West Winch Housing Access Road

Traffic Signal Strategy

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Contents

Tables

Figures

1 Traffic Signal Strategy

1.1 Introduction

1.1.1 This document sets out the approach to the proposed traffic signals which are to be included in the West Winch Housing Access Road (WWHAR) project.

1.1.2 WWHAR will include new traffic signal provision on both the new carriageway and the modified existing roads, as follows;

- Modifications to the existing signalised Hardwick Interchange junction;
- Signalisation of the proposed A47 / WWHAR roundabout;
- Provision of a new signalised crossing to maintain NMU connectivity for the severed Chequers Lane;
- Signalised crossings along the existing A10, forming part of the Sustainable Transport Strategy (STS) route.

1.1.3 This document will detail, for each of the above areas, the design rationale that that has influenced the proposed design with a particular focus on the impact on safety and traffic movements.

1.1.4 During design development, traffic signal officers from both Norfolk County Council (NCC) and National Highways (NH) have been consulted and their comments have been considered in the final proposals. The signal strategy has also taken into consideration the schemes Sustainable Transport Strategy (STS), with a particular focus on improving pedestrian facilities.

2 Hardwick Interchange

2.1 Option Assessment

2.1.1 The existing Hardwick Interchange utilises a satellite roundabout to the east to provide access to and from the junction from the A47. Under the WWHAR proposals, this roundabout will be removed and replaced with slip roads connecting the A47 directly to the junction. As a result the geometry of the

southern part of the roundabout, which comprises the new A47 off-slip, the A10 and Beveridge Way, along with the traffic signal layout on these arms, will be altered.

2.1.2 The existing junction layout has all arms signalised, with the exception of Beveridge Way. The A10 connection to the roundabout incorporates a signal-controlled pedestrian crossing, which links West Winch to the south with King's Lynn via a route around the western side of the interchange. Beveridge way currently has an uncontrolled crossing.

2.1.3 A number of options for Hardwick Interchange have been considered, as summarised in Table 1 below;

Table 2-1 - Summary of Options

Option	A47 Off-Slip	A10	Beveridge Way	STS Proposals
Option 1	Signal Control	Signal Control	Priority Control	None
Option 2	Signal Control	Priority Control	Priority Control	None
Option 3	Signal Control	Priority Control	Signal Control	None
Option 4	Signal Control	Priority Control	Signal Control	Bus Lane on A10

2.2 Option 1

2.2.1 Option 1 provides signal control on the new A47 off-slip and retains the existing control on the A10. Reduced traffic flows on the A10 following completion of the Housing Access Road and the inclusion of signal control here means that the A10 approach can be reduced to two lanes and incorporates signalised pedestrian crossings in line with STS proposals.

2.2.2 This option is not currently being taken forward due to National Highways concerns that the two stop lines for the A10 and A47 control on the circulatory carriageway will be too close together to operate practically in the way that the modelling predicts. Comments from NH, received on June 12th 2023 suggested that a proposal including a signal to the south on the new A47 roundabout or the

existing signals on the current A10 remaining in place would not be acceptable to them. This was due to the link lengths being too short on the Hardwick Interchange which would block the exits from the roundabout as well as the carbon savings by not installing unnecessary signals where not required.

2.3 Option 2

2.3.1 Following National Highways challenge to Option 1, further modelling was carried out on an alternative layout that removed signal control from the A10, and relocated the crossing point to a signal-controlled crossing to the south.

2.3.2 Whilst this showed minimal negative impact on the A10, it had a significant negative impact on Beveridge Way due to a lack of control on the flow of traffic from the A10 and the lack of opportunities for vehicles to exit Beveridge way in peak times as a result. In the PM peak, this resulted in predicted queues of over 200m on Beveridge Way.

2.3.3 Widening Beveridge Way to 3 lanes to compensate for this was considered but modelling showed that this was ineffective.

2.4 Option 3

2.4.1 To alleviate the congestion at Beveridge way caused in Option 2, signal control at Beveridge Way has been introduced for Option 3. This is shown to be effective at clearing traffic on Beveridge Way, however the queuing traffic on the circulatory carriageway blocks the A10 entrance, resulting in additional queuing on this arm and anticipated difficulties for buses to pull out into traffic.

2.4.2 To maximise road space and mitigate this issue, for this option the A10 has been modelled with a three-lane approach to Hardwick Interchange, with space for this provided by reducing the roundabout exit from 2 lanes to 1. This shows an improvement in queue lengths; however they are still predicted to be between 50 and 100m for a short period during the AM and PM periods.

