

# Technical Note

Project:	<b>A414 Corridor Study</b>	Job No:	<b>60304737</b>
Subject:	<b>Sequential Option Testing - Summary and Recommendations</b>		
Prepared by:	<b>Rekel Ahmed</b>	Date:	<b>25 February 2014</b>
Checked by:	<b>Steven Ward</b>	Date:	<b>25 February 2014</b>
Approved by:	<b>Ian Burrows</b>	Date:	<b>27 February 2014</b>

## INTRODUCTION

Initial planning designs of individual, sequential option tests are provided in the enclosed plans. There are nine options to summarise and this note provides the main points from our option testing.

## OVERVIEW OF OPTIONS

Nine options were identified to be tested across several junctions, to ascertain if the junction improvements in isolation decreased congestion and delays along the A414 corridor. This section sets out the options tested at each of the junctions, Table 1. It is important to note that the junction improvement options have been tested in isolation, in order to determine the impact of each individually. The last section of this note then recommends packages of options to be tested which combine the best performing individual options.

Option	Scheme summary
1	Hale Road (J4) - increased circulatory capacity, approach lane/flare widening, white line/markings adjustments
2	Hale Road (J4) - partial signalisation, A414 (W) only
3	Hale Road (J4) - full signalisation of existing roundabout
4	Hale Road (J4) - convert to four arm signalised junction
5	Bluecoats (J3) - increased circulatory capacity, approach lane widening with dedicated left turn from London Road to Gascoyne Way, white line/markings adjustments
6	Bluecoats (J3) - convert to four arm signalised junction
7	Rush Green (J1) - localised widening on the approach to the service area
8	Caxton Hill proposal
9	A414/Campfield Road roundabout (J5) - dual carriageway through the adjacent railway bridge

Table 1: Options summary

SUMMARY OF OPTIONS

The qualitative summary of the option testing, below, is complemented by comparison of modelled journey times between the Base 2013 model and each individual option test model, in order to quantify the potential implications of each option (Table 2 and Table 3). The Base year model was calibrated and validated based on observed flows, with additional qualitative consideration of queue lengths. The validity of modelled journey times along the corridor in the Base year scenario has not been assessed against observed data. Therefore journey time comparisons between the Base model and the individual junction options are indicative only. The performance of the options considering future year growth has not been tested at this stage.

Morning	Base 2013	O1	O2	O3	O4	O5	O6	O7	O8	O9
Westbound	16:09	+01:06	+01:31	N/A	+00:13	-08:07	N/A	N/A	N/A	-01:53
Eastbound	10:27	-00:27	+01:14	N/A	-00:08	-00:11	N/A	N/A	N/A	+00:18

Table 2: Morning Peak Modelled Journey Times - A414 Corridor between A10 and Thieves Lane - Base versus Options

Evening	Base 2013	O1	O2	O3	O4	O5	O6	O7	O8	O9
Westbound	06:26	00:00	00:00	N/A	+00:50	-00:40	N/A	N/A	N/A	-00:11
Eastbound	11:02	-00:13	+08:14	N/A	+00:31	-00:32	N/A	N/A	N/A	-00:09

Table 3: Evening Peak Modelled Journey Times - A414 Corridor between A10 and Thieves Lane - Base versus Options

Whilst these results provide a reasonable metric for scheme comparison and resultant change in modelled journey time along the entire A414 corridor, between the Base model and each Option, the results should not be considered in isolation, the options assessment section provides further detail of potential impact. For instance, while Option 5 offers potentially significant journey time savings along the A414 these should be balanced against potential induced delays and reduced vehicle throughput along Ware Road (Table 4 and Table 5). Under Option 5, overall throughput is only marginally increased in the morning peak and is modelled to decrease in the evening peak.

