

Warwickshire County Council
**Stratford-on-Avon Strategic
Transport Assessment**
Stratford (Canal Quarter)
Regeneration Zone Scenario
Analysis

232815-07.R001

Issue | November 2013

This report takes into account the particular instructions and requirements of our client.

It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

Job number 232815-07

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Contents

	Page
1 Introduction	1
1.1 Overview	1
1.2 Scope	1
1.3 Study Objectives	1
1.4 Study Area	1
2 Assessment Scenario Development	3
2.1 2028 Reference Case Forecasting	3
2.2 Stratford Regeneration Zone	4
2.3 SRZ Demand Summary	6
2.4 Stratford Transport Package (STP) Scheme Overview	8
2.5 Scenario Assessment	16
2.6 Sensitivity Test Networks	17
3 Results Analysis	18
3.1 Overview	18
3.2 Model Stability	18
3.3 Number of Runs	19
3.4 Network Wide Statistics	19
3.5 Queue Lengths	20
4 2028 Reference Case vs. 2028 + SRZ	22
4.1 Overview	22
4.2 Model Stability	22
4.3 Network Wide Statistics	22
4.4 Average Journey Speed	23
Average Journey Time (Seconds)	24
4.5 Completed Trips	25
4.6 Maximum Queue Length Analysis	26
4.7 Summary	27
5 SRZ STP Plus 01 to Plus 04	28
5.1 Overview	28
5.2 Model Stability	28
5.3 Network Wide Statistics	29
5.4 Average Journey Time (Seconds)	31
5.5 Completed Trips	32
5.6 Maximum Queue Length Analysis	34
5.7 Summary	35

6	Warwick Signage Strategy	36
6.1	Overview	36
6.2	Model Stability	37
6.3	Network Wide Statistics	37
6.4	Average Journey Speed	38
6.5	Average Journey Time (Seconds)	39
6.6	Completed Trips	39
6.7	Maximum Queue Length Analysis	41
6.8	Economic Analysis	42
6.9	Summary	43
7	Revised mode share assumptions	44
7.1	Overview	44
7.2	Model Stability	44
7.3	Network Wide Statistics	44
7.4	Average Journey Time (Seconds)	46
7.5	Summary	48
8	Scheme Review Findings	49
8.1	Scheme Analysis	49
8.2	Outline Scheme Review	49
8.3	Scheme Review Summary	51
8.4	Scheme Assessments	51
8.5	Summary	53
9	Refined Stratford Transport Package Assessment	54
9.1	Overview	54
9.2	Model Stability	54
9.3	Network Wide Statistics	54
9.4	Average Journey Speed	55
9.5	Average Journey Time (Seconds)	56
9.6	Completed Trips	56
9.7	Maximum Queue Length Analysis	58
9.8	Summary	59
10	Phasing	60
10.1	Overview	60
10.2	Initial Phasing Plan	60
11	Summary & Conclusions	62
11.1	Summary	62
11.2	Conclusion	63

Appendices

Appendix A

SDC STA - SRZ/STP Queue Analysis Plots

Appendix B

STP Scheme Drawings

Appendix C

STP/SRZ Review Notes

Appendix D

Scheme Assessment Cordon Locations

1 Introduction

1.1 Overview

Arup have been commissioned by Warwickshire County Council (WCC), and Stratford on Avon District Council (SDC) to undertake strategic level testing and impact analysis of potential SDC Core Strategy allocations

The purpose of this report is to document the specific testing, undertaken within the Stratford-upon-Avon PARAMICS model, of a number of potential developments.

1.2 Scope

This report outlines some initial impact analysis outputs, extracted from the Stratford-upon-Avon PARAMICS model, in relation to the assessment of the allocation of the Stratford Regeneration Zone (SRZ) Allocation Policy as well as the emerging local development framework mitigation strategy known as the Stratford Transport Package.

1.3 Study Objectives

The objectives of this stage of analysis are as follows:

- To understand the potential impacts on the Stratford area, of delivering the SRZ Policy
- To test and optimise the schemes proposed as part of the Stratford Transport Package (STP)
- To identify impacts of Warwick Signage Strategy
- To identify the significance of 15% mode share assumptions.

1.4 Study Area

The focus of the study area is that which is encompassed by the coverage of the Stratford-upon-Avon PARAMICS model. An overview of the coverage of this model is provided within Figure 1 on the following page.

Figure 1 - Study Area and Key Junctions



2 Assessment Scenario Development

2.1 2028 Reference Case Forecasting

During the previous phase of the STA the existing Stratford-upon-Avon 2021 model network was updated to be reflective of the likely network conditions in 2028.

The original update involved amending the 2021 demands to include the new developments. On this occasion the purpose of the update is to reforecast these demands to 2028 levels.

The resultant levels of demand now assigned within the revised 2028 Reference Case model are presented within the following Table 1:

Table 1 – Stratford-upon-Avon Amended Demands

	0700 to 0800	0800 to 0900	1600 to 1700	1700 to 1800
Background	9534	14730	13993	15404
HGV	792	813	825	527
Com Dev.	1241	769	2150	1259
Growth	522	575	531	528
Hourly Demand	12089	16887	17499	17718
Periodic Demand	28976		35217	
2011 Demand	26519		32550	
Growth from 2011(%)	9.27%		8.19%	
TEMPRO Factors	8.57%		9.85%	

The previous table demonstrates that the level of growth assigned within the model is greater than the 2028 levels predicted by TEMPRO in the AM but marginally lower within the PM. However, since these demand levels are going to be exceeded by the addition of sites allocated through the Core Strategy there was little benefit in incorporating the additional, TEMPRO informed, internal growth to simply remove it again during the development of the first Core Strategy test.

Thus, at this stage, the demand levels included within the 2028 Reference Case are considered a robust and reflective basis from which the various CS options can be derived.

2.1.1 Warwick Road Amendments

A few years ago, the direction signposting at the A46/A439 Warwick Road roundabout at Marraway was revised to 'local traffic' in order to encourage greater usage of Stratford Park and Ride at Bishopton.

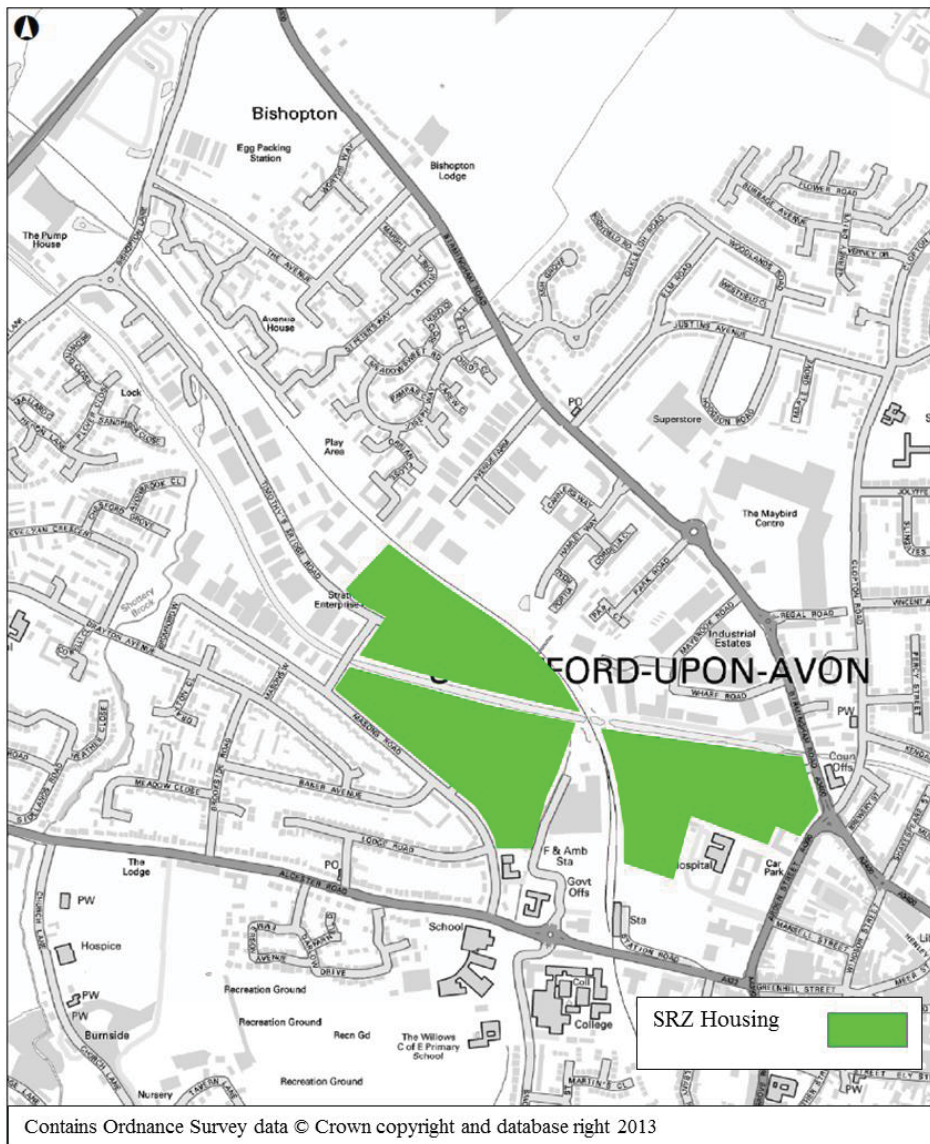
As a result, the A439 Warwick Road was reconfigured to a minor signposted route in PARAMICS between the A46 to the North and the Stratford gyratory to the south to reflect these changes.

2.2 Stratford Regeneration Zone

The first scenario derived from the Stratford-upon-Avon 2028 Reference Case was the 2028 SRZ scenario. It was understood that the SRZ policy was looking to re-allocate land within Stratford-upon-Avon (SuA) for housing and relocate existing and proposed employment from that area to areas which are on the periphery of the existing SuA road network.

The initial assumption for the allocation of housing is that 700 dwellings will be delivered within the areas outlined within the following Figure 2:

Figure 2- SRZ Housing Allocation Areas



In addition to the housing, two areas have been identified as being required to accommodate the re-allocated and proposed employment; these areas (Area 1 and Area 4) have been illustrated within Figure 3.

Figure 3 - SRZ Employment Allocation Areas



The proposed split of employment to be delivered within Area 1 (15 Ha gross) was assumed as follows:

- B1 = 30%
- B2 = 40%
- B8 = 30%

The proposed split of employment to be delivered within Area 4 (10 Ha gross) was assumed to be as follows:

- B1 = 50%
- B2 = 20%
- Sui generis, e.g. car showrooms = 30%

2.3 SRZ Demand Summary

The trip generation figures assigned to the model as a result of the inclusion of the SRZ policy, as well as the net trip generation that these values represent, once the impact of the supplanted trips has been considered, are presented within Table 2 and Table 3 respectively. These trip values are based on the trip rates and development assumptions identified during the Phase 2 STA work¹

Table 2 - SRZ Total Trip Generation

	In	Out	Total
0700 to 0800	417	278	695
0800 to 0900	815	396	1211
1600 to 1700	327	600	927
1700 to 1800	363	754	1117

Table 3 - SRZ Net Trip Generation

	In	Out	Total
0700 to 0800	73	201	274
0800 to 0900	118	294	412
1600 to 1700	215	104	319
1700 to 1800	292	111	403

2.3.1 SRZ Demand Allocation

2.3.2 Peak Spreading

Historically, demands allocated to the Stratford-upon-Avon model have been subject to peak spreading which is informed by the interpolation of existing growth rates by hour into forecast hourly growth rates. The existing growth rates have been derived using observed annual cordon count data that is collected by WCC. A full overview of the process that underpins peak spreading within the modelling is provided within the 2021 Model Update Report².

Since growth in background demands and committed developments have been subjected to peak spreading it appears reasonable that the same assumptions should be applied to the demand allocated within the model as a result of the implementation of the SRZ policy.

¹ 211439-19.R014 Stratford-on-Avon STA: Phase 2 Modelling Report, Arup,, June 2013, Tables 8 to 10.

² MID3176.R001 Stratford-upon-Avon Model Update Report, 2015 & 2021 Scenario Years, JMP Consultants, August 2011

However, the likelihood for peak spreading to occur is dependent upon the premise that vehicles will elect to retime their journeys in response to adverse network conditions present within the period that they would most like to depart.

Since the SuA PARAMICS model only covers 2 hours in both AM and PM time periods it is only possible to consider peak spreading over the same periods. Otherwise, retiming of trips into the ‘post-peak’ hour would simply mean the removal of demand from the model which is an approach which would be difficult to justify.

When reviewing the demand levels within the current 2028 Reference Case, it is difficult to see how further peak spreading could be justified within the PM period. There is very little difference in the magnitude of demand that is being assigned within the model during either the 16:00 to 17:00 or 17:00 to 18:00 hour. Thus, it is unrealistic to assume that trips assigned within the model during the PM Peak hour would choose to retime into the preceding hour when the levels of congestion are likely to be comparable between both hours. If that is the case, it is more likely that the trips will simply depart within the originally intended departure window.

The hourly demand levels, assigned within the 2028 Reference Case, are illustrated within Table 4:

Table 4 - 2028 Reference Case, Demands by Matrix Levels

	0700 to 0800	0800 to 0900	1600 to 1700	1700 to 1800
Background	9534	14730	13993	15404
HGV	792	813	825	527
Com Dev.	1241	769	2150	1259
Growth	522	575	531	528
Hourly Demand	12089	16887	17499	17718

The previous table illustrates the parity in demand levels between the PM pre-peak and peak hours. As a result no additional account of peak spreading has been incorporated when assigning the SRZ demand into the model.

When considering the AM, demands within the 07:00 to 08:00 hour are considerably lower than those within the 08:00 to 09:00 hour. As a result, some account of peak spreading has been incorporated within the assignment of SRZ demand into the model during the AM period

The historic peak spreading proportions that have previously been adopted, during the AM period, are presented within the following Table:

Table 5 – Stratford-upon-Avon Forecast Peak Spreading Proportions AM (07:00 to 09:00)

Period	Proportion
07:00 to 08:00	97%
08:00 to 09:00	7%

If the aforementioned proportions were adopted in entirety this would lead to a substantial reassignment of SRZ demand into the pre-peak hour. In order to reduce this propensity, the process has been applied to only 50% of the predicted

growth in trips. The remaining 50% of the demand is assigned to the model in line with original SRZ trip generation totals.

The initial and adjusted SRZ demand totals that have been adopted within the modelling are summarised within Table 6:

Table 6 - SRZ Modelled Demand Totals

	07:00 to 08:00	08:00 to 09:00	16:00 to 17:00	17:00 to 18:00
Unadjusted*	693	1209	927	1116
Peak Spread*	1233	669	927	1116

*Demand totals vary from initial trip generation values as a result of the rounding process involved in translating trip generation figures into model demands.

2.3.3 Demand Summary

The resultant demand levels assigned within the 2028 Stratford-upon-Avon plus SRZ scenario are outlined within Table 7:

Table 7 - SRZ Model Demand Summary

	07:00 to 08:00	08:00 to 09:00	16:00 to 17:00	17:00 to 18:00
Background	9225	14176	13730	15093
HGV	757	780	797	507
Com Dev.	1758	1040	2751	1628
Growth	522	575	531	528
SRZ	1233	669	927	1116
Total	13495	17240	18736	18872
Periodic	30735		37607	
Growth	15.90%		15.54%	

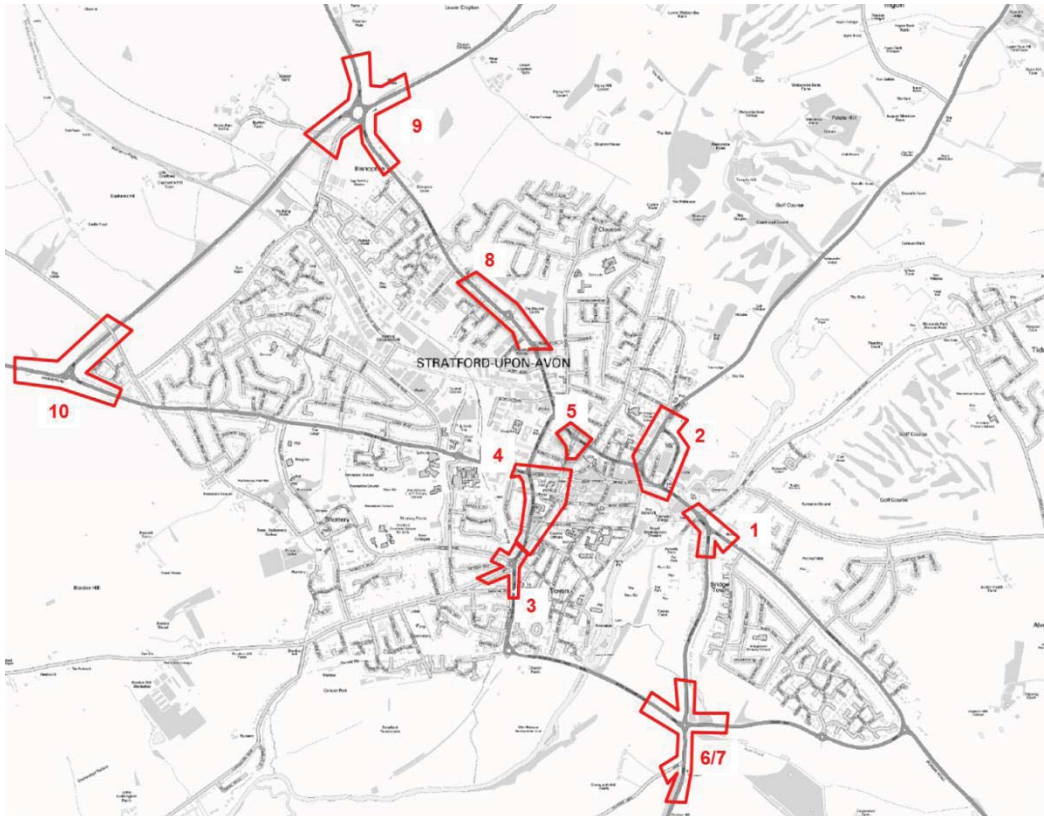
During previous stages of the STA, the application of the cap to the levels of growth within the model was based on NTEM Adjusted TEMPRO factor for Stratford-upon-Avon. The AM and PM NTEM adjusted factors currently stand at **17.5%** and **18.9%** respectively and, thus, it was not felt necessary to redistribute any of the demands within the current round of assessment.

2.4 Stratford Transport Package (STP) Scheme Overview

During previous stages of the Stratford on Avon Strategic Transport Assessment (STA) ten schemes were identified as being likely to mitigate the impacts of Core Strategy and general growth as well as addressing issues which act to constrain the movement of traffic across the network.

An overview of the extent of the schemes proposed during the initial stages of the assessment is provided within Figure 4..

Figure 4 - Scheme Locations



An overview of each of these schemes is outlined as follows:

2.4.1 Scheme 01 - Tiddington Road/Banbury Road 'Alveston Manor' Junction

Issues

Large queues are observed to form along the Banbury Road NB approach to the Banbury Road/Shipston Road roundabout during both AM and PM periods. Similarly, large queues are observed along Tiddington Road within the same period.

The queuing issues are compounded by the restriction of the right turn from Tiddington Road SB to Clopton Bridge NB, vehicles instead have to turn left and then complete a U-turn at the Shipston Road/Banbury Road roundabout which exacerbates the queuing in this area. Within the Reference Case vehicles have been observed using Loxely Road/Tiddington Road as a means of by-passing the large queue along the Banbury Road NB.

Delivery of a scheme at the Clifford Lane/Seven Meadows Road junctions (Schemes 06 and 07 discussed later in this section) will unlock a substantial amount of capacity which will, in turn, increase the traffic volumes in this area.

Scheme Principles

Proposals involve reconfiguration of the existing priority junction into a signalised junction. The layout will be reconfigured to allow traffic to turn right from Tiddington Road as currently traffic has to turn left and then complete a U-turn

manoeuvre at the Shipston Road / Banbury Road roundabout to travel NB along Clopton Bridge. Left turning traffic from Tiddington Road is provided with a merge facility to join Banbury Rd EB/SB. The right turn from Bridge Foot into Swans Nest Lane is still barred so a U-turn at the roundabout is required to complete this movement. Traffic turning left into Swans Nest Lane and the Recreation Ground car park can do so via a segregated slip which negates the need for vehicles to wait at the signals. Traffic exiting Swans Nest Lane is provided green time via vehicle actuated control within the AM. The precise nature of this arrangement within the PM is still to be determined as the stage is likely to need to be called every cycle.

Key risks

There is a history of schemes being proposed within this area that have not since been taken forward. These proposals have been applied without prejudice to the previous schemes but there is a significant risk of a barrier to delivery being identified at an early stage. Furthermore, there are potential risks regarding the location of the signal heads in relation to Clopton Bridge which is a Scheduled Ancient monument which may mean the scheme cannot be delivered on safety grounds. Consideration may also need to be given to the nearby Gazebo which is a Grade II listed building and the need to manage periods of peak visitor demands during summer months when a significant number of vehicles require egress from the Recreation Ground Car Park via Swan's Nest Lane

Scheme Status – This was assumed within the testing and will be promoted as part of the Stratford Transport Package.

2.4.2 Scheme 02 – Bridgefoot/Bridgeway Stratford Gyratory

Issues

Currently there are issues entering into the gyratory from Bridgefoot/Clopton Bridge NB. Similarly there are issues entering the gyratory from Bridge Street. In the case of Bridgefoot the pedestrian crossings act as a signal control mechanism and create the necessary gaps for traffic to enter onto the gyratory. In the case of Bridge Street the existing pedestrian crossing can inhibit the entry of vehicles onto the gyratory and reduce the entry capacity.

The gyratory is already a heavily trafficked area and it is likely that this will continue to be the case meaning that as traffic volumes around Stratford upon Avon grow these problems are likely to be exacerbated. Furthermore, the gyratory is in a central location and it is likely that as capacity constraints are minimised in other areas the flow of traffic through the town will converge in this area and, without a formal means of controlling the traffic movements within the gyratory, it will be difficult to maintain vehicular movements across the junction.

Scheme Principles

Proposals involve signalisation of the Bridgeway/Bridgefoot and Bridge Street/Bridgefoot entry arms onto the junction. These signals are synchronised with the Tiddington Road/ Bridgefoot proposals so as to minimise the amount of time vehicles allocated green time at the Tiddington Road signals approach a red signal at the gyratory.

Issues

In general signal heads are already in place in close proximity to the areas where they would be proposed as part of the formal signalisation scheme. This means that the risks of delivering this scheme should be minimal. In all cases the schemes can be delivered in a way which maintains the pedestrian flow within the area albeit the location of the crossings may have to move.

Scheme Status – This was assumed within the testing and will be promoted as part of the Stratford Transport Package.

2.4.3 Scheme 03 - Evesham Place/Evesham Road roundabout

Issues

Within the AM period there are heavy queues observed on the Seven Meadows Road NB and Evesham Road EB approaches (it should be noted that the latter has been reduced since the Link West of Shottery has been included within the modelling). Within the PM period there are large queues which are observed on Rother Street/Evesham Place SB that are caused partly by the need to yield to vehicles travelling along Grove Road SB and, furthermore, by queue propagation back from the Evesham Road/Evesham Place roundabout. This is to be expected as there is a large volume of traffic travelling outwards from Stratford upon Avon town centre during the PM period.

Scheme Principles

Potential capacity benefits of switching from a roundabout to traffic signal-controlled priority junction. Signalisation required due to the tidal nature of movements across the junction. During the AM heavy traffic flows are present northwards into Stratford whilst the opposite occurs in the PM. The use of signals allows the junction to be better tailored to the differing AM and PM conditions. Queue detectors have been used to minimise the queuing on approach to the signals. Two lane entry widths have been retained on all approaches whilst the existing highway area is used to provide stacking space for right turning traffic.

Risks

The main issue concerning the delivery of this scheme is the need to ensure that there is sufficient space to deliver the design without compromising the existing pedestrian and cycle facilities. Issues concerning the access to properties which front onto the existing carriageway will need to be considered.

Scheme Status – This was assumed within the testing and will be promoted as part of the Stratford Transport Package.

2.4.4 Scheme 04 – Grove Road/Rother Street

Issues

Queuing on Rother Street is frequently exacerbated by the limited opportunity for traffic travelling SB to exit onto Evesham Place, which, in turn results in lengthy queues that frequently block back through Greenhill Street and beyond.

Scheme principles

By making Grove Road one-way NB and Rother Street one-way SB the propensity for blocking back to occur is reduced significantly. Furthermore, the additional 2 lane directional links provide extra storage capacity for any queues that do occur and they limit the propensity for queues to reach such an extent that they begin to impact upon the operation of adjacent major junctions.

Risks

There are a number of issues pertaining to the delivery of this scheme that require consideration, these include, but are not limited to, the following:

- Constraints regarding the Road space and the need to deliver a 2 lane Evesham Place SB approach to the newly signalised Evesham Place/Evesham Road junction.
- The proximity of the access of Broad Walk to the junction and the need to ban the right turn from Evesham Place into Broad Walk.
- The need to retain existing pedestrian and cyclist facilities in and around the junction.
- Possible implications of vehicles not being able to turn right from Evesham Place into Chestnut Walk.
- Possible risk of creating a more circuitous route for local residents and people accessing businesses in the area – this could lead to objections and make a scheme difficult to deliver.

Scheme Status – This was assumed within the testing as one which would be promoted as part of the Stratford Transport Package.

The subsequent strategic review of the schemes has resulted in the removal of this scheme from the final package of measures in view of the risks identified above.

2.4.5 Scheme 05 – Windsor Street/Birmingham Road roundabout.

Issues

This roundabout is in close proximity to the strategically important Birmingham Road/Arden Street signalised junction. At times vehicles can elect to use Windsor Street SB as a route from Birmingham Road to the Evesham Road/Evesham Place junction. Queuing back from the Windsor Street/Rother Street signalised junction can block back into the Windsor Street/Birmingham Road junction which, in turn, blocks the movement of traffic along Guild Street/Birmingham Road.

Scheme principles

By converting the roundabout into a priority junction and restricting the propensity for right turns at the junction the movements are simplified and delays at the junction are minimised. Traffic wishing to travel from Birmingham Road to Evesham Road is largely encouraged to use the Arden Street Greenhill Street route which has a much higher capacity than the Windsor Street route and thus, the propensity for queuing at the Windsor Street/Rother Street junction to block back through adjacent junctions is largely mitigated. The scheme also assumes that two lanes can be provided for the length of the Birmingham Road NB approach to the Birmingham Road/Arden Street signalised junction.

Risks

Most of the scheme lies within existing highway and so risks regarding feasibility are likely to be minimal. However, one risk that has been identified is the need to establish that there is sufficient road space to deliver 2 lanes NB along the Birmingham Road without compromising existing pedestrian and cyclist facilities. One major risk is posed by the significant number of right turners out of Shakespeare Street (756 per 12 hour weekday). Changing junction to an uncontrolled priority arrangement is likely to make this movement more difficult which may lead to local objections. This could pose a risk to scheme delivery.

Scheme Status – This was assumed within the testing as one which would be promoted as part of the Stratford Transport Package.

The subsequent strategic review of the schemes resulted in the removal of this scheme from the final package of measures in view of the risks identified above.

2.4.6 Scheme 06 & Scheme 07 - Shipston Road/Clifford Lane and Shipston Road/Seven Meadows Road roundabouts.

Issues

The future year modelling appears to indicate that significant queues are anticipated within close proximity of the two roundabouts. During the AM large queues manifest on the Shipston Road and Clifford Lane NB approaches to the Clifford Lane/Shipston Road roundabout whilst, during the PM, large queues appear on the Seven Meadows Road and Trinity Way approaches to the Shipston Road/Seven Meadows Road roundabout.

Scheme principles

By widening the approaches to the roundabouts as well as, where necessary, the circulating carriageway, the capacity of both junctions is improved. Two lane exit flares are provided on the Trinity Way WB, Shipston Road NB and Shipston Road SB exit arms which allow certain movements across the junction to be made from two lanes. Furthermore the two lane exit flare on the Shipston Road SB exit can be extended to a dual section between the two junctions which will provide additional capacity. There is also a segregated left turn lane for Shipston Road NB to Seven Meadows Road left turning traffic.

Risks

The optimum enhancements require a considerable amount of highway works and there is currently a risk that the requirements for the junction radii may push the scheme extent outside of the existing highway boundary.

The scheme will need to ensure that the shared foot/cycleway around the roundabout are retained at their current widths and that access to the Tramway path is considered. The provision of the multi-lane entrances/exits and separate left hand turn lanes will need careful design as these may make it more difficult for pedestrians and cyclists to cross. There may also be a need to relocate the existing toucan crossing on Trinity Way east of the roundabout east of the splitter islands.

***Scheme Status* – This was assumed within the testing and will be promoted as part of the Stratford Transport Package.**

2.4.7 Scheme 08 - Birmingham Road between Regal Road and Justins Avenue

Issues

The reconfiguration of the Warwick Road to a minor route in the PARAMICS model has significantly increased the traffic volumes utilising the Birmingham Road. Frequently queues are observed to propagate along the Birmingham Road NB from the newly signalised Hamlet Way junction, the Birmingham Road / Park Road and the Birmingham Road / Regal Road roundabouts. This queue propagation can extend back to the Arden Street / Birmingham Road signalised junction. When that occurs the network is significantly constrained as a major exit point for vehicles is blocked. Traffic can quickly build up within the town centre as a result of this issue. It should be noted that similar issues are observed on the Birmingham Road SB but the implications of queue propagation in this direction mean that queues are stored on the Birmingham Road and do not affect traffic wishing to exit the town centre.

Scheme Principles – provision of two lanes NB along the Birmingham Road from just south of the junction with Regal Road to just north of the Junction with Hamlet Way.

Risks

A scheme which enables two lanes of traffic to travel NB across the Hamlet Way junction has previously been investigated but the costs were assessed as prohibitive. A revised version of the scheme was delivered which does not unlock the capacity benefits that the two lanes NB appear capable of delivering. Thus, cost should be considered as a major risk. Furthermore, there are a number of properties which are accessed directly from the Birmingham Road NB over an existing foot/cycleway that may pose a barrier to the delivery of the two lane element of the scheme in this area. Finally whilst there is existing space within the highway boundary to deliver the proposed two lane section it is unclear whether this would compromise the existing NMU facilities which, given the close proximity of a large retail area, would likely be unacceptable.

***Scheme Status* – This was assumed within the testing and will be promoted as part of the Stratford Transport Package.**

2.4.8 Scheme 09 – Birmingham Road/A46 ‘Bishopston Roundabout’

Issues

At various points during the future year model runs large queues are observed to occur on all approaches to the roundabout. The queues tend to form on different approaches at different times within the simulation period with the tendency for queuing to occur on links into Stratford within the AM and out of Stratford within the PM.

Scheme Principles

Substantial widening of the circulating carriageway and entry and exit flares are proposed in order that the capacity of the junction can be increased. The scheme could potentially be adapted further to include signals but these have not been included at this stage.

Risks

The main risk is ensuring that the scheme can be delivered within the existing highway boundary and can be delivered in a way which conforms to the HA design standards.

***Scheme Status* – This was assumed within the testing and will be promoted as part of the Stratford Transport Package.**

The final design for this scheme will require agreement between WCC and the Highways Agency and it is likely that the final scheme will require further detailed design before it can be considered as appropriate to progress.

Scheme 10 – Alcester Road/A46 ‘Wildmoor Roundabout’

Issues

Large queues are observed on three of the four approaches, A46 WB, Alcester Road NB and the new link road NB. The roundabout is already due to be reconfigured as a result of the new link road and it is therefore difficult to assess the full implications of the proposed demands in an area of the model which is currently not possible to fully calibrate.

Scheme principles

The potential to amend the current junction layout is limited due to the limited junction radius. Any scheme enhancements that are proposed will need to be delivered in a way which minimises the changes to the layout; as a result, the final scheme will likely require the implementation of signals. This scheme has not yet been determined, some inception work has identified that the delivery of a dedicated left turn lane from the A246 SB to the A46 EB would likely alleviate some of the impacts identified in this area.

Risks

The major risk in this area is that neither the slip lane, nor the introduction of signals, is achievable within existing highway boundaries.

***Scheme Status* – The form of this scheme is still to be determined, an outline scheme was assumed within the testing that may be promoted as part of the Stratford Transport Package.**

The final design for this scheme will require agreement between WCC and the Highways Agency and it is likely that the final scheme will require further detailed design before it can be considered as appropriate to progress.

2.5 Scenario Assessment

Initially, the models which were inclusive of the Stratford Transport Package measures were derived on an iterative basis to assess the incremental impact of including each of the key measures. Furthermore, the schemes were added incrementally in response to issues observed within the model network.

The production of the core Stratford Transport Package Scenarios was undertaken in the following order:

Stratford 2028 Reference Case

This scenario was produced as per the process outlined within section 2.1 of this report.

Stratford 2028 + SRZ

This scenario was produced by adding the Stratford Regeneration Zone assumptions into the 2028 Reference Case

Stratford 2028 + SRZ + STP Original

This scenario was produced by adding the original assumptions pertaining to the Stratford Town Centre Improvements into the model network. The assumptions regarding the delivery of the STP in this scenario are consistent with those adopted during the previous stage of the STA.

Stratford 2028 + SRZ + STP Plus

This scenario was produced by amending the previous scenario to include the Windsor Street junction proposals as well as reverting the original STP proposals at the Banbury Road/Shipston Road junction, which assumed the delivery of signals in this location, to an improved roundabout.

Stratford 2028 + SRZ + STP Plus_02

This scenario was produced by incorporating the proposals at Bishopton Roundabout and the proposals along Birmingham Road within the model.

Stratford 2028 + SRZ + STP Plus_03

This scenario was produced by incorporating the proposals at Clifford Lane/Seven Meadows Road into the model network.

Stratford 2028 + SRZ + STP Plus_04

This scenario was produced by incorporating the proposals at the A46 'Wildmoor' roundabout into the model as well as amending the Evesham Road/Evesham Place junction to include a two lane SB merge from Evesham Place SB to Evesham Road.

2.6 Sensitivity Test Networks

In addition to the scenarios outline previously there have also been a number of sensitivity test scenarios produced to address a number of the additional study objectives, namely;

Stratford 2028 + SRZ + STP Mode Share

This scenario has been produced from the ‘Stratford 2028 + SRZ + STP Plus_04’ scenario and includes a revised set of demands which uplifts the SRZ demands to the level likely to be observed should a 15% shift in demand to sustainable modes not be achieved.

Stratford 2028 + SRZ + STP + Warwick Major

This scenario has been produced from the ‘Stratford 2028 + SRZ + STP Plus_04’ scenario and includes a revised set of assumptions for the Warwick Road, specifically the signposting of the Warwick Road has been revised from Minor to Major between the A46 to the North and the Stratford gyratory to the south.

Stratford 2028 + SRZ + STP + Warwick Major_Major

This scenario has been produced from the ‘Stratford 2028 + SRZ + STP + Warwick Major’ scenario and includes a revised set of assumptions for the Warwick Road, specifically the signposting of the Warwick Road has been revised to reflect an increased level of attractiveness by have the SB cost factor between the A46 to the North and the Stratford gyratory to the south reduced to 0.5.

2.6.1 Demands

The demands within the Warwick Road signage scenarios are consistent with those outlined previously within Table 7. The model share sensitivity testing required an amendment to the demands to compensate for the original 15% reduction in SRZ demands, this meant demand levels were increased in response to the assumption that 15% mode share was not achieved. As a result of this process the following demands have been assigned within the ‘Stratford 2028 + SRZ + STP Mode Share’ model network:

Table 8 - Stratford 2028 + SRZ + STP Mode Share Network Demand

	0700 to 0800	0800 to 0900	1600 to 1700	1700 to 1800
Stratford 2028 + SRZ + STP Mode Share	13495	17240	18736	18872

3 Results Analysis

3.1 Overview

The following sections of the report are intended to present the results obtained from the detailed testing undertaken using the Stratford-upon-Avon PARAMICS model.

The analysis of the impacts across the various scenarios has been presented at a high level which is pertinent to the overall level of assessment. It should be noted that further, more detailed, analysis should be undertaken before any of the measures proposed as part of the Stratford Transport Package are taken forward to detailed design stages. All of the measures used to inform the assessment are outlined as follows:

3.2 Model Stability

Due to the deterministic nature of assignment within PARAMICS it is possible for vehicles to continue to attempt to enter a network even when congestion has reached such an extent that the network is effectively 'grid-locked'. In some cases the grid-lock can occur due to problems that will require mitigation, in other cases it can be something as simple as vehicles entering a mini-roundabout from all three approaches at exactly the same time.

When a model becomes grid-locked vehicles still continue to be assigned to the network and so delay begins to increase exponentially. It should be acknowledged that these issues may be occurring due to a need for mitigation in one or more areas of the model but, if the models do not lock up every time it can be concluded that the problem is not severe enough to cause the network to cease to function. Furthermore, the fact that some model runs are completed without mitigation indicates that a mitigation strategy can only provide additional improvements and should be deliverable. If it is model error causing the issues then these results should also be discounted due to the fact that they cannot be considered realistic.

It should also be acknowledged that experience gained elsewhere in the application of PARAMICS micro simulation modelling, in projects of a similar size, has highlighted that the level of instability within the models is frequently improved as the options are looked at in more detail. Partly this is because of the fact that, as developments are progressed in isolation, more localised impacts are identified and mitigated than can be achieved during such a high level assessment and partly this is because the existing mitigation that has been proposed will be subject to further refinement and improvement beyond this stage of the assessment.

Twenty model runs were initially undertaken, where model stability has been particularly poor, the propensity for a model to lock up (and thus to be considered to have failed), is assessed to allow the reliability of the model network across the various scenarios to be better understood. Additional runs were then collected to

ensure that, where practicable, model outputs were based on a minimum of twelve runs per time period.

Based on an initial review of the model performance it was decided that an AM model run could be considered as having locked up whenever more than 3,000 vehicles are observed to remain on the model network at the end of the AM or PM simulation period. A greater level of latent demand is deemed acceptable during the PM than the AM due to the inherently higher level of variability contained within the PM scenario between each of the individual runs.

3.3 Number of Runs

Network statistics analysis has been based, consistently, on 10 runs per period per scenario due to the method of production, however, unless stated otherwise, all other statistics are based on a minimum of 10 runs and a maximum of 20 depending upon the number of successful runs collected.

3.4 Network Wide Statistics

A number of statistics used in the analysis have been obtained from analysing each individual trip that has occurred within the network. This information is collected within PARAMICS through the Trips-all file and contains information specific to each individual trip that has been completed within the model period. This information is then aggregated and processed to provide the following comparative statistics:

- **Average Distance (Km)** – The average distance travelled by a vehicle that completed their journey during the model simulation period.
- **Average Time (seconds)** – The average travel time of a completed trip during the model simulation period.
- **Average Speed (Km/h)** – The average speed travelled by all vehicles that completed a journey during the model simulation period.
- **Completed Trips (vehicles)** – The number of completed trips recorded during the model simulation.

