are shown in Table 3.6.

Table 3.6: Major development sites in Bromsgrove and Redditch

Land Use Type	Expected Construction Period	Location
Employment	2020 – 2040	Perryfields Road, Bromsgrove
	2022 – 2036	Eastern Gateway (Phases 1-3), Redditch
	2020 – 2021	Nash Road, Old Forge Drive Redditch
Residential	2020 – 2040	Perryfields Road, Bromsgrove
	2017 – 2021	Birmingham Road (Norton Farm), Bromsgrove
	2020 – 2040	Foxlydiate (Redditch expansion site in Bromsgrove District)
	2017 – 2028	Brockhill East (A441 Birmingham Road, off Weights Lane, Redditch)
	2017 – 2036	Webheath Strategic Site
	2017 – 2036	Whitford Road (BROM3)

As part of defining the core scenario for forecast models, TAG unit M4 specifies that local sources of uncertainty that depend on the transport scheme should adopt the guidance on induced investments of which dependent developments is one type.

A meeting to discuss the approach to dependent development assessment was held with DfT in February 2019. At this meeting the potential approach to the assessment of the following three key site was discussed:

- Foxlydiate;
- Perryfields Road; and
- Whitford Road.

For each site, the status in the planning system, at that time, was discussed. Upon consideration of this information DfT confirmed (as minuted) that "There is dependency of the developments on the A38 scheme as it is driven by planning requirement and a dependency assessment is required to define the core scenario. The dependency assessment should inform the quantum of development that can be accommodated without the scheme (not dependent on the scheme). The transport user benefits assessments has to be based on the development quantum that is not dependent on the scheme.

On this basis a dependency assessment was undertaken in accordance with TAG unit A2.2. This work was undertaken after the submission of the SOBC, in preparation for OBC stage. A draft technical note on Dependent Development tests was submitted to the DfT in November 2019. Subsequently DfT provided a number of comments and responses to these have been documented.

As the planning status of the three sites progressed, DfT were informed of their status in Spring 2021 when two of the sites (Foxydiate and Whitford Road site) had obtained planning consent while the Perryfield Road site had progressed to an appeal. The Perryfield site has since won their appeal and consent granted in summer 2021. As a result, these developments are not considered to be dependent on the A38 BREP scheme and therefore form part of the core scenario. There are no further developments that are considered dependent on the scheme.

Trip rates for the development sites as provided by WCC was used to determine site specific vehicle trip rates and vehicle trips generated (all-purpose trips by direction) over a 12-hr period. Where development trips rates were not provided by WCC, they have been determined using publicly available transport assessments or TRICS database. The final trip rates for all developments have been agreed with WCC and are reported in the forecasting report.

The development trips derived from the trip rates were disaggregated to home-based and non home-based purposes based on either existing zone/surrounding zones/sectors as in the synthetic base model and car occupancy factors applied to derive the total car users as person-trips (driver and passengers). The development trips (in PA form) were thereafter added to the base year trip ends (by purpose) to derive the

forecast trip ends for internal zones. The latest release of TEMPro (currently v7.2) growth factors was applied to base year trip ends (PA) for external zones to derive their forecast trip ends. The forecast demand was constrained to TEMPro forecasts at the district level.

The LGV and HGV traffic growth forecasts were based on the DfT's Road Traffic Forecasts (RTF) Sep 2018 – Scenario 1.

The validated base year model networks were adjusted to create the forecast networks. The WoS forecast represents a scenario of network impacts in the absence of the scheme proposals. It corresponds to maintaining existing transport facilities and implementing the 'near certain' and 'more than likely' aspects of regional and local transport strategies details of which are provided in Table 3.7.

Table 3.7: Without scheme network improvements

ID	Network Improvement	Geographical Location	Uncertainty	Scheme details
1	Junction Improvements	Perryfields Road/A448 Kidderminster Road	Near Certain	Section 278 scheme comprising new roundabout, ghost island junction, and signal junction along Kidderminster Road, and closure of Perryfields Road at approach to A448 junction.
2	Junction Improvements	Perryfields Road/B4091 Stourbridge Road	Near Certain	Section 278 scheme comprising new signal junction on Stourbridge Road (north of existing Perryfields Road/Stourbridge Road junction)
3	New Spine Road	Perryfields development site	Near Certain	Development spine road linking A448 Kidderminster Road and B4091 Stourbridge Road
4	Junction Improvements	Fox Lane (Whitford Road) & Rock Hill	Near Certain	Altered junctions at Whitford Road / Kidderminster Road and B4091 Rock Hill/Fox Lane/Albert Road (Greyhound PH)
5	Reduced Speed limit	Charford Road	Completed	A new reduced speed limit of 20mph on Charford Road
6	Junction Improvements	A448 Kidderminster Road/ St John Street	More than likely	Currently 3 arm roundabout; a new scheme to create three arm signalised junction incorporating pedestrian movements, single lane on each approach. Phasing not defined assumed that Kidderminster Road and Hanover Street would run as main movement with opposed right turn movement, with St John Street being unopposed movements.
7	PT Improvements	West Midlands	Operational	New cross city train services between Bromsgrove and Birmingham New Street resulting in 3 trains per hour during weekdays
8	Package 1 Junction Improvements	A38 Bromsgrove	Completed	A38 Bromsgrove Major Scheme - Package 1 schemes
9	WLEP funded active mode schemes	A38 Bromsgrove	Near certain	Part 2 Early delivery schemes identified in Section 3.2
10	Junction improvements	Foxlydiate development site	Near certain	S278 scheme comprising new signalised junction

The WS scenario includes a series of A38 mainline and junction improvements described in Section 3.2. The proposed A38 BREP scheme includes various packages that includes improving signalised junctions as well as introducing new signals at existing junction. Signal timings for the scheme junctions were based on outputs

from stand-alone junction models developed in LinSig and refined through an iterative process between the strategic model and operational models.

Values of Time (VoT) are based on and are assumed to increase in line with guidance in TAG unit A1 – Cost-benefit analysis. Vehicle Operating Costs (VOC) were taken from TAG unit A1 and adjusted for the forecast years modelled to take into account changes in fuel cost and vehicle fuel efficiency. Generalised cost parameters for the future years were derived using values from 'TAG data book-, May 2021 Forthcoming change'.

3.8 Model results

The section below illustrates the model results and compares the key metrics of the WS scenario against the WoS scenario. The results compared are:

- Matrix changes;
- Network summary statistics;
- Link Flow changes;
- Select link analysis;
- Junction delays and queues; and
- Journey time along the A38.

3.9 Forecast matrices

The forecast models were run through the VDM to convergence using reference case demand input in 12-hr PA form. The outputs of the VDM were converted time period and peak hour OD matrices for assignment. The post-VDM matrices for movements that interact with the Fully Modelled Area under the WoS and WS scenarios are given in

Table 3.8 and Table 3.9.

The tables show that the change in demand in 2025 between the WS and WoS are minimal with the AM and PM demand slightly increasing for the HBW and HEB purposes whilst the 'other' purpose trips show a slight drop in demand. During the IP, all car user classes except HEB show a decrease in demand due primarily to the higher costs the scheme imposes in 2025 during the IP period.

In 2040, all car user classes show an increase in demand due to the scheme except for HBW during the Inter peak that shows a marginal decrease in demand. The increase in demand is marginal across all time periods indicating the scheme does not induce much additional demand overall.

Table 3.8: Matrices comparisons – 2025

User Class	2025 WoS Vehicles -Post VDM	2025 WoS Vehicles -Post VDM	2025 WoS Vehicles -Post VDM	2025 WS Vehicles -Post VDM	2025 WS Vehicles -Post VDM	2025 WS Vehicles -Post VDM	%Diff (2025WS – 2025WoS)	%Diff (2025WS – 2025WoS)	%Diff (2025WS – 2025WoS)
	AM Peak	Inter Peak	PM Peak	AM Peak	Inter Peak	PM Peak	AM Peak	Inter Peak	PM Peak
HBW	13254	2974	13309	13327	2962	13350	0.5%	-0.4%	0.3%
HBEB	1370	782	1261	1374	784	1266	0.3%	0.2%	0.4%
HBO	8460	12446	10767	8450	12437	10752	-0.1%	-0.1%	-0.1%
NHBEB	1023	1052	1178	1024	1051	1178	0.0%	-0.1%	0.0%
NHBO	1668	2590	2473	1666	2587	2468	-0.1%	-0.1%	-0.2%
LGV	4016	3835	3944	4016	3835	3944	0.0%	0.0%	0.0%
HGV	824	1259	568	824	1259	568	0.0%	0.0%	0.0%
Total	**30616**	**24938**	**33501**	**30682**	**24914**	**33527**	**0.2%**	**-0.1%**	**0.1%**