Equally, whilst Option 4 does not appear to offer significant journey time benefits along the corridor and is unlikely to significantly reduce delay between Rushgreen and Bluecoats, the modelling suggests increased flow through the Hale Road junction and the corridor as a whole (Table 4 and Table 5) with approximately 600 additional vehicles modelled to pass through the corridor in the morning peak and almost 300 in the evening peak. Furthermore, reduced journey times between Hale Road and adjacent junctions are modelled in both directions.

Comparison of overall junction throughput in flow terms is a useful metric which gives an indication of potential additional vehicles which could be accommodated at each junction along the corridor for Options 1, 4 and 5 (Table 4 and Table 5).

Morning	Base 2013 (In/Out)	O1	O4	O5
Rushgreen (J1)	3781	+17	+26	-25
Foxholes (J2)	3217	-8	+66	+128
Bluecoats (J3)	4272	+20	+91	-66
Hale Road (J4)	4738	+41	+261	-9
Cross Lane (J7)	3614	+99	+223	+59
Campfield Road (J5)	2528	+2	-64	-36
Thieves Lane (J6)	3024	-3	-4	-26
Total	25173	+168	+599	+26

Table 4: Morning Peak Modelled Junction Throughput - A414 Corridor between A10 and Thieves Lane - Base versus Options

Evening	Base 2013 (In/Out)	O1	O4	O5
Rushgreen (J1)	3989	+2	+20	1
Foxholes (J2)	3399	-1	+26	-2
Bluecoats (J3)	4582	+4	+16	-120
Hale Road (J4)	4491	-14	+132	-54
Cross Lane (J7)	3525	+14	+117	-44
Campfield Road (J5)	2459	+7	-28	-29
Thieves Lane (J6)	3064	+2	-2	-37
Total	25509	+13	+282	-285

Table 5: Evening Peak Modelled Junction Throughput - A414 Corridor between A10 and Thieves Lane - Base versus Options

OPTION ASSESSMENT

A414/Hale Road (J4)

Option 1 - increases the capacity at the A414/Hale Road junction by increasing roundabout circulatory capacity, plus minor approach lane/flare widening and white line marking adjustments.

All model parameters and model demand were kept consistent with the base model when testing this option. The only changes made to the base model were inclusion of the new junction layout as shown in the CAD drawings.

Overall reduction in journey times in the eastbound direction along the A414 in the region of 15-30 seconds - cutting into the central island suggests that vehicles may have a smoother path through the roundabout in the eastbound direction.

Modelling tests of this arrangement suggest a detrimental effect in the morning peak in the westbound direction, resulting in an increase in journey time >1 minute. Greater traffic volumes entering the roundabout from the A414 West, potentially lead to increased conflicting circulatory movements with traffic from the A414 East arm. Journey times in the evening peak in the westbound direction are modelled to remain broadly the same.

Despite there being the potential to reduce journey times and delay eastbound, introduction of this measure has the potential to induce a delay westbound along the A414 particularly in the morning peak. As such, it was concluded that this option is unlikely to significantly improve vehicle flows along the A414 corridor.

Capacity at the Bluecoats junction is likely to be largely unaffected by this option. Journey times along Ware Road joining the A414 were not considered in detail for this option, a negligible number of additional vehicles were modelled to/from Ware Road, qualitatively no significant additional delay was observed at the Bluecoats roundabout associated with this option.

## *BENEFITS*

- Slight reduction in journey time eastbound along the A414 corridor.

## *DIS-BENEFITS*

- Increased journey time westbound along the A414 corridor.

Option 2 - involves partial signalisation of the roundabout at the A414/Hale Road junction. The design adopted was to signalise the A414 Gascoyne Way (W) arm of the roundabout so that vehicles from this arm would be held back and create additional gaps for vehicles from Gascoyne Way (E) and Hale Road with the aim of reducing delay on these arms.

Modelling of this option suggests that delays along the A414 corridor are unlikely to be reduced by partial signalisation. Modelled journey times increased in both east and westbound directions along the A414 for the morning and evening peaks.