The first three measurements are averages so can be used to compare between the various scenarios. The final measurement is an absolute and is dependent on congestion on the network (as this will prevent trips from completing) and the demand within the model (i.e. the number of trips actually trying to complete). As demand differs between scenarios, as well as small variations between runs of the same scenario, we cannot expect the number of completed trips to be the same. However, as the demands do not differ significantly it can still provide an indication of the relative congestion on each network. The use of these statistics is in line with the methodology adopted during the previous Strategic Transport Assessment work.

3.5 Queue Lengths

A second, more detailed, level of analysis has been undertaken in the form of queue length analysis. Queue length analysis is intended to accompany the mean speed analysis as it provides a more detailed picture of the impacts at specific junctions within the model network.

At this stage the analysis of queue lengths has been based on the average hourly maximum queue length. Results presented for each junction are based on the worst performing single approach. The hourly maximum for each individual model run has been calculated and then the average of all runs has been calculated for each hour. The maximum of these values, across all hours, is reported as the maximum periodic average maximum queue length and is reported in vehicles.

The junctions for which average hourly maximum queue lengths have been calculated and compared are illustrated within **Figure 6** on the following page.

Junctions where queue differences have not been plotted on the maps simply represent junctions which did not trigger any of the assessment criteria across any one approach.

Queue difference plots have been produced for all model scenarios and have been presented within **Appendix A** of this report.

At this stage these results simply identify areas where further attention is required.

A queue length increase of 50 vehicles does not necessarily mean that a scheme will not work, it may indicate that further optimisation of the layout or any signal times are required. Furthermore it may not account for improvements on other arms of the same junction which, when investigated further, may contain additional capacity which could be unlocked to reduce the queue length on the offending approach.

The classification of differences used within the queue length analysis is outlined as follows:

- **Queue Reduction** (a reduction in queue lengths of greater than 5 vehicles)
- **Moderate Increase** (an increase in queue lengths of between 10 and 25 vehicles)
- **Severe Increase** (an increase in queue lengths of between 25 and 50 vehicles)
- **Very Severe Increase** (an increase in queue length of over 50 vehicles)

The locations of the junctions that have been included within the assessment are outlined within **Figure 5** on the following page.

Figure 5 - Queue Assessment, Junction Locations



4 2028 Reference Case vs. 2028 + SRZ

4.1 Overview

The first stage of this assessment was to review the performance of the network following the introduction of the SRZ policy in relation to the Reference Case. In order to understand the potential impacts on the Stratford area, of delivering the SRZ Policy, the ten schemes proposed for the area are introduced into the model. This allows a comparison of statistics for a 'Do Nothing' scenario defined as the Reference Case and a SRZ 'Do Something' scenario.

4.2 Model Stability

An initial assessment of the level of model stability was undertaken by comparing the number of completed runs against the number of runs assumed to have failed, as outlined earlier within Section 3.2.

The apparent network stability exhibited within the AM and PM simulation runs across the two scenarios is illustrated in the following Table 9:

Table 9 - Model Stability Assessment 2028 Reference Case vs. 2028 + SRZ

	2028 Reference Case	2028 + SRZ
AM	100%	100%
PM	90%	80%

Given the sample size it is reasonable to conclude from the previous table, that there are no notable differences between the two scenarios when considering network stability. Both scenarios effectively demonstrate the same level of stability within two runs.

4.3 Network Wide Statistics

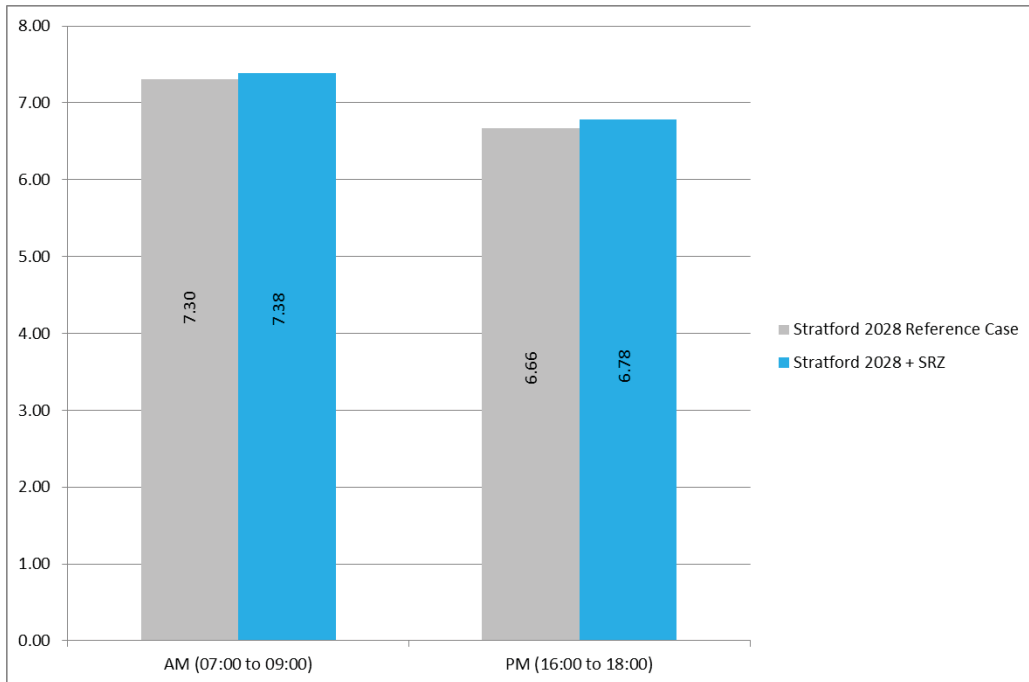
The following set out the changes in network wide statistics between the 2028 Reference Case and the Revised Allocation Scenario.

4.3.1 Average Journey Distance

Analysis of the average journey distance travelled with each scenario, across the entire AM and PM model periods is presented in Figure 6Error! Reference source not found. on the following page.

Analysis of Figure 6 6 indicates an approximate 1-2% difference between the two scenarios. An increase in distance travelled may indicate an increase in the number of longer distance trips occurring within an option, or it may indicate an increased propensity for vehicles to reassign along longer routes in response to congestion.

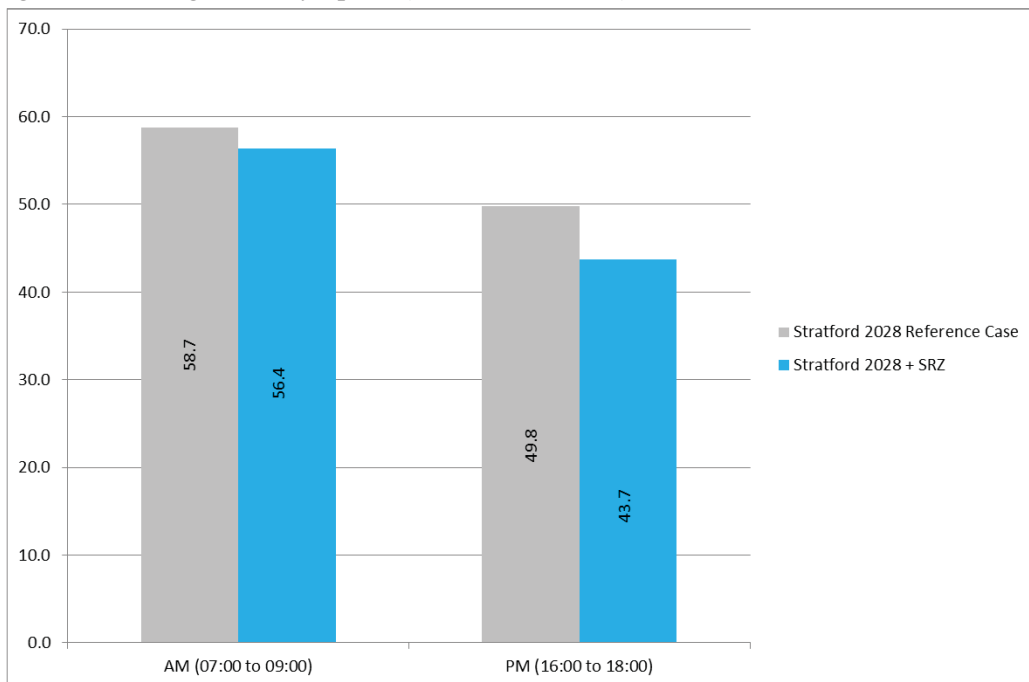
Figure 6 - Average Journey Distance (2028 Ref vs 2028 SRZ), km



4.4 Average Journey Speed

Analysis of the average journey speed (km/h) within the two scenarios, across the entire AM and PM model periods, is presented within the following **Figure 7**:

Figure 7 - Average Journey Speed (2028 Ref vs. SRZ), km/h

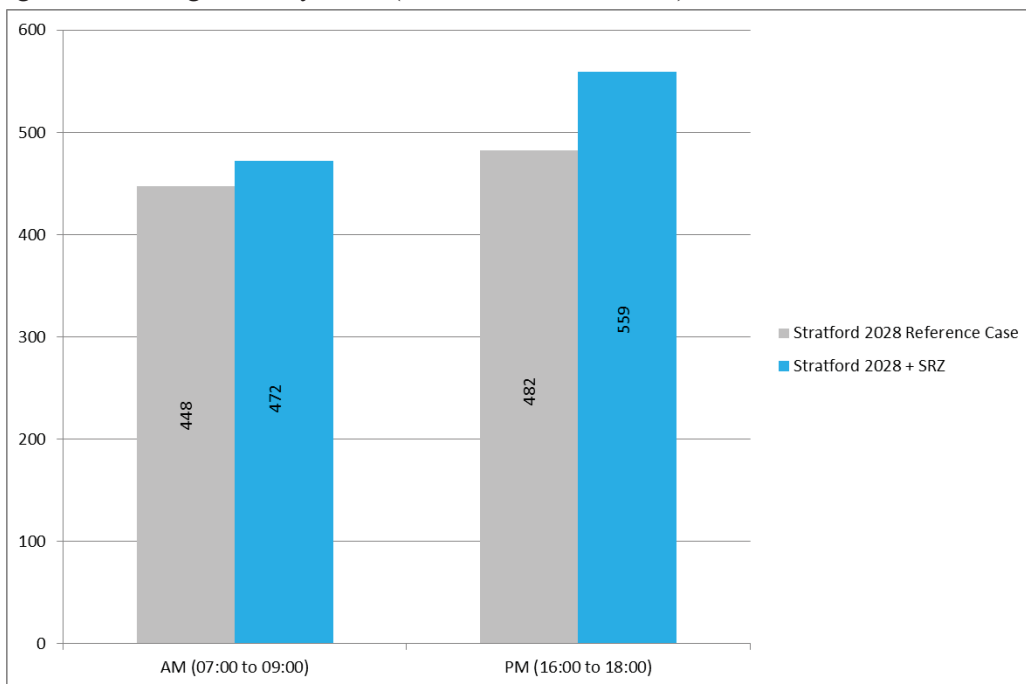


The previous figure demonstrates that the SRZ policy results in a drop in the average speed of vehicles on the network, of approximately 5% and 12% in the AM and PM model periods respectively. The drop in average speeds is likely to be indicative of the assignment of the additional demand and the congestion effects thereof.

Average Journey Time (Seconds)

Analysis of the average journey time, in seconds, within each scenario across the entire AM and PM model periods is presented in Figure 8:

Figure 8 - Average Journey Time (2028 Ref vs. 2028 SRZ), seconds



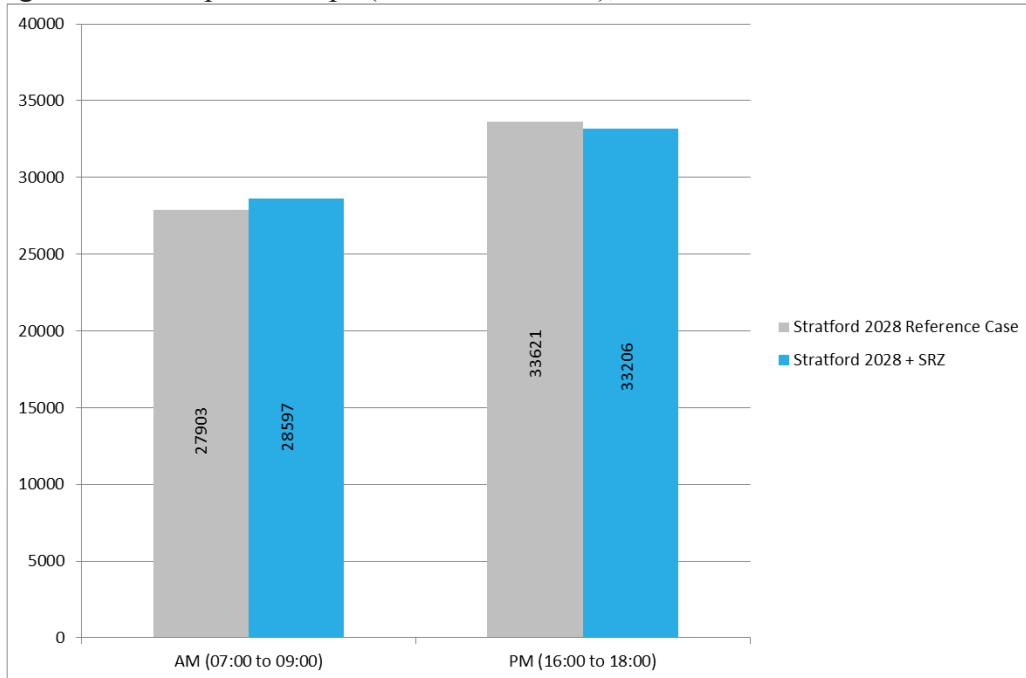
Analysis of the difference in journey time across the scenarios indicates an increase in the time it takes to complete a journey when compared to the 2028 Reference Case conditions of around 7% and 16% in the AM and PM peak periods. This increase will be as a result of the additional demand that has been assigned across the network which will, in turn, increase queuing and delay at various locations within the model network.

Overall it can be assumed that there will be a general increase in the average time spent travelling on the network once the demand associated with the SRZ is assigned to the network.

4.5 Completed Trips

Analysis of the total number of completed trips within each scenario, across the entire AM and PM model periods, is presented within Figure 10:

Figure 10 - Completed Trips (2028 Ref vs SRZ), Vehicles



Analysis of Figure 10 indicates that there is an increase in completed trips of around 2.5% in the AM peak period and a slight 1% drop during the PM peak period, when compared to the 2028 Reference Case.

Notably, the level of demand assigned within the SRZ option is around 5.7% higher in the AM and 6.4% higher in the PM. This indicates that when the mitigation is assigned to the network, it is largely able to accommodate the additional demand created by the allocation and that the AM performs better than the PM overall. It is worth noting that the increase in completed trips is lower than the increase in assigned demand between the two scenarios.

Because of the need for a cut off period it is never possible that 100% of the demand assigned within the model network will complete the entire journey by the end of the model period. Some trips will have only just started when the model ends whilst some may be released onto the network later due to congestion effects.

To understand how much demand is either unreleased or retained on the network at the end of the simulation period, the number of completed trips has been compared against the total demand levels assigned within the model. This information has been presented within Table 10 on the following page:

Table 10 - Completed trips Analysis (2028 Ref vs. SRZ)

	AM (07:00 to 10:00)			PM (16:00 to 19:00)		
	Demand	Completed	Completed (%)	Demand	Completed	Completed (%)
Stratford 2028	28976	27903	96.29%	35217	33621	95.47%
Stratford 2028 + SRZ	30735	28597	93.04%	37607	33206	88.30%

The previous Table illustrates that, as a proportion of the demand assigned, the number of trips that are completed during the AM model period, increases slightly within the SRZ scenario but the trip completion ratio has reduced. This indicates that the AM network conditions are able to accommodate some of the additional demands assigned within the model network without issue but not all of the additional trips that are assigned within the model network will complete within the simulation period. Within the PM there is a small drop in the number of trips that are completed within the SRZ scenario which, in turn, represents a much greater reduction in the trip completion ratio.

This indicates that there is the potential for the network conditions within the AM to accommodate at least some of the additional trips that are created as a result of the SRZ policy but there are likely to be negative impacts experienced within the PM Period and these impacts are likely to affect existing trips as well as those newly assigned as a result of the SRZ policy.

4.6 Maximum Queue Length Analysis

The following sets out some initial observations based on the differences in queue lengths between the 2028 Reference Case and 2028 SRZ scenarios.

The maps which are referred to within the following analysis are presented within **Appendix A** of this report.

4.6.1 AM Analysis (MQ001)

Analysis of the difference in queuing between the 2028 Reference and 2028 SRZ scenarios, during the AM period, reveals the following:

- There is one instance of very severe increases in queue lengths exceeding 50 vehicles on the network at the junction of A3400 Shipston Road/ A422 Banbury Road roundabout.
- Six locations assessed experience a maximum increase of between 10 and 25 vehicles (moderate increase). These queue increases are all expected to occur where schemes 3, 4, 6/7 and 9 are proposed.

4.6.2 PM Analysis (MQ002)

Analysis of the difference in queuing between the 2028 Reference and 2028 SRZ scenarios, during the PM period, reveals the following:

- There are a larger number of instances whereby queues increase between 10 and 50 vehicles in the PM when compared to the AM

- There is still one instance of very severe queue length increase occurring at the A3400 Shipston Road/A422 Banbury Road roundabout.
- There are 10 locations where a moderate increase in queue length is expected to occur and 7 instances of severe queue length increases expected

4.6.3 Queue Analysis Summary

A summary of the findings obtained through comparing the changes in queuing between the 2028 Reference Case and 2028 SRZ Scenario is provided as follows:

- During both the AM and PM peak hour there is one instance of a very severe queue length increase at the A3400 Shipston Road/ A422 Banbury Road roundabout. It should be noted that this junction is not located near the proposed development and so it is reasonable to conclude that it is almost at capacity currently. Any additional traffic which travels through this junction will have a disproportionately negative impact on junction performance
- Analysis of both AM and PM model outputs reveals that the majority of junction impacts identified range between a moderate and severe increase. However, most junctions are unaffected within the AM period.

4.7 Summary

The initial analysis of the 2028 SRZ scenario set out within the previous section of this report reveals the following:

- The network appears to be more able to accommodate the SRZ demand during the AM peak period than the PM peak period. However the ratio of assigned demand to completed trips is likely to fall across both periods
- There are likely to be negative impacts on journey times and speeds across the network as a result of the assignment of the SRZ demands and these effects will be more prominent within the PM than the AM
- There is one instance of a very severe queue length increase at the A3400 Shipston Road/A422 Banbury Road roundabout, however this junction is not located near the development so it is reasonable to conclude the junction is almost at capacity.

5 SRZ STP Plus 01 to Plus 04

5.1 Overview

The second stage of this assessment was to identify the incremental impact on the network performance for each stage of the STP schemes. As part of this assessment, five additional scenarios are tested that represent variations of the original SRZ scheme. A summary of the additional scenarios tested is provided below:

Stratford 2028 + SRZ + STP Original: This scenario was produced by adding the original assumptions pertaining to the Stratford Town Centre Improvements into the model network.

Stratford 2028 + SRZ + STP Plus: This scenario was produced by amending the previous scenario to include the Windsor Street junction proposals as well as reverting the original STP proposals at the Banbury Road/Shipston Road junction, which assumed the delivery of signals in this location, to an improved roundabout.

Stratford 2028 + SRZ + STP Plus_02: This scenario was produced by incorporating the proposals at Bishopton Roundabout and the proposals along Birmingham Road within the model.

Stratford 2028 + SRZ + STP Plus_03: This scenario was produced by incorporating the proposals at Clifford Lane/Seven Meadows Road into the model network.

Stratford 2028 + SRZ + STP Plus_04: This scenario was produced by incorporating the proposals at the A46 'Wildmoor' roundabout into the model as well as amending the Evesham Road/Evesham Place junction to include a two lane SB merge from Evesham Place SB to Evesham Road.

5.2 Model Stability

The apparent network stability exhibited within the AM and PM simulation runs across the scenarios is illustrated in the following Table 11:

Table 11 - Model Stability Assessment 2028 Reference vs. 2028 SRZ VS SRZ+ STP Plus_01-04)

	1 Stratford 2028	2 Stratford 2028 + SRZ	3 Stratford 2028 + SRZ + STP Original	4 Stratford 2028 + SRZ + STP Plus	5 Stratford 2028 + SRZ + STP Plus_02	6 Stratford 2028 + SRZ + STP Plus_03	7 Stratford 2028 + SRZ + STP Plus_04
AM	100%	100%	90%	90%	90%	100%	100%
PM	90%	80%	40%	40%	60%	100%	100%

Given the 20 run sample size it is reasonable to conclude from the previous table that, during the AM peak period, there is no notable change in model stability across the scenarios.

During the PM peak period, however, the model stability is relatively low for scenarios 3 4 and 5. The stability levels demonstrated within scenarios 3 and 4 are considered too low to be acceptable; as a result, these scenarios have been discounted from any further analysis.

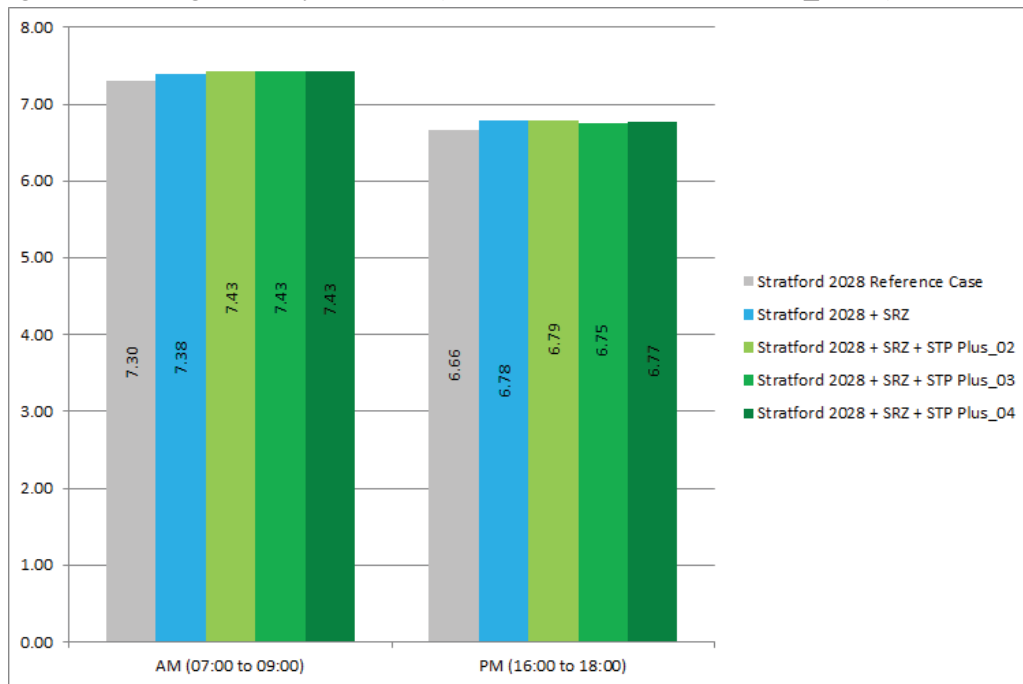
5.3 Network Wide Statistics

The following set out the changes in network wide statistics between the 2028 Reference Case and the emerging STP Scenarios.

5.3.1 Average Journey Distance

Analysis of the average journey distance with each scenario, across the entire AM and PM model periods is presented within the following Figure 9:

Figure 9 - Average Journey Distance (2028 Ref vs. SRZ vs STP Plus_01-04), km

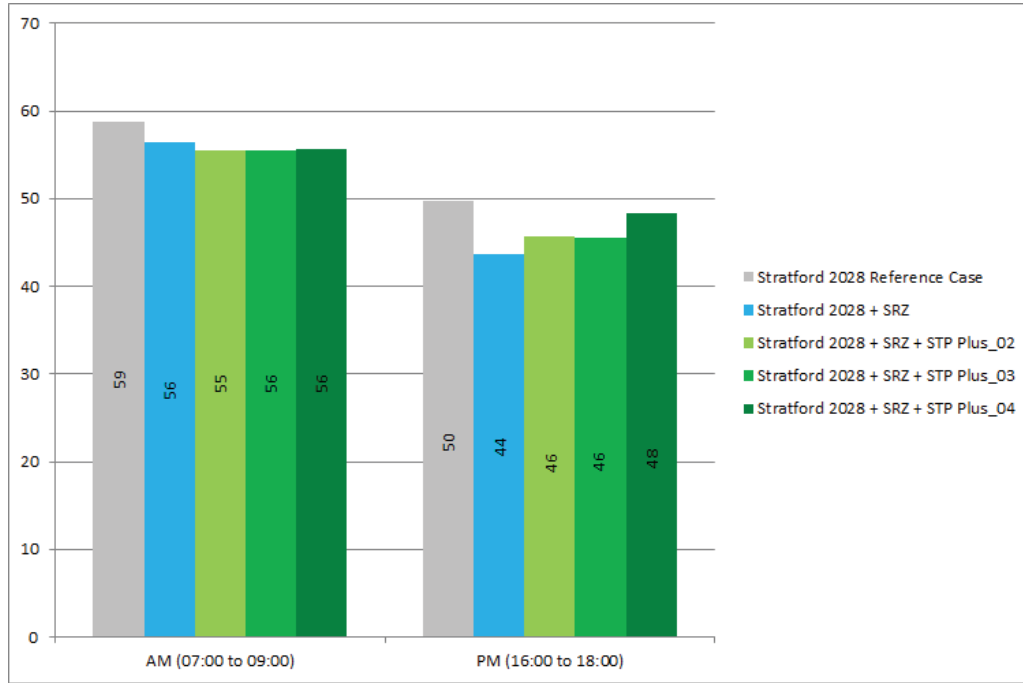


Analysis of the previous Figure indicates the four STP scenarios result in very similar average journey distances in both the AM and PM peak periods. In both peak periods, these scenarios are expected to result in only a 1-2% increase in journey distances with respect to the Reference Case.

5.3.2 Average Journey Speed

Analysis of the average journey speed (km/h) within the various scenarios, across the entire AM and PM model periods, is presented within Figure 10:

Figure 10 - Average Journey Speed (2028 Ref vs. SRZ vs STP Plus_01-04), km/h



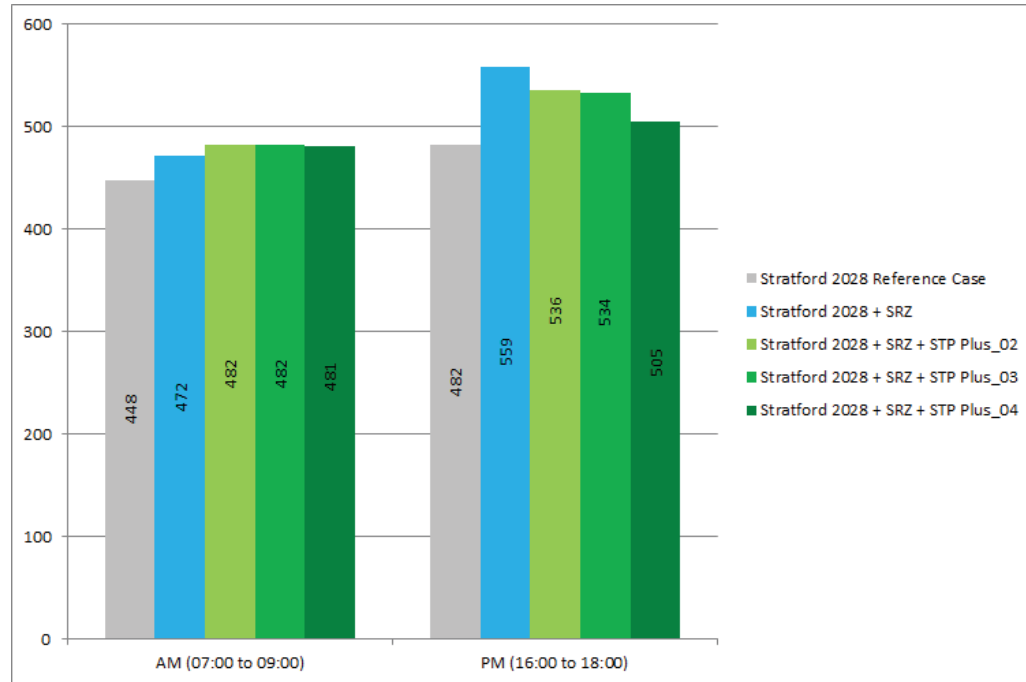
When compared to the Reference Case, the previous figure demonstrates that the STP scenarios all result in a drop in the average speed of vehicles on the network. This drop is approximately 5% and 4% in the AM and PM model periods respectively. This drop in average speeds is likely to be indicative of the assignment of the additional demand.

However once mitigation measures are introduced there is a 4-9% increase in speeds during the PM peak period for the STP scenarios in reference to the SRZ scenario. The average journey speeds appear more consistent across the SRZ scenarios in the AM peak period than the PM peak period. The STP_Plus04 scenario is expected to result in the highest average journey speeds of the four STP scenarios and is the closest to the Reference Case speeds. Thus by introducing the mitigation measures it can be seen that the impacts of the additional demand associated with the SRZ policy are mitigated to an extent.

5.4 Average Journey Time (Seconds)

Analysis of the average journey time, in seconds, within each scenario across the entire AM and PM model periods is presented in Figure 11:

Figure 11 - Average Journey Time (2028 Ref vs. SRZ vs STP Plus_01-04), seconds



Analysis of the difference in journey time across the scenarios indicates again the AM peak period results are more consistent across the STP scenarios than in the PM peak period. It is expected that all STP scenarios will result in an increase in the time it takes to complete a journey when compared to the 2028 Reference Case as a result of the increased demand on the network.

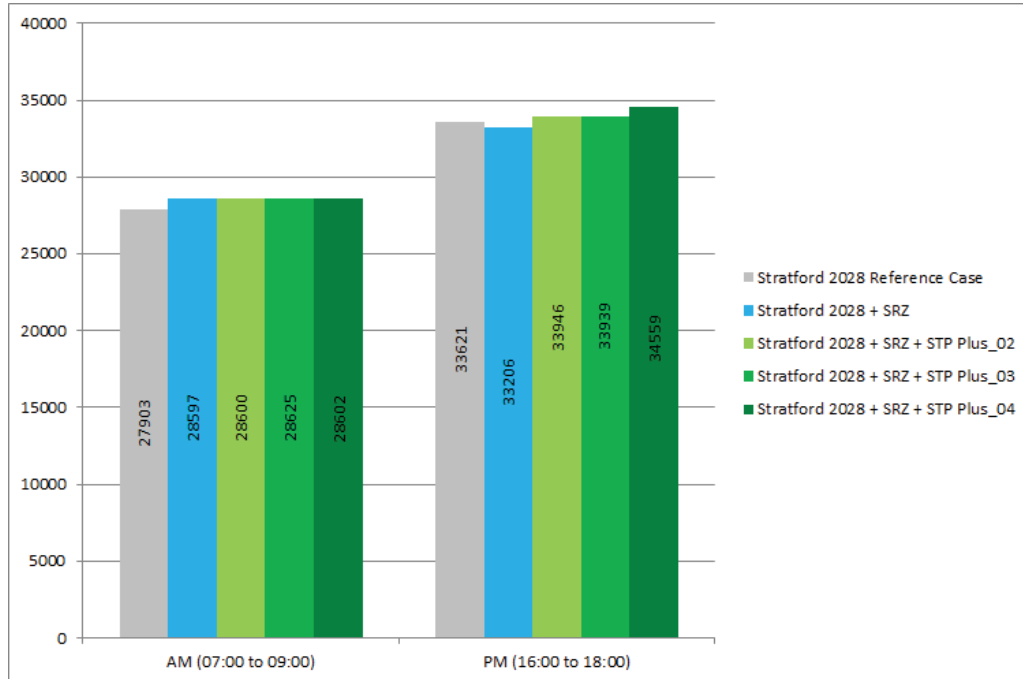
With the introduction of mitigation measures, it can be seen that journey times actually increase during the AM peak period with respect to the SRZ scenario. This suggests the extra traffic signals are incurring latent delay not present in the earlier options. However during the PM peak period when traffic demands are at their highest, the mitigation measures result in an approximate 50 second decrease in journey times for the STP_Plus04 scenario when compared to the SRZ scenario.

Overall it can be assumed that there will be a general increase in the average time spent travelling on the network once the allocated demand has been assigned to the network when compared to the Reference Case. The STP_Plus04 scenario is expected to result in the lowest average journey time of the four STP scenarios and is the closest to the Reference Case average journey time. However, whilst this scenario results in reduced journey times in the PM peak period when compared to the SRZ scenario, journey times are fairly static in the AM peak period with only an approximate 2% increase expected during the AM peak period.

5.5 Completed Trips

Analysis of the total number of completed trips within each scenario, across the entire AM and PM model periods, is presented within the following Figure 12:

Figure 12 - Completed trips (2028 Ref vs. SRZ vs STP Plus_01-04)



From the previous figure, it can be seen that more trips are completed than the Reference Case for both the AM and PM peak hour for all STP scenarios. During the AM time period the level of completed trips remains fairly static as the STP mitigation level increases whilst, within the PM, there is a gradual increase in the number of trips that are completed which occurs in parallel to the increasing level of STP mitigation.

It is worth noting that the increase in completed trips is lower than the increase in assigned demand between the two scenarios. This means that although it is demonstrable that the STP measures will increase network capacity and accommodate the additional demand levels with reduced impacts, when compared to the scenario in which mitigation is not added, not all of the additional development demands will be accommodated within the modelled time periods. This does not necessarily mean that there is a need for further mitigation as the nature of some of the additional trips that have been assigned within the model will have changed and the presence of more, longer-distance, trips may mean an improvement in the trip completion ration is not possible. This is especially pertinent when considering the location of the employment sites on the periphery of the existing town boundary. Trip ends associated with these sites will, by the nature of the location, travel longer distances and take longer to complete than the average modelled trip. Thus the trip completion levels may naturally reduce.

Because of the need for a cut off period it is never possible that 100% of the demand assigned within the model network will complete the entire journey by the end of the model period. Some trips will have only just started when the model

ends whilst some may be released onto the network later due to congestion effects.

To understand how much demand is either unreleased or left on the network at the end of the simulation period the number of completed trips has been compared against the total demand levels assigned within the model. This information has been presented within the following Table 12:

Table 12 - Completed trips Analysis (2028 Ref vs. SRZ vs STP Plus_01-04)

	AM (07:00 to 10:00)			PM (16:00 to 19:00)		
	Demand	Completed	Completed (%)	Demand	Completed	Completed (%)
Stratford 2028 Reference	28976	27903	96.29%	35217	33621	95.47%
Stratford 2028 + SRZ	30735	28597	93.04%	37607	33206	88.30%
Stratford 2028 + SRZ + STP Plus_02	30735	28600	93.05%	37607	33946	90.27%
Stratford 2028 + SRZ + STP Plus_03	30735	28625	93.13%	37607	33939	90.25%
Stratford 2028 + SRZ + STP Plus_04	30735	28602	93.06%	37607	34354	91.35%

The previous Table illustrates that, as a proportion of the demand assigned, the number of trips that are completed during the peak periods is comparable between all STP scenarios and is likely to reduce as a result of the inclusion of the SRZ Policy. This is not necessarily a function of an increase in delay and congestion rather it could be influenced by a number of factors, delay and congestion inclusive, such as an increase in average journey distances meaning a natural reduction in the number of trips that can be completed within the given model periods. During both peak periods, when compared to the Reference scenario, the trip completion reduction is minimised overall for the STP Plus_04 scenario.

This indicates that, in general, some of the reduction in trips completed may be natural during the AM peak period, especially as the AM model performance is more stable and the impacts of the allocation of the SRZ policy less discernible than those which are presented within the PM.

5.6 Maximum Queue Length Analysis

In order to identify the improvements that are possible with the STP Plus_04 scenario over the original SRZ scenario, queue plots have been produced with respect to the reference case. The following sets out some initial observations based on the differences in queue lengths between the 2028 Reference Case and 2028 STP Plus_04 scenarios.

The maps which are referred to within the following analysis are presented within **Appendix A** of this report.

5.6.1 AM Analysis (MQ003)

Analysis of the difference in queuing between the 2028 Reference and 2028 + SRZ + STP Plus_04 scenario, during the AM period, reveals the following:

- There is no instances of very severe increases in queue length
- There are three junctions assessed that trigger the criteria experience a maximum increase of between 25 and 50 vehicles.
- There are nine junctions where queue length reductions are expected to occur.

5.6.2 PM Analysis (MQ004)

Analysis of the difference in queuing between the 2028 Reference and 2028 + SRZ + STP Plus_04 scenarios, during the PM period, reveals the following:

- There are a larger number of instances whereby queues increase between 10 and 25 vehicles in the PM when compared to the AM
- There is one instance of very severe queue length increase occurring at the B439 Evesham Road/A4390 Evesham Place roundabout
- There are 5 instances where queue length reductions are expected to occur.

5.6.3 Queue Analysis Summary

A summary of the findings obtained through comparing the changes in queuing between the 2028 Reference and 2028 + SRZ + STP Plus_04 scenario is provided as follows:

- During the AM peak hour there are a number of instances where queue length reductions are expected to occur
- During the PM peak hour there is one instance of a very severe queue length increase at Evesham Place roundabout (there are none during the AM peak hour). It is still felt that signals are necessary in this area but the results indicate that further optimisation of proposals in this area would be desirable.
- Analysis of both AM and PM model outputs reveals that the majority of junction impacts range between a reduction in queuing and an increase of up to 25 vehicles.

