

A167 / A691 Durham Sniperley Roundabout

Sniperley Roundabout Development

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Table of Contents

1.	Introduction.....	1
2.	Existing Layout	2
3.	Option Development.....	4
	Fully Signalised Options.....	4
	Four-Arm Signalised Option	4
	Three-Arm and Two Arm Signalised Options.....	4
4.	Proposed Shortlisted Layouts.....	7
	Option 1 – Signalised Roundabout	7
	Option 2 – Priority Controlled Roundabout.....	9
5.	Microsimulation Modelling	11
	Assessment.....	11
	Queue Length Outputs.....	11
	Journey Time Outputs.....	11
6.	Modelling Results	13
	Model Observations.....	13
	AM Peak Queue Results	16
	PM Peak Queue Results	18
	AM Peak Journey Times Results	19
	PM Peak Journey Times Results	20
7.	Option Cost Estimates	21
	Option 1	21
	Option 2 – Sniperley Roundabout.....	22
	Northern Roundabout (Sniperley P&R).....	22
8.	Summary and Conclusions.....	23
	Appendix A – Signal Phasing and Staging from LinSig	26
	Appendix B – Queue Graphs	28
	Appendix C Journey Times Graphs.....	38
	Appendix D Option 1 Feasibility Drawing	44

Figures

Figure 1: Aerial photography showing existing layout of the Sniperley Roundabout.	2
Figure 2: Shared use path signing and informal pedestrian / cycle crossing on the A691 (south-east arm).	3
Figure 1: Proposed Sniperley Roundabout Option 1 layout.....	8
Figure 3: Potential Rerouting for Park & Rise Services with removal of bus lane under Option 2.....	9
Figure 4: Proposed Sniperley Roundabout Option 2 layout (top) and alterations to the roundabout to the north of Sniperley roundabout (bottom).	10
Figure 5: Journey Times Routes in the models.....	12
Figure 6: Queuing along the A167 southbound AM and PM Peak	13
Figure 7: Option 1 Traffic Conditions around Sniperley roundabout.....	14
Figure 8: Option 2 Traffic Conditions around Sniperley roundabout.....	15
Figure 9: Queue graph A167 Northbound AM peak	16
Figure 10: Queue graph A691 South-eastbound AM peak	16
Figure 11: Queue graph Dryburn Park South-westbound AM peak.....	17
Figure 12: Queue graph A167 Northbound PM peak	18
Figure 13: Queue graph A691 North-westbound PM peak.....	18
Figure 14: Journey Times Routes in the models.....	19
Figure 15: Journey times graph along the Orange Route NEB.....	19
Figure 16: Journey times graph along the Green Route NB (PM Peak).....	20
Figure 17: Journey times graph along the Red Route SB (PM Peak)	20

Tables

Table 1. Summary of tested initial options	5
Table 2. Worst lane Degree of Saturation (DoS) and Mean Max Queue (MMQ) results for 4-arm signalised option (2027).	6
Table 3: AM Peak Journey Time Summary (unweighted)	24
Table 4: PM Peak Journey Time Summary (unweighted).....	24
Table 5: Advantages and Disadvantages Summary of Options 1 & 2.....	25

Executive Summary

Option Development

Following initial option development using LinSig traffic signal software, a single option for the introduction of traffic signal control at Sniperley Roundabout was selected and refined. Signalisation of four out of five arms (Dryburn Park excluded) was considered to offer the greatest level of control and capacity at the junction, while allowing more efficient apportioning of green time to all arms, and control of circulatory queueing. This option was taken forward to microsimulation modelling alongside a priority arrangement developed as part of nearby development mitigation. The tested options therefore included:

- **Option 1:** designed as part of this study, consisting of 4 signalised arms at the A167 and A691 arms, retaining Dryburn Park under priority control due to poor performance of the junction under full signal control.
- **Option 2:** designed as part of mitigation for a development site adjacent to Sniperley Park & Rise, retaining priority control with capacity enhancements through widening.

Conclusions

The key advantages and disadvantages details for each scheme are summarised below. Specific journey time/delays are not included in the summary as the performance varies by peak by arm by queues or journey times.

Item	Option 1 (signal controlled)	Option 2 (Priority controlled)
Advantages	<ul style="list-style-type: none"> ▪ Improvement over Do Minimum ▪ Control and consistency over queues and delays across approaches ▪ Retains southbound bus lane ▪ Introduction of controlled pedestrian/cycle crossing facilities ▪ Benefits to journey times compared to Option 2 on some routes (particularly A691 S-EB) 	<ul style="list-style-type: none"> ▪ Improvement over Do Minimum ▪ Lower cost than Option 1, though cost excludes requirement for bus priority to offset loss of southbound A167 bus lane ▪ Benefits to journey times compared to Option 1 on some routes (A167 NB)
Disadvantages	<ul style="list-style-type: none"> ▪ Higher cost than Option 2 (on account of signals and additional widening) ▪ Introduces inherent delay to approaches as a result of the introduction of traffic signals 	<ul style="list-style-type: none"> ▪ No control/consistency over queues and delays across approaches ▪ Removes southbound bus lane used by Park & Ride services ▪ Cost will increase if include new link road to offset loss of SB bus lane ▪ No improvement to pedestrian/cycle crossing facilities
Cost	<p>Civils estimate £708,999</p> <p>Total inc ancillary costs/risk £1,801,896</p>	<p>Civils estimate £372,484</p> <p>Total inc ancillary costs/risk £946,655</p> <p>(Excluding Sniperley P&R roundabout and provision of new bus link road/junction)</p>

The above table highlights that both options offer a capacity improvement over the Do Minimum scenario. Option 1 (signal control) provides generally a more positive impact on capacity in terms of reducing queues compared to the Do Minimum, with the ability to control the queues and delays across the approach arms. Option 2 (priority control), not having the same inherent delay from the introduction of traffic signal control, performs better on certain arms (for example the A167 northbound approach) but in the AM peak the A691 queue is not addressed when compared to the Do Minimum scenario.

Option 1 (signal control) is a higher cost scheme compared to Option 2 (priority control) considering Sniperley Roundabout in isolation, however Option 1 retains the southbound bus lane on approach to the roundabout. Option 2 would require introduction of a replacement bus priority scheme to maintain bus journey times; this is likely to be via a link/junction onto the B6532 from the Park & Ride site, and physical bus priority towards 'Blackie Boy' roundabout which is constrained by an overbridge and embankments.

Option 1 also provides much needed controlled pedestrian/cycle crossing facilities, particularly across the A691 south-east arm. Option 2 provides no mitigation for the increased crossing distances over the A167 north and south arms as a result of the proposed widening.

Option 1 does result in additional throughput that in the S-Paramics modelling reported a queue on A691 Southfield Way back from Framwellgate Peth towards Sniperley Roundabout. Sniperley roundabout could be used to slightly throttle traffic such that this blocking does not occur.

It is therefore recommended that Option 1 is selected as the preferred option for Sniperley Roundabout. This can be supported by the proposed improvements to the Sniperley Park & Ride junction as part of the proposed development of the adjacent allocated land. It is important to note that the assessments have been carried out on the basis that the A167 corridor improvement schemes will also be implemented to remove the southbound blocking back that will stifle the benefits of a scheme at Sniperley roundabout.

1. Introduction

AECOM has been appointed by Durham County Council (DCC) to identify options to improve the A167/A691 'Sniperley' roundabout. The purpose of this study is to cater for the predicted 2027 traffic growth aligned with the local plan and is proposed to be complementary to a scheme to widen the A167 to two lanes southbound to alleviate congestion which causes blocking back through Sniperley roundabout.

The junction has been identified as a key node on the A167 providing interchange between routes into, and around Durham City Centre. As a result, high levels of traffic demand and congestion are a feature, and the proposed scheme to widen the A167 south of the roundabout have revealed its limitation to the effectiveness of schemes to increase capacity south of the junction.

This report presents the results of AECOM's study, including:

- A summary of initial proposed options for introduction of traffic signal control;
- The methodology adopted to develop and assess proposed signal controlled options;
- The proposed layouts for the preferred options; and
- The results of Paramics Microsimulation modelling analysis.

AECOM has undertaken initial testing and design development of 6, fully or partially signalised option layouts for the junction using LinSig, narrowing an initial longlist of options to a preferred signalised solution, which has been developed as a feasibility design layout including consideration for pedestrian crossing facilities.

To the north of Sniperley roundabout, there is a proposed development consisting of a primarily residential urban extension. The developer has employed Fore Consulting to develop a design to mitigate the traffic associated with the development. This design retains priority control at Sniperley Roundabout and has been provided to AECOM to be modelled. AECOM has therefore modelled the two options (priority controlled and signal controlled) using the existing 2027 S-Paramics microsimulation model of Durham, and report on the findings.

This report presents the results of the modelling work undertaken for both the signalised and priority options and compares them to a Do Minimum model provided by AECOM for the forecast year of 2027. The report includes the following sections:

- **Section 2** summarises the existing junction layout and facilities.
- **Section 3** details the initial option development process to identify which signal controlled option is considered most appropriate for further development.
- **Section 4** details the two options to be compared, including the priority controlled and signal controlled Sniperley Roundabout layouts.
- **Section 5** summarises the Paramics modelling methodology.
- **Section 6** details the Paramics modelling results.
- **Section 7** provides a summary and conclusions to the study.

2. Existing Layout

Sniperley roundabout is located to the north-west of Durham and is a priority controlled 5-arm roundabout subject to a 40mph speed limit. The key features of the roundabout have been summarised below and shown in Figure 1;

- Existing circulatory:
 - The existing circulatory carriageway consists of 2 lanes with an inscribed central diameter of approximately 90m.
- A167:
 - The northern approach is a three-lane carriageway that merges into a two-lanes upon entry to the roundabout. The nearside lane is a bus lane which terminates approximately 40m north of the give way line. The north exit arm is a single lane exit.
 - The southern A167 arm consist of the dual carriageway with two lanes in each direction.
- A691:
 - The southern arm features a two-lane entry and two lane exit, merging to a single lane approximately 70m southeast of the roundabout.
 - The north west arm features a two-lane entry and single two-lane exit.
- Dryburn Park:
 - 2-lane entry and one lane exit arm located on the north-east of the roundabout.

The junction features high level of congestion during peak periods, as a key junction for traffic entering Durham from the north and west and circulating past Durham on its western side. The junction is also located near key employers, including two NHS hospitals, New College Durham and Durham Secondary School.

Part of the observed congestion at the roundabout is due to exit blocking from the A167 southbound towards Toll House Road. Implementing a scheme at Sniperley Roundabout to improve capacity will only realise its full benefit if the exit blocking is alleviated, which has been considered as part of a prior study looking at the A167 corridor between Sniperley Roundabout and Nevilles Cross junction.



Figure 1: Aerial photography showing existing layout of the Sniperley Roundabout.

Facilities for non-motorised users (NMUs) are provided in the form of a shared use path is located around the perimeter of the roundabout with informal (without tactile paving) uncontrolled pedestrian and cycle crossings located on each of the roundabout arms, as illustrated in Figure 2 below. Currently there are no signal controlled pedestrian crossing facilities within the close proximity of the roundabout. There are signed cycle routes across the roundabout linking the A691 (NW), A167 (N) and A167 (S) arms.



Figure 2: Shared use path signing and informal pedestrian / cycle crossing on the A691 (south-east arm).

3. Option Development

Initial option development was undertaken by AECOM to develop options to signalise, or part signalise, the roundabout. The six variants tested in LinSig fall into three broad categories:

1. Full signalisation of the four major nodes (A691 and A167), with the Dryburn Park arm signalised **or** retained under priority control;
2. Signalisation of three of the five nodes; and
3. Signalisation of two of the five nodes.

For comparison all options were initially modelled assuming traffic-to-traffic intergreens of 5 seconds, saturation flows of 1800 on entry arms and 1900 on internal links, and default LinSig give-way parameters on priority arms featuring a slope of 0.33, and intercept of 1000.

A summary table of the initial options modelled, rationale and comments is shown in Table 1 below.

Fully Signalised Options

A fully signalised roundabout was initially modelled, providing signal control on all five arms of the roundabout. This option has poor capacity performance, primarily due to the relatively short circulatory carriageway length upstream of Dryburn Park where the large flows from A167 (N) or A691 are required to stack while Dryburn Park is on green. The short circulatory lengths result in signal co-ordination requirements limiting the green time that can be allocated to the three northern arms of the roundabout - the A167 (N), A194 (N) and Dryburn Park. When combined with heavy right turning flows from the A167 (S) to Dryburn Park, the resulting signal strategy and layout offers poor operational capacity.

Four-Arm Signalised Option

An option has been tested with all arms signalised except the 'minor' Dryburn Park arm. This removes the need to store vehicles on the short section of circulatory carriageway at Dryburn Park and allows green time to be better apportioned between the two major arms on the north side of the roundabout. This layout results in a strong capacity performance in both the AM and the PM, reducing delay and with management of circulating queues, with the A691(S) just over 90% DoS in 2027. Full modelling results for this option are presented in Table 2.

This option allows co-ordination of traffic signals to the major arms to manage internal circulatory queue lengths, with all arms but one (A691 S) operating at a Degree of Saturation <90% in both AM and PM peaks. The option keeps queues low on circulatory links by retaining priority control at Dryburn Park and giving the A167 (N) arm a greater throughput. It should be noted, that while part signalised options offer a greater PRC and lower delay values due to unsignalised links, it is recommended that a greater level of control is provided to ensure the circulatory can be kept clear of significant queueing. This option was the preferred solution as it offered the most promising results (see Table 1). Further design development of the option is discussed in section 4.

Three-Arm and Two Arm Signalised Options

Other options tested as part of the initial option development included three signalised arm arrangements, and two-arm signalised arrangements.

Two options were tested with three signalised nodes as shown in Table 1. The first retains priority control of the A167 nodes (signalising the A691). This option leaves the heaviest movements uncontrolled, which risks blocking within the roundabout, particularly when combined with short stacking length on the circulatory between the A167 (N) arm and Dryburn Park.


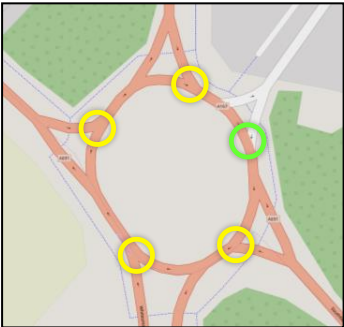
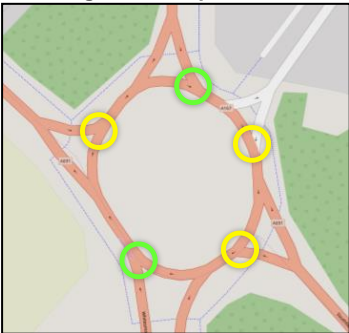
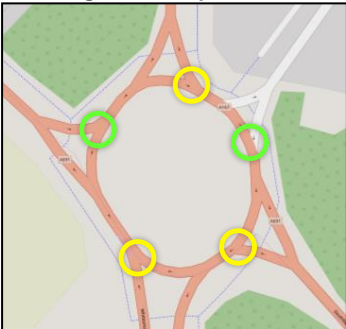
The second option in this category retains priority control of Dryburn Park and A691 (N), signalising the A167. This layout provides signal control of the major movements and heaviest flows into the roundabout but lacks operational capacity and circulatory storage space downstream of the priority-controlled arms.

Two options were tested with two signalised nodes. The first keeps only the A167 arms signalised, controlling the major movements, but leaves the minor arms without sufficient circulatory stacking due to the geometry of the roundabout.

The second option controls the A691 arms, and as such provides the greatest circulatory stacking space for the priority-controlled arms; however, the option does not control the arms with the greatest traffic demand thus internal link queue lengths risk blocking through the roundabout.

Table 1 summarises the tested options with PRC and Delay Values from initial testing. The reasoning behind each option and comments on the operation are also provided. Note: Yellow represents a signalised arm and green a priority arm.

Table 1. Summary of tested initial options

Option	PRC	Delay	Rationale	Comments
5-arm Signalled				
	AM		Full control of all movements and co-ordination between stop lines.	Poor capacity, especially at the northern side of the roundabout where co-ordination and need for capacity compromises operation, splitting green time between three arms onto roundabout.
	-8.0%	62		
	PM			
	-11.0%	86		
4-arm Signalled				
	AM		Removal of arm from signalisation to improve capacity and signal co-ordination. Dryburn Park has lowest flow of 5 arms, and longest downstream circulatory for stacking for priority arm.	Preferred Option - allows better signal co-ordination and use of roundabout stacking by providing priority control on Dryburn Park.
	2.3%	50		
	PM			
	-2.5%	52		
3-arm Signalled – Option A				
	AM		3 nodes generally offer the most efficient signalised roundabout arrangement. Arms chosen for signalisation reflect even cruise times between each other for efficient operation.	Model shows adequate capacity and queue lengths on internal links. However heaviest movements not controlled, and there is a lack of stacking space on circulatory approaching Dryburn Park.
	1.2%	37		
	PM			
	1.2%	60		
3-arm Signalled – Option B				
	AM		3 nodes generally offer the most efficient signalised roundabout arrangement. Arms chosen for signalisation as those with greatest flows. Less stacking for priority arms in this option than Option A.	Signalised arms arranged this way controls heaviest movements into the junction but results in queues on short circulatory links, blocking other movements.
	5.7%	37		
	PM			
	8.0%	39		

Option	PRC	Delay	Rationale	Comments
2-arm Signalled – Option A				
	AM		Heaviest flow arms selected for signalisation (A167).	Capacity is poor on A691 (S) approach, and lack of storage for priority movements on circulatory limits operational capacity.
	5.7%	32		
	PM			
	-7.5%	39		
2-arm Signalled – Option B				
	AM		A691 arms selected to maximise circ. Stacking space for priority movements joining roundabout.	Improved operation over 2-arm Signalled Option A, though stacking exit blocking is still an issue. Major arms are not priority and hence are unstable.
	4.6%	25		
	PM			
	1.1%	35		

Table 2. Worst lane Degree of Saturation (DoS) and Mean Max Queue (MMQ) results for 4-arm signalised option (2027).