Large queues were observed in the model on Hale Road, the signalisation meant that there was very little space for ahead/right turning vehicles to queue on the circulatory.

This effect was even more pronounced in the evening peak. Due to the nature of prevailing traffic conditions, this measure only served to increase delays and queues along the corridor. The queues that were present at Hale Road and eastbound on the A414 became even more pronounced with a large number of vehicles being unable to load onto the network at Hale Road due to space limitations on the roundabout gyratory.

Again all model parameters and demand for all user classes were kept consistent with the base model.

## *BENEFITS*

- No significant benefits

## *DIS-BENEFITS*

- Delays along the A414 corridor unlikely to be reduced.
- Increased queuing on Hale Road

Option 3 - fully signalise the existing roundabout at the A414/Hale Road junction. Several different options of signal stages/times were tested.

Signal staging sequences were tested using LinSig (AM & PM Peak) and Paramics (AM Peak only). Option tests suggest that there is likely to be significant queuing on the gyratory, which in-turn means there is insufficient capacity on the gyratory to accommodate circulatory movements.

From the modelling, our conclusion for this option is that the volume of traffic passing through the junction, combined with space restrictions mean that it is unlikely that full signalisation of the A414/Hale Road junction will provide improved performance of the corridor. In order to signalise this junction extra capacity would need to be provided to the roundabout gyratory, Hale Road and also the B158.

## *BENEFITS*

- No significant benefits.

## *DIS-BENEFITS*

- The junction cannot accommodate this layout from an engineering design perspective.
- Delays along the A414 corridor unlikely to be reduced.
- Increased queuing on Hale Road.

Option 4 - Replace the roundabout at A414/Hale Road with a four-arm signalised junction with left turn filter lanes for all approach arms. During scheme refinement, two different design layouts and a number of different signal stages and timings were tested.

The first design was rejected as it caused a problem to the traffic on the westbound approach arm of the A414 as traffic trying to go straight ahead got caught in a queue behind the right turning traffic.

Ultimately, the alignment of the lanes was re-designed to create a smoother path for the straight ahead movement. This design was tested with a number of different signal staging and timings until an optimum solution was reached.

It was found that the best solution was to have four stages. Demand and all model parameters were again kept consistent between the base model and the option test.

In the morning peak, there has been a slight increase in westbound journey times across the peak hour. This is mainly due to an increase in journey times between Hale Road and Cross Lane. This is perhaps due to the fact that vehicles cannot U-turn at Hale Road when it is signalised and must travel to Cross Lane to U-turn and complete their trip. Whilst there is an overall increase in modelled average journey times westbound, there is some reduction in journey time/delay between the A10 and Hale Road.

Journey times eastbound are modelled to decrease marginally in the morning peak, with journey time savings between Cross Lane and Hale Road. There are some modelled delays between Thieves Lane/Campfield Road/Cross Lane; this is perhaps due to the increased number of U-turners at Cross Lane, which causes delays to the vehicles travelling eastbound.

Similar patterns are experienced in the evening peak with a significant reduction in queuing observed at Hale Road.

Whilst the model suggests an overall increase in journey times westbound, it should be noted that modelled flows through the junction have the potential to increase as a result of implementing this option, with approximately 300 additional vehicles able to pass through the Hale Road junction eastbound and 70 additional vehicles westbound in the morning peak. In addition, modelled queues on Hale Road are reduced in the evening peak with an additional 80 vehicles are able to pass through the junction in the peak hour.

Overall the modelling of this option suggests that this layout has the potential to smooth flow along the A414 and also to potentially relieve queues in the evening peak on Hale Road. At the Bluecoats roundabout, capacity is largely unaffected by this option. Journey times along Ware Road joining the A414 were not considered in detail for this option, with a negligible number of additional vehicles were modelled to/from Ware Road. From qualitative assessment, no significant additional delay was observed at the Bluecoats roundabout associated with this option.

