A628 Dodworth Road / Pogmoor Road Gyratory Option Variant C-A LinSig Assessment

Project number	Client	Subject	Date
60550593	Barnsley Metropolitan Borough Council	LinSig Assessment of Option Variant C-A	November 2018
Prepared by	**Checked by**	**Verified by**	**Approved by**
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Executive Summary

AECOM has been commissioned by Barnsley Metropolitan Borough Council (BMBC) to assess the capacity of a proposed layout, referred to as **Option Variant C-A**, to replace the existing A628 Dodworth Road / Pogmoor Road crossroads.

This assessment is an extension of the "A628 Dodworth Road / Pogmoor Road Junction Study" undertaken in December 2017. The operation of Option Variant C-A has been compared against the preferred option.

Conclusion: This report based on LinSig modelling concludes that the preferred Option provides more capacity than Option Variant C-A. The operation of Option Variant C-A will be affected by its ability to accommodate weaving movements. LinSig does not account for loss of capacity caused by weaving vehicles, this assessment may overestimate the capacity of Option Variant C-A. If the operation of Option Variant C-A is to be understood in detail AECOM recommend that it is modelled in VISSIM.

1. Introduction

1.1 Overview

Barnsley Metropolitan Borough Council (BMBC) is developing a scheme to improve the capacity and operation of A628 Dodworth Road / Pogmoor Road junction.

The preferred option is a new gyratory to replace the existing crossroads. The gyratory allows simpler signal control which greatly improves traffic capacity on Dodworth Road in both directions. A variation of this option, Option Variant C-A, has been suggested, with some modifications to the footprint of the scheme.

The proposed layouts of the preferred option and Option Variant C-A are provided in **Appendix A**.

This technical note compares the capacity of both options.

1.2 Report Structure

This report contains the following sections:

- **Section 2:** Model Assumptions;
- **Section 3:** Model Results;
- **Section 4:** Summary and Conclusions;
- **Appendix A:** Scheme Designs; and
- **Appendix B:** Traffic Flows.

2. Model Assumptions

This section of the report summarises the modelling assumptions made in this assessment.

The method of control, inter greens and link lengths to be input into the LinSig model were based on a concept design of Option Variant C-A. The feasibility of signal equipment location; swept paths; alignments; turning radii and so forth have not been assessed. It is noted that any design modifications could change model results.

2.1 Traffic Flows

The AM Peak (08:00 – 09:00) and PM Peak (17:00 – 18:00) assessment has been undertaken using the "*2024 With Claycliffe Link Plus Development*" AM and PM peak flow scenarios. Details of the flow assumptions can be found in '*A628 Dodworth Road / Pogmoor Junction Study, Stage 2 Option Assessment*' report, dated December 2017.

The Inter Peak has been assessed using traffic flows from Barnsley Transport Model 2034 IP Do Something proposed gyratory with Claycliffe link and represents an average Inter Peak hour.

The flow matrices used for all time periods are provided within **Appendix B** of this note.