Table 3.9: Matrices comparisons - 2040

User Class	2040 WoS Vehicles -Post VDM	2040 WoS Vehicles -Post VDM	2040 WoS Vehicles -Post VDM	2040 WS Vehicles -Post VDM	2040 WS Vehicles -Post VDM	2040 WS Vehicles -Post VDM	%Diff (2040WS – 2040WoS)	%Diff (2040WS – 2040WoS)	%Diff (2040WS – 2040WoS)
	AM Peak	Inter Peak	PM Peak	AM Peak	Inter Peak	PM Peak	AM Peak	Inter Peak	PM Peak
HBW	13656	3071	13991	13760	3056	14048	0.8%	-0.5%	0.4%
HBEB	1446	826	1300	1450	828	1305	0.3%	0.3%	0.4%
HBO	9087	13509	11785	9092	13526	11806	0.1%	0.1%	0.2%
NHBEB	1104	1156	1256	1104	1157	1256	0.0%	0.1%	0.0%
NHBO	1858	2965	2950	1859	2966	2952	0.1%	0.0%	0.1%
LGV	4842	4624	4755	4842	4624	4755	0.0%	0.0%	0.0%
HGV	857	1308	591	857	1308	591	0.0%	0.0%	0.0%
Total	**32849**	**27457**	**36627**	**32963**	**27465**	**36713**	**0.3%**	**0.0%**	**0.2%**

3.10 Network summary statistics

The network performance summary of the WoS and WS scenarios across the fully modelled area and a comparison between them for 2025 and 2040. The comparisons are given in Table 3.10 to Table 3.15.

Table 3.10 shows vehicle-hours reduce for all vehicle classes in 2025 AM Peak under WS compared to WoS whilst vehicle-kms increase in WS for all vehicle classes. Average speed increases across all vehicle classes, ranging from 0.24% to 0.64% in 2025.

Table 3.11 shows marginal change in vehicle-hours for all vehicle classes. Vehicle-kms also change marginally in WS for all vehicle classes during the Inter-Peak resulting in the average speeds reducing slightly in 2025 Inter-peak hour.

Table 3.12 shows vehicle-hours reduce for all vehicle classes in 2025 PM Peak under WS compared to WoS. Vehicle-kms increase slightly in WS for all vehicle classes. Average speed increases across all vehicle classes, ranging from 0.12% to 0.67% in 2025 PM Peak.

Table 3.10: Without Scheme and With Scheme - 2025 AM Peak Highway network statistics

User Class	2025 WoS- AM Peak	2025 WoS- AM Peak	2025 WoS- AM Peak	2025 WS - AM Peak	2025 WS - AM Peak	2025 WS - AM Peak	%Diff (2025WS – 2025WoS) AM Peak	%Diff (2025WS – 2025WoS) AM Peak	%Diff (2025WS – 2025WoS) AM Peak
	Veh-km	Veh-hrs	Aver Speed (kph)	Veh-km	Veh-hrs	Aver Speed (kph)	Veh-km	Veh-hrs	Aver Speed (kph)
Car	551019	10650	51.74	552305	10608	52.07	0.23%	-0.40%	0.64%
LGV	100860	1863	54.14	100911	1855	54.41	0.05%	-0.44%	0.49%
HGV	71218	1174	60.65	71233	1172	60.79	0.02%	-0.22%	0.24%
Total	**723097**	**13688**	**52.83**	**724449**	**13634**	**53.13**	**0.19%**	**-0.39%**	**0.58%**

Table 3.11: Without Scheme and With Scheme - 2025 Inter Peak Highway network statistics

User Class	2025 WoS- Inter Peak	2025 WoS- Inter Peak	2025 WoS- Inter Peak	2025 WS - Inter Peak	2025 WS - Inter Peak	2025 WS - Inter Peak	%Diff (2025WS – 2025WoS) Inter Peak	%Diff (2025WS – 2025WoS) Inter Peak	%Diff (2025WS – 2025WoS) Inter Peak
	Veh-km	Veh-hrs	Aver Speed (kph)	Veh-km	Veh-hrs	Aver Speed (kph)	Veh-km	Veh-hrs	Aver Speed (kph)
Car	397501	7349	54.09	396866	7348	54.01	-0.16%	0.00%	-0.16%
LGV	111251	1916	58.05	111261	1917	58.04	0.01%	0.02%	-0.01%
HGV	100306	1614	62.14	100303	1614	62.14	0.00%	0.00%	0.00%
Total	**609058**	**10879**	**55.98**	**608429**	**10879**	**55.93**	**-0.10%**	**0.00%**	**-0.10%**

Table 3.12: Without Scheme and With Scheme - 2025 PM Peak Highway network statistics

User Class	2025 WoS - PM Peak	2025 WoS - PM Peak	2025 WoS - PM Peak	2025 WS - PM Peak	2025 WS - PM Peak	2025 WS - PM Peak	%Diff (2025WS – 2025WoS) PM Peak	%Diff (2025WS – 2025WoS) PM Peak	%Diff (2025WS – 2025WoS) PM Peak
	Veh-km	Veh-hrs	Aver Speed (kph)	Veh-km	Veh-hrs	Aver Speed (kph)	Veh-km	Veh-hrs	Aver Speed (kph)
Car	687103	13442	51.12	688097	13372	51.46	0.14%	-0.52%	0.67%
LGV	106151	1985	53.47	106186	1977	53.72	0.03%	-0.44%	0.47%
HGV	52863	875	60.40	52873	874	60.48	0.02%	-0.10%	0.12%
Total	**846117**	**16302**	**51.90**	**847156**	**16223**	**52.22**	**0.12%**	**-0.49%**	**0.61%**

Table 3.13 shows vehicle-hours reduce for all vehicle classes in 2040 AM Peak under WS compared to WoS whilst vehicle-kms increase in WS for all vehicle classes similar to the pattern in 2025. Average speed increases across all vehicle classes, ranging from 0.39% to 0.87% in 2025.

Table 3.14 shows marginal change in vehicle-hours for all vehicle classes and vehicle-kms in WS for all vehicle classes during the Inter-Peak. Cars show a slight increase in vehicle-kms with an insignificant increase in vehicle hours. All vehicle classes show a marginal increase in average speeds in 2040 Inter-peak hour.

Table 3.15 shows vehicle-hours reduce for all cars and HGVs in 2040 PM Peak under WS compared to WoS whilst vehicle-kms increase slightly in WS for cars and HGVs. For LGVs however, vehicle-hours increase by 2,84% but vehicle-kms reduce by 1.29%. Average speed increases across cars and HGVs but reduce for LGVs.

Table 3.13: Without Scheme and With Scheme – 2040 AM Peak Highway network statistics

User Class	2040 WoS- AM Peak	2040 WoS- AM Peak	2040 WoS- AM Peak	2040 WS - AM Peak	2040 WS - AM Peak	2040 WS - AM Peak	%Diff (2040WS – 2040WoS) AM Peak	%Diff (2040WS – 2040WoS) AM Peak	%Diff (2040WS – 2040WoS) AM Peak
	Veh-km	Veh-hrs	Aver Speed (kph)	Veh-km	Veh-hrs	Aver Speed (kph)	Veh-km	Veh-hrs	Aver Speed (kph)
Car	628562	12262	51.26	631303	12209	51.71	0.44%	-0.43%	0.87%
LGV	122341	2296	53.28	122466	2282	53.67	0.10%	-0.62%	0.73%
HGV	74383	1228	60.58	74420	1224	60.81	0.05%	-0.33%	0.39%
Total	**825287**	**15787**	**52.28**	**828190**	**15715**	**52.70**	**0.35%**	**-0.45%**	**0.81%**

Table 3.14: Without Scheme and With Scheme – 2040 Inter-Peak Highway network statistics

User Class	2040 WoS- Inter Peak	2040 WoS- Inter Peak	2040 WoS- Inter Peak	2040 WS - Inter Peak	2040 WS - Inter Peak	2040 WS - Inter Peak	%Diff (2040WS – 2040WoS) Inter Peak	%Diff (2040WS – 2040WoS) Inter Peak	%Diff (2040WS – 2040WoS) Inter Peak
	Veh-km	Veh-hrs	Aver Speed (kph)	Veh-km	Veh-hrs	Aver Speed (kph)	Veh-km	Veh-hrs	Aver Speed (kph)
Car	465767	8650	53.85	466702	8651	53.95	0.20%	0.02%	0.18%
LGV	134833	2353	57.30	134851	2350	57.38	0.01%	-0.12%	0.13%
HGV	104718	1683	62.20	104707	1682	62.25	-0.01%	-0.08%	0.07%
Total	**705318**	**12686**	**55.60**	**706260**	**12684**	**55.68**	**0.13%**	**-0.02%**	**0.16%**

Table 3.15: Without Scheme and With Scheme – 2040 PM Peak Highway network statistics

User Class	2040 WoS - PM Peak	2040 WoS - PM Peak	2040 WoS - PM Peak	2040 WS - PM Peak	2040 WS - PM Peak	2040 WS - PM Peak	%Diff (2040WS – 2040WoS) PM Peak	%Diff (2040WS – 2040WoS) PM Peak	%Diff (2040WS – 2040WoS) PM Peak
	Veh-km	Veh-hrs	Aver Speed (kph)	Veh-km	Veh-hrs	Aver Speed (kph)	Veh-km	Veh-hrs	Aver Speed (kph)
Car	785355	15640	50.22	786947	15565	50.56	0.20%	-0.48%	0.68%
LGV	128741	2455	52.44	127076	2525	50.34	-1.29%	2.84%	-4.02%
HGV	55155	915	60.31	55674	896	62.11	0.94%	-1.99%	2.99%
Total	**969251**	**19009**	**50.99**	**969696**	**18986**	**51.07**	**0.05%**	**-0.12%**	**0.17%**

3.11 Link Flow Changes

Figure 3.6 to

Figure 3.11 illustrate the link flow differences between WoS and WS scenarios for the two forecast years. The link bar/text in red indicates an increase in traffic flow under WS scenario whilst the green bar/text indicates a reduction in traffic under WS scenario compared to the WoS scenario.