#### *BENEFITS*

- Slight reduction in journey time/delay westbound between the A10 and Hale Road.
- Journey times eastbound are modelled to decrease marginally in the morning peak.
- Potential for reduced Hale Road queuing.
- Potential for additional vehicle throughput.

#### *DIS-BENEFITS*

- Overall, slight increase in westbound journey times across the peak hour.
- Vehicles cannot U-turn at Hale Road when it is signalised and must travel to Cross Lane to U-turn this potentially increases journey times between Hale Road and Cross Lane.
- Some modelled delays eastbound between Thieves Lane/Campfield Road/Cross Lane, perhaps due to increased number of U-turners at Cross Lane.

#### Bluecoats (J3)

Option 5 - Introduce approach lane widening and a dedicated left turn filter from London Road to Gascoyne Way and some realignment of the junction. Realignment of the junction has meant a reduction in capacity on Ware Road, with only one straight ahead lane in the new alignment whereas the base model has two ahead lanes. All model parameters and demand were again kept constant between the base and option test.

Modelling of this option performed well along the A414 corridor in the morning peak with decreases in journey times of around 8 minutes westbound. The queues between Bluecoats and the junction with the A10 in the morning peak are significantly relieved in the modelling.

It should be noted that whilst the modelling suggests this option has the potential to reduce queues, delays, congestion and journey times along the A414 corridor, there are likely to be capacity reductions and increases in delay in other parts of the network. The reduction in capacity on Ware Road is likely to cause extensive queues. Model outputs suggest up to 7 minutes of additional delay along Ware Road on the approach to Bluecoats with fewer vehicles able to access the junction in the morning and evening peak hours (Table 6).

This option also performs well along the A414 corridor in the evening peak with modelled journey time savings of between 30 - 40 seconds. As in the morning peak, this option reduces congestion along the A414 but delays are experienced on Ware Road, this potential problem is not as pronounced in the evening peak.

Overall this option reduces journey times across the A414 corridor. However it should be noted that additional queues are modelled on Mill Road and Ware Road in the morning peak and further afield at Hale Road in the evening peak (Table 6).

Morning	Base Model A414*	Option 5 A414*	Base Model Ware Road**	Option 5 Ware Road**
Westbound	16:09	-08:07	08:31	+07:09
Eastbound	10:27	-00:11	09:13	+00:45
Evening				
Westbound	06:26	-00:40	05:43	+00:44
Eastbound	11:02	-00:32	12:10	-03:06

Table 6: Detailed Journey Time Comparison for Option 5 Test versus Base along the modelled corridor

\*A414 = between A10 and Thieves Lane

\*\*Ware Road = along A119 Ware Road (west of Stanstead Road) and A414 to Thieves Lane

**BENEFITS**

- Along the A414 corridor in the morning peak decreases in journey times of around 8 minutes westbound are modelled.
- Queues between Bluecoats and the junction with the A10 in the morning peak are significantly relieved in the modelling.

**DIS-BENEFITS**

- Reduction in capacity on Ware Road is modelled to cause extensive queues in the morning peak.
- Model outputs suggest up to 7 minutes of additional delay along Ware Road on the approach to Bluecoats roundabout.
- Additional queues are modelled on Mill Road and Ware Road in the morning peak.
- Fewer vehicles are able to pass through the junction in the morning and evening peak hours.
- Additional queues are modelled further afield at Hale Road in the evening peak.

Option 6 - Involves converting the Bluecoats roundabout into a four arm signalised junction. The junction has been designed with the main movement from A414 London Road to A414 Gascoyne Way as a single, un-signalised left turn filter lane that gives way to all other traffic. The modelling suggests a reduction in capacity when compared to the existing design, there is only one lane to turn left from London Road, where currently there are two and these vehicles have to give way to other movements. When this design was modelled, it was found that queues at London Road could potentially block back to the A10, with large numbers of unreleased vehicles. This suggests that this design would not be suitable for the traffic volumes and prevailing east to west movement at this junction.

