Appendix J – Technical Appendix

This document is out of date. The latest information on the government's aviation and airports policy is available on GOV.UK.

Modelling Technical Note 1: Connectivity to LBIA Feasibility Study – Modelling Methodology (Final)

1. Introduction

This note describes the proposed modelling methodology for the Leeds Bradford International Airport (LBIA) Connectivity Study, which is at WebTAG Stage 1 Option Development. The modelling will support the assessment of a number of options; the outcome of each will be presented in an Option Assessment Report (OAR) showing how each option performs.

In terms of modelling stages, the modelling will be used to support scheme assessment at Stage 2 only. A review of the models and any preparation work to update the models in readiness for use will be undertaken in Stage 1(b). Stage 1(a) involves an initial sift of schemes which will be carried out using Early Assessment & Sifting Tool (EAST) and our own bespoke Multi Criteria Assessment Tool (MCAT).

During the study inception meeting the DfT requested further detail on the modelling approach and how this will be used in the appraisal, expanding on the outline approach already set out in the project proposal. This was further reinforced with a more recent discussion.

This note therefore aims to provide this additional detail under the following headings:

- Modelling method;
- Contingency modelling method;
- Approach for using the model outputs in the appraisal;
- Transport user and provider impacts; and
- Annualisation

2. Modelling method

Overview

The modelling will be undertaken using the Leeds Transport Model (LTM). This is a multi-model modelling suite with variable demand capability. However it is proposed that the modelling of different options will not be undertaken using the full LTM suite due to the anticipated lengthy scenario set up and model run times which would over stretch the time scales available for undertaking the option assessments. Instead it is proposed that the highway and public transport models would be used as standalone components. This is a more simplistic approach for using the LTM but considered proportional to the requirements for modelling options at this early stage of appraisal and in line with our original proposals.

The model base year is 2008 with forecast years of 2016 and 2031.

Model Time Periods

The LTM represents the following time periods:

- Highway
  - AM peak hours 7-8, 8-9 & 9-10;
  - Inter-peak average hour 10-16; and
  - PM peak hours 16-17, 17-18, 18-19.
- Public Transport
  - AM Peak period average hour 7-10;
  - Inter-peak average hour 10-16; and

- PM peak hours average hour 16-18.

A proportionate approach will be taken to which model time periods are used. While it is expected that only one of the peak period hours in the AM and one in the PM will be used, it is noted the highway model provides the opportunity for testing during the peak hours and the shoulder hours. However the decision about which model hours are used will be determined based on a review of the information and data collected for the study, particularly in terms of passenger demand profile at the airport for the baseline and forecast.

The Leeds Highway model LMVR describes linkage between the individual peak period hours in terms of information being passed from subsequent hours. However looking at the parameter settings in the model they appear contrary to this where PASSQ=F. Further investigation will determine whether linkage is in fact an issue and agreement about a proportionate approach.

There is also linkage in the LTM set up in terms of congested travel times being passed from the Highway model to the Public transport model adjusting bus service run times. However this process is embedded within the wider LTM suite and would be considerably time consuming to extract and set up to run in isolation.

Model Base

For highway scheme options, the existing Saturn highway model will be used as a basis. For public transport scheme options, the existing Cube Voyager Public Transport model will be used as a basis. For both a review of the model detail in the area of interest in terms of validation, network, services for PT, and zone definition coverage will be undertaken. This process will identify the suitability of using the models for the study (being fit for purpose), and any changes required which will need to be agreed and considered within the bounds of the study scope.

The performance of the models in terms of validation against observed data will in the first instance be based on information described in the LMVR's. Where this is not sufficiently conclusive a proportionate approach within the bounds of the study scope will be agreed, for example using other data collected as part of the study to compare traffic and public transport flows and journey times within the area of interest. The Highway model provides demand segmented by user class categorised into personal and employer business enabling passenger and employer demand to be checked where data is available.

Model Forecast

The existing LTM core / central case forecast years will be used as a basis for the future year modelling. The 2016 and 2031 models will be available for the study. 2016 is not an ideal first year forecast for the assessment as many of the scheme options are unlikely to be on the ground by then, but nevertheless is considered acceptable as a basis for the scheme modelling.

The aim of the study is to provide a strategy for connectivity to the airport both in the near term and future stages and therefore consideration will be given to the possibility of representing an intermediate year as required. However this will need to be agreed and set within the bounds of the study scope.

An uncertainty log will be created listing developments and schemes significant to the study identified through stakeholder consultation and information gathered for the study. This will be cross referenced against the forecast assumptions described in the model forecasting report. The uncertainty log will also be used as one of the inputs to inform the requirements for the forecast year modelling, including an approach for representing intermediate model years.

Scheme Testing

For the scheme testing an iterative approach will be undertaken as follows:

- Run the models with fixed demand;
- Scope for the requirements of variable demand using an own cost elasticity function; and
- Where variable demand is required, the next steps will need to be agreed with the client bearing in mind the bounds of the study scope.

If variable demand modelling is required and an own cost elasticity approach in isolation is not considered appropriate, this would go beyond the study scope and risk a requirement for further work to the time and costs agreed. The potential options for a more sophisticated approach could involve setting up a simple variable demand model, or use the full LTM suite in some way as part of a benchmarking exercise.

Until this step in the scheme testing is reached and a more detailed approach agreed it is not clear what the exact time and cost implications would be, however as a broad indication it is expected that the modelling work would need to continue for further month.

Model Runs

For each scheme option it is anticipated that the list of model runs set out below would be required. However this will be refined further down the line based on the nature of options to be tested bearing in mod the study scope.

List of model runs:

- Highway model runs (for testing Highway schemes)
  - AM peak hours 8-9;
  - Inter-peak average hour 10-16; and
  - PM peak hours 17-18.
- Public Transport (for testing Public Transport schemes)
  - AM Peak period average hour 7-10;
  - Inter-peak average hour 10-16; and
  - PM peak hours average hour 16-18.

Do-minimum and Do-something will need to be run for the two model years 2016 and 2031. There will also be a requirement for model runs to test for the variable demand model scope.

So for example to test a single option which is highway only and where there is a need for representation of all AM, IP and PM time periods, it is expected that the following model runs would be required:

2016 model runs

- 3 x Do Min model runs (AM, IP and PM);
- 3 x Do Something model runs (AM, IP and PM) – Fixed demand;
- 3 x Do Something model runs (AM, IP and PM) – Own cost elasticity test for variable demand scope;

2031 model runs

- 3 x Do Min model runs (AM, IP and PM);
- 3 x Do Something model runs (AM, IP and PM) – Fixed demand; and
- 3 x Do Something model runs (AM, IP and PM) – Own cost elasticity test for variable demand scope.

For options that involve a package of schemes, highway and public transport, both models will need to be run therefore potentially reducing the modelling time available for testing other options.

3. Contingency modelling method

Where one or both of the highway and public transport models proves unsuitable for assessment of options within the time scales available (which we believe unlikely), a contingency modelling approach will be undertaken. This will involve developing a spreadsheet based transport modelling tool.

A basis of traffic flow and passenger demand information will be established. This will use a combination of outputs from the Highway and Public Transport model, and data collected for the study as appropriate. Transport model forecasts and the scheme option assessments will then pivot off this base information, using agreed assumptions about future supply and demand, and the impact of the schemes on the transport system.

The following traveller responses will be accommodated in a simplistic way:

Route choice; and

Demand model response (primarily mode choice) using an elasticity function approach

4. Approach for using the model outputs in the appraisal

Appraisal Summary Tables (AST's) will be presented for each option in the OAR. These will demonstrate the performance of each option against the value for money assessment areas of economy, environment and society as set out in the Transport Analysis Guidance Option Assessment Framework.

Table 1, Table 2 and Table 3 below present each of the assessment areas, indicating where there is a requirement for any quantitative assessment and how the modelling will support it.

Table 1 Impact on the Economy

Assessment Area	Quantitative Assessment	Assessment Method
Business Users and Transport Providers	Business Users: Monetary Assessment: Indicative £PV time impacts; £PV money travel costs Transport Providers: Monetary Assessment: Indicative £PV revenue	User and provider impacts will be derived based on a tuba run with inputs from the model.
Reliability	None	Although no quantitative assessment is required, outputs from the model could be used to forecast change in journey times for each of these assessment areas. While improving journey time reliability isn't a specific objective of the scheme, journey time reliability will be qualitatively assessed based on travel time and traffic condition changes in model.
Regeneration	None	The airport is not identified as a regeneration area, therefore no benefits will be estimated
Wider Impacts	None	Wider impacts will be qualitatively assessed based on travel time changes between key employment locations in the model. This will be a simplistic assessment, for example limited to an assessment of travel time changes between the airport and the city centres of Leeds and/ or Bradford.

Table 2 Impact on the Environment

Assessment Area	Quantitative Assessment	Assessment Method
Noise	Estimate number of people in the area who are likely to be annoyed	Changes in traffic flows and speeds in the model will be reviewed and assessed against flow and speed thresholds set out in the Web TAG Transport Appraisal Process guidance. Where thresholds are exceeded these will be flagged up, but no further quantitative analysis due to requirements to keep the modelling and appraisal proportionate to the study timescale. The output will be a qualitative assessment.
Air Quality	Estimate change in assessment score of PM10 and NO_2. Estimated change in NO_X emitted	A similar approach will be taken for air quality as described above for the noise assessment. Changes in traffic flows and speeds in the model will be reviewed against flow and speed thresholds set out in the Web TAG Transport Appraisal Process guidance. Where thresholds are exceeded these will be flagged up, but no further quantitative analysis. The output will be a qualitative assessment.
Greenhouse Gases	Estimated change in tonnes of carbon emitted. Monetary assessment: Indicative £PVB	Outputs will be taken from a Tuba run.
Landscape	Does the option impact on a designated site: Yes/no	A quantitative assessment will be undertaken where supportive information is available. A qualitative assessment will be made based on available information on scheme design.
Townscape	Number of strategically important views and / or key vistas directly affected: Yes/no	
Historic Environment	Does the option impact on a designated site: Yes/no	
Biodiversity	Does the option impact on a designated site: Yes/no	
Water Environment	Extent of development in the flood plain, residual flows risk and quality standards	

Table 3 Impact on Society

Assessment Area	Quantitative Assessment	Assessment Method
Non-business users	Non-business Users: Monetary Assessment: Indicative £PV time impacts; £ PV money travel costs	User and provider impacts will be derived based on a tuba run with inputs from the model.
Physical activity	If a walk/cycle scheme, then estimate change in the number of persons walking and cycling, average journey time, resultant change in mortality – based on initial catchment analysis.	A quantitative analysis will be undertaken only if the scheme is walk / cycle. A qualitative assessment will be made based on available information on scheme design.
Journey quality	None	Travel times and traffic condition changes from the model will be used as a proxy for traveller stress and a qualitative assessment.
Accidents	None	Unless the assessment area has been identified as amongst the key problems/challenges to be addressed, then then a qualitative assessment will be undertaken based on available information on scheme design.
Security	None	
Access to services	None	Qualitative assessment based on GIS accessibility analysis.
Affordability	None	In the event that the scheme has been designed to address affordability, a qualitative assessment will be made based on available evidence.
Severance	None	A qualitative assessment will be made based on available information on scheme design.
Option values	Number of Households Affected	A quantitative and qualitative assessment will be made based on GIS analysis.

5. Transport User and Provider Impacts

TUBA will be used to calculate transport user and provider benefits.

Where the LTM proves unsuitable for use, then a spreadsheet appraisal tool will be set up for the study, based on the principles set out in TAG unit A1.3 User and Provider impacts. The following inputs would be included:

- Model data inputs – demand, time, distance and user charge (fares for PT); and
- TAG data book inputs to calculate monetary benefits for the following:
  - Value of time savings for working and non-working segments;
  - Vehicle operating costs for fuel and non-fuel; and
  - User charges (fares for PT).

6. Annualisation

Annualisation will follow the guidance set out in TAG unit A1.3 User and Provider Impacts. It is expected that the main benefits of the scheme options will be realised during the weekday and particularly the peak periods. During this time it is expected that the demand on the transport system will be at its greatest and highway congestion at its worst.

The transport models will provide outputs for the AM, IP and PM weekday time periods. The outline approach will be to derive annualisation factors to cover benefits over a 12 hour day, Monday to Friday, annualised to represent one year. The factors will be derived based on a demand weighted basis using traffic flow and passenger count data collected for the study.

Modelling Technical Note 2: Connectivity to LBIA Feasibility Study – Review of LTM 2008 Base Year Assignment Models (Final)

Prepared by: Adam Truman Date: 7th July 2014

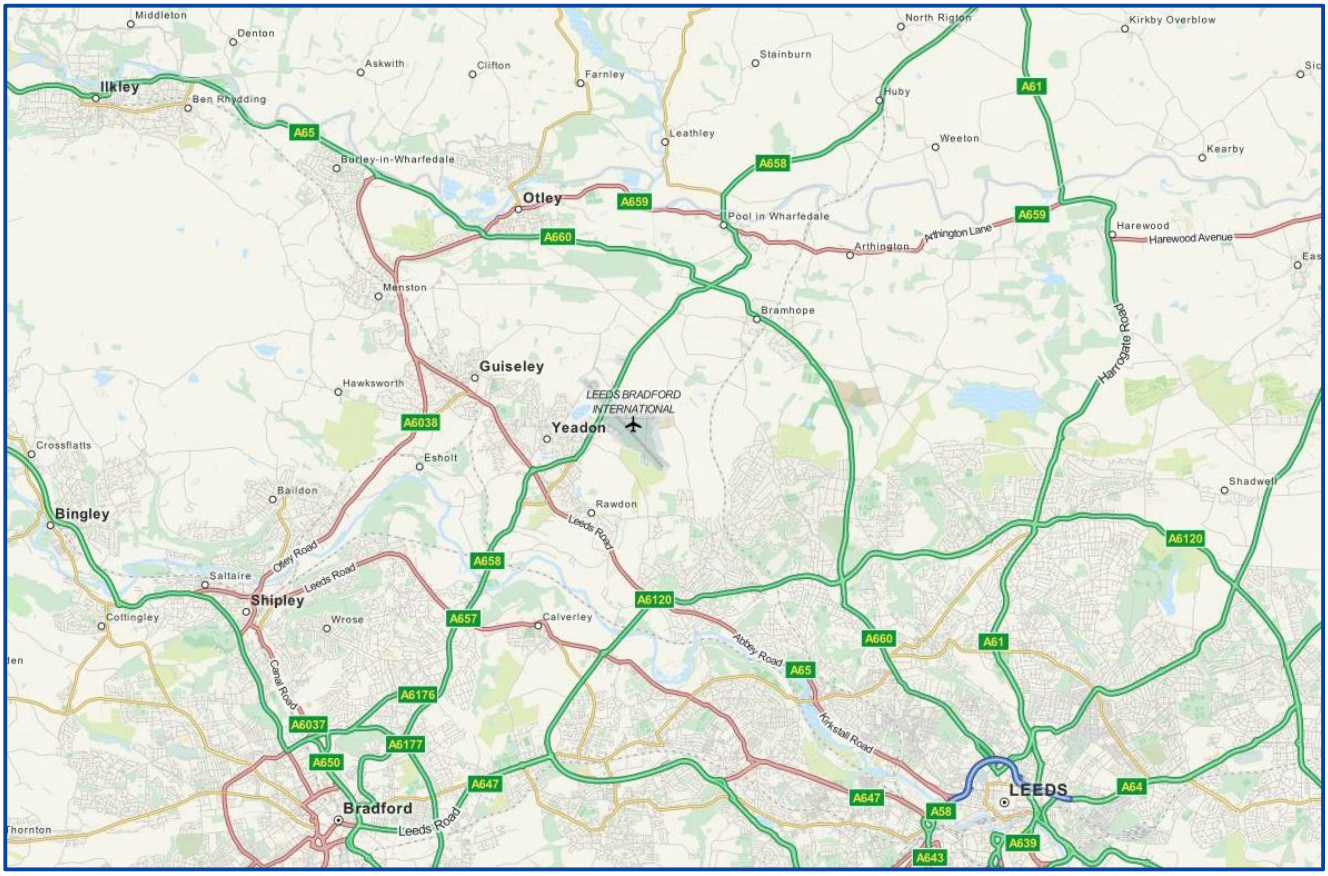
Checked by: Alec Curley Date: 10th July 2014

1 Introduction

This note presents a review of the LTM 2008 Base Highway and Public Transport Models and performance in the vicinity of LBIA.

Figure 1 below shows the location of LBIA in the context of the surrounding road network.

Figure 1 Map centred on the LBIA showing the nearby transport network



Data, imagery and map information provided by MapQuest, OpenStreetMap and contributors CC-BY-SA

The LTM Highway and Public Transport assignment models were developed during 2008-2010 as component parts of the WebTAG compliant LTM variable demand and supply modelling platform. They are described in respective Local Model Validation Reports (LMVR's). More recently the models were updated (post March 2012) as part of the ongoing NGT scheme assessment, with relatively minor changes described in a model update report. These reports are all available on the internet.

2 Highway Model

2.1 Time Periods

The model includes the following time periods:

- AM peak hours 7-8, 8-9 & 9-10;
- Inter-peak average hour 10-16; and
- PM peak hours 16-17, 17-18 & 18-19.

2.2 User Classes

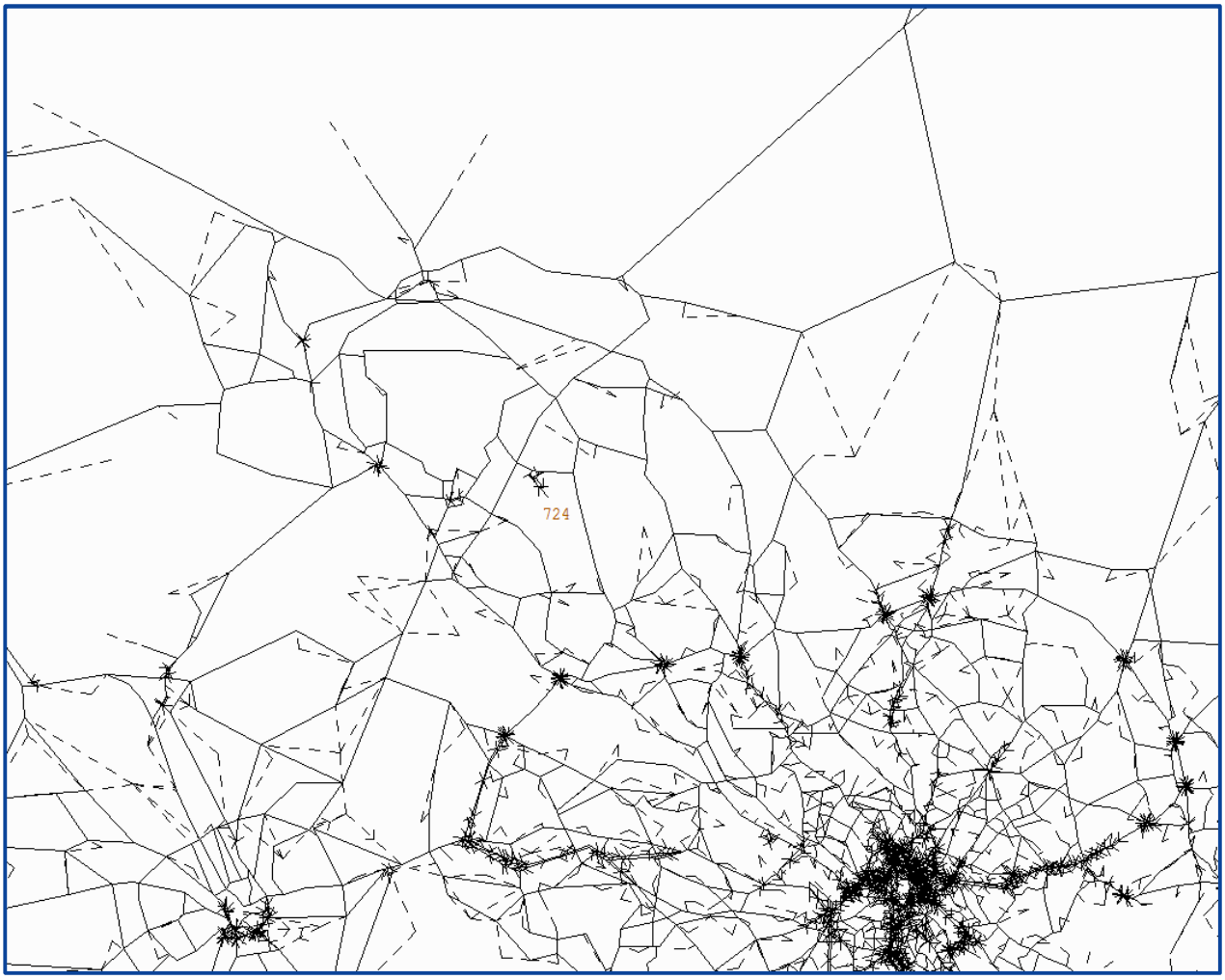
The model segments demand by the following user classes:

- Car Personal Low Income (<15k);
- Car Personal Medium Income (£15k to £30k);
- Car Personal High Income (>£30k);
- Car Employers Business;
- LGV; and
- OGV.

2.3 Network Coverage

Figure 2 shows the model network coverage. Zone 724 represents the airport and is highlighted.

Figure 2 Network coverage of the 2008 Base Highway model



This shows that the network coverage in the immediate study area is good. Further afield the model only retains its network detail in the Leeds District area; in Bradford the network becomes more simplified.

Junctions across the network shown in the plot are all simulated with the exception of the following 2 nodes:

- the first node is located on Bingley Rd, east of Mentson; and
- the second node is located on the A65, east of Burley in Wharfedale.

The figure shows that the Greengates junction is not represented accurately as an arm is missing. This junction is anticipated to be significant for the study based on the scheme sifting undertaken so far, where an intervention is expected to be modelled. Therefore representing it accurately is important.

The lane movement allocation for the Harrogate Road (B6152) northern arm at the A65 / B6152 (New Road / Harrogate Road) junction in Rawdon is incorrect.

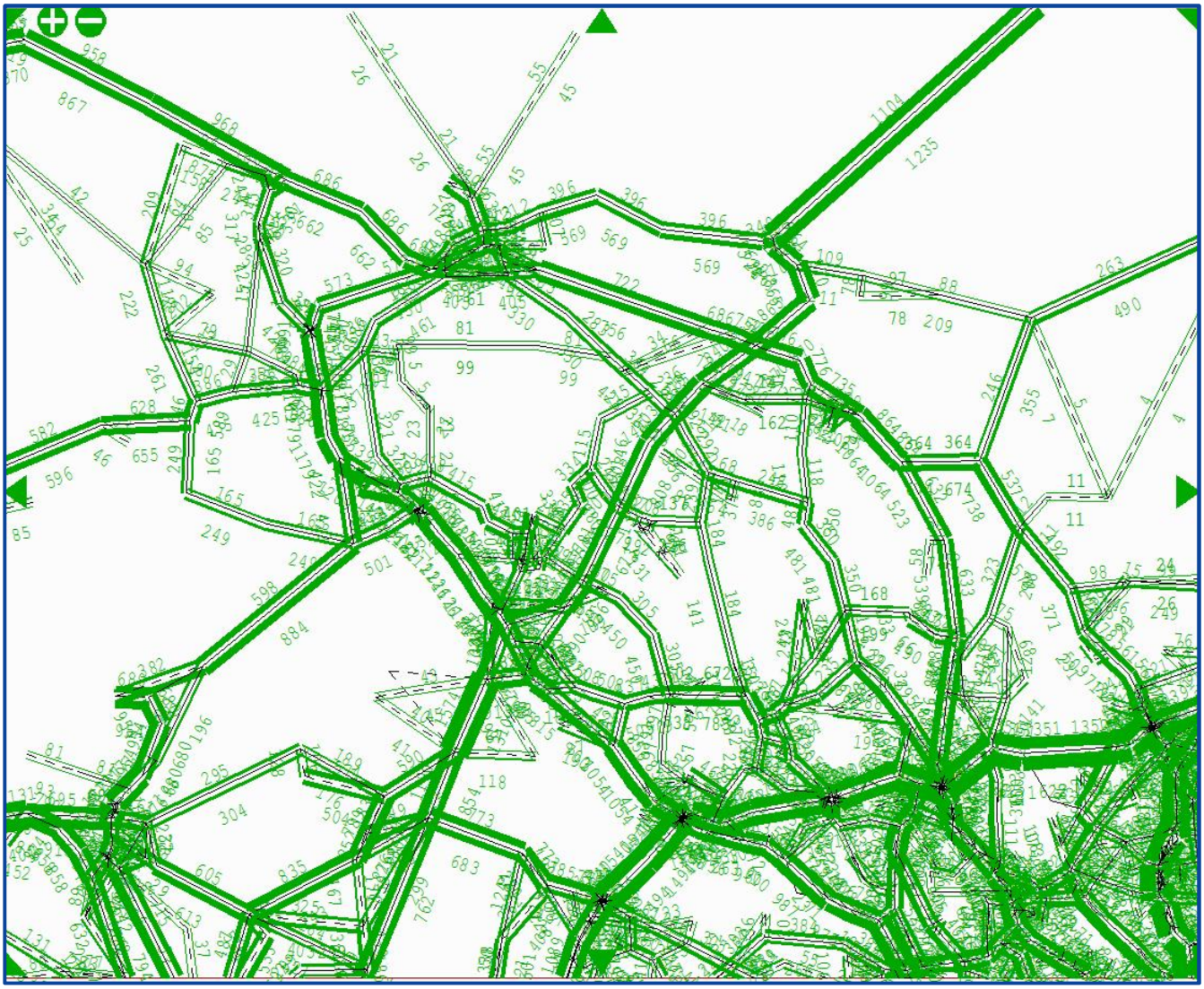
2.4 Traffic Flows

The figures below show the model network traffic flows (actual) in the study area.

Figure 3 Model Traffic Flows AM 8-9 (Actual Flows, All Vehicles. pcu)

Figure 4 Model Traffic Flows IP (Actual Flows, All Vehicles, pcu)

Figure 5 Model Traffic Flows PM 17-18 (Actual Flows, All Vehicles, pcu)



The pattern and scale of flows across the area shown in the pictures is generally as expected.

2.5 Comparison against Calibration and Validation Data

The model files made available for the study included calibration and validation flow and journey time data. As the LMVR only provides summary calibration information, and which has since been superseded by the March 2012 model update, this data is useful for gaining an understanding of the model performance in the vicinity of LBIA.

The LMVR describes the varying confidence in the different types of data used across the individual calibration and validation sites used (ATC, MCC and RSI). Therefore to mitigate and improve confidence, the model was calibrated based on site flow data aggregated in to screen lines. There is no indication of the performance at individual count sites.

Flow Differences (Model-Observed)

The following pictures show flow differences between the model and the observed data provided with the model files. For the AM and PM this is a comparison for all vehicles. For the IP data an inconsistency was identified, with only the car flows appearing sensible, and therefore used in the comparison.

Figure 6 Model Flow Differences AM 8-9 (Actual, All vehicles, pcu)

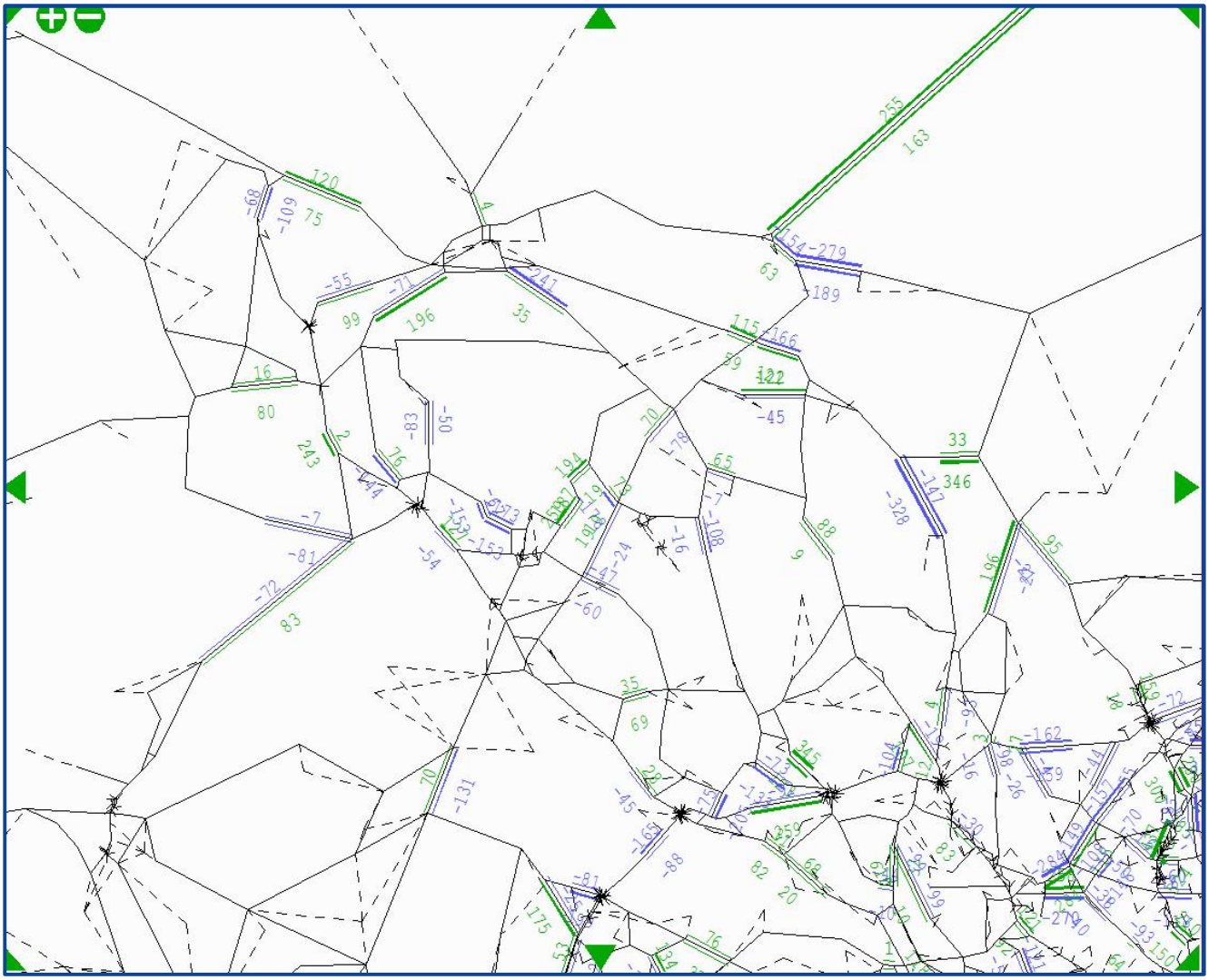


Figure 7 Model Flow Differences IP (Actual, Car, pcu)

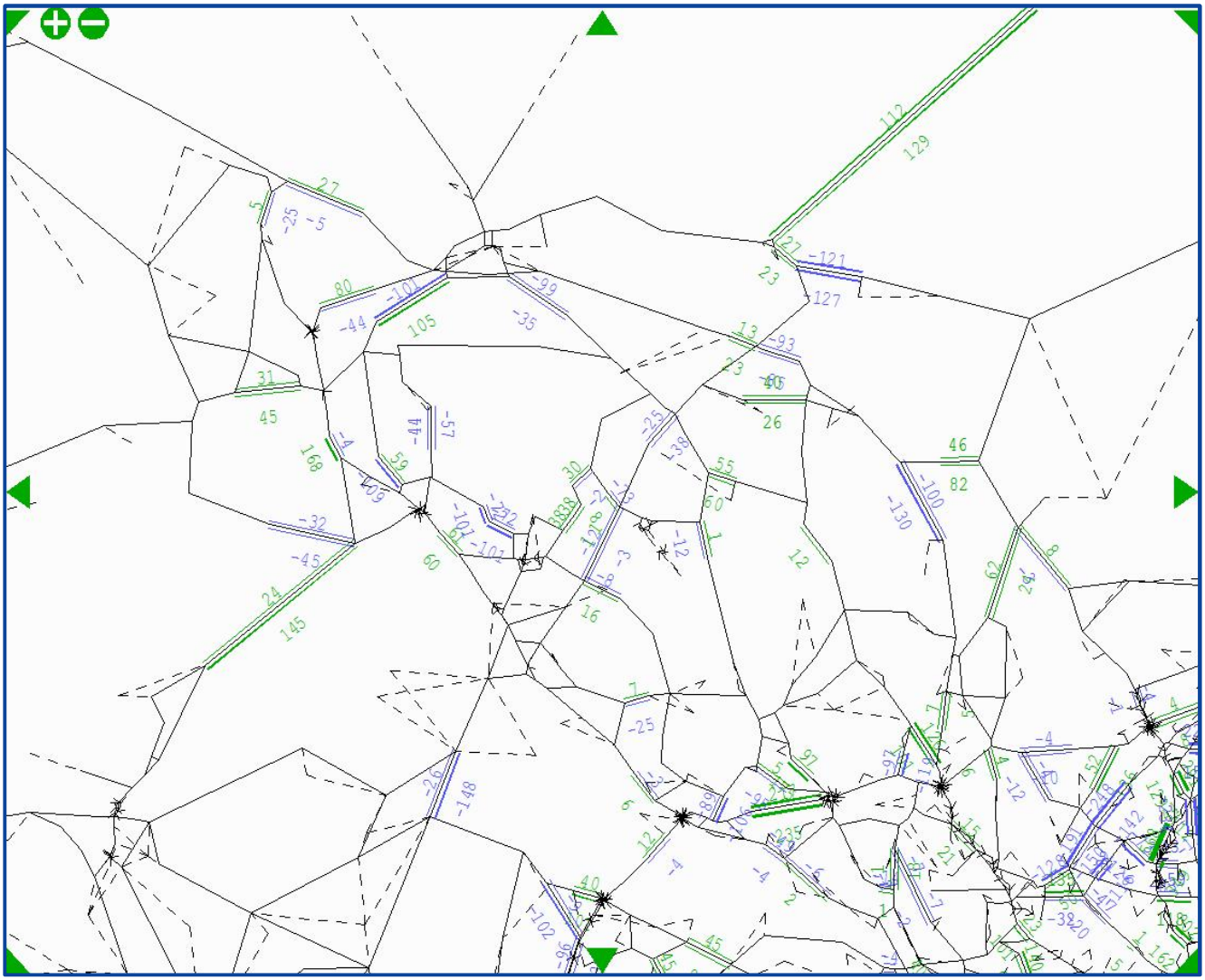
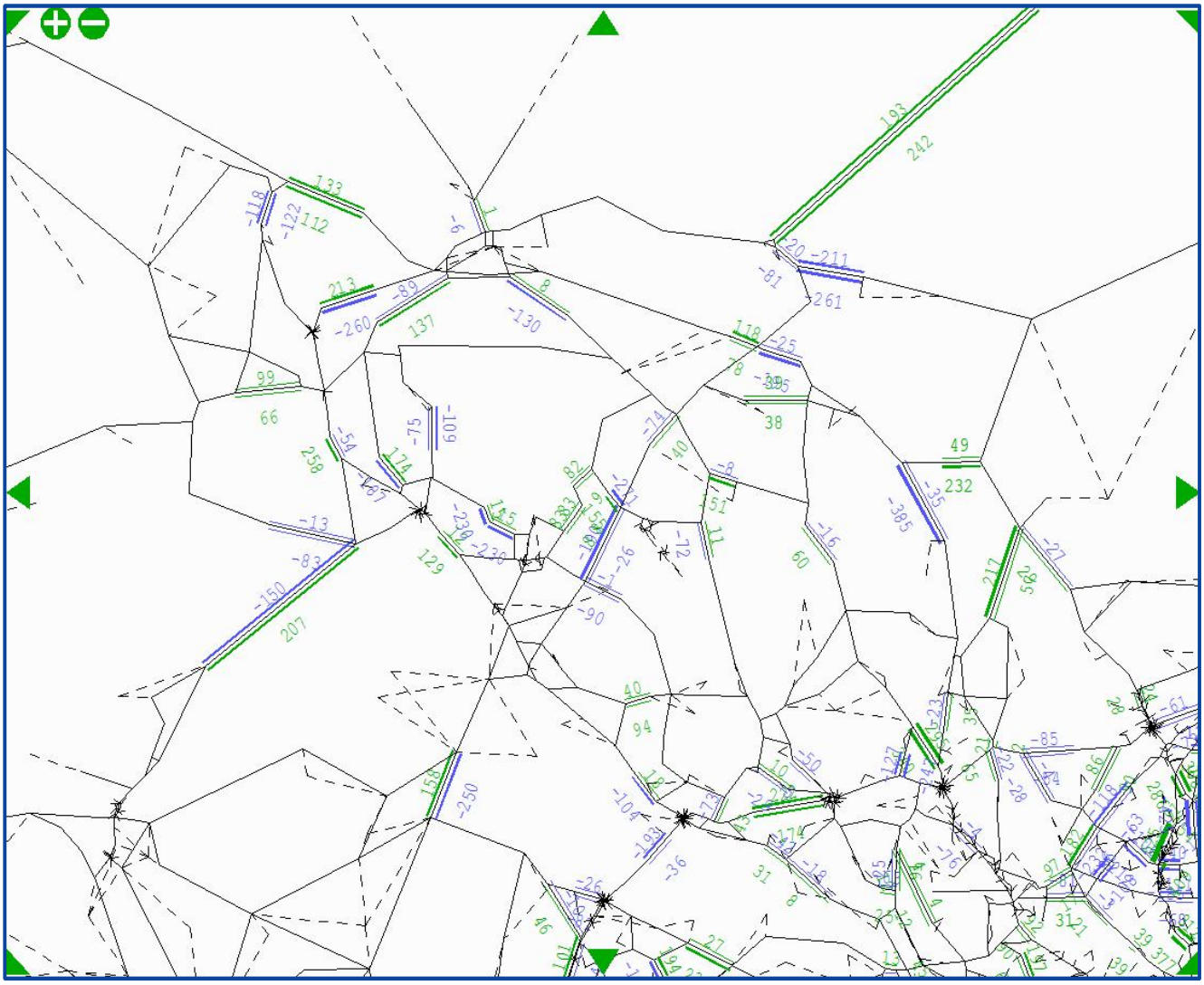


Figure 8 Model Flow Differences PM 17-18 (Actual, All vehicles, pcu)



The figures show a combination of some negligible and some more significant flow differences.

GEH

The following figures show GEH statistics at the individual sites.

The bands have been coloured as follows:

- Green, GEH <5
- Orange, GEH =>5, <10
- Red =>10

Figure 9 GEH Statistics AM 8-9 (All vehicles)

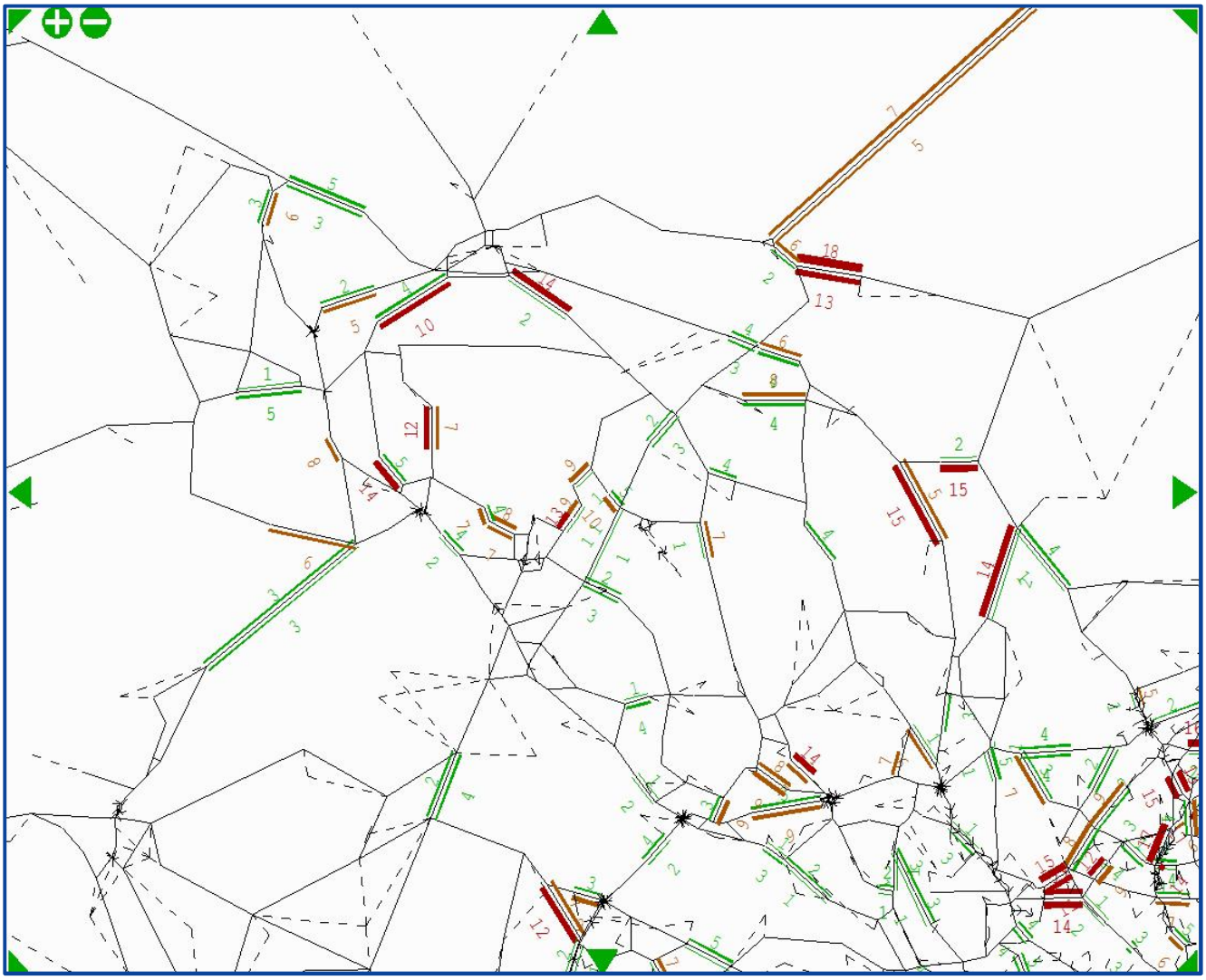


Figure 10 GEH Statistics IP (Car)

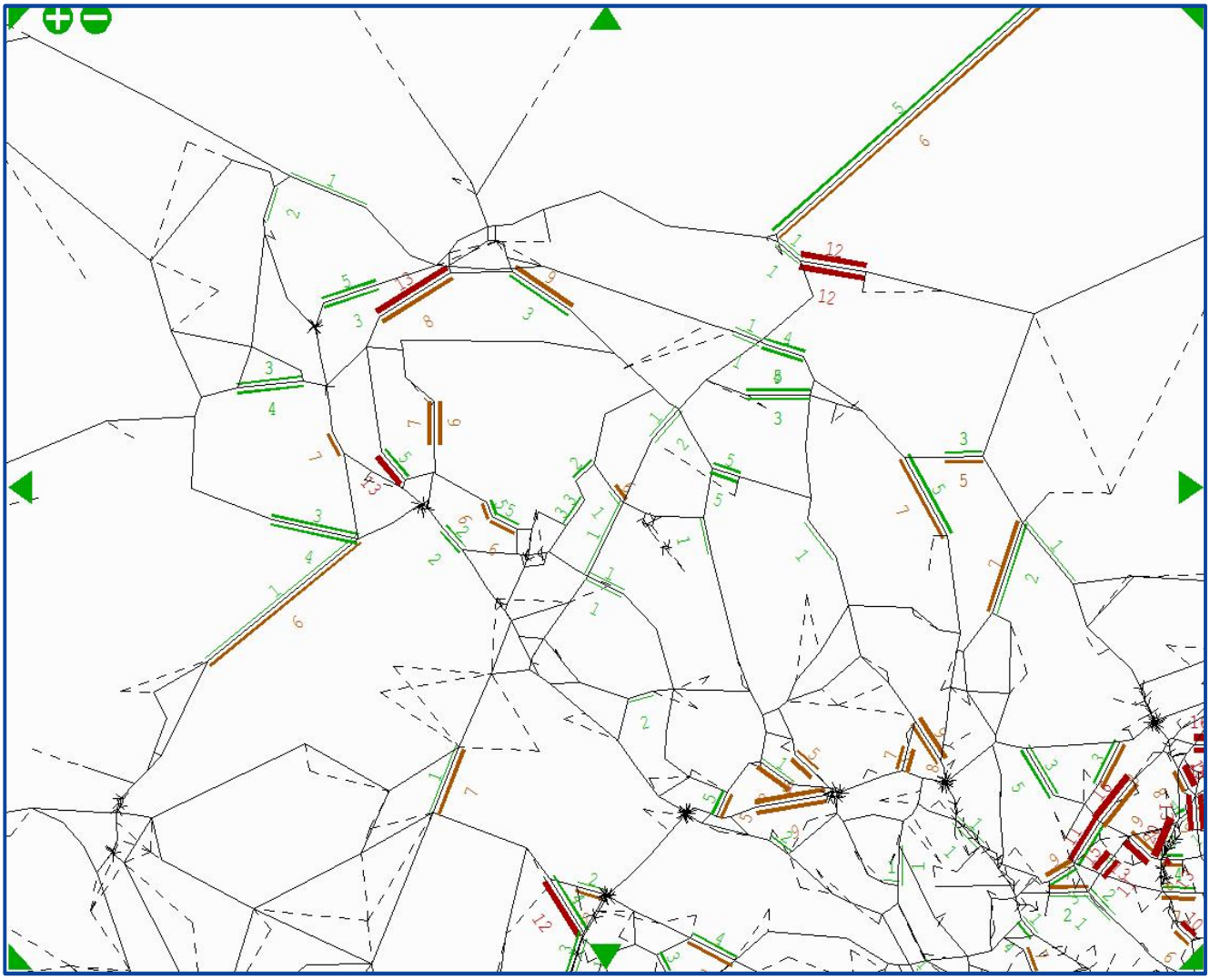
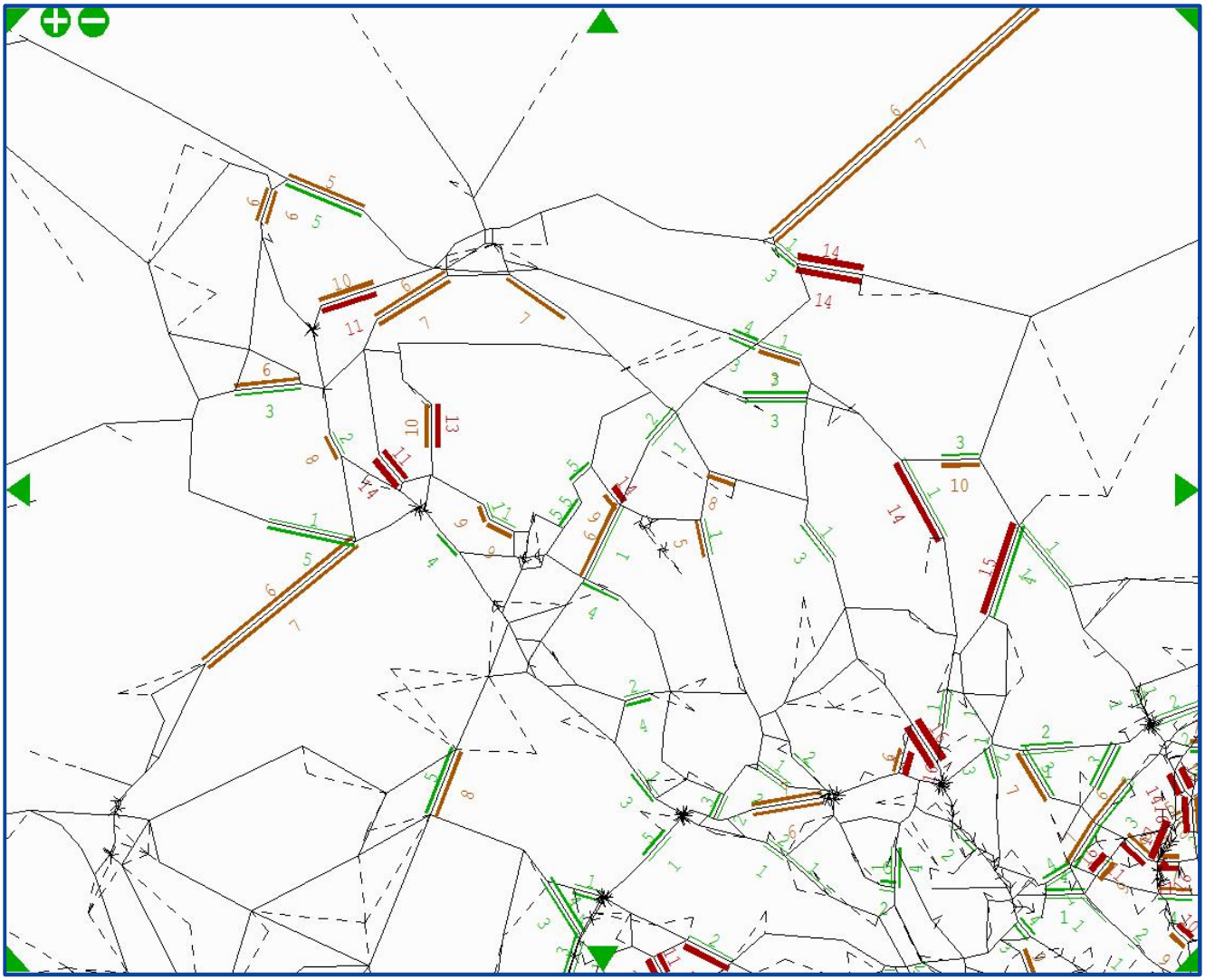


Figure 11 GEH Statistics PM 17-18 (All vehicles)



The figures show that the majority of GEH statistics are within or close to 5.

The results shown in the figures are tabulated in Appendix A and summarised below.

Table 1 Summary of GEH results within the vicinity of the airport

GEH band	AM sites	IP sites	PM sites
<5	98 (65%)	105 (70%)	99 (66%)
<10	31 (21%)	32 (21%)	31 (21%)
>=10	21 (14%)	13 (9%)	20 (13%)
Total	150 (100%)	150 (100%)	150 (100%)

Based on the GEH results shown in the figures the following list indicates where the model performs less well (GEH greater than 5) at the more significant locations in terms of access to the airport:

- A658 Harrogate Road, North of Pool – NB and SB GEH values greater than 5 but no more than 7 across the AM, IP and PM;

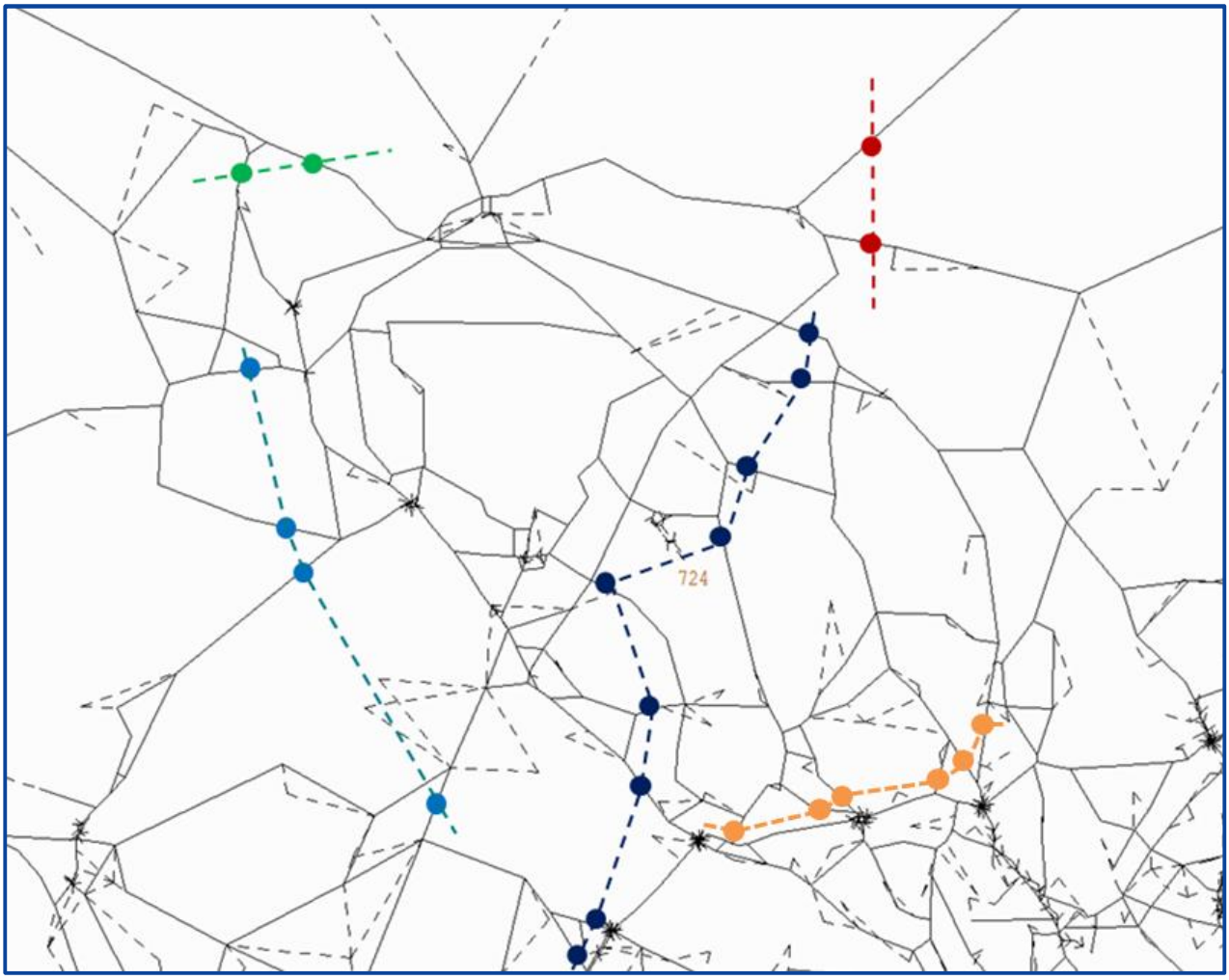
- A658 Harrogate Road, South of Rawdon – SB only GEH of 7 in the IP and 8 in PM;
- A660 Otley Road, South of Bramhope – NB only GEH of 15 in the AM, 7 in the IP and 14 in the PM;
- A65, North of Guiseley – SB only GEH of 8 in the AM, 7 in the IP and 8 in the PM;
- A657 Rodley Lane – WB only GEH of 9 in the AM;
- A6120 Outer Ring Road – EB and WB GEH values greater than 5 but no more than 9 across the AM, IP and PM; and
- Otley Old Road – NB and SB GEH values greater than 5 across all periods with the exception of the AM SB, IN the PM the SB GEH is 16.

Of these, a small number of sites result in GEH values much greater than 5, the others are only slightly greater than 5.

Screenlines

Screenlines have been defined based on count sites to inform model performance at a more aggregate level for movements from the LBIA towards Leeds, Bradford, Harrogate and Ilkley. Figure 12 below shows the location of the screen lines.

Figure 12 Screen line locations



- Leeds 1 screenline
- Leeds 2 screenline
- Bradford screenline
- Harrogate screenline
- Ilkley screenline

Table 2 shows the screenline results for each time period.

Table 2 AM Screen line Results (All vehicles)

Screen line	Towards the LBIA					Away from the LBIA				
	Observed	Modelled	Dif	% Dif	GEH	Observed	Modelled	Dif	% Dif	GEH
Leeds 1	3329	3322	-7	0%	0.1	4175	3998	-177	-4%	2.8
Leeds 2	2333	2255	-78	-3%	1.6	3295	3261	-34	-1%	0.6
Harrogate	1165	1139	-26	-2%	0.8	1496	1472	-24	-2%	0.6
Bradford	2178	2186	8	0%	0.2	2312	2263	-49	-2%	1.0
Ilkley	3141	3160	19	1%	0.3	955	962	7	1%	0.2

Table 3 IP Screen line Results (Cars)

Screen line	Towards the LBIA					Away from the LBIA				
	Observed	Modelled	Dif	% Dif	GEH	Observed	Modelled	Dif	% Dif	GEH
Leeds 1	2271	2256	-15	-1%	0.3	2200	2230	30	1%	0.6
Leeds 2	1822	1824	2	0%	0.0	1760	1768	8	0%	0.2
Harrogate	646	648	2	0%	0.1	644	635	-9	-1%	0.3
Bradford	1252	1250	-2	0%	0.1	1264	1260	-4	0%	0.1
Ilkley	1844	1843	-1	0%	0.0	616	615	-1	0%	0.0

Table 4 Screen lines Results PM (All vehicles)

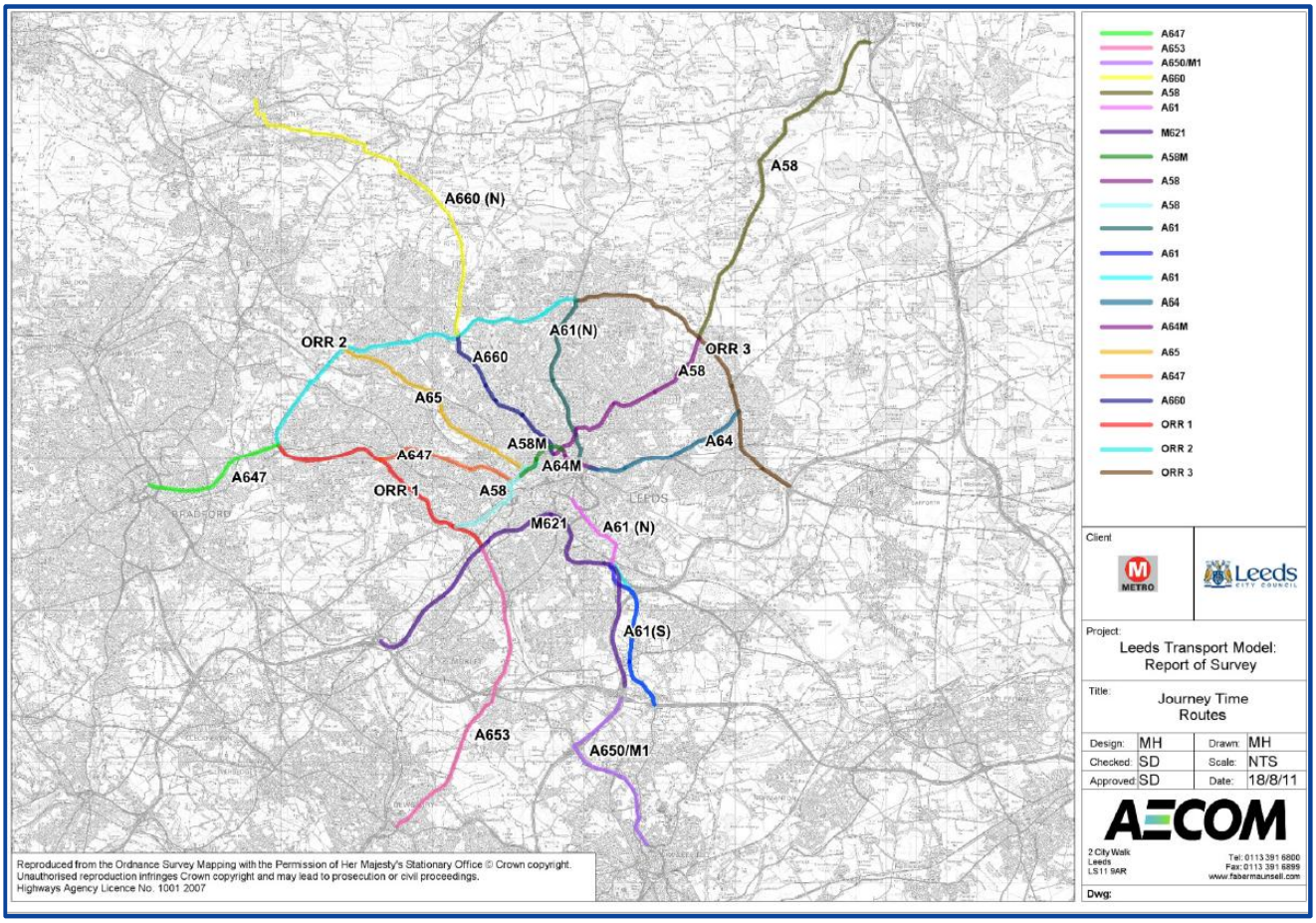
Screen line	Towards the LBIA					Away from the LBIA				
	Observed	Modelled	Dif	% Dif	GEH	Observed	Modelled	Dif	% Dif	GEH
Leeds 1	4404	4191	-213	-5%	3.3	3713	3751	38	1%	0.6
Leeds 2	3393	3477	84	2%	1.4	2421	2508	87	4%	1.7
Harrogate	1465	1446	-19	-1%	0.5	1231	1214	-17	-1%	0.5
Bradford	2125	2219	94	4%	2.0	2472	2412	-60	-2%	1.2
Ilkley	3130	3235	105	3%	1.9	1013	1007	-6	-1%	0.2

Differences between modelled flows and counts are less than 5% for nearly all screenlines. The only exception is the Leeds screenline 1 inbound in the PM which shows a difference of -5%. This demonstrates that the model matrix validates well in the vicinity of the LBIA.

Journey Times

Figure 13 below is a map taken from the LMVR showing journey time routes used for model validation.

Figure 13 Model Validation Journey Time Routes (from LMVR)



Charts produced by WSP comparing model and observed journey times (using the observed 2008 data provided within the model files) are shown in Appendix B. They show the following selected routes considered relevant for the study:

- A65;
- A660;
- Outer Ring Road (ORR) Section 2; and
- Otley (Section of A660).

They show the modelled travel time profiles against the observed average, upper and lower limits.

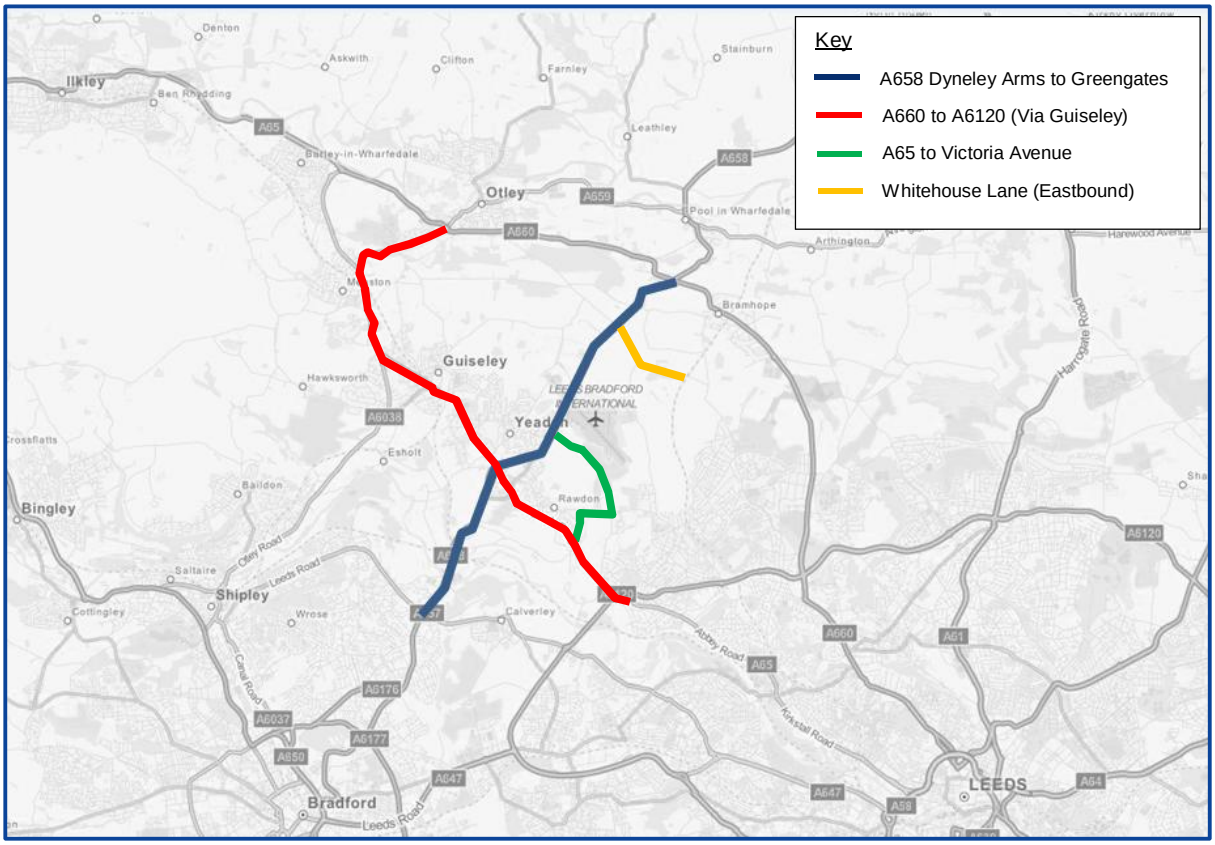
In summary the charts show that the model reflects travel times well across all time periods, with the exception of the following:

- A65 Inbound AM 8-9, the model is too fast; and
- A660 Inbound AM 8-9, the model is too fast.