The figures illustrate an increase in traffic on A38 (north-south) in both peak hours and model forecast years. The flow increase on the A38 is more pronounced in the AM period with flows increasing by up to 450 vehicles in the southbound direction. There are appreciable increases in flow of up to 500 vehicles along the A448 between the A38 and Redditch due to the scheme. These increases are due primarily to traffic re-routeing from alternative routes (B4096, B4184) that experience a reduction in flows and using the A448 to access the A38. During the Inter peak, the scheme does not attract much traffic from alternative routes and along some sections, traffic moves away from the scheme due to better alternatives. This is more so in 2025 than in 2040 Inter peak.

There are also reductions in flows west of A38 in Bromsgrove town, but these are relatively low compared to the increases along the A38.

Figure 3.6: 2025 AM Peak (WS minus WoS)

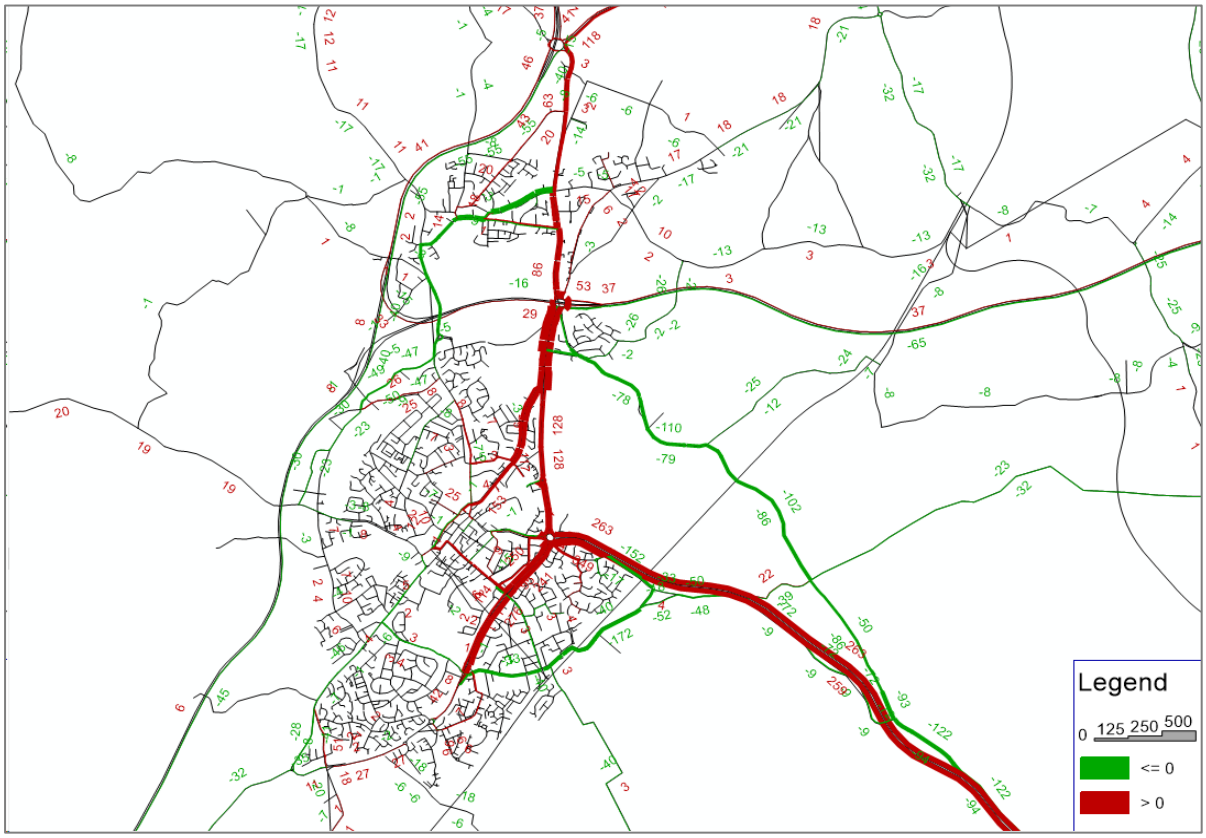


Figure 3.7: 2025 Inter Peak (WS minus WoS)

Figure 3.8: 2025 PM Peak (WS minus WoS)

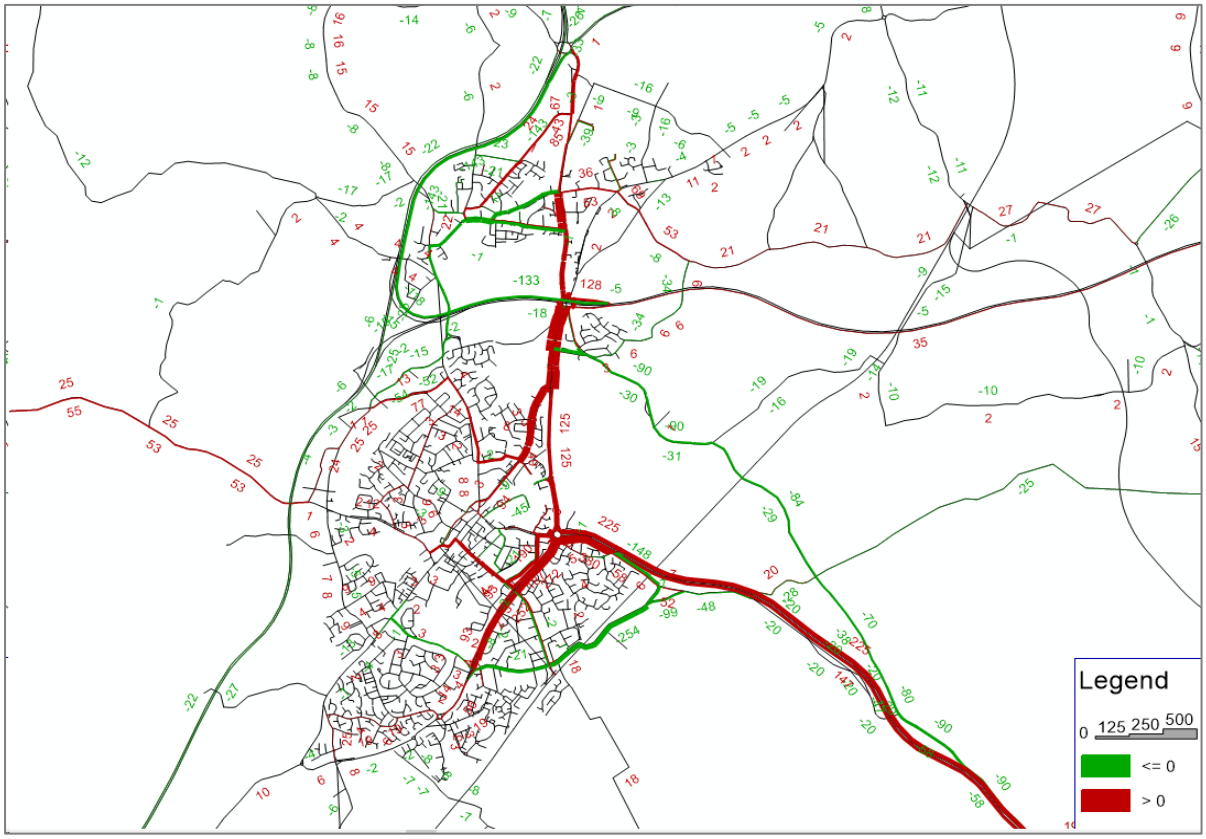


Figure 3.9: 2040 AM Peak (WS minus WoS)

Figure 3.10: 2040 Inter Peak (WS minus WoS)

