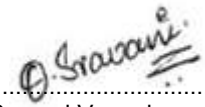
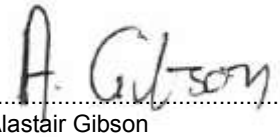
Minworth Roundabout – Option Development and Appraisal Report

Final Report

Prepared by:		Checked by:	
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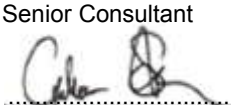
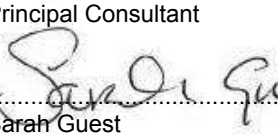
Verified by:		Approved by:	
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Capabilities on project:
Transportation

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Construction (Design and Management) Notes

1. A high pressure oil pipeline operating at 1400psi passes close to the south side of Minworth roundabout. A six metre “safety zone” has been installed around the pipelines. No works of any kind should be undertaken without prior permission from Fisher German LLP. Prior to the works commencing Mr Richard Gent should be contacted on 0845 4378293.

2. Three 500mm 32 kVA High Voltage power cables at 1.44 metre depth pass directly through the junction. No works should be undertaken without contacting and requesting permission from Western Power Distribution.

3. A National Grid gas main runs to the south and east of the junction. It is not considered that the works will not affect this utility.

4. It has been identified that this area has an enhanced risk of discovering unexploded ordnance near to the site. Appropriate measures should therefore be taken.

5. A stream is located to the north perimeter of the site and should be considered before the construction phase

6. Pedestrian provision will need to be managed during the construction phase. The base provision of the junction is poor.

1 Introduction

1 Introduction

1.1 Overview

This report details the options tested for the A38/A4097 Minworth roundabout in Birmingham to accommodate the growth projected by strategic modelling of a 2031 future year scenario.

1.2 Background

The Birmingham Development Plan (BDP) sets out the statutory planning framework that will guide development and regeneration in the period to 2031. It is anticipated that by 2031 Birmingham's population will grow by 150,000. The BDP is being formally consulted on during early 2014 and proposes to release green belt land in the north of the city, specifically in the Sutton Coldfield and Walmley areas, to accommodate around 6,000 residential dwellings and up to 80 hectares of new employment land (which we understand is known as the Peddimore development). In this context a transport infrastructure plan is being developed to consider necessary interventions to facilitate such development.

Birmingham City Council (BCC) has commissioned AECOM to develop and appraise options for improving and increasing capacity at the A38/A4097 Minworth roundabout, to accommodate this development and to recommend a preferred option.

1.3 Study Objectives

The objectives of this study are to develop improvement options including, but not limited to, additional lanes and slips, signalisation or a hamburger arrangement at the Minworth roundabout. A preferred option should be recommended, supported by traffic modelling, preliminary drawings, costings and key proposal benefits and risks.

Minworth roundabout is illustrated in **Figure 1.1** and comprises of the following five arms;

- A – A38 North;
- B – Lindridge Drive;
- C – A4097 Kingsbury Road;
- D - A38 South;
- E – Walmley Ash Road.

Figure 1.1 Minworth Roundabout

Capabilities on project:
Transportation

1.4 Option Development and Appraisal Report

This report outlines the methodology adopted to produce a validated 2013 base model and also option models of Minworth roundabout. Following on from this introduction, the report is set out as follows:

- **Chapter 2** outlines the Observed Conditions;
- **Chapter 3** details the Base Model;
- **Chapter 4** details the Future Year Model results for the existing layout;
- **Chapter 5** outlines Option Development;
- **Chapter 6** provides the Summary and Recommendation.

2 Observed Conditions

2 Observed Conditions

2.1 Traffic Surveys

In order to create the base models of Minworth roundabout, traffic surveys were provided by BCC. The traffic surveys were undertaken on 19th November 2013 by PCC Traffic Information Consultancy for a period 07:00 to 10:00 and 16:00 to 19:00 at the Minworth roundabout, collecting the following information:

- Manual Classified Counts (MCC)
- Queue Length Survey

2.2 Analysis of Observed Data

To verify the suitability of the observed data, a sense check was undertaken to identify any potential issues which could have led to problems validating the base model.