TrafficMaster

TrafficMaster data has been extracted to assess the model travel time performance in the immediate vicinity of the LBIA. Figure 14 below presents a plan of the routes which have been chosen for analysis.

Figure 14 TrafficMaster Routes



The data represents average times over a neutral month in 2008.

The routes selected represent what are considered significant links for vehicles accessing the airport not already covered by routes in the LMVR and in the near vicinity of the airport. Further away from the airport the journey times potentially become less significant; however it is noted that further analysis may be required when it becomes clear which schemes will be tested in the model.

Table 5, Table 6, and Table 7 below compare the model and observed (TrafficMaster) journey times.

Table 5 AM Peak Traffic Master Journey Times compared to Modelled Journey Times

Journey Path	Am Peak Period				
	Sample	Traffic Master	Modelled	Dif	% Dif
A658, Dyneley Arms to Greengates	52	984	1163	179	18%
A658, Greengates to Dyneley Arms	55	763	917	154	20%
A65, A660 to A6120 (Via Guiseley)	54	1070	1209	138	13%
A65, A6120 to A660 (Via Guiseley)	48	1050	1100	50	5%
A65 to Victoria Avenue	14	262	254	-9	-3%
Victoria Avenue to A65	16	239	254	15	6%
Whitehouse Lane (Eastbound)	59	112	118	5	5%

Table 6 Inter Peak Traffic Master Journey Times compared to Modelled Journey Times

Journey Path	Inter Peak Period				
	Sample	Traffic Master	Modelled	Dif	% Dif
A658, Dyneley Arms to Greengates	320	926	1019	93	10%
A658, Greengates to Dyneley Arms	342	798	885	87	11%
A65, A660 to A6120 (Via Guiseley)	274	1103	1214	111	10%
A65, A6120 to A660 (Via Guiseley)	281	1103	1105	3	0%
A65 to Victoria Avenue	93	276	250	-26	-10%
Victoria Avenue to A65	77	264	251	-13	-5%
Whitehouse Lane (Eastbound)	114	125	117	-8	-6%

Table 7 PM Peak Traffic Master Journey Times compared to Modelled Journey Times

Journey Path	Pm Peak Period				
	Sample	Traffic Master	Modelled	Dif	% Dif
A658, Dyneley Arms to Greengates	45	936	1060	123	13%
A658, Greengates to Dyneley Arms	54	816	935	119	15%
A65, A660 to A6120 (Via Guiseley)	43	1001	1237	236	24%
A65, A6120 to A660 (Via Guiseley)	38	1042	1242	200	19%
A65 to Victoria Avenue	20	274	252	-22	-8%
Victoria Avenue to A65	12	235	254	19	8%
Whitehouse Lane (Eastbound)	18	105	118	12	12%

In summary the journey time analysis shows that the model compares well with reality across all periods for the majority of the journey time routes, with the exception of the following:

- A658 Greengates to A658 Dyneley Arms, AM Peak;
- A65, A660 to A6120 (Via Guiseley), AM and PM Peak; and
- A65, A6120 to A660 (Via Guiseley), AM and PM Peak;

LBIA Demand

The LBIA Terminal Extension Transport Assessment provides data on 2008 vehicle arrivals and departures, mode split and vehicles occupancy which has been used to derive a benchmark for comparison against model demand at the airport.

The UK Aviation Forecasts 2013 indicates that 80% of air passenger journeys are for leisure purposes.

Only AM and PM data is presented in the Transport Assessment. For the IP the values have been estimated based on scaling the AM data by following the arrival and departure chart profiles presented in the document.

Table 8 compares the benchmark data against the model.

Table 8 Comparison of study data and model demand at LBIA

Time /Direction	Trips (vehicles)					
	Personal			Business / Other		
	Benchmark	Model	Difference	Benchmark	Model	Difference
AM Peak Arrivals	190	165	-25 (-13%)	47	42	-5 (-11%)
AM Peak Departures	129	56	-73 (-57%)	32	40	+8 (+24%)
PM Peak Arrivals	150	70	-80 (-53%)	38	27	-11 (-30%)
PM Peak Departures	281	108	-173 (-62%)	70	20	-50 (-72%)
IP Peak Arrivals	203	82	-121 (-60%)	51	59	8 (+16%)
IP Peak Departures	203	82	-121 (-60%)	51	46	-5 (+10%)

The results show that demand at the LBIA is generally underrepresented, but that the pattern and proportion split between personal and business trips is reasonable.

2.6 PASSQ

The models are set up to pass information from one peak period hour to the next using the PASSQ parameter.

PASSQ=T for the following models:

- AM peak hours 8-9 & 9-10; and

- PM peak hours 17-18 & 18-19.

To assess the impact this parameter setting has on the modelled traffic conditions, comparisons against versions of the models where PASSQ=F have been made for flows and travel times.

Flow differences (Model-Observed)

Figure 15 Model Flow Differences vs PASSQ=F AM 8-9 (Actual, All vehicles, pcu)

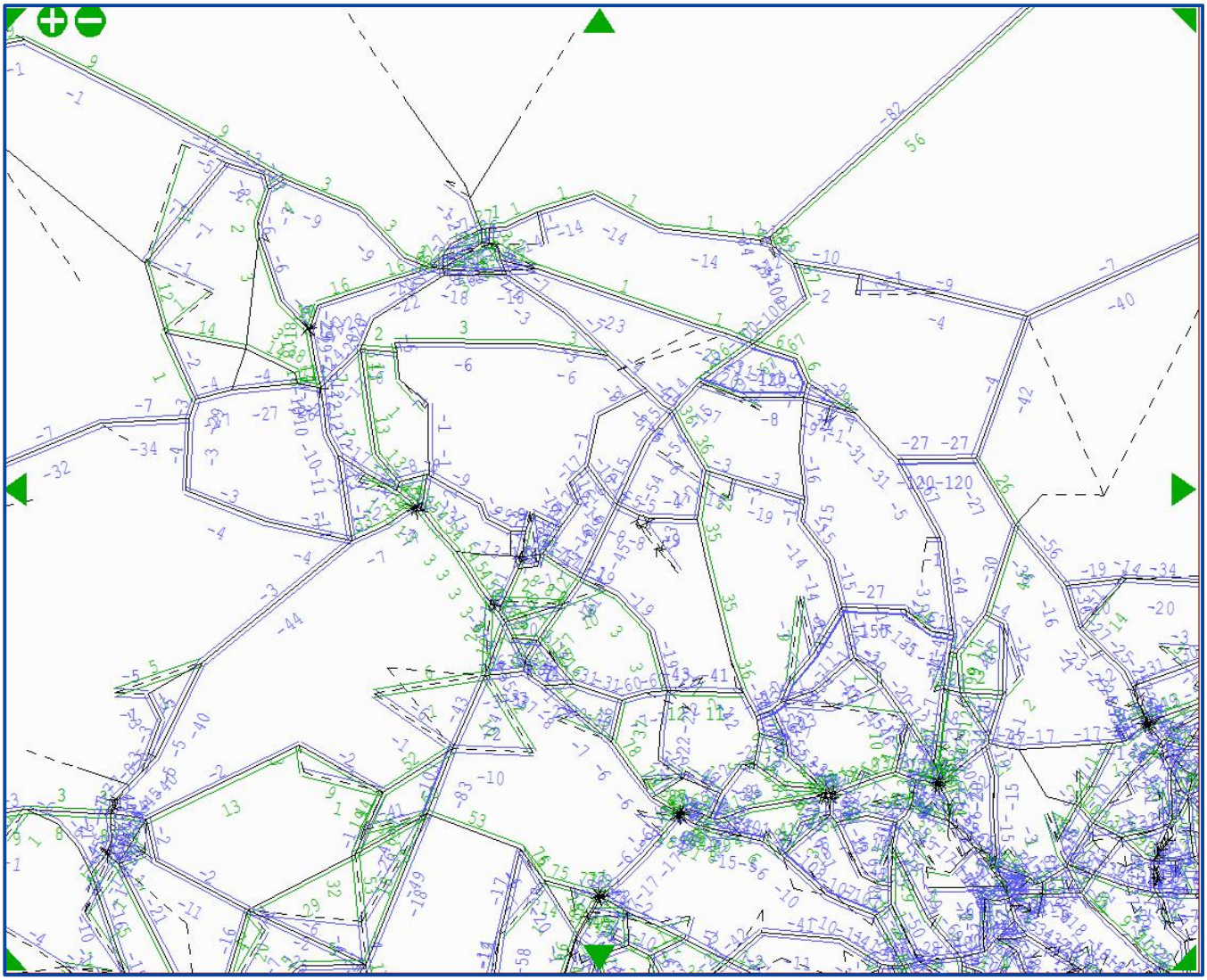
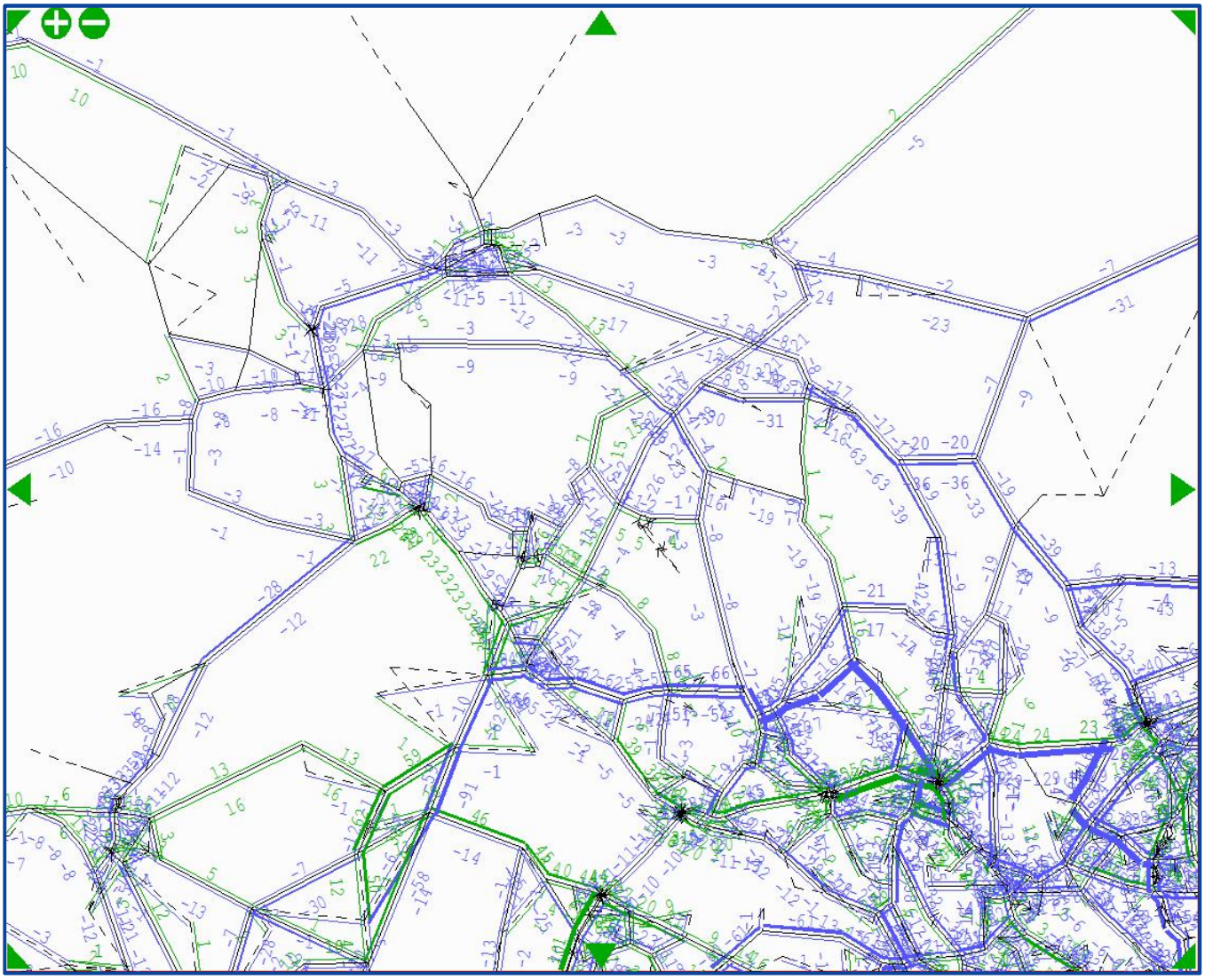


Figure 16 Model Flow Differences vs PASSQ=F PM 17-18 (Actual, All vehicles, pcu)



The figures show that the flow differences are generally negligible.

Travel Time Differences (Model-Observed)

Figure 17 Model Travel Time Differences vs PASSQ=F AM 8-9 (Actual, All Vehicles, seconds)

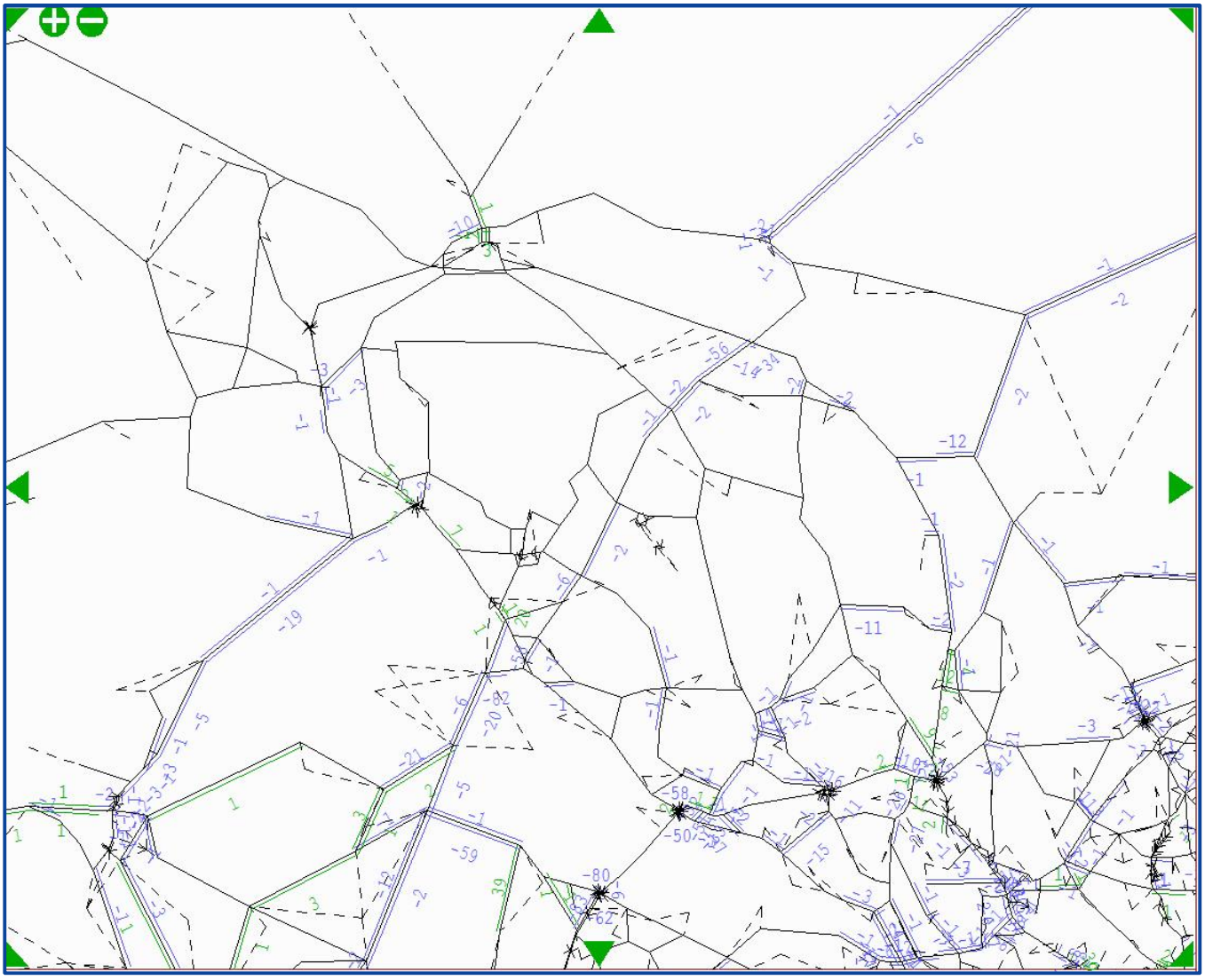
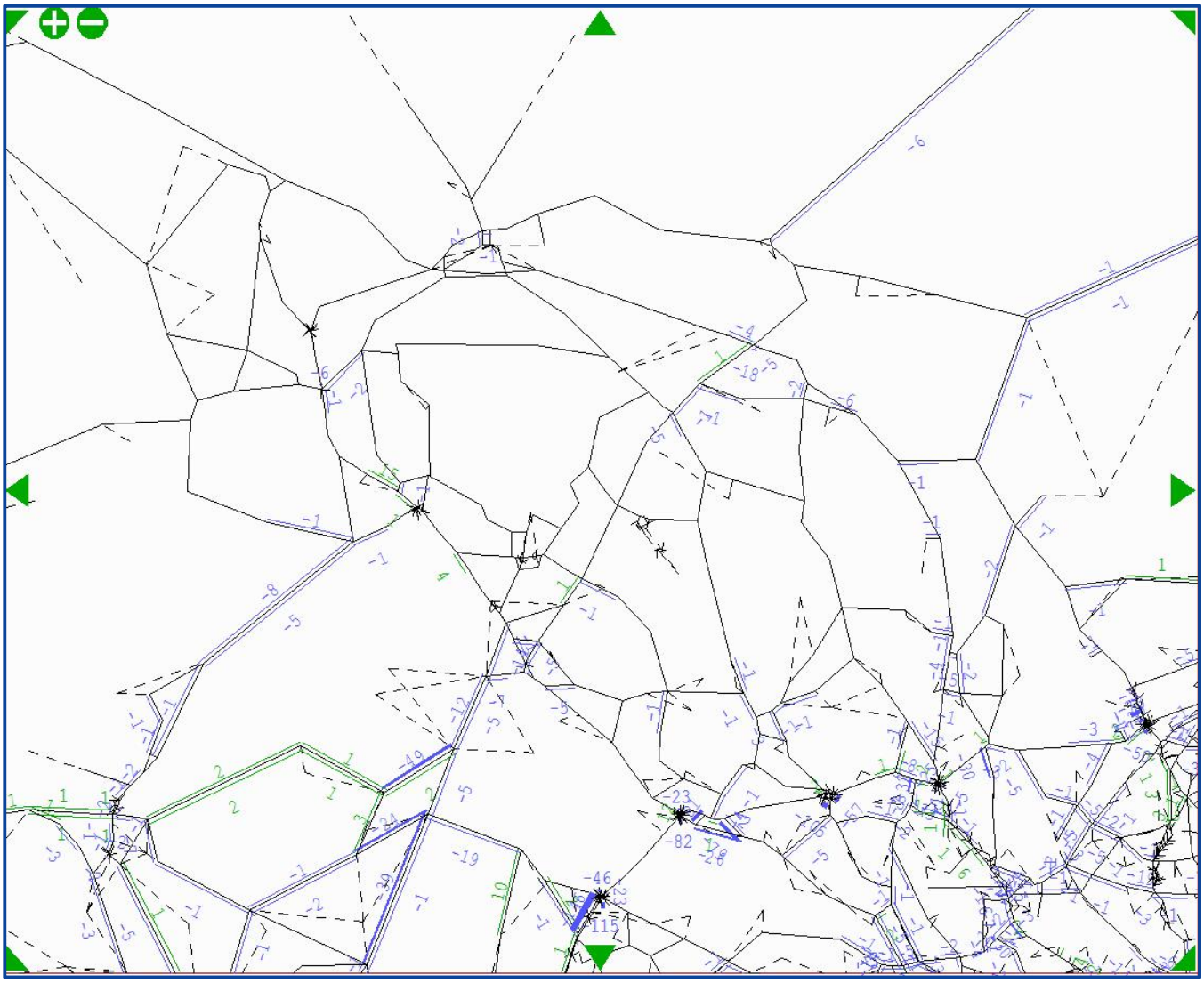


Figure 18 Model Travel Time Differences vs PASSQ=F PM 17-18 (Actual, All vehicles, seconds)



The figures show that the travel time differences are generally negligible.

2.7 Conclusions

The conclusions from the Highway mode review are as follows:

- The range of model time periods available provides good coverage for representing the varying traffic conditions during a weekday. A weekend model is not available but it is expected that it could be represented in proxy by the IP;
- Network coverage is good in the immediate vicinity of LBIA and the wider Leeds District area. However it becomes simplified further afield for example towards Bradford;
- Comparison of model flows against the observed calibration and validation data shows that the model performs well on the screelines and reasonably well on an individual site basis. There are a small number of sites at potentially significant locations with high GEH values but these are relatively small in number;
- Comparison of travel times, based on data also presented in the LMVR, against the observed validation data shows that the model reflects travel times on the selected routes well across all time periods, with the exception of the A65 and A660, both inbound, and in the AM (8-9). Both are too fast in the model.

- Comparison between journey times taken from TrafficMaster data and the Model identifies for the majority of routes close to the airport the model is reflective of reality, which the exception of the A65 show significant differences in both the Am and Pm peak periods. Also the A658 NB in the AM only. In all cases the highway model forecasts a higher journey time in both peaks;
- The IP and PM (17-18) models generally perform better than the AM against the observed data;
- The representation of LBIA demand is low however the general pattern of trips and proportion split between personal and business trips is reasonable; and
- Assessment of the impact of the PASSQ parameter shows that flow and travel time differences are negligible.

3 Public Transport Model

3.1 Time Periods

The model includes the following time periods:

- AM Peak period average hour 7-10;
- Inter-peak average hour 10-16; and
- PM peak hours average hour 16-18.

3.2 User Classes

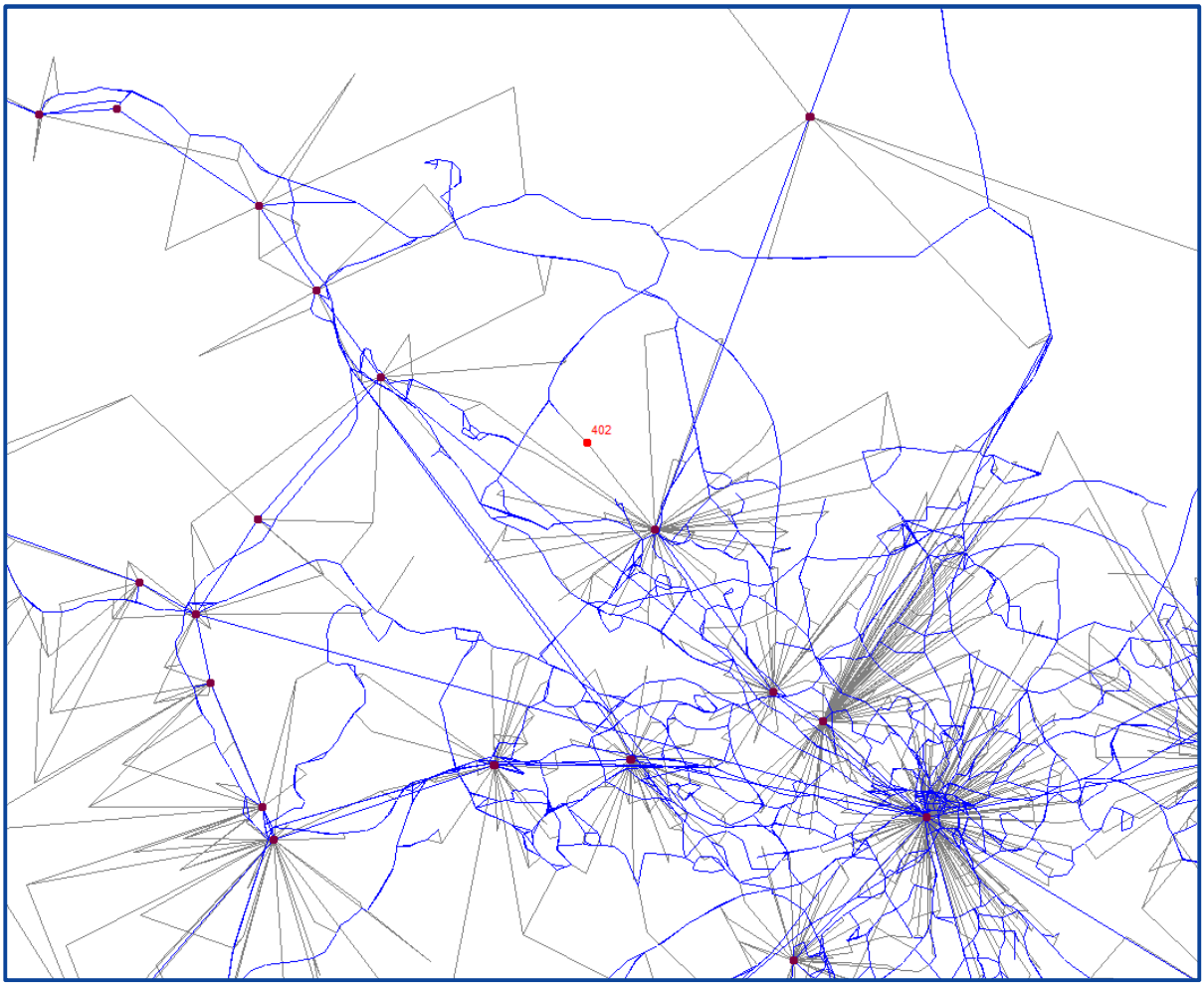
The model segments demand by the following user classes:

- Non concessionary fare payers; and
- Concessionary fare payers

3.3 Network Coverage and Services

Figure 19 shows the model network coverage. Zone 402 represents the airport and is highlighted in red. Rail station nodes are highlighted in purple. All stations across West Yorkshire Metro area are included in the model, as well as other major stations on connecting routes into Leeds.

Figure 19 Network coverage of the 2008 Base Public Transport model



This shows that network coverage in the immediate vicinity of the LBIA is reasonable. Further afield the model only retains its network detail in the Leeds District area; in Bradford the network becomes more simplified.

Table 9 shows bus services currently serving LBIA, taken from the WY Metro website. The table also indicates which are represented in the base model.

Table 9 Airport bus services

Service	Frequency	Route	Included in the model
737	Hourly	Bradford - Shipley - Guiseley - Yeadon - Leeds Bradford Airport - Harrogate	No
747	Hourly	Bradford - Apperley Bridge - Yeadon - Leeds Bradford Airport	No
757	30 mins	Leeds - Kirkstall - Horsforth - Leeds Bradford Airport	Yes
967	30 mins	Menston Rail Station - Otley - Pool - Leeds Bradford Airport	No

Of the bus services that serve the airport only the 757 is included. in the model represent all franchises that operate within or through Leeds.

Rail services included

Non-transit legs are used in the public transport model to provide access between the model zones and services, and for interchanging between services. These have been reviewed at the airport zone to confirm that it is adequately connected to nearby bus stops on the A658 (Harrogate Rd) and A65, and Horsforth railway station.

3.4 Fares

Different fare systems are represented for the following services:

- Rail;
- First Bus;
- Arriva Bus; and
- Free City Bus

First and Arriva are operate the majority of services within the model area. Bus services which are not First or Arriva, for example the 757 LBIA service, have been assigned the First fare system.

3.5 Public Transport Flows

The figures below show the model network public transport flows in the study area.

- LBIA zone
- Rail Station
- Bus passenger flows
- Rail passenger flows

Figure 20 Public Transport Flows AM

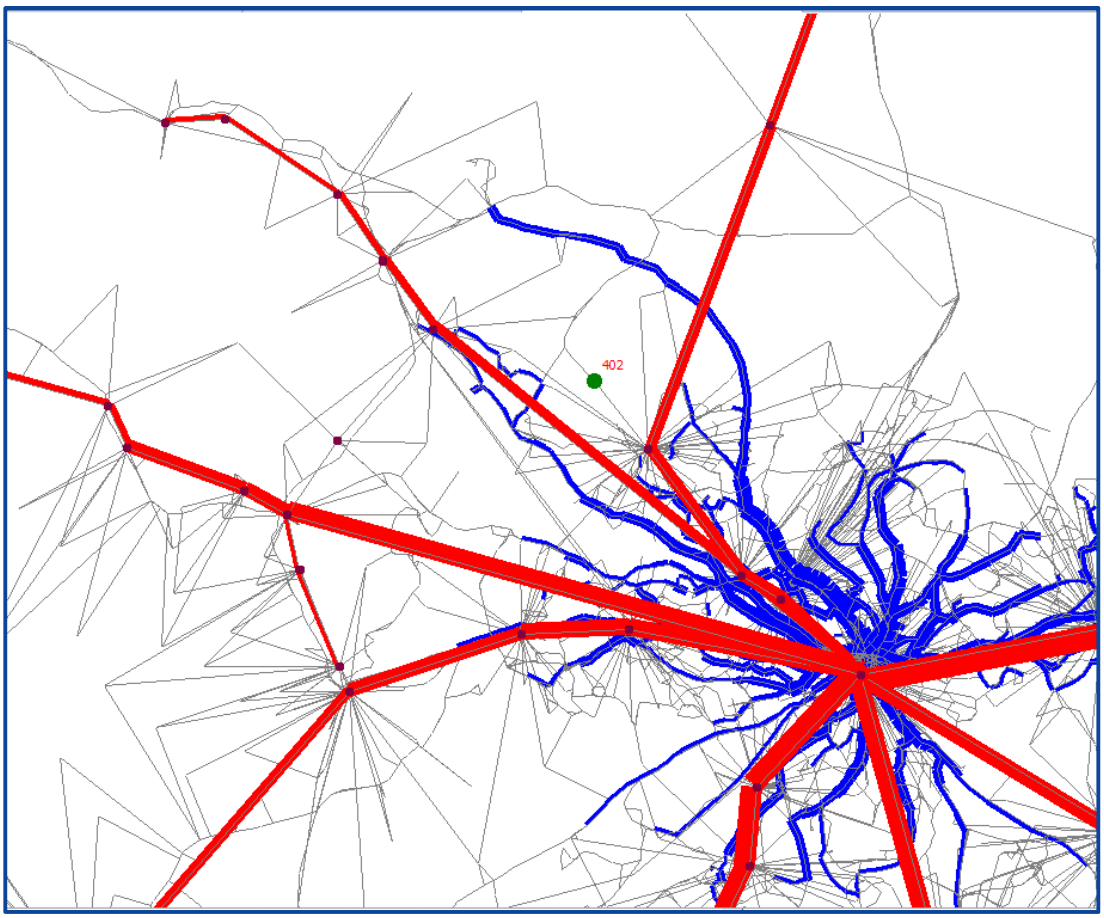


Figure 21 Public Transport Flows IP

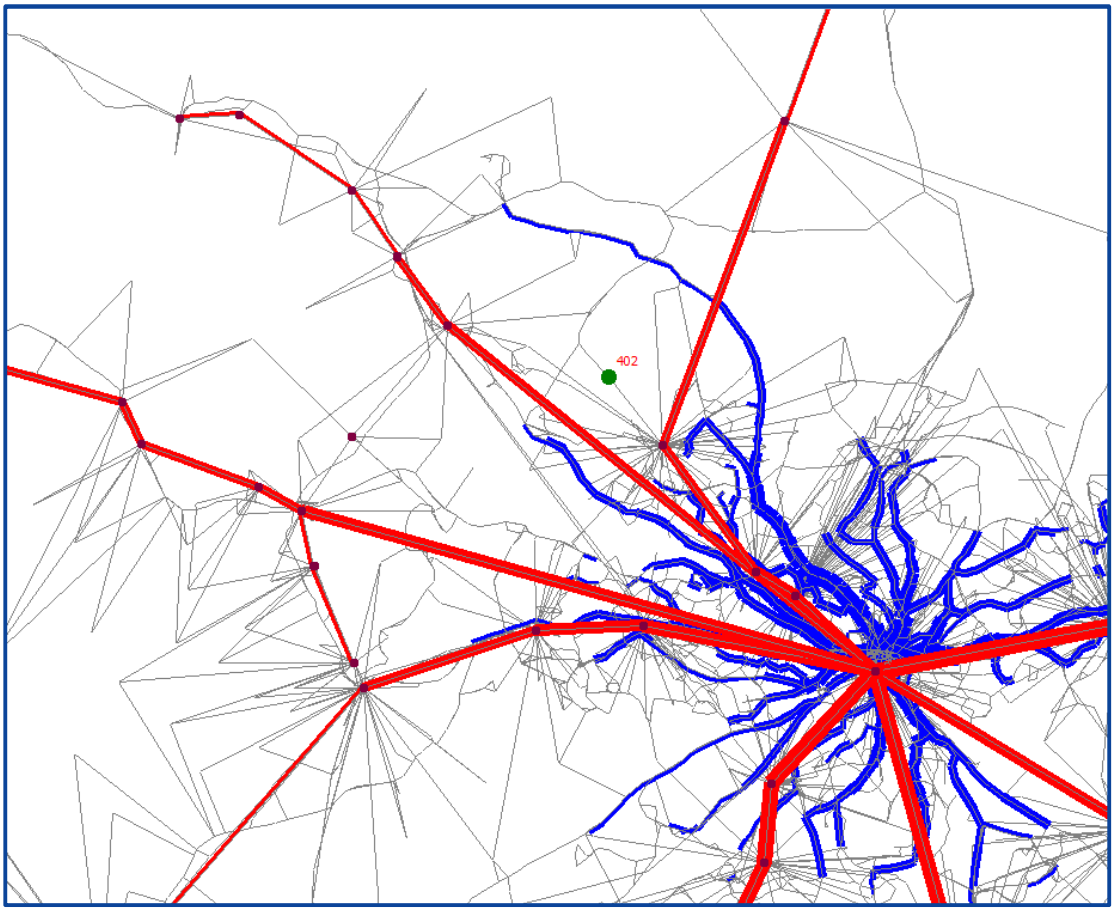
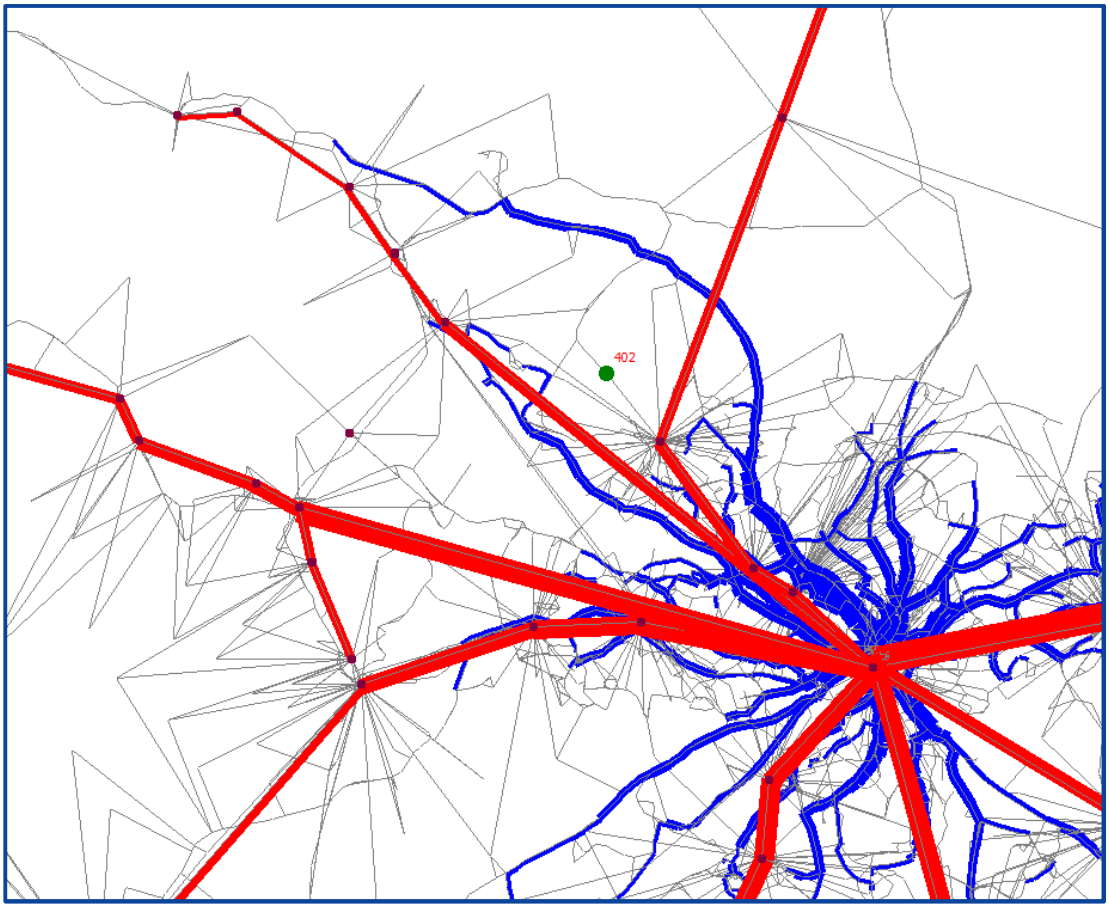


Figure 22 Public Transport Flows PM



The figures show relatively significant public transport flows near the LBIA as follows:

- Bus demand on the A65 and A660 corridors connecting nearby the LBIA and Leeds city centre; and
- Rail demand nearby the LBIA on the Ilkley and Harrogate lines.

It is evident that bus demand in the Bradford area is limited to flows in the Leeds city centre direction only.

Table 10 below shows two-way public transport demand at the airport.

Table 10 Demand at the Airport (Two-way, pass /hr)

Time Period	Demand (Two-way, pass/hr)
AM	22
IP	51
PM	6

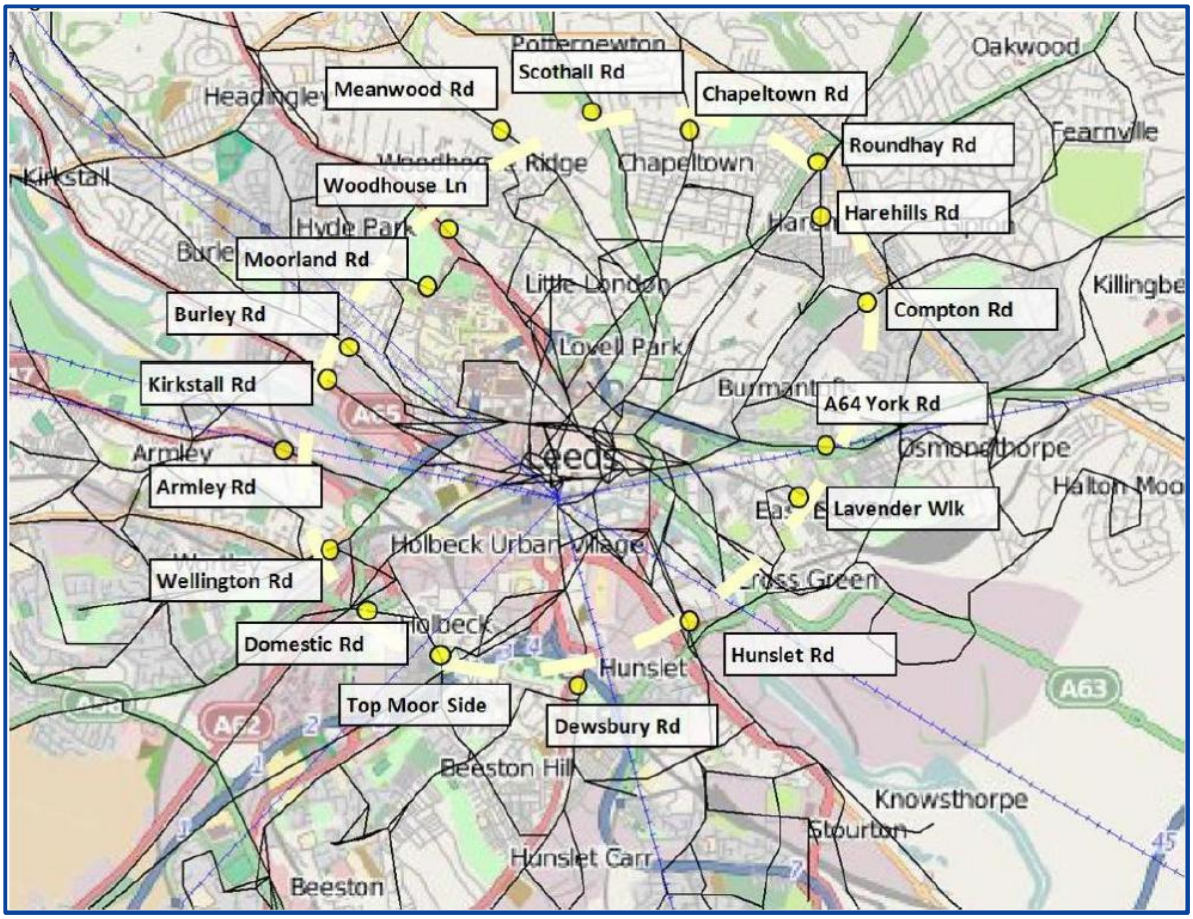
The demand is broadly split equally between the north and south network connecting points.

Compared against benchmark data derived from the LBIA Terminal Extension Transport Assessment, the model appears to significantly under represent public transport demand at the LBIA.

Flows

Figure 23 is taken from the LMVR and shows the location of count sites where passenger flow information was collected in 2008 to calibrate and validate the model.

Figure 23 Bus Corridor Count Sites and Cordon (from LMVR)



The following sites have been selected as particularly relevant to the study:

- Woodhouse Lane (A660);
- Kirkstall Road (A65); and
- Armley Road (A647).

Table 11 below summarises the % flow differences taken from the LMVR at these selected locations. Sites indicated in red are outside of the WebTAG 15% difference threshold.

Table 11 Summary of % Flow Differences

Corridor	% Flow Difference (Modelled - Observed)					
	AM		IP		PM	
	Inbound	Outbound	Inbound	Outbound	Inbound	Outbound
Woodhouse Lane	13%	21%	2%	-14%	18%	-17%
Kirkstall Road	-1%	-15%	-22%	-22%	-15%	-20%
A647 Armley Road	4%	0%	11%	-24%	40%	2%

About half of the sites satisfy the WebTAG 15% difference threshold. The majority are within 25%; except for Armley Road inbound in the PM.

It should be noted however that these sites are focussed on Leeds city centre and some distance away from the LBIA.

Journey Times

The LMVR describes all bus journey times in the model having been validated against AVL data covering key radials connecting peripheral areas in the model with Leeds city centre. All model travel times are within 5% of the observed data.

3.6 Conclusions

The conclusions from the Public Transport model review are as follows:

- The range of model time periods available provides good coverage for representing the varying traffic conditions during a weekday. A weekend model is not available but it is expected that it could be represented in proxy by the IP;
- Network and service coverage and connectivity with nearby bus stops and rail stations is good in the immediate vicinity of LBIA and the wider Leeds District area. However this becomes simplified further afield for example towards Bradford;
- The coverage of rail demand in the study area is good, but for bus it is limited to flows to and from Leeds city centre only;
- Comparison of model flows against observed data shows that about half the sites comply with the 15% WebTAG threshold, and the majority within 25%; and
- Travel times covering key radials connecting peripheral areas in the model with Leeds city centre are all within 5% of AVL data.

3.7 Outcome

The tables below summarise the outcome of the highways and public transport model reviews.

Table 12 Outcome of model highway model review

Review Item	Acceptable for the study	Comment	Action required
Time periods	✓	Good coverage of time periods	
Demand segmentation	✓	Personal and business segmentation available	
Network representation	X	Network is generally well represented, but with some simplification away from the Leeds District area.	Improved network representation of Greengates junction (Bradford). Lane movement re-allocation at A65 / B6152
Model performance			
■ Pattern of assigned flows across the network	✓	Intuitive flow patterns	
■ Flows	✓	Matrix validates well across screen lines. Analysis of the individual count sites in the vicinity of the airport has identified a reasonably good representation of the observed data. In only a small number of cases the GEH values are high at potentially significant locations, but these are considered acceptable for the study.	
■ Travel Times	X	Journey times are generally representative on less significant routes, however the model over estimates delay along the strategically important A65	Revisiting signal timings on the A65 should improve model performance
■ LBIA demand	X	Pattern of trip and split between personal and business trips is reasonable but overall demand under represented	Adjust the airport demand in the matrix to better reflect the benchmark

The review also looked at the impact of breaking the linkage between the hourly models in the peak period by setting PASSQ=F. The outcome is that the impact on flows and journey times is negligible and therefore using the model hours independently (unlinked) will be acceptable.

Table 13 Outcome of model public transport model review

Review Item	Acceptable for the study	Comment	Action required
Time periods	✓	Good coverage of time periods	Do not use the Public Transport model and instead set up a simple spreadsheet model.
Demand segmentation	✓	Demand segmented into fare and non-fare payers only	
Network and service representation	X	Networks and services are generally well represented, but with some simplification away from the Leeds District area.	
Model performance			
■ Pattern of assigned flows across the network	X	Pattern of flows is very much Leeds centric, with representation in other areas poor.	
■ Flows	X	At counts sites close to Leeds city centre the flows validate reasonably well at some of the selected locations, but not considered acceptable for the study.	
■ Travel Times	X	For routes into Leeds city centre the travel times are well represented, but not considered acceptable for the study.	
■ LBIA demand	X	Model demand is under represented at the LBIA zone.	

The outcome of the public transport model review is that it is currently not an acceptable modelling tool for the study, and that a simple spreadsheet based model should be developed instead to assess the impact of public transport schemes.

3.7 Consideration of schemes to be tested

While the contents of this note provide some of the geographical context for the model fit within the vicinity of the airport, there is no consideration for the types and locations of schemes that will be tested. Therefore it is proposed that when the schemes are finalised, their type and location will be reviewed against the information provided in this note. Further information will be provided demonstrating the model performance based on a similar approach to the evidence base presented in this note. This will then help in the understanding of forecasting uncertainty. However it should be noted that there is not an intention to provide further model development adjustments beyond those actions listed in Table 12 and Table 13 above.

Appendix A

Tabulated GEH results

	AM				IP				PM			
Site No.	Obs	Mod	% Dif	GEH	Obs	Mod	% Dif	GEH	Obs	Mod	% Dif	GEH
1	805	651	-19%	5.7	383	410	7%	1.3	784	764	-3%	0.7
2	788	903	15%	4.0	401	415	3%	0.7	634	752	19%	4.5
3	415	174	-58%	14.1	165	66	-60%	9.2	275	283	3%	0.5
4	273	469	72%	10.2	127	232	82%	7.8	324	461	42%	6.9
5	295	394	34%	5.3	250	206	-17%	2.9	690	430	-38%	11.0
6	887	950	7%	2.1	392	415	6%	1.2	942	861	-9%	2.7
7	517	576	11%	2.5	349	372	7%	1.2	731	809	11%	2.8
8	304	339	11%	1.9	186	151	-19%	2.7	460	330	-28%	6.6
9	306	235	-23%	4.3	116	15	-87%	12.5	275	186	-32%	5.9
10	658	603	-8%	2.2	254	335	32%	4.7	360	573	59%	9.9
11	1109	1017	-8%	2.8	569	786	38%	8.3	932	1154	24%	6.9
12	776	807	4%	1.1	469	420	-10%	2.3	629	587	-7%	1.7
13	221	297	35%	4.7	137	182	33%	3.6	278	305	10%	1.6
14	754	1013	34%	8.7	524	759	45%	9.3	885	1059	20%	5.6
15	556	638	15%	3.4	450	446	-1%	0.2	879	910	4%	1.0
16	236	267	13%	2.0	129	217	68%	6.7	207	445	115%	13.2
17	886	954	8%	2.2	529	523	-1%	0.3	747	730	-2%	0.6
18	358	314	-12%	2.4	157	143	-9%	1.1	225	162	-28%	4.5
19	444	476	7%	1.5	299	317	6%	1.0	514	605	18%	3.9
20	924	825	-11%	3.4	295	288	-2%	0.4	401	405	1%	0.2
21	836	806	-4%	1.1	619	634	2%	0.6	881	877	-1%	0.2
22	473	375	-21%	4.7	160	164	3%	0.3	201	179	-11%	1.6
23	665	595	-10%	2.8	327	185	-43%	8.9	411	348	-15%	3.3
24	680	625	-8%	2.1	226	362	60%	7.9	310	400	29%	4.8
25	4	0	-100%	2.8	4	0	-100%	2.8	4	0	-100%	2.8
26	684	704	3%	0.7	513	515	0%	0.1	979	987	1%	0.3
27	167	157	-6%	0.8	157	158	0%	0.0	264	289	10%	1.5
28	458	467	2%	0.4	300	301	0%	0.1	511	486	-5%	1.1
29	232	242	4%	0.7	236	234	-1%	0.1	680	692	2%	0.5
30	829	912	10%	2.8	643	664	3%	0.8	1115	1039	-7%	2.3
31	193	177	-8%	1.2	190	196	3%	0.5	530	595	12%	2.7
32	406	249	-39%	8.6	376	128	-66%	15.6	471	353	-25%	5.8
33	453	409	-10%	2.1	254	306	20%	3.1	774	860	11%	3.0
34	26	0	-100%	7.2	12	0	-100%	4.9	28	0	-100%	7.5
35	928	930	0%	0.1	562	558	-1%	0.2	871	817	-6%	1.8

Site No.	AM				IP				PM			
	Obs	Mod	% Dif	GEH	Obs	Mod	% Dif	GEH	Obs	Mod	% Dif	GEH
36	233	309	32%	4.6	126	185	47%	4.8	147	321	118%	11.4
37	81	31	-61%	6.6	69	12	-82%	8.9	130	21	-84%	12.5
38	247	266	8%	1.2	161	159	-1%	0.2	491	500	2%	0.4
39	227	300	32%	4.5	181	108	-40%	6.1	516	245	-53%	13.9
40	905	827	-9%	2.6	545	507	-7%	1.7	768	808	5%	1.4
41	817	1060	30%	7.9	546	714	31%	6.7	921	1179	28%	8.0
42	184	40	-78%	13.6	130	21	-84%	12.5	262	75	-72%	14.5
43	90	7	-92%	11.9	59	15	-75%	7.3	98	23	-76%	9.6
44	324	518	60%	9.4	173	203	17%	2.2	252	334	33%	4.8
45	410	232	-43%	9.9	145	153	5%	0.6	225	380	69%	8.9
46	810	880	9%	2.4	535	510	-5%	1.1	977	903	-8%	2.4
47	731	846	16%	4.1	399	317	-21%	4.3	429	343	-20%	4.4
48	137	29	-79%	11.9	180	30	-84%	14.7	332	100	-70%	15.8
49	230	214	-7%	1.1	156	83	-47%	6.7	252	146	-42%	7.5
50	1154	1678	45%	13.9	502	851	70%	13.4	474	883	86%	15.7
51	409	260	-37%	8.2	409	218	-47%	10.8	593	775	31%	7.0
52	318	172	-46%	9.3	174	58	-67%	10.7	191	83	-57%	9.2
53	149	99	-34%	4.5	153	27	-82%	13.3	447	235	-47%	11.5
54	430	867	102%	17.2	521	1089	109%	20.0	996	1621	63%	17.3
55	497	213	-57%	15.1	259	131	-49%	9.1	445	542	22%	4.4
56	375	633	69%	11.5	297	432	45%	7.1	493	412	-16%	3.8
57	575	859	49%	10.6	286	336	18%	2.8	536	553	3%	0.7
58	531	261	-51%	13.6	320	288	-10%	1.8	561	592	6%	1.3
59	489	584	20%	4.1	249	257	3%	0.5	519	492	-5%	1.2
60	314	287	-9%	1.6	85	109	28%	2.4	151	208	38%	4.3
61	489	468	-4%	1.0	249	246	-1%	0.2	549	578	5%	1.2
62	88	284	222%	14.3	49	111	126%	6.9	106	323	205%	14.8
63	1733	1571	-9%	4.0	902	898	0%	0.1	1436	1351	-6%	2.3
64	247	266	8%	1.2	158	159	1%	0.1	492	500	2%	0.4
65	533	380	-29%	7.2	376	275	-27%	5.6	748	518	-31%	9.2
66	1478	1319	-11%	4.3	908	898	-1%	0.3	1676	1622	-3%	1.3
67	259	518	100%	13.1	165	203	23%	2.8	252	335	33%	4.8
68	398	331	-17%	3.5	291	219	-25%	4.5	400	415	4%	0.7
69	939	1060	13%	3.8	543	566	4%	1.0	632	724	15%	3.5
70	1077	1039	-4%	1.2	509	462	-9%	2.2	460	457	-1%	0.1
71	589	681	16%	3.6	474	575	21%	4.4	658	748	14%	3.4
72	520	480	-8%	1.8	589	569	-3%	0.8	1178	1199	2%	0.6
73	924	825	-11%	3.3	295	288	-2%	0.4	401	405	1%	0.2

Site No.	AM				IP				PM			
	Obs	Mod	% Dif	GEH	Obs	Mod	% Dif	GEH	Obs	Mod	% Dif	GEH
74	232	242	4%	0.7	236	234	-1%	0.1	680	692	2%	0.5
75	1230	1137	-8%	2.7	497	498	0%	0.0	451	490	9%	1.8
76	434	498	15%	3.0	587	592	1%	0.2	1231	1270	3%	1.1
77	257	557	117%	14.9	199	328	65%	7.9	283	569	101%	13.9
78	231	154	-33%	5.6	95	83	-13%	1.3	146	128	-13%	1.6
79	314	298	-5%	0.9	210	127	-39%	6.4	357	172	-52%	11.3
80	329	609	85%	12.9	179	460	157%	15.7	265	573	116%	15.1
81	147	145	-1%	0.1	99	143	44%	4.0	232	323	39%	5.5
82	230	290	26%	3.7	179	136	-24%	3.4	354	214	-40%	8.3
83	1767	1602	-9%	4.0	1071	1083	1%	0.4	1733	1540	-11%	4.8
84	1181	1182	0%	0.0	558	554	-1%	0.2	895	908	1%	0.4
85	1614	1526	-5%	2.2	1110	1106	0%	0.1	1530	1494	-2%	0.9
86	798	802	1%	0.2	656	649	-1%	0.3	1195	1174	-2%	0.6
87	750	778	4%	1.0	610	607	0%	0.1	838	856	2%	0.6
88	670	465	-31%	8.6	446	340	-24%	5.3	501	544	9%	1.9
89	455	800	76%	13.8	316	413	31%	5.1	555	505	-9%	2.2
90	131	58	-56%	7.6	80	85	6%	0.6	122	132	8%	0.9
91	352	333	-5%	1.0	155	281	81%	8.5	204	499	144%	15.7
92	611	623	2%	0.5	260	141	-46%	8.4	351	104	-70%	16.4
93	1076	983	-9%	2.9	503	508	1%	0.2	688	723	5%	1.3
94	526	553	5%	1.2	210	210	0%	0.0	220	222	1%	0.1
95	906	1065	18%	5.1	495	491	-1%	0.2	585	609	4%	1.0
96	783	738	-6%	1.6	656	662	1%	0.2	1158	1054	-9%	3.1
97	577	502	-13%	3.2	402	313	-22%	4.7	632	559	-12%	3.0
98	285	408	43%	6.6	288	463	61%	9.0	565	560	-1%	0.2
99	288	155	-46%	9.0	183	88	-52%	8.1	342	313	-9%	1.6
100	291	398	37%	5.8	181	282	56%	6.6	394	734	86%	14.3
101	299	195	-35%	6.6	269	172	-36%	6.5	591	464	-21%	5.5
102	593	597	1%	0.2	499	506	1%	0.3	869	846	-3%	0.8
103	266	269	1%	0.2	221	221	0%	0.0	499	520	4%	0.9
104	517	536	4%	0.8	532	531	0%	0.1	895	923	3%	0.9
105	764	683	-11%	3.0	404	444	10%	1.9	804	778	-3%	0.9
106	25	0	-100%	7.1	9	0	-100%	4.2	10	0	-100%	4.5
107	595	396	-34%	9.0	336	437	30%	5.1	519	438	-16%	3.7
108	112	287	156%	12.4	119	17	-86%	12.4	180	226	26%	3.3
109	843	847	0%	0.1	445	445	0%	0.0	634	635	0%	0.0
110	539	659	22%	4.9	353	380	8%	1.4	553	686	24%	5.3
111	424	315	-26%	5.7	239	214	-11%	1.7	452	330	-27%	6.2

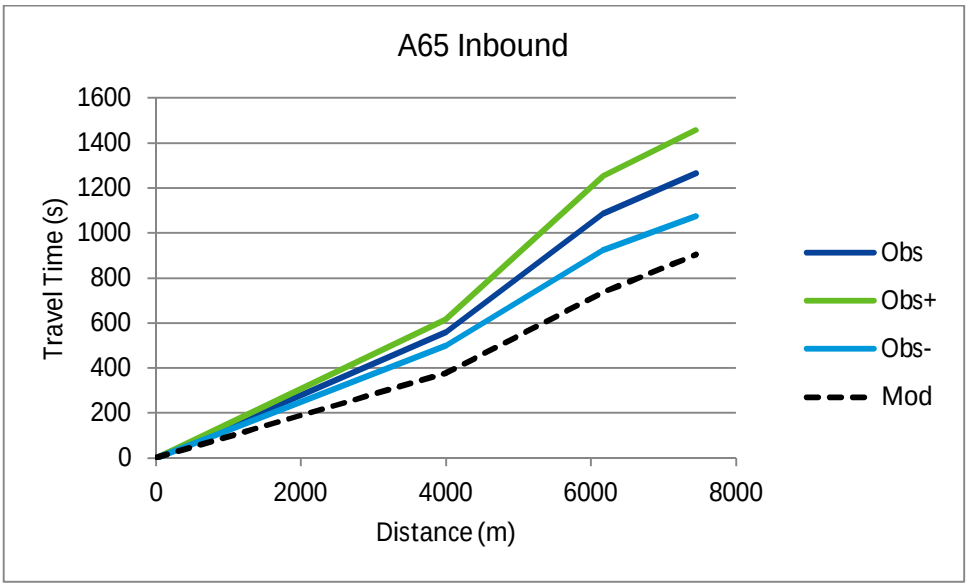
Site No.	AM				IP				PM			
	Obs	Mod	% Dif	GEH	Obs	Mod	% Dif	GEH	Obs	Mod	% Dif	GEH
112	340	356	5%	0.9	119	150	26%	2.7	257	356	39%	5.7
113	207	200	-3%	0.5	122	90	-26%	3.1	178	165	-8%	1.0
114	742	670	-10%	2.7	469	493	5%	1.1	748	598	-20%	5.8
115	889	959	8%	2.3	542	516	-5%	1.1	942	1100	17%	4.9
116	280	349	25%	3.9	181	156	-14%	1.9	415	509	23%	4.4
117	362	302	-17%	3.3	247	263	7%	1.0	540	450	-17%	4.1
118	165	149	-10%	1.3	86	74	-14%	1.3	213	141	-34%	5.4
119	393	402	2%	0.5	197	209	6%	0.9	421	481	14%	2.8
120	654	326	-50%	14.8	460	330	-28%	6.6	908	523	-42%	14.4
121	429	462	8%	1.5	180	226	26%	3.2	315	364	16%	2.7
122	369	90	-76%	18.4	170	49	-71%	11.5	320	109	-66%	14.4
123	638	638	0%	0.0	450	450	0%	0.0	802	796	-1%	0.2
124	524	599	14%	3.1	368	363	-1%	0.3	550	662	20%	4.5
125	431	363	-16%	3.4	248	253	2%	0.3	463	345	-25%	5.9
126	260	340	31%	4.6	114	159	40%	3.9	359	425	18%	3.3
127	254	173	-32%	5.6	152	107	-30%	4.0	332	249	-25%	4.9
128	762	845	11%	2.9	463	608	31%	6.3	677	884	31%	7.4
129	1036	905	-13%	4.2	535	387	-28%	6.9	1104	854	-23%	8.0
130	585	620	6%	1.4	225	232	3%	0.5	397	437	10%	2.0
131	416	369	-11%	2.4	210	202	-4%	0.5	306	305	0%	0.1
132	277	169	-39%	7.2	89	90	1%	0.1	173	184	6%	0.8
133	479	567	18%	3.8	182	182	0%	0.0	366	350	-4%	0.9
134	906	759	-16%	5.1	492	392	-20%	4.8	667	632	-5%	1.4
135	360	706	96%	15.0	193	275	43%	5.4	442	674	53%	9.8
136	324	135	-58%	12.5	177	50	-72%	11.9	472	211	-55%	14.1
137	144	266	84%	8.5	48	88	83%	4.8	108	147	36%	3.5
138	288	353	23%	3.6	114	169	48%	4.6	276	268	-3%	0.5
139	744	720	-3%	0.9	490	487	-1%	0.1	699	673	-4%	1.0
140	247	266	8%	1.2	158	159	1%	0.1	492	500	2%	0.4
141	504	331	-34%	8.5	291	219	-25%	4.5	400	415	4%	0.7
142	956	1083	13%	4.0	712	773	9%	2.2	1003	1015	1%	0.4
143	926	760	-18%	5.7	491	398	-19%	4.4	801	776	-3%	0.9
144	142	97	-31%	4.1	56	82	47%	3.1	124	162	31%	3.2
145	219	212	-3%	0.5	122	182	49%	4.9	313	464	48%	7.7
146	841	841	0%	0.0	527	515	-2%	0.5	971	781	-20%	6.4
147	331	518	56%	9.1	165	203	23%	2.8	252	335	33%	4.8
148	533	380	-29%	7.2	376	275	-27%	5.6	748	518	-31%	9.2
149	993	939	-5%	1.7	713	773	8%	2.2	993	1122	13%	4.0

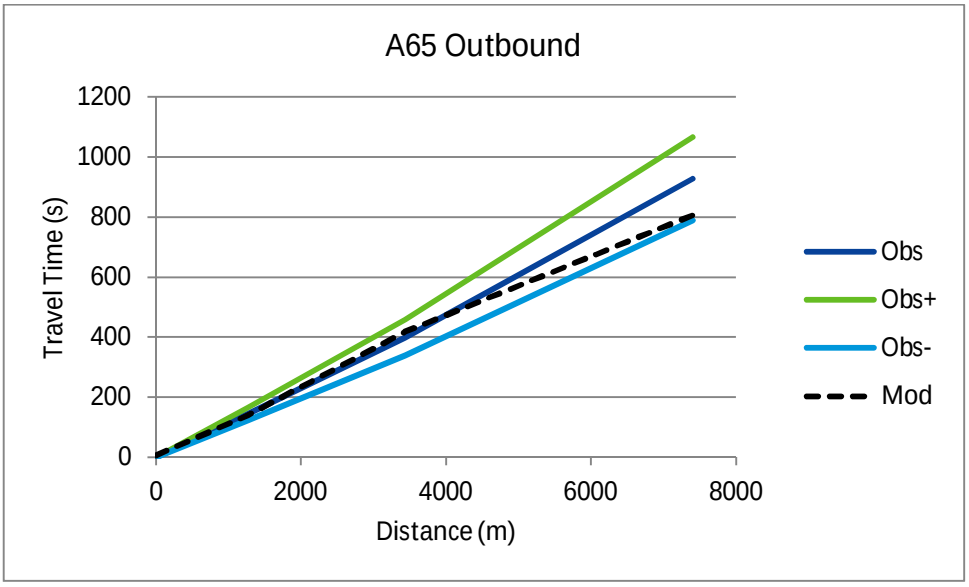
Site No.	AM				IP				PM			
	Obs	Mod	% Dif	GEH	Obs	Mod	% Dif	GEH	Obs	Mod	% Dif	GEH
150	671	792	18%	4.5	468	383	-18%	4.1	942	747	-21%	6.7