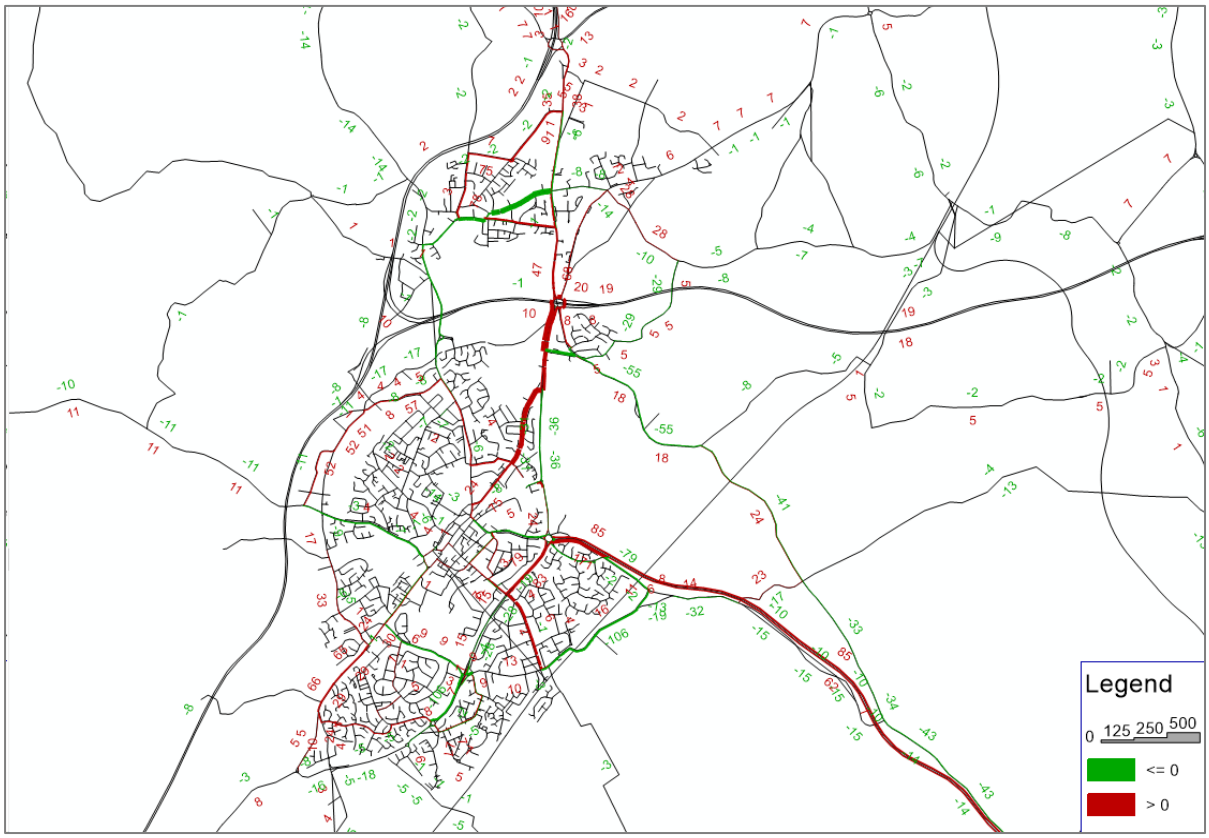
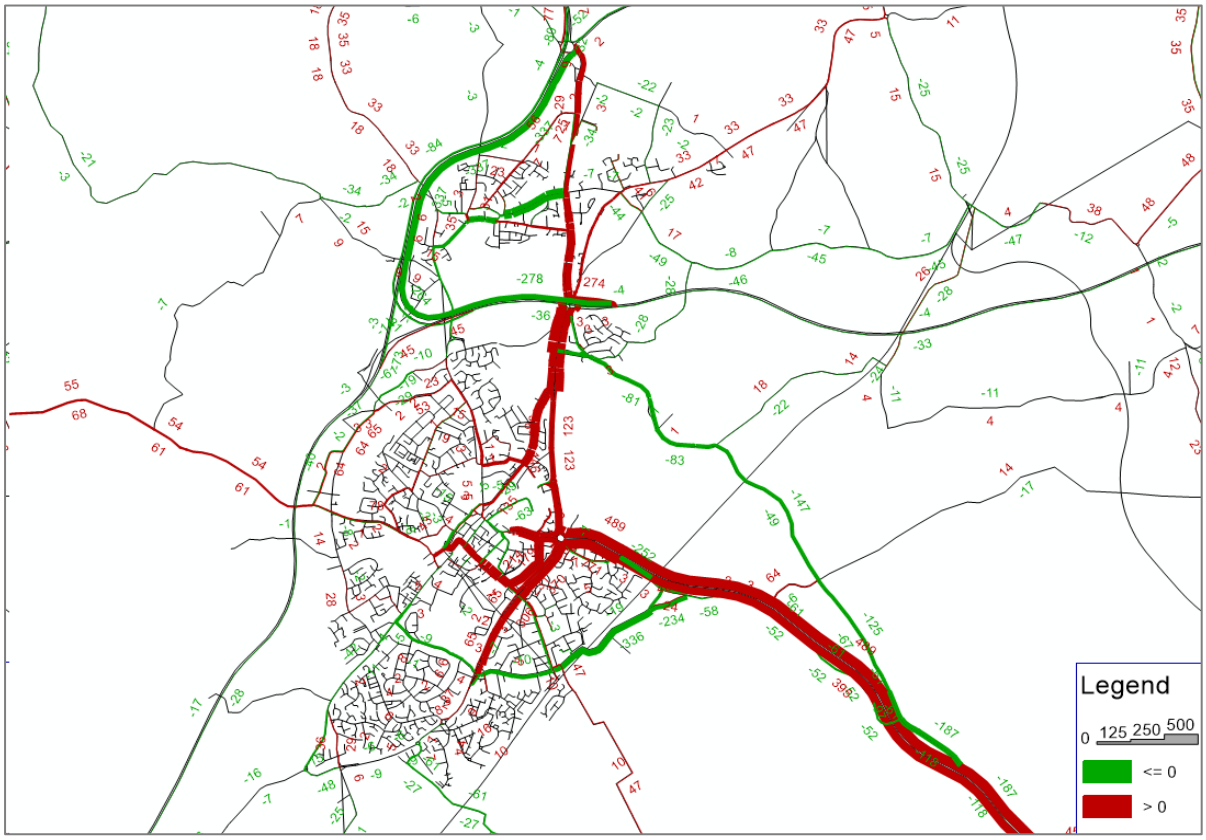


Figure 3.11: 2040 PM Peak (WS minus WoS)



3.12 Select Link Analysis

Select link analysis of flows travelling along any of the A38 BREP scheme sections for 2040 AM and PM peak are shown in

Figure 3.12 to Figure 3.15 for the WoS and WS. The patterns of movement using the A38 sections are very similar in both the WoS and WS scenarios, but the quantum of flows are greater in WS due to the attractiveness of the scheme. The plots demonstrate the A38 BREP scheme corridor acts as a primary distributor for trips to access the SRN and other radial routes into Redditch to the East and Wyre Forest to the west.