Arm	Control	AM (70s Cycle Time)		PM (84s Cycle Time)	
		DoS	MMQ	DoS	MMQ
A167 (N)	Signalised	86.9%	10.1	87.5%	16.3
Circulatory @ A167 (N)		57.2%	3.2	61.6%	6.1
Dryburn Park	Priority	65.8%	2.8	37.9%	2.0
A691 (S)	Signalised	84.3%	8.9	91.2%	17.7
Circulatory @ A691 (N)		43.1%	4.5	60.7%	6.2
A167 (S)	Signalised	88.0%	13.0	89.1%	17.8
Circulatory @ A167 (S)		32.1%	1.5	53.1%	4.4
A691 (N)	Signalised	87.9%	9.9	82.9%	8.4
Circulatory @ A691 (N)		60.2%	11.3	63.3%	7.2

4. Proposed Shortlisted Layouts

The following section discusses the two proposed layouts that have been developed for more detailed testing using the 2027 Paramics model for Durham city centre. The first, Option 1, was identified as the preferred option for signal control of Sniperley roundabout during the option development process carried out by AECOM (see Section 0). The second refers to the design that was developed by Fore Consulting as part of the proposed development to the north of the roundabout, Option 2.

Option 1 – Signalised Roundabout

Option 1 is a signal controlled junction utilising enhanced capacity through physical widening. The proposal includes:

- Four arms operating under traffic signal control, with Dryburn Park arm retained under priority control. This removes the need to store vehicles on the short section of circulatory carriageway between the A167 north and Dryburn Park and allows green time to be better apportioned between the two major arms on the north side of the roundabout.
- An increase from two lanes to three lanes on the circulatory carriageway, enabling the A167 northbound approach to be widened to 3 lanes.
- All other approaches remain 2 lanes as per the current layout, with the retention of the two lane exit merge on the A691 south east exit, and southbound bus lane on the A167. In order to reduce lane weaving, spiral markings are provided on the circulatory carriageway.
- The existing north-westbound exit onto the A691 is proposed to be widened to provide a two-lane exit (that merges downstream). The provision of this two lane exit assists with the road marking scheme to enable right turning traffic from Dryburn Park and the A167 (N) to stack offline on the southern circulatory without blocking the offside southbound exiting the roundabout onto the A167 (S) arm.
- The southbound A167 retains the existing bus lane and two traffic lanes on approach to the roundabout, with the bus lane terminating in advance of the roundabout give-way to merge with the nearside traffic lane.
- NMU facilities have been provided in the form of Toucan crossings on three of the four arms, located on the north arm (A167), south east arm (A691) and south arm (A167), with an informal crossing will be kept on Dryburn Park. A link through the centre of the roundabout provides a signal controlled route (avoiding Dryburn Park) for pedestrians and cyclists between the A167(N)/A691(W) and the A167(S). These crossings have been designed in order to provide for key movements on cycle routes and to local schools and colleges. The key pedestrian/cycle crossing is the A691 east arm due to the route to nearby schools.

Figure 3 illustrates the proposed layout for Option 1 below, a drawing is included in Appendix D.

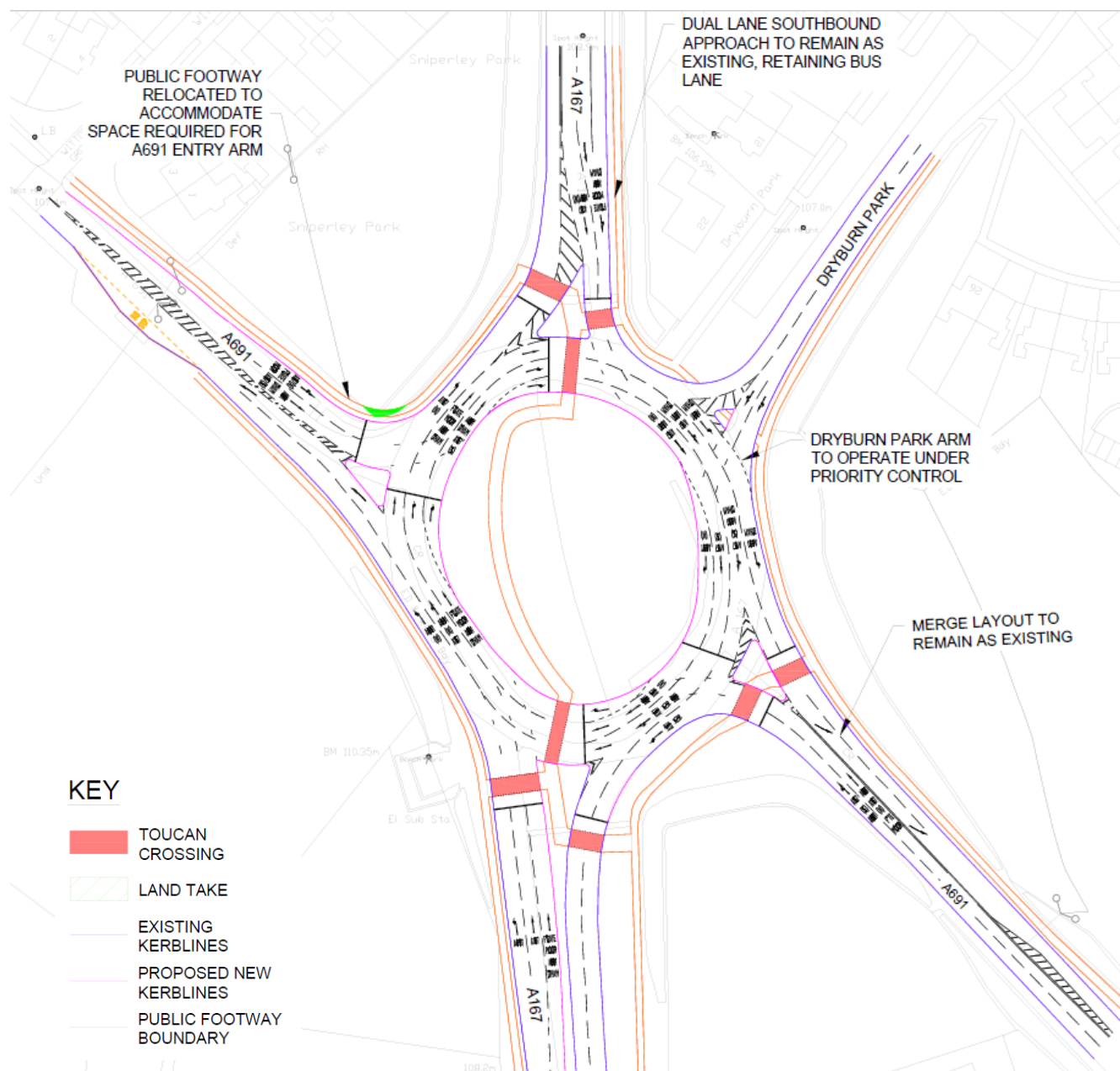


Figure 3: Proposed Sniperley Roundabout Option 1 layout

Option 2 – Priority Controlled Roundabout

Option 2 retains priority control on all entries to the roundabout and provides the following capacity improvements:

- Similar to Option 1 the number of lanes on the circulatory carriageway has been increased from 2 to 3 lanes between the A167 northbound entry and exit arms only (western side of the roundabout). The A167 northbound approach is widened to 3 lanes
- Two of the northbound A167 approach lanes continue ahead through the roundabout and exit onto a two lane cross section northbound from Sniperley Roundabout towards the downstream roundabout adjacent to Sniperley Park & Ride.
- A side-effect of the above two lane northbound exit is the removal of the southbound bus lane approaching Sniperley Roundabout. This would increase bus journey times, particularly the inbound Park & Ride services, if the existing routes are maintained. An alternative route has been mentioned to provide a route through the potential development site adjacent to Sniperley Park & Ride onto the B6532 via a new junction. This is illustrated in Figure 4 below.
- It is noted that the B6532 suffers from congestion approaching the roundabout with Dryburn Park, particularly in the AM peak for inbound Durham City Centre trips. All arms at this roundabout queue in peak periods however the B6532 must give way to the Dryburn Park northbound approach.

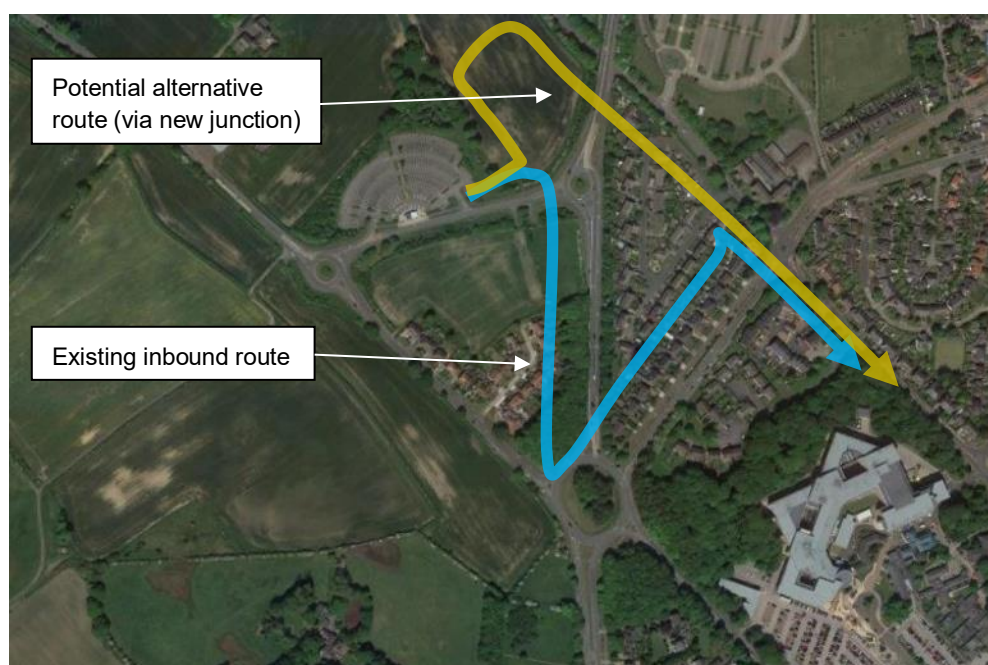
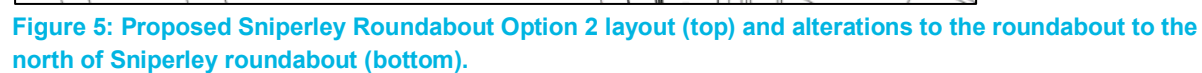


Figure 4: Potential Rerouting for Park & Ride Services with removal of bus lane under Option 2.

- The Dryburn Park southbound approach has been widened to accommodate a two-lane flared approach of approximately 60m.
- No change is proposed to the A691 (east) arm; the west arm includes a minor modification to the flare length on approach through road marking renewal.
- As part of the proposed mitigation for the potential development north of Sniperley roundabout, the roundabout to the north, adjacent to Sniperley Park & Ride, has been enlarged and the western and northern arms realigned. If the development progresses, an additional arm on the roundabout (not modelled) would provide access to the A167.

The proposed layout for Option 2 is shown on Figure 5 below.



5. Microsimulation Modelling

The following modelling methodology has been adopted to assess the two proposed options using S-Paramics version 2011.1. The existing Durham City Centre 2027 Do Minimum model was used as a base, updating the network structure to reflect the two proposed options by importing AutoCAD drawings into S-Paramics and adjusting the existing roundabout to reflect the changes of each option i.e. increase in number of lanes, changes in priority control etc.

For Option 1, traffic signal information from the LinSig traffic signal software model described in Section 3 was coded into the S-Paramics model. The following information was taken from the LinSig model for the S-Paramics Option 1 model.

- Cycle times for both AM and PM peaks;
- Start and end times for each traffic stage;
- Phase green times;
- Intergreen periods.

After a review of the operation of the roundabouts for the two models, driver behaviour was adjusted to better reflect the schemes, including stopline points, lane usage through the roundabout based on road marking schemes.

Queue length markers and journey time measurements were added to both the 'Do Minimum' and 'Do Something' Option models in both the AM and PM period.

Assessment

All three models have been assessed within S-Paramics, for the AM Peak hour (08:00 – 09:00) and PM Peak hour (17:00 – 18:00). The models have been run ten times for each peak period, each run using a different seed value (seeds adjust the distribution variables within the model to ensure a robust average result).

With regards to model outputs, only queue lengths and journey times have been presented.

Queue Length Outputs

Queue data has been reported for each entry arm to the roundabout. The modelling results compare the queues from the option models to the Do Minimum model.

Journey Time Outputs

Journey times routes were placed in the model to output as follows.

- Red route: journey times along the A691 north-westbound and south-eastbound between the Park and Ride access roundabout and the Southfield Way / Old Dryburn Way roundabout
- Green route: journey times along the A167 northbound and southbound between the park and ride access roundabout and the Redhill Lane / Newcastle Road junction.
- Orange route: journey times along Dryburn Park and the A167 in both directions between the Dryburn Park / Dryburn Road junction and the A167 Newcastle Road / Long Garth junction

The average journey times were taken from each seed run and averaged for all vehicle types.

The routes are shown in Figure 6.



Figure 6: Journey Times Routes in the models

6. Modelling Results

The following section presents the S-Paramics model observations and results. It should be noted that screenshots can only be taken from specific seed runs and may not present the average conditions from the multi-seed runs.

The section presents a sample of queue and journey time comparison graphs; however, a comprehensive list can be found in Appendix B and C respectively.

Model Observations

Do Minimum 2027:

During the AM and PM peaks, the model shows significant queues propagating back along the A167 from Sniperley roundabout. In the PM peak only, queues are observed along the A691 Southfield Way on the approach to Sniperley roundabout.

In the AM peak, queues are also observed along the A691 south-eastbound and the A167 southbound approaches (inbound routes) with traffic extending back through the Park & Ride junction; this is shown in Figure 7.

In the PM peak, extensive queues are observed outbound along the A167 on the northbound approach to Sniperley roundabout, which blocks back through the upstream junctions. Some queuing is also observed along the A691 travelling north-westbound towards the roundabout, as shown in Figure 7.

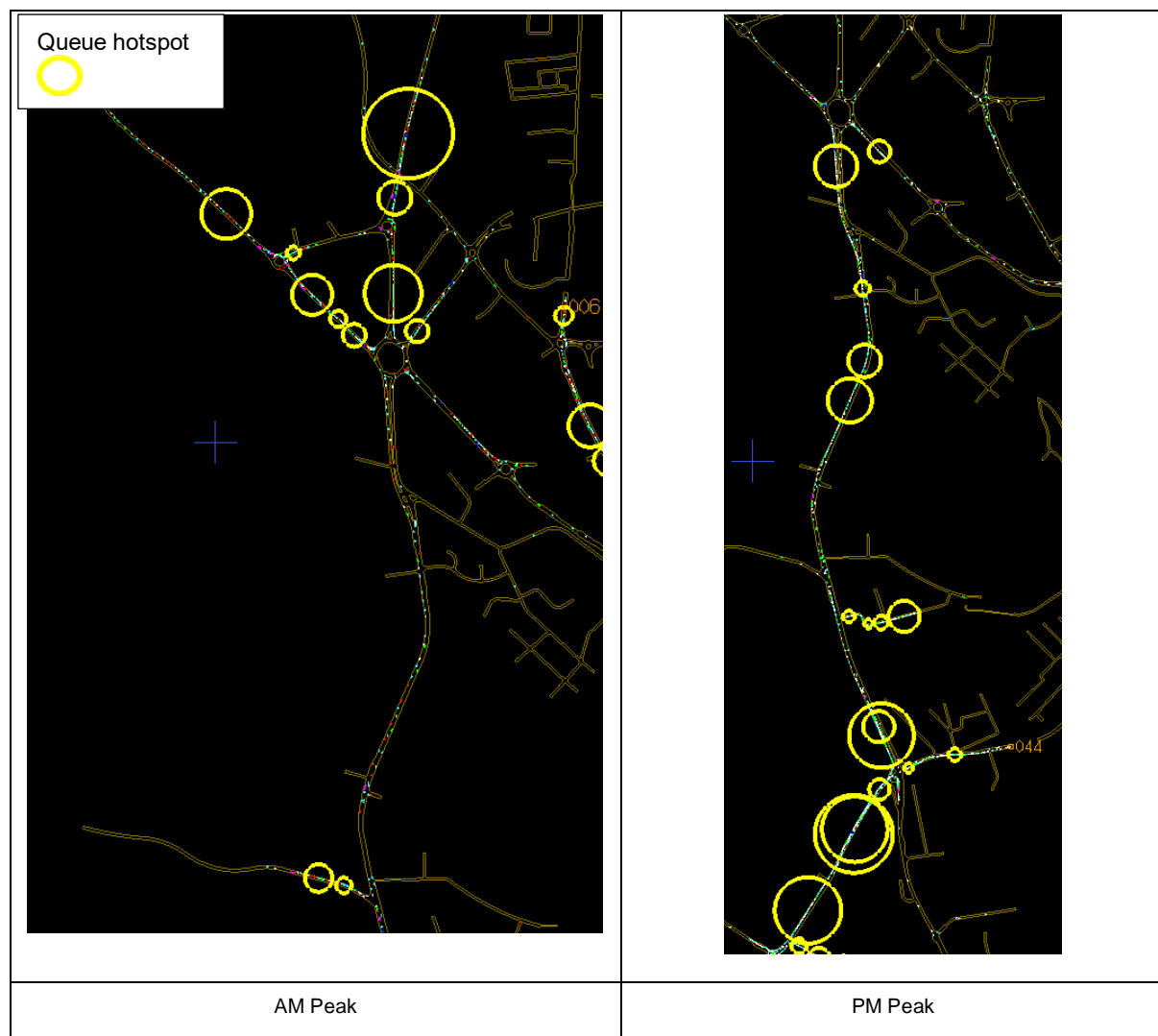


Figure 7: Queuing along the A167 southbound AM and PM Peak

Option 1 – Signalised Roundabout

The model shows reduced queueing overall, however some queueing during the AM peak along the A691 Southfield Way northbound approach due to the introduction of signal control of the arm. On occasion queues on the A691 Southfield Way are observed blocking back onto Sniperley roundabout, likely due to increased traffic flow arriving at downstream junctions as a result of the scheme's improved throughput. The signal controlled crossing on the exit arm along A691 Southfield Way is also observed on occasion blocking traffic from Dryburn Park entering onto Sniperley roundabout (see Figure 8, circled in red). The extent of this queueing will depend on the frequency of demand for the crossing and servicing of the crossing could be restricted.

