WARRINGTON EAST PHASE 3 TRANSPORT PROJECT

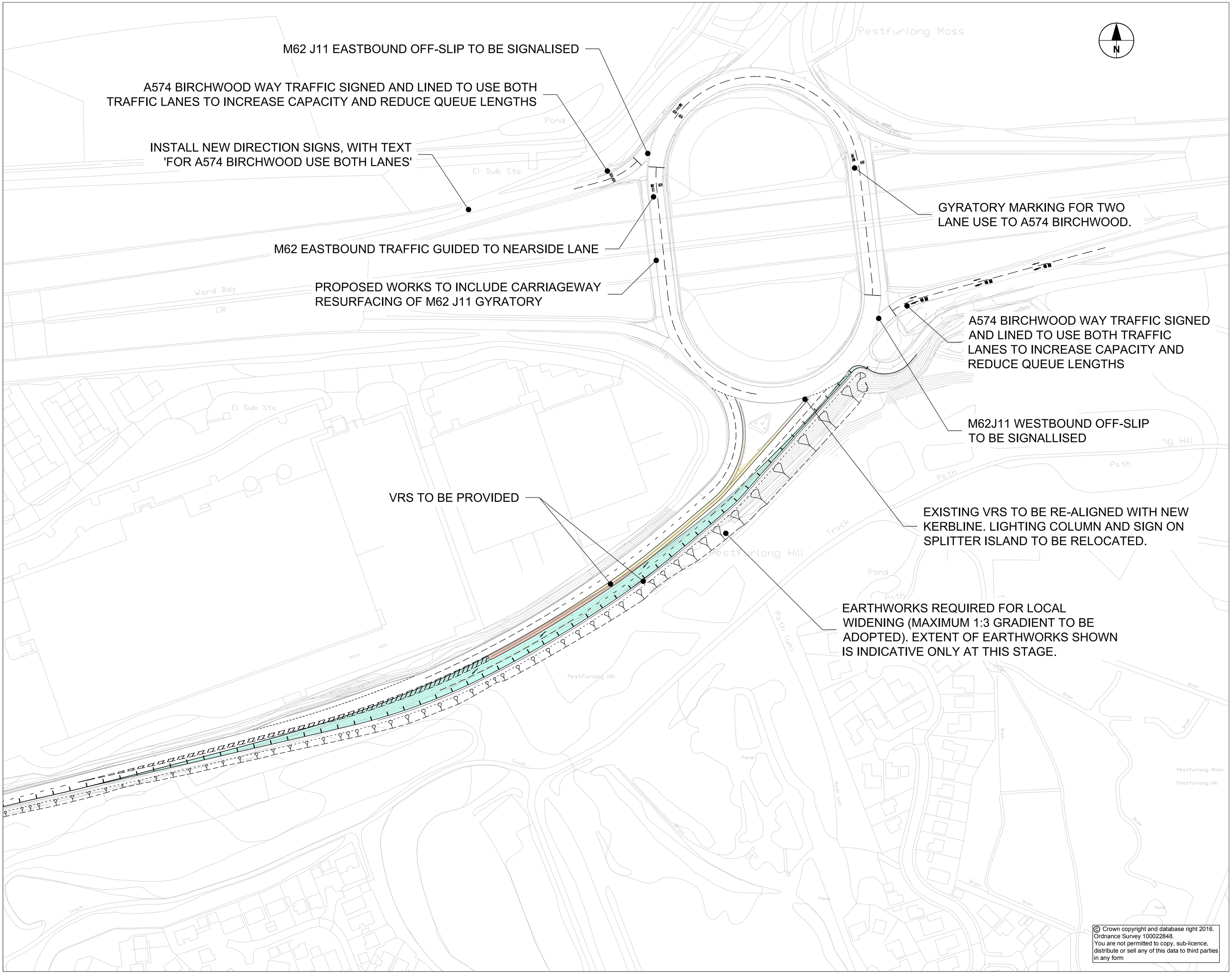
A bid to the National Productivity Investment Fund (NPIF)

June 2017

Appendices

WARRINGTON
Borough Council

Appendix 1



Warrington East phase 3 Transport Project

Equality Analysis

NPIF Application

WARRINGTON
Borough Council

27 June 2017

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Tables

SECTION 1: Aims and Objectives of the Policy / Service / Function

Equality Analysis	
Project Name	Warrington East phase 3 Transport Project (WE3)
Project Reference	NPIF Application 2017 – WE3
Version	1
Assessment Lead	Alan Dickin
Job Title	Transport Planning & Development Control Manager
Department	Transport Planning and Development Control
Directorate	Economy Regeneration Growth and the Environment
Organisation	Warrington Borough Council
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In the box below please provide background information on the policy / service / function.

Aims/purpose

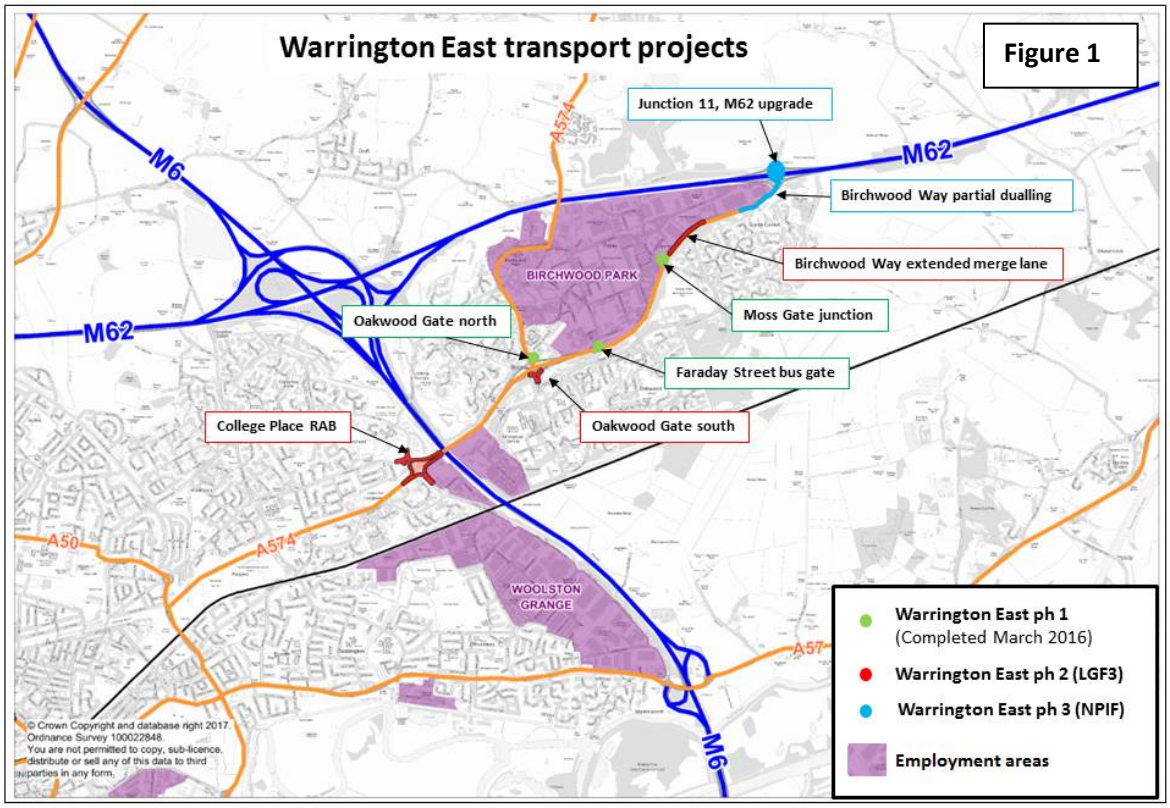
To improve the eastern gateway into Warrington on the A574 Birchwood Way

Objectives and outcomes

- Eases traffic congestion and reduces delay for vehicular traffic;
- Improves air quality at peak times;
- Provides network resilience to support future residential and commercial development in east and north Warrington;
- Improves attractiveness of east Warrington as a place to live and play with improved access to the reclaimed Biffa landfill site north of Junction 11.

Description of scheme

Upgrade of the eastern gateway into Warrington and the Birchwood Enterprise Zone. The project consists of new traffic signals on Junction 11 of the M62 and the partial widening of the A574 Birchwood Way to reduce peak hour traffic congestion and improve road safety. As shown in Figure 1 this scheme is the third phase of the Warrington East Transport Project.


Warrington East transport projects
Figure 1
Junction 11, M62 upgrade
Birchwood Way partial dualling
Birchwood Way extended merge lane
Moss Gate junction
Faraday Street bus gate
Oakwood Gate south
Oakwood Gate north
College Place RAB
BIRCHWOOD PARK
WOOLSTON GRANGE
M6
M62
A574
A50
A57
Warrington East ph 1
(Completed March 2016)
Warrington East ph 2 (LGF3)
Warrington East ph 3 (NPIF)
Employment areas
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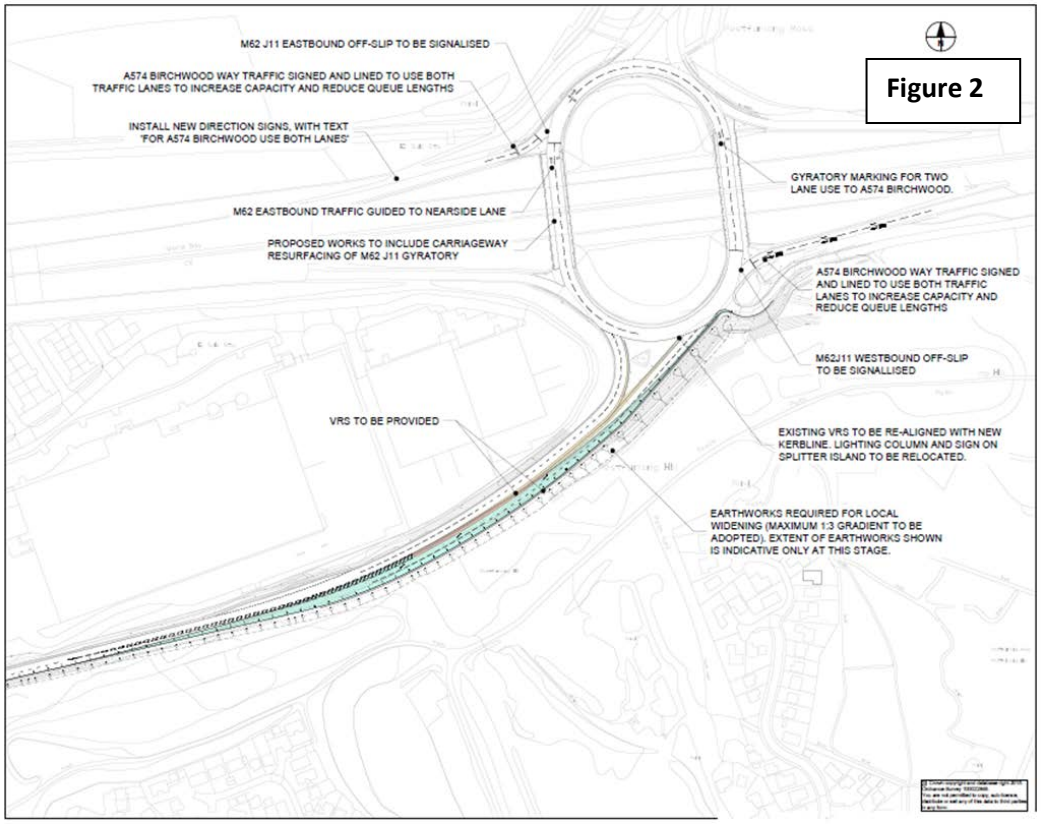
Figure 2
M62 J11 EASTBOUND OFF-SLIP TO BE SIGNALISED
A574 BIRCHWOOD WAY TRAFFIC SIGNED AND LINED TO USE BOTH TRAFFIC LANES TO INCREASE CAPACITY AND REDUCE QUEUE LENGTHS
INSTALL NEW DIRECTION SIGNS, WITH TEXT 'FOR A574 BIRCHWOOD USE BOTH LANES'
M62 EASTBOUND TRAFFIC GUIDED TO NEARSIDE LANE
PROPOSED WORKS TO INCLUDE CARRIAGEWAY RESURFACING OF M62 J11 GYRATORY
GYRATORY MARKING FOR TWO LANE USE TO A574 BIRCHWOOD.
A574 BIRCHWOOD WAY TRAFFIC SIGNED AND LINED TO USE BOTH TRAFFIC LANES TO INCREASE CAPACITY AND REDUCE QUEUE LENGTHS
M62J11 WESTBOUND OFF-SLIP TO BE SIGNALLISED
VRS TO BE PROVIDED
EXISTING VRS TO BE RE-ALIGNED WITH NEW KERBLINE. LIGHTING COLUMN AND SIGN ON SPLITTER ISLAND TO BE RELOCATED.
EARTHWORKS REQUIRED FOR LOCAL WIDENING (MAXIMUM 1:3 GRADIENT TO BE ADOPTED). EXTENT OF EARTHWORKS SHOWN IS INDICATIVE ONLY AT THIS STAGE.

Who are the main stakeholders?

Key stakeholders with an interest due to the opportunity it presents to unlock and maximise the economic potential of development land include:

Warrington Borough Council: project sponsor

Birchwood Enterprise Zone

Birchwood Forum: representing interests of businesses across East Warrington

Warrington & Co: promote economic development and physical regeneration in Warrington

Local Residents/Businesses: adjacent to proposed junction improvements

What outcomes will be delivered as a result?

Ease congestion for vehicular traffic along A574 and at Junction 11 of M62

Support commuters travelling to Warrington employment sites during peak times with queues to be reduced sufficiently to accommodate demand and the cumulative corridor capacity improvements having a positive impact on highway capacity

Potential to improve air quality at peak times; and

Complement the Warrington East phase 1 improvements (completed March 2016) and the Warrington East phase 2 project (due to start in May 2018).

How will/is the service promoted/explained to those it might affect directly or indirectly?

Public consultation planned for Winter 2017 to complement the Stage 2 Stakeholder engagement for the Warrington East phase 2 project.

Is there evidence of any complaints on grounds of discrimination? If yes, how have these been resolved?

No

SECTION 2: Research and Intelligence

Nearby services

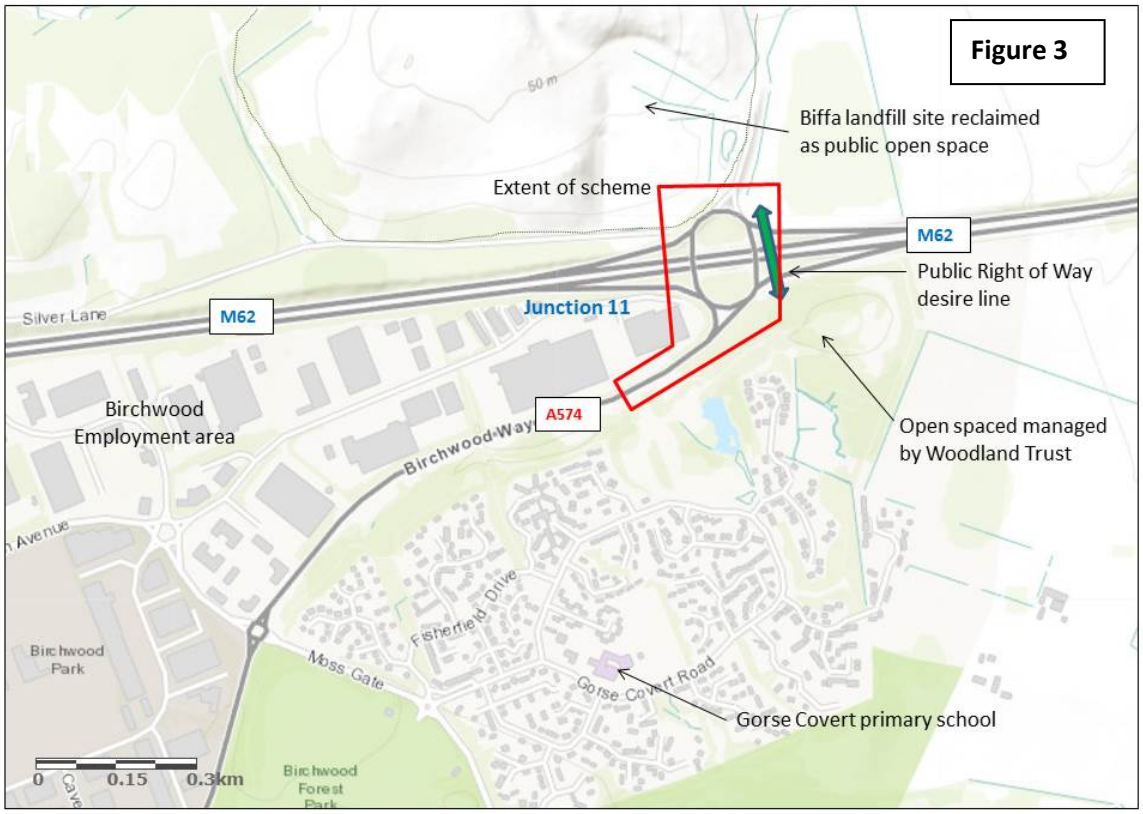

Figure 3 shows that the scheme is located on the northern edge of the Warrington urban area and is close to the Gorse Covert residential area of Birchwood and is adjacent to the Birchwood employment area.

- The nearest school is Gorse Covert primary school which is approximately 0.5km to the south of the scheme.
- The scheme is adjacent to the managed open space owned and managed by the Woodland Trust.
- There is a Public Right of Way which crosses the northern side of the Junction 11 roundabout. There is a path which continues northwards to the town of Culcheth. Silver Lane continues on the south side of the M62 but is severed by the Junction 11 roundabout.
- The landfill site to the north of Junction 11 managed by Biffa has been reclaimed and landscaped and is now open for public use. Access from the residential areas of Birchwood however is compromised by the M62.

Table 1: Consultation to date

List the groups you have consulted or reference previous relevant consultation?	What issues were raised in relation to one or many of the protected characteristics?
Local residents and employees.	Warrington Borough Council held a number of public consultation events during May and June 2017 for the Warrington East phase 2 LGF3 project. The consultation events allowed local people and stakeholders to give their views on the project and also on wider transport issues in the area. Over 600 people attended and over 100 online responses were received. The key issues raised through the consultation relevant to this project included: • A need for more capacity on local routes to cope with the daily traffic congestion experienced near junction 11. • The impact of the ongoing growth of Birchwood Park and other employment areas in east Warrington to local traffic levels. • The poor access for pedestrians and cyclists across Junction 11 to reach the new opened open space managed by Biffa. • Poor air quality near Birchwood Way. Further consultation on the Phase 2 project is planned for December 2017 to obtain stakeholder agreement to the final proposals. It is intended that the WE3 project would utilise this calendar slot for consultation.

Notification of a Public Consultation exercise

WARRINGTON EAST PHASE 2
Transportation project

Following the success of the Birchwood Pinchpoint project, Warrington Borough Council is proposing a number of further improvements on and near the A574 Birchwood Way in east Warrington. The overall aim is to help local people and commuters travel more easily by car, bus, cycle or on foot, and to support the local economy.

The proposals include improvements at the College Place roundabout, the southern part of Oakwood Gate, an extended merge lane at the Moss Gate junction, and a new bus gate from Gig Lane to Hardwick Grange in the Woolston Grange employment area.

So far we have been successful in obtaining the funds from the government to help pay for the improvements. We have also done a lot of work testing different designs. We are now ready to explain these proposals to our stakeholders and to the public.

This leaflet explains where you can find out more information. There will be the opportunity to comment on the proposals and to let us have your views.

WARRINGTON
Borough Council

Update edition

SECTION 3: Assessing the Impact

Positive impacts or benefits

The proposed improvements will have a broadly positive impact on all of the protected characteristics. It will:

- Improve journey times / ease congestion for vehicle traffic on Birchwood Way (car users). Reductions in average and overall journey times have been realised on similar junction improvement schemes within Warrington, e.g. Warrington East phase 1;
- Support those travelling to east Warrington employment sites (including Birchwood Park, Birchwood Boulevard, and Woolston) (i.e. improved access) during peak times with queues to be reduced sufficiently to accommodate demand and the cumulative corridor capacity improvements having a positive impact on highway capacity;
- Improved access for all age groups from young to elderly drivers;
- More free flowing traffic conditions, running at a constant speed could help to relieve anxiety of under-confident drivers and reduce the level of weaving/manoeuvres;
- Support improvements to air quality for the community;
- Enhance benefits for pedestrians and cyclists, creating better movement across the junction; and
- During scheme construction there will be an invaluable opportunity to engage, train and inspire local people. One of the key benefits of the Scape procurement route, includes community engagement and the use of local workforce and supply chain for which it has won a CECA social value award for the Warrington East phase 1 scheme in 2016.

Negative Impacts

The nature and scale of the proposed scheme is such that the impacts are generally vehicle related rather than person related i.e. focused on physical movement of traffic flows and individual vehicles. The new infrastructure improvements are a generic proposal provided for all groups. Where direct interaction with individual people is likely to occur, including modification to footpaths and crossings. Warrington Borough Council has assessed no negative impacts for protected characteristics.

Table 2: Impact by protected characteristic

Protected Characteristic	Y/N	Explain the potential negative impact
Disability (physical or sensory impairments, learning disability and mental illness)	N	No negative impact on people with this protected characteristic
Age (younger and older people)	N	No negative impact on people with this protected characteristic
Pregnancy / maternity (the rights of a woman and her maternity leave)	N	No negative impact on people with this protected characteristic

Protected Characteristic	Y/N	Explain the potential negative impact
Race (include nationality, ethnicity inc. Gypsy and Travellers)	N	No negative impact on people with this protected characteristic
Religious / Faith Group (specify group)	N	No negative impact on people with this protected characteristic
Gender (men and women)	N	No negative impact on people with this protected characteristic
Sexual orientation (lesbian, gay, heterosecual and bisexual)	N	No negative impact on people with this protected characteristic
Marriage/Civil Partnership	N	No negative impact on people with this protected characteristic
Gender reassignment (person proposing to undergo, is undergoing or has undergone reassigning their sex)	N	No negative impact on people with this protected characteristic
Other (these other groups could include factors such as deprivation or poverty, literacy, rurality)	N	No negative impact on people with this protected characteristic

Match with Warrington Borough Council's three equality pledges

- Protect the most vulnerable - by improving road safety and reducing traffic pollution due to queuing traffic
- Support the local economy - by supporting the growth of the Birchwood Enterprise Zone and other key employment and commercial areas in east Warrington. This will provide more work opportunities for local people.
- Help build strong and active communities for all - by providing links to new open spaces for local residents

Meeting the three aims of the General Equality Duty

- Eliminate unlawful discrimination - None of the diversity groups will be discriminated against. A public consultation exercise was undertaken in May and June 2017 with 8 public drop in events at locations with a high footfall and leaflets delivered to over 1,500 local homes. Diversity questions were included within the feedback form which was available on-line and in paper format.

- Harassment and victimisation – Not applicable
- Advance equality of opportunity and foster good relations – The contractor would work with the local community to ensure any concerns over noise and disturbance are addressed and to keep them informed over temporary road closures and footpath severances.

SECTION 4: Improvement Plan

Warrington Borough Council is committed to ensuring that equality and diversity is at the heart of our organisation and responds to the needs of all our customers and communities.

We want everyone living in Warrington to have a good quality of life and we want to ensure that all communities continue to get along together. These values are set out in our new equality objectives for 2016-2020.

The Council wholly endorses the principles of the Equality and Diversity Policy and seeks to increase awareness and action in this area through leading by example.

In delivering the outline infrastructure improvements, Warrington Borough Council will ensure that proper consideration is given to equality and diversity which is the subject of this assessment. Whilst no negative impacts were identified against the protected characteristic target groups, the following actions have been identified for future work:

Table 2: Action Planning

Action	Desired Outcome	By when	By who
Discuss options through public consultation with local users – better information and communication will have the effect of considerable boosting confidence for people with protected characteristics regarding the proposed changes. The clear message endorsed by Council is that enhanced information increases confidence in the use of the local highway network.	Enhanced engagement with users to ensure delivered outcome meets expectations	Winter 2017	Project team
Preparation of a Road Safety Audit – this will ensure the proposed junction improvements do not introduce new safety concerns for users	Ensure design meets road safety requirements	2018	Project team
Appropriate traffic management arrangements to be put in place during construction to limit impact for users	Ensure delivery is managed efficiently and effectively to minimise disruption	During construction	Project team
No further actions have been identified as part of the Equality and Diversity Analysis			

Sign Off

This document acts as evidence that due regard to equality and diversity has been given.

Table 3: Sign Off

Name	Position	Signed	Date
Equality Analysis Owner	Transport Planning & Development Control Manager Warrington Borough Council	Alan Dickin	28.06.2017
Senior Manager	Transport for Warrington Service Manager	Steve Hunter	28.06.2017

20 June 2017

Steve Hunter
Transport for Warrington Service Manager
Warrington Borough Council
New Town House
Buttermarket Street
Warrington
WA1 2NH

Dear Steve

NATIONAL PRODUCTIVITY INVESTMENT FUND BID – Warrington East Phase 3

On behalf of the Cheshire and Warrington Local Enterprise Partnership I would like to offer support for the Warrington East phase 3 project in its bid for funding from the Department for Transport's National Productivity Investment Fund (NPIF).

This project will follow on from the excellent phase 1 project delivered last year – the Birchwood Pinchpoint project - which has already greatly improved journey times and non vehicular transport accessibility in the area. The project has received numerous awards including Best Transportation Project of the Year by the CIHT North West branch which demonstrates the Council's ability to deliver large scale transport projects. The phase 2 project supported by the LGF3 Cheshire and Warrington Growth Deal will further develop these benefits and support our ambition for Birchwood as a primary destination for inward investment.

I believe the proposed package of improvements for the phase 3 project will be of great benefit to vehicle journeys being made between the M62 and the Warrington East area including trips to the employment sites of Birchwood Park Enterprise Zone, Birchwood Boulevard and Woolston Grange.

In conclusion, I fully endorse the proposals for the Warrington East phase 3 project and I wish you every success with your application for funding.

Yours sincerely

Philip Cox
Chief Executive, Cheshire and Warrington LEP

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01606 812280 871CANDWEP.CO.UK

MOTT MACDONALD

WARRINGTON Borough Council

Warrington East LEP Phase 2 VISSIM

Local Model Validation Report

14 June 2017

Warrington Borough Council

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Warrington East LEP Phase 2 VISSIM

Local Model Validation Report

14 June 2017

Warrington Borough Council

Issue and Revision Record

Revision	Date	Originator	Checker	Approver	Description
A	24/01/2017	Andreas Theofanous	Nick Young	Matt Hall	First Issue
B	12/05/2017	Andreas Theofanous	Steven Arthur	Matt Hall	Second Issue (Additional Journey Times)
C	14/06/2017	Andreas Theofanous	Steven Arthur	Matt Hall	Third Issue (Amended Eastbound approach of Oakwood Gate Roundabout)

Information class: Standard

Contents

1 Introduction

1.1 Background

Mott MacDonald has been commissioned by Warrington Borough Council (WBC) to develop a series of capacity improvement schemes along Birchwood Way, between College Place and M62 Junction 11. To assess the benefits of the proposals to traffic, a validated base micro-simulation model has been developed using VISSIM.

The micro-simulation model has been built using VISSIM version 5.40-13 and PCMOVA v1.1. The model has been prepared in accordance with WebTAG and Design Manual for Roads and Bridges (DMRB) guidelines for model development, calibration and validation.

This Local Model Validation Report (LMVR) concerns the development, calibration and validation of the 2016 base VISSIM model only. The modelling of the subsequent proposals will be reported on in the Major Scheme Business Case.

In March 2017 a review of the LMVR was undertaken by WSP/PB, on behalf of WBC. Following the review, a meeting was held on the 23rd of March 2017, at which it was agreed that the model should be extended to the west, to include Blackbrook Avenue/Birchwood Way roundabout and the immediate approaches. As a result, three additional travel time routes have also been included in the model:

- Birchwood Way, between College Place roundabout and Blackbrook Avenue roundabout (Westbound);
- Woolston Grange Avenue, between College Place roundabout and Kingsland / Woolston Grange Avenue roundabout (Southbound); and,
- Woolston Grange Avenue, between Kingsland / Woolston roundabout and College Place roundabout (Northbound).

In May 2017 a review of the revised LMVR (Revision B) was undertaken by WSP/PB, on behalf of WBC. Following the review, the LMVR (Revision B) addressed all the issues raised in the review of the LMVR (Revision A). Furthermore, WSP/PB has undertaken a review on the VISSIM Model in which it was noted that the Eastbound approach to Oakwood Gate Roundabout had been coded incorrectly with the flare on the left (as the scheme had not been built and implemented at the time of the original model development). As a result the Eastbound approach has been amended and coded with the flare on the right as built.

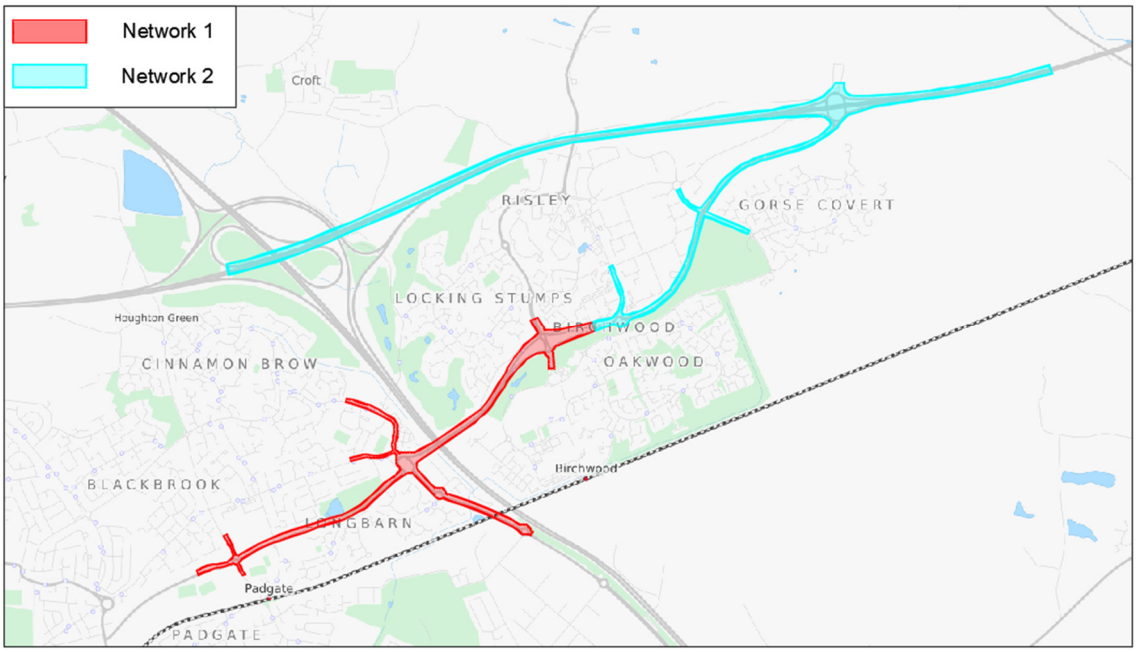
1.2 Model Extents

The model was originally developed as two separate networks, which were subsequently combined prior to being validated. The model extents are shown in **Figure 1.1**.

The following junctions have been modelled:

- Signal controlled:
  - Oakwood Gate roundabout (west approach);
  - Birchwood Way / Moss Gate; and
  - M62 eastbound on-slip ramp metering.
- Priority controlled:
  - Crab Lane / Fearnhead Lane;
  - College Place roundabout;
  - Oakwood Gate roundabout (north, east and south approaches);
  - Faraday Street roundabout;
  - M62 J11 roundabout; and,
  - Blackbrook Avenue / Birchwood Way roundabout.

Figure 1.1: Warrington VISSIM Model Extents



Source: © OpenStreetMap contributors

1.3 Base Model Methodology Overview

The base model represents 2016 traffic and network conditions. Classified turning count surveys were carried out in May 2016 for Network 1 and in September 2016 for Network 2. Additional turning count surveys were undertaken in March 2017, to include Blackbrook Avenue / Birchwood Way roundabout (Network 1).

Three time periods have been modelled with traffic input in 15-minute intervals. The peak hours were calculated from the traffic surveys, which are:

- AM Peak 07:45 – 08:45
- Inter Peak 12:30 – 13:30
- PM Peak 16:45 – 17:45

The model uses traffic data input in 15 minute intervals for each of the peak hours. A 15 minute warm-up period has been modelled before each peak hour, to ensure the correct level of traffic is already on the network before the analysis period begins. A 15 minute cool down period has been modelled after each peak hour to monitor network recovery.