2.4.3 Modelled queue lengths for this option are reflected in Figure 1 and Figure 2;

Figure 2-1 - Indicative queue lengths for the design year (Paramics) – AM Period

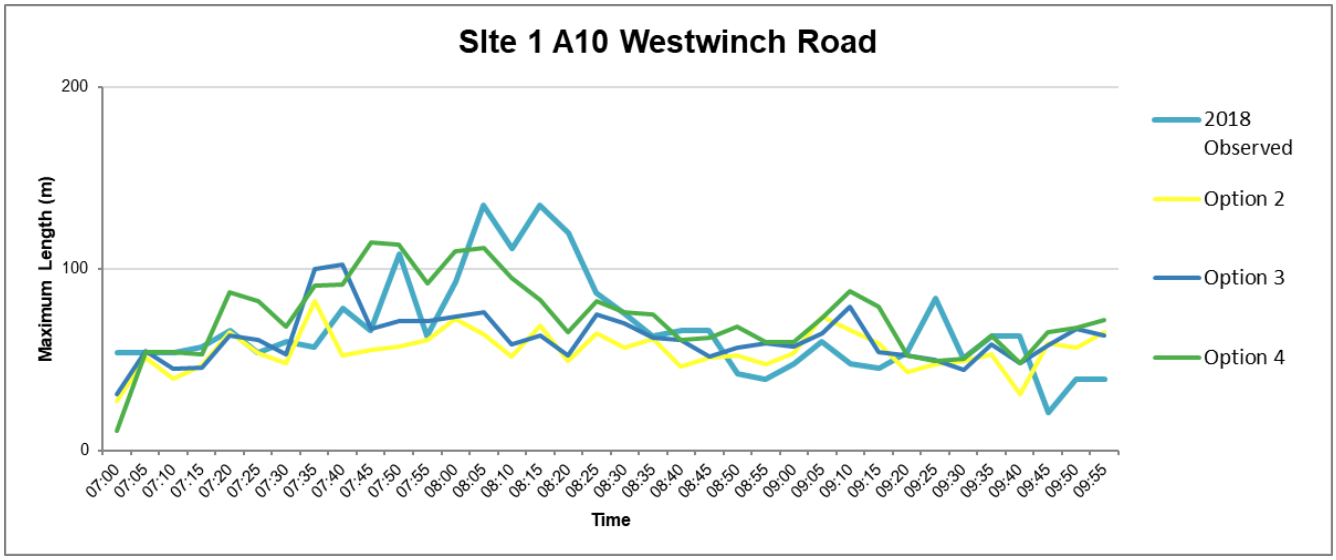
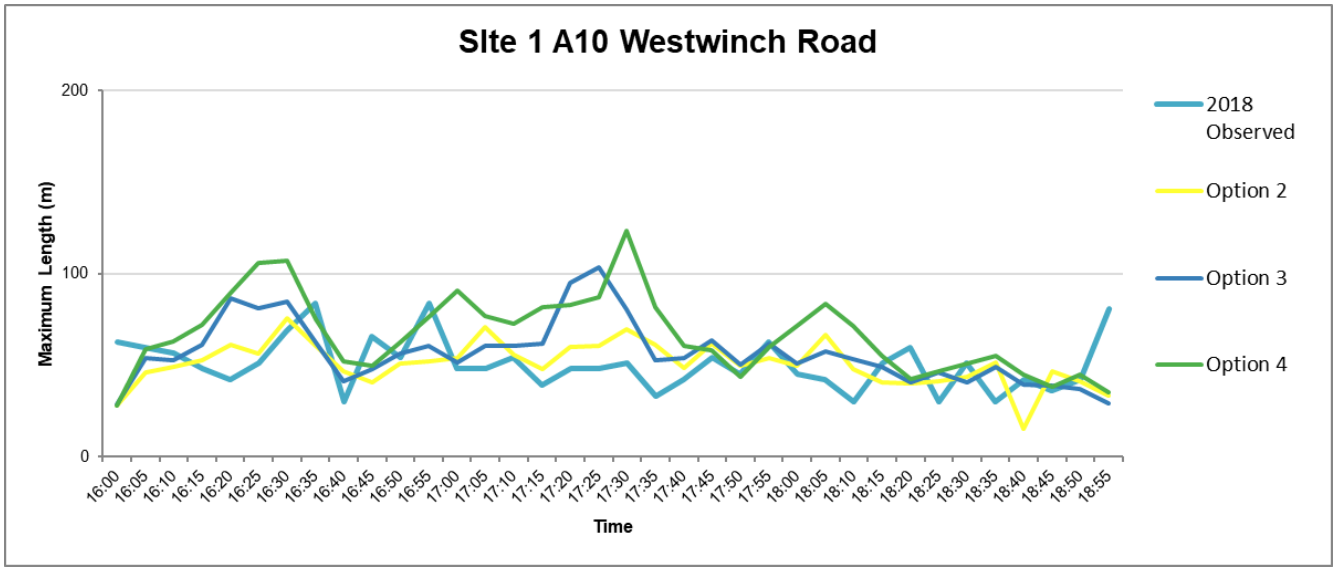


Figure 2-2 - Indicative queue lengths for the design year (Paramics) – PM Period



2.4.4 This option has been discussed and presented to National Highways (Operations and Spatial Planning) and Norfolk County Council (Network Performance) who are in general agreement in relation to the proposals for Hardwick Interchange. However, a key issue raised through the introduction of signals at Beveridge Way centred around managing the extent of the queuing at the circulatory approach. The concern centred around ensuring the additional Beveridge Way signals did not persistently block traffic trying to enter the interchange from the A10, and crucially the queuing did not cause an issue with the proposed signalised A47 westbound off-slip or traffic seeking to exit the interchange onto the A10. The

detailed Paramics micro-simulation modelling undertaken for the WWHAR planning application demonstrates this issue does not occur, as shown in Figures 3 and 4. The distance between the circulatory and the A47 off-slip is approximately 120m, and the maximum queue on the circulatory never exceeds 100m. Queues on the circulatory block the A10 approach while the circulatory shows a red signal, but the queue quickly clears once the circulatory gets the green aspect.

Figure 2-3 - Circulatory indicative queue lengths– AM Period

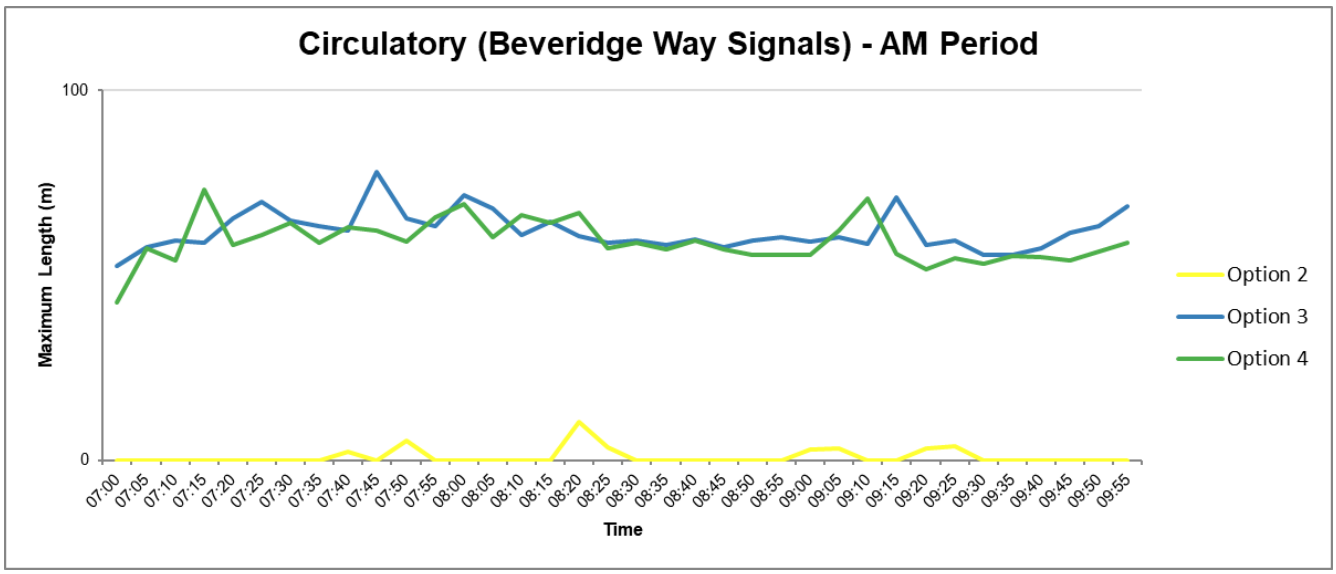
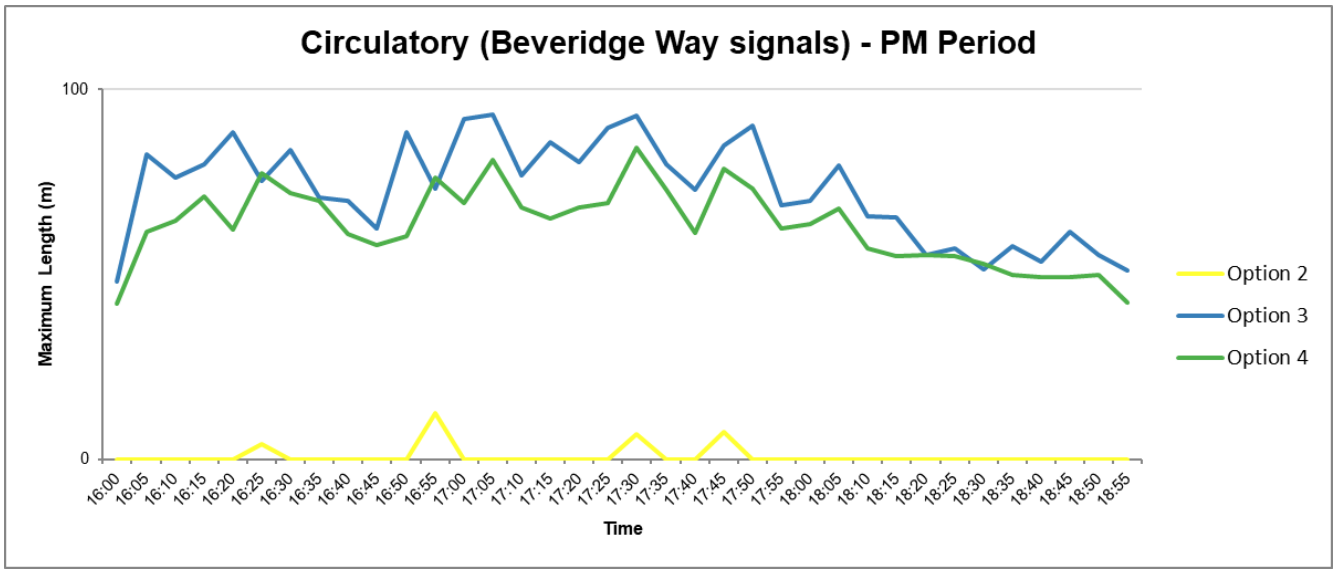