Similar to the AM peak, the PM peak displays significantly reduced queueing on the approach to Sniperley roundabout, as shown in Figure 8, however the A691 Southfield Way northbound can experience queues which extend towards the upstream junction.

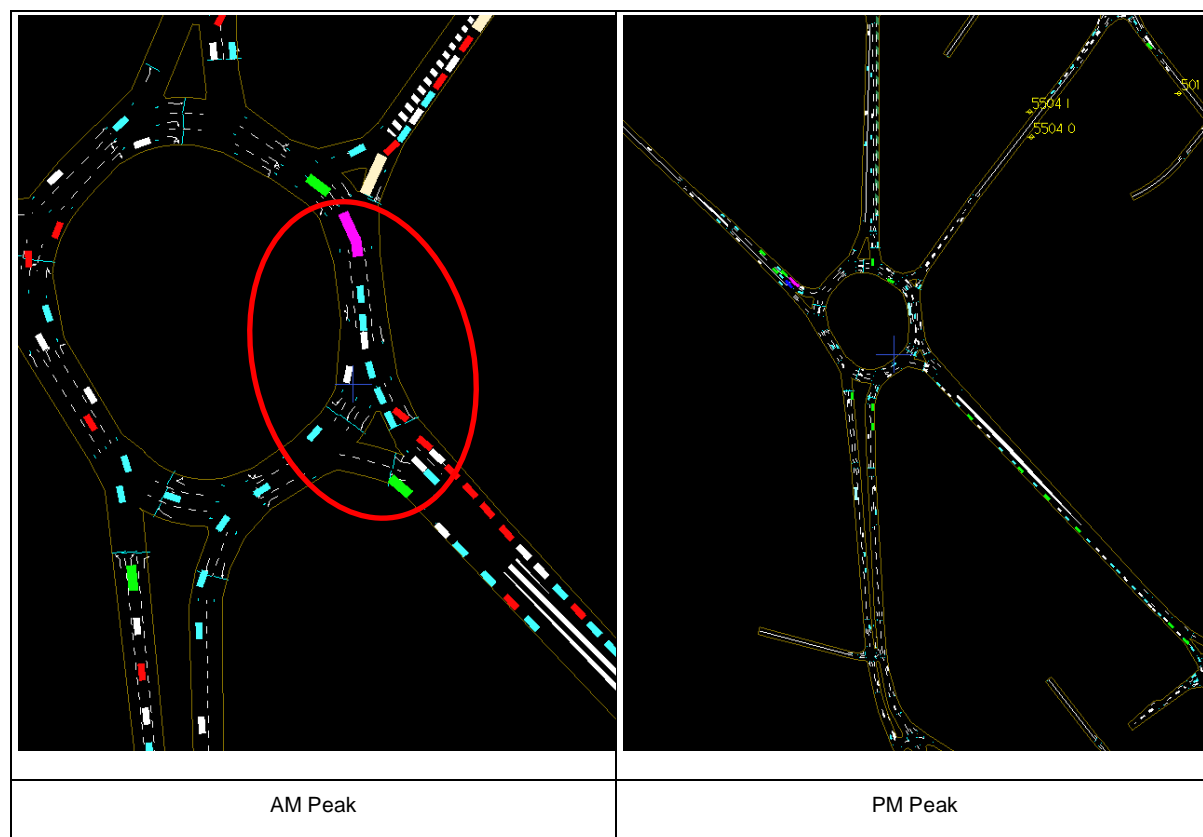


Figure 8: Option 1 Traffic Conditions around Sniperley roundabout

Option 2 – Priority Control

The model also reports reduced queueing overall, though reports regular queueing on the A691 heading south-eastbound towards Sniperley roundabout that stretches back through the upstream junction. Some moderate queueing along the A167 southbound in the AM peak and A691 Southfield Way during the PM peak is also observed as shown in Figure 9.

Unlike Option 1, there is no blocking back observed from Southfield Way back towards the Sniperley Roundabout, attributed to a lower throughput at Sniperley Roundabout, particularly from the A691 south-eastbound approach; this eases congestion downstream on Southfield Way inbound to the city centre.

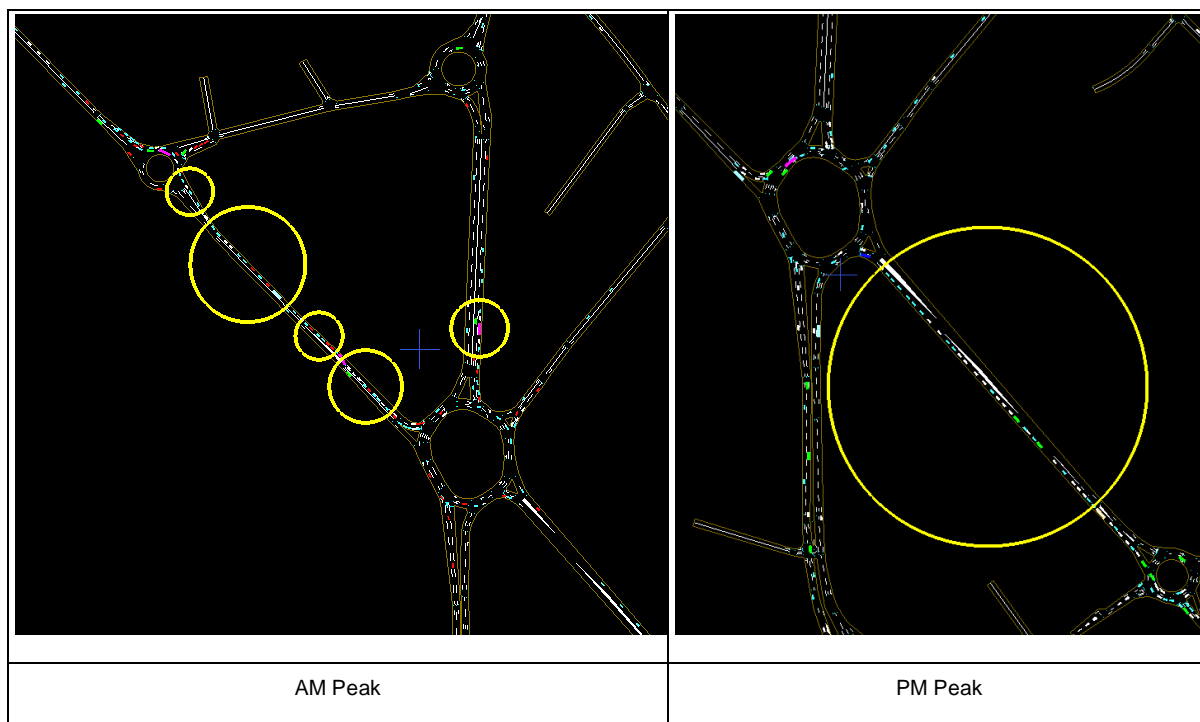


Figure 9: Option 2 Traffic Conditions around Sniperley roundabout

AM Peak Queue Results

The following figures present the main changes in queue profiles between the Do Minimum and Option models during the AM peak, however a comprehensive set of queue profile figures are presented in Appendix B.

A167 Northbound

Figure 10 shows that Option 2 improves the average AM queues along the A167 northbound. This is due to the increased capacity on the north approach from 2 lanes to 3 lanes and without applying signal control to an arm that is less congested in the AM peak. Option 1 sees slightly longer queues than that of Option 2 due to the signalisation of the arm.

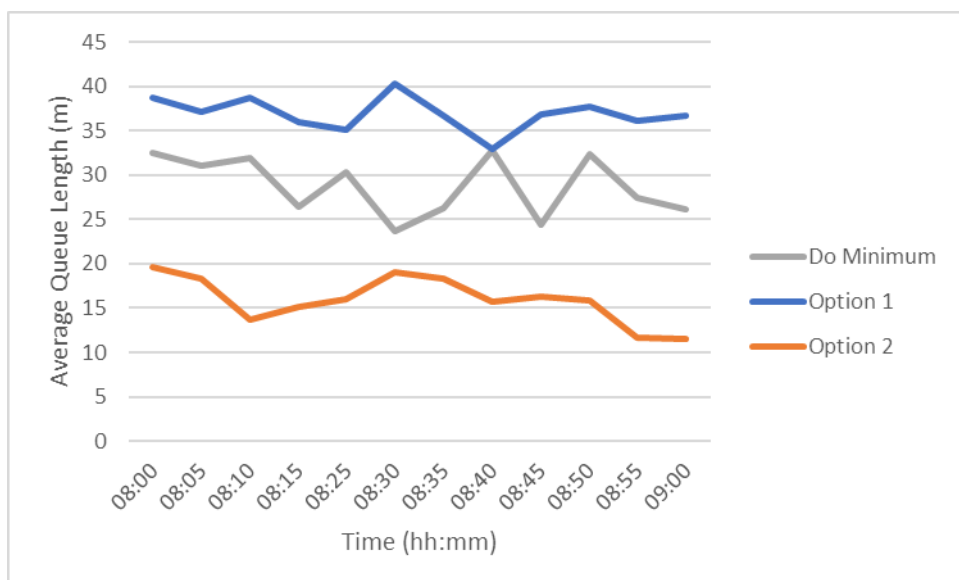


Figure 10: Queue graph A167 Northbound AM peak

A691 South-eastbound

Figure 11 displays large queues for the do minimum and Option 2 priority controlled option. The queues are slightly shorter on average for Option 2 compared to the Do Minimum, with increased capacity for circulatory traffic. With the introduction of traffic signals in Option 1, queues remain consistent through the peak hour with little variation, and significantly lower than Option 2.

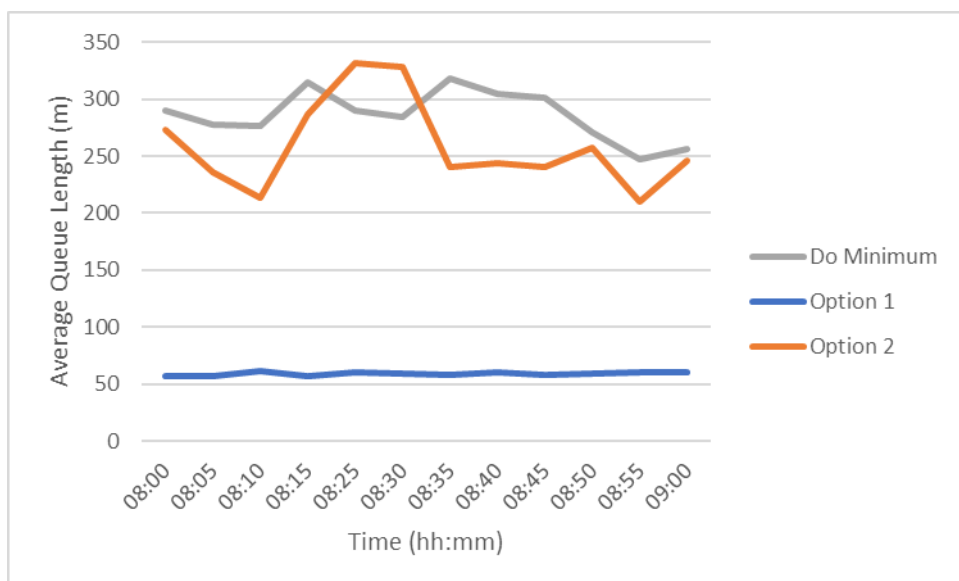


Figure 11: Queue graph A691 South-eastbound AM peak

Dryburn Park South-westbound

Figure 12 reports that the Dryburn Park queue profiles for the three models are similar, with a queue peaking around 8:30 am. Option 2 shows slightly shorter queues than Option 1 due to an increase in its flare length of 60m. This change could be applied to the Option 1 layout.

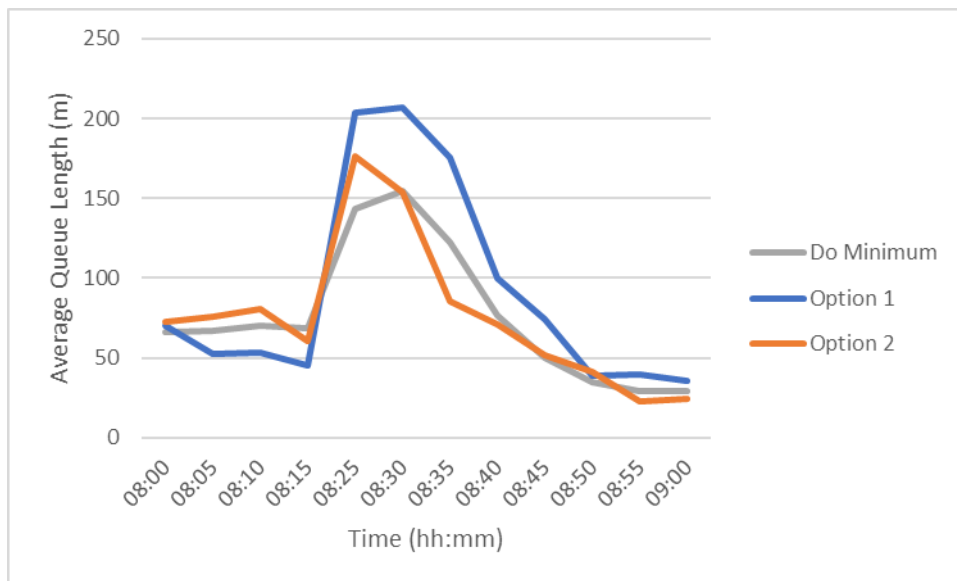


Figure 12: Queue graph Dryburn Park South-westbound AM peak

PM Peak Queue Results

A167 Northbound

Figure 13 shows that both options drastically reduce the queues on the northbound approach of the roundabout. Both options have greater capacity on the approach and on the circulatory carriageway due to the additional third lane. Option 1 manages the queue length to approximately 50m throughout the peak hour, while Option 2 shows a marginal betterment with a queue length of 35m.

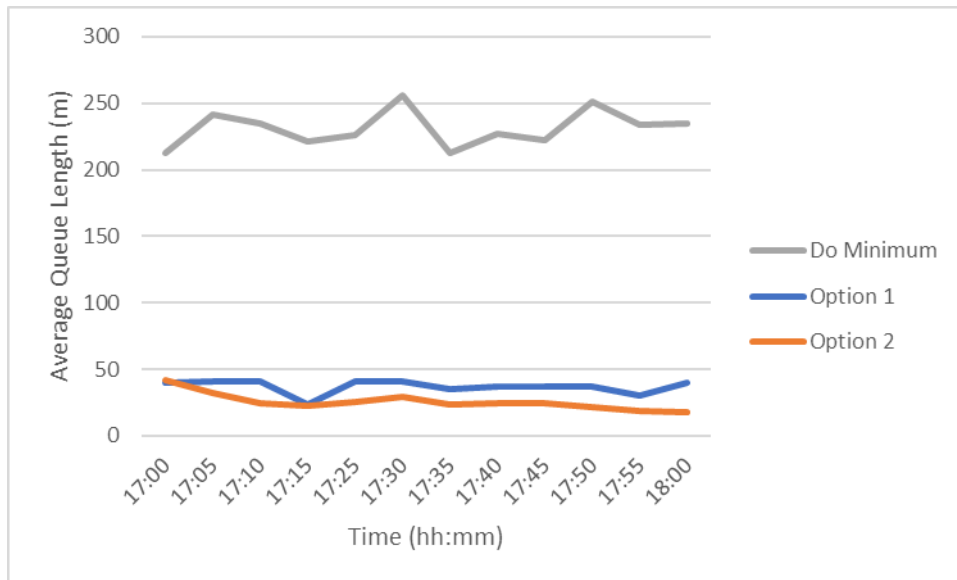


Figure 13: Queue graph A167 Northbound PM peak

A691 North-westbound

Figure 14 shows that the Do Minimum and the two options have a similar queue profile throughout the peak; however Option 1 displays shorter queues due to the signals providing better queue management.

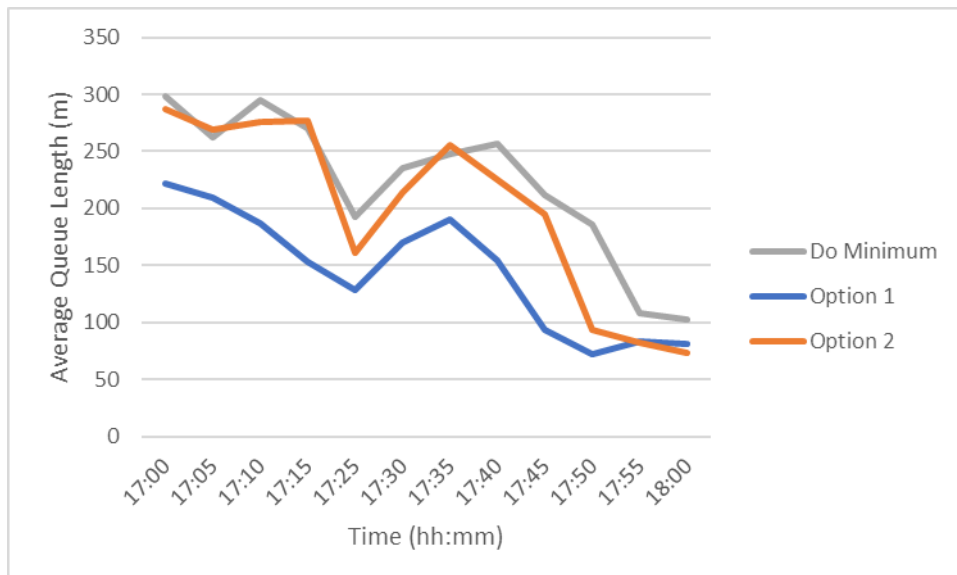


Figure 14: Queue graph A691 North-westbound PM peak

AM Peak Journey Times Results

Figure 15 (also in section 0), displays the journey time routes which have been examined within the S-Paramics models. This section only presents specific journey routes which show large changes in journey times between the Do Minimum and option models (Appendix C contains all journey time comparison figures).

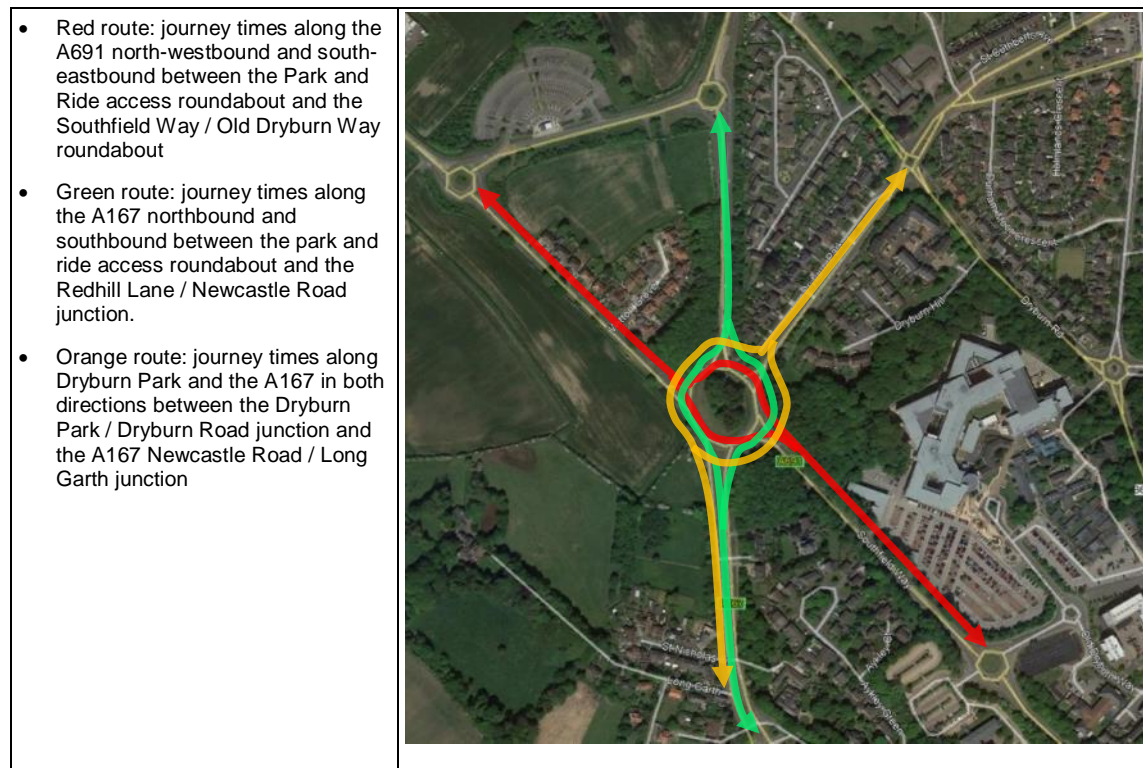


Figure 15: Journey Times Routes in the models

Orange Route North-eastbound

Figure 16 highlights that Option 1 has the longest journey time compared to the Do Minimum and Option 2 during the AM Peak though the differences over the route length are in the order of 20 seconds over 650m. This is attributed to inherent delays introduced by traffic signals, with traffic travelling north from the A167 to Dryburn Park being delayed by the two sets of signals, on approach to the roundabout and on the circulatory carriageway turning right. The Do Minimum and Option 2 show very similar journey times.

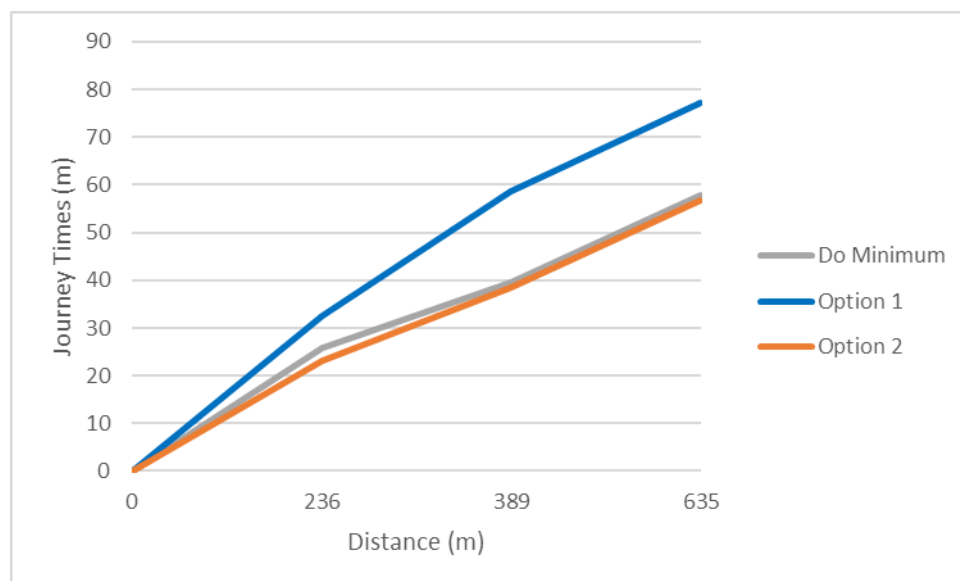


Figure 16: Journey times graph along the Orange Route NEB

PM Peak Journey Times Results

Green Route Northbound

Figure 17 shows that the journey times are significantly higher in the Do Minimum model when compared to the two options. This is in line with the queues observed along the A167 northbound, due to the two-lane circulatory carriageway and overall reduced capacity with the current roundabout layout compared to the options.

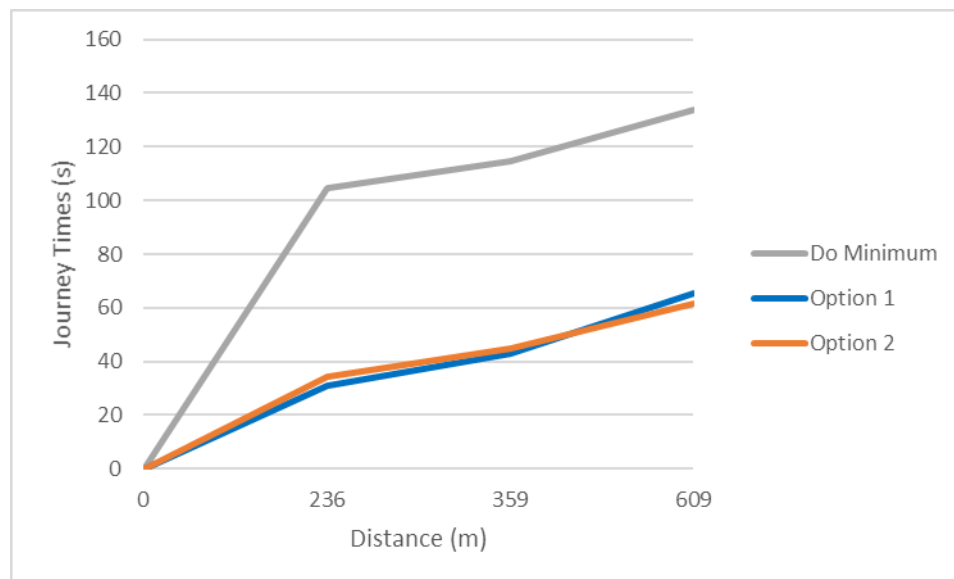


Figure 17: Journey times graph along the Green Route NB (PM Peak)

Red Route North-westbound

Figure 18 shows that the journey time for Option 2 is similar to that of the Do Minimum, with both routes showing around 223 seconds, whereas Option 1 performs better with a journey time of 160 seconds. With regards to Option 1 the introduction of signal control on the A691 Southfield Way arm reduces the queuing over the PM peak hour (see Figure 14), whereas Option 2 has a similar capacity as that of the Do Minimum model, hence the comparable journey time.

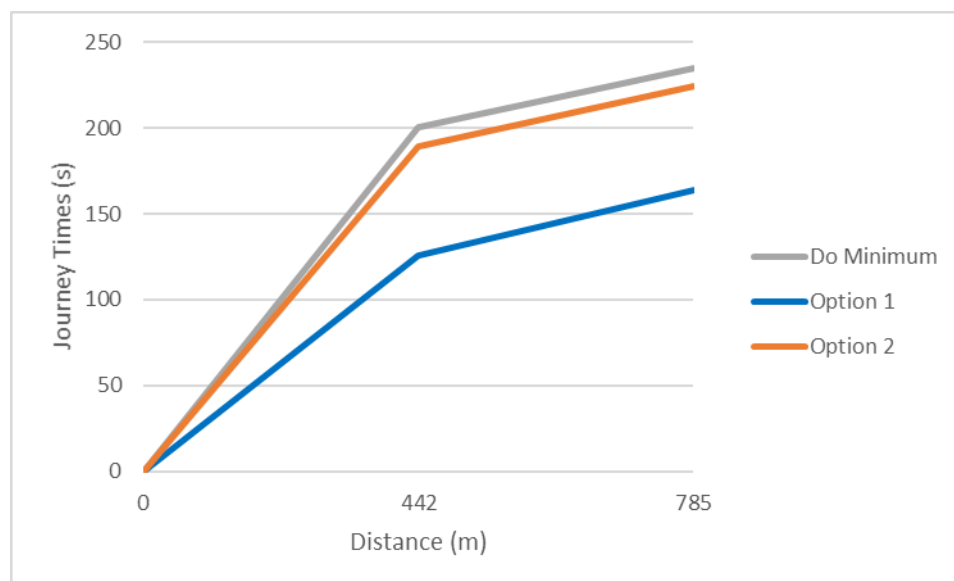


Figure 18: Journey times graph along the Red Route SB (PM Peak)

7. Option Cost Estimates

Feasibility level cost estimates have been developed for both Option 1 (signal controlled) and Option 2 (priority controlled). A cost estimate has also been produced for the reconfiguration of the Sniperley Park & Rise east roundabout with the larger inscribed circle diameter and additional arm.

Assumptions applicable to both options include:

- Both options assume the extents of the scheme will include resurfacing to the extents of the scheme including kerblines and road markings, as per Durham County Council policy.
- Costs exclude land purchase costs (though not relevant on assumption area to north-west of Sniperley Roundabout owned by DCC).
- Includes assumptions on unknown items including contractor preliminaries, utilities, temporary traffic management and design development costs. Risk Allowance included at 20%, cost subject to QRA process. Utilities allowance increased due to known presence of statutory under equipment around Sniperley Roundabout.

Option 1

Option 1 includes the introduction of traffic signal control and civils works required for widening at Sniperley Roundabout.

Cost Element	Total Cost (£)
Roadworks	£708,999
Preliminaries and Contingencies	
- Contractor Preliminaries of 20%	£141,800
- Utilities allowance of 30%	£212,700
- Temporary traffic management allowance of 20%	£141,800
Inflation ((Q2 2017 to Q2 2020) OF 6.48%)	£78,103
Design (at 10% of costs, including inflation)	£128,340
Contract Management (at 2% of costs, including inflation)	£25,668
SITE SUPERVISION (at 5% of costs, including inflation)	£64,170
Land	-
Sub Total	£1,501,580
Risk Allowance (15%)	£300,316
Total	£1,801,896

Option 2 – Sniperley Roundabout

Option 2 includes the civils works required at Sniperley Roundabout for comparison with Option 1 but excludes the Sniperley Park & Ride junction – this Park & Ride reconfiguration is mandatory with Sniperley Option 2 due to the two lane northbound exit from Sniperley Roundabout.

The cost also excludes the requirement for a bus priority scheme along the B6532 on the approach to 'Blackie Boy' roundabout to offset the loss of the southbound bus lane on the A167 towards Sniperley Roundabout.

Cost Element

Total Cost (£)

Roadworks	£372,484
Preliminaries and Contingencies	
- Contractor Preliminaries of 20%	£74,496
- Utilities allowance of 30%	£111,745
- Temporary traffic management allowance of 20%	£74,497
Inflation ((Q2 2017 to Q2 2020) OF 6.48%)	£41,033
Design (at 10% of costs, including inflation)	£67,426
Contract Management (at 2% of costs, including inflation)	£13,485
SITE SUPERVISION (at 5% of costs, including inflation)	£33,713
Land	-
Sub Total	£788,879
Risk Allowance (15%)	£157,776
Total	£946,655

Northern Roundabout (Sniperley P&R)

This cost estimate includes reconstruction of the existing Park & Ride east roundabout for a larger inscribed circle diameter, and provision of an additional arm for the extents shown in Fore Consulting drawing 2029_SK001 005.

Cost Element

Total Cost (£)

Roadworks	£559,036
Preliminaries and Contingencies	£391,325
Inflation ((Q2 2017 to Q2 2020) OF 6.48%)	£61,583
Design (at 10% of costs, including inflation)	£101,194
Contract Management (at 2% of costs, including inflation)	£20,239
SITE SUPERVISION (at 5% of costs, including inflation)	£60,597
Sub Total	£1,183,976
Risk Allowance (20%)	£236,795
Total	£1,420,771

8. Summary and Conclusions

Option Development

Following initial option development using LinSig traffic signal software, a single option for the introduction of traffic signal control at Sniperley Roundabout was selected and refined. Signalisation of four out of five arms (Dryburn Park excluded) was considered to offer the greatest level of control and capacity at the junction, while allowing more efficient apportioning of green time to all arms, and control of circulatory queueing. This option was taken forward to microsimulation modelling alongside a priority arrangement developed as part of nearby development mitigation. The tested options therefore included:

- **Option 1:** designed as part of this study, consisting of 4 signalised arms at the A167 and A691 arms, retaining Dryburn Park under priority control due to poor performance of the junction under full signal control.
- **Option 2:** designed as part of mitigation for a development site adjacent to Sniperley Park & Rise, retaining priority control with capacity enhancements through widening.

The two options have been compared against the reference “Do Minimum” model using S-Paramics software. Queue and journey time information along with model observations have been presented within this report.

Results Summary - Queues

In terms of reported queue results:

- The Do Minimum model shows extensive queues on the A691 heading south-eastbound and the A167 southbound, with queues blocking back onto the upstream junctions during the AM peak. During the PM peak, queues along the A691 Southfield Way heading north-westbound are observed, as well as extensive queueing along the A167 northbound.
- Option 1 shows some queuing during the AM peak along the A691 Southfield Way northbound, due to the introduction of signal control. On occasion queues on the A691 Southfield Way (south-eastbound) are observed blocking back onto Sniperley roundabout as a result of increased throughput from the A691 at Sniperley Roundabout. The signalised Toucan crossing on the exit arm of A691 Southfield Way is observed to block traffic from Dryburn Park entering Sniperley roundabout when a queue forms back towards Sniperley Roundabout. During the PM peak, the A691 Southfield Way can experience queues which stretch towards the upstream junction.
- The signalisation of the roundabout results in consistent queues throughout the peaks, with queue profiles being reasonably flat.
- Option 2 shows regular queuing on the A691 heading south-eastbound towards Sniperley roundabout, which stretches back onto the upstream junction. Some moderate queueing along the A167 southbound can also be observed. The model shows queueing along the A691 Southfield Way during the PM peak.
- Priority controls at the entry arms of the roundabout results in greater variability in queue lengths during the peak hours.

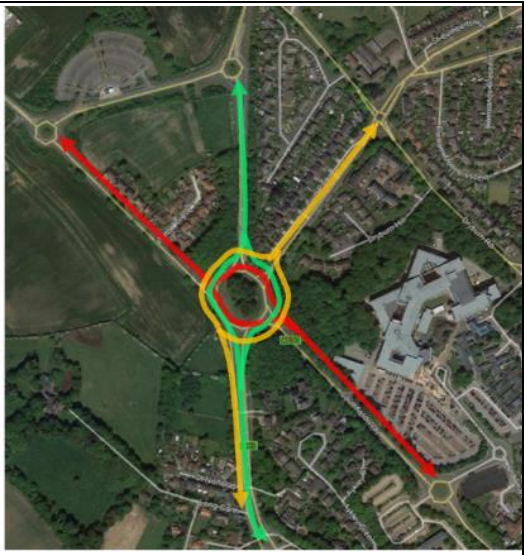
Journey time data has been summarised in the Table 3 and Table 4 below:

Results Summary – Journey Times

Table 3 indicates that during the AM peak, both Options 1 and Option 2 represent an overall benefit over the Do Minimum scenario. Option 1 displays an increase in the Red Route north-westbound (A691) over the other two models, Option 2 displays the biggest increases in journey time along the Orange Route southbound (Dryburn Park to A167) and Red Route SEB compared to Option 1. There are benefits and disbenefit for different approaches between the options; the benefit of signal control is the consistency of operation.

Table 3: AM Peak Journey Time Summary (unweighted)

Route	Average Journey Time (s)		
	Do Min	Option 1	Option 2
Orange Route NEB	58	77	57
Orange Route SB	99	119	132
Green Route NB	58	73	52
Green Route SB	204	179	181
Red Route NWB	70	154	71
Red Route SEB	311	134	266




Note: The number of vehicles undertaking these routes have not been extracted (unweighted).

Table 4 also highlights that Options 1 and 2 perform better than the Do Minimum scenario along most routes, with significant improvements being observed along the Orange Route north-eastbound (A167 to Dryburn Park) and the Green Route northbound (A167). Option 2 reports longer journey times along the Red Route north-westbound when compared to the Do Minimum and Option 1.

Table 4: PM Peak Journey Time Summary (unweighted)

Route	Average Journey Time (s)		
	Do Min	Option 1	Option 2
Orange Route NEB	160	103	104
Orange Route SB	50	64	56
Green Route NB	134	65	62
Green Route SB	151	162	164
Red Route NWB	235	164	224
Red Route SEB	138	126	121



Note: The number of vehicles undertaking these routes have not been extracted (unweighted).