2.2.1 Manual Classified Counts (MCC)

A sense check was carried out on the spreadsheets provided by PCC to ensure that they were correct in terms of formulae used and totals given. No independent data such as Automatic Traffic Counts are available. Therefore no checks were made against the MCC data itself, in terms of whether it represents typical flow conditions at the junction.

The strategic model peak hour flows were compared to the actual peak flows derived from the traffic counts and the strategic model flows were found to be around 4% lower. Therefore base modelling has been undertaken using the actual peak period flows as identified above, which represents worst case scenario.

2.2.2 Peak Determination

Once the MCC data had been reviewed, the AM and PM peak periods were determined based on the MCC data. From the MCC data it was found that the overall peak hours were as follows:

- AM peak: 07:30 to 08:30;
- PM peak: 17:00 to 18:00.

The MCC data was then compared with strategic model flows provided by BCC for the 2013 base year scenario. This identified that the peak hour flows in the strategic model are the standard peak hours 08:00 to 09:00 and 17:00 to 18:00.

2.2.3 Queue Length Survey

Checks were made to ensure that all lanes had been included, and that the formulae and average calculations were correct. Average queues observed for the peak hours are provided in **Table 1** and **Table 2** below.

Time (07:30-08:30)	A38 (N)		Lindridge Drive		Kingsbury Road		A38 (S)		Walmley Ash Road	
	Lane 1	Lane 2	Lane 1	Lane 2	Lane 1	Lane 2	Lane 1	Lane 2	Lane 1	Lane 2
Average Queues (m)	13	7	3	0	19	3	4	3	7	3
Average queues for arm (m)	10		1		11		4		5	

Table 1: AM peak average queue lengths

Time (17:00-18:00)	A38 (N)		Lindridge Drive		Kingsbury Road		A38 (S)		Walmley Ash Road	
	Lane 1	Lane 2	Lane 1	Lane 2	Lane 1	Lane 2	Lane 1	Lane 2	Lane 1	Lane 2
Average Queues (m)	7	2	1	0	16	3	10	2	10	3
Average queues for arm (m)	4		1		9		6		6	

Table 2: PM peak average queue lengths

No independent queue counts are available to verify the queue data provided by PCC. However, queue data has been compared against site visit observations which are detailed below.

2.3 Site observations

AECOM undertook an AM peak site visit on 14th January 2014, to help understand traffic behaviour at the junction. It was observed that A38 North approach had severe queues. This is shown in **Figure 2.1** below. Several journeys along the A38 North approach were undertaken in the peak hour in order to derive an estimate of the average length of the queue. From these observations it was estimated that the average peak hour queue on this approach was 200 pcus and that at the end of the peak 250 pcus were prevented from entering the junction.

Figure 2.1: Queues along A38 North approach

Queuing traffic is not usually accounted for in a MCC, as only traffic crossing the stop/give way line is counted. Therefore suppressed demand of around 250 vehicles was assumed from this approach and included in the further modelling.

The queues observed on the site visit were compared with the PCC queue survey data and this analysis is tabulated in **Table 3** below.

Time	A38 (N)	Lindridge Drive	Kingsbury Road	A38 (S)	Walmley Ash Road
Average queues from survey data (19/11/13)	10	1	11	4	5
Average queues from Site Visit (14/01/14)	200	1	10	4	5

Table 3: Queue length comparison survey data and site visit

Table 3 shows that the PCC queue survey data does not match the observed queues from the site visit on the A38 North approach. It is unclear whether the queue survey data represents typical conditions on the network. However, in discussions with BCC it was suggested that the queuing observed on AECOM's site visit is a common occurrence. Therefore, for validation purposes, the site visit observed queues were used. This represents a worst case scenario.