Figure 2-4 - Circulatory indicative queue lengths– AM Period

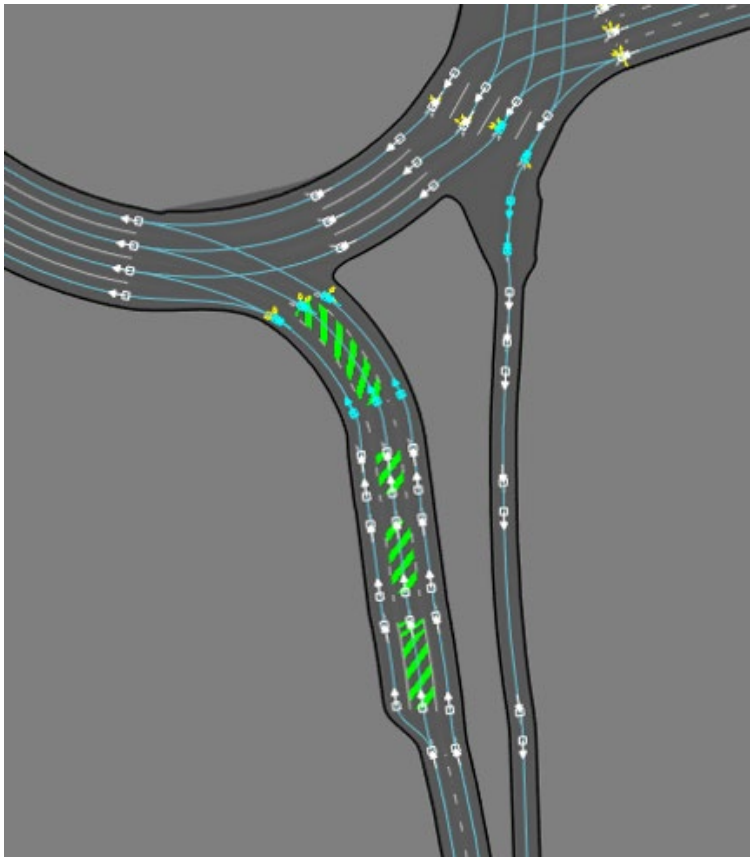


2.5 Option 4

2.5.1 Although Option 3 shows the best compromise for maximising capacity across the three arms, there remains concern that the AM peak time queue lengths would negatively impact on the attractiveness and reliability of current and future bus services on this route, and therefore may not be consistent with the projects STS strategy. As a result, this option was amended to provide a Bus Lane within lane 2, as shown in green in Figure 5.

2.5.2 By introducing this bus lane, the road space for general traffic is significantly reduced, resulting in queue lengths between 50m and 100m during peak times, as indicated in green in Figure 1 above. As the bus lane could practically only be provided for approximately 80m, there would still be significant queue times for buses before they could access it, therefore this is not considered a suitable solution.

Figure 2-5 - Schematic diagram of Option 4



2.6 Preferred Option

2.6.1 As described, a number of options for the traffic signal configuration at Hardwick Interchange have been considered. Traffic modelling has shown Option 3 to be the best performing option, and this has been chosen to be carried forwards to the planning layout.

2.6.2 Options for improving bus journey times on the A10 have also been considered but due to site constraints it is not possible to introduce bus priority features without a significant negative impact on general traffic.

2.6.3 As the A10 will now be uncontrolled, the existing controlled crossing will also be removed. It is proposed that this is re-provided further south on the A10 which will better suit pedestrian movements, as described in Chapter 5.

2.6.4 The options detailed above were presented to the signals teams within both NCC and NH during further engagement. During the meeting with National Highways on the 20th September 2023, the NH representative agreed the preferred approach proposed above dealt with NH concerns raised in relation to the previous intention to have both the A10 and A47 westbound off-slip signalised in close proximity. The introduction of signals at Beveridge Way rather than the A10 was generally perceived to result in signals which were a sufficient distance away from the A47 westbound off-slip signals. During meetings with NCC Network Management Team on the 12th and 14th September 2023 the NCC representatives agreed with the preferred approach proposed above. However, during the 14th September 2023 queries were raised by the NCC representatives in relation to how the queuing introduced by signalisation at Beveridge Way would interact with the A10 and A47.