The public transport routes and stops have been coded into the model using data gathered from online sources. As dwell time data was not available (and bus flows are low) VISSIM's default has been assumed. At Oakwood Gate and Moss Gate the traffic signals are controlled by MOVA. Therefore, in the VISSIM model, these are controlled by PCMOVA. Elsewhere, the traffic signals are controlled using VisVAP, which is a Vehicle Actuated Programming module in VISSIM.

Other calibration inputs used to assist journey time validation include; gap times at priority junctions; desired speeds; reduced speed areas; and driving behaviour modifications.

The model has been validated against TrafficMaster journey times along Birchwood Way and the M62.

1.4 Report Structure

The report structure is as follows:

- Section 2 Calibration and Validation Data
- Section 3 Calibration
- Section 4 Validation
- Section 5 Junction and Network Performance
- Section 6 Summary

Supporting information is included in the appendices as follows:

- Appendix A Observed (Balanced) Traffic Flows
- Appendix B Travel Time Outputs

2 Calibration and Validation Data

2.1 Introduction

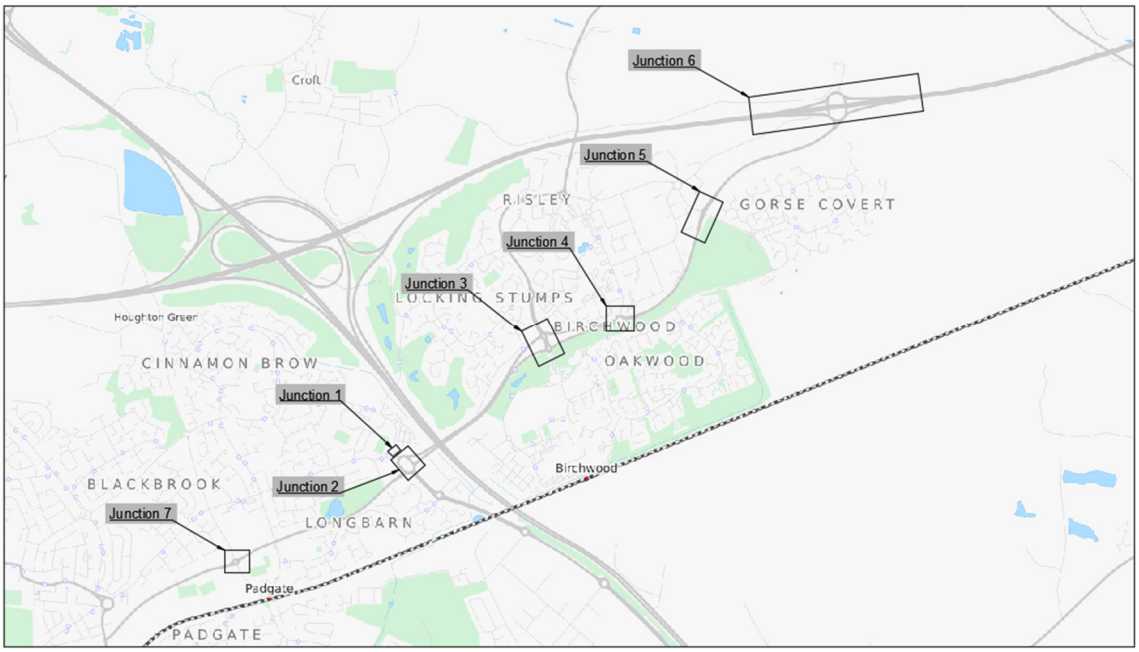
The purpose of this section is to summarise the data that has been used to construct and validate the base model.

2.2 Traffic

Traffic surveys were carried out on Wednesday 11th May 2016 for Network 1 and on Thursday 15th September 2016 and Tuesday 27th September 2016 for Network 2.

Additional traffic surveys were carried out on Thursday 30th March 2017, to include the Blackbrook Avenue / Birchwood Way roundabout. These were conducted at the seven junctions within the network, shown in **Figure 2.1**.

Figure 2.1: Junctions



Source: © OpenStreetMap contributors

The surveys were carried out during three time periods:

- Weekday AM peak (07:00-10:00);
- Weekday Inter peak (12:00 – 14:00); and,
- Weekday PM peak (16:00-19:00).

The fully classified turning count surveys included seven vehicle categories, with data provided in 15-minute intervals. The vehicle categories are:

- Pedal cycle;
- Motorcycle;
- Car;
- Light Goods Vehicle;
- Other Goods Vehicle 1;
- Other Goods Vehicle 2; and,
- Bus.

As the pedal cycle and motor cycle flows are very low and VISSIM does not model overtaking within a lane accurately, these have been omitted from the model.

Buses have been modelled as public transport lines and are not included in the vehicle compositions.

2.3 Pedestrians

During the site visits no pedestrian demand was observed so pedestrians have not been modelled.

2.4 Traffic and Signal Data

The traffic signals in the model have been coded according to traffic signal specifications and MOVA datasets provided by Warrington Borough Council.

The junctions where traffic signal data was collected are:

- Birchwood Way / Oakwood Gate Roundabout (west approach)
- Birchwood Way / Moss Gate

The coding of the M62 Junction 11 eastbound on-slip ramp metering has been replicated using a VISSIM model developed by Mott MacDonald for Highways England.

2.5 Public Transport Data

A combination of sources has been used to obtain information on the bus services operating within the study area. The location and type of the bus stops were identified using aerial mapping and site visits. Bus services, routes and frequencies were gathered from the Network Warrington website (http://www.networkwarrington.co.uk/) during September 2016.

2.6 Journey Time Data

Traffic Master journey time data has been gathered for Crab Lane, Fearnhead Lane, Birchwood Way and M62 for the period spanning from September 2015 to August 2016. However, only May 2016 to June 2016 (Tuesday to Thursday, term-time only) was used in the validation as this was

when the first batch of surveys was carried out. At the time of developing the model, no data was available for September 2016.

3 Calibration

3.1 Introduction

The calibration process involves coding the network set-up and behavioural characteristics of vehicles to achieve a match between observed and modelled data.

The VISSIM model comprises five basic components:

- Highway network (links and connectors);
- Traffic control systems (signals, stop signs and give-way control);
- Traffic and pedestrians;
- Vehicle routes; and,
- Driver behaviour.

3.2 Highway Network

The VISSIM model for the AM peak was developed based on the Ordnance Survey, aerial mapping and observations made during site visits. The subsequent inter peak and PM peak models were created using the validated AM peak model network.

3.3 Traffic Control Systems

Priority rules were coded at all give-way locations, including at signalised junctions where opposing phases run together, and also to replicate the 'keep clear' area at Crab Lane / Fearnhead Lane. No 'stop' signs exist within the network.

3.3.1 Traffic Signal Data

The eastbound approach at Oakwood Gate Roundabout and the Birchwood Way / Moss Gate Junction have been setup using MOVA. The pedestrian Crossing at Faraday Street Roundabout has been modelled as demand dependant using VisVap and the eastbound approach to M62 at Junction 11 as ramp metering.

3.3.2 Priority Rules

Locations where drivers give-way to others were generally coded using priority rules rather than conflict areas. Gap acceptance time has been modelled further to the site survey observations and to the model validation. Conflict areas were used on the entries to the two bus laybys on Birchwood Way.

3.4 Traffic and Pedestrians

3.4.1 Vehicle Types and Classes

VISSIM uses individual vehicle models that are grouped into vehicle types which are then grouped into vehicle classes. Separate vehicle classes for car, LGV, OGV1 and OGV2 have been modelled.

3.4.2 Vehicle Inputs and Compositions

Vehicles have been coded into the model using static assignment as there is no route choice. Vehicles are assigned to the network at the entry points as total volumes in 15-minute intervals. At this point the split of vehicles by class is applied using compositions. Compositions for each entry point for each 15-minute interval have been calculated using the traffic survey data.

As the traffic surveys were carried out on different days there are small differences in the volumes of traffic leaving one junction compared to those arriving at the next. Therefore, the traffic flows have been balanced along Birchwood Way. All balancing was carried out on Birchwood Way only; the traffic volumes travelling to and from the side roads remains consistent with the survey. The balanced traffic flows are included in **Appendix A**.

3.4.3 Bus Routes

Buses have been coded in the model as public transport lines. For each service the time of entry into the network has been estimated by the timetable at the stop nearest the entry point. All further stop times within the model are determined by the time spent travelling through the network and by the dwell time at each stop. Buses have been coded to stop at each of their designated stops; skipping stops is not permitted.

3.4.4 Bus Dwell Times

As no survey data of bus dwell times was available, default times of 20 seconds mean and 2 seconds standard deviation, normally distributed, have been assumed at all stops.

3.4.5 Pedestrians

Following a number of site visits, no pedestrians were observed using the controlled crossing and have therefore not been modelled. Similarly, where pedestrians cross at uncontrolled crossing points, they do so through gaps in the traffic and do not interact with vehicles. Again, these pedestrians have not been modelled.

3.5 Vehicle Routes

Vehicle routes, or turning proportions, have been applied in accordance with the balanced traffic survey data. Due to the close proximity of Crab Lane / Fearnhead Lane and College Place roundabout, the turning movements through this part of the network have been combined to form a mini origin destination network, ensuring vehicles use the correct lane on the approach to College Place.

The default distance for drivers to begin to move into the correct lane to reach their destination has been adjusted in the model to reflect the location where these lane changes were typically observed to occur.

3.6 Driver Behaviour

3.6.1 Speed Distributions

Speed distributions define the free-flow speeds at which vehicles will travel through the network. The distributions have been calculated using Automatic Traffic Count data. In some instances, these have been adjusted to best match the TrafficMaster travel times.

Reduced speed areas have been placed on turning connectors throughout the network and on roundabout circulatory lanes. Reduced speed areas have also been applied on the M62 eastbound mainline carriageway in the PM peak model to reflect the low traffic speeds caused by extensive congestion around the western and northern side of the M60 between Junctions 7 and 18, which is not modelled explicitly. The speeds here have been calibrated to reflect the journey time data.

3.6.2 Vehicle Following Behaviour and Link Types

The model is built largely using default values. There are a few areas, mainly merges and the M62 mainline where the driver behaviour parameters have been adjusted to reflect observed conditions, as set out below:

- Urban (Motorised) link behaviour type has been used on all single lane sections of the network and on roundabout circulatory lanes. Wiedemann 74 car following model has been applied with default parameters.
- Left-side rule (motorised) has been used on two-lane dual carriageway sections. The Wiedemann 99 car following model has been applied with default parameters.
- Urban (Merging) has been applied at merge sections on Birchwood Way. The Wiedemann 74 car following model has been applied with minor amendments to the car following parameters to reflect observations.
- Urban (Transition) has been applied to the eastbound section of Birchwood Way between Moss Gate and the M62. The Wiedemann 74 car following model has been used, with the average standstill and multiplication part of safety distance reduced to reflect observed conditions.
- Left side rule (Motorway). The Wiedemann 99 car following model that has been used with adjustments to the CC0, CC1, CC5 and CC8 parameters to reflect the observed congestion.
- Transition Merge to Motorway has been applied to the mainline M62 carriageway at Junction 11. The Wiedemann 99 car following model has been used with adjustments to the CC0, CC1, CC2, CC3, CC4, CC5 and CC8 parameters to reflect observed conditions.
- Motorway Merges has been applied to merges on the M62. The Wiedemann 99 car following model that has been used with adjustments to the CC0, CC1, CC2, CC3, CC4 and CC5 parameters to reflect observed conditions.

3.6.3 Acceleration and Deceleration

Default values were assumed for rates of vehicle acceleration and deceleration and weight distributions.

3.7 Traffic Flow Calibration Analysis

Once the traffic flows had been coded, the model parameters were adjusted until the modelled flows matched with balanced surveyed flows. A comparison was then carried out using the Geoffrey E. Havers (GEH) statistic, which is an industry standard method of comparing observed and modelled flows, as defined in the Design Manual for Roads and Bridges (DMRB) Volume 12, Chapter 4 and WebTAG Unit M3.1.

The GEH statistic is used to remove the bias that exists when comparing flows of different magnitudes using percentages. For example, an absolute difference of 10 in a flow of 100 vehicles per hour (vph) is less significant (GEH = 3.0) than a difference of 100 in a 1000vph flow (GEH = 11.5), even though they both show a percentage difference of 10%.

The GEH statistic is calculated as follows:

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

Where:

M is the modelled flow; and,

C is the observed flow.

The accuracy of the modelled flows can also be assessed by comparing observed and modelled flows on an x-y plot and performing a linear regression analysis to calculate R^2, and the slope of the regression line through the origin. A value of R^2 =1 implies a perfect match while R^2 = 0 an imperfect match between the observed and modelled flows. Typically, a value of $R^2 \geq 0.95$, and slope within the range 0.90 and 1.10 would imply that the modelled flows are a good fit within the observed flows. A slope exceeding unity implies that the model is over-predicting flows, while a slope less that unity suggests that the model is under-predicting observed flows.

In summary, the following set of acceptable ranges and limits have been used to assess model calibration based upon all turning movements within the study area where a direct comparison to count data exists:

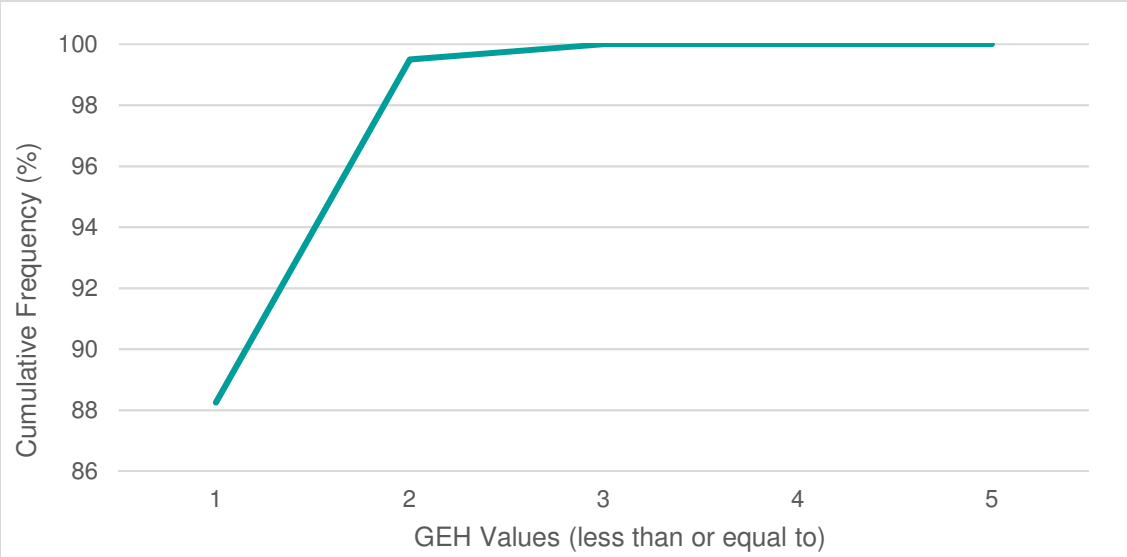
- GEH value: ≤ 2.0 in at least 85% of cases;
- R^2 value: greater than or equal to 0.95; and,
- Slope of linear regression: within the range 0.90 to 1.10.

The GEH statistic assessments have been conducted on all turning movements at all junctions in the modelled network where an observed count was available.

3.7.1 AM Peak

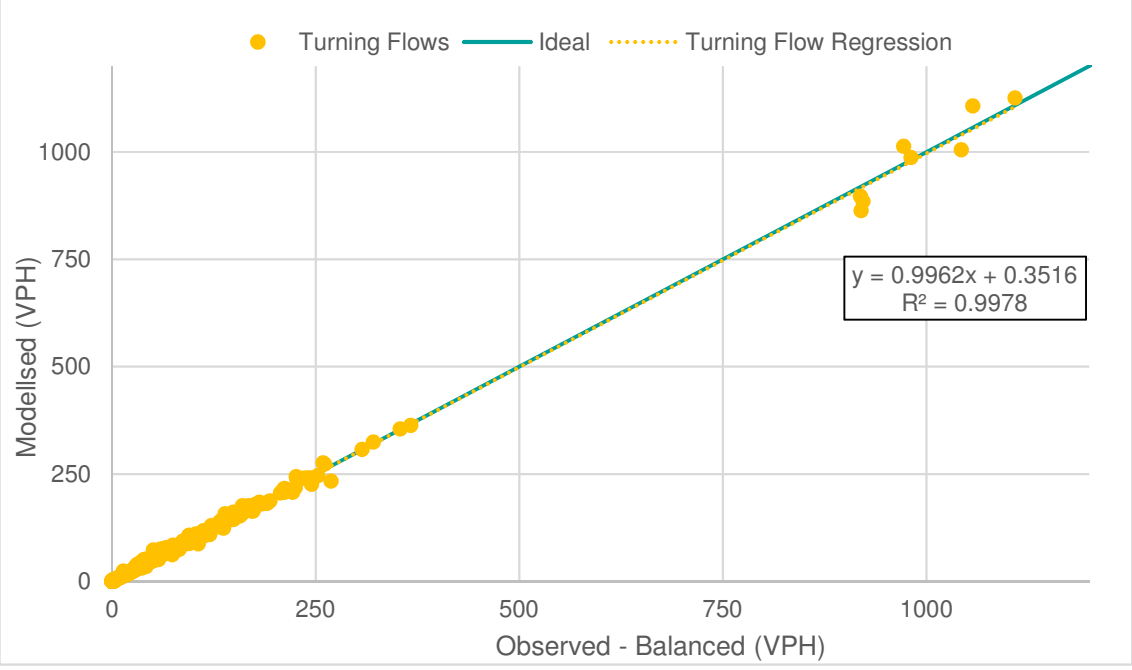
A cumulative frequency graph of the AM peak GEH assessment is shown **Figure 3.1**. The graph indicates that the model meets the first criteria with 99% of modelled flows within a GEH of 2 when compared to the surveyed flows.

Figure 3.1: 2016 AM Peak Cumulative Frequency of GEH Values



The linear regression of the modelled total flows and observed total flows was also analysed. A high co-efficient correlation (R^2) was achieved with the results shown in **Figure 3.2.** Regression of the AM peak observed versus modelled flows gives an R^2 value of 0.9978 and a slope of 0.9962 demonstrating that the model also meets the second and third calibration criteria.

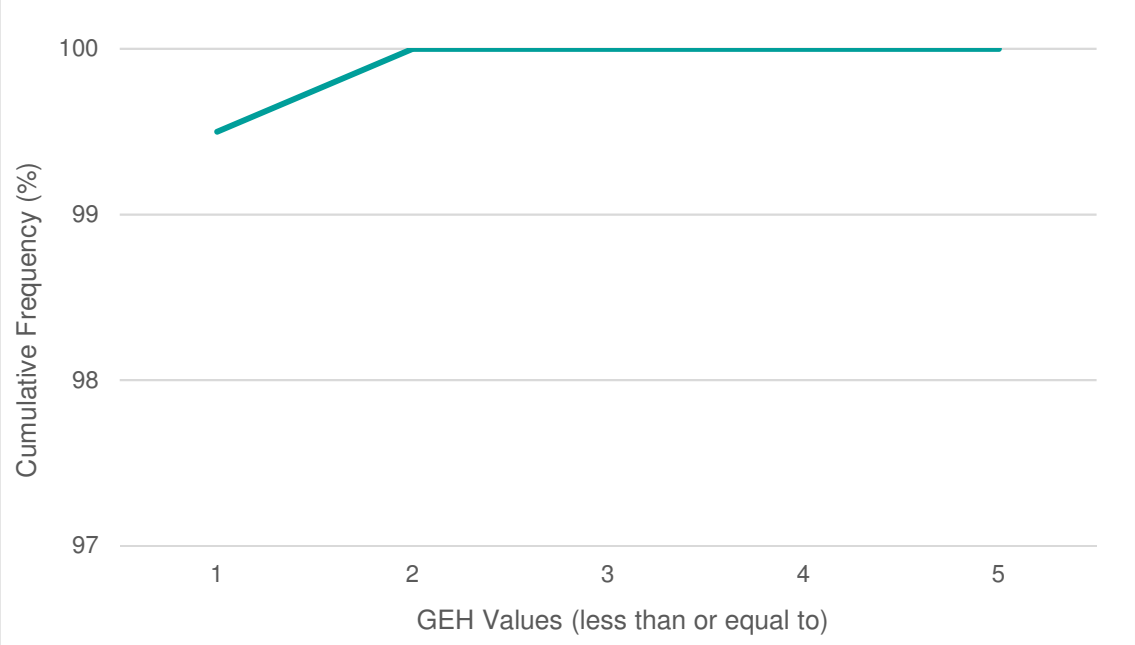
Figure 3.2: 2016 AM Peak Linear Regression of Traffic Flows



3.7.2 Inter Peak

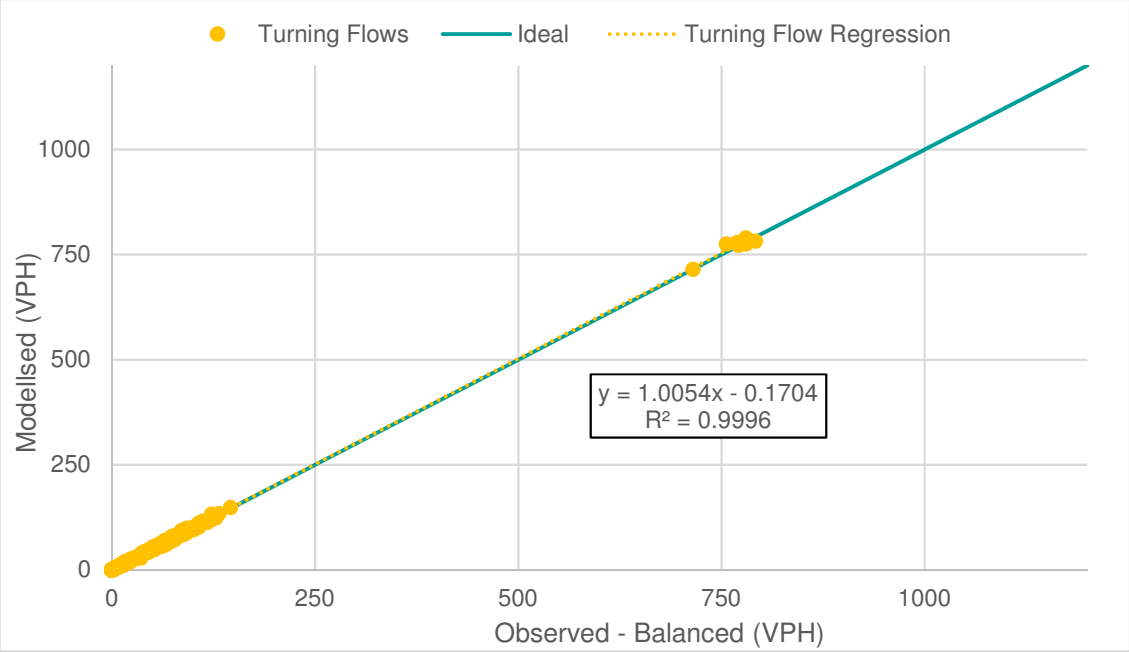
A cumulative frequency graph of the inter peak GEH values is shown in **Figure 3.3**. The graph indicates that the model meets the first criteria with 100% of modelled flows within a GEH of 2 when compared to the surveyed flows.

Figure 3.3: 2016 Inter Peak Cumulative Frequency of GEH Values



The linear regression of the modelled total flows and observed total flows was also analysed with the results shown in **Figure 3.4**. Regression of the inter peak observed versus modelled flows showed an R^2 value of 0.9996 and a slope of 1.0054 demonstrating that the model shows a very good fit and meets the second and third calibration criteria.

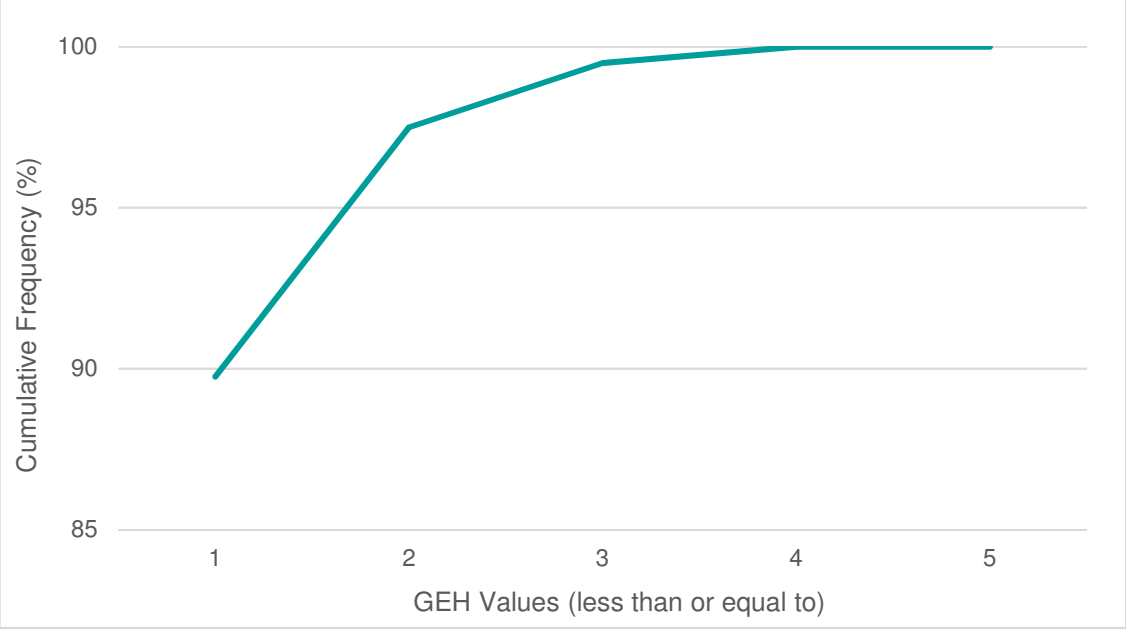
Figure 3.4: 2016 Inter Peak Linear Regression of Traffic Flows



3.7.3 PM Peak

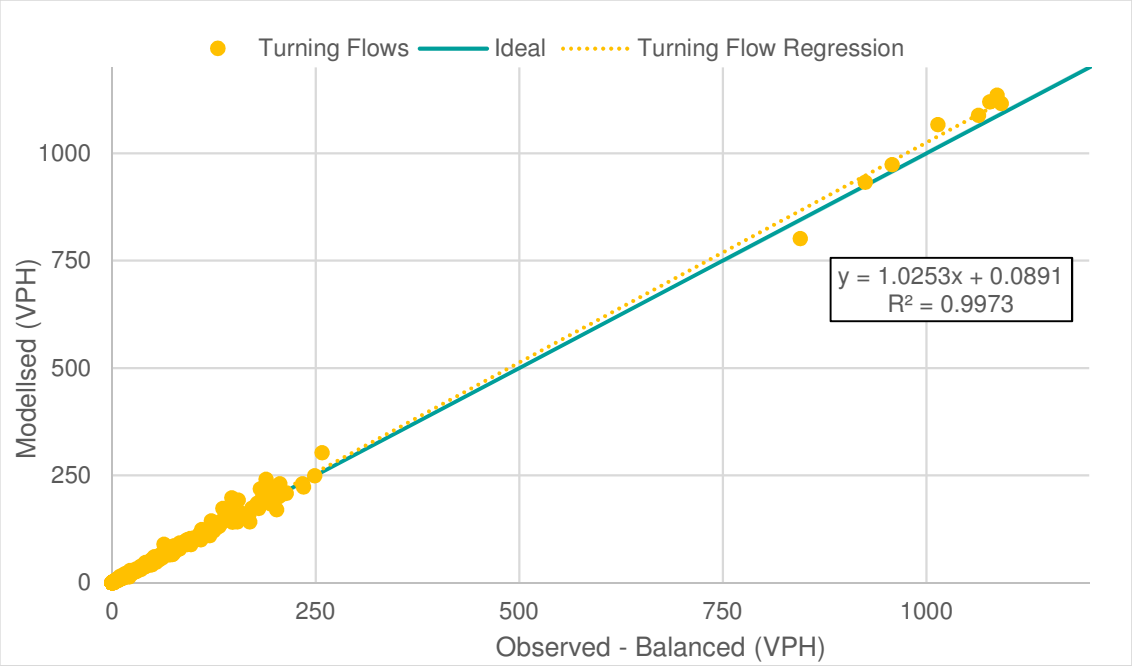
A cumulative frequency graph of the PM peak GEH values is shown **Figure 3.5** below. The graph indicates that the model meets the first criteria with 98% of modelled flows within a GEH of 2.

Figure 3.5: 2016 PM Peak Cumulative Frequency of GEH Values



The linear regression of the modelled total flows and observed total flows was also analysed with the results shown in **Figure 3.6**. Regression of the PM peak observed versus modelled flows showed an R^2 value of 0.9973 and a slope of 1.0253 demonstrating that the model shows a good fit and meets the second and third calibration criteria.

Figure 3.6: 2016 PM Peak Linear Regression of Traffic Flows



3.7.4 Traffic Flow and Calibration Summary

For each of the AM, inter and PM peak models, the analysis shows that the modelled flows are consistent with the balanced surveyed flows, meeting all of the comparison criteria.

4 Validation

4.1 Criteria

4.1.1 Parameters to validate this model

To confirm that the model is suitable for purpose of the evaluation of the Warrington East Phase 2 capacity improvement scheme and to provide credibility to the results, the model has been validated against observed journey times.

Model validation assesses the accuracy of the model by comparing data from the model with independent data not used to calibrate the model. Validation is directly linked to the calibration process as adjustments in calibration are needed to improve the models accuracy against observations.

DfT's WebTAG Unit M3.1 sets out the criteria for journey time validation, as shown in **Table 4.1**.

Table 4.1: Journey Time Validation Criterion and Acceptability Guidance

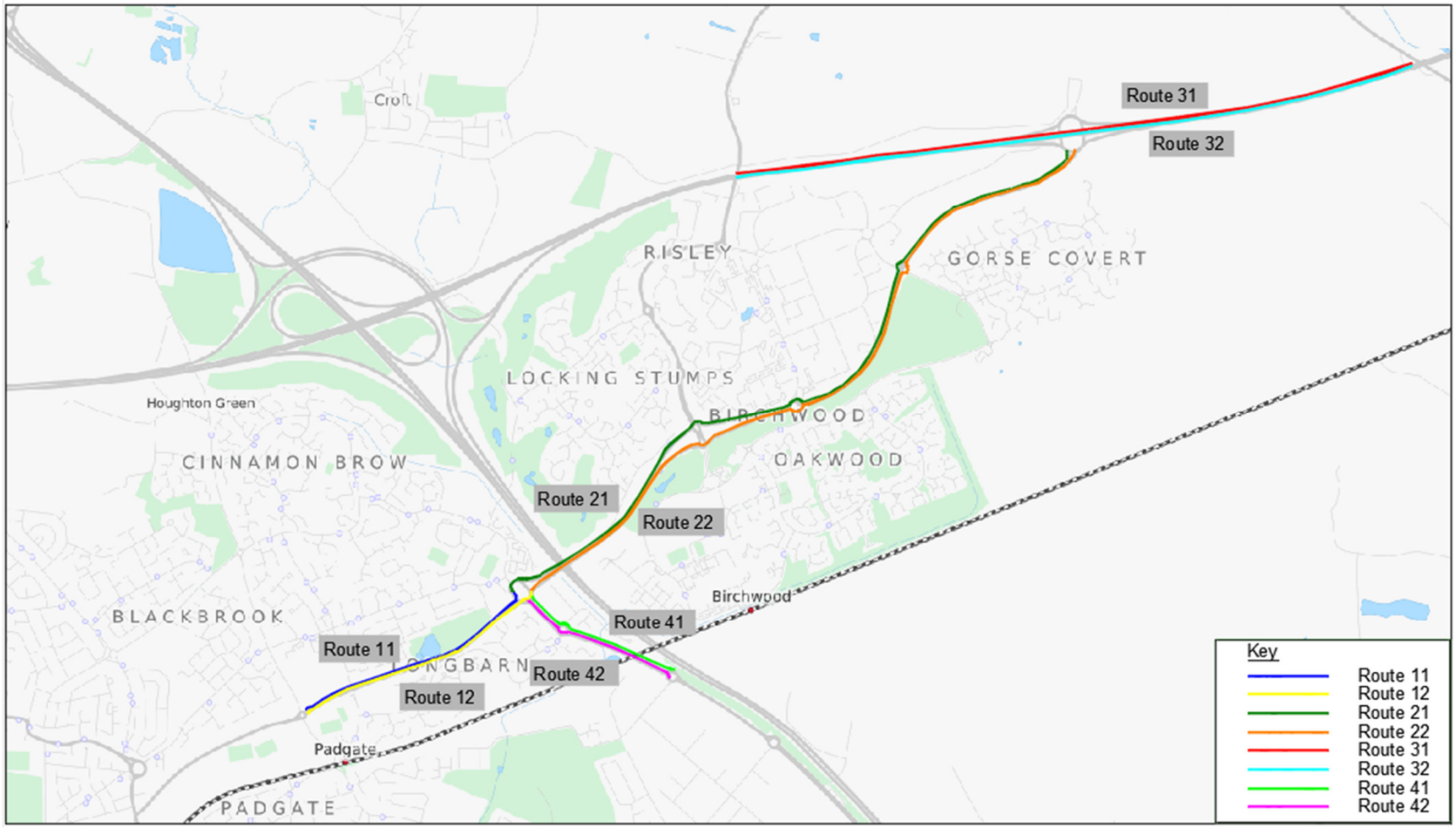
Modelled Times along Routes should be within 15% of surveyed times (or 1 minute, if beyond 15% and distance is longer than 3km)[1]	> 85% of routes

As discussed in **Section 2.6**, TrafficMaster journey time data has been gathered for Crab Lane, Fearnhead Lane, Birchwood Way and the M62 for the period spanning from May to June 2016.