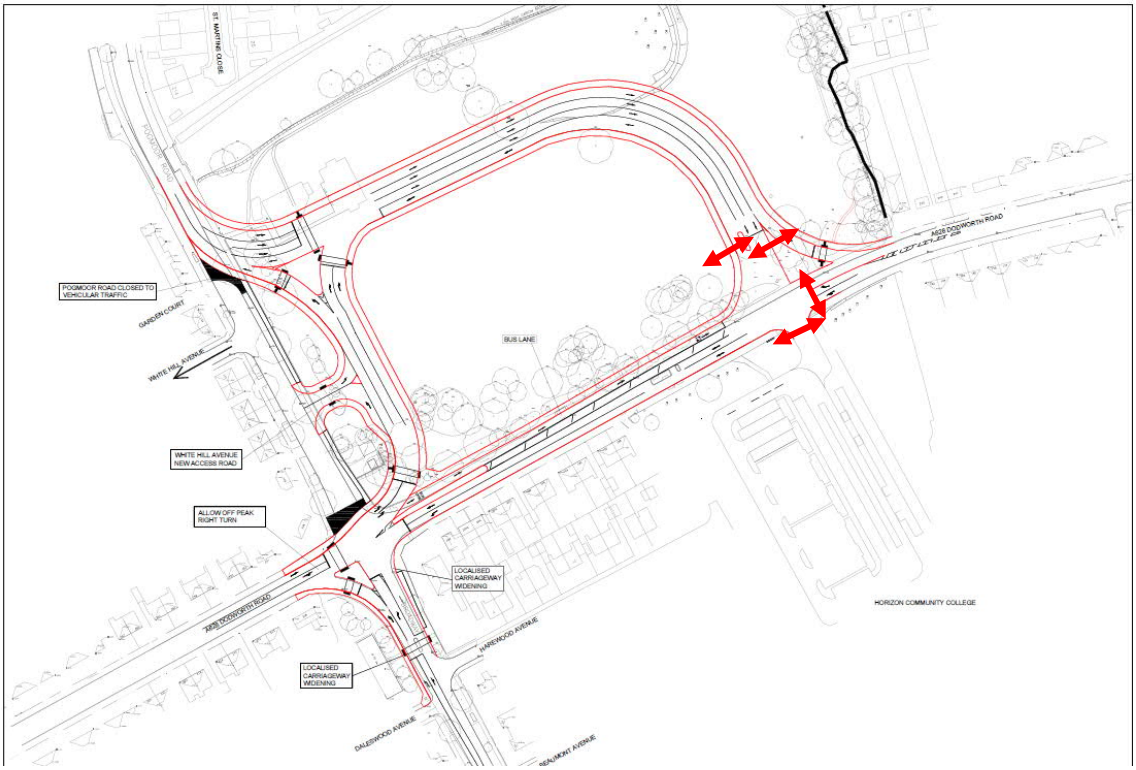
2.2 Cycle time

The options have been modelled with a 90 second cycle time.

2.3 Pedestrian Crossings

It has been assumed the crossings shown below in **Figure 1** with red arrows would be provided although they have not been included in the concept design.

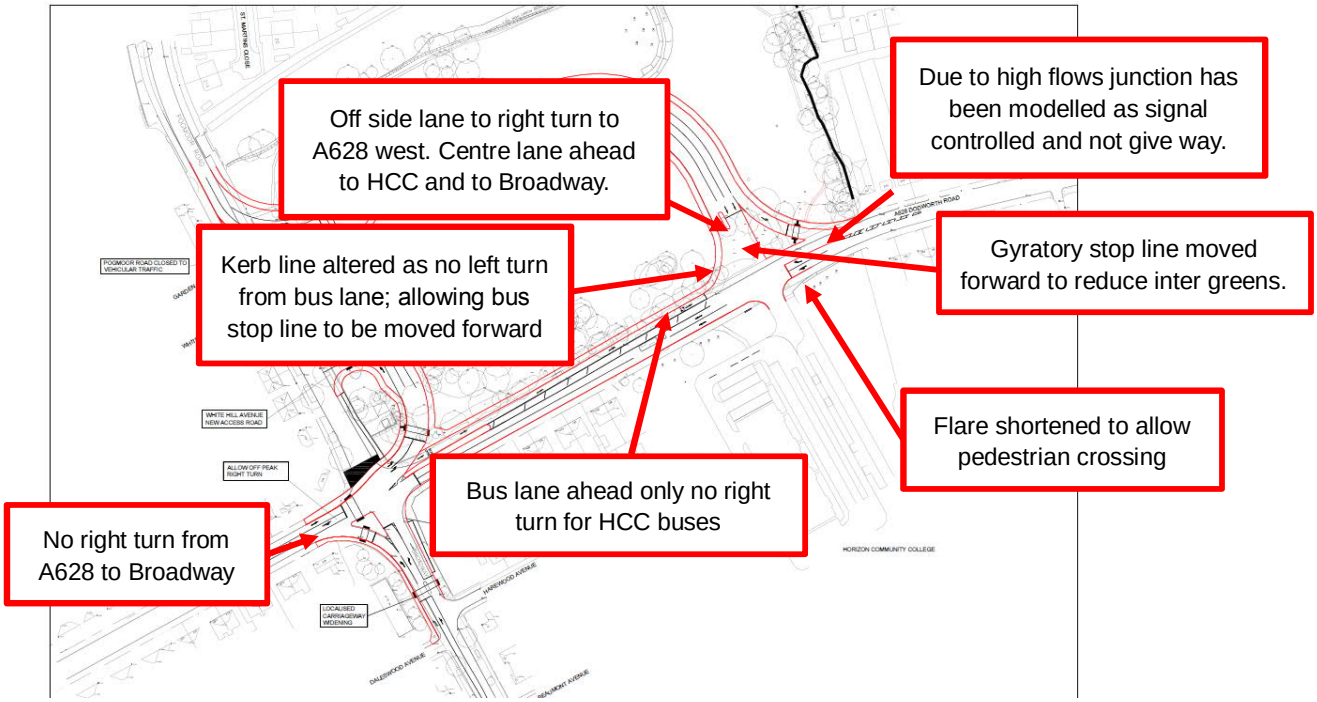
Figure 1: Additional Pedestrian Crossings assumed in Option Variant C-A modelling



2.4 Lane use assumptions

Assumptions regarding modelled turning movements, lane usage and stop line location are summarised in **Figure 2** below.

Figure 2: Option Variant C-A lane operation assumptions



2.5 Saturation Flows

Saturation flows have been modelled consistently in both LinSig models. For simplicity saturation flows of 1800 have been used on all lanes in both models.

3. Model Results

The following LinSig performance measures are used in this assessment:

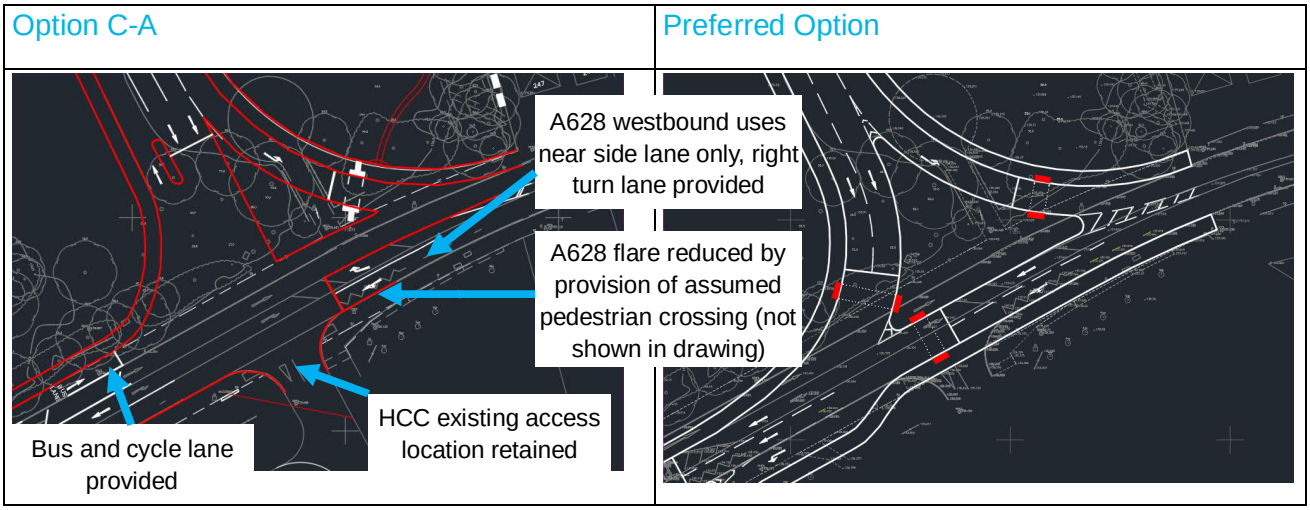
- Degree of Saturation (DoS); and
- Mean Max Queue in PCU (MMQ).

At each node a design change summary is provided with model results.

3.1 A628 Dodworth Road / Horizon Community College Access / Circulatory

The alternative layouts are presented in **Figure 3** below for ease of reference.

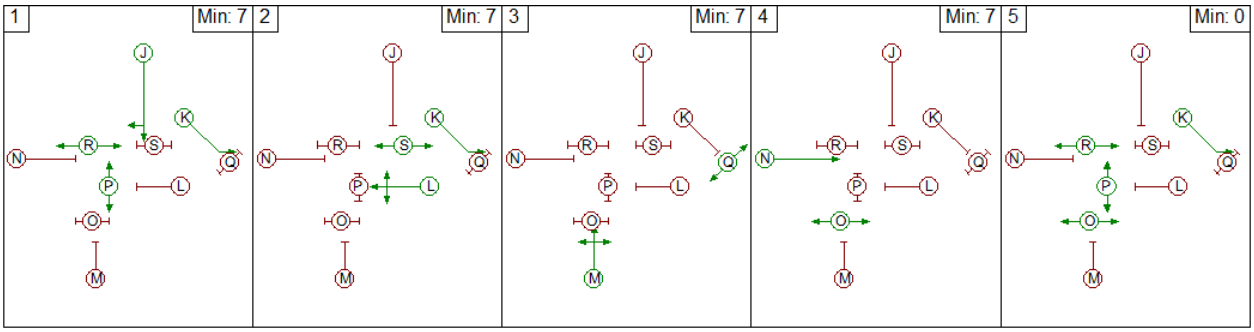
Figure 3: Alternative Dodworth Road / Horizon Community College Access / Circulatory layouts



The five signal stages for this node are shown in **Figure 4** below. Three of these stages are likely to be demand dependant:

- **Stage 3** is required for either Horizon Community College (HCC) traffic or pedestrians crossing to the northern side of Dodworth Road;
- **Stage 4** is required for either eastbound buses and cycles or pedestrians crossing HCC access; and
- **Stage 5** could be called by pedestrians crossing HCC access when Stage 4 has not appeared. All other pedestrian phases occur in parallel with non-demand dependent traffic phases.

Figure 4: Stage Diagram for A628 / HCC Access / Circulatory – Option Variant C-A



The five stages would not be called each cycle as Stage 4 and 5 would not appear in the same cycle. It is considered unlikely that four stages would be consistently called every cycle although there are no observed flows to indicate how well the pedestrian crossing may be used.

The variability in signal timings caused by the introduction of three demand dependent stages could mean that it is harder to effectively co-ordinate timings with adjacent nodes, this would make operation of adaptive signal control such as SCOOT harder to implement.

Two scenarios have been defined to explore how the junction could operate under different levels of demand:

- **Maximum Capacity:** This scenario provides maximum green time for traffic, with Stages 4 and 5 never being called. In short, if the node does not operate within capacity in this scenario, it will not operate within capacity when Stage 4 or 5 are called. The scenario is unrealistically optimistic because there will be guaranteed bus demands in all modelled time periods.
- **Central Case:** This assumes that a demand dependent stage will be called in 60 percent of the cycles. The specific assumptions are presented in **Table 1** below.

Table 1: Stage Combinations

Stage Combination	Frequency	Notes
Stage 1, 2, 3 & 4	4 times per hour	Bus calls bus stage
Stage 1,2,3	16 times per hour	No bus demand, no pedestrian demand across HCC access
Stage 1,2,3 & 5	20 times per hour	No bus demand, pedestrians demand to cross HCC access

3.1.1 Maximum Capacity

The highest link Degree of Saturation and Mean Max Queue per approach are shown in **Table 2** below.

Table 2: Dodworth Road / HCC Access Maximum Capacity Scenario LinSig outputs

Approach	AM		IP		PM	
	DoS (%)	MMQ (PCU)	DoS (%)	MMQ (PCU)	DoS (%)	MMQ (PCU)
Southbound Circulatory	95	19	73	8	104	32
A628 east	99	30	72	14	104	51
HCC Access	99	14	0	0	48	2

If the bus and pedestrian stages were not called in any of the peaks, the junction would operate with a Degree of Saturation greater than 90 percent on all arms in the AM peak. In the PM peak the southbound circulatory and A628 east are forecast to have Degree of Saturation greater than 100 percent.

This demonstrates that this layout does not provide sufficient capacity to accommodate forecast traffic flows.

3.1.2 Central Case

The highest link Degree of Saturation and Mean Max Queue per approach are shown in **Table 3** below.

Table 3: Dodworth Road / HCC Access Central Case Scenario LinSig outputs

Approach	AM		IP		PM	
	DoS (%)	MMQ (PCU)	DoS (%)	MMQ (PCU)	DoS (%)	MMQ (PCU)
Southbound Circulatory	107	37	84	10	123	70
A628 east	115	71	83	16	119	108
HCC Access	115	30	0	0	49	2

In the central case; when bus demand and pedestrian demand are placed at the junction; the Degree of Saturation increases in all periods.

In the AM peak all approaches are modelled to operate over capacity. In the PM peak the southbound circulatory and A628 east both have Degree of Saturation greater than 110 percent.

This demonstrates that this layout does not provide sufficient capacity to accommodate forecast traffic flows.

3.1.3 Preferred Option

The operation of the preferred scheme is shown below in **Table 4**. This shows that in the AM and Inter Peak all arms operate with a Degree of Saturation lower than 90 percent. In the PM the southbound circulatory and HCC access have Degree of Saturations greater than or equal to 90 percent. The preferred option provides significantly more capacity than Option Variant C-A.

Table 4 – Dodworth Road / HCC Access Preferred Option LinSig outputs

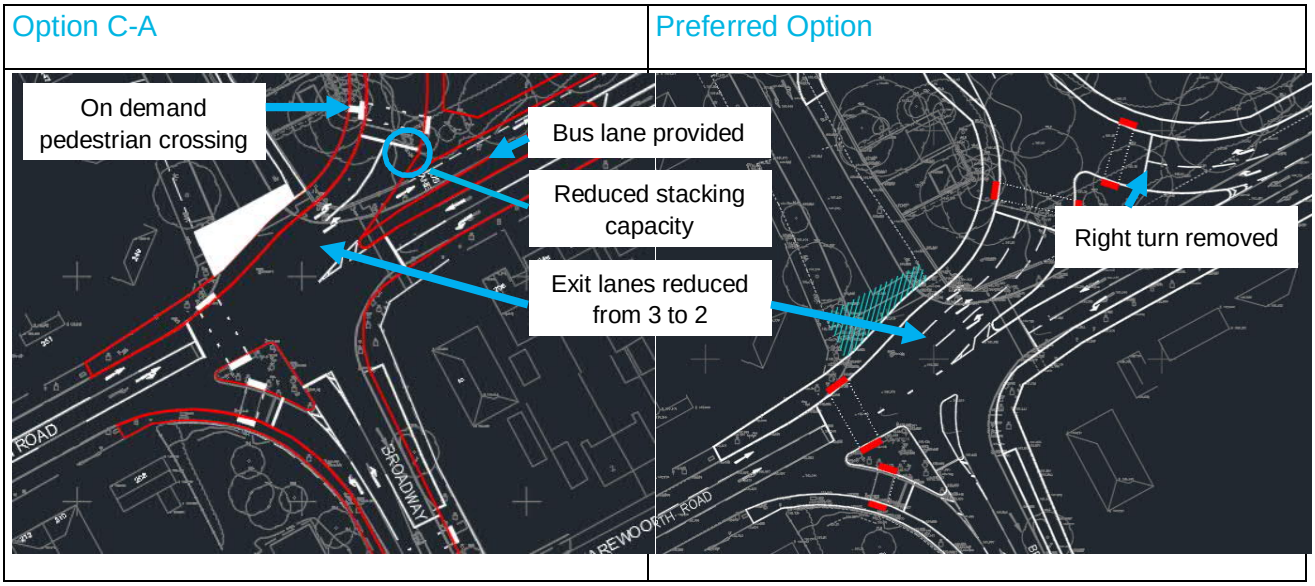
Approach	AM		IP		PM	
	DoS (%)	MMQ (PCU)	DoS (%)	MMQ (PCU)	DoS (%)	MMQ (PCU)
Southbound Circulatory*	86	24	67	4	90	18
A628 east	75	12	58	10	91	25
HCC Access	73	8	0	0	39	2

** It has been assumed that the pedestrian crossing across the left turn would be called every cycle in all time periods*

3.2 Broadway / A628 Dodworth Road

The alternative layouts are presented in **Figure 5Figure 3** below for ease of reference.

Figure 5 Alternative Broadway / A628 Dodworth Road layouts

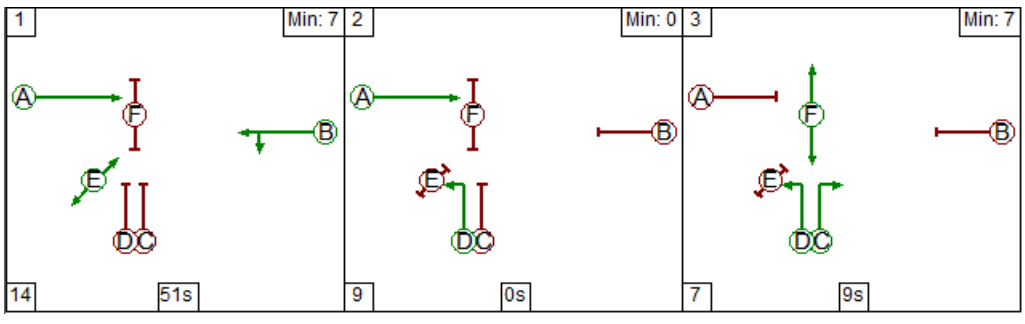


Due to reduced stacking capacity (circled blue above), there is a risk that the bus lane or A628 westbound could be blocked by queueing vehicles. To prevent a queue forming an optimiser queue constraint has been added to the LinSig model.