Figure 3.12: Select Link Analysis on A38 - 2040 AM WoS

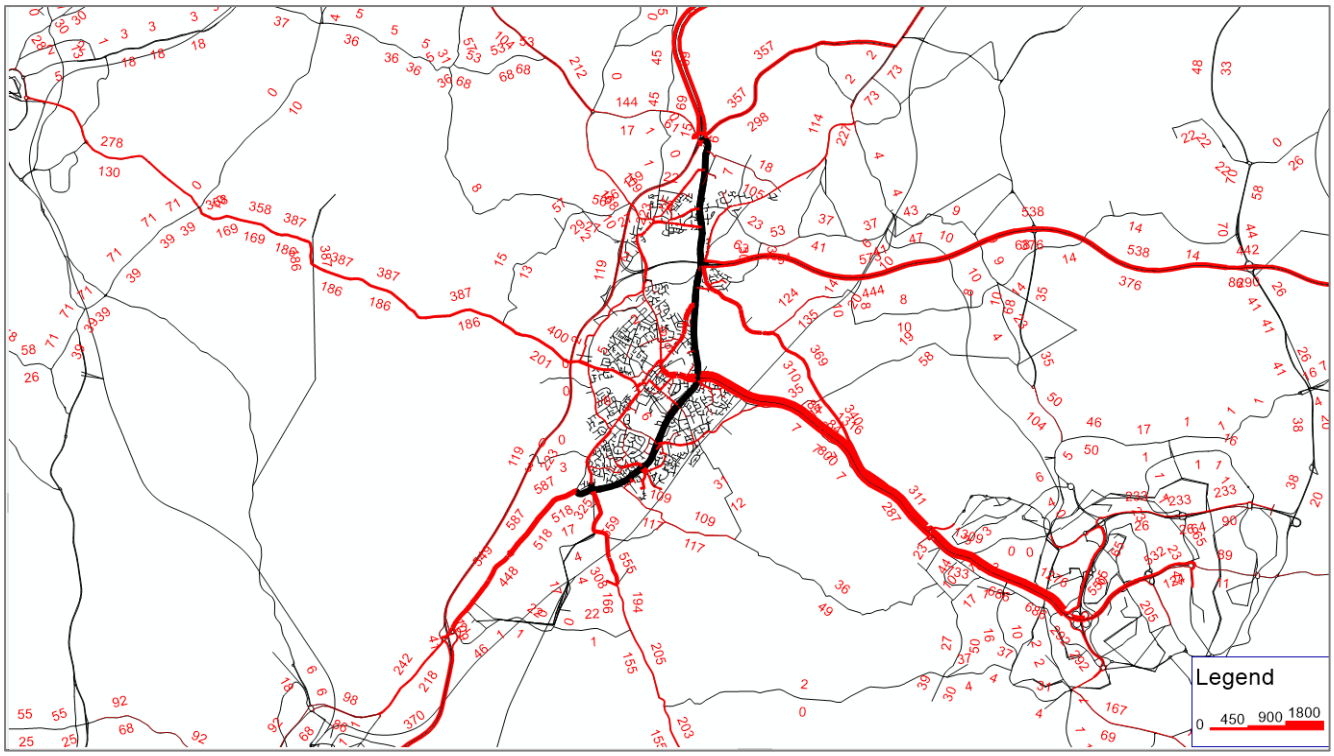


Figure 3.13: Select Link Analysis on A38 - 2040 AM WS

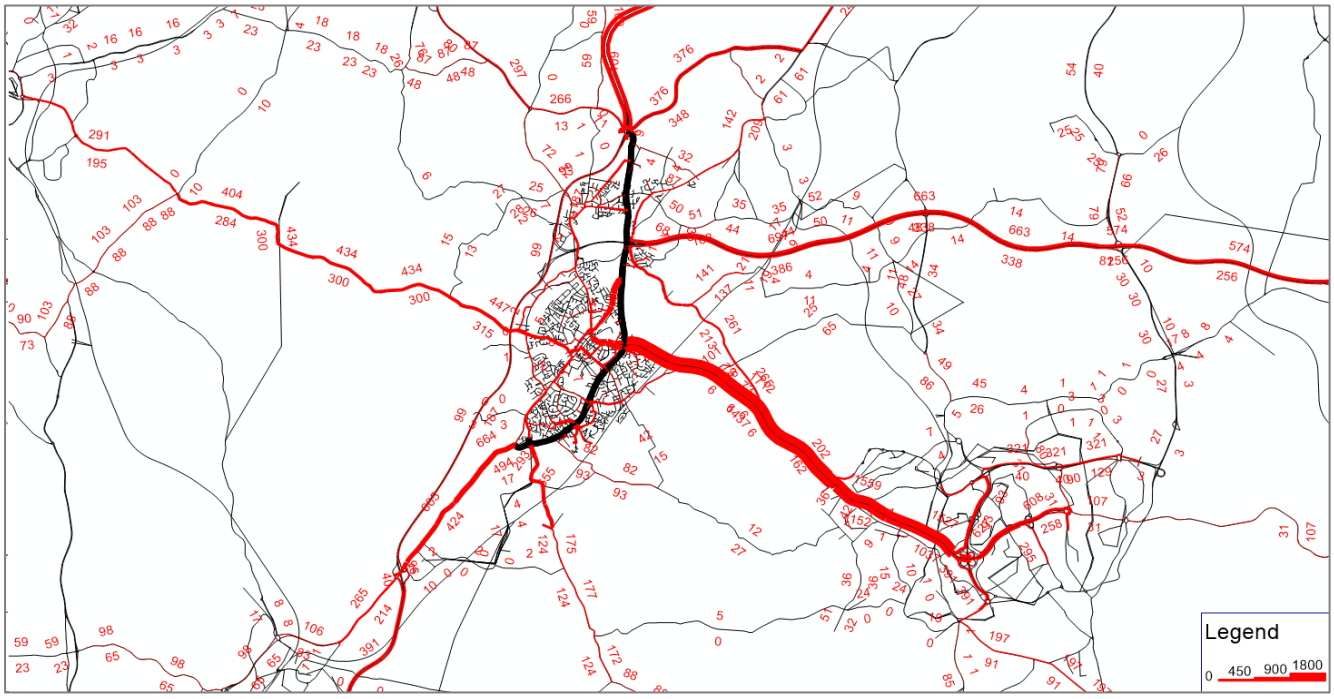


Figure 3.14: Select Link Analysis on A38 - 2040 PM WoS

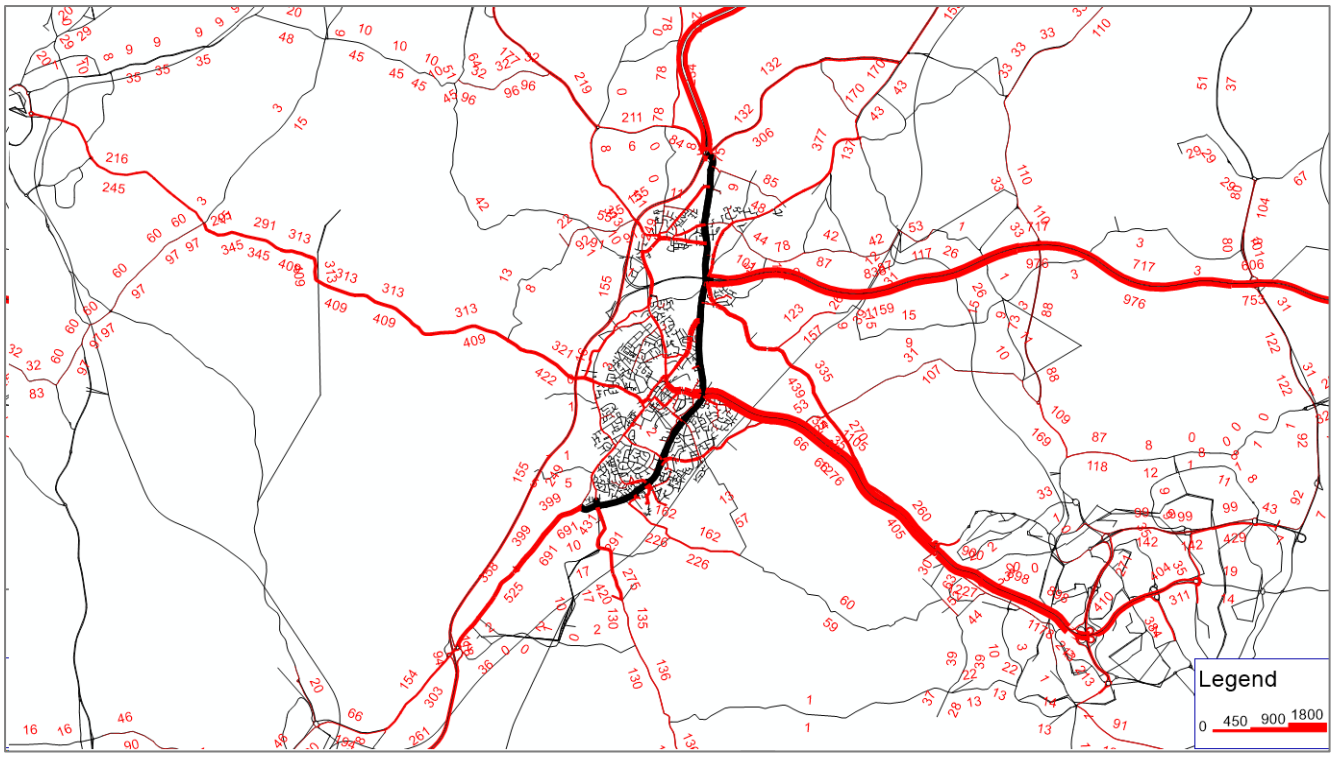
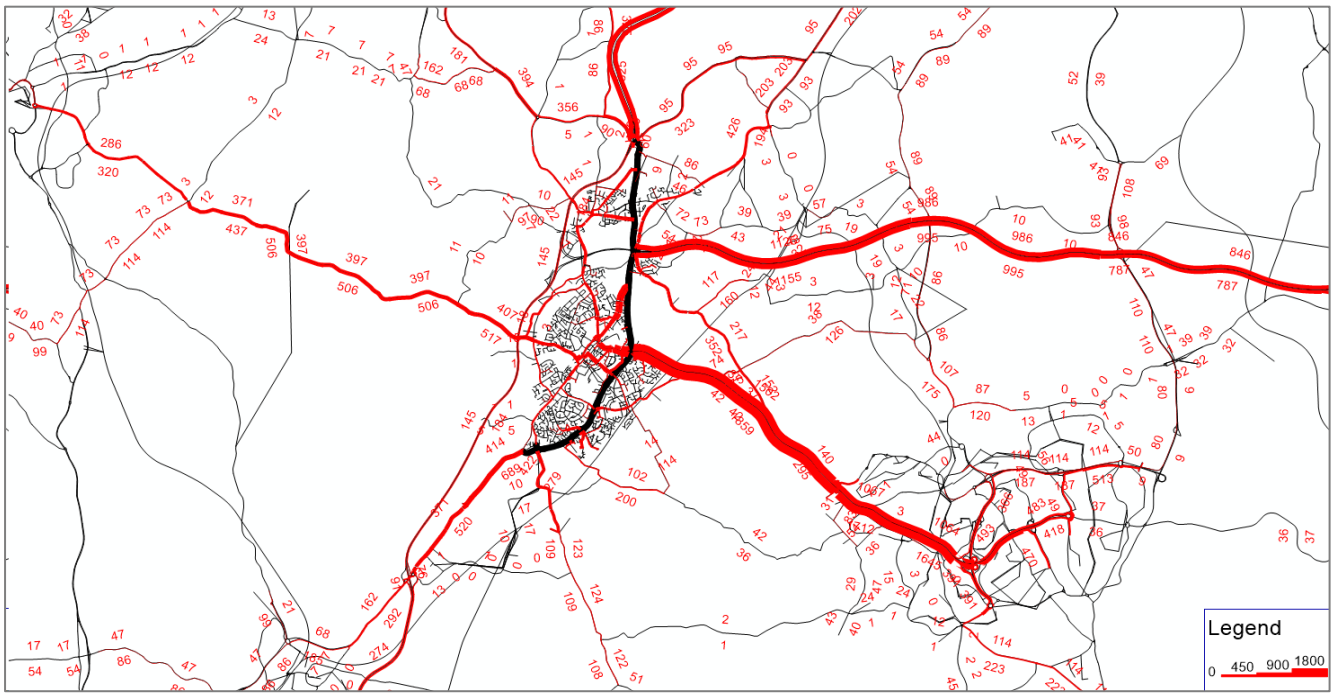