Eight travel time sections have been analysed, as shown in **Figure 4.2**.

[1] WebTAG Unit M3.1 recommends that travel time sections should be between 3km and 15km. However, this is aimed at much larger, strategic models. All travel time sections analysed in this LMVR meet the criterion except for Route 11, which is 1.1km. This is limited by the presence of a junction immediately outside of the modelled network. The ±1 minute criterion has not been applied to this section.

Figure 4.2: Travel Time Sections



Source: ©OpenStreetMap contributors

Figure 4.3 to **Figure 4.26** show the travel time performances for the cumulative travel time routes by hour with the modelled times in blue, the observed in green. The error bars represent the 15% threshold from the observed travel time. However, on routes greater than 3 kilometres (routes 21, 22, 31 and 32), the threshold is 60 seconds. A full comparison of modelled and observed travel times is included in **Appendix B.**

4.1.2 Random Seeds

As VISSIM is a stochastic model the results differ slightly depending on the random seed assigned to each simulation run. Therefore, to obtain statistically significant results, the peak hour models were simulated ten times with different 'random seeds'. Random seeds can be thought of as different days and therefore account for daily variation. The results presented are an average of the ten random seed runs for each peak period.

4.2 AM Peak Travel Time Validation

Figure 4.3 to **Figure 4.10** show the travel time performances for the AM peak. The graphs illustrate that all travel time sections are within 15% of the observed travel times and therefore the model is considered to be validated.

Figure 4.3: Travel Time Section 11 - Blackbrook Avenue Roundabout to College Place Roundabout – AM Peak

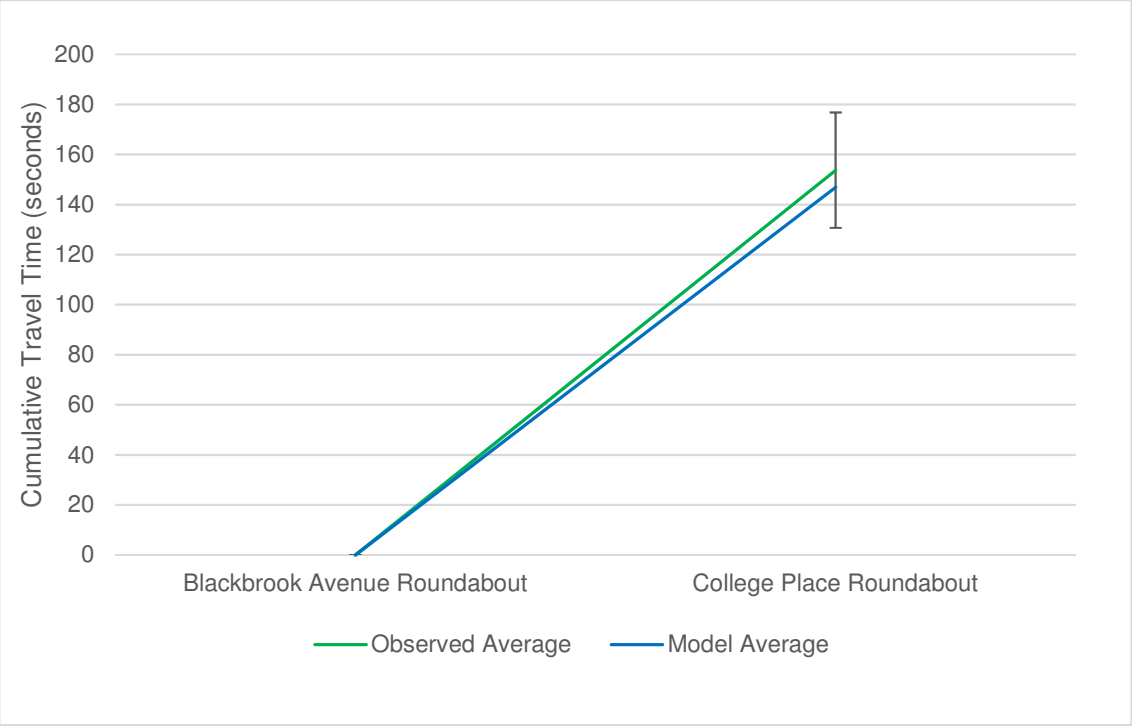


Figure 4.4: Travel Time Section 12 - College Place Roundabout to Blackbrook Avenue Roundabout – AM Peak

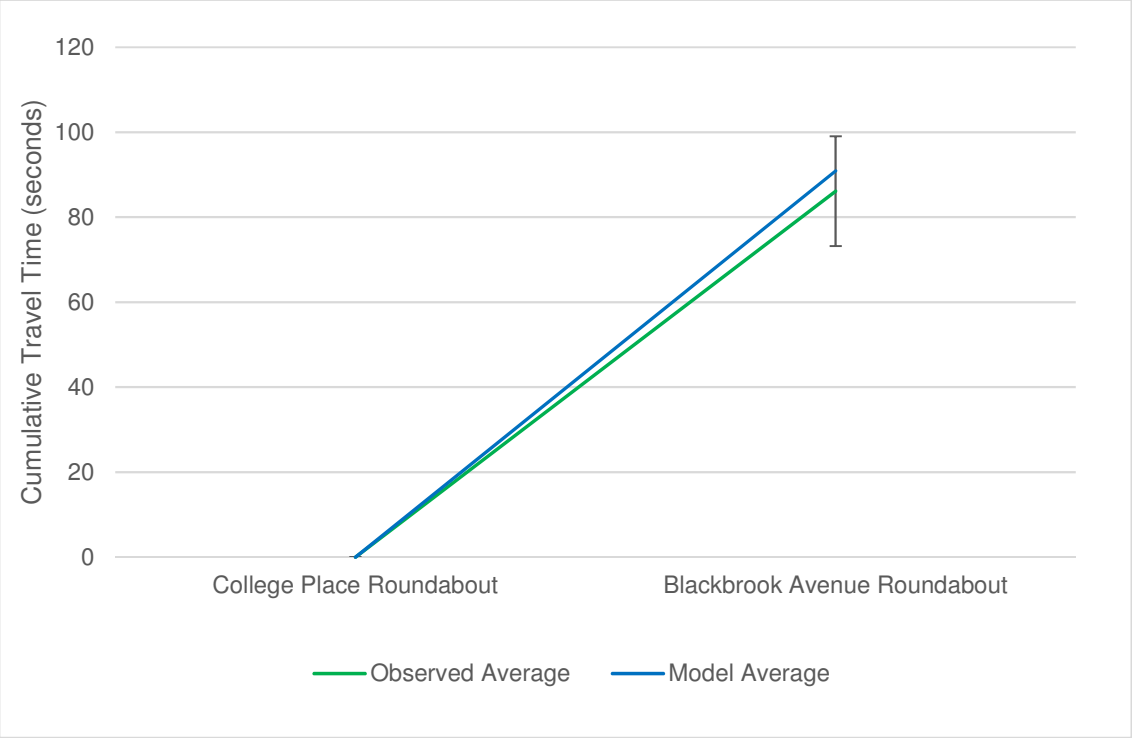


Figure 4.5: Travel Time Section 21 – College Place Roundabout to M62 J11 – AM Peak

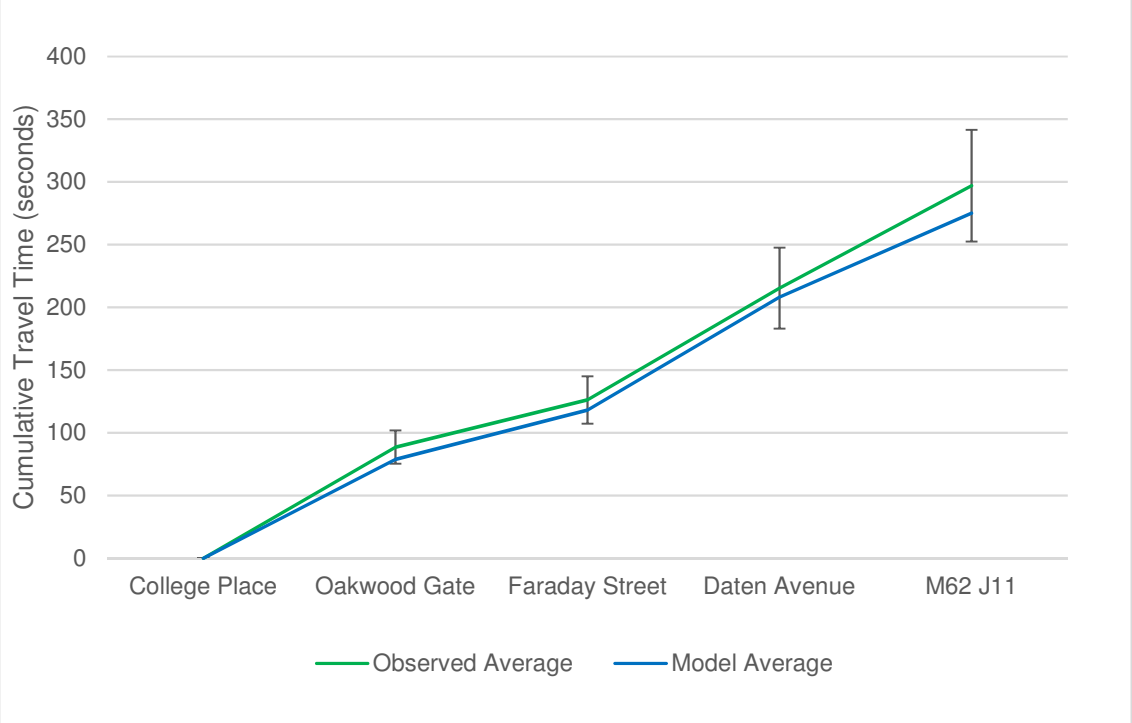


Figure 4.6: Travel Time Section 22 – M62 J11 to College Place Roundabout – AM Peak

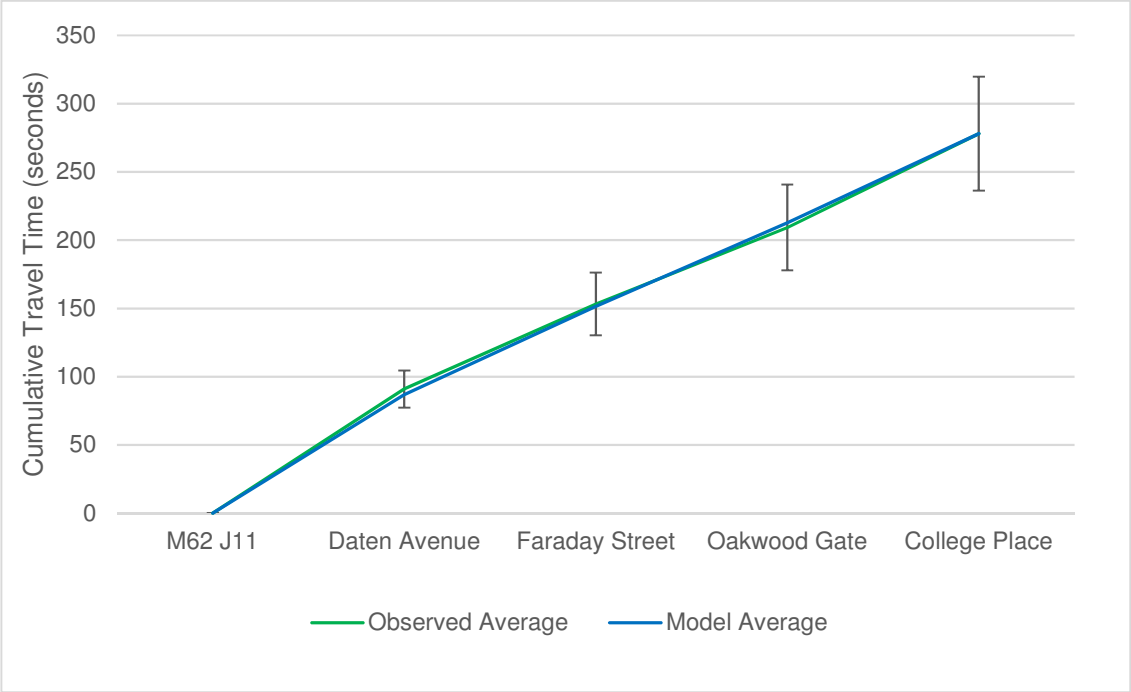


Figure 4.7: Travel Time Section 31 – M62 Croft Interchange to Holcroft Lane – AM Peak

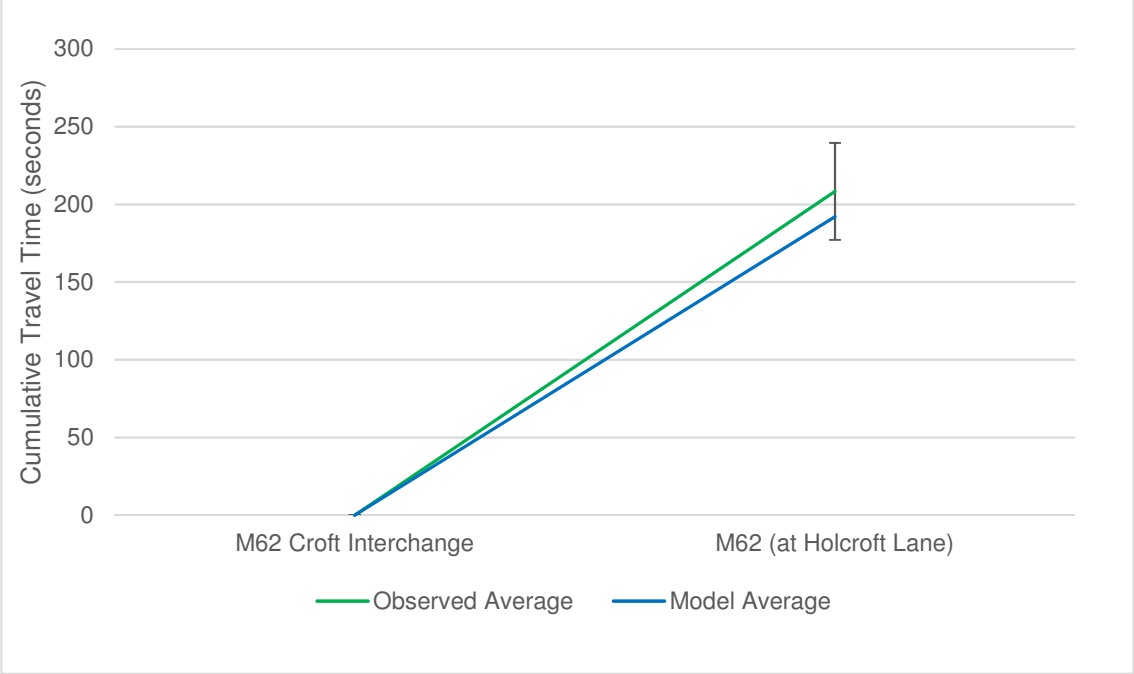


Figure 4.8: Travel Time Section 32 - M62 Holcroft Lane to Croft Interchange – AM Peak

Figure 4.9: Travel Time Section 41 – College Place Roundabout to Kingsland Roundabout – AM Peak

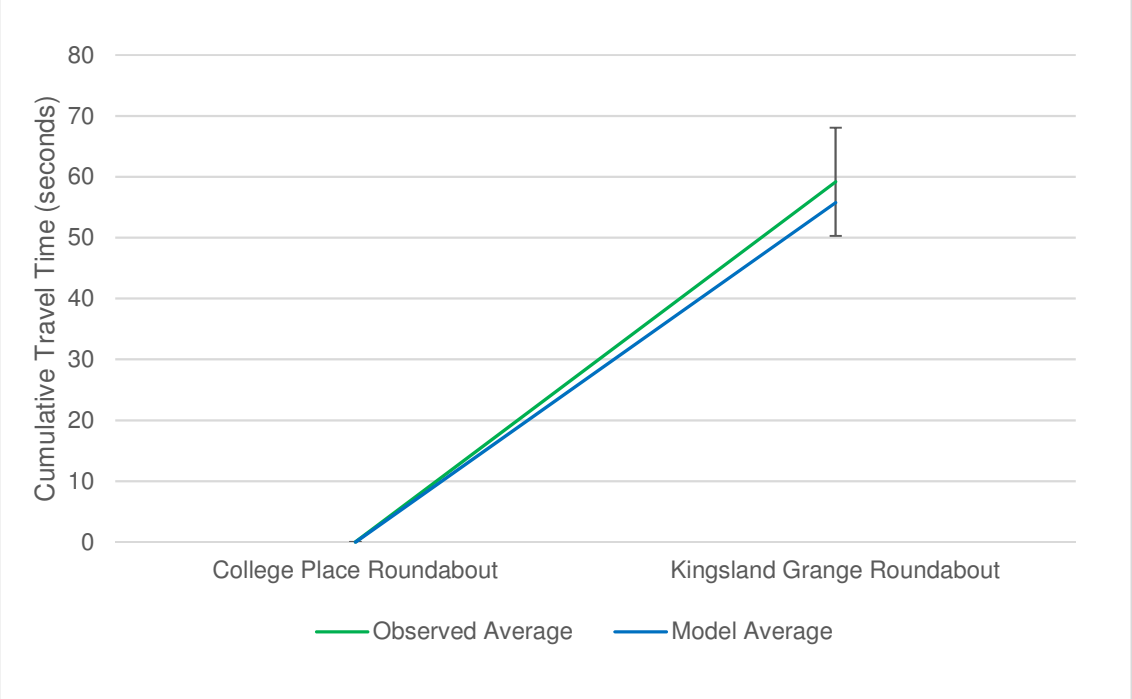
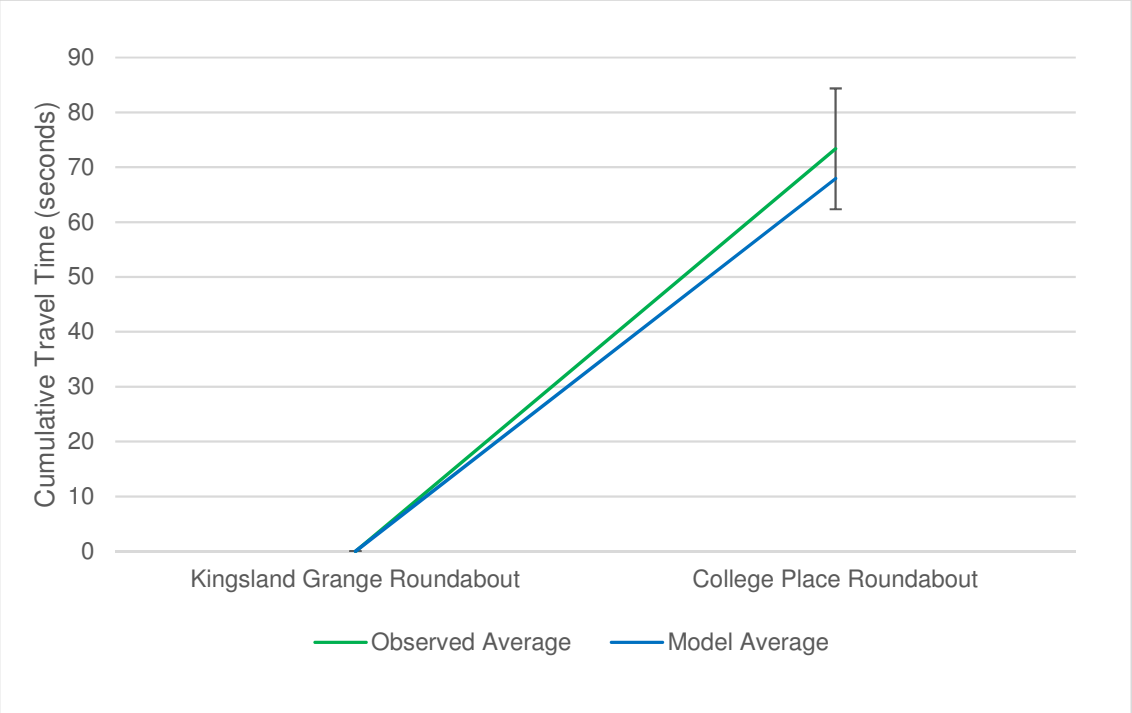


Figure 4.10: Travel Time Section 42 – Kingsland Roundabout to College Place Roundabout – AM Peak



4.3 Inter Peak Travel Time Validation

Figure 4.11 to **Figure 4.18** show the travel time performances for the inter peak. The graphs illustrate that all travel time sections are within 15% of the observed travel times and therefore the model is considered to be validated.

Figure 4.11: Travel Time Section 11 - Blackbrook Avenue Roundabout to College Place Roundabout – Inter Peak

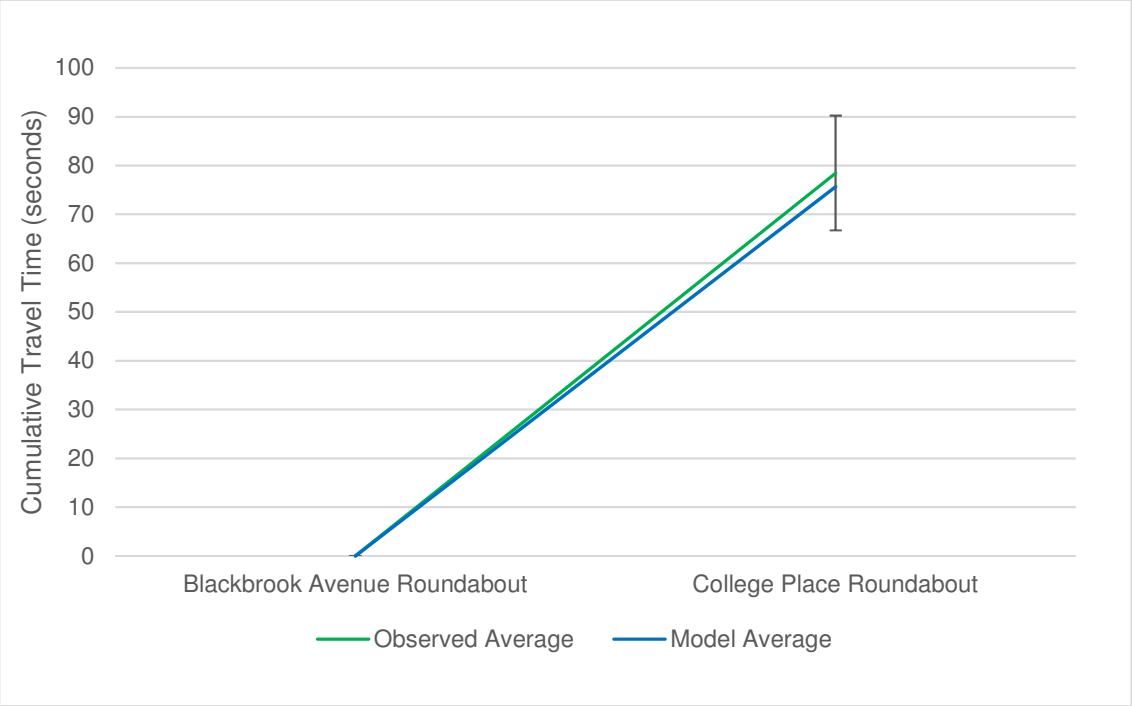


Figure 4.12: Travel Time Section 12 - College Place Roundabout to Blackbrook Avenue Roundabout – Inter Peak

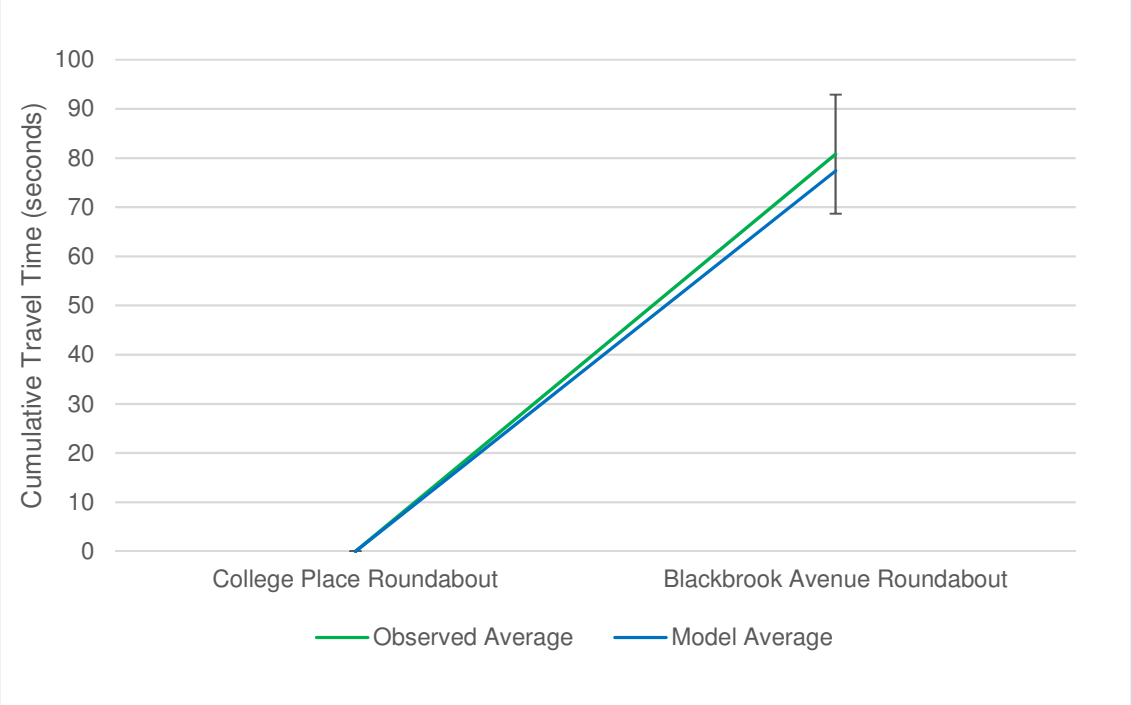


Figure 4.13: Travel Time Section 21 – College Place Roundabout to M62 J11– Inter Peak

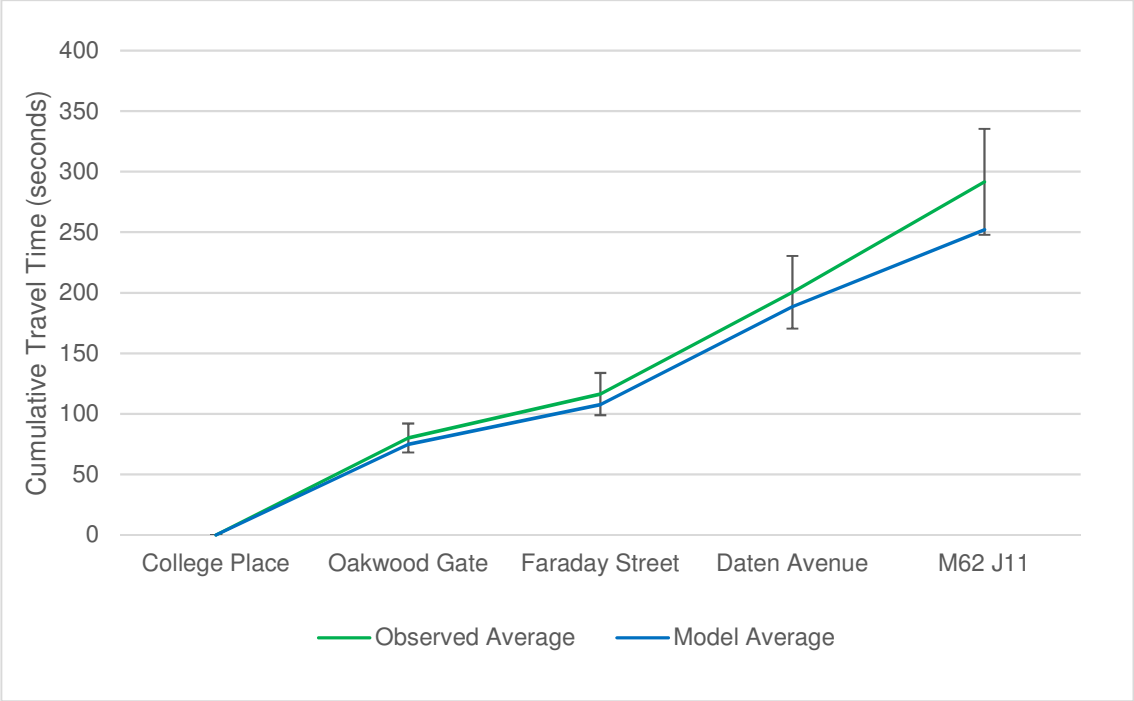


Figure 4.14: Travel Time Section 22 – M62 J11 to College Place Roundabout – Inter Peak

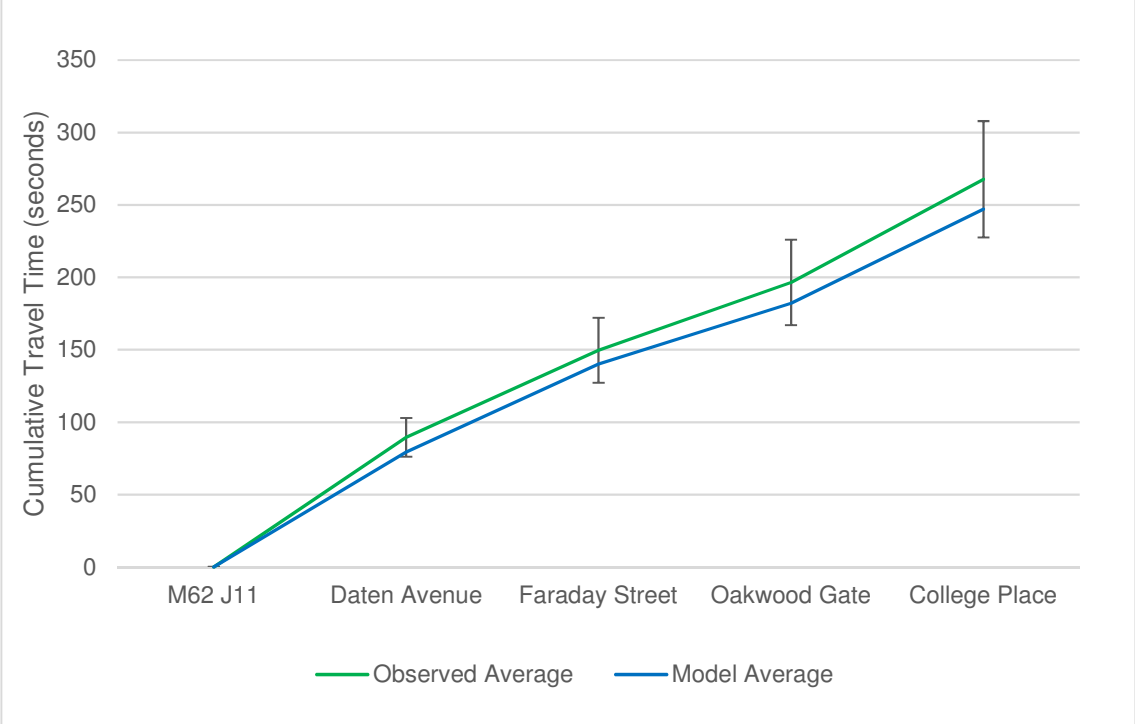


Figure 4.15: Travel Time Section 31 – M62 Croft Interchange to Holcroft Lane – Inter Peak