The exit lanes have been reduced from three lanes to two; which may compromise vehicles' ability to move smoothly into downstream lanes to travel to Broadway or east on A628. It is noted that LinSig is not the appropriate modelling tool to represent potential operational issues associated with weaving movements.

The three signal stages for this node are the same in both options, as shown in **Figure 6** below.

Figure 6: Stage Diagram for A628 / HCC Access / Circulatory



This demand dependent pedestrian stage which crosses the circulatory (Figure 5 On demand pedestrian crossing) is called each cycle in the model.

The operation of Option Variant C-A and the Preferred Option are shown below in **Table 5** and **Table 6** respectively.

Table 5: Broadway / Dodworth Road Option Variant C-A LinSig outputs

Approach	AM		IP		PM	
	DoS (%)	MMQ (PCU)	DoS (%)	MMQ (PCU)	DoS (%)	MMQ (PCU)
Broadway	81	10	88	15	79	11
Dodworth Road west	76	17	63	11	78	18
Dodworth Road east	80*	8	88	14	81*	23

**The actual modelled flow is less than the demand flow on this link due to upstream congestion*

Table 6: Broadway / Dodworth Road Preferred Option LinSig outputs

Approach	AM		IP		PM	
	DoS (%)	MMQ (PCU)	DoS (%)	MMQ (PCU)	DoS (%)	MMQ (PCU)
Broadway	85	11	88	15	88	10
Dodworth Road west	71	14	55	9	75	16
Dodworth Road east	87	13	88	18	93	29

The LinSig results for Option Variant C-A suggest that the node would operate within capacity, the operation of this node is more complicated than the results above suggest. AECOM believe that this node would operate better in the preferred option than in Option Variant C-A. VISSIM modelling of Option Variant C-A may be required to demonstrate this.

Westbound traffic in Option C-A is restricted at the Dodworth Road / Horizon Community College Access / Circulatory junction. Which means there is less traffic on Dodworth Road east in Option Variant C-A.

In preferred option Dodworth Road east in the PM has a Degree of Saturation greater than 90 percent, because more traffic can reach Dodworth Road east in Option Variant C-A.

As noted above potential operational issues exist in Option Variant C-A if vehicles stopped at a red sign on the northbound circulatory block:

- Buses tying to access the bus lane; or
- Westbound vehicles.

These operational issues may not be shown in the LinSig model results, the operation of Broadway / Dodworth Road in Option Variant C-A may be worse than forecast by LinSig.

We have added a queue constraint within the LinSig optimiser to protect the junction from blocked vehicles. The level of mitigation we have provided may not be sufficient. In which case other options for example providing ‘dummy stages’ or incorporating the pedestrian crossing within the main Broadway junction operation would need to be considered. This would reduce the capacity of the junction.

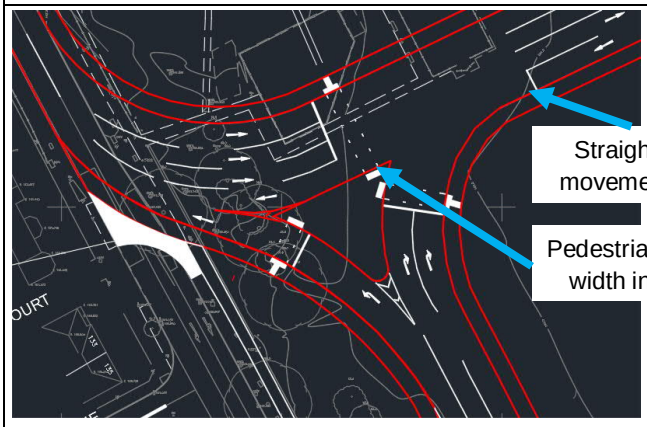
The operation of this node in the preferred option is also sensitive to vehicles being caught at the second stopline but its greater stacking capacity offers increased resilience. The preferred option has been modelled in VISSIM, and this node operated without vehicles being held at the northern stop line.