There may be some flexibility to change the design so that the left turn filter lane has its own dedicated exit lane (as in Option 5) and left turners would not have to give way to any movements. This arrangement would probably experience delays on Ware Road as observed in Option 5 (as the number of straight ahead lanes would need to be reduced), offsetting the benefits given to the A414.

**BENEFITS**

- No significant benefits with this design.

**DIS-BENEFITS**

- Modelling suggests a reduction in capacity when compared to the existing design.
- Space within the highway boundary means that only one turn left turn lane from London Road can be provided, where currently there are two, in addition these left turning vehicles have to give way to other movements.
- Queues along London Road could potentially block back to the A10, with large numbers of unreleased vehicles.

Rushgreen (J1)

Option 7 - Consider provision of additional stacking capacity accessing the service station and restaurant at the Rushgreen roundabout.

The drawing shows the additional capacity that could be provided. This option has not been modelled as delays caused by the service station access are not represented in the model.

Signal timings are optimised as per current operation and off-sets and it is felt that this is the optimum solution for the level of existing demand.

Caxton Hill

Option 8 - In modelling terms, testing of revised access/egress arrangements from Caxton Hill industrial sites could ultimately provide relief along Ware Road. In relation to this option the HCC engineering team have concluded that the changes to Caxton Hill and the provision of access via the Foxholes roundabout is unlikely to be feasible due to the roads not being adopted public highways and associated significant costs of adopting them. Hence, this option has not been pursued further at this stage.

Hertingfordbury Road (A414)

Option 9 - involves building additional lanes in both directions through the railway bridge to the east of the Campfield Road r/a, providing two lanes on the approach to Campfield Road, two circulatory lanes at the roundabout and 2 lanes between Campfield Road and Cross lane.

When modelling this option, the demand and all model parameters (apart from signposting) were kept consistent with the base model. The signposting value at Junction 7 was lowered from 250m in the base model to 200m in the option test. This was done in order to stop vehicles changing lanes too early as vehicles were getting into lane for the roundabout at Junction 7 before navigating through the previous junction.

In the morning peak, the modelling suggests that this option provides a significant reduction in queues and journey times on the westbound route along the A414, giving a total journey time saving of almost 2 minutes. This is mainly due to a large time saving between Cross Lane and Campfield Road. In the base model, queues are experienced between these junctions. Dualling through the railway bridge has the potential to relieve these queues.

However, this option has had a negative impact on queues and journey times in the eastbound direction. This is mainly due to increased queues and delays between Campfield Road and Cross Lane, these queues are related to the fact that ahead capacity along the A414 is only provided in a single lane at Cross Lane.

In the evening peak, this option generally reduces journey times across the peak hour by providing small time savings in both directions in the region of 10 seconds.

In the eastbound direction, the models suggest a significant reduction in journey times and queues between Thieves Lane and Campfield Road, as two lanes are provided along this stretch of the A414. However, even though traffic can now navigate the Campfield Road r/a more efficiently, there is still a pinch point at Cross Lane, with one lane on the southbound approach to the junction being a dedicated left turn lane. Implementing this option would potentially transfer the queuing at Campfield Road to Cross Lane. This option is unlikely to have any significant benefits unless something can be done to resolve the pinch point at Cross Lane, potentially increasing capacity at the roundabout or some form of signalisation.

## *BENEFITS*

- For the morning peak, the modelling suggests that this option provides a reduction in queues and journey times on the westbound route along the A414.
- In the evening peak, this option generally reduces journey times across the peak hour by providing small time savings in both directions in the region of 10 seconds.

## *DIS-BENEFITS*

- For the morning peak, this option has had a negative impact on queues and journey times in the eastbound direction.
- Increased queues and delays between Campfield Road and Cross Lane, these queues are related to the fact that ahead capacity along the A414 is only provided in a single lane at the Cross Lane junction.