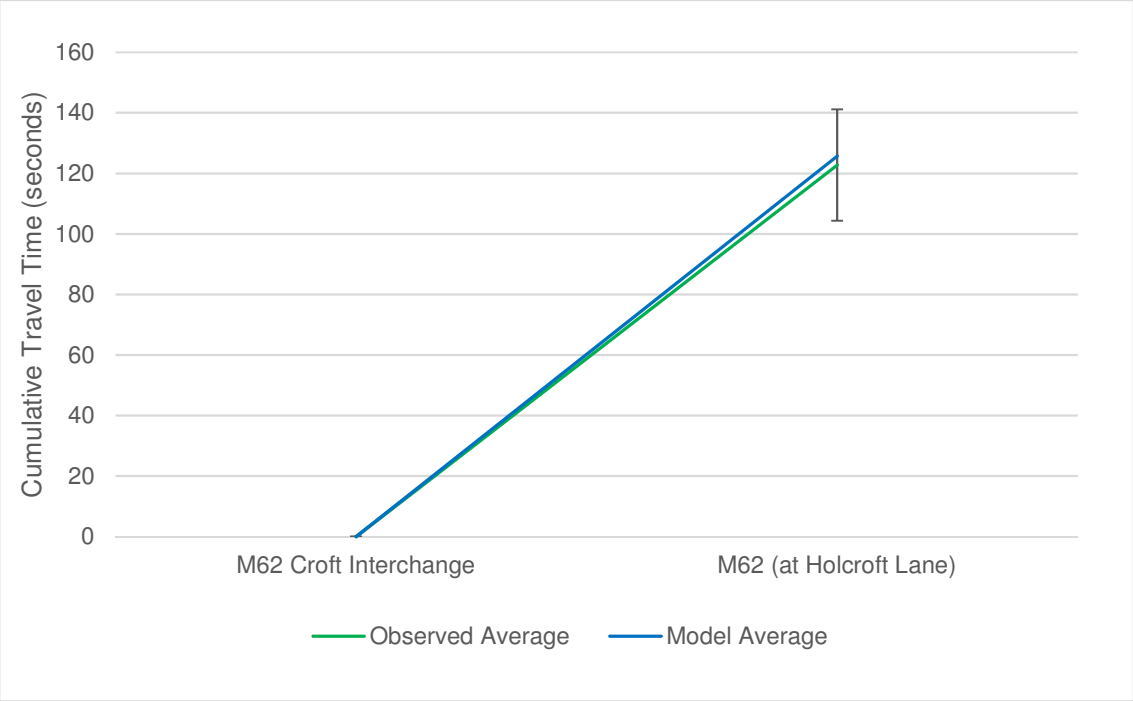


Figure 4.16: Travel Time Section 32 - M62 Holcroft Lane to Croft Interchange – Inter Peak

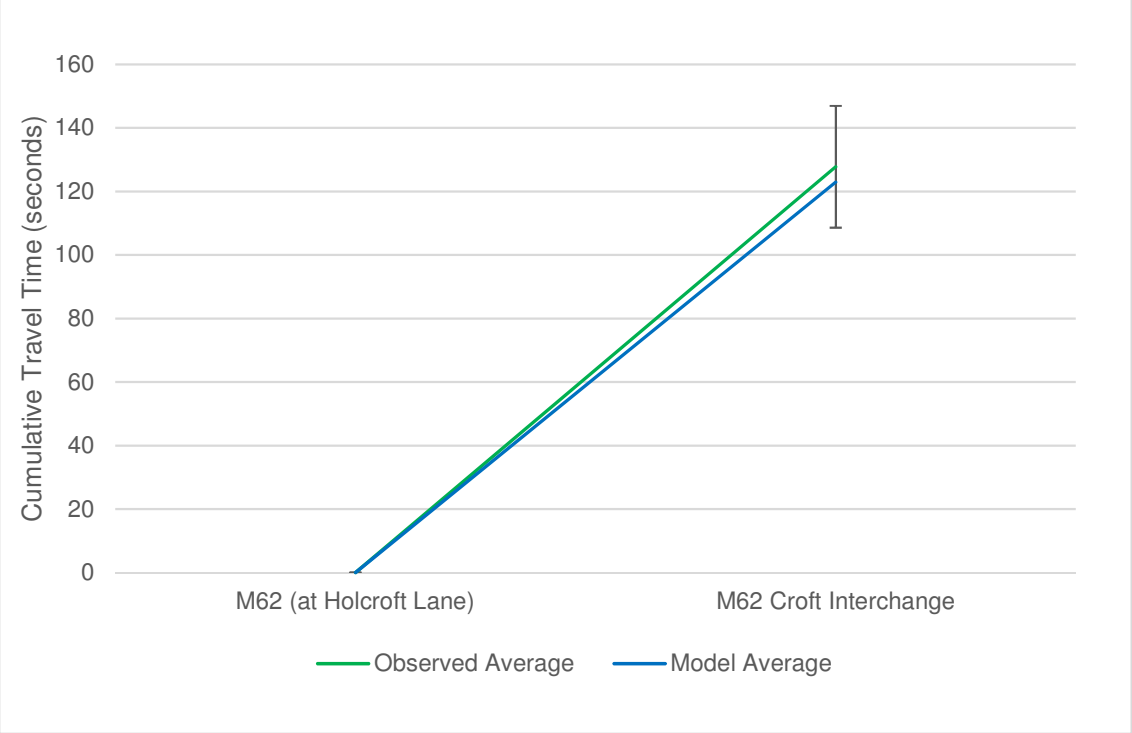


Figure 4.17: Travel Time Section 41 – College Place Roundabout to Kingsland Roundabout – Inter Peak

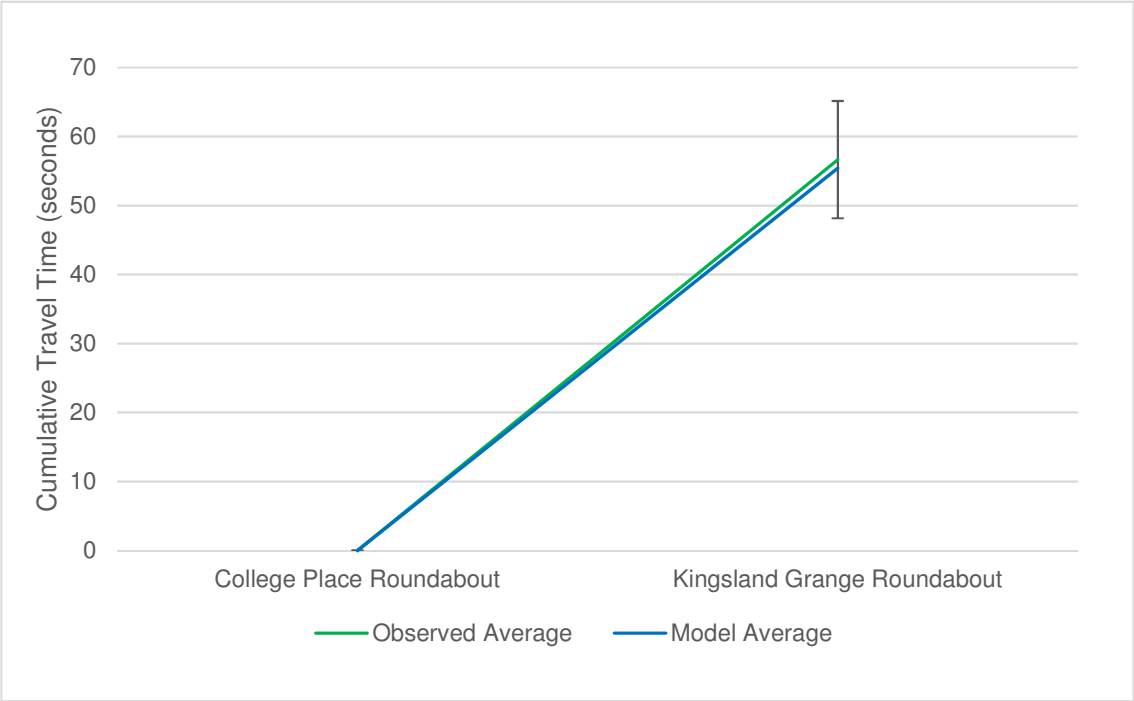
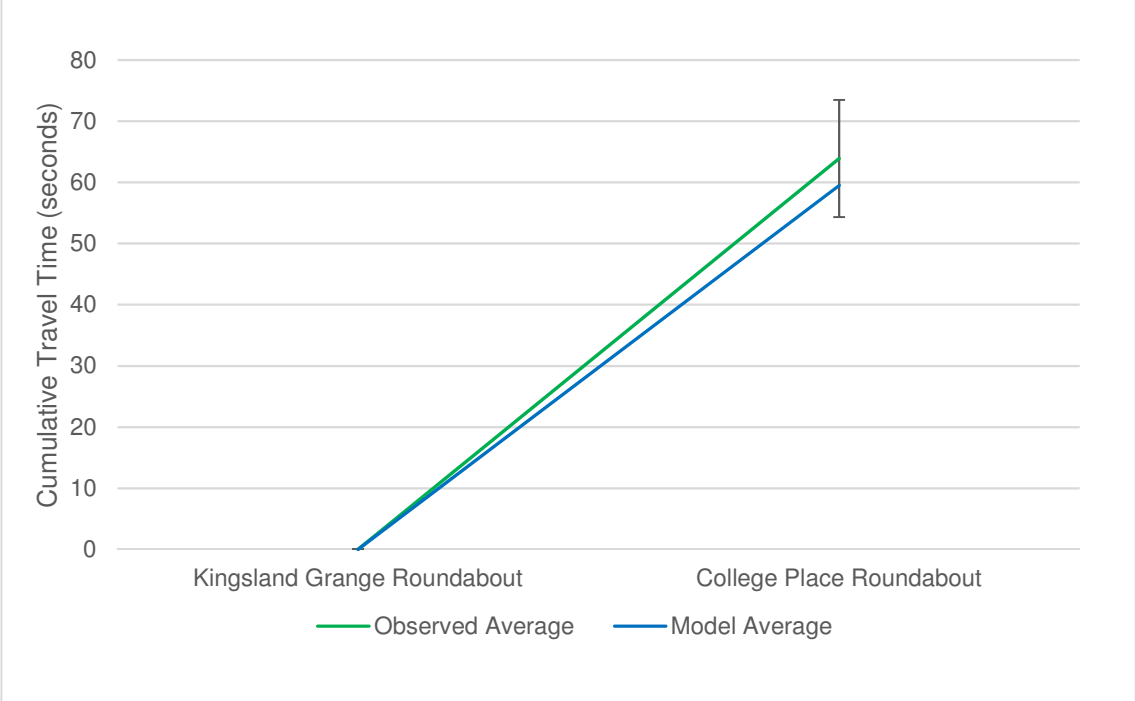


Figure 4.18: Travel Time Section 42 – Kingsland Roundabout to College Place Roundabout – Inter Peak



4.4 PM Peak Travel Time Validation

Figure 4.19 to **Figure 4.26** show the travel time performances for the PM peak. The graphs illustrate that seven out of eight of the travel time sections validate to within 15% of the observed journey times. The remaining travel time section is the eastbound mainline M62. However, the modelled average is within 1 minute of the observed average. As this section is greater than 3 kilometres in length it meets the validation criteria as set out in WebTAG, which gives an overall pass rate of 100%.

Figure 4.19: Travel Time Section 11 - Blackbrook Avenue Roundabout to College Place Roundabout – PM Peak

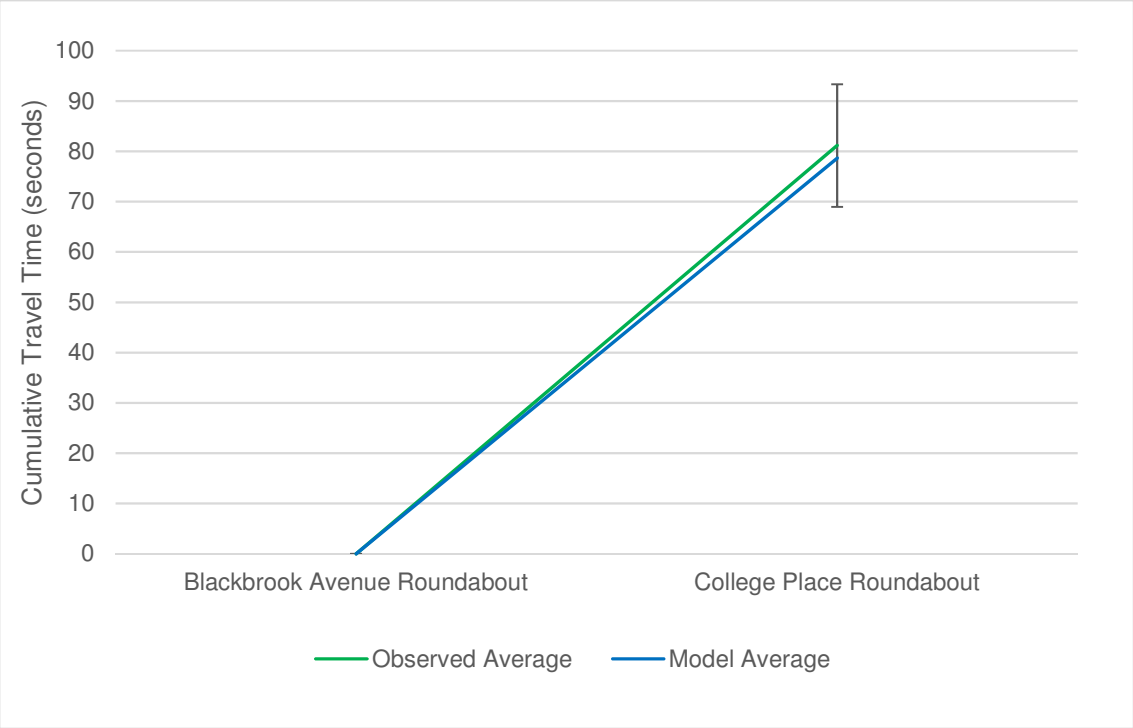


Figure 4.20: Travel Time Section 12 - College Place Roundabout to Blackbrook Avenue Roundabout – PM Peak

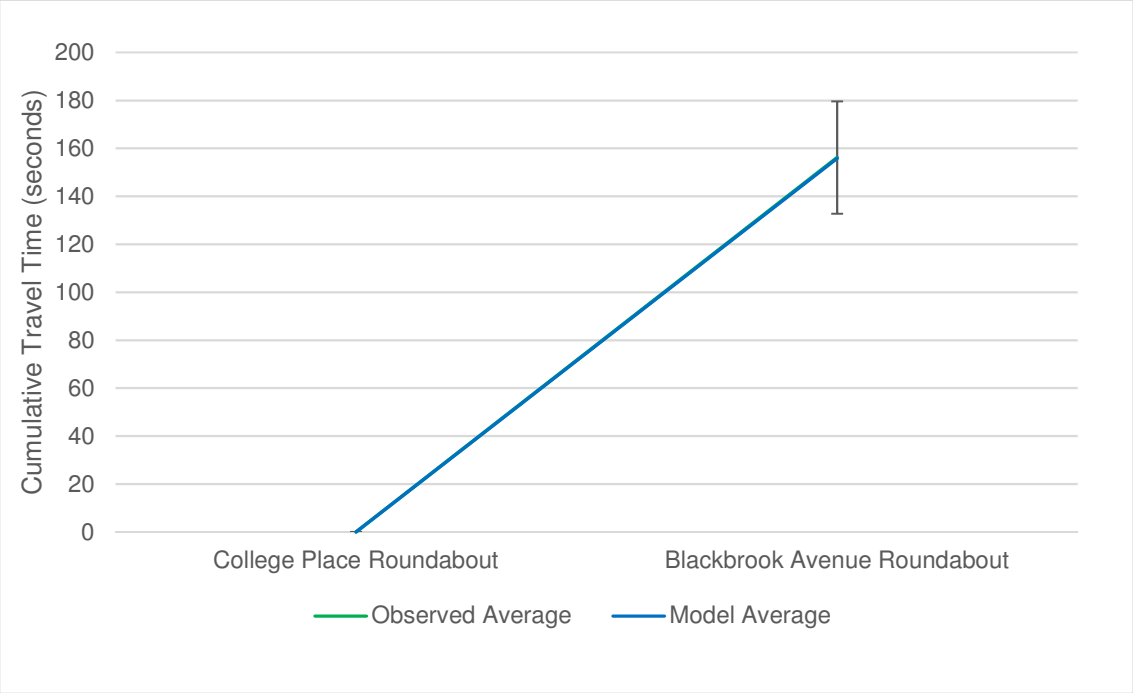


Figure 4.21: Travel Time Section 21 – College Place Roundabout to M62 J11– PM Peak

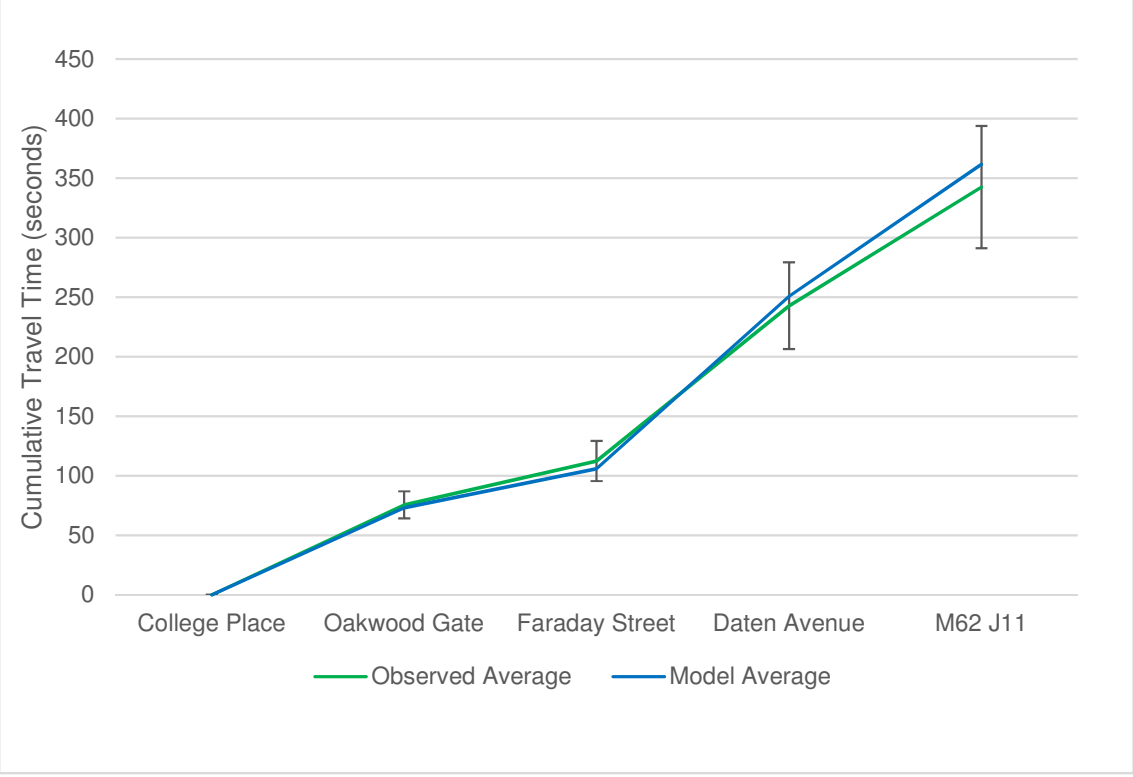


Figure 4.22: Travel Time Section 22 – M62 J11 to College Place Roundabout – PM Peak

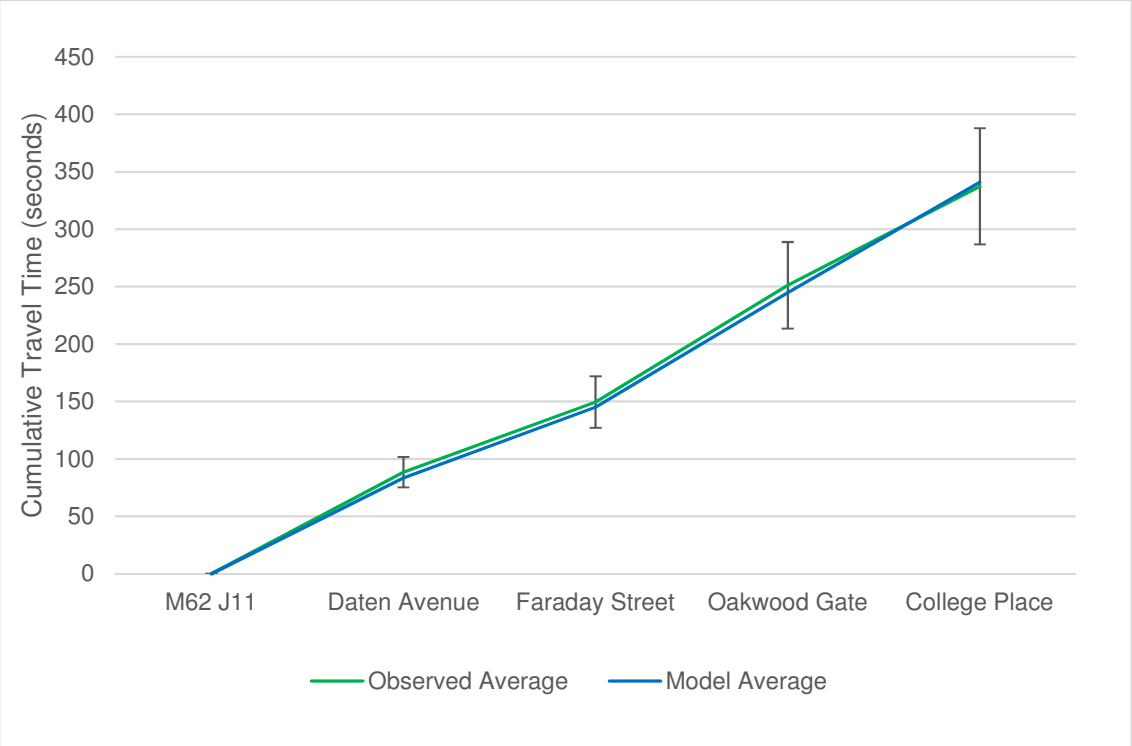


Figure 4.23: Travel Time Section 31 – M62 Croft Interchange to Holcroft Lane – PM Peak

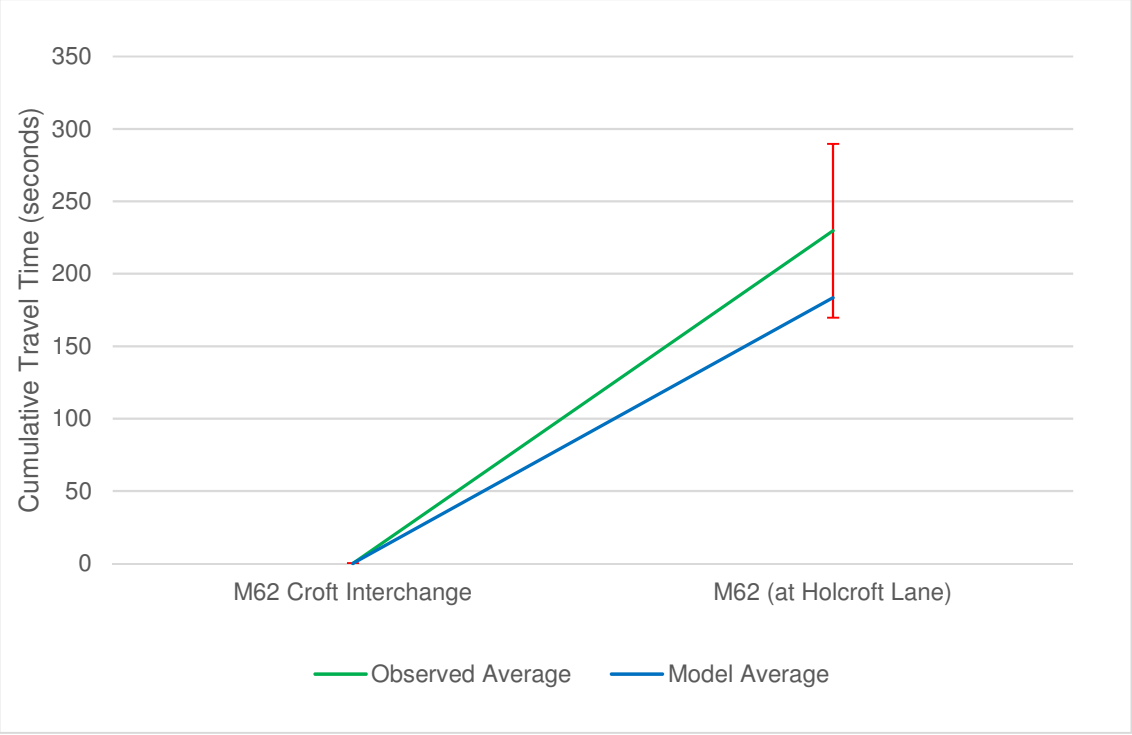


Figure 4.24: Travel Time Section 32 - M62 Holcroft Lane to Croft Interchange – PM Peak

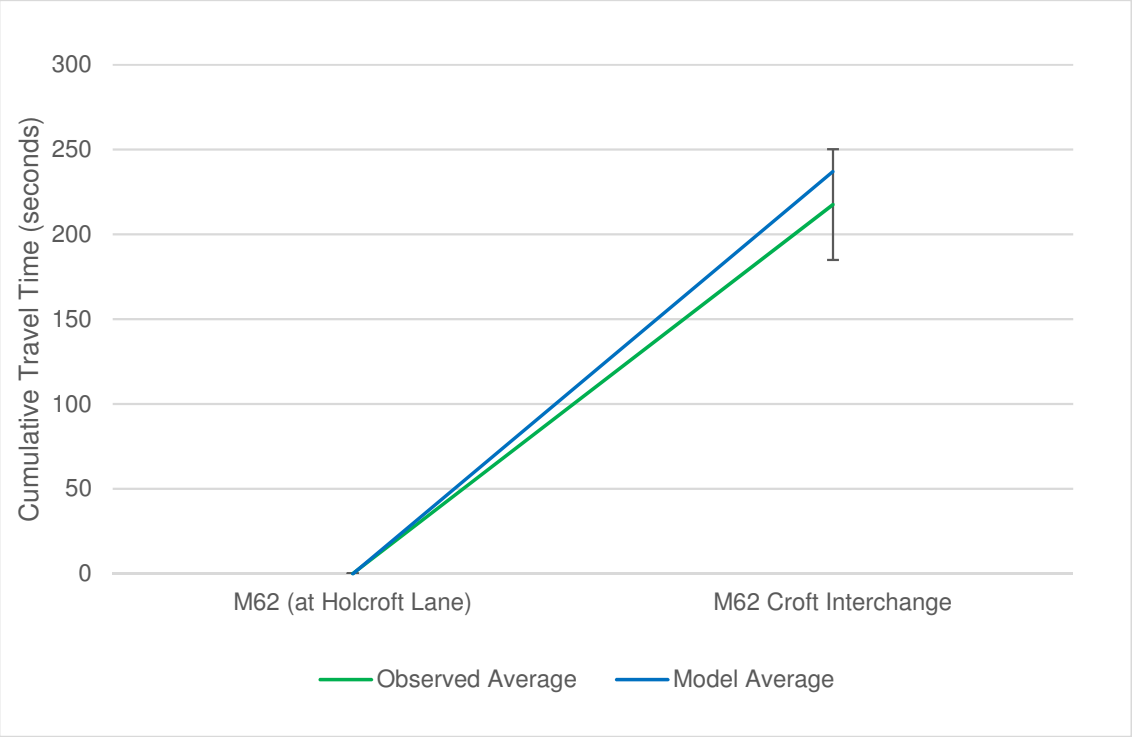


Figure 4.25: Travel Time Section 41 – College Place Roundabout to Kingsland Roundabout – PM Peak

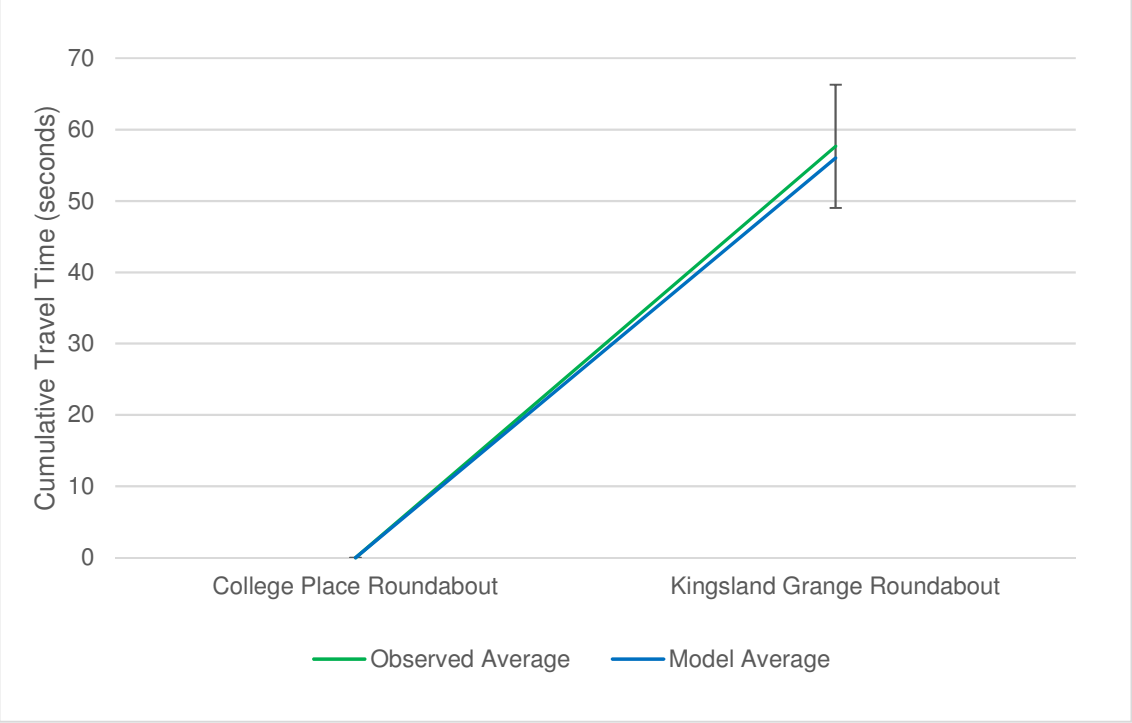
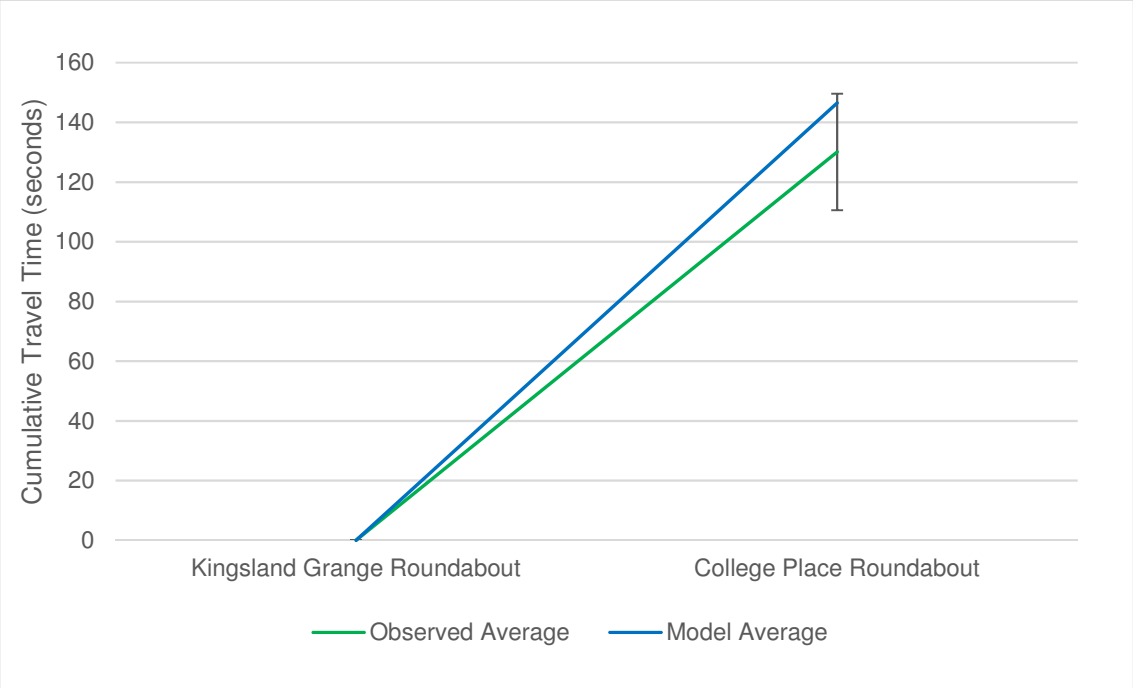


Figure 4.26: Travel Time Section 42 – Kingsland Roundabout to College Place Roundabout – PM Peak



5 Junction and Network Performance

5.1 Junction Performance

The Level of Service (LOS) indicator has been included in the analysis to provide a quick reference to junction performance.