2.4 Downstream Junctions

In addition to reviewing Minworth Roundabout, a brief observation of the downstream junctions on the A38 was undertaken. This highlighted queuing in both directions in the AM and PM peak at the Tyburn Roundabout and also peak time queues on the approaches to the Norton Crossroads. This queuing suggests that these junctions are at capacity, despite the suppression of demand in the corridor caused by the lack of capacity at the Minworth Roundabout. Any additional traffic released onto the A38 at peak times, by improvements at Minworth, will add to the queuing at these junctions unless complementary improvements at other junctions along the corridor are undertaken.

2.5 Statutory Undertakers Equipment

AECOM have requested statutory information from various companies to determine what buried or aerial equipment is present in the area around the junction. This has been collated as detailed in **Table 4** in the next section, and the relevant drawings have been appended in **Appendix A**.

Statutory undertaker equipment in the vicinity of Minworth was requested via LinsearchbeforeUdig.co.uk and direct contact with any undertakers that do not subscribe to this service. The responses to these queries are summarised below in **Table 4**. It should be noted that at the time of issuing this report there were a number of outstanding responses, which are detailed at the end of Table 4 therefore these remain a risk to the project.

Company	Apparatus at Location	Date Received	Comments
Mainline Pipelines Limited	Yes	14th January 2014.	A location plan of Minworth roundabout has been provided, along with a letter of guidance, safety warnings and method. A high pressure pipeline operating at 1400psi passes close to the south side of Minworth roundabout and crosses under the A38 Kingsbury Road and A4097.
Western Power Distribution	Yes		Layout plan of Minworth roundabout showing the underground live electrical cables around the site, a letter and general guideline document explaining the site layout of live cables, Emergency Contact information and Health and Safety warning. Three buried 132kv Western Power Distribution power lines passing through the central island of the Minworth roundabout and also in the vicinity of the approaches for Lindridge Drive and A38 South approach
National Grid Gas Distribution	Yes	30th Jan 2014	The National Grid apparatus that has been identified as being in the vicinity of Minworth Roundabout is: Low or medium pressure gas pipes and associated equipment, Electricity transmission underground cables and associated equipment, above ground gas sites and equipment. Site maps included of apparatus location in work area.
Virgin Media	Yes	17th Apr 2014	Via BCC (Atkins). Virgin cables on all arms of junction, trunk route appears to run along A38.
Vodafone	Yes	17th Apr 2014	Via BCC (Atkins). Vodaphone confirm Other Licensed operator on A38 (likely to be Virgin Media)
Severn Trent Water	Yes	25th June 2014	Via BCC (Atkins). 6in Cast Iron Water Main runs along southern kerb of central island from Walmley Ash Rd to Lindridge Drive
Severn Trent Sewers	Yes	25th June 2014	Via BCC (Atkins) Trunk Surface Water concrete gravity sewer 525mm dia crosses the central island from Walmley Ash Rd to Kingsbury Road.
BT	Yes	17th Apr 2014	Via BCC (Atkins) BT cables on southern verge of Kingsbury Road, crosses A38 (S) arms and Walmley Ash Road in verge.
AWE Pipeline	No		No further action was required.
BOC Limited (A Member of the Linde Group)			
BP Midstream Pipelines			
BPA			
Centrica Energy			
Centrica Storage Ltd			

ConocoPhillips (UK) Ltd			
Coryton Energy Co Ltd (Gas Pipeline)			
EirGrid			
Electricity North West Limited			
E-on UK Plc (Gas Pipelines Only)			
ESP Utilities Group			
ESSAR			
Esso Petroleum Company Limited			
FibreSpeed Limited			
Gamma			
Geo Networks Limited			
Government Pipelines & Storage System			
Humbly Grove Energy			
HV Cables	No	14th January 2014	No further action was required.
IGas Energy			
Ineos Enterprises Limited			
INEOS Manufacturing (Scotland and TSEP)			
Lark Energy Manchester			
Manchester Jetline Limited			
Marchwood Power Ltd (Gas Pipeline)			
National Grid Gas and National Grid Electricity Transmission			
NPower CHP Pipelines			
Oikos Storage Limited			
Perenco UK Limited (Purbeck Southampton Pipeline)			
Phillips 66			
Premier Transmission Ltd (SNIP)			
RWEnpower (Little Barford and South Haven			
SABIC UK			
Scottish Power Generation			
Sea Fibre Networks			