5.7 Summary

The analysis of the STP scenarios set out within the previous section of this report reveals the following:

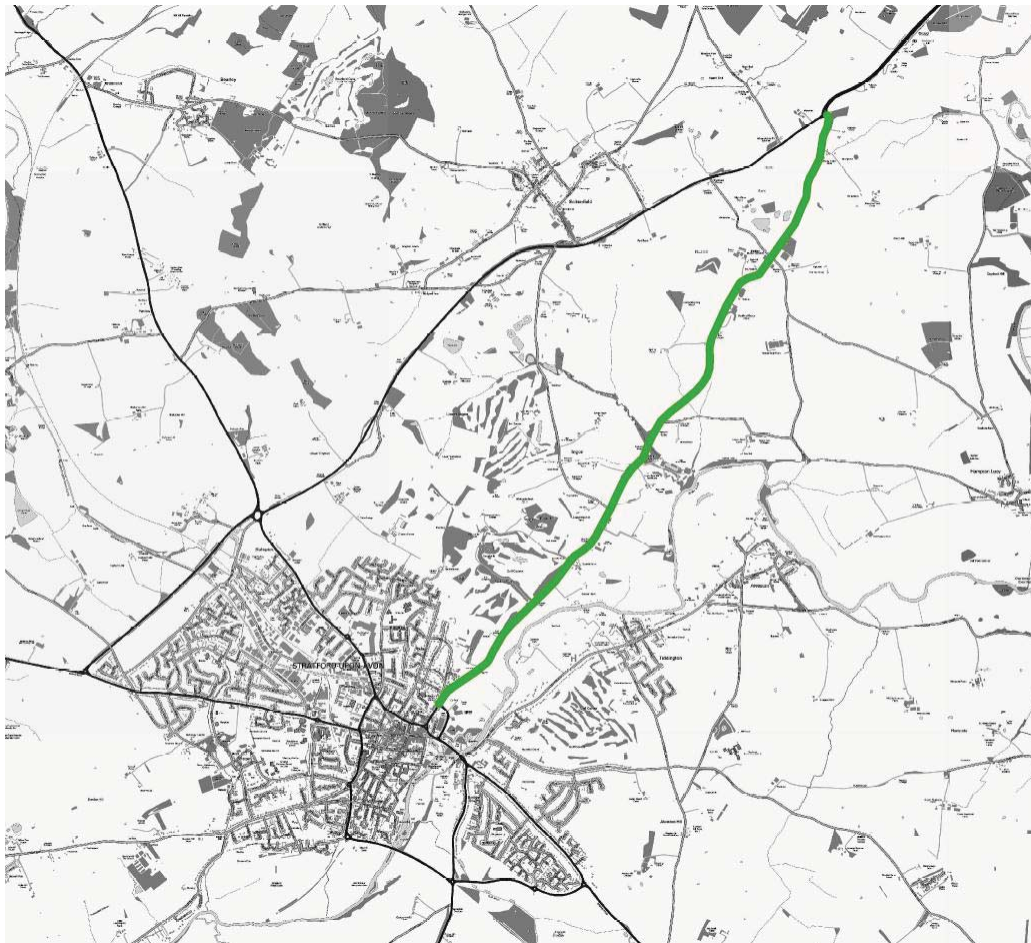
- Of the STP scenarios, that with the most favourable network conditions is STP Plus_04. Whilst network conditions remain the most favourable for the Reference Case, the introduction of mitigation measures sees a relatively stable result for average journey distance and delays in the AM peak period. However, during the PM peak period, as mitigation measures increase, these network conditions gradually improve
- This same result is identified for the overall trips completed with a relatively stable amount of trips completed during the AM peak period for all scenarios whilst the introduction of mitigation measures results in an increasing number of trips completed. In fact, the total number of trips completed is higher during both peak hours for the STP Plus_04 scenario when compared to the Reference Case
- There is one instance of a severe queue length increase expected in the PM peak hour under the STP Plus_04 scenario when compared to the Reference Case. However there are a number of instances where queue length reductions are expected to occur across the network as a result of the introduction of mitigation measures.

6 Warwick Signage Strategy

6.1 Overview

The third stage of this assessment was to identify the incremental impact on the network performance for two different signage strategies along Warwick Road. Figure 13 indicates the extent of Warwick Road that has been subject to change.

Figure 13 - Extent of Warwick Road subject to changes



The intention of the analysis of the signage strategy is to better control routing within the area to encourage traffic to use Warwick Road during times when Birmingham Road is busy and vice versa. Ultimately this would be achieved by a signage strategy that would encourage users to use Birmingham Road/ Warwick Road depending on the conditions recorded on the network and, specifically, in response to the detection of low speeds along the Birmingham Road.

The first of these strategies was to assign Warwick Road as a 'major' road in PARAMICS making it more attractive for unfamiliar users. The second strategy was to not only change the road's designation to major but also to reduce the cost factor to 0.5 which makes it even more attractive as a route option. This cost factor was only applied to the south bound route during the PM peak hour. This is due to the fact that when this cost factor was applied to the NB route, this route

becomes overly attractive which in turn attracts trips which would have previously assigned along the A46 to travel through Stratford Town Centre and back out on the A46 via Warwick Road. Such impacts are both undesirable and unrealistic as the purpose is to encourage route switching between the Birmingham Road and Warwick Road with respect Stratford bound trips from the A46. It is unlikely that this dynamic approach to signing would be used to increase the attractiveness of the Warwick Road for trips that would otherwise remain on the A46. As a result, when the attractiveness of the Warwick Road has been increased substantially these changes have focussed only on the SB direction.

6.2 Model Stability

The apparent network stability exhibited within the AM and PM simulation runs across the scenarios is illustrated in the following Table 13:

Table 13 - Model Stability Assessment 2028 STP_04 vs STP04_Major vs STP_majour_0.5cost)

	7 Stratford 2028 + SRZ + STP Plus_04	8 Stratford 2028 + SRZ+ STP Warwick Major	9 Stratford 2028 + SRZ+ STP Warwick Major_Major
AM	100%	100%	100%
PM	100%	90%	60%

Given the sample size of 20 runs it is reasonable to conclude from the previous table, that during the AM peak period, the final scenario results in a significant drop in model stability during the PM peak period. The reduced stability is likely to indicate a need for additional mitigation measures to ensure that the change in travel patterns that is incurred by the revisions to the signing of Warwick Road can be satisfactorily accommodated within the network.

6.3 Network Wide Statistics

The following sections set out the changes in network wide statistics between the original 2028 STP scenario and the two signage options along Warwick Road.

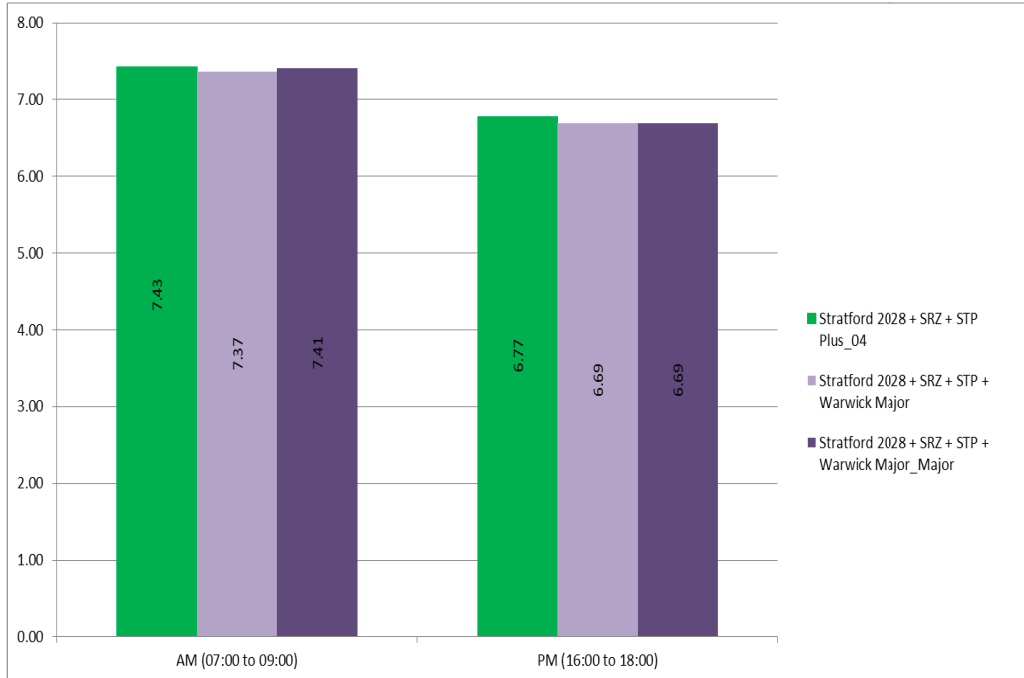
6.3.1 Average Journey Distance

Analysis of the average journey distance with each scenario, across the entire AM and PM model periods is presented in Figure 14 on the following page.

Analysis of Figure 14 indicates there is very little difference in average journey distance between the three scenarios. Given that there is no change in network demands across the three scenarios, the results appear to indicate a slight drop in journey distances when the signing strategy is implemented as some vehicles are encouraged to travel more direct routes. Although the differences are only small they represent an average of all journeys undertaken within the model period and,

therefore, the cumulative effects of this reduction in journey distances could be considered more significant.

Figure 14 - Average Journey Distance (2028 STP Plus_04 vs STP + Warwick_Major vs STP + Warwick_Major_Major), km



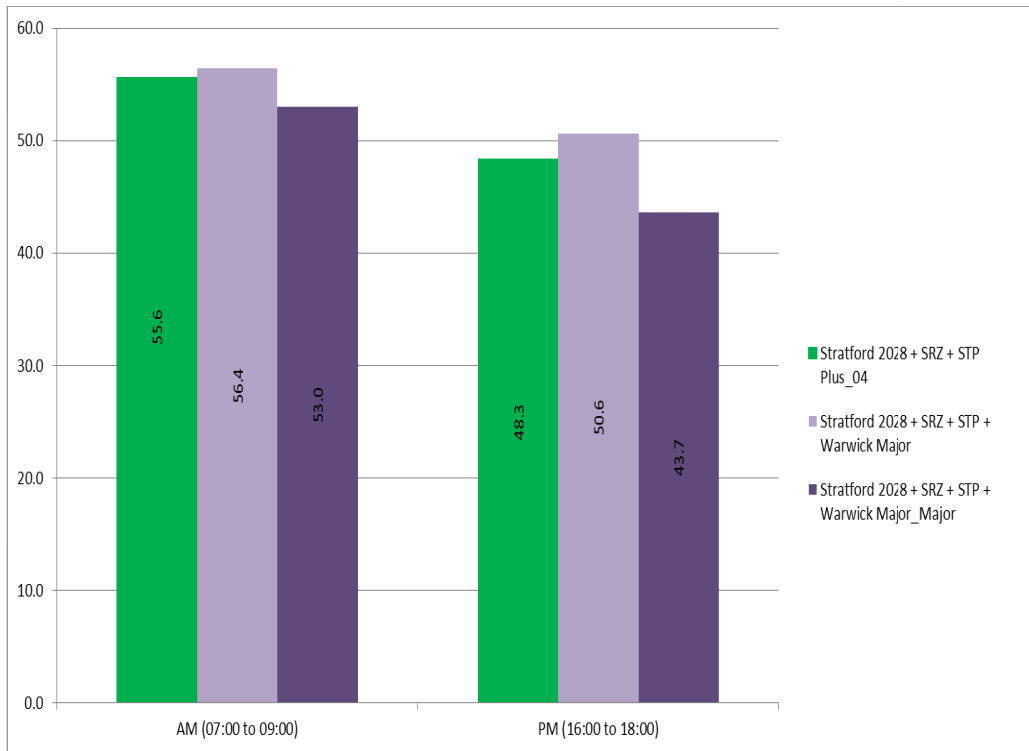
6.4 Average Journey Speed

Analysis of the average journey speed (km/h) within the three scenarios, across the entire AM and PM model periods, is presented within Figure 15.

Figure 15 demonstrates that the first signage strategy for Warwick Road will result in a slight increase in average journey speed with respect to the original STP scenario in both peak periods with the effect being more pronounced during the PM peak period.

However, if Warwick Road is made 'too attractive' journey speeds will actually decrease. This reduction in speeds is likely to occur because there are impacts within the town centre which are incurred as a result of the change in travel patterns across the town centre as more vehicles use the Warwick Road to access the town centre as opposed to the Birmingham Road.

Figure 15 - Average Journey Speed (2028 STP Plus_04 vs STP + Warwick_Major vs STP + Warwick_Major_Major), km/h



6.5 Average Journey Time (Seconds)

Analysis of the average journey time, in seconds, within each scenario across the entire AM and PM model periods is presented in Figure 16..

Analysis of Figure 16 shows that by increasing the attractiveness of the Warwick Road, the average journey time will reduce. However when a lower cost factor is applied, more drivers are encouraged to use Warwick Road and this actually results in higher average journey times in both peak periods with respect to the original STP scenario.

6.6 Completed Trips

Analysis of the total number of completed trips within each scenario, across the entire AM and PM model periods, is presented within Figure 17 on the following page.

Analysis of the figure on the following page indicates that there is an increase in completed trips for the Warwick Road Major scenario in both the AM and PM periods, when compared to the STP Original scenario.

The final scenario results in fewer trips being completed in both peak periods with respect to the original STP scenario.

Figure 16 - Average Journey Time (2028 STP Plus_04 vs STP + Warwick_Major vs STP + Warwick_Major_Major), seconds

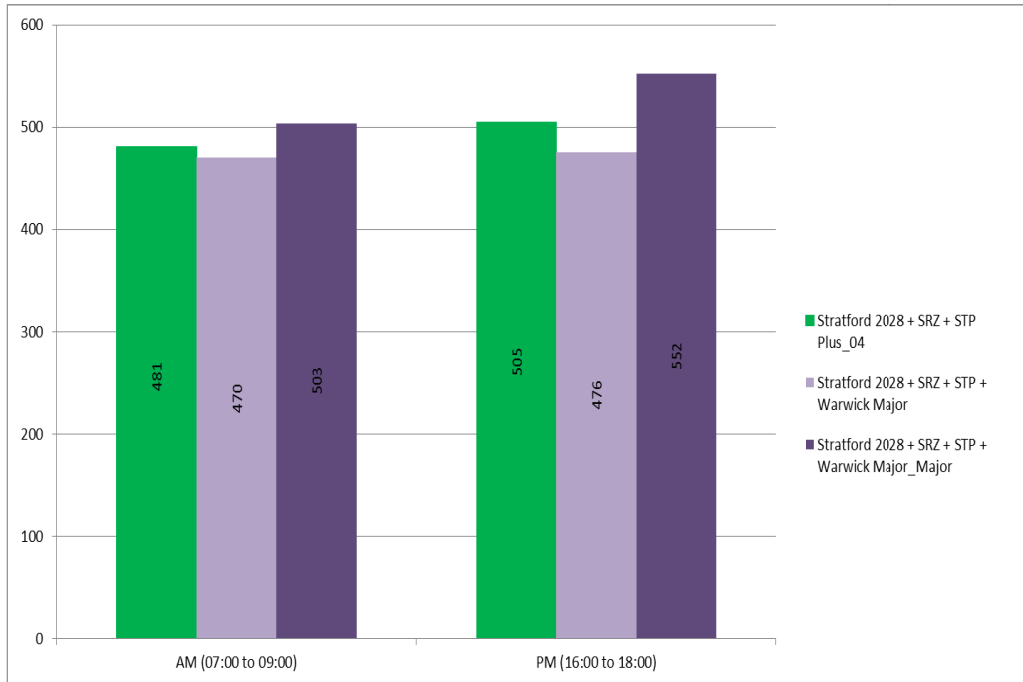
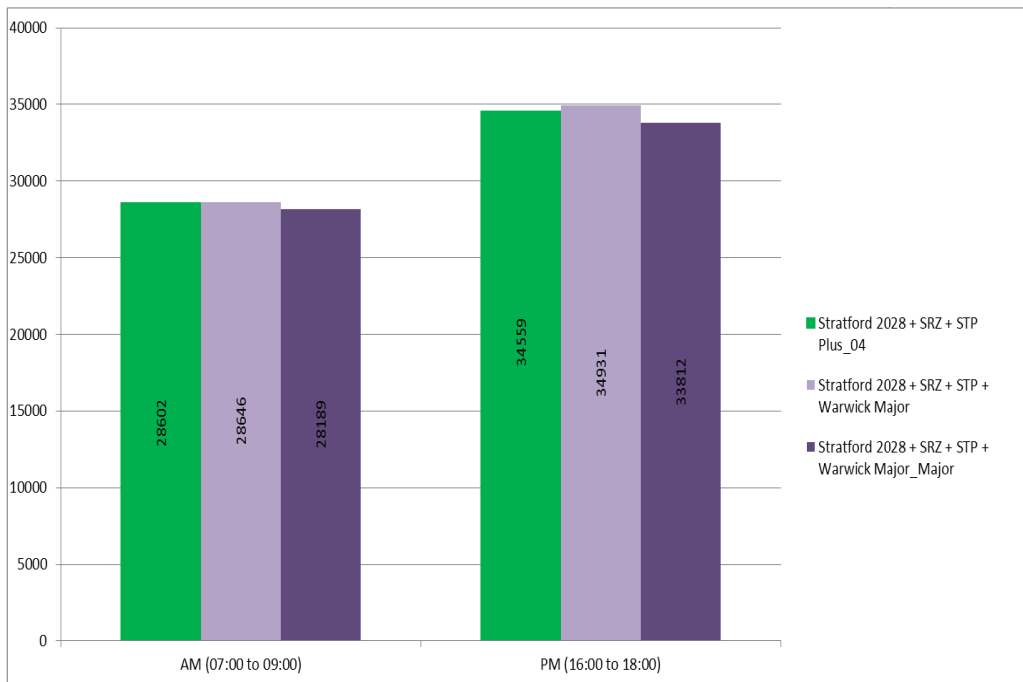


Figure 17 - Completed trips (2028 STP Plus_04 vs STP + Warwick_Major vs STP + Warwick_Major_Major)



To understand how much demand is either unreleased or left on the network at the end of the simulation period the number of completed trips has been compared against the total demand levels assigned within the model. This information has been presented within Table 14.

Table 14 - Completed trips Analysis (2028 Ref vs. SRZ)

	AM (07:00 to 10:00)			PM (16:00 to 19:00)		
	Demand	Completed	Completed (%)	Demand	Completed	Completed (%)
STP Plus_04	30735	28602	93.06%	37607	34354	91.35%
STP Plus_04 + Warwick_Major	30735	28646	93.20%	37607	34931	92.89%
STP Plus_04 + Warwick_Major_Major	30735	28189	91.72%	37607	33812	89.91%

The previous Table illustrates that revising the Warwick Road signage strategy, at least in the first instance, results in an increase in the number of completed trips and therefore reflects the highest trip completion ratio for both peak periods.

This indicates that, in general, the some signage to encourage drivers to use Warwick Road results in the most favourable outcome, but in order for the road to accommodate the level of users associated with the final scenario would require an upgrade of other areas of the network.

6.7 Maximum Queue Length Analysis

In order to identify the improvements that are possible with the introduction of a dynamic signage strategy on Warwick Road, queue plots have been produced with respect to the Reference Case. The following sets out some initial observations based on the differences in queue lengths between the 2028 Reference Case and 2028 + STP + Warwick Road Major scenarios.

The maps which are referred to within the following analysis are presented within **Appendix A** of this report.

6.7.1 AM Analysis (MQ005)

Analysis of the difference in queuing between the 2028 Reference Case and 2028 + STP + Warwick Road Major scenarios, during the AM period, reveals the following:

- There are two instances of very severe increases in queue lengths exceeding 50 vehicles on the network at the A4300/Bridgeway Junction and the A4300/Shipston Road/A422 roundabout.
- There are six junctions assessed that trigger the queue increase criteria of between 10 and 25 vehicles
- There are thirteen instances where queue length reductions are expected to occur as a result of increased usage of Warwick Road
- There is a large increase in the number of junctions experiencing queue length reductions when the signage strategy is introduced for Warwick Road (MQ003 v MQ005 and MQ004 v MQ006)

6.7.2 PM Analysis (MQ006)

Analysis of the difference in queuing between the 2028 Reference Case and 2028 + STP + Warwick Road Major scenarios during the PM period, reveals the following:

- There are two instances of very severe queue length increase occurring at the junction of A439 Warwick Road/Bridgeway and the B439 Evesham Road/A4390 Evesham Place roundabout
- There is one instance of a severe queue increase at the A3400 Shipston Road/A422 Banbury Road roundabout.
- There are 12 locations where a moderate increase in queue length is expected to occur
- There are twelve instances where queue length reductions are expected to occur as a result of increased usage of Warwick Road.

6.7.3 Queue Analysis Summary

A summary of the findings obtained through comparing the changes in queuing between the 2028 Reference Case and 2028 + STP + Warwick Road Major scenarios is provided as follows:

- There is a large increase in the number of junctions experiencing queue length reductions when the signage strategy is introduced for Warwick Road (MQ003 v MQ005 and MQ004 v MQ006)
- As a result of re-routed traffic, there is a small increase in the number of junctions experiencing very severe increases in queue length as a result of the signage strategy.

6.8 Economic Analysis

Whilst it is intended that some of the other schemes that are to be promoted as part of the STP will be subject to further more detailed cordon and economic analysis it is not possible to undertake such analysis of the signing strategy tests along the Warwick Road. As a result some outline economic analysis has been undertaken to ascertain an outline economic value of the benefits of implementation of the strategy. Once the costs of implementation have been ascertained these could be used to provide a very high level Benefit Cost Ratio (BCR) for the scheme implementation. An overview of the initial economic assessment has been provided as follows:

The total benefits of the scheme have been calculated in line with WebTAG guidance for the Do Something scheme compared with the Do Nothing. The opening year of the scheme was taken to be 2021 with benefits beginning in this year and the final year of the 60 year appraisal therefore being 2080. All values were discounted to 2010. Benefits were calculated using 2028 model outputs and were assumed to be constant in all years. Calculations were made for the AM (0700-0900) and PM (1600-1800) periods only and annualised using a factor of 253 (number of weekdays in a year). No benefits were calculated outside of the peak periods and weekdays. The benefits reported are therefore conservative as it

is likely there would also be benefits outside of the periods for which the calculations have been made.

The scheme has large time saving benefits of over 160,000 person hours per annum. These account for the majority of the scheme benefits. There are also vehicle operating cost savings as a result of increases in average speed across the network and carbon emission benefits resulting from reduced fuel consumption. Over the 60 year appraisal the Present Value of Benefits discounted to 2010 is £88.5 million.

Table 15 - Economic benefits of implementing an effective signage strategy on Warwick Road

	PVB (£ million)
Time savings	83.4
Vehicle operating costs	5.2
Indirect tax revenues	-1.2
Carbon emissions	1.1
Total benefits	88.5

6.9 Summary

Whilst more detailed analysis is required to determine the specific strategy, the results strongly support implementation of a dynamic signage strategy on Warwick Road but indicate that if the road becomes ‘too attractive’ other junctions on the network would require an upgrade to service the rerouted traffic. The initial analysis set out within the previous section of this report reveals the following:

- All network performance measures improve to an extent (more notably during the PM peak period) with some signage is implemented along Warwick Road to encourage road users along this route
- The initial signage strategy along Warwick Road results in virtually no change in the average journey distance but speeds are increased slightly with the effect more pronounced during the PM peak period
- The number of completed trips remains relatively unchanged during the AM peak period but increases by approximately 50 trips compared to the reference case during the PM peak period, however the trip completion rate is higher during both periods
- Under this signage strategy there are two instances of very severe queue length increases occurring at the junction of A439 Warwick Road/Bridgeway and the junction of B439 Evesham Road/A4390 Evesham Place roundabout. However there are multiple instances of queue length reductions expected during both peak periods
- The 60 year economic benefit of this change to Warwick Road is valued at £88.4 million.

7 Revised mode share assumptions

7.1 Overview

The final stage of this assessment was to identify the incremental impact on the network performance if there was a 15% shift in mode share. Currently, the SRZ policy assumes a 15% reduction in trips as they transfer from private car to sustainable modes. For the final scenario, this reduction has been ignored in order to identify the potential impact if the development was delivered without the 15% mode shift.

7.2 Model Stability

The apparent network stability exhibited within the AM and PM simulation runs across the scenarios is illustrated in the following Table 16:

Table 16 - Model Stability Assessment (2028 STP Plus_04 vs STP Mode Share)

	7 Stratford 2028 + SRZ + STP Plus_04	10 Stratford 2028 + SRZ + STP Plus_04_sensitivity
AM	100%	90%
PM	100%	70%

Given the relatively limited sample size of 20 runs it is reasonable to conclude from the previous table, that during the AM peak period, there is no notable change in model stability across the scenarios. During the PM peak period however, the model stability is reduced when the additional demands are included within the model network.

7.3 Network Wide Statistics

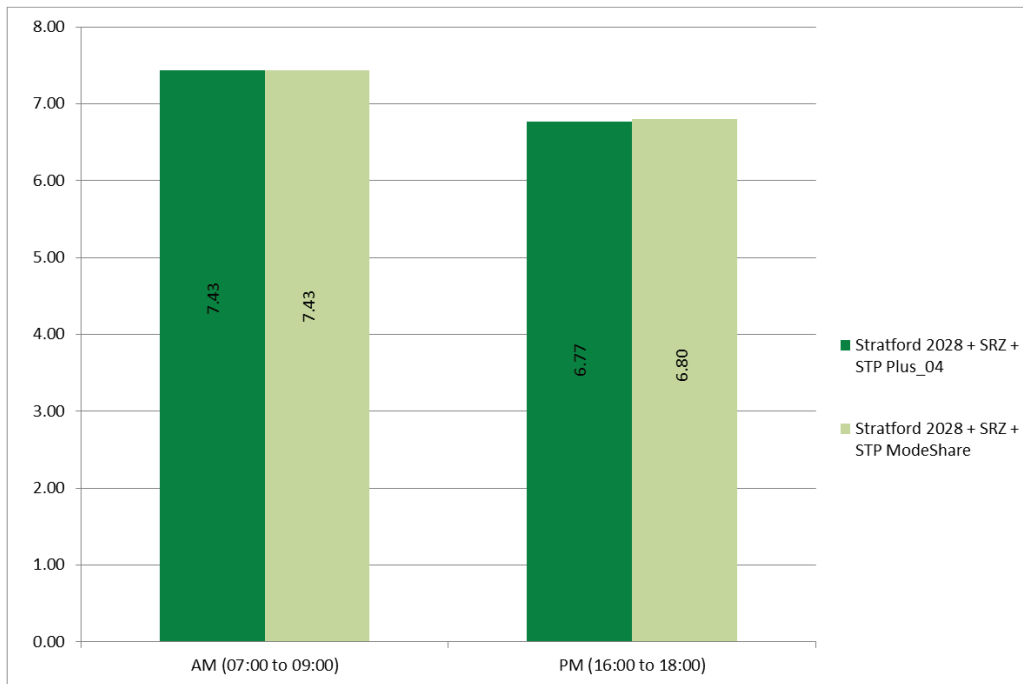
The following set out the changes in network wide statistics between the STP Plus_04 and the mode share sensitivity scenario.

7.3.1 Average Journey Distance

Analysis of the average journey distance with each scenario, across the entire AM and PM model periods is presented in Figure 18 on the following page.

Analysis of the Figure on the following page indicates there is almost no difference between the average journey distance between the two scenarios for both the AM and PM peak periods. This indicates that there are no additional impacts on routeing and assignment thereof within the model as a result of the inclusion of the extra demand within the model.

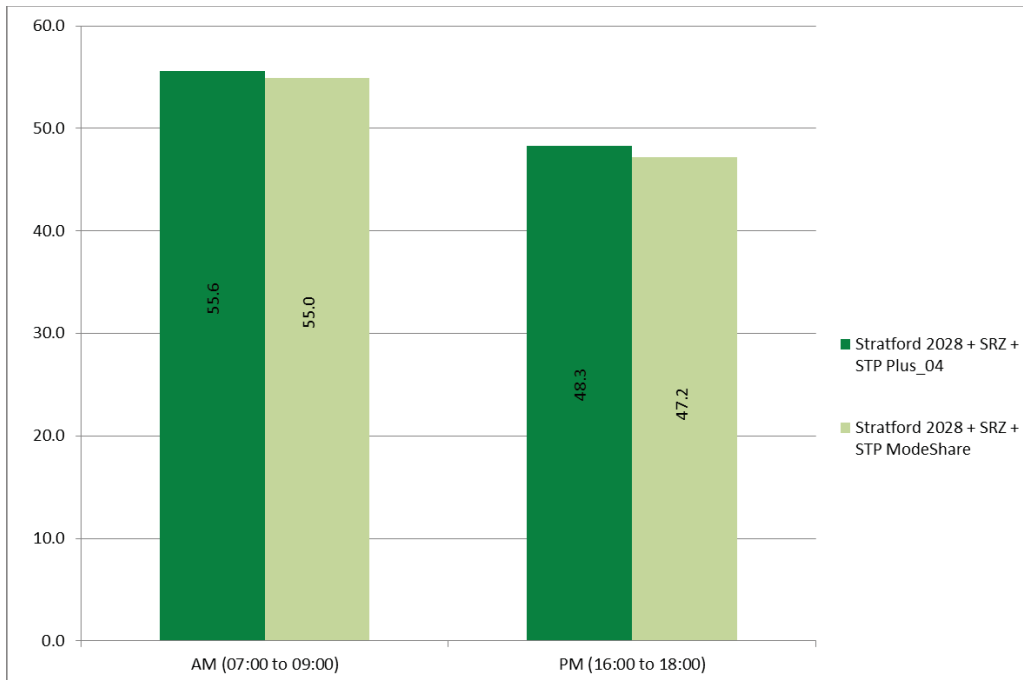
Figure 18 - Average Journey Distance (2028 STP Plus_04 vs STP Mode Share), km



7.3.2 Average Journey Speed

Analysis of the average journey speed (km/h) within the two scenarios, across the entire AM and PM model periods, is presented within the following Figure 19:

Figure 19 - Average Journey Speed (2028 STP Plus_04 vs STP Mode Share), km/h



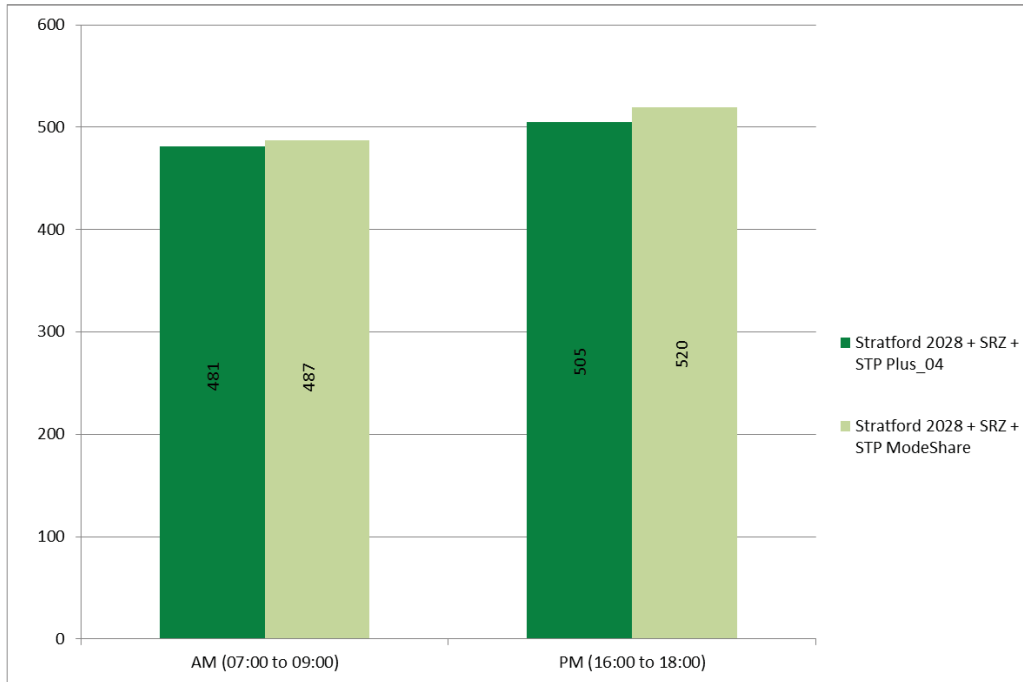
The previous figure demonstrates that the sensitivity scenario results in a slight drop in the average speed of vehicles on the network during both peak periods.

The drop in average speeds is likely to be indicative of the assignment of the additional demand and associated congestion effects but it should be noted that this is a very minor change.

7.4 Average Journey Time (Seconds)

Analysis of the average journey time, in seconds, within each scenario across the entire AM and PM model periods is presented in Figure 20:

Figure 20 - Average Journey Time (2028 STP Plus_04 vs STP Mode Share), km/h



Analysis of the difference in journey time across the scenarios indicates an increase in the time it takes to complete a journey when compared to the STPPlus04 scenario of around 1% and 3% in the AM and PM peak periods. This increase will be as a result of the additional demand that has been assigned across the network.

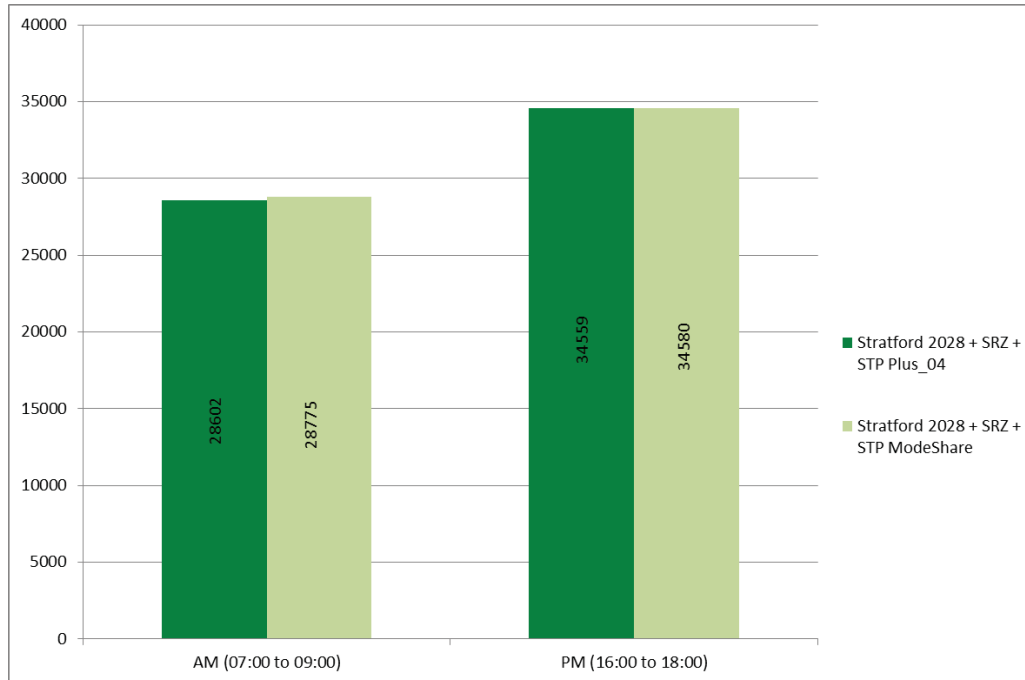
Overall it can be assumed that there will be a general increase in the average time spent travelling on the network once the additional demand has been assigned to the network.

7.4.1 Completed Trips

Analysis of the total number of completed trips within each scenario, across the entire AM and PM model periods, is presented within Figure 21.

Analysis of Figure below indicates that there is an increase in completed trips of less than 1%, in both the AM and PM periods, when compared to the 2028 STP Plus_04 scenario.

Figure 21 - Completed trips (2028 STP Plus_04 vs STP Mode Share)



To understand how much demand is either unreleased or left on the network at the end of the simulation period the number of completed trips has been compared against the total demand levels assigned within the model. This information has been presented within the following Table 17:

Table 17 - Completed trips Analysis (2028 STP Plus_04 vs STP Mode Share)

	AM (07:00 to 10:00)			PM (16:00 to 19:00)		
	Demand	Completed	Completed (%)	Demand	Completed	Completed (%)
Stratford 2028 + SRZ + STP Plus_04	30735	28602	93.06%	37607	34354	91.35%
Stratford 2028 + SRZ + STP Mode Share	31071	28775	92.61%	37968	34580	91.08%

During both the AM and PM peak periods the trip completion ratio reduces. This indicates that additional impacts may be occurred as a result of the inclusion of the additional demands that were previously assumed to be catered for by sustainable modes.

7.5 Summary

The analysis indicates that even if the 15% shift in mode share that the SRZ policy assumes is not achieved, the additional impacts on the network are unlikely to be substantial. Whilst network conditions do worsen slightly with increased journey times and distances, these are in the order of 1-2%.

Detailed analysis may be required during the planning stage to ascertain whether there are any specific areas likely to suffer additional impacts as a result of the failure to achieve the 15% mode share assumptions as such areas may benefit from further, specific, mitigation.

8 Scheme Review Findings

The following is intended to provide a short summary of the progress regarding each of the proposed schemes that comprise the Stratford Transport Package (STP).

The final, outline, scheme drawings which reflect the schemes that are likely to comprise the complete STP are presented within **Appendix B**. A series of summary Technical Notes have been produced whilst the review was being undertaken and these have been provided, for information purposes, within **Appendix C** of this Report.

8.1 Scheme Analysis

In addition to the analysis set out previously a review of the schemes that are to be promoted through the STP has also been undertaken. The purpose of the review was twofold:

- 1) To review the feasibility and deliverability of the proposed schemes both in terms of highway feasibility as well as any local considerations.
- 2) To undertake some initial, high level, analysis pertaining to the potential benefits that could be unlocked as a result of the delivery of each of the additional schemes.

8.2 Outline Scheme Review

Each of the schemes is summarised separately as follows:

8.2.1 Scheme 01 – Tiddington Road/Shipston Road Gyratory & Bridgeway/Bridgefoot Gyratory

Scheme 01 & 02 are considered feasible and should now be promoted as a single strategy. Detailed cordon analysis should be considered to ascertain an economic value of delivery and provide further, more detailed, analysis regarding the potential benefits of delivery.

Further refinement is also recommended in order that it can be established that the scheme that is being proposed reflects the optimum scheme.

It is anticipated that further refinement would be informed through the completion of the following steps during that process:

- 1) Undertake an NMU survey of the area to understand pedestrian and cyclist demands.
- 2) Development of a LinSig model of the scheme which demonstrates that the scheme can be delivered in a manner which will either maintain or enhance the level of NMU provision.

8.2.2 Scheme 03 – Evesham Road/Evesham Place

Scheme 03 is considered feasible and will continue to be promoted as a single strategy.

Consideration should be given as to whether delivery of a linked signalised scheme at Grove Road/Rother Street junction would further reduce and queuing issues in this area.

A feasibility review of proposals at the Grove Road/Rother Street junction may also be required.

8.2.3 Scheme 04 – Grove Road/ Rother Street one-way system

This scheme is considered unfeasible and it is therefore recommended that it should be removed from the Stratford Transport Package. It is recommended that work is undertaken to assess potential improvements that can be delivered in the area of the Grove Road/Rother Street junction separately.

8.2.4 Scheme 05 – Birmingham Road/Windsor Street

This scheme is considered unfeasible at this time. No further work is anticipated within this area at this stage.