The LOS is an American concept derived from the Highway Capacity Manual (2000). It rates performance based upon delay thresholds on an A to F grading as follows:

- LOS A – 0 to 10 seconds;
- LOS B – 10 to 20 seconds (10 to 15 seconds for unsignalised);
- LOS C – 20 to 35 seconds (15 to 25 seconds for unsignalised);
- LOS D – 35 to 55 seconds (25 to 35 seconds for unsignalised);
- LOS E – 55 to 80 seconds (35 to 50 seconds for unsignalised); and,
- LOS F – Over 80 seconds (over 50 seconds for unsignalised).

The overall junction analysis results for the 2016 AM, inter and PM peak is shown in **Table 5.1** to **Table 5.3**. The tables provide data on modelled and observed flow differences, average and maximum queue lengths, and average delays. The tables also show the LOS at each junction within the network.

Table 5.1: 2016 AM Peak Overall Junction Performance Summary

Junction	Type	From	To	Links			Volume						Queue Length		Delay			
															Movement		Junction	
				Direction	From	To	Model	Count	Absolute Difference	Percentage Difference	GEH	Accept	Max (m)	Average (m)	Average (s per veh)	LOS*	Average (s per veh)	LOS*
Crab Lane / Fearnhead Lane	Priority	Fearnhead Lane	*Crab Lane (N)*	*W-N*	26	24	58	65	-7	-10.8%	0.9	✓	319.0	145.4	273.8	F	*194.8*	*F*
			Crab Lane (S)	*W-S*	26	16	131	145	-14	-9.7%	1.2	✓	319.6	146.2	346.3	F		
		Crab Lane (N)	*Fearnhead Lane*	*N-W*	23	27	7	7	0	0.0%	0.0	✓	418.7	186.7	282.1	F		
			Crab Lane (S)	*N-S*	23	16	290	297	-7	-2.4%	0.4	✓	418.7	186.7	275.1	F		
		Crab Lane (S)	Fearnhead Lane	S-W	24	27	69	63	6	9.5%	0.7	✓	0.0	0.0	0.4	A		
			Crab Lane (N)	S-N	24	24	180	176	4	2.3%	0.3	✓	0.0	0.0	0.8	A		
College Place roundabout	Priority	Birchwood Way (W)	*Crab Lane*	*W-N*	20	24	14	14	0	0.0%	0.0	✓	412.6	58.4	97.8	F	*36.2*	*E*
			Birchwood Way (E)	*W-E*	20	10	1005	973	32	3.3%	1.0	✓	412.6	58.4	88.1	F		
			Woolston Grange Ave.	*W-S*	20	18	90	91	-1	-1.1%	0.1	✓	412.6	58.4	109.1	F		
			Birchwood Way (W)	W-W	20	21	0	0	0	0.0%	0.0	✓	412.6	58.4	0.0	A		
		Crab Lane	Birchwood Way (E)	N-E	33	10	233	247	-14	-5.7%	0.9	✓	56.8	27.0	20.5	C		
			Woolston Grange Ave.	*N-S*	33	18	172	180	-8	-4.4%	0.6	✓	56.8	27.0	66.8	F		
			Birchwood Way (W)	*N-W*	33	21	12	13	-1	-7.7%	0.3	✓	56.8	27.0	75.7	F		
			Crab Lane	*N-N*	33	24	2	2	0	0.0%	0.0	✓	56.8	27.0	88.9	F		
		Birchwood Way (E)	Woolston Grange Ave.	E-S	32	18	478	478	0	0.0%	0.0	✓	40.6	0.9	5.0	A		
			Birchwood Way (W)	E-W	32	21	441	448	-7	-1.6%	0.3	✓	40.6	0.9	4.4	A		
			Crab Lane	E-N	32	24	98	95	3	3.2%	0.3	✓	40.6	0.9	8.3	A		
			Birchwood Way (E)	E-E	32	10	0	0	0	0.0%	0.0	✓	40.6	0.9	0.0	A		
		Woolston Grange Ave.	Birchwood Way (W)	S-W	17	21	43	43	0	0.0%	0.0	✓	92.6	3.0	16.8	C		
			Crab Lane	*S-N*	17	24	135	130	5	3.8%	0.4	✓	92.6	3.0	17.3	C		
			Birchwood Way (E)	S-E	17	10	1349	1349	0	0.0%	0.0	✓	92.6	3.0	16.7	C		
			Woolston Grange Ave.	S-S	17	18	10	8	2	25.0%	0.7	✓	92.6	3.0	14.8	B		
Birchwood Way / Oakwood Gate	Priority & Signalised	Birchwood Park Ave.	Birchwood Way (E)	N-E	2	5	81	84	-3	-3.6%	0.3	✓	100.0	17.5	19.0	C	20.5	C
			Oakwood Gate	N-S	2	7	352	352	0	0.0%	0.0	✓	100.0	17.5	24.4	C		
			Birchwood Way (W)	N-W	2	9	342	341	1	0.3%	0.1	✓	100.0	17.5	27.8	D		
			Birchwood Park Ave.	N-N	2	3	3	2	1	50.0%	0.6	✓	100.0	17.5	56.3	F		
		Birchwood Way (E)	Oakwood Gate	E-S	6	7	229	239	-10	-4.2%	0.7	✓	114.4	16.5	34.7	D		
			Birchwood Way (W)	E-W	6	9	294	300	-6	-2.0%	0.3	✓	114.4	16.5	23.7	C		
			Birchwood Park Ave.	*E-N*	6	3	89	91	-2	-2.2%	0.2	✓	114.4	16.5	45.7	E		
			Birchwood Way (E)	E-E	6	5	1	1	0	0.0%	0.0	✓	114.4	16.5	25.8	D		
		Oakwood Gate	Birchwood Way (W)	S-W	8	9	377	380	-3	-0.8%	0.2	✓	45.1	1.5	9.0	A		
			Birchwood Park Ave.	*S-N*	8	3	188	187	1	0.5%	0.1	✓	45.1	1.5	30.3	D		
			Birchwood Way (E)	*S-E*	8	5	119	121	-2	-1.7%	0.2	✓	45.1	1.5	29.9	D		
			Oakwood Gate	S-S	8	7	1	2	-1	-50.0%	0.8	✓	45.1	1.5	27.7	D		
		Birchwood Way (W)	Birchwood Park Ave.	W-N	11	3	902	904	-2	-0.2%	0.1	✓	212.2	12.8	15.4	B		
			Birchwood Way (E)	W-E	11	5	932	920	12	1.3%	0.4	✓	212.2	12.8	15.5	B		
			Oakwood Gate	W-S	11	7	751	745	6	0.8%	0.2	✓	212.2	12.8	20.8	C		
			Birchwood Way (W)	W-W	11	9	0	0	0	0.0%	0.0	✓	212.2	12.8	4.0	A		
Birchwood Way / Faraday Street	Priority	Faraday Street	Birchwood Way (E)	N-E	58	100	44	43	1	2.3%	0.2	✓	20.9	0.6	7.3	A	8.0	A
			Bus Gate	N-S	58	52	4	0	4	0.0%	2.8	✓	20.9	0.6	9.3	A		
			Birchwood Way (W)	N-W	58	44	74	75	-1	-1.3%	0.1	✓	20.9	0.6	8.6	A		
			Faraday Street	N-NE	58	56	0	0	0	0.0%	0.0	✓	20.9	0.6	0.0	A		
		Birchwood Way (E)	Bus Gate	NE-S	40	52	0	0	0	0.0%	0.0	✓	15.1	0.0	0.0	A		
			Birchwood Way (W)	NE-W	40	44	538	550	-12	-2.2%	0.5	✓	15.1	0.0	5.8	A		
			Faraday Street	NE-NE	40	56	208	219	-11	-5.0%	0.8	✓	15.1	0.0	6.8	A		
			Birchwood Way (E)	NE-E	40	100	1	1	0	0.0%	0.0	✓	15.1	0.0	5.4	A		
		Bus Gate	Birchwood Way (W)	S-W	55	44	0	0	0	0.0%	0.0	✓	8.2	0.0	0.0	A		
			Faraday Street	S-NE	55	56	4	0	4	0.0%	2.8	✓	8.2	0.0	8.6	A		
			Birchwood Way (E)	S-E	55	100	0	0	0	0.0%	0.0	✓	8.2	0.0	0.0	A		
			Bus Gate	S-S	55	52	0	0	0	0.0%	0.0	✓	8.2	0.0	0.0	A		
		Birchwood Way (W)	Faraday Street	SW-NE	41	56	592	597	-5	-0.8%	0.2	✓	75.1	4.8	11.1	B		
			Birchwood Way (E)	SW-E	41	100	533	523	10	1.9%	0.4	✓	75.1	4.8	7.2	A		
			Bus Gate	SW-S	41	52	1	0	1	0.0%	1.4	✓	75.1	4.8	0.7	A		
			Birchwood Way (W)	SW-W	41	44	7	6	1	16.7%	0.4	✓	75.1	4.8	6.6	A		

Junction	Type	From	To	Links			Volume						Queue Length		Delay			
															Movement		Junction	
				Direction	From	To	Model	Count	Absolute Difference	Percentage Difference	GEH	Accept	Max (m)	Average (m)	Average (s per veh)	LOS*	Average (s per veh)	LOS*
Birchwood Way / Moss Gate	Signalised	Daten Ave.	Birchwood Way (N)	NW-NE	49	108	378	377	1	0.3%	0.1	✓	69.9	7.9	24.2	C	31.7	C
			Moss Gate	NW-E	49	112	46	47	-1	-2.1%	0.1	✓	40.6	4.2	33.9	C		
			Birchwood Way (E)	NW-S	49	39	38	39	-1	-2.6%	0.2	✓	40.6	4.2	41.1	D		
		Birchwood Way (N)	Moss Gate	NE-E	35	112	65	66	-1	-1.5%	0.1	✓	74.8	18.4	33.2	C		
			Birchwood Way (E)	NE-S	35	39	629	647	-18	-2.8%	0.7	✓	74.8	18.4	35.8	D		
			Daten Ave.	NE-NW	35	48	584	602	-18	-3.0%	0.7	✓	56.2	9.4	26.8	C		
		Moss Gate	Birchwood Way (E)	E-S	73	39	84	81	3	3.7%	0.3	✓	51.3	11.1	32.1	C		
			Daten Ave.	E-NW	73	48	122	126	-4	-3.2%	0.4	✓	51.3	11.1	32.0	C		
			Birchwood Way (N)	E-NE	73	108	184	183	1	0.5%	0.1	✓	51.3	11.1	37.0	D		
		Birchwood Way (E)	Daten Ave.	S-NW	42	48	70	71	-1	-1.4%	0.1	✓	63.6	13.3	32.1	C		
			Birchwood Way (N)	S-NE	42	108	492	471	21	4.5%	1.0	✓	63.6	13.3	34.8	C		
			Moss Gate	S-E	42	112	23	22	1	4.5%	0.2	✓	17.0	0.7	35.0	C		
M62 Junction 11	Priority	M62 Off-slip (E)	*Birchwood Way (N)*	*W-NE*	79	91	3	4	-1	-25.0%	0.5	✓	106.5	9.1	44.1	E	21.2	C
			M62 (E)	W-E	79	70	0	0	0	0.0%	0.0	✓	106.5	9.1	0.0	A		
			Birchwood Way (S)	*W-SW*	79	20034	382	386	-4	-1.0%	0.2	✓	106.5	9.1	38.1	E		
			M62 (W)	*W-W*	79	76	9	9	0	0.0%	0.0	✓	106.5	9.1	35.9	E		
		Birchwood Way (N)	M62 (E)	N-E	88	70	6	6	0	0.0%	0.0	✓	8.9	0.1	12.2	B		
			Birchwood Way (S)	N-SW	88	20034	1	1	0	0.0%	0.0	✓	8.9	0.1	7.6	A		
			M62 (W)	N-W	88	76	3	2	1	50.0%	0.6	✓	8.9	0.1	8.2	A		
			Birchwood Way (N)	N-NE	88	91	0	0	0	0.0%	0.0	✓	8.9	0.1	0.0	A		
		M62 Off-slip (W)	Birchwood Way (S)	E-SW	92	20034	900	928	-28	-3.0%	0.9	✓	173.6	12.5	26.6	D		
			M62 (W)	E-W	92	76	2	2	0	0.0%	0.0	✓	173.6	12.5	18.8	C		
			Birchwood Way (N)	E-NE	92	91	5	4	1	25.0%	0.5	✓	173.6	12.5	26.2	D		
			M62 (E)	E-E	92	70	8	7	1	14.3%	0.4	✓	173.6	12.5	27.3	D		
		Birchwood Way (S)	M62 (W)	SW-W	74	76	328	323	5	1.5%	0.3	✓	6.1	0.0	9.1	A		
			Birchwood Way (N)	SW-NE	74	91	11	10	1	10.0%	0.3	✓	6.1	0.0	10.4	B		
			M62 (E)	SW-E	74	70	726	698	28	4.0%	1.0	✓	6.1	0.0	10.9	B		
			Birchwood Way (S)	SW-SW	74	20034	0	0	0	0.0%	0.0	✓	6.1	0.0	0.0	A		
	Through	M62 (Eastbound)	M62 (Eastbound)	W-E	120	62	4132	4101	31	0.8%	0.5	✓	182.6	11.7	25.2	D		
	Through	M62 (Westbound)	M62 (Westbound)	E-W	117	64	3795	3782	13	0.3%	0.2	✓	0.0	0.0	17.0	C		
Birchwood Way / Blackbrook Avenue	Priority	Blackbrook Avenue (N)	Blackbrook Avenue (S)	N-S	75	124	404	423	-19	-4.5%	0.9	✓	257.5	64.9	60.9	F	30.3	D
			Blackbrook Ave (N)	N-N	75	128	1	2	-1	-50.0%	0.8	✓	257.5	64.9	51.5	F		
			Birchwood Way (W)	N-W	75	132	53	53	0	0.0%	0.0	✓	257.5	64.9	51.9	F		
			Birchwood Way (E)	N-E	75	129	46	45	1	2.2%	0.1	✓	257.5	64.9	60.4	F		
		Birchwood Way (W)	Blackbrook Avenue (S)	W-S	126	124	211	209	2	1.0%	0.1	✓	340.7	52.0	31.8	D		
			Blackbrook Ave (N)	W-N	126	128	38	38	0	0.0%	0.0	✓	340.7	52.0	32.3	D		
			Birchwood Way (W)	W-W	126	132	1	0	1	0.0%	1.4	✓	340.7	52.0	32.3	D		
			Birchwood Way (E)	W-E	126	129	714	701	13	1.9%	0.5	✓	340.7	52.0	39.8	E		
		Blackbrook Avenue (S)	Blackbrook Avenue (S)	S-A	131	124	4	3	1	33.3%	0.5	✓	22.9	0.2	5.3	A		
			Blackbrook Ave (N)	S-N	131	128	228	231	-3	-1.3%	0.2	✓	22.9	0.2	4.1	A		
			Birchwood Way (W)	S-W	131	132	149	154	-5	-3.2%	0.4	✓	22.9	0.2	4.6	A		
			Birchwood Way (E)	S-E	131	129	332	332	0	0.0%	0.0	✓	22.9	0.2	5.9	A		
		Birchwood Way (E)	Blackbrook Avenue (S)	E-S	22	124	133	146	-13	-8.9%	1.1	✓	111.1	10.6	20.7	C		
			Blackbrook Ave (N)	E-N	22	128	22	21	1	4.8%	0.2	✓	111.1	10.6	13.5	B		
			Birchwood Way (W)	E-W	22	132	312	337	-25	-7.4%	1.4	✓	111.1	10.6	22.4	C		
			Birchwood Way (E)	E-E	22	129	0	0	0	0.0%	0.0	✓	111.1	10.6	0.0	A		

* LOS E and F, highlighted in italics, indicates where a movement is operating at or over its operational capacity.

Table 5.2: 2016 Inter Peak Overall Junction Performance Summary

Junction	Type	From	To	Links			Volume						Queue Length		Delay			
															Movement		Junction	
				Direction	From	To	Model	Count	Absolute Difference	Percentage Difference	GEH	Accept	Max (m)	Average (m)	Average (s per veh)	LOS*	Average (s per veh)	LOS*
Crab Lane / Fearnhead Lane	Priority	Fearnhead Lane	*Crab Lane (N)*	*W-N*	26	24	46	46	0	0.0%	0.0	✓	59.4	1.6	4.7	A	5.1	A
			Crab Lane (S)	*W-S*	26	16	116	116	0	0.0%	0.0	✓	60.1	2.0	14.3	B		
		Crab Lane (N)	*Fearnhead Lane*	*N-W*	23	27	53	51	2	3.9%	0.3	✓	37.8	0.4	8.5	A		
			Crab Lane (S)	*N-S*	23	16	295	295	0	0.0%	0.0	✓	37.8	0.4	6.4	A		
		Crab Lane (S)	Fearnhead Lane	S-W	24	27	117	109	8	7.3%	0.8	✓	0.0	0.0	0.5	A		
			Crab Lane (N)	S-N	24	24	252	244	8	3.3%	0.5	✓	0.0	0.0	0.8	A		
College Place roundabout	Priority	Birchwood Way (W)	*Crab Lane*	*W-N*	20	24	79	78	1	1.3%	0.1	✓	15.5	0.2	5.4	A	4.8	A
			Birchwood Way (E)	*W-E*	20	10	450	453	-3	-0.7%	0.1	✓	15.5	0.2	6.4	A		
			Woolston Grange Ave.	*W-S*	20	18	78	80	-2	-2.5%	0.2	✓	15.5	0.2	6.8	A		
			Birchwood Way (W)	W-W	20	21	0	0	0	0.0%	0.0	✓	15.5	0.2	0.0	A		
		Crab Lane	Birchwood Way (E)	N-E	33	10	218	223	-5	-2.2%	0.3	✓	15.6	0.2	1.1	A		
			Woolston Grange Ave.	*N-S*	33	18	134	131	3	2.3%	0.3	✓	15.6	0.2	3.1	A		
			Birchwood Way (W)	*N-W*	33	21	60	57	3	5.3%	0.4	✓	15.6	0.2	3.0	A		
			Crab Lane	*N-N*	33	24	0	0	0	0.0%	0.0	✓	15.6	0.2	0.0	A		
		Birchwood Way (E)	Woolston Grange Ave.	E-S	32	18	386	387	-1	-0.3%	0.1	✓	58.9	1.0	4.8	A		
			Birchwood Way (W)	E-W	32	21	420	424	-4	-0.9%	0.2	✓	58.9	1.0	3.9	A		
			Crab Lane	E-N	32	24	150	146	4	2.7%	0.3	✓	58.9	1.0	6.3	A		
			Birchwood Way (E)	E-E	32	10	16	15	1	6.7%	0.3	✓	58.9	1.0	3.1	A		
		Woolston Grange Ave.	Birchwood Way (W)	S-W	17	21	68	69	-1	-1.4%	0.1	✓	21.4	0.2	6.3	A		
			Crab Lane	*S-N*	17	24	140	139	1	0.7%	0.1	✓	21.4	0.2	5.7	A		
			Birchwood Way (E)	S-E	17	10	354	355	-1	-0.3%	0.1	✓	21.4	0.2	5.3	A		
			Woolston Grange Ave.	S-S	17	18	7	6	1	16.7%	0.4	✓	21.4	0.2	2.9	A		
Birchwood Way / Oakwood Gate	Priority & Signalised	Birchwood Park Ave.	Birchwood Way (E)	N-E	2	5	46	47	-1	-2.1%	0.1	✓	48.9	2.2	9.4	A	13.6	B
			Oakwood Gate	N-S	2	7	316	310	6	1.9%	0.3	✓	48.9	2.2	9.2	A		
			Birchwood Way (W)	N-W	2	9	262	261	1	0.4%	0.1	✓	48.9	2.2	9.3	A		
			Birchwood Park Ave.	N-N	2	3	1	1	0	0.0%	0.0	✓	48.9	2.2	0.0	A		
		Birchwood Way (E)	Oakwood Gate	E-S	6	7	226	222	4	1.8%	0.3	✓	36.7	1.3	10.7	B		
			Birchwood Way (W)	E-W	6	9	224	220	4	1.8%	0.3	✓	36.7	1.3	8.3	A		
			Birchwood Park Ave.	*E-N*	6	3	18	18	0	0.0%	0.0	✓	36.7	1.3	24.0	C		
			Birchwood Way (E)	E-E	6	5	0	0	0	0.0%	0.0	✓	36.7	1.3	0.0	A		
		Oakwood Gate	Birchwood Way (W)	S-W	8	9	487	491	-4	-0.8%	0.2	✓	68.5	1.7	10.2	B		
			Birchwood Park Ave.	*S-N*	8	3	388	386	2	0.5%	0.1	✓	68.5	1.7	20.1	C		
			Birchwood Way (E)	*S-E*	8	5	242	241	1	0.4%	0.1	✓	68.5	1.7	22.8	C		
			Oakwood Gate	S-S	8	7	2	2	0	0.0%	0.0	✓	68.5	1.7	0.0	A		
		Birchwood Way (W)	Birchwood Park Ave.	W-N	11	3	271	277	-6	-2.2%	0.4	✓	61.5	5.0	9.8	A		
			Birchwood Way (E)	W-E	11	5	253	253	0	0.0%	0.0	✓	61.5	5.0	12.6	B		
			Oakwood Gate	W-S	11	7	510	516	-6	-1.2%	0.3	✓	61.5	5.0	18.4	B		
			Birchwood Way (W)	W-W	11	9	0	0	0	0.0%	0.0	✓	61.5	5.0	0.0	A		
Birchwood Way / Faraday Street	Priority	Faraday Street	Birchwood Way (E)	N-E	58	100	42	42	0	0.0%	0.0	✓	23.0	0.7	4.6	A	3.2	A
			Bus Gate	N-S	58	52	0	0	0	0.0%	0.0	✓	23.0	0.7	0.0	A		
			Birchwood Way (W)	N-W	58	44	164	162	2	1.2%	0.2	✓	23.0	0.7	5.9	A		
			Faraday Street	N-NE	58	56	1	1	0	0.0%	0.0	✓	23.0	0.7	2.6	A		
		Birchwood Way (E)	Bus Gate	NE-S	40	52	0	0	0	0.0%	0.0	✓	15.6	0.0	0.0	A		
			Birchwood Way (W)	NE-W	40	44	297	294	3	1.0%	0.2	✓	15.6	0.0	3.7	A		
			Faraday Street	NE-NE	40	56	41	41	0	0.0%	0.0	✓	15.6	0.0	3.1	A		
			Birchwood Way (E)	NE-E	40	100	1	1	0	0.0%	0.0	✓	15.6	0.0	9.8	A		
		Bus Gate	Birchwood Way (W)	S-W	55	44	0	0	0	0.0%	0.0	✓	0.0	0.0	0.0	A		
			Faraday Street	S-NE	55	56	0	0	0	0.0%	0.0	✓	0.0	0.0	0.0	A		
			Birchwood Way (E)	S-E	55	100	0	0	0	0.0%	0.0	✓	0.0	0.0	0.0	A		
			Bus Gate	S-S	55	52	0	0	0	0.0%	0.0	✓	0.0	0.0	0.0	A		
		Birchwood Way (W)	Faraday Street	SW-NE	41	56	192	194	-2	-1.0%	0.1	✓	16.6	0.0	2.3	A		
			Birchwood Way (E)	SW-E	41	100	345	343	2	0.6%	0.1	✓	16.6	0.0	2.0	A		
			Bus Gate	SW-S	41	52	0	0	0	0.0%	0.0	✓	16.6	0.0	0.0	A		
			Birchwood Way (W)	SW-W	41	44	4	4	0	0.0%	0.0	✓	16.6	0.0	0.0	A		

Junction	Type	From	To	Links			Volume						Queue Length		Delay			
															Movement		Junction	
				Direction	From	To	Model	Count	Absolute Difference	Percentage Difference	GEH	Accept	Max (m)	Average (m)	Average (s per veh)	LOS*	Average (s per veh)	LOS*
Birchwood Way / Moss Gate	Signalised	Daten Ave.	Birchwood Way (N)	NW-NE	49	108	248	245	3	1.2%	0.2	✓	32.4	4.9	21.2	C	24.3	C
			Moss Gate	NW-E	49	112	60	59	1	1.7%	0.1	✓	45.4	3.5	28.2	C		
			Birchwood Way (E)	NW-S	49	39	32	32	0	0.0%	0.0	✓	45.4	3.5	35.0	C		
		Birchwood Way (N)	Moss Gate	NE-E	35	112	56	55	1	1.8%	0.1	✓	47.9	6.9	24.5	C		
			Birchwood Way (E)	NE-S	35	39	251	251	0	0.0%	0.0	✓	47.9	6.9	27.2	C		
			Daten Ave.	NE-NW	35	48	259	267	-8	-3.0%	0.5	✓	33.2	4.6	20.4	C		
		Moss Gate	Birchwood Way (E)	E-S	73	39	56	53	3	5.7%	0.4	✓	30.4	5.3	23.5	C		
			Daten Ave.	E-NW	73	48	84	88	-4	-4.5%	0.4	✓	30.4	5.3	24.2	C		
			Birchwood Way (N)	E-NE	73	108	87	86	1	1.2%	0.1	✓	30.4	5.3	31.0	C		
		Birchwood Way (E)	Daten Ave.	S-NW	42	48	56	58	-2	-3.4%	0.3	✓	36.5	4.7	23.3	C		
			Birchwood Way (N)	S-NE	42	108	274	276	-2	-0.7%	0.1	✓	36.5	4.7	22.8	C		
			Moss Gate	S-E	42	112	55	52	3	5.8%	0.4	✓	25.5	1.7	31.9	C		
M62 Junction 11	Priority	M62 Off-slip (E)	*Birchwood Way (N)*	*W-NE*	79	91	5	6	-1	-16.7%	0.4	✓	18.2	0.2	16.7	C	4.5	A
			M62 (E)	W-E	79	70	3	3	0	0.0%	0.0	✓	18.2	0.2	17.5	C		
			Birchwood Way (S)	*W-SW*	79	20034	250	248	2	0.8%	0.1	✓	18.2	0.2	12.6	B		
			M62 (W)	*W-W*	79	76	23	23	0	0.0%	0.0	✓	18.2	0.2	13.2	B		
		Birchwood Way (N)	M62 (E)	N-E	88	70	5	5	0	0.0%	0.0	✓	6.5	0.0	6.8	A		
			Birchwood Way (S)	N-SW	88	20034	4	5	-1	-20.0%	0.5	✓	6.5	0.0	4.3	A		
			M62 (W)	N-W	88	76	5	4	1	25.0%	0.5	✓	6.5	0.0	7.8	A		
			Birchwood Way (N)	N-NE	88	91	0	0	0	0.0%	0.0	✓	6.5	0.0	0.0	A		
		M62 Off-slip (W)	Birchwood Way (S)	E-SW	92	20034	314	321	-7	-2.2%	0.4	✓	28.1	0.2	11.1	B		
			M62 (W)	E-W	92	76	3	3	0	0.0%	0.0	✓	28.1	0.2	14.3	B		
			Birchwood Way (N)	E-NE	92	91	9	7	2	28.6%	0.7	✓	28.1	0.2	11.3	B		
			M62 (E)	E-E	92	70	32	33	-1	-3.0%	0.2	✓	28.1	0.2	11.4	B		
		Birchwood Way (S)	M62 (W)	SW-W	74	76	306	309	-3	-1.0%	0.2	✓	6.5	0.0	7.0	A		
			Birchwood Way (N)	SW-NE	74	91	1	1	0	0.0%	0.0	✓	6.5	0.0	2.0	A		
			M62 (E)	SW-E	74	70	305	298	7	2.3%	0.4	✓	6.5	0.0	7.9	A		
			Birchwood Way (S)	SW-SW	74	20034	0	0	0	0.0%	0.0	✓	6.5	0.0	0.0	A		
	Through	M62 (Eastbound)	M62 (Eastbound)	W-E	120	62	3122	3126	-4	-0.1%	0.1	✓	0.0	0.0	3.4	A		
	Through	M62 (Westbound)	M62 (Westbound)	E-W	117	64	3010	3040	-30	-1.0%	0.5	✓	0.0	0.0	3.4	A		
Birchwood Way / Blackbrook Avenue	Priority	Blackbrook Avenue (N)	Blackbrook Avenue (S)	N-S	75	124	206	205	1	0.5%	0.1	✓	16.5	0.2	4.2	A	6.3	A
			Blackbrook Ave (N)	N-N	75	128	0	1	-1	-100.0%	1.4	✓	16.5	0.2	0.0	A		
			Birchwood Way (W)	N-W	75	132	50	48	2	4.2%	0.3	✓	16.5	0.2	5.4	A		
			Birchwood Way (E)	N-E	75	129	42	43	-1	-2.3%	0.2	✓	16.5	0.2	4.2	A		
		Birchwood Way (W)	Blackbrook Avenue (S)	W-S	126	124	88	86	2	2.3%	0.2	✓	26.1	0.4	6.1	A		
			Blackbrook Ave (N)	W-N	126	128	54	52	2	3.8%	0.3	✓	26.1	0.4	6.2	A		
			Birchwood Way (W)	W-W	126	132	0	0	0	0.0%	0.0	✓	26.1	0.4	0.0	A		
			Birchwood Way (E)	W-E	126	129	424	426	-2	-0.5%	0.1	✓	26.1	0.4	7.3	A		
		Blackbrook Avenue (S)	Blackbrook Avenue (S)	S-A	131	124	1	1	0	0.0%	0.0	✓	13.4	0.0	7.0	A		
			Blackbrook Ave (N)	S-N	131	128	165	166	-1	-0.6%	0.1	✓	13.4	0.0	2.9	A		
			Birchwood Way (W)	S-W	131	132	82	83	-1	-1.2%	0.1	✓	13.4	0.0	3.1	A		
			Birchwood Way (E)	S-E	131	129	143	141	2	1.4%	0.2	✓	13.4	0.0	2.7	A		
		Birchwood Way (E)	Blackbrook Avenue (S)	E-S	22	124	147	155	-8	-5.2%	0.7	✓	65.9	1.4	8.8	A		
			Blackbrook Ave (N)	E-N	22	128	28	28	0	0.0%	0.0	✓	65.9	1.4	6.9	A		
			Birchwood Way (W)	E-W	22	132	346	366	-20	-5.5%	1.1	✓	65.9	1.4	9.4	A		
			Birchwood Way (E)	E-E	22	129	1	1	0	0.0%	0.0	✓	65.9	1.4	2.8	A		

* LOS E and F, highlighted in italics, indicates where a movement is operating at or over its operational capacity.