## RECOMMENDATIONS

### Option Packages

Following individual sequential option testing, two packages of options are proposed for assessment of current (2013) and future (2036) performance based on the relative qualitative and quantitative assessment presented above. The benefits and dis-benefits presented should be weighed up against each other when putting together potential options packages - particularly if Option 5 is to be taken forward.

### *Package 1*

Package 1 could combine Option 5 (improvements to the existing roundabout at Bluecoats) with Option 4 (replacement of the roundabout at Hale Road with a four-arm signalised junction). Initial modelling of Option 4 suggests that additional capacity can be provided to movements along the A414 and Hale Road, it is has the potential to work well when combined with Option 5 as this is likely to release existing queues along the A414. It is intended that combining these two options together will relieve the congestion along the A414 and reduce journey times along this route. However it should be noted that Option 5 has the potential to cause significant delay to movements from Ware Road and Mill Road, particularly in the morning peak, which are unlikely to be reduced by combining with Option 4. In developing this package, associated measures such as reviewing signal optimisation may be required in order to resolve potential congestion along Ware Road. Removing Option 5 from this package leaves Option 4 alone, which is unlikely to significantly reduce queuing/delay along the A414 corridor.

## *Package 2*

Package 2 would be incremental to Package 1 combining it with Option 9 (dualling through the Hertingfordbury Road railway bridge). As discussed, combining Options 4 and 5 together has the potential to release queues and relieve delays between the A10 and Hale Road along the A414. However, this may simply move the problem of congestion further along the corridor. Provision of two lanes through the Campfield Road junction has the potential to provide additional westbound capacity. It is though important to bear in mind that there are limited opportunities to provide additional eastbound capacity at Cross Lane. There is potential that Cross Lane may become a significant pinch point along the corridor if this package is implemented in the modelling.

## Technical Note

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Project:	A414 Corridor Study	Job No:	60304737
Subject:	Option Package 1 and 2 - Summary and Recommendations		
Prepared by:	Jenny Lampropoulou	Date:	24 April 2014
Checked by:	Steven Ward	Date:	14 May 2014
Approved by:	Ian Burrows	Date:	14 May 2014

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### Introduction

This note follows the sequential option testing along the A414 corridor and sets out the results from the recommended options; Package 1 and Package 2.

The Base year model was calibrated and validated based on observed flows, with additional qualitative consideration of queue lengths. The validity of modelled journey times along the corridor in the Base year scenario has not been assessed against observed data. Therefore journey time comparisons between the Base model and the individual options should be treated as indicative only, demonstrating the broad impact of the package.

The performance of the options considering future year growth has not been tested at this stage. This is intended to be carried out once the outcome of the base year packaged options is determined and the additional capacity through the corridor is identified.

### Overview of Options

Previously, nine options were identified to be tested across several junctions, to ascertain if the junction improvements in isolation decreased existing congestion and delays along the A414 corridor. Following this, two option packages with the potential to improve highway performance along the A414 corridor were selected to be tested.

Package 1 combined Option 4 (replacement of the roundabout at Hale Road with a four-arm signalised junction) and Option 5 (improvements to the existing roundabout at Bluecoats).

Package 2 includes a further network modification measure to Package 1 combining Option 4 and Option 5, as above, with Option 9 (dualling through the Hertingfordbury Road railway bridge).

### SUMMARY OF OPTIONS

The modeling suggests that Package 1 may be able to provide a reduction in journey times compared to the existing traffic conditions during the morning and evening peak in both the westbound and eastbound direction along the A414 corridor.

Direct Tel: +44 (0)131 301 8763  
T +44 (0)131 301 8600  
F +44 (0)131 301 8699  
E Jenny.Lampropoulou@aecom.com  
www.aecom.com

1 Tanfield  
Edinburgh  
EH3 5DA  
United Kingdom

The modelled westbound journey times are reduced by more than half the base modelled time under Option Package 2 in the morning peak.