2.7 Proposed Traffic Signal Arrangement

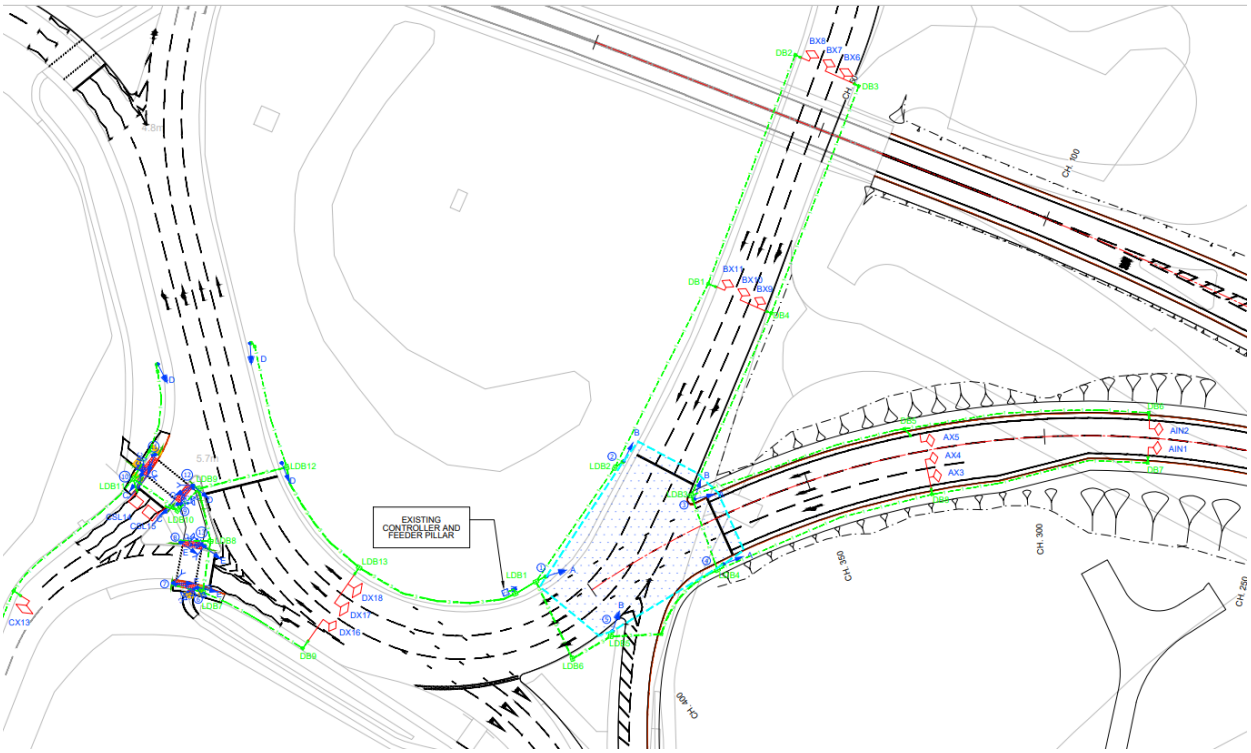
2.7.1 Existing traffic signals will be replaced with new equipment, which will link into the existing controller on the King's Lynn side of the roundabout.

2.7.2 The control strategy will be dictated by National Highways during detailed design. It is currently thought to operate under fixed time plans, with the ability to run under SCOOT when necessary. The scheme proposals also introduce MOVA detection, which may also be required.

2.7.3 There will be pedestrian and cycle facilities, in the form of a Toucan crossing, at the Beveridge Way node, and a separate standalone Toucan crossing south of the interchange on the A10 to replace the facilities which have been removed at the A10 node.

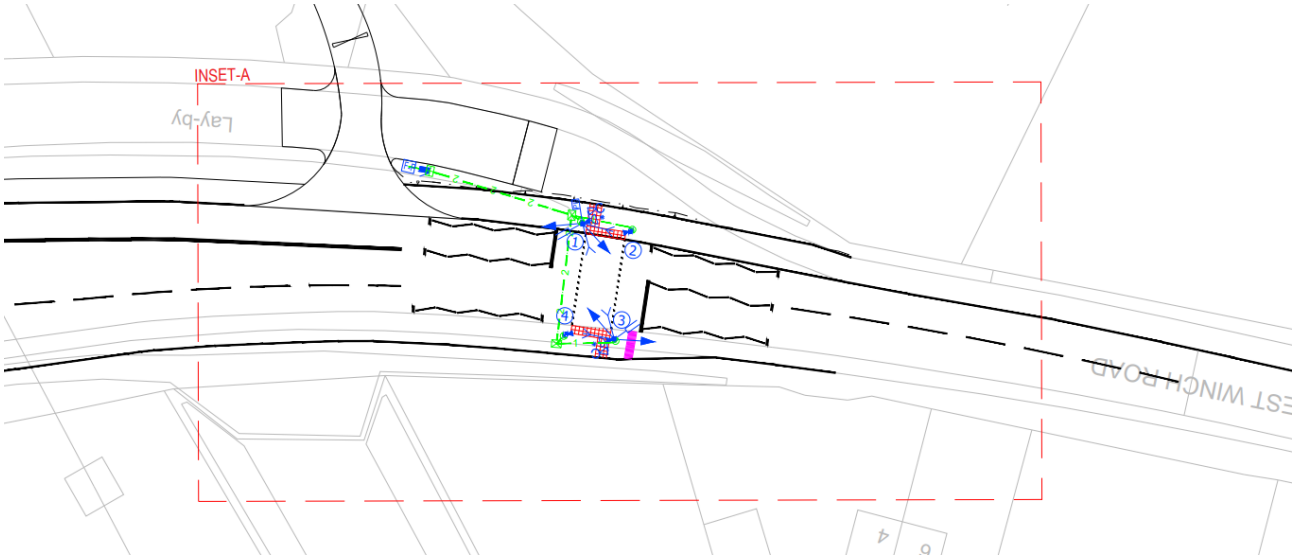
2.7.4 Figure 6 is an extract from Traffic Signals layout drawing 70100518-WSP-HSL-HI-DR-TS-001, which shows the proposed traffic signals layout at Hardwick Interchange. The full drawing is included in Appendix A.

Figure 2-6 - Proposed Signal Layout at Hardwick Interchange



2.7.5 Figure 7 is an extract from the same drawing and shows the proposed Toucan Crossing layout on the A10.

Figure 2-7 - Proposed A10 Toucan Crossing



3 A47 / WWHAR Roundabout

3.1 Introduction

3.1.1 A new 3 arm roundabout will be constructed on the A47 to provide a connection to the new housing access road. The housing access road will have a segregated left turn lane to provide free flowing access to the A47 in the direction of King's Lynn. The roundabout will also have a connection to a pond maintenance track to the east, which will also serve as a Private Means of Access (PMA) for the adjacent agricultural land.

3.1.2 4 options have been considered for the control of this roundabout, as follows;

Option 1 – Priority Control

Option 2 – Priority Control in opening year with provision for future part signalisation

Option 3 – Part signalisation in opening year

Option 4 – Full signalisation in opening year

3.1.3 These options have been investigated through traffic modelling in Paramics Discovery, using forecast scenarios **2027 Scenario R** (WWHAR and 300 dwellings at WWGA) and **2042 Scenario R** (WWHAR and 4,000 dwellings at WWGA). The modelled flows for the junction in these scenarios are presented in Figures 8 – 11 and the A47 (East) queue results are shown in Figures 12 - 13. The findings from the model are described below.

3.2 Option 1

3.2.1 As shown in the flow diagrams below, the turning flows at the roundabout are heavily unbalanced. The right turning flow from the WWHAR to the A47 (East) is insignificant, which leads to the traffic from A47 (West) being unopposed. This in turn results in a reduced number of gaps at the A47 (East) approach, where a queue quickly builds up.

3.2.2 The level of queuing and delay depends on the right turning flow from the A47 (West) approach and the total flow on the A47 (East) approach. During opening

year (2027), the right turning traffic from the A47 (West) is not yet large enough to hamper the operation of the A47 (East) approach and queues remain at a constant level below 100m during the AM period, as shown in Figure 12. However, in the PM the right turning movement from the A47 (West) increases and the capacity left on the A47 (East) approach is not enough to accommodate the demand. This leads to significant queues in excess of 300m. and rerouting to local roads (New Road, Rectory Lane) to avoid the congestion.