Table 5.3: 2016 PM Peak Overall Junction Performance Summary

Junction	Type	From	To	Links			Volume						Queue Length		Delay			
															Movement		Junction	
				Direction	From	To	Model	Count	Absolute Difference	Percentage Difference	GEH	Accept	Max (m)	Average (m)	Average (s per veh)	LOS*	Average (s per veh)	LOS*
Crab Lane / Fearnhead Lane	Priority	Fearnhead Lane	*Crab Lane (N)*	*W-N*	26	24	40	44	-4	-9.1%	0.6	✓	145.2	34.9	101.7	F	21.5	C
			Crab Lane (S)	*W-S*	26	16	72	77	-5	-6.5%	0.6	✓	145.8	36.0	161.0	F		
		Crab Lane (N)	*Fearnhead Lane*	*N-W*	23	27	99	98	1	1.0%	0.1	✓	157.9	15.1	30.5	D		
			Crab Lane (S)	*N-S*	23	16	406	403	3	0.7%	0.1	✓	157.9	15.1	24.6	C		
		Crab Lane (S)	Fearnhead Lane	S-W	24	27	195	198	-3	-1.5%	0.2	✓	0.0	0.0	0.5	A		
			Crab Lane (N)	S-N	24	24	549	578	-29	-5.0%	1.2	✓	0.0	0.0	1.0	A		
College Place roundabout	Priority	Birchwood Way (W)	*Crab Lane*	*W-N*	20	24	138	134	4	3.0%	0.3	✓	25.5	1.0	9.9	A	41.8	*E*
			Birchwood Way (E)	*W-E*	20	10	427	416	11	2.6%	0.5	✓	25.5	1.0	9.8	A		
			Woolston Grange Ave.	*W-S*	20	18	54	56	-2	-3.6%	0.3	✓	25.5	1.0	11.2	B		
			Birchwood Way (W)	W-W	20	21	0	0	0	0.0%	0.0	✓	25.5	1.0	0.0	A		
		Crab Lane	Birchwood Way (E)	N-E	33	10	167	171	-4	-2.3%	0.3	✓	41.5	1.5	1.2	A		
			Woolston Grange Ave.	*N-S*	33	18	181	184	-3	-1.6%	0.2	✓	41.5	1.5	5.5	A		
			Birchwood Way (W)	*N-W*	33	21	124	121	3	2.5%	0.3	✓	41.5	1.5	6.0	A		
			Crab Lane	*N-N*	33	24	5	4	1	25.0%	0.5	✓	41.5	1.5	6.1	A		
		Birchwood Way (E)	Woolston Grange Ave.	E-S	32	18	789	824	-35	-4.2%	1.2	✓	299.8	50.6	35.2	E		
			Birchwood Way (W)	E-W	32	21	739	782	-43	-5.5%	1.6	✓	299.8	50.6	31.2	D		
			Crab Lane	E-N	32	24	258	268	-10	-3.7%	0.6	✓	299.8	50.6	33.2	D		
			Birchwood Way (E)	E-E	32	10	7	6	1	16.7%	0.4	✓	299.8	50.6	30.0	D		
		Woolston Grange Ave.	Birchwood Way (W)	S-W	17	21	150	153	-3	-2.0%	0.2	✓	383.3	134.8	99.2	F		
			Crab Lane	*S-N*	17	24	343	360	-17	-4.7%	0.9	✓	383.3	134.8	105.1	F		
			Birchwood Way (E)	S-E	17	10	520	534	-14	-2.6%	0.6	✓	383.3	134.8	85.2	F		
			Woolston Grange Ave.	S-S	17	18	9	9	0	0.0%	0.0	✓	383.3	134.8	75.9	F		
Birchwood Way / Oakwood Gate	Priority & Signalised	Birchwood Park Ave.	Birchwood Way (E)	N-E	2	5	204	207	-3	-1.4%	0.2	✓	207.6	18.7	14.2	B	*66.7*	*E*
			Oakwood Gate	N-S	2	7	374	369	5	1.4%	0.3	✓	207.6	18.7	14.3	B		
			Birchwood Way (W)	N-W	2	9	687	682	5	0.7%	0.2	✓	207.6	18.7	26.2	D		
			Birchwood Park Ave.	N-N	2	3	0	0	0	0.0%	0.0	✓	207.6	18.7	7.8	A		
		Birchwood Way (E)	Oakwood Gate	E-S	6	7	81	82	-1	-1.2%	0.1	✓	234.0	53.7	77.4	F		
			Birchwood Way (W)	E-W	6	9	546	561	-15	-2.7%	0.6	✓	234.0	53.7	74.0	F		
			Birchwood Park Ave.	*E-N*	6	3	30	30	0	0.0%	0.0	✓	234.0	53.7	66.2	F		
			Birchwood Way (E)	E-E	6	5	0	0	0	0.0%	0.0	✓	234.0	53.7	0.0	A		
		Oakwood Gate	Birchwood Way (W)	S-W	8	9	587	636	-49	-7.7%	2.0	✓	505.0	198.8	166.8	F		
			Birchwood Park Ave.	*S-N*	8	3	271	276	-5	-1.8%	0.3	✓	505.0	198.8	185.4	F		
			Birchwood Way (E)	*S-E*	8	5	177	192	-15	-7.8%	1.1	✓	505.0	198.8	189.0	F		
			Oakwood Gate	S-S	8	7	6	8	-2	-25.0%	0.8	✓	505.0	198.8	222.6	F		
		Birchwood Way (W)	Birchwood Park Ave.	W-N	11	3	352	358	-6	-1.7%	0.3	✓	53.5	3.9	9.1	A		
			Birchwood Way (E)	W-E	11	5	270	267	3	1.1%	0.2	✓	53.5	3.9	10.5	B		
			Oakwood Gate	W-S	11	7	497	501	-4	-0.8%	0.2	✓	53.5	3.9	16.8	B		
			Birchwood Way (W)	W-W	11	9	1	1	0	0.0%	0.0	✓	53.5	3.9	11.5	B		
Birchwood Way / Faraday Street	Priority	Faraday Street	Birchwood Way (E)	N-E	58	100	295	285	10	3.5%	0.6	✓	114.7	9.6	17.7	C	8.7	A
			Bus Gate	N-S	58	52	4	1	3	300.0%	1.9	✓	114.7	9.6	17.7	C		
			Birchwood Way (W)	N-W	58	44	291	290	1	0.3%	0.1	✓	114.7	9.6	18.8	C		
			Faraday Street	N-NE	58	56	0	0	0	0.0%	0.0	✓	114.7	9.6	0.0	A		
		Birchwood Way (E)	Bus Gate	NE-S	40	52	2	2	0	0.0%	0.0	✓	16.0	0.1	2.8	A		
			Birchwood Way (W)	NE-W	40	44	365	378	-13	-3.4%	0.7	✓	16.0	0.1	4.6	A		
			Faraday Street	NE-NE	40	56	31	32	-1	-3.1%	0.2	✓	16.0	0.1	4.8	A		
			Birchwood Way (E)	NE-E	40	100	2	2	0	0.0%	0.0	✓	16.0	0.1	4.1	A		
		Bus Gate	Birchwood Way (W)	S-W	55	44	0	0	0	0.0%	0.0	✓	9.4	0.0	0.0	A		
			Faraday Street	S-NE	55	56	2	0	2	0.0%	2.0	✓	9.4	0.0	9.5	A		
			Birchwood Way (E)	S-E	55	100	0	0	0	0.0%	0.0	✓	9.4	0.0	0.0	A		
			Bus Gate	S-S	55	52	0	0	0	0.0%	0.0	✓	9.4	0.0	0.0	A		
		Birchwood Way (W)	Faraday Street	SW-NE	41	56	73	75	-2	-2.7%	0.2	✓	15.7	0.1	2.8	A		
			Birchwood Way (E)	SW-E	41	100	574	586	-12	-2.0%	0.5	✓	15.7	0.1	2.5	A		
			Bus Gate	SW-S	41	52	0	0	0	0.0%	0.0	✓	15.7	0.1	0.0	A		
			Birchwood Way (W)	SW-W	41	44	5	5	0	0.0%	0.0	✓	15.7	0.1	1.5	A		

Junction	Type	From	To	Links			Volume						Queue Length		Delay			
															Movement		Junction	
				Direction	From	To	Model	Count	Absolute Difference	Percentage Difference	GEH	Accept	Max (m)	Average (m)	Average (s per veh)	LOS*	Average (s per veh)	LOS*
Birchwood Way / Moss Gate	Signalised	Daten Ave.	Birchwood Way (N)	NW-NE	49	108	726	788	-62	-7.9%	2.3	✓	402.6	187.2	157.4	F	*104.9*	*F*
			Moss Gate	NW-E	49	112	63	70	-7	-10.0%	0.9	✓	73.5	6.3	97.1	F		
			Birchwood Way (E)	NW-S	49	39	33	37	-4	-10.8%	0.7	✓	73.5	6.3	109.7	F		
		Birchwood Way (N)	Moss Gate	NE-E	35	112	177	181	-4	-2.2%	0.3	✓	77.9	14.7	31.0	C		
			Birchwood Way (E)	NE-S	35	39	322	331	-9	-2.7%	0.5	✓	77.9	14.7	31.2	C		
			Daten Ave.	NE-NW	35	48	207	220	-13	-5.9%	0.9	✓	30.1	4.0	23.3	C		
		Moss Gate	Birchwood Way (E)	E-S	73	39	46	46	0	0.0%	0.0	✓	75.4	21.3	53.2	D		
			Daten Ave.	E-NW	73	48	74	74	0	0.0%	0.0	✓	75.4	21.3	53.2	D		
			Birchwood Way (N)	E-NE	73	108	216	215	1	0.5%	0.1	✓	75.4	21.3	110.9	F		
		Birchwood Way (E)	Daten Ave.	S-NW	42	48	12	14	-2	-14.3%	0.6	✓	350.6	106.7	84.2	F		
			Birchwood Way (N)	S-NE	42	108	822	813	9	1.1%	0.3	✓	350.6	106.7	131.5	F		
			Moss Gate	S-E	42	112	48	46	2	4.3%	0.3	✓	27.1	2.7	86.1	F		
M62 Junction 11	Priority	M62 Off-slip (E)	*Birchwood Way (N)*	*W-NE*	79	91	1	1	0	0.0%	0.0	✓	106.7	13.6	17.2	C	27.2	D
			M62 (E)	W-E	79	70	3	3	0	0.0%	0.0	✓	106.7	13.6	29.2	D		
			Birchwood Way (S)	*W-SW*	79	20034	257	262	-5	-1.9%	0.3	✓	106.7	13.6	45.9	E		
			M62 (W)	*W-W*	79	76	27	28	-1	-3.6%	0.2	✓	106.7	13.6	39.0	E		
		Birchwood Way (N)	M62 (E)	N-E	88	70	3	3	0	0.0%	0.0	✓	12.8	0.1	14.2	B		
			Birchwood Way (S)	N-SW	88	20034	5	5	0	0.0%	0.0	✓	12.8	0.1	10.3	B		
			M62 (W)	N-W	88	76	8	8	0	0.0%	0.0	✓	12.8	0.1	10.1	B		
			Birchwood Way (N)	N-NE	88	91	0	0	0	0.0%	0.0	✓	12.8	0.1	0.0	A		
		M62 Off-slip (W)	Birchwood Way (S)	E-SW	92	20034	445	466	-21	-4.5%	1.0	✓	33.7	0.4	28.3	D		
			M62 (W)	E-W	92	76	4	4	0	0.0%	0.0	✓	33.7	0.4	48.3	E		
			Birchwood Way (N)	E-NE	92	91	8	7	1	14.3%	0.4	✓	33.7	0.4	29.0	D		
			M62 (E)	E-E	92	70	16	16	0	0.0%	0.0	✓	33.7	0.4	23.4	C		
		Birchwood Way (S)	M62 (W)	SW-W	74	76	976	1006	-30	-3.0%	1.0	✓	13.4	0.0	14.7	B		
			Birchwood Way (N)	SW-NE	74	91	4	5	-1	-20.0%	0.5	✓	13.4	0.0	15.1	C		
			M62 (E)	SW-E	74	70	780	806	-26	-3.2%	0.9	✓	13.4	0.0	18.0	C		
			Birchwood Way (S)	SW-SW	74	20034	0	0	0	0.0%	0.0	✓	13.4	0.0	0.0	A		
	Through	M62 (Eastbound)	M62 (Eastbound)	W-E	120	62	3742	3776	-34	-0.9%	0.6	✓	0.0	0.0	10.2	B		
	Through	M62 (Westbound)	M62 (Westbound)	E-W	117	64	4320	4461	-141	-3.2%	2.1	✓	396.5	46.8	45.2	E		
Birchwood Way / Blackbrook Avenue	Priority	Blackbrook Avenue (N)	Blackbrook Avenue (S)	N-S	75	124	300	299	1	0.3%	0.1	✓	32.2	0.6	5.7	A	*36.5*	*E*
			Blackbrook Ave (N)	N-N	75	128	0	0	0	0.0%	0.0	✓	32.2	0.6	0.0	A		
			Birchwood Way (W)	N-W	75	132	42	41	1	2.4%	0.2	✓	32.2	0.6	6.6	A		
			Birchwood Way (E)	N-E	75	129	38	38	0	0.0%	0.0	✓	32.2	0.6	6.1	A		
		Birchwood Way (W)	Blackbrook Avenue (S)	W-S	126	124	186	184	2	1.1%	0.1	✓	82.8	2.1	9.6	A		
			Blackbrook Ave (N)	W-N	126	128	86	85	1	1.2%	0.1	✓	82.8	2.1	11.3	B		
			Birchwood Way (W)	W-W	126	132	0	0	0	0.0%	0.0	✓	82.8	2.1	0.0	A		
			Birchwood Way (E)	W-E	126	129	425	421	4	1.0%	0.2	✓	82.8	2.1	12.4	B		
		Blackbrook Avenue (S)	Blackbrook Avenue (S)	S-A	131	124	0	0	0	0.0%	0.0	✓	45.3	0.9	0.0	A		
			Blackbrook Ave (N)	S-N	131	128	306	314	-8	-2.5%	0.5	✓	45.3	0.9	6.9	A		
			Birchwood Way (W)	S-W	131	132	126	125	1	0.8%	0.1	✓	45.3	0.9	7.0	A		
			Birchwood Way (E)	S-E	131	129	150	145	5	3.4%	0.4	✓	45.3	0.9	6.0	A		
		Birchwood Way (E)	Blackbrook Avenue (S)	E-S	22	124	298	339	-41	-12.1%	2.3	✓	475.4	174.9	84.5	F		
			Blackbrook Ave (N)	E-N	22	128	40	46	-6	-13.0%	0.9	✓	475.4	174.9	77.4	F		
			Birchwood Way (W)	E-W	22	132	576	669	-93	-13.9%	3.7	✓	475.4	174.9	89.2	F		
			Birchwood Way (E)	E-E	22	129	2	2	0	0.0%	0.0	✓	475.4	174.9	102.0	F		

* LOS E and F, highlighted in italics, indicates where a movement is operating at or over its operational capacity.

5.2 Network Performance

The average and standard deviation values for various network performance indicators of the AM, inter and PM peaks are summarised in **Table 5.4** to **Table 5.6** for all motorised vehicles except buses. The relative standard deviation allows for comparison between the different network performance indicators. Overall, the network is busier and therefore more congested during the PM peak compared with the AM peak. As would be expected the inter peak is quieter and therefore has the most spare capacity.

Table 5.4: 2016 AM Peak Network Performance

Measure	Average	Std Dev	Relative Std Dev
Average delay time per vehicle [s]	117	10	0.09
Average number of stops per vehicles	1	0	0.20
Average speed [mph]	39	1	0.03
Average stopped delay per vehicle [s]	11	3	0.26
Total delay time [h]	563	49	0.09
Total Distance Travelled [km]	96376	713	0.01
Latent demand	13	22	1.74
Latent delay time [h]	2	3	1.44
Number of Stops	14401	2848	0.20
Number of vehicles in the network	1435	94	0.07
Number of vehicles that have left the network	15882	101	0.01
Total stopped delay [h]	52	14	0.26
Total travel time [h]	1527	50	0.03

Table 5.5: 2016 Inter Peak Network Performance

Measure	Average	Std Dev	Relative Std Dev
Average delay time per vehicle [s]	26	2	0.07
Average number of stops per vehicles	0	0	0.05
Average speed [mph]	55	0	0.01
Average stopped delay per vehicle [s]	2	0	0.05
Total delay time [h]	91	7	0.07
Total Distance Travelled [km]	68373	959	0.01
Latent demand	0	0	-
Latent delay time [h]	0	0	0.60
Number of Stops	2617	143	0.05
Number of vehicles in the network	782	34	0.04
Number of vehicles that have left the network	11641	87	0.01
Total stopped delay [h]	7	0	0.06
Total travel time [h]	777	15	0.02

Table 5.6: 2016 PM Peak Network Performance

Measure	Average	Std Dev	Relative Std Dev
Average delay time per vehicle [s]	194	13	0.07
Average number of stops per vehicles	3	0	0.13
Average speed [mph]	28	1	0.03
Average stopped delay per vehicle [s]	14	2	0.13
Total delay time [h]	962	66	0.07
Total Distance Travelled [km]	90152	363	0.00
Latent demand	121	53	0.44
Latent delay time [h]	13	6	0.50
Number of Stops	46716	6041	0.13
Number of vehicles in the network	2363	89	0.04
Number of vehicles that have left the network	15458	46	0.00
Total stopped delay [h]	71	9	0.13
Total travel time [h]	1994	66	0.03

6 Summary

A VISSIM network was developed for the AM peak hour based on the Ordnance Survey, aerial mapping and a site visit.

The subsequent one-hour Inter Peak and PM peak models were created using the validated AM model network. Any network or driver behaviour changes made during the calibration of the Inter Peak and PM peak models were applied to the AM peak model, to ensure a consistent network base. The only exception to this are the reduced speed areas on the eastbound carriageway of the M62 towards the edge of the network. These were altered to artificially represent congestion created by capacity constraints on the M60 which vary by peak.

Classified turning count surveys were originally carried out on Wednesday 11th May 2016 for the western half of the network and on Thursday 15th September 2016 and Tuesday 27th September 2016 for the eastern half of the network. These were followed up by new data collection undertaken at the end of March 2017 at Blackbrook Avenue / Birchwood Way roundabout. As the traffic surveys were carried out on different days there are some discrepancies in flows between junctions. The flows have therefore been balanced along Birchwood Way with the side road flows remaining as per the counted values.

6.1 Model Calibration

The model has been calibrated using data from a variety of sources, including traffic surveys, bus timetables, traffic signal specifications and site observations.

The model is built largely on default values but does contain some bespoke driving behaviour sets. These have been applied to match observed driver behaviour at specific locations.

A comparison of the flows input into the model and those processed through the model shows good correlations at turning movement level, and meet all three of the GEH acceptance criteria for each modelled period.

Pedestrian surveys were not carried out as the pedestrian demand in the network is very low and does not affect the flow of traffic. Controlled pedestrian crossings are modelled but with zero pedestrian flow.

The traffic signal operation has been coded using MOVA for the junctions and VisVAP for the ramp metering and pedestrian crossings. The signal coding reflects site recorded timings.

Bus routes and service frequencies have been taken from timetables. In the absence of any dwell time data, VISSIM's default dwell time distribution has been applied throughout.

6.2 Model Validation

The model has been validated against Traffic Master journey time data taken from May to June 2016.

In the AM peak model, the comparison between observed and modelled journey times meets the criteria set out in WebTAG Unit M3.1, which requires the modelled times to be within 15% or sixty seconds (if the length is more than 3km) of the observed times for at least 85% of the routes.

Similarly, in the Inter Peak and PM peak models, all routes meet the journey time validation criteria.

6.3 Conclusion

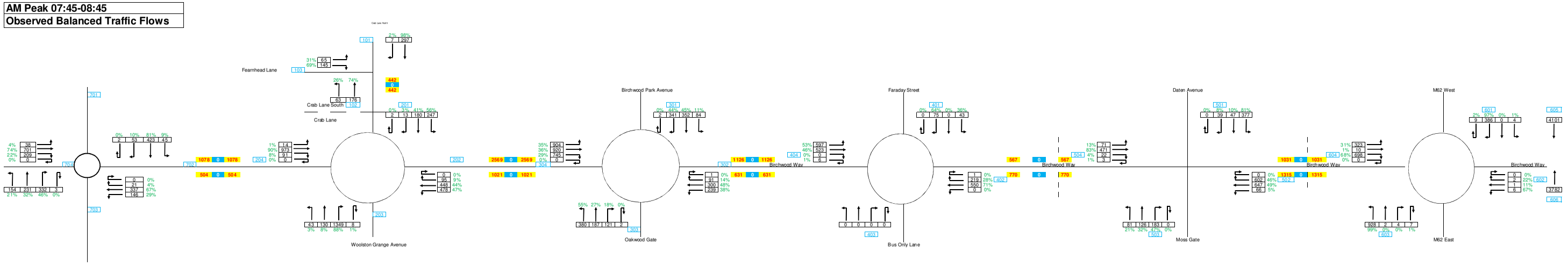
The model has been developed to represent 2016 conditions for the AM, PM and Inter Peak periods identified. Each model has been successfully validated to journey time criteria as set out in the WebTAG Highway Appraisal Guidelines.

In conclusion, the models are considered suitable to be used to evaluate the impact of a series of highway improvement schemes along Birchwood Way.

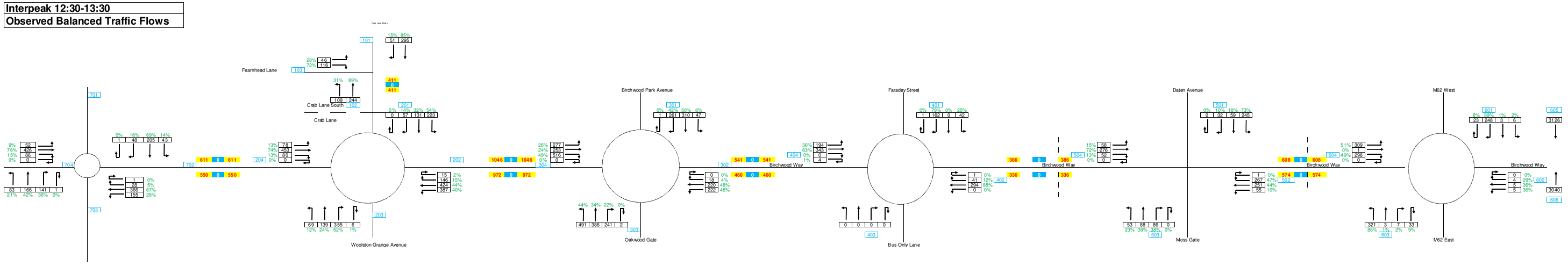
Appendices

A. Observed (Balanced) Traffic Flows

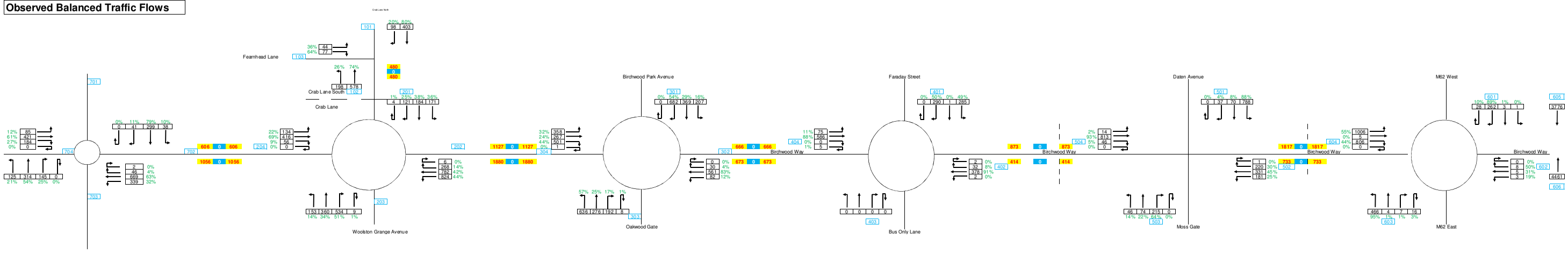
AM Peak 07:45-08:45
Observed Balanced Traffic Flows



Interpeak 12:30-13:30
Observed Balanced Traffic Flows



PM Peak 16:45-17:45
Observed Balanced Traffic Flows



B. Travel Time Outputs

AM Validation Journey Times

	Loc	From Description	To Description	Direction	Distance (m)	Weighted Average Journey Times (secs)								
						Model Average	Observed Average	Average Limits						
						All		-15%	+15%	-60s	+60s	Lower Limit	Upper Limit	Accept
07:45 - 08:45	11	Blackbrook Avenue Roundabout	College Place Roundabout	EB	1125	147	154	131	177	N/A	N/A	131	177	✓
	12	College Place Roundabout	Blackbrook Avenue Roundabout	WB	1125	91	86	73	99	N/A	N/A	73	99	✓
	21	College Place Roundabout	M62 J11	WB	4000	272	297	252	342	237	357	237	357	✓
	22	M62 J11	College Place Roundabout	WB	4000	272	278	236	320	218	338	218	338	✓
	31	M62 Croft Interchange	M62 (at Holcroft Lane)	EB	3600	192	208	177	240	148	268	148	268	✓
	32	M62 (at Holcroft Lane)	M62 Croft Interchange	WB	3600	149	133	113	153	73	193	73	193	✓
	41	College Place Roundabout	Kingsland Grange Roundabout	SB	850	56	59	50	68	N/A	N/A	50	68	✓
	42	Kingsland Grange Roundabout	College Place Roundabout	NB	850	68	73	62	84	N/A	N/A	62	84	✓

100%

IP Validation Journey Times

	Loc	From Description	To Description	Direction	Distance (m)	Weighted Average Journey Times (secs)								
						Model Average	Observed Average	Average Limits						
						All		-15%	+15%	-60s	+60s	Lower Limit	Upper Limit	Accept
12:30 - 13:30	11	Blackbrook Avenue Roundabout	College Place Roundabout	EB	1125	76	78	67	90	N/A	N/A	67	90	✓
	12	College Place Roundabout	Blackbrook Avenue Roundabout	WB	1125	77	81	69	93	N/A	N/A	69	93	✓
	21	College Place Roundabout	M62 J11	WB	4000	250	292	248	335	232	352	232	352	✓
	22	M62 J11	College Place Roundabout	WB	4000	245	268	228	308	208	328	208	328	✓
	31	M62 Croft Interchange	M62 (at Holcroft Lane)	EB	3600	126	123	104	141	63	183	63	183	✓
	32	M62 (at Holcroft Lane)	M62 Croft Interchange	WB	3600	123	128	109	147	68	188	68	188	✓
	41	College Place Roundabout	Kingsland Grange Roundabout	SB	850	55	57	48	65	N/A	N/A	48	65	✓
	42	Kingsland Grange Roundabout	College Place Roundabout	NB	850	60	64	54	73	N/A	N/A	54	73	✓

100%

PM Validation Journey Times

	Loc	From Description	To Description	Direction	Distance (m)	Weighted Average Journey Times (secs)								
						Model Average	Observed Average	Average Limits						
						All		-15%	+15%	-60s	+60s	Lower Limit	Upper Limit	Accept
16:45 - 17:45	11	Blackbrook Avenue Roundabout	College Place Roundabout	EB	1125	79	81	69	93	N/A	N/A	69	93	✓
	12	College Place Roundabout	Blackbrook Avenue Roundabout	WB	1125	156	156	133	180	N/A	N/A	133	180	✓
	21	College Place Roundabout	M62 J11	WB	4000	364	342	291	394	282	402	282	402	✓
	22	M62 J11	College Place Roundabout	WB	4000	341	337	287	388	277	397	277	397	✓
	31	M62 Croft Interchange	M62 (at Holcroft Lane)	EB	3600	184	230	195	264	170	290	170	290	✓
	32	M62 (at Holcroft Lane)	M62 Croft Interchange	WB	3600	237	218	185	250	158	278	158	278	✓
	41	College Place Roundabout	Kingsland Grange Roundabout	SB	850	56	58	49	66	N/A	N/A	49	66	✓
	42	Kingsland Grange Roundabout	College Place Roundabout	NB	850	146	130	111	150	N/A	N/A	111	150	✓

100%

Scheme Impact Pro Forma for Small Project Bids - Please fill in the cells highlighted in yellow
NPIF

Year of assessment	2018

Scenario	Vissim network performance outputs	Input Data / Key Performance Indicators	Unit	AM Peak Hr Weekday	PM Peak Hr Weekday	Inter-Peak Hr Weekday
Base *	Number of vehicles in the network, All Vehicle Types + Number of vehicles that have left the network, All Vehicle Types+Latend demand	Number of highway trips affected	vehicles	18,128	18,720	12,976
	Total travel time [h], All Vehicle Types	Total vehicle travelled time	vehicle-hours	1,624	2,171	825
	Total Distance Traveled [km], All Vehicle Types	Total vehicle travelled distance	vehicle-km	99,401	91,058	70,794
		Highway peak period conversion factor	-	-	-	-
	(Number of vehicles in the network, Vehicle Class Bus + Number of vehicles that have left the network, Vehicle Class Bus)*(Bus Occupancy)	Number of PT passenger trips on affected routes ****	passenger trips	131	93	-
	(Total travel time [h], Vehicle Class Bus) *(Bus Occupancy)	Total PT travelled time ****	passenger-hrs	5.464	4.423	-
		PT peak period conversion factor	-	-	-	-
Do-Something Option 1 **	Number of vehicles in the network, All Vehicle Types + Number of vehicles that have left the network, All Vehicle Types+Latend demand	Number of highway trips affected	vehicles	18,088	18,687	12,960
	Total travel time [h], All Vehicle Types	Total vehicle travelled time	vehicle-hours	1,594	2,140	808
	Total Distance Traveled [km], All Vehicle Types	Total vehicle travelled distance	vehicle-km	97,683	90,016	69,992
		Highway peak period conversion factor	-	-	-	-
	(Number of vehicles in the network, Vehicle Class Bus + Number of vehicles that have left the network, Vehicle Class Bus)*(Bus Occupancy)	Number of PT passenger trips on affected routes ****	passenger trips	131	93	-
	(Total travel time [h], Vehicle Class Bus) *(Bus Occupancy)	Total PT travelled time ****	passenger-hrs	5.257	4.387	-
		PT peak period conversion factor	-	-	-	-
Do-Something Option 2 ***	Number of vehicles in the network, All Vehicle Types + Number of vehicles that have left the network, All Vehicle Types+Latend demand	Number of highway trips affected	vehicles	18,094	18,698	12,965
	Total travel time [h], All Vehicle Types	Total vehicle travelled time	vehicle-hours	1,610	2,145	812
	Total Distance Traveled [km], All Vehicle Types	Total vehicle travelled distance	vehicle-km	97,726	90,088	70,092
		Highway peak period conversion factor	-	-	-	-
	(Number of vehicles in the network, Vehicle Class Bus + Number of vehicles that have left the network, Vehicle Class Bus)*(Bus Occupancy)	Number of PT passenger trips on affected routes ****	passenger trips	131	93	-
	(Total travel time [h], Vehicle Class Bus) *(Bus Occupancy)	Total PT travelled time ****	passenger-hrs	5.260	4.461	-
		PT peak period conversion factor	-	-	-	-

* Base: Final Option for WEP2
** Do-Something Option 1: M62J11 EB & WB entry ramps to be priority controlled
*** Do-Something Option 2: M62J11 EB & WB entry ramps to be signal controlled
**** Bus Occupancy taken from the project 3253-TAD / Warrington Bus Occupancy. Occupancy for IP not available.
Average occupancy for Outer Site 5 data has been used.
Occupancy growth factors assumes to be same with the respective traffic growth factors for 2018 and 2028

Scheme Impact Pro Forma for Small Project Bids - Please fill in the cells highlighted in yellow
NPIF

Year of assessment	2028

Scenario	Vissim network performance outputs	Input Data / Key Performance Indicators	Unit	AM Peak Hr Weekday	PM Peak Hr Weekday	Inter-Peak Hr Weekday
Base *	Number of vehicles in the network, All Vehicle Types + Number of vehicles that have left the network, All Vehicle Types+Latend demand	Number of highway trips affected	vehicles	20,143	20,949	14,384
	Total travel time [h], All Vehicle Types	Total vehicle travelled time	vehicle-hours	1,994	2,630	968
	Total Distance Traveled [km], All Vehicle Types	Total vehicle travelled distance	vehicle-km	103,289	91,823	78,186
		Highway peak period conversion factor	-	-	-	-
	(Number of vehicles in the network, Vehicle Class Bus + Number of vehicles that have left the network, Vehicle Class Bus)*(Bus Occupancy)	Number of PT passenger trips on affected routes ****	passenger trips	145	102	-
	(Total travel time [h], Vehicle Class Bus) *(Bus Occupancy)	Total PT travelled time ****	passenger-hrs	9.935	6.229	-
		PT peak period conversion factor	-	-	-	-
Do-Something Option 1 **	Number of vehicles in the network, All Vehicle Types + Number of vehicles that have left the network, All Vehicle Types+Latend demand	Number of highway trips affected	vehicles	20,098	20,921	14,363
	Total travel time [h], All Vehicle Types	Total vehicle travelled time	vehicle-hours	1,955	2,574	951
	Total Distance Traveled [km], All Vehicle Types	Total vehicle travelled distance	vehicle-km	101,649	90,850	77,329
		Highway peak period conversion factor	-	-	-	-
	(Number of vehicles in the network, Vehicle Class Bus + Number of vehicles that have left the network, Vehicle Class Bus)*(Bus Occupancy)	Number of PT passenger trips on affected routes ****	passenger trips	145	102	-
	(Total travel time [h], Vehicle Class Bus) *(Bus Occupancy)	Total PT travelled time ****	passenger-hrs	8.792	5.701	-
		PT peak period conversion factor	-	-	-	-
Do-Something Option 2 ***	Number of vehicles in the network, All Vehicle Types + Number of vehicles that have left the network, All Vehicle Types+Latend demand	Number of highway trips affected	vehicles	20,090	20,938	14,368
	Total travel time [h], All Vehicle Types	Total vehicle travelled time	vehicle-hours	1,950	2,583	954
	Total Distance Traveled [km], All Vehicle Types	Total vehicle travelled distance	vehicle-km	101,730	90,993	77,457
		Highway peak period conversion factor	-	-	-	-
	(Number of vehicles in the network, Vehicle Class Bus + Number of vehicles that have left the network, Vehicle Class Bus)*(Bus Occupancy)	Number of PT passenger trips on affected routes ****	passenger trips	145	102	-
	(Total travel time [h], Vehicle Class Bus) *(Bus Occupancy)	Total PT travelled time ****	passenger-hrs	9.192	5.976	-
		PT peak period conversion factor	-	-	-	-

* Base: Final Option for WEP2
** Do-Something Option 1: M62J11 EB & WB entry ramps to be priority controlled
*** Do-Something Option 2: M62J11 EB & WB entry ramps to be signal controlled
**** Bus Occupancy taken from the project 3253-TAD / Warrington Bus Occupancy. Occupancy for IP not available.
Average occupancy for Outer Site 5 data has been used.