The modelling of both Packages suggests queuing along Ware Road on the approach to the Bluecoats roundabout has reduced in the westbound direction when compared to the standalone modelling of Option 5, but a modelled increase in journey time of less than one minute remains.

Modelling of Package 2, whilst reducing overall journey time, reveals a reduction in capacity at the Cross Lane roundabout as the A414 mainline movement filters down to a single lane to accommodate the dedicated left turn filter from Cross Lane to the A414. .

Comparison of overall junction throughput in flow terms is a useful metric which gives an indication of potential additional vehicles which could be accommodated at each junction along the corridor for Package 1 and Package 2 (Table 1 and Table 2). Positive values indicate increase in traffic throughput.

Morning	Base 2013 (In/Out)	Package 1	Package 2
Rushgreen (J1)	3781	-8	+12
Foxholes (J2)	3217	+134	+174
Bluecoats (J3)	4272	+96	+198
Hale Road (J4)	4738	+198	+358
Cross Lane (J7)	3614	+224	+354
Campfield Road (J5)	2528	-45	+31
Thieves Lane (J6)	3024	-15	+129

Table 1: Morning Peak Modelled Junction Throughput - A414 Corridor between A10 and Thieves Lane – Base versus Options

Evening	Base 2013 (In/Out)	Package 1	Package 2
Rushgreen (J1)	3989	-2	-1
Foxholes (J2)	3399	-7	-9
Bluecoats (J3)	4582	-141	-132
Hale Road (J4)	4491	+52	+55
Cross Lane (J7)	3525	+41	+47
Campfield Road (J5)	2459	-81	-60
Thieves Lane (J6)	3064	-33	-28

Table 2: Evening Peak Modelled Junction Throughput - A414 Corridor between A10 and Thieves Lane – Base versus Options

Qualitatively, the modelling of Option Package 2 appears to offer potential journey time benefits along the corridor and delay reductions between Rushgreen and Bluecoats in the morning peak. The modelling also suggests potential for increased flow through the Hale Road junction.

The modelling of the evening peak suggests a decrease in throughput at Bluecoats, this is likely to be as a result of vehicles from the Mill Road supermarket egress queuing. This junction is very close to the Bluecoats roundabout, the proposed layout has the potential to reduce journey times along A119, but traffic from Mill Road is unreleased in the afternoon period. It is recommended that traffic demand and signal optimisation on this junction is reviewed.

## OPTION ASSESSMENT

### Option Package 1

Junction improvements Option 4 and Option 5 have been combined to create package 1. Option 4 replaces the roundabout at A414/Hale Road with a four-arm signalised junction with left turn filter lanes for all approach arms. While under Option 5, the roundabout at Bluecoats has an approach lane widening and a dedicated left turn filter from London Road to Gascoyne Way and some realignment of the junction. Realignment of the junction has meant a reduction in capacity on Ware Road, with only one straight ahead lane in the proposed layout, whereas the current situation has two ahead lanes. All model parameters and demand were kept constant between the base and option test, in order to assess the junction improvement options.

The Package test model includes revised signal optimisation at Bluecoats roundabout in the morning period to reduce queuing on Ware Road east, as noted above. It was intended that this option would relieve the congestion along the A414 and reduce journey times along the corridor. The modelling of revised signal timings in the morning peak has the potential to result in a reduction in the queuing along Ware Road as modelled in the sequential option testing. The adjacent junction at Mill Road may become an issue with a high demand being unreleased in the afternoon period due to the reduced capacity for traffic travelling from Ware Road to Gascoyne Way.

Although the morning peak simulation of Package 1 does demonstrate a potential reduction of congestion along the A414, the modelled network has been observed to become significantly congested at around 08:30 during the peak hour. The release of queued vehicles from the A414 may cause a pinch point at Campfield Road in a westbound direction and queued vehicles may extend back along Gascoyne Way towards London Road.