Seabank Power Ltd			
Shell Pipelines			
Spiecapag UK Limited (Carrington)			
Total (Finaline, Colnbrook & Colwick Pipelines)			
Transmission Capital			
Wingas Storage UK Ltd			
York Potash			
Colt	No	24th Jan 2014	No further action was required.
Energetics Electricity	No	24th Jan 2014	
Fulcrum	No	29th Jan 2014	
Instalcom	No	17th Jan 2014	No further action was required.
Interoute	No	16th Jan 2014	
Utilicom Limited	No	20th Jan 2014	
Verizon Business	No	27th Jan 2014	
South Staffs Water	No	17th April 2014	Via Bcc (Atkins) No Further Action required.
GTC	No	17th April 2014	Via BCC (Atkins) No further action required
McNicholas	No	30th April 2014	Via BCC (Atkins) No further action required
Teliasonera			Awaiting feedback
BskyB Telecommunications	No	30th April 2014	Via BCC (Atkins) No further action required
Vtesse Networks			Required to register and submit enquiry to company processing portal which has a processing fee. Therefore AECOM have not undertaken any further enquiries.

Table 4: Record of Statutory Undertakers responses

From the enquiries it is understood that the following equipment is in the vicinity of the junction:

- Three buried 132kv Western Power Distribution power lines passing through the central island of the Minworth roundabout and also in the vicinity of the approaches for Lindridge Drive and A38 South approach. C3 enquires will be required to establish the costs of protecting these cables as part of any scheme taken forward in the future.
- A gas main running to the south and east of the junction, broadly along the line of the canal. It is not considered likely that this equipment will be affected.

- A Mainline Pipelines Ltd high pressure pipeline operating at 1400psi passes close to the south side of Minworth roundabout and crosses under the A38 Kingsbury Road and A4097. C3 enquires will be required to establish the costs of protecting this pipeline as part of any scheme taken forward in the future.
- Virgin Media have a trunk cable which runs along the A38, there are also local feeds on all arms of the junction, which may be impacted by the widening. C3 enquires will be required to establish the costs of protecting these cables as part of any scheme taken forward in the future.
- Severn Trent Water has a 6in Cast Iron water main which follows the southern kerb line of the central island; this will require diversion/protection as part of the central island widening works. C3 enquires will be required to establish the costs of protecting/diverting this water main as part of any scheme taken forward in the future.
- Severn Trent Sewers have a 525mm diameter trunk surface water gravity sewer, which crosses the central island between Walmley Ash Road and Kingsbury Road, depending on its depth this is likely to require protection as part of the central island widening works. C3 enquires will be required to establish the costs of protecting this sewer as part of any scheme taken forward in the future.
- BT has cables which may be impacted by the works. C3 enquires will be required to establish the costs of protecting/diverting these as part of any scheme taken forward in the future.

3 Base Model

3 Base Model

3.1 Approach Overview

A base model has been built using ARCADY 6 software and validated against site observations to represent the current operation of the Minworth roundabout. This will allow improvement options to be evaluated against a 'Do nothing' future year scenario.

3.2 Model Inputs

The geometric parameters used in the ARCADY model were measured using AutoCAD and Ordnance Survey Mastermap Topographic mapping. MCC data has been used to prepare the Origin and Destination matrix to be entered into the ARCADY model. Heavy Goods Vehicles (HGV) proportions were calculated using MCC data and the percentage of HGVs was entered in ARCADY for both peaks.

The inputs used in the ARCADY model are provided in **Appendix B.**

3.3 Base Model Results

The model was run and the capacity and queue results from the model for both peaks are detailed below in **Table 5.** Full base model outputs for both peaks are in **Appendix C.**

Results		2013 AM		2013 PM	
Arms	Approach	RFC*	Queues	RFC*	Queues
A	A38 N	1.119	82	0.559	1
B	Lindridge Drive	0.333	1	0.058	0
C	A4097 Kingsbury Road	0.843	5	0.769	3
D	A38 South	0.416	1	0.834	5
E	Walmley Ash Road	0.791	4	0.761	3

**Note: RFC is Ratio of Flow to Capacity*

Table 5: 2013 Base Model Results

The results show that the junction operates at capacity in the AM peak and within capacity in the PM peak. This correlates with observations that junction operation is worst in the AM peak.

3.4 Model Validation

The modelled queues were compared with the observed queues to check for validation for both the AM and PM peak models.

3.4.1 AM Peak

The results from the observed and modelled queues for AM peak are in **Table 6** below.

Time (07:30-08:30)	A38 (N)	Lindridge Drive	A4097 Kingsbury Road	A38 (S)	Walmley Ash Road
Average queues from survey data (19/11/13)	10	1	11	4	5
Average queues from Site Visit (14/01/14)	200	1	10	4	5
Modelled Queues	82	1	5	1	4

Table 6: Comparison of 2013 AM Peak Modelled and Observed queues

Table 6 indicates that the model does not represent the severe queues on the A38 N approach to the roundabout as observed during the site visit but results in a queue of around 50% of this length. In addition the queues recorded by PCC are very low compared to modelled queues. Therefore a site intercept correction was applied to this arm to represent the queues on the existing network. The intercept correction used is -4veh/min.

Queues on the A4097 Kingsbury Road are also not representative of the observed queues from the site visit observations and the PCC queue survey data. It is observed that along this approach, there is unequal lane usage which can be seen from site visit observations photographs as in **Figure 3.1** below.

Figure 3.1: Unequal lane usage along A4097 Kingsbury Road

Therefore site intercept corrections were applied to A4097 Kingsbury Road approach to represent unequal lane usage and queues on this arm. The intercept correction used is also -4veh/min.

The revised AM peak model capacity and queues results with intercept corrections are in **Table 7**.

Results		2013 AM – with Correction factor		2013 PM – with Correction factor	
Arms	Approach	RFC*	Queues	RFC*	Queues
A	A38 N	1.367	196	0.659	2
B	Lindridge Drive	0.263	0	0.058	0
C	A4097 Kingsbury Road	0.93	10	0.909	9
D	A38 South	0.405	1	0.832	5
E	Walmley Ash Road	0.791	4	0.760	3

**Note: RFC is Ratio of Flow to Capacity*

Table 7: 2013 AM and PM Peak Site Intercept Corrections - Base Model Results

The results from the observed and modelled queues for AM peak with site intercept corrections are in **Table 8** below.

Time (07:30-08:30)	A38 (N)	Lindridge Drive	A4097 Kingsbury Road	A38 (S)	Walmley Ash Road
Average queues from survey data (19/11/13)	10	1	11	4	5
Average queues from Site Visit (14/01/14)	200	1	10	4	5
Modelled Queues	82	1	5	1	4
Modelled Queues with intercept correction	196	0	10	1	4

Table 8: Comparison of 2013 AM Peak Modelled and Observed queues

Following the addition of site intercept corrections, the model replicates the queues on the existing network. It is considered a reasonable tool which can be used for comparison of results with the option models for the future year flows. Therefore the base model has been used to estimate capacity at the junction with the 2031 future year flows.

3.4.2 PM Peak

The results from the observed and modelled queues for PM peak are in **Table 9** below.

Time (17:00-18:00)	A38 (N)	Lindridge Drive	A4097 Kingsbury Road	A38 (S)	Walmley Ash Road
Average queues from survey data (19/11/13)	4	1	9	6	6
Modelled Queues	2	0	9	5	3

Table 9: 2013 PM Peak Base Model Results

Although the results indicate that the modelled queues are lower than observed queues there are no independent observations in the PM peak. Therefore no correction has been made to the PM peak model and it has been used to estimate capacity at the junction with the 2031 future year flows.

4 Future Year Model

4 Future Year Model Results

4.1 Introduction

This section describes the modelling results for the 2031 future year flow test for the A38/A4097 Minworth roundabout for the existing network.

4.2 Development Scenarios

BCC have provided two scenarios for development flows and these are explained below:

Scenario 1: Access to the Peddimore development via the A4097 Kingsbury Road to the south and the A38 to the west.

Scenario 2: Access to the Peddimore development via the A38 to the west only.

AECOM have briefly reviewed the two scenarios and understand that Scenario 2 reflects the worst case scenario for future year modelling. Therefore further modelling has only been undertaken using Scenario 2 flows.

4.3 2031 Future Year Flows

AECOM have calculated 2031 future year flows by adding the development flows for Scenario 2 to the 2013 base year peak hour flows. The following assumptions have been made:

- It is assumed that all the development flows are in PCUs as BCC advised that the future year flows are from the PRISM strategic model.
- For modelling purposes it has been assumed that the HGV percentages for the future year are the same as in the base year.
- It has been assumed that it is appropriate to add together the AM Peak Hour flows (07:30-08:30) with the AM Peak Strategic Model Development flows (08:00-09:00) to derive the future year peak hour flows.
- It should be noted that no growth assumptions have been made for the future year flows.

The resulting 2031 future year flows used for further modelling are in **Appendix D**.

4.4 2031 Future Model Results

The ARCADY model has been run with the 2031 future year flows and the results from the model are reported in **Table 10** below. The full model input and output report can be found in **Appendix E.**

Results		2031 AM		2031 PM	
Arms	Approach	RFC	Queues	RFC	Queues
A	A38 N	1.936	1343	1.456	465
B	Lindridge Drive	0.17	0	0.068	0
C	A4097 Kingsbury Road	1.229	140	1.24	163
D	A38 South	1.104	89	1.328	309
E	Walmley Ash Road	1.619	365	0.931	10

Table 10: 2031 Future Year Model Results

The results from the model indicate that the junction would operate with severe queues on most of the approaches and would be unable to accommodate any development traffic in either peak. Therefore improvements are required.

5 Option Development

5 Option Development

5.1 Introduction

This section describes the various options considered for the A38/A4097 Minworth roundabout as mitigation measures.

5.2 Options Developed

AECOM have considered the following options for Minworth roundabout:

5.2.1 Option 1

Option 1 is partial signalisation (A38 North, A4097 Kingsbury Road and A38 South) of the Minworth roundabout, retaining the existing layout without any widening of the approaches or circulatory. When developing lane allocation diagrams (part of the preparation for building a TRANSYT model for this option), it became apparent that lane flows on the A38 North circulatory would be in excess of 1,500 pcu/hr. It is our view that for a signalised node in TRANSYT, should have the critical lane flow at each lane should be less than 1,500 pcu/hr if there is to be a reasonable chance of converging on a solution. Therefore this option has been discounted.

5.2.2 Option 2

Option 2 is partial signalisation (A38 North, A4097 Kingsbury Road and A38 South) of the roundabout with a hamburger type cut through from A38 North to A38 South (one way only) in the central island of the roundabout. AECOM have requested plans of statutory undertakers' equipment at the roundabout and Western Power Distribution has advised that three buried 132kV cables run through the junction. Plans of the equipment (included at **Appendix A**) shows that these cables pass through the central island of the roundabout.

Any improvements through the centre of the roundabout would require protection or relocation of these cables, at potentially significant cost. In light of these anticipated costs, the option of a hamburger arrangement has discounted, assuming an alternative viable alternative option can be found.

5.2.3 Option 3

Option 3 is partial signalisation of the Minworth roundabout with widening on two approaches (A38 North and A4097 Kingsbury Road) and on the adjacent circulatory to provide three lanes. The A38 North, A4097 Kingsbury Road and A38 South approaches are to be signalised, with the dedicated left turn lane along the A38 South removed and the approach signalised as a three lane approach.

Initial testing in TRANSYT suggested that there would be severe queues on the circulatory and also on the signalised approaches and exits of the roundabout. Therefore this option has been discounted and a further option has been developed with more extensive widening and flares and merges on the exit of the arms.

5.2.4 Option 4

Option 4 is partial signalisation (A38 North, A4097 Kingsbury Road and A38 South) and the following improvements:

- Widening on the A38 North approach from two lanes to four, each around 100m long. The circulatory adjacent to A38 North is widened to three lanes.
- Widening of the circulatory adjacent to Lindridge Drive to four lanes.
- Widening of the A4097 Kingsbury Road to two lanes, flaring to four lanes at the approach with flares of around 40m and the adjacent circulatory widened to three lanes.
- Removal of the dedicated left turn lane on the A38 South, with the approach signalised as a three lane approach. The adjacent circulatory is also widened to three lanes.
- The exits onto the A38 North and A38 South would be widened to three lanes, merging to two lanes after 100m.
- The exit on the A4097 Kingsbury Road would be modified to relocate the bus stop away from the junction and remove the hatched area, with two lanes merging to a single lane after 100m.
- Addition of a 30m flare on the Walmley Ash Road approach off side lane.

- No changes have been made to the Lindridge Drive approach or exit.
- Toucan crossings are provided on the three signalised arms of the roundabout. In addition, it is recommended that the current pedestrian access from the A38 North arm into the Asda development (**Figure 5)** be upgraded with a bound surface suitable for pedestrians and cyclists.

Figure 5: Existing Access from A38 North arm into the Asda development

A drawing of Option 4 is included in **Appendix F**. The option has been assessed in TRANSYT 14 using the 2031 future year flows. Saturation flows in the model have been based on RR67 calculations, since it is not possible to measure saturation flows at a junction which is not currently signalised and some of the lanes do not exist.

Flows in the model have been balanced using the lane balancing option in TRANSYT. Queue limits have been applied on the circulatory stop lines and delay and stop weightings have been used on the signalised approaches so that queues are predominantly held on the entries.

The 88 second cycle time used in the model is long for a signalised roundabout, but is based on cycle time optimisation (CYOP) analysis. It is likely that the concentration of flows onto a limited number of movements combined with long storage sections between nodes allows the junction to operate successfully at this cycle time. Phase minimums used in signals are seven seconds for traffic and five seconds for pedestrians.

The model has been run and the results indicate that with the doubling of demand to 2031, the roundabout operates within capacity where the highest degree of saturation, of 91%, occurs on the Walmley Ash Road approach. Full model outputs for this option are in **Appendix G**.

The results from the Option 4 TRANSYT model have been compared with the 2031 Future Year, Existing Layout ARCADY model in **Table 11** below.

Results		2031 AM				2031 PM			
		Base Model		Option 4 Model		Base Model		Option 4 Model	
Arms	Approach	RFC	Queues	DOS	MMQ	RFC	Queues	DOS	MMQ
A	A38 N	1.936	1343	0.82	17	1.717	722	0.65	12
B	Lindridge Drive	0.170	0	0.70	2	0.059	0	0.10	0
C	A4097 Kingsbury Road	1.229	140	0.81	16	1.359	262	0.88	19
D	A38 South	1.104	89	0.47	9	1.248	226	0.69	15
E	Walmley Ash Road	1.619	365	0.91	18	0.965	15	0.71	12

Table 11: Comparison of 2031 Future Year Model Results with Existing and Proposed layouts

The results indicate that the proposed option provides a reduction in queuing at the junction, compared with the Do Nothing scenario, and lower degree of saturation results. The comparison of delays for the Do Nothing and Proposed options in **Table 12** also show that overall delay at the junction is reduced.

Delay on the junction	2031 AM		2031 PM	
	Base Model (min/veh)	Option 4 Model (min/pcu)	Base Model (min/veh)	Option 4 Model (min/pcu)
A38/A4097 Minworth roundabout	14.22	0.76	8.04	0.67

Table 12: Comparison of 2031 Future Year Model Results on existing and proposed layout

5.3 Preferred Option

The preferred option considered for Minworth roundabout is Option 4.

Cost estimates for this option have been derived using MCHW series. The estimated cost associated with this improvement option is £3,123,057.23, subject to a number of exclusions and assumptions appropriate to the level of scheme design. Full details of this cost estimate are in **Appendix H**. It should be noted that the cost estimates has the following standard caveats and exclusions:

- Land 3rd Party Land acquisition costs and accommodation works costs
- Dedication of Land, Land to be passed over to the council as highway.
- Legal costs
- Landscaping design
- Statutory Undertakers design fee
- Statutory Undertakers diversion and or protection costs
- Third Party Ground Investigation costs. Trial Pits and Geotechnical surveying will be supplied by third parties
- Traffic Regulation Orders & any associated TRO consultation
- Contract documentation for appointment of the preferred contractor, as this is being progressed by others.
- Tendering of the works

6 Summary & Recommendation

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6.1 Summary

This study has reviewed the existing operation of the A38/A4097 Minworth roundabout, with a view to developing a preferred scheme to support the traffic generation arising from the proposed Peddimore development to 2031.

A 2013 base model for the junction has been built and updated with site intercept corrections to reflect the current operation of the junction as observed on site. Currently, the junction operates at capacity with severe queues on the A38 North approach in the AM peak.

As an output of strategic modelling, 2031 future year development scenario has been developed. These flows have been used to develop a 2031 Do Nothing Future Year Scenario. The results of this model suggest that the junction would be operating at almost double its capacity, with unacceptable levels of queuing.

AECOM have considered various options for improving the junction to accommodate an increase in traffic through to 2031. Two of these options did not provide sufficient capacity, whilst a third (a Hamburger Type junction) was ruled out based on the likely cost of providing protection to statutory undertaker's equipment in the centre of the junction.

A fourth option has been developed, based on widening of approaches and the circulatory and partial signalisation, which operates just within capacity with the forecast 2031 flows. This option has an estimated cost in the region of £3.13 million, plus additional costs for items excluded from this estimate.

A preliminary drawing for the proposed preferred option and the initial cost estimate for this Option are undertaken and presented in the appendices.

6.2 Project Risks

A risk register has been included in **Appendix I**. The most significant risks associated with the scheme related to the Statutory undertakers equipment identified in the vicinity of the improvements, whilst we do not anticipate the scheme to have a significant impact on the equipment itself, this nationally important infrastructure will required careful protection during the works and therefore carries, health and safety, cost and programme risks until further information can be gathered. We recommend that the C3 process is started as soon as possible in order to reduce these risks to a known quantity.

Other risks will become known and quantifiable as the design progresses to a more detailed stage.

6.3 Recommendation

AECOM recommend that Option 4 is developed as the preferred option. Modelling suggests that this option will accommodate all of the proposed growth, and will also accommodate the existing suppressed demand at 2031, whilst operating within capacity.

The option presents a significant increase in capacity at the junction, which must also be matched by increases in capacity at the downstream junctions on the A38 if the benefits of the scheme are to be fully realised. In light of this, it is recommended that similar assessments are undertaken for the Tyburn Roundabout and the Norton Crossroads, which already operate at capacity in the peak periods.