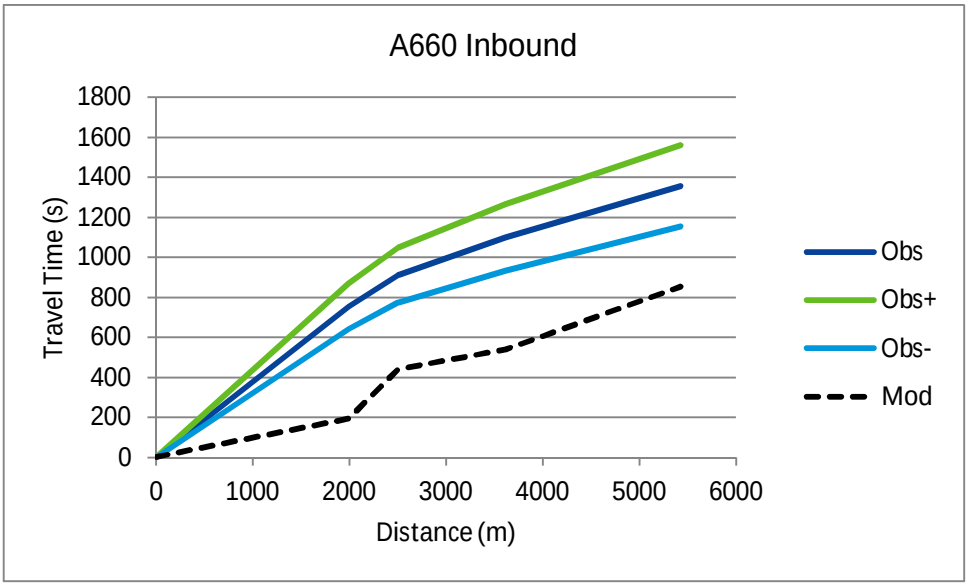
Appendix B

Highway model journey time validation

AM



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1800
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1400
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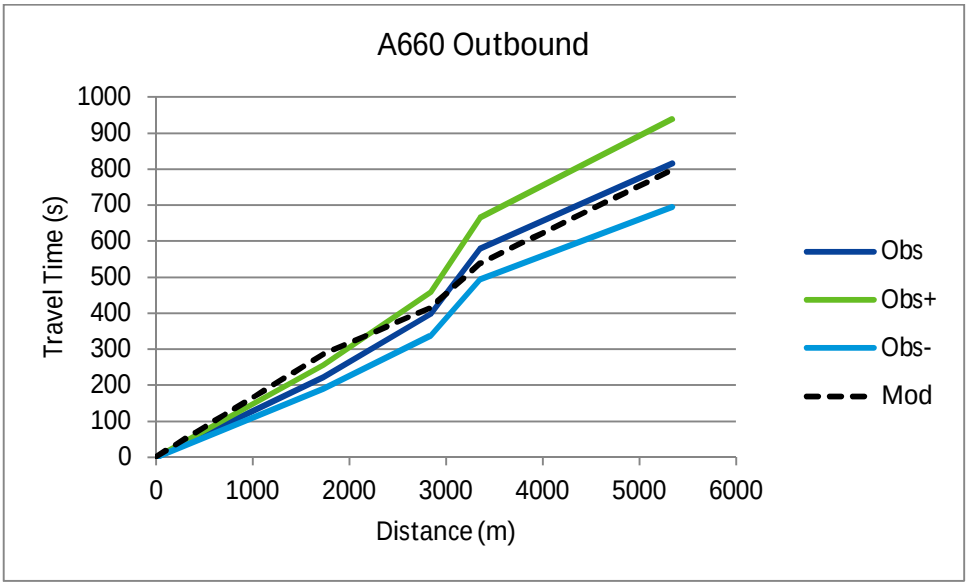
5000
6000
Distance (m)
Obs
Obs+
Obs-
Mod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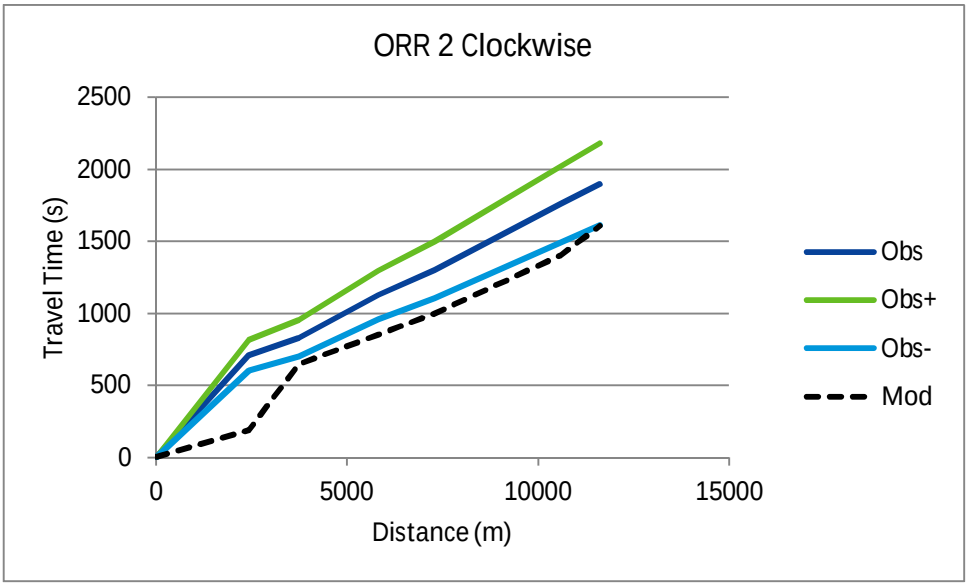
6000
Distance (m)
Obs
Obs+
Obs-
Mod


ORR 2 Clockwise
Travel Time (s)
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Distance (m)
Obs
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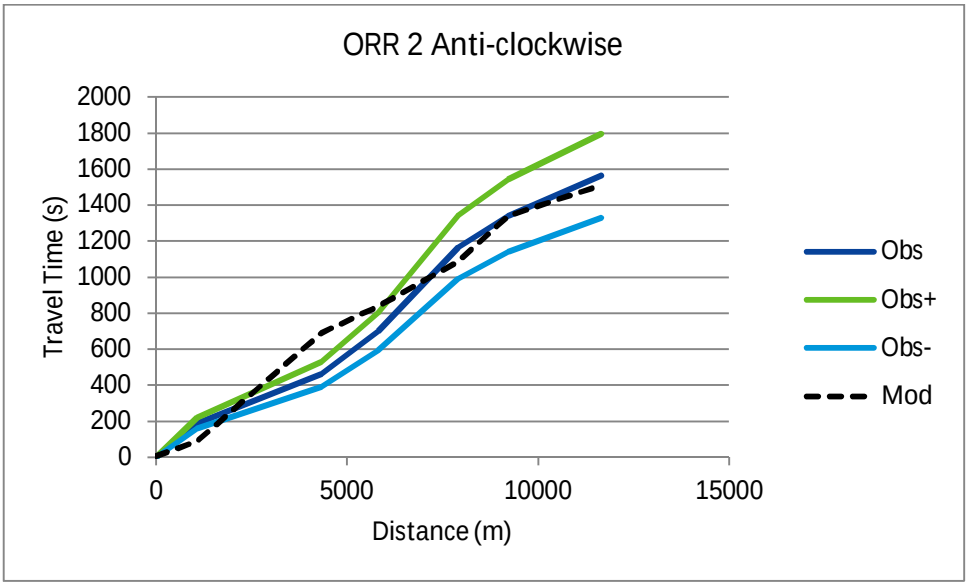
Obs-
Mod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Travel Time (s)
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Distance (m)
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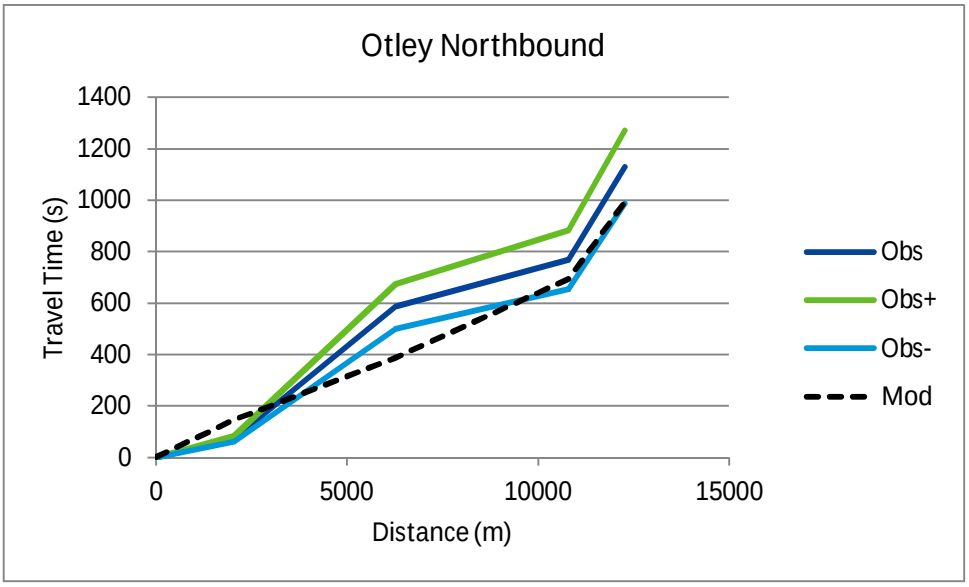
Obs-
Mod


Otley Northbound
Travel Time (s)
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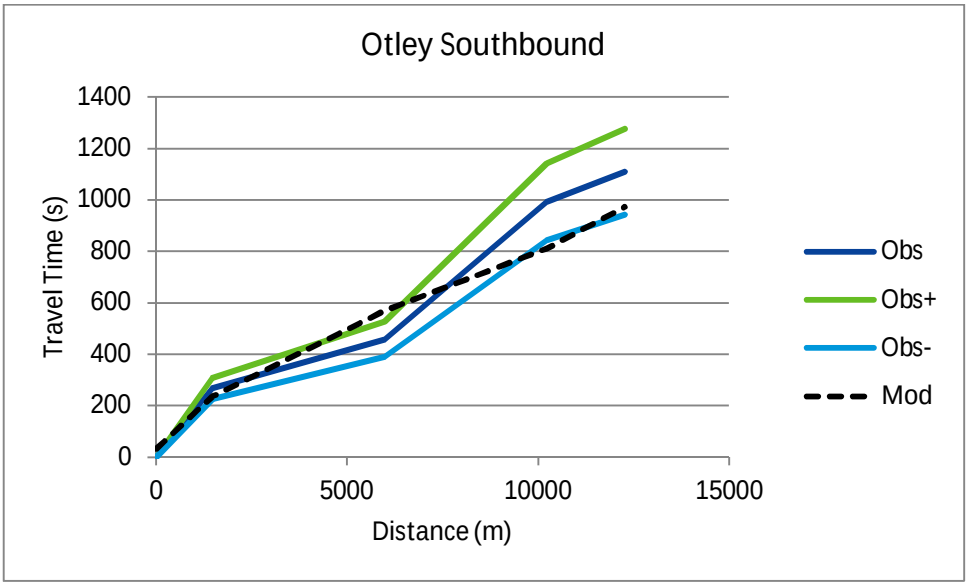
10000
15000
Distance (m)
Obs
Obs+
Obs-
Mod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Travel Time (s)
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Distance (m)
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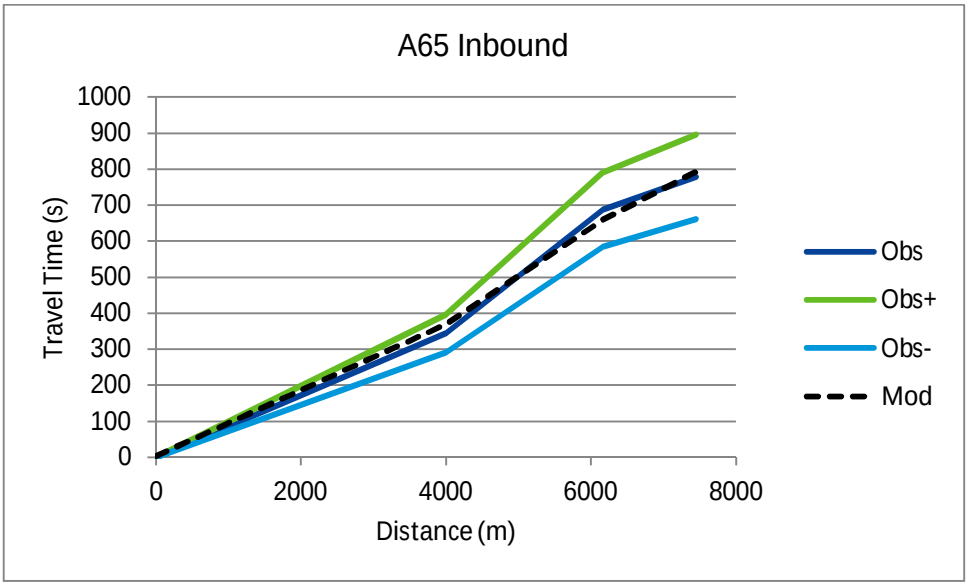
Mod

IP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Travel Time (s)
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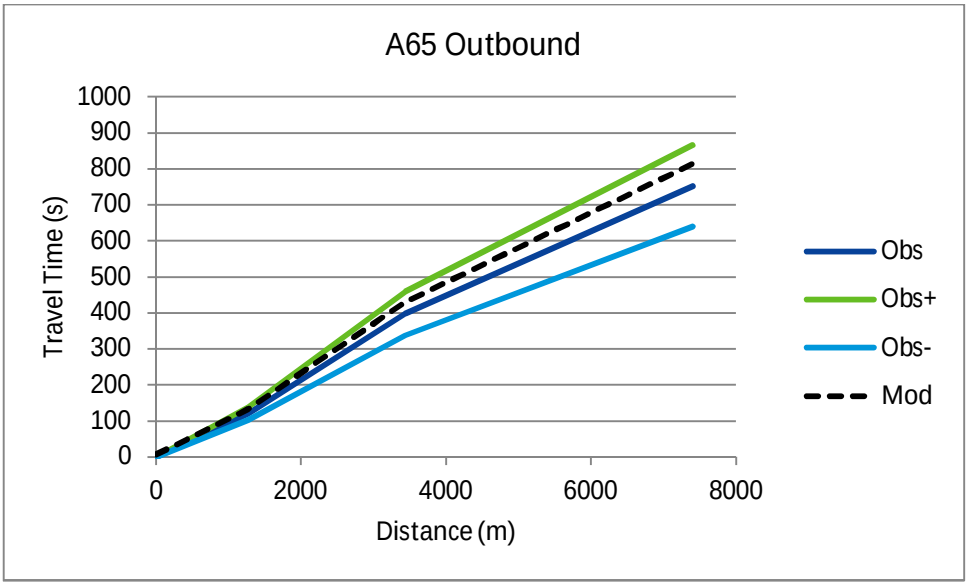
Distance (m)
Obs
Obs+
Obs-
Mod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Distance (m)
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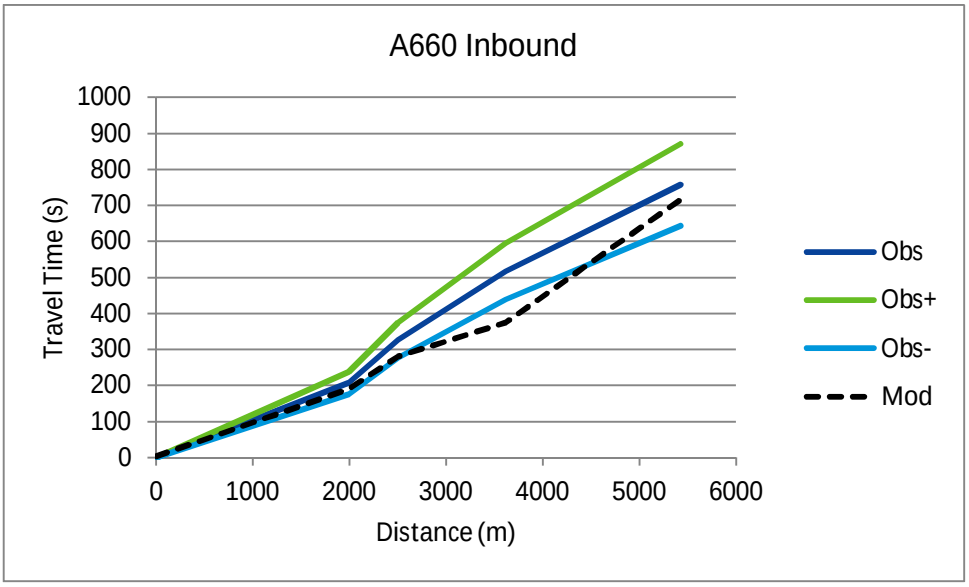
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Distance (m)
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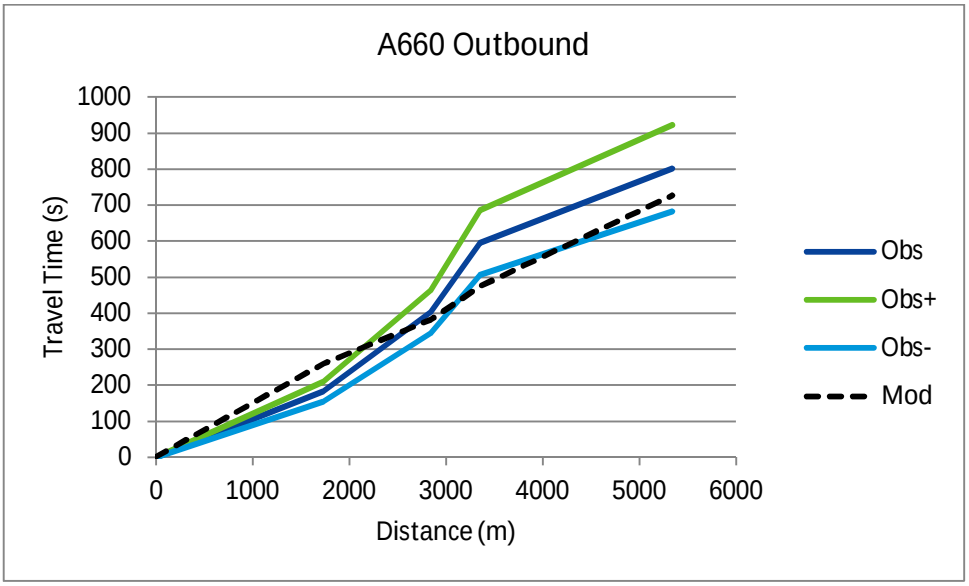
Mod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Travel Time (s)
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Distance (m)
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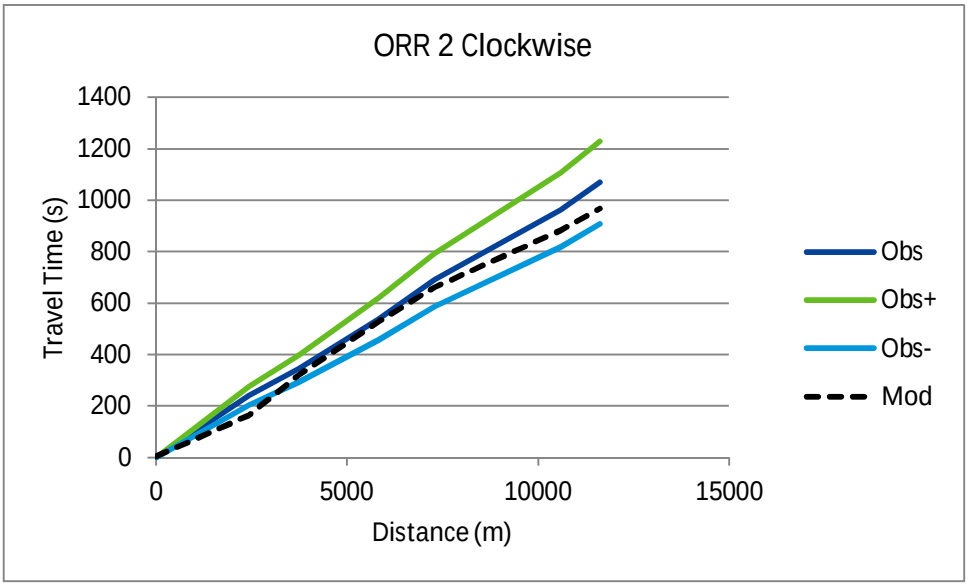
Mod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Travel Time (s)
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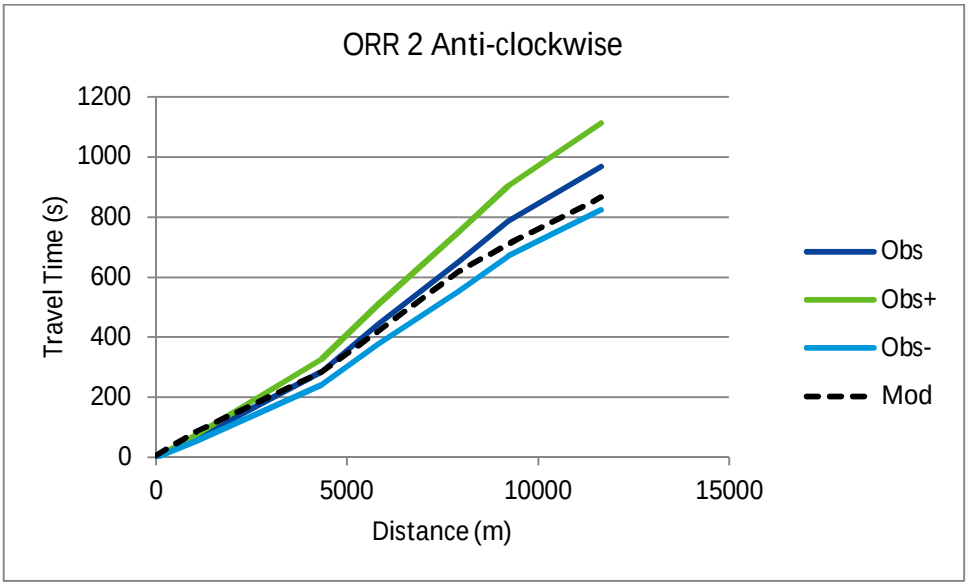
Distance (m)
Obs
Obs+
Obs-
Mod


ORR 2 Anti-clockwise
Travel Time (s)
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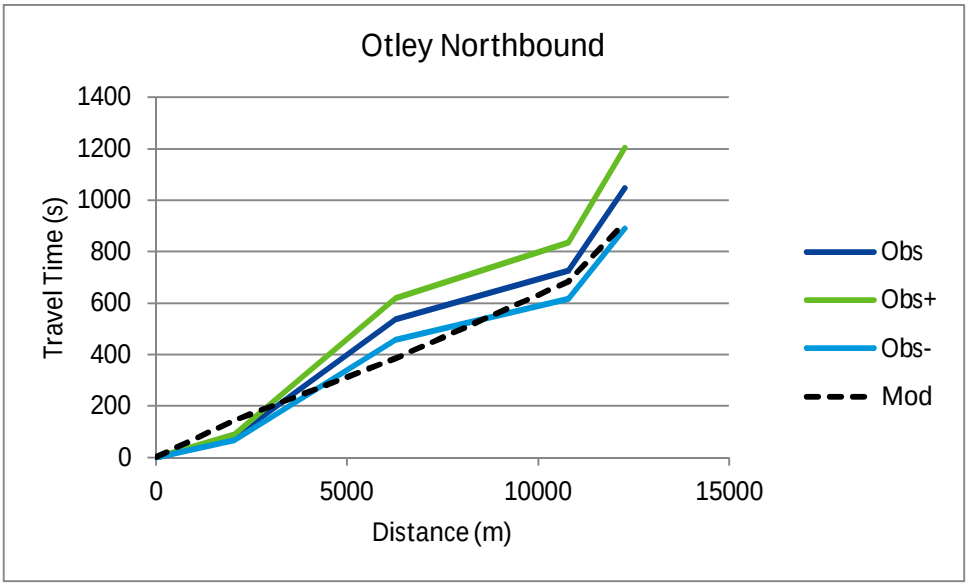
Distance (m)
Obs
Obs+
Obs-
Mod


Otley Northbound
Travel Time (s)
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Distance (m)
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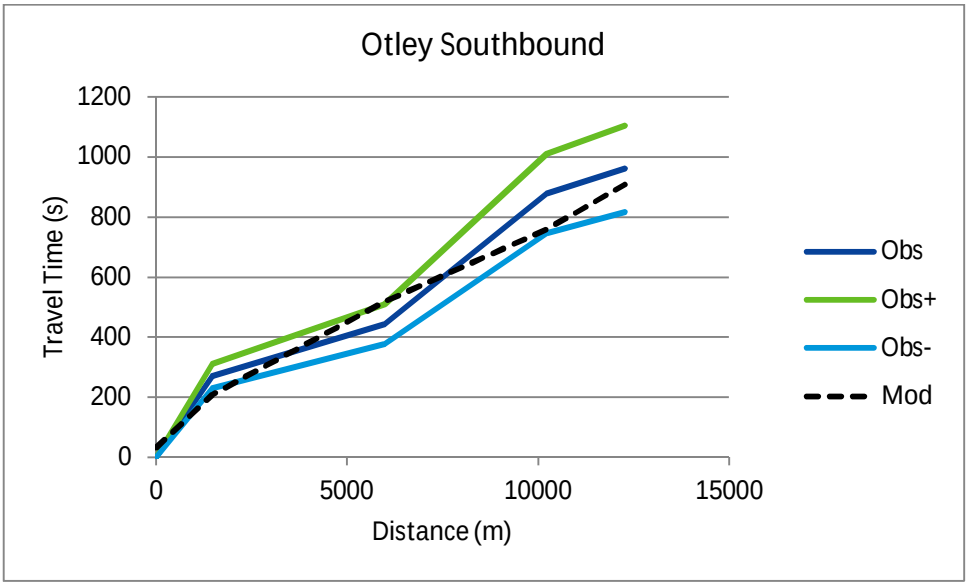
Obs-
Mod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Travel Time (s)
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Distance (m)
Obs
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Obs-
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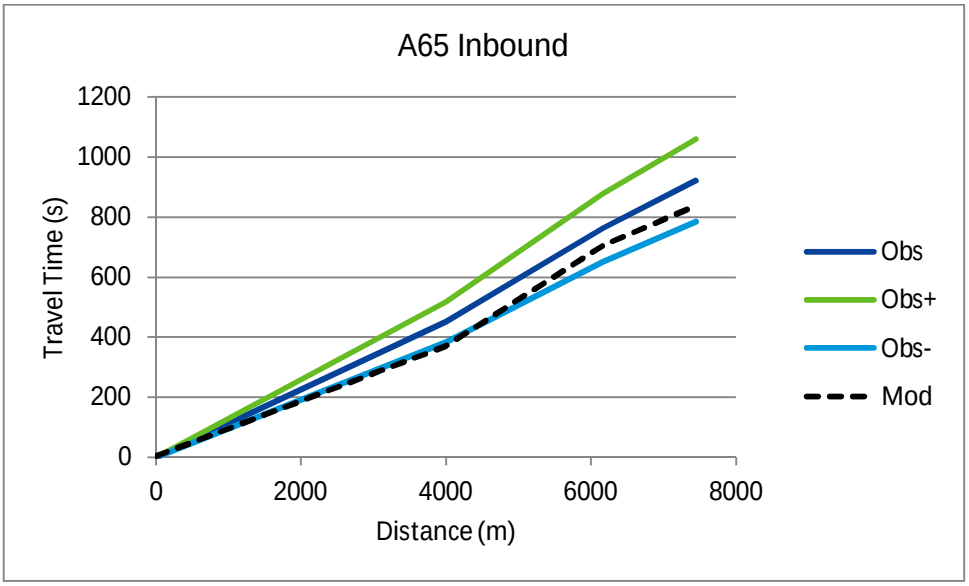
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Travel Time (s)
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Distance (m)
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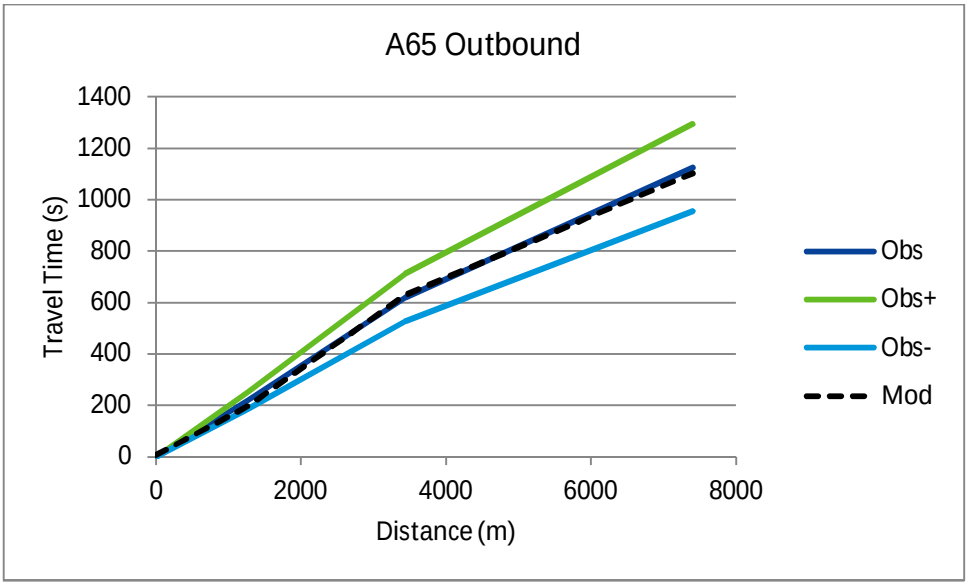
Obs-
Mod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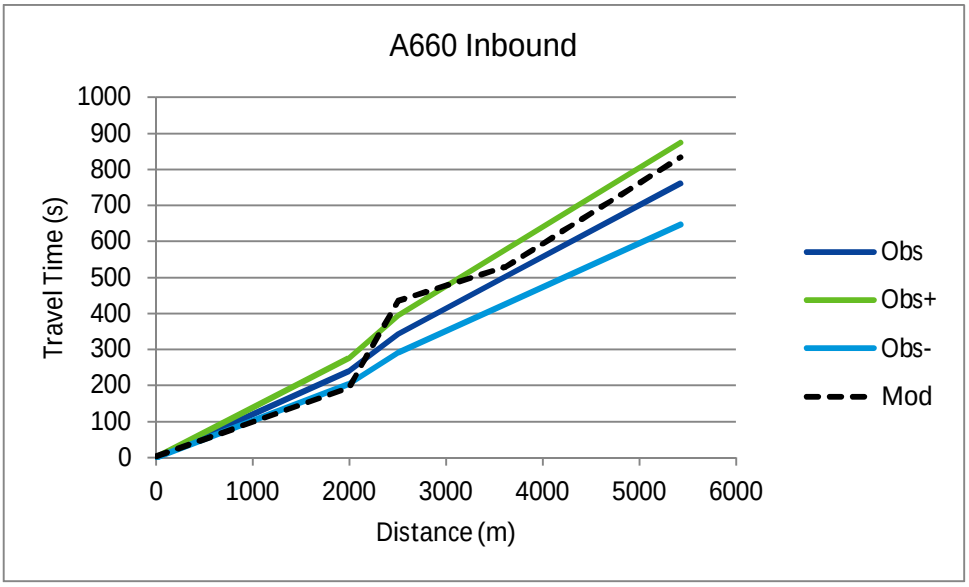
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Distance (m)
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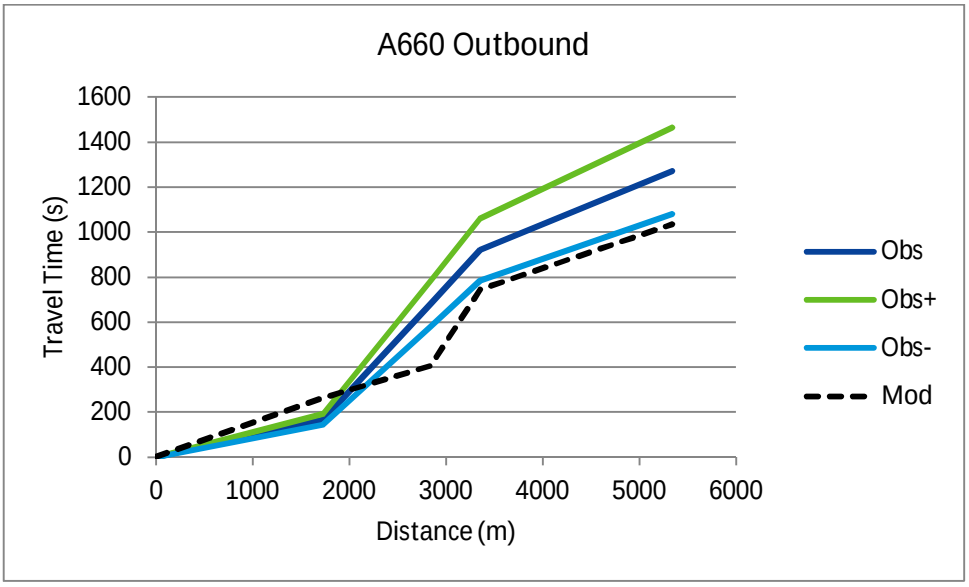
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Distance (m)
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Obs-
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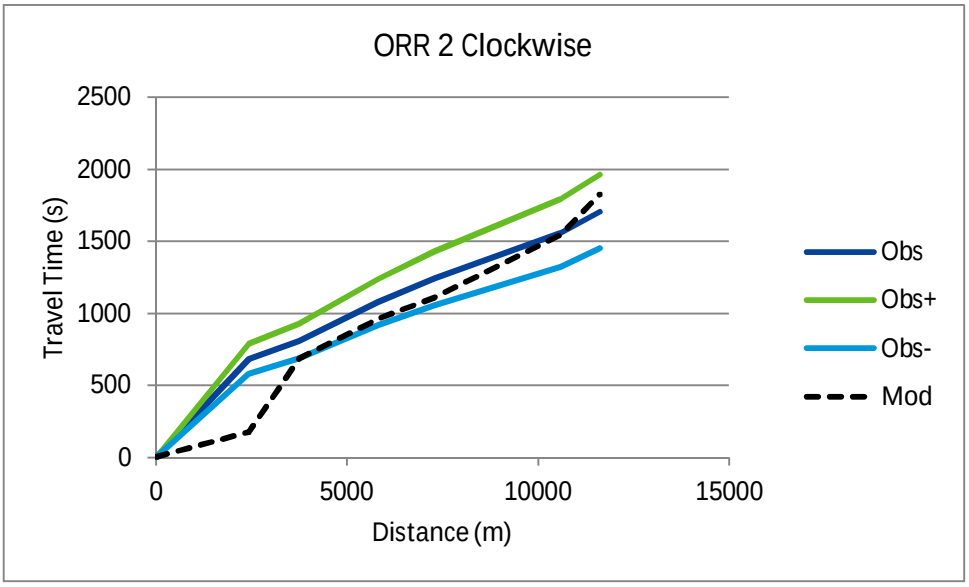
ORR 2 Clockwise
Travel Time (s)
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2000
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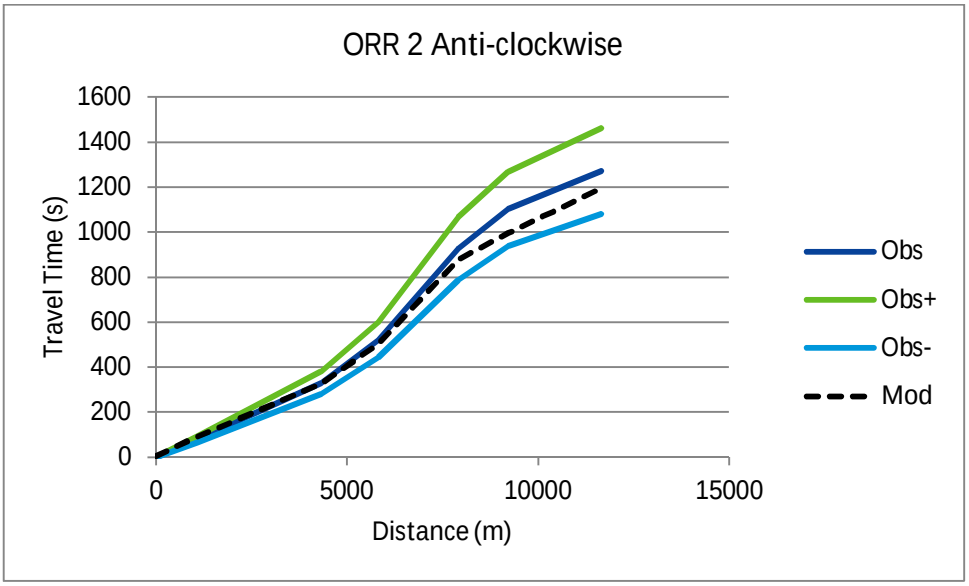
15000
Distance (m)
Obs
Obs+
Obs-
Mod


ORR 2 Anti-clockwise
Travel Time (s)
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Distance (m)
Obs
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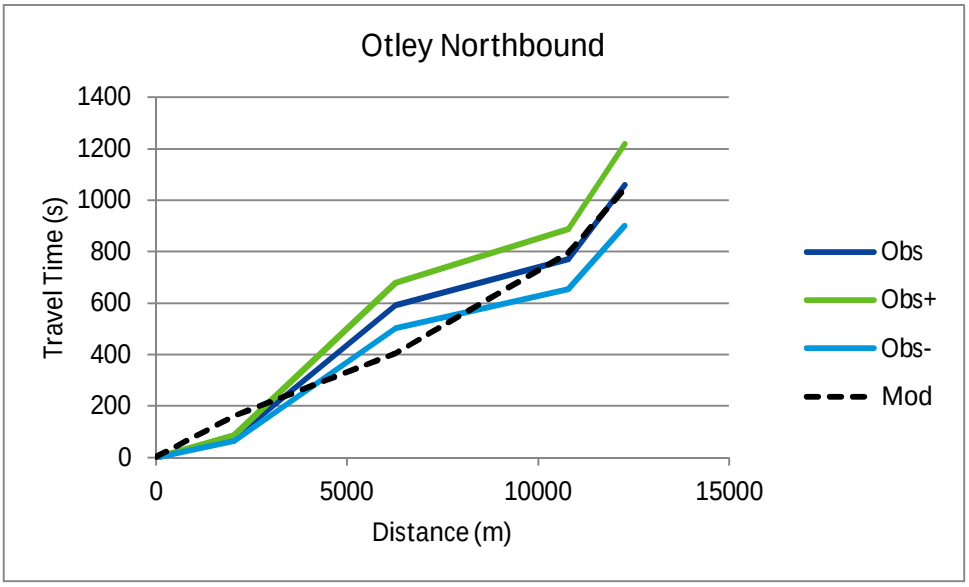
Obs-
Mod


Otley Northbound
Travel Time (s)
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15000
Distance (m)
Obs
Obs+
Obs-
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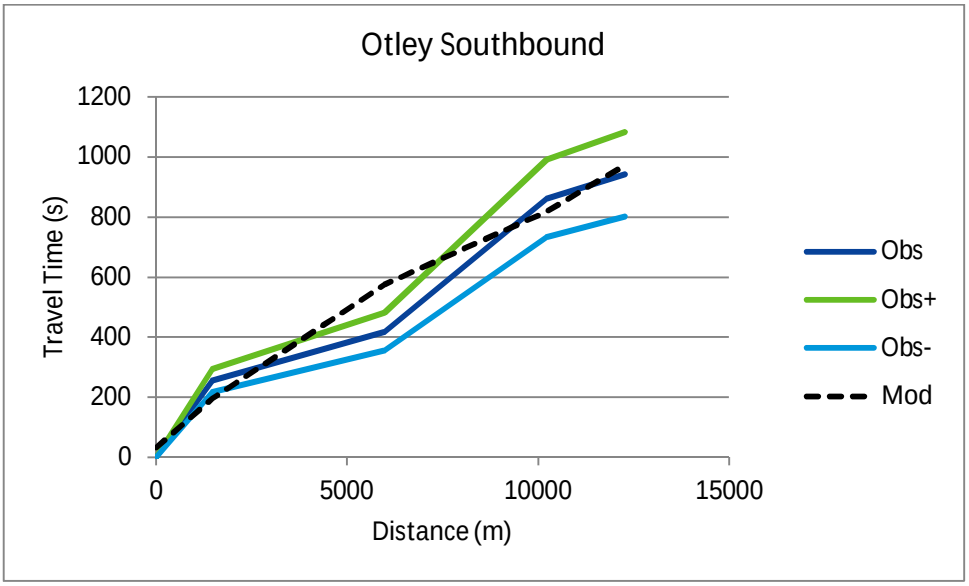
Otley Southbound
Travel Time (s)
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Distance (m)
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Mod

Modelling Technical Note 3: Connectivity to LBIA Feasibility Study – Modelling Decision Points (Final)

Introduction

This note sets out the decision points that will be used to progress the modelling for the study, as follows:

- Base modelling platform approach;
- Base modelling platform approval;
- Forecasting approach;
- Forecasting approval; and
- Variable demand modelling.

Dates are provided for each decision point. This is when the required inputs for decision making will be supplied. Within the same week it is expected that a decision will be reached.

Decision Point 1: Base Modelling Platform Approach

Description	Decision about the approach for developing the base year modelling platform
Date	23rd June
Inputs for decision making	Modelling Technical Note 2: Review of LTM 2008 Base Year Assignment Models Modelling Technical Note 4: Public Transport Spreadsheet Model Specification

Decision Point 2: Base Modelling Platform Approval

Description	Decision about approval of the base year modelling platform
Date	14th July
Inputs for decision making	Modelling Technical Note 5a: Review of Base Models for the Study, vicinity of LBIA Modelling Technical Note 5b: Review of Base Models for the Study, scheme locations

Decision Point 3: Forecasting Approach

Description	Decision about the model forecasting approach
Date	21st July
Inputs for decision making	Modelling Technical Note 6: Forecasting Review Modelling Technical Note 7: Uncertainty Log

Decision Point 4: Forecasting Approval

Description	Decision about the model forecasting approach
Date	18th August
Inputs for decision making	Modelling Technical Note 9a: PT results for OAR Modelling Technical Note 9b: Highway results for OAR Modelling Technical Note 10: Trip Distribution at LBIA

Decision Point 5: Variable Demand Modelling

Description	Decision about the need and approach for variable demand modelling
Date	8th September
Inputs for decision making	Modelling Technical Note 8: Variable Demand Model Testing

Decision Point and Input Programme

Decision Point / Input	26-May	02-Jun	09-Jun	16-Jun	23-Jun	30-Jun	07-Jul	14-Jul	21-Jul	28-Jul	04-Aug	11-Aug	18-Aug	25-Aug	01-Sep	08-Sep
Decision Point 1: Base Modelling Platform Approach					■											
Modelling Technical Note 2: Review of LTM 2008 Base Year Assignment Models					▪											
Modelling Technical Note 4: Public Transport Spreadsheet Model Specification					▪											
Decision Point 2: Base Modelling Platform Approval								■								
Modelling Technical Note 5a: Review of Base Models for the Study, vicinity of LBIA							▪									
Modelling Technical Note 5b: Review of Base Models for the Study, scheme locations								▪								
Decision Point 3: Forecasting Approach									■							
Modelling Technical Note 6a: Forecasting Review									▪							
Modelling Technical Note 6b: Forecasting Approach									▪							
Modelling Technical Note 7: Uncertainty Log									▪							
Decision Point 4: Forecasting Approval													■			
Modelling Technical Note 9a: PT Modelling Results for OAR													▪			
Modelling Technical Note 9b: Highway Modelling Results for OAR													▪			
Modelling Technical Note 9b: Trip distribution at LBIA													▪			
Decision Point 5: Variable Demand Modelling																■
Modelling Technical Note 8: Variable Demand Model Testing																▪

Key

Decision Point ■

Input ▪

Modelling Technical Note 4: Connectivity to LBIA Feasibility Study – Public Transport Spreadsheet Model Specification (Final)

Prepared by: Adam Truman Date: 9th Sep 2014

Checked by: Nadia Lyubimova (checked v4) Date: 2nd July 2014

1 Introduction

A review of the Leeds Transport Model (LTM) base year network assignment highway and public transport models was undertaken to assess their suitability for use in the study (Modelling Technical Note 2 – Review of LTM 2008 Base Year Assignment Models). The result of the review was that the highway assignment model, with relatively minor modifications, was suitable but that the public transport model was not due to the poor representation of public transport demand away from the Leeds district area.

The agreed contingency approach was to set up a simple spreadsheet model as described in this note.

In summary, the model will be structured to capture benefits based on a simplistic representation of demand at either end of the scheme. Demand will be based on an analysis of patronage data. Demand response and public transport route choice will be based on logit choice involving a simple two-tiered representation for mode choice (highway vs public transport) and sub mode (public transport options).

The spreadsheet will provide a basic set of route options. Generalised costs will be built up based on elements represented in the public transport assignment model (but not including crowding). The same time periods and user classes will also be used.

The forecasting approach will be agreed as the modelling progresses.

2 Model Purpose

The purpose of the model is to provide a simple representation of the impacts of the scheme options being tested in the study as part of the Stage 1 Appraisal, step 7 – development and assessment of potential options.

3 Model Structure

The model will be structured to quantify benefits based on the generalised cost changes of demand at either end of the scheme.

The modelling methodology for the study (Technical note 1 – Modelling Methodology) describes that where a network assignment model is not suitable, then the following traveller responses would be represented in a simple spreadsheet model:

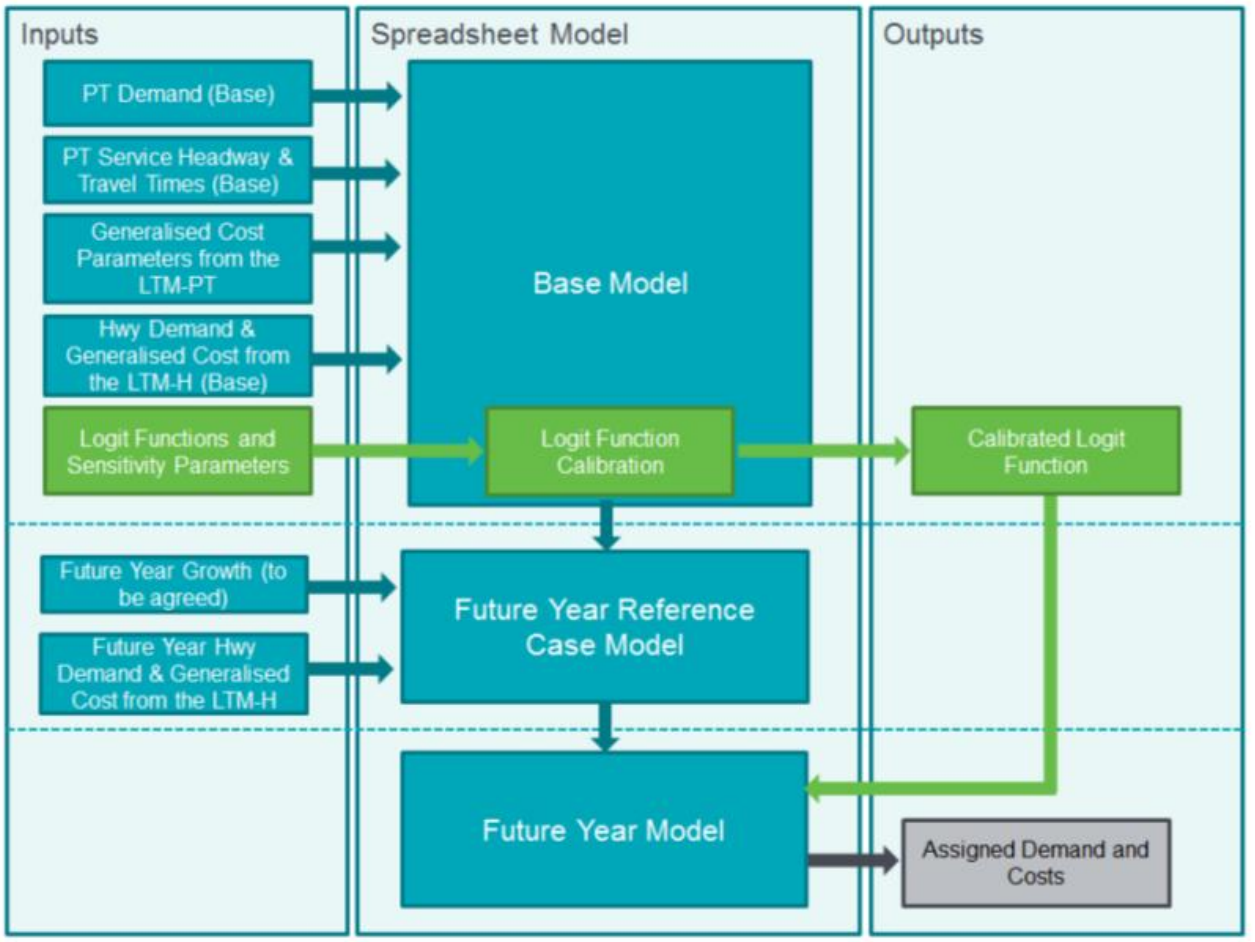
- Route choice; and
- Demand response

Route choice will be represented in terms of an existing and new (scheme) option. In the Do-Min scenario there will be one public transport route option, the existing option. In the Do-Something scenario there will be an additional option, the new (scheme).

Demand response will be based on a logit choice set up reflecting mode and sub mode choice. As the modelling progresses there may be a requirement to seek out a more sophisticated approach, but this would be beyond the scope of this study.

Figure 1 below summarises the model structure.

Figure 1: Spreadsheet Model Structure



LTM-PT = Leeds Public Transport Model

LTM-H = Leeds Highway Model

More detail is described in the following sections.

The model clearly has limitations in terms of both its representation of the various factors that impact on public transport travel, and the scope of demand which will form the basis for the scheme benefits. However to extend the design scope and develop a more sophisticated approach would significantly increase the complexity of the model development time which would be disproportionate for the study.

In more detail, the limitations are as follows:

- Representation of demand is not part of a validated model;
- Representation of demand is limited to specific corridors and services only;
- Limited route choice;
- No representation of the change in travel conditions beyond the specific route options being modelled;
- No crowding impacts;
- Simplistic mechanism for testing demand response;
- Existing public transport demand will be based on bus patronage and Moira rail data. Highway demand from the LTM-H will also be included to model demand response. Where the airport has aspirations to increase public transport mode share, forecasting based on existing demand may bias the result;
- The generalised costs are fixed;

- The model will not be iterating to equilibrium; and
- No representation of acess and egress times

4 Base Demand

Patronage data will be used as the source of base demand. Buses currently run between the airport and Leeds, Bradford and Harrogate. Demand from these services will cover all movements required to model the schemes except for the York to Leeds express bus service where CAA data can be used instead.

Other sources of data are available which could be used to derive demand, however they are considered less relevant than the patronage data for the spreadsheet model.

For modelling demand response, highway demand will be included from the LTM-H Saturn model version developed for the study. The demand will be based on an analysis of the flows on the scheme routes. For example highway demand for a rail scheme linking LBIA with Leeds city centre station would be taken from a select link of model demand arriving and departing at the airport zone, with only demand from Leeds city centre being selected.

5 Generalised Cost

The public transport network assignment model represents generalised cost based on the following elements:

- Access/ Egress time;
- Origin wait time;
- Boarding penalty;
- In vehicle time;
- Transfer time;
- Transfer wait time;
- Transfer penalty;
- Fare; and
- Crowding

The following weightings and curves are used:

- Walk weight;
- Initial weight curve;
- Transfer weight curve; and
- Crowding curve

The same components, weightings and curves will be included in the spreadsheet model, with the exception of crowding as described below.

5.1 Access and Egress Time

Access and egress times will not be included as they would be expected to remain broadly unchanged at an aggregate level across all the various origin / destination locations. To include the impacts of changes in access and egress times would be beyond the scope of the spreadsheet model.

5.2 Crowding

In the public transport assignment model (LTM-PT), crowding is switched on for rail only. Bus is excluded as it has been assumed that bus operators would have the flexibility in the future to respond to changes in demand.

In the spreadsheet model crowding is not included. However the scale of model demand relative to service capacity will be reviewed to flag up any crowding issues that might occur.

5.3 Fares

The public transport assignment model represents fares for the following segments:

- First bus;
- Arriva bus;
- Rail; and
- Free city bus

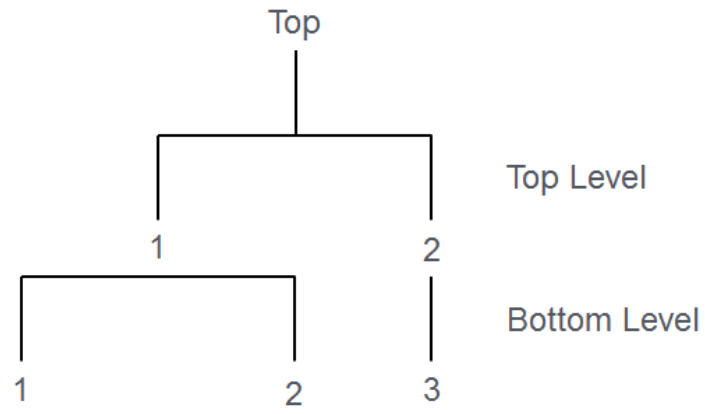
Fares will be based on the bus fare curves (shown in Appendix A) and rail fare matrices.

6 Logit Model

The logit model will be a simple two level mechanism as follows, and illustrated in Figure 2 below:

- Top level: Choice between Highway and Public Transport (demand response); and
- Bottom level: Choice between Public Transport alternatives

Figure 2: Logit structure



- The top level logit model will be based on the standard incremental logit formulation described in TAG Unit M2 Appendix D section D.1.5.
- For the main mode choice logit scaling parameters there are two options. The first is to use the parameters used in the LTM. The second will be to use the illustrative main mode choice parameters set out in WebTAG. The first option is preferred as the parameters have been calibrated in the context of travel in Leeds.
- The bottom level logit model will be based on the standard absolute logit formulation described in TAG Unit M2 Appendix D section D.1.5. The Lambda parameter will be calibrated to better represent the observed base model demand split. The LTM-PT uses a lambda of -0.2 for choice between boarding and alighting

stops (the default specified by Citilabs for the Cube software platform), and -0.08 for choice between NGT and other modes. The Irish National Transport Model: Variable Demand Model uses a submode lambda of -0.1. Of these -0.08 is considered the most relevant lambda as it is taken from the same form of model for sub mode choice in the Leeds area.

The model will run through one iteration only.

The bottom level logit function will be calibrated so that it provides a reasonable representation of the observed base demand split. This will be for demand across all movements being considered for scheme testing i.e. between the airport and Leeds, Bradford, Harrogate and York. A sinlge 'best fit' lambda will be selected.

A sensitivity tests will be carried out to determine the impact of the calibrated parameters. This will be based on the recommendations described in TAG Unit M2 for parameter values that have been imported, testing +50% against the mean. The range of lambdas tested during calibration will also be considerd.

Incremental logit is the correct choice in the context of this simple model. The model has a number of limitations which have been set out in this note. Incremental logit wll be expected to minimise the degree of modelling uncertainty.

7 Time Periods

The same time periods represented in the public transport network assignment model will be used, as follows:

- AM Peak period average hour 7-10;
- Inter-peak average hour 10-16; and
- PM peak average hour 16-18.

8 User classes

The public transport assignment model segments demand as follows:

- Non concessionary fare payers; and
- Concessionary fare payers

For fares modelling this differentiates demand between passengers that do and don't pay fares. Values of time extracted from the public transport assignment model will be used in the spreadsheet to convert monetary fares into generalised cost.

Non-concessionary and concessionary demand proportions will be calculated based on global demand proportions in the public transport assignment model. However it is understood that this could be better reflected by data for travel patterns at the airport, where available.

The non-concessionary / concessionary fares split will remain constant irrespective of demand response.

9 Forecasting

A decision about the forecasting will be agreed as the modelling work progresses. A key input will be developments and schemes collated in an uncertainty log for the study. Nevertheless the spreadsheet model will need to include a mechanism for uplifting the base demand to at least two, yet to be agreed, forecast years.

10 Appraisal

The model outputs will be used to assess the value for money for the public transport schemes. Tuba will be used to generate the economic outputs.

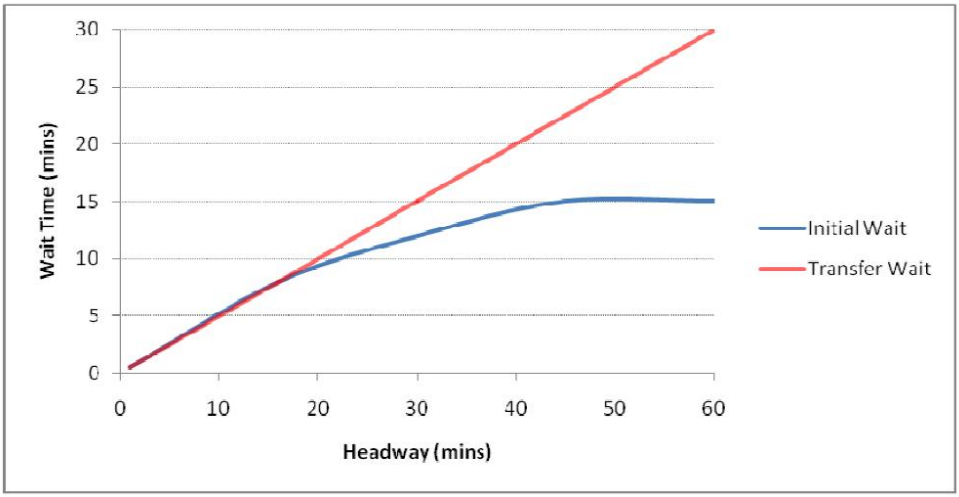
Appendix A – Details of the various generalised cost elements

The following values are from the Base Year 2008 Public transport assignment model:

Walk Time Factor = 1.3 (note that this is used for the access / egress time which will not be included)

Wait Factor = 2.85

Initial Wait and Transfer Time Curves

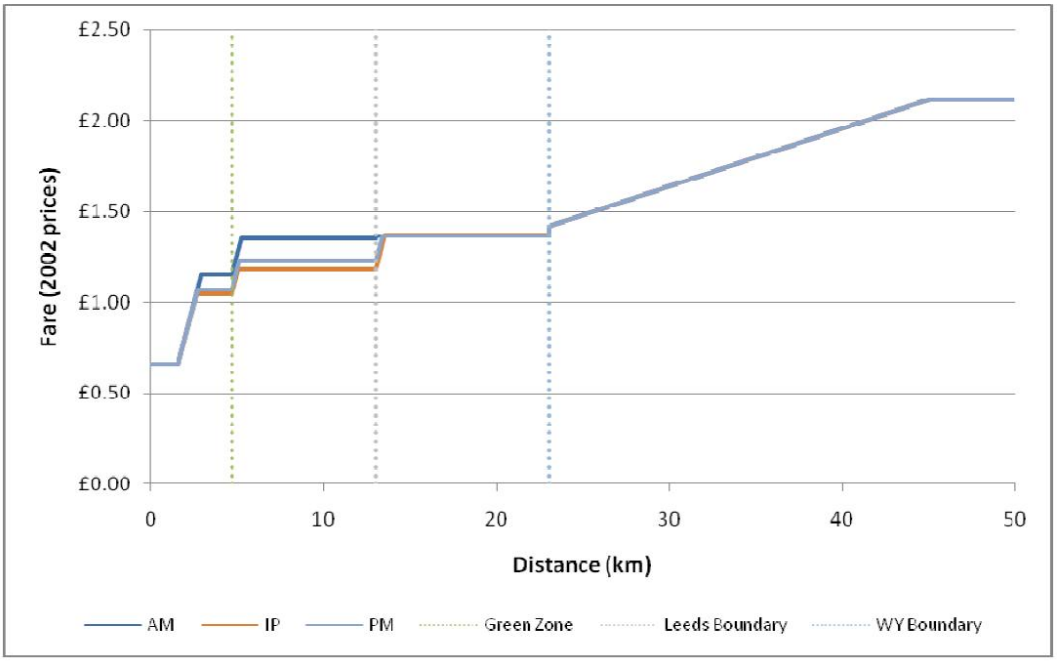


Boarding Penalty=5.5 mins

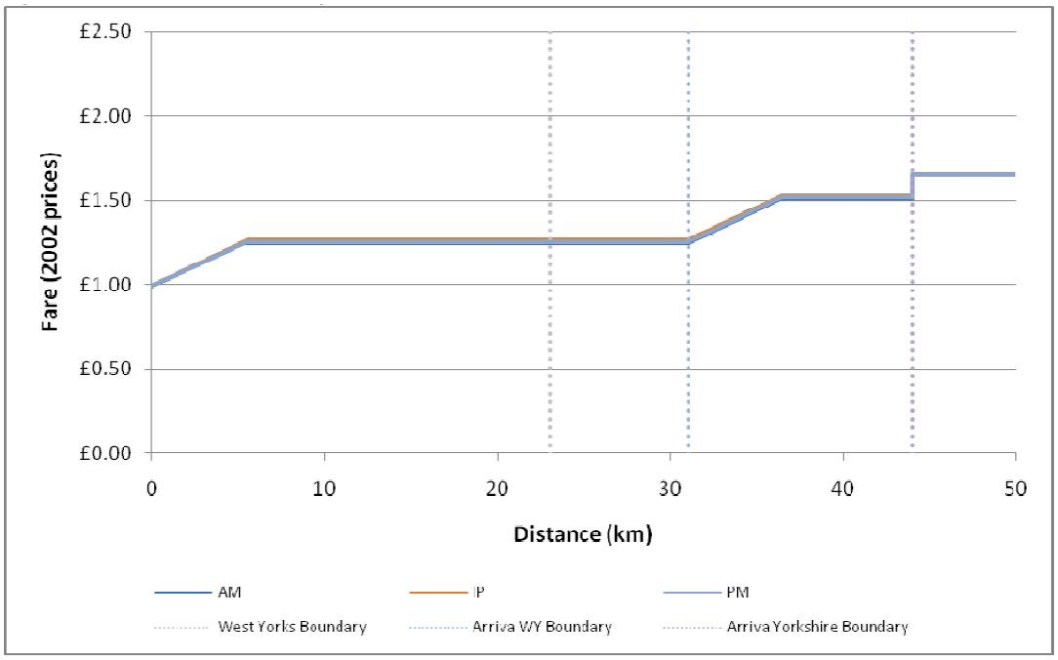
Run Time Factor=1

Transfer Penalty=5 mins

First Bus Fare Curve (2008 price base, discounted to 2002)



Arriva Bus Fare Curve (2008 price base, discounted to 2002)



Rail fares are in the form of a fare matrix based on fares between Metro rail zones for trips within West Yorkshire.

Values of time (for converting fares to time, £/hr)

- AM: 6.92
- IP: 6.28
- PM: 6.88

Fare / non-fare payer (concessionary / non-concessionary) split assumption, will be based on a review of the public transport assignment model demand.

Modelling Technical Note 5a: Connectivity to LBIA Feasibility Study – Review of Base Models for the Study, Airport Vicinity (Final)

Prepared by: Adam Truman Date: 9th Sep 2014

Checked by: Date:

1 Introduction

This note describes the changes that have been made to improve the Base 2008 Saturn Highway model performance in the vicinity of the airport.

In summary this involves the changes which were identified in Modelling Technical Note 2 which are as follows:

- Greengates junction – improved representation;
- Airport demand – better reflection of demand benchmark; and
- Correct lane movement allocation for the Harrogate Road (B6152) northern arm of Rawdon cross roads.

Modelling Technical Note 5 has been split up as follows:

- Modelling Technical Note 5a: Connectivity to LBIA Feasibility Study - Review of Base Models for the Study, Airport Vicinity; and
- Modelling Technical Note 5b: Connectivity to LBIA Feasibility Study - Review of Base Models for the Study, Scheme Locations

2 Model Outputs

The following outputs demonstrate the model performance following the changes made to improve its traffic representation for the study.