Modelling of this option performed well along the A414 corridor at the beginning of the morning peak simulation with journey times and queues between Rush Green and Bluecoats potentially improved. The existing narrowing of the A414 to a single lane and associated reduced capacity at the Campfield Road railway bridge has the potential to become a significant pinch-point if latent demand is released from Bluecoats.

The overall modelled performance of package 1 can be summarised as follows:

<i>BENEFITS</i>	<i>DIS-BENEFITS</i>
Queues on A414 on the approach to the Bluecoats roundabout are significantly relieved in the morning peak.	Lower capacity to the east of Campfield Road has the potential to cause extensive queues in the morning peak.

Option Package 2

Option package 2 is similar to Package 1, but with the addition of assuming the provision of two lanes through the railway bridge adjacent to Campfield Road. When modelling this package of options, the demand and all model parameters were kept consistent with the base model.

In the morning peak, the modelling suggests this option could provide a reduction in queues and journey times on the westbound route along the A414, giving a journey time saving. This is due to a combination of potential journey time savings between Rush Green and Hale Road and the time saving between Cross Lane and Campfield Road related to the provision of additional capacity at the A414, Hertingfordbury Road railway bridge. Junction throughput increases compared to Package 1 and this is due to the increase in westbound capacity on A414.

However, this option is understood to have a detrimental impact on queues and journey times in the eastbound direction. This is mainly due to increased queues and delays between Campfield Road and Cross Lane, these queues are related to the fact that ahead capacity along the A414 is only provided in a single lane at Cross Lane.

The afternoon period shows a decrease in traffic throughput at Bluecoats. This is a result of the traffic from Mill Road being blocked from the righthand lane on Ware Road. This junction is immediately adjacent to the Bluecoats roundabout and whilst queuing on Ware Road east has been reduced with the proposed layout and optimised signal timings, the single lane for westbound movements does not allow sufficient capacity for traffic turning right from Mill Road. It is suggested that this junction arrangement may need to be revised.

<i>BENEFITS</i>	<i>DIS-BENEFITS</i>
For the morning peak, the modelling suggests that this option provides a reduction in queues and journey times on the westbound route along the A414 and A119.	Increased queues and delays between Campfield Road and Cross Lane, these queues are related to the fact that ahead capacity along the A414 is only provided in a single lane at the Cross Lane junction.
In the evening peak, this option generally reduces journey times across the peak hour by providing small time savings in both directions.	Additional queues are modelled on Mill Road in the evening peak period, with a significant volume of unreleased vehicles.

CONCLUSIONS and NEXT STEPS

The package testing suggests that the A414 corridor performance between the A10 and Hale Road can potentially be improved by the combination of previously tested individual junction options. The potential release of latent demand is likely to lead to pinch-points elsewhere within the corridor under both Package 1 and 2.

Further to the testing of packages 1 and 2 above, it is recommended the following steps are taken, in order to fully understand the implications of possible junction improvements along the A414:

- Obtain reliable and accurate journey time information along the corridor representing current travel conditions.
- Review of demand to and from Mill Road and possibility of further signal optimization at Mill Road/Bluecoats.
- Consider revised layout at the Cross Lane junction with the A414. Existing demand levels for the left turn from Cross Lane and the eastbound A414 ahead movement are comparable with each other and may not support removal of the dedicated left turn filter.
- Testing the Package layouts with future year growth to determine potential 'headway' which could be provided by implementation of the Packages.
- Consideration of possible designs for improvements to provide additional capacity outside the existing highway boundary.
- It will be important to consider knowledge gained from this study in the wider context of the on-going A414 strategic study. In particular, it will be important to reflect on the travel patterns along the corridor, to determine if the movements are to/from Hertford or indeed if there is a larger proportion of longer distance through trips.