Conclusions

The key advantages and disadvantages details for each scheme are summarised below. Specific journey time/delays are not included in the summary as the performance varies by peak by arm by queues or journey times.

Table 5: Advantages and Disadvantages Summary of Options 1 & 2

Item	Option 1 (signal controlled)	Option 2 (Priority controlled)
Advantages	<ul style="list-style-type: none"> Improvement over Do Minimum Control and consistency over queues and delays across approaches Retains southbound bus lane Introduction of controlled pedestrian/cycle crossing facilities Benefits to journey times compared to Option 2 on some routes (particularly A691 S-EB) 	<ul style="list-style-type: none"> Improvement over Do Minimum Lower cost than Option 1, though cost excludes requirement for bus priority to offset loss of southbound A167 bus lane Benefits to journey times compared to Option 1 on some routes (A167 NB)
Disadvantages	<ul style="list-style-type: none"> Higher cost than Option 2 (on account of signals and additional widening) Introduces inherent delay to approaches as a result of the introduction of traffic signals 	<ul style="list-style-type: none"> No control/consistency over queues and delays across approaches Removes southbound bus lane used by Park & Ride services Cost will increase if include new link road to offset loss of SB bus lane No improvement to pedestrian/cycle crossing facilities
Cost	<p>Civils estimate £708,999</p> <p>Total inc ancillary costs/risk £1,801,896</p>	<p>Civils estimate £372,484</p> <p>Total inc ancillary costs/risk £946,655</p> <p>(Excluding Sniperley P&R roundabout and provision of new bus link road/junction)</p>

The above table highlights that both options offer a capacity improvement over the Do Minimum scenario. Option 1 (signal control) provides generally a more positive impact on capacity in terms of reducing queues compared to the Do Minimum, with the ability to control the queues and delays across the approach arms. Option 2 (priority control), not having the same inherent delay from the introduction of traffic signal control, performs better on certain arms (for example the A167 northbound approach) but in the AM peak the A691 queue is not addressed when compared to the Do Minimum scenario.

Option 1 (signal control) is a higher cost scheme compared to Option 2 (priority control) considering Sniperley Roundabout in isolation, however Option 1 retains the southbound bus lane on approach to the roundabout. Option 2 would require introduction of a replacement bus priority scheme to maintain bus journey times; this is likely to be via a link/junction onto the B6532 from the Park & Ride site, and physical bus priority towards 'Blackie Boy' roundabout which is constrained by an overbridge and embankments.

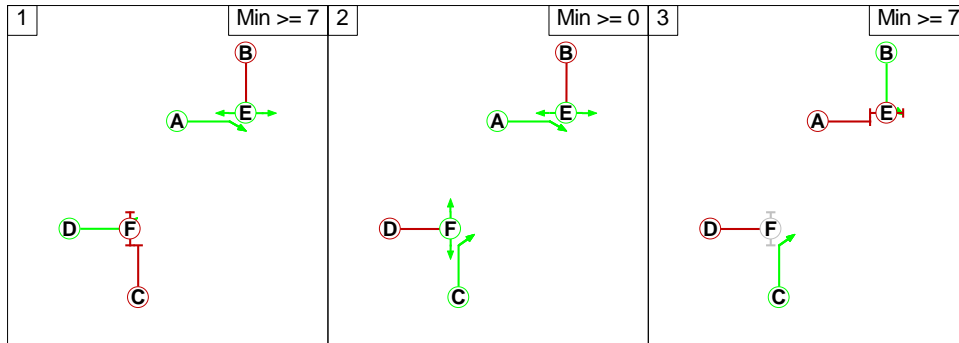
Option 1 also provides much needed controlled pedestrian/cycle crossing facilities, particularly across the A691 south-east arm. Option 2 provides no mitigation for the increased crossing distances over the A167 north and south arms as a result of the proposed widening.

Option 1 does result in additional throughput that in the Paramics modelling reported a queue on A691 Southfield Way back from Framwellgate Peth towards Sniperley Roundabout. Sniperley roundabout could be used to slightly throttle traffic such that this blocking does not occur.

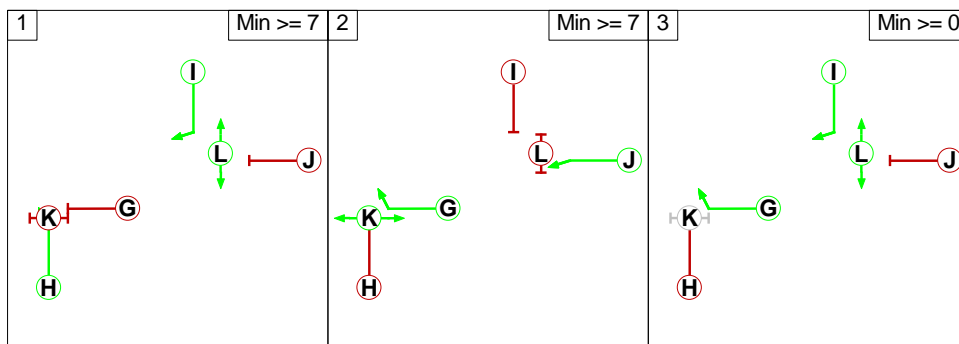
It is therefore recommended that Option 1 is selected as the preferred option for Sniperley Roundabout. This can be supported by the proposed improvements to the Sniperley Park & Ride junction as part of the proposed development of the adjacent allocated land. It is important to note that the assessments have been carried out on the basis that the A167 corridor improvement schemes will also be implemented to remove the southbound blocking back that will stifle the benefits of a scheme at Sniperley roundabout.

Appendix A – Signal Phasing and Staging from LinSig

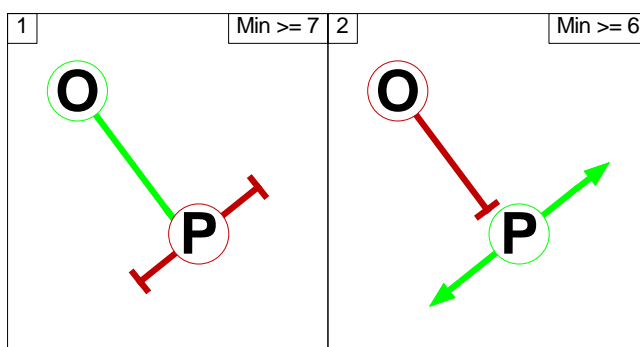
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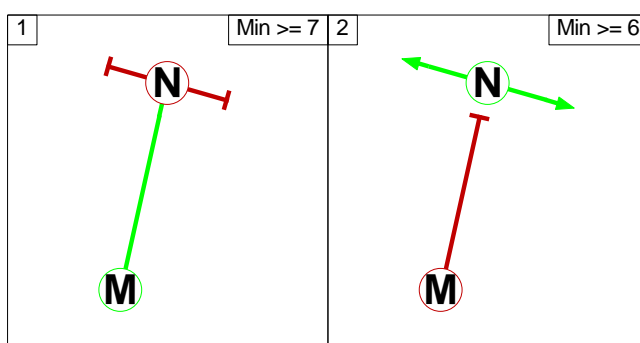
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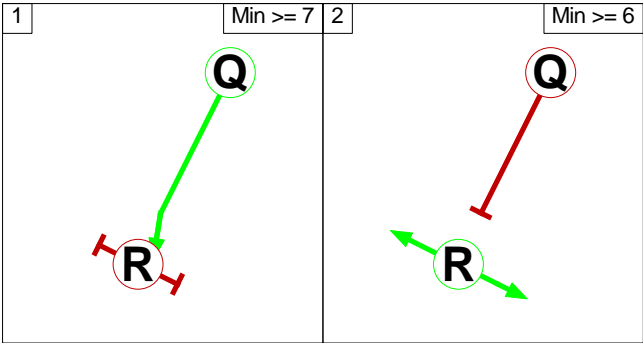
Stage Stream: 3



Stage Stream: 4



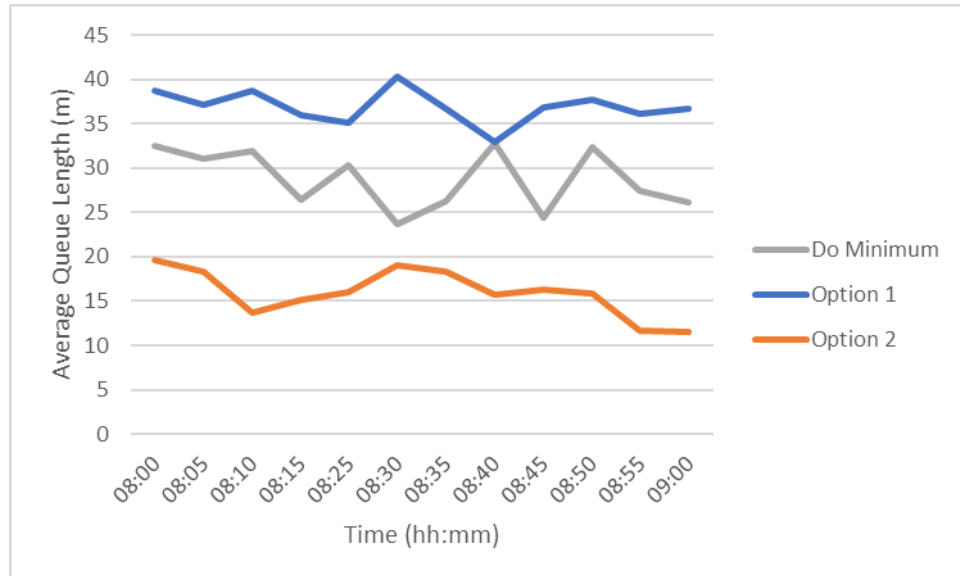
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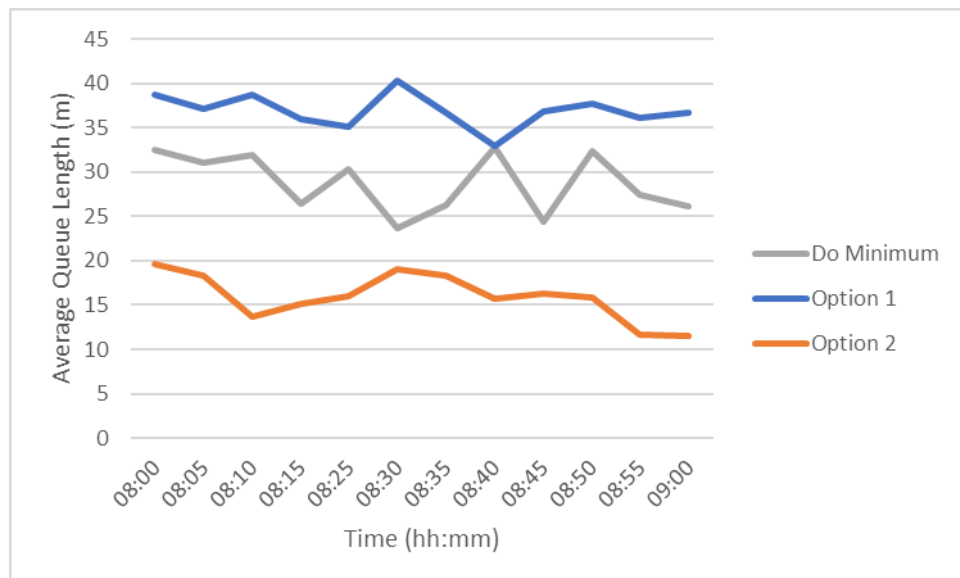
Appendix B – Queue Graphs

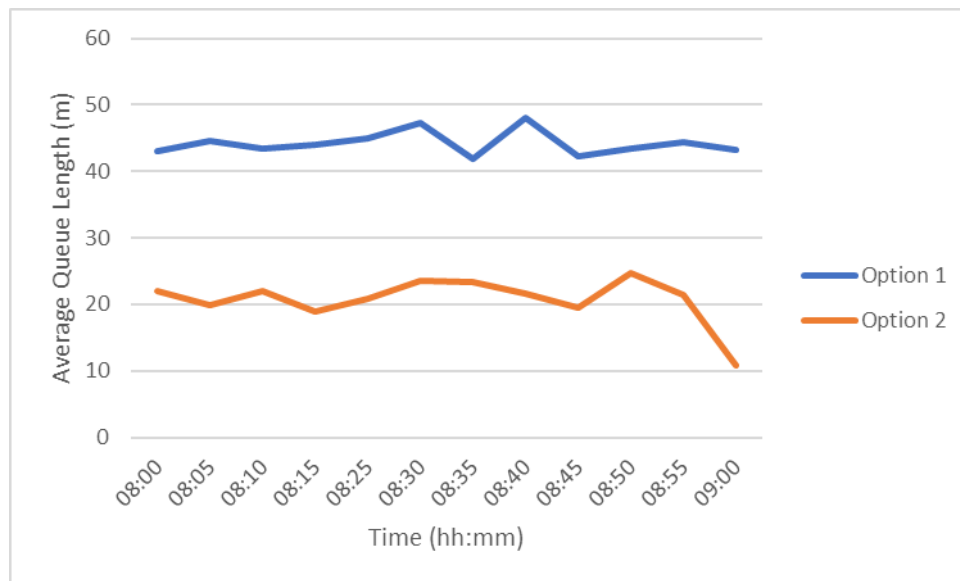
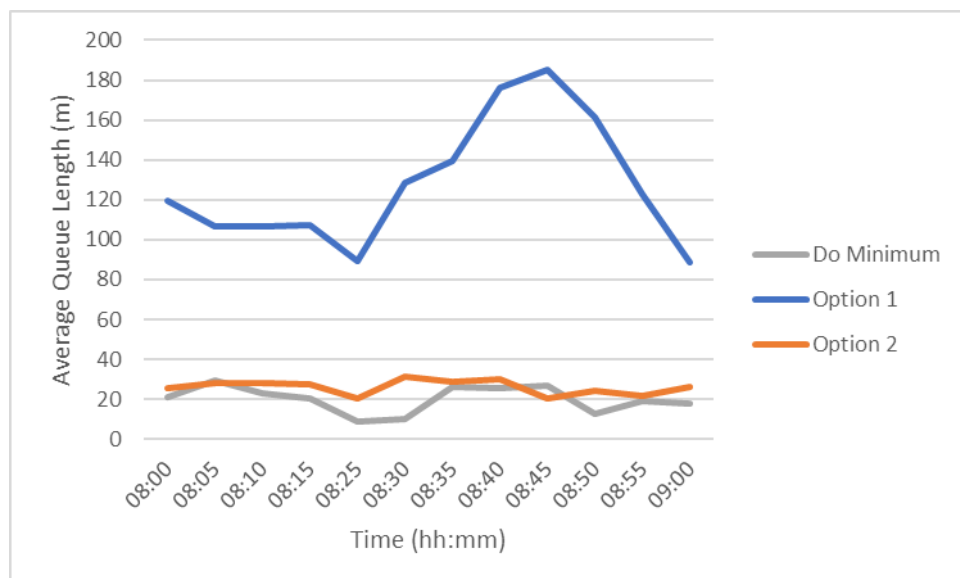
AM PEAK

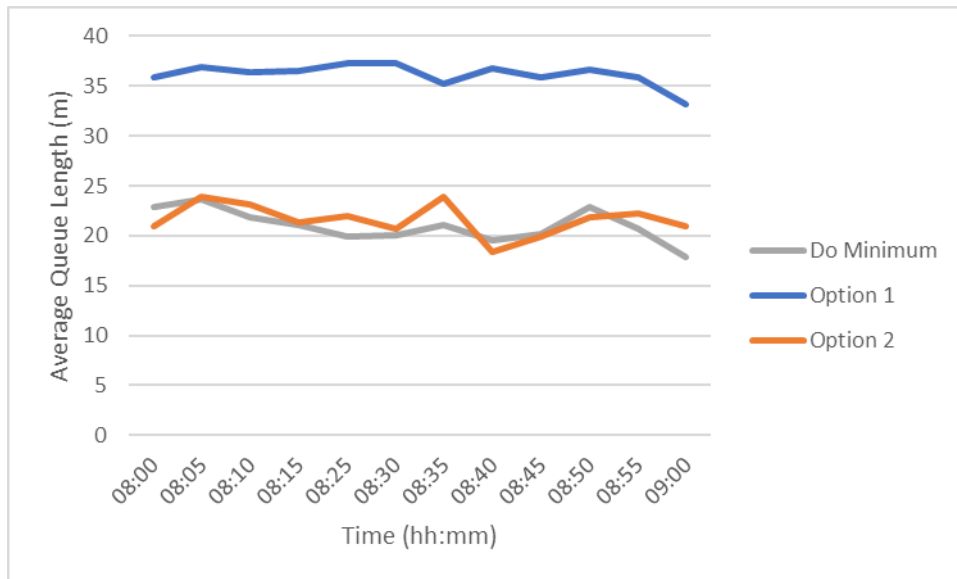
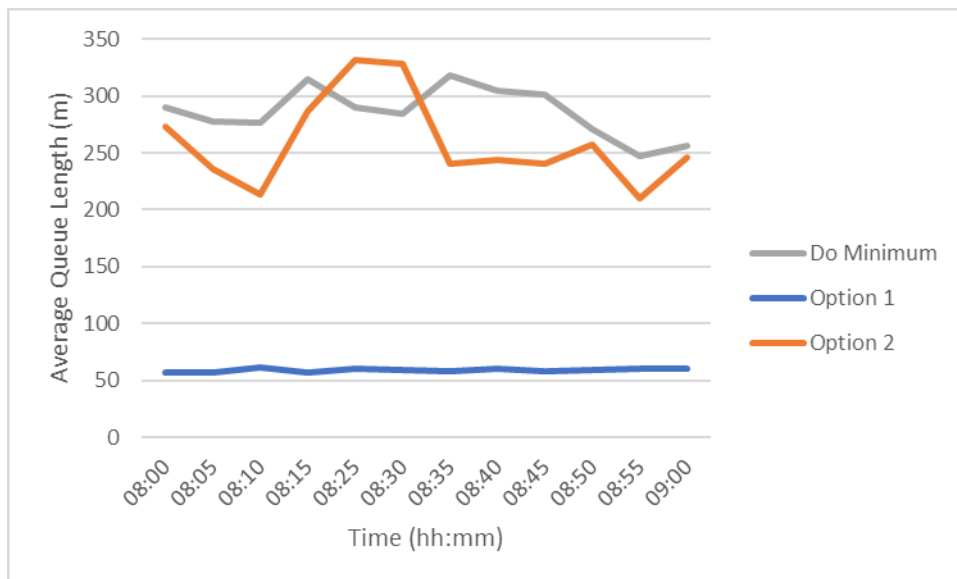
A167 Northbound Lane 1