8.2.5 Scheme 06 & 07 – Shipston Road/Seven Meadows Road and Shipston Road/Clifford Lane Roundabout

Scheme 06 and 07 are considered feasible and will continue to be promoted as a single strategy. The current layout conforms to the required design standards but would require third party land.

8.2.6 Scheme 08 – Birmingham Road NB widening between Regal Road and Hamlet Way

Scheme 08 is considered feasible and will continue to be promoted as a single strategy. At this stage there are no further changes to the proposals anticipated in the short term

The feasibility review and subsequent scrutiny process have identified that there are further enhancements that should be considered for delivery alongside the proposed scheme. In particular by implementing a directional strategy at the Wharf Road/Maybrook Road area there may be further potential to minimise the movements in this area.

Furthermore, there would undoubtedly be benefits in considering linking the scheme proposals with a wider access strategy for the Maybird Retail Park as this could be used to further simplify the movements within the area whilst improving access to the retail facilities. Further work is essential to ascertain a picture of the benefits that could be unlocked as a result of the scheme implementation.

8.2.7 Scheme 09 – Bishopton Roundabout

Scheme 09 is considered feasible and will continue to be promoted as a single strategy. At this stage there are no further changes to the proposals anticipated in the short term however it should be acknowledged that of the scheme is taken forward as a candidate for Major Scheme funding then a further assessment is recommended to determine with more accuracy what the optimum proposals for this area are likely to be.

8.2.8 Scheme 10 – Wildmoor Roundabout

The current scheme assumptions within the modelling, which comprise the dedicated left slip lane, demonstrate that the impacts of the SRZ can be mitigated. The current form of scheme proposed within the modelling would not conform to the standards required by the Highways Agency. To improve visibility the scheme would require third party land.

Any further design and assessment work should be undertaken in conjunction with the HA.

8.3 Scheme Review Summary

Based on the findings of the scheme review it was decided that schemes 04 and 05 would be withdrawn. Further refinement of Scheme 10 is also required before any further assessment of this particular scheme can be undertaken.

8.4 Scheme Assessments

Following the initial review of the scheme proposals an assessment of specific performance indicators relating to each scheme has also been undertaken. The assessment has focussed on the following measures:

- Throughput
- Queuing
- Delay

Initially cordon analysis has been used to identify appropriate values for each of the aforementioned measures. Cordons have been defined across the boundaries of each of the respective schemes. The level of delay and queuing experienced on each of the links within the model has then been captured and aggregated firstly across all links and then, secondly, across all time periods.

An overview of the cordons used to inform the analysis has been provided within **Appendix D**.

Further refinement of this analysis is likely to be required before an accurate understanding of the potential benefits of scheme implementation can be identified.

Through the use of pre-defined cordons, the method of analysis of each of the aforementioned performance indicators has been adopted as follows:

- Throughput – has been measured by calculating the total number of vehicles entering each cordon across the entire AM and PM model period.
- Queuing – has been measured by calculating the average maximum queuing levels, in metres, across all links within the cordon boundary. These have been aggregated across each link and hour to produce a single comparative value for both the Reference Case and Scheme scenarios
- Delay – has been calculated in a similar method to the queuing analysis although the measure used is the average time it takes for vehicles to traverse each of the links within the cordon area.

Each of the measures has been compared to the Reference Case to provide an outline score whereby the reference levels are assumed to be 1. Where a reduction is desirable the scheme performance has been expressed as a function of the Reference Case levels. Where an increase is desirable, i.e. throughput, the opposite approach has been adopted. It should be acknowledged that the current outputs reflect a high level snapshot of the initial levels of scheme performance. It is highly likely that during future stages of refinement the overall level of scheme performance will improve further.

The outcome from this analysis is presented within

Table 18 on the following page. Analysis of the outputs presented within table below reveal that, in all cases, implementation of the proposed schemes are likely to result in a net improvement in conditions overall.

In most cases, considering the performance across both the AM and PM time periods queuing levels are likely to reduce considerably. Similarly, in most cases, there is an increase in throughput albeit the impact, relative to the Reference Case, is less than the impact on queuing. When considering the impact on delay within the cordon the initial analysis appears to indicate that implementation of the schemes increase the travel time within the cordon assessment areas. However, since the schemes are drawing more vehicles through the area there is potential that this increase is linked to more vehicles travelling through the area. This seems more likely given the fact that queuing levels are observed to reduce in every scheme assessment.

As has been mentioned previously, this analysis should be superseded by a more detailed stage of analysis prior to drawing any final conclusions with regards the potential performance level of each scheme.

Table 18 - Relative Scheme Performance (AM & PM Combined)

Scheme	Queuing	Throughput	Delay	Total
1	0.76	1.00	1.23	2.99
2	0.63	0.98	1.19	2.80
3	0.52	0.98	1.38	2.88
6 & 7	0.26	0.95	0.52	1.73
8	0.53	0.94	1.06	2.52
9	0.47	0.92	1.07	2.46

8.5 Summary

The feasibility review of the schemes has revealed that Schemes 04 and 05 should not be progressed as there are issues related with the delivery of the schemes that are unable to be overcome.

The impact analysis associated with the scheme delivery has also revealed that Schemes 06 and 07 are most likely to unlock the greatest benefits whilst the benefits of delivering Scheme 1 are the least discernible at this stage. It should be noted that further refinement of all schemes is likely to be required before it can be determined how closely what has already been modelled reflects the likely, optimum, proposals for the areas.

9 Refined Stratford Transport Package Assessment

9.1 Overview

The final stage of this assessment was to review the performance of the network following under a refined network model scenario. This final scenario was built by utilising the results of the previous scenarios to build a refined network that introduces the SRZ Policy with optimal network statistics.

9.2 Model Stability

An initial assessment of the level of model stability was undertaken by comparing the number of completed runs against the number of runs assumed to have failed, as outlined earlier within Section 3.2.

The apparent network stability exhibited within the AM and PM simulation runs across the two scenarios is illustrated in the following Table 19:

Table 19 - Model Stability Assessment (2028 Ref vs 2028 SRZ vs STP Refined)

	2028 Reference Case	2028 + SRZ	2028 + SRZ + STP Refined
AM	100%	100%	93%
PM	90%	80%	93%

Given the sample size it is reasonable to conclude from the previous table, that there are no notable differences between the three scenarios when considering network stability. All scenarios effectively demonstrate the same level of stability within two runs.

9.3 Network Wide Statistics

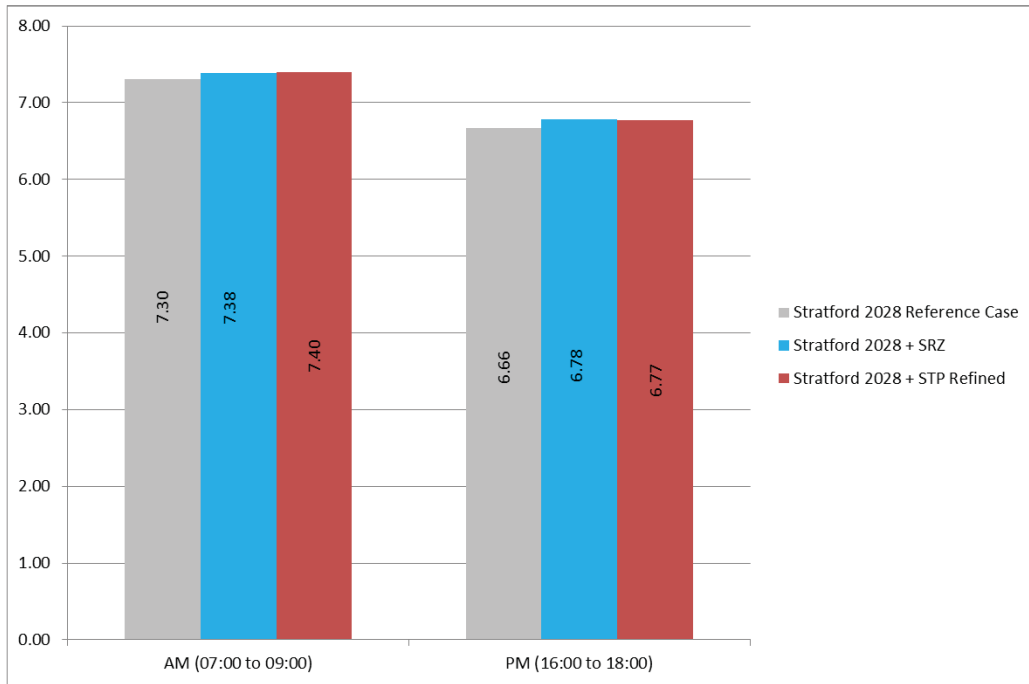
The following set out the changes in network wide statistics between the 2028 Reference Case, the Revised Allocation Scenario and the refined network scenario.

9.3.1 Average Journey Distance

Analysis of the average journey distance travelled with each scenario, across the entire AM and PM model periods is presented in Figure 22 on the following page.

Analysis of Figure 22 indicates there is relatively no difference in average journey distances across the three scenarios in both peak periods. Thus the SRZ strategy can be introduced under the refined scenario with relatively no effect on the average journey distance across the network.

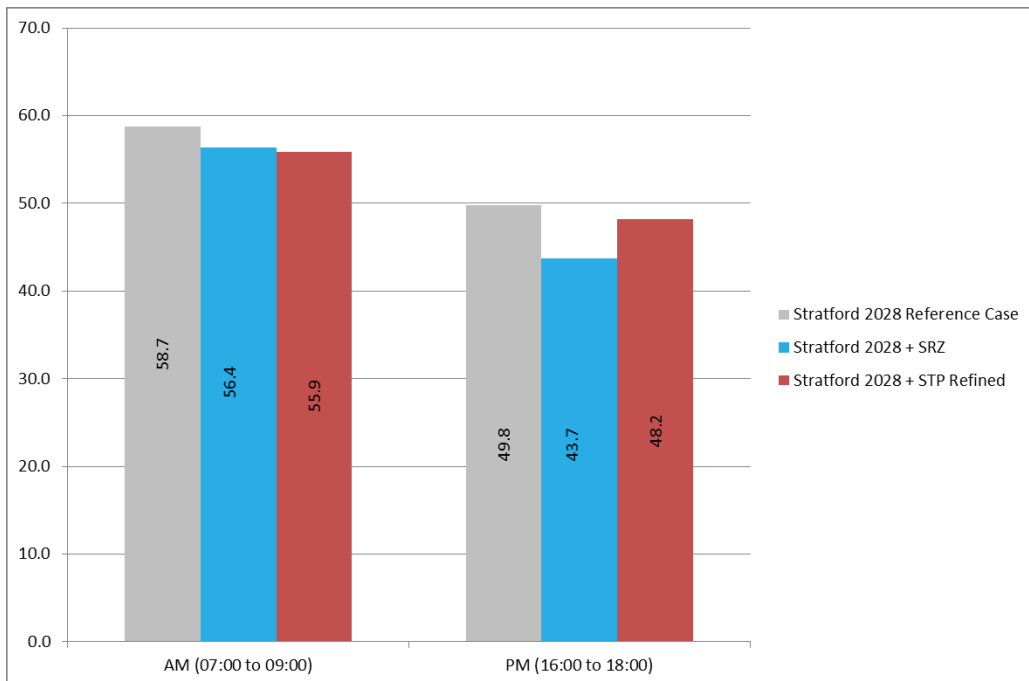
Figure 22 - Average Journey Distance (2028 Ref vs 2028 SRZ vs STP Refined), km



9.4 Average Journey Speed

Analysis of the average journey speed (km/h) within the three scenarios, across the entire AM and PM model periods, is presented within the following Figure 23:

Figure 23 - Average Journey Speed (2028 Ref vs 2028 SRZ vs STP Refined), km/h

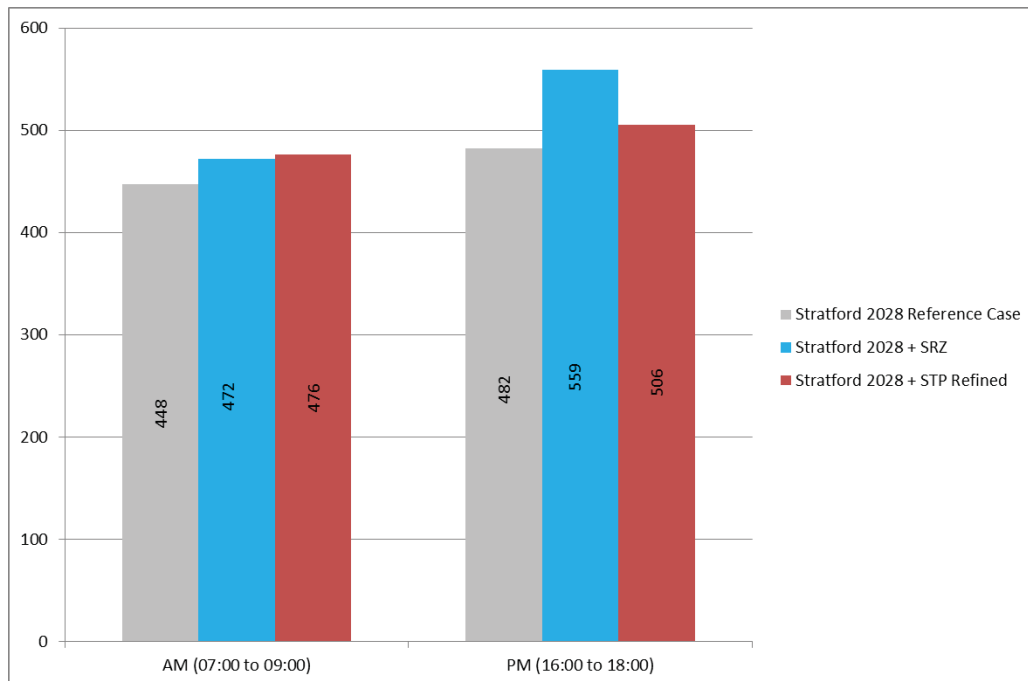


The previous figure demonstrates that whilst the SRZ policy results in a drop in the average speed of vehicles on the network, of approximately 5% and 12% in the AM and PM model periods respectively, this can be reduced to a 4% drop in the PM peak period under the refined network scenario. However, the refined network assumptions are observed to have no effect in the AM peak period when compared to the SRZ scenario.

9.5 Average Journey Time (Seconds)

Analysis of the average journey time, in seconds, within each scenario across the entire AM and PM model periods is presented in Figure 24:

Figure 24 - Average Journey Time (2028 Ref vs 2028 SRZ vs STP Refined), seconds



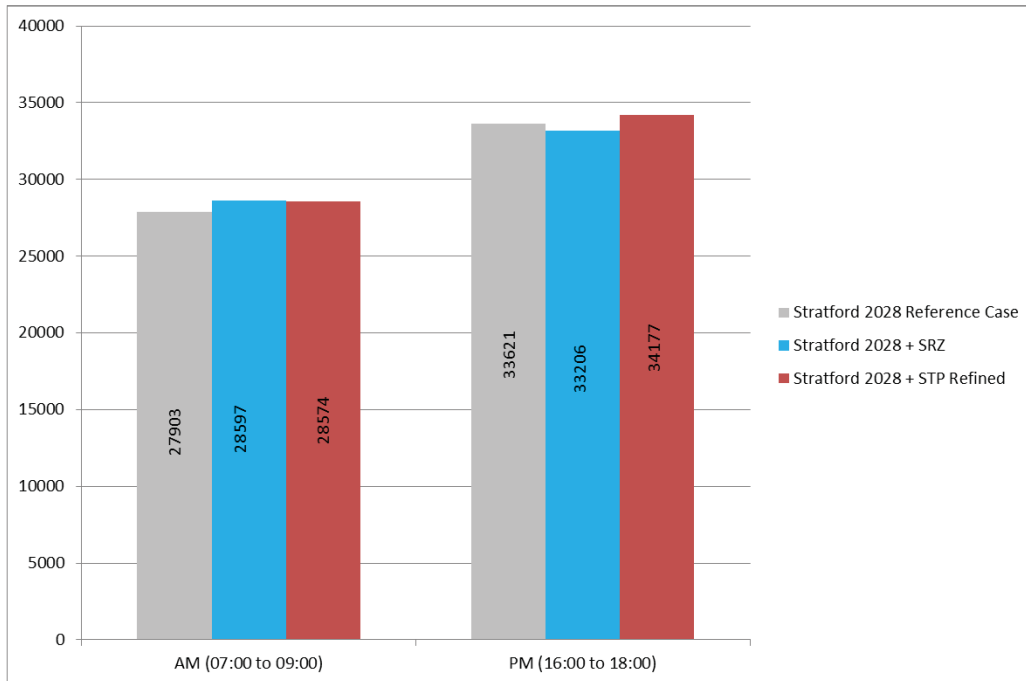
Analysis of the above figure indicates that whilst no improvements are realised during the AM peak period under the refined network scenario, an approximate 10% improvement in average journey time can be realised during the PM peak period under the refined network scenario. Overall the refined network results in an expected 6% and 5% increase in journey times during the AM and PM peak periods respectively when compared to the Reference Case with the additional demand from the SRZ is assigned to the network.

9.6 Completed Trips

Analysis of the total number of completed trips within each scenario, across the entire AM and PM model periods, is presented within Figure 25.

Analysis of Figure 25 indicates that the model is relatively stable in the AM peak period and no additional trips are completed under the refined scenario when compared to the SRZ scenario. During the PM peak period, there is an additional 3% trips completed under the refined scenario when compared to the SRZ scenario and an additional 2% completed when compared to the Reference Case.

Figure 25- 2028 Ref vs 2028 SRZ vs STP Refined), Vehicles



To understand how much demand is either unreleased or retained on the network at the end of the simulation period, the number of completed trips has been compared against the total demand levels assigned within the model. This information has been presented within the following Table 20:

Table 20 - Completed trips Analysis (2028 Ref vs. SRZ)

	AM (07:00 to 10:00)			PM (16:00 to 19:00)		
	Demand	Completed	Completed (%)	Demand	Completed	Completed (%)
Stratford 2028	28976	27903	96.29%	35217	33621	95.47%
Stratford 2028 + SRZ	30735	28597	93.04%	37607	33206	88.30%
Stratford 2028 +SRZ Refined	30735	28574	92.97%	37607	34177	90.88%

The previous Table illustrates that, as a proportion of the demand assigned, the number of trips that are completed during the AM model period, remains relatively constant between the SRZ and the refined scenario during the AM peak period. This indicates that the AM network conditions are able to accommodate some of the additional demands assigned within the model network without issue but not all of the additional trips that are assigned within the model network will complete within the simulation period.

Within the PM peak period, the refined scenario sees an approximate 100 additional trips completed as compared to the SRZ scenario. This results in an increased trip completion ratio during this period.

These results indicate that whilst the network is relatively stable during the AM peak period, the refined network scenario is able to better cope with the additional demand on the network under the SRZ policy.

9.7 Maximum Queue Length Analysis

The following sets out some initial observations based on the differences in queue lengths between the 2028 Reference Case and 2028 SRZ Refined Scenario.

The maps which are referred to within the following analysis are presented within **Appendix A** of this report.

9.7.1 AM Analysis (MQ007)

Analysis of the difference in queuing between the 2028 Reference and 2028 SRZ Refined scenarios, during the AM period, reveals the following:

- There is one instance of very severe increases in queue lengths exceeding 50 vehicles on the network at the roundabout of A4390 Seven meadows Road/Wetherby Way.
- There are nine instances where a queue length reduction is occurring.
- From MQ005, the A439 Warwick Road/A3400 Bridgeway junction was experiencing a very severe queue length increase, but it is now experiencing no notable queue length change.
- From MQ005, the A3400Shipston Road/A422 Banbury Road roundabout was experiencing a very severe queue length increase which is now reduced to a severe queue length increase under this refined network scenario.

9.7.2 PM Analysis (MQ008)

Analysis of the difference in queuing between the 2028 Reference and 2028 SRZ scenarios, during the PM period, reveals the following:

- There is one instance of very severe increases in queue lengths exceeding 50 vehicles on the network at the B439 Evesham Road/A4390 Evesham Place roundabout.
- There are many more instances of moderate and severe queue length increase during the PM peak hour than in the AM peak hour.
- There are seven instances of queue length reduction occurring.
- From MQ006, the A439 Warwick Road/A3400 Bridgeway junction was experiencing a very severe queue length increase which is now reduced to a moderate queue length increase under this refined network scenario.

9.7.3 Queue Analysis Summary

A summary of the findings obtained through comparing the changes in queuing between the 2028 Reference Case and 2028 SRZ Refined scenarios is provided as follows:

- During both the AM and PM peak hour there is one instance of a very severe queue length increase. It should be noted that these junctions are not located near the proposed development and so it is reasonable to conclude these are almost at capacity currently. Any additional traffic which travels through these junctions will have a disproportionate impact on the junction performance

- The introduction of the refined network results in a reduction in the number of very severe queue length increases over the STP + Warwick Major scenario. However, there is an increase in junctions experiencing a moderate to severe queue length increase. Therefore it can be concluded that the refined scenario results in a more even spread of traffic and therefore queues across the network.

9.8 Summary

The analysis within the previous section of work reveals the following:

- The introduction of the refined network scenario results in a general improvement in key performance indicators when considering the 2028 SRZ scenario.
- The effect on results is more notable for all performance indicators during the PM peak period as opposed to the AM peak period where results are relatively stable across scenarios
- During the PM peak period, the refined scenario results in an approximate 4% drop in average speeds as compared to the SRZ scenario which results in a 12% drop
- The average journey times are increased by 5% and 6% across the network during the AM and PM peak periods respectively when compared to the reference scenario. (These results represent an approximate 10% improvement on journey times during the PM peak period when compared to the SRZ scenario)
- The trip completion ratio for this scenario is approximately 93% and 91% during AM and PM peak periods respectively which represents an approximate 2.5% increase on the completion ratio for the SRZ scenario during the PM peak period
- The refined scenario reduces the number of junctions experiencing a very severe queue length increase across both periods but there is an overall increase in the number of junctions experiencing moderate to severe queue length increases. This implies that there may be impacts which occur as a result of the reassignment of vehicles across the model network which did not occur previously.
- The instances of severe increases in queue lengths along Seven Meadows Road are directly attributable to the performance of the proposed scheme at Evesham Road/Evesham Place. Further analysis and optimisation of the signals in this area would likely result in a reduction in these impacts compared to those which have currently been presented.

10 Phasing

10.1 Overview

A key element of this work is intended to identify an outline approach to the phasing of these schemes. The basis of the phasing strategy proposed within the following section of this report is based on a number of factors namely:

- 1) The emergence of the need for each of the schemes within previously phases of testing, in particular the original STA Phase 1 Threshold Assessment.
- 2) The latest phase of mitigation refinement.
- 3) The importance of each of the proposed schemes in improving network conditions, the complexities involved in delivering each of the schemes and the ability for schemes to be delivered as one or two single entities.

10.2 Initial Phasing Plan

Based on the outcome of the modelling thus far as well as the threshold testing that was completed in 2012, the following sets out an initial approach to the phasing of the mitigation measures and the rationale thereof:

- 1) The first phase of schemes that should be considered for delivery is the Tiddington Road/Banbury Road signal scheme as well as the Stratford Gyratory. The large queues observed within this area, and particularly along the Banbury Road NB, pose a barrier to all development in this area of Stratford as well as having strategic implications due to the levels of constraint and the high level of delay that can be significantly reduced by the mitigation of this queuing. The package of works presented as schemes 01 and 02 could be progressed as a single mitigation strategy or, if required, discrete packages could be delivered which deal firstly with queuing in the Tiddington Road area and then, subsequently with the Bridgefoot Gyratory.
- 2) Once the aforementioned schemes have been delivered the capacity within the town centre will likely be increased and, as a result, it is reasonable to consider that the Clifford Lane/Shipston Road and Seven Meadows Road/Trinity Way schemes are considered for delivery. Since both schemes are intrinsically linked it is recommended that they are considered for implementation as a single scheme. At the same time consideration should be given to the proposals at Bishopton Roundabout (scheme 09) as this can be progressed in isolation of the other elements which comprise the Stratford Transport Package.
- 3) Phases 01 and 02 are relatively straightforward, represent discrete packages and in some cases are intended to alleviate existing network capacity issues that are forecast to get significantly worse in the future and thus, will prove to be barriers to vehicular movements across the town.
- 4) The third phase should consider the proposals along Birmingham Road for delivery as there is likely to be an increase in vehicular movements NB along Birmingham Road due to the removal of a number of preceding

network constraints, furthermore, the works at Bishopton Roundabout (Scheme 09) would likely benefit from the removal of some of the traffic constraints along the Birmingham Road.

- 5) The final phase that should be considered is the Evesham Place/Evesham Road junction proposals and the gyratory signalisation proposals. This is a scheme of strategic importance. The need for this scheme is more likely to be triggered by the delivery of the Link West of Shotton than the general growth in the area since the link Road is likely to change travel patterns in this area which will exacerbate issues which are likely to occur as result of the overall growth within the area

Based on the information set out previously, the following mitigation phasing strategy is proposed:

- **Phase 1** – Delivery of Scheme 01 & 02
- **Phase 2** – Delivery of Scheme 06/07 & 09
- **Phase 3** – Delivery of Schemes 03
- **Phase 4** – Delivery of Scheme 08

The above sets out an initial approach to the phasing strategy associated with the mitigation measures that have been identified thus far.

It should be acknowledged that the next stages of assessment may identify one or more schemes that unlock significant levels of benefits when compared to the other schemes, or are relatively low cost and ‘shovel ready’ which could impact upon the proposed phasing strategy referred to above.

11 Summary & Conclusions

11.1 Summary

Warwickshire County Council (WDC) and Stratford on Avon District Council (SDC) commissioned Arup to undertake strategic level testing and impact analysis of potential SDC Core Strategy allocations.

The purpose of this report was to document the specific testing, undertaken within the Stratford-upon-Avon PARAMICS model, of a number of potential developments.

The objectives of this stage of analysis are as follows:

- To understand the potential impacts on the Stratford area, of delivering the SRZ Policy
- To test and optimise the schemes proposed as part of the Stratford Transport Package
- To identify impacts of Warwick Road Signage Strategy
- To identify significance of 15% mode share assumptions.

11.1.1 Impact Analysis

Whilst more detailed analysis is still required to determine any localised impacts that are likely to occur as a result of the delivery of one or all of the proposed development sites, the initial analysis set out within the previous sections of this reports indicates:

- The network appears to be more able to accommodate the SRZ demand during the AM peak period than the PM peak period. However the ratio of assigned demand to completed trips is likely to fall across both periods
- There are likely to be negative impacts on journey times and speeds across the network as a result of the assignment of the SRZ and these effects will be more prominent within the PM than the AM
- All network performance measures improve to an extent (more notably during the PM peak period) when a dynamic signage strategy is implemented along Warwick Road to encourage road users along this route
- Of the STP scenarios, that with the most favourable network conditions is STP Plus_04. Whilst unlikely to revert conditions back to those present within the Reference Case, the currently proposed mitigation measures result in a relatively stable result for average journey distance and delays in the AM peak period. However, during the PM peak period, as mitigation measures increase, these network conditions gradually improve.
- The introduction of the refined network scenario results in a general improvement in key performance indicators when considering the STP + Plus_04 and STP + Warwick_Major scenarios.
- Mitigation measures are implemented, generally the key network performance indicators improve across the scenarios. This effect is

always more pronounced during the PM peak period as than in the AM peak period.

- The refined scenario reduces the number of junctions experiencing a very severe queue length increase across both periods but there is an overall increase in the number of junctions experiencing moderate to severe queue length increases when compared to the Reference scenario. This implies that this scenario spreads the additional demand associated with the SRZ policy across the network more evenly than the other scenarios.

11.2 Conclusion

Whilst it should be recognised that the analysis undertaken to date has only focussed on the strategic level impacts, based on the analysis presented within this report, the following conclusions have been drawn:

- There will be impacts on the key network performance indicators associated with the delivery of the SRZ
- There are likely to be significant benefits accrued from the implementation of a dynamic signage strategy along the Warwick Road
- Failure to achieve the 15% mode share target is unlikely to significantly alter the impacts that occur as a result of the SRZ and STP mitigation measures
- The full STP, or similar, is likely to be required but further work may be required to determine whether any additional impacts can be mitigated and whether the scheme that has been proposed represents the optimal solutions, for example:
 - The proposed works on the Birmingham Road (Scheme 08) would likely benefit from consideration of the movements around the Maybird Retail Park as well as reconfiguration of the Wharf Road/Maybird Road arrangement.
 - Further investigation of the signal configuration proposed Around the Tiddington Road/Clopton Bridge/Bridgefoot area (Scheme 01) will be essential to determine an appropriate linkage strategy as well as ensuring each individual junction is proposed to the optimum configuration.
 - Further analysis of the feasibility of delivering a dynamic signage strategy along Warwick Road to ensure the potential benefits and impacts can be better estimated.

Appendix A

SDC STA - SRZ/STP Queue Analysis Plots

A1 Contents

- **MQ001** – 2028 SRZ AM (07:00 to 09:00)
- **MQ002** – 2028 SRZ PM (16:00 to 18:00)
- **MQ003** – 2028 SRZ STP Plus_04 AM (07:00 to 09:00)
- **MQ004** – 2028 SRZ STP Plus_04 PM (16:00 to 18:00)
- **MQ005** – 2028 SRZ STP Plus_04 + WRM AM (07:00 to 09:00)
- **MQ006** – 2028 SRZ STP Plus_04 + WRM PM (16:00 to 18:00)
- **MQ007** – 2028 SRZ STP + STP Refined AM (07:00 to 09:00)
- **MQ008** – 2028 SRZ STP + STP Refined PM (16:00 to 18:00)

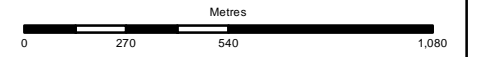


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- between +10 and +25
- between +25 and +50
- greater than +50

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P1	25-11-13	ZW	JE	JE
Issue	Date	By	Chkd	Appd



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Client
Warwickshire County Council

Job Title
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**Stratford 2028 + SRZ
0800 - 0900
Average Maximum Queue**

Scale at A3
N.T.S.

Job No 232815-07	Drawing Status Information
Drawing No MQ001	Issue P1

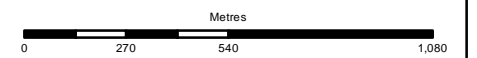


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Job No 232815-07	Drawing Status Information
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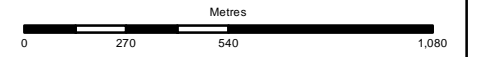


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0800 - 0900
Average Maximum Queue

Scale at A3
N.T.S.

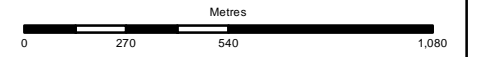
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Drawing No MQ003	Issue P1



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 1700- 1800
 Average Maximum Queue**

Scale at A3
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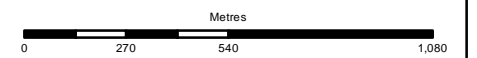


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0800 - 0900
Average Maximum Queue**

Scale at A3
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Job No
232815-07

Drawing Status
Information

Drawing No
MQ005

Issue
P1

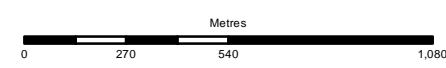


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1700 - 1800
Average Maximum Queue**

Scale at A3
N.T.S.

Job No 232815-07	Drawing Status Information
Drawing No MQ006	Issue P1

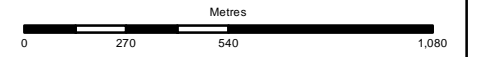


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0800 - 0900
Average Maximum Queue**

Scale at A3
N.T.S.

Job No 232815-07	Drawing Status Information
Drawing No MQ007	Issue P1

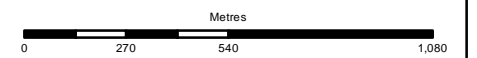


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Scale at A3
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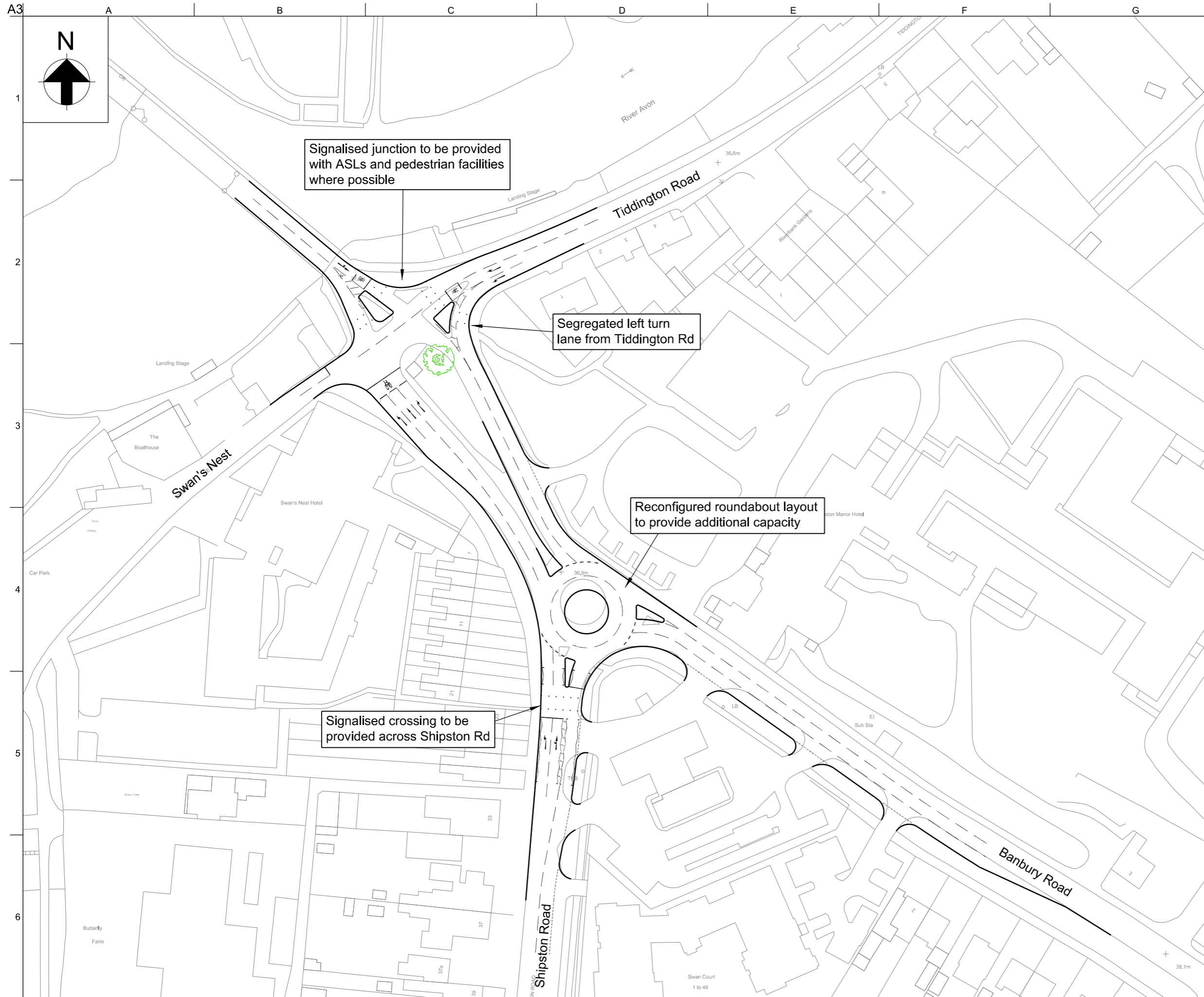
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Appendix B

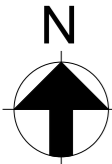
STP Scheme Drawings

B1 Contents

- **Scheme 01 & 02** – Tiddington Road/Shipston Road Gyrotory & Bridgeway/Bridgefoot Gyrotory
- **Scheme 03** – Evesham Road/Evesham Place
- **Scheme 06 & 07** – Shipston Road/Seven Meadows Road and Shipston Road/Clifford Lane Roundabout
- **Scheme 08** – Birmingham Road NB widening between Regal Road and Hamlet Way
- **Scheme 09** – Bishopton Roundabout
- **Scheme 10** – Wildmoor Roundabout – *indicative sketch*



A3



1

2

3

4

5

6

Signalised junction to be provided with ASLs and pedestrian facilities where possible

Segregated left turn lane from Tiddington Rd

Reconfigured roundabout layout to provide additional capacity

Signalised crossing to be provided across Shipston Rd

02	22/11/13	NS	JE	JE
Minor Amendments				
01	04/11/13	NS	JE	JE
First Issue				
Issue	Date	By	Chkd	Appd

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**Stratford Transport
 Package Scheme Review**

Tiddington Road /
 Shipston Road Gyratory

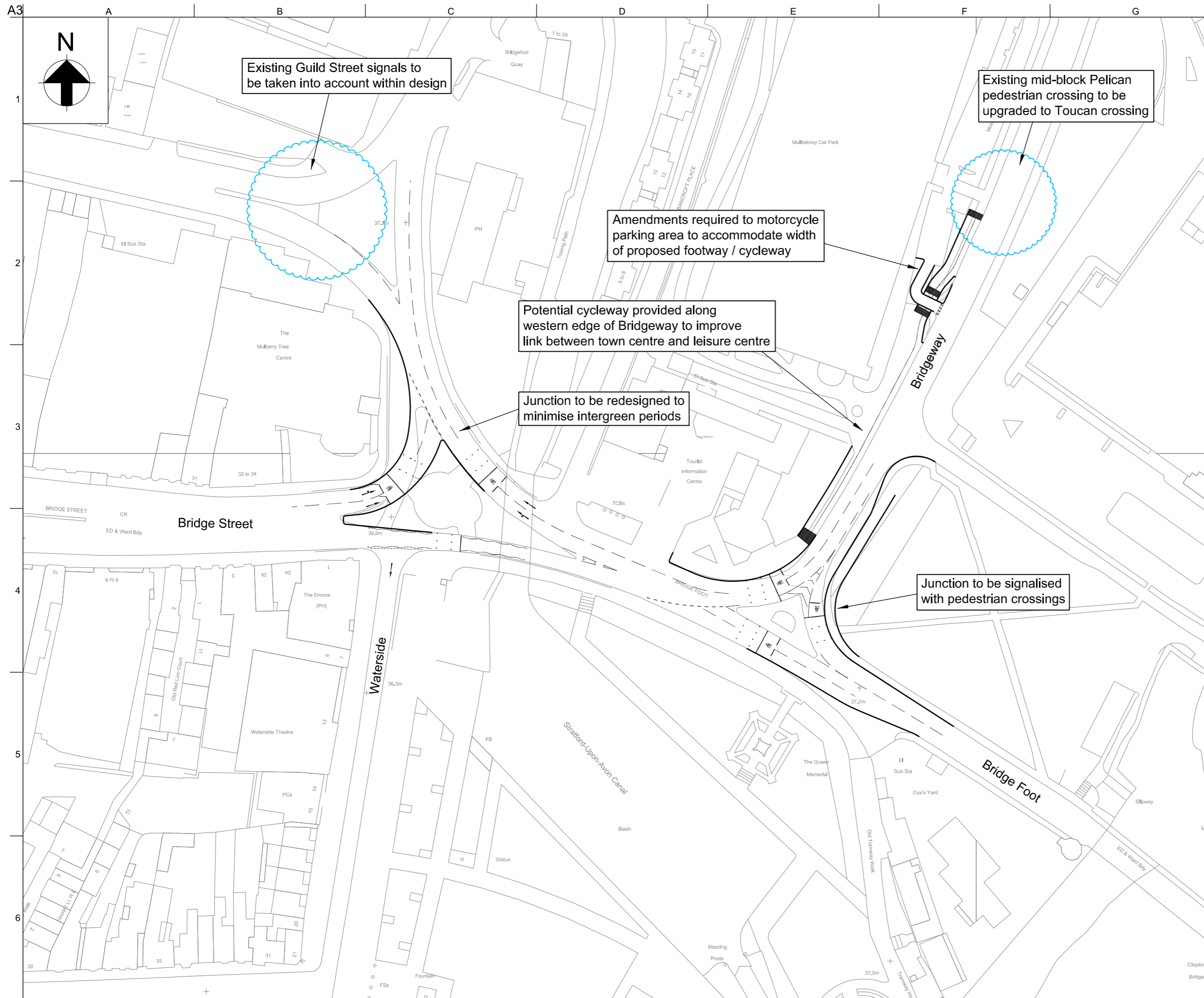
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Discipline **Transport Planning**