3.3 Pogmoor / Circulatory

The alternative layouts are presented in **Figure 7** below for ease of reference.

Figure 7: Alternative Pogmoor / Circulatory layouts

Option C-A



Preferred Option

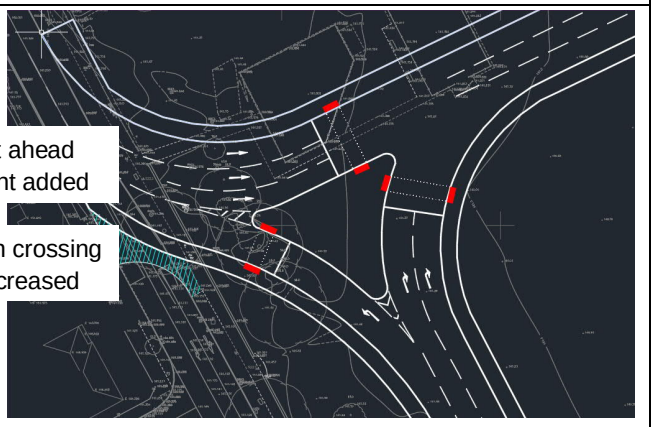


Table 7 Error! Reference source not found. shows model results for Option Variant C-A and **Table 8** shows the Preferred Option results. It can be seen that in both designs the node is predicted to operate within capacity. The northbound gyratory approach has lower Degree of Saturation in Option Variant C-A as traffic from Dodworth Road (west) has been transferred onto the westbound gyratory link.

Table 7 – Option Variant C-A Full Pedestrian Demand

Approach	AM		IP		PM	
	DoS (%)	MMQ (PCU)	DoS (%)	MMQ (PCU)	DoS (%)	MMQ (PCU)
Pogmoor	78	10	60	5	77	10
Gyratory NB & EB	76	11	46	3	76	10
Gyratory WB to Pogmoor	37	2	21	1	46	2

Table 8 - Preferred Option results

Approach	AM		IP		PM	
	DoS (%)	MMQ (PCU)	DoS (%)	MMQ (PCU)	DoS (%)	MMQ (PCU)
Pogmoor	81	10	66	6	85	13
Gyratory NB & EB	77	8	47	4	71	15

4. Summary and Conclusion

This report has presented an indicative capacity assessment of Option Variant C-A compared with the preferred A628 Dodworth Road / Pogmoor Road improvement option.

The assessment has been based on concept design. The feasibility of signal equipment location; swept paths; alignments; and turning radii have not been assessed. It is noted that design refinements could impact on model results.

The study has concluded that the preferred option provide more capacity than Option Variant C-A. Option Variant C-A gas operational at the A628 Dodworth Road / Horizon Community College intersection shown.

The operation of Option Variant C-A will be affected by its ability to accommodate weaving movements. LinSig does not account for loss of capacity caused by weaving vehicles, this assessment may overestimate the capacity of Option Variant C-A. If the operation of Option Variant C-A is to be understood in detail AECOM recommend that it is modelled in VISSIM.

The PM assessment has been undertaken for the 17:00 to 18:00 time period. Whilst this is the peak time for general traffic it is noted that the highest PM flows for the HCC access will occur before this and have not been assessed.

In summary:

- **A628 Dodworth Road / Horizon Community College Access / Circulatory:** This node is predicted to operate over capacity in Option Variant C-A in both the AM and PM peaks. The operation will be sensitive to the demands for the demand dependent stages for buses, cycles and pedestrians. The variability in signal timings caused by the introduction of three demand dependent stages could mean that it is harder to effectively co-ordinate timings with adjacent nodes. This would make installation of adaptive signal control more difficult.
- **Broadway / A628 Dodworth Road:** This node is modelled to operate within capacity in both options. It is noted that there is a significant reduction in internal stacking capacity in Option Variant C-A which may reduce its resilience and that the timings applied within the model may not be feasible. LinSig modelling software cannot assess the impact of blocking back or weaving between lanes which affect junction operation and capacity.
- **Pogmoor / Circulatory:** This node is forecast to operate within capacity in both options.

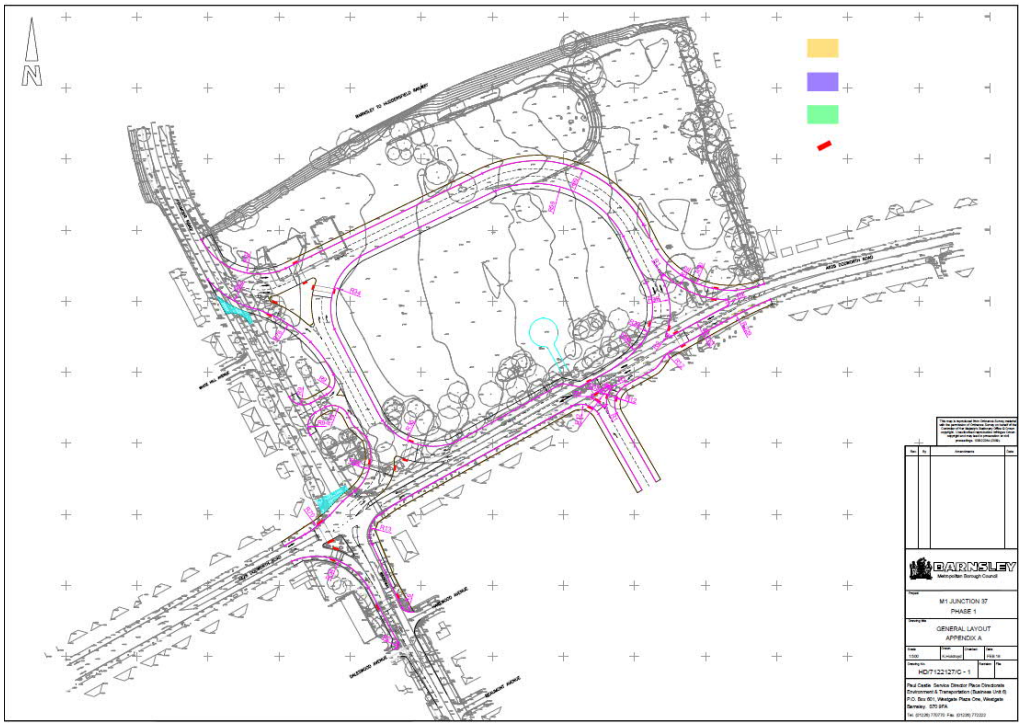
Overall it is concluded that the proposed Option Variant C-A would be unlikely to operate within capacity in the selected flow scenarios.

Appendix A Scheme Diagrams

Preferred Option



Option Variant C-A



Appendix B - Traffic Flows (PCU)

AM 2024 With Claycliffe Link + Horizon + Development Origin Destination matrix

O/D	Pogmoor Road	Dodworth Road (East arm)	Horizon College	Broadway	Dodworth Road (West arm)	Total (PCU)
Pogmoor Road		245	60	147	398	**850**
Dodworth Road (East arm)	27		181	44	478	**730**
Horizon College	66	106		56	48	**276**
Broadway	226	66	51		350	**693**
Dodworth Road (West arm)	462	815	43	361		**1681**
Total (PCU)	**781**	**1232**	**335**	**608**	**1274**	**4230**

IP 2034 With Claycliffe Link + Gyratory (Source: Barnsley Transport Model. Horizon College not explicitly modelled)

O/D	Pogmoor Road	Dodworth Road (East arm)	Horizon College	Broadway	Dodworth Road (West arm)	Total (PCU)
Pogmoor Road	0	53	0	100	339	**492**
Dodworth Road (East arm)	38	0	0	53	557	**648**
Horizon College	0	0	0	0	0	**0**
Broadway	183	51	0	0	494	**728**
Dodworth Road (West arm)	447	584	0	282	0	**1313**
Total (PCU)	**668**	**688**	**0**	**435**	**1390**	**3181**

PM 2024 With Claycliffe Link + Horizon + Development Origin Destination matrix

O/D	Pogmoor Road	Dodworth Road (East arm)	Horizon College	Broadway	Dodworth Road (West arm)	Total (PCU)
Pogmoor Road		85	18	312	325	**740**
Dodworth Road (East arm)	77		58	83	723	**941**
Horizon College	18	31		16	13	**78**
Broadway	186	80	15		381	**662**
Dodworth Road (West arm)	531	899	13	398		**1841**
Total (PCU)	**812**	**1095**	**104**	**809**	**1442**	**4262**