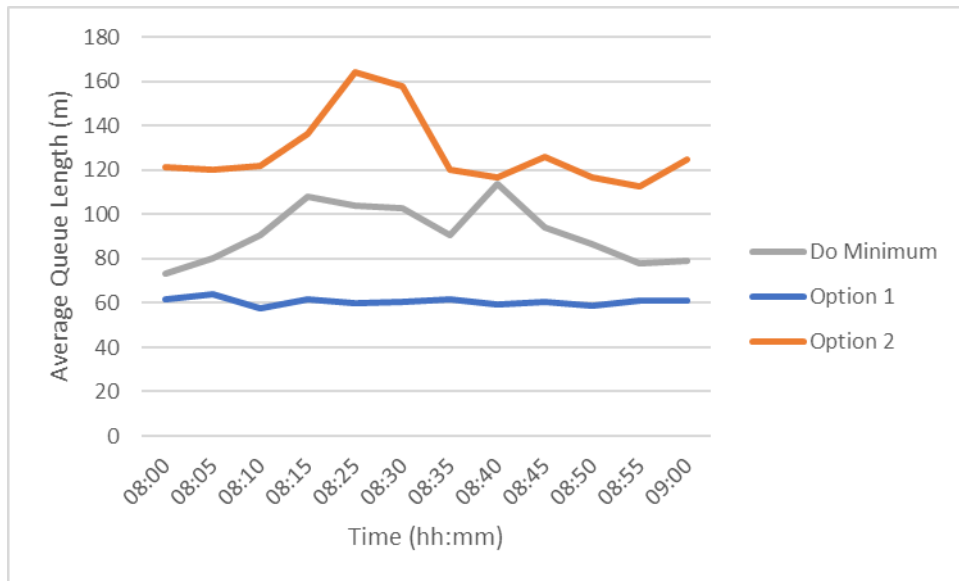
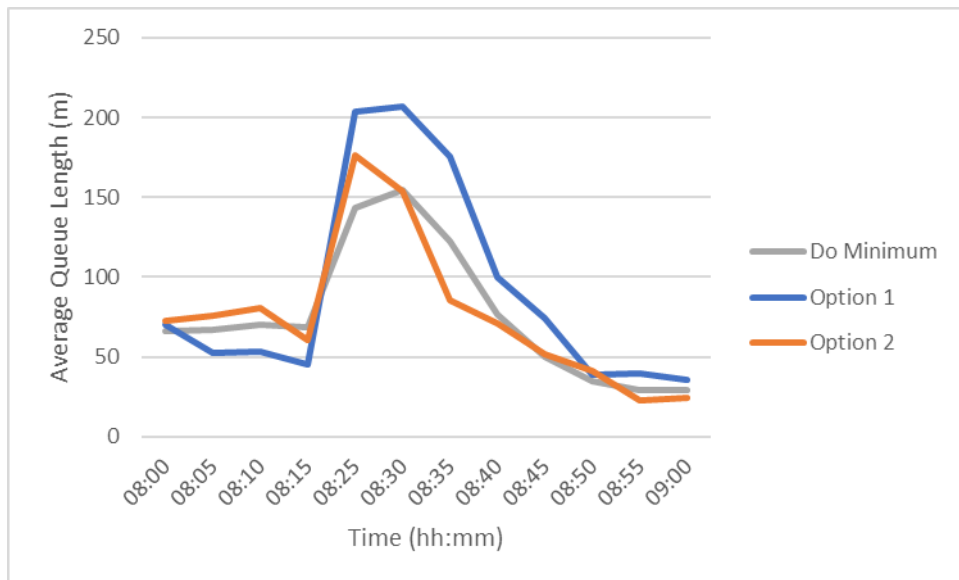


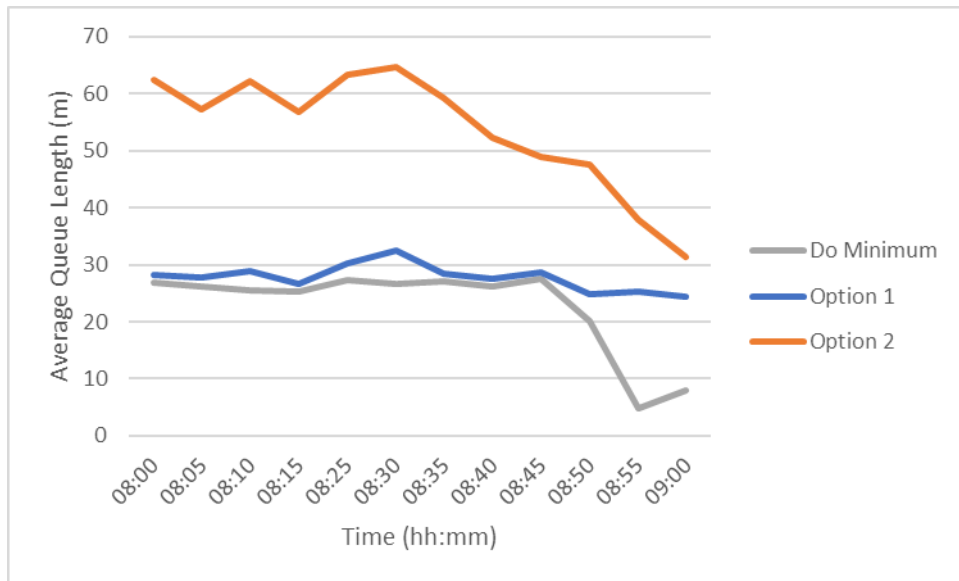
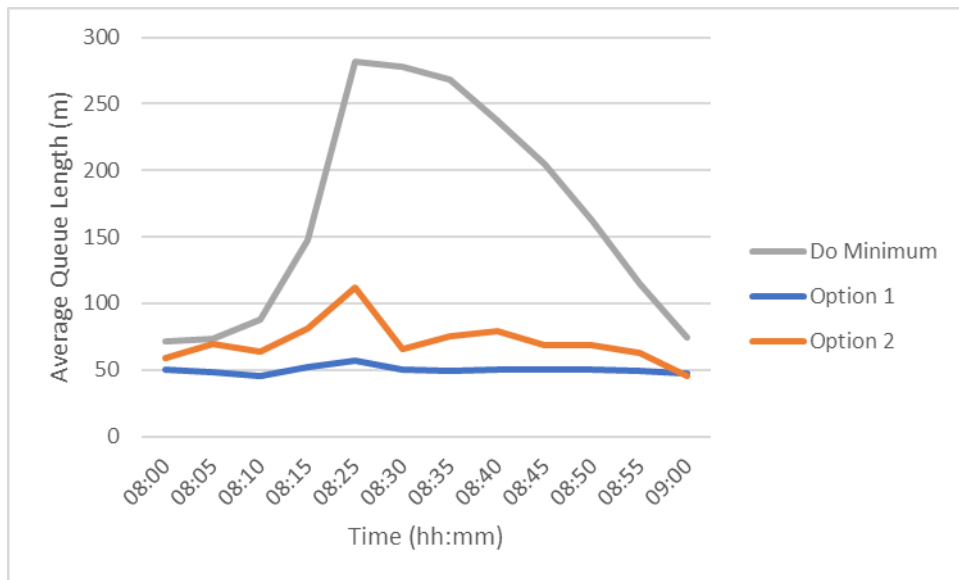
A167 Northbound Lane 2

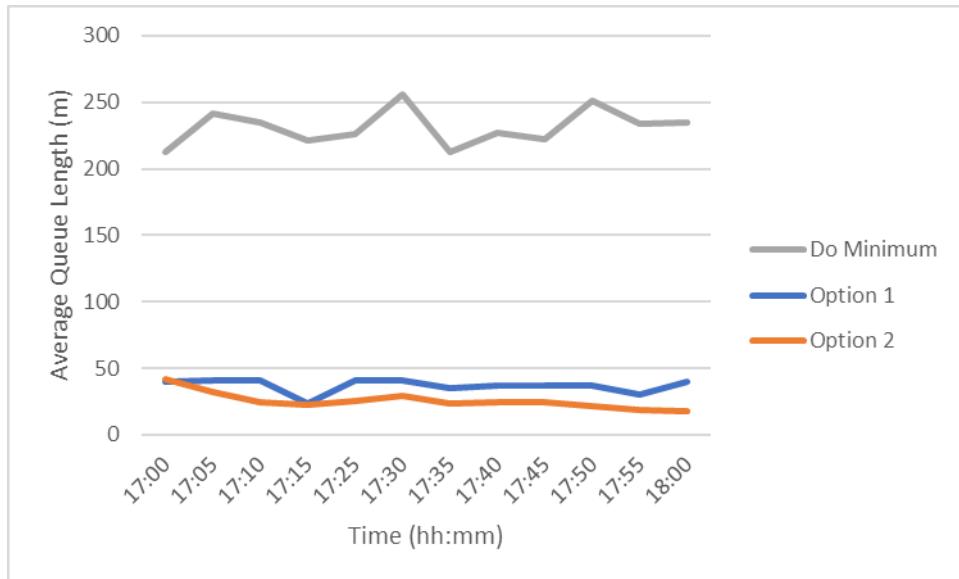
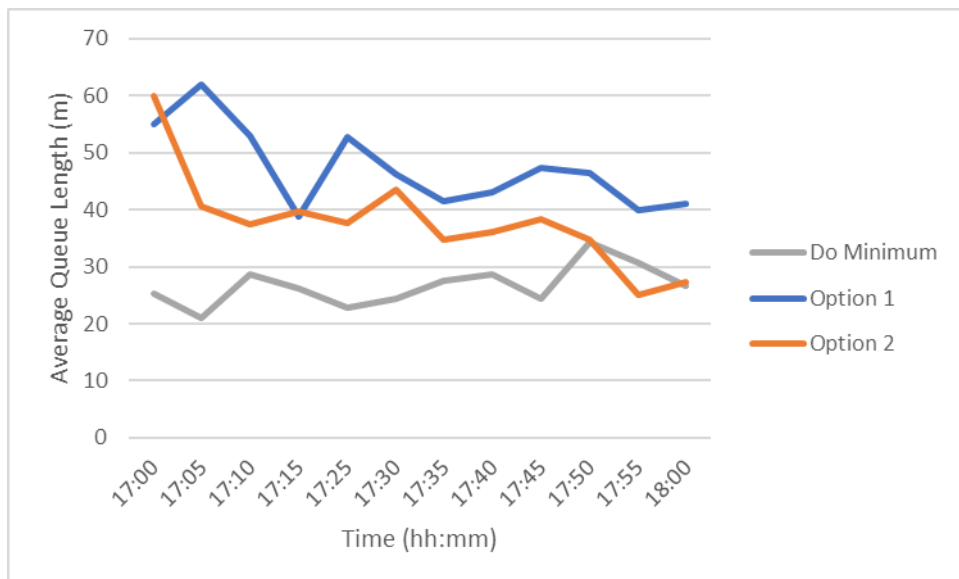


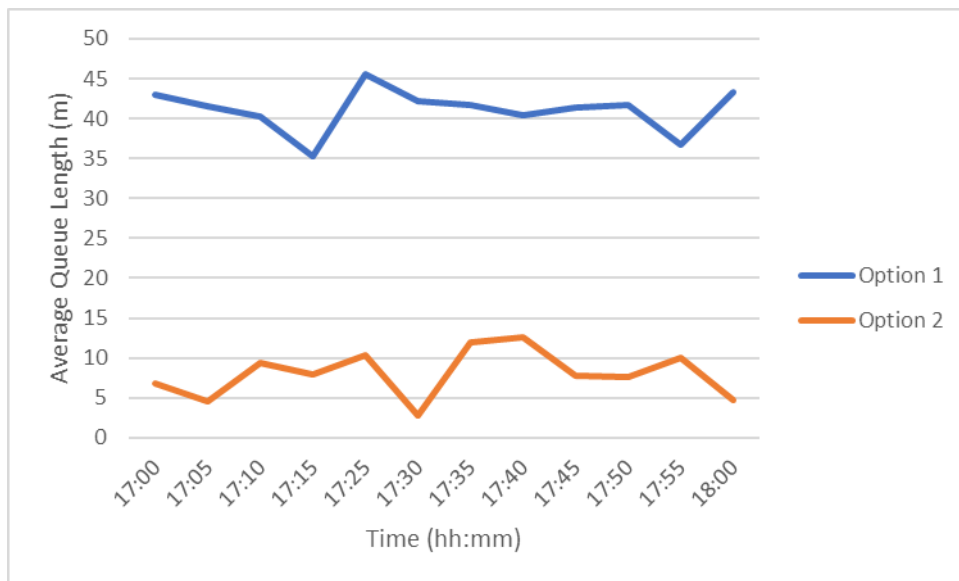
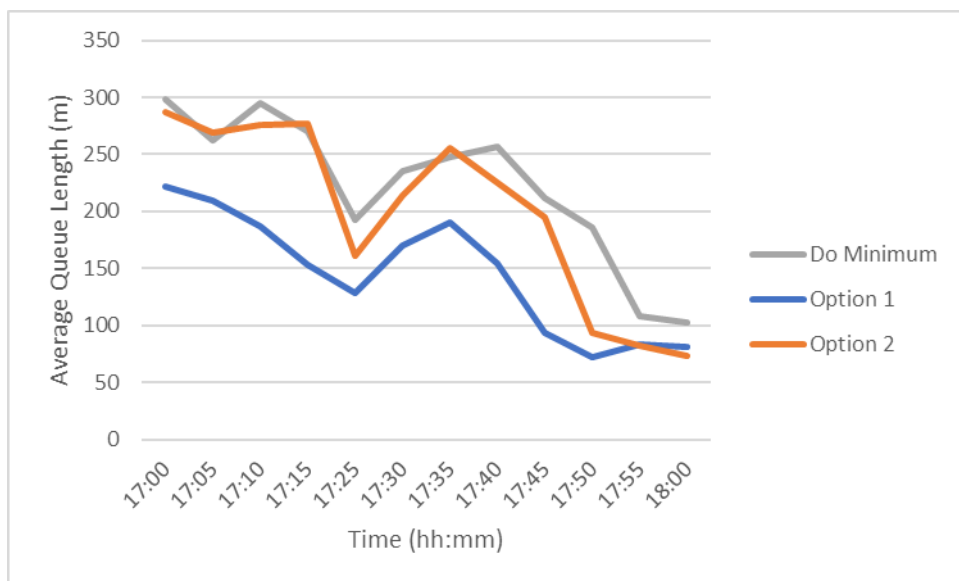
A167 Northbound Lane 3**A691 North-westbound Lane 1**

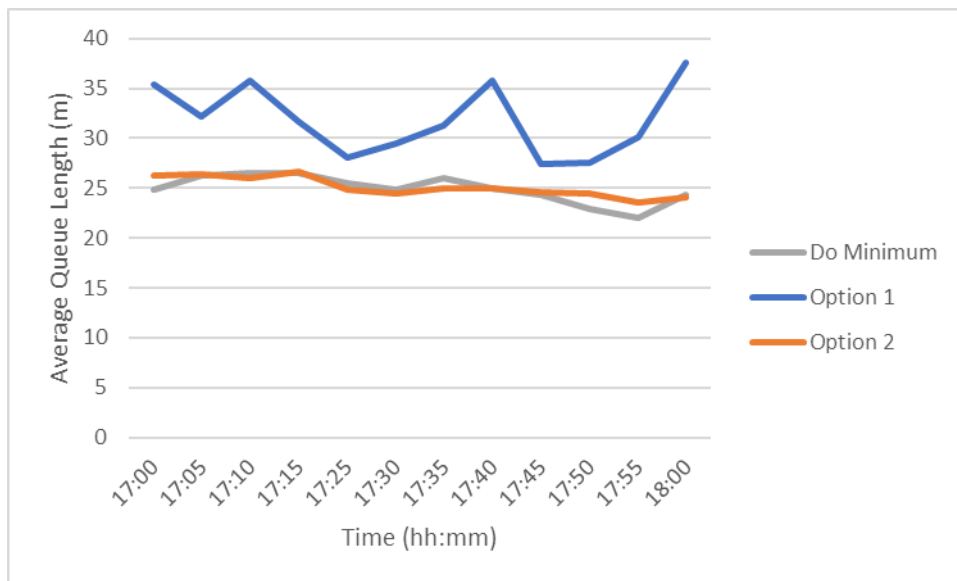
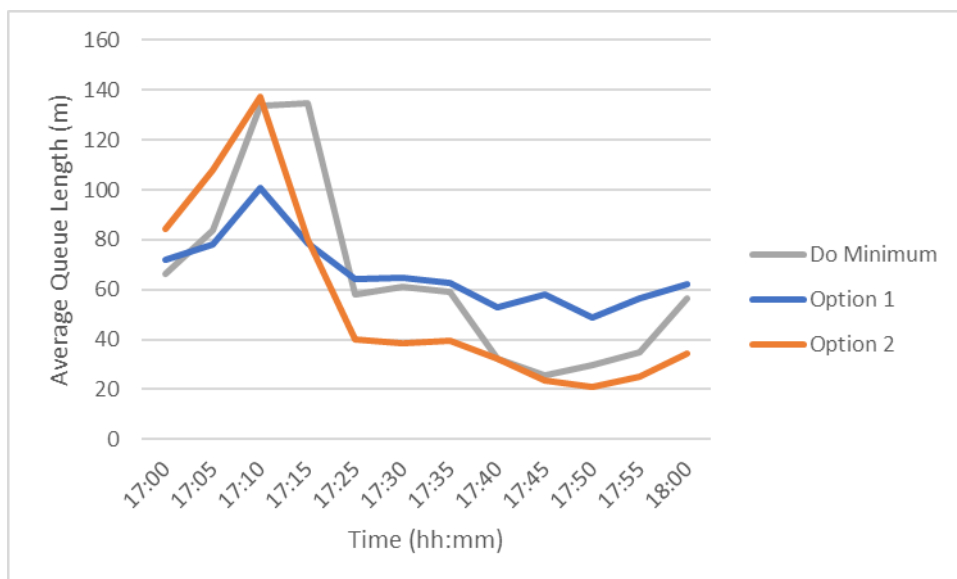
A691 North-westbound Lane 2**A691 South-eastbound Lane 1**