Job No **232815-08** Drawing Status **Information**

Drawing No **CH001**

Issue **02**



A3
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6

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Minor Amendments				
01	04/11/13	NS	JE	JE
First Issue				
Issue	Date	By	Chkd	Appd

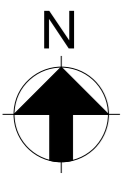
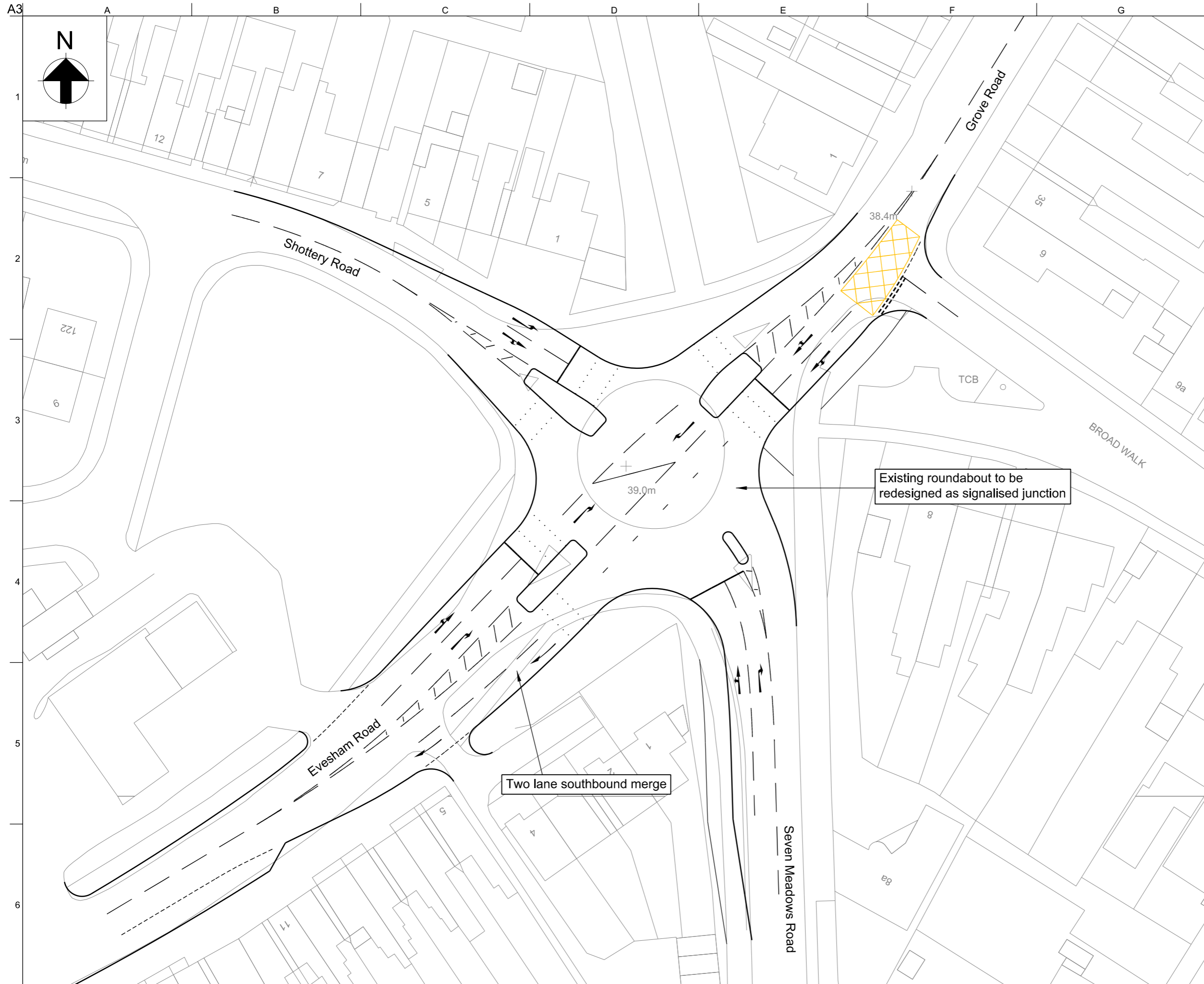
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 Job Title
Stratford Transport Package Scheme Review

Bridge Foot / Bridgeway Gyratory

Scale at A3	1:1000
Discipline	Transport Planning
Job No	232815-08
Drawing Status	Information
Drawing No	CH002
Issue	02



Existing roundabout to be redesigned as signalised junction

Two lane southbound merge

01	04/11/13	NS	JE	JE
First Issue				
Issue	Date	By	Chkd	Appd

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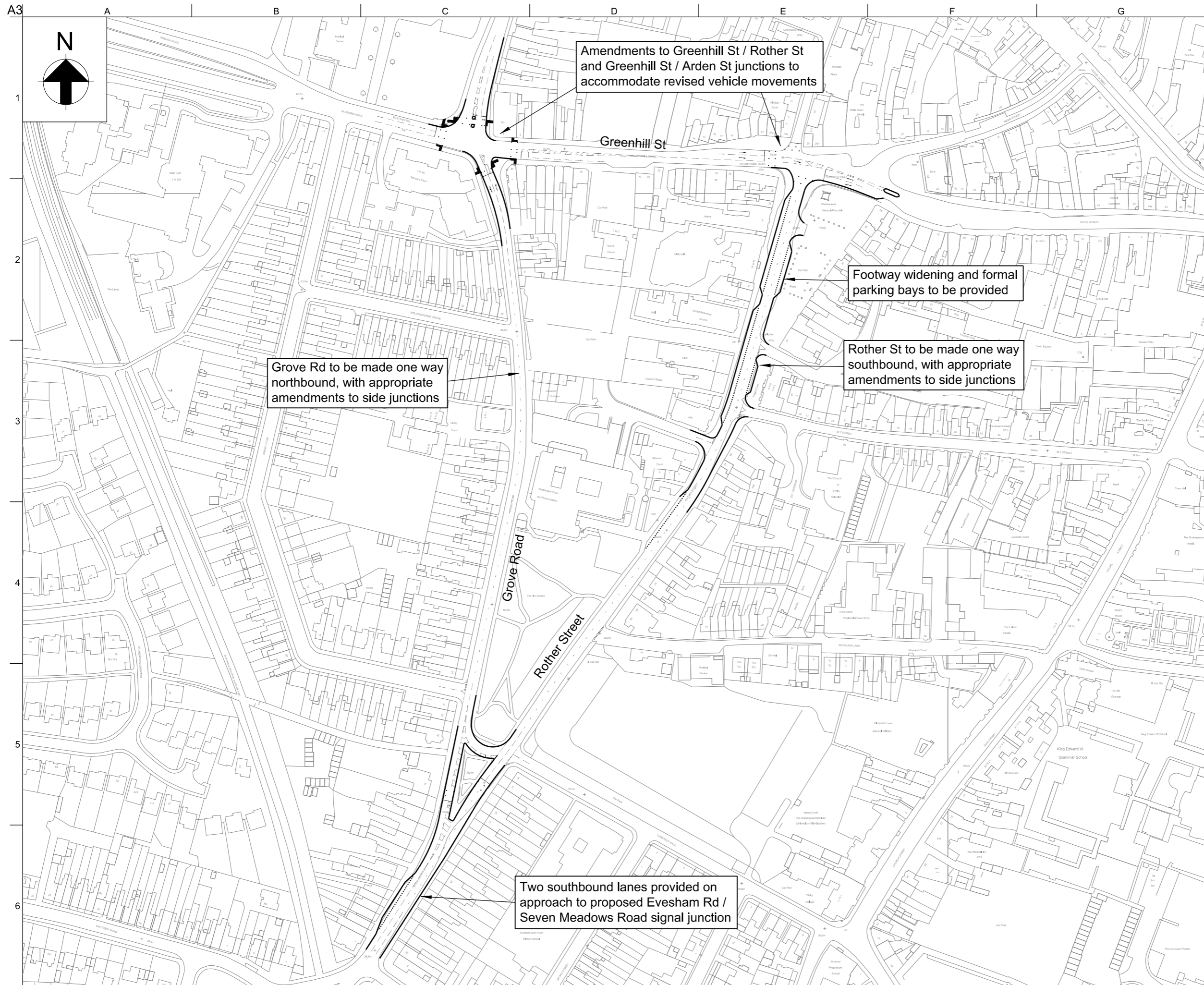
Evesham Place / Evesham Road Roundabout

Scale at A3 1:500

Discipline **Transport Planning**

Job No 232815-08	Drawing Status Information
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Drawing No CH003	Issue 01
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01	04/11/13	NS	JE	JE
First Issue				
Issue	Date	By	Chkd	Appd

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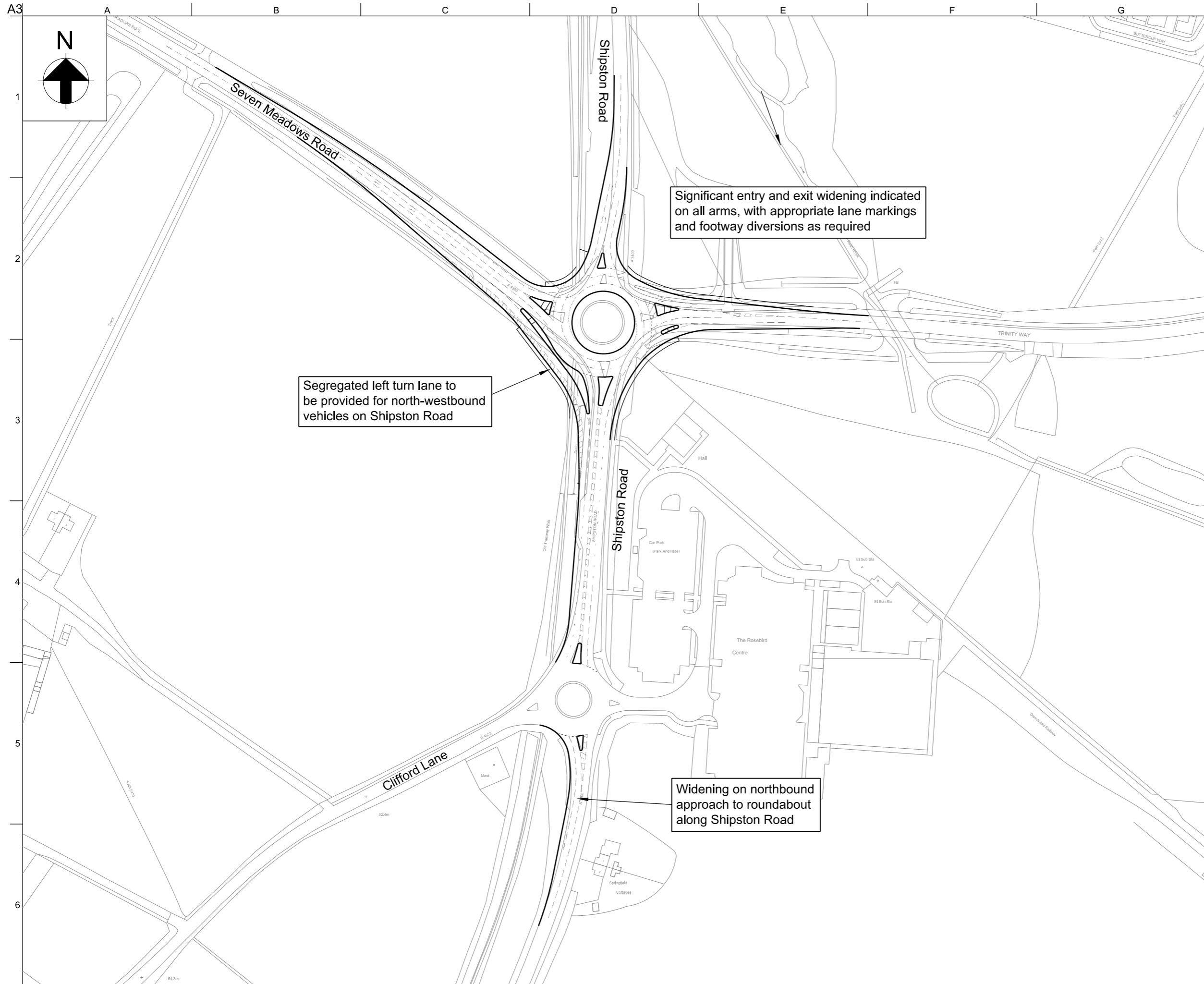
Client



Job Title
**Stratford Transport
 Package Scheme Review**

**Grove Road / Rother Street
 Reconfiguration**

Scale at A3	1:2000
Discipline	Transport Planning
Job No	Drawing Status
232815-08	Information
Drawing No	Issue
CH004	01



Significant entry and exit widening indicated on all arms, with appropriate lane markings and footway diversions as required

Segregated left turn lane to be provided for north-westbound vehicles on Shipston Road

Widening on northbound approach to roundabout along Shipston Road

01	04/11/13	NS	JE	JE
First Issue				
Issue	Date	By	Chkd	Appd

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Job Title
**Stratford Transport
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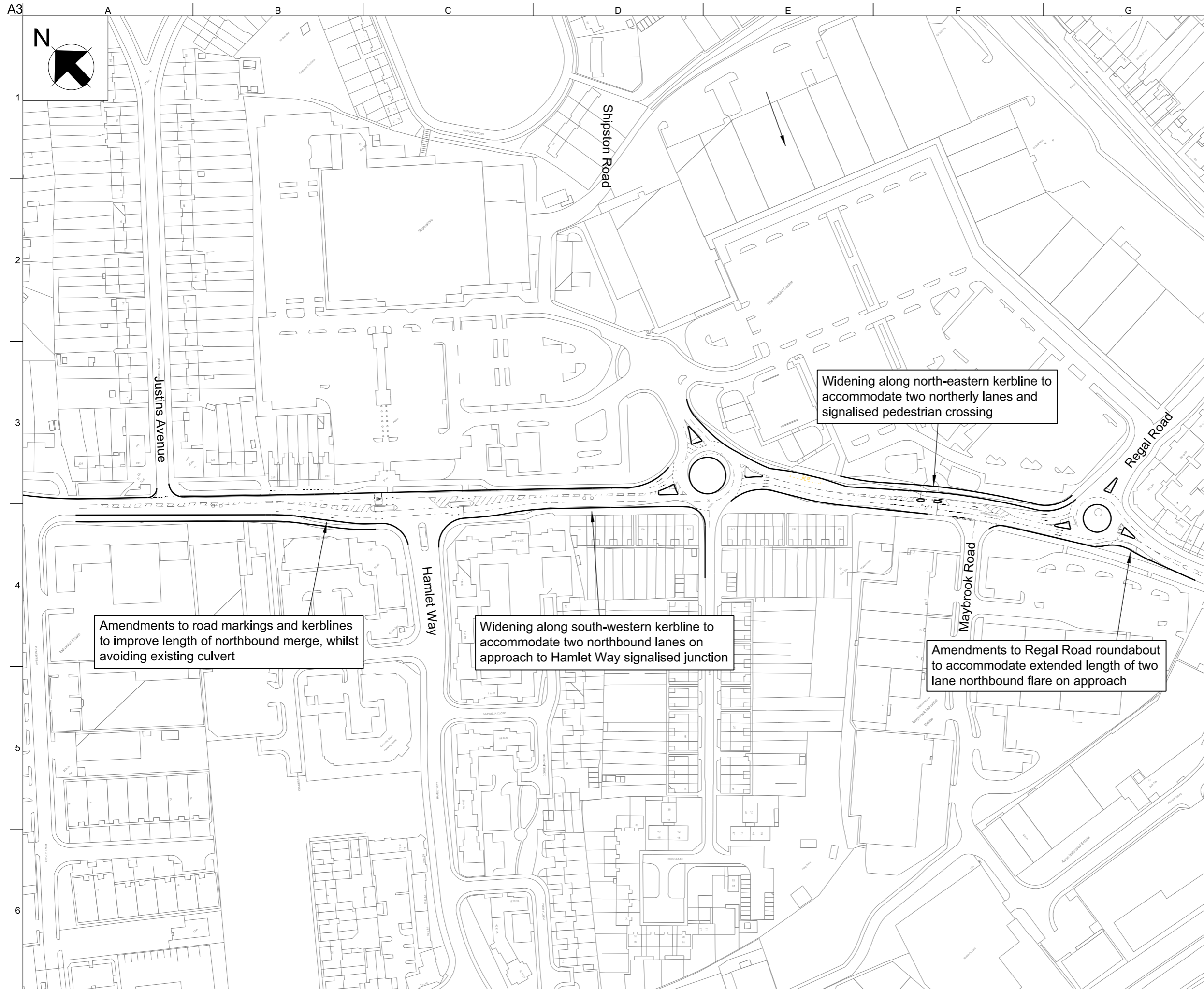
**Shipston Road / Clifford Lane
 and Shipston Road / Seven
 Meadows Road Roundabouts**

Scale at A3 1:2000

Discipline Transport Planning

Job No 232815-08	Drawing Status Information
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Drawing No CH005	Issue 01
----------------------------	--------------------



02	22/11/13	NS	JE	JE
Minor Amendments				
01	04/11/13	NS	JE	JE
First Issue				
Issue	Date	By	Chkd	Appd

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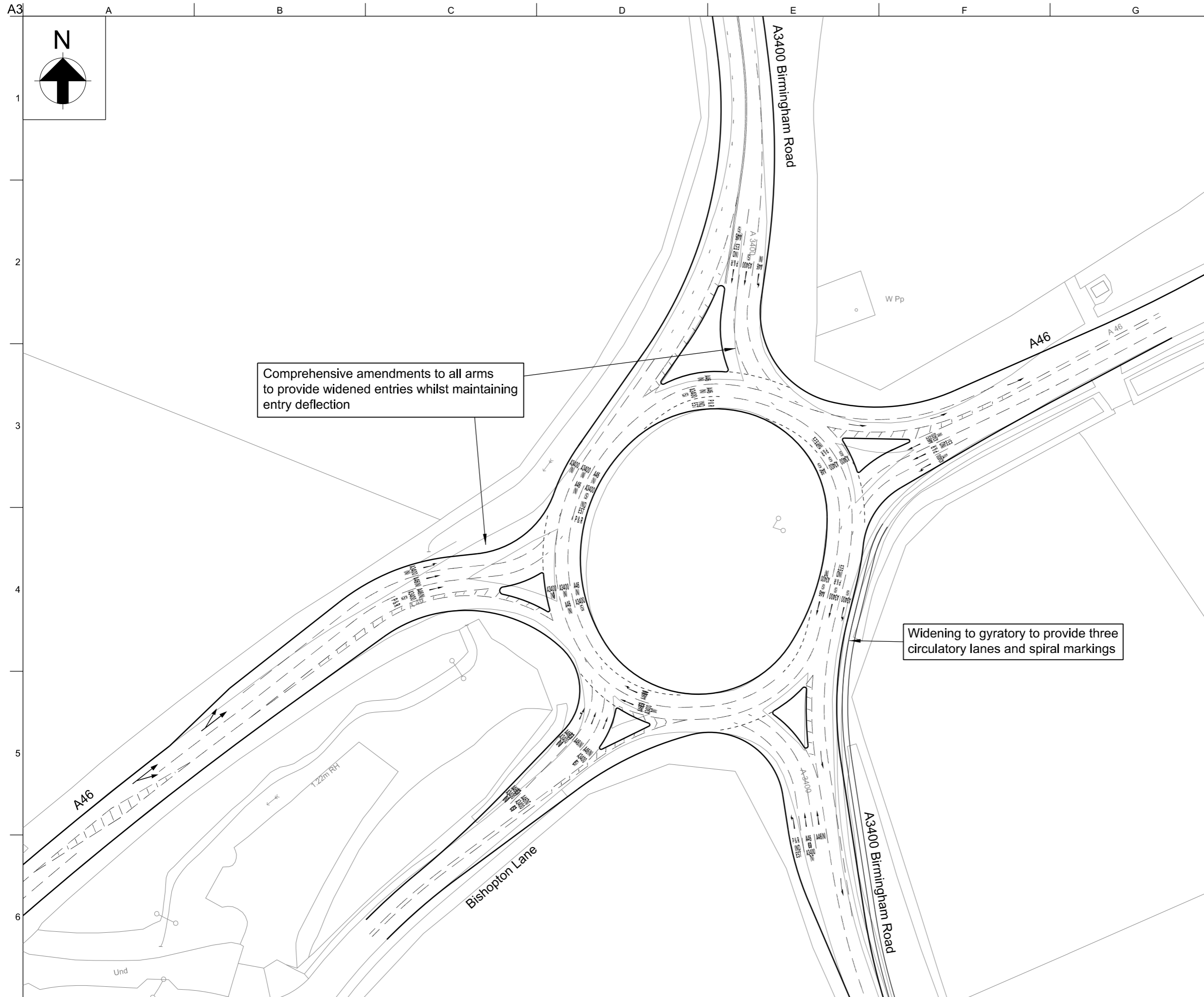
**Birmingham Road Widening
 Between Regal Road and
 Hamlet Way**

Scale at A3 1:2000

Discipline Transport Planning

Job No **232815-08** Drawing Status **Information**

Drawing No **CH006** Issue **02**



Comprehensive amendments to all arms to provide widened entries whilst maintaining entry deflection

Widening to gyratory to provide three circulatory lanes and spiral markings

01	04/11/13	NS	JE	JE
First Issue				
Issue	Date	By	Chkd	Appd

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**Stratford Transport
 Package Scheme Review**

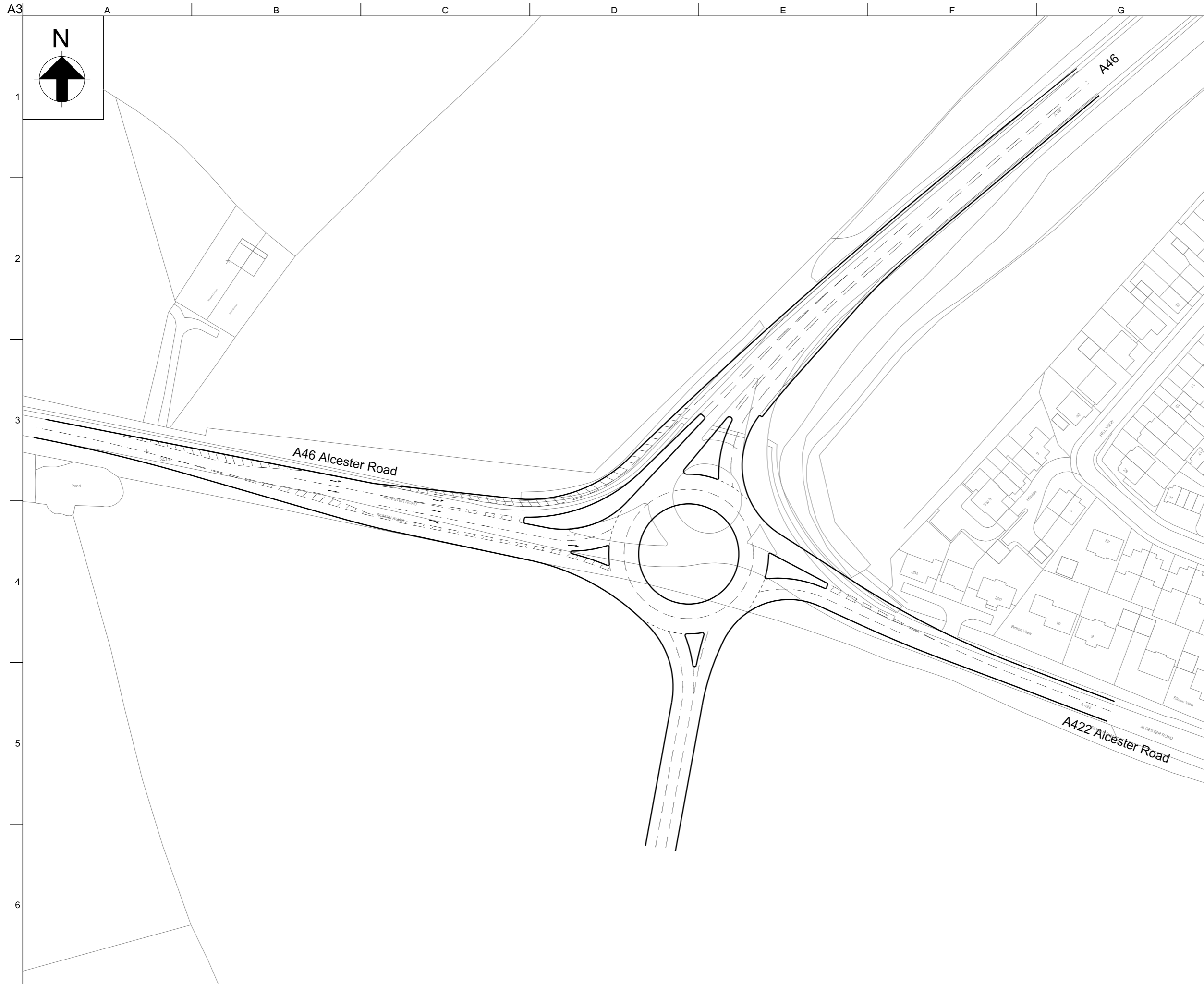
**Birmingham Road / A46
 Bishopton Island**

Scale at A3 1:1000

Discipline **Transport Planning**

Job No 232815-08	Drawing Status Information
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Drawing No CH007	Issue 01
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Do not scale

01	10/04/14	NS	JE	JE
First Issue				
Issue	Date	By	Chkd	Appd

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Client



Job Title
**Stratford Transport
 Package Scheme Review**

**Wildmoor Roundabout
 - Option 1**

Scale at A3 1:1250

Discipline **Transport Planning**

Job No 232815-08	Drawing Status Information
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Drawing No CH008	Issue 01
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Appendix C

STP/SRZ Review Notes

C1 Contents

- 232815-07.TN001 – Outline Scheme Phasing Review
- 232815-07.Memo001 – Scheme Feasibility Notes
- 232815-07.Memo002 – STP Scheme Progress Summary 25.10.2013
- 232815-07.TN002 – STP Initial Scheme Review
- 232815-07 Meeting notes 23131023

File Note

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Project title	Stratford Transport Package Review	Job number	232815-07
cc	Warwickshire County Council	File reference	232815-07.TN001
Prepared by	James Edwards	Date	25 September 2013
Subject	Mitigation Schedule - Outline Phasing Review (DRAFT)		

Introduction

Arup have been commissioned by Warwickshire County Council (WCC) to undertake a review of the mitigation measures that have been identified for implementation within the area of Stratford-upon-Avon.

The mitigation measures have been proposed through previous phases of the Stratford District Council Strategic Transport Assessment (SDC STA). As the Local Plan aspirations and known development proposals emerge there is a need to determine, with more accuracy, the nature of the mitigation measures that should be delivered as well as the benefits of delivery as a whole. In addition to this there is a need to ascertain an appropriate phasing strategy concerning the delivery of the measures so that appropriate resources are allocated to each scheme within a suitable timeframe.

Objective

This document is intended to serve as a working Technical Note, it is intended to set out an initial position regarding a likely phasing strategy. This is based on the outcome of previous stages of assessment as well as the iterative process by which the schemes have been defined within the latest round of modelling.

Scheme Overview

At the time of writing this note, potentially 10 schemes have been identified as likely to mitigate the impacts of Local Plan and general growth as well as addressing issues which currently act to constrain the movement of traffic across the network.

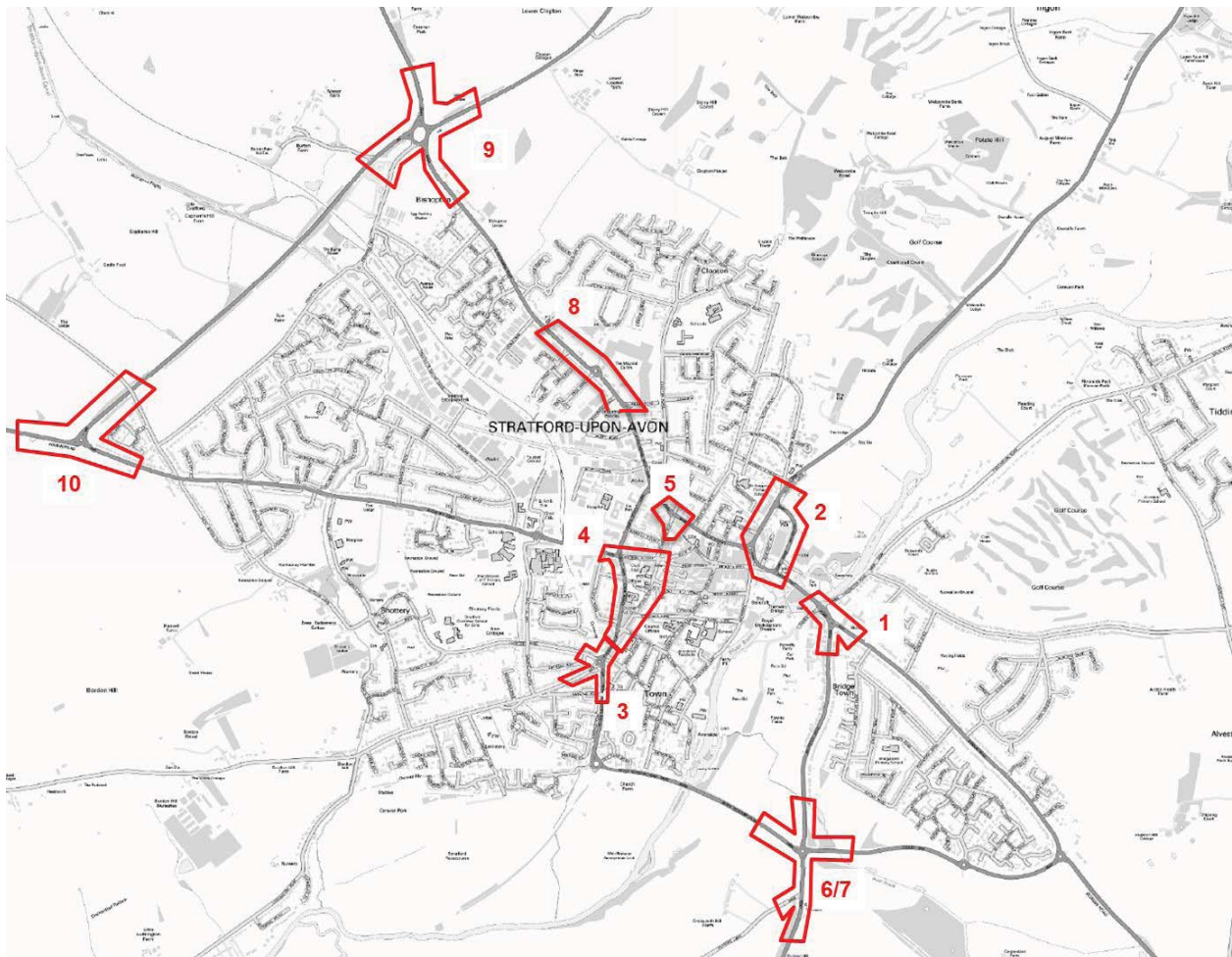
An overview of the extent of the schemes proposed thus far is provided within **Figure 1** on the following page.

File Note

232815-07

25 September 2013

Figure 1 - Scheme Locations



The schemes outlined within the previous figure are only those that have been identified thus far. Furthermore the precise nature of some of these schemes is still to be determined as the optimisation and review process is currently on-going.

An overview of the schemes that have been identified so far is outlined as followed:

Scheme 01

Location - Tiddington Road/Banbury Road 'Alveston Manor' Junction

Issues – Large queues are observed to form along the Banbury Road NB approach to the Banbury Road/Shipston Road roundabout during both AM and PM periods. Similarly, large queues are observed along Tiddington Road within the same period.

The queuing issues are compounded by the restriction of the right turn from Tiddington Road SB to Clopton Bridge NB, vehicles instead have to turn left and then complete a U-turn at the Shipston Road/Banbury Road roundabout which exacerbates the queuing in this area. Within the Reference Case vehicles have been observed using Loxely Road/Tiddington Road as a means of by-passing the large queue along the Banbury Road NB.

Delivery of a scheme at the Clifford Lane/Seven Meadows Road junctions will unlock a substantial amount of capacity which will, in turn, increase the traffic volumes in this area.

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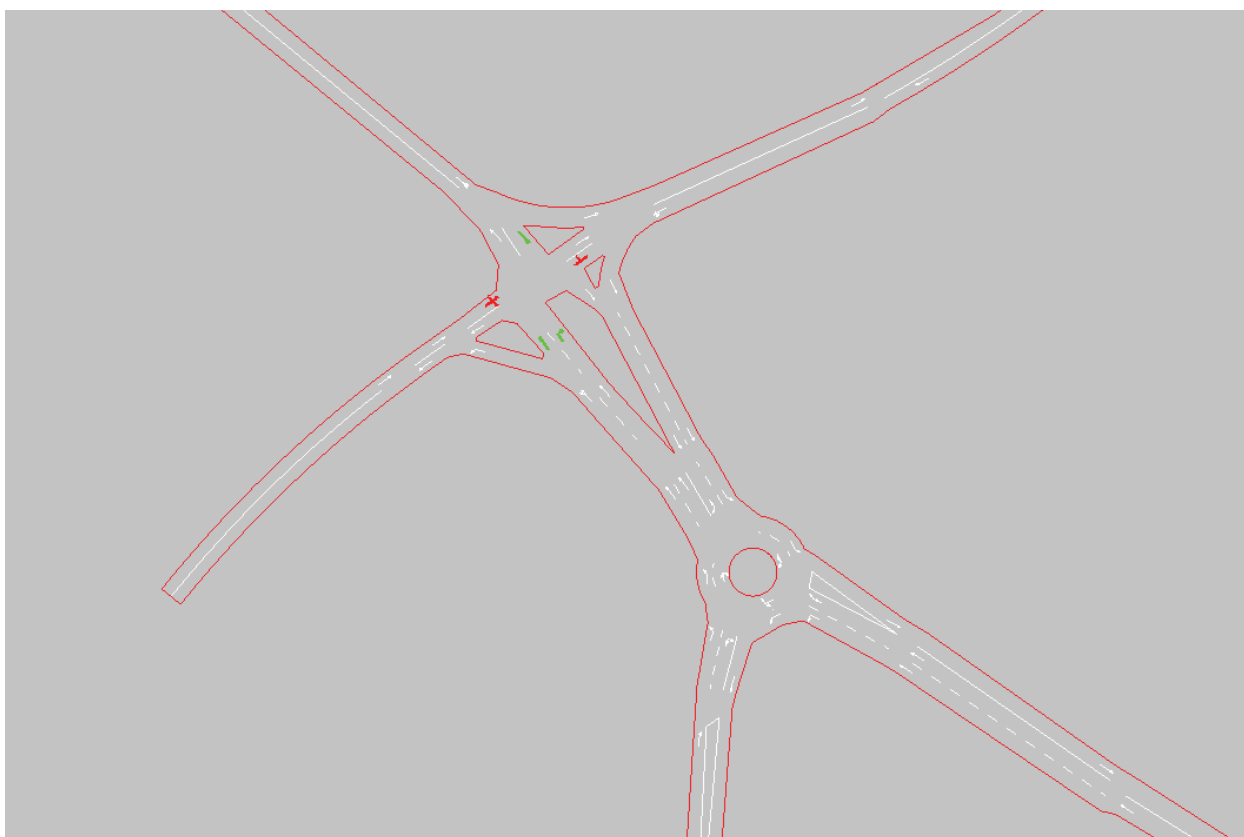
232815-07

25 September 2013

Scheme Principles - proposals involve reconfiguration of the existing priority junction into a signalised junction. The layout will be reconfigured to allow traffic to turn right from Tiddington Road as currently traffic has to turn left and then complete a U-turn manoeuvre at the Shipston Road / Banbury Road roundabout to travel NB along Clopton Bridge. Left turning traffic from Tiddington Road is provided with a merge facility to join Banbury Rd EB/SB. The right turn from Bridge Foot into Swans Nest Lane is still barred so a U-turn at the roundabout is required to complete this movement. Traffic turning left into Swans Nest Lane and the Recreation Ground car park can do so via a segregated slip which negates the need for vehicles to wait at the lights. Traffic exiting Swans Nest Lane is provided green time via vehicle actuated control within the AM. The precise nature of this arrangement within the PM is still to be determined as the stage is likely to need to be called every cycle.

Key risks – There is a history of schemes being proposed within this area that have not since been taken forward. These proposals have been applied without prejudice to the previous schemes but there is a significant risk of a barrier to delivery being identified at an early stage. Furthermore, there are potential risks regarding the location of the signal heads in relation to Clopton Bridge which is a Scheduled Ancient monument which may mean the scheme cannot be delivered on safety grounds. Consideration may also need to be given to the nearby Gazebo which is a Grade II listed building.

Scheme Status – **This scheme is currently included within the Stratford Transport Package**



Scheme 02

Location – Bridgefoot/Bridgeway Stratford Gyratory

Issues – Currently there are issues entering into the gyratory from Bridgefoot/Clopton Bridge NB. Similarly there are issues entering the gyratory from Bridge Street. In the case of Bridgefoot the

File Note

232815-07

25 September 2013

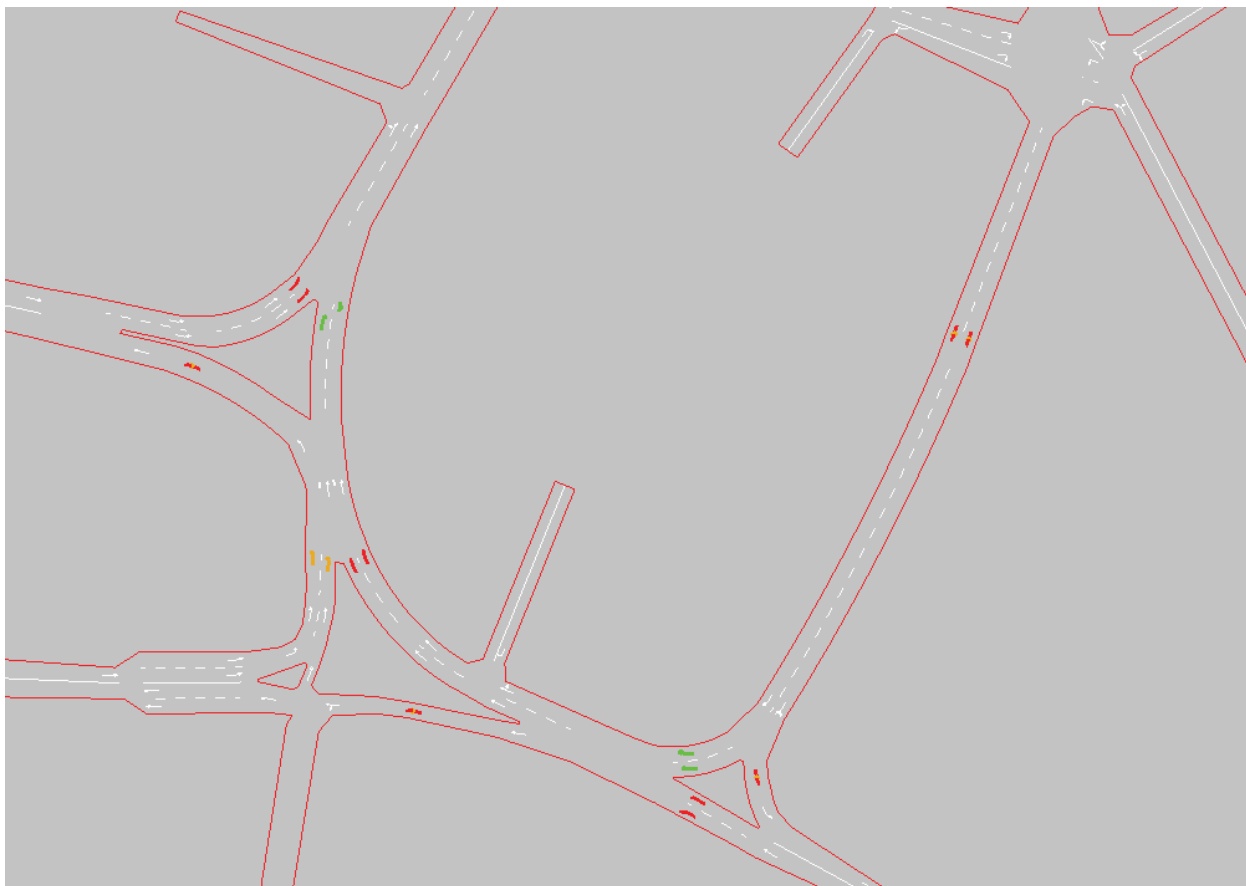
pedestrian crossings act as a signal control mechanism and create the necessary gaps for traffic to enter onto the gyratory. In the case of Bridge Street the existing pedestrian crossing can inhibit the entry of vehicles onto the gyratory and reduce the entry capacity.

The gyratory is already a heavily trafficked area and it is likely that this will continue to be the case meaning that as traffic volumes around Stratford upon Avon grow these problems are likely to be exacerbated. Furthermore, the gyratory is in a central location and it is likely that as capacity constraints are minimised in other areas the flow of traffic through the town will converge in this area and, without a formal means of controlling the traffic movements within the gyratory, it will be difficult to maintain vehicular movements across the junction.

Scheme Principles - proposals involve signalisation of the Bridgeway/Bridgefoot and Bridge Street/Bridgefoot entry arms onto the junction. These signals are synchronised with the Tiddington Road/ Bridgefoot proposals so as to minimise the amount of time vehicles allocated green time at the Tiddington Road signals approach a red signal at the gyratory.

Issues – In general signal heads are already in place in close proximity to the areas where they would be proposed as part of the formal signalisation scheme. This means that the risks of delivering this scheme should be minimal. In all cases the schemes can be delivered in a way which maintains the pedestrian flow within the area albeit the location of the crossings may have to move.

Scheme Status – **This scheme is currently included within the Stratford Transport Package**



File Note

232815-07

25 September 2013

Scheme 03

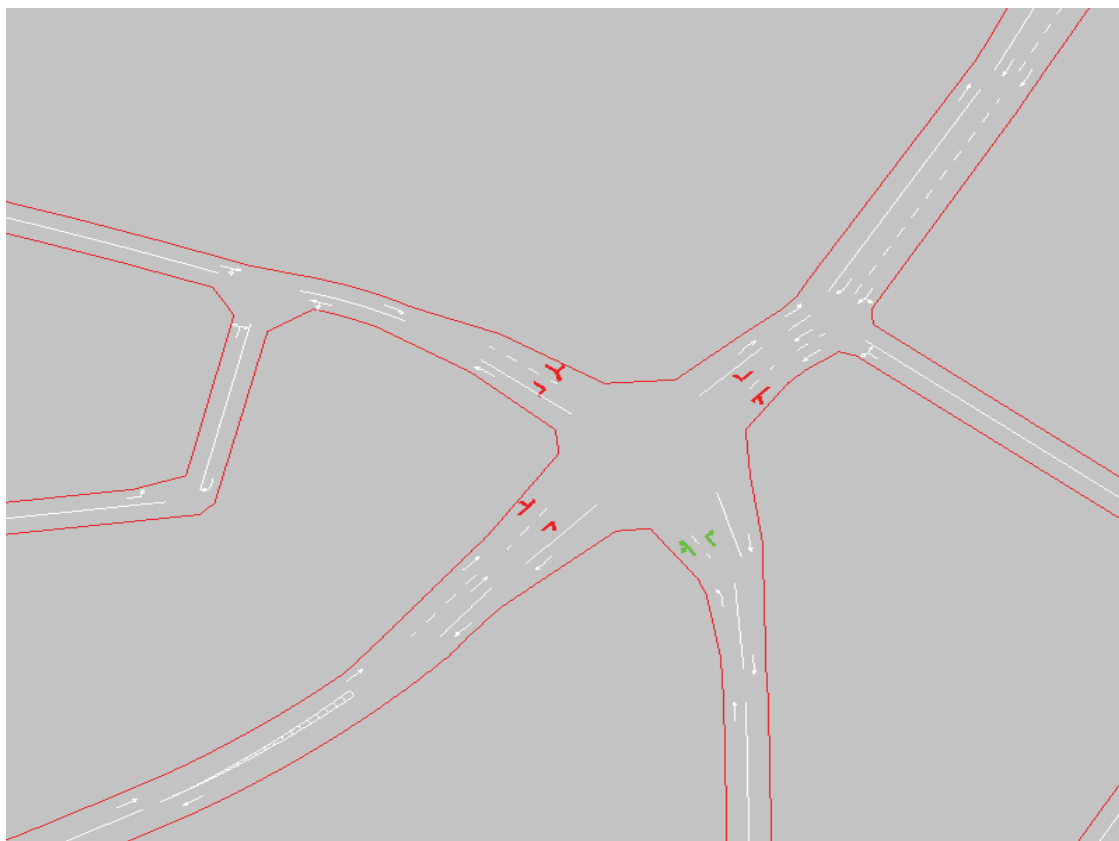
Location – Evesham Place/Evesham Road roundabout

Issues – Within the AM period there are heavy queues observed on the Seven Meadows Road NB and Evesham Road NB approaches (it should be noted that the latter has been reduced since the Link West of Shotton has been included within the modelling). Within the PM period there are large queues which are observed on Rother Street/Evesham Place SB that are caused partly by the need to yield to vehicles travelling along Grove Road SB and, furthermore, by queue propagation back from the Evesham Road/Evesham Place roundabout. This is to be expected as there is a large volume of traffic travelling outwards from Stratford upon Avon town centre during the PM period.

Scheme Principles – Potential capacity benefits of switching from a roundabout to traffic signal-controlled priority junction. Signalisation required due to the tidal nature of movements across the junction. During the AM heavy traffic flows are present northwards into Stratford whilst the opposite occurs in the PM. The use of signals allows the junction to be better tailored to the differing AM and PM conditions. Queue detectors have been used to minimise the queuing on approach to the signals. Two lane entry widths have been retained on all approaches whilst the existing highway area is used to provide stacking space for right turning traffic.

Risks – The main issue concerning the delivery of this scheme is the need to ensure that there is sufficient space to deliver the design without compromising the existing pedestrian and cycle facilities. Issues concerning the access to properties which front onto the existing carriageway will need to be considered.

Scheme Status – **This scheme is currently included within the Stratford Transport Package**



File Note

232815-07

25 September 2013

Scheme 04

Location – Grove Road/Rother Street

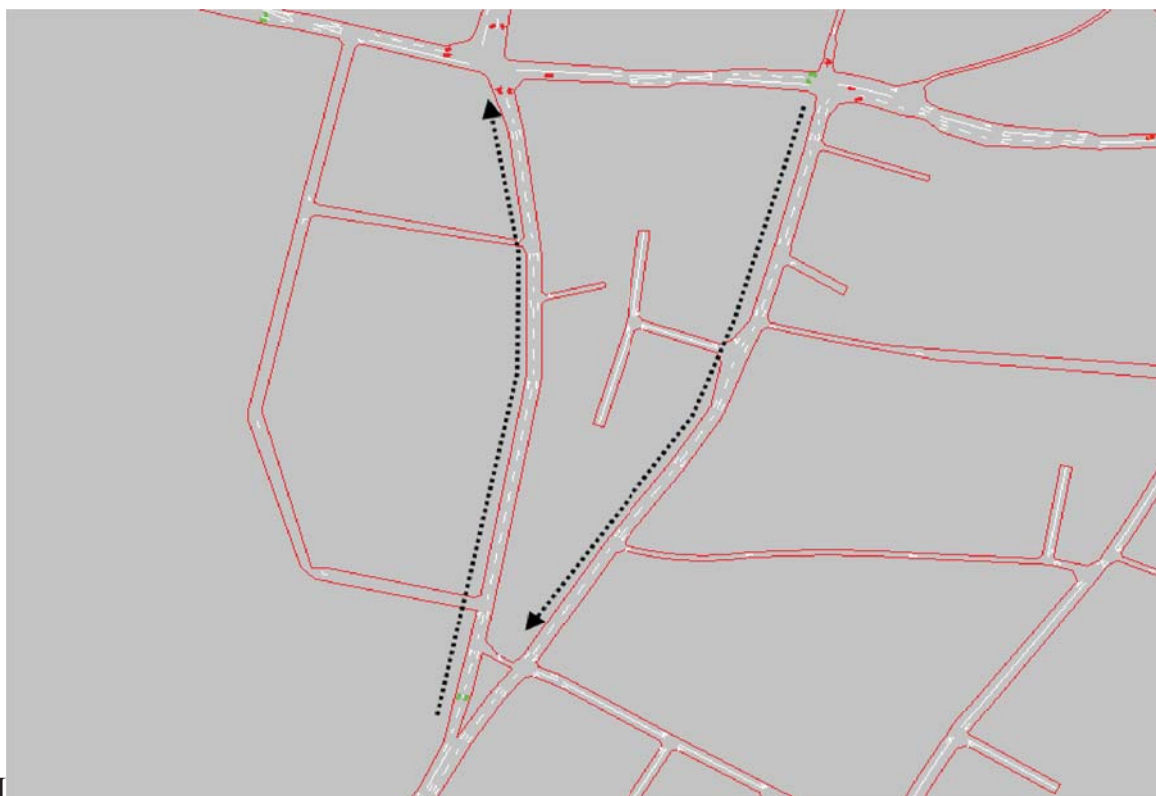
Issues – Queuing on Rother Street is frequently exacerbated by the limited opportunity for traffic travelling SB to exit onto Evesham Place, which, in turn results in lengthy queues that frequently block back through Greenhill Street and beyond.

Scheme principles - By making Grove Road one-way NB and Rother Street one-way SB the propensity for blocking back to occur is reduced significantly. Furthermore, the additional 2 lane directional links provide extra storage capacity for any queues that do occur and they limit the propensity for queues to reach such an extent that they begin to impact upon the operation of adjacent major junctions.

Risks – There are a number of issues pertaining to the delivery of this scheme that require consideration, these include, but are not limited to, the following:

- Constraints regarding the road space and the need to deliver a 2 lane Evesham Place SB approach to the newly signalised Evesham Place/Evesham Road junction.
- The proximity of the access of Broad Walk to the junction and the need to ban the right turn from Evesham Place into Broad Walk.
- The need to retain existing pedestrian and cyclist facilities in and around the junction.
- Possible implications of vehicles not being able to turn right from Evesham Place into Chestnut Walk
- Possible risk of creating a more circuitous route for local residents and people accessing businesses in the area – could lead to objections and make a scheme difficult to deliver

Scheme Status – **This scheme is currently included within the Stratford Transport Package**



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File Note

232815-07

25 September 2013

Scheme 05

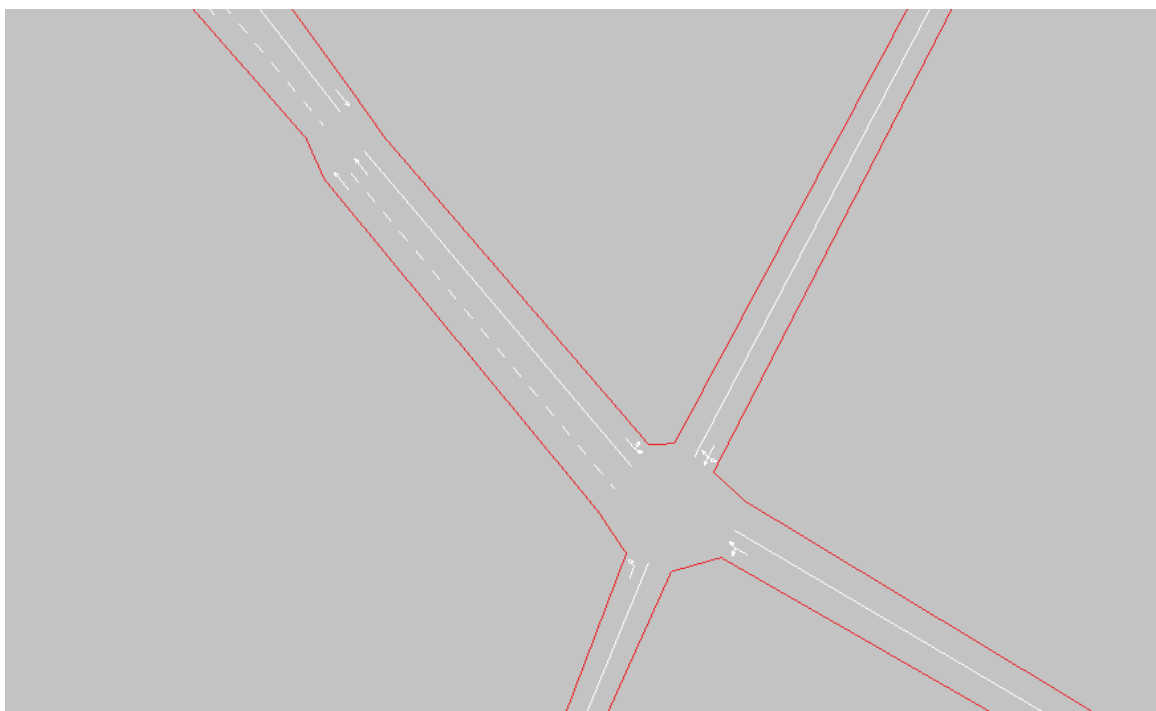
Location – Windsor Street/Birmingham Road roundabout.

Issues – This roundabout is in close proximity to the strategically important Birmingham Road/Arden Street signalised junction. At times vehicles can elect to use Windsor Street SB as a route from Birmingham Road to the Evesham Road/Evesham Place junction. Queuing back from the Windsor Street/Rother Street signalised junction can block back into the Windsor Street/Birmingham Road junction which, in turn, blocks the movement of traffic along Guild Street/Birmingham Road.

Scheme principles – By converting the roundabout into a priority junction and restricting the propensity for right turns at the junction the movements are simplified and delays at the junction are minimised. Traffic wishing to travel from Birmingham Road to Evesham Road is largely encouraged to use the Arden Street Greenhill Street route which has a much higher capacity than the Windsor Street Route and thus, the propensity for queuing at the Windsor Street/Rother Street junction to block back through adjacent junctions is largely mitigated. The scheme also assumes that two lanes can be provided for the length of the Birmingham Road NB approach to the Birmingham Road/Arden Street signalised junction.

Risks – Most of the scheme lies within existing highway and so risks regarding feasibility are likely to be minimal, one risk that has been identified is the need to establish that there is sufficient road space to deliver 2 lanes NB along the Birmingham Road without compromising existing pedestrian and cyclist facilities. One major risk is posed by the significant number of right turners out of Shakespeare Street (756 per 12 hour weekday). Changing junction to an uncontrolled priority arrangement is likely to make this movement more difficult which may lead to local objections. This could pose a risk to scheme delivery.

Scheme Status – **This scheme is currently included within the Stratford Transport Package**



File Note

232815-07

25 September 2013

Scheme 06 & Scheme 07

Location – Shipston Road/Clifford Lane and Shipston Road/Seven Meadows Road roundabouts.

Issues – The future year modelling appears to indicate that heavy queues are anticipated within close proximity of the two roundabouts. During the AM large queues manifest on the Shipston Road and Clifford Lane NB approaches to the Clifford Lane/Shipston Road roundabout whilst, during the PM, large queues appear on the Seven Meadows Road and Trinity Way approaches to the Shipston Road/Seven Meadows Road roundabout.

Scheme principles - by widening the approaches to the roundabouts as well as, where necessary, the circulating carriageway, the capacity of both junctions is improved. Two lane exit flares are provided on the Trinity Way WB, Shipston Road NB and Shipston Road SB exit arms which allow certain movements across the junction to be made from two lanes. Furthermore the two lane exit flare on the Shipston Road SB exit can be extended to a dual section between the two junctions which will provide additional capacity.

Risks – The optimum enhancements require a considerable amount of highway works and there is currently a risk that the requirements for the junction radii may push the scheme extent outside of the existing highway boundary.

Scheme Status – **This scheme is currently included within the Stratford Transport Package**



File Note

232815-07

25 September 2013

Scheme 08

Location – Birmingham Road between Regal Road and Justins Avenue

Issues – The recent reconfiguration of the Warwick Road to a minor route in the PARAMICS model has significantly increased the traffic volumes utilising the Birmingham Road. Frequently queues are observed to propagate along the Birmingham Road NB from the newly signalised Hamlet Way junction, the Birmingham Road / Park Road and the Birmingham Road / Regal Road roundabouts. This queue propagation can extend back to the Arden Street / Birmingham Road signalised junction. When that occurs the network is significantly constrained as a major exit point for vehicles is blocked. Traffic can quickly build up within the town centre as a result of this issue. It should be noted that similar issues are observed on the Birmingham Road SB but the implications of queue propagation in this direction are less severe as the queues are stored on the Birmingham Road.

Scheme Principles – provision of two lanes NB along the Birmingham Road from just south of the junction with Regal Road to just North of the Junction with Hamlet Way.

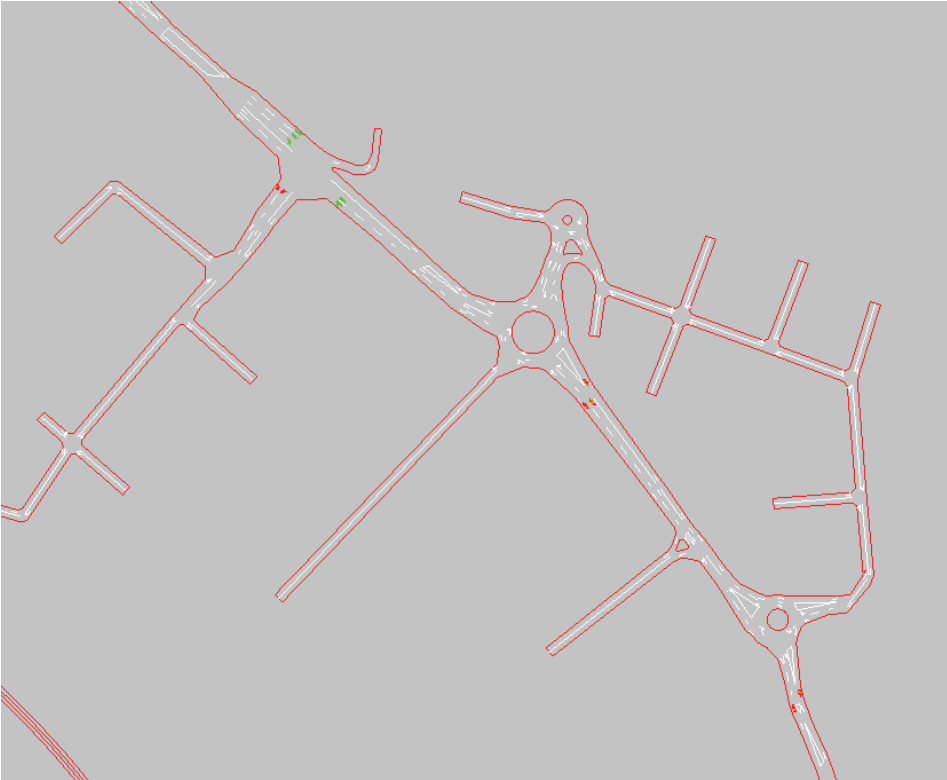
Risks – A scheme which enables two lanes of traffic to travel NB across the Hamlet Way junction has previously been investigated but the costs were initially assessed as prohibitive. A revised version of the scheme was delivered which does not unlock the capacity benefits that the two lanes NB appear capable of delivering. Thus, cost should be considered as a major risk. Furthermore, there are a number of properties which are accessed directly from the Birmingham Road NB over an existing foot/cycleway that may pose a barrier to the delivery of the two lane element of the scheme in this area. Finally whilst there is existing space within the highway boundary to deliver the proposed two lane section it is unclear whether this would compromise the existing NMU facilities which, given the close proximity of a large retail area, would likely be unacceptable.

Scheme Status – **This scheme is currently included within the Stratford Transport Package but potential risks may result in its withdrawal from the proposals.**

File Note

232815-07

25 September 2013



File Note

232815-07

25 September 2013

Scheme 09

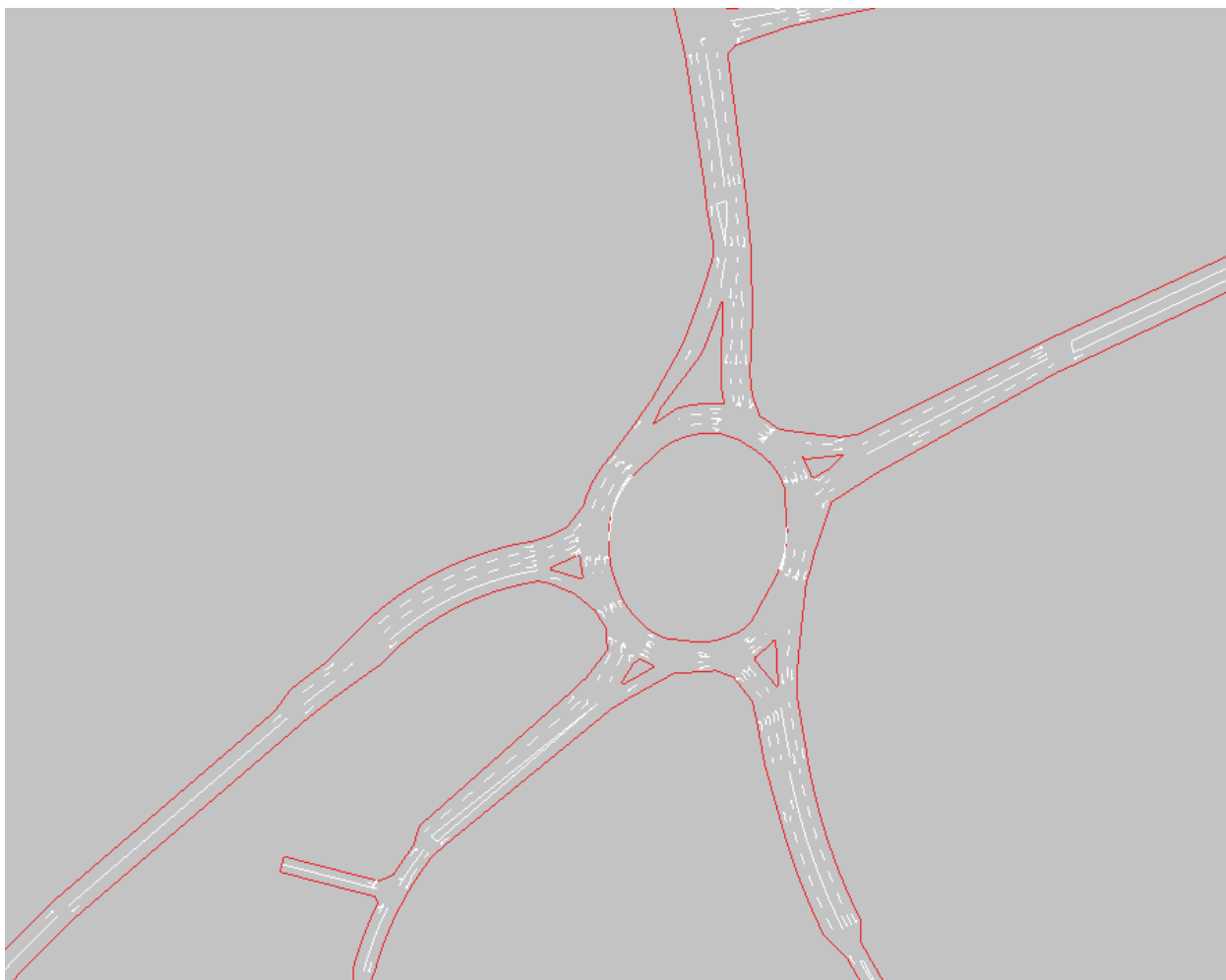
Location – Birmingham Road/A46 ‘Bishopton Island’

Issues – During various points during the future year model runs large queues are observed to occur on all approaches to the roundabout. The queues tend to form on different approaches at different times within the simulation period with the tendency for queuing to occur on links into Stratford within the AM and out of Stratford within the PM.

Scheme Principles – Substantial widening of the circulating carriageway and entry and exit flares are proposed in order that the capacity of the junction can be increased. The scheme could potentially be adapted further to include signals but these have not been included at this stage.

Risks – The main risk is ensuring that the scheme can be delivered within the existing highway boundary and can be delivered in a way which conforms to the HA design standards.

Scheme Status – **The final form of this scheme will likely require a specific assessment to be completed. The scheme described above has been included within the assessment work but more detailed work is required to determine the final form of the scheme, therefore it has not been included within the Stratford Transport Package.**



File Note

232815-07

25 September 2013

Scheme 10

Location – Alcester Road/A46 ‘Wildmoor Roundabout’

Issues – Large queues are observed on three of the four approaches, A46 WB, Alcester Road NB and the new link road NB. The roundabout is already proposed to be reconfigured as a result of the new link road and it is therefore difficult to assess the full implications of the proposed demands in an area that has not been fully calibrated.

Scheme principles – the potential to amend the current junction layout is limited due to the limited junction radius. Any scheme enhancements that are proposed will need to be delivered in a way which minimises the changes to the layout, as a result, the final scheme will likely require the implementation of signals. This scheme has not yet been determined.

Risks – The major risk in this area is that a signalisation scheme cannot be configured to mitigate the current queuing levels.

Scheme Status – **The form of this scheme is still to be determined, there are risks associated with deriving a scheme that will be considered acceptable to the Highways Agency and there are risks associated with deriving a scheme enhancement which changes a scheme that has not yet been delivered. The status of this scheme is still to be determined.**

Previous Assessment Findings

During the initial Phase 1 testing and assessment was undertaken whereby growth was assigned to the network incrementally (i.e. in thresholds) and the performance of the network was revised for areas where impacts were most noticeable.

A comprehensive overview of this process and the findings thereof is provided within the Stratford-on-Avon Strategic Transport Assessment, Phase 1 Modelling Report, produced by Ove Arup and Partners, October 2012 (Section 3 & 4).

The areas of the proposed schemes are all identified as areas, within the threshold assessment described above, that are prone to low speeds and high levels of queuing.

During the early phases of the assessment (2011 to 2017) the areas to the South East of Stratford are identified as areas of concern. Both the Tiddington Road/Banbury Road and Evesham Place/Evesham Road junctions are identified as areas likely to require mitigation at an early stage. Queuing at Bishopton Island is also noted as an issue, particularly queuing on the Bishopton Lane approach.

By 2017 onwards queue propagation on the approaches to the gyratory increased significantly as has the queuing on the Rother Street SB approach to the Evesham Place Roundabout. At the same time queue propagation around Clifford Lane/Shipston Road in the AM and Seven Meadows Road/Trinity Way in the PM has become an issue. Similarly queuing at Wildmoor roundabout is also likely to become an issue.

The issues on Birmingham Road may be underestimated because within the threshold testing the Warwick Road had been set to major and so will attract greater volumes of traffic than is reflected within the current modelling assessment.

File Note

232815-07

25 September 2013

Initial Phasing Plan

Based on the outcome of the modelling thus far as well as the threshold testing that was completed last year, the following sets out an initial approach to the phasing of the mitigation measures and the rationale thereof:

- 1) The first scheme that should be considered for delivery is the Tiddington Road/Banbury Road signal scheme as the large queues observed within this area, and particularly along the Banbury Road NB, pose a barrier to all development in this area of Stratford as well as having strategic implications due to the levels of constraint and the high level of delay that can be significantly reduced by the mitigation of this queuing.
- 2) The second schemes that should be considered are the Evesham Place/Evesham Road junction proposals and the gyratory signalisation proposals. The latter should be delivered to compliment the Tiddington Road proposals whilst the former is a scheme of strategic importance in its own right. It may be possible to deliver both in unison due to the perception that delivering the gyratory proposals is likely to be a relatively low cost scheme. If only one can be delivered initially, then the outcome of the future stages of assessment may identify which scheme delivers greater benefits and, thus should be delivered first. The remaining scheme should then subsequently be delivered.
- 3) Once the aforementioned schemes have been delivered the capacity within the town centre will likely be increased and, as a result, it is reasonable to consider that the Clifford Lane/Shipston Road and Seven Meadows Road/Trinity Way schemes are considered for delivery. Since both schemes are intrinsically linked it is recommended that they are considered for implementation as a single scheme.
- 4) It is likely that the delivery of the Shipston Road schemes will remove a constraint to traffic entering the town from the south. This will likely result in the need for the delivery of the Rother Street/Grove Street proposals in order that the movement of vehicles across the town centre can be better maintained.
- 5) The implementation of the Rother Street/Grove Road proposals will increase demand along Windsor Street. Thus, the delivery of the Windsor Street/Birmingham Road proposals should be considered next to reduce the potential for queuing from Windsor Street/Wood Street to extend back onto Guild Street.
- 6) Finally the proposals along Birmingham Road should be considered for delivery as there is likely to be an increase in vehicular movements NB along Birmingham Road due to the removal of a number of preceding network constraints.
- 7) Schemes along the strategic road network should be considered for early implementation due to the strategic nature of the trips that are affected by the impacts in these areas couple with the need to ensure that the operation of the HA network is maintained throughout the plan period. The phasing of these works however (Bishopton Island and Wildmoor Roundabout) should be considered outside of the scope of the Stratford Transport Package.

File Note

232815-07

25 September 2013

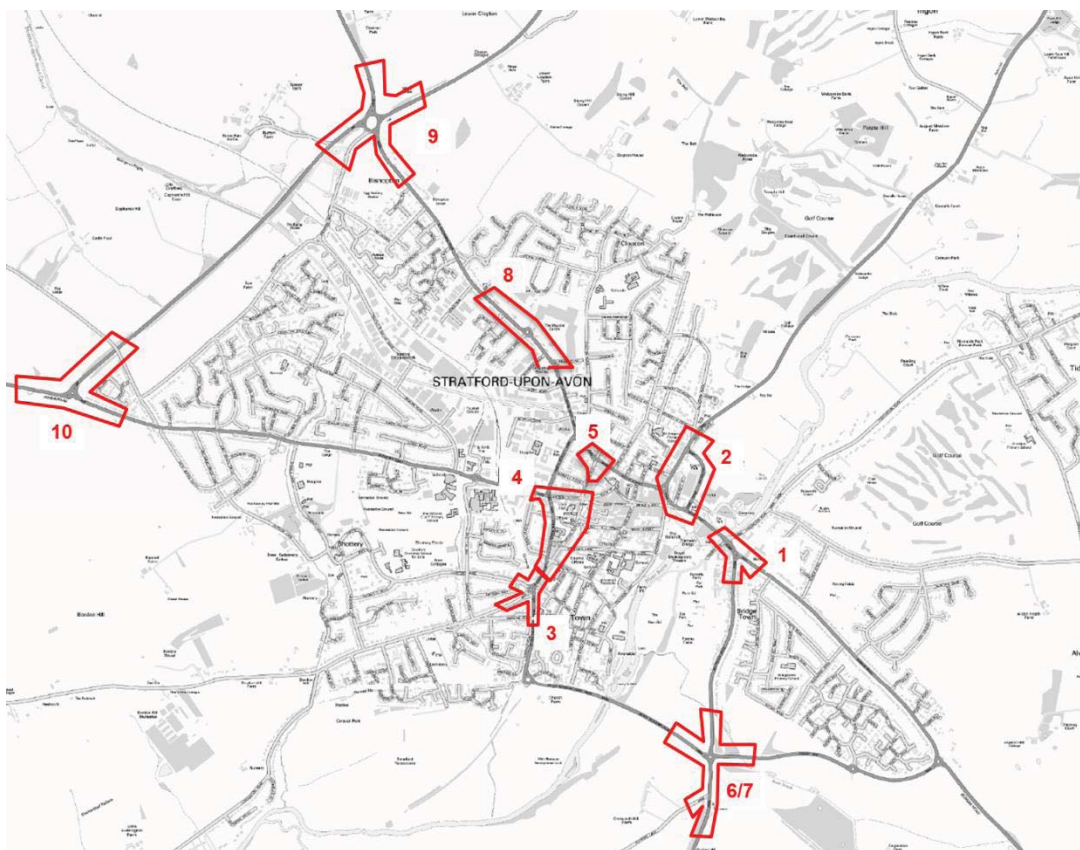
Summary

Based on the information set out previously, the following mitigation phasing strategy is proposed:

- Phase 1 – Delivery of Scheme 1
- Phase 2 – Delivery of Scheme 2 and 3
- Phase 3 – Delivery of Schemes 6 & 7
- Phase 4 – Delivery of Scheme 4
- Phase 5 – Delivery of Scheme 5
- Phase 6 – Delivery of Scheme 8

The above sets out an initial approach to the phasing strategy associated with the mitigation measures that have been identified thus far. It should be acknowledged that the next stages of assessment may identify one or more schemes that unlock significant levels of benefits when compared to the other schemes, or are relatively low cost and ‘shovel ready’ which could impact upon the proposed phasing strategy referred to above.

Figure 2 - Scheme Locations



DOCUMENT CHECKING (not mandatory for File Note)

	Prepared by	Checked by	Approved by
Name	James Edwards	Nick Dauncey (WCC)	James Edwards
Signature			

To	WCC	Date	16 October 2013
Copies		Reference number	232815-07
From	James Edwards	File reference	232815-07.Memo001
Subject	Initial Scheme Commentary - Summary		

Scheme 01 – Tiddington Road/Shipston Road Gyratory

Engineer Comments:

Version 01

- The very short length of left turn flare into Tiddington, which in reality would be pretty useless;
- The set back of the stop lines, meaning the intergreens will be quite onerous;
- The trimming back of the central island, requiring the very old tree to be removed / relocated;
- The width of the two lane approach section of Tiddington Rd, where I've had to use 2.65m lanes.

Response 01 – is it possible to avoid the tree?

- I've revisited the layout with the intention of avoiding realignment of the central island, whilst maintaining a 3.25m minimum lane width. Whilst the amendment is possible (see attached), it does however mean that the hatched separation between the free-flow left turn from Tiddington Rd and straight on movement from Bridge Foot is reduced in scale.
- **Note that the proximity of the tree to the kerblines means that any carriageway realignment in this area would likely affect the root zone.**

Scheme 02 – Evesham Road/Shipston Road

Engineer Comments:

Version 01

- I'm not entirely convinced the layout as attached is acceptable in terms of pedestrian crossings etc., as the north-eastern arm would have to be walk with traffic as opposed to having its own stage (there isn't enough width / room to accommodate a staggered crossing);
- The existing standalone crossing on the south-eastern arm has to be removed / displaced further to the south, well off the desire line. There is no width to accommodate a crossing point at the junction itself due to the angle of the arms and the requirement to accommodate HGV manoeuvres;
- The flare on the north-western arm is minimal, with a couple of private accesses blocked off by the splitter island;
- The short two lane merge on the south-western arm is pretty abysmal, and creates a very tight left turn into the access road fronting nos. 1-4;
- I'm unsure what the flow is for vehicles turning right into Broad Walk, but the lack of right turn bay means the junction would block back quickly should a vehicle be waiting to turn. Similar to the existing situation, I suspect.

Response 01 – is it possible to remove the Evesham Place SB Right Turn Lane?

- You could remove the right turn lane however the length of storage for right turners would be minimal.

Memorandum

Scheme 03 – Bridge Street Gyratory

Engineer Comments:

Version 01

- A signalised junction is shown between Bridgeway and Bridge Foot, as per your proposal. The crossing points move slightly to minimise intergreens, and I've shown a section of dedicated left turn lane. It may be that this could be extended further to the north if necessary, as whilst this proposal extends beyond the highway boundary it appears to be council owned land- this would need to be investigated.
- An amended layout is shown at the junction between Bridge Foot and Bridge Street, again to minimise intergreens. The existing cut through for northbound vehicles on Waterside has been removed, which helps declutter and simplify the area. I've shown the pedestrian crossing to the east of Waterside as moving to the west, to maximise the vehicle queue length between the crossing and gyratory itself.