3.2.3 In 2042 the flows increase significantly due to the WWGA being fully built with 4,000 dwellings and the A47 (East) approach operates over capacity in both peak periods. This is especially acute during the PM Peak, where the right turning movement from the A47 (West) is at its maximum and there are barely any gaps for the A47 (East) approach, resulting in queues exceeding 800m, as shown in Figure 13. during the whole simulation period.

3.3 Option 2

3.3.1 As mentioned in Option 1, during the opening year the junction operates within capacity as priority controlled during the AM Peak, but in the PM Peak the increased level of right turning flow from the A47 (West) leads to significant level of queuing on the A47 (East) approach, where the approach operates over capacity. Besides this, due to the congestion at the approach vehicles take alternative routes through local roads and increase traffic and delay in these.

3.4 Option 3

3.4.1 Two different tests have been conducted on part signalisation:

- A47 (East) approach signalised (1 signal in the queue graphs)
- A47 (East) approach and A47 (West) approach signalised (2 signals in the queue graphs)

3.4.2 As shown in Figures 12 and 13 both options achieve a similar performance and effectively reduce the level of queueing to an operational level below 100m. This suggests that in reality only the A47 (East) approach signals are necessary to control the priority between the A47 (East) and A47 (West).

3.4.3 The signals at the A47 (West) approach are not necessary as the right turning flow from the WWHAR approach is insignificant. However, without these signals the right turning traffic from the A47 (West) would be stopped at the circulatory while the signals are in red, with A47 through traffic moving at speed through the circulatory and posing a potential safety concern.

3.4.4 Therefore, it is proposed that the junction operates with both A47 (East) approach and A47 (West) approach signalised. These two set of signals can be coordinated and the delay for the A47 (West) right turning movement would be minimised.

3.5 Option 4

3.5.1 Similar to Option 3, full signalisation of the roundabout would result in the junction operating well within capacity. However, due to the low number of vehicles at the WWHAR approach it has been deemed unnecessary to control this approach through signals. This in turn will improve the flow on the circulatory and avoid the potential queue on the circulatory blocking back the exit at the WWHAR.

Figure 3-1 - 2027 Scenario R AM Peak flow (veh/h)

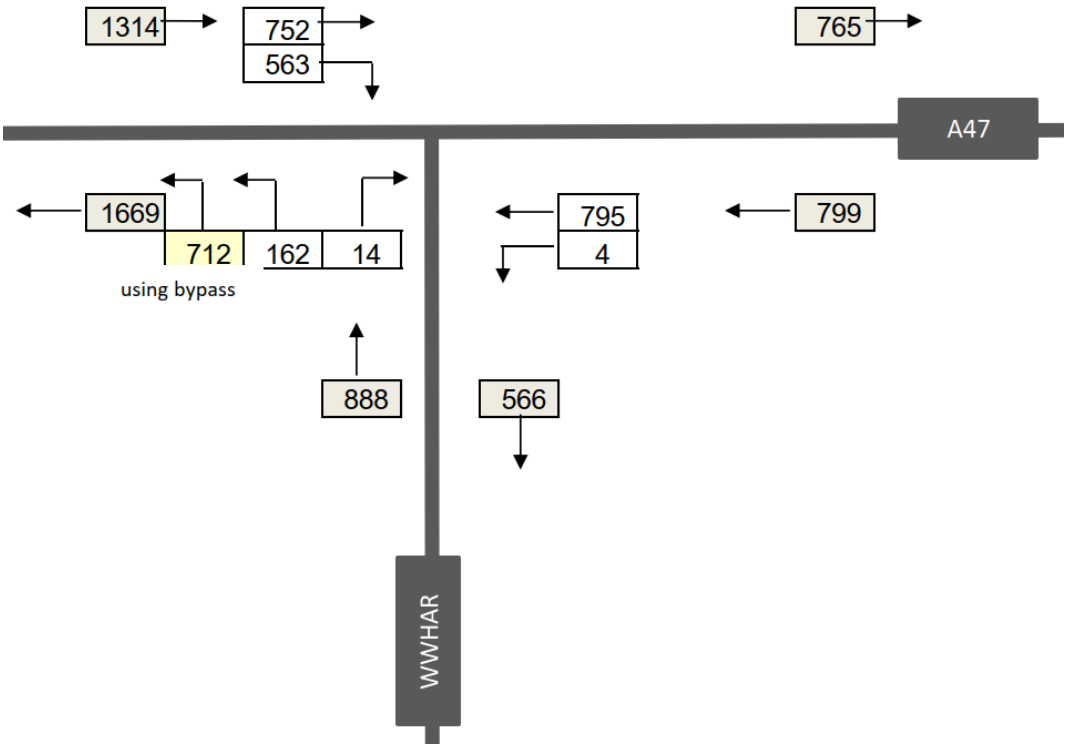


Figure 3-2 - 2027 Scenario R PM Peak flow (veh/h)

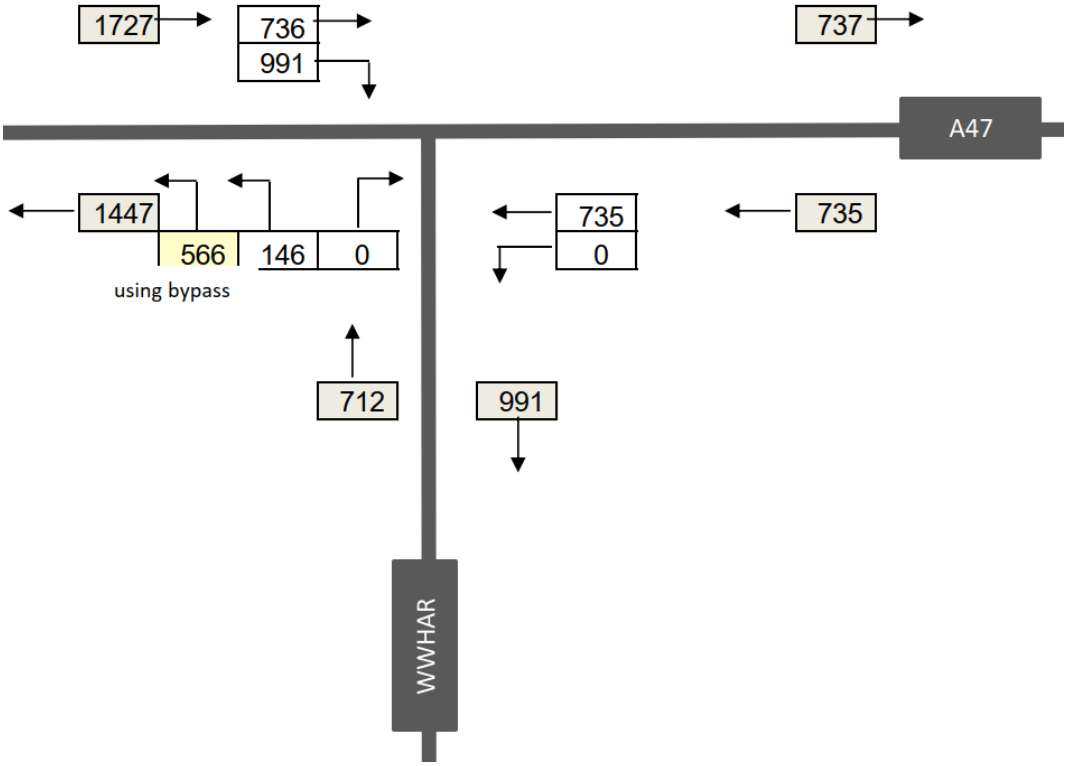


Figure 3-3 - 2042 Scenario R AM Peak flow (veh/h)