2.1 Flow Differences (adjusted model – original)

Figure 1 Flow Differences AM 8-9 (Actual, All vehicles, pcu)

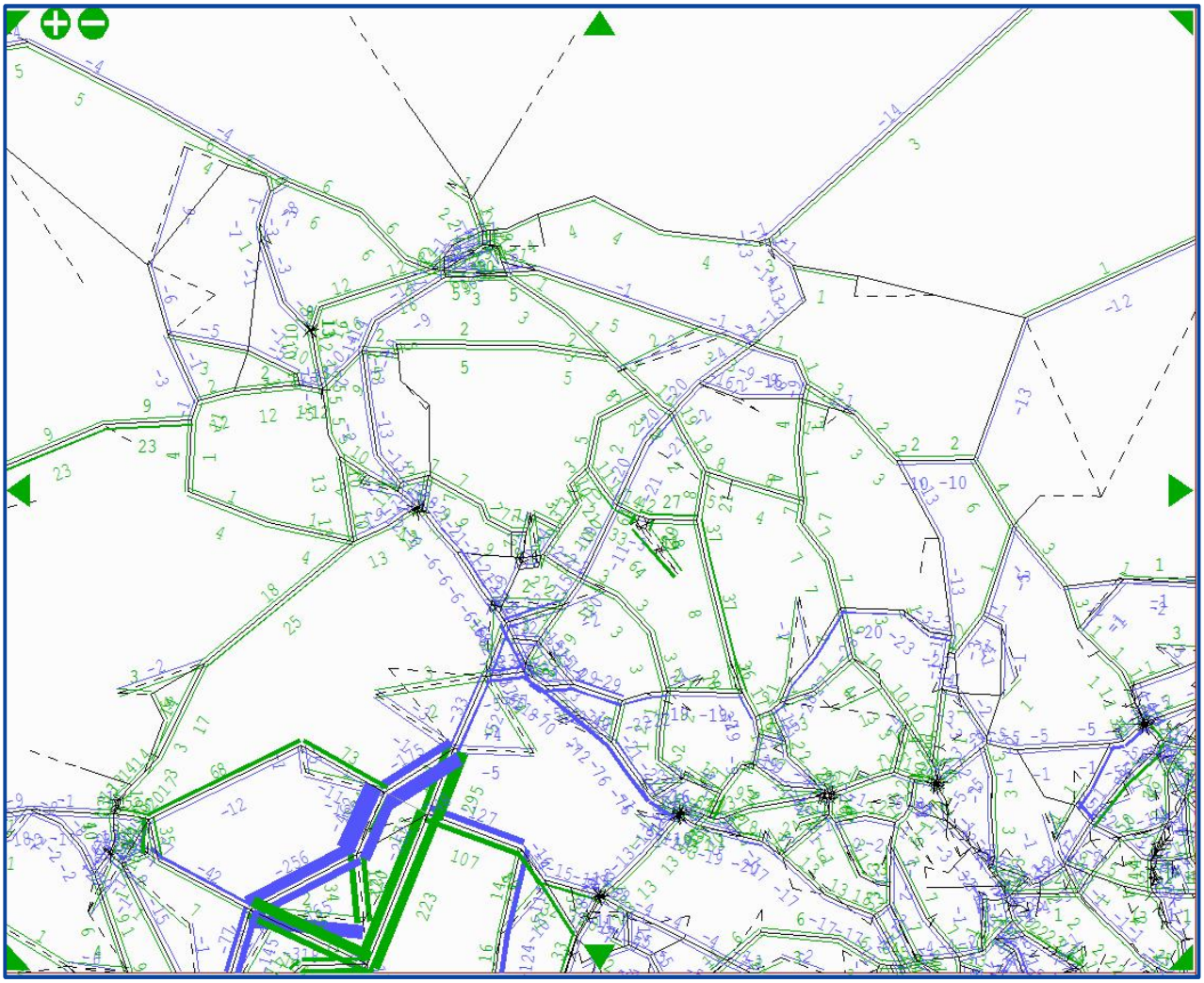


Figure 2 Flow Differences IP (Actual, All vehicles, pcu)

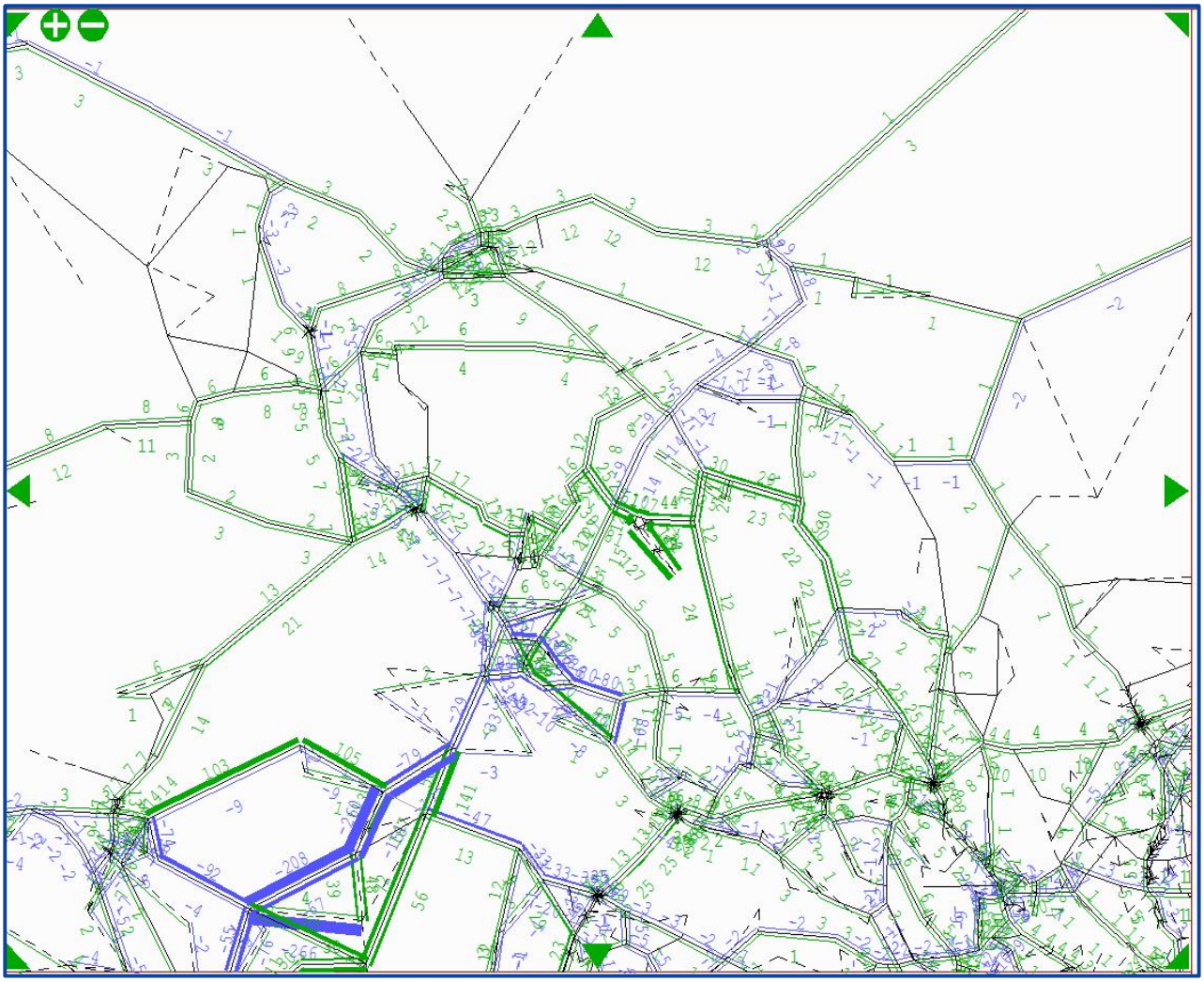
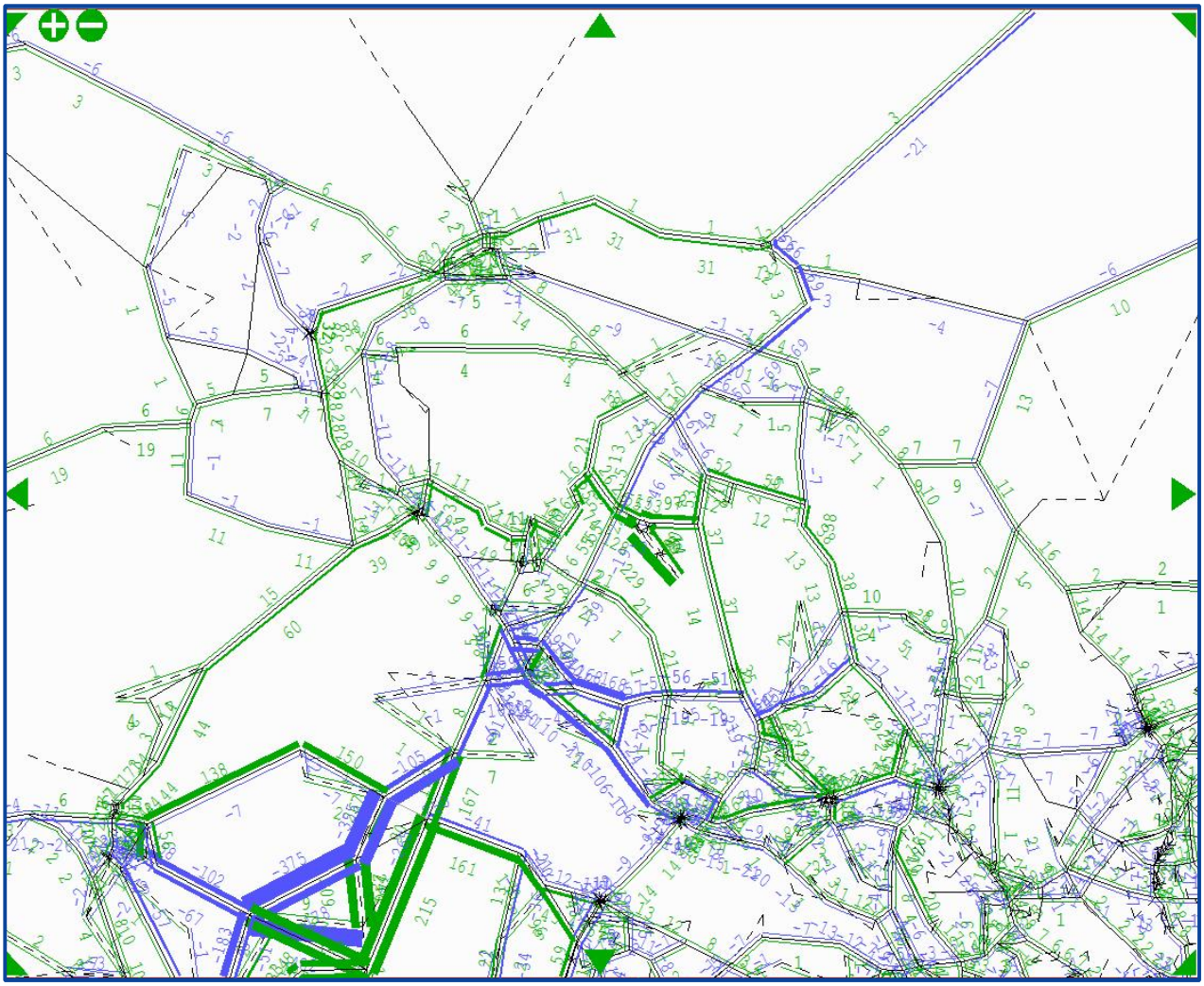


Figure 3 Flow Differences PM 17-18 (Actual, All vehicles, pcu)



The more significant flow differences are concentrated at the following locations:

- Greengates junction – more traffic has switched on to the A658 from Dapperly Road with impacts on connecting links; and
- LBIA – where the demand has been increased.

Otherwise the differences are considered relatively negligible.

2.1 Travel Time Differences (adjusted model – original)

Figure 4 Travel Time Differences AM 8-9 (Actual, All vehicles, seconds)

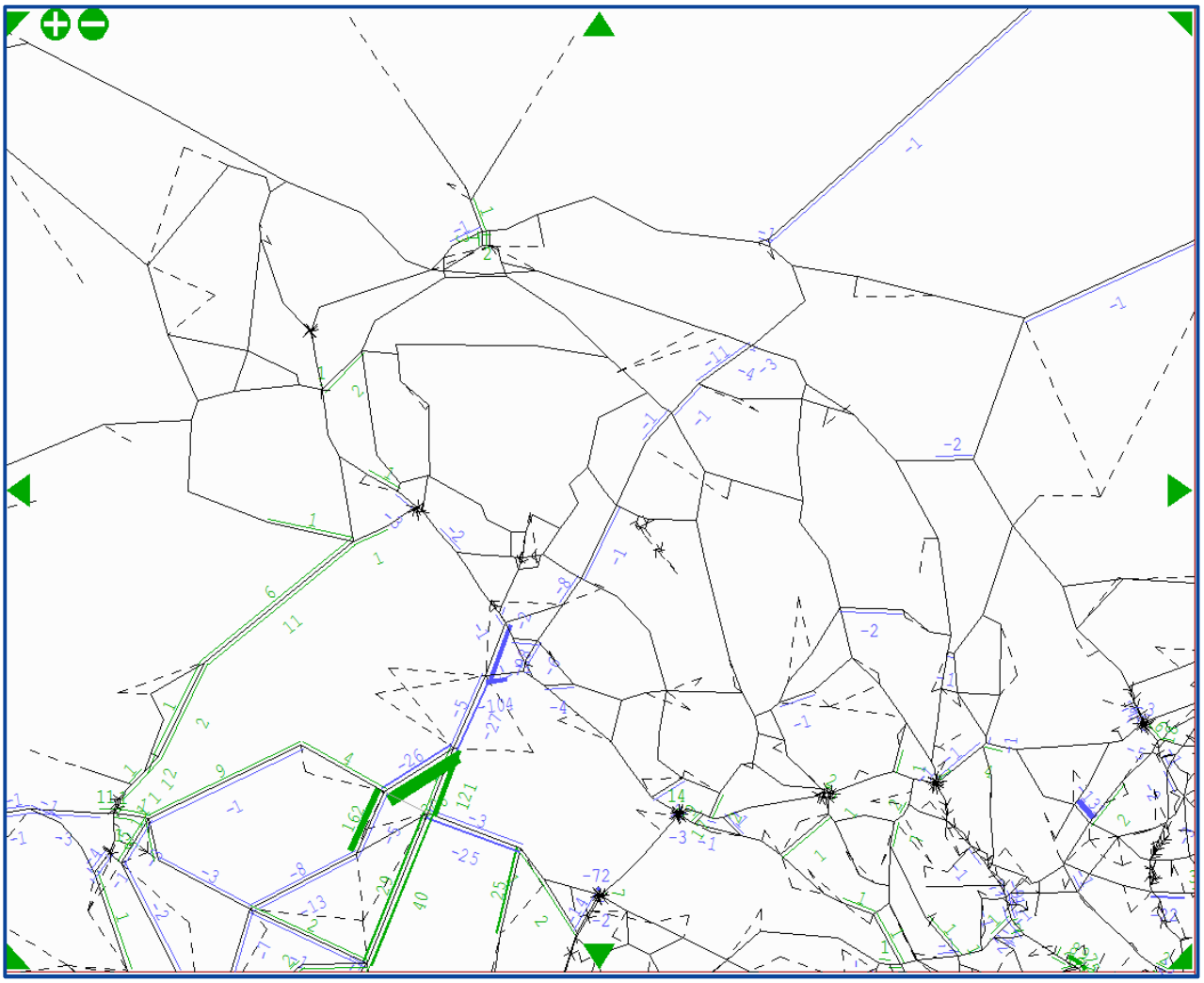


Figure 5 Travel Time Differences IP (Actual, All vehicles, seconds)

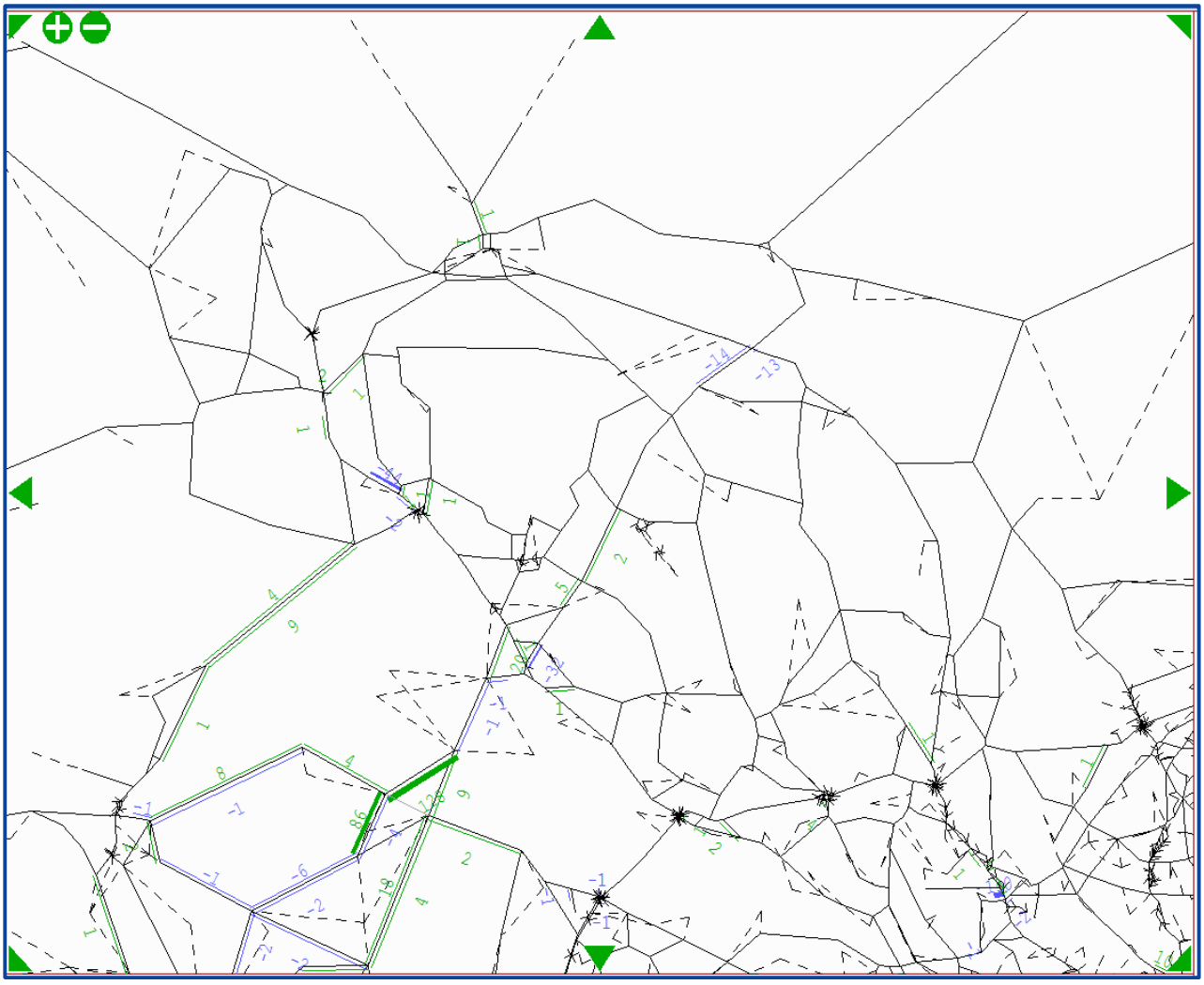
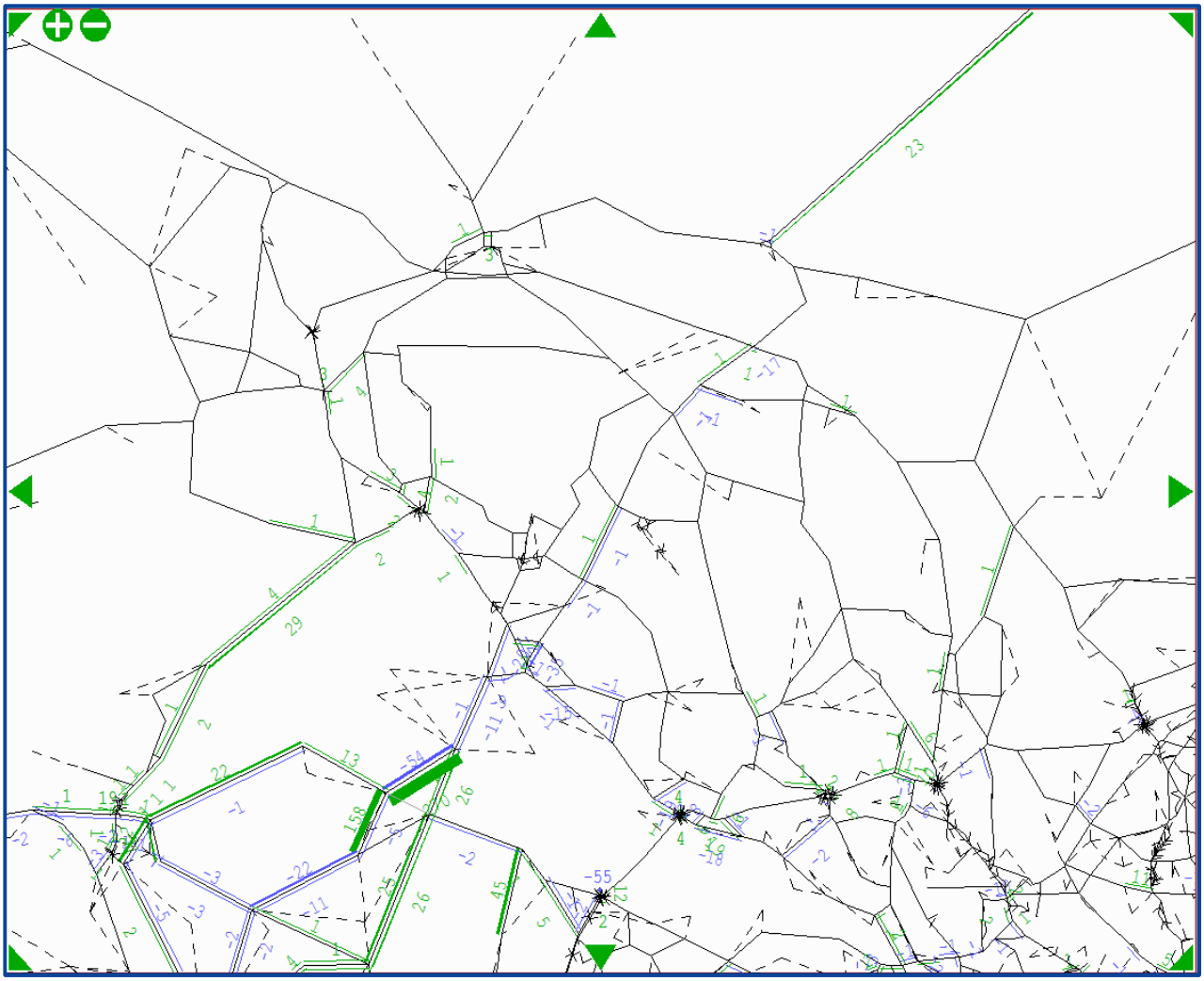


Figure 6 Travel Time Differences PM 17-18 (Actual, All vehicles, seconds)



There are some significant changes on the A658 southbound approach to Greengates and Apperley Road. Travel times have also increased but less significantly on the A658 and A6038 corridors. Other differences are generally considered negligible.

2.1 Stage 2 – LBIA Demand

Table 1 Comparison of study data and Stage 1 model demand at LBIA

Time /Direction	Trips (vehicles)					
	Personal			Business / Other		
	Benchmark	Model	Difference	Benchmark	Model	Difference
AM Peak Arrivals	190	191	1 (1%)	47	47	0 (0%)
AM Peak Departures	129	130	1 (1%)	32	32	0 (1%)
PM Peak Arrivals	150	150	0 (0%)	38	38	0 (0%)
PM Peak Departures	281	282	1 (0%)	70	73	3 (4%)
IP Peak Arrivals	203	204	1 (0%)	51	52	1 (1%)
IP Peak Departures	203	203	0 (0%)	51	52	1 (1%)

Table 1 demonstrates that the changes been carried satisfactorily and that the demand now better reflects the benchmark.

2.1 Stage 2 – GEH Statistics

Figure 7 GEH Statistic AM 8-9 (All vehicles)

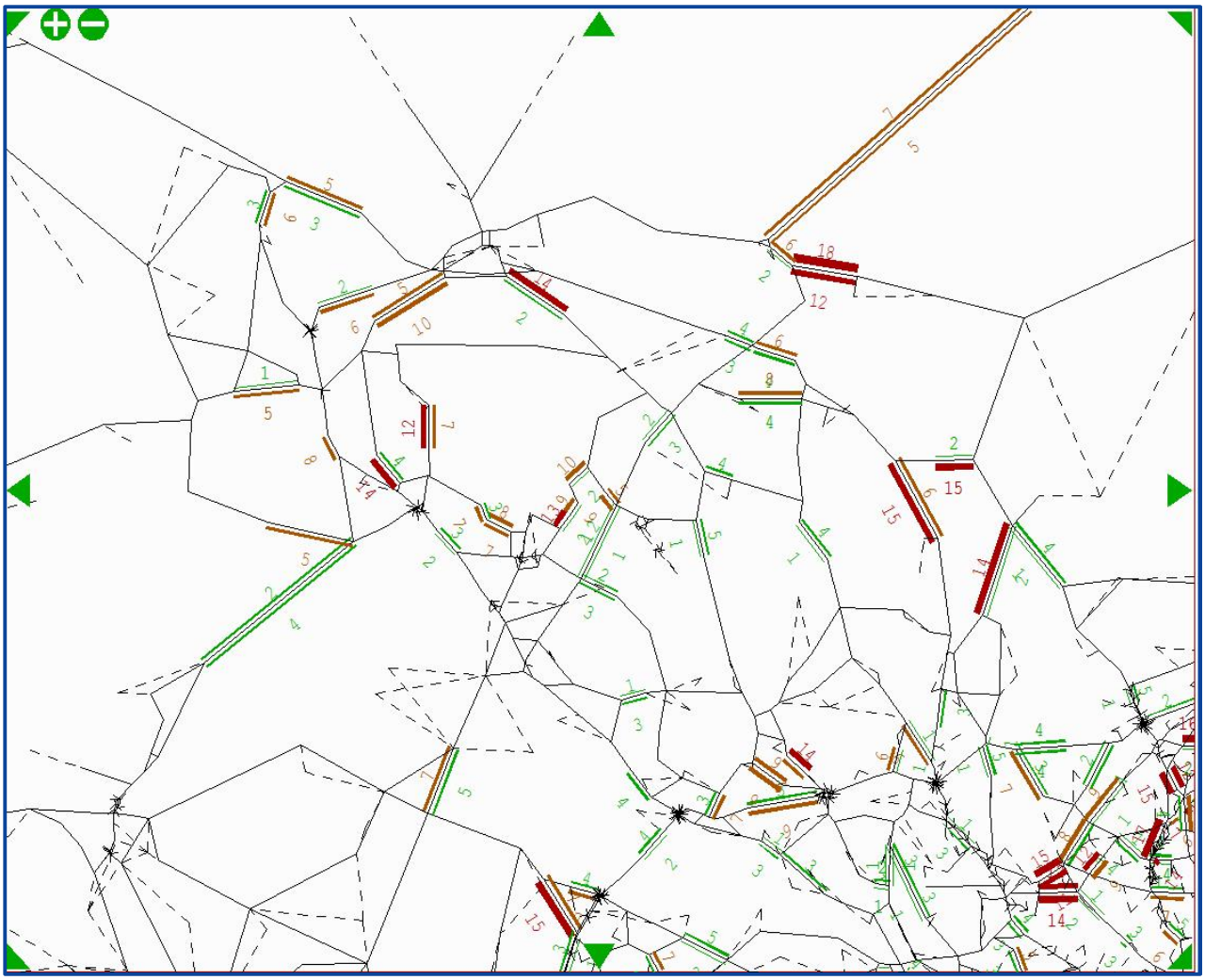


Figure 8 GEH Statistic IP (Car)

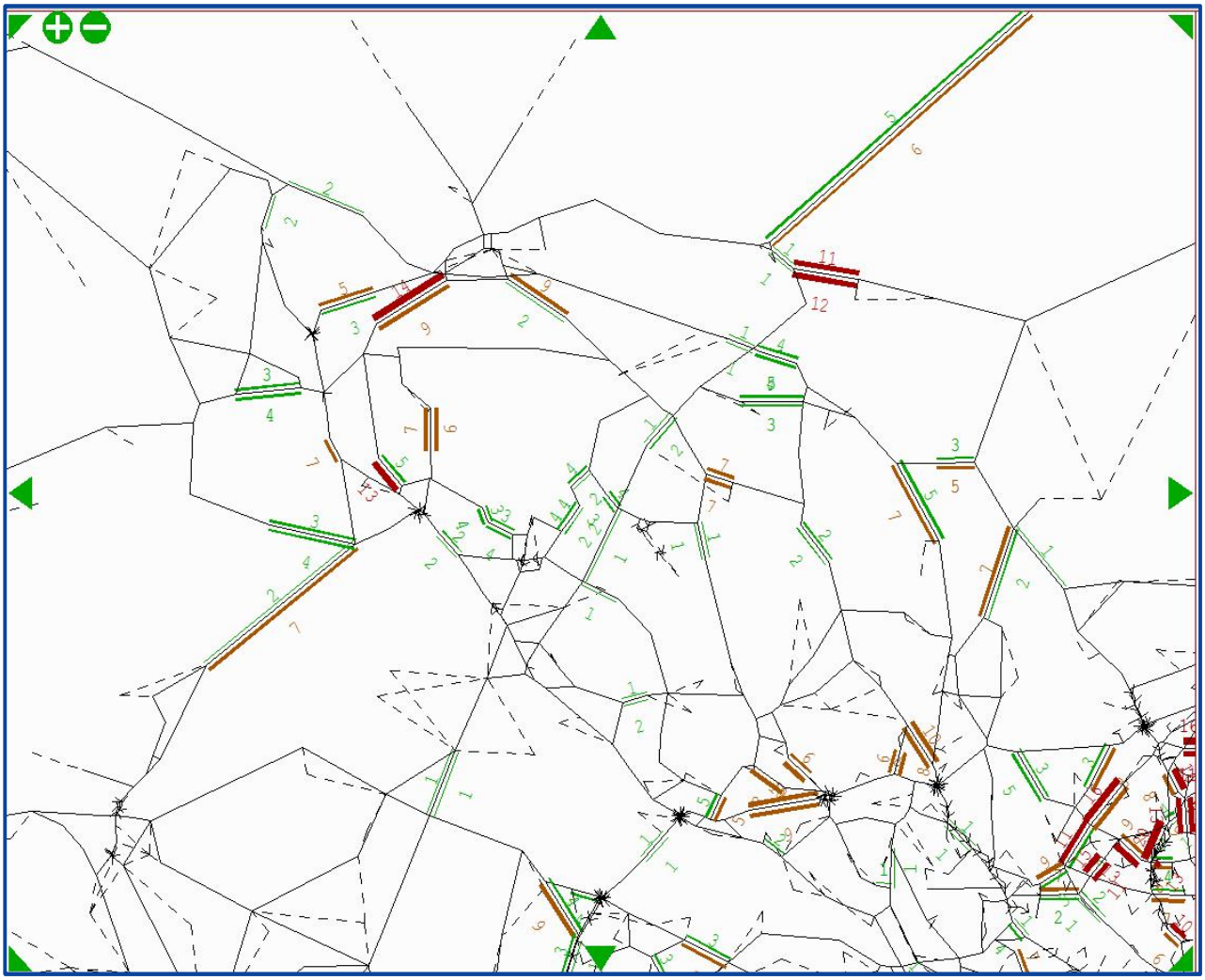
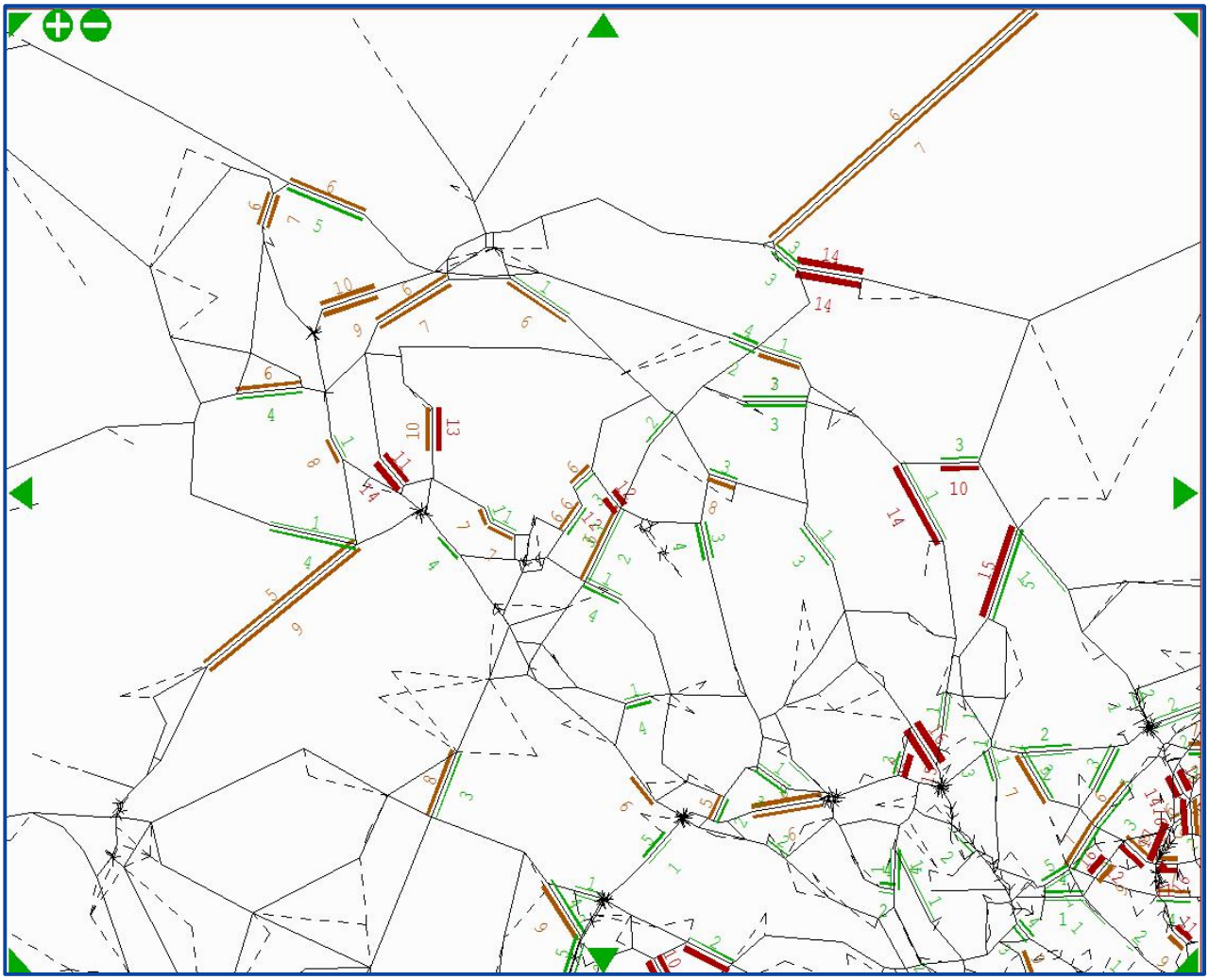


Figure 9 GEH Statistic PM 17-18 (All vehicles)



Any differences between these and the original model GEH results are generally considered negligible.

Table 2 Summary of GEH results within the vicinity of the airport

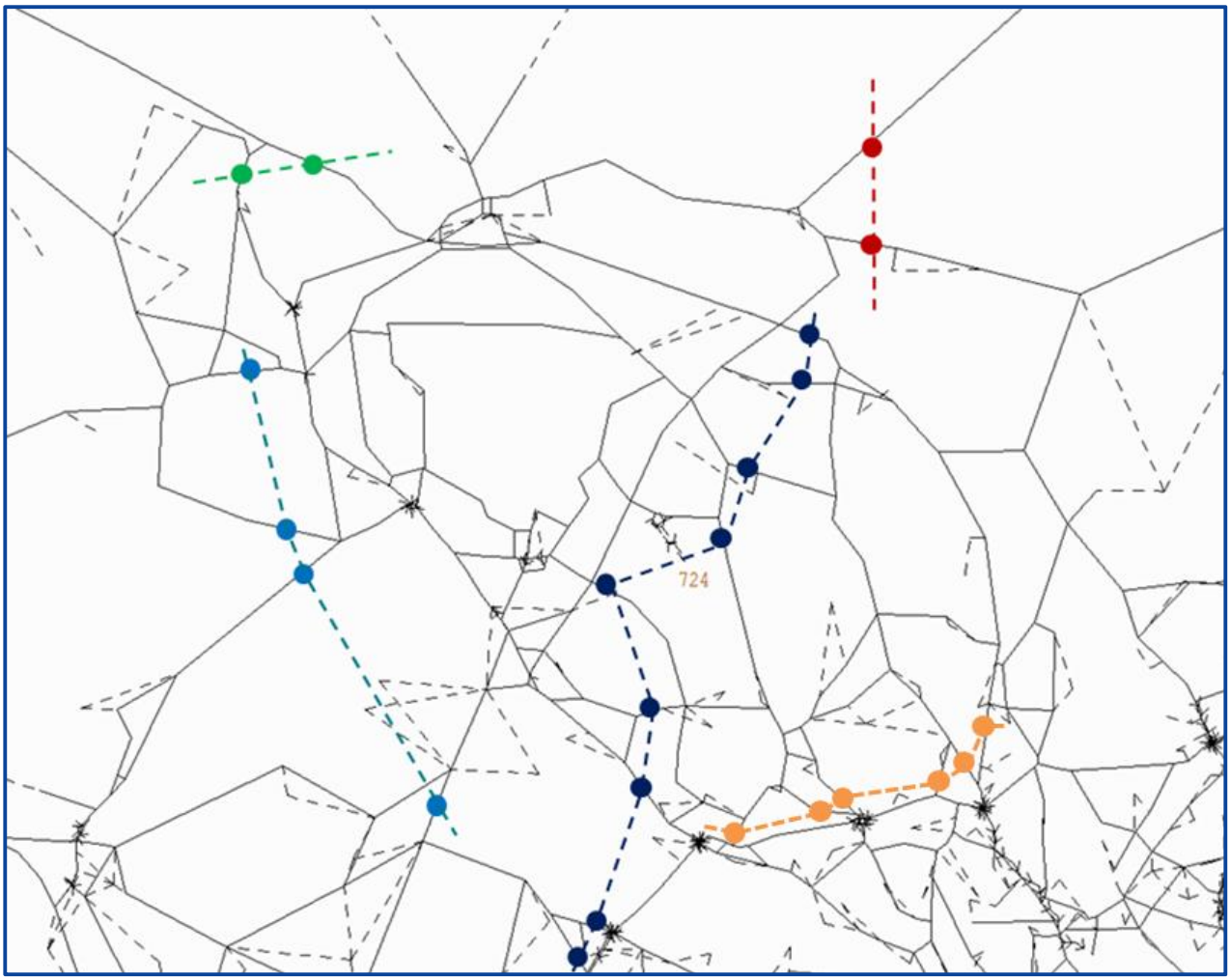
GEH band	AM sites	IP sites	PM sites
<5	95 (63%)	107 (71%)	95 (63%)
<10	35 (24%)	31 (21%)	34 (23%)
>=10	20 (13%)	12 (8%)	21 (14%)
Total	150 (100%)	150 (100%)	150 (100%)

The banded GEH results in Table 2 are broadly similar to the original model results.

Tabulated Results are shown in Appendix A.

2.1 Stage 2 – Screen line Results

Figure 10 Screen line locations



- Leeds 1 screenline
- Leeds 2 screenline
- Bradford screenline
- Harrogate screenline
- Ilkley screenline

Table 3 shows the screenline results for each time period.

Table 3 AM Screen line Results (All vehicles)

Screen line	Towards the LBIA					Away from the LBIA				
	Observed	Modelled	Dif	% Dif	GEH	Observed	Modelled	Dif	% Dif	GEH
Leeds 1	3329	3314	-15	0%	0.3	4175	3997	-178	-4%	2.8
Leeds 2	2333	2250	-83	-4%	1.7	3295	3296	1	0%	0.0
Harrogate	1165	1142	-23	-2%	0.7	1496	1458	-38	-3%	1.0
Bradford	2178	2341	163	7%	3.4	2312	2598	286	12%	5.8
Ilkley	963	977	14	1%	0.5	955	967	12	1%	0.4

Table 4 IP Screen line Results (Cars)

Screen line	Towards the LBIA					Away from the LBIA				
	Observed	Modelled	Dif	% Dif	GEH	Observed	Modelled	Dif	% Dif	GEH
Leeds 1	2271	2319	48	2%	1.0	2200	2277	77	3%	1.6
Leeds 2	1822	1860	38	2%	0.9	1760	1811	51	3%	1.2
Harrogate	646	651	5	1%	0.2	644	637	-7	-1%	0.3
Bradford	1252	1312	60	5%	1.7	1264	1410	146	12%	4.0
Ilkley	592	594	2	0%	0.1	616	618	2	0%	0.1

Table 5 Screen lines Results PM (All vehicles)

Screen line	Towards the LBIA					Away from the LBIA				
	Observed	Modelled	Dif	% Dif	GEH	Observed	Modelled	Dif	% Dif	GEH
Leeds 1	4404	4248	-156	-4%	2.4	3713	3767	54	1%	0.9
Leeds 2	3393	3486	93	3%	1.6	2421	2593	172	7%	3.4
Harrogate	1465	1421	-44	-3%	1.2	1231	1218	-13	-1%	0.4
Bradford	2125	2337	212	10%	4.5	2472	2657	185	7%	3.6
Ilkley	1005	1015	10	1%	0.3	1013	1010	-3	0%	0.1

These screenline results show that the performance on the Bradford screenline has been compromised compared with the original model. This is where the model has been changed as part of updating Greengates junction and the travel time improvements. Otherwise the performance is of a broadly similar standard.

2.1 Stage 2 – Traffic Master

Figure 11 TrafficMaster Routes

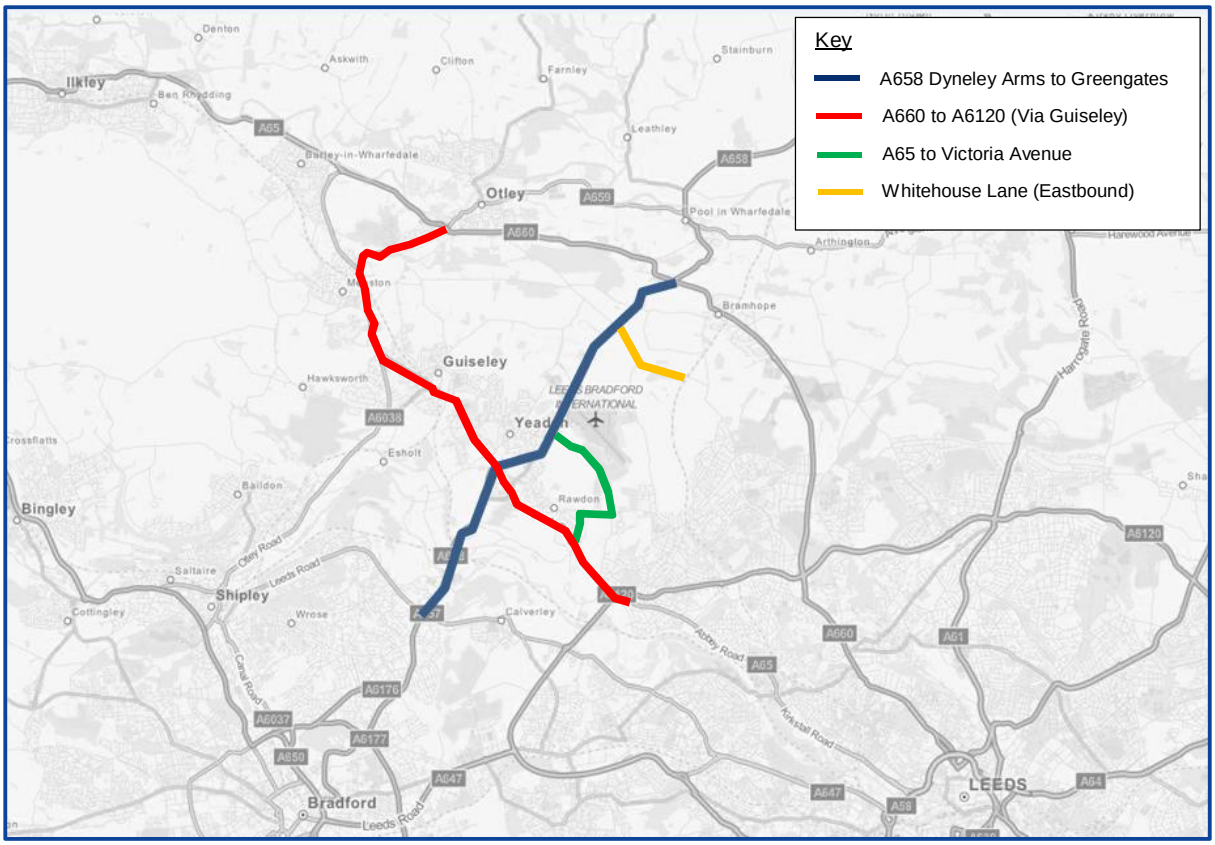


Table 6 AM Peak Traffic Master Journey Times compared to Modelled Journey Times

Journey Path	Am Peak Period				
	Sample	Traffic Master	Modelled	Dif	% Dif
A658, Dyneley Arms to Greengates	52	984	1043	59	6%
A658, Greengates to Dyneley Arms	55	763	907	144	19%
A65, A660 to A6120 (Via Guiseley)	54	1070	1206	136	13%
A65, A6120 to A660 (Via Guiseley)	48	1050	1095	45	4%
A65 to Victoria Avenue	14	262	253	-9	-4%
Victoria Avenue to A65	16	239	254	15	6%
Whitehouse Lane (Eastbound)	59	112	118	6	5%

Table 7 Inter Peak Traffic Master Journey Times compared to Modelled Journey Times

Journey Path	Inter Peak Period				
	Sample	Traffic Master	Modelled	Dif	% Dif
A658, Dyneley Arms to Greengates	320	926	1023	98	11%
A658, Greengates to Dyneley Arms	342	798	890	92	12%
A65, A660 to A6120 (Via Guiseley)	274	1103	1178	75	7%
A65, A6120 to A660 (Via Guiseley)	281	1103	1104	1	0%
A65 to Victoria Avenue	93	276	250	-27	-10%
Victoria Avenue to A65	77	264	251	-13	-5%
Whitehouse Lane (Eastbound)	114	125	118	-7	-6%

Table 8 PM Peak Traffic Master Journey Times compared to Modelled Journey Times

Journey Path	Pm Peak Period				
	Sample	Traffic Master	Modelled	Dif	% Dif
A658, Dyneley Arms to Greengates	45	936	1035	99	11%
A658, Greengates to Dyneley Arms	54	816	937	121	15%
A65, A660 to A6120 (Via Guiseley)	43	1001	1238	237	24%
A65, A6120 to A660 (Via Guiseley)	38	1042	1241	199	19%
A65 to Victoria Avenue	20	274	251	-23	-8%
Victoria Avenue to A65	12	235	254	19	8%
Whitehouse Lane (Eastbound)	18	105	118	13	12%

The travel times are broadly unchanged from the original (existing model) base.

3.6 Conclusions

The conclusions from the study base model review in the vicinity of the airport are as follows:

- The Greengates junction has been changed to better represent this part of the network. The impact has involved some significant reassignment of demand away from Apperley Road and on to the A658;
- The airport demand now better reflects the demand benchmark calculated; and
- The correction at Rawdon crossroads (lane movement allocation for Harrogate Road northern arm) has had no noticeable impact.

In terms of model fitness for purpose, the analysis has shown that there are some areas where the model representation is unsatisfactory. However on the whole, and considering the different traffic flow indicators presented (flows and travel times) and their performance against TAG thersholds for model standards, the model is considered fit for purpose in terms of its representation in the vicinity of the airport and as an appraisal tool for this particular study.

Appendix A

Tabulated GEH results

Site No.	AM				IP				PM			
	Obs	Mod	% Dif	GEH	Obs	Mod	% Dif	GEH	Obs	Mod	% Dif	GEH
1	805	651	-19%	5.7	383	402	5%	1.0	784	699	-11%	3.1
2	788	901	14%	3.9	401	415	3%	0.7	634	751	18%	4.4
3	415	175	-58%	14.0	165	70	-57%	8.7	275	291	6%	0.9
4	273	460	69%	9.8	127	243	92%	8.6	324	453	40%	6.5
5	295	410	39%	6.1	250	209	-16%	2.7	690	468	-32%	9.2
6	887	936	6%	1.6	392	415	6%	1.1	942	863	-8%	2.6
7	517	580	12%	2.7	349	373	7%	1.2	731	799	9%	2.5
8	304	341	12%	2.1	186	164	-12%	1.7	460	344	-25%	5.8
9	306	221	-28%	5.2	116	7	-94%	14.0	275	188	-32%	5.7
10	658	615	-7%	1.7	254	340	34%	5.0	360	571	59%	9.8
11	1109	1020	-8%	2.7	569	792	39%	8.5	932	1210	30%	8.5
12	776	814	5%	1.3	469	419	-11%	2.4	629	577	-8%	2.1
13	221	294	33%	4.5	137	180	32%	3.4	278	313	13%	2.1
14	754	1016	35%	8.8	524	760	45%	9.3	885	1067	21%	5.8
15	556	621	12%	2.7	450	447	-1%	0.1	879	890	1%	0.4
16	236	263	11%	1.7	129	218	69%	6.8	207	445	115%	13.2
17	886	967	9%	2.7	529	525	-1%	0.2	747	742	-1%	0.2
18	358	318	-11%	2.2	157	143	-9%	1.1	225	163	-27%	4.4
19	444	471	6%	1.3	299	316	6%	1.0	514	613	19%	4.2
20	924	831	-10%	3.1	295	294	0%	0.1	401	425	6%	1.2
21	836	804	-4%	1.1	619	639	3%	0.8	881	885	0%	0.1
22	473	379	-20%	4.6	160	165	3%	0.4	201	180	-10%	1.5
23	665	645	-3%	0.8	327	186	-43%	8.8	411	346	-16%	3.3
24	680	568	-17%	4.5	226	362	60%	7.9	310	400	29%	4.8
25	4	0	-100%	2.8	4	0	-100%	2.8	4	0	-100%	2.8
26	684	687	0%	0.1	513	518	1%	0.2	979	975	0%	0.1
27	167	157	-6%	0.8	157	157	0%	0.0	264	290	10%	1.5
28	458	471	3%	0.6	300	300	0%	0.0	511	482	-6%	1.3
29	232	241	4%	0.6	236	237	1%	0.1	680	689	1%	0.3
30	829	909	10%	2.7	643	670	4%	1.1	1115	1037	-7%	2.4
31	193	175	-9%	1.3	190	196	3%	0.4	530	594	12%	2.7
32	406	248	-39%	8.7	376	125	-67%	15.8	471	352	-25%	5.9
33	453	410	-10%	2.1	254	309	22%	3.3	774	855	10%	2.8
34	26	0	-100%	7.2	12	0	-100%	4.9	28	0	-100%	7.5
35	928	934	1%	0.2	562	564	0%	0.1	871	845	-3%	0.9
36	233	295	27%	3.8	126	186	48%	4.8	147	310	111%	10.8
37	81	31	-61%	6.6	69	13	-82%	8.8	130	21	-84%	12.5
38	247	275	11%	1.8	161	185	15%	1.8	491	555	13%	2.8
39	227	311	37%	5.1	181	133	-26%	3.8	516	271	-48%	12.4

Site No.	AM				IP				PM			
	Obs	Mod	% Dif	GEH	Obs	Mod	% Dif	GEH	Obs	Mod	% Dif	GEH
40	905	806	-11%	3.4	545	495	-9%	2.2	768	761	-1%	0.2
41	817	1060	30%	7.9	546	718	32%	6.9	921	1179	28%	8.0
42	184	38	-79%	13.8	130	16	-88%	13.4	262	74	-72%	14.5
43	90	7	-92%	11.9	59	15	-74%	7.2	98	23	-76%	9.6
44	324	520	61%	9.6	173	224	29%	3.6	252	350	39%	5.7
45	410	253	-38%	8.6	145	189	30%	3.4	225	454	102%	12.4
46	810	860	6%	1.7	535	505	-6%	1.3	977	908	-7%	2.3
47	731	844	16%	4.0	399	316	-21%	4.4	429	344	-20%	4.3
48	137	29	-79%	11.9	180	30	-84%	14.7	332	98	-70%	15.9
49	230	211	-8%	1.3	156	83	-47%	6.6	252	140	-44%	8.0
50	1154	1675	45%	13.8	502	850	69%	13.4	474	889	88%	15.9
51	409	258	-37%	8.3	409	218	-47%	10.8	593	779	31%	7.1
52	318	173	-45%	9.2	174	58	-67%	10.7	191	83	-57%	9.3
53	149	99	-33%	4.5	153	27	-82%	13.3	447	228	-49%	11.9
54	430	870	102%	17.3	521	1094	110%	20.2	996	1621	63%	17.3
55	497	211	-57%	15.2	259	132	-49%	9.1	445	551	24%	4.8
56	375	635	69%	11.6	297	431	45%	7.0	493	411	-17%	3.9
57	575	856	49%	10.5	286	344	20%	3.2	536	553	3%	0.7
58	531	262	-51%	13.5	320	282	-12%	2.2	561	593	6%	1.3
59	489	587	20%	4.2	249	259	4%	0.6	519	508	-2%	0.5
60	314	282	-10%	1.9	85	109	28%	2.4	151	213	41%	4.6
61	489	467	-5%	1.0	249	247	-1%	0.1	549	579	6%	1.3
62	88	285	223%	14.4	49	111	127%	6.9	106	325	207%	14.9
63	1733	1566	-10%	4.1	902	903	0%	0.0	1436	1344	-6%	2.5
64	247	275	11%	1.8	158	185	17%	2.0	492	555	13%	2.8
65	533	388	-27%	6.7	376	295	-21%	4.4	748	566	-24%	7.1
66	1478	1318	-11%	4.3	908	907	0%	0.0	1676	1615	-4%	1.5
67	259	520	101%	13.2	165	224	36%	4.2	252	350	39%	5.7
68	398	338	-15%	3.2	291	236	-19%	3.4	400	426	6%	1.3
69	939	1080	15%	4.4	543	569	5%	1.1	632	732	16%	3.8
70	1077	1038	-4%	1.2	509	463	-9%	2.1	460	459	0%	0.0
71	589	675	15%	3.4	474	576	22%	4.5	658	748	14%	3.4
72	520	483	-7%	1.7	589	570	-3%	0.8	1178	1199	2%	0.6
73	924	832	-10%	3.1	295	294	0%	0.1	401	425	6%	1.2
74	232	241	4%	0.6	236	237	1%	0.1	680	689	1%	0.3
75	1230	1136	-8%	2.7	497	499	0%	0.1	451	492	9%	1.9
76	434	501	15%	3.1	587	593	1%	0.2	1231	1270	3%	1.1
77	257	552	115%	14.7	199	329	65%	8.0	283	570	101%	13.9
78	231	148	-36%	6.0	95	83	-13%	1.3	146	128	-12%	1.5
79	314	299	-5%	0.8	210	128	-39%	6.3	357	172	-52%	11.4
80	329	596	81%	12.4	179	462	158%	15.8	265	578	118%	15.2
81	147	145	-1%	0.1	99	144	45%	4.0	232	325	40%	5.6

Site No.	AM				IP				PM			
	Obs	Mod	% Dif	GEH	Obs	Mod	% Dif	GEH	Obs	Mod	% Dif	GEH
82	230	291	27%	3.8	179	136	-24%	3.4	354	212	-40%	8.4
83	1767	1588	-10%	4.4	1071	1094	2%	0.7	1733	1531	-12%	5.0
84	1181	1187	1%	0.2	558	553	-1%	0.2	895	901	1%	0.2
85	1614	1539	-5%	1.9	1110	1129	2%	0.6	1530	1508	-1%	0.6
86	798	818	3%	0.7	656	650	-1%	0.2	1195	1198	0%	0.1
87	750	758	1%	0.3	610	621	2%	0.4	838	832	-1%	0.2
88	670	492	-27%	7.4	446	345	-23%	5.1	501	557	11%	2.4
89	455	803	76%	13.9	316	425	35%	5.7	555	556	0%	0.1
90	131	49	-63%	8.7	80	84	5%	0.4	122	133	9%	1.0
91	352	336	-5%	0.9	155	298	92%	9.5	204	504	147%	15.9
92	611	633	4%	0.9	260	147	-43%	7.9	351	118	-66%	15.2
93	1076	983	-9%	2.9	503	511	2%	0.4	688	724	5%	1.4
94	526	552	5%	1.1	210	210	0%	0.0	220	232	6%	0.8
95	906	1061	17%	4.9	495	491	-1%	0.2	585	625	7%	1.6
96	783	663	-15%	4.5	656	665	1%	0.4	1158	948	-18%	6.5
97	577	505	-12%	3.1	402	313	-22%	4.7	632	511	-19%	5.0
98	285	391	37%	5.7	288	480	67%	9.8	565	582	3%	0.7
99	288	156	-46%	8.8	183	88	-52%	8.1	342	284	-17%	3.3
100	291	403	38%	6.0	181	298	64%	7.5	394	755	92%	15.1
101	299	197	-34%	6.5	269	176	-35%	6.3	591	510	-14%	3.5
102	593	598	1%	0.2	499	505	1%	0.3	869	844	-3%	0.9
103	266	265	0%	0.0	221	222	0%	0.1	499	519	4%	0.9
104	517	537	4%	0.9	532	531	0%	0.0	895	921	3%	0.9
105	764	669	-12%	3.5	404	413	2%	0.4	804	767	-5%	1.3
106	25	0	-100%	7.1	9	0	-100%	4.2	10	0	-100%	4.4
107	595	428	-28%	7.4	336	423	26%	4.5	519	481	-7%	1.7
108	112	338	201%	15.0	119	36	-70%	9.5	180	322	79%	9.0
109	843	848	1%	0.2	445	447	0%	0.1	634	637	0%	0.1
110	539	665	23%	5.1	353	382	8%	1.5	553	692	25%	5.6
111	424	312	-26%	5.8	239	212	-11%	1.8	452	324	-28%	6.5
112	340	358	5%	1.0	119	155	30%	3.1	257	361	40%	5.9
113	207	202	-3%	0.4	122	92	-25%	2.9	178	164	-8%	1.1
114	742	688	-7%	2.0	469	504	7%	1.6	748	613	-18%	5.2
115	889	1094	23%	6.5	542	561	4%	0.8	942	1199	27%	7.9
116	280	327	17%	2.7	181	157	-13%	1.8	415	503	21%	4.1
117	362	305	-16%	3.1	247	268	8%	1.3	540	451	-17%	4.0
118	165	157	-5%	0.7	86	99	15%	1.3	213	155	-27%	4.3
119	393	409	4%	0.8	197	232	18%	2.4	421	494	17%	3.4
120	654	326	-50%	14.8	460	329	-28%	6.6	908	523	-42%	14.4
121	429	464	8%	1.6	180	228	26%	3.3	315	372	18%	3.1
122	369	90	-76%	18.4	170	50	-71%	11.4	320	110	-65%	14.3
123	638	640	0%	0.1	450	452	0%	0.1	802	798	0%	0.1

Site No.	AM				IP				PM			
	Obs	Mod	% Dif	GEH	Obs	Mod	% Dif	GEH	Obs	Mod	% Dif	GEH
124	524	605	15%	3.4	368	365	-1%	0.2	550	666	21%	4.7
125	431	363	-16%	3.4	248	254	2%	0.4	463	344	-26%	6.0
126	260	352	35%	5.2	114	167	46%	4.4	359	432	20%	3.7
127	254	176	-31%	5.3	152	109	-28%	3.8	332	260	-22%	4.2
128	762	870	14%	3.8	463	628	36%	7.1	677	944	39%	9.4
129	1036	1200	16%	4.9	535	507	-5%	1.2	1104	1021	-8%	2.5
130	585	619	6%	1.4	225	245	9%	1.3	397	380	-4%	0.9
131	416	372	-11%	2.2	210	209	-1%	0.1	306	326	7%	1.1
132	277	206	-26%	4.6	89	101	14%	1.3	173	221	28%	3.4
133	479	574	20%	4.1	182	211	16%	2.1	366	388	6%	1.1
134	906	746	-18%	5.6	492	392	-20%	4.8	667	643	-4%	1.0
135	360	697	94%	14.6	193	274	42%	5.3	442	684	55%	10.2
136	324	135	-58%	12.4	177	51	-71%	11.8	472	208	-56%	14.3
137	144	250	74%	7.5	48	87	82%	4.8	108	142	31%	3.0
138	288	362	26%	4.1	114	199	74%	6.8	276	320	16%	2.6
139	744	710	-5%	1.3	490	505	3%	0.7	699	654	-6%	1.7
140	247	275	11%	1.8	158	185	17%	2.0	492	555	13%	2.8
141	504	338	-33%	8.1	291	236	-19%	3.4	400	426	6%	1.3
142	956	1062	11%	3.3	712	772	8%	2.2	1003	1004	0%	0.0
143	926	762	-18%	5.7	491	402	-18%	4.2	801	779	-3%	0.8
144	142	97	-32%	4.1	56	82	46%	3.1	124	163	31%	3.3
145	219	217	-1%	0.1	122	207	70%	6.7	313	476	52%	8.2
146	841	822	-2%	0.7	527	534	1%	0.3	971	788	-19%	6.2
147	331	520	57%	9.2	165	224	36%	4.2	252	350	39%	5.7
148	533	388	-27%	6.7	376	295	-21%	4.4	748	566	-24%	7.1
149	993	933	-6%	1.9	713	763	7%	1.8	993	1131	14%	4.2
150	671	783	17%	4.2	468	382	-18%	4.2	942	748	-21%	6.7

Modelling Technical Note 5b: Connectivity to LBIA Feasibility Study – Review of Base Models for the Study, Scheme Locations (Final)

Prepared by: Adam Truman Date: 9th Sep 2014

Checked by: Date:

Introduction

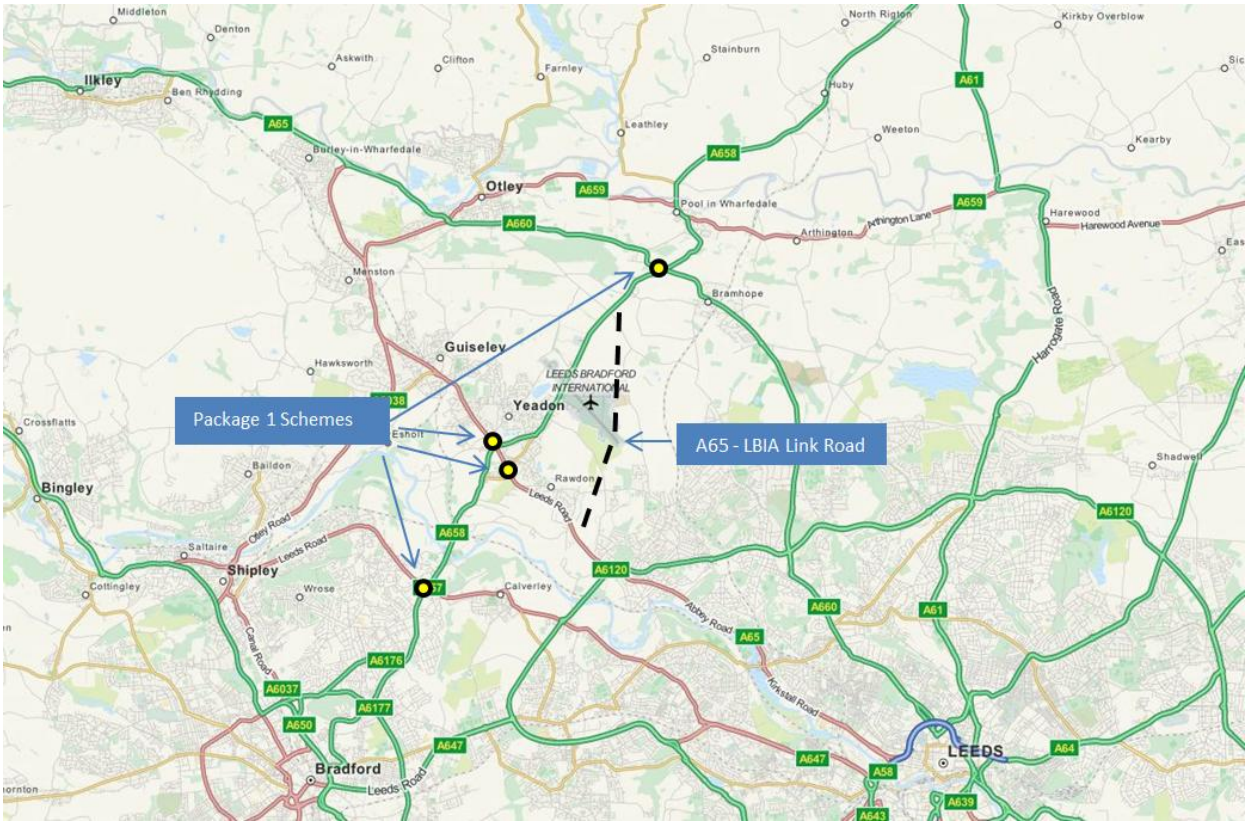
This note provides a review of the Base 2008 Saturn Highway model performance at the study scheme locations.

The agreed highway schemes that will be tested are as follows (all short / medium term):

- A65 to LBIA Link Road
- Package 1- Bradford / Harrogate Corridor Junction Improvements
  - A660 / A658 (Poole Bank Road)
  - New Rd / Harrogate Rd (A65 / B6152)
  - A65 / A658 Roundabout
  - New Line / Harrogate Rd (Greengates)

Their locations are shown in Figure 1 below.

Figure 1 Location of Highway Schemes



Data, imagery and map information provided by MapQuest, OpenStreetMap and contributors CC-BY-SA

Traffic Flows

Modelling Technical Note 5a (review of study base models in the vicinity of the airport), presented GEH statistics as a comparison of model versus observed flow. The studay scheme locations are covered by the area of the network reviewed. The network plots presented are re-produced in the figures below.

Figure 2 GEH Statistic AM 8-9 (All vehicles)

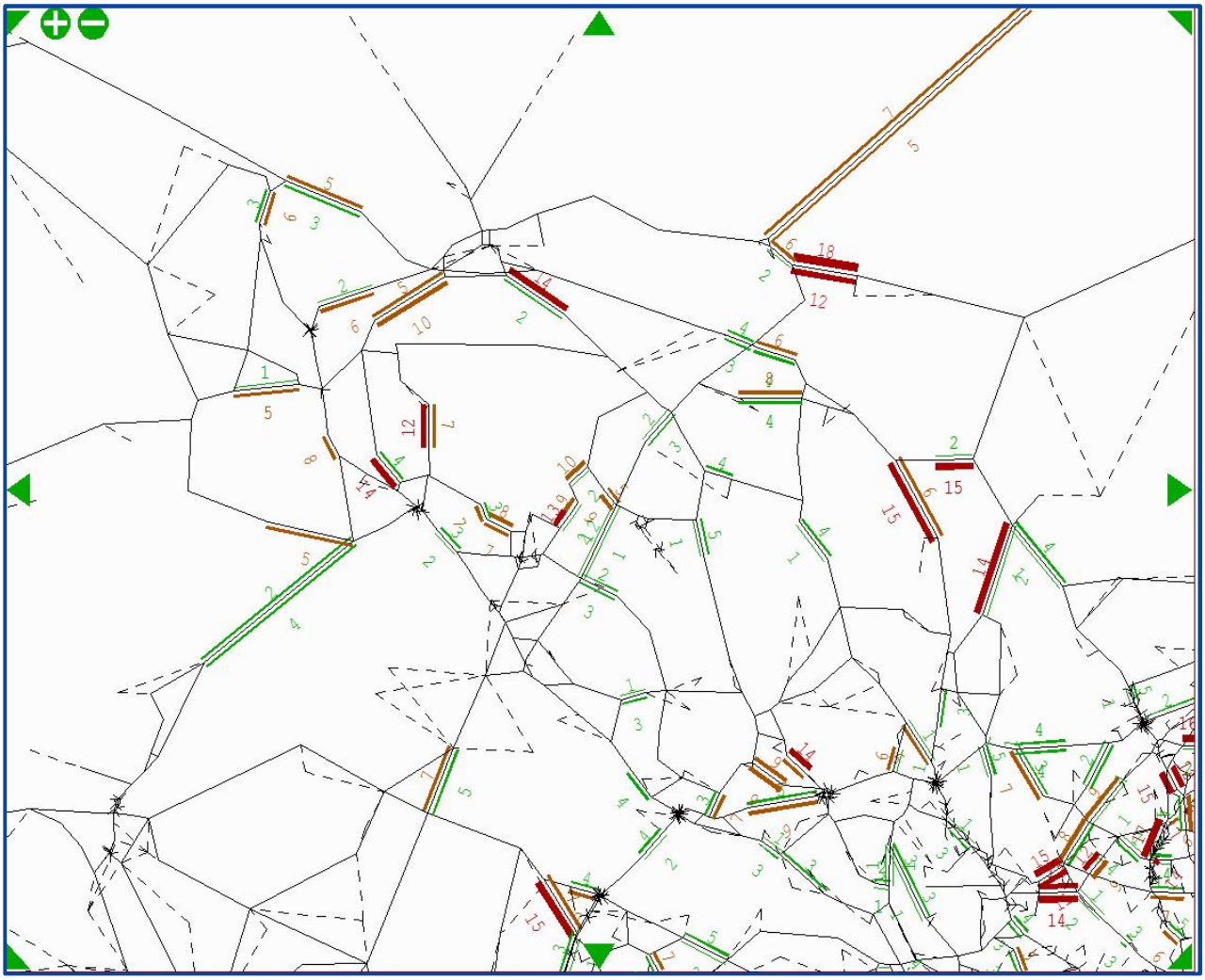


Figure 3 GEH Statistic IP (Car)

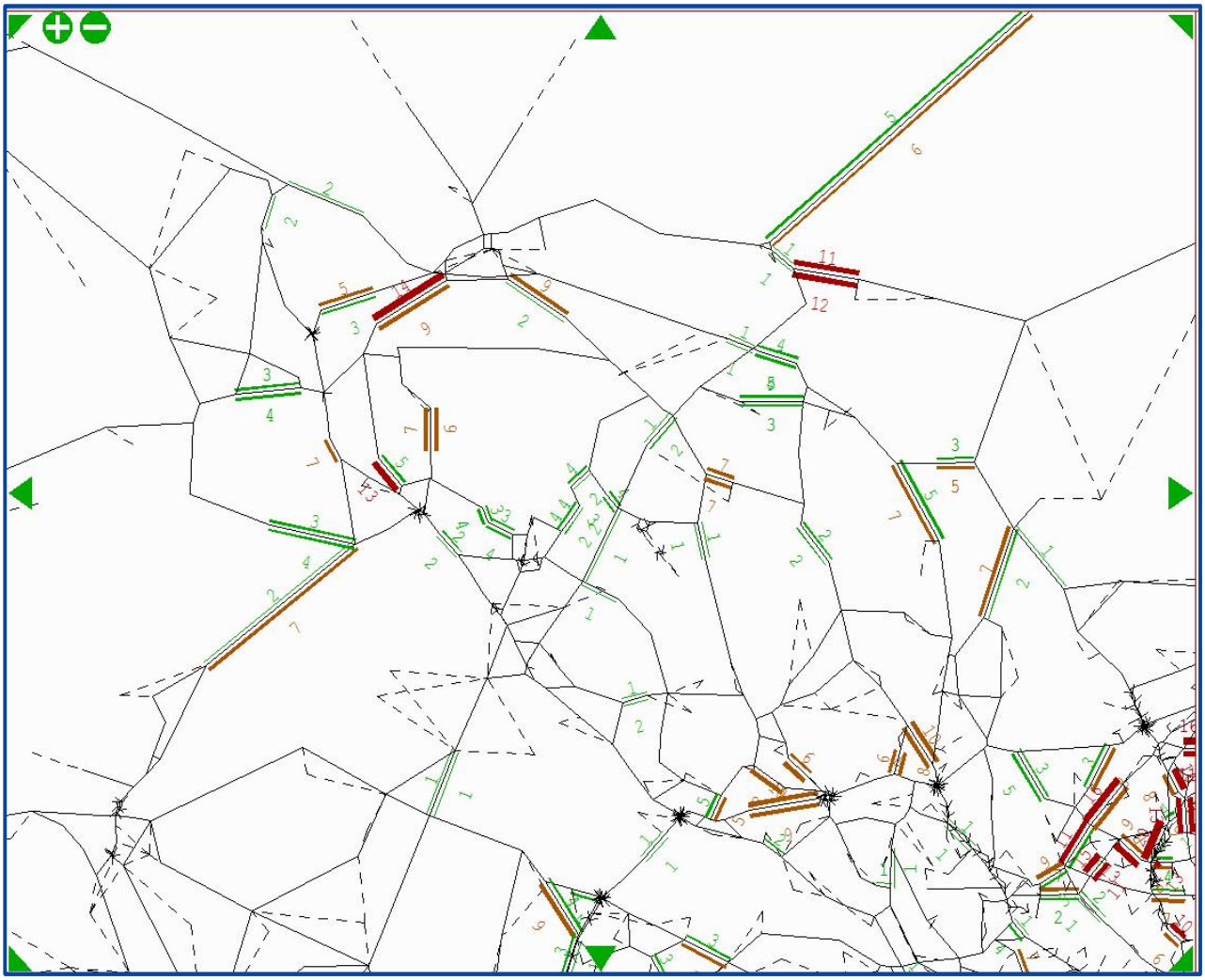
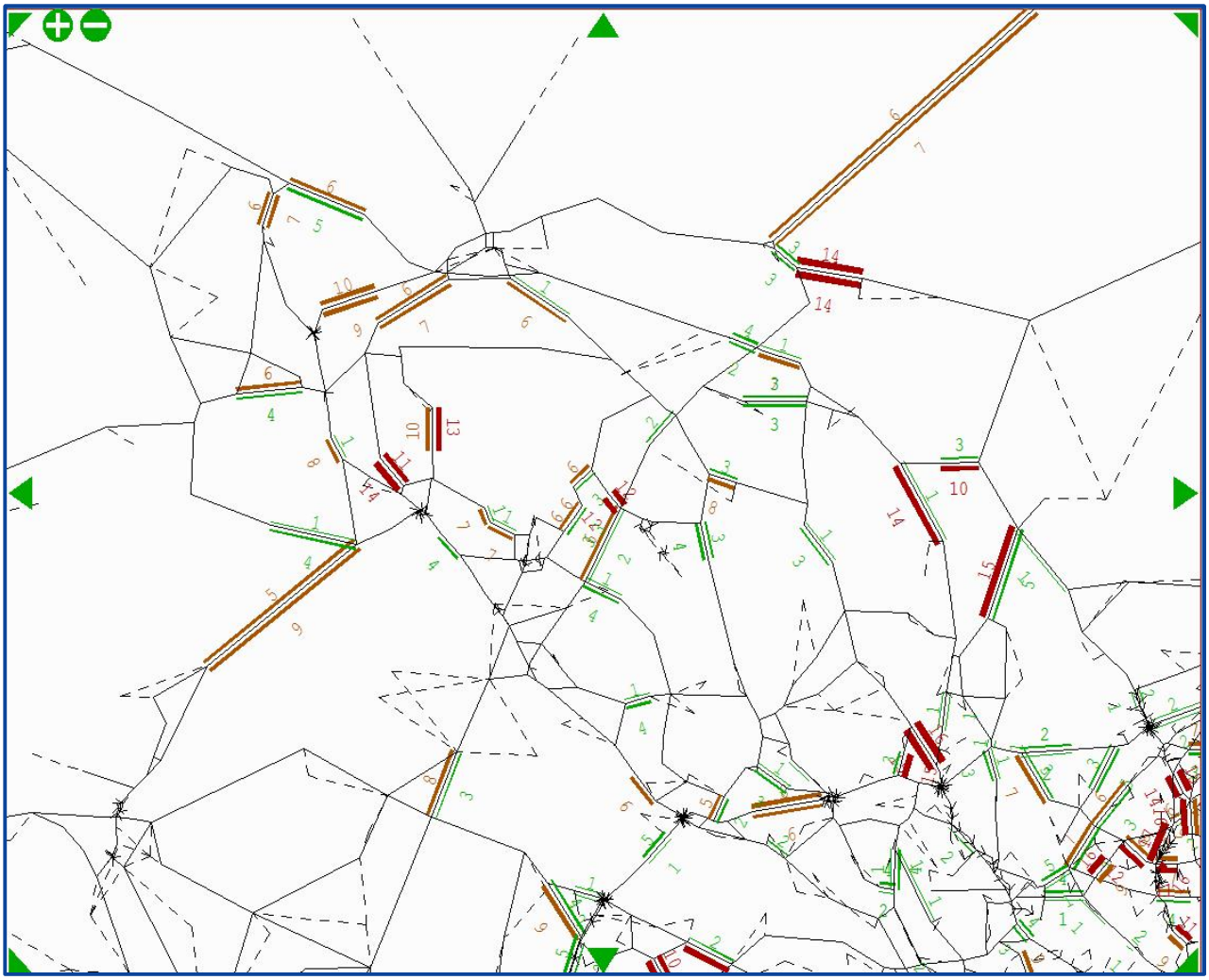


Figure 4 GEH Statistic PM 17-18 (All vehicles)



Comments on these results in the context of the scheme locations are provided in the conclusions section.

Travel Time comparisons

Modelling Technical Note 5a (review of study base models in the vicinity of the airport) presented a comparison of the travel times based on Traffic Master data from routes which partially cover the scheme location areas. These are reproduced below together with some additional travel time routes to provide further evidence of the model travel time performance at the scheme locations.

Figure 5 TrafficMaster Routes

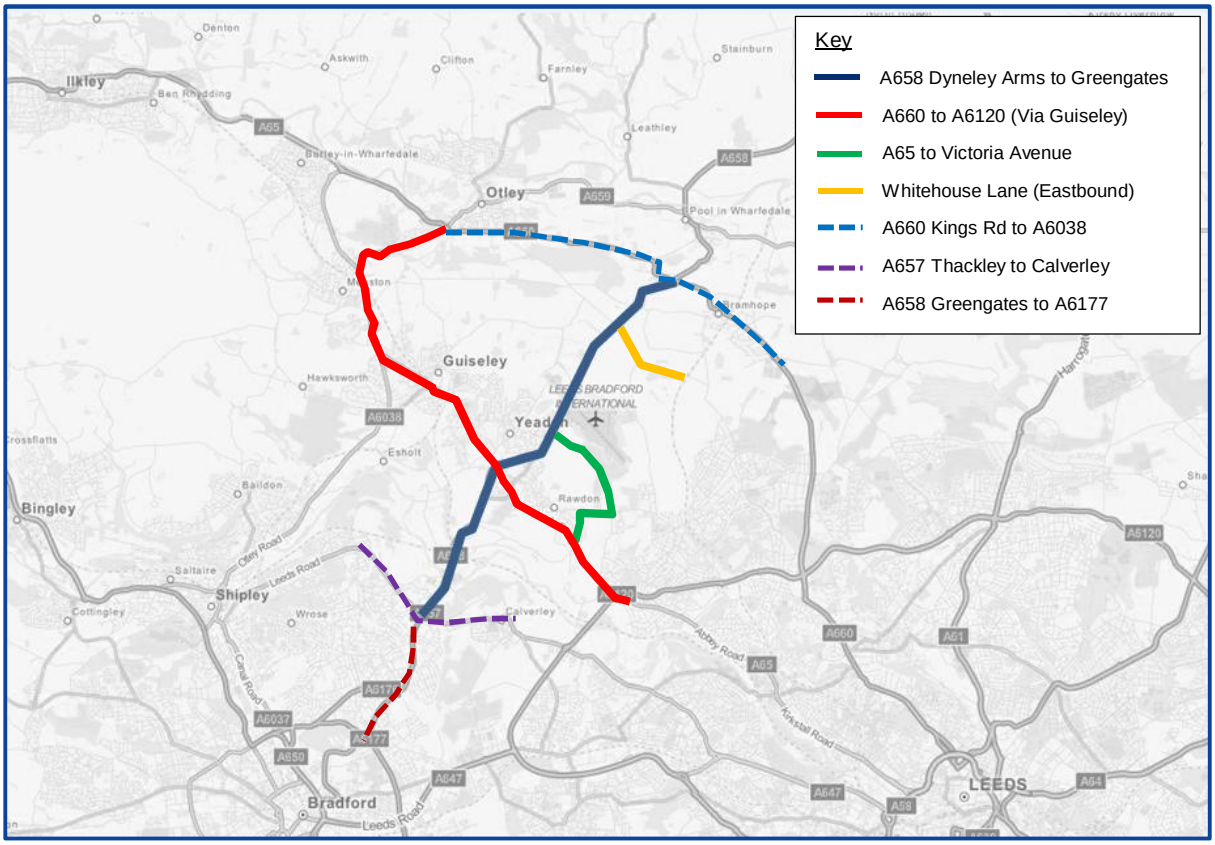


Table 1 AM Peak Traffic Master Journey Times compared to Modelled Journey Times

Journey Path	Am Peak Period				
	Sample	Traffic Master	Modelled	Dif	% Dif
Results from Tech Note 5a					
A658, Dyneley Arms to Greengates	52	984	1043	59	6%
A658, Greengates to Dyneley Arms	55	763	907	144	19%
A65, A660 to A6120 (Via Guiseley)	54	1070	1206	136	13%
A65, A6120 to A660 (Via Guiseley)	48	1050	1095	45	4%
A65 to Victoria Avenue	14	262	253	-9	-4%
Victoria Avenue to A65	16	239	254	15	6%
Whitehouse Lane (Eastbound)	59	112	118	6	5%
Additional Results					
A657 - Thackley to Calverley	56	463	494	31	6%
A657 - Calverley to Thackley	34	518	646	128	20%
A660 - A6038 to Kings Road	28	553	559	5	1%
A660 - Kings Road to A6038	51	612	536	-76	-14%
A658 - Greengates to A6177	40	330	346	16	5%
A658 - A6177 to Greengates	60	333	314	-19	-6%

Table 2 Inter Peak Traffic Master Journey Times compared to Modelled Journey Times

Journey Path	Inter Peak Period				
	Sample	Traffic Master	Modelled	Dif	% Dif
Results from Tech Note 5a					
A658, Dyneley Arms to Greengates	320	926	1023	98	11%
A658, Greengates to Dyneley Arms	342	798	890	92	12%
A65, A660 to A6120 (Via Guiseley)	274	1103	1178	75	7%
A65, A6120 to A660 (Via Guiseley)	281	1103	1104	1	0%
A65 to Victoria Avenue	93	276	250	-27	-10%
Victoria Avenue to A65	77	264	251	-13	-5%
Whitehouse Lane (Eastbound)	114	125	118	-7	-6%
Additional Results					
A657 - Thackley to Calverley	256	413	478	64	13%
A657 - Calverley to Thackley	255	423	480	57	12%
A660 - A6038 to Kings Road	299	560	535	-25	-5%
A660 - Kings Road to A6038	283	591	529	-62	-12%
A658 - Greengates to A6177	353	328	264	-63	-24%
A658 - A6177 to Greengates	301	323	284	-39	-14%

Table 3 PM Peak Traffic Master Journey Times compared to Modelled Journey Times

Journey Path	Pm Peak Period				
	Sample	Traffic Master	Modelled	Dif	% Dif
Results from Tech Note 5a					
A658, Dyneley Arms to Greengates	45	936	1035	99	11%
A658, Greengates to Dyneley Arms	54	816	937	121	15%
A65, A660 to A6120 (Via Guiseley)	43	1001	1238	237	24%
A65, A6120 to A660 (Via Guiseley)	38	1042	1241	199	19%
A65 to Victoria Avenue	20	274	251	-23	-8%
Victoria Avenue to A65	12	235	254	19	8%
Whitehouse Lane (Eastbound)	18	105	118	13	12%
Additional Results					
A657 - Thackley to Calverley	50	450	507	57	11%
A657 - Calverley to Thackley	47	799	496	-303	-61%
A660 - A6038 to Kings Road	52	564	607	43	7%
A660 - Kings Road to A6038	50	644	622	-22	-4%
A658 - Greengates to A6177	35	299	304	5	2%
A658 - A6177 to Greengates	48	511	332	-179	-54%

Comments on these results in the context of the scheme locations are provided in the conclusions section.

Conclusions

The conclusions on model performance at the scheme locations are as follows:

- A65 to LBIA Link Road

Traffic flows on the A65 (to the south) and the A658 (to the north) adjacent to where the scheme joins the existing network are reflected reasonably well.

Travel times are also reflected reasonably well on network supporting traffic that could be expected to use the scheme, the main exception being the A65 A660 to A6120 (via Guiseley) where the model is 24% slower than the observed data in the PM.

- Package 1- Bradford / Harrogate Corridor Junction Improvements
  - A660 / A658 (Poole Bank Road)
  - New Rd / Harrogate Rd (A65 / B6152)
  - A65 / A658 Roundabout
  - New Line / Harrogate Rd (Greengates)

At the A660 / A658 (Poole Bank Road) traffic flows are reflected reasonably well where there is observed data for comparison against the model on the eastern and western junction arms (A660 Leeds Rd), however the GEH values are marginally greater than 5 on the eastern arm travelling towards Leeds in the AM and away in

the PM. Further afield the GEH values are poor on the A659 (Arthington Road), and between 5 and 10 in most cases on the A658 north of Pool in Wharfedale across all time periods.

The New Rd / Harrogate Rd (A65 / B6152) and A65 / A658 Roundabout junctions are situated in close proximity to one another. There is no observed data on the network directly connecting the junctions. However there is data further afield on the A658 and A65. Here, the GEH values demonstrate a reasonably good fit with the observed data (as already commented on in the context of the A65 to LBIA link road).

At the New Line / Harrogate Rd (Greengates) junction there is data for the northern arm which generally reflect very well, but with an exception for the northbound traffic flow where the GEH is 7 and 8 for the AM and PM respectively.

For travel times, the model performance is based on the TrafficMaster observed routes that intersect the scheme junctions, as follows:

- Travel times on the A658 Dyneley Arms to Greengates section are in the main within 15% (except for the AM NB where the difference is 19%).
- The A658, Greengates to A6177 (in the direction of Bradford centre), is satisfactorily represented in the AM, but less so in the IP and PM. The PM northbound the model is 54% too fast.
- The A657, Thackley to Calverley, and which intersects the Greengates junction from west to east, is well satisfactorily represented in the IP. In the AM the EB times are 20% too slow. In the PM the WB times are 61% too fast.
- The A660, A6038 to Kings Road is satisfactorily represented across all time periods.

In summary, the majority of network in the vicinity of the schemes is reflected well. However the analysis has picked up on some instances where the model performance is poor, the most significant of these are some of the journey times intersecting the Greengates junction.

Nevertheless, the model is considered fit for purpose as a tool for appraising the airport link road for this study. It is also considered fit for purpose as a tool for appraising the the pacakage 1 schemes for this study, albeit with some uncertainty at the Greengates junction. Howver bearing in mind the stage of appraisal, time scales and scope of work and that further adjustments to improve this would be dis-proportionate.

Modelling Technical Note 6a: Connectivity to LBIA Feasibility Study – Forecasting Review (Final)

Prepared by: Adam Truman Date: 9th Sep 2014

Checked by: Date:

1 Introduction

This is Modelling Technical Note 6a. Modelling Technical Note 6 has been sub divided into the following notes:

- Modelling Technical Note 6a provides a review of the Leeds Transport Model forecasting assumptions and outturn growth; and
- Modelling Technical Note 6b describes a suggested approach for developing forecasts for the study.

2 LTM Global Growth

The Leeds Transport Model Forecasting Methodology and Core Scenario Results (2012) document is available on-line. It sets out the assumptions that were made to produce the following two forecast years:

- 2016; and
- 2031.

The future year demand matrices were created using the following 2 basic datasets:

- Land use; and
- Control data.

The land use data was collected from local authorities and used to provide a spatial distribution of the growth across Leeds and surrounding authorities. The information was presented as a series of developments in an uncertainty log with probabilities (levels of uncertainty) and anticipated build completion year defined.

The control data was based on NTEM forecasts, version 6.2.

The demand forecasts are driven by the demand model with the highway and public transport supply models providing cost feedback.

Table 1 and Table 2 below show the demand and growth across the entire model area for highway and public transport, based on reference case demand outputs (this is the unconstrained projection based on socio-demographic and car ownership changes). The results are taken from the Leeds NGT Leeds Transport Model – Forecasting and NGT Central Case Report (2014), which presents the results of the more recent forecast for the NGT business case (and which is the model version being used for the study).

Table 1 – Trips and Growth by Time Period – Highway

Period	Person Trips			Change in Base Year	
	2008 Base	2016 Core	2031 Core	2016 Core	2031 Core
AM	159,813	173,254	206,031	8%	29%
IP	373,554	394,000	477,541	5%	28%
PM	204,484	210,561	255,008	3%	25%

Table 2 – Trips and Growth by Time Period – Public Transport

Period	Person Trips			Change in Base Year	
	2008 Base	2016 Core	2031 Core	2016 Core	2031 Core
AM	70,878	77,424	86,153	9%	22%
IP	131,114	141,217	168,064	8%	28%
PM	68,566	74,096	84,643	8%	23%

For comparison, the weekday average growth for the Leeds area has been extracted from Tempro (NTEM v6.2).

Table 3 – Tempro Growth (NTEM v6.2)

Year	Car driver	Rail Underground + Bus Coach
2008	-	-
2016	10%	4%
2031	34%	20%

It appears that the model growth compared with Tempro for the Leeds area is marginally under represented for highway, and slightly over-represented for public transport

3 Growth at the LBIA

In the model growth at the airport is not treated separately, rather growth at the airport is based on NTEM.

Table 4 shows the 2-way trip demand extracted from the Saturn model Base and 2016 and 2031 forecasts, with growth from the base shown in brackets.

Table 4 – Highway Model Two Way Trip Demand at the Airport

Period	Two way demand (pcu)		
	Base	2016	2031
AM	310	315 (+2%)	353 (+14%)
IP	276	285 (+3%)	336 (+22%)
PM	229	232 (+1%)	263 (+15%)

For comparison, Table 5 below show the terminal passenger forecasts (constrained) from the UK Aviation Forecasts 2013, with growth from 2011 shown in brackets. This indicates that growth at the airport in the LTM is significantly under represented. However is should be noted that the model forecast are demand reference case.

Table 5 – Terminal passenger forecasts, central demand case (constrained)

Airport	Passenger Demand (mmpa)		
	2011	2020	2030
Leeds/Bradford	2.9	4.4 (+52%)	6.4 (+121%)

3 Conclusions

The conclusions are as follows:

- Highway and public transport growth compared against Tempro (NTME v6.2) for the Leeds area are only marginally different, albeit that the model forecasts are demand reference case; and
- Growth at the airport is significantly under-represented.

Modelling Technical Note 6b: Connectivity to LBIA Feasibility Study – Forecasting Approach (Final)

Prepared by: Adam Truman Date: 9th Sep 2014

Checked by: Alec Curley reviewed v1 Date:

1 Introduction

This is Modelling Technical Note 6b. Modelling Technical Note 6 has been sub divided into the following notes:

- Modelling Technical Note 6a provides a review of the Leeds Transport Model forecasting assumptions and outturn growth; and
- Modelling Technical Note 6b describes a suggested approach for developing forecasts for the study.

For highway, two suggested forecasting approaches are described which have both been discussed with the DfT. Both involve generating a new set of highway forecasts. The second is more simplistic and involves using the existing LTM highway forecasts and interpolating for intermediate years based on the local NTEM growth profile. The second approach is considered as the most appropriate within the study timescales, and is the approach that has been used.

For public transport only one approach is described.

2 Uncertainty Log

Modelling Technical Note 7 describes the Uncertainty Log that has been prepared for the study. This has been formed from a selection of the larger sized developments from the LTM uncertainty log which have been mapped to illustrate locations, certainty classification and build completion year across Leeds, Bradford and Harrogate districts. The following maps were produced:

- 2016 – Existing LTM forecast year;
- 2021 – Intermediate year option;
- 2026 – Intermediate year option; and
- 2031 – Existing LTM forecast year

For schemes (which aren't included) the assumption has been made that the schemes coded in to the LTM forecast year networks, which are the same for both 2016 and 2031 existing model forecast years, will remain unchanged for the study.

These land use assumptions were updated in 2012 for the NGT scheme business case. The schemes were also updated recently as reported in the LTM – Forecasting and NGT Central Case report (2014).

3 Forecasting Approach

The approach is described under the following sub headings:

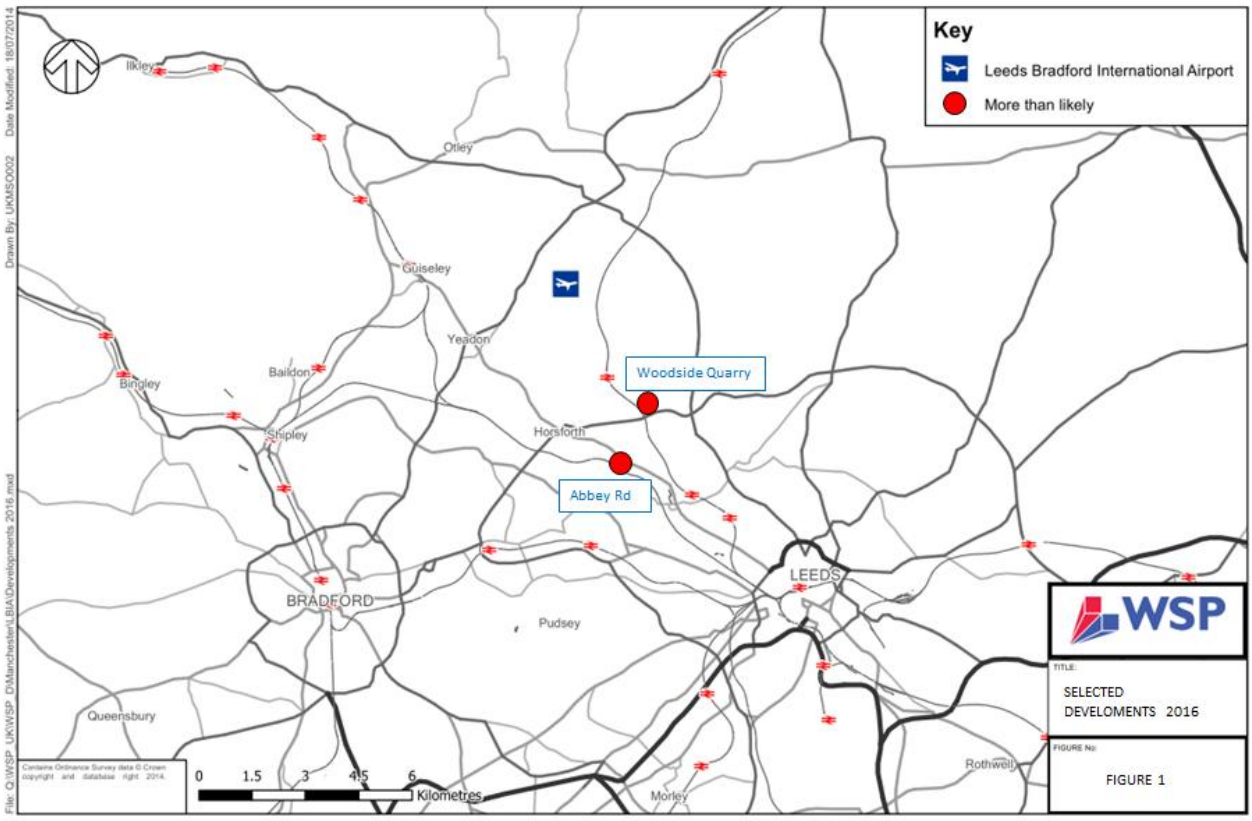
- Developments;
- Highway Forecasting Approaches 1 and 2; and
- Public Transport Forecasting Approach.

Developments

The developments in the uncertainty log have been reviewed in terms of their vicinity to the airport, certainty classification and build completion year. Those considered significant (in terms of their potential impact on the study) have been selected out and are shown in Figure 1 Figure 2 below.

Significant developments have been cited in terms of their size and nearby location in the vicinity of the airport and schemes to be tested.

Figure 1 Significant Development for the Study Built by 2016

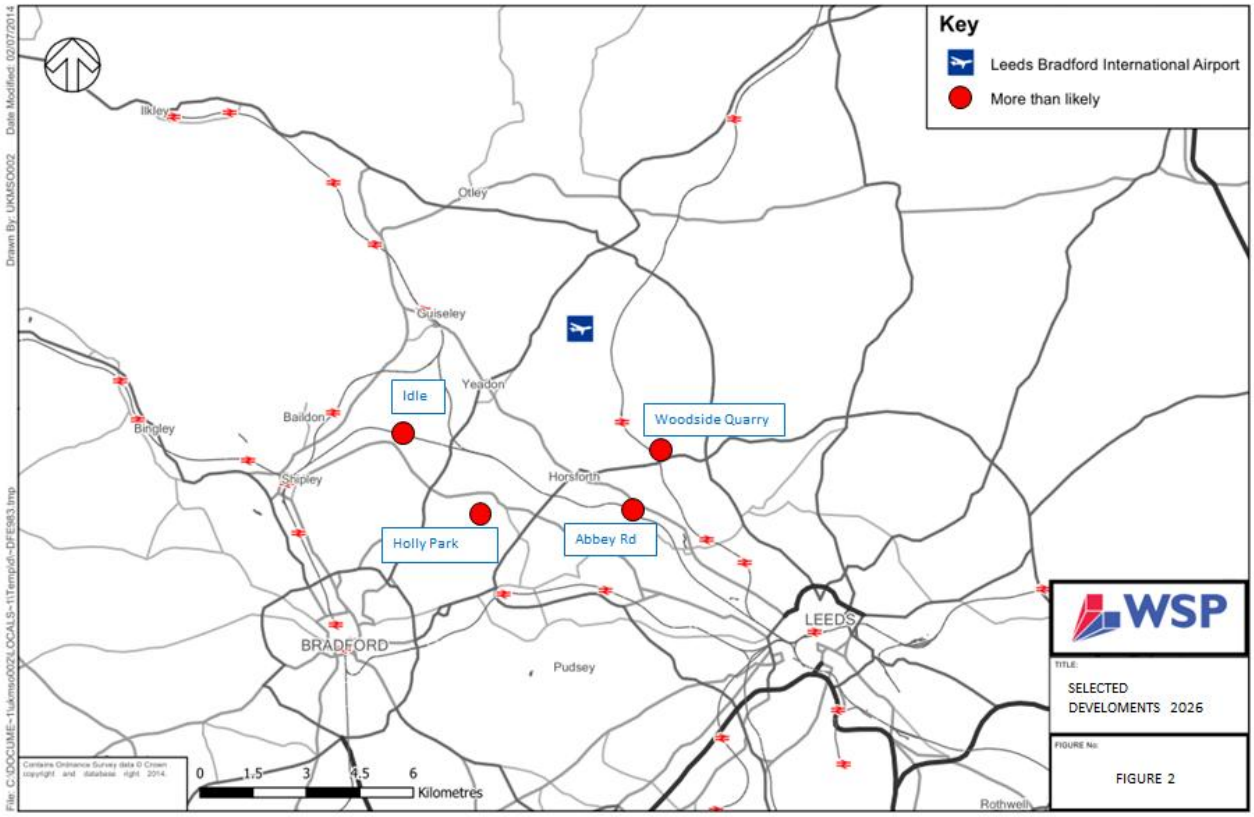


Details of the two development sites built by 2016 are as follows (as shown in the map above):

- Abbey Road, Kirkstall Forge Leeds, Land Use C3, 450 Dwellings, Build Completion 2015, More than likely; and
- Woodside Quarry, Ring Road West Leeds, Land Use C3, 472 Dwellings, Build Completion 2015, More than likely

There is then no change in the development land use assumptions until 2026 (for those developments considered significant to the study), which are shown below.

Figure 2 Significant Developments for the Study Built by 2026



Details of the further two development sites built by 2026 are as follows (as shown in the map above):

- Idle Housing Development Bradford, Land Use C3, 1204 Dwellings, Build Completion 2026, More than likely; and
- Holly Park Mills Calverley Leeds, Land Use B2, 39700 GFA SQM, Build Completion 2023, More than likely

The maps demonstrate a step change in development assumptions during 2016 and 2026. However this needs to be considered alongside timescales for the short / medium and long term schemes.

Following discussion with the DfT, the modelled years for the scheme studies are as follows:

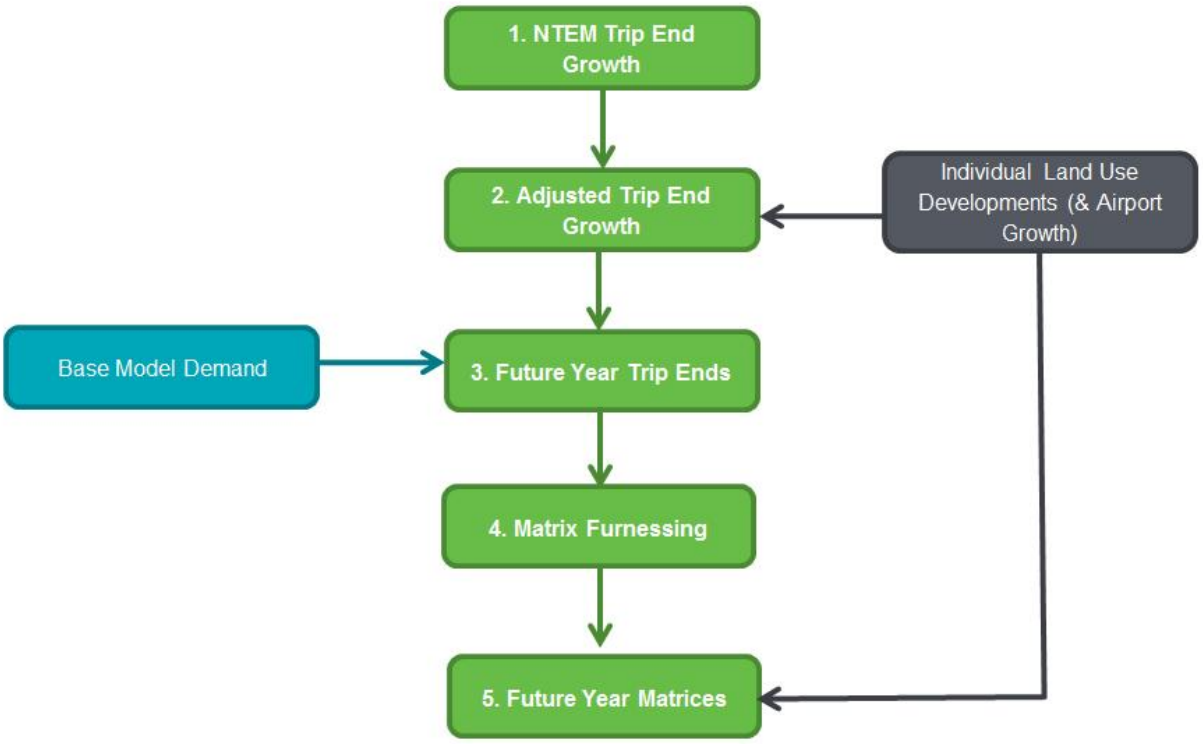
- Highway short / medium term: 2021 first year, 2031 second year;
- PT Bus short / medium term: 2016 first year, 2031 second year;
- PT Rail short / medium term: 2021 first year, 2031 second year; and
- PT Rail long term: 2026 first year, 2031 second year.

Highway Forecasting Approach 1

Please note that highway forecasting approach 1 was initially discussed with the DfT as the preferred option for developing the study matrices. However after a review of the project timescales it was decided that a more simplistic approach was required, as described for Highway forecasting approach 2 in the next section. Nevertheless for completeness approach 1 is described below.

Figure 3 below summarises highway forecasting approach 1.

Figure 3 Summary of Highway Forecast Approach



Step 1 NTEM Trip End Growth

Trip End NTEM v6.2 Growth would be applied to the 2008 base year highway model taken from growth aggregated across the UK for the area outside of Yorkshire, and by the following areas for within the Yorkshire region:

- Humberside;
- North Yorkshire;
- South Yorkshire;
- For West Yorkshire growth from the following areas will be used:
  - Bradford;
  - Calderdale;
  - Kirklees;
  - Leeds; and
  - Wakefield.

Step 2 Adjusted Trip End Growth

The four individual land use developments identified as significant in the study uncertainty log would be included following WebTAG guidance to adjust down the NTEM trip end growth. Information on employment, population and trip rates would be sourced from available Transport Assessments or TRICS (for trip rates) for the TEMPRO alternative assumptions calculations.

For the airport, the trip forecasts are a reflection of the DfT Aviation forecasts 2013 constrained (as opposed to development land use assumptions) and their inclusion would therefore be treated differently, including them by simply subtracting the airport trips from the forecast year trip totals (derived from NTEM).

Step 3 Future Year Trip Ends & Step 4 Matrix Furnessing

The adjusted trip ends would then be applied to the base model demand to form future year trip ends. The trip ends would undergo a furnessing process to balance the origin and destination demand controlled to the NTEM growth totals.

Step 5 Future Year Matrices

Finally the development and airport trips would be added to form the final forecast year matrices.

Development trip distributions would be based on existing distributions in the model.

Highway Forecasting Approach 2

This is the approach that is proposed as more appropriate considering time scales and project scope. It is a more simplistic approach and involves using the existing LTM highway forecasts and pivoting off these based on the local NTEM growth profile.

The following highway forecast year matrices would be developed:

- 2021; and
- 2031

For 2021 the existing 2016 matrices will be used as a basis. NTEM growth will be calculated between 2016 and 2021. The growth areas would follow those set out in approach 1.

For 2031 the existing 2031 matrices will be used as a basis, with no NTEM growth change required.

The airport zone would be adjusted to account for agreed growth uplift, adjusting down non-airport demand across the model to maintain the original matrix totals. The agreed uplift has been agreed as the DfT Aviation Forecasts 2013 (constrained) at LBIA.

Public Transport Forecasting Approach

Including the development trips for the public transport forecasts would not be appropriate due to the structure of the simplistic modelling approach (spreadsheet model). Therefore growth in demand would be based on the DfT Aviation Forecasts 2013 (constrained) at LBIA only.

3 Appropriateness of the existing LTM forecasts

Highway forecasting approach 2 involves pivoting off the existing LTM forecasts.

As described in modelling technical note 6a, these have been built up based on land use data in the form of an uncertainty log describing land use assumptions, and control data in the form of NTEM v6.2. The uncertainty log information was most recently updated in 2012. NTEM v6.2 is the latest version of the NTEM forecasts.

On the supply side the forecast year schemes included in the existing LTM forecasts were updated more recently as reported in the LTM – Forecasting and NGT Central Case report (2014).

Based on this it is concluded that use of the existing LTM forecasts as a basis for the study forecasts is appropriate bearing in mind the stage of scheme development and method proportionality in the context of otherwise developing a fresh uncertainty log for the study and integrating this in to the study forecasts.

Importantly the existing forecasts also include the effects of variable demand.

Modelling Technical Note 7: Connectivity to LBIA Feasibility Study – Uncertainty Log (Final)

Prepared by: Adam Truman Date: 21st July 2014

Checked by: Alec Curley Date: 21st July 2014

1 Introduction

In defined the scope of work for the Leeds Bradford International Airport Feasibility Study, it was agreed that an uncertainty log would be prepared to assist with deciding model forecast years. The idea is that the study uncertainty log would include the locations of significant sized developments across the Leeds, Bradford and Harrogate authority areas.

2 Building the Uncertainty Log

The study uncertainty log has been built based on the developments listed in the Leeds Transport Model (LTM) uncertainty log. The developments listed vary in location, size, type, build completion and input probability (certainty of being built).

The probability inputs are defined in TAG Unit M4 Forecasting and Uncertainty and set out below in Table 1.

Table 1 Classification of Future Inputs

Probability of the Input	Status
Near Certain: The outcome will happen or there is a certain 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 a number of possible inputs in an initial consultation process. Or, a policy aspiration.

The approach taken in selecting developments for the study uncertainty log has been as follows.

- Select developments in the adjoining areas of Leeds, Harrogate and Bradford;

- Select only developments of a significant size and which are considered likely to have a notable impact on traffic flows in the surrounding area;
- Form the study uncertainty log based on this selection and map to show their locations based on the following years which have been defined to fit with the existing LTM model years and selected intermediate years:
    - 2016 (existing LTM year);
    - 2021 (intermediate year);
    - 2026 (intermediate year); and
    - 2031 (existing LTM year)

2 Uncertainty Log Developments

All developments in the study uncertainty log are listed in Appendix A. The maps below show their locations categorised by the selected years and probability input.

Figure 1 Uncertainty Log Developments 2016

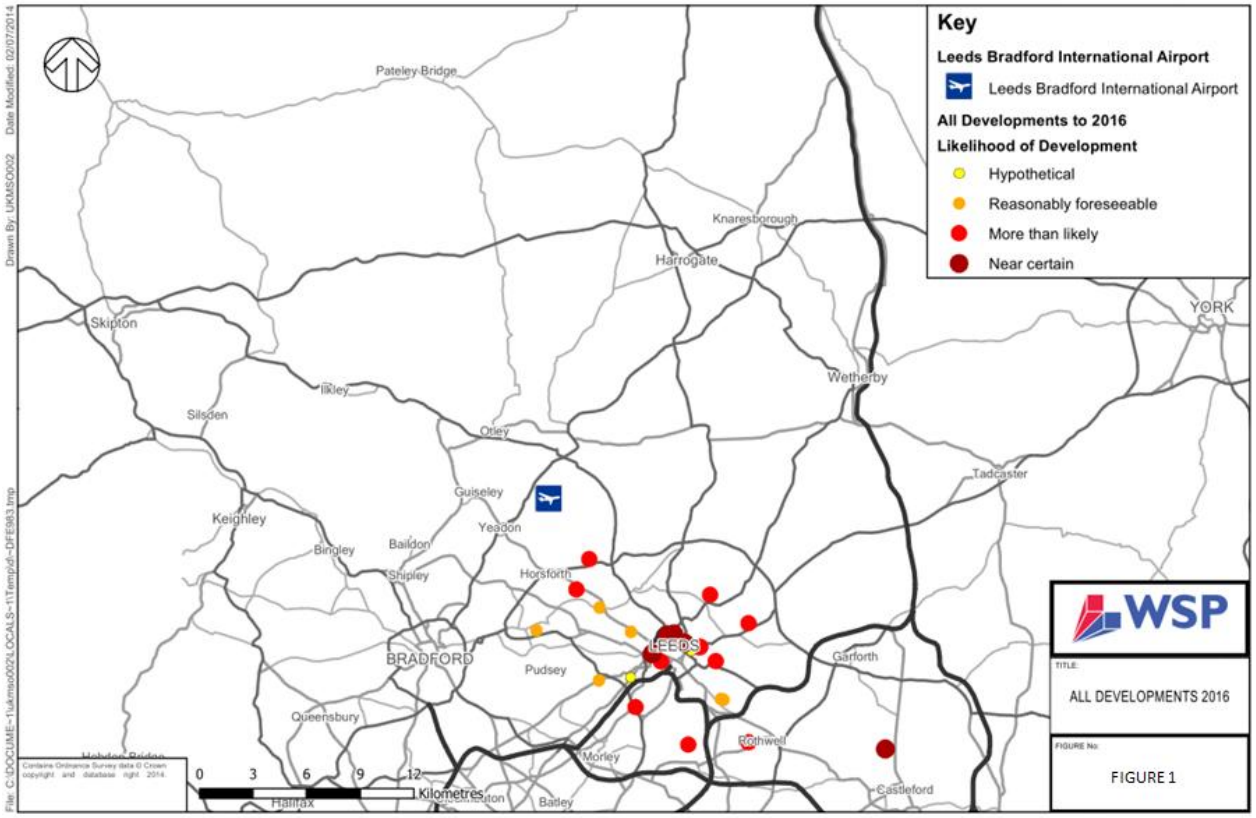


Figure 2 Uncertainty Log Developments 2021

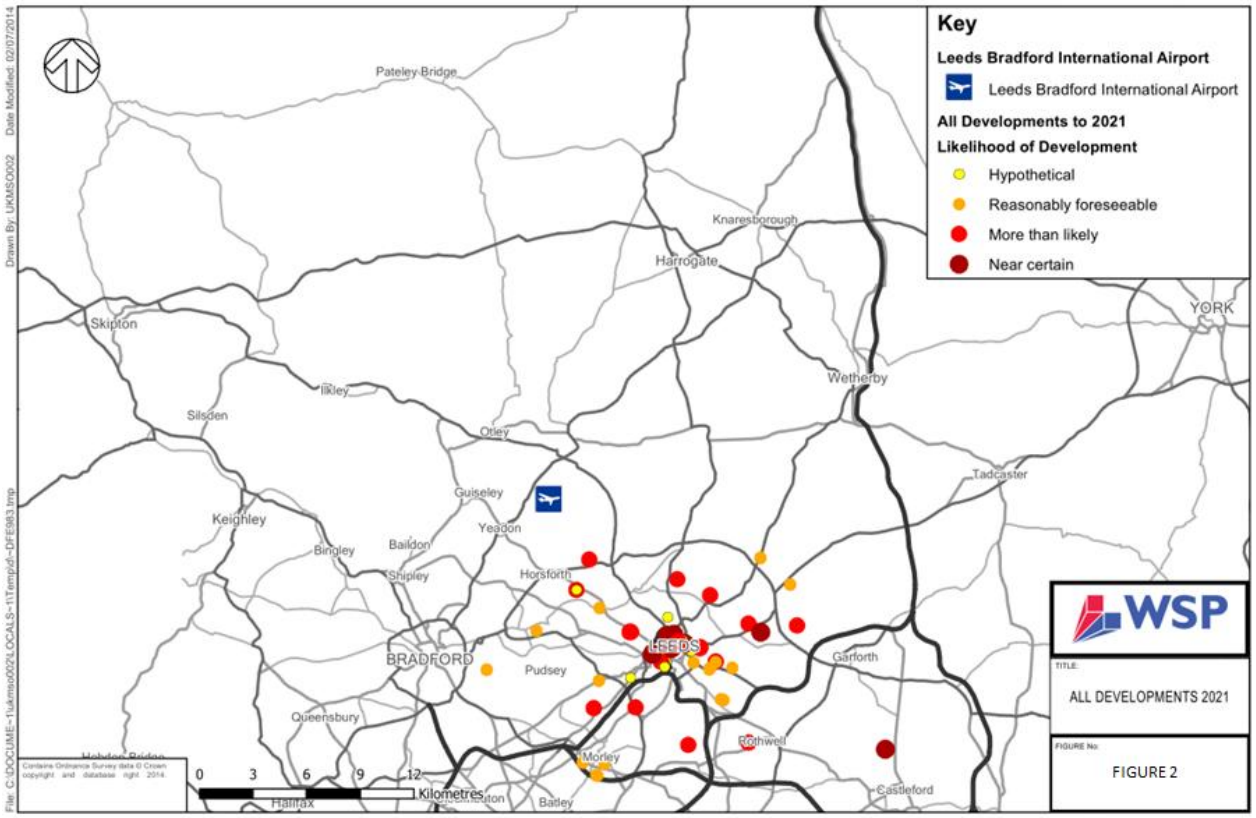


Figure 3 Uncertainty Log Developments 2026

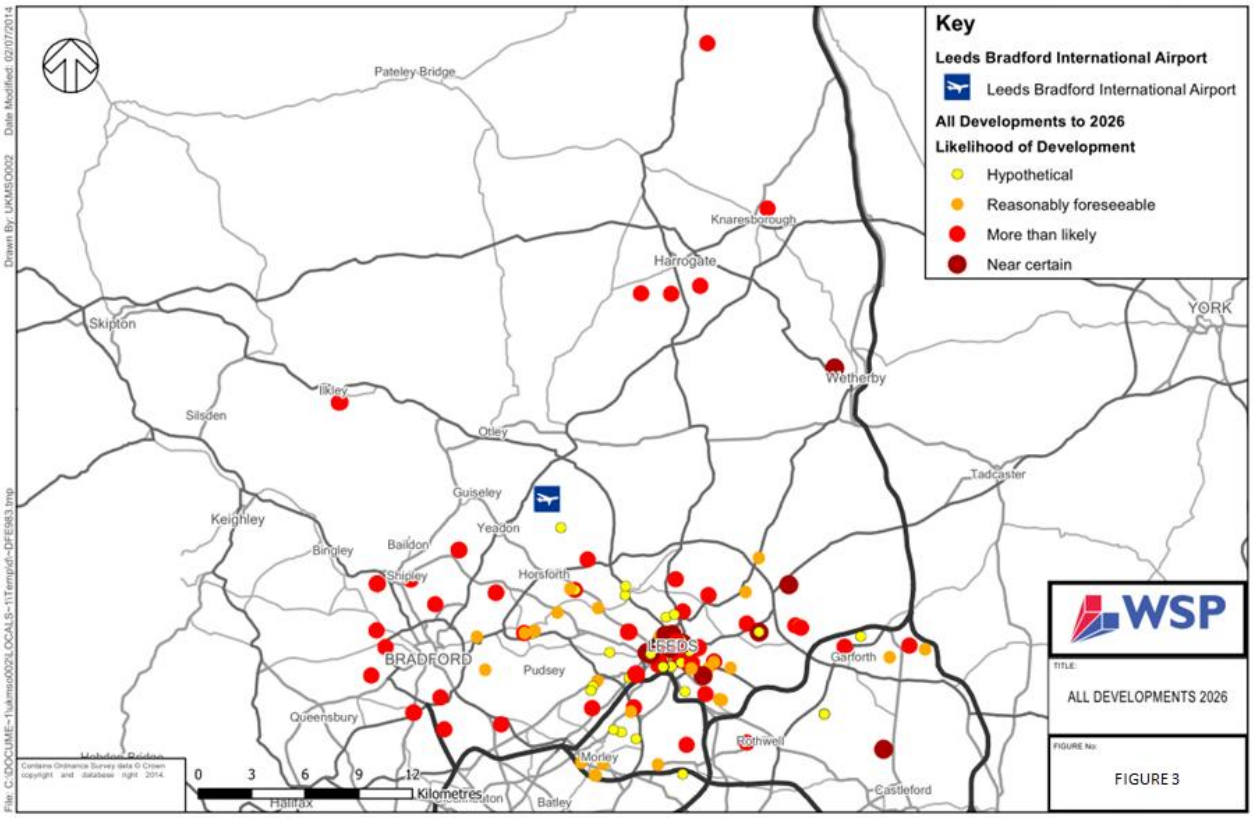
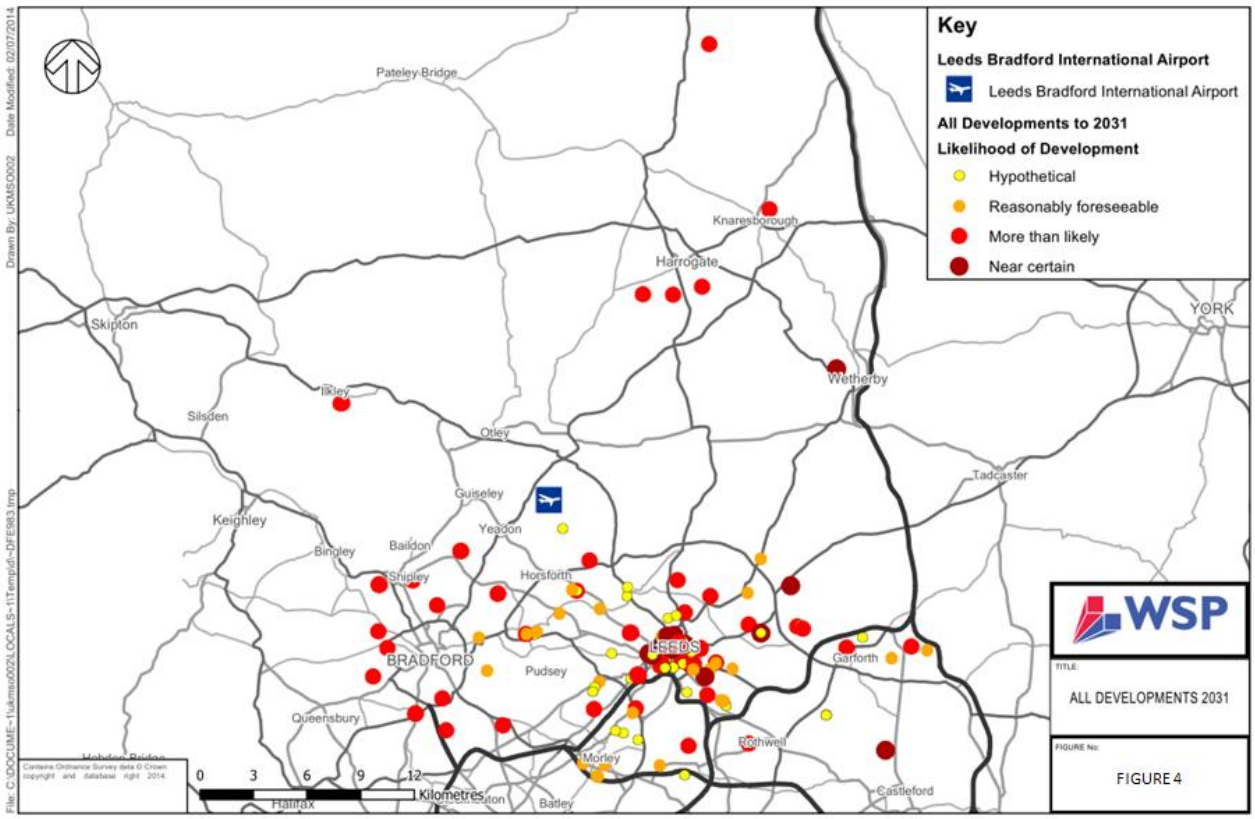


Figure 4 Uncertainty Log Developments 2031



Appendix A

Study Uncertainty Log

Item	LA	Ward Code	Address	Land Use	Unit	Size	Classified certainty Level	Start Year	End Year
1	Bradford	00CXGC	-	B1	GFA, SQM	13133	Reasonably Foreseeable	2012	2026
2	Bradford	00CXFK	-	B1	GFA, SQM	11550	More than Likely	2012	2026
3	Bradford	00CXFK	-	B1	GFA, SQM	16250	More than Likely	2012	2026
4	Bradford	00CXFT	-	B1	GFA, SQM	24360	More than Likely	2012	2026
5	Bradford	00CXFT	-	B2	GFA, SQM	24360	More than Likely	2012	2026
6	Bradford	00CXFT	-	B8	GFA, SQM	24360	More than Likely	2012	2026
7	Bradford	00CXGB	-	B1	GFA, SQM	13520	More than Likely	2012	2026
8	Bradford	00CXGB	-	B1	GFA, SQM	15680	More than Likely	2012	2026
9	Bradford	00CXGB	-	B1	GFA, SQM	281120	More than Likely	2012	2026
10	Bradford	00CXFD	-	C3	Dwellings	347	More than Likely	2012	2026
11	Bradford	00CXFM	-	C3	Dwellings	1204	More than Likely	2012	2026
12	Bradford	00CXFM	-	C3	Dwellings	1204	More than Likely	2012	2026
13	Bradford	00CXFM	-	C3	Dwellings	1204	More than Likely	2012	2026
14	Bradford	00CXFN	-	C3	Dwellings	1204	More than Likely	2012	2026

Item	LA	Ward Code	Address	Land Use	Unit	Size	Classified certainty Level	Start Year	End Year
15	Bradford	00CXFN	-	C3	Dwellings	1204	More than Likely	2012	2026
16	Bradford	00CXFN	-	C3	Dwellings	1204	More than Likely	2012	2026
17	Bradford	00CXFX	-	C3	Dwellings	2294	More than Likely	2012	2026
18	Bradford	00CXFY	-	C3	Dwellings	514	More than Likely	2012	2026
19	Bradford	00CXFY	-	C3	Dwellings	514	More than Likely	2012	2026
20	Bradford	00CXFY	-	C3	Dwellings	514	More than Likely	2012	2026
21	Bradford	00CXFY	-	C3	Dwellings	514	More than Likely	2012	2026
22	Bradford	00CXFY	-	C3	Dwellings	514	More than Likely	2012	2026
23	Bradford	00CXFY	-	C3	Dwellings	514	More than Likely	2012	2026
24	Bradford	00CXGA	-	C3	Dwellings	417	More than Likely	2012	2026
25	Harrogate	36UDGT	Land SE of Showground	B1	GFA, SQM	55259	More than Likely	2012	2026
26	Harrogate	36UDGT	Land SE of Showground	B2	GFA, SQM	16135	More than Likely	2012	2026
27	Harrogate	36UDHP	Farnell Technology Park and land to the rear	B8	GFA, SQM	37232	More than Likely	2012	2026
28	Harrogate	36UDHL	Land between Aldborough Gate & Minskip Road	B8	GFA, SQM	37232	More than Likely	2012	2026
29	Harrogate	36UDGS	Rear of 7 Rossett Drive, Harrogate	B1	GFA, SQM	17351	More than Likely	2012	2026
30	Harrogate	36UDGW	Former nursery, Halfpenny Lane	B8	GFA, SQM	22423	More than Likely	2012	2026

Item	LA	Ward Code	Address	Land Use	Unit	Size	Classified certainty Level	Start Year	End Year
31	Harrogate	36UDGN	Land at Jackland House Farm	B2	GFA, SQM	16356	More than Likely	2012	2026
32	Harrogate	36UDGU	Land adjacent the Cricket Ground, Killinghall	B2	GFA, SQM	55259	More than Likely	2012	2026
33	Harrogate	36UDGT	Land North of Crimple Farm	B2	GFA, SQM	22423	More than Likely	2012	2026
34	Leeds	0	138 CHAPELTOWN ROAD LEEDS LS7	B1	GFA, SQM	14270	More than Likely	2012	2022
35	Leeds	Beeston & Holbeck	139 GELDERD ROAD LEEDS 12	B1	GFA, SQM	24000	Hypothetical	2021	2016
36	Leeds	0	17 Calverley Lane Bramley LS13 3LP	B8	GFA, SQM	62820	Reasonably Foreseeable	2016	2026
37	Leeds	0	2A St Annes Road LS6 3NX	B2	GFA, SQM	47380	hypothetical	2012	2022
38	Leeds	0	6 ALLERTON HILL CHAPEL ALLERTON LS7	B1	GFA, SQM	40810	More than Likely	2012	2017
39	Leeds	-	Abbey Road - Kirkstall Forge LS5	C3	Dwellings	450	More than likely	2012	2015
40	Leeds	-	Abbey Road - Kirkstall Forge LS5	C3	Dwellings	750	Hypothetical	2015	2020
41	Leeds	0	ADJ CLARO HOUSE SERVIA ROAD LEEDS LS7	B2	GFA, SQM	18056	hypothetical	2016	2021
42	Leeds	0	ADJ LCC DEPOT RICHARDSHAW ROAD PUDSEY LS28	B2	GFA, SQM	26160	Hypothetical	2021	2026
43	Leeds	Morley South	ADJ RAVENHEAT LTD CHARTISTS WAY MORLEY	B2	GFA, SQM	62820	Reasonably Foreseeable	2016	2026
44	Leeds	Burmantofts & Richmond Hill	ADJ WHOLESALE MARKETS SITE NEWMARKET APPROACH LEEDS LS9	B1	GFA, SQM	10784	More than Likely	2013	2015
45	Leeds	-	Askets and Boggarts (A-D), Seacroft	C3	Dwellings	631	Reasonably Foreseeable	2016	2026
46	Leeds	Burmantofts & Richmond Hill	AVEA SITE 51 EAST LEEDS LINK OFF PONTEFRACT LANE LS9	B1	GFA, SQM	19680	More than Likely	2012	2014
47	Leeds	Burmantofts & Richmond Hill	AVEA SITE 51 EAST LEEDS LINK OFF PONTEFRACT LANE LS9	B1	GFA, SQM	25350	More than Likely	2012	2017

Item	LA	Ward Code	Address	Land Use	Unit	Size	Classified certainty Level	Start Year	End Year
48	Leeds	Burmantofts & Richmond Hill	BELL WOOD SITE (E4:9) OFF PONTEFRACT LANE LS9	B1	GFA, SQM	81784	Hypothetical	2021	2026
49	Leeds	-	Black Bull Street - Yorkshire Chemicals Plc - The Works	C3	Dwellings	396	more than likely	2020	2025
50	Leeds	Beeston & Holbeck	BROWN LANE LS 12	B2	GFA, SQM	137500	More than Likely	2012	2022
51	Leeds	Beeston & Holbeck	BROWN LANE LS 12	B8	GFA, SQM	137500	More than Likely	2012	2022
52	Leeds	Morley South	BRUNTCLIFFE ROAD MORLEY LS27	B1	GFA, SQM	20352	Reasonably Foreseeable	2016	2021
53	Leeds	Armley	CARR CROFTS DRIVE ARMLEY MOOR LS 12	B1	GFA, SQM	49268	Hypothetical	2021	2026
54	Leeds	-	Church Lane and Manor Farm (existing phase 3 housing allocations), Micklefield	C3	Dwellings	450	Reasonably Foreseeable	2016	2026
55	Leeds	City & Hunslet	CINDER OVEN BRIDGE PONTEFRACT ROAD LS26	B2	GFA, SQM	51672	Hypothetical	2026	2031
56	Leeds	City & Hunslet	CINDER OVEN BRIDGE PONTEFRACT ROAD LS26	B8	GFA, SQM	51670	Hypothetical	2026	2031
57	Leeds	-	Clarence Road - former Hydro Works	C3	Dwellings	337	more than likely	2020	2025
58	Leeds	Burmantofts & Richmond Hill	CROSS GREEN APPROACH LS9	B8	GFA, SQM	22200	Reasonably Foreseeable	2016	2021
59	Leeds	Burmantofts & Richmond Hill	CROSS GREEN APPROACH LS9	B1	GFA, SQM	26112	Reasonably Foreseeable	2016	2021
60	Leeds	-	Dewsbury Road - Cotton Mill (Site A) and Grove Farm (Site B) LS11	C3	Dwellings	862	Hypothetical	2016	2026
61	Leeds	-	East Leeds Extension	C3	Dwellings	1600	Reasonably Foreseeable	2016	2020
62	Leeds	-	East Leeds Extension	C3	Dwellings	3400	Near certain	2020	2026
63	Leeds	-	Education Road - former Buslingthorpe Tannery, Sheepscar	C3	Dwellings	644	Hypothetical	2016	2026

Item	LA	Ward Code	Address	Land Use	Unit	Size	Classified certainty Level	Start Year	End Year
64	Leeds	Crossgates & Whinmoor	FORMER VICKERS DEFENCE FACTORY MANSTON LANE LS 15	B2	GFA, SQM	31500	More than Likely	2014	2018
65	Leeds	Crossgates & Whinmoor	FORMER VICKERS DEFENCE FACTORY MANSTON LANE LS 15	B1	GFA, SQM	104240	Reasonably Foreseeable	2014	2026
66	Leeds	0	GELDERD ROAD LEEDS 12	B2	GFA, SQM	66740	More than Likely	2011	2021
67	Leeds	-	Globe Road - Doncasters/Lattitude LS11	C3	Dwellings	592	More than likely	2020	2026
68	Leeds	-	Great George Street - LGI	C3	Dwellings	1990	Reasonably Foreseeable	2016	2026
69	Leeds	Morley South	HOWLEY PARK IND EST MORLEY	B1	GFA, SQM	29904	Reasonably Foreseeable	2016	2021
70	Leeds	Morley South	HOWLEY PARK IND EST MORLEY	B1	GFA, SQM	11516	Reasonably Foreseeable	2016	2021
71	Leeds	-	Hunslet Road - Reg Vardy plc LS10 1LD	C3	Dwellings	394	Hypothetical	2020	2026
72	Leeds	-	Kidacre Street - former gas works site	C3	Dwellings	450	Hypothetical	2020	2026
73	Leeds	-	Killingbeck Hospital - C LS14	C3	Dwellings	329	More than likely	2009	2015
74	Leeds	Kirkstall	KIRKSTALL ROAD AND MILFORD PLACE LS4	B1	GFA, SQM	20500	More than Likely	2014	2018
75	Leeds	Kirkstall	KIRKSTALL ROAD AND MILFORD PLACE LS4	B1	GFA, SQM	20370	More than Likely	2015	2018
76	Leeds	-	Knowsthorpe, Hunslet East LS9	C3	Dwellings	491	Near certain	2020	2026
77	Leeds	0	LAND AT HEWLETTS DEPOT BEZA RD LS10	B8	GFA, SQM	50898	Hypothetical	2021	2026
78	Leeds	Beeston & Holbeck	LAND INC PLOT 7 THE PIGGERIES BROWN LANE WEST LS 12	B2	GFA, SQM	47630	More than Likely	2012	2022
79	Leeds	Beeston & Holbeck	LAND INC PLOT 7 THE PIGGERIES BROWN LANE WEST LS 13	B8	GFA, SQM	47630	More than Likely	2012	2022
80	Leeds	0	LAND OFF MANOR ROAD INGRAM ROW & SWEET STREET	B1	GFA, SQM	14100	hypothetical	2016	2018
81	Leeds	-	Lane Side Farm Extension, Morley	C3	Dwellings	560	Hypothetical	2016	2026

Item	LA	Ward Code	Address	Land Use	Unit	Size	Classified certainty Level	Start Year	End Year
82	Leeds	-	Lane Side Farm, PAS Morley	C3	Dwellings	342	Hypothetical	2016	2026
83	Leeds	-	Lowfold, East Street	C3	Dwellings	358	Reasonably Foreseeable	2014	2020
84	Leeds	-	Lowfold, East Street	C3	Dwellings	450	More than likely	2020	2026
85	Leeds	-	Manston Lane - former Vickers Tank Factory Site, Cross Gates	C3	Dwellings	645	More than likely	2020	2026
86	Leeds	-	Marsh Lane Goods Yard	C3	Dwellings	385	Reasonably Foreseeable	2020	2026
87	Leeds	0	MATTHEW CLARK WAREHOUSE SKELTON MOOR FARM PONTEFRACT LANE LS9	B2	GFA, SQM	54096	Hypothetical	2026	2031
88	Leeds	0	MILLSHAW AND RING ROAD LS11	B1	GFA, SQM	11250	More than Likely	2011	2016
89	Leeds	-	Millshaw Park Industrial Estate, Millshaw Park Lane, Millshaw LS11	C3	Dwellings	334	Reasonably Foreseeable	2016	2026
90	Leeds	-	North of Lotherton Way, Hawks Nest Wood (west off), Garforth	C3	Dwellings	954	Hypothetical	2016	2026
91	Leeds	0	OFF MARSH STREET/ CARLTON LANE ROTHWELL LS26	B8	GFA, SQM	49596	hypothetical	2011	2021
92	Leeds	Pudsey	OFF TYERSAL LANE TYERSAL BD4	B1	GFA, SQM	14100	Reasonably Foreseeable	2016	2018
93	Leeds	-	Kirkstall Forge Abbey Road Leeds LS5	A1-5	GFA, SQM	3060	Reasonably Foreseeable	2012	2022
94	Leeds	City & Hunslet	OFFICE SCHEME WELLINGTON ROAD & GOTTS ROAD LEEDS 12	B1	GFA, SQM	19040	hypothetical	2016	2021
95	Leeds	Burmantofts & Richmond Hill	PONTEFRACT LANE LS 9	B1	GFA, SQM	12360	More than Likely	2012	2014
96	Leeds	Kirkstall	PREMISES OF A TAYLOR & SON WEAVER STREET LS4	B1	GFA, SQM	12596	Reasonably Foreseeable	2014	2016

Item	LA	Ward Code	Address	Land Use	Unit	Size	Classified certainty Level	Start Year	End Year
97	Leeds	Kirkstall	PREMISES OF A TAYLOR & SON WEAVER STREET LS4	B1	GFA, SQM	14000	More than Likely	2014	2017
98	Leeds	City & Hunslet	PT SITE 2 STOURTON POINT HAIGH PARK ROAD STOURTON LS10	B1	GFA, SQM	10100	Reasonably Foreseeable	2014	2016
99	Leeds	City & Hunslet	PT SITE 2 STOURTON POINT HAIGH PARK ROAD STOURTON LS10	B1	GFA, SQM	10660	Reasonably Foreseeable	2014	2015
100	Leeds	Calverley & Farsley	R/O HOLLY PK MILLS CALVERLEY	B2	GFA, SQM	39700	More than Likely	2013	2023
101	Leeds	Calverley & Farsley	R/O HOLLY PK MILLS CALVERLEY	B8	GFA, SQM	39700	More than Likely	2013	2023
102	Leeds	Calverley & Farsley	R/O LEIGH HOUSE VARLEY STREET PUDSEY LS25	B1	GFA, SQM	50380	More than Likely	2013	2023
103	Leeds	Calverley & Farsley	R/O LEIGH HOUSE VARLEY STREET PUDSEY LS25	B1	GFA, SQM	102190	Reasonably Foreseeable	2013	2026
104	Leeds	Cross Gates & Whinmoor	RED HALL RED HALL LANE LS17	B1	GFA, SQM	17340	Reasonably Foreseeable	2014	2017
105	Leeds	-	Ridge Road, East of	C3	Dwellings	7538	More than likely	2016	2026
106	Leeds	Morley South	RODS MILLS LA - HIGH ST MORLEY	B1	GFA, SQM	24830	Reasonably Foreseeable	2016	2021
107	Leeds	City & Hunslet	S/O 23-31 GLOBE ROAD LEEDS LS11	B1	GFA, SQM	11340	hypothetical	2014	2017
108	Leeds	0	S/O JOINERS WORKSHOP PARK TERRACE HEADINGLEY LS6	B8	GFA, SQM	47458	hypothetical	2012	2022
109	Leeds	0	S/O SAVILE HOUSE TRINITY STREET ARCADE LS1	B8	GFA, SQM	27040	Hypothetical	2026	2031
110	Leeds	0	S/O UNIT 15 ASTLEY LANE IND EST ASTLEY WAY LS26 8XT	B1	GFA, SQM	38840	Hypothetical	2021	2026
111	Leeds	0	S/O UNIT 15 ASTLEY LANE IND EST ASTLEY WAY LS26 8XT	B2	GFA, SQM	50898	Hypothetical	2021	2026
112	Leeds	Burmantofts & Richmond Hill	S/O WHOLESALE MARKETS NEWMARKET APPROACH LEEDS LS9	B1	GFA, SQM	53100	Reasonably Foreseeable	2016	2021
113	Leeds	-	Scotland Lane, Ling Bob, Horsforth	C3	Dwellings	1914	Hypothetical	2016	2026

Item	LA	Ward Code	Address	Land Use	Unit	Size	Classified certainty Level	Start Year	End Year
114	Leeds	-	Seacroft Hospital (rear of)	C3	Dwellings	320	Near certain	2015	2020
115	Leeds	-	Seacroft Hospital (rear of)	C3	Dwellings	400	Hypothetical	2020	2026
116	Leeds	Temple Newsam	SITE ADJ MERCADO CARPETS THORNES FARM WAY	B2	GFA, SQM	22200	Reasonably Foreseeable	2016	2021
117	Leeds	-	South Accommodation Road and Atkinson Street	C3	Dwellings	335	Reasonably Foreseeable	2016	2026
118	Leeds	-	Spofforth Hill, Wetherby LS22	C3	Dwellings	405	Near certain	2016	2026
119	Leeds	Calverley & Farsley	STANNINGLEY STATION LS 28	B1	GFA, SQM	11510	Reasonably Foreseeable	2013	2016
120	Leeds	Ardsley & Robin Hood	STATION LANE EAST ARDSLEY WF3	B2	GFA, SQM	17062	Hypothetical	2021	2026
121	Leeds	-	Station Road, Allerton Bywater	C3	Dwellings	334	Near certain	2009	2015
122	Leeds	-	Stourton Grange Farm (land at), Selby Road - Ridge Road, Garforth LS25	C3	Dwellings	6300	Reasonably Foreseeable	2016	2026
123	Leeds	Middleton Park	STOURTON NORTH LEEDS 10	B1	GFA, SQM	128500	More than Likely	2015	2025
124	Leeds	-	Sweet Street West (Land South of) Holbeck	C3	Dwellings	519	more than likely	2020	2026
125	Leeds	-	The Parade & The Drive LS9	C3	Dwellings	410	Hypothetical	2009	2012
126	Leeds	Ardsley & Robin Hood	THORPE HALL THORPE LANE THORPE WF3	B1	GFA, SQM	43050	Reasonably Foreseeable	2012	2022
127	Leeds	-	Wakefield Road and Barrowby Lane, Garforth	C3	Dwellings	575	More than likely	2016	2026
128	Leeds	-	Water Lane - Westbank	C3	Dwellings	346	hypothetical	2016	2026
129	Leeds	City & Hunslet	WELLBRIDGE INDUSTRIAL ESTATE GRAINGERS WAY LS12	B8	GFA, SQM	26160	near certain	2021	2026
130	Leeds	Farnley & Wortley	WHITEHALL PARK WHITEHALL ROAD LEEDS 12	B1	GFA, SQM	10275	Reasonably Foreseeable	2014	2016
131	Leeds	-	Whitehall Road - Doncasters LS12	C3	Dwellings	526	hypothetical	2016	2020
132	Leeds	-	Whitehall Road (south of) - Harpers Farm	C3	Dwellings	445	Hypothetical	2016	2026

Item	LA	Ward Code	Address	Land Use	Unit	Size	Classified certainty Level	Start Year	End Year
133	Leeds	-	Whitehall Road, Craven Park, Farnley	C3	Dwellings	570	Hypothetical	2016	2026
134	Leeds	-	Woodside Quarry, Ring Road West , Leeds	C3	Dwellings	472	more than likely	2014	2015
135	Leeds	00DAFH	Quarry Hill Eastgate Leeds LS9 8AW	A1-5	GFA, SQM	2770	near certain	2014	2016
136	Leeds	00DAFH	Land Bounded By Boar Lane, Briggate, Commercial Street, Albion Street Including Bank Street And Burton Arcade Leeds 1	A1-5	GFA, SQM	32010	near certain	2014	2021
137	Leeds	00DAFR	Bridge Road Leeds LS5	A1-5	GFA, SQM	6648	Reasonably Foreseeable	2014	2016
138	Leeds	00DAFH	Sweet Street Meadow Road And Jack Lane Leeds LS10	D2	GFA, SQM	8660	Hypothetical	2016	2021
139	Leeds	00DAFH	Sweet Street Meadow Road And Jack Lane Leeds LS10	C3	GFA, SQM	450	Hypothetical	2016	2021
140	Leeds	00DAFH	Sweet Street Meadow Road And Jack Lane Leeds LS10	B1	GFA, SQM	53100	Hypothetical	2016	2021
141	Leeds	00DAGC	Land Off Commercial Street And Meynell Avenue Rothwell Leeds LS26 0NY	A1-5	GFA, SQM	5000	More Than Likely	2010	2014
142	Leeds	00DAGD	Tesco	A1-5	GFA, SQM	7070	More Than	2012	2013

Item	LA	Ward Code	Address	Land Use	Unit	Size	Classified certainty Level	Start Year	End Year
			361 Roundhay Road Leeds LS8 4BU				Likely		
143	Leeds	00DAFH	Temple Works Marshall Street Holbeck Leeds LS1 1UL	D2	GFA, SQM	6400	More Than Likely	2010	2013
144	Leeds	00DAGF	Land Bounded By Bridge Street, New York Road, Regent Street And Gower Street LS2	A1-5	GFA, SQM	3424	Hypothetical	2014	2021
145	Leeds	00DAFH	Site Bounded By Clay Pit Lane, Inner Ring Road, Wade Lane, Jacob Street And Brunswick Terrace LS2	D2	GFA, SQM	19600	near certain	2014	2016
146	Leeds	-	Eastgate And Harewood Quarter Leeds 2	A1-5	GFA, SQM	93080	Reasonably Foreseeable	2014	2021
147	Leeds	-	Eastgate And Harewood Quarter Leeds 2	D2	GFA, SQM	13840	Reasonably Foreseeable	2014	2021
148	Leeds	-	Car Park Portland Crescent Leeds	D2	GFA, SQM	12300	Near Certain	2008	2009
149	Leeds	-	Doncaster Monk Bridge Ltd Whitehall Road Leeds	B1	GFA, SQM	69500	near certain	2014	2016
150	Leeds	-	Land At St Georges Road Middleton LS10	A1-5	GFA, SQM	6270	More Than Likely	2011	2013
151	Leeds	-	Sweet Street Meadow Road And Jack Lane Leeds LS10	B1	GFA, SQM	93070	Hypothetical	2016	2021
152	Leeds	-	Sweet Street Meadow Road And Jack Lane	D2	GFA, SQM	8910	Hypothetical	2016	2021

Item	LA	Ward Code	Address	Land Use	Unit	Size	Classified certainty Level	Start Year	End Year
			Leeds LS10						
153	Leeds	-	Sweet Street Meadow Road And Jack Lane Leeds LS10	A1-5	GFA, SQM	3980	Hypothetical	2016	2021
154	Leeds	-	Whitehall Road Leeds LS12	B1	GFA, SQM	22000	hypothetical	2013	2023
155	Leeds	-	Eastgate And Harewood Quarter Leeds 2 - John Lewis	A1-5	GFA, SQM	24000	More than Likely	2014	2021

Modelling Technical Note 7: Connectivity to LBIA Feasibility Study – Uncertainty Log (Final)

Prepared by: Adam Truman Date: 21st July 2014

Checked by: Alec Curley Date: 21st July 2014

1 Introduction

In defined the scope of work for the Leeds Bradford International Airport Feasibility Study, it was agreed that an uncertainty log would be prepared to assist with deciding model forecast years. The idea is that the study uncertainty log would include the locations of significant sized developments across the Leeds, Bradford and Harrogate authority areas.

2 Building the Uncertainty Log

The study uncertainty log has been built based on the developments listed in the Leeds Transport Model (LTM) uncertainty log. The developments listed vary in location, size, type, build completion and input probability (certainty of being built).

The probability inputs are defined in TAG Unit M4 Forecasting and Uncertainty and set out below in Table 1.

Table 1 Classification of Future Inputs

Probability of the Input	Status
Near Certain: The outcome will happen or there is a certain 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 a number of possible inputs in an initial consultation process. Or, a policy aspiration.

The approach taken in selecting developments for the study uncertainty log has been as follows.

- Select developments in the adjoining areas of Leeds, Harrogate and Bradford;

- Select only developments of a significant size and which are considered likely to have a notable impact on traffic flows in the surrounding area;
- Form the study uncertainty log based on this selection and map to show their locations based on the following years which have been defined to fit with the existing LTM model years and selected intermediate years:
    - 2016 (existing LTM year);
    - 2021 (intermediate year);
    - 2026 (intermediate year); and
    - 2031 (existing LTM year)

2 Uncertainty Log Developments

All developments in the study uncertainty log are listed in Appendix A. The maps below show their locations categorised by the selected years and probability input.

Figure 1 Uncertainty Log Developments 2016

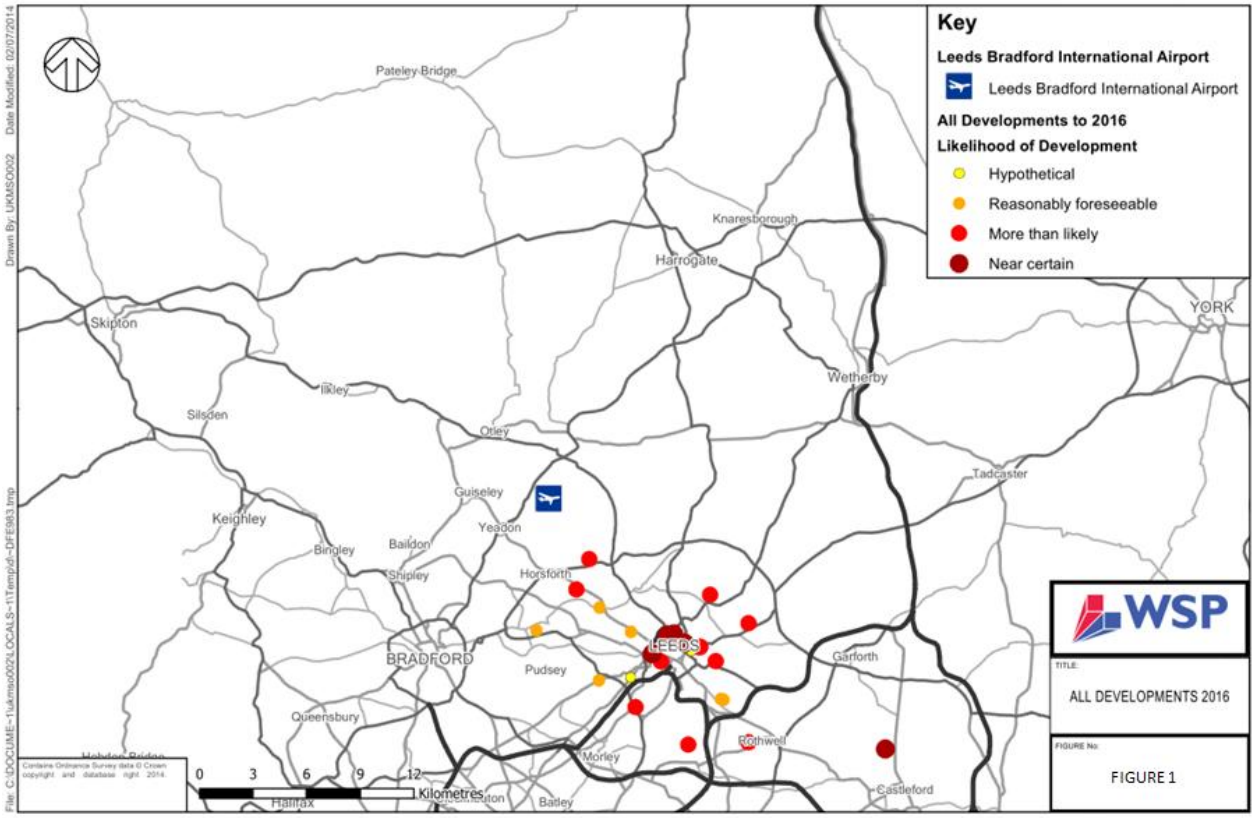


Figure 2 Uncertainty Log Developments 2021

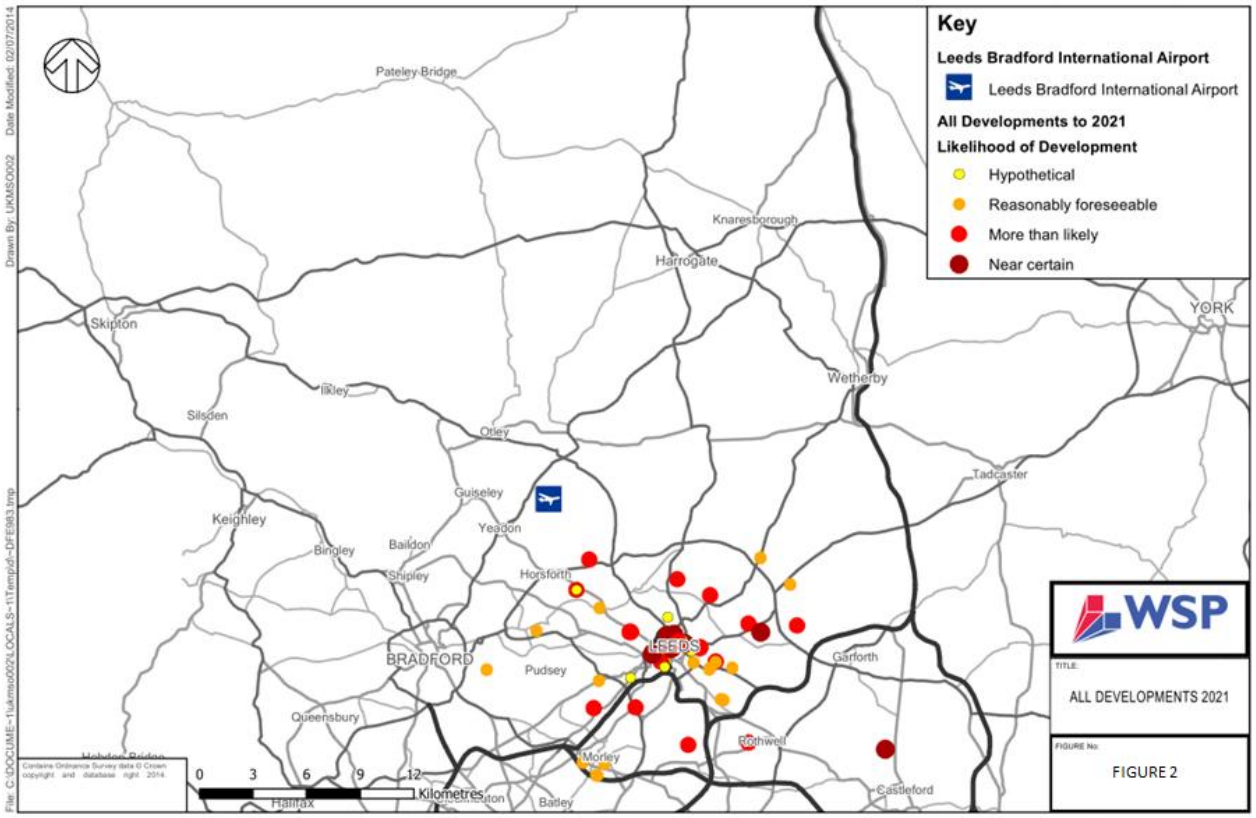


Figure 3 Uncertainty Log Developments 2026

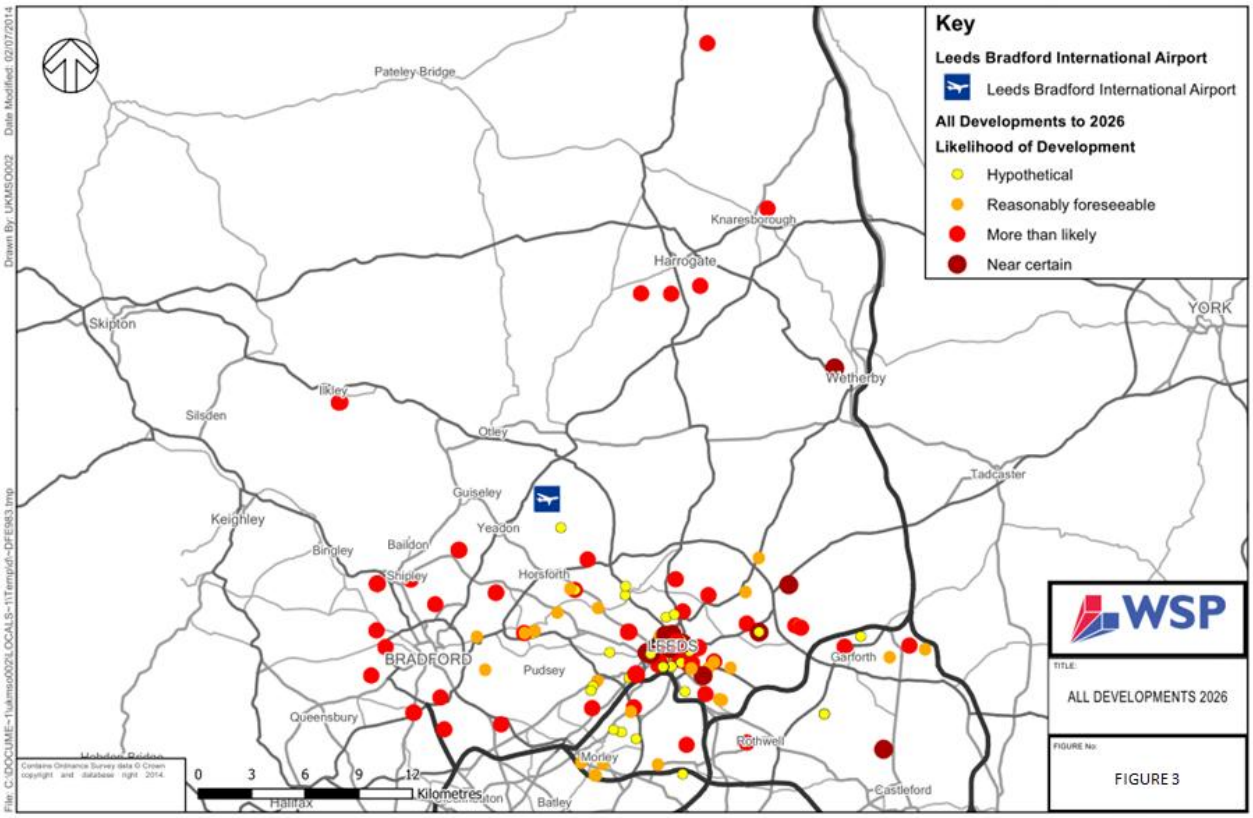
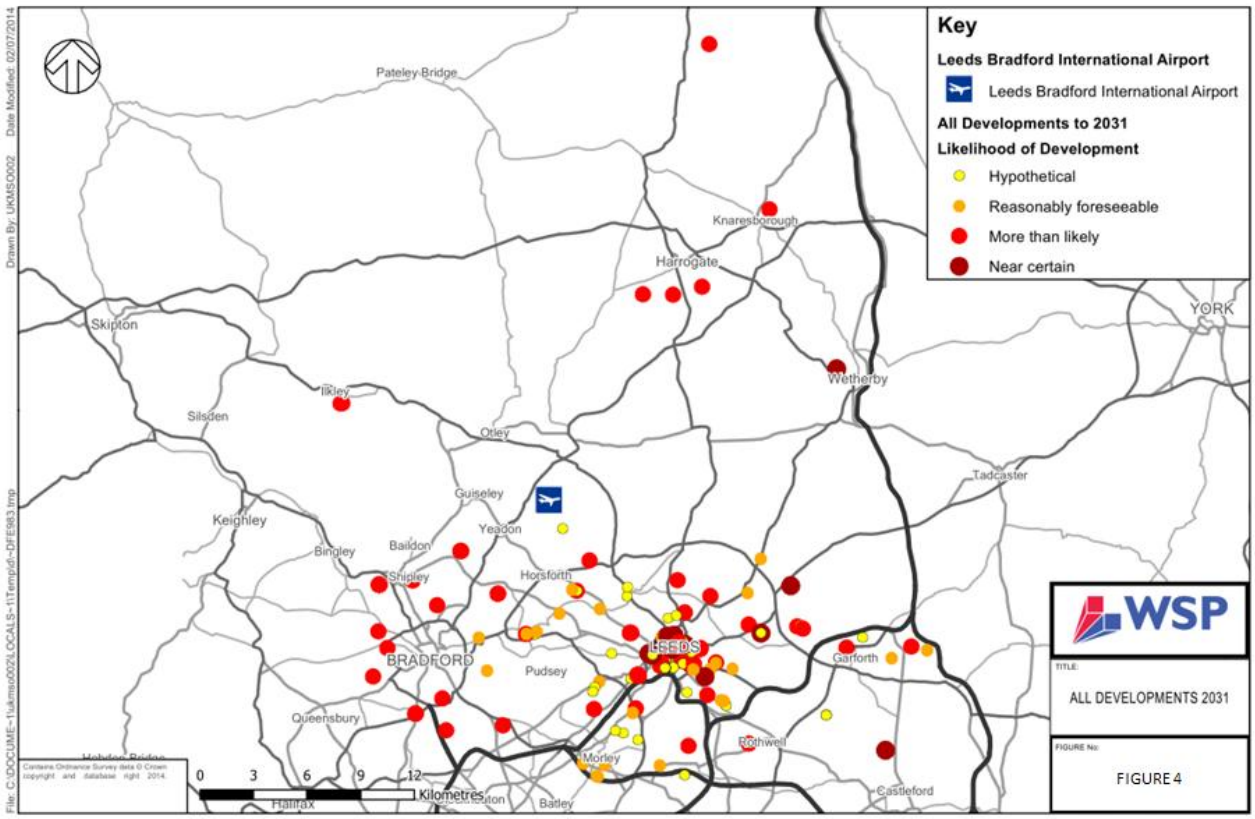


Figure 4 Uncertainty Log Developments 2031



Appendix A

Study Uncertainty Log

Item	LA	Ward Code	Address	Land Use	Unit	Size	Classified certainty Level	Start Year	End Year
1	Bradford	00CXGC	-	B1	GFA, SQM	13133	Reasonably Foreseeable	2012	2026
2	Bradford	00CXFK	-	B1	GFA, SQM	11550	More than Likely	2012	2026
3	Bradford	00CXFK	-	B1	GFA, SQM	16250	More than Likely	2012	2026
4	Bradford	00CXFT	-	B1	GFA, SQM	24360	More than Likely	2012	2026
5	Bradford	00CXFT	-	B2	GFA, SQM	24360	More than Likely	2012	2026
6	Bradford	00CXFT	-	B8	GFA, SQM	24360	More than Likely	2012	2026
7	Bradford	00CXGB	-	B1	GFA, SQM	13520	More than Likely	2012	2026
8	Bradford	00CXGB	-	B1	GFA, SQM	15680	More than Likely	2012	2026
9	Bradford	00CXGB	-	B1	GFA, SQM	281120	More than Likely	2012	2026
10	Bradford	00CXFD	-	C3	Dwellings	347	More than Likely	2012	2026
11	Bradford	00CXFM	-	C3	Dwellings	1204	More than Likely	2012	2026
12	Bradford	00CXFM	-	C3	Dwellings	1204	More than Likely	2012	2026
13	Bradford	00CXFM	-	C3	Dwellings	1204	More than Likely	2012	2026
14	Bradford	00CXFN	-	C3	Dwellings	1204	More than Likely	2012	2026

Item	LA	Ward Code	Address	Land Use	Unit	Size	Classified certainty Level	Start Year	End Year
15	Bradford	00CXFN	-	C3	Dwellings	1204	More than Likely	2012	2026
16	Bradford	00CXFN	-	C3	Dwellings	1204	More than Likely	2012	2026
17	Bradford	00CXFX	-	C3	Dwellings	2294	More than Likely	2012	2026
18	Bradford	00CXFY	-	C3	Dwellings	514	More than Likely	2012	2026
19	Bradford	00CXFY	-	C3	Dwellings	514	More than Likely	2012	2026
20	Bradford	00CXFY	-	C3	Dwellings	514	More than Likely	2012	2026
21	Bradford	00CXFY	-	C3	Dwellings	514	More than Likely	2012	2026
22	Bradford	00CXFY	-	C3	Dwellings	514	More than Likely	2012	2026
23	Bradford	00CXFY	-	C3	Dwellings	514	More than Likely	2012	2026
24	Bradford	00CXGA	-	C3	Dwellings	417	More than Likely	2012	2026
25	Harrogate	36UDGT	Land SE of Showground	B1	GFA, SQM	55259	More than Likely	2012	2026
26	Harrogate	36UDGT	Land SE of Showground	B2	GFA, SQM	16135	More than Likely	2012	2026
27	Harrogate	36UDHP	Farnell Technology Park and land to the rear	B8	GFA, SQM	37232	More than Likely	2012	2026
28	Harrogate	36UDHL	Land between Aldborough Gate & Minskip Road	B8	GFA, SQM	37232	More than Likely	2012	2026
29	Harrogate	36UDGS	Rear of 7 Rossett Drive, Harrogate	B1	GFA, SQM	17351	More than Likely	2012	2026
30	Harrogate	36UDGW	Former nursery, Halfpenny Lane	B8	GFA, SQM	22423	More than Likely	2012	2026

Item	LA	Ward Code	Address	Land Use	Unit	Size	Classified certainty Level	Start Year	End Year
31	Harrogate	36UDGN	Land at Jackland House Farm	B2	GFA, SQM	16356	More than Likely	2012	2026
32	Harrogate	36UDGU	Land adjacent the Cricket Ground, Killinghall	B2	GFA, SQM	55259	More than Likely	2012	2026
33	Harrogate	36UDGT	Land North of Crimple Farm	B2	GFA, SQM	22423	More than Likely	2012	2026
34	Leeds	0	138 CHAPELTOWN ROAD LEEDS LS7	B1	GFA, SQM	14270	More than Likely	2012	2022
35	Leeds	Beeston & Holbeck	139 GELDERD ROAD LEEDS 12	B1	GFA, SQM	24000	Hypothetical	2021	2016
36	Leeds	0	17 Calverley Lane Bramley LS13 3LP	B8	GFA, SQM	62820	Reasonably Foreseeable	2016	2026
37	Leeds	0	2A St Annes Road LS6 3NX	B2	GFA, SQM	47380	hypothetical	2012	2022
38	Leeds	0	6 ALLERTON HILL CHAPEL ALLERTON LS7	B1	GFA, SQM	40810	More than Likely	2012	2017
39	Leeds	-	Abbey Road - Kirkstall Forge LS5	C3	Dwellings	450	More than likely	2012	2015
40	Leeds	-	Abbey Road - Kirkstall Forge LS5	C3	Dwellings	750	Hypothetical	2015	2020
41	Leeds	0	ADJ CLARO HOUSE SERVIA ROAD LEEDS LS7	B2	GFA, SQM	18056	hypothetical	2016	2021
42	Leeds	0	ADJ LCC DEPOT RICHARDSHAW ROAD PUDSEY LS28	B2	GFA, SQM	26160	Hypothetical	2021	2026
43	Leeds	Morley South	ADJ RAVENHEAT LTD CHARTISTS WAY MORLEY	B2	GFA, SQM	62820	Reasonably Foreseeable	2016	2026
44	Leeds	Burmantofts & Richmond Hill	ADJ WHOLESALE MARKETS SITE NEWMARKET APPROACH LEEDS LS9	B1	GFA, SQM	10784	More than Likely	2013	2015
45	Leeds	-	Askets and Boggarts (A-D), Seacroft	C3	Dwellings	631	Reasonably Foreseeable	2016	2026
46	Leeds	Burmantofts & Richmond Hill	AVEA SITE 51 EAST LEEDS LINK OFF PONTEFRACT LANE LS9	B1	GFA, SQM	19680	More than Likely	2012	2014
47	Leeds	Burmantofts & Richmond Hill	AVEA SITE 51 EAST LEEDS LINK OFF PONTEFRACT LANE LS9	B1	GFA, SQM	25350	More than Likely	2012	2017

Item	LA	Ward Code	Address	Land Use	Unit	Size	Classified certainty Level	Start Year	End Year
48	Leeds	Burmantofts & Richmond Hill	BELL WOOD SITE (E4:9) OFF PONTEFRACT LANE LS9	B1	GFA, SQM	81784	Hypothetical	2021	2026
49	Leeds	-	Black Bull Street - Yorkshire Chemicals Plc - The Works	C3	Dwellings	396	more than likely	2020	2025
50	Leeds	Beeston & Holbeck	BROWN LANE LS 12	B2	GFA, SQM	137500	More than Likely	2012	2022
51	Leeds	Beeston & Holbeck	BROWN LANE LS 12	B8	GFA, SQM	137500	More than Likely	2012	2022
52	Leeds	Morley South	BRUNTCLIFFE ROAD MORLEY LS27	B1	GFA, SQM	20352	Reasonably Foreseeable	2016	2021
53	Leeds	Armley	CARR CROFTS DRIVE ARMLEY MOOR LS 12	B1	GFA, SQM	49268	Hypothetical	2021	2026
54	Leeds	-	Church Lane and Manor Farm (existing phase 3 housing allocations), Micklefield	C3	Dwellings	450	Reasonably Foreseeable	2016	2026
55	Leeds	City & Hunslet	CINDER OVEN BRIDGE PONTEFRACT ROAD LS26	B2	GFA, SQM	51672	Hypothetical	2026	2031
56	Leeds	City & Hunslet	CINDER OVEN BRIDGE PONTEFRACT ROAD LS26	B8	GFA, SQM	51670	Hypothetical	2026	2031
57	Leeds	-	Clarence Road - former Hydro Works	C3	Dwellings	337	more than likely	2020	2025
58	Leeds	Burmantofts & Richmond Hill	CROSS GREEN APPROACH LS9	B8	GFA, SQM	22200	Reasonably Foreseeable	2016	2021
59	Leeds	Burmantofts & Richmond Hill	CROSS GREEN APPROACH LS9	B1	GFA, SQM	26112	Reasonably Foreseeable	2016	2021
60	Leeds	-	Dewsbury Road - Cotton Mill (Site A) and Grove Farm (Site B) LS11	C3	Dwellings	862	Hypothetical	2016	2026
61	Leeds	-	East Leeds Extension	C3	Dwellings	1600	Reasonably Foreseeable	2016	2020
62	Leeds	-	East Leeds Extension	C3	Dwellings	3400	Near certain	2020	2026
63	Leeds	-	Education Road - former Buslingthorpe Tannery, Sheepscar	C3	Dwellings	644	Hypothetical	2016	2026

Item	LA	Ward Code	Address	Land Use	Unit	Size	Classified certainty Level	Start Year	End Year
64	Leeds	Crossgates & Whinmoor	FORMER VICKERS DEFENCE FACTORY MANSTON LANE LS 15	B2	GFA, SQM	31500	More than Likely	2014	2018
65	Leeds	Crossgates & Whinmoor	FORMER VICKERS DEFENCE FACTORY MANSTON LANE LS 15	B1	GFA, SQM	104240	Reasonably Foreseeable	2014	2026
66	Leeds	0	GELDERD ROAD LEEDS 12	B2	GFA, SQM	66740	More than Likely	2011	2021
67	Leeds	-	Globe Road - Doncasters/Lattitude LS11	C3	Dwellings	592	More than likely	2020	2026
68	Leeds	-	Great George Street - LGI	C3	Dwellings	1990	Reasonably Foreseeable	2016	2026
69	Leeds	Morley South	HOWLEY PARK IND EST MORLEY	B1	GFA, SQM	29904	Reasonably Foreseeable	2016	2021
70	Leeds	Morley South	HOWLEY PARK IND EST MORLEY	B1	GFA, SQM	11516	Reasonably Foreseeable	2016	2021
71	Leeds	-	Hunslet Road - Reg Vardy plc LS10 1LD	C3	Dwellings	394	Hypothetical	2020	2026
72	Leeds	-	Kidacre Street - former gas works site	C3	Dwellings	450	Hypothetical	2020	2026
73	Leeds	-	Killingbeck Hospital - C LS14	C3	Dwellings	329	More than likely	2009	2015
74	Leeds	Kirkstall	KIRKSTALL ROAD AND MILFORD PLACE LS4	B1	GFA, SQM	20500	More than Likely	2014	2018
75	Leeds	Kirkstall	KIRKSTALL ROAD AND MILFORD PLACE LS4	B1	GFA, SQM	20370	More than Likely	2015	2018
76	Leeds	-	Knowsthorpe, Hunslet East LS9	C3	Dwellings	491	Near certain	2020	2026
77	Leeds	0	LAND AT HEWLETTS DEPOT BEZA RD LS10	B8	GFA, SQM	50898	Hypothetical	2021	2026
78	Leeds	Beeston & Holbeck	LAND INC PLOT 7 THE PIGGERIES BROWN LANE WEST LS 12	B2	GFA, SQM	47630	More than Likely	2012	2022
79	Leeds	Beeston & Holbeck	LAND INC PLOT 7 THE PIGGERIES BROWN LANE WEST LS 13	B8	GFA, SQM	47630	More than Likely	2012	2022
80	Leeds	0	LAND OFF MANOR ROAD INGRAM ROW & SWEET STREET	B1	GFA, SQM	14100	hypothetical	2016	2018
81	Leeds	-	Lane Side Farm Extension, Morley	C3	Dwellings	560	Hypothetical	2016	2026

Item	LA	Ward Code	Address	Land Use	Unit	Size	Classified certainty Level	Start Year	End Year
82	Leeds	-	Lane Side Farm, PAS Morley	C3	Dwellings	342	Hypothetical	2016	2026
83	Leeds	-	Lowfold, East Street	C3	Dwellings	358	Reasonably Foreseeable	2014	2020
84	Leeds	-	Lowfold, East Street	C3	Dwellings	450	More than likely	2020	2026
85	Leeds	-	Manston Lane - former Vickers Tank Factory Site, Cross Gates	C3	Dwellings	645	More than likely	2020	2026
86	Leeds	-	Marsh Lane Goods Yard	C3	Dwellings	385	Reasonably Foreseeable	2020	2026
87	Leeds	0	MATTHEW CLARK WAREHOUSE SKELTON MOOR FARM PONTEFRACT LANE LS9	B2	GFA, SQM	54096	Hypothetical	2026	2031
88	Leeds	0	MILLSHAW AND RING ROAD LS11	B1	GFA, SQM	11250	More than Likely	2011	2016
89	Leeds	-	Millshaw Park Industrial Estate, Millshaw Park Lane, Millshaw LS11	C3	Dwellings	334	Reasonably Foreseeable	2016	2026
90	Leeds	-	North of Lotherton Way, Hawks Nest Wood (west off), Garforth	C3	Dwellings	954	Hypothetical	2016	2026
91	Leeds	0	OFF MARSH STREET/ CARLTON LANE ROTHWELL LS26	B8	GFA, SQM	49596	hypothetical	2011	2021
92	Leeds	Pudsey	OFF TYERSAL LANE TYERSAL BD4	B1	GFA, SQM	14100	Reasonably Foreseeable	2016	2018
93	Leeds	-	Kirkstall Forge Abbey Road Leeds LS5	A1-5	GFA, SQM	3060	Reasonably Foreseeable	2012	2022
94	Leeds	City & Hunslet	OFFICE SCHEME WELLINGTON ROAD & GOTTS ROAD LEEDS 12	B1	GFA, SQM	19040	hypothetical	2016	2021
95	Leeds	Burmantofts & Richmond Hill	PONTEFRACT LANE LS 9	B1	GFA, SQM	12360	More than Likely	2012	2014
96	Leeds	Kirkstall	PREMISES OF A TAYLOR & SON WEAVER STREET LS4	B1	GFA, SQM	12596	Reasonably Foreseeable	2014	2016

Item	LA	Ward Code	Address	Land Use	Unit	Size	Classified certainty Level	Start Year	End Year
97	Leeds	Kirkstall	PREMISES OF A TAYLOR & SON WEAVER STREET LS4	B1	GFA, SQM	14000	More than Likely	2014	2017
98	Leeds	City & Hunslet	PT SITE 2 STOURTON POINT HAIGH PARK ROAD STOURTON LS10	B1	GFA, SQM	10100	Reasonably Foreseeable	2014	2016
99	Leeds	City & Hunslet	PT SITE 2 STOURTON POINT HAIGH PARK ROAD STOURTON LS10	B1	GFA, SQM	10660	Reasonably Foreseeable	2014	2015
100	Leeds	Calverley & Farsley	R/O HOLLY PK MILLS CALVERLEY	B2	GFA, SQM	39700	More than Likely	2013	2023
101	Leeds	Calverley & Farsley	R/O HOLLY PK MILLS CALVERLEY	B8	GFA, SQM	39700	More than Likely	2013	2023
102	Leeds	Calverley & Farsley	R/O LEIGH HOUSE VARLEY STREET PUDSEY LS25	B1	GFA, SQM	50380	More than Likely	2013	2023
103	Leeds	Calverley & Farsley	R/O LEIGH HOUSE VARLEY STREET PUDSEY LS25	B1	GFA, SQM	102190	Reasonably Foreseeable	2013	2026
104	Leeds	Cross Gates & Whinmoor	RED HALL RED HALL LANE LS17	B1	GFA, SQM	17340	Reasonably Foreseeable	2014	2017
105	Leeds	-	Ridge Road, East of	C3	Dwellings	7538	More than likely	2016	2026
106	Leeds	Morley South	RODS MILLS LA - HIGH ST MORLEY	B1	GFA, SQM	24830	Reasonably Foreseeable	2016	2021
107	Leeds	City & Hunslet	S/O 23-31 GLOBE ROAD LEEDS LS11	B1	GFA, SQM	11340	hypothetical	2014	2017
108	Leeds	0	S/O JOINERS WORKSHOP PARK TERRACE HEADINGLEY LS6	B8	GFA, SQM	47458	hypothetical	2012	2022
109	Leeds	0	S/O SAVILE HOUSE TRINITY STREET ARCADE LS1	B8	GFA, SQM	27040	Hypothetical	2026	2031
110	Leeds	0	S/O UNIT 15 ASTLEY LANE IND EST ASTLEY WAY LS26 8XT	B1	GFA, SQM	38840	Hypothetical	2021	2026
111	Leeds	0	S/O UNIT 15 ASTLEY LANE IND EST ASTLEY WAY LS26 8XT	B2	GFA, SQM	50898	Hypothetical	2021	2026
112	Leeds	Burmantofts & Richmond Hill	S/O WHOLESALE MARKETS NEWMARKET APPROACH LEEDS LS9	B1	GFA, SQM	53100	Reasonably Foreseeable	2016	2021
113	Leeds	-	Scotland Lane, Ling Bob, Horsforth	C3	Dwellings	1914	Hypothetical	2016	2026

Item	LA	Ward Code	Address	Land Use	Unit	Size	Classified certainty Level	Start Year	End Year
114	Leeds	-	Seacroft Hospital (rear of)	C3	Dwellings	320	Near certain	2015	2020
115	Leeds	-	Seacroft Hospital (rear of)	C3	Dwellings	400	Hypothetical	2020	2026
116	Leeds	Temple Newsam	SITE ADJ MERCADO CARPETS THORNES FARM WAY	B2	GFA, SQM	22200	Reasonably Foreseeable	2016	2021
117	Leeds	-	South Accommodation Road and Atkinson Street	C3	Dwellings	335	Reasonably Foreseeable	2016	2026
118	Leeds	-	Spofforth Hill, Wetherby LS22	C3	Dwellings	405	Near certain	2016	2026
119	Leeds	Calverley & Farsley	STANNINGLEY STATION LS 28	B1	GFA, SQM	11510	Reasonably Foreseeable	2013	2016
120	Leeds	Ardsley & Robin Hood	STATION LANE EAST ARDSLEY WF3	B2	GFA, SQM	17062	Hypothetical	2021	2026
121	Leeds	-	Station Road, Allerton Bywater	C3	Dwellings	334	Near certain	2009	2015
122	Leeds	-	Stourton Grange Farm (land at), Selby Road - Ridge Road, Garforth LS25	C3	Dwellings	6300	Reasonably Foreseeable	2016	2026
123	Leeds	Middleton Park	STOURTON NORTH LEEDS 10	B1	GFA, SQM	128500	More than Likely	2015	2025
124	Leeds	-	Sweet Street West (Land South of) Holbeck	C3	Dwellings	519	more than likely	2020	2026
125	Leeds	-	The Parade & The Drive LS9	C3	Dwellings	410	Hypothetical	2009	2012
126	Leeds	Ardsley & Robin Hood	THORPE HALL THORPE LANE THORPE WF3	B1	GFA, SQM	43050	Reasonably Foreseeable	2012	2022
127	Leeds	-	Wakefield Road and Barrowby Lane, Garforth	C3	Dwellings	575	More than likely	2016	2026
128	Leeds	-	Water Lane - Westbank	C3	Dwellings	346	hypothetical	2016	2026
129	Leeds	City & Hunslet	WELLBRIDGE INDUSTRIAL ESTATE GRAINGERS WAY LS12	B8	GFA, SQM	26160	near certain	2021	2026
130	Leeds	Farnley & Wortley	WHITEHALL PARK WHITEHALL ROAD LEEDS 12	B1	GFA, SQM	10275	Reasonably Foreseeable	2014	2016
131	Leeds	-	Whitehall Road - Doncasters LS12	C3	Dwellings	526	hypothetical	2016	2020
132	Leeds	-	Whitehall Road (south of) - Harpers Farm	C3	Dwellings	445	Hypothetical	2016	2026

Item	LA	Ward Code	Address	Land Use	Unit	Size	Classified certainty Level	Start Year	End Year
133	Leeds	-	Whitehall Road, Craven Park, Farnley	C3	Dwellings	570	Hypothetical	2016	2026
134	Leeds	-	Woodside Quarry, Ring Road West , Leeds	C3	Dwellings	472	more than likely	2014	2015
135	Leeds	00DAFH	Quarry Hill Eastgate Leeds LS9 8AW	A1-5	GFA, SQM	2770	near certain	2014	2016
136	Leeds	00DAFH	Land Bounded By Boar Lane, Briggate, Commercial Street, Albion Street Including Bank Street And Burton Arcade Leeds 1	A1-5	GFA, SQM	32010	near certain	2014	2021
137	Leeds	00DAFR	Bridge Road Leeds LS5	A1-5	GFA, SQM	6648	Reasonably Foreseeable	2014	2016
138	Leeds	00DAFH	Sweet Street Meadow Road And Jack Lane Leeds LS10	D2	GFA, SQM	8660	Hypothetical	2016	2021
139	Leeds	00DAFH	Sweet Street Meadow Road And Jack Lane Leeds LS10	C3	GFA, SQM	450	Hypothetical	2016	2021
140	Leeds	00DAFH	Sweet Street Meadow Road And Jack Lane Leeds LS10	B1	GFA, SQM	53100	Hypothetical	2016	2021
141	Leeds	00DAGC	Land Off Commercial Street And Meynell Avenue Rothwell Leeds LS26 0NY	A1-5	GFA, SQM	5000	More Than Likely	2010	2014
142	Leeds	00DAGD	Tesco	A1-5	GFA, SQM	7070	More Than	2012	2013

Item	LA	Ward Code	Address	Land Use	Unit	Size	Classified certainty Level	Start Year	End Year
			361 Roundhay Road Leeds LS8 4BU				Likely		
143	Leeds	00DAFH	Temple Works Marshall Street Holbeck Leeds LS1 1UL	D2	GFA, SQM	6400	More Than Likely	2010	2013
144	Leeds	00DAGF	Land Bounded By Bridge Street, New York Road, Regent Street And Gower Street LS2	A1-5	GFA, SQM	3424	Hypothetical	2014	2021
145	Leeds	00DAFH	Site Bounded By Clay Pit Lane, Inner Ring Road, Wade Lane, Jacob Street And Brunswick Terrace LS2	D2	GFA, SQM	19600	near certain	2014	2016
146	Leeds	-	Eastgate And Harewood Quarter Leeds 2	A1-5	GFA, SQM	93080	Reasonably Foreseeable	2014	2021
147	Leeds	-	Eastgate And Harewood Quarter Leeds 2	D2	GFA, SQM	13840	Reasonably Foreseeable	2014	2021
148	Leeds	-	Car Park Portland Crescent Leeds	D2	GFA, SQM	12300	Near Certain	2008	2009
149	Leeds	-	Doncaster Monk Bridge Ltd Whitehall Road Leeds	B1	GFA, SQM	69500	near certain	2014	2016
150	Leeds	-	Land At St Georges Road Middleton LS10	A1-5	GFA, SQM	6270	More Than Likely	2011	2013
151	Leeds	-	Sweet Street Meadow Road And Jack Lane Leeds LS10	B1	GFA, SQM	93070	Hypothetical	2016	2021
152	Leeds	-	Sweet Street Meadow Road And Jack Lane	D2	GFA, SQM	8910	Hypothetical	2016	2021

Item	LA	Ward Code	Address	Land Use	Unit	Size	Classified certainty Level	Start Year	End Year
			Leeds LS10						
153	Leeds	-	Sweet Street Meadow Road And Jack Lane Leeds LS10	A1-5	GFA, SQM	3980	Hypothetical	2016	2021
154	Leeds	-	Whitehall Road Leeds LS12	B1	GFA, SQM	22000	hypothetical	2013	2023
155	Leeds	-	Eastgate And Harewood Quarter Leeds 2 - John Lewis	A1-5	GFA, SQM	24000	More than Likely	2014	2021

Modelling Technical Note 8: Connectivity to LBIA Feasibility Study – Variable Demand Model Testing (Draft v1)

Prepared by: Adam Truman Date: 13th Sep 2014

Checked by: Date:

Introduction

This note describes the variable demand model testing that has been undertaken for the highway schemes for the study. The approach has been based on the guidance set out in TAG Unit M2 Variable Demand Modelling.

Approach

The TAG Unit describes that it would be acceptable in general to use a fixed demand assessment where the resulting difference in suppressed/included traffic when using a variable demand model do not change benefits resulting from a scheme by more than 10% in the opening year and 15% in the forecast year (10 to 15 years later) relative to a fixed demand case.

The approach for undertaking this test has been to use an own-cost elasticity function to reflect demand response (model variable demand) as opposed to running the LTM demand model which would be too time consuming to set up and run, and dis-proportional to the stage of scheme appraisal.

The own cost elasticity function follows the power function described in the TAG Unit Appendix A Elasticity Models (Figure 1). Note that the variable growth relative to an earlier base year is irrelevant and has therefore been ignored.

Figure 1 Own Cost Elasticity Power Function

$$T_{ij} = g_{ij} *_0 T_{ij} * \left(\frac{G_{ij}}{{}_0G_{ij}} \right)^A$$

Where:

T_{ij} is the forecast number of trips between zones i and j

G_{ij} is the forecast disutility or generalised cost

g_{ij} is the forecast growth rate relative to an earlier or base year

${}_0T_{ij}$ is the number of trips in the earlier or base year

${}_0G_{ij}$ is the disutility or generalised cost in the earlier or base year

A is the elasticity, which should be negative and is the same for all trips in the same user class.

The TAG Unit sets out recommended starting values for elasticity of demand with respect to journey time. These are set out in the TAG Unit Table A1 Derived Long-Term Elasticities for Different Purposes. The Time elasticity – High model competition including time switching values have been selected as most appropriate. Within the study area there is significant model competition. The elasticities are set out in Table 1 below.

Table 1 Elasticities from TAG Unit M2 Variable Demand Modelling (Long Term Car Journey Time Elasticities)

Purpose	Time Elasticity – High model competition including time-switching
HB Work	-0.48
Employer's Business	-0.96
Essential Other	-0.65
Discretionary Other	-0.5

The model segments demand by the following user classes:

- Car Personal Low Income (<15k);
- Car Personal Medium Income (£15k to £30k);
- Car Personal High Income (>£30k);
- Car Employers Business;
- LGV; and
- OGV.

Therefore the elasticities have been converted to fit with these purposes using proportions from the WebTAG data book, Table A 1.3.4 Proportion of trips made in work and non-work time (vehicle trips). As the proportions vary by time period, a set of elasticities have been produced for each. The elasticities are presented in Table 2 below.

Table 2 Elasticities converted to fit with model purposes

Purpose	Elasticity by purpose/ time period		
	AM	IP	PM
Car Personal	-0.53	-0.56	-0.54
Car Employers Business	-0.96	-0.96	-0.96
LGV	-0.96	-0.96	-0.96
OGV	-0.96	-0.96	-0.96

Results

Link Road

The following Saturn network results are presented;

- Flow difference plots, showing the change between the original test flows and the Variable demand model test flows
- Travel time difference plots, showing the change between the original test flows and the Variable demand model test flows

Flow differences Variable demand model – original model (Actual flow pcu/ hr)

Figure 2 2031 AM

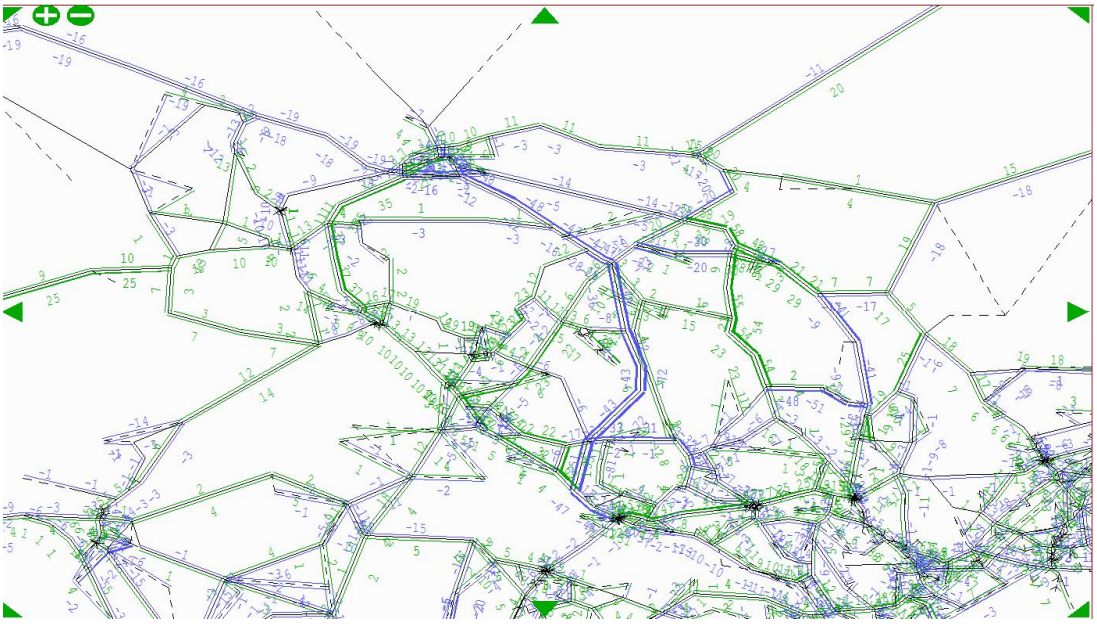


Figure 3 2031 IP

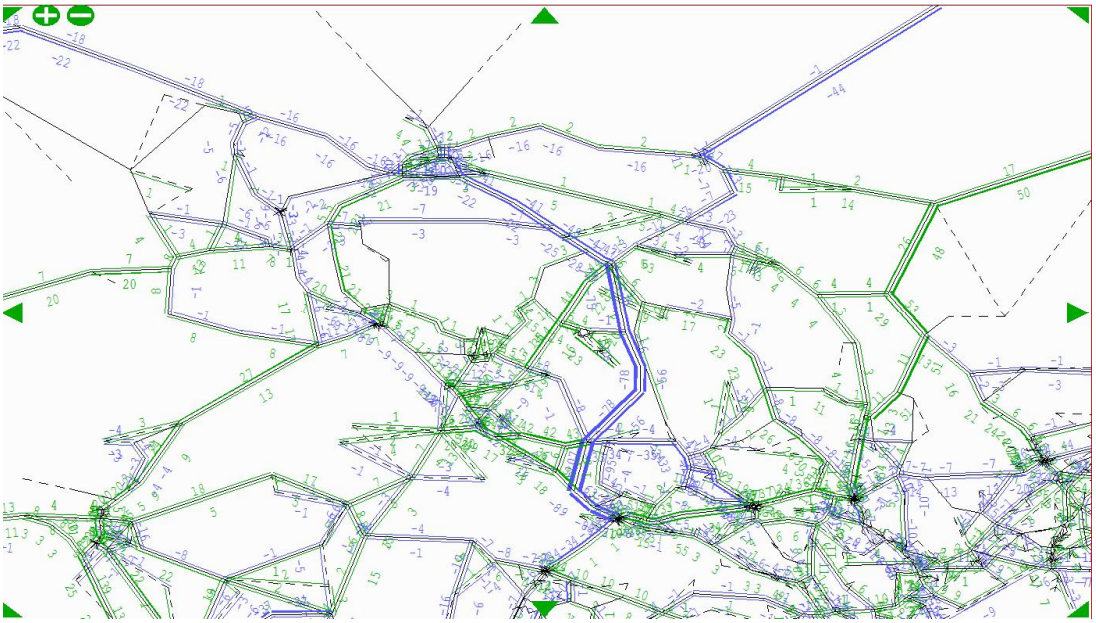
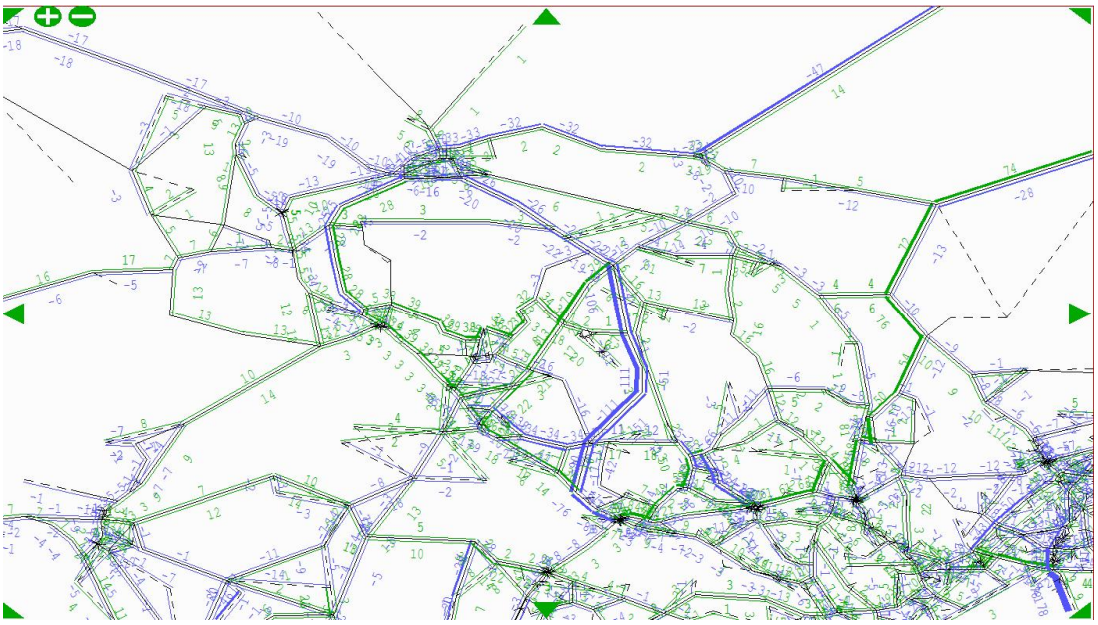


Figure 4 2031 PM



Travel time differences Variable demand model – original model (seconds)

Figure 5 2031 AM

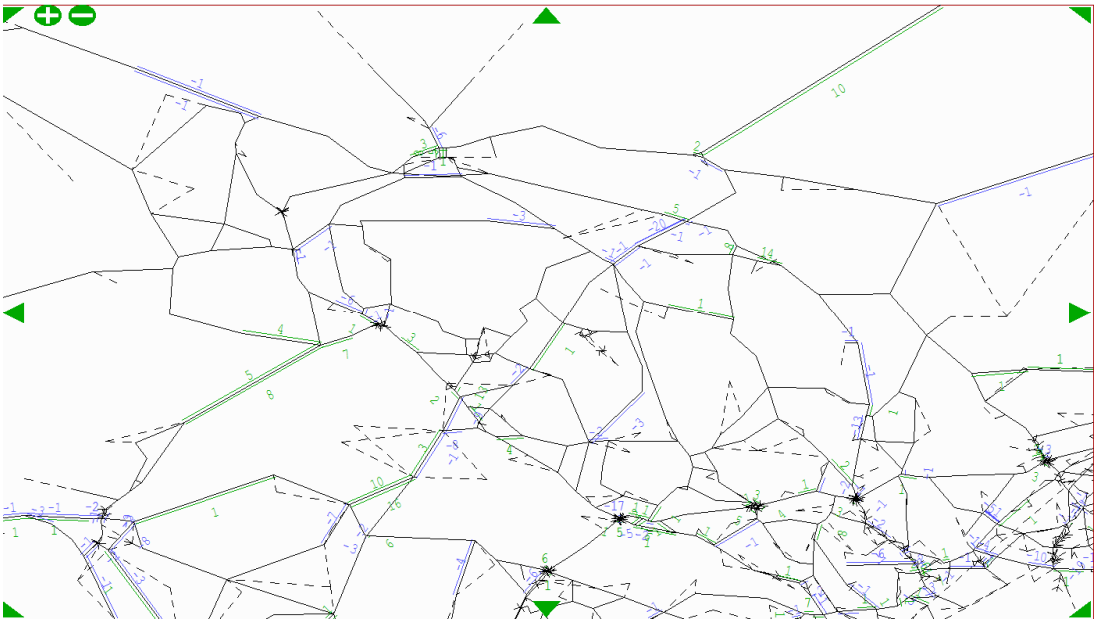


Figure 6 2031 IP

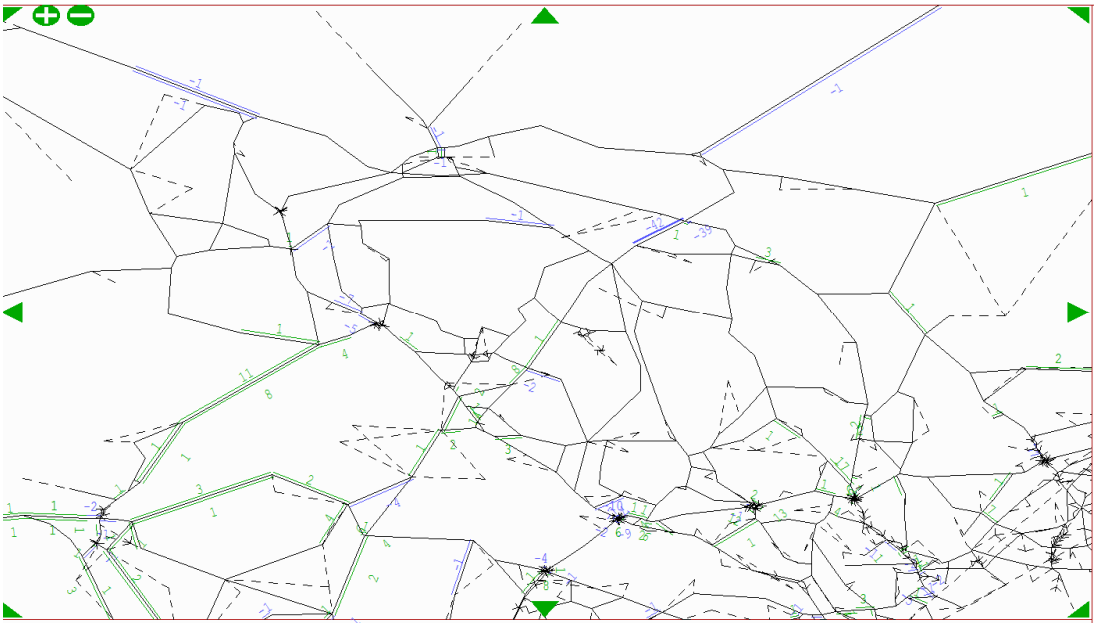
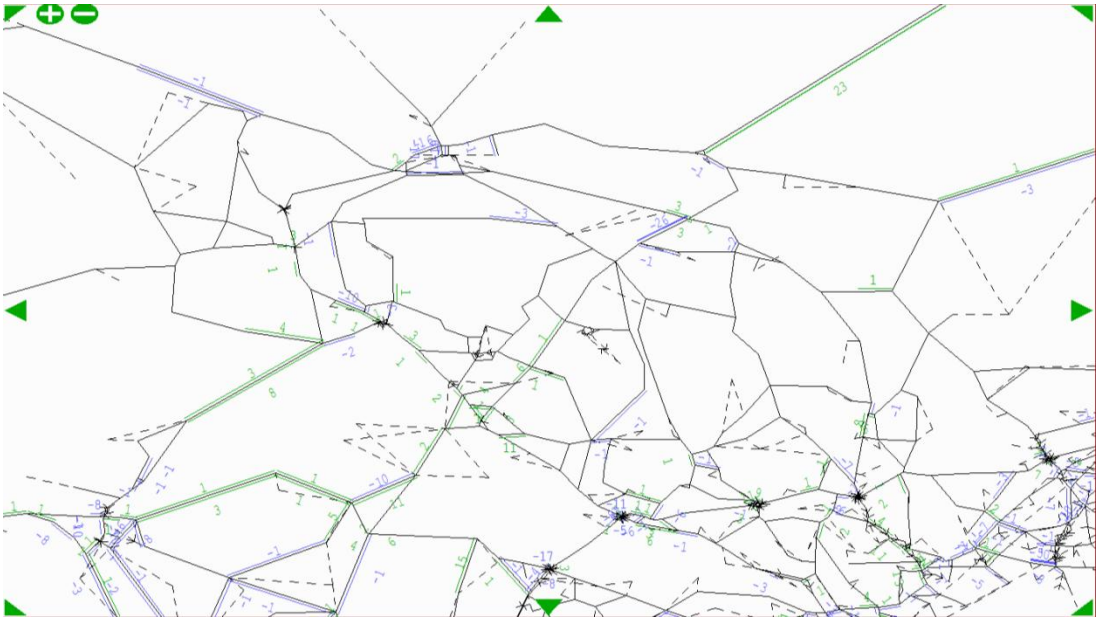


Figure 7 2031 PM



The flow difference plots show that the traffic flows on the link road have reduced as a result of the variable demand matrix adjustment. This can be justified by considering the range of positive and negative cost changes, associated demand adjustments and the net impact on demand re-assignment.

Tuba Results

The following results are presented from the Tuba runs

- Demand totals
- User Time Benefits; and
- BCR

Figure 8 Tuba matrix demand

Year	Period	DM	Orig	VDM	VDM-Orig
2021	AM peak	51047	51028	51234	0.4%
2021	PM peak	52786	52792	52933	0.3%
2021	Inter-peak	186144	186042	186538	0.3%
2021	All	289976	289862	290704	0.3%
2031	AM peak	55555	55542	55728	0.3%
2031	PM peak	57275	57267	57486	0.4%
2031	Inter-peak	212715	212636	213442	0.4%
2031	All	325545	325445	326657	0.4%

Figure 9 User Time Benefits

Period	Year	User Time Benefits		VDM-Orig
		Orig	VDM	
AM peak	2021	592	417	-30%
AM peak	2031	507	260	-49%
PM peak	2021	621	337	-46%
PM peak	2031	765	55	-93%
Inter-peak	2021	1338	1259	-6%
Inter-peak	2031	1853	1478	-20%
AM peak	Total	24917	13349	-46%
PM peak	Total	36147	4113	-89%
Inter-peak	Total	86612	70121	-19%

Figure 10 BCR

	Orig	VDM
BCR	4.867	2.741

The Tuba results generally reflect the impacts shown in the Saturn network plots. While there are only negligible increases in network wide demand, the changes in user benefits are more significant showing a reduction across all time periods and years, most notably in the PM peak. The BCR has also reduced significantly.

Package 1

The following Saturn network results are presented;

- Flow difference plots, showing the change between the original test flows and the Variable demand model test flows

- Travel time difference plots, showing the change between the original test flows and the Variable demand model test flows

Flow differences Variable demand model – original model (Actual flow pcu/ hr)

Figure 11 2031 AM

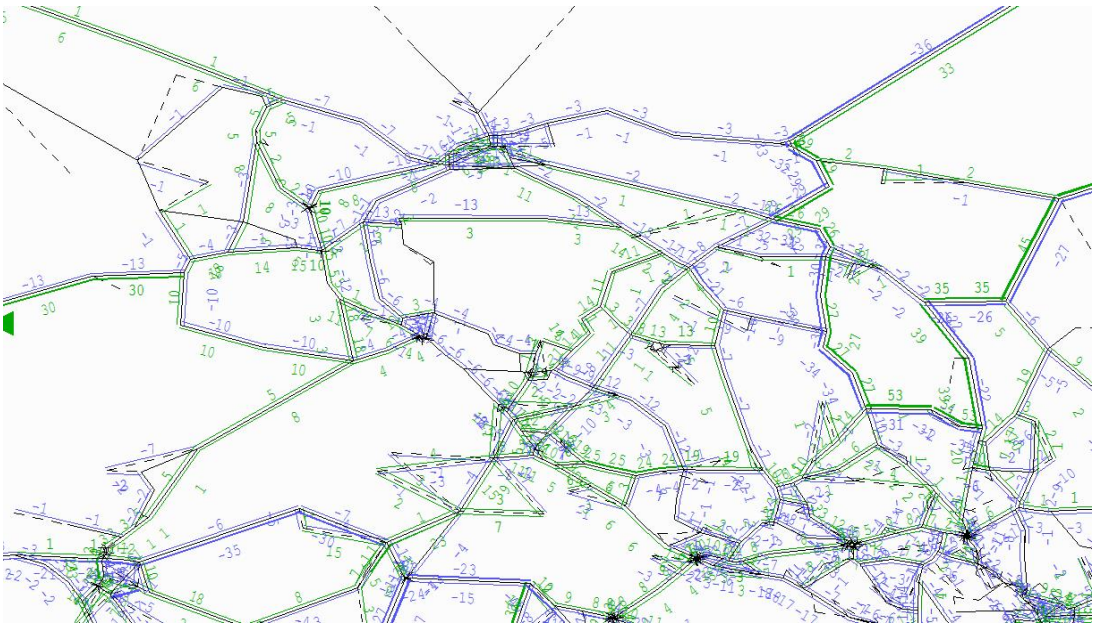


Figure 12 2031 IP

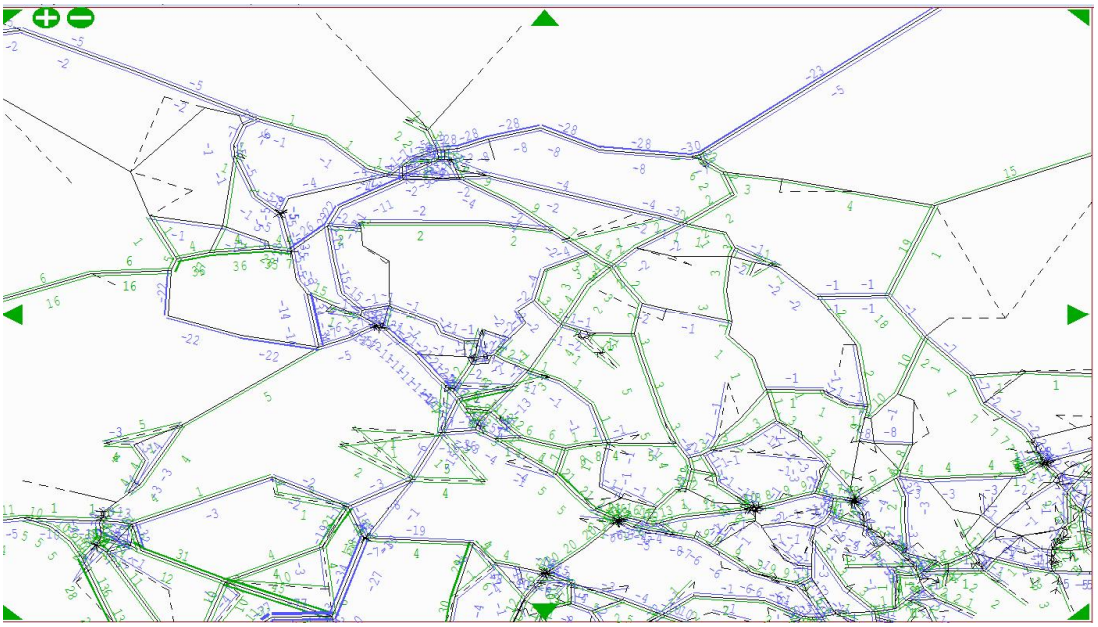
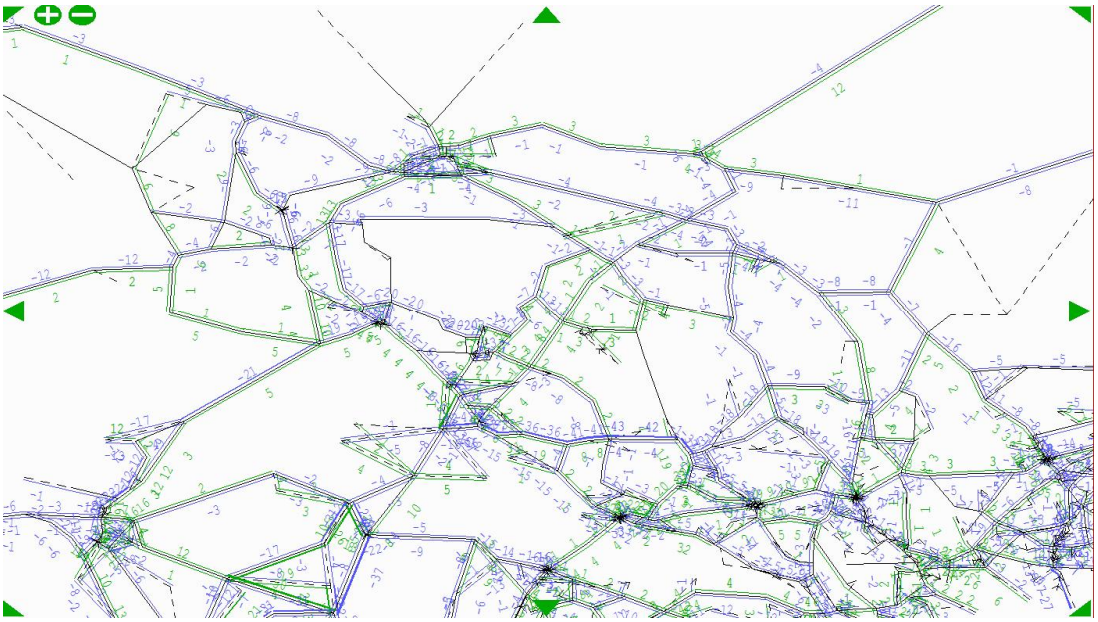


Figure 13 2031 PM



Travel time differences Variable demand model – original model (seconds)

Figure 14 2031 AM

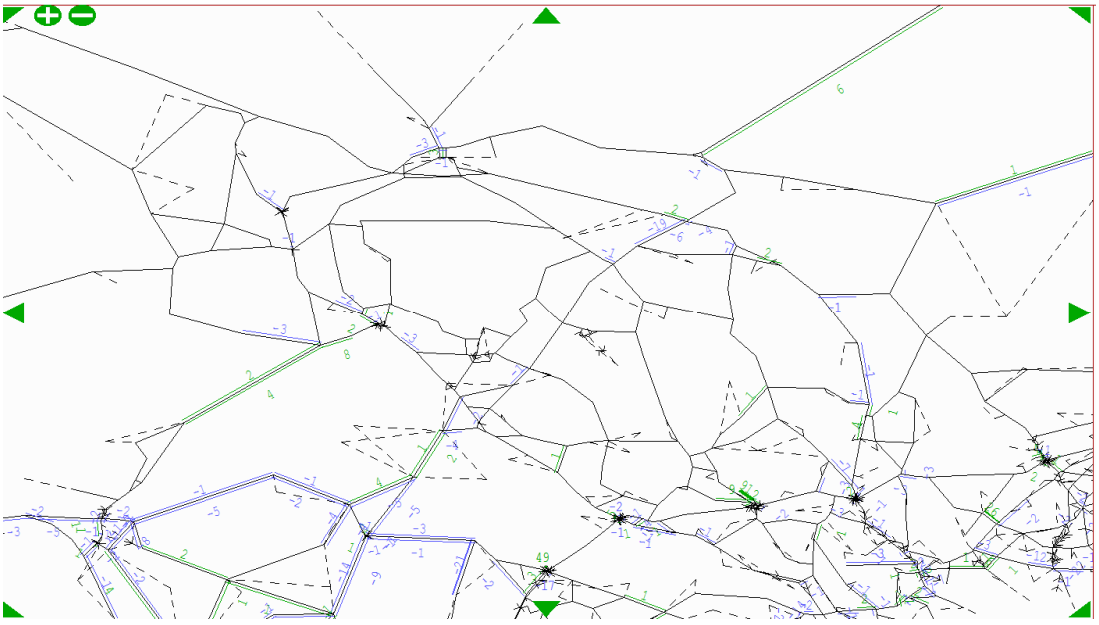


Figure 15 2031 IP

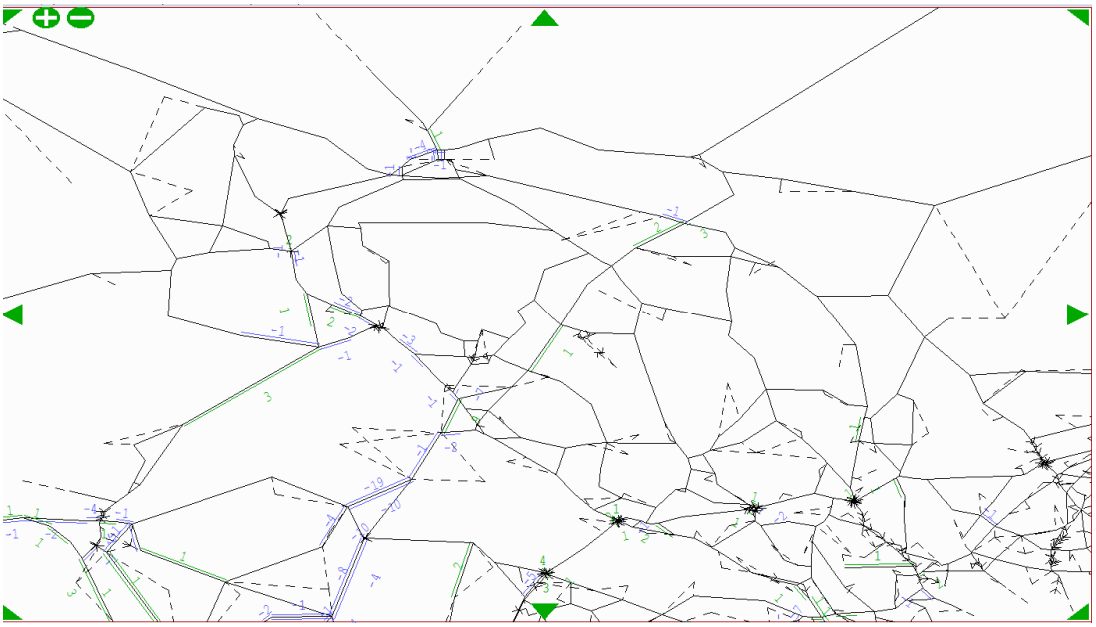
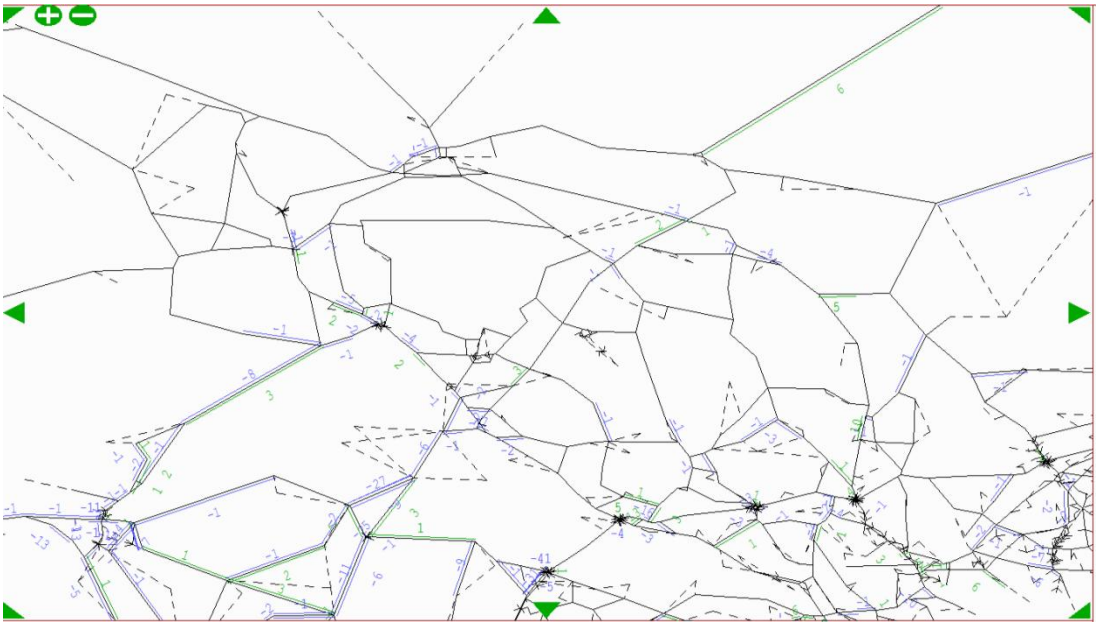


Figure 16 2031 PM



The flow difference plots show on small change along the Bradford and Harrogate corridor.

Tuba Results

The following results are presented from the Tuba runs

- Demand totals;
- User Time Benefits; and
- BCR.

Figure 17 Tuba matrix demand

Year	Period	DM	Orig	VDM	VDM-Orig
2021	AM peak	51047	51088	51145	0.1%
2021	PM peak	52786	52798	52901	0.2%
2021	Inter-peak	186144	186059	186305	0.1%
2021	All	289976	289945	290352	0.1%
2031	AM peak	55555	55606	55658	0.1%
2031	PM peak	57275	57312	57408	0.2%
2031	Inter-peak	212715	212710	212816	0.0%
2031	All	325545	325627	325882	0.1%

Figure 18 User Time Benefits

Period	Year	User Time Benefits		VDM-Orig
		Orig	VDM	
AM peak	2021	418	-52	-112%
AM peak	2031	360	-121	-134%
PM peak	2021	351	26	-93%
PM peak	2031	363	-288	-179%
Inter-peak	2021	766	713	-7%
Inter-peak	2031	420	751	79%
AM peak	Total	17676	-5458	-131%
PM peak	Total	17464	-12235	-170%
Inter-peak	Total	22068	36001	63%

Figure 19 BCR

	Orig	VDM
BCR	10.327	3.221

The results show only a negligible increase in network wide demand. Change in user benefits is significant showing a reduction in user benefits and in fact di-benefit in the AM and PM. The BCR has also reduced significantly.

Conclusion

The results show that the impact of the variable demand model test is significant exceeding the benefits change threshold set out in TAG Unit M2 Variable Demand Modelling. The results show a reduction rather than increase in benefits brought about by the change in demands, which for both schemes is an overall net increase but consisting of a series of demand increases and decreases associated with the respective generalised journey time changes brought about by the scheme inclusion.

The conclusion is that variable demand is significant and should be included for future scheme development.

Modelling Technical Note 9a: Connectivity to LBIA Feasibility Study – Public Transport Scheme Modelling Results for the OAR (Final)

Prepared by: Adam Truman Date: 9th Sep 2014

Checked by: Date:

1 Introduction

This note sets out details of the assumptions and results for the public transport scheme modelling, as follows:

- Modelling assumptions;
- Cost Assumptions;
- Option Assessment Framework (Value for Money) Economic Outputs;
    - All public transport schemes
    - Bus package component parts
- Generalised Cost Components;
- Demand Mode Shift; and
- Sensitivity Tests;
    - Rail schemes – no interchanging
    - Logit choice parameters
    - Wait curves

2 Modelling Assumptions

Table 1 sets out the public transport modelling assumptions. For the forecast years the demand shown has been growthed in line with the Department for Transport UK Aviation Forecasts (Central - Constrained) for Leeds Bradford International Airport.

Table 1 Modelling Assumptions

Scheme Type	**Scheme Details**	**Opening Year**	**Demand**	**Service Run Travel Time**	**Service Headway**	**Service Fares** (all fares from the PT model, shown below converted to 2014 prices)
Short / Medium Term	Package 2 - Express Bus Services	2016	2014 Bus Patronage Data: *Leeds Centre>LBIA* AM Pk Hr 20 pass/hr IP Avg Hr 20 pass/hr PM Pk Hr 22 pass/hr *Bradford Centre>LBIA* AM Pk Hr 2 pass/hr IP Avg Hr 4 pass/hr PM Pk Hr 7 pass/hr *Harrogate Centre>LBIA* AM Pk Hr 1 pass/hr IP Avg Hr 1 pass/hr PM Pk Hr 2 pass/hr CAA data 2010: York Centre>LBIA AM Pk Hr 4 pass/hr IP Avg Hr 5 pass/hr PM Pk Hr 6 pass/hr	*Leeds Centre>LBIA* Base: 34 mins Scheme: 32 mins *Bradford Centre>LBIA* Base: 38 mins Scheme: 30 mins *Harrogate Centre>LBIA* Base: 36 mins Scheme: 36 mins *York Centre>LBIA* Base: 72 mins (23 min rail + 34 min bus + 15 min int) Scheme: 59 mins	*Leeds Centre>LBIA* Base: 20 mins Scheme: 15 mins *Bradford Centre>LBIA* Base: 30 mins Scheme: 20 mins *Harrogate Centre>LBIA* Base: 60 mins Scheme: 20 mins *York Centre>LBIA* Base: rail 10 mins, bus 20 mins, assume combined 20 mins Scheme: 30 mins	*Leeds Centre>LBIA* Base & Scheme: £1.85 *Bradford Centre>LBIA* Base & Scheme: £1.80 *Harrogate Centre>LBIA* Base & Scheme: £1.96 *York Centre>LBIA* Base: rail £5.79, bus £1.85 Scheme: £3.14

Scheme Type	Scheme Details	Opening Year	Demand	Service Run Travel Time	Service Headway	Service Fares (all fares from the PT model, shown below converted to 2014 prices)
	Heavy Rail - Horsforth LBIA (Interchange at Horsforth)	2021	2014 Bus Patronage Data: *Leeds Centre>LBIA* *Harrogate Centre>LBIA* (as above for Package 2)	Leeds Centre>LBIA Base: 34 mins Scheme: 26 mins (12 min rail leg_1 + 4 min rail leg_2 + 10 min int) Harrogate Centre>LBIA Base: 36 mins Scheme: 33 mins (19 min rail leg_1 + 4 min rail leg_2 + 10 min int)	Leeds Centre>LBIA Base: 20 mins Scheme: 30 mins *Harrogate Centre>LBIA* Base: 60 mins Scheme: 30 mins	*Leeds Centre>LBIA* Base: £1.85 Scheme: £2.29 *Harrogate Centre>LBIA* Base: £1.96 Scheme: £5.48
	LBIA Parkway Station (Harrogate Line)	2021	2014 Bus Patronage Data: *Leeds Centre>LBIA* *Harrogate Centre>LBIA* (as above for Package 2)	*Leeds Centre>LBIA* *Harrogate Centre>LBIA* As above for Heavy Rail - Horsforth LBIA	*Leeds Centre>LBIA* *Harrogate Centre>LBIA* As above for Heavy Rail - Horsforth LBIA	*Leeds Centre>LBIA* *Harrogate Centre>LBIA* As above for Heavy Rail - Horsforth LBIA
Long Term	Heavy Rail - Guiseley - LBIA - Horsforth	2026	2014 Bus Patronage Data: *Leeds Centre>LBIA* *Bradford Centre>LBIA* *Harrogate Centre>LBIA* (as above for Package 2)	*Leeds Centre>LBIA* *Harrogate Centre>LBIA* As above for Heavy Rail - Horsforth LBIA *Bradford Centre>LBIA* Base: 38 mins Scheme: 29 mins (15 min rail leg_1 + 4 min rail leg_2 + 10 min int)	*Leeds Centre>LBIA* *Harrogate Centre>LBIA* As above for Heavy Rail - Horsforth LBIA *Bradford Centre>LBIA* Base: 30 mins Scheme: 30 mins	*Leeds Centre>LBIA* *Harrogate & Centre>LBIA* *As above for Heavy* Rail - Horsforth LBIA *Bradford Centre>LBIA* Base: Base: £1.80 Scheme: £2.30

3 Cost Assumptions

The cost assumptions for the public transport scheme appraisal are set out in Table 2 below.

Table 2 Cost Assumptions

Scheme Type	Scheme Details	Scheme Costs (£)				Assumptions
		Capital Costs	Operating / Maintenance	Price Base	Delivery Period	
Short / Medium Term	Package 2 - Express Bus Services					Costs based on consultant estimates. Capital cost per vehicle = £140,000; £201,600 including 44% OB, Low Floor Single Deck operating 7 days over an 18 hour day span. Capital Cost per vehicle spread over 5 years (£28k/year). Operating cost per vehicle = £117,000 per year. Assumes low floor single deck operating 7 days over an 18 hour day span.
	■ *For competing services*	2,822,400	1,638,000 per year	2014	1 year	Required vehicles: - Leeds Express = 4 veh/hr (15 min headway). - Bradford & Harrogate Express = 6 veh/hr (20 min headway). - York Express = 4 veh/hr (30 min headway).
	■ *For upgrading existing services*	1,814,400	1,053,000 per year	2014	1 year	Required vehicles: - Leeds Express = 1 veh/hr (15 min headway). - Bradford & Harrogate Express = 4 veh/hr (20 min headway). - York Express = 4 veh/hr (30 min headway).
	Heavy Rail - Horsforth LBIA (Interchange at Horsforth)	70,230,000	590,000 per year	2012	5 years	Costs based on Aecom review of proposed scheme to LBIA. Light rail costs scaled for heavy rail estimates. Includes 66% OB.
	LBIA Parkway Station (Harrogate Line)	7,784,000	161,000 per year	2011	5 years	Costs based on consultants estimates using costs for a similar size station. Includes 44% OB.
Long Term	Heavy Rail - Guiseley - LBIA - Horsforth	168,220,000	1,360,000 per year	2012	5 years	Costs based on Aecom review of proposed scheme to LBIA. Light rail costs scaled for heavy rail estimates. Includes 66% OB.

4 Option Assessment Framework (Value for Money) Economic Outputs

4.1 All schemes

Table 3 below sets out the option assessment framework (value for money) economic outputs for the public transport schemes, based on Tuba outputs.

Note that the Vehicle Operating Costs (fuel and non-fuel) have not been calculated in Tuba, and therefore there are no greenhouse gas outputs.

Table 3 Economic Outputs – All Public Transport Schemes

Assessment Area	Output	Scheme Type / Package			
		Short / Medium Term			Long Term
		Package 2 – Express Bus Services (upgrading the existing service)	Heavy Rail – Horsforth LBIA (Interchange at Horsforth)	LBIA Parkway Station (Harrogate Line)	Heavy Rail – Guiseley – LBIA – Horsforth
Impact on the Economy					
Business Users and Transport Providers	£ PVB Time Impacts	3,943	-11	-11	-82
	£ PVB Money Travel Costs	318	-14	-14	-3
	£ PVB Revenue	-605	-301	-301	-287
Greenhouse Gases	£ PVB	Not Quantified	Not Quantified	Not Quantified	Not Quantified
Impact on the Society					
Non-business Users	£ PVB Time Impacts	24,533	-64	-64	-503
	£ PVB Money Travel Costs	9,815	-459	-459	-93
Public Accounts					
Cost to broad transport budget	£ PVC Central Government	0	0	0	0
	£ PVC Local Government	31,387	75,181	10,629	143,932
Indirect Tax	£ PVB Indirect Tax Revenues	-94	-46	-47	-44
Indicative Benefit Cost Ratio					
Cost to Private Sector	£ PVC Private Sector	0	0	0	0
Indicative Net Present Value	£ NPV	6,523	-76,076	-11,525	-144,944
Indicative Economic BCR	BCR	1.2	-0.0	-0.1	-0.0

4.2 Express Bus Service Component Parts

Table 4 sets out the option assessment framework (value for money) economic outputs for component parts of Package 2 – the express bus services scheme.

Table 4 Economic Outputs – Bus Component Parts (upgrading the existing service)

Assessment Area	Output	Scheme Type / Package			
		Package 2 – Express Bus Services			
		Leeds Service	Bradford – Harrogate Service; Bradford Section	Bradford – Harrogate Service; Harrogate Section	York Service
Impact on the Economy					
Business Users and Transport Providers	£ PVB Time Impacts	1864	703	150	1,226
	£ PVB Money Travel Costs	0	0	0	318
	£ PVB Revenue	4276	2054	141	-7076
Greenhouse Gases	£ PVB	Not Quantified	Not Quantified	Not Quantified	Not Quantified
Impact on the Society					
Non-business Users	£ PVB Time Impacts	11,604	4,254	947	7,728
	£ PVB Money Travel Costs	0	0	0	9815
Public Accounts					
Cost to broad transport budget	£ PVC Central Government	0	0	0	0
	£ PVC Local Government	3,487	6,975	6,975	13,950
Indirect Tax	£ PVB Indirect Tax Revenues	665	319	22	-1100
Indicative Benefit Cost Ratio					
Cost to Private Sector	£ PVC Private Sector	0	0	0	0
Indicative Net Present Value	£ NPV	14,922	355	-5,715	-3,039
Indicative Economic BCR	BCR	5.3	1.1	0.2	0.8

Table 5 Economic Outputs – Bus Component Parts (run competing services)

Assessment Area	Output	Scheme Type / Package

		Package 2 – Express Bus Services			
		Leeds Service	**Bradford – Harrogate Service; Bradford Section**	**Bradford – Harrogate Service; Harrogate Section**	**York Service**
Impact on the Economy					
Business Users and Transport Providers	£ PVB Time Impacts	1,448	605	133	1,226
	£ PVB Money Travel Costs	0	0	0	318
	£ PVB Revenue	3,417	1,826	126	-7,069
Greenhouse Gases	£ PVB	Not Quantified	Not Quantified	Not Quantified	Not Quantified
Impact on the Society					
Non-business Users	£ PVB Time Impacts	9,011	3,662	840	7,722
	£ PVB Money Travel Costs	0	0	0	9807
Public Accounts					
Cost to broad transport budget	£ PVC Central Government	0	0	0	0
	£ PVC Local Government	13,950	10,462	10,462	13,950
Indirect Tax	£ PVB Indirect Tax Revenues	531	283	20	-1,099
Indicative Benefit Cost Ratio					
Cost to Private Sector	£ PVC Private Sector	0	0	0	0
Indicative Net Present Value	£ NPV	457	-4,086	-9,343	-3,044
Indicative Economic BCR	BCR	1.0	0.6	0.1	0.8

5 Generalised Cost Components

Figure 1 to Figure 9 show the modelled generalised cost component parts for each scheme. The results for each year and scenario are presented as an aggregation of the AM, IP and PM generalised costs averaged using the annualisation factor proportions.

Perceived (Perc) elements are shown in terms of their difference from the actual (Act) elements. So for example where the actual wait time is 1 minute, and the perceived wait time is 2.85 minutes, the charts show the actual wait time as 1 minute and the perceived as 2.85 - 1 minute = 1.85 minutes.

Perceived wait and transfer times include weight factors and boarding / transfer penalties from the Leeds Public Transport model.

Charts for package 2 – express bus services represent upgrades to the existing services.

Figure 1 Package 2 – Express Bus Services: Leeds Service (Short / Med Term)

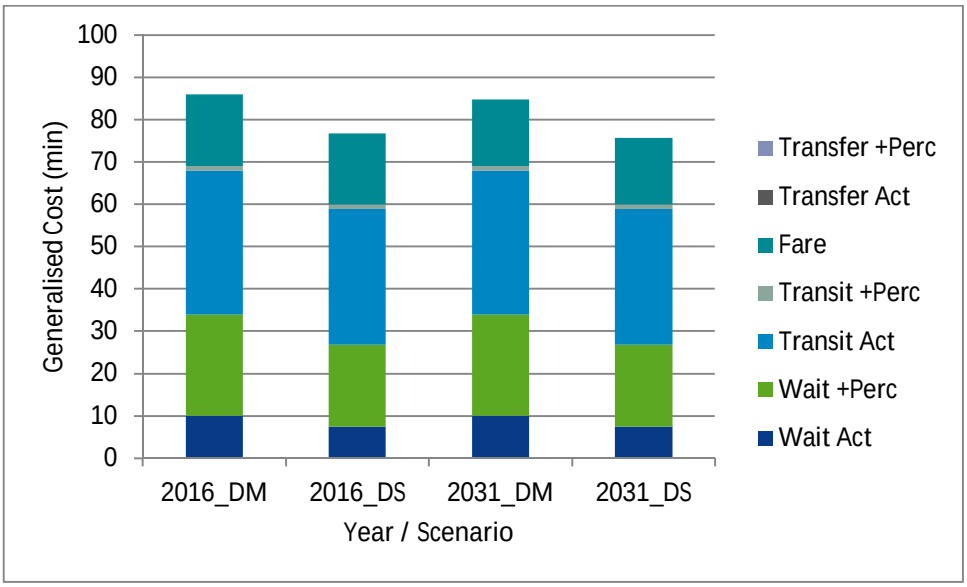


Figure 2 Package 2 – Express Bus Services: Bradford – Harrogate Service; Bradford Section (Short / Med Term)

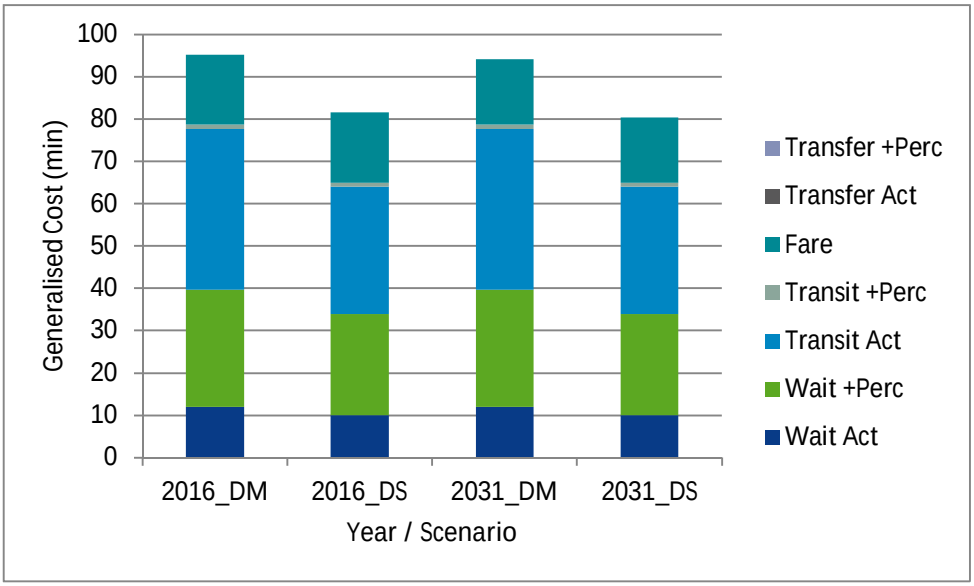


Figure 3 Package 2 – Express Bus Services: Bradford – Harrogate Service; Harrogate Section (Short / Med Term)

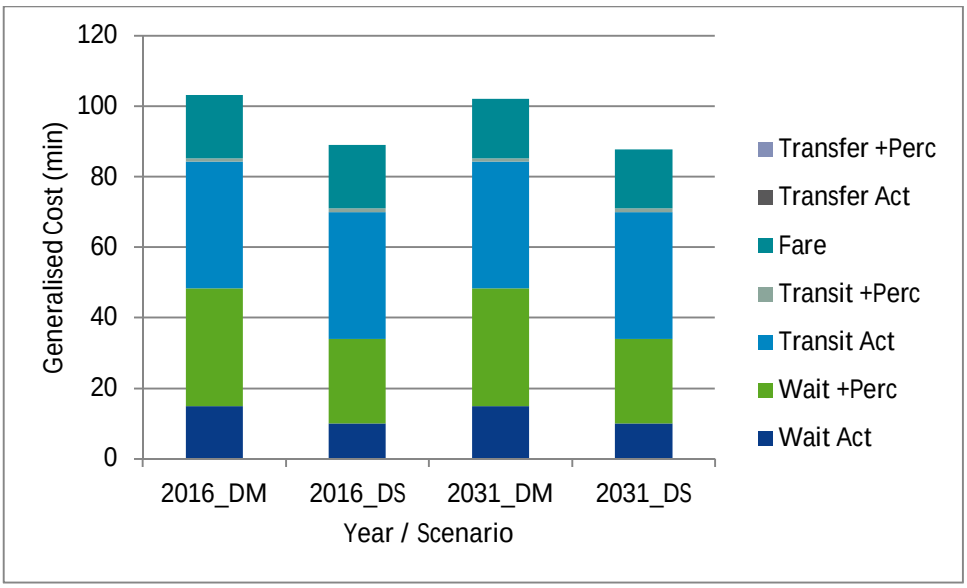


Figure 4 Package 2 – Express Bus Services: York Service (Short / Med Term)

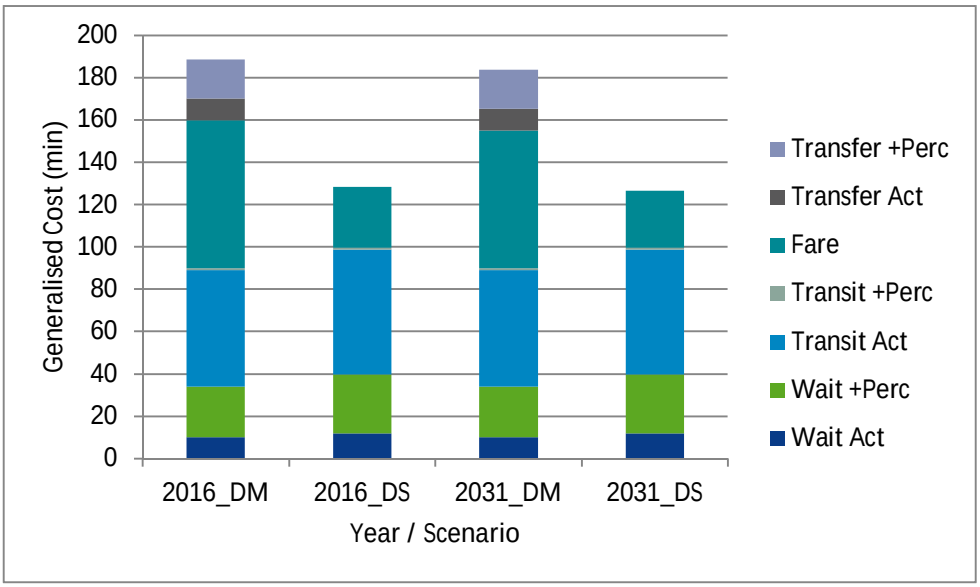


Figure 5 Heavy Rail – Horsforth LBIA (Interchange at Horsforth); Leeds Section (Short / Med Term)

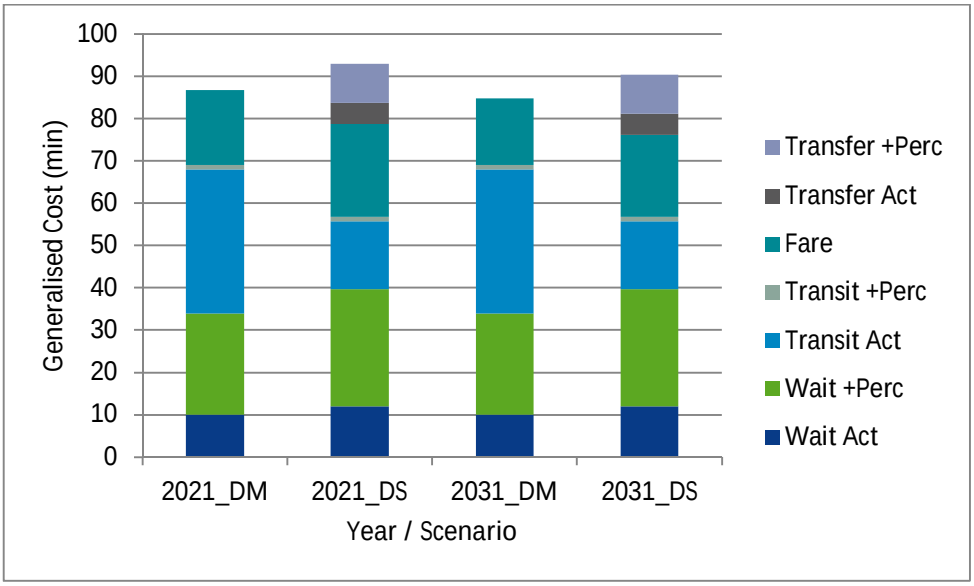


Figure 6 Heavy Rail – Horsforth LBIA (Interchange at Horsforth); Harrogate Section (Short / Med Term)

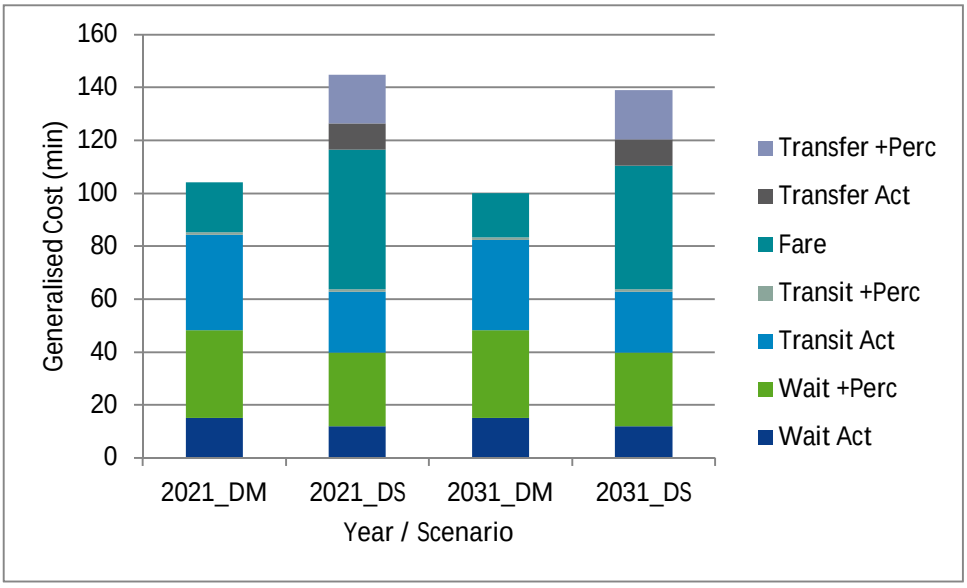


Figure 7 Heavy Rail – Guiseley – LBIA – Horsforth; Leeds Section (Long Term)

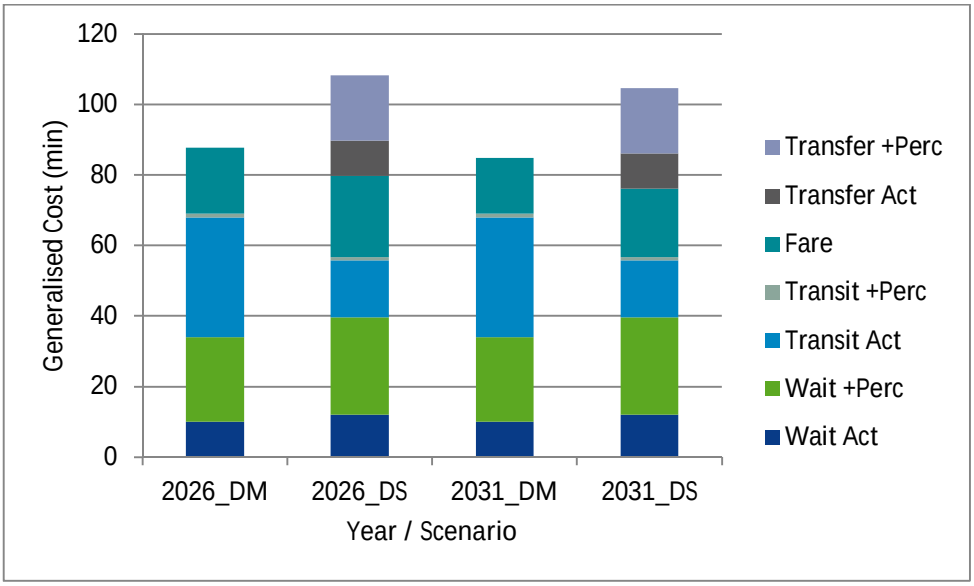


Figure 8 Heavy Rail – Guiseley – LBIA – Horsforth; Bradford Section (Long Term)

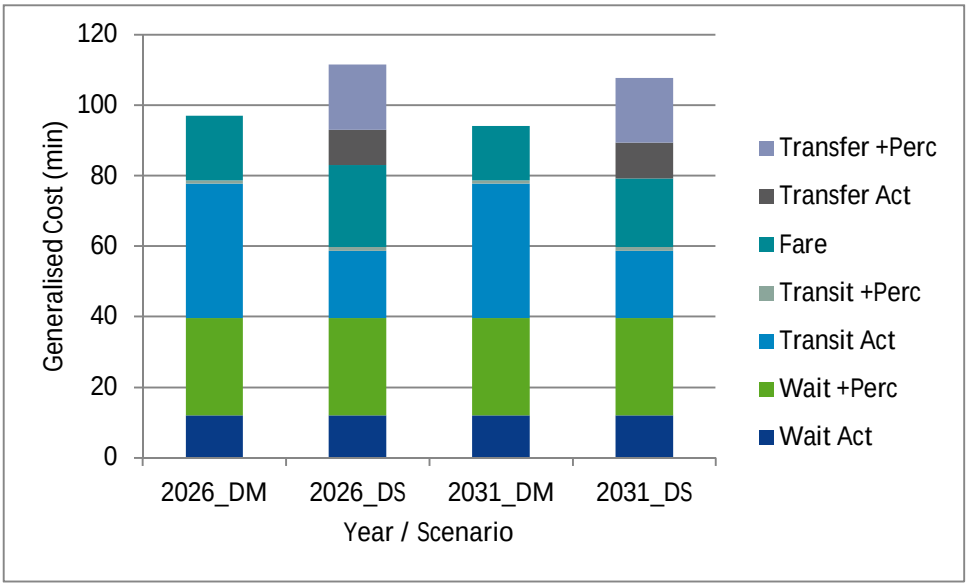
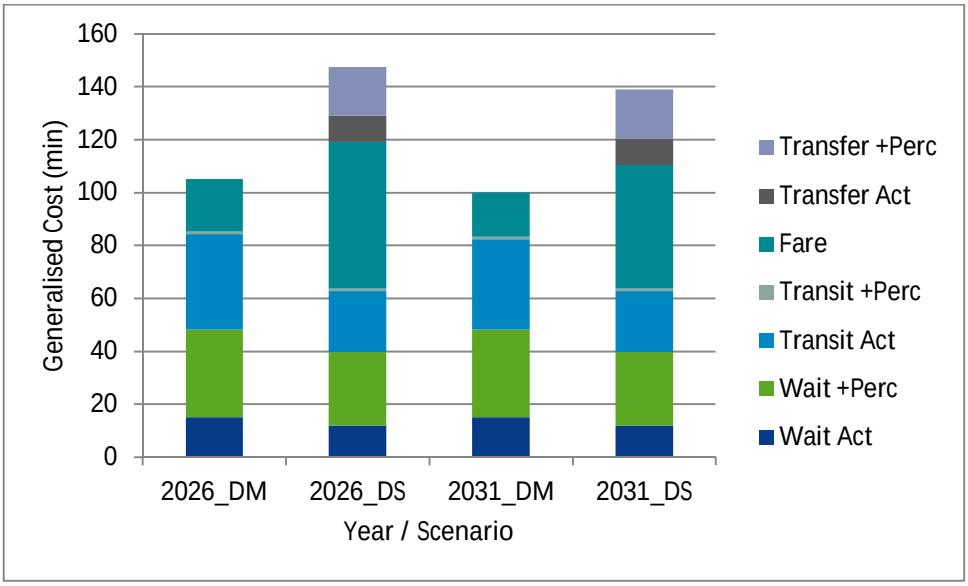


Figure 9 Heavy Rail – Guiseley – LBIA – Horsforth; Harrogate Section (Long Term)



6 Demand Mode Shift

Figure 10 to Figure 18 show the proportion of demand assigned to the different public transport options for each scheme, for each scenario and year. They provide an indication of the demand mode shift between public transport and highway, and also between the different public transport sub-mode options (existing public transport option, and scheme public transport option).

The scale of mode shift is dependent on the cost change when the public transport scheme is included, and the future year demand and cost included from the highway Saturn model.

Charts for package 2 – express bus services represent upgrades to the existing services.

Figure 10 Package 2 – Express Bus Services: Leeds Service (Short / Med Term)

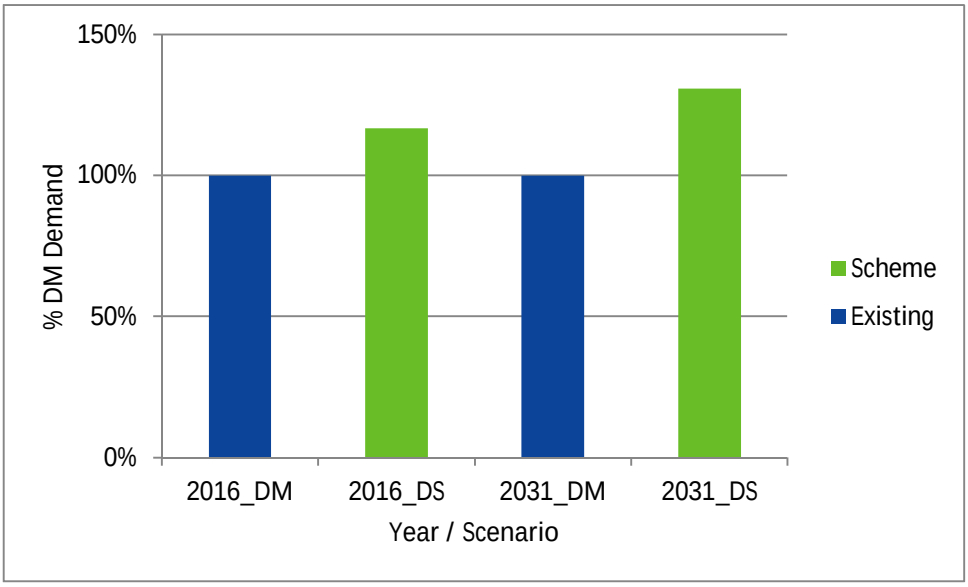


Figure 11 Package 2 – Express Bus Services: Bradford – Harrogate Service; Bradford Section (Short / Med Term)

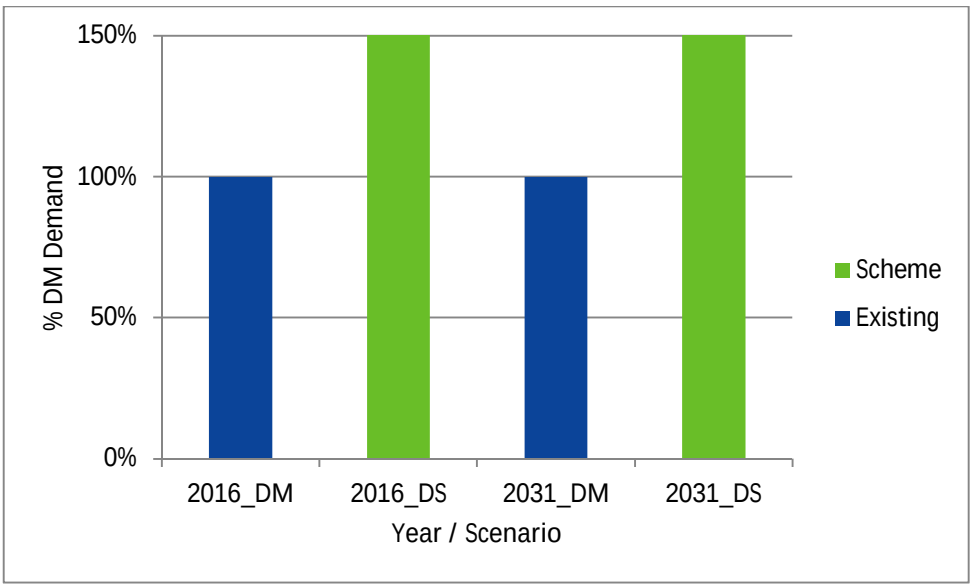


Figure 12 Package 2 – Express Bus Services: Bradford – Harrogate Service; Harrogate Section (Short / MedTerm)

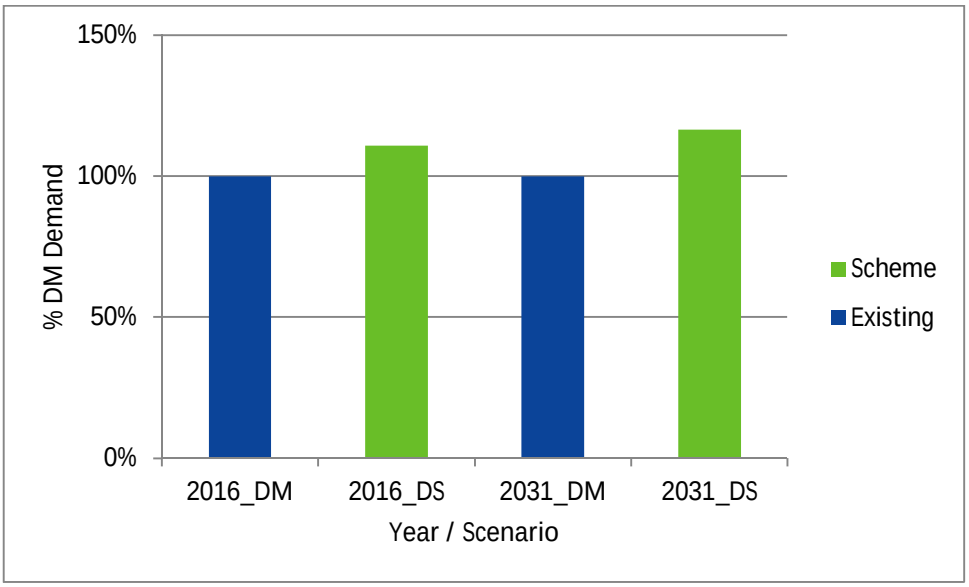


Figure 13 Package 2 – Express Bus Services: York Service (Short / Med Term)

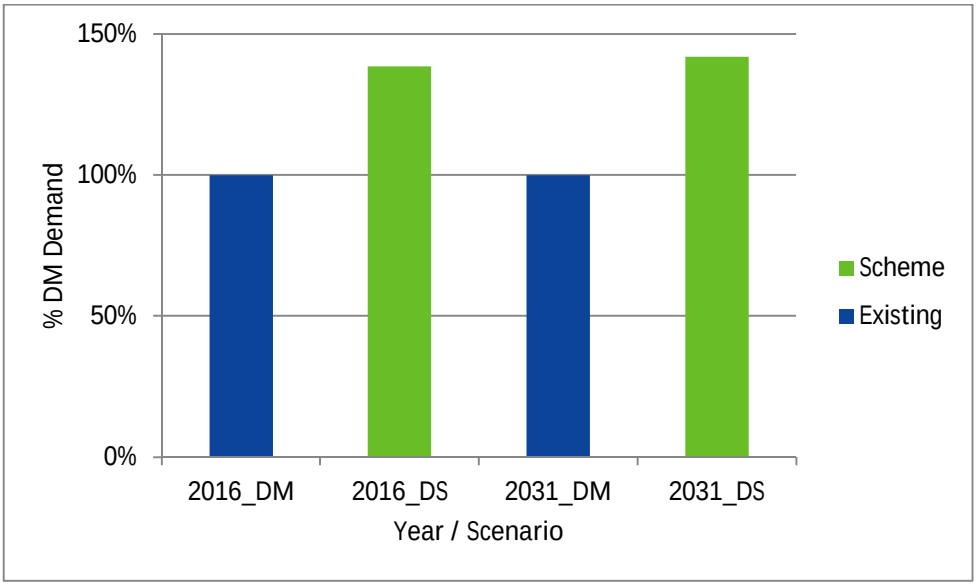


Figure 14 Heavy Rail – Horsforth LBIA (Interchange at Horsforth); Leeds Section (Short / Med Term)

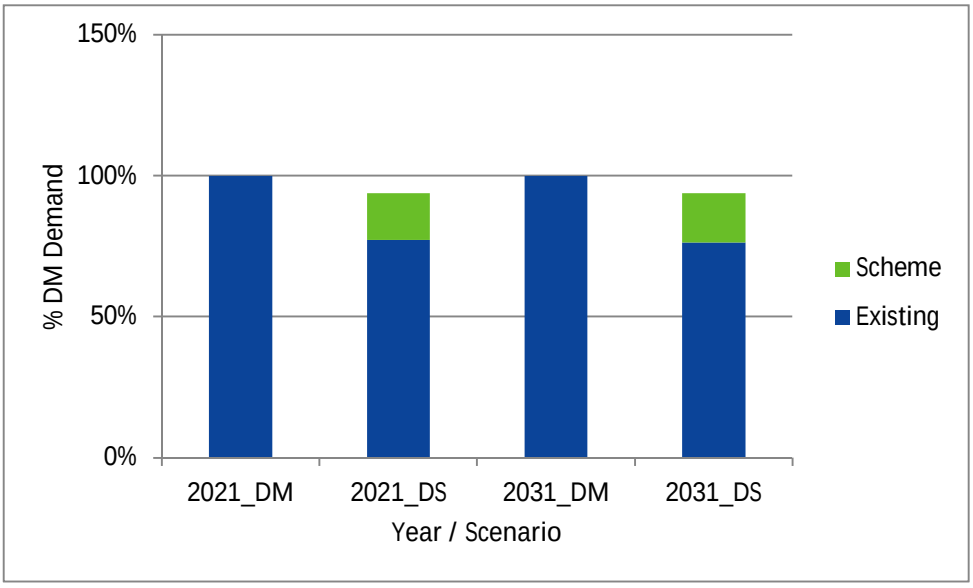


Figure 15 Heavy Rail – Horsforth LBIA (Interchange at Horsforth); Harrogate Section (Short / Med Term)

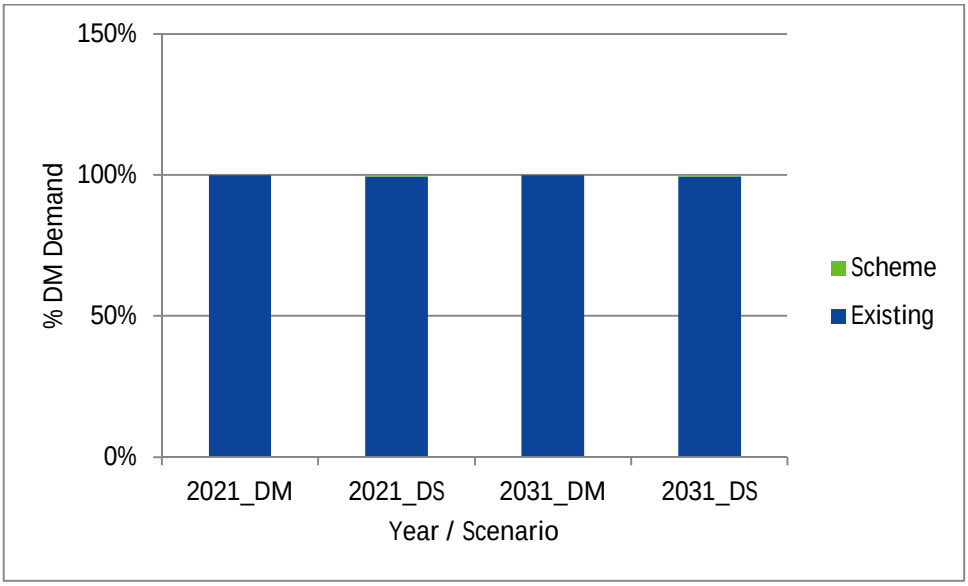


Figure 16 Heavy Rail – Guiseley – LBIA – Horsforth; Leeds Section (Long Term)

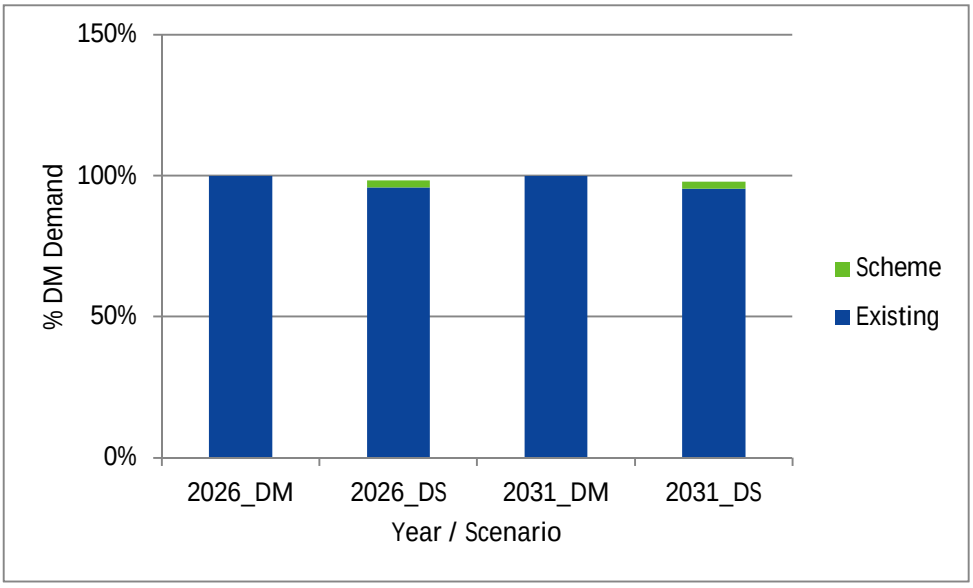


Figure 17 Heavy Rail – Guiseley – LBIA – Horsforth; Bradford Section (Long Term)

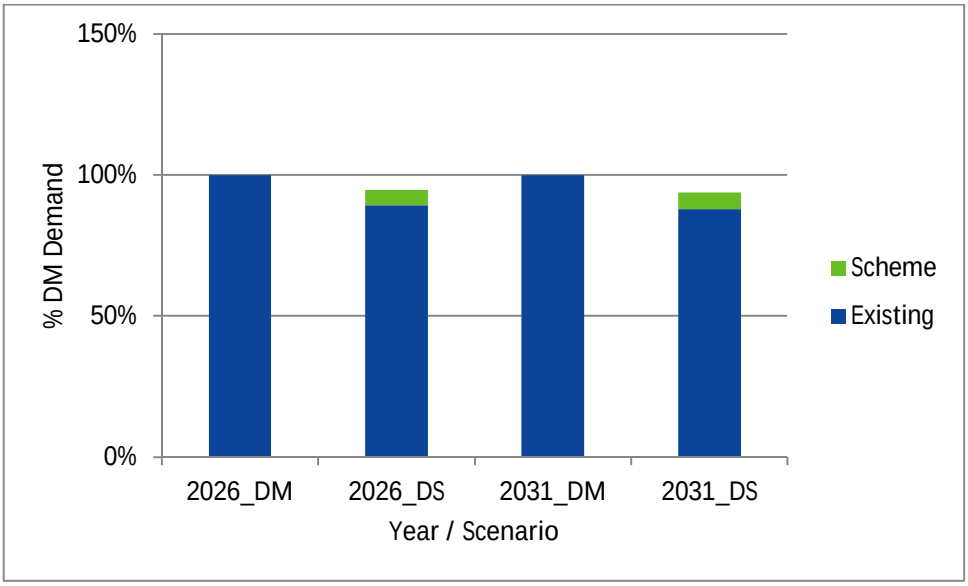
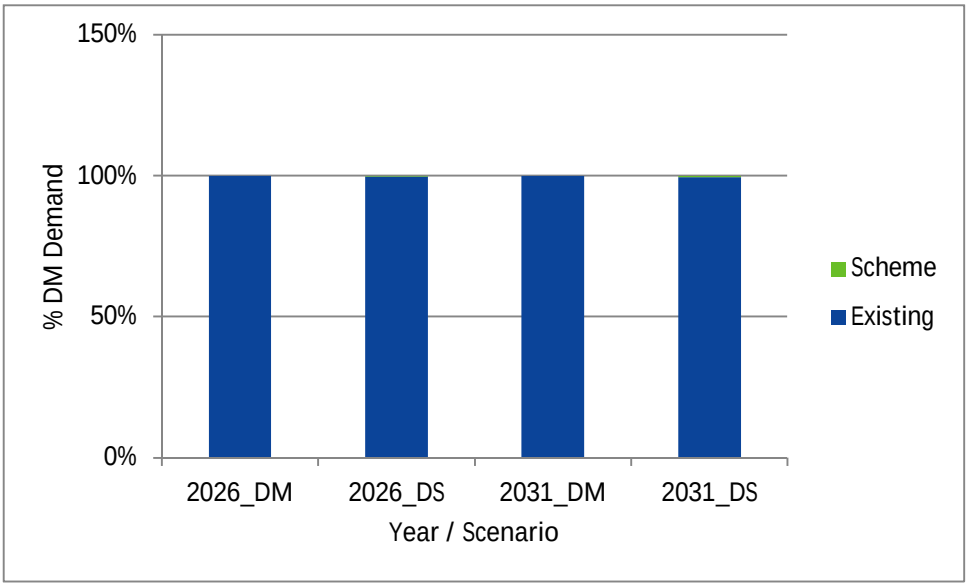


Figure 18 Heavy Rail – Guiseley – LBIA – Horsforth; Harrogate Section (Long Term)



7 Sensitivity Tests

7.1 Rail Schemes – No Interchanging

Table 6 shows the results of the rail scheme sensitivity tests, which involves removing the interchange time, therefore assuming direct rail services to the airport.

Table 6 Rail Schemes No Interchanging Sensitivity (or 5 minute for LBIA Parkway Station)

Assessment Area	Output	Scheme Type / Package		
		Short / Medium Term		Long Term
		Heavy Rail - Horsforth LBIA (Interchange at Horsforth)	LBIA Parkway Station (Harrogate Line)	Heavy Rail - Guiseley - LBIA - Horsforth
Impact on the Economy				
Business Users and Transport Providers	£ PVB Time Impacts	2,499	-9	3,324
	£ PVB Money Travel Costs	-85	-15	-96
	£ PVB Revenue	7,081	-269	8,950
Greenhouse Gases	£ PVB	Not Quantified	Not Quantified	Not Quantified
Impact on the Society				
Non-business Users	£ PVB Time Impacts	15,523	-52	20,474
	£ PVB Money Travel Costs	-2,725	-490	-3,046
Public Accounts				
Cost to broad transport budget	£ PVC Central Government	0	0	0
	£ PVC Local Government	75,181	10,629	143,932
Indirect Tax	£ PVB Indirect Tax Revenues	1,101	1,024	1,390
Indicative Benefit Cost Ratio				
Cost to Private Sector	£ PVC Private Sector	0	0	0
Indicative Net Present Value	£ NPV	-51,787	-10,440	-112,936
Indicative Economic BCR	BCR	0.3	0.0	0.2

7.2 Logit Choice Parameters

Table 7 shows the results of the logit choice parameters sensitivity tests. The tests have involved factoring both the mode choice and sub mode choice logit sensitivity parameters together, in the spreadsheet model, by +50% and -50%.

Table 7 Logit Choice Sensitivity (package 2 – upgrading the existing services)

Assessment Area	Output	Scheme Type / Package		
		Package 2 – Express Bus Services		
		Core	Core with logit parameter values factored +50%	Core with logit parameter values factored -50%
Impact on the Economy				
Business Users and Transport Providers	£ PVB Time Impacts	3,943	4,163	3,706
	£ PVB Money Travel Costs	318	324	310
	£ PVB Revenue	-605	4,121	-5,756
Greenhouse Gases	£ PVB	Not Quantified	Not Quantified	Not Quantified
Impact on the Society				
Non-business Users	£ PVB Time Impacts	24,533	25,926	23,013
	£ PVB Money Travel Costs	9,815	10,005	9,516
Public Accounts				
Cost to broad transport budget	£ PVC Central Government	0	0	0
	£ PVC Local Government	31,387	31,387	31,387
Indirect Tax	£ PVB Indirect Tax Revenues	-94	640	-895
Indicative Benefit Cost Ratio				
Cost to Private Sector	£ PVC Private Sector	0	0	0
Indicative Net Present Value	£ NPV	6,523	13,792	-1,493
Indicative Economic BCR	BCR	1.2	1.4	1.0

7.3 Wait curves

Table 8 shows the results of the wait curve sensitivity tests. The tests have involved changing the assumptions for the wait times, which are based on service headway. The core assumption was that the wait times were based on the wait curves used in the Leeds Transport Model. The sensitivity test assumption is that it is based on the example wait curve set out in TAG unit M3-2 public transport assignment modelling which is half headway with a maximum wait time of 7.5 minutes.

Table 8 Wait Curve Sensitivity (upgrading the existing services)

Assessment Area	Output	Scheme Type / Package			
		Package 2 – Express Bus Services			
		Leeds Service	Bradford – Harrogate Service; Bradford Section	Bradford – Harrogate Service; Harrogate Section	York Service
Impact on the Economy					
Business Users and Transport Providers	£ PVB Time Impacts	423	392	0	1,568
	£ PVB Money Travel Costs	0	0	0	323
	£ PVB Revenue	943	1,210	0	-6,817
Greenhouse Gases	£ PVB	Not Quantified	Not Quantified	Not Quantified	Not Quantified
Impact on the Society					
Non-business Users	£ PVB Time Impacts	2,630	2,383	0	9,882
	£ PVB Money Travel Costs	0	0	0	9,966
Public Accounts					
Cost to broad transport budget	£ PVC Central Government	0	0	0	0
	£ PVC Local Government	3,487	6,975	6,975	13,950
Indirect Tax	£ PVB Indirect Tax Revenues	147	188	0	-1060
Indicative Benefit Cost Ratio					
Cost to Private Sector	£ PVC Private Sector	0	0	0	0
Indicative Net Present Value	£ NPV	656	-2,802	-6,975	-88
Indicative Economic BCR	BCR	1.2	0.6	0.0	1.0

Modelling Technical Note 10: Connectivity to LBIA Feasibility Study – Distribution of Trips to and from the LIBA (Final)

Prepared by: Alistair Johnson Date: 9th Sep 2014

Checked by: Adam Truman Date: 9th Sep 2014

1. Introduction

This note details the trip distribution for trips to and from the Airport in the base 2008 and future years 2021 and 2031 models. The information is presented numerically and visually through flow plots taken directly from SATURN.

2. Base Model

Two way trips for the LIBA base model are presented below in Table 1 split by districts within West Yorkshire, and county within the rest of Yorkshire.

Table 1, Base Year Two Way Trips

Description	Am	IP	PM
Outside of Yorkshire	3%	4%	3%
Humberside	0%	0%	0%
North Yorkshire	5%	4%	7%
South Yorkshire	0%	0%	0%
Bradford	19%	18%	20%
Calderdale	2%	1%	2%
Kirkless	3%	2%	2%
Leeds	67%	70%	67%
Wakefield	0%	0%	0%

Origin and destination plots for each 2008 base year time period are presented in Figures 1 -6.

Figure 1, Base Year Am Origin

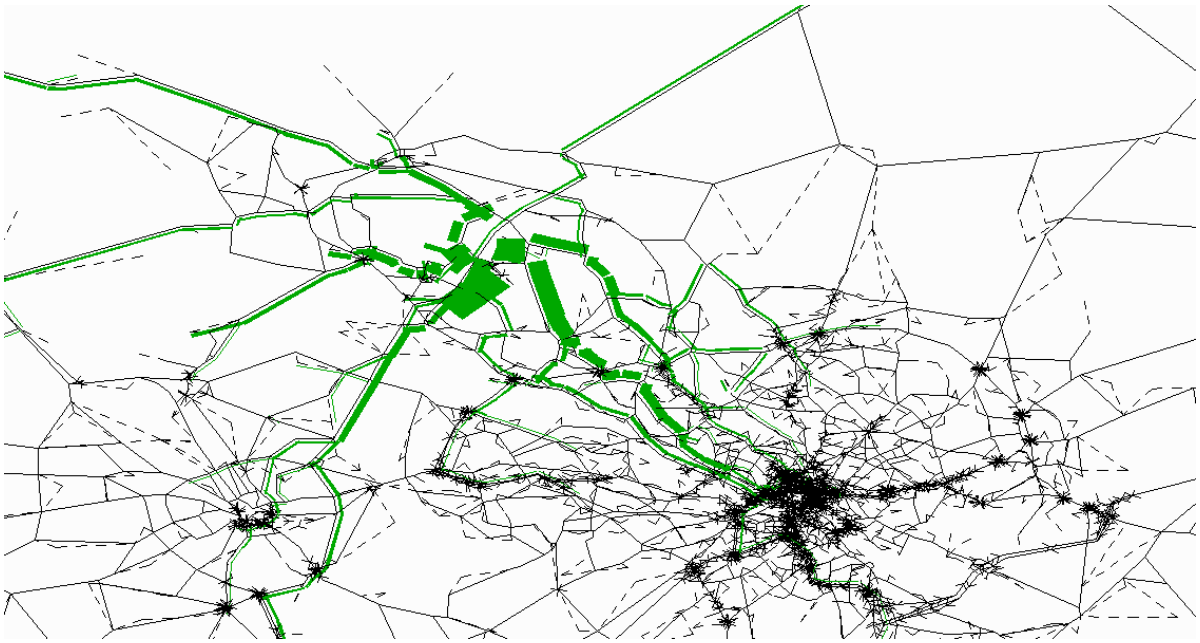


Figure 2, Base Year Am Destination

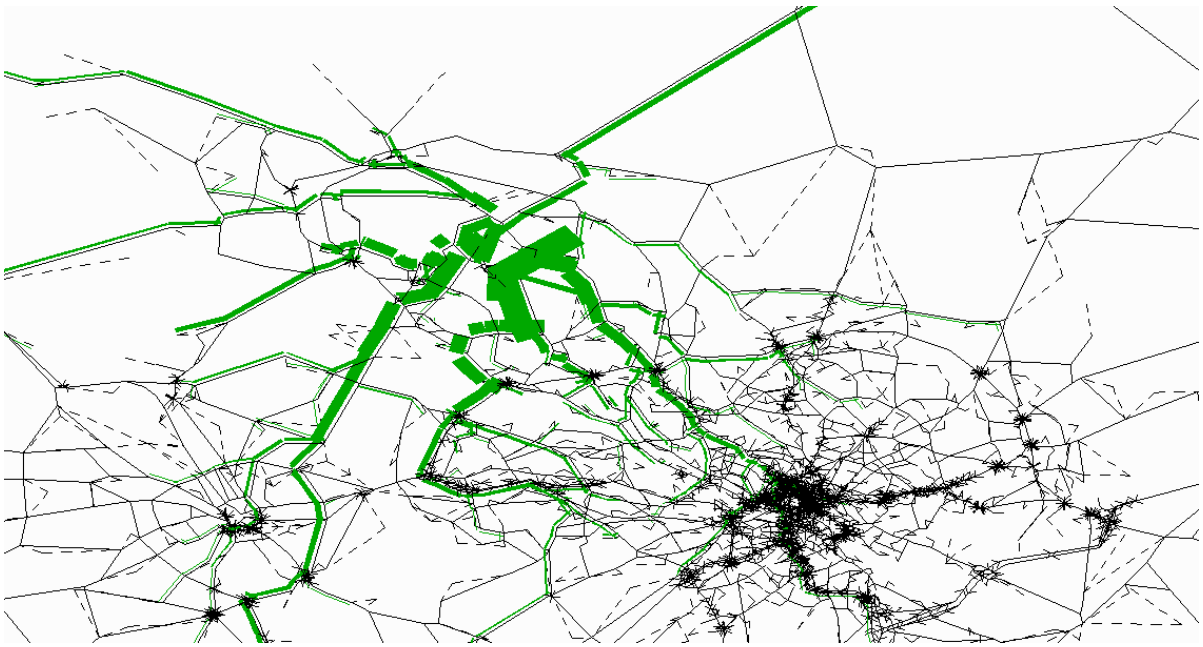


Figure 3, Base Year Ip Origin

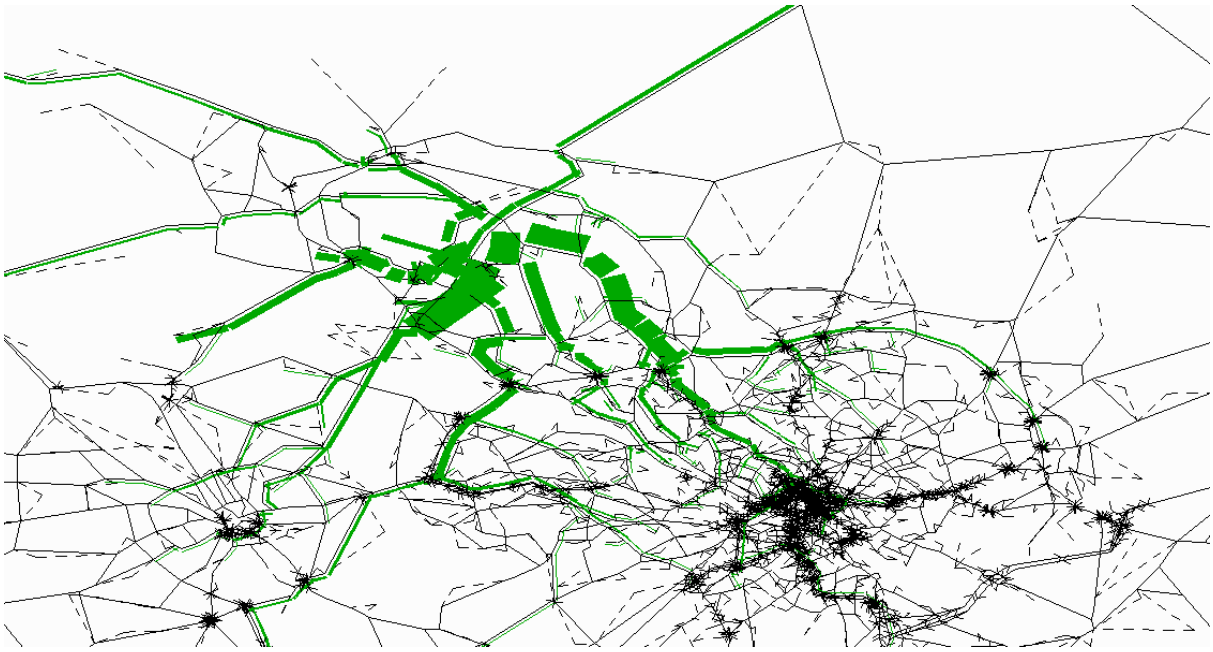


Figure 4, Base Year Ip Destination

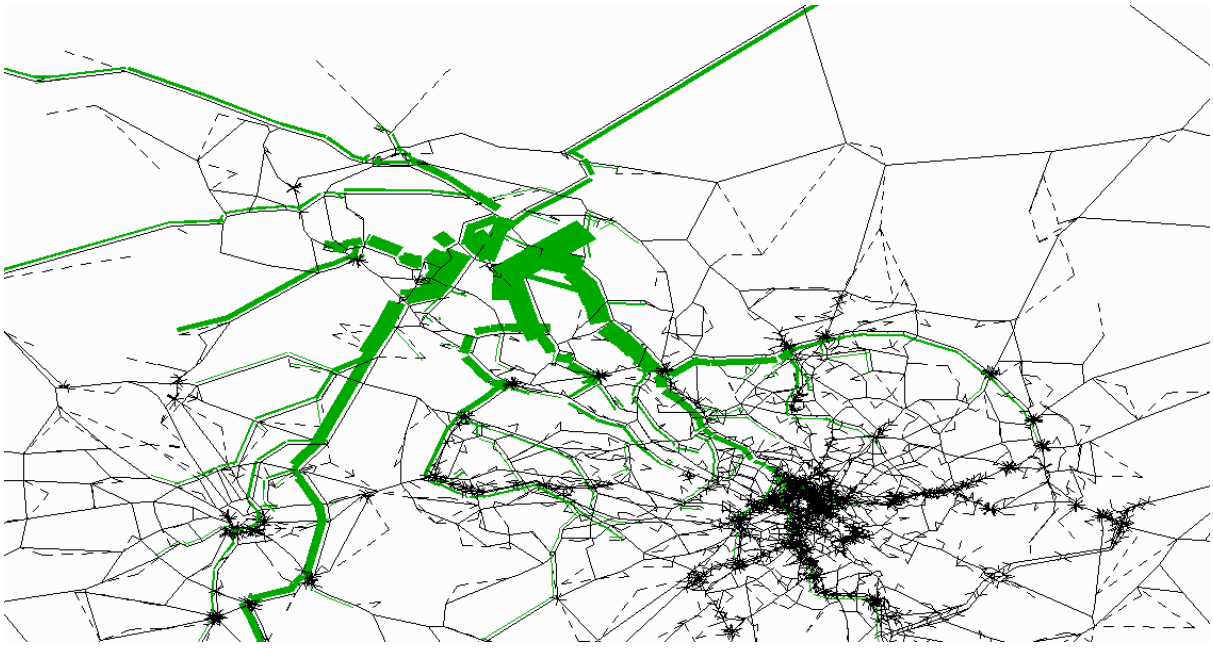


Figure 5, Base Year Pm Origin

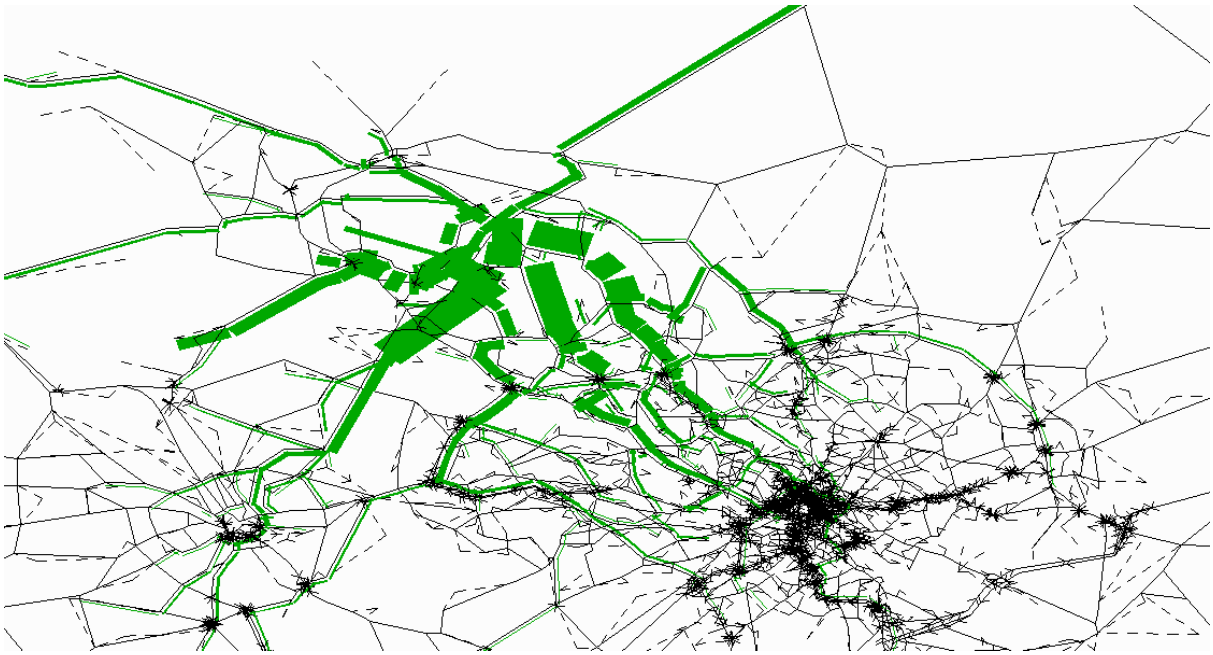
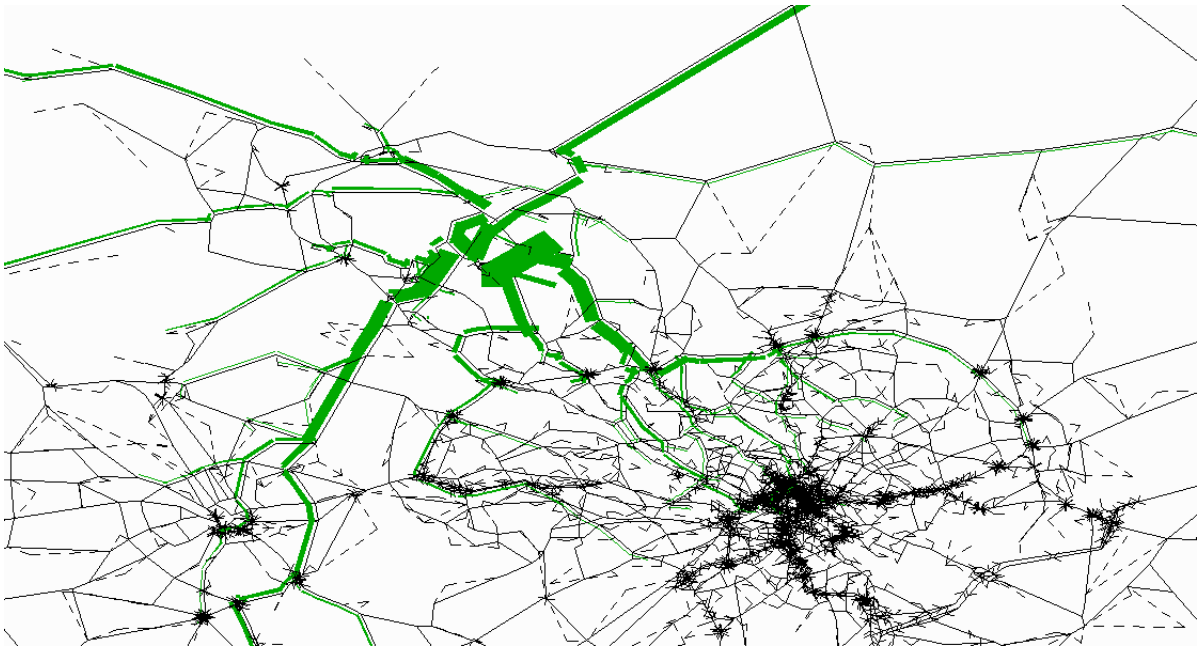


Figure 6, Base Year Pm Destination



2. 2021 Future year

Two way trips for the LIBA 2021 future year model are presented below in Table 2 split by districts within West Yorkshire, and county within the rest of Yorkshire.

Table 2, 2021 Two Way Trips

Description	Am	IP	PM
Outside of Yorkshire	3%	4%	3%
Humberside	0%	0%	0%
North Yorkshire	5%	4%	7%
South Yorkshire	0%	0%	0%
Bradford	19%	19%	20%
Calderdale	2%	1%	1%
Kirkless	3%	2%	2%
Leeds	68%	69%	67%
Wakefield	0%	0%	0%

Origin and destination plots for each 2021 future year time period are presented in Figures 7 -12.

Figure 7, 2021 Future Year Am Origin

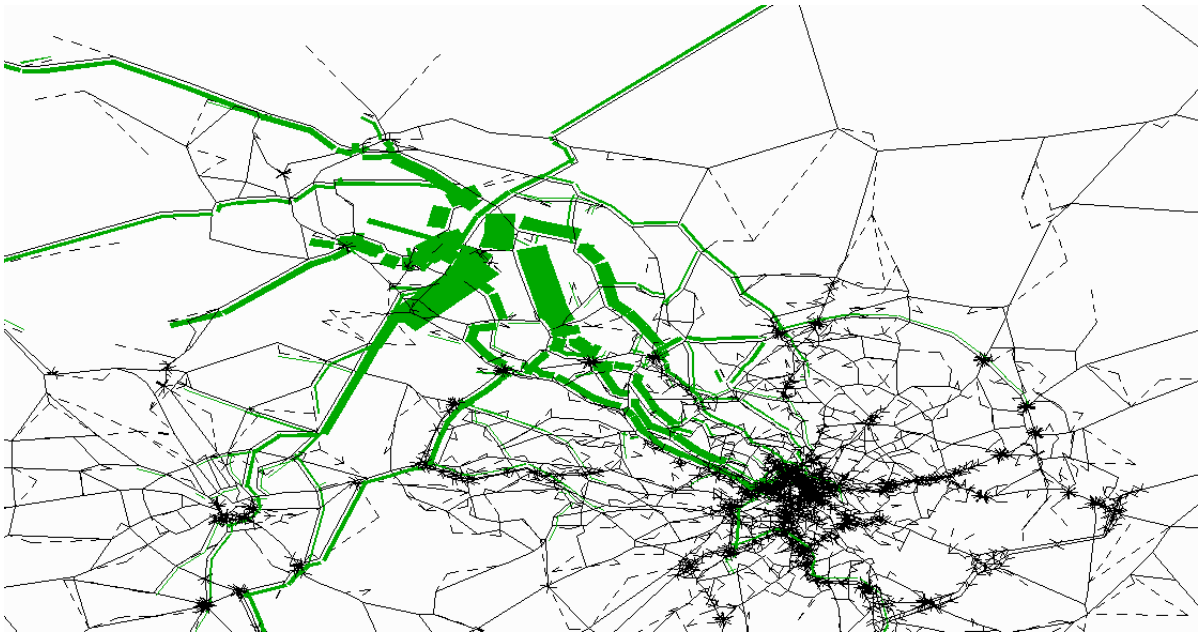


Figure 8, 2021 Future Year Am Destination

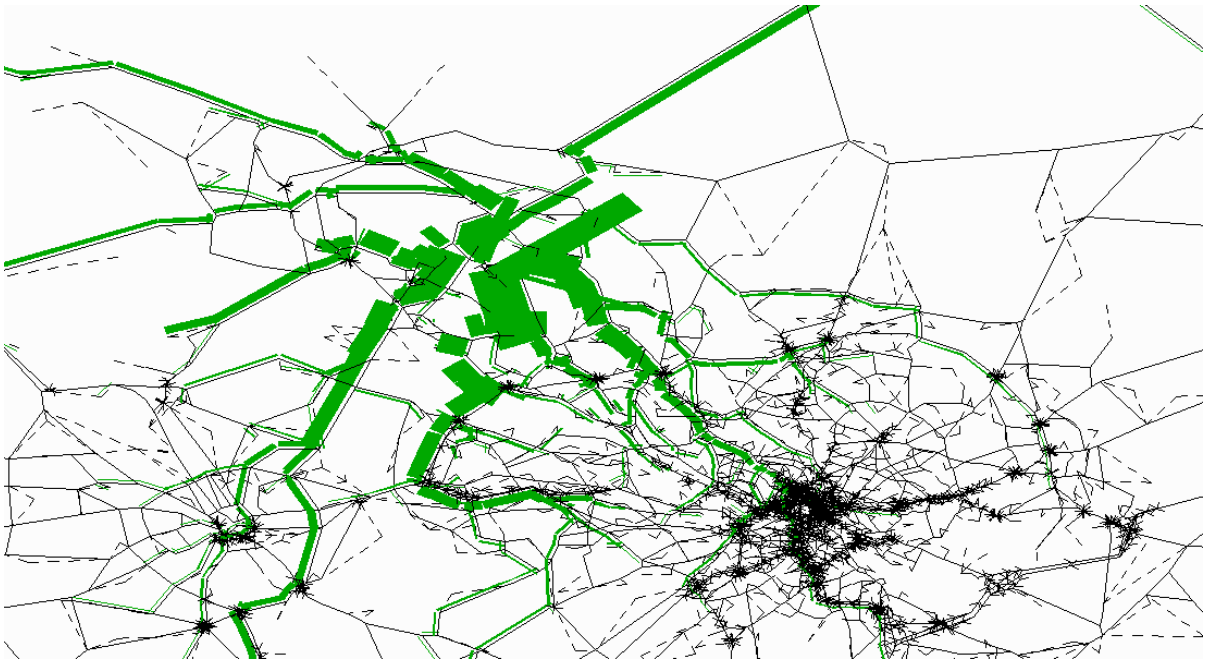


Figure 9, 2021 Future Year Ip Origin

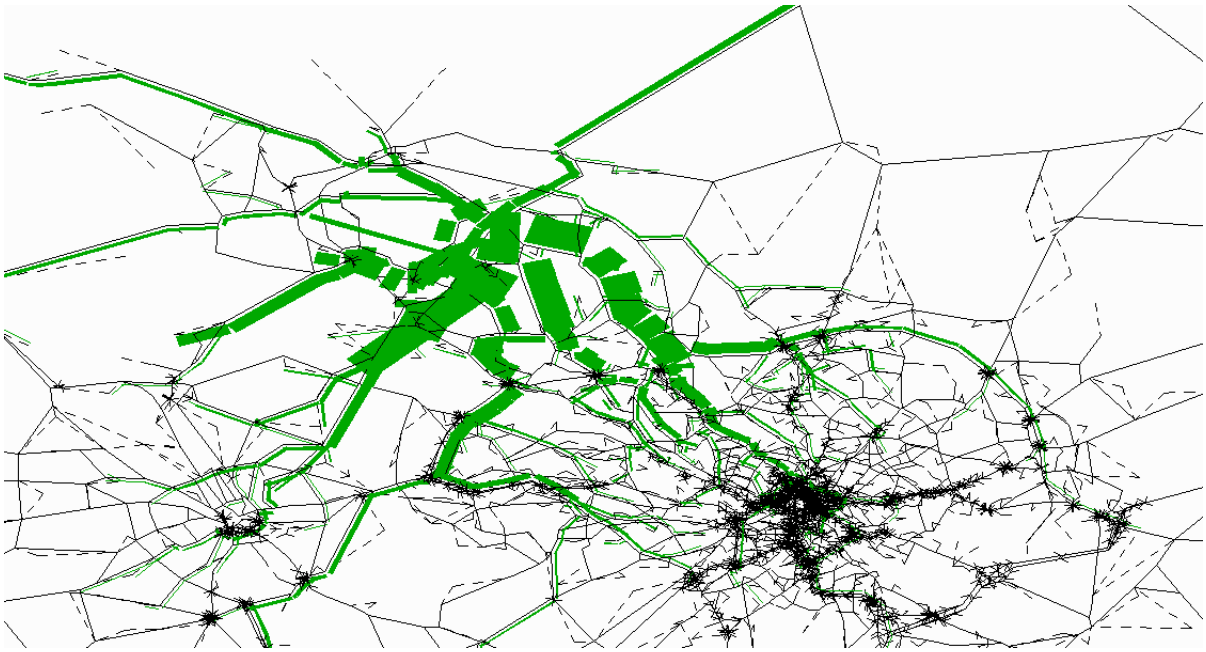


Figure 10, 2021 Future Year Ip Destination

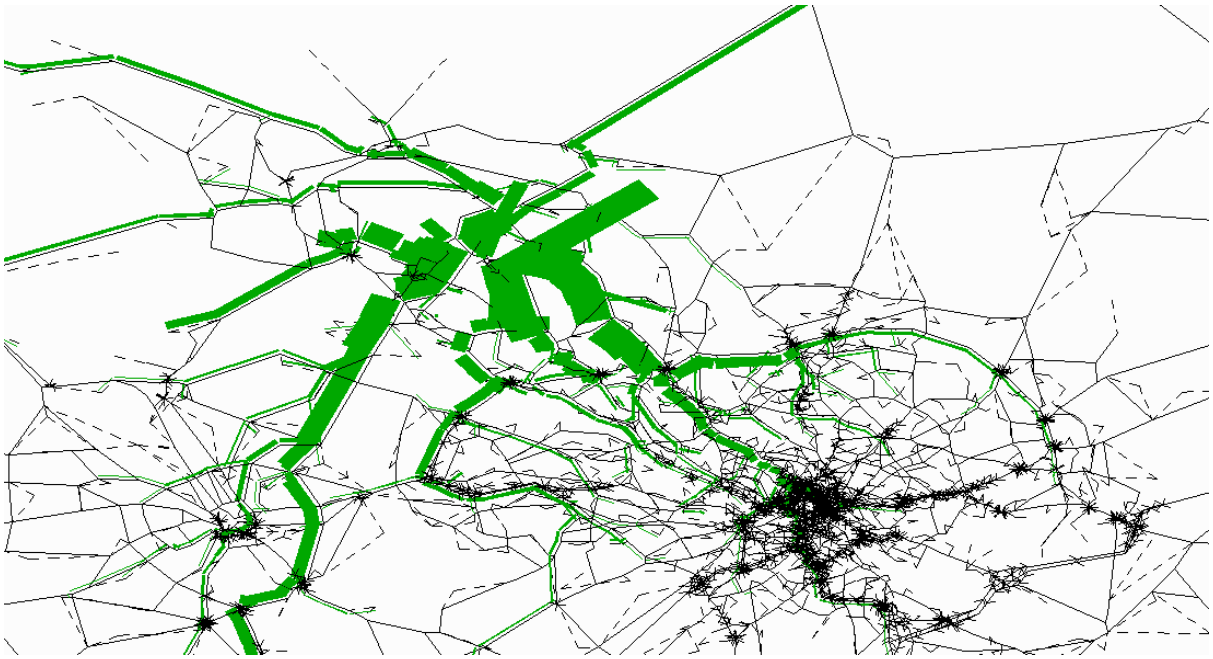


Figure 11, 2021 Future Year Pm Origin

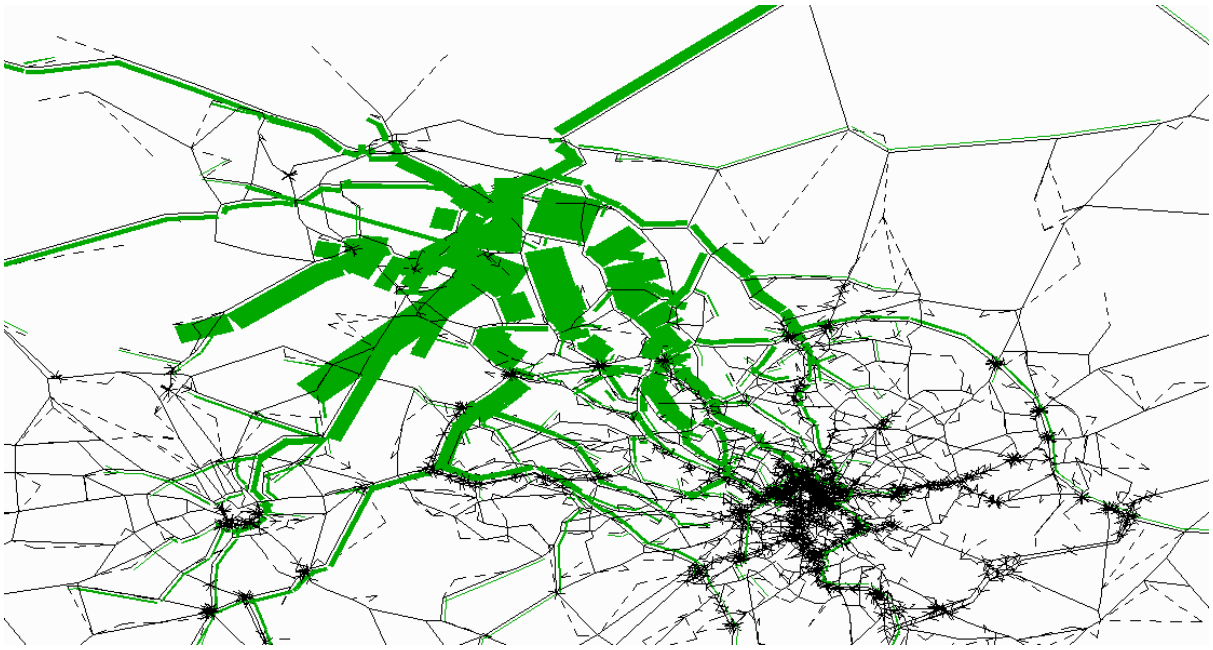
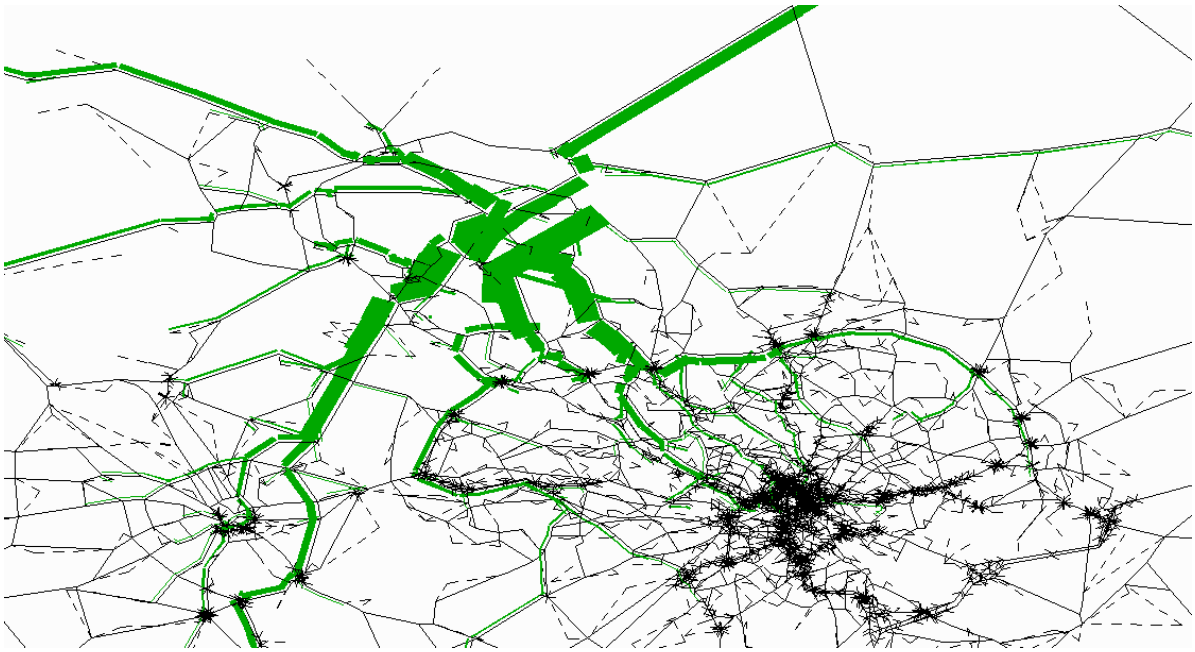


Figure 12, 2021 Future Year Pm Destination



2. 2031 Future year

Two way trips for the LIBA 2031 future year model are presented below in Table 2 split by districts within West Yorkshire, and county within the rest of Yorkshire.

Table 2, 2031 Two Way Trips

Description	Am	IP	PM
Outside of Yorkshire	4%	4%	3%
Humberside	0%	0%	0%
North Yorkshire	5%	4%	7%
South Yorkshire	0%	0%	0%
Bradford	19%	20%	19%
Calderdale	2%	1%	2%
Kirkless	2%	2%	1%
Leeds	67%	68%	67%
Wakefield	0%	0%	0%

Origin and destination plots for each 2021 future year time period are presented in Figures 13 -18.

Figure 13, 2021 Future Year Am Origin

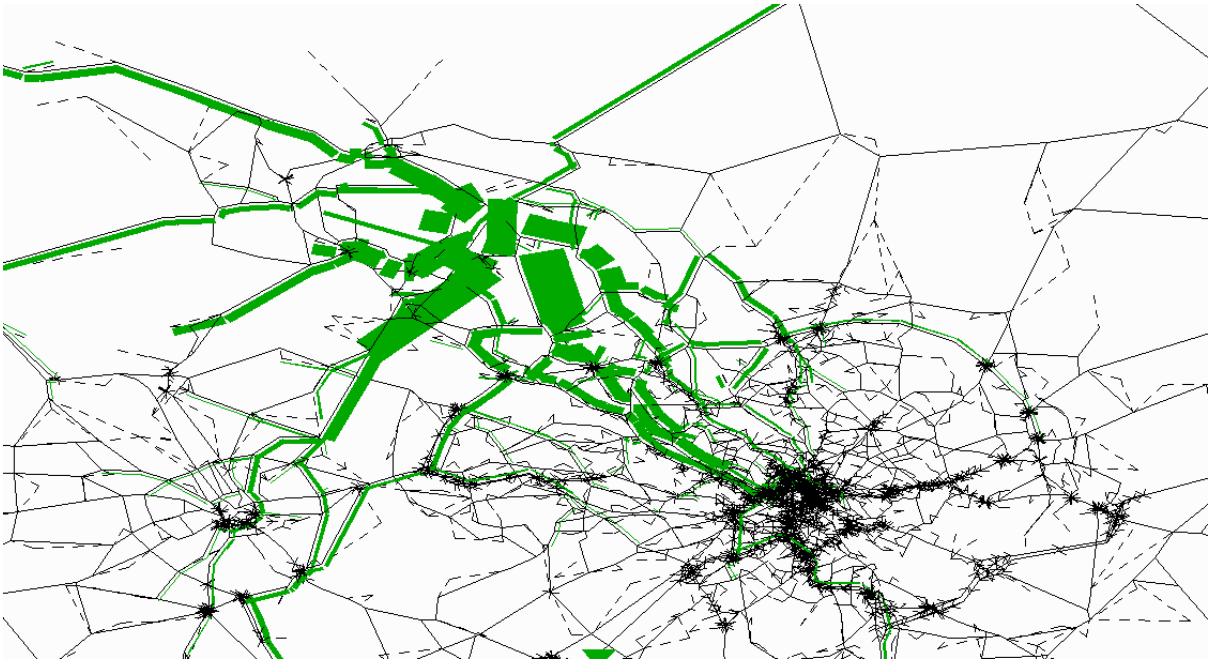


Figure 14, 2031 Future Year Am Destination

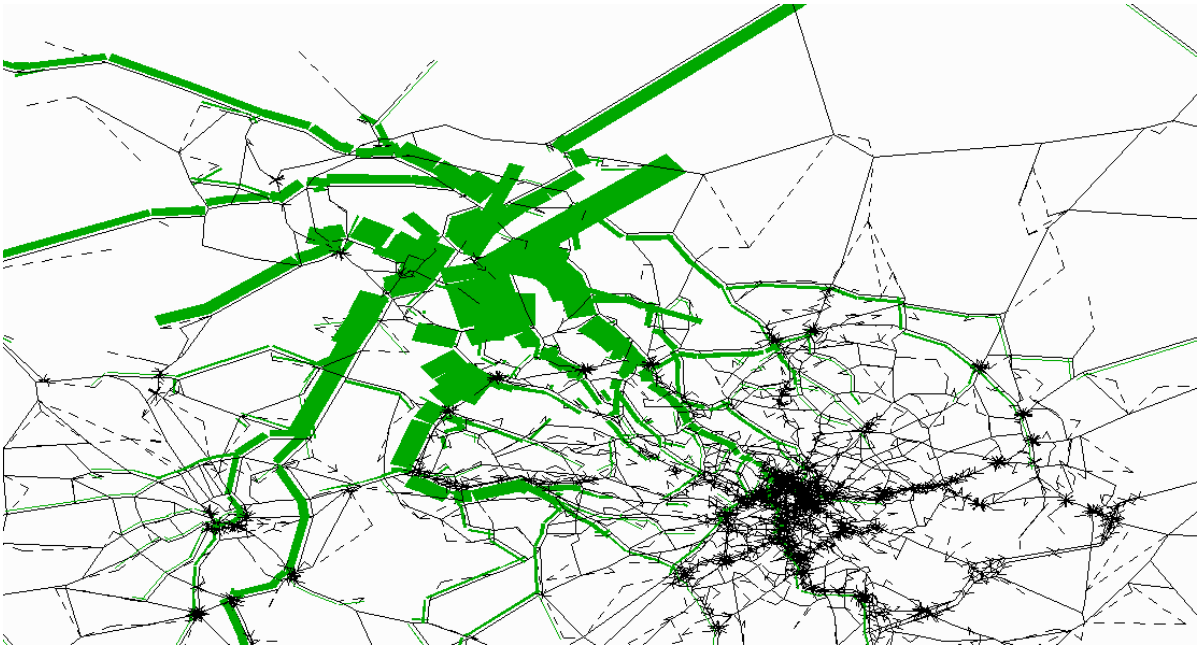


Figure 15, 2031 Future Year Ip Origin

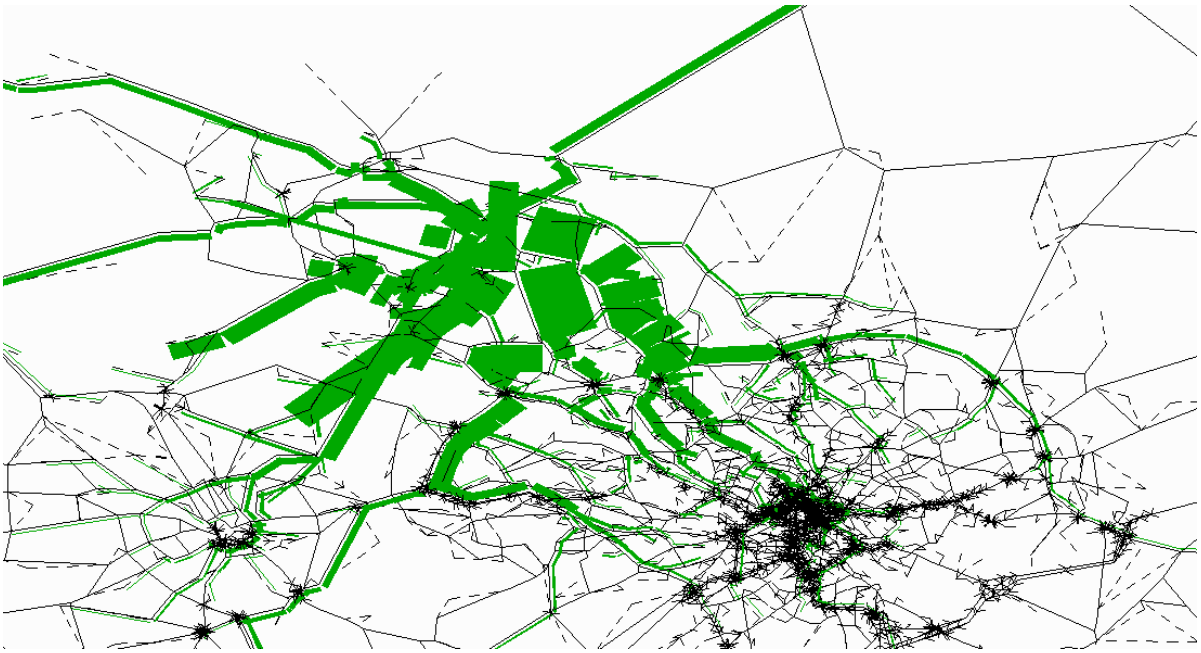


Figure 16, 2031 Future Year Ip Destination

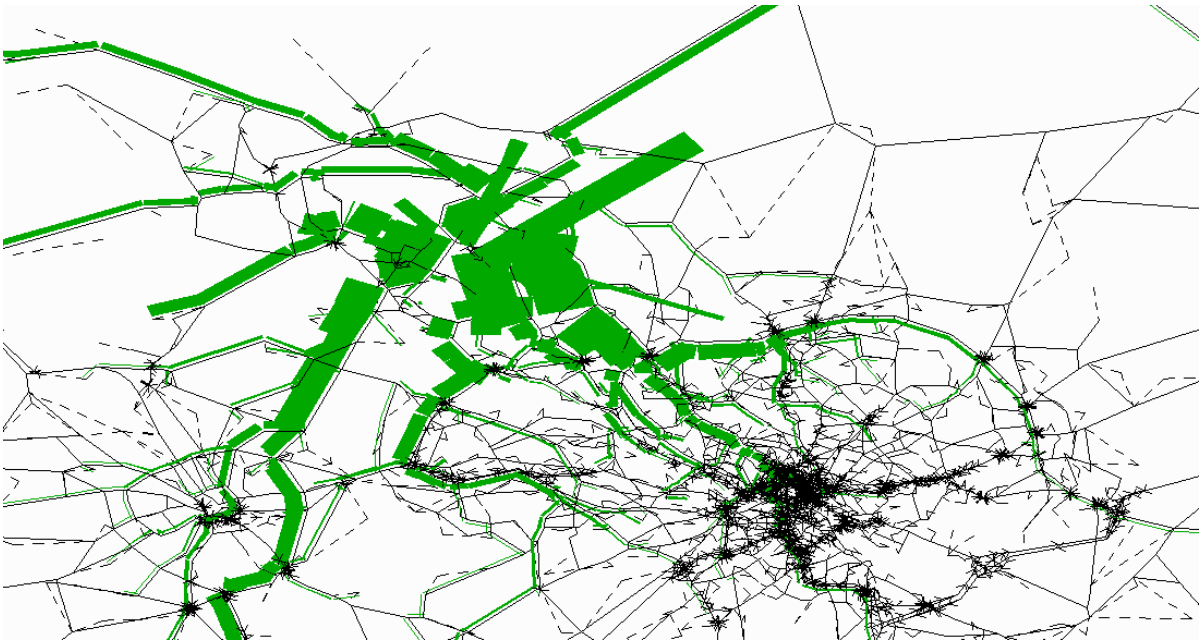


Figure 17, 2031 Future Year Pm Origin

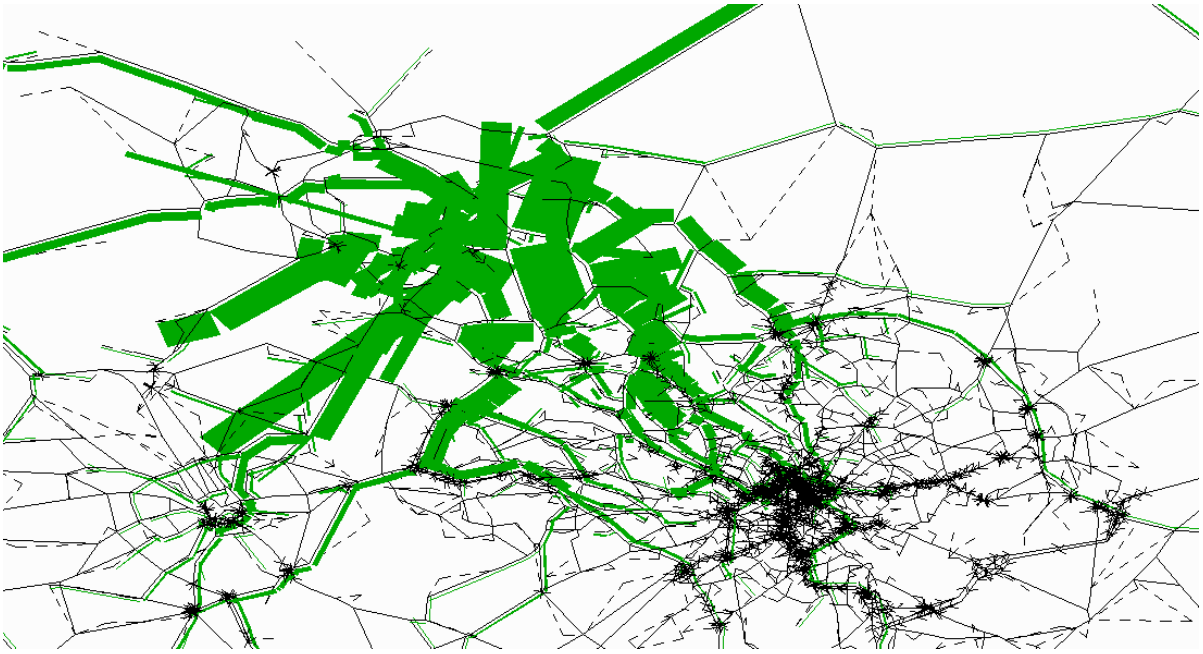
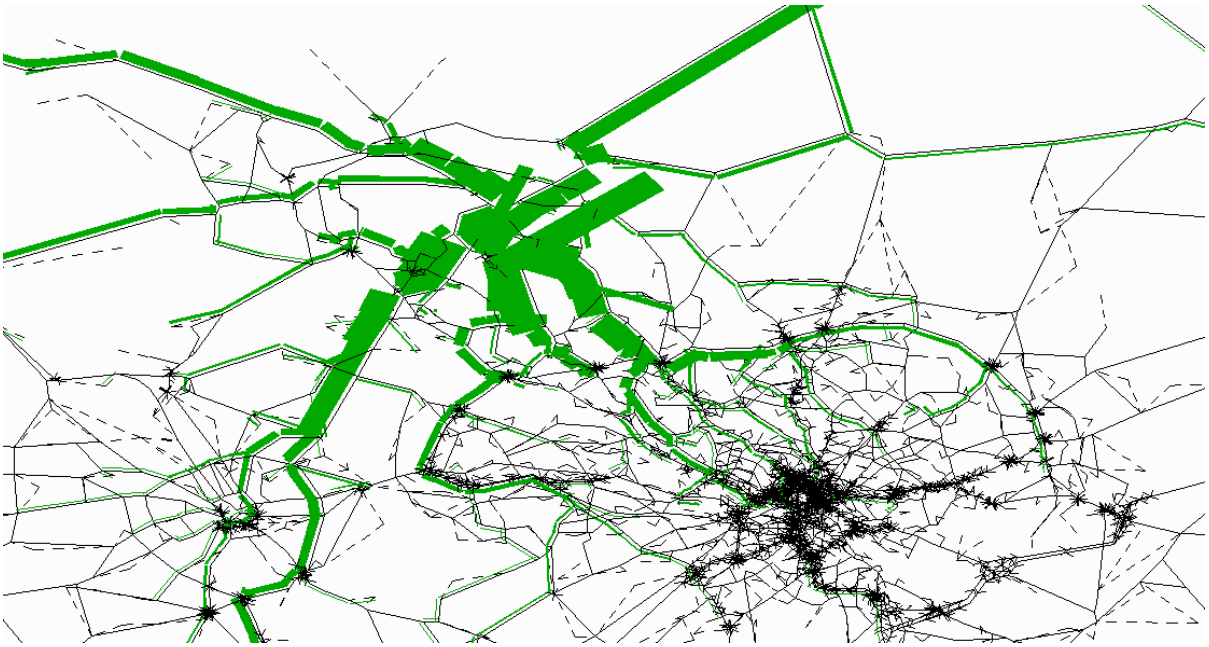


Figure 18, 2031 Future Year Pm Destination



3. Comparison against 2010 CAA survey for Leeds Bradford Airport

The latest CAA survey for Leeds Bradford Airport was undertaken in 2010. Table 3 presents the results of origin / destination patterns of terminating passengers within the Yorkshire and Humber Planning region, compared against the demand presented from the Saturn model.

Table 3, 2010 CAA data compared against the Leeds Saturn Model

Location	Saturn			CAA Data
	Am	IP	PM	
Humberside	0%	0%	0%	5%
North Yorkshire	5%	4%	7%	22%
South Yorkshire	0%	0%	0%	6%
West Yorkshire	95%	96%	93%	67%
Bradford	*20%*	*19%*	*20%*	-
Calderdale	*2%*	*1%*	*2%*	-
Kirklees	*3%*	*2%*	*2%*	-
Leeds	*70%*	*74%*	*68%*	-
Wakefield	*0%*	*0%*	*0%*	-
Total	100%	100%	100%	100%

The table shows that the distribution of trips in the Saturn model is different to the distribution shown in the CAA survey data. In the Saturn model the majority of demand arrives /departs from locations within West Yorkshire (93 – 96%); mainly Leeds (68 – 74%).

The CAA data shows a different pattern. While the majority of demand also arrives / departs from locations within West Yorkshire it is to a lesser extent (67%); and there is a significant proportion of demand from North Yorkshire (22%).

The CAA data was taken from a survey that ran throughout the whole of 2010 and was structured so that all scheduled routes and flights within a route were regularly sampled. Based on this it is assumed that the data provides a good representation of passenger travel patterns.

The Saturn model for the study is based on the existing Leeds Transport Saturn Model (LTM), adjusted to take account of the latest (2013) DfT Aviation forecasts (constrained) for Leeds Bradford International Airport, but retaining the existing model trip distribution patterns.

The LTM LMVR describes a process of building the existing model matrices based on sectors defined by RSI site cordons (the airport is included in the North West cordon). Observed sector to sector movement matrices were combined with synthetic matrices to form a prior matrix which then underwent matrix estimation exercise, followed by more recent further calibration and validation refinements to better reflect traffic flows in the vicinity of the NGT scheme. The airport zone was not treated separately during matrix development. It is therefore likely that some of the airport traffic movement detail captured in the original data collected could have been lost as part of the process, contributing towards the discrepancy shown between the model and CAA survey data.

Modelling Technical Note 9a: Connectivity to LBIA Feasibility Study – Annualisation (Final)

Prepared by: Adam Truman Date: 2nd Sep 2014

Checked by: Date:

1 Introduction

This note describes the calculation of annualisation factors for the highway and public transport scheme appraisal.

When the Leeds Transport Model (LTM) was used to model the NGT scheme for the programme entry business case submission in 2012, Aecom produced a note which describes the annualisation derivation. This method has been reproduced for the study but using different traffic count and flow data sets.

2 Highway

2.1 Data

The highway annualisation factors for the study were calculated based on data provided by Leeds City Council from the Drakewell C2-Cloud Traffic Data. Figure 1 below shows the location of the sites used which pick up traffic flows in the vicinity of the airport. Details of the site locations are set out in Table 1.

Figure 1 Location of counts sites

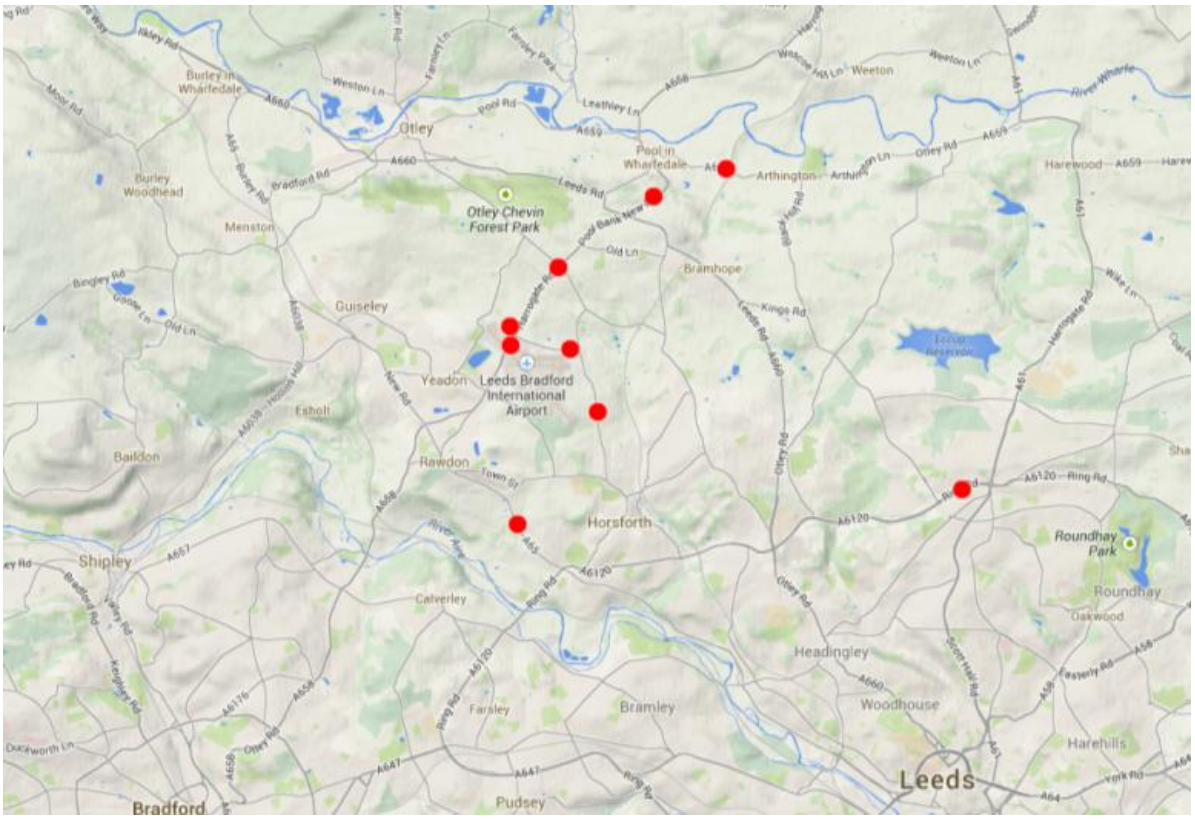


Table 1 List of count sites

Site id	Location
1	A658 South of Pool
2	Victoria Avenue, Yeadon
3	Scotland Lane, East of the Airport
4	A658 North of the Airport
5	Warren House Lane, North West of the Airport
6	Dean Lane, Yeadon
7	A659 Arthington Lane, East of Pool
8	A65 Leeds Road between Rawdon and Horsforth
9	A6120 Outer Ring Road, West of A61

The data set represented historic traffic flows covering a number of years. 2008 was the preferred data year as it coincides with the modelling base (also 2008), however due to lack of availability a more recent year, 2011, was used instead providing a more comprehensive coverage. The data used represented traffic flows from May 2011 to April 2012.

2.2 Approach

The approach was as follows:

- Establish over what flow range the inter peak highway model can be used to represent other time periods;
- Derive the volume of flow in these hours relative to the average inter peak hour flow;
- Derive factors to convert the model time periods (Tue to Thurs in October) to an average daily value (Mon to Fri); and
- Convert these into annualisation factors.

The inter peak is used to represent flows in other time periods (off peak, weekends and bank holidays).

Aecom undertook a test using the IP model to determine the ratio of flow to benefits for flow levels less than 60% of the IP hour flow. This showed that flows in excess of 60% of the full inter peak demand reflected benefits broadly in proportion to the flows. This has also been assumed for the study.

2.2 Annualisation derivation

Table 2 below shows the derivation of annualisation based on each of the steps described above.

Table 2 Derivation of Highway Annualisation

Day	Time Period	Hours per day	Days in Year	Model Day to Average Year Factor	% of AM flow	% of IP Flow	% of PM flow	% of Benefits	Annualisation Factor
Weekday	7-8	1	253	1.05	94%	NA	NA	100%	250.1
Weekday	8-9	1	253	1.03	NA	NA	NA	100%	261.2
Weekday	9-10	1	253	1.02	83%	NA	NA	100%	215.3
Weekday	IP	6	253	1.00	NA	100%	NA	100%	1521.3
Weekday	16-17	1	253	1.05	NA	NA	94%	100%	251.0
Weekday	17-18	1	253	1.04	NA	NA	NA	100%	264.2
Weekday	18-19	1	253	1.03	NA	NA	83%	100%	215.8
Weekday	19-20	1	253	1.03	NA	77%	NA	100%	200.4
Weekday	6-7 & 20-22	3	253	1.03	NA	47%	NA	81%	296.2
Saturday	10-19	9	52	1.03	NA	102%	NA	100%	491.5
Saturday	08-10 & 19-21	4	52	1.05	NA	61%	NA	81%	108.2
Sunday	11-18	7	52	1.10	NA	107%	NA	100%	428.2
Sunday	10-11 & 18-21	4	52	1.01	NA	65%	NA	81%	110.5
Bank Hols	11-18	7	5	1.10	NA	85%	NA	100%	32.6
Bank Hols	10-11 & 18-20	3	5	1.01	NA	54%	NA	81%	6.6
Total									4653

The model to day average year factor provides an adjustment to account for the highway model representing hours of a typical weekday (average Tuesday to Thursday in October) rather than an average day across the whole year.

The % of AM, IP and PM benefits reflects the proportion of peak hour demand, for the AM and PM period hours, or IP period demand relative to each time period.

It has been assumed that the % of benefits is retained based on the Aecom tests.

2.2 Final Highway Annualisation Factors

Table 3 shows the final highway annualisation factors.

Table 3 Highway Annualisation Factors

TUBA Time Period	Annualisation Factors
AM	727
IP	3195
PM	731
Total	4653

3 Public Transport

3.1 Data

The data used for annualisation was the passenger ticket data received from Yorkshire Tiger representing passengers on all services calling at the airport. Data was provided covering the period December 2013 to June 2014.

3.2 Approach

A similar approach was undertaken for the public transport annualisation, again following the method set out by Aecom for the NGT scheme programme entry business case submission.

Note that for the public transport annualisation derivation there is not a step in the process to take account of any change in the ratio of flow to benefits for flow levels less than 60% of the IP hour flow.

3.3 Annualisation derivation

Table 4 below shows the derivation of annualisation based on each of the steps described above.

Table 4 Derivation of public transport annualisation

Day / period	Time Period	Hours per day	Days in Year	Model Day to Average Year Factor	% of IP Flow	Annualisation Factor
Weekday	7-10	3	253	1	NA	759
Weekday	10-16	6	253	1	100%	1518
Weekday	16-19	3	253	1	NA	759
Weekday	5-7	2	253	1	30%	151
Weekday	19-23	5	253	1	39%	492
Weekday	6-24	36	52	1	63%	1172
Weekday	6-24	18	6	1	63%	68
Total						4919

The model day to average year factor has been assumed as 1 throughout, due to the limited data used which does not cover a complete year.

3.4 Final Public Transport Annualisation Factors

Table 5 shows the final highway annualisation factors.

Table 5 Highway Annualisation Factors

TUBA Time Period	Annualisation Factors
AM	759
IP	3401
PM	759
Total	4919

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