Scheme 04 – Rother Street one-way system

Engineer Comments:

Version 01

- A reconfigured junction is shown between Rother St and Greenhall St, with widened footways and the inherent benefits associated with the removal of a stage from the signals.
- Along Rother St itself we are able to provide 2.5m wide parking bays along the majority of the western kerblines, in addition to two southbound lanes @ 3.25m.
- Significant footway widening is shown on the western kerblines to provide minimum widths of 3.0m adjacent to the parking bays, with a buildout to provide an informal crossing point to the southern end of the market.
- The junction between Rother Street / Evesham Place has been reconfigured to show a dedicated southbound right turn from Rother St onto Grove Rd. There is insufficient width to provide two southbound lanes between Evesham Road junction and Chestnut Place due to the provision of existing parking bays, telegraph poles, lighting columns and two mature trees along the eastern kerblines. (Note: Removing the trees, lighting columns and telegraph pole, providing 3.0m lanes and 2.0m footways- reduced from 3.0m- would enable the provision of two southbound lanes).
- The junction between Grove Rd and Greenhall Street has been amended to reflect the removal of the ahead movement into Grove Road. Footway widening is possible together with geometry improvements to Arden Street.

Response 01 – is it possible to retain two lanes SB along the length of Rother Street

- Drawing amended to reflect two lanes SB, this results in 2.0m footways to ensure 3.0 lanes can be delivered SB.

Scheme 05 – Birmingham Road/Windsor Street

Engineer Comments:

Version 01

- Visibility from both side roads is below standard at approx. 45m. Whilst this is a historic problem the provision of give way lines on the roundabout would have slowed vehicles down on the approach to the junction. With a priority junction this is not the case, hence the reduced visibility becomes more of a safety concern.
- A ghost island right turn bay into Windsor Rd should still be provided to cater for coaches approaching the terminal on Windsor Rd. It will be very difficult to prevent general traffic from making the right turn.
- The roundabout allowed coaches to swing wide and use the entire road width when turning into / out of Windsor Rd, whereas the priority junction forces vehicles to keep to their lanes. In this sense manoeuvres for buses / HGVs etc. are made more difficult.

Memorandum

Response 01 – The presence of the terminal and the need to retain the right turn means that this scheme is unlikely to be deliverable. The recommendation is that this scheme should not be progressed. Further investigation of potential improvements within this area is recommended before any scheme is taken forward/.

Scheme 06 & 07 – Shipston Road/Seven Meadows Road and Shipston Road/Clifford Lane Roundabout

Engineer Comments:

Northern Roundabout:

- I've managed to fit your proposed amendments within WCC owned land, however the northbound two lane exit has a substandard merge length. Again, the highway boundary info in this area may be misleading, as the adjacent land looks to be within council owned land if not highway land. If this is the case there may be potential for improving the length of exit merge and two lane flare section on this arm, at the expense of a significant number of trees.
- The eastern arm is showing a fairly significant length of three lane flare, however there is a bridge structure and embankment some 125m to the east of the roundabout. Therefore the scheme may require costly retaining structure / embankment to accommodate the flared length as shown. There is probably scope for some VE here.
- I can't be sure (as it isn't shown on Google Earth) but it looks as though we've ploughed through a bus stop / layby on the section of Shipston Road between the two roundabouts.
- Entry deflection is reduced below the required standard on all arms, as a direct result of the widening. This will likely be an issue with the HA.

Southern Roundabout:

- No comments. The proposed amendments can be incorporated within the highway boundary.

Scheme 08 – Birmingham Road NB widening between Regal Road and Hamlet Way

Engineer Comments:

- Footway parking is permitted along the frontages of the houses to the north of the signalised junction with Hamlet Way. These can be maintained by narrowing the adjacent footway to 2.0m.
- Two pedestrian splitter islands are removed along the stretch of Bham Rd; one near to Justins Av and one near to Park Rd junction. The splitter nearest Park Rd is less of an issue given that a signalised crossing is provided 70m to the north, and an enlarged splitter is shown at the Park Rd roundabout.
- The right turn lane into Maybrook Rd has been removed to accommodate the two NB lanes. This could potentially be mitigated by banning the right turn and forcing all vehicles through the Regal Rd roundabout, which I have shown as being formalised into a 30m ICD design. I will look into a second option which attempts to maintain the right turn lane, however it will be very tight.
- I've got rid of the nasty NB merge through some kerblines and white lining realignment, but haven't gone any further into the verge to avoid the culvert. I don't have any pictures of the existing junction layout, so it is difficult to say whether or not I've reduced the right turn lane length into Hamlet Way.

Response 01 – is it possible to retain the right turn lane into Maybrook Road

- As discussed I've attached an option which maintains the right turn lane into Maybrook Road, and I've squeezed in a half-depth bus layby too. As suspected we're hard against the highway boundary along the NE side of the road, and we manage to wipe out some fancy paved area at the entrance to the new Costa Coffee / Game retail units. This change also comes at the expense of the dedicated right turn lane into the retail park at Park Rd roundabout.

Memorandum

Response 02 – is it possible to incorporate pedestrian facilities on the Birmingham Road between Regal Road and Park Road.

- We'd need to provide central islands to house signalheads on (to overcome the visibility issue caused by the proximity of the bus stop), but aside from that it doesn't look as bad as I had previously thought. The only potential issue I have now is the reduced length of right turn into Maybrook Road.

Scheme 09 – Bishopton Island

Engineer Comments:

- Can't fit in a two lane WB exit on the A46. There isn't enough distance between the carriageway edge and existing stream culvert- there is potential to extend the culvert, but I think it would be prohibitively expensive

Scheme 10 – Wildmoor Roundabout

Engineer Comments:

- The inclusion of the dedicated left slip would require a considerable amount of third party land to ensure visibility standards can be maintained.

Response 01 - The implementation of a signalised scheme may be a cheaper option but further, more detailed design work is required before the scheme can be progressed. It is anticipated that this will be dealt with jointly between WCC & the HA.

To	WCC	Date	16 October 2013
Copies		Reference number	232815-07
From	James Edwards	File reference	232815-07.Memo001
Subject	Initial Scheme Commentary - Summary		

Introduction

The following is intended to provide a short summary of the progress regarding each of the proposed schemes that comprise the Stratford Transport Package.

It is intended to record the progress to date. Any immediate drawing revisions and the proposed way forward in respect of each of the proposed schemes and the overriding objectives of the Stratford Core Strategy.

Each of the schemes is summarised separately as follows:

Scheme Progress

Scheme 01 – Tiddington Road/Shipston Road Gyratory & Bridgeway/Bridgefoot Gyratory

Scheme 01 & 02 should now be promoted as a single strategy. Amendments to each of the drawings should be undertaken as follows:

Tiddington Road/Shipston Road

- 1) The mainline left turn slips should be removed to provide better pedestrian facilities.
- 2) The drawing should be amended to illustrate potential pedestrian facilities
- 3) The drawing should be amended, if possible to demonstrate how cycle provision could potentially be delivered across the junction, specifically with regards cycle movements northwards from Tiddington Road.
- 4) The Shipston Road pedestrian facility should be redrawn as a controlled crossing.

Bridgeway/Bridgefoot Gyratory

- 5) The drawing should be amended to include the Guild Street signals as these will be linked to the final scheme.
- 6) The drawing should also include the Leisure Centre car park access and, if possible, provision for a flared entry lane into the car park should be included within the drawing.

Memorandum

Next Steps

Short Term

Amendments will be made to the drawing and this will be made available for developers to undertake a more detailed assessment of the scheme should it be required.

A cordon model of the scheme proposals will be derived based on the Refined Stratford Transport Package Scenario model, cordon demands will also be extracted for the 2021 scenario model. At the moment it is anticipated that the cordon model would stretch from the Shipston Road/Banbury Road roundabout to the West and the Guild Street signals to the East.

The cordon analysis will be used to undertake detailed analysis of the travel time, delay, journey distance outputs. In addition Air Quality outputs will also be extracted and an outline BCR will be produced using the PEARS add-on to PARAMICS.

Medium Term

It is anticipated that a developer may consider promoting part or all of the scheme. It is anticipated that the developer would have to complete the following steps during that process:

- 1) Undertake an NMU survey of the area to understand pedestrian and cyclist demands.
- 2) Develop a LinSig model of the scheme which demonstrates that the scheme can be delivered in a manner which will either maintain or enhance the level of NMU provision.

Long Term

Long term it is recommended that proposals are retested once the existing Stratford-upon-Avon PARAMICS model has been updated. Consideration should also be given with regards the potential benefits of developing a bespoke cordon model of the area so as to ensure the WCC Design Service can be satisfied that a synchronised signalisation scheme can be delivered in this area and to demonstrate how such a linkage may be achieved.

Scheme 03 – Evesham Road/Shipston Road

Scheme 03 will continue to be promoted as a single strategy. Amendments to the drawing should be undertaken as follows:

- 1) The NB Merge should be removed.
- 2) The SB Merge should be extended to at least 100m
- 3) Any additional NMU provision that can be delivered as part of the scheme should be included within the modelling.

Next Steps

Short Term

Amendments will be made to the drawing as outlined previously.

Consideration should be given as to whether delivery of a linked signalised scheme at Grove Road/Rother Street junction would further reduce and queuing issues in this area.

A cordon model of the scheme proposals will be derived based on the Refined Stratford Transport Package Scenario model, cordon demands will also be extracted for the 2021 scenario model. Subject to the outcome of the testing of additional proposals at the Grove Road/Rother Street junction it is anticipated that the cordon model will only include one or both junctions.

The cordon analysis will be used to undertake detailed analysis of the travel time, delay, journey distance outputs. In addition Air Quality outputs will also be extracted and an outline BCR will be produced using the PEARS add-on to PARAMICS.

Memorandum

Medium Term/Long Term

A feasibility review of proposals at the Grove Road/Rother Street junction may also be required.

Subject to completion of the aforementioned feasibility review and cordon analysis, no further work is anticipated for this junction at this stage.

Scheme 04 – Rother Street one-way system

This scheme is considered unfeasible and it is therefore recommended that it should be removed from the Stratford Transport Package. Work will be undertaken to assess potential improvements that can be delivered in the area of the Grove Road/Rother Street junction separately.

Scheme 05 – Birmingham Road/Windsor Street

This scheme is considered unfeasible at this time. No further work is anticipated within this area at this stage.

Scheme 06 & 07 – Shipston Road/Seven Meadows Road and Shipston Road/Clifford Lane Roundabout

The current scheme proposals reflect a sub-standard design. A second drawing will be issued which outlines a design which conforms to the required standards but would also require third party land.

Next Steps

Short Term

Amendments will be made to the drawing as outlined previously.

A cordon model of the scheme proposals will be derived based on the Refined Stratford Transport Package Scenario model, cordon demands will also be extracted for the 2021 scenario model.

The cordon analysis will be used to undertake detailed analysis of the travel time, delay, journey distance outputs. In addition Air Quality outputs will also be extracted and an outline BCR will be produced using the PEARS add-on to PARAMICS.

Medium Term/Long Term

Subject to completion of the aforementioned feasibility review and cordon analysis, no further work is anticipated for this junction at this stage.

Scheme 08 – Birmingham Road NB widening between Regal Road and Hamlet Way

At this stage there are no further changes to the proposals anticipated in the short term

Next Steps

Short Term

A cordon model of the scheme proposals will be derived based on the Refined Stratford Transport Package Scenario model, cordon demands will also be extracted for the 2021 scenario model.

The cordon analysis will be used to undertake detailed analysis of the travel time, delay, journey distance outputs. In addition Air Quality outputs will also be extracted and an outline BCR will be produced using the PEARS add-on to PARAMICS.

Long Term

The feasibility review and subsequent scrutiny process have identified that there are further enhancements that should be considered for delivery alongside the proposed scheme. In particular by implementing a

Memorandum

directional strategy at the Wharf Road/Maybrook Road area there may be further potential to minimise the movements in this area.

Furthermore, there would undoubtedly be benefits in considering linking the scheme proposals with a wider access strategy for the Maybird Retail Park as this could be used to further simplify the movements within the area whilst improving access to the retail facilities. Further work is essential to ascertain a picture of the benefits that could be unlocked as a result of the scheme implementation.

Scheme 09 – Bishopton Island

At this stage there are no further changes to the proposals anticipated in the short term however it should be acknowledged that if the scheme is taken forward as a candidate for Major Scheme funding then a further assessment is recommended to determine with more accuracy what the optimum proposals for this area are likely to be.

Next Steps

Short Term

A cordon model of the scheme proposals will be derived based on the Refined Stratford Transport Package Scenario model, cordon demands will also be extracted for the 2021 scenario model.

The cordon analysis will be used to undertake detailed analysis of the travel time, delay, journey distance outputs. In addition Air Quality outputs will also be extracted and an outline BCR will be produced using the PEARS add-on to PARAMICS.

Medium Term

Provided that the results from the cordon assessment can be made available in time these should be presented to the Highways Agency during the next WCC/HA progress meeting.

Provided that there is support from the Highways Agency, the scheme design should be progressed and an outline business case for the scheme should be developed.

Long Term

It is desirable for the scheme to be jointly promoted by WCC and the HA as a major infrastructure scheme.

Scheme 10 – Wildmoor Roundabout

The current scheme assumptions within the modelling demonstrate that the impacts of the SRZ can be mitigated.

The current form of scheme proposed within the modelling would not conform to the standards required by the Highways Agency. To improve visibility the scheme would require third party land.

Any further design and assessment work should be undertaken in conjunction with the HA.

Short Term

Potentially a sketch of the aspirations for this junction could be produced in advance of the next progress meeting with the Highways Agency.

Medium Term

Provided that there is support from the Highways Agency, the scheme design should be progressed towards a more detailed assessment.

Memorandum

Long Term

The long term aspirations for the scheme are still to be determined.

Next Stages of Assessment

The current round of the Stratford STA testing is about to be completed and the results are being summarised within a draft report. Once this draft report has been completed the following steps will be undertaken:

- 1) The Stratford Transport Package will be refined within the model so as to better reflect the findings of the scheme review process.
- 2) The model will be rerun and a review of the Grove Road/Rother Street area will be undertaken to assess whether there is scope for delivery of signal improvements within that area.
- 3) The outputs from the revised model runs will be assessed and presented to WCC.
- 4) A review of the impacts will be undertaken to identify whether there are any further areas that require attention due to the inclusion of the SRZ.
- 5) If stage 4) identifies a need for further schemes these will be proposed and assessed within the modelling.
- 6) The findings from this work will be summarised and presented as an addendum to the original Stratford STA/SRZ Report

Prior to the commencement of the cordon modelling exercise the scope and requirements will need to be agreed between Arup, WCC and, if appropriate, the HA.

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Project title	Stratford Transport Package Review	Job number	232815-07
cc	Warwickshire County Council	File reference	232815-07.TN002
Prepared by	James Edwards	Date	17 October 2013
Subject	Stratford Transport Package - Initial Scheme Review Outcome		

Introduction

This Technical Note has been produced to summarise the findings from the initial feasibility review of the 10 schemes which comprise the Stratford Transport Package.

The purpose of this Note is to present the findings from the initial review of the schemes, record any on-going concerns regarding the schemes and to document the initial outcome of the cost estimates that have been produced for each scheme.

Overview

The Stratford Transport Package (STP) refers to a series of highway schemes that have emerged during the course of the Stratford-upon-Avon Strategic Transport Assessments which have been undertaken to identify the impacts and identify potential mitigation measures, associated with the delivery of Stratford District Councils housing and employment supply to be allocated as part of the Core Strategy.

In total, ten potential schemes have been identified within the STP. These schemes have been derived based on a review of the Stratford-upon-Avon PARAMICS model and the forecast performance levels when considering various scenarios concerning the growth of traffic within the area.

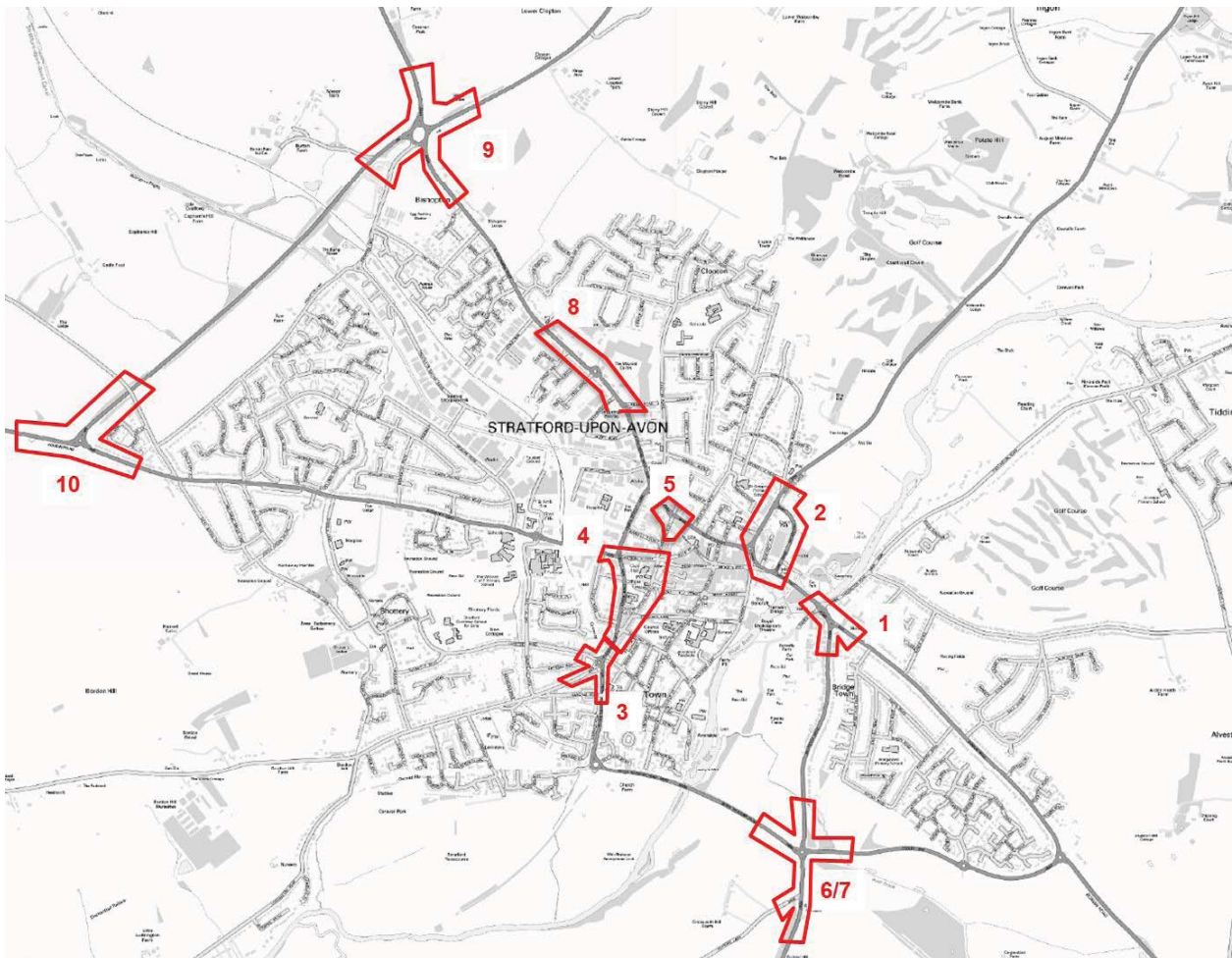
In all scenarios one or more of the schemes which comprise the STP have been identified as necessary and early investigation of the impacts of delivering these schemes appears to indicate that additional road user benefits and mitigation of existing and forecast impacts will be accrued by the delivery of these schemes. The area of coverage for each of the proposed schemes has been illustrated within **Figure 1** on the following page.

Technical Note

232815-07

17 October 2013

Figure 1 - Scheme Locations



For each of the schemes illustrated above the following has been undertaken:

- A review of what has been proposed within the original modelling. The review has considered both the ability of the scheme to be delivered within the highway boundary and the principles of the design. Where possible, amendments to the schemes have been suggested to improve the level of conformity to the design standards and any on-going issues have been noted for further consideration.
- An outline sketch of the proposal has been produced.
- An outline cost estimate has been produced for each scheme. The initial estimates include basic provision for diversion and protection of statutory undertakers' plant and services, but the estimates for this element are not detailed and would likely be subject to change on receipt of statutory utilities information. Each cost estimate includes provision for contingency and fees as well as the highway cost estimate. The cost estimates do not include drainage, demolition; land costs; inflation; non highways clearance; or VAT.

The findings from this initial stage of work have been presented, for each individual scheme, within the following section of this report, where appropriate the sketch and cost estimate for each of these schemes has been provided within the accompanying documentation.

Technical Note

232815-07

17 October 2013

Scheme 01 – Tiddington Road/Shipston Road Gyratory

Initial Issues

Large queues are observed to form along the Banbury Road NB approach to the Banbury Road/Shipston Road roundabout during both AM and PM periods. Similarly, large queues are observed along Tiddington Road within the same period.

The queuing issues are compounded by the restriction of the right turn from Tiddington Road SB to Clopton Bridge NB; vehicles instead have to turn left and then complete a U-turn at the Shipston Road/Banbury Road roundabout which exacerbates the queuing in this area. Within the Reference Case vehicles have been observed using Loxely Road/Tiddington Road as a means of by-passing the large queue along the Banbury Road NB.

Delivery of a scheme at the Clifford Lane/Seven Meadows Road junctions will unlock a substantial amount of capacity which will, in turn, increase the traffic volumes in this area.

Scheme Principles

Proposals involve reconfiguration of the existing priority junction into a signalised junction. The layout will be reconfigured to allow traffic to turn right from Tiddington Road as currently traffic has to turn left and then complete a U-turn manoeuvre at the Shipston Road / Banbury Road roundabout to travel NB along Clopton Bridge. Left turning traffic from Tiddington Road is provided with a free-flow merge facility to join Banbury Road EB/SB. The right turn from Bridge Foot into Swans Nest Lane is still barred so a U-turn at the roundabout is required to complete this movement. Traffic turning left into Swans Nest Lane and the Recreation Ground car park can do so via a segregated slip which negates the need for vehicles to wait at the lights. Traffic exiting Swans Nest Lane is provided green time via vehicle actuated control within the AM. The precise nature of this arrangement within the PM is still to be determined as the stage is likely to need to be called every cycle.

Initial Risks

There is a history of schemes being proposed within this area that have not since been taken forward. These proposals have been applied without prejudice to the previous schemes but there is a significant risk of a barrier to delivery being identified at an early stage. Furthermore, there are potential risks regarding the location of the signal heads in relation to Clopton Bridge which is a Scheduled Ancient monument which may mean the scheme cannot be delivered on safety grounds. Consideration may also need to be given to the nearby Gazebo which is a Grade II listed building.

Scheme 01 - Feasibility Review Comments

Is there potential for the scheme to be delivered within the existing highway boundary? - Yes

Initial Comments on the Scheme

1. The very short length of left turn flare into Tiddington Road is likely to deliver limited capacity enhancements.
2. The set back of the stop lines may result in a significant level of intergreens.
3. The trimming back of the central island will need to ensure that a very old tree within the island can be retained. This does, however, mean that the hatched separation between the free-flow left turn from Tiddington Road and straight on movement from Bridge Foot is reduced in scale. It is likely that the proximity of the tree to the kerb line means that any carriageway realignment in this area would affect the root zone.

Technical Note

232815-07

17 October 2013

4. The width of the two lane approach section of Tiddington Road required 2.65m wide lanes.

Risk Review

Highway risk level - Medium

Risk of local objection - High

Decision - proceed scheme to cost estimate stage.

Cost Estimate

Outline Cost Estimate - £716,500

Inclusion for Services - £100,000 (14%)

Inclusion for contingencies & fees - £117,000 (16%)

Cost uplift (44% Optimism Bias) - **£1.03 Million**

Technical Note

232815-07

17 October 2013

Scheme 02 – Bridgefoot/Bridgeway Gyratory Stratford Town Centre

Initial Issues

Currently there are issues entering into the gyratory from Bridgefoot/Clopton Bridge NB. Similarly there are issues entering the gyratory from Bridge Street. In the case of Bridgefoot the pedestrian crossings act as a signal control mechanism and create the necessary gaps for traffic to enter onto the gyratory. In the case of Bridge Street the existing pedestrian crossing can inhibit the entry of vehicles onto the gyratory and reduce the entry capacity.

The gyratory is already a heavily trafficked area and it is likely that this will continue to be the case meaning that as traffic volumes around Stratford upon Avon grow these problems are likely to be exacerbated. Furthermore, the gyratory is in a central location and it is likely that as capacity constraints are minimised in other areas the flow of traffic through the town will converge in this area and, without a formal means of controlling the traffic movements within the gyratory, it will be difficult to maintain vehicular movements across the junction.

Scheme Principles

Proposals involve signalisation of the Bridgeway/Bridgefoot and Bridge Street/Bridgefoot entry arms onto the junction. These signals are synchronised with the Tiddington Road/ Bridgefoot proposals so as to minimise the amount of time vehicles allocated green time at the Tiddington Road signals approach a red signal at the gyratory.

Initial Risks

In general signal heads are already in place in close proximity to the areas where they would be proposed as part of the formal signalisation scheme. This means that the risks of delivering this scheme should be minimal. In all cases the schemes can be delivered in a way which maintains the pedestrian flow within the area albeit the location of the crossings may have to move.

Scheme 02 - Feasibility Review Comments

*Is there potential for the scheme to be delivered within the existing highway boundary? – **Yes although the optimum scheme requires additional land which appears to be Council controlled.***

Initial Comments on the Scheme

1. The crossing points at the Bridgeway / Bridgefoot junction move slightly to minimise intergreens, and a section of dedicated left turn lane from Bridgeway SB to Bridgefoot is shown. This could be extended further to the north if necessary, as whilst this proposal extends beyond the highway boundary, it appears to be council owned land- **this requires further investigation.**
2. An amended layout is shown at the junction between Bridge Foot and Bridge Street, to minimise intergreens and rationalise the existing layout in terms of scale. The existing cut through for northbound vehicles on Waterside has been removed, which helps simplify the area. The pedestrian crossing to the east of Waterside moves to the west, to maximise the vehicle queue length between the crossing and gyratory itself.

Technical Note

232815-07

17 October 2013

Risk Review

Highway risk level - Low

Risk of local objection - Low

Decision - proceed scheme to cost estimate stage.

Cost Estimate

Outline Cost Estimate - £563,000

Inclusion for Services - £150,000 (26%)

Inclusion for contingencies & fees - £73,000 (13%)

Cost uplift (44% Optimism Bias) - **£0.82 Million**

Technical Note

232815-07

17 October 2013

Scheme 03 – Evesham Place/Evesham Road Roundabout

Initial Issues

Within the AM period there are heavy queues observed on the Seven Meadows Road NB and Evesham Road NB approaches (it should be noted that the latter has been reduced since the Link West of Shottery has been included within the modelling). Within the PM period there are large queues which are observed on Rother Street/Evesham Place SB that are caused partly by the need to yield to vehicles travelling along Grove Road SB and, furthermore, by queue propagation back from the Evesham Road/Evesham Place roundabout. This is to be expected as there is a large volume of traffic travelling outwards from Stratford upon Avon town centre during the PM period.

Scheme Principles

There are potential capacity benefits obtainable through switching from a roundabout to traffic signal-controlled priority junction. Signalisation is required due to the tidal nature of movements across the junction. During the AM peak heavy traffic flows are present northwards into Stratford whilst the opposite occurs in the PM; therefore the use of signals allows the junction to be better tailored to the differing AM and PM conditions. Queue detectors have been used to minimise the queuing on approach to the signals. Two lane entry widths have also been retained on all approaches, whilst the existing highway area is used to provide stacking space for right turning traffic.

Initial Risks

The main issue concerning the delivery of this scheme is the need to ensure that there is sufficient space to deliver the design without compromising the existing pedestrian and cycle facilities. Issues concerning the access to properties which front onto the existing carriageway will need to be considered.

Scheme 03 - Feasibility Review Comments

Is there potential for the scheme to be delivered within the existing highway boundary? – Yes although there may be issues ensuring shared use of footways is deliverable

Initial Comments on the Scheme

1. The existing standalone crossing on the south-eastern arm has to be removed or alternatively displaced further to the south, which is away from the desire line. There is no width to accommodate a crossing point at the junction itself due to the converge angle of the various arms and the requirement to accommodate HGV manoeuvres;
2. The flare on the north-western arm is minimal and a couple of private accesses may prove to be blocked off by the splitter island;
3. The short two lane merge on the south-western arm is of limited use, it also creates a very tight left turn into the access road fronting nos. 1-4;
4. A yellow box will be required to prevent queues at the signals from blocking the entry into Broad Walk.

Risk Review

Highway risk level -

High

Risk of local objection -

Medium

Technical Note

232815-07

17 October 2013

Decision –proceed scheme to cost estimate stage, high risk concerning highway standards should be noted

Cost Estimate

<i>Outline Cost Estimate -</i>	£556,000
<i>Inclusion for Services -</i>	£50,000 (9%)
<i>Inclusion for contingencies & fees -</i>	£92,000 (17%)
Cost uplift (44% Optimism Bias) -	<u>£0.80 Million</u>

Technical Note

232815-07

17 October 2013

Scheme 04 – Grove Road/Rother Street Reconfiguration of flows.

Initial Issues

Queuing on Rother Street is frequently exacerbated by the limited opportunity for traffic travelling SB to exit onto Evesham Place, which in turn results in lengthy queues that frequently block back through Greenhill Street and beyond.

Scheme principles

By making Grove Road one-way NB and Rother Street one-way SB the propensity for blocking back to occur is reduced significantly. Furthermore, the additional 2 lane directional links provide extra storage capacity for any queues that do occur, limiting the propensity for queues to reach such an extent that they begin to impact upon the operation of adjacent major junctions.

Initial Risks

There are a number of issues pertaining to the delivery of this scheme that require consideration, these include, but are not limited to, the following:

- Constraints regarding the road space and the need to deliver a 2 lane Evesham Place SB approach to the newly signalised Evesham Place/Evesham Road junction.
- The proximity of the access of Broad Walk to the junction and potential for right turning traffic to be blocked by vehicles queuing at the signals will require the introduction of a yellow box.
- The need to retain existing pedestrian and cyclist facilities in and around the junction.
- Possible implications of vehicles not being able to turn right from Evesham Place into Chestnut Walk
- Possible risk of creating a more circuitous route for local residents and people accessing businesses in the area – could lead to objections and make a scheme difficult to deliver

Scheme 04 - Feasibility Review Comments

*Is there potential for the scheme to be delivered within the existing highway boundary? – **Yes although there may be issues ensuring shared use of footways is deliverable***

Initial Comments on the Scheme

1. A reconfigured junction is shown between Rother St and Greenhill St, with widened footways and the inherent benefits associated with the removal of a stage from the signals.
2. Along Rother St itself we are able to provide 2.5m wide parking bays along the majority of the western kerblines, in addition to two southbound lanes of 3.25m width
3. Significant footway widening is shown along the western kerblines of Rother St to provide minimum widths of 3.0m adjacent to the parking bays, with a build out to provide an informal crossing point to the southern end of the market.
4. The junction between Grove Road and Greenhill Street has been amended to reflect the removal of the straight on SB movement into Grove Road. Significant footway widening is possible around the junction together with geometry improvements to Arden Street.
5. In order to accommodate two required SB lanes between Evesham Place and Chestnut Walk, it would be necessary to remove parking bays, telegraph poles, lighting columns and two mature trees along the eastern kerblines. By removing the trees, lighting columns and

Technical Note

232815-07

17 October 2013

telegraph pole, and providing 2.0m footways in this area (reduced from 3.0m) we are able to provide two southbound lanes of 3.0m width.

Risk Review

Highway risk level - High

Risk of local objection - High

Decision –proceed scheme to cost estimate stage, high risk should be noted & a further review of the scheme should be undertaken before any further work is undertaken.

Cost Estimate

Outline Cost Estimate - £593,000

Inclusion for Services - £150,000 (25%)

Inclusion for contingencies & fees - £118,000 (20%)

Cost uplift (44% Optimism Bias) - **£0.85 Million**

Technical Note

232815-07

17 October 2013

Scheme 05 – Birmingham Road/Windsor Street Roundabout

Issues

This roundabout is in close proximity to the strategically important Birmingham Road/Arden Street signalised junction. At times vehicles can elect to use Windsor Street SB as a route from Birmingham Road to the Evesham Road/Evesham Place junction. Queuing back from the Windsor Street/Rother Street signalised junction can block back into the Windsor Street/Birmingham Road junction which, in turn, blocks the movement of traffic along Guild Street/Birmingham Road.

Scheme Principles

By converting the roundabout into a priority junction and restricting the propensity for right turns at the junction the movements are simplified and delays at the junction are minimised. Traffic wishing to travel from Birmingham Road to Evesham Road is largely encouraged to use the Arden Street Greenhill Street route which has a much higher capacity than the Windsor Street Route and thus, the propensity for queuing at the Windsor Street/Rother Street junction to block back through adjacent junctions is largely mitigated. The scheme also assumes that two lanes can be provided for the length of the Birmingham Road NB approach to the Birmingham Road/Arden Street signalised junction.

Initial Risks

Most of the scheme lies within existing highway and so risks regarding feasibility are likely to be minimal. One risk that has been identified is the need to establish that there is sufficient road space to deliver 2 lanes NB along the Birmingham Road without compromising existing pedestrian and cyclist facilities. A major risk is posed by the significant number of right turners out of Shakespeare Street (756 per 12 hour weekday). Changing junction to an uncontrolled priority arrangement is likely to make this movement more difficult which may lead to local objections. This could pose a risk to scheme delivery.

Scheme 05 - Feasibility Review Comments

Is there potential for the scheme to be delivered within the existing highway boundary? – Yes

Initial Comments on the Scheme

1. Visibility from both side roads is below standard at approx. 2.4m x 45m. Whilst this is a historic problem the provision of give way lines on the roundabout would have slowed vehicles down on the approach to the junction. With a priority junction this would no longer be the case, hence the reduced visibility becomes more of a safety concern.
2. A ghost island right turn bay into Windsor Road should still be provided to cater for coaches approaching the terminal on Windsor Road. It will therefore be very difficult to prevent general traffic from making the right turn.
3. The roundabout allows coaches to swing wide and use the entire road width when turning into / out of Windsor Road, whereas the priority junction forces vehicles to keep to their lanes. In this sense manoeuvres for buses / HGVs etc. are made noticeably more difficult.

Technical Note

232815-07

17 October 2013

Risk Review

Highway risk level - High

Risk of local objection - High

Decision –Do not proceed to cost estimate stage.

The presence of the coach terminal and the need to retain the right turn means that this scheme is unlikely to be deliverable. The recommendation is that this scheme should not be progressed. Further investigation of potential improvements within this area is recommended before any scheme is taken forward.

Technical Note

232815-07

17 October 2013

Scheme 06 & 07 – Shipston Road/Clifford Lane and Shipston Road/Seven Meadows Road roundabouts

Issues

The future year modelling appears to indicate that heavy queues are anticipated within close proximity of the two roundabouts. During the AM large queues manifest on the Shipston Road and Clifford Lane NB approaches to the Clifford Lane/Shipston Road roundabout whilst, during the PM, large queues appear on the Seven Meadows Road and Trinity Way approaches to the Shipston Road/Seven Meadows Road roundabout.

Scheme Principles

By widening the approaches to the roundabouts as well as, where necessary, the circulating carriageway, the capacity of both junctions is improved. Two lane exit flares are provided on the Trinity Way WB, Shipston Road NB and Shipston Road SB exit arms which allow certain movements across the junction to be made from two lanes. Furthermore the two lane exit flare on the Shipston Road SB exit can be extended to a dual section between the two junctions which will provide additional capacity.

Initial Risks

The optimum enhancements require a considerable amount of highway works and there is currently a risk that the requirements for the junction radii may push the scheme extent outside of the existing highway boundary.

Scheme 06 & 07 - Feasibility Review Comments

*Is there potential for the scheme to be delivered within the existing highway boundary? – **Yes although further clarification on the boundary could unlock additional scheme enhancements.***

Initial Comments on the Scheme

Northern Roundabout:

1. The northbound two lane exit has a substandard merge length. The highway boundary info in this area may be misleading, as the adjacent land looks to be within council owned land if not highway land. If this is the case there may be potential for improving the length of exit merge and two lane flare section on this arm, at the expense however of a significant number of trees.
2. The eastern arm is showing a fairly significant length of three lane flare, however there is a bridge structure and embankment some 125m to the east of the roundabout. Therefore the scheme may require costly retaining structure / embankment to accommodate the flared length as shown. There is scope for Value Engineering here following detailed analysis of the layout.
3. A bus stop / layby on the western kerblines of Shipston Road between the two roundabouts will need to be reduced in size or removed to ensure the widening can be accommodated.
4. Entry path deflection is reduced below the required standard on all arms, as a direct result of the proposed widening to entries and the circulatory.

Southern Roundabout:

Technical Note

232815-07

17 October 2013

5. No comments. The proposed amendments can be incorporated within the highway boundary, maintaining the existing entry deflection.

Risk Review

Highway risk level - Med

Risk of local objection - Low

Decision - proceed scheme to cost estimate stage.

Cost Estimate

Outline Cost Estimate - £747,000

Inclusion for Services - £50,000 (7%)

Inclusion for contingencies & fees - £144,000 (19%)

Cost uplift (44% Optimism Bias) - **£1.1 Million**

Technical Note

232815-07

17 October 2013

Scheme 08 – Birmingham Road NB widening between Regal Road and Hamlet Way

Issues

The recent reconfiguration of the Warwick Road to a minor route in the PARAMICS model has significantly increased the traffic volumes utilising the Birmingham Road. Frequently queues are observed to propagate along the Birmingham Road NB from the newly signalised Hamlet Way junction, the Birmingham Road / Park Road and the Birmingham Road / Regal Road roundabouts. This queue propagation can extend back to the Arden Street / Birmingham Road signalised junction. When that occurs the network is significantly constrained as a major exit point for vehicles is blocked. Traffic can quickly build up within the town centre as a result of this issue. It should be noted that similar issues are observed on the Birmingham Road SB but the implications of queue propagation in this direction are less severe as the queues are stored on the Birmingham Road.

Scheme Principles

Provision of two lanes NB along the Birmingham Road from just south of the junction with Regal Road to just north of the junction with Hamlet Way to improve exit capacity during the PM period.

Additional consideration (not included within current design) - potential to ban right turn into Maybrook Road, as vehicles could use Wharf Road as an alternative means of entry & exit. This may become more of an issue if the introduction of the second lane limits the available gaps for right turning traffic to such an extent as it blocks SB traffic.

Initial Risks

A scheme which enables two lanes of traffic to travel NB across the Hamlet Way junction has previously been investigated but the costs were initially assessed as prohibitive. A revised version of the scheme was delivered which does not unlock the capacity benefits that the two lanes NB appear capable of delivering. Thus, cost should be considered as a major risk. Furthermore, there are a number of properties which are accessed directly from the Birmingham Road NB over an existing foot/cycleway that may pose a barrier to the delivery of the two lane element of the scheme in this area. Finally whilst there is existing space within the highway boundary to deliver the proposed two lane section it is unclear whether this would compromise the existing NMU facilities which, given the close proximity of a large retail area, are likely to be unacceptable.

Scheme 08 - Feasibility Review Comments

Is there potential for the scheme to be delivered within the existing highway boundary? – Yes although to maintain footway parking adjacent footways may need to be reduced to 2.0m widths.

Initial Comments on the Scheme

1. Regal Road roundabout is enlarged to allow the provision of two NB lanes, with splitter island positions also amended.
2. Two pedestrian splitter islands are removed along the stretch of Birmingham Road; one near to Justins Avenue and one near to Park Road junction. The splitter nearest Park Road is perhaps less of an issue given that a signalised crossing is provided 70m to the north, and an enlarged splitter is shown at the Park Road roundabout. NB - There is also a possibility that the existing Toucan crossing south of Park Road may be relocated further south on Birmingham Road in future as recommended by the A3400 Birmingham Road Traffic Management Study.

Technical Note

232815-07

17 October 2013

3. Minor amendments are shown to Park Road roundabout in order to permit the provision of two northbound lanes. White lining measures are shown within the roundabout to provide additional clarity.
4. The NB merge beyond Hamlet Way signals is improved through kerb line and white lining realignment, without the requirement for additional land take from the verge to avoid the existing culvert.
5. Footway parking is permitted along the frontages of the houses to the north of the signalised junction with Hamlet Way. These can be maintained by narrowing the adjacent footway to 2.0m.
6. The right turn lane into Maybrook Road has been retained alongside a half-depth bus layby but this means that the scheme is likely to be hard against the highway boundary along the NE side of the road, also creating an impact with the paved area at the entrance to the new Costa Coffee / Game retail units.
7. To deliver the pedestrian crossing splitter islands are required to house the signal heads, which will in turn reduce the length of right turn bay into Maybrook Road.

Risk Review

Highway risk level - High

Risk of local objection - High

Decision - proceed scheme to cost estimate stage, should be noted that scheme is high risk.

Cost Estimate

Outline Cost Estimate - £1,155,000

Inclusion for Services - £200,000 (17%)

Inclusion for contingencies & fees - £180,000 (16%)

Cost uplift (44% Optimism Bias) - **£1.7 Million**

Technical Note

232815-07

17 October 2013

Scheme 09 – Birmingham Road/A46 ‘Bishopton Island’

Issues

During various points during the future year model runs large queues are observed to occur on all approaches to the roundabout. The queues tend to form on different approaches at different times within the simulation period with the tendency for queuing to occur on links into Stratford within the AM and out of Stratford within the PM.

Scheme Principles

Substantial widening of the circulating carriageway and entry and exit flares is proposed in order that the capacity of the junction can be increased. The scheme could potentially be adapted further to include signals but these have not been included at this stage.

Additional consideration (not included within current design) – Signalisation, including MOVA, would likely improve the operation of the roundabout further.

Initial Risks

The main risk is ensuring that the scheme can be delivered within the existing highway boundary and can be delivered in a way which conforms to the HA design standards.

Scheme 09 - Feasibility Review Comments

Is there potential for the scheme to be delivered within the existing highway boundary? – Yes although a two lane flare along the A46WB exit cannot be accommodated within the highway extent

Initial Comments on the Scheme

1. It is not possible to provide a two lane WB exit onto the A46 within existing constraints. The distance between carriageway edge and stream culvert is insufficient; extending the culvert is possible, but this would likely be prohibitively expensive.

Risk Review

Highway risk level - Low

Risk of local objection - Low

Decision - proceed scheme to cost estimate stage.

Cost Estimate

Outline Cost Estimate - £1,515,000

Inclusion for Services - £100,000 (7%)

Inclusion for contingencies & fees - £289,000 (19%)

Cost uplift (44% Optimism Bias) - **£2.2 Million**

Technical Note

232815-07

17 October 2013

Scheme 10 – Alcester Road/A46 ‘Wildmoor’ Roundabout

Issues

During various points in the future year model runs, large queues are observed to occur on all approaches to the roundabout. The queues tend to form on different approaches at different times within the simulation period with the tendency for queuing to occur on links into Stratford within the AM and out of Stratford within the PM.

Scheme Principles

Initial scheme assumption is for the delivery of a dedicated A46 left turn slip so that SB/EB vehicles do not have to enter the junction, provision of a two lane EB exit flare along the A46, widening of all entry links as well as the circulating carriageway, if possible a two lane exit flare along the A46NB exit (towards Alcester) should also be included.

Initial Risks

The current scheme assumptions are likely to require substantial third party land to facilitate delivery.

Scheme 10 - Feasibility Review Comments

Is there potential for the scheme to be delivered within the existing highway boundary? – No

Initial Comments on the Scheme

1. The current scheme assumptions cannot be accommodated within the existing highway boundaries, and therefore significant third party land is likely to be required.
2. Further design work is required to determine the optimum scheme and this should be done in conjunction with the Highways Agency as it will potentially involve the addition of signals and/or third party land

Risk Review

Highway risk level - High

Risk of local objection - High

Decision –Do not proceed to cost estimate stage.

The current scheme requires third party land; an alternative scheme may involve signals. Further work should be undertaken in conjunction with the HA to determine an appropriate scheme.

Technical Note

232815-07

17 October 2013

Summary

The following table presents the headline findings from the initial feasibility review undertaken for the ten schemes which have been assumed to comprise the Stratford Transport Package:

Table 1 - Initial Findings

Scheme	Description	Highway Risk	Local Risk	Progress to Cost Estimate Stage?	Cost Estimate (£million)
1	Tiddington Road/Shipston Road Gyratory	Medium	High	Yes	1.03
2	Bridgefoot/Bridgeway Gyratory	Low	Low	Yes	0.83
3	Evesham Place/Evesham Road Roundabout	High	Medium	Yes	0.80
4	Grove Road/Rother Street Reconfiguration	High	High	Yes	0.85
5	Birmingham Road/Windsor Street	High	High	No	-
6 & 7	Shipston Road/Clifford Lane & Shipston Road/Seven Meadows Road roundabouts	Medium	Low	Yes	1.1
8	Birmingham Road Widening	High	High	Yes	1.7
9	Bishopton Island	Low	Low	Yes	2.2
10	Wildmoor	High	High	No	-

The estimated cost of the 7/8 schemes, that have been identified as feasible through this review, currently stands at just over £8.5 million.

Based on this initial review of the proposed schemes it is recommended that further design work is undertaken with regards the following schemes:

- Scheme 05 Birmingham Road/Windsor Street roundabout
- Scheme 10 A46/Alcester Road 'Wildmoor' roundabout

It is unlikely that the schemes that have been proposed thus far will conform to the required design standards.

It is highly unlikely that the localised impacts that are likely to be incurred as a result of the implementation of the Birmingham Road/Windsor Street proposals would be considered acceptable. It is therefore recommended that no further work is undertaken with regards the current scheme proposals. Further design work is recommended for this scheme which should then be re-assessed to establish the feasibility and acceptability of the new proposals.

It is likely that any proposed works at the A46/Alcester Road 'Wildmoor' roundabout will require third party land. Furthermore, the optimum scheme will likely involve the implementation of traffic signals. In order for a design to be considered both feasible and deliverable it is recommended that further work is undertaken to identify the optimum proposals for this area which require as little third party controlled land as possible.

Scheme Analysis

An initial assessment of the relative performance of each scheme has been undertaken using the latest Stratford-upon-Avon PARAMICS model which has been developed to test the impacts of both the SRZ policy allocation and the STP scheme implementation.

Technical Note

232815-07

17 October 2013

A first sift of measures has been undertaken at a very high level and has compared the performance of each of the proposed schemes against the Reference Case conditions using the following measures:

- Throughput
- Queuing
- Delay

Initially cordon analysis has been used to identify appropriate values for each of the aforementioned measures. Cordons have been defined across the boundaries of each of the respective schemes. The level of delay and queuing experienced on each of the links within the model has then been captured and aggregated firstly across all links and then, secondly, across all time periods.

Further refinement of this analysis is likely to be required before an accurate understanding of the potential benefits of scheme implementation can be identified.

Through the use of pre-defined cordons, the method of analysis of each of the aforementioned performance indicators has been adopted as follows:

- Throughput – has been measured by calculating the total number of vehicles entering each cordon across the entire AM and PM model period.
- Queuing – has been measured by calculating the average maximum queuing levels, in metres, across all links within the cordon boundary. These have been aggregated across each link and hour to produce a single comparative value for both the Reference Case and Scheme scenarios
- Delay – has been calculated in a similar method to the queuing analysis although the measure used is the average time it takes for vehicles to traverse each of the links within the cordon area.

Each of the measures has been compared to the reference case to provide an outline score whereby the reference levels are assumed to be 1. Where a reduction is desirable the scheme performance has been expressed as a function of the reference case levels. Where an increase is desirable, i.e. throughput, the opposite approach has been adopted.

It should be acknowledged that the current outputs reflect a high level snap shot of the initial levels of scheme performance. It is highly likely that during future stages of refinement the overall level of scheme performance will improve further.

The outcome from this analysis is presented within **Table 2** on the following page. Analysis of the outputs presented within **Table 2** reveals that, in all cases, implementation of the proposed schemes are likely to result in a net improvement in conditions overall.

In most cases, considering the performance across both the AM and PM time periods queuing levels are likely to reduce considerably. Similarly, in most cases, there is an increase in throughput albeit the impact, relative to the reference case, is less than the impact on queuing. When considering the impact on delay within the cordon the initial analysis appears to indicate that implementation of the schemes increase the travel time within the cordon assessment areas. However, since the schemes are drawing more vehicles through the area there is potential that this increase is linked to more vehicles travelling through the area. This seems more likely given the fact that queuing levels are observed to reduce in every scheme assessment.

As has been mentioned previously, this analysis should be superseded by a more detailed stage of analysis prior to drawing any final conclusions with regards the potential performance level of each scheme.

Technical Note

232815-07

17 October 2013

Table 2 - Relative Scheme Performance (AM & PM Combined)

Scheme	Queuing	Throughput	Delay	Total
1	0.76	1.00	1.23	2.99
2	0.63	0.98	1.19	2.80
3	0.52	0.98	1.38	2.88
4	0.55	0.90	1.26	2.71
5	0.56	0.93	0.82	2.31
6 & 7	0.26	0.95	0.52	1.73
8	0.53	0.94	1.06	2.52
9	0.47	0.92	1.07	2.46
10	0.71	0.93	0.90	2.54

Conclusions

The analysis and commentary set out previously within this note reveals the following conclusions:

- Schemes 05 and 10 are not considered suitable for delivery in the current proposed format. Further work is necessary on both schemes before they can progress further;
- Based on the initial assessment of highway and local risk levels, schemes 04 and 08 reflect the greatest risk levels whilst schemes 02 and 09 reflect the lowest risk levels;
- Scheme 09 represents the most expensive scheme for implementation with a current cost estimate of £2.2 million. Whilst schemes 02 to 04 are likely to be the cheapest with the costs for each scheme currently estimated to be below £0.9 million.

DOCUMENT CHECKING (not mandatory for File Note)

	Prepared by	Checked by	Approved by
Name	James Edwards	Neil Scott/Nick Dauncey	James Edwards
Signature			

Project title	Stratford-upon-Avon Transport Package	Job number 232815-08
Meeting name and number	Feasibility Review - Progress Update	File reference 232815-08.2013.10.23 - Meeting Notes
Location	Arup Campus	Time and date 10:00 23 October 2013
Purpose of meeting	Summary of Findings and progress update	
Present	Nick Dauncey & David Matthewson (WCC) James Edwards & Neil Scott (Arup)	
Apologies		
Circulation	Those present	

Action

1. Introductions

2. Scheme Review Findings/Cost Estimates

• Scheme 01 – Tiddington Road/Shipston Road Gyratory

Currently there are no issues with safety at this junction – there is a risk that changing the junction layout may impact upon this.

The junction should be reconsidered in order that ped flows can be better facilitated. Specifically, consideration should be given to the impact of removing the left turn slips from the mainline to incorporate wider pedestrian facilities.

Maintaining ped flows across the wider junction is critical. Therefore the junction would benefit from enhanced pedestrian facilities.

Detailed modelling should be undertaken in LinSig or similar to determine whether the design will work and cater for the pedestrian movements. This work would potentially benefit from a pedestrian movement survey either commissioned externally or undertaken through CCTV analysis.

• Scheme 02 – Bridgefoot/Bridgeway Gyratory

Current proposals could be amended to include the Leisure Centre Car Park entrance which could be amended to accommodate an additional flared turning lane.

Prepared by James Edwards

Date of circulation 2013.10.23

Date of next meeting

Minutes

Project title	Job number	Date of Meeting
Stratford-upon-Avon Transport Package	232815-08	23 October 2013

Action

There is work currently being undertaken to determine the potential to change the Guild Street signals so that the ped controller is 'on-demand' so that existing phase delays can be minimised.

The signals are currently linked at least in part across the junction.

Future scheme proposals will need to demonstrate that linking the signals will work and, if possible how the linkages may be further enhanced. This could include Great William Street and, possibly, Arden Street/Cattle Market signals.

- **Scheme 03 – Eveshame Place/Eveshame Road Junction**

The NB merge needs to be removed from the design as this cannot be accommodated.

The SB merge needs to be extended further south, potentially at the expense of one or two car parks, to improve this facility.

The final scheme needs to consider the issues with parking at Shottery Road.

The yellow box across Broad Walk will have a negative impact on the performance of the signalised junction. We need to establish a better understanding of the demand for this movement before considering implementing these, or similar, measures.

- **Scheme 04 – Grove Road/Rother Street**

There are fundamental issues with these schemes that mean it should not be progressed. Some of these include:

- *High level of local opposition is anticipated due to the number of residencies and commercial properties that would be affected by the scheme.*
- *There are a large number of pedestrian movements in and around the Wood Street/Windsor Street area that means it is highly undesirable to implement any scheme in this area that would result in substantial flow increases.*
- *Greenhill Street provides a drop off point for a number of deliveries that can, at times, cause substantial issues on the local network. Any measures which increase flows along this link would exacerbate these issues further.*

Further consideration should be given to the potential implementation of a signal scheme between Rother Street and Grove Road to minimise the potential for queuing on Rother street SB, during the PM period, to extend back into the Rother Street/Wood Street junction.

Minutes

Project title	Job number	Date of Meeting
Stratford-upon-Avon Transport Package	232815-08	23 October 2013

Action

- **Scheme 05 – Birmingham Road/Windsor Street**

The Proposals for Birmingham Road/Windsor Street are unsustainable due to the impact on local amenities; therefore this scheme has been withdrawn.

- **Scheme 06/07 – Road/Clifford Lane**

The current scheme proposals are sub-standard.

There is potential for the design costs to be reduced through Value Engineering but, at the same time, there is potential for a higher capacity scheme to be delivered albeit with a need for third party land requirements.

The existing layout should be amended so that there is a reduced capacity when considering the Shipston Road NB movement as encouraging this movement would be contradictory to proposals at Schemes 01 and 03.

Consideration should be given to developing two schemes for promotion, a sub-standard scheme which requires lies within the existing highway boundary and a more comprehensive scheme which may require third party land.

- **Scheme 08 – Birmingham Rd NB Widening**

The proposals should consider the wider level of interaction within the Maybird Retail Park. The scheme should consider the movements within the retail park as they have an influence on the operation along Birmingham Road.

The pedestrian facilities should be simplified, in particular consideration should be given to making the ped stages at Hamlet Way uncontrolled.

The current proposals involve moving the ped facility just south of the Park Road roundabout to a more central point between the two roundabouts which is also better placed with regards the main pedestrian thoroughfare into the retail park.

Consideration could be given to making Wharf Road inbound and Maybrook Road outbound as far as the adjacent industrial use is concerned.

- **Scheme 09 – Bishopton Island**

A widening scheme has been proposed in the current round of works. A signalised MOVA scheme could also be promoted in this area.

The current scheme demonstrates a benefit of implementation and can be used to indicate that the potential impacts incurred through the adoption

Minutes

Project title	Job number	Date of Meeting
Stratford-upon-Avon Transport Package	232815-08	23 October 2013

Action

of the SRZ policy can be mitigated.

Consideration should be given as to how this can be progressed jointly with the HA.

- **Scheme 10 – Wildmoor Roundabout**

The scheme proposed within the modelling cannot be delivered without third party land.

A second scheme may exist in the form of signals.

Both schemes require extensive redesign work and consideration should be given as to how this can be progressed jointly with the HA.

3. Technical Note Comments

- Scope for Value Engineering Scheme 06/07
- Scope for enhancing Scheme 06/07

The above points have been addressed previously

4. Warwick Road Dynamic Signing

- Scheme Principles
- Cost Estimate Requirements
- Outputs/presentation

There is a need to determine an appropriate cost for the scheme – this is necessary if we are to progress with a basic BCR calculation. If the BCR is not necessary at this stage network wide performance indicators can be used alongside standard economic analysis using WebTag values for time can be calculated and presented within the report

The following issues will be discussed at a subsequent meeting to be held 24th October 2013:

5. Other Progress

- Studley Analysis – General & AQMA
- Stratford SRZ/STP Testing Phase one outcomes

6. Outstanding Tasks/Timescales

- Mode Share Sensitivity Test

Minutes

Project title	Job number	Date of Meeting
Stratford-upon-Avon Transport Package	232815-08	23 October 2013

Action

- Warwick Road Testing
- Studley Report
- Stratford SRZ/STP Report

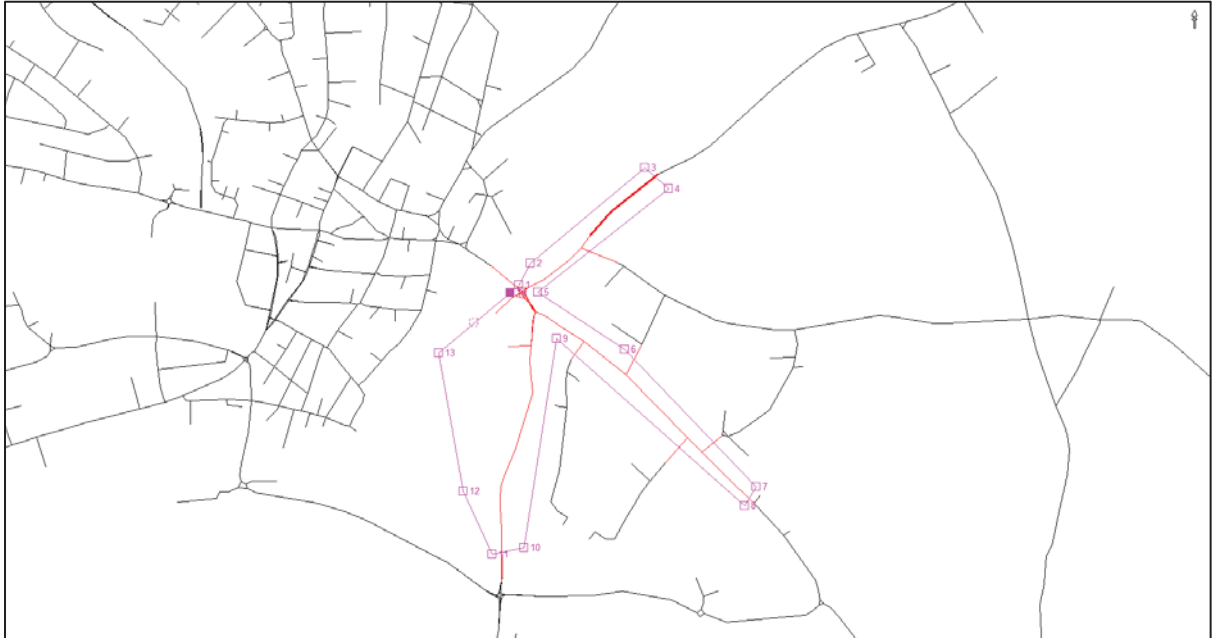
7. A.O.B

Appendix D

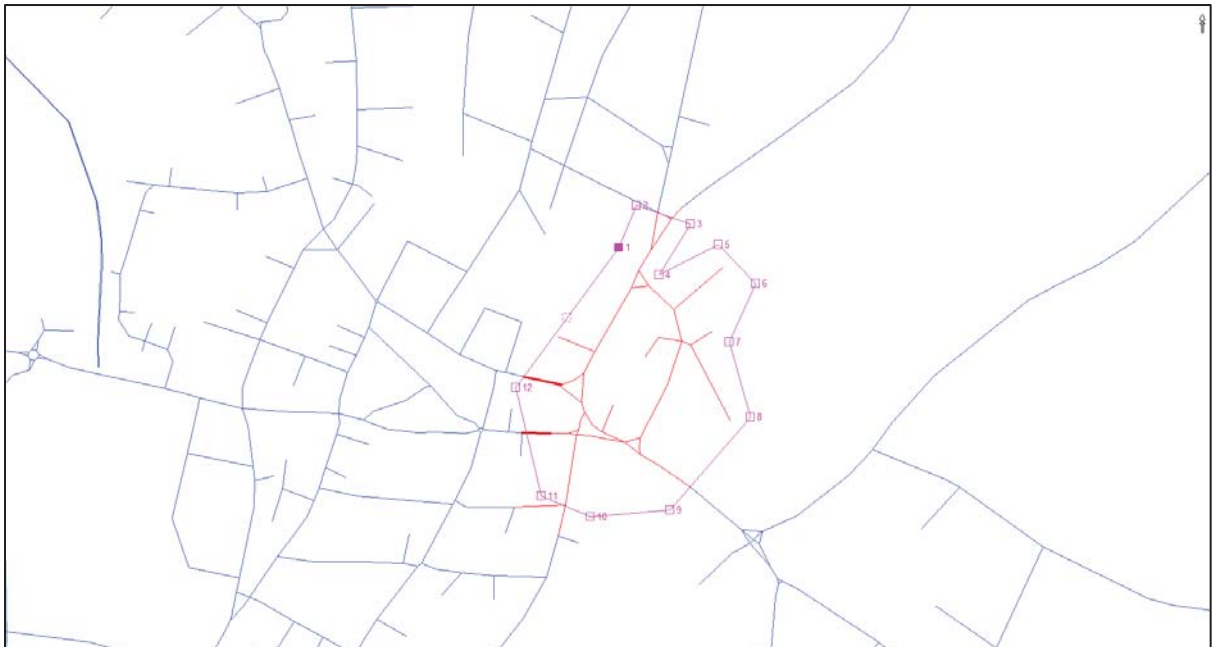
Cordon Assessment Locations

D1 Model Cordon Assessment Boundaries

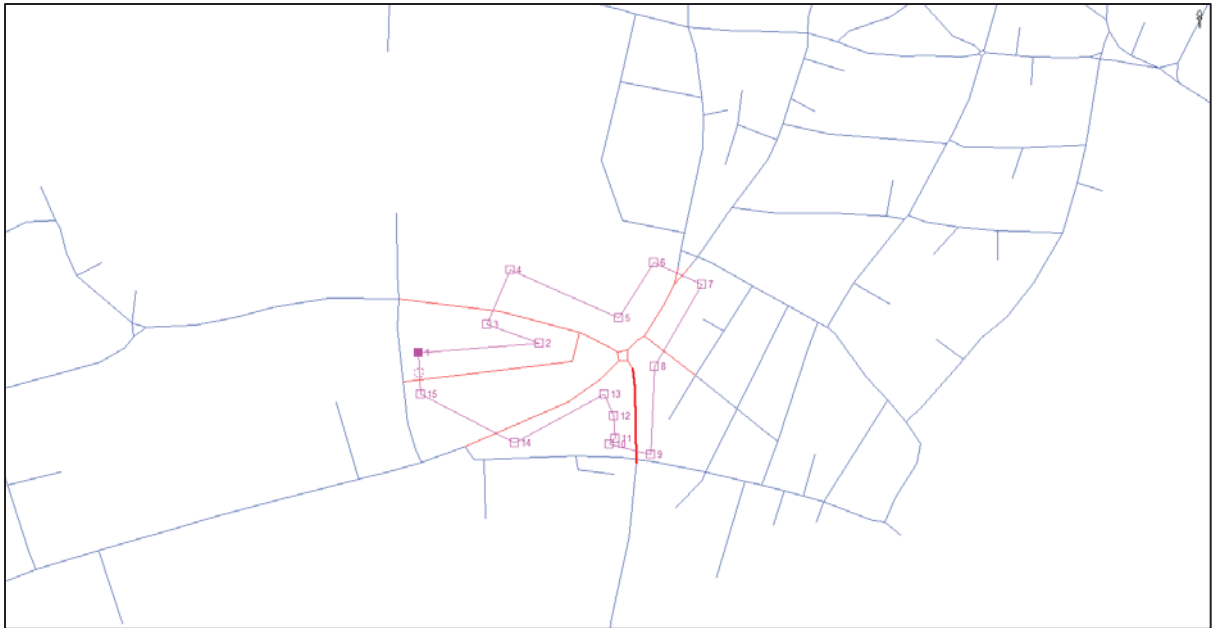
Scheme 01 - Tiddington Road/Banbury Road 'Alveston Manor' Junction



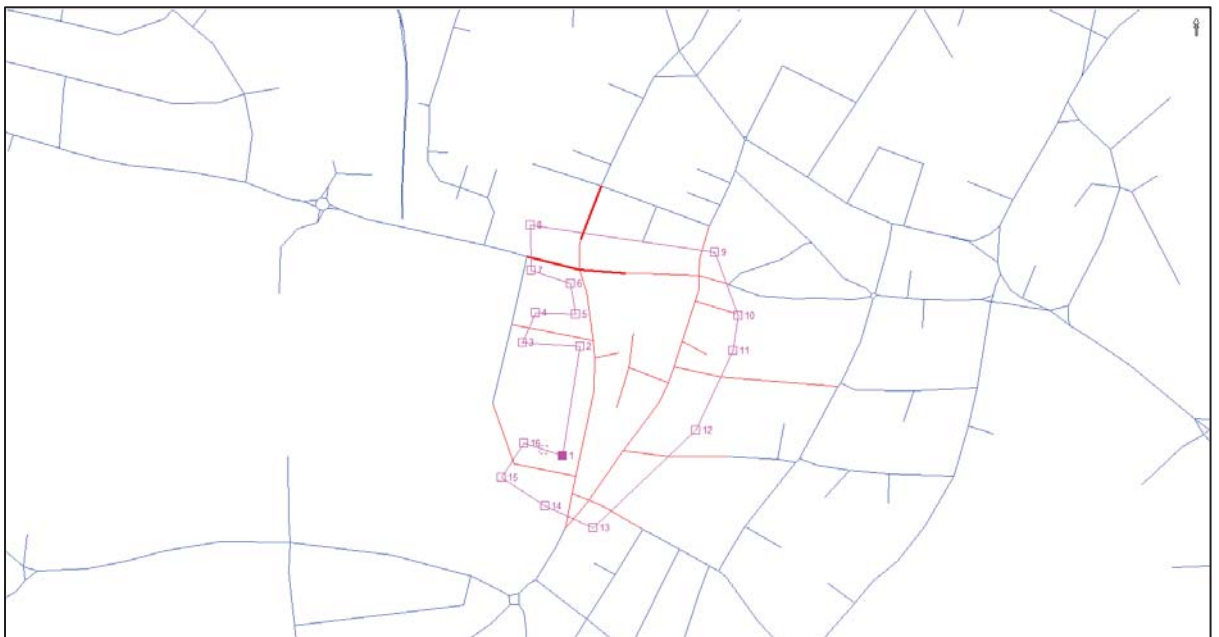
Scheme 02 – Bridgefoot/Bridgeway Stratford Gyratory



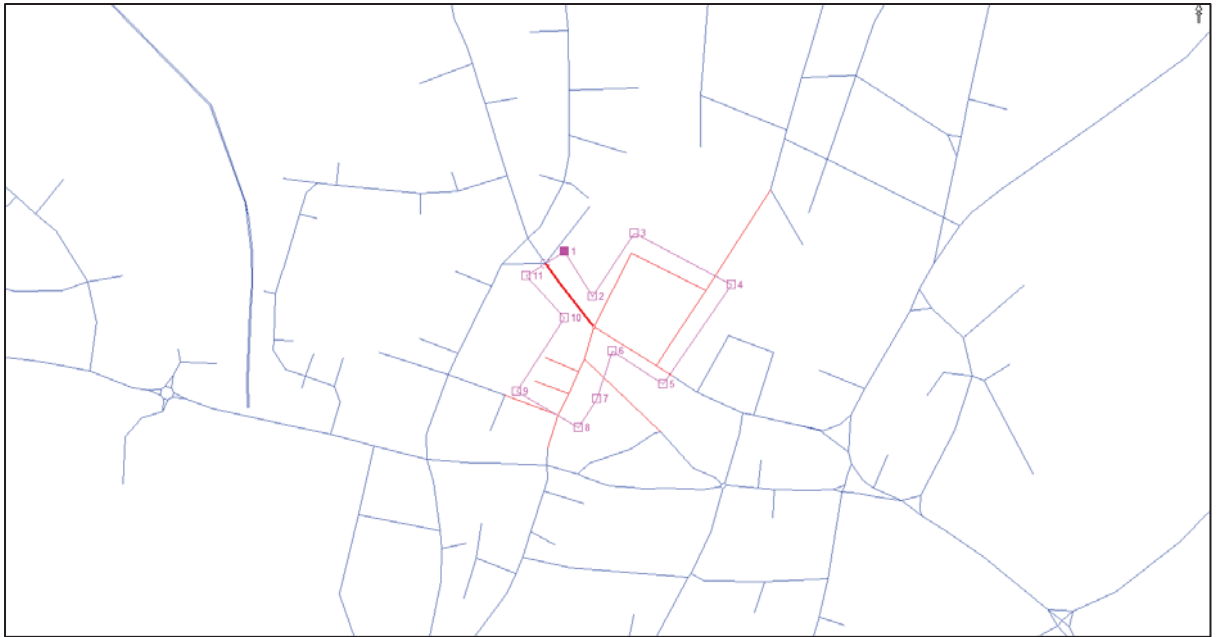
Scheme 03 - Evesham Place/Evesham Road roundabout



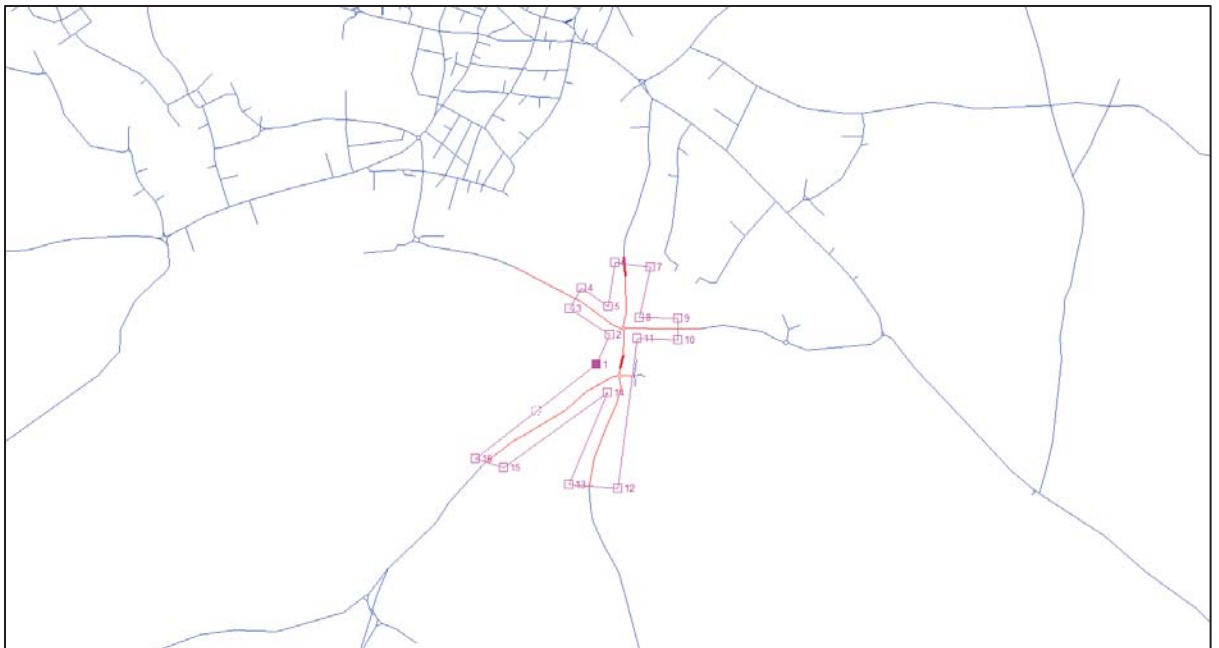
Scheme 04 – Grove Road/Rother Street



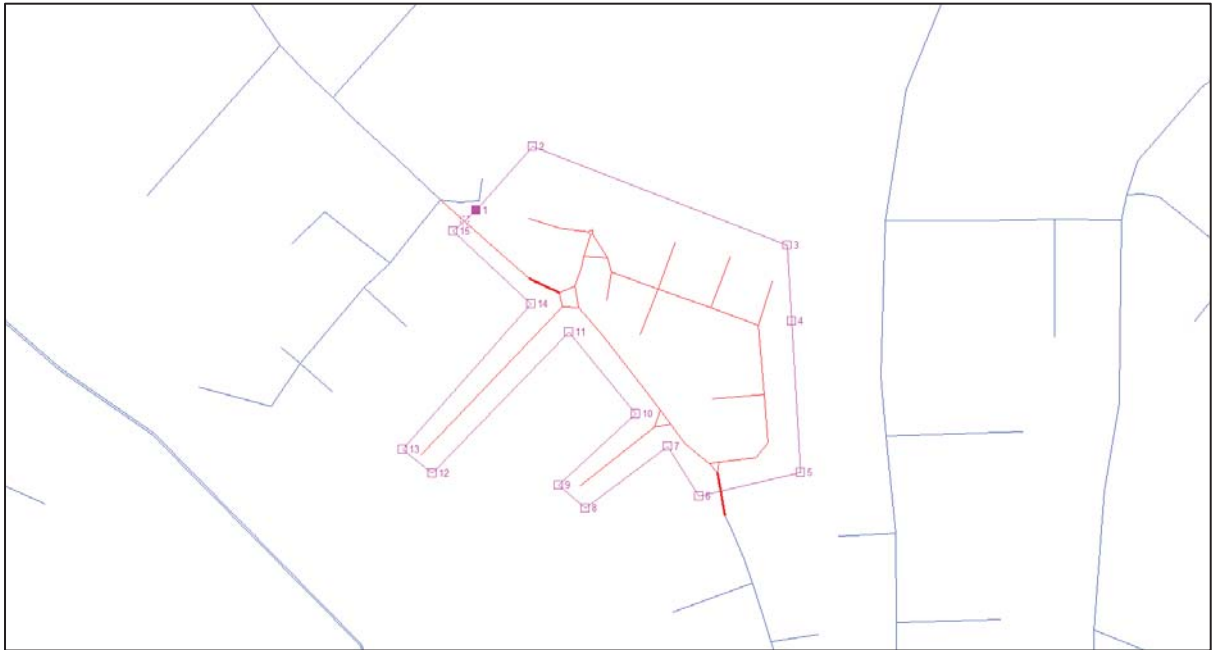
Scheme 05 – Windsor Street/Birmingham Road roundabout.



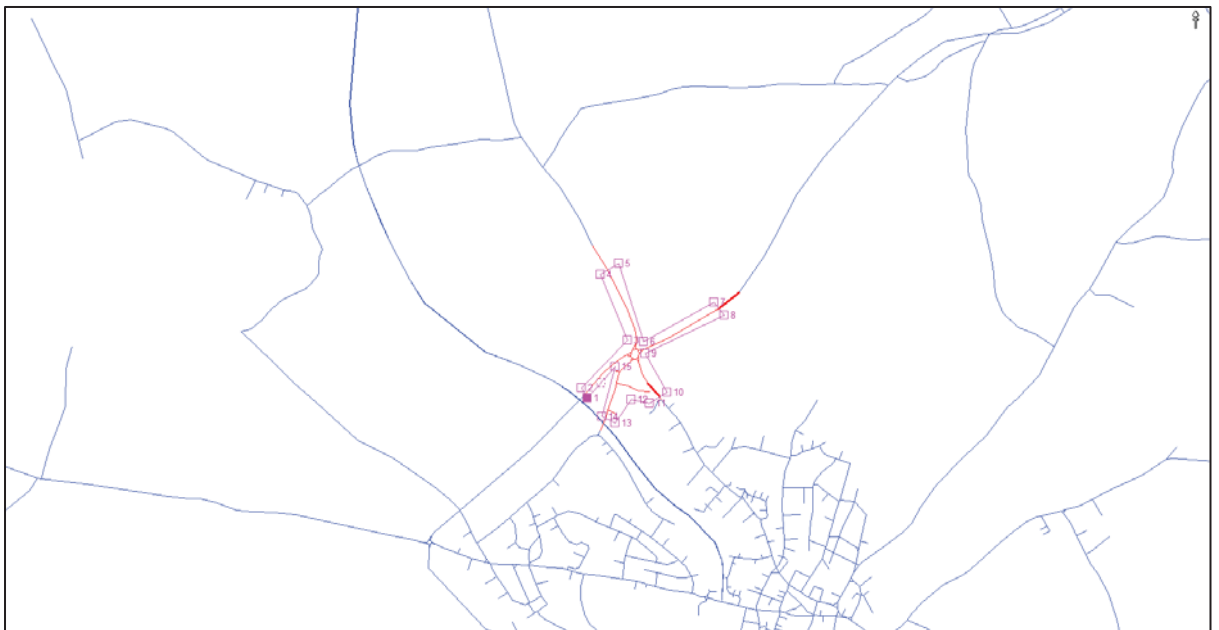
Scheme 06 & Scheme 07 - Shipston Road/Clifford Lane and Shipston Road/Seven Meadows Road roundabouts.



Scheme 08 - Birmingham Road between Regal Road and Justins Avenue



Scheme 09 – Birmingham Road/A46 ‘Bishopton Roundabout’



Scheme 10 – Alcester Road/A46 ‘Wildmoor Roundabout’