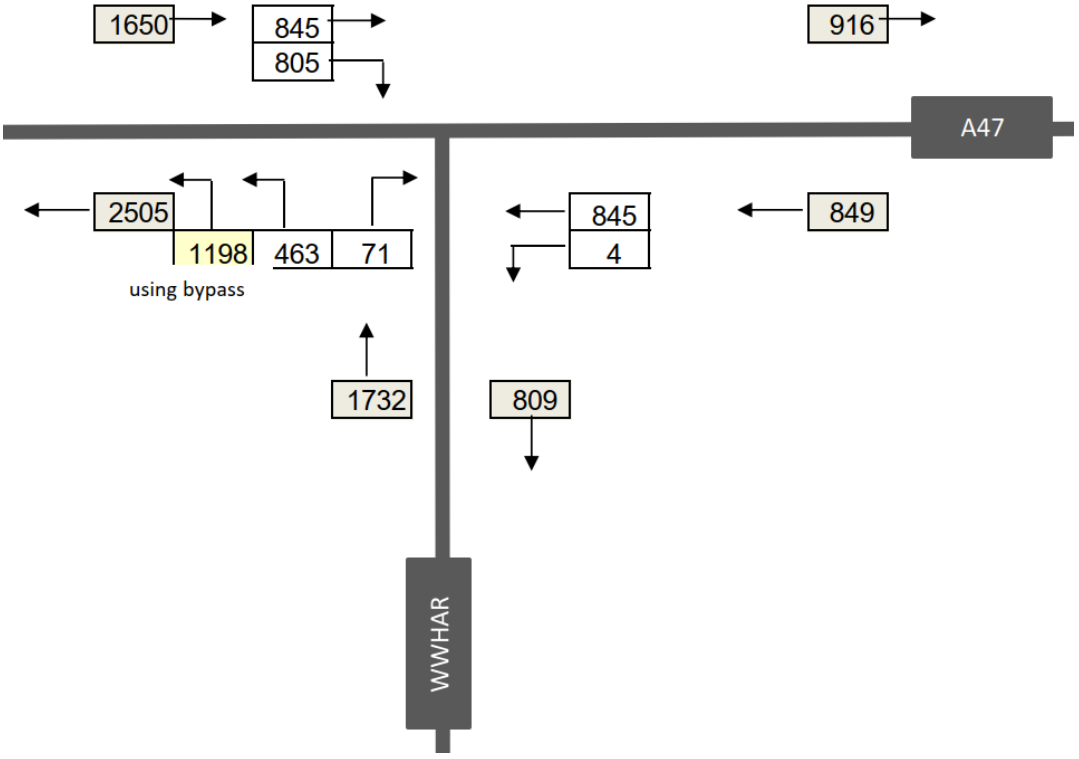


Figure 3-4 - 2042 Scenario R PM Peak flow (veh/h)

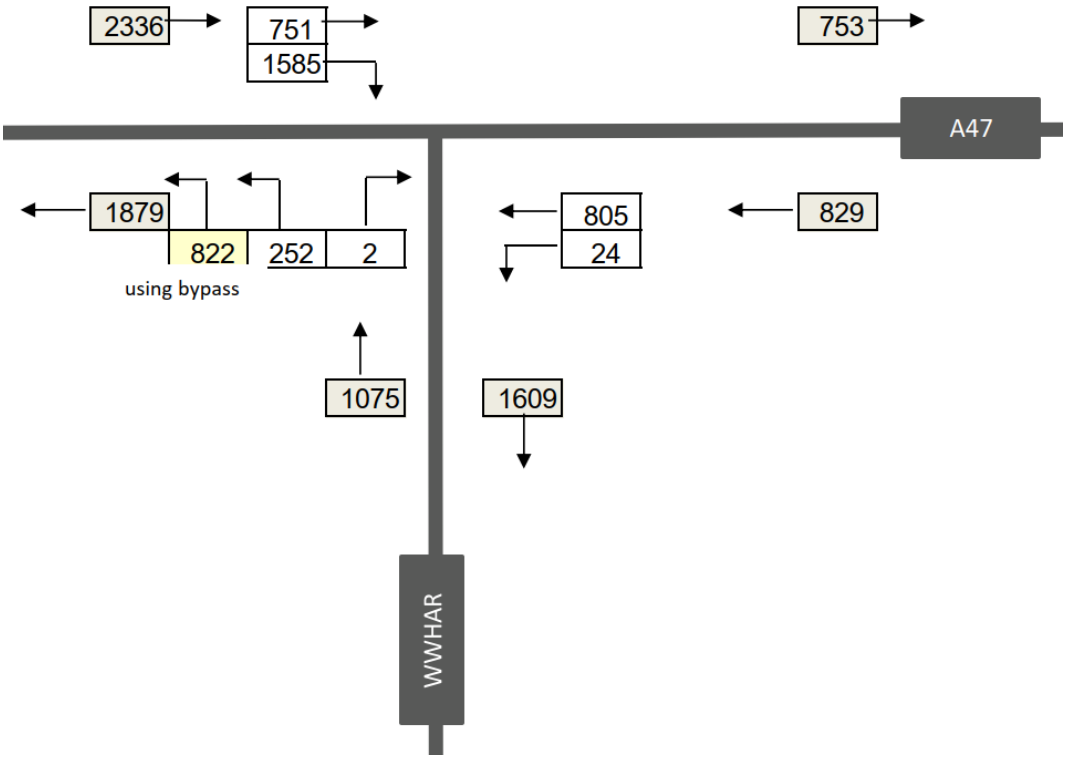


Figure 3-5 - A47 (East) approach, AM Period maximum queue (m.)

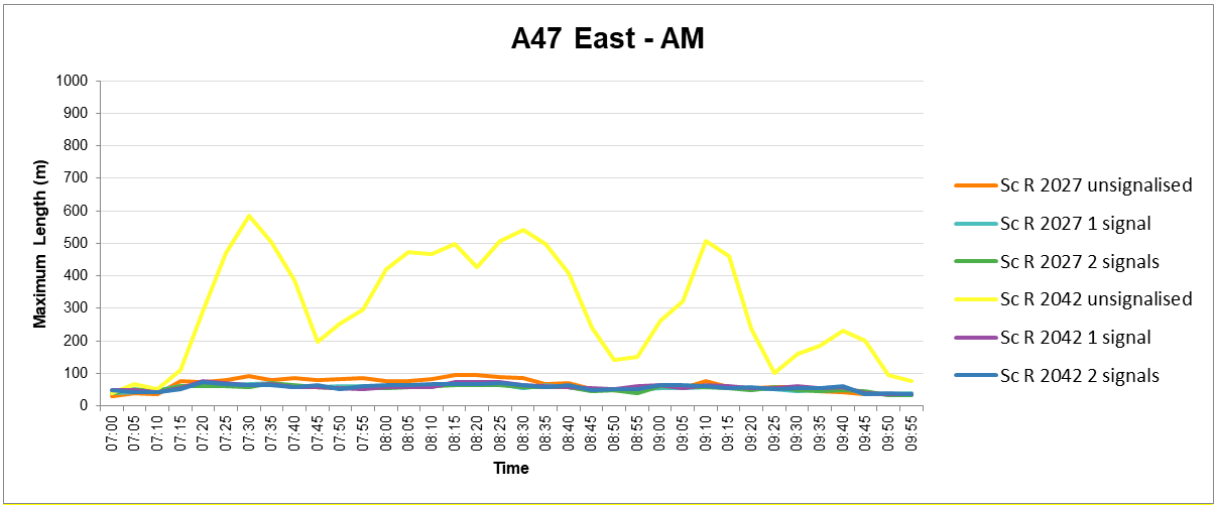
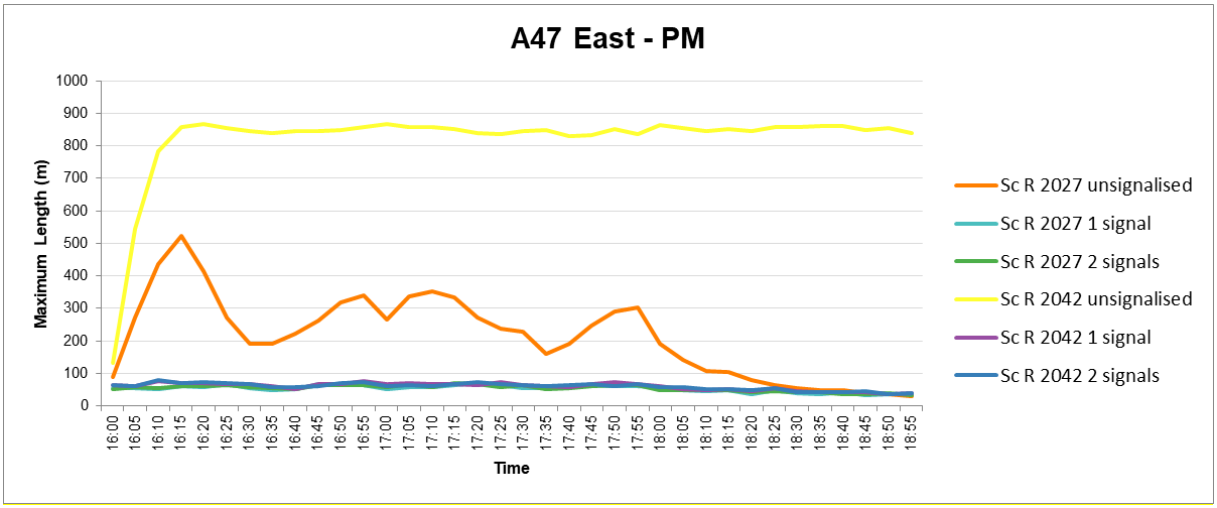


Figure 3-6 - A47 (West) approach, AM Period maximum queue (m.)



3.6 Preferred Option

3.6.1 Following the assessment of the above options, it has been concluded that Option 3 is the most suitable for inclusion in the scheme.

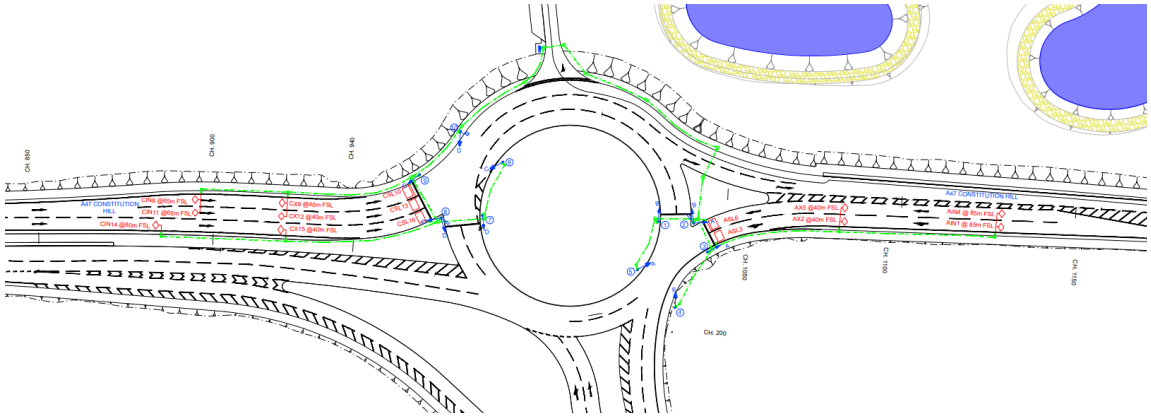
3.6.2 As detailed below the A47 approaches will be traffic signal controlled, with the HAR will operating as 'give way' priority control. As this roundabout will not be linked to any other set of traffic signals it will be under MOVA control. There is no provision for pedestrians or cyclists as there are no footways / cycleway at this location.

3.6.3 Options detailed above were presented to the Network Management team within NCC and Operations / Spatial Planning team at NH during further engagement. During the meeting with National Highways operations on the 20th September 2023, the NH representative generally agreed with the preferred approach proposed above in principle however had some reservations about the need for signalising the western arm of the roundabout. During meetings with NCC Network Management Team on the 12th and 14th September 2023 the NCC representatives had mixed views on the preferred approach proposed above. The signalisation of both A47 arms was deemed to provide safety benefits, avoiding the potential for queuing traffic within the circulatory being passed by faster moving A47 west to east traffic in the outside lane. During a meeting with NH Spatial Planning on 23rd November 2023 where the proposal to signalise both A47

arms was again presented, the NH feedback was that whilst signalisation did increase queuing on the A47 western arm, the proposal offered greater control over managing the flows within the junction.

3.6.4 Following the engagement above it was agreed that both arms of the A47 would be signalised at this stage. Figure 14 is an extract from Traffic Signals Layout drawing 70100518-WSP-HSL-A47-DR-TS-001 and shows the proposed signal arrangement for the A47 roundabout. The full drawing is included in Appendix B.

Figure 3-7 - Proposed Traffic Signals at the A47 Roundabout



4 Chequers Lane

4.1 Introduction

4.1.1 The construction of the housing access road will sever Chequers Lane immediately to the west of the existing Scout hall. A previous iteration of the scheme proposals, which were presented during public consultation, included a footbridge to maintain pedestrian and cyclist access, however this has been removed from the layout submitted for planning and has been replaced by a proposed signalised Toucan crossing.

4.1.2 A number of options for maintaining connectivity were considered, including;

Option 1 – Retaining the proposed footbridge

Option 2a – Non-signalised at grade crossing

Option 2b – Signalised at grade crossing

Option 3 – Diversion to northern roundabout

Option 4 – Diversion to rectory lane

4.1.3 The option assessment for the Chequers Lane crossing and the adjacent Manor Farm direct access, is documented in the Chequers Lane Options Report ref NCC/70100518-WSP-HGN-CL-RP-CH-001.

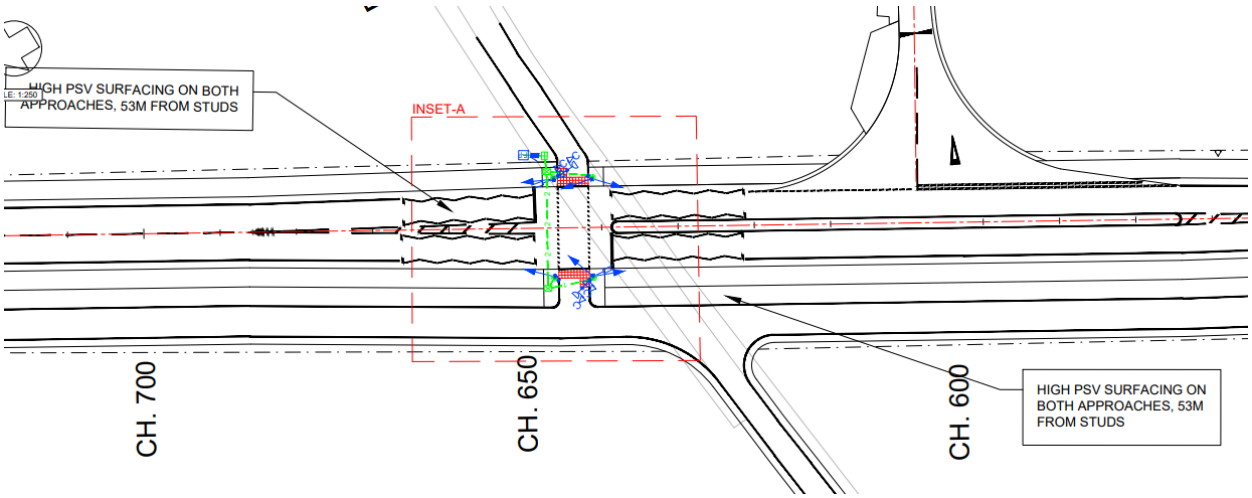
4.2 Preferred Option

4.2.1 Following the option assessment process, and a scoring exercise undertaken in accordance with LTN 1/20 Option 2b, a signalised at grade crossing, has been selected as the preferred option.

4.2.2 As both pedestrians and cyclists will use this crossing a 'Toucan' crossing is proposed as it caters for both user groups. The crossing will be in accordance with NCC requirements, and at this stage it is expected to have MOVA control as the approaches will be subject to 40mph speed limits, so Microwave Vehicle Detectors (MVDs) won't be appropriate. The crossing will have pedestrian and cycle detection via kerb side and on-crossing detection.

4.2.3 Figure 15 is an extract from signals layout drawing 70100518-WSP-HI-DR-TS-001 and shows the proposed Chequers Lane signalised crossing layout. The full drawing is included in Appendix C.

Figure 4-1 - Proposed Chequers Lane crossing



5 STS – Sustainable Transport Strategy Elements

5.1 Introduction

5.1.1 A sustainable Transport Strategy (STS) was produced for submission alongside the Outline Business Case as requested by DfT (Department for Transport). The STS is intended to identify measures which support sustainable housing growth at West Winch by encouraging increased active travel and uptake of public transport. The STS identifies opportunities for reducing the dominance of vehicle traffic on the existing A10 through the village of West Winch and increasing opportunities for crossing the road once the Housing Access Road is in place.

5.1.2 A high-level appraisal of crossing requirements and specification was carried out based on the principles set out within LTN1/20 and predicted volumes and speeds of traffic remaining on the existing A10 in the future year scenario with the WWHAR in place. The LTN1/20 core design principles of Coherent, Direct, Safe, Comfortable and Attractive were considered within the proposed design.

- Coherent – A review of the existing active travel network in the vicinity of the A10 at West Winch was carried out and links to Public Rights of Way and adjacent side roads were identified. The July 2022 strategic masterplan for the proposed development was also reviewed There are two existing signalised crossings on A10 at the northern edge of West Winch close to Hardwick roundabout and in the centre of the village

- Direct - Crossings should be positioned as closely as practical to existing and future desire lines. Crossing the A10 were plotted based on existing and proposed land uses as shown in Appendix and crossing locations were chosen to best suit these, whilst seeking to minimise the number of total crossing points overall along the route. Desire lines are shown in Appendix 3 of the STS (Document Reference **NCC/4.02.03/WWHAR**).

- Safe – this has been considered based on 10.2 of LTN1/20 taking the forecast residual traffic volumes for the A10 corridor, with the WWHAR in place and whilst there is predicted to be a significant reduction in place as a result of the scheme, there would still be more than 8000 vehicles per day. The speed limit on the A10

would be reduced from its existing 40mph limit to 30mph north of its junction with the Proposed Scheme alignment (with a short section of 20mph proposed in the centre of the village around West Winch Stores).

Figure 5-1 - Extract from LTN 1/20

Table 10-2: Crossing design suitability

Speed Limit	Total traffic flow to be crossed (pcu)	Maximum number of lanes to be crossed in one movement	Uncontrolled	Cycle Priority	Parallel	Signal	Grade separated
≥ 60mph	Any	Any					
40 mph and ≤ 50 mph	> 10000	Any					
	6000 to 10000	2 or more					
	0-6000	2					
	0-10000	1					
≤ 30mph	> 8000	> 2					
	> 8000	2					
	4000-8000	2					
	0-4000	2					
	0-4000	1					

Provision suitable for most people

Provision not suitable for all people and will exclude some potential users and/or have safety concerns

Provision suitable for few people and will exclude most potential users and/or have safety concerns

Notes:
1. If the actual 85th percentile speed is more than 10% above the speed limit the next highest speed limit should be applied
2. The recommended provision assumes that the peak hour motor traffic flow is no more than 10% of the 24 hour flow

- Comfortable - a signalised crossing offers a more comfortable solution than an uncontrolled crossing as the user has more certainty that traffic will stop in both directions enabling them to cross safely.
- Attractive - an at grade option with signals would be more attractive than an uncontrolled crossing or a grade separated crossing as there would be no ramps or steps to negotiate and the signals provide an easy to use option that is clearly visible and a legible part of the network.

5.2 Preferred Option

5.2.1 A number of new crossing locations were identified for the A10 corridor coinciding where possible with desire lines. The proposed revisions to the A10 are shown in Appendix 4 of the STS (Document Reference **NCC/4.02.04/WWHAR**).

5.2.2 The approach to treatment of the existing A10 to accompany the WWHAR scheme is documented in the Sustainable Transport Strategy (Document Reference **NCC/4.02.00/WWHAR**).

5.2.3 Stakeholder and public consultation informed the proposed scheme design and led to the solution that is currently proposed.

5.2.4 The proposals are currently being discussed with Active Travel England as part of the Outline Business Case.

5.2.5 Appendix D shows the layout of the proposed signalised crossing on the A10 south of Harwick Interchange.