Appendix 6

Appraisal Summary Table

Date produced:	28	6	2017

Contact:	
Name	J Nichol
Organisation	Warrington B.C
Role	Promoter/Official

Name of scheme:	Warrington East phase 3 transport project
Description of scheme:	Upgrade of the eastern gateway into Warrington and the Birchwood Enterprise Zone. Project consists of new traffic signals on Junction 11 of the M62 and the partial widening of the A574 Birchwood Way to reduce peak hour traffic congestion and improve road safety. Pedestrian crossing points will be provided on the J11 roundabout to reduce the severance created by the original scheme and allow access to the newly created open space on a reclaimed landfill site north of the M62.

Impacts		Summary of key impacts	Assessment			
			Quantitative	Qualitative	Monetary £(NPV)	Distributional 7-pt scale/ vulnerable grp
Economy	Business users & transport providers	A high-level economic appraisal for both junctions following WebTAG guidance identifies benefits to all trip purposes in the form of journey time savings. At the time of assessment trip purpose data was not available, therefore all journey time savings have been derived based on WebTAG average values of time by vehicle type and are presented in the commuter trips section below. The scheme provides cumulative corridor capacity improvements which have a positive impact on highway capacity and access to east Warrington for residences and those travelling to Warrington employment sites particularly those coverd by the Birchwood Enterprise Zone.	Value of journey time changes(£): Net journey time changes (£): 0 to 2min | 2 to 5min | > 5min	Moderate Beneficial	See Social and Commuting Below	
	Reliability impact on Business users	Delivers enhanced reliability and predictability for vehicle journey times on the A574 Birchwood Way, particularly for business users. The provision of traffic signals at J11 will enhance reliability of the junction, particularly during the peak.		Moderate Beneficial	Not monetised	
	Regeneration	The improvements will provide support for several housing schemes in east Warrington including 60 **potential dwellings** and **over 85,000m2 of employment space**. Delivery of the package is not a specific planning condition; however will support the wider aspirations of the area to ensure the economic potential is maximised.	n/a	Moderate Beneficial	Not monetised	
	Wider Impacts	The package will support the Birchwood Enterprise Zone which is a key strategic priority of the Cheshire and Warrington LEP Strategic Economic Plan.		Slight Beneficial	Not monetised	
Environmental	Noise	The scheme is likely to have a limited impact on noise with a temporary impact during construction. The construction of the scheme will involve limited noise impacts including a variety of equipment; and traffic related noise associated with the construction workforce and transport of materials/waste to and from the works area.	n/a	Neutral	Not monetised	
	Air Quality	The scheme is designed to improve congestion and reduce queueing traffic within the Warrington motorway AQMA and could significantly improve air quality and CO2 emissions. Increased congestion leads to higher levels of stop-start traffic with increased fuel usage and therefore emissions. The Defra Emissions Factor Toolkit (v6.0.2) has been used to estimate the indicative changes in emissions with the scheme with an improved journey time. By estimating an increased average speed through the route with a change of average speed from 25 Kph to 50 Kph, and by using Dft traffic data, the change in emissions has been estimated. From this, the scheme could approximately result in NOx reductions of around 30%, CO2 reductions by 25% and fine particulates PM2.5 by up to 8%. (This uses the 2016 DfT data and the 2016 fleet emission data.)	n/a	Moderate beneficial	Not monetised	
	Greenhouse gases	The package is forecast to have a positive impact on greenhouse gases with a reduction in CO2 emission.	Change in non-traded carbon over 60y (CO2e): xxx Tonnes Change in traded carbon over 60y (CO2e):	Positive	Not monetised	
	Landscape	This scheme will involve significant earthworks to widen the main carriageway of the A574. However it is not expected that this would result in an overall negative impact on the surrounding landscape and has therefore been assessed Neutral.	n/a	Neutral	Not monetised	
	Townscape	Townscape impact is defined in WebTAG Unit A.3 (Environment Impact Appraisal) as the physical and social characteristics of the built and non-built urban environment and the way in which those characteristics are perceived. This scheme has no impact on townscape considerations with no impact on local amenities and facilities around the improvement area and has therefore been assessed Neutral.	n/a	Neutral	Not monetised	
	Historic Environment	This scheme has no impact on the historic environment and has therefore been assessed Neutral.	n/a	Neutral	Not monetised	
	Biodiversity	This scheme has some potential impact on biodiversity due to the proximity to sites which may contain crested newts which are a protected species. This is based on a volunteer survey carried out for the Woodland Trust in 2008 and which will require confirming with a ecological survey. However based on experience of similar sites elsewhere in Warrington it is expected that a strategy to protect or relocate the newts should ensure that this impact would be assessed Neutral.	n/a	Neutral	Not monetised	
	Water Environment	This scheme has no impact on the water environment and has therefore been assessed Neutral.	n/a	Neutral	Not monetised	
Social	Commuting and Other users	A high level economic appraisal for this project following WebTAG guidance identifies benefits to all trip purposes in the form of journey time savings. The scheme provides cumulative corridor capacity improvements which have a positive impact on highway capacity and access to east Warrington for residences and those travelling to Warrington employment sites.	Value of journey time changes(£): Net journey time changes (£): 0 to 2min | 2 to 5min | > 5min	Beneficial	£57,899,818	
	Reliability impact on Commuting and Other users	Delivers enhanced reliability and predictability for vehicle journey times on the transport network. The provision of traffic signals at J11 will enhance reliability of this junction and along Birchwood Way, particularly during the peak period.	n/a	Moderate Beneficial	Not monetised	
	Physical activity	The proposed scheme will look at providing for a safe pedestrian and cyclist access over Junction 11 of the M62 to allow residents to access the recently reclaimed landfill site managed by Biffa Ltd. The footways would be 2-3metres wide so they can be shared by cyclists.	n/a	Slight Beneficial	Not monetised	
	Journey quality	Detailed design for the package of works will include good design and layout principles to ensure no negative impacts are experienced as a result of the new junction arrangements. Improvements to journey times, queue lengths for motorists travelling to/from east Warrington will have a slight beneficial impact for journey quality.	n/a	Slight Beneficial	Not monetised	
	Accidents	Improvements to congestion experienced on the on slip roads to the M62 may contribute to an improvement for accidents influenced by changes to queue lengths, average speed etc.	n/a	Neutral	Not monetised	
	Security	As highlighted within the physical activity assessment, new crossing facilities and improved footways across the J11 roundabout will be provided providing a security benefit for pedestrians.	n/a	Neutral	Not monetised	
	Access to services	The scheme would improve access to the commercial centre of Birchwood which includes the Birchwood Shopping Centre, medical centre, library and the Birchwood tennis and sports centre.	n/a	Neutral	Not monetised	
	Affordability	The appraisal highlights the package of improvements is unlikely to add any direct or indirect additional cost in terms of transport affordability (peoples ability to use the transport network) (i.e. the package doesn't introduce new parking charges, road user charges, public transport fare changes, alter public transport concession availability etc.).	n/a	Neutral	Not monetised	
	Severance	The proposals would not create more severance but has the opportunity to reduce it. Currently the J11 roundabout creates severence of pedestrian movements between Birchwood and the footpaths and open spaces north of the M62. The proposals will help to reduce this severance by creating safer crossing points.	n/a	Slight Beneficial	Not monetised	
	Option and non-use values	There will be no change to the availability of transport services for the study area as a result of the proposals. Therefore, factoring in a proportionate approach to the appraisal, option and non-use values is not required within the assessment and as such assessed as Neutral.	n/a	Neutral	Not monetised	
Public Accounts	Cost to Broad Transport Budget	The ongoing revenue costs of this project has been calculatd as £74,000 pa based on a 40 year life of the scheme.	n/a	n/a	xxxx	
	Indirect Tax Revenues	The change in indirect tax revenues has not been monetised, however given the forecast journey time savings it is likely there would be a decrease in indirect tax revenues.	n/a	n/a	-	

Appendix 7

Birchwood Pinch Point Project

Scape Civil Engineering and Infrastructure Framework

Employment and Skills Plan – Nov 16

The below targets/results are proposed for the delivery of the £3.5m, 6 months Birchwood Pinch Point Project with Warrington Borough Council;

	Employment and Skills Areas	Measured by	Framework Target (Overarching target to be met)	Project Target	Achieved	Comments
1.	**Work Experience**					
1.1	Work experience opportunities under 16 years	No of pupils	1	1	1	2 weeks completed
1.2	Work experience opportunities over 16 years	No of pupils	4	3	5	2 weeks completed each – 1no has applied to BB Graduate scheme
2.	**Engagement with schools/colleges**					
2.1	School college visits	No of pupils	50	100	366	Safety Talks, Careers Talks, Curriculum Involvement
3.	**Adult Employment Opportunities (19+)**					
3.1	Number of opportunities created		3	2	4	Achievement in the supply chain by D Morgan
3.2	Number of opportunities advertised locally		3	2	3	
4.	**Apprentices (including Apprentice Training Agency placements)**					
4.1	Number of starts / completions		1	1	C	Commercial apprentice for BB – Ella Sherrington
4.2	Weeks on site	Weeks on site per apprentice	10	5	10	
5.	**Training courses (internal and external)**					
5.1	Health & Safety	No of people days on training courses	12	12	15	Various courses
5.2	Professional Development		3	2	4	Training for on-site staff and external stakeholders including training completed at local JCP
5.3	Sustainability/innovation		3	3	4	Various courses – and onsite development
6.	**Professional and Academic Qualifications**					
6.1	CIAT; CIBSE; CIOB; ICE etc– Starts / Completions		0	1	0	Project team already had provision in place
6.2	Degree/HNC or similar – Starts / Completions		0	0	0	1no site staff on an appointed persons course and 1no admin NVQ commenced
6.3	NVQ (any level) – Starts / Completions		1	0	2	

Additional results:

Over **300** newsletters delivered locally

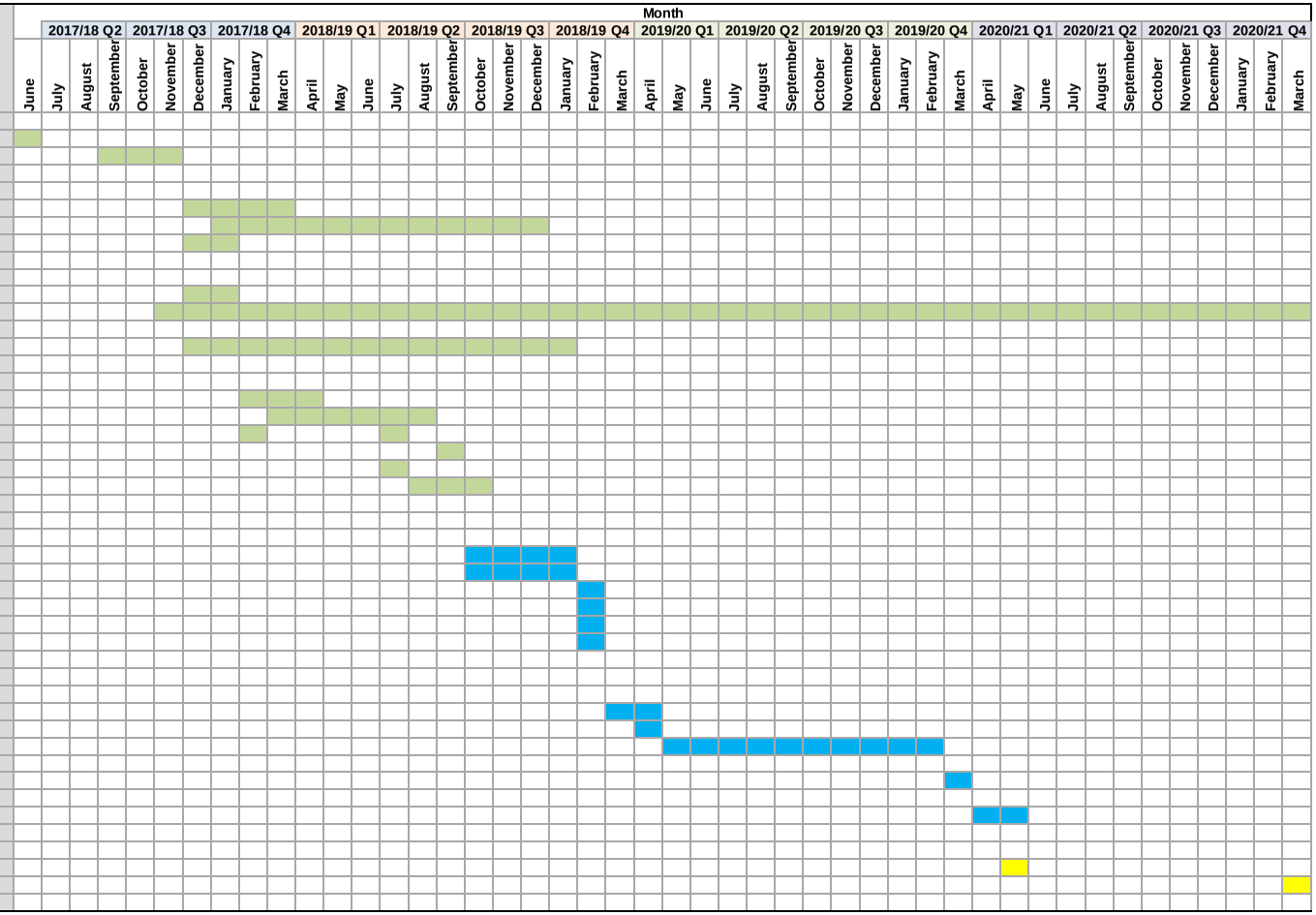
1 volunteer event (Warrington Run)

£648 in kind and charitable donations to local groups

Appendix 8

Warrington East phase 2 programme - freestanding project not linked to WE phase 2

ID	Activity Name	Days	Start	Finish
1	**NPIF Application**			
1.1	Submission of NPIF bid	1	30/06/2017	30/06/2017
	NPIF decision of bid		Anticipated Autumn 2017	
2	**Project Aprovals**			
2.1	Planning permission if required .			
2.2	Highway notices including permits and TROs			
2.3	Council approvals			
3	**Stakeholder Engagement**			
3.1	Public consultation (linked to Phase 2 project)			
3.2	Liaison with Highways England - ongoing			
4	**Land and Property Acquisition**			
5	**Design**			
5.1	Site Investigation and surveys			
5.2	Detailed highway design			
5.3	Road Safety Audits (RSA1/2)			
5.4	Approval of detailed design			
5.5	C3/C4 Estimates for Statutory Undertakers			
5.6	Place Statutory Undertakers Diversion orders			
6	**Procurement**			
6.1.1	Balfour Beatty develop/submit FINAL target cost for Construction			
6.1.2	Balfour Beatty prepare/submit Stage 4 and 5 proposals			
6.1.3	WBC Review Balfour Beatty proposal and make recommendation			
6.1.4	WBC Executive Board Meeting (Internal Approvals)			
6.1.5	Colling off period			
6.1.6	Notice to Proceed			
7	**Construction**			
7.1.1	Mobilisation and Site Set Up			
7.1.2	Start of works			
7.1.3	Completion of works			
7.3.1	Demobilisation / Hand Over			
8	**Project Close Out**			
9	**Monitoring and Evaluation**			
9.1	Scheme delivery			
9.2	1 year post scheme			
9.3	4 years post scheme			



Appendix 9

Balfour Beatty — **Risk & Opportunity Register**

Revision: Rev 0 | Last review Date: ##/##/#### | Next review Date: Award Date

RISK		Escalation information					Risk & Probability Impact Matrix						Risk & Probability Impact Matrix					Commentary				WEPH				
Ref. No	Work Area / Location	Escalation Level	Category	Risk event	Cause	Consequence	Delivery	Safety	Cost	Likelihood	Severity	Mitigation	Delivery	Safety	Cost	Likelihood	Severity	Risk Owner	Current Status	Current Actions	By When	Changes from last period	Least Likely LB £	Most Likely MLB £	Maximum MB £	Probability P - %	= ((LB+2*MLB+MB)/4)* P £
Additional Dualling of A574 Moss Gate from M62J11																											
1	All	F - Project	HSE	Work force struck by moving plant	People interface with moving plant. Failure to comply with company procedures.	Accident,harm , injury, death, prosecution, damage to reputation, suspension of works	3	4	3	3	Orange	People and plant segregated by physical barrier, exclusion zones around excavators. Operation of the Project Management HSEQ Plan (PMP) All operations to be planned and the devised SSoW documented in RAMS. RAMS approval. RAMS Briefings to work force. Periodic RAMS review. "	3	4	3	1	Yellow						£100,000	£200,000	£250,000	2%	£3,750.00
2	All		HSE	Temporary Works Collapse	Bad ground	Programme delay	3	4	2	2	Orange	Key bore hole and SI	2	2	2	1	Green						£150,000	£300,000	£450,000	1%	£3,560.00
3	All		HSE	Falls from Height	Failure to comply with company procedures.	Accident,harm , injury, death, prosecution, damage to reputation, suspension of works	3	4	3	3	Orange	Working to works package plan	3	4	3	1	Yellow						£50,000	£100,000	£200,000	1%	£1,125.00
4	All		HSE	Damage to existing road due to construction plant and lifting operations	Wagon movements	Damage	1	2	3	3	Yellow	Concrete access points	1	1	3	2	Yellow						£10,000	£20,000	£30,000	5%	£1,000.00
5	All		HSE	Contraction of Infectious Diseases (Leptospirosis)	Working near existing drains/sewers.	Accident, Harm, Injury, Ill Health, Death Work Stopped. Delay	1	2	2	3	Yellow	Assess the site surroundings for potential areas of substance abuse. Assess the works area for potential for Leptospirosis (presence of vermin) Instruction on Leptospirosis provided to all personel during site induction. Provision of topical tool box talks to workforce. No smoking/ eating in high risk areas or during high risk operations. Ensure correct use of identified PPE (including barrier creams and personal hygene procedures).	1	2	2	1	Green						£10,000	£20,000	£50,000	5%	£1,250.00
6	All		HSE	Lifting Operations	Dropped loads Lifting equipment collapse Plant in contact with people Hands in contact with plant/equipment	Accident, Harm, Injury, Ill Health, Death Work Stopped. Delay & Litigation	2	4	3	3	Orange	Appoint SQEP Lift Coordinator. Adherence to LOLER, BB Company Standards & Procedures. Prior to works, prepare Project Lift Plan.Lifting operations planned and Safe System of Work documented in RAMS. RAMS approval. RAMS Briefings to work force.. All lifting operations carried out under operation specific Lift Plans and under supervision by an appointed SQEP Lift Supervisor.Use of competent/ experienced temporary works designers/ coordinator. Obtain Approval to use selected crane company. Ticketed trained and competent crane operator & banksmen. Lifting equipment testing, inspection, examination and insurance documentation checked prior to use on site. High Risk Work Zone enforced .All lifting carried out with appropriate enforced clearance zones.	2	4	3	1	Yellow						£10,000	£200,000	£350,000	2%	£3,800.00
7	All		HSE	Damage to existing services underground - Known Service	Hitting services while excavating or travelling over existing services	Accident, Harm, Injury, Ill Health, Death Work Stopped. Delay & Litigation, cost of repairs	2	4	3	3	Orange	All excavation operations carried out under operation of 'Permit to Dig' and under supervision by an appointed qualified & experienced Supervisor. Appointed Supervisor to inspect excavations at the start of each day, when anything changes and prior to any works taking place after a period of absence.	2	4	3	2	Orange						£50,000	£100,000	£150,000	5%	£5,000.00
8	All		HSE	Damage to existing services underground - UnKnown Service	Hitting services while excavating or travelling over existing services	Accident, Harm, Injury, Ill Health, Death Work Stopped. Delay & Litigation, cost of repairs	2	4	3	3	Orange	All excavation operations carried out under operation of 'Permit to Dig' and under supervision by an appointed qualified & experienced Supervisor. Appointed Supervisor to inspect excavations at the start of each day, when anything changes and prior to any works taking place after a period of absence.	2	4	3	2	Orange						£50,000	£100,000	£150,000	5%	£5,000.00
9	All		Programme	Service diversions costs increase from C3 Stage	Costs are above that quoted in C3, unforseen service diversions required.	Additional works, costs and prolongation	1	1	3	3	Yellow	Liaise with Stats during Pre construction and fully understand their requirements. GPR carried out during Pre construction, Trial holes to verify findings carried out in mobilisation	1	1	3	2	Yellow						£100,000	£150,000	£200,000	15%	£22,500.00
10	All		Programme	Service diversions costs increase, additional diversions required, take longer and additional civils attendances from C4 stage	Statutory Undertakers require civils attendance above that allowed., costs are above that quoted in C4, unforseen service diversions required, service diversions take longer.	Additional works, costs and prolongation	1	1	3	3	Yellow	Liaise with Stats during Pre construction and fully understand their requirements. GPR carried out during Pre construction, Trial holes to verify findings carried out in mobilisation	1	1	3	2	Yellow						£100,000	£150,000	£200,000	15%	£22,500.00
11	All		HSE	Road Traffic Accident	Interface between construction traffic and travelling public	Accident,harm , injury, death, prosecution, damage to reputation, suspension of works	3	5	4	3	Red	Ensure construction traffic on public roads is minimised and that all plant crossings and plant interfaces with the travelling public are well maintained and signed.	3	5	4	1	Orange						£10,000	£200,000	£400,000	5%	£10,125.00
12	All		HSE	Members of the public enter the site	Lack of fencing, historic rights of way, historic used paths	Accident, Harm, Injury, Death Work Stopped. Delay & Litigation	3	4	3	2	Orange	Ensure an understanding of the public use of the site, ensure appropriate fencing and signage is provided to deter treespassers. Provide alternative routes where feasible.	3	4	3	1	Yellow						£5,000	£10,000	£15,000	15%	£1,500.00

Balfour Beatty

Risk & Opportunity Register

Revision: Rev 0

Last review Date ##/##/####

Next review Date: Award Date

WEPH

RISK		Escalation information					Risk & Probability Impact Matrix						Risk & Probability Impact Matrix					Commentary					Quantitative Cost Calculation				
Ref. No	Work Area / Location	Escalation Level	Category	Risk event	Cause	Consequence	Delivery	Safety	Cost	Likelihood	Severity	Mitigation	Delivery	Safety	Cost	Likelihood	Severity	Risk Owner	Current Status	Current Actions	By When	Changes from last period	Least Likely LB £	Most Likely MLB £	Maximum MB £	Probability P - %	= ((LB+2*MLB+MB)/4)* P £
13	All		HSE	Presence of unforeseen invasive plants	Presence of invasive plants	Additional works and delay	1	1	2	3	Yellow	MM carried out survey and confirmed no invasive plants were found	1	1	2	1	Green						£10,000	£100,000	£500,000	5%	£8,875.00
14	All		Design	New surface water drainage cannot outfall into existing system	Errors in assumptions of current drainage, outfall consents and attenuation, condition of existing unknown		3	2	4	3	Orange		3	1	3	2	Yellow						£50,000	£75,000	£100,000	10%	£7,500.00
15	All		Design	Road Safety Audits and NUM Audits identify additional works	Additional construction works required as a result of safety audit of the works	Increased design and construction cost and programme delays	1	1	3	4	Yellow		1	1	3	4	Yellow						£50,000	£100,000	£200,000	10%	£11,250.00
16	All		Design	Additional RRS replacement required by BBMM/HE		Increased design and construction cost and programme delays	1	1	3	4	Yellow		1	1	3	4	Yellow						£100,000	£175,000	£250,000	20%	£35,000.00
17	All		Design	Design Creep	Works increase or change during detail design	Increase construction cost and programme 1 % of Construction Cost	3	1	4	4	Red		4	1	3	3	Orange						£150,000	£200,000	£250,000	50%	£100,000.00
18	All		Design	Scope Creep		Increase construction cost and programme 20 % of Construction Cost	4	2	4	4	Red		4	1	3	3	Orange						£200,000	£400,000	£600,000	60%	£240,000.00
19	All		Cost	Increased Volume of unacceptable material and soft areas encountered	Ground conditions vary from those expexcted from the Site Investigation	Increased volume of unacceptable, soft areas. Programme prolonged and costs increased.	1	1	2	3	Yellow	Early trial holes and hot spotting to reduced quantities	2	1	2	2	Green						£200,000	£300,000	£500,000	35%	£113,750.00
20	All		Cost	Unidentified Unexploded Ordnance not discovered in Ground Investigation	Presence of Unexploded Ordnance	Additional works and delay to construction	1	1	2	2	Green	Carry out desk top study	1	1	2	1	Green						£5,000	£10,000	£15,000	20%	£2,000.00
21	All		Cost	Existing carriageways unsuitable for incorporation into permanent works as shown	Existing carriageway has failed or is sub standard	Existing carriageway has to be reconstructed	3	2	4	2	Orange	Existing carriageway has been inspected and shows no sign	3	1	4	1	Yellow						£10,000	£50,000	£100,000	30%	£15,750.00
22	All		Cost	Additional site clearance required	Site clearance carried out and shown on drawings is insufficient	Additional works and cost and prolongation	1	1	2	3	Yellow	MM increasing site clearance area on drawings	1	1	2	2	Green						£5,000	£10,000	£20,000	20%	£2,250.00
23	All		Cost	Vandalism / Theft	Vandalism / Theft	Additional costs and rework	1	1	2	3	Yellow		1	1	2	3	Yellow						£1,000	£5,000	£10,000	20%	£1,050.00
24	All		Cost	Third Party claims / property damage - walls, boundary treatments,- condition not known	Public interface with site	Additional costs	1	1	2	2	Green		1	1	2	2	Green						£1,000	£5,000	£10,000	20%	£1,050.00
25	All		Cost	Quantities Increase	BOQ incorrectly measured	Additional costs	1	1	2	3	Yellow	Check on BOQ carried out during pre construction	1	1	2	3	Yellow						£400,000	£750,000	£1,250,000	10%	£78,750.00
26	All		Cost	Contaminated land	Inaccurate SI information	Delays to programme and increased costs	2	3	4	4	Red	Further site investigation	1	2	3	3	Yellow						£200,000	£300,000	£400,000	25%	£75,000.00
27	All		Cost	Supply Chain insolvency			4	1	3	2	Orange		2	1	2	1	Green						£10,000	£50,000	£100,000	10%	£5,250.00
28	All		Cost	Increased Inflation			2	1	3	2	Yellow		2	1	2	2	Green						£15,000	£50,000	£100,000	10%	£5,375.00
29	All		Cost	Additional Ecological Works	Identification of protected species by ecological surveys	Delays to programme due to requirement to protect, relocate or work round protected species.	3	1	4	4	Red	Early identification of ecological issues to include within overall programme.	3	1	4	3	Orange						£20,000	£100,000	£150,000	20%	£18,500.00
30	All		Cost	Existing top soil is unsuitable for reuse	8812 sq.m @150mm, 1321 cu.m say 50% import gives 660 cu.m @ £50 cu.m		2	1	4	3	Orange		2	1	3	2	Yellow						£25,000	£50,000	£75,000	10%	£5,000.00
31	All		Cost	Insufficient traffic management allowance			2	4	3	3	Orange		2	3	2	2	Yellow						£10,000	£50,000	£100,000	15%	£7,875.00
32	All		Cost	CPO of land	Delay in land acquisition and/or access across third party land	Delay in programme and subsequent increase in costs due to contractor inactivity	5	1	4	3	Red	Early discussions with landowners to seek approval for land acquisition or dedication order. Also to obtain licences for access for pre-ocnstruction works and for movement of plant during construction.	3	1	3	3	Yellow						£50,000	£100,000	£150,000	10%	£10,000.00
33	All		Programme	Additional works required at tie ins	Existing levels do not suit new design more works required	Additional works and regulating required	1	1	2	3	Yellow		1	1	2	3	Yellow						£1,000	£10,000	£100,000	20%	£6,050.00
34	All		Programme	Delays to receiving approvals, roadspace conflicts with other schemes (Mway) licences and consents	Unable to obtain required licences,consents and approvals to comply with proposed scope stated in tender documents	Third parties refuse to accept design based on current information. Additional costs and delay to the programme	2	1	2	3	Yellow		2	1	2	2	Green						£150,000	£250,000	£500,000	35%	£100,625.00
35	All		Programme	Works delayed due to adverse weather	Occurrence of weather above that normally allowed for in rates. Less than 1 in 10, 4 weeks preliminaries	Construction delayed and costs increased, 4 weeks at £25,000 per week	3	1	2	3	Yellow	Minimise areas of excavation left uncovered. Monitor daily weather forecasts for specific area	3	1	2	3	Yellow						£200,000	£250,000	£500,000	10%	£30,000.00
	SUMMARY																										£1,037,010.00

Warrington East phase 3 Transport Project

Risk Management Strategy

NPIF Application

WARRINGTON
Borough Council

28 June 2017

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Introduction

The management of risk and uncertainty will be key to the successful delivery of the Warrington East phase 3 transport project, as it will identify threats to project delivery and enable effective risk management actions to be assigned.

This document sets out the '*Risk Management Strategy*' for the package of works, providing for:

- a continuous approach to the risk management;
- a thorough approach to the identification of risks;
- active risk avoidance and mitigation;
- effective communication of risks throughout the project team, and where necessary, escalation to Project Board level to ensure that issues can be managed with an appropriate level of authority; and
- delivery of the scheme objectives to cost, quality and time.

Risk Management Process

The risk management process includes the following:

- Risk identification
- Qualitative risk assessment;
- Risk management comprising, the allocation of risk actions and owners, reviews and value engineering, risk removal and/or reduction; and
- Quantified risk assessment.

The *SCAPE National Civil Engineering and Infrastructure Framework* is the proposed commercial mechanism to deliver the identified works. The framework provides for a balance of risk, control and cost certainty to enable value for money to be achieved.

The successful contractor appointed to the SCAPE Framework in January 2015 is *Balfour Beatty*, a nationally recognised construction company with more than 100 years of experience in complex infrastructure projects.

This procurement method was identified to capture construction efficiencies/deliver synergies with the Warrington East Phase 1 project (Birchwood Pinchpoint) completed in March 2016[1] and the M62 Junction 8 improvement works currently under construction[2], thereby reducing the risk associated with delivering Warrington's wider improvements to the network.

Within this context, Balfour Beatty also has a corporately agreed risk management process which is further outlined below in **Figure 1** and **Figure 2**.

Balfour Beatty's risk management process is aligned with the broader approach/process outline above and has been developed through the delivery of over £300m of schemes in the North West region in the last three years proving its value and effectiveness when avoiding project delays or cost increases.

[1] www.warrington.gov.uk/birchwoodpinchpoint
[2] https://www.warrington.gov.uk/info/201363/junction_8_m62

Balfour Beatty will also appoint a project Risk Champion who will oversee the risk and opportunity management for the junction improvement. The Risk Champion will promote the importance of the risk and opportunity management process and ensure effective communication of the risks throughout the team.

Figure 1: Risk Management Process - Construction UK (Part 1)

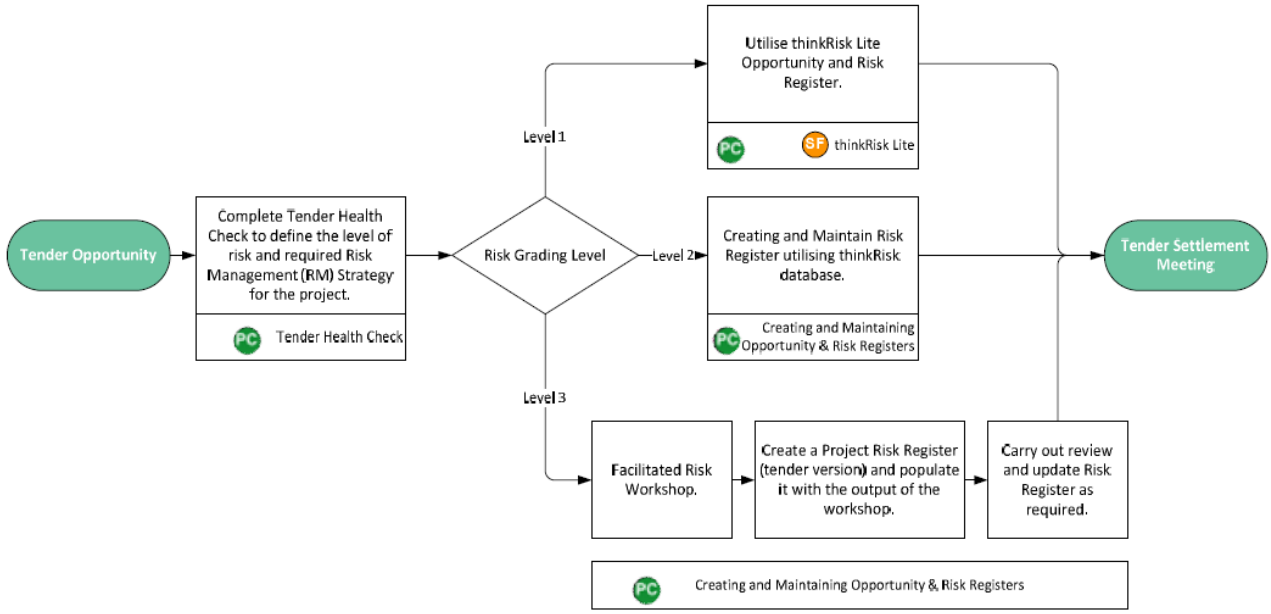
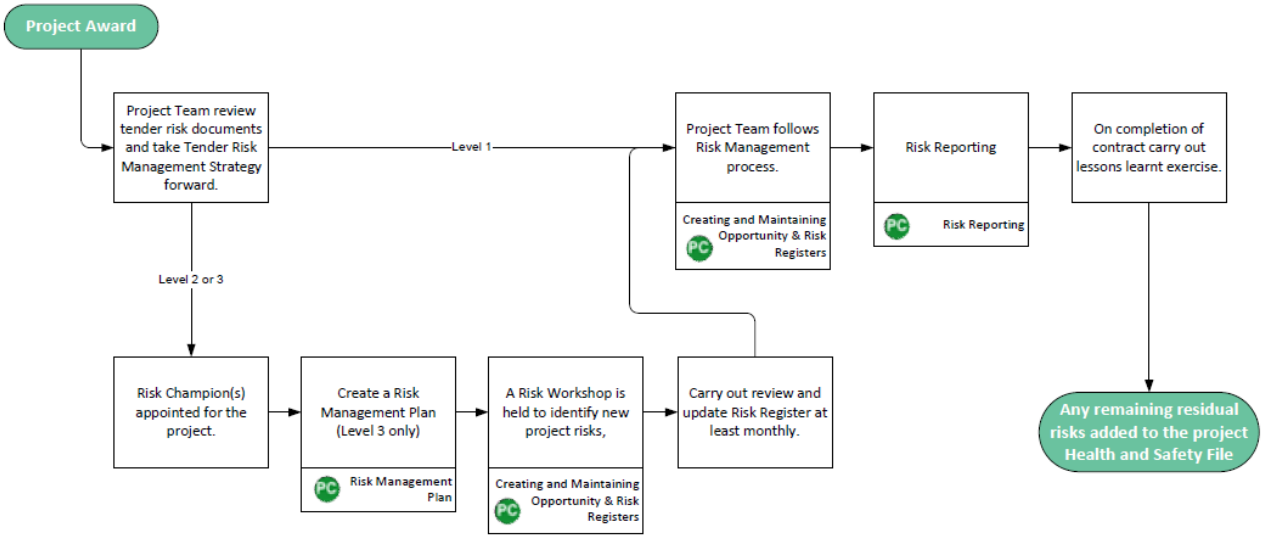


Figure 2: Risk Management Process - Construction UK (Part 2)



Risk Management Strategy Ownership

The overall Risk Management Strategy will be owned by the SRO.

However the day to day management of the strategy and project risk onsite will be managed by the construction partner.

Stakeholder Management

Public Consultation

Warrington Borough Council will hold a public consultation exercise during Winter 2017 for the Phase 3 project concurrent with the Stage 2 consultation for the Phase 2 project. This will ensure that the various aspirations of the general public and key stakeholders are taken into account throughout development and delivery of the package of works.

The Council has considerable experience with consultation / engaging with public. The approach will be highly engaging and inclusive to reach those seldom heard audiences such as the working population, families and younger people.

Noting the location of the project and its proximity to residential areas and a major employment site, the consultation will be devised to be geographically appropriate to ensure the relevant users and those impacted by the scheme (such as commuters) are fully engaged and informed.

The consultation will inform the option design to limit risks for delivery.

Land Ownership

Early engagement with adjacent land owners with regard to land acquisition has already been undertaken. A Letter of support and reference to land access requirements have been sourced from the Woodland Trust. The issue of land access and possible acquisition has also been raised at Member Level.

This early engagement is designed to limit the risk associated with land access and acquisition and ensure early buy in from key stakeholders.

Risk Workshop / Register

A Risk Workshop was held for the Phase 2 project in March 2017, attended by Warrington Borough Council, Balfour Beatty and Mott MacDonald. Lessons learnt were also brought forward from the completed Warrington East Phase 1 project which helped to introduce an element of realism to the risk assessment process.

The outcome of the workshop was a clearly defined project specific risk and opportunity register, which effectively identifies, manages and mitigates risks, whilst maximising opportunities. Most of the issues identified are directly applicable to the Phase 3 project and have been used for the Warrington East phase 3 QRA and Risk Register.

The risk and opportunity register includes the following information:

- Event;
- Cause;
- Consequence;
- Mitigation;
- Likelihood – probability impact matrix; and
- Quantitative Cost Calculation.

The risks have been grouped under the following headings:

- Health, safety and environment;
- Design;
- Cost;
- Programme;
- Quality; and
- Reputation.

The table below outlines high level key risks identified for the project shown as Red in the completed QRA attached at **Appendix 9** of the NPIF Application.

Table 1: High level risks for the WE3 project

Risk Register ID	Risk Event	Cause	Consequence	Mitigation Measure
11	Road Traffic Accident	Interface between construction traffic and travelling public	Accident, harm , injury, death, prosecution, damage to reputation, suspension of works	Ensure construction traffic on public roads is minimised and that all plant crossings and plant interfaces with the travelling public are well maintained and signed.
17	Design Creep	Works increase or change during detail design	Increase construction cost and programme 1 % of Construction Cost	Regular design team meetings and clear decision making on the final design.
18	Scope Creep	Scope changes during scheme development stage	Increase construction cost and programme 20 % of Construction Cost	Ensure all scheme options are properly assessed and modelled to minimise impact on the programme.
26	Contaminated land	Inaccurate SI information	Delays to programme and increased costs due to need to follow contaminated material procedures	Carry out Ground Investigations including soil sampling especially in locations where land is “brownfield” in status.
29	Additional Ecological Works	Identification of protected species by ecological surveys	Delays to programme due to requirement to protect, relocate or work round protected species.	Early identification of ecological issues to include within overall programme.
32	CPO of land	Delay in land acquisition and/or access across third party land	Delay in programme and subsequent increase in costs due to contractor inactivity	Early discussions with landowners to seek approval for land acquisition or dedication order. Also to obtain licences for access for pre-construction works and for movement of plant during construction.

Risk Review and Reporting

Risk information is required to be kept up-to-date at all times to facilitate reporting at the monthly Project Team meetings. Risk will be a standing item on the agenda.

During construction, updates to the Risk Register will be undertaken by a joint risk and opportunity forum including the appointed Principal Designer, Project Manager and appropriate members of the Construction Team, and Client Team.

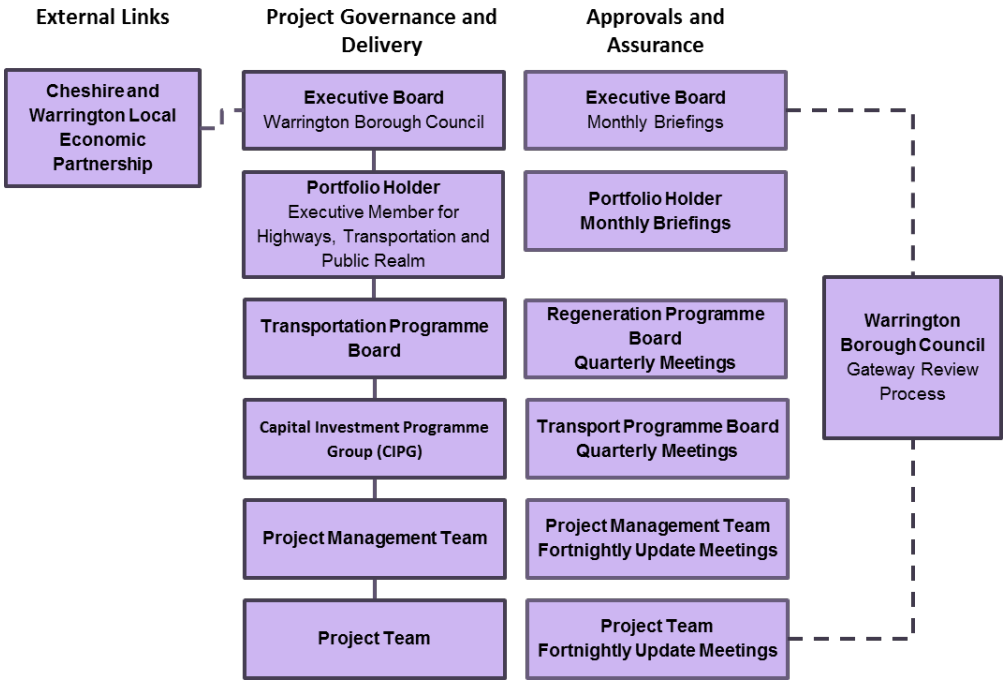
In addition to monthly reporting tasks, risk reviews will be undertaken ahead of any major gateways or following any significant changes.

Escalation of Risks

The process for escalation of risks is outlined below to demonstrate accountability levels within Warrington Borough Council. Where an individual does not have appropriate accountability, the risk will be escalated and managed at a higher level. Risks may also require escalation if they cannot be resolved within the Construction or Client team or if the risk has wider impacts beyond the scope of the Warrington East phase 3 project. Risk escalation levels are shown below and aligned to the Governance arrangements. Risks flow upwards from 1-4:

1. Project Manager;
2. Programme Manager;
3. Senior Responsible Owner;
4. Transportation Programme Board;
5. Regeneration Programme Board; and
6. Executive Board.

Figure 3: Warrington Borough Council Governance Process



Separately, Balfour Beatty have identified the following internal escalation process separate to Warrington Borough Council:

Table 2: Balfour Beatty Escalation Process

Category	Response
A – Group	Requires escalation by CSUK to BB Group
B – CSUK	Requires escalation by Business Stream to CSUK and must be included in Business Stream monthly reporting pack
C – Business Stream	Requires escalation from sector to Business Stream and must be included in Sector/Hub monthly reporting pack
D – Sector/Hub	Requires escalation from Sub-sector / delivery unit to Sector/Hub for review
E - Subsector / Delivery Unit / Balvac / BPH / OPL / JV Board	Requires escalation from Project to Sub-sector / delivery unit for review
F – Project	Risk does not require escalation as impact and mitigation can be managed by Project
G – to be reviewed	Risk not yet reviewed and classified for escalation

Sign Off

This document acts as evidence that due regard to project risks has been given.

Table 3: Sign Off

Name	Position	Signed	Date
Risk Management Strategy Owner	Transport Planning & Development Control Manager Warrington Borough Council	Alan Dickin	28.06.2017
Senior Manager	Transport for Warrington Service Manager	Steve Hunter	28.06.2017

Appendix A: QRA Probability Impact (PI) Matrix

Table 3. Likelihood

Rating	Description	Range
5	Almost Certain	>90%
4	Probable	50 % – 90%
3	Possible	10% – 49.9%
2	Remote	1% – 10%
1	Unlikely	<1%

Table 4. Opportunity Benefit

Rating	Opportunity Benefit
5	**Red**
4	**Orange**
3	**Yellow**
2	**Green**
1	**Green**

Table 5. Risk Impact / Likelihood Matrix

Risk Impact	5	Orange	Red	Red	Red	Red
	4	Yellow	Orange	Orange	Red	Red
	3	Yellow	Yellow	Yellow	Yellow	Yellow
	2	Green	Green	Yellow	Yellow	Yellow
	1	Green	Green	Green	Yellow	Yellow
		1	2	3	4	5
		Likelihood				

Table 6. Assessment Outcome

Rating	Description
Red	Unacceptable risk, plan out or add further controls, requires senior management review &/or support
Orange	Acceptable only if no other method viable and with high level controls in place, requires senior management review & support
Yellow	Acceptable with additional suitable controls, will require Senior Operational Management review & support
Green	Acceptable, no additional controls required,

Severity Impact Rating	Risk Impact Related Description								
	D - Delivery			**S** - Safety / Health / Environment			**Cost**		
	Sustainability	**Quality & Reputation**	**Programme**	**Safety**	**Health**	**Environment**	**Group**	**Business Stream**	**Project**
5 **Major**	Extreme reputational damage resulting in permanent loss of BB revenue	Serious long term impact that may affect Group or other BB OpCos	* Permanent Stoppage * Non conformance resulting in Catastrophic failure	Death of member of public Multiple worker deaths e.g. asbestosis, cancers	Fatal accident to a member of the public Multiple employee deaths	Extreme environmental incident resulting in irreversible, long term or widespread harm	>£50M	>£10M	>£1M
4 **Significant**	Reputational damage resulting in loss of revenue /customer base	Serious impact that will affect CSUK operations	Major non-conformance or delay that adversely affects customer's interests.	Single worker death Life-shortening health effect Heath effect causing significant irreversible disability e.g. lung diseases	Single worker death Multiple major injuries (worker or third party) Significant irreversible disability	Major environmental incident resulting in significant impact requiring management by external authorities and/or high level of resources for response and remedy Environmental incident	£10M - £49.9M	£5M - £9.99M	£500k - £999k
3 **Moderate**	Serious failure to comply with customer / Government mandatory obligations	Impact that will affect Business Stream reputation	Partial delivery or delay to customer requirements	Irreversible health effect e.g. loss of hearing, HAVS cases Serious illness from which there is full recovery e.g. poisoning, legionnaires disease, MRSA, serious dermatitis	Single major injury (worker or third party) Worker injury resulting in more than three days away from work Injury to a member of the public requiring hospital visit.	Moderate environmental impact requiring management response to aid recovery Reportable to authorities e.g. fuel tank spillage	£5M - £9.99M	£500k - £4.99M	£100k - £499k
2 **Minor**	Consistent failure to meet customer requirements	Impact that will affect Project reputation	Delayed or inconsistent delivery of customer requirements	Reversible health effect, e.g. minor dermatitis, asthma, tinnitus. Minor illness, e.g. slight poisoning Restricted work Medical treatment beyond first aid	Minor injury (worker or third party) Injuries resulting in one to three days away from work Restricted work Medical treatment beyond first aid	Local impact requiring management response, but from which there is natural recovery e.g. recovery of fly tip waste, low levels of silt into spawning river	£1M - £4.99M	£250k - £499k	£10k - £99k
1 **Negligible**	Failure to meet customer expectations	Little or no reputational impact	Slight deviation from specification of little customer concern	Mild health effect for short period, with no lost time e.g. local skin irritation.	First aid case, with no lost time Negligible safety impact	Minimal environmental impact e.g. minor oil drips	<£1M	<£250k	<£10k

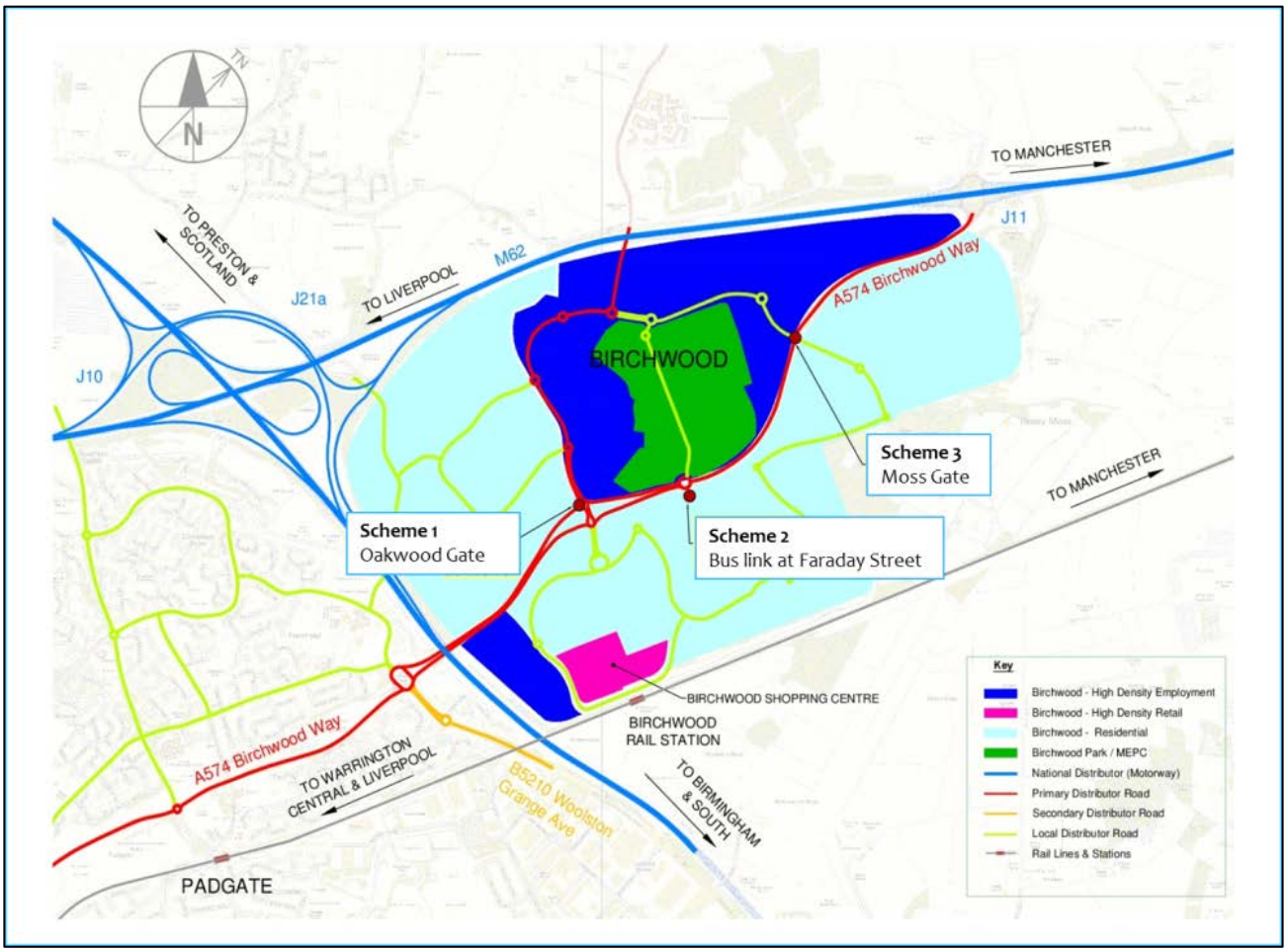
Birchwood Pinchpoint Project
Post Opening Project Evaluation Report

Scheme description

The £5.0 million Birchwood Pinchpoint project on the A574 Birchwood Way, Birchwood, Warrington, is phase one of the Warrington East transport strategy. It was funded by a combination of Growth Deal funding, Council capital funds and a £1.1 million contribution from the owners of Birchwood Park. The principal designer was Mott MacDonald transport consultancy and the Principal Contractor was Balfour Beatty. Works started in July 2015 and finished in March 2016.

The project consisted of the following key elements:

- Introduction of two-way traffic signals to the northern end of the **Oakwood Gate** ('dog bone') roundabout, re-alignment of Birchwood Way to create a three lane approach to the junction, and a refresh of all signs, street lighting and markings at the junction.
- Creation of a new **bus only link** between Ordnance Avenue and Faraday Street which incorporates phase 1 of the Warrington bus lane enforcement system. New signs, markings and replacement of street lighting also took place.
- Conversion of the **Moss Gate** roundabout to a four way signalled controlled junction, widened approaches on Birchwood Way, improved highway drainage, diversion of utilities, two sets of pedestrian crossings, and refresh of all markings, signs and street lighting.



Objectives

The underlying aim of the project is to improve network reliability and resilience along this corridor in order to help enhance the attractiveness of Birchwood as a primary destination for inward investment. In particular the project was designed to meet the following strategic objectives:

- Reduction of peak time congestion particularly during the peak periods
- Reduction of journey times of bus services within Birchwood which use (or cross) this corridor
- Improvements to road and personal safety along the corridor
- Improvement of active travel permeability along the corridor
- Improvement to local air quality, noise, and visual amenity
- Reduced carbon emissions

Specific impacts

Environment	Reduction of 37 tonnes of carbon emissions from use of Scape framework 3,884 tonnes of material being recycled during construction Reduction in vehicle emissions due to less queuing traffic
Safety	No PIAs recorded in first 6 months (April to September 2016)
Economy	99% of local spend within 40 miles of project 97% of local labour used for the project £48,719 of socio economic value generated from employment and training on the project
Accessibility	Improved bus accessibility and permeability using new bus link Increase footfall and cycle use at Moss Gate junction
Integration	Expansion of development at Birchwood Park (App No. 2015/26044) Birchwood Park designated as Enterprise Zone (Autumn Statement, 25/11/2015)

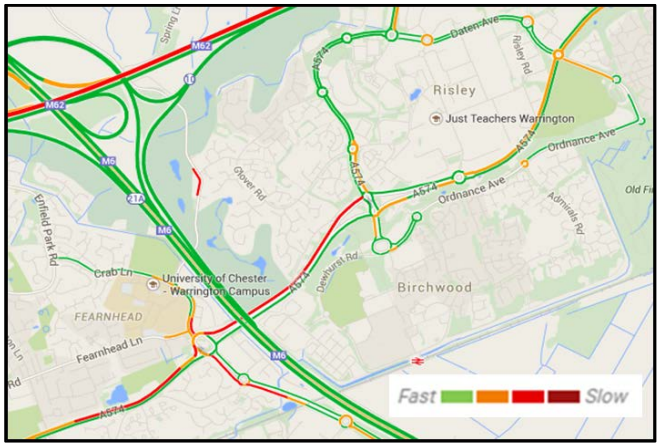

Oakwood Gate

New bus link at Faraday Street

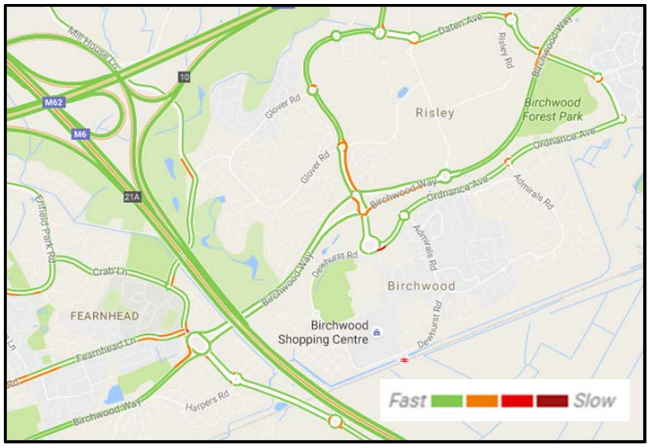

Moss Gate

Detailed traffic impacts 2015 to 2016

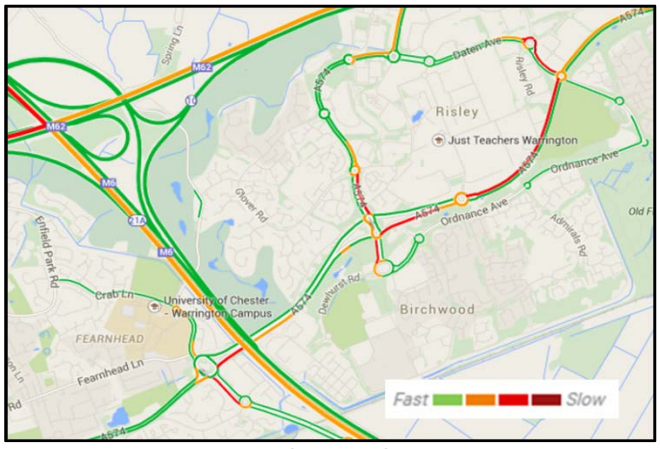
- No significant change in traffic levels along Birchwood Way from west of College Place roundabout to east of Moss Gate. The average daily 12 hour two way flow (Mon to Fri) in 2016 is 28,600 vehicles.
- 5 minutes savings in AM peak eastbound along Birchwood Way corridor with largest savings at Oakwood Gate
- 5 minutes savings in PM peak eastbound along Birchwood Way corridor with the largest savings at Oakwood Gate
- 2minute savings in PM peak westbound along Birchwood Way corridor with the largest savings at Oakwood Gate
- 9 minute savings in PM peak eastbound from Daten Avenue into Birchwood Way
- Reduction in traffic levels on local roads including Moss Gate (15%) and Ordnance Avenue (12%).



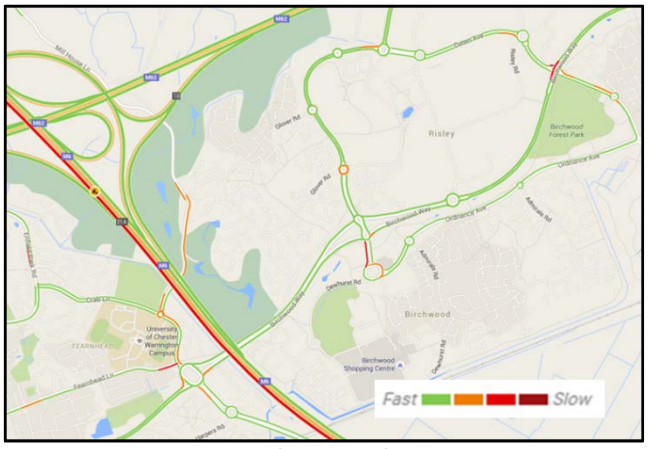
AM peak pre scheme



AM peak post scheme



PM peak pre scheme



PM peak post scheme

Economic summary

2010 prices/values	**Moss Gate**	**Oakwood Gate**	**New Bus Link**	**All Schemes**
Scheme Costs (£000s)	2,577	478	550	3,606
Scheme Benefits (£000s)	12,374	16,845	1,379	30,598
Benefit to Cost Ratio (BCR)	4.80	35.22	2.51	**8.49**

Project Accreditations

- The project achieved 42/50 from the Considerate Constructors Scheme which included a 9/10 for 'Respecting the Community'.
- Balfour Beatty received the Social Values Award for the Birchwood Pinchpoint project at the 2016 CECA NW Awards
- A successful launch of the project on 24th June 2016 featuring representatives from the delivery team, Cheshire and Warrington LEP and Patrizia PLC, the owners of Birchwood Park.
- Strong endorsements from local businesses:

> *"We're already receiving excellent feedback from occupiers and visitors about the completed Birchwood Pinch-Point improvements … An integral part of Birchwood Park's appeal is its connectivity and its convenience for the staff that work here."*
>
> **Jonathan Walsh, Birchwood Park Director**

Public Affairs

An important part of the scheme is the need to ensure good relations with the public and stakeholders.

- Installation of three large information signs on site advising on the forthcoming works and where to find more information
- A project specific website was created in order to keep the public informed of progress on the scheme: www.warrington.gov.uk/birchwoodpinchpoint
- Community newsletters, talks to local schools and local employers by the Balfour Beatty Community Engagement officer.
- Site office located in the car park of the local park which allowed easy access by the public with any issues on the construction process.
- Regular press releases issued during and after the construction process to inform the public

Lessons learnt

- Signing up to the Scape public sector procurement framework has been a success and allowed an early start to meet LEP funding deadlines.
- The early involvement of contractor was very useful as it helped to plan the construction programme and develop the traffic management plan.
- The early engagement with utilities allowed for the successful diversion of services and establish good working relationships to be built up.
- The alignment of the construction process with other planned Council highway projects helps to reduce delays and duplication of resources. These include the street lighting replacement programme, highway maintenance, and the speed limit review along Birchwood Way.
- A prominent and regular client and site supervision presence is essential for quality control and dealing with issues.
- An ongoing Communications Plan helped to maintain good public relations and reduce complaints from the public and stakeholders

Appendix 12

WOODLAND TRUST

The Woodland Trust
Kempton Way
Grantham
Lincolnshire
NG31 6LL
01476 581111
woodlandtrust.org.uk

Mr. N. Poole MRICS
Senior Estates Surveyor
Property and Estate Management
Warrington Borough Council Quattro,
Buttermarket Street
Warrington
WA1 2NL

Our Ref: GorseCovertMounds/kew

29th June 2017

Dear Nigel

Further to our email correspondence, I am writing to confirm that the Woodland Trust is willing to enter into an access licence to allow Warrington Borough Council to undertake investigation works on Trust property for the M62 Junction 11 works and to discuss with you the future works which are to take place in due course.

If you have any queries, please do not hesitate to contact me.

Yours Sincerely

Kate Weightman MRICS FAAV
Land & Property Manager
Email: kateweightman@woodlandtrust.org.uk
Tel: 0343 770 5428

Helen Jones MP

HOUSE OF COMMONS
LONDON SW1A 0AA

Steve Hunter
Transport for Warrington - Service Manager
Warrington Borough Council
New Town House
Buttermarket Street
Warrington
WA1 2NH

28 June 2017

Dear Mr Hunter

NATIONAL PRODUCTIVITY INVESTMENT FUND BID - Warrington East Phase 3

I would like to take this opportunity to provide written support for the proposed package of the signalisation of M62 Junction 11 and dualling of the northern section of Birchwood Way to receive funding from the Department for Transport's National Productivity Investment Fund.

I believe the package of improvements will be of great benefit to journeys being made between the M62 and the Warrington East area including trips to the employment sites of Birchwood Park, Birchwood Boulevard and Woolston Grange. I am keen to support these improvements which would greatly improve network reliability along this corridor by removing peak hour traffic congestion and improving highway safety.

I fully endorse the proposals and wish you every success with your application for funding.

Yours sincerely

H.M. Jones

Helen Jones MP

Constituency Office
Tel: 01925 232480
E-mail: jonesh@parliament.uk
Twitter: @HelenJonesMP
Facebook: Helen Jones MP

From: Mike Sinnott
Asset Development
Operations (Northwest)
Highways England
Piccadilly Gate
Store Street
Manchester M1 2WD

GTN: 0300 470 6015

Our ref:
Your ref:

cc:

30 June 2017

Dear John,

Re: NPIF, Birchwood A574 and M62 J11

Thank you for writing to me with your outline plans, and proposed bid for funding through the National Productivity Investment Fund (NPIF), for alterations to M62 Junction 11 and extended merge lane on the A574 Birchwood Way.

I can confirm that Highways England is supportive of Warrington Borough Council's proposal to bid for NPIF to deliver this scheme.

We are supportive of the proposed alterations at Junction 11, as set out in your e-mail to me of 23rd June 2017. Implementing two lanes on the slip roads will enhance the capacity of the slip roads, bringing safety and congestion benefits to the Strategic Road Network, and installing traffic signals will help both highway authorities to manage traffic more effectively.

We are also supportive in principle of your proposal to deliver this in an integrated way with our Smart Motorways scheme, M62 J10 – J12. We will, of course, work with you to ensure the two scheme designs are complementary and operate effectively together, but we will need to understand the detailed design and programme timetable of the NPIF scheme before we can commit to coordinating construction of the two schemes. This does not affect our support for your proposed bid to NPIF.

Regards,

Mike Sinnott