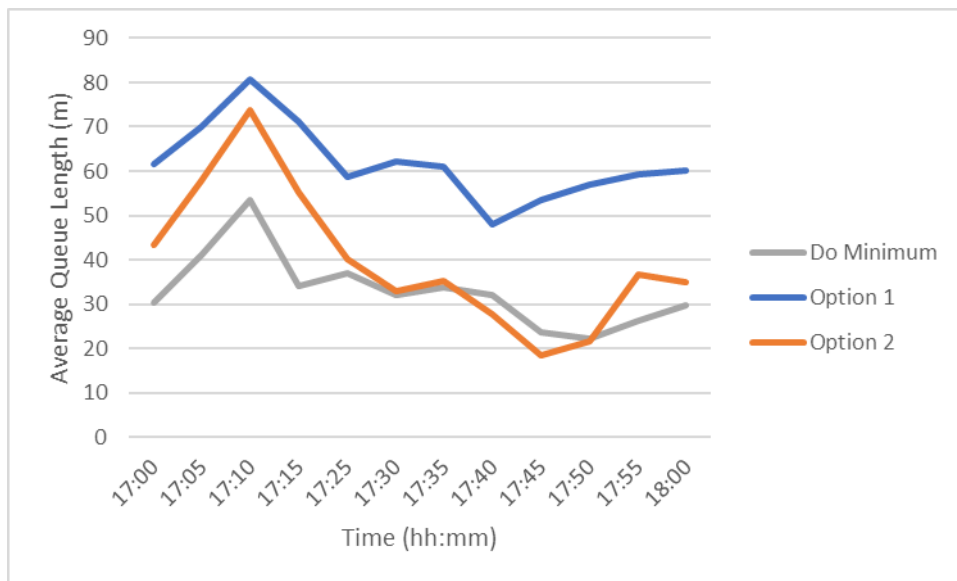
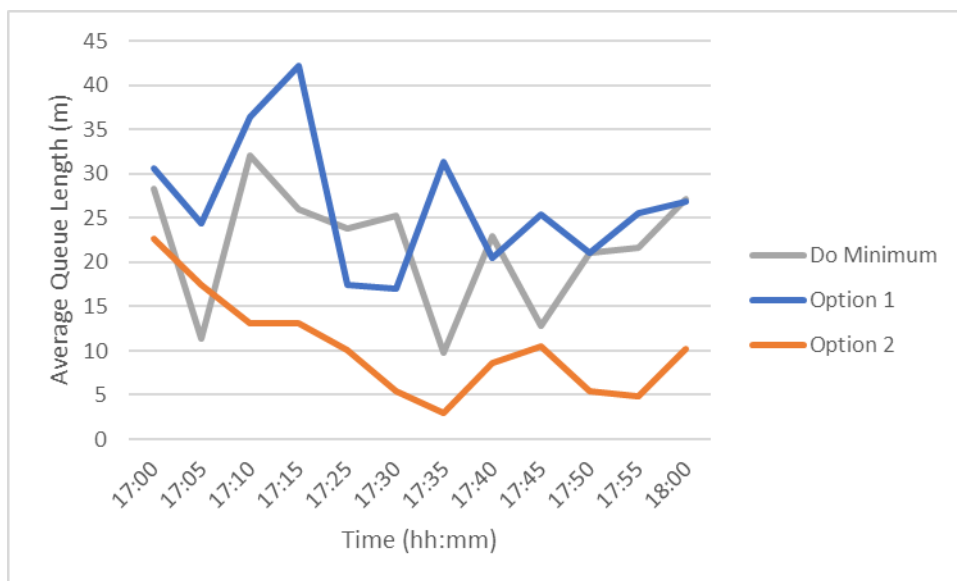
A691 South-eastbound Lane 2**Dryburn Park south-westbound Lane 1**

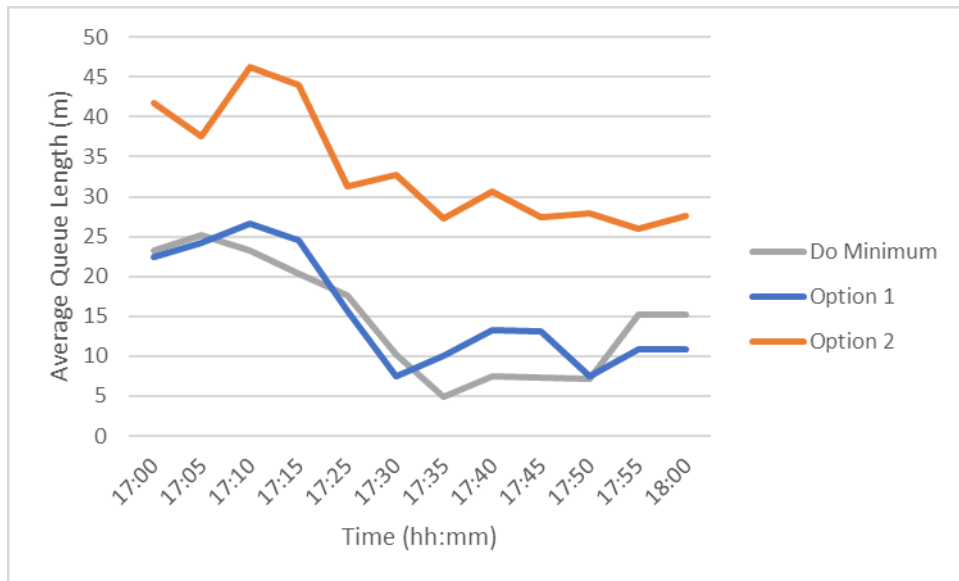
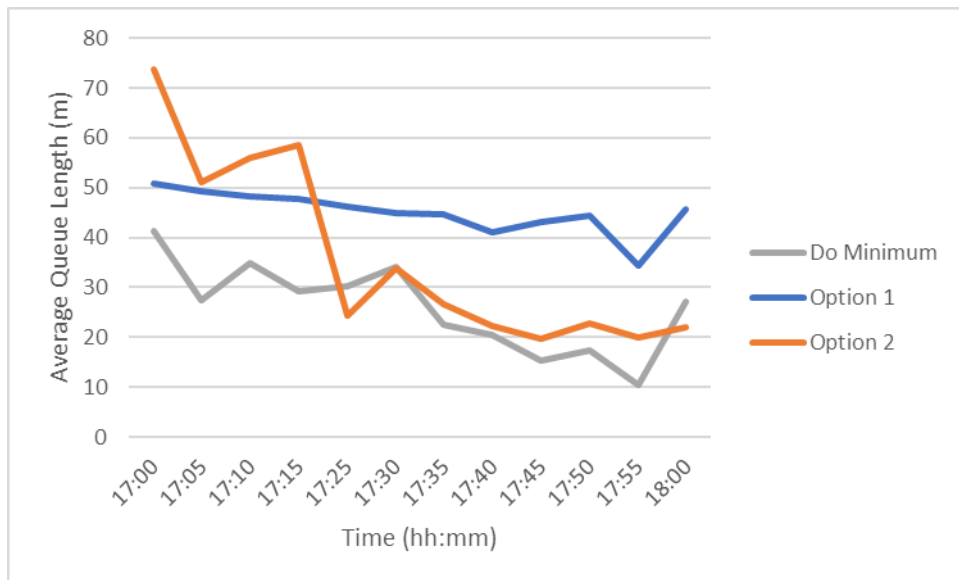
Dryburn Park South-westbound Lane 2**A167 Southbound**

PM PEAK**A167 Northbound Lane 1****A167 Northbound Lane 2**

A167 Northbound Lane 3**A691 North-westbound Lane 1**

A691 North-westbound Lane 2**A691 South-eastbound Lane 1**

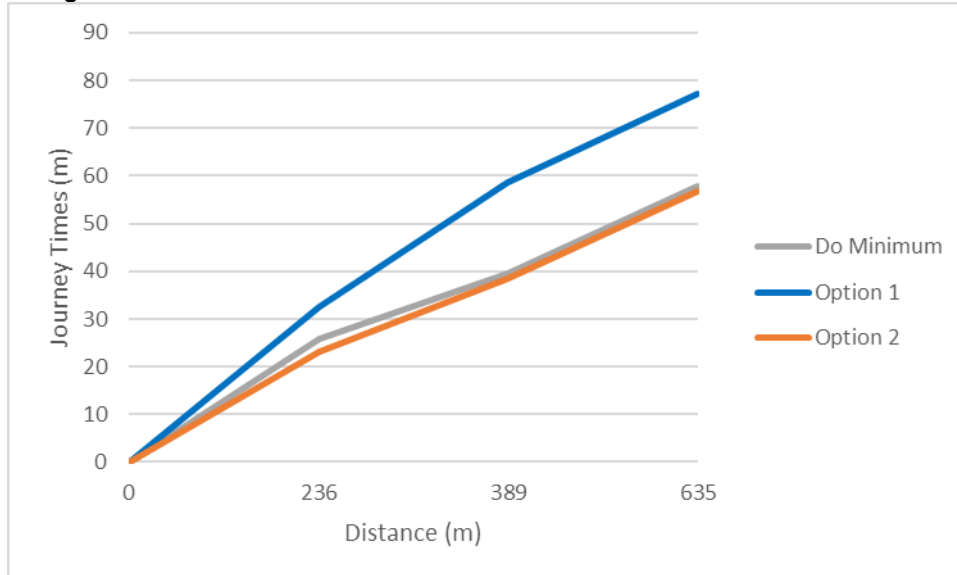
A691 South-eastbound Lane 2**Dryburn Park South-westbound Lane 1**

Dryburn Park South-westbound Lane 2**A167 Southbound**

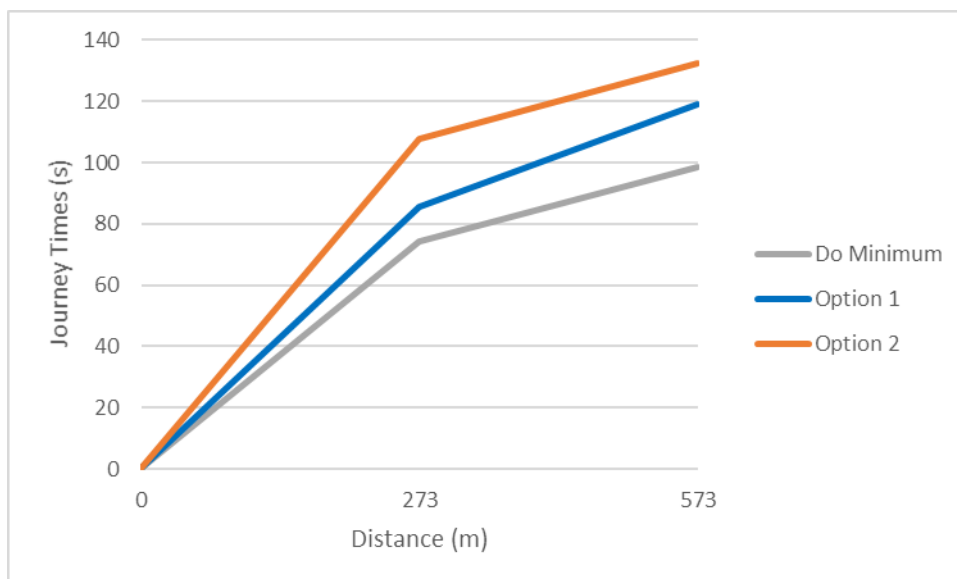
Appendix C Journey Times Graphs

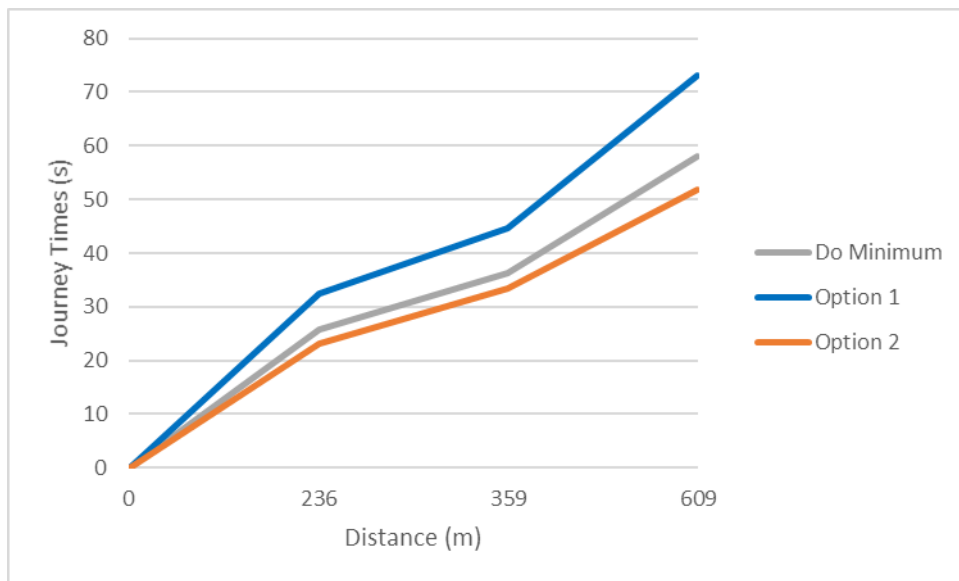
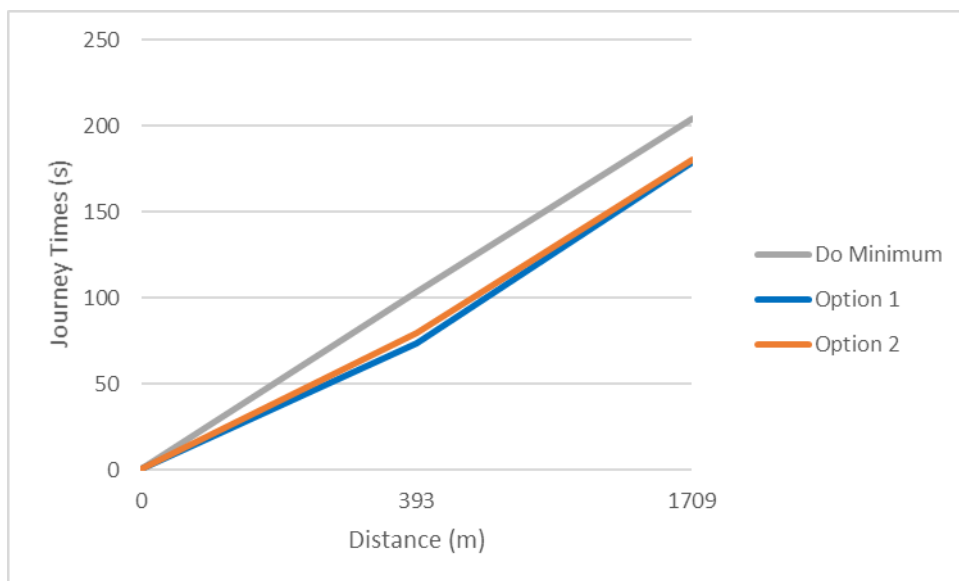
AM PEAK

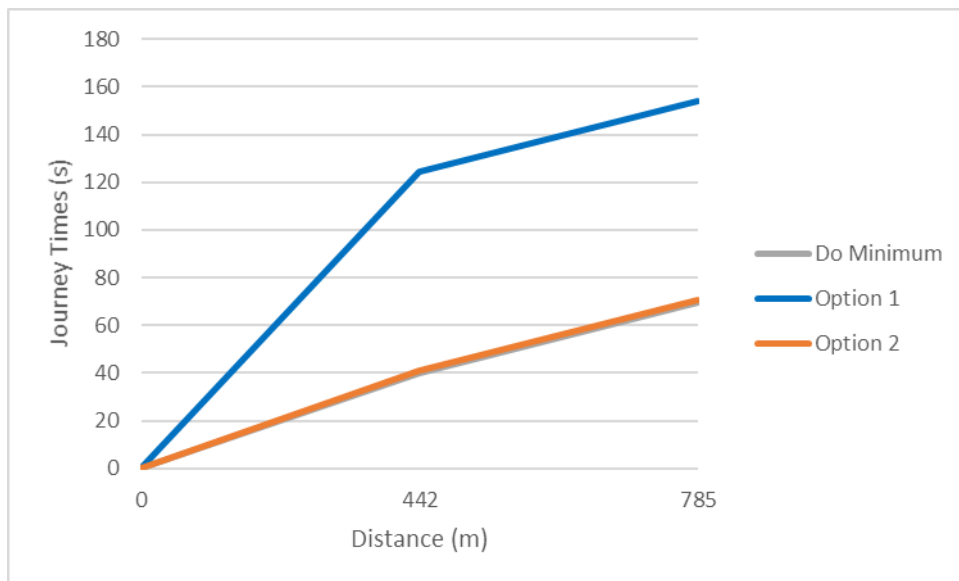
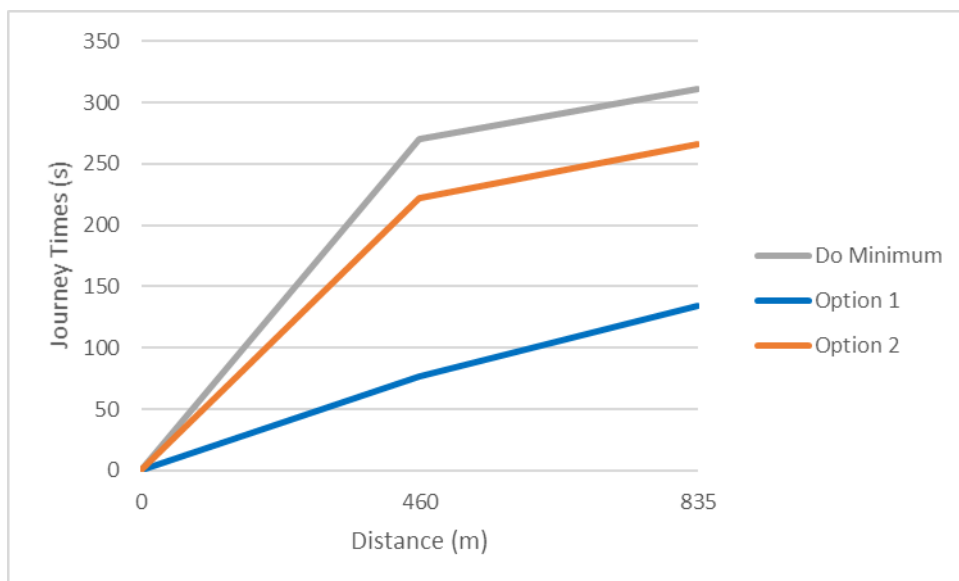
Orange Route NEB



Orange Route SB

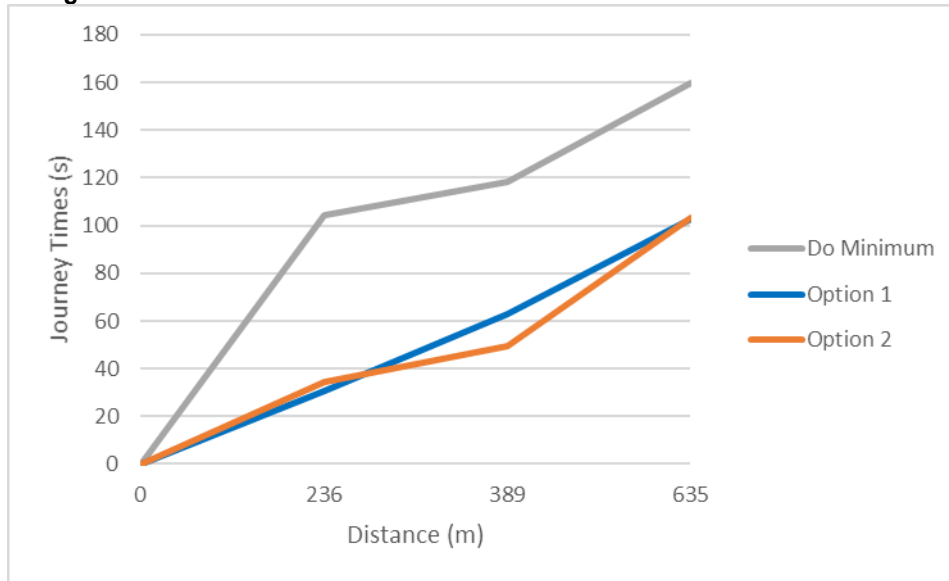


Green Route NB**Green Route SB**

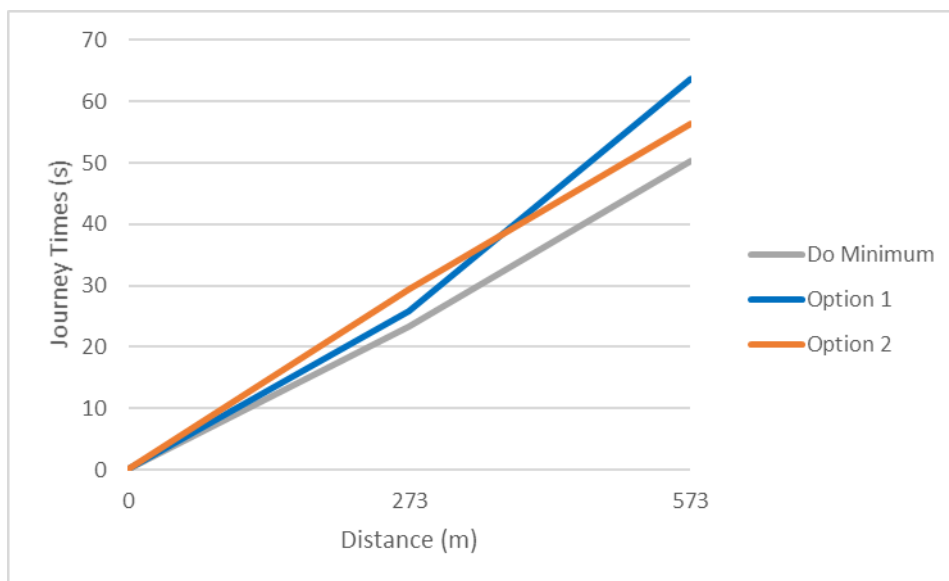
Red Route NWB**Red Route SEB**

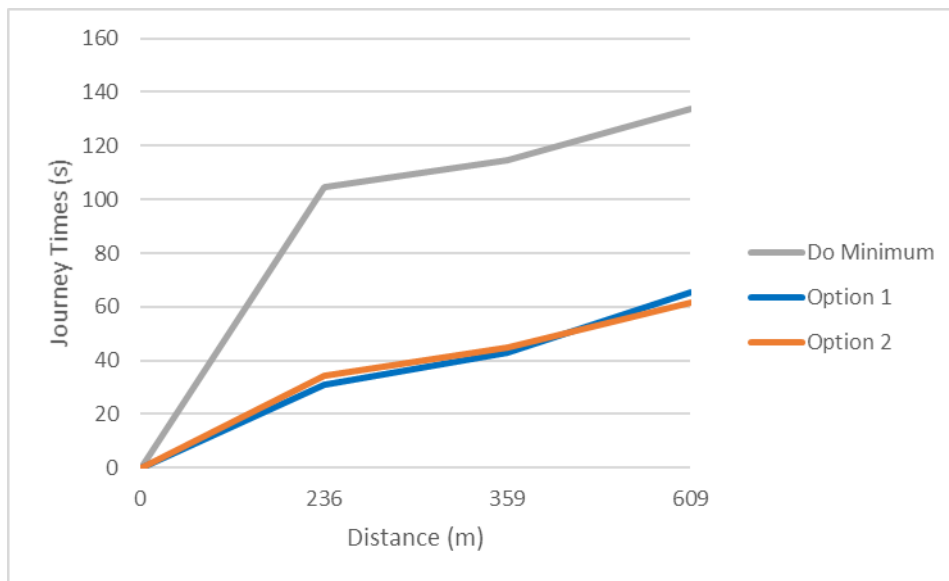
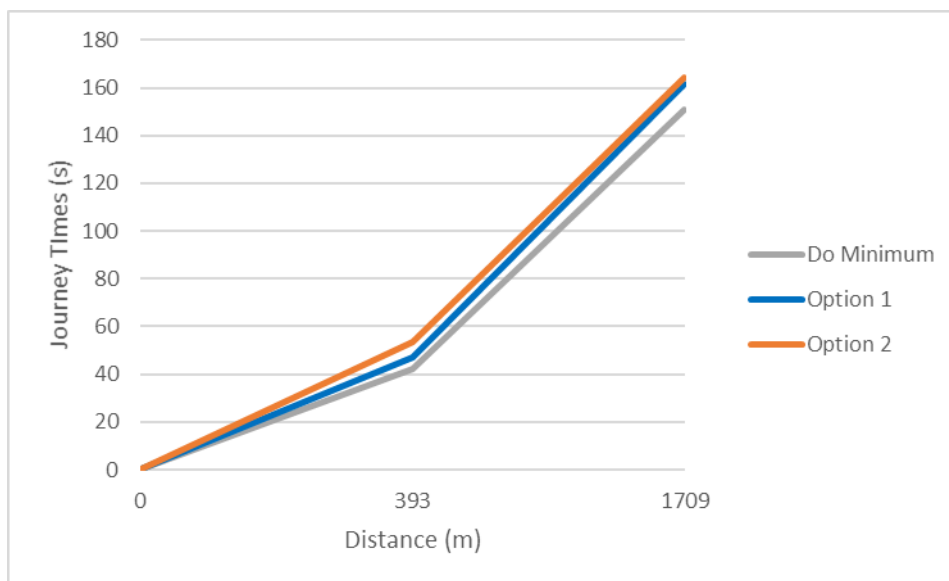
PM PEAK

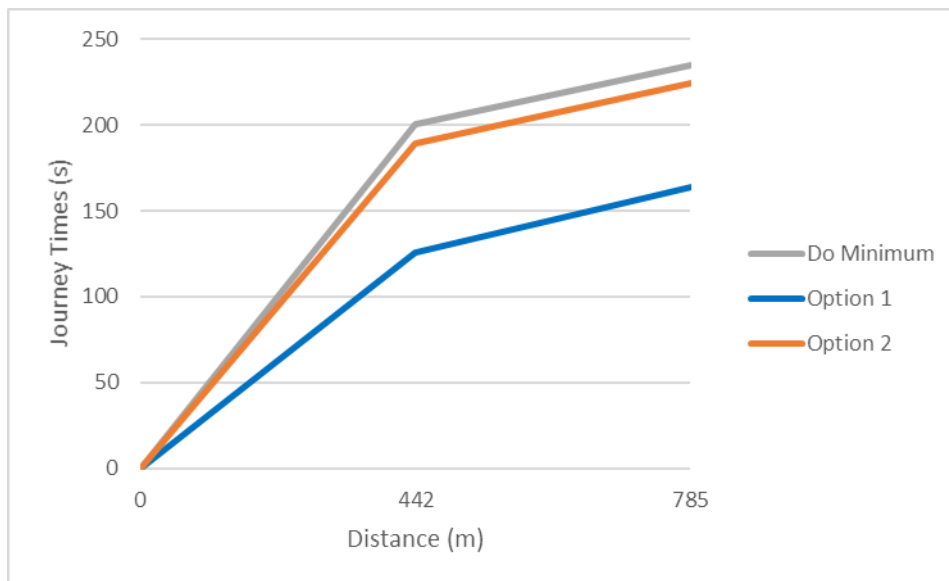
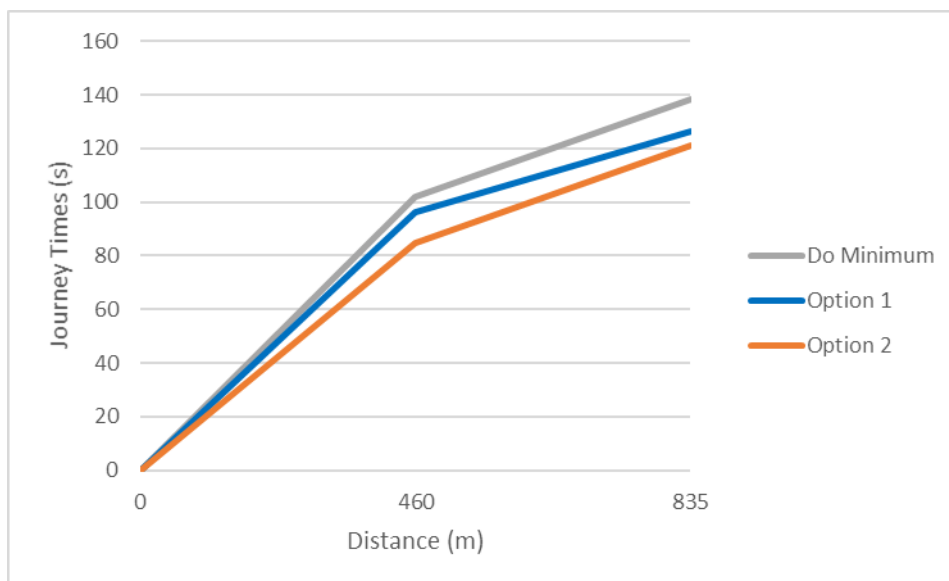
Orange Route NEB



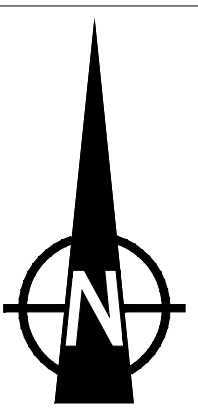
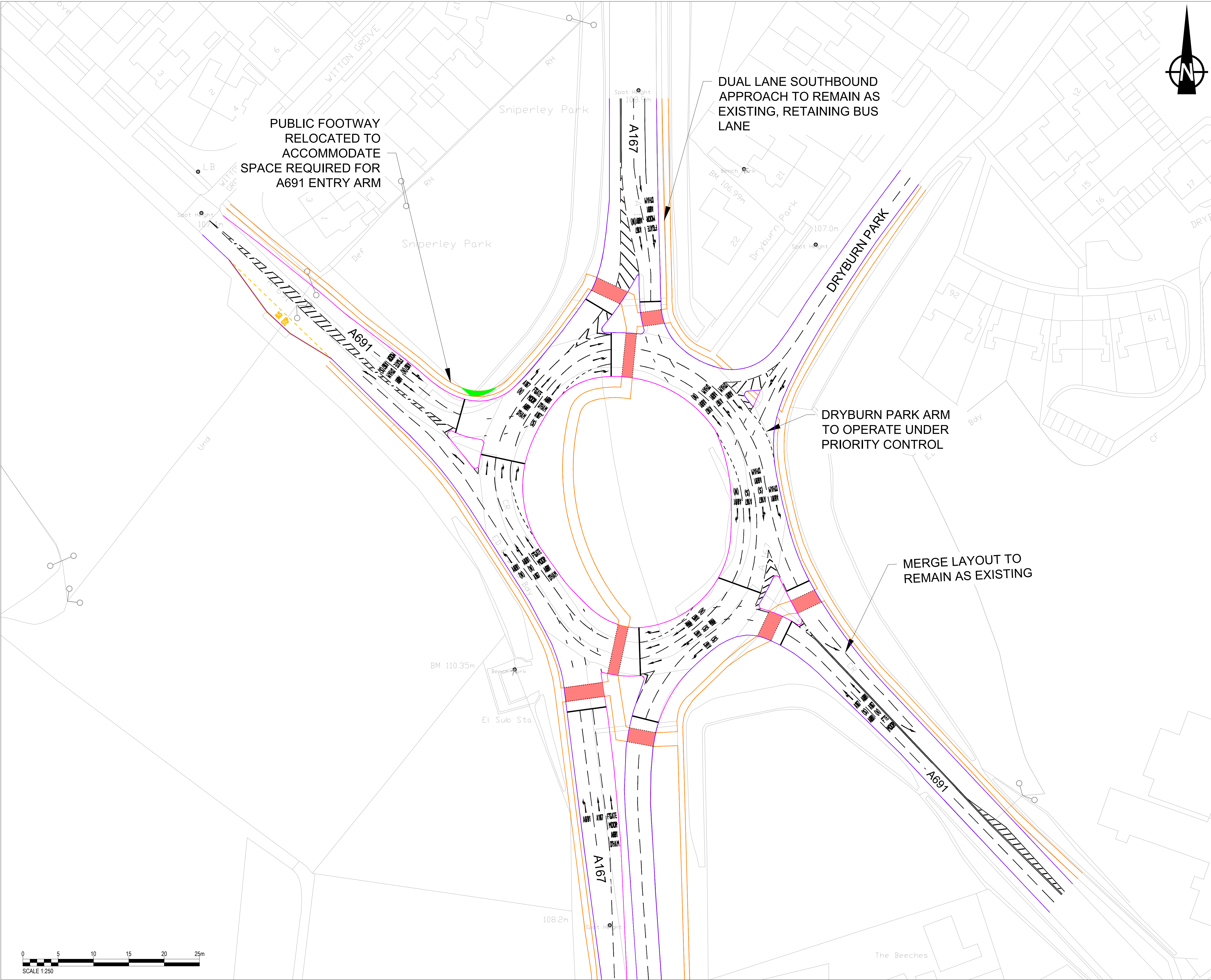
Orange Route SB



Green Route NB**Green Route SB**

Red Route NWB**Red Route SEB**

Appendix D Option 1 Feasibility Drawing



PROJECT

Durham Sniperley

CLIENT

DURHAM COUNTY COUNCIL

COUNTY HALL
DURHAM
DH1 5VL

CONSULTANT

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NOTES

KEY

- TOUCAN CROSSING
- LAND TAKE
- EXISTING KERBLINES
- PROPOSED NEW KERBLINES
- PUBLIC FOOTWAY BOUNDARY

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ISSUE/REVISION

4	04.03.2020	FINAL ISSUE
3	06.02.2020	THIRD DRAFT
2	13.01.2020	SECOND DRAFT
1	24.12.2019	FIRST DRAFT
I/R	DATE	DESCRIPTION

Proj Mgr : NW	Status : Feasibility
Date Created : 17.12.2019	Scale : 1:250

PROJECT NUMBER

60620899

SHEET TITLE

A617 / A197 SNIPERLEY
ROUNDABOUT DURHAM
SIGNAL CONTROLLED OPTION

SHEET NUMBER

60620899-SHT-20-DSR-X-001

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the 1990s, the number of people in the UK who are employed in the public sector has increased by 1.5 million (from 2.5 million in 1980 to 4 million in 1999) and the number of people in the private sector has increased by 1.5 million (from 2.5 million in 1980 to 4 million in 1999) (Department of Health 2000).

There is a growing emphasis on the need to improve the quality of care and to ensure that the public sector is able to meet the needs of the population. This has led to a number of initiatives, including the introduction of the Health Care Act 1999, which aims to improve the quality of care and to ensure that the public sector is able to meet the needs of the population.

The Health Care Act 1999 has led to a number of changes in the way that the public sector is run. These changes include the introduction of the Health Care Act 1999, which aims to improve the quality of care and to ensure that the public sector is able to meet the needs of the population.

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