Figure 3.15: Select Link Analysis on A38 - 2040 PM WS



3.13 Junction delays and queues

Figure 3.16 to

Figure 3.19 show the mean junction delay (>10s) and relative queue lengths (proportion of link queued up) for the 2040 peak hours under both WoS and WS scenarios. The plots show the delays are predominantly experienced at the same junctions in both WoS and WS but the magnitude of delay is mostly lower under the WS scenario. In addition, the relative queue lengths on links significantly reduces in the WS scenario compared to the WoS scenario along the A38 corridor

Figure 3.16: Junction delay and link queue lengths – 2040 AM WoS

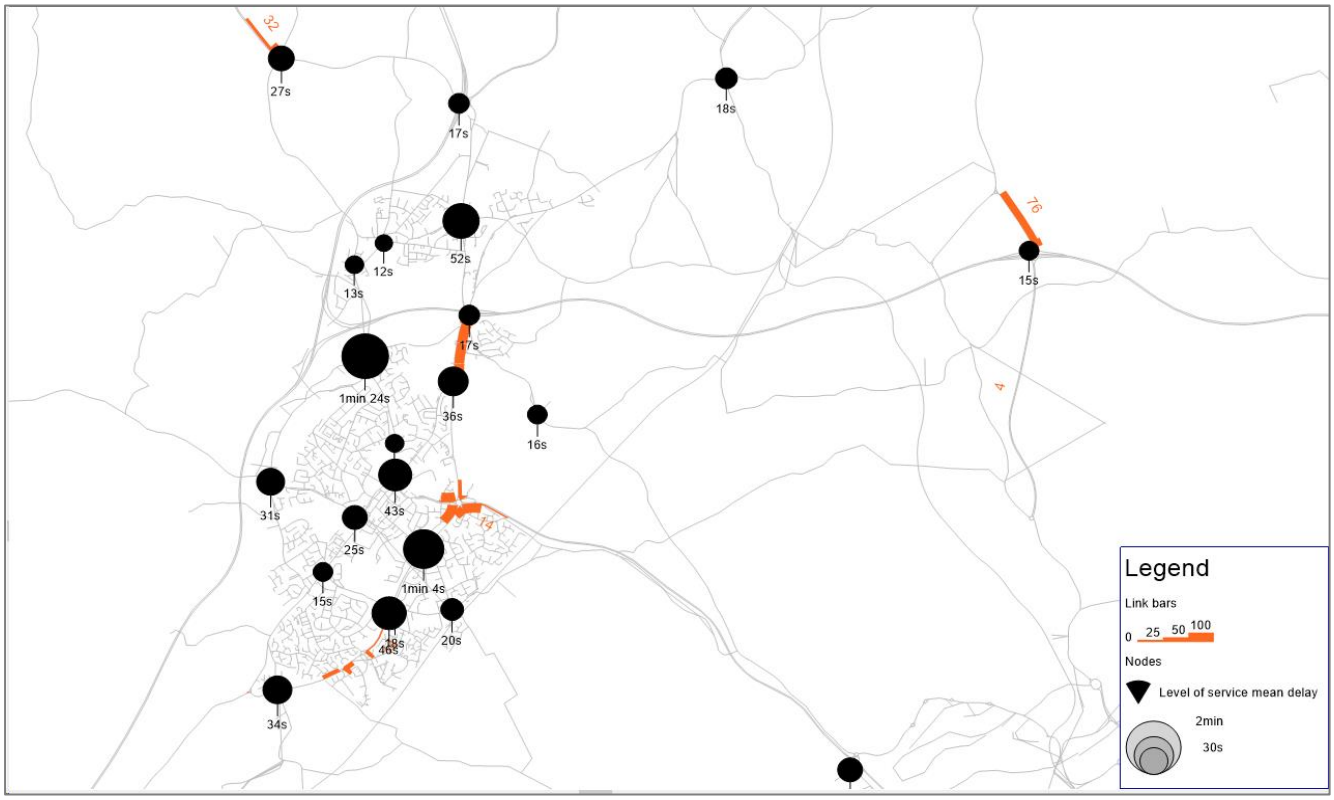


Figure 3.17: Junction delay and link queue lengths – 2040 AM WS

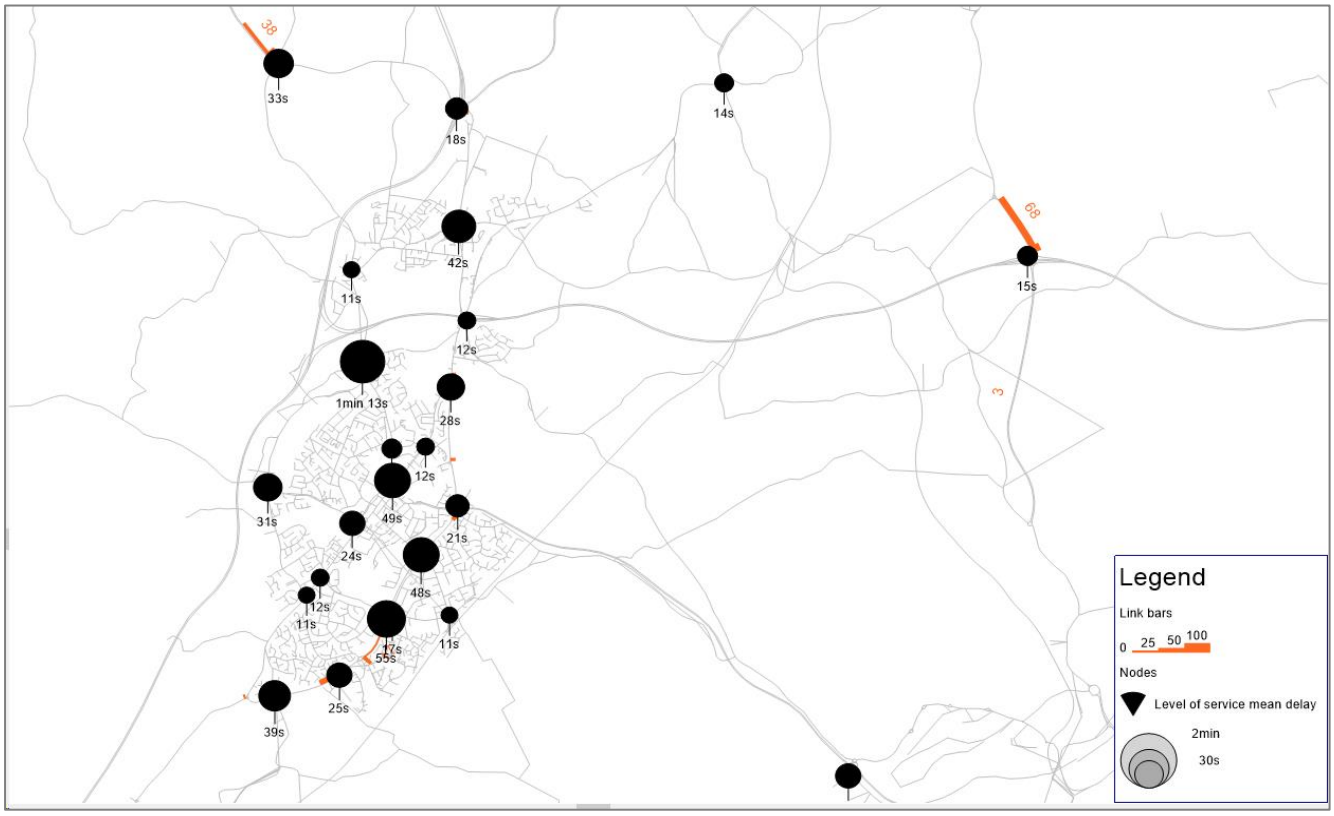
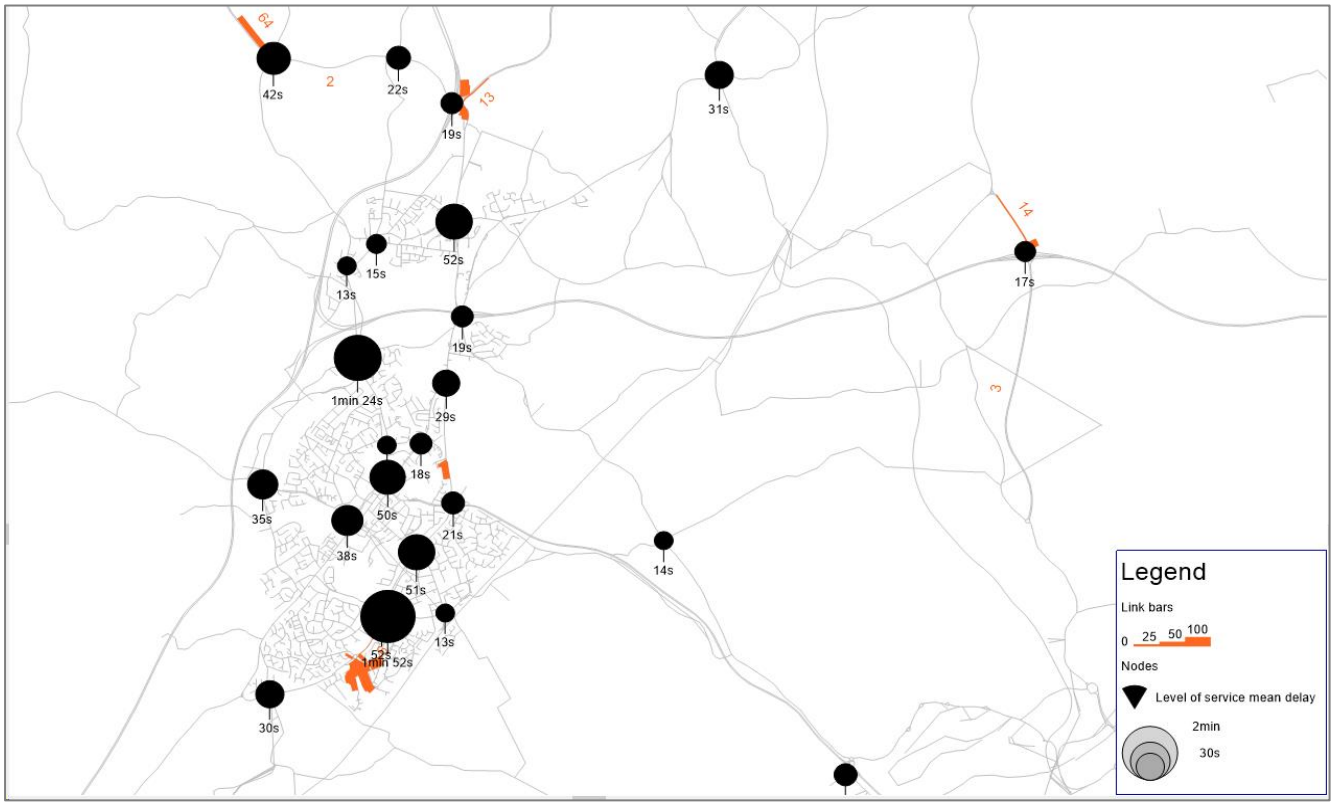


Figure 3.18: Junction delay and link queue lengths – 2040 PM WoS

Figure 3.19: Junction delay and link queue lengths – 2040 PM WS



3.14 Analysis of Journey Times

In order to understand the impact of the scheme to the vehicles using the A38 scheme, modelled journey times have been extracted. Table 3.16 shows the time taken to travel along the A38 route in Bromsgrove between its junction with M5 J4 in the north and M5 J5 via M42 J1 and A38/A448 roundabout under the WoS and WS scenarios in both 2025 and 2040 for all modelled hours. Table 3.17 shows the change in journey times between WoS and WS for the two forecast years and all modelled hours.

The tables show the WS scenario provides journey time savings primarily in the southbound direction in both 2025 and 2040 and across the AM and PM peak hours. The scheme results in savings of up to 3.6 minutes in the peak hours with the AM peak hour showing greater savings than the PM peak.

The journey times in the inter peak hour however slightly increase of 0.3 minutes in the WS scenario compared to the WoS. This is primarily due to signals at the A38/A448 roundabout at Scheme E and reduction in speed limits at Scheme 7 in the WS scenario compared to the WoS scenario.

In the Northbound direction, the journey times in the WS scenario are lower than the WoS scenario in 2040 across all modelled hours with savings of up to 1.1 minute. However, in 2025, only the AM and IP hours show journey time savings of up to 0.6 minutes whilst the PM hour shows a marginal increase in journey times in the WS scenario compared to the WoS scenario.

The journey time improvements will help traffic from Bromsgrove a quicker access to the Strategic Road Network and therefore enhance its connectivity to the Birmingham conurbation (including the Birmingham airport, planned HS2 stations) and beyond.

Table 3.16: A38 Forecast Journey time

Route	WoS Journey Times (min)	WoS Journey Times (min)	WoS Journey Times (min)	WoS Journey Times (min)	WoS Journey Times (min)	WoS Journey Times (min)	WS Journey Times (min)	WS Journey Times (min)	WS Journey Times (min)	WS Journey Times (min)	WS Journey Times (min)	WS Journey Times (min)
	2025	2025	2025	2040	2040	2040	2025	2025	2025	2040	2040	2040
	AM	IP	PM	AM	IP	PM	AM	IP	PM	AM	IP	PM
A38 North bound	22.6	20.4	23.0	24.0	21.0	24.6	22.0	20.0	23.1	22.9	20.6	24.6
A38 South bound	25.1	20.5	24.1	27.1	22.0	24.7	22.2	20.9	21.8	23.5	22.2	23.1

Table 3.17: A38 Forecast Journey time changes

Journey Times difference

Route	2025 WS vs WoS	2025 WS vs WoS	2025 WS vs WoS	2040 WS vs WoS	2040 WS vs WoS	2040 WS vs WoS
	AM	IP	PM	AM	IP	PM
Absolute difference (min)						
A38 Northbound	-0.6	-0.4	0.1	-1.1	-0.4	-0.1
A38 Southbound	-2.8	0.3	-2.3	-3.6	0.3	-1.6
% difference						
A38 Northbound	-2.7%	-1.9%	0.5%	-4.7%	-1.7%	-0.3%
A38 Southbound	-11.3%	1.5%	-9.6%	-13.3%	1.1%	-6.6%

3.15 Sensitivity tests

Sensitivity tests around the core scenario 'central forecasts' were undertaken in line with TAG guidance. To provide an indication of the uncertainty around these forecasts, high and low growth scenarios have been produced based on the guidance detailed in Section 4 of TAG Unit M4.

The adjustment of the matrices were made by taking the appropriate proportion of the 2017 base year matrix and adding or subtracting it from the incremental adjustment as recommended in Box1 of TAG Unit M4. In order to provide the required future year sensitivity tests the adjusted matrices were used to iterate the demand and supply models to convergence. The TAG high / low growth sensitivity tests have been run from 2025 and 2040 and compared to the Core scenario.

The forecast demand totals after VDM for WoS and WS for 2025 in the low growth scenario varies between -6.3% and -7.1% compared to the core scenario. The high growth demand similarly varies between 6.3% and 7.1% for 2025 WoS and WS scenario.

The forecast demand totals after VDM for WoS and WS for 2040 2025 in the low growth scenario varies between -8.8% and -12.0% compared to the core scenario. The high growth demand similarly varies between 8.8% and 12.0% for 2040 WoS and WS scenario.

The change in demand in both 2025 and 2040 scenarios show similar pattern of demand changes in the high / low growth scenarios.

The network performance summary statistics of the WoS and WS scenarios across the Fully Modelled Area and comparison with the Core scenario are given in Table 3.18 to Table 3.21 for vehicle-kms. The tables show that there is a good correspondence between the expected difference in vehicle-kms and the difference in demand forecasts between the high / low growth scenario and the Core forecasts for highway demand.

Table 3.18: Veh-km comparisons between WoS Low and Core Growth- 2025

User Class	2025 WoS - Low Growth	2025 WoS - Low Growth	2025 WoS - Low Growth	2025 WoS - Core Growth	2025 WoS - Core Growth	2025 WoS - Core Growth	2025 WoS - High Growth	2025 WoS - High Growth	2025 WoS - High Growth	%Diff (Low – Core)	%Diff (Low – Core)	%Diff (Low – Core)	%Diff (High – Core)	%Diff (High – Core)	%Diff (High – Core)
	AM Peak	Inter Peak	PM Peak	AM Peak	Inter Peak	PM Peak	AM Peak	Inter Peak	PM Peak	AM Peak	Inter Peak	PM Peak	AM Peak	Inter Peak	PM Peak
HBW	251162	60499	297184	268290	64786	317499	285609	69228	338700	-6.4%	-6.6%	-6.4%	6.5%	6.9%	6.7%
HBEB	56843	39887	54784	61257	42916	58801	65555	45864	62766	-7.2%	-7.1%	-6.8%	7.0%	6.9%	6.7%
HBO	117630	176989	176578	126020	189567	189214	134208	201657	201488	-6.7%	-6.6%	-6.7%	6.5%	6.4%	6.5%
NHBEB	57996	47133	61746	62365	50547	66403	66703	54029	71065	-7.0%	-6.8%	-7.0%	7.0%	6.9%	7.0%
NHBO	30839	46314	51445	33086	49686	55186	35327	52966	58903	-6.8%	-6.8%	-6.8%	6.8%	6.6%	6.7%
LGV	94452	104269	99690	100860	111251	106151	107294	118237	112777	-6.4%	-6.3%	-6.1%	6.4%	6.3%	6.2%
HGV	66172	93187	49115	71218	100306	52863	76296	107444	56613	-7.1%	-7.1%	-7.1%	7.1%	7.1%	7.1%
Total	**675093**	**568276**	**790541**	**723097**	**609058**	**846117**	**770992**	**649425**	**902312**	**-6.6%**	**-6.7%**	**-6.6%**	**6.6%**	**6.6%**	**6.6%**

Table 3.19: Veh-km comparisons between WS and Core Growth- 2025

User Class	2025 WS - Low Growth	2025 WS - Low Growth	2025 WS - Low Growth	2025 WS - Core Growth	2025 WS - Core Growth	2025 WS - Core Growth	2025 WS - High Growth	2025 WS - High Growth	2025 WS - High Growth	%Diff (Low – Core)	%Diff (Low – Core)	%Diff (Low – Core)	%Diff (High – Core)	%Diff (High – Core)	%Diff (High – Core)
	AM Peak	Inter Peak	PM Peak	AM Peak	Inter Peak	PM Peak	AM Peak	Inter Peak	PM Peak	AM Peak	Inter Peak	PM Peak	AM Peak	Inter Peak	PM Peak
HBW	252333	60611	298694	269922	64843	319148	287928	69422	340574	-6.5%	-6.5%	-6.4%	6.7%	7.1%	6.7%
HBEB	56838	39870	54817	61164	42843	58840	65509	45799	62837	-7.1%	-6.9%	-6.8%	7.1%	6.9%	6.8%
HBO	117391	176546	175927	125849	189109	188682	134164	201160	200937	-6.7%	-6.6%	-6.8%	6.6%	6.4%	6.5%
NHBEB	57996	47094	61747	62366	50541	66408	66722	54022	71073	-7.0%	-6.8%	-7.0%	7.0%	6.9%	7.0%
NHBO	30751	46172	51234	33004	49530	55019	35256	52787	58744	-6.8%	-6.8%	-6.9%	6.8%	6.6%	6.8%
LGV	94536	104274	99704	100911	111261	106186	107325	118232	112796	-6.3%	-6.3%	-6.1%	6.4%	6.3%	6.2%
HGV	66173	93175	49110	71233	100303	52873	76288	107446	56630	-7.1%	-7.1%	-7.1%	7.1%	7.1%	7.1%
Total	**676018**	**567742**	**791233**	**724449**	**608429**	**847156**	**773194**	**648869**	**903590**	**-6.7%**	**-6.7%**	**-6.6%**	**6.7%**	**6.6%**	**6.7%**

Table 3.20: Veh-km comparisons between WoS Low and Core Growth- 2040

User Class	2040 WoS - Low Growth	2040 WoS - Low Growth	2040 WoS - Low Growth	2040 WoS - Core Growth	2040 WoS - Core Growth	2040 WoS - Core Growth	2040 WoS - High Growth	2040 WoS - High Growth	2040 WoS - High Growth	%Diff (Low – Core)	%Diff (Low – Core)	%Diff (Low – Core)	%Diff (High – Core)	%Diff (High – Core)	%Diff (High – Core)
	AM Peak	Inter Peak	PM Peak	AM Peak	Inter Peak	PM Peak	AM Peak	Inter Peak	PM Peak	AM Peak	Inter Peak	PM Peak	AM Peak	Inter Peak	PM Peak
HBW	258483	62335	310136	290448	70193	349435	320372	77788	385204	-11.0%	-11.2%	-11.2%	10.3%	10.8%	258483
HBEB	63752	43574	57323	72547	49421	64833	81451	55267	72361	-12.1%	-11.8%	-11.6%	12.3%	11.8%	63752
HBO	135685	201691	202401	152500	225802	226581	168377	248215	249900	-11.0%	-10.7%	-10.7%	10.4%	9.9%	135685
NHBEB	64128	51809	66363	72738	59008	75437	81369	65657	84359	-11.8%	-12.2%	-12.0%	11.9%	11.3%	64128
NHBO	35945	54886	61938	40330	61344	69070	44508	67497	76026	-10.9%	-10.5%	-10.3%	10.4%	10.0%	35945
LGV	111393	123084	117527	122341	134833	128741	133223	146468	139916	-8.9%	-8.7%	-8.7%	8.9%	8.6%	111393
HGV	65773	92580	48807	74383	104718	55155	83000	116811	61517	-11.6%	-11.6%	-11.5%	11.6%	11.5%	65773
Total	**735158**	**629959**	**864496**	**825287**	**705318**	**969251**	**912299**	**777702**	**1069282**	**-10.9%**	**-10.7%**	**-10.8%**	**10.5%**	**10.3%**	**735158**

Table 3.21: Veh-km comparisons between WS and Core Growth- 2040

User Class	2040 WS - Low Growth	2040 WS - Low Growth	2040 WS - Low Growth	2040 WS - Core Growth	2040 WS - Core Growth	2040 WS - Core Growth	2040 WS - High Growth	2040 WS - High Growth	2040 WS - High Growth	%Diff (Low – Core)	%Diff (Low – Core)	%Diff (Low – Core)	%Diff (High – Core)	%Diff (High – Core)	%Diff (High – Core)
	AM Peak	Inter Peak	PM Peak	AM Peak	Inter Peak	PM Peak	AM Peak	Inter Peak	PM Peak	AM Peak	Inter Peak	PM Peak	AM Peak	Inter Peak	PM Peak
HBW	260533	62580	311596	293023	70529	350628	323447	78044	387887	-11.1%	-11.3%	-11.1%	10.4%	10.7%	10.6%
HBEB	63626	43492	57375	72448	49350	64910	81146	55100	72378	-12.2%	-11.9%	-11.6%	12.0%	11.7%	11.5%
HBO	135982	202301	202564	152719	226448	226916	168822	249419	250388	-11.0%	-10.7%	-10.7%	10.5%	10.1%	10.3%
NHBEB	64127	52191	66376	72751	58986	75373	81344	65706	84381	-11.9%	-11.5%	-11.9%	11.8%	11.4%	12.0%
NHBO	35963	54930	61877	40362	61390	69120	44569	67633	76066	-10.9%	-10.5%	-10.5%	10.4%	10.2%	10.0%
LGV	111427	123086	117530	122466	134851	127076	133255	146687	139947	-9.0%	-8.7%	-7.5%	8.8%	8.8%	10.1%
HGV	65800	92584	48805	74420	104707	55674	83042	116806	61547	-11.6%	-11.6%	-12.3%	11.6%	11.6%	10.5%
Total	**737460**	**631163**	**866123**	**828190**	**706260**	**969696**	**915627**	**779395**	**1072592**	**-11.0%**	**-10.6%**	**-10.7%**	**10.6%**	**10.4%**	**10.6%**

3.16 Summary

The analysis of the modelled outputs discussed shows the A38 BREP scheme helps in relieving congestion along the corridor compared to the WoS scenario while also drawing in traffic from other routes and thereby reducing congestion in other parts of the Bromsgrove town network. Additional information on VISUM highway model can be found in the Traffic Forecasting report (Appendix TM.5).

3.17 Outputs for appraisal

The forecast model outputs in terms of skims (demand, time, distance) for all user classes modelled were extracted to feed into the economic appraisal for the calculation of transport user benefits using TUBA. Link flow, congested speeds, travel times, and junction performance data were used to inform COBALT, wider impacts and operational modelling.

Model outputs in terms of journey times/total travel times (in vehicle-hours) in the Fully Modelled Area were extracted to undertake a reliability assessment in accordance with section 6.3 of TAG unit A1.3. This analysis is reported in the Economic Case.