Shrewsbury West Sustainable Urban Extension - Welshpool Road

Transport Issues Technical Note

Shropshire Council
October 2010

Contents

1. Introduction

The Shrewsbury West sustainable urban extension has particular transport issues associated with it, with its strategic benefits including the provision of the western section of the Shrewsbury North West Relief Road (SNWRR), referred to hereafter as the "Oxon Link Road" and the relocation and enhancement of Park and Ride facilities. A number of objectors have questioned the soundness of the identification of this sustainable urban extension on the basis of a perceived dependency on the delivery of the whole SNWRR and related uncertainty of delivery. This technical note seeks to set out the current position on the transport issues and to provide information on related matters, including the benefits of the Oxon Link Road as a stand - alone scheme.

2. Shrewsbury North West Relief Road position

Shrewsbury North West Relief Road (NWRR) was included in the West Midlands Regional Funding Allocation programme submitted to government in February 2009 with a programmed completion date of late 2016. In July 2009, government responded to that programme and sought business cases from individual scheme promoters.

Since then Shropshire Council has been developing the business case for submission, in accordance with its programme, in September 2010. As part of that preparation a further round of public consultation was carried out in April / May 2010. In that consultation 59% of those responding agreed or strongly agreed that NWRR should be built, an increased level of support from previous consultations.

In late April 2010 the Department for Transport (DfT) wrote to all scheme promoters advising them that it would not consider business cases for future schemes until after a "stocktake" as part of a new Government's Comprehensive Spending Review. Because of the uncertainty in future programming which this brought, the council decided, in response to that letter, to complete the consultation but to stop work on both the preparation of the business case and the appointment of a contractor.

Subsequently in June 2010 the Secretary of State for Transport has confirmed that the future budget for transport projects would be determined as part of the spending review which would report in October and that the consideration of which schemes would be part of a future programme and of the process for approving transport schemes would follow the conclusion of that review. Until the outcome of this review DfT has put on hold all transport projects which are not already committed.

Shropshire Council's Cabinet resolved at its meeting on 4 August, notwithstanding the increased level of support for the scheme demonstrated through the public consultation, that "no further work is undertaken on the scheme until after the outcome of the Comprehensive Spending Review is known and subsequent discussions with the Department for Transport." In taking that position Cabinet recognised that in the current economic climate NWRR will not be delivered to the programme previously identified and that further dialogue will be needed with DfT to understand how future investment in transport infrastructure in Shrewsbury can be secured. DfT guidance on Major Schemes development is currently awaited following the Public Spending Review.

3. Highways Authority comments on proposed Oxon Link Road line and junction arrangements

The highway proposals for the link between Churncote roundabout and Holyhead Road shown on Drg No 500_002 are broadly acceptable to Shropshire Council as local Highway Authority. They are considered to be

capable of being developed into a detailed design in accordance with current standards which will fulfil the function of a future Shrewsbury North West Relief Road over this length. The proposed line is close to that proposed for this section as part of the Shrewsbury North West Relief Road on which significant investigation and design work has already been carried out.

4. Churncote Island junction options

The Council has been working with the Highways Agency, in line with a Memorandum of Understanding, to assess the traffic impacts of growth in Shrewsbury and the related need and scope for junction improvements on the A5. The Churncote Island junction is currently a four arm roundabout at the junction of the A5 and the A458. The joint work has identified that a 4 arm signalised junction could ensure that the junction has sufficient capacity to accommodate traffic levels forecast for 2026, as set out in the A5 Shrewsbury Corridor Transport Evidence in ShropsEV61. However, Shropshire Council has been planning the SNWRR for many years on the basis of a five arm roundabout, and this has been reflected in the indicative masterplan for the Shrewsbury West sustainable urban extension. The Highways Agency and the Council have given consideration to the junction options and have concluded that both junction arrangements are technically feasible. This is reflected in the Statement of Common Ground between the Council and the Highways Agency. Relevant correspondence and assessment reports are attached in Appendix A.

5. Transport benefits associated with Shrewsbury West sustainable urban extension

Relevant information is set out in the Welshpool Road Delivery Statement (ShropsEV134), including the Outline Transport Strategy in its Appendix 4. However, the following are relevant key points.

5.1 New Highways Provision and A5 Junction Improvement.

The Oxon Link Road will be a high quality road which could ultimately form part of a Shrewsbury North West Relief Road and so is a major investment in the town's long term highways network. In the interim, it will provide an improved route for traffic from the west of the town towards the town centre, avoiding Welshpool Road. The improvements to the Churncote Island will increase the capacity of this important A5/A458 junction for the benefit of through and local traffic. The new road will provide good access to the expanded Oxon Business Park employment area, the healthcare/retirement/leisure campus and to the Leisure Caravan Park, removing this traffic from Welshpool Road but promoting the visibility and profile of these business areas.

5.2 Welshpool Road

The completion of the Oxon Link Road will allow a number of transport improvements to the Welshpool Road.

The reduction in traffic volumes allows road space re-allocation to:

5.2.1 Bus priority.
This is a key route into the town centre, improving bus journey times and reliability along this route, through priority at junctions, and due to a reduction in general traffic allows the potential to increase bus mode share, as bus travel becomes more attractive as a mode choice.

5.2.2 Park & Ride.
Relocation of the Park and Ride site closer to the A5 junction, still accessed from Welshpool Road would reduce traffic volumes on part of the Welshpool Road, as the current site is accessed at Little Oxon Lane further east.
The relocation of the Park and Ride site is considered an advantage as visibility to potential users should improve, and improved access/priority, and therefore journey time, for buses to a new site can be designed in at an early stage. Any potential to increase the capacity of the Park and Ride should also produce benefits by facilitating a reduction in traffic volumes into the town centre.

5.2.3 Cycle provision, on/off road.
The reduction in traffic volumes should allow road space reallocation to provide better on road facilities for cyclists along the length of Welshpool Road. The draft Local Transport Plan and the wider assessment for Shrewsbury in the 'Smarter Choices for Shrewsbury Preferred Option' (Mouchel May 2010) identifies the need for a range of infrastructure improvements on this major radial route into the town centre. The scheme provides the opportunity to improve cycle accessibility for significant residential areas located either side of a key route.

Enhancement of sustainable travel modes increases the potential for a further shift away from car trips from existing development in Shrewsbury along the Welshpool Road, in addition to the assessed mode share for the new Shrewsbury West extension.

5.2.4 Environmental improvements.
Reduction of traffic would impact on residential properties fronting Welshpool Road and scope to change the character of Welshpool Road from a major through route to a local distributor road.

5.2.5 Enhancement of Local Centre.
The reduction in traffic and scope to change the character of Welshpool Road will enable the local centre/retail facilities on Welshpool Road to develop as an accessible hub at the heart of an enlarged residential and business community.

5.3 Shrewsbury West – alternative mode infrastructure.
In addition to the locations already identified as key links for improvement on the cycle network, it is critical that access into the new developments on the

Shrewsbury West extension, maximises the potential for travel on foot, by cycle or public transport.

5.3.1 Pedestrian and cycle network.
The movement of pedestrians and cyclists will be considered at an early stage and desire lines identified to create the most direct/shortest route links to local attractions and Welshpool Road. There will be a general assumption of good links to the Welshpool Road as a key radial to and from the town centre. Permeable pedestrian access is planned into the new development. Additionally this should be supported by links to the wider cycle priority network as set out in the LDF Implementation Plan. Links to the north, including the Caravan Park, will be facilitated by the proposed footbridge west of Little Oxon Lane and the at-grade signalised crossing at Clayton Way.

5.3.2 Bus network.
Access for pedestrians to Welshpool Road should be via the shortest possible routes to access the existing bus route, which is also expected to be the highest frequency route in the vicinity of the development. Opportunities for a bus route to serve the maximum catchment of the new development by the shortest route will be considered at an early stage of development planning.

Appendix A - Assessment of Five Arm Roundabout Option for Churncote Island junction

1. Letter from Shropshire Council to Highways Agency dated 21st September 2010

2. Churncote Roundabout A5/A458 Junction – Proposed Alterations Report (Mouchel September 2010)

3. Highways Agency Churncote Roundabout Analysis (JMP October 2010)

Mr D McCann
Network Strategy Manager
Planning Team (NDDWM)
Highways Agency, The Cube
199 Wharfside Street
Birmingham
B1 1RN

21 September 2010
MA516

Dear Mr McCann

A5 / A458 Churncote Roundabout, Shrewsbury

I refer to recent discussions and correspondence between the Highways Agency and Shropshire Council in the context of both the Local Development Framework (LDF) and the proposed Shrewsbury North West Relief Road (NWRR), and in particular in relation to Churncote roundabout at the junction of the A5 and A458.

In February I met with Darren Clark, Kevin Harvey and others in Birmingham to discuss the connection of the proposed NWRR with the A5 and A458 trunk roads at Churncote roundabout. At that meeting, it was agreed that Shropshire Council would update an earlier report on its proposals for the junction using agreed future traffic forecasts which would take account of development proposals in Shrewsbury. In the meeting, the Agency raised concerns regarding the acceptability of a five arm junction and it was agreed that the report would form the basis for future discussions on the form of the junction.

As you will be aware, it has taken some time to agree those traffic forecasts but following that agreement, I am now able to enclose for your attention the revised report on our proposed junction layout at Churncote to accommodate the NWRR. The report demonstrates that the proposed design of a 90m ICD 5 arm roundabout operates within capacity over its design life accommodating the agreed effect of growth and giving significant additional capacity to the strategic road network at this location.

As noted above, the Agency has expressed concern over the performance and acceptability of a five arm roundabout. I believe that these concerns may arise particularly from the poor performance of two local examples at Emstrey and at Dobbies. Indeed, the Council shares those concerns but is of the view that neither of these examples is representative of a well designed 5 arm roundabout of appropriate ICD. I have set out some brief comments on each below:

Emstrey – The recent signalisation scheme was understandably implemented within the constraint of existing highway land including the River Severn bridge approach. The roundabout size and geometric layout on which the scheme has been overlaid is therefore not that which would emerge from a design process less constrained by land issues, and whilst it has delivered some improvement, particularly to some movements on the Strategic Road Network, the layout is not as effective as one which would evolve if additional land were available.

Dobbies (A5 / A49) – I think that everyone at the Agency and the Council is well aware of the history of this junction where a fifth arm has been "forced" into the design of a reasonably symmetrical four arm layout. Again, whilst signalisation has improved matters, it has not corrected the deficiencies of the initial design.

I believe a better comparison with our proposals at Churncote is the Battlefield roundabout in north Shrewsbury, which at the time of its redesign and reconstruction was part of the A49 trunk road. As part of the construction of the Battlefield Link Road, which ultimately will form part of the NWRR route when that is constructed, this junction which was a 45m ICD four arm roundabout was redesigned and reconstructed as a 80m ICD five arm junction. (This compares with existing ICD at Churncote of 60m and proposed of 90m). Additional land required for the roundabout was acquired as part of the Compulsory Purchase Order for the scheme. Recalling the discussions at the time and going back over the old files, there was rightly much debate over the detail of the design to ensure that the geometry of the roundabout met standards and that the design was appropriate and safe. I do not recall nor have any record of any concern over the principle of a five arm roundabout designed in accordance with standards. The successful conclusion of those negotiations was a s278 agreement under which Shropshire County Council carried out the reconstruction of the roundabout to the Agency's requirements. This section of the A49 has been detrunked since that time but the roundabout has performed well both as a trunk road and since detrunking as part of the county principal road network.

I note your comment in your letter to Dave Wallace that a five arm junction at Churncote "is likely to be a significantly more costly and technically challenging option to deliver than the approach set out in the assessment work of having the NWRR connecting with the A458". However, I also believe that it would ultimately provide a solution which is likely to be beneficial to both the Strategic Road Network and county road network.

The design of this junction is on the agenda for our meeting on 5 October. If you need any further information in the meantime, please contact me.

Yours sincerely

Martin Allard
Head of Major Projects

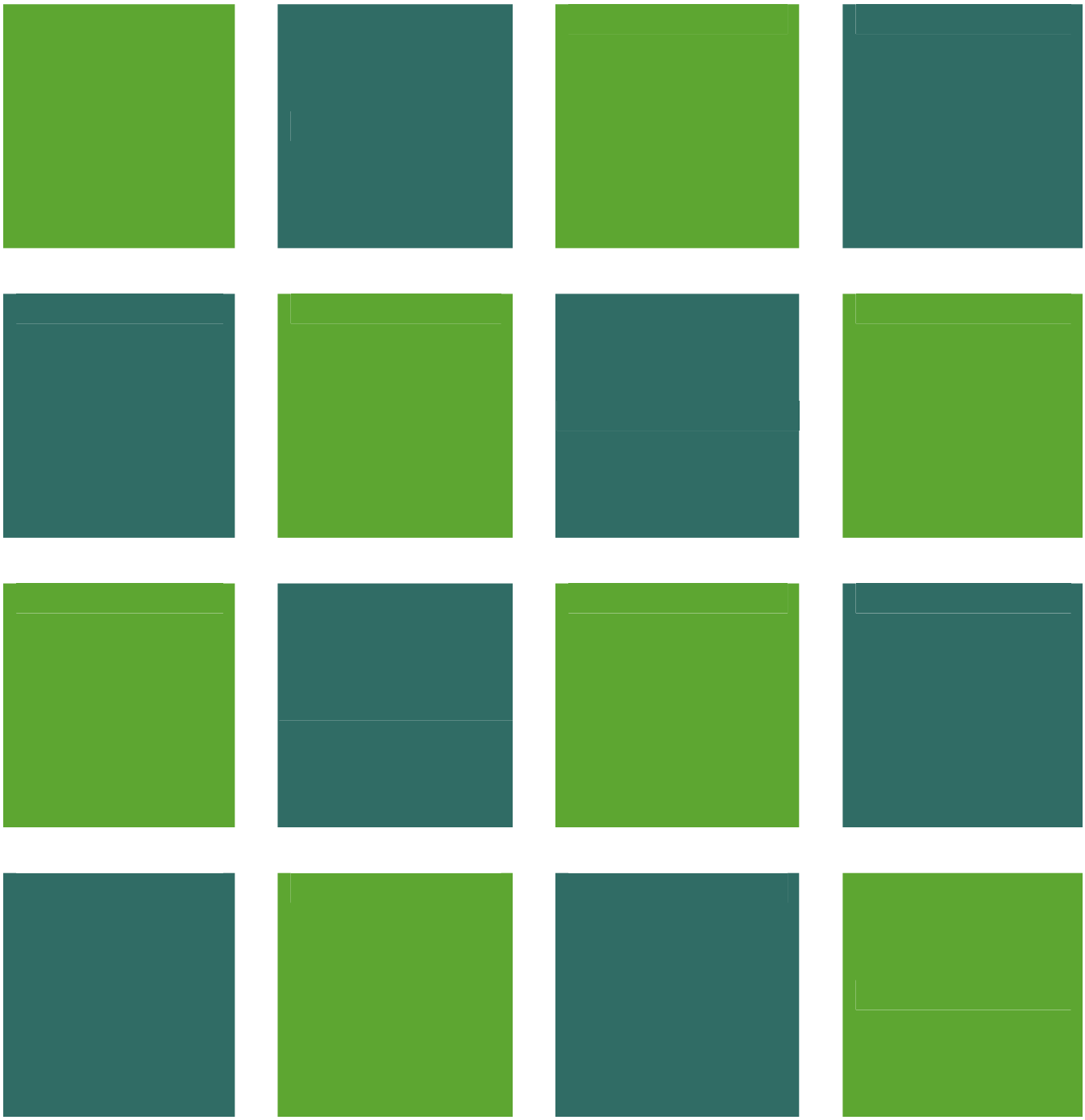
Copy to: Darren Clark HA, Martin Withington, Dave Wallace

Shrewsbury North Western Relief Road

Churncote Roundabout A5 / A458 Junction
Proposed Alterations Report

Scheme No 1023131

Client: Shropshire Council



Shrewsbury North Western Relief Road

Churncote Roundabout A5 / A458 Junction
Proposed Alterations Report

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1 Introduction

1.1 This report has been prepared by Mouchel on behalf of Shropshire Council to enable further discussions with the Highways Agency (HA) regarding proposed alterations to the A5 / A458 Churncote roundabout. The alterations are proposed as part of the development work for the Shrewsbury North West Relief Road (SNWRR) and will see the junction remodelled with a fifth arm.

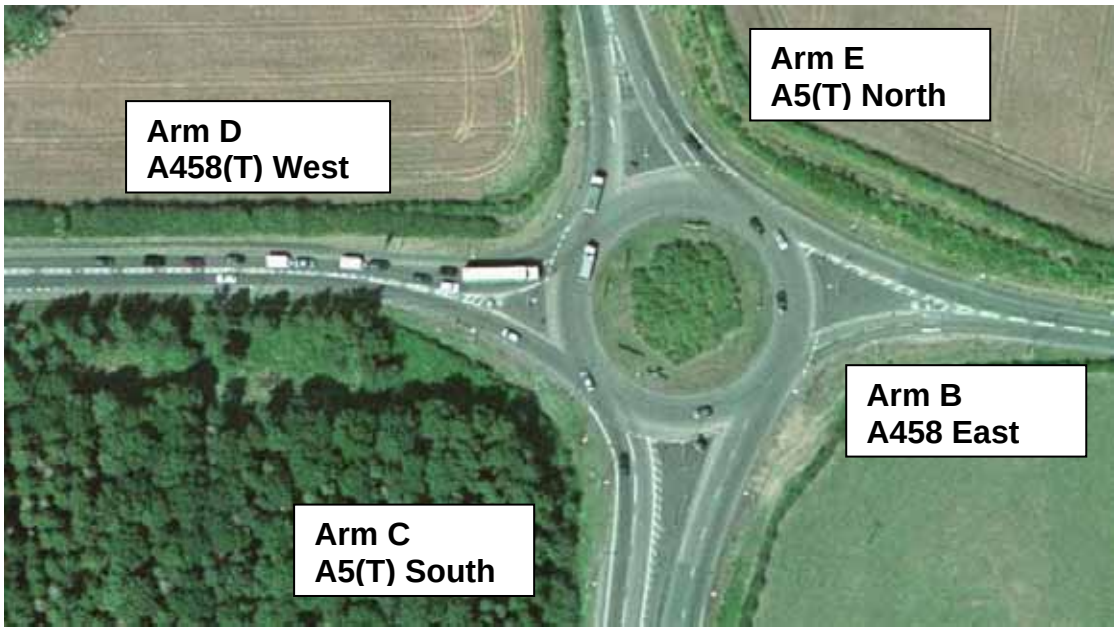
1.2 Previous work was undertaken on this in 2006, *Churncote Roundabout Junction Analysis – 20/07/2006*, and a further update in August 2007 *Working Paper for the proposed alterations to the Churncote Roundabout A5 / A458 Junction*. Both reports demonstrated that the construction of the Shrewsbury North Western Relief Road (SNWRR) would ease traffic delays in the future years of 2011 and 2026, assuming that no improvement works are carried out on the existing junction.

1.3 This report updates the findings of these previous reports, using traffic figures from a new Saturn Model developed in 2009. The future years now being considered are 2017 and 2032, based upon opening year and 15 years hence. The proposals within this report aims to demonstrate that a robust solution can be implemented providing for future traffic growth on both the existing highway network and the development traffic associated with the new SNWRR.

2 Existing Situation / Issues

2.1 The Churncote roundabout is located approximately 3 miles west of Shrewsbury and forms a 4-arm junction with the A5(T) and the A458(T). The existing 4-arm roundabout has an Inscribed Circle Diameter (ICD) of 60m. The roundabout approaches and exits have high friction surfacing, applied following the 2010 maintenance scheme. The existing roundabout carries large volumes of traffic on the A458(T) West and the A5(T), with a reduced volume of traffic using the A458 East. There is considerable tourism traffic along the A458(T) West and A5(T) South route particularly on Sunday evenings during the summer with holiday makers returning from Wales and other destinations to the west. The A5 north is also an important link to Snowdonia and the North Wales coastline.

Figure 1



3 Safety Problems with Existing Arrangement

3.1 The most important safety concern at roundabouts is the attainment of entry path deflection (EPD). Providing sufficient EPD prevents the approaching driver from entering the roundabout at excessive speed. Adequate EPD has been measured for arms C and D only. Arm B is marginally sub-standard, whereas arm E is considerably sub-standard. (in accordance with TD 16/93 Geometric Design of Roundabouts).

3.2 Despite the roundabout being used to form the reduction from dual carriageway to WS2 along the A5, the convergence of traffic does not appear to produce side-swipe accidents. Following the resurfacing of the roundabout in early 2010, the northbound exit has been marked as a 2 lane exit for approximately 20m. The exit taper is in accordance with TD16/07, though the change from D2AP to WS2 has a greater potential for conflict. There are no recorded side swipe accidents of sufficient magnitude to cause personal injury, and on numerous site visits there was no evidence of crash damage at the north bound A5(T) exit.

3.3 As illustrated in Figure 1, the approach from the A458(T) has insufficient flare length and too sinuous an alignment to allow HGVs easy entry to the roundabout without encroaching into the adjacent queuing lane. This results in poor lane discipline and reduces capacity (usable flare length and entry width) of the arm. Considering the

level and type of traffic using this link e.g. HGVs, caravans, etc, journey time and traffic safety could be compromised by the continual blockage of one approach lane.

4 Existing Junction Arm Arrangements

4.1 **Arm B -** This arm is single carriageway (S2) which widens to two lanes upon entry. It is an important arterial route from Shrewsbury town centre for travel to the north and west. From the driver's perspective there is a readily understandable layout with good flare development and effective two lane queuing. There is relatively little HGV traffic compared to the other arms of the junction. Unlike arms D and E, traffic doesn't "platoon" behind slower moving vehicles due to the urban approach upstream of the junction, which has frequent junctions. The traffic could generally be considered a steady stream.

4.2 **Arm C -** This arm is dual carriageway and maintains two lanes at entry with very little flare. No "platooning" occurs on this approach due to the overtaking opportunities afforded by a dual carriageway. Over this junction the A5 changes from a dual carriageway (D2AP) to the south to a wide single 2 (WS2) carriageway to the north. The majority of drivers use lane 1 to continue along the A5, minimising conflict with merging traffic at the start of the WS2 carriageway. All of the traffic surveys, including bank holiday peaks indicate that the turning proportions are approximately 30% onto arm D and 70% towards arm E, with a negligible turning proportion onto arm B. Drivers naturally use lane 1 for turning left onto arm D, but due to the conflict downstream as discussed above, the vast majority of drivers continuing along the A5 also prefer to use lane 1. This exacerbates the length of queuing vehicles in lane 1 and does not make efficient use of the available space. See figure 2.

Figure2

Recent resurfacing work at this junction, has led to a short merging area to the north of the roundabout to encourage the use of lane 2 for the ahead movement. At this time it is unclear as to whether this has had a significant effect. As with the previous reports, the latest five years of accident data do not indicate any accidents which may have resulted from vehicles making this manoeuvre.

4.3 **Arm D -** This Arm is single carriageway and widens to two lanes at entry. The A458(T) continues west for over 14 miles before encountering the next major junction at Buttington Cross. This narrow, winding stretch of road offers little opportunity for overtaking, thus slower vehicles impede those following which results in the “platooning” of traffic. This sporadic traffic pattern results in large convoys of vehicles (20-30 vehicles are not uncommon) arriving at the junction at once followed by periods (1-2 minutes) with no traffic.

The weekday turning proportions indicate an approximate 60-40% split between arms C and B respectively, with negligible flows onto arm E. It would be expected that a 60-40% split would lead to good separation and equal queuing over the two lanes at entry, but due to the unusual flare geometry (discussed above), if four

consecutive vehicles wish to turn right, then lane1 becomes blocked. As the traffic approaches in “convoy” this blocking of lanes is a frequent occurrence and greatly reduces the effective capacity of the arm. See Figure 3. This problem is exacerbated further by holiday traffic which has a 70-30% split between arms C and B respectively, hence an even higher proportion of cars turning right and therefore longer queues.

Figure 3

4.4 **Arm E –** This arm is WS2 and widens to two lanes at entry. Whilst there is a crawler lane (approaching from the North) approximately 1km from this junction which allows vehicles to pass, much of the previous 5-6 km is single carriageway at a standard width with very few opportunities to overtake. This does lead to some “platooning” with the majority of traffic coming from the A5 North continues along the A5 to the south with a small amount of traffic turning onto the A458 East and West. Lane 2 at entry is used effectively due to the assurance of an easy exit onto the downstream dual carriageway.

5 Existing Capacity Problems

5.1 The Transport Research Laboratory computer programme Arcady has been used to measure the current level of capacity at Churncote Roundabout. Arcady uses the physical geometry of the roundabout and the traffic flows to produce a Ratio of Flow to capacity figure for each arm of the junction. It also indicates the likely queues and delays incurred. Arcady has an inherent standard error of + or – 15% and therefore the maximum capacity on any arm must not exceed 0.85 RFC.

5.2 The following are the Arcady results using 2009 traffic counts used in the development of the Saturn model. The flows for 2017 and 2032 have been taken from the Saturn model "do-Minimum" scenario for each year.

Existing Churncote Roundabout Geometry

Arm	V - Half Width (m)	E - Entry Width (m)	L - Flare Length (m)	R - Entry Radii (m)	ICD - (m)	Phi- Entry Angle (°)
ARM B - A458 E	3.70	6.70	22.40	20.00	60.00	19.5
ARM C - A5 S	7.30	8.50	32.1	50.00	60.00	18.0
ARM D - A458 W	3.70	7.90	23.70	25.00	60.00	29.5
ARM E - A5 N	5.00	7.50	48.60	30.00	60.00	10.5

Existing Churncote Roundabout Results

Scenario	AM			PM		
	Total Hourly Flow	Max RFC Value	Max Q (Veh)	Total Hourly Flow	Max RFC Value	Max Q (Veh)
2009	3423	0.806	4.1	3696	0.818	4.4
2017	3692	0.863	6.1	3974	0.920	9.9
2032	4024	0.944	13.4	4209	1.020	37.2

5.3 The table above indicates that the junction operates within capacity now but is forecast to exceed its capacity within the next few years in both the AM and PM peak periods. Furthermore, once the RFC goes above 1.0 the level of queuing forecast by Arcady is less accurate, and should only be used as an indication of significant queues rather than the actual length of queues.

6 Proposed Solution

6.1 Previous work has proposed a five-arm roundabout and this approach is continued here. The revised traffic figures have been applied to the previous designs developed. All previous roundabout designs, options with and without a segregated left slip from the A5 south to the A458 west have been considered. In this report the need for the left slip has been revisited due to the marked differences in the traffic flows based on the current expected growth. The geometry of the proposed roundabout without the segregated left slip lane has been used for the assessment and the results for 2017 and 2032 are show in the tables below. The roundabout's capacity is defined by the maximum Ratio of Flow to Capacity (RFC) of each arm, with operational capacity at 0.85 due to a standard error (based on site-to-site variation) of 15%.

Proposed Churncote Roundabout Geometry

Arm	V - Half Width (m)	E - Entry Width (m)	L - Flare Length (m)	R - Entry Radii (m)	ICD - (m)	Phi- Entry Angle (°)
ARM A - NWRR	3.65	9.00	35.00	20.00	90.00	30.00
ARM B - A458 E	3.65	9.00	22.80	20.00	90.00	30.00
ARM C - A5 S	7.30	10.60	22.60	15.00	90.00	24.00
ARM D - A458 W	3.60	10.55	27.00	20.00	90.00	24.00
ARM E - A5 N	5.00	10.70	27.50	20.00	90.00	31.00

2017	AM			PM		
Arm	Entry Hourly Flow	Max RFC Value	Max Q (Veh)	Entry Hourly Flow	Max RFC Value	Max Q (Veh)
ARM A - NWRR	424	0.562	1.3	538	0.769	3.3
ARM B - A458 E	433	0.566	1.3	669	0.433	0.8
ARM C - A5 S	1297	0.745	2.9	1698	0.505	1.0
ARM D - A458 W	775	0.426	0.7	542	0.432	0.8
ARM E - A5 N	1237	0.460	0.8	953	0.633	1.7
Junction Totals	4166	0.745	2.9	4400	0.769	3.3

2032	AM			PM		
Arm	Entry Hourly Flow	Max RFC Value	Max Q (Veh)	Entry Hourly Flow	Max RFC Value	Max Q (Veh)
ARM A - NWRR	446	0.636	1.7	612	0.822	4.6
ARM B - A458 E	493	0.642	1.8	807	0.493	1.0
ARM C - A5 S	1447	0.842	5.2	1742	0.549	1.2
ARM D - A458 W	833	0.493	1.0	584	0.521	1.1
ARM E - A5 N	1339	0.529	1.1	1006	0.824	4.5
Junction Totals	4558	0.842	5.2	4751	0.824	4.6

6.2 As can be seen the results indicate that roundabout will work within capacity in the opening and design years without the need for the segregated left slip lane. Furthermore queues indicated by the models are much shorter at around 5 vehicles. Therefore we would propose to implement a five arm roundabout without the additional segregated left slip lane at the current time.

7 Sensitivity Testing

7.1 With the junction being on a busy tourist route there is significant traffic in the summer Sunday PM periods. Previous studies have found a significant increase in the number of vehicles making the movement from the A458 West to A5 south. As a sensitivity test this has been repeated here using the 2010 inter peak flows factored up to 2017 and 2032 and a further 300 vehicles added to this specific movement. The results of this test are RFC 0.566 (2017) and 0.671 (2032) with maximum queues of 1.3 and 2.0 vehicles respectively. This indicates that the junction will operate well within capacity at these times.

8 Future Requirements

8.1 The main difference with this piece of work has been the development of a new Saturn model. This model was used in the preparation of the major scheme business case for the SNWRR and to evaluate the local development framework traffic impact appraisal working closely with the HA's consultant JMP.The model has been calibrated to 2009 traffic flows with increased emphasis on the HA's strategic road network. The HA have accepted that the flows developed using TEMPRo 6.1

(the Department for Transport's trip growth prediction system) are in line with the current expectations for growth through to opening in 2017 and design year in 2032.

8.2 Whilst it has been shown that the design proposed operates within capacity through to 15 years post opening, the HA have been signalising roundabouts along the local network in recent years. With this in mind the design of the new roundabout with a larger ICD and greater separation between arms, would mean that any future signal scheme for this junction could be considered.

9 Roundabout Construction

9.1 The construction of this roundabout is relatively simple as much of the construction work is offline. As the proposed roundabout is approximately at grade with the existing, it is envisaged that the construction would be done under simple traffic management without road closures.

10 Other Five-Arm Roundabouts

10.1 Whilst we are proposing a five-arm roundabout, it is understood that the HA are currently reluctant to see the implementation of further five-arms roundabouts. However along the A5 Shrewsbury bypass there are two other five-arm roundabouts, both of which have now been signalised and operated reasonably. To the north of Shrewsbury is Battlefield Roundabout which operates effectively at the junction of the A49 to the north and south, the A53 towards Shawbury and Market Drayton, the A5112 arterial route in to Shrewsbury and the A5024 Battlefield Link Road. A5 / A483 Mile End roundabout on the Oswestry Bypass is also a successful five arm roundabout, which has recently been altered to further it's design life.

10.2 In each of the examples above, the geometry is not ideal, with uneven spacing between arms. Furthermore in the case of the Mile End roundabout the whole roundabout is asymmetrical. The proposed roundabout for Churncote realigns the approaches where necessary to provide reasonably even spacing between arms. Five-arm roundabouts are successfully used at many motorway junctions and in urban and rural locations across England.

11 Conclusions / Recommendations

11.1 The existing layout of Churncote roundabout has been shown to have safety and capacity concerns. The layout has insufficient entry path deflection on two arms and therefore can lead to excessive on entry.

11.2 As the junction forms the reduction on the A5 from two lane dual to wide single carriageway, the recent maintenance scheme (which has re-lined the exit to A5 north to encourage drivers to use both the left and right lanes on the approach form the south) may lead to reductions in queuing by making drivers more inclined to use both lanes for the ahead movement but also increase the number of vehicles conflicting on this exit.

11.3 The revised 5-arm proposal would allow the approaches to be realigned which will eradicate the problem of the sinuous flare on the A458 (T) Welshpool Road and also meet the entry path deflection requirements in the DMRB TD 16. Further more the drawing (755633/P/HWY/013B (Appendix A) also shows a wider exit for the A5 Northbound which will improve the merging of vehicles exiting to the north.

11.4 The alteration in the size of the roundabout also leads to the improvement of the entry path deflection, and also the alignment and spacing of the arms leading into the junction. This will lead to better lane usage than at the current time.

11.5 The Arcady results forecast that the existing layout will exceed its operational capacity within the next 7 years using the most recent modelling results, which have been agreed with the HA as part of the development of the Shrewsbury Local Development Framework. Whilst the results do not accurately predict queues at this junction (from anecdotal evidence), the figures can be used as a guide for comparison.

11.6 The proposed design reduces the RFC of the roundabout in the opening year of 2017 from 0.920 to 0.769. In the design year of 2032 the RFC is reduced from 1.020 for the existing layout to 0.842 with the proposed design. These results mean that the roundabout has extended life based upon the traffic modelling developed over the last 12-18 months. Furthermore, the increased ICD will mean that the roundabout has greater potential for changing the control from priority to signal

controlled should the HA follow-up the current trend along the A5 Shrewsbury Bypass of signalling such roundabout.

11.7 Arm B works reasonably well at present and the new layout retains the readily understandable 2-lane approach.

11.8 Arm C currently has excessive queuing in lane one, due to the exit arm not making merging between vehicles easy. The new roundabout layout will increase the width of the exit and encourage merging on the exit. In turn this should lead to a better balance of queuing on this arm. The additional fifth arm will also have a traffic associated with it that will utilise the offside lane.

11.9 Arm D would be re-aligned to remove the sinuous nature of the approach, this leads to better lane usage and therefore increased capacity at the stop line. Furthermore, the proposed lane allocation for this arm would allow right turning traffic to use two lanes, with the nearside (third) lane being used by vehicles heading to arms E, A and B.

11.10 Arm E works well at present, but the additional entry lane at the give way, means that vehicles continuing along the A5(T) can use the two offside lanes, with the nearside lane used for arms A and B.

11.11 It is expected that much of the roundabout can be built offline, at existing levels. As suggested previously this is unlikely to mean road closures, but works under Chapter 8 traffic management.

11.12 Considering all of the above the proposed roundabout addresses the current inadequacies in the entry path deflection and approach alignments by providing a larger roundabout which will operate within capacity well in to the future. The larger junction is an improvement on the existing layout in terms of DMRB standards, capacity and driver understanding and should be considered through discussions between Shropshire Council and the Highways Agency.

APPENDIX A

DETAILED PROPOSED ROUNDABOUT LAYOUT.

90m ICD LAYOUT IN COMPLIANCE WITH TD16.

ARM E
A5(T) North
To Oswestry

ARM A
SNWRR

ARM D
A458(T) West
To Welshpool

ARM B
A458 East
To Bicton

ARM C
A5(T) South
To Telford

1150.
1100.
1050.
1045.
80.3m
81.6m
6441
Churncote Coppice

0 5 10 15 20 25m
SCALE 1 : 500

Revision	Amendment	Originated by and date	Checked by and date	Approved by and date
C	New frame and renumbered	TJ 21/09/10	BB 21/09/10	FB 21/09/10
B	Removal of dedicated left turn lane following revised traffic flows due to scrapping of TIFF application.	AC 21/02/08	AP 21/02/08	AP 21/02/08
A	Minor amendments following safety audit	WG 17/09/07	AP 17/09/07	AP 17/09/07

mouchel
Haughmond View, Sitka Drive,
Shrewsbury Business Park Shrewsbury SY2 6LG
Tel: 01743 276300 Fax: 01743 276301
Web Site: www.mouchel.com

Client: Shropshire Council

Project: Shrewsbury North Western Relief Road

Drawing Title: Churncote Rbt Layout

Drawn By:	Checked By:	Approved By:	Scale: (at A1 size)
WG Aug 07	AP Aug 07	AP Aug 07	1:500

Purpose: Discussion — Draft ☐ Issue ☐

Drawing Number: 1023131-P-030 — Revision: C

G:\HIGH_TRAFF CONNECT\10xxxxxx\1023131 Shrews NWRR - MSBC03 Drawings\Preliminary\1023131-P-030-C Churncote Rbts.dwg

APPENDIX B

EXISTING AND PROPOSED ARCADY RESULTS, 2009, 2017 & 2032.

A5 Churncote AM 2009
TRL LIMITED

CAPACITIES, QUEUES AND DELAYS AT ROUNDABOUTS

ARCADY 5.0 ANALYSIS PROGRAM
RELEASE 1.1 (MAY 2001)

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Run with file:-
"g:\755633 North West Relief Road - Preferred Route\A5 Roundabouts\CHruncote RDBT REPORT\Existing\
  A5 Churncote AM 2009.vai"
(drive-on-the-left) at 14:56:27 on Wednesday, 15 September 2010

.ROUNDABOUT CAPACITY AND DELAY
 ****

.RUN TITLE
 ****
  A5 Churncote RDBT Base 2009 AM

.INPUT DATA
 ****
 ARM A - A5 Oswestry
 ARM B - A488 Shrewsbury
 ARM C - A5 Telford
 ARM D - A488 Welshpool

.GEOMETRIC DATA

ARM	V (M)	E (M)	L (M)	R (M)	D (M)	PHI (DEG)	SLOPE	INTERCEPT (PCU/MIN)
ARM A	5.00	7.00	40.30	45.00	60.00	10.5	0.674	37.187
ARM B	3.65	5.90	24.70	25.00	60.00	19.5	0.571	28.489
ARM C	7.30	7.70	0.00	25.00	60.00	18.0	0.701	40.884
ARM D	3.65	7.55	20.60	30.00	60.00	29.5	0.592	31.251

V = approach half-width L = effective flare length D = inscribed circle diameter
E = entry width R = entry radius PHI = entry angle

WARNING ARM A: Effective flare length is outside normal range.
Treat capacities with increasing caution.

.TRAFFIC DEMAND DATA

TIME PERIOD BEGINS 08.00 AND ENDS 09.00
.LENGTH OF TIME PERIOD - 60 MINUTES.
LENGTH OF TIME SEGMENT - 15 MINUTES.

.DEMAND FLOW PROFILES ARE INPUT DIRECTLY.

TIME	FROM/TO	TURNING PROPORTIONS / TURNING COUNTS (PERCENTAGE OF H.V.S) ARM A	ARM B	ARM C	ARM D
08.00 - 09.00	ARM A	0.000	0.263	0.736	0.001
		0.0	322.0	900.0	1.0
		(10.0)	(10.0)	(10.0)	(10.0)
	ARM B	0.434	0.000	0.295	0.270
		175.0	0.0	119.0	109.0
		(10.0)	(10.0)	(10.0)	(10.0)
	ARM C	0.633	0.054	0.000	0.314
		682.0	58.0	0.0	338.0
		(10.0)	(10.0)	(10.0)	(10.0)
	ARM D	0.028	0.374	0.599	0.000
		20.0	269.0	431.0	0.0
		(10.0)	(10.0)	(10.0)	(10.0)

TURNING PROPORTIONS ARE CALCULATED FROM TURNING COUNT DATA
DEFAULT PROPORTIONS OF HEAVY VEHICLES ARE USED

. QUEUE AND DELAY INFORMATION FOR EACH 15 MIN TIME SEGMENT

TIME	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT)
08.00-08.15								
ARM A	20.39	25.36	0.804		0.0	3.8	51.4	
ARM B	6.71	13.37	0.502		0.0	1.0	14.0	
ARM C	17.96	33.87	0.530		0.0	1.1	16.3	

```
 I ARM D      12.00     19.43   0.618                  0.0    1.6       22.2
                I
 I
                I

--------------------------------------------------------------------------------
----------------
.--------------------------------------------------------------------------------
-----------------.
 I  TIME      DEMAND  CAPACITY  DEMAND/   PEDESTRIAN  START   END       DELAY
 GEOMETRIC DELAYI
 I         (VEH/MIN) (VEH/MIN) CAPACITY      FLOW     QUEUE  QUEUE    (VEH.MIN/
    (VEH.MIN/   I
 I                              (RFC)    (PEDS/MIN) (VEHS) (VEHS)  TIME
SEGMENT)  TIME SEGMENT) I
 I 08.15-08.30
                I
 I ARM A      20.39     25.29   0.806                  3.8    4.0       59.2
                I
 I ARM B       6.71     13.23   0.507                  1.0    1.0       15.1
                I
 I ARM C      17.96     33.84   0.531                  1.1    1.1       16.8
                I
 I ARM D      12.00     19.39   0.619                  1.6    1.6       23.9
                I
 I
                I

--------------------------------------------------------------------------------
----------------
.--------------------------------------------------------------------------------
-----------------.
 I  TIME      DEMAND  CAPACITY  DEMAND/   PEDESTRIAN  START   END       DELAY
 GEOMETRIC DELAYI
 I         (VEH/MIN) (VEH/MIN) CAPACITY      FLOW     QUEUE  QUEUE    (VEH.MIN/
    (VEH.MIN/   I
 I                              (RFC)    (PEDS/MIN) (VEHS) (VEHS)  TIME
SEGMENT)  TIME SEGMENT) I
 I 08.30-08.45
                I
 I ARM A      20.39     25.29   0.806                  4.0    4.1       60.6
                I
 I ARM B       6.71     13.23   0.507                  1.0    1.0       15.3
                I
 I ARM C      17.96     33.84   0.531                  1.1    1.1       16.9
                I
 I ARM D      12.00     19.38   0.619                  1.6    1.6       24.1
                I
 I
                I

--------------------------------------------------------------------------------
----------------
.--------------------------------------------------------------------------------
-----------------.
 I  TIME      DEMAND  CAPACITY  DEMAND/   PEDESTRIAN  START   END       DELAY
 GEOMETRIC DELAYI
 I         (VEH/MIN) (VEH/MIN) CAPACITY      FLOW     QUEUE  QUEUE    (VEH.MIN/
    (VEH.MIN/   I
 I                              (RFC)    (PEDS/MIN) (VEHS) (VEHS)  TIME
SEGMENT)  TIME SEGMENT) I
 I 08.45-09.00
                I
 I ARM A      20.39     25.29   0.806                  4.1    4.1       61.1
                I
 I ARM B       6.71     13.23   0.507                  1.0    1.0       15.3
                I
 I ARM C      17.96     33.84   0.531                  1.1    1.1       16.9
```

I ARM	D	12.00	19.38	0.619		1.6	1.6	24.2

.QUEUE AT ARM A

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE	
08.15	3.8	****
08.30	4.0	****
08.45	4.1	****
09.00	4.1	****

.QUEUE AT ARM B

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE	
08.15	1.0	*
08.30	1.0	*
08.45	1.0	*
09.00	1.0	*

.QUEUE AT ARM C

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE	
08.15	1.1	*
08.30	1.1	*
08.45	1.1	*
09.00	1.1	*

.QUEUE AT ARM D

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE	
08.15	1.6	**
08.30	1.6	**
08.45	1.6	**
09.00	1.6	**

. QUEUEING DELAY INFORMATION OVER WHOLE PERIOD

ARM	TOTAL DEMAND	* QUEUEING * DELAY *	* INCLUSIVE QUEUEING * DELAY *

	(VEH)	(VEH/H)	(MIN)	(MIN/VEH)	(MIN)	(MIN/VEH)
A	1223.4	1223.4	232.3	0.19	232.6	0.19
B	402.6	402.6	59.7	0.15	59.7	0.15
C	1077.6	1077.6	66.9	0.06	66.9	0.06
D	720.0	720.0	94.5	0.13	94.5	0.13
ALL	3423.6	3423.6	453.4	0.13	453.8	0.13

* DELAY IS THAT OCCURRING ONLY WITHIN THE TIME PERIOD.
* INCLUSIVE DELAY INCLUDES DELAY SUFFERED BY VEHICLES WHICH ARE STILL QUEUEING AFTER THE END OF THE TIME PERIOD.
* THESE WILL ONLY BE SIGNIFICANTLY DIFFERENT IF THERE IS A LARGE QUEUE REMAINING AT THE END OF THE TIME PERIOD.

END OF JOB

****** ARCADY 5 run completed.

A5 Churncote PM 2009
TRL LIMITED

CAPACITIES, QUEUES AND DELAYS AT ROUNDABOUTS

ARCADY 5.0 ANALYSIS PROGRAM
RELEASE 1.1 (MAY 2001)

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EMAIL: SoftwareBureau@trl.co.uk

Run with file:-
"g:\755633 North West Relief Road - Preferred Route\A5 Roundabouts\CHruncote RDBT REPORT\Existing\
A5 Churncote PM 2009.vai"
(drive-on-the-left) at 14:58:11 on Wednesday, 15 September 2010

.ROUNDABOUT CAPACITY AND DELAY
****

.RUN TITLE
****
A5 Churncote RDBT Base 2009 PM

.INPUT DATA
****
ARM A - A5 Oswestry
ARM B - A488 Shrewsbury
ARM C - A5 Telford
ARM D - A488 Welshpool

.GEOMETRIC DATA

ARM	V (M)	E (M)	L (M)	R (M)	D (M)	PHI (DEG)	SLOPE	INTERCEPT (PCU/MIN)
ARM A	5.00	7.00	40.30	45.00	60.00	10.5	0.674	37.187
ARM B	3.65	5.90	24.70	25.00	60.00	19.5	0.571	28.489
ARM C	7.30	7.70	0.00	25.00	60.00	18.0	0.701	40.884
ARM D	3.65	7.55	20.60	30.00	60.00	29.5	0.592	31.251

V = approach half-width L = effective flare length D = inscribed circle diameter
E = entry width R = entry radius PHI = entry angle

WARNING ARM A: Effective flare length is outside normal range.
Treat capacities with increasing caution.

.TRAFFIC DEMAND DATA

TIME PERIOD BEGINS 08.00 AND ENDS 09.00
.LENGTH OF TIME PERIOD - 60 MINUTES.
LENGTH OF TIME SEGMENT - 15 MINUTES.

.DEMAND FLOW PROFILES ARE INPUT DIRECTLY.

TIME	FROM/TO	TURNING PROPORTIONS / TURNING COUNTS (PERCENTAGE OF H.V.S) ARM A	ARM B	ARM C	ARM D
08.00 - 09.00	ARM A	0.000	0.207	0.791	0.002
		0.0	204.0	781.0	2.0
		(10.0)	(10.0)	(10.0)	(10.0)
	ARM B	0.426	0.000	0.227	0.348
		289.0	0.0	154.0	236.0
		(10.0)	(10.0)	(10.0)	(10.0)
	ARM C	0.619	0.047	0.000	0.334
		941.0	72.0	0.0	508.0
		(10.0)	(10.0)	(10.0)	(10.0)
	ARM D	0.012	0.283	0.705	0.000
		6.0	144.0	359.0	0.0
		(10.0)	(10.0)	(10.0)	(10.0)

TURNING PROPORTIONS ARE CALCULATED FROM TURNING COUNT DATA
DEFAULT PROPORTIONS OF HEAVY VEHICLES ARE USED

. QUEUE AND DELAY INFORMATION FOR EACH 15 MIN TIME SEGMENT

TIME	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT)
08.00-08.15								
ARM A	16.45	27.42	0.600		0.0	1.5	21.2	
ARM B	11.31	15.12	0.748		0.0	2.8	37.1	
ARM C	25.36	31.12	0.815		0.0	4.2	55.9	

I ARM D	8.47	15.72	0.539		0.0	1.1	16.2

I TIME GEOMETRIC DELAY	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	(VEH.MIN/ TIME SEGMENT)
I 08.15-08.30								
I ARM A	16.45	27.36	0.601		1.5	1.5	22.3	
I ARM B	11.31	15.04	0.752		2.8	2.9	43.0	
I ARM C	25.36	31.02	0.818		4.2	4.3	64.0	
I ARM D	8.47	15.57	0.544		1.1	1.2	17.5	

I TIME GEOMETRIC DELAY	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	(VEH.MIN/ TIME SEGMENT)
I 08.30-08.45								
I ARM A	16.45	27.36	0.601		1.5	1.5	22.5	
I ARM B	11.31	15.04	0.752		2.9	3.0	44.1	
I ARM C	25.36	31.02	0.818		4.3	4.4	65.4	
I ARM D	8.47	15.56	0.544		1.2	1.2	17.7	

I TIME GEOMETRIC DELAY	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	(VEH.MIN/ TIME SEGMENT)
I 08.45-09.00								
I ARM A	16.45	27.36	0.601		1.5	1.5	22.5	
I ARM B	11.31	15.04	0.752		3.0	3.0	44.5	
I ARM C	25.36	31.02	0.818		4.4	4.4	65.9	

I ARM D	8.47	15.56	0.544		1.2	1.2	17.8

.QUEUE AT ARM A

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE	
08.15	1.5	*
08.30	1.5	*
08.45	1.5	*
09.00	1.5	**

.QUEUE AT ARM B

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE	
08.15	2.8	***
08.30	2.9	***
08.45	3.0	***
09.00	3.0	***

.QUEUE AT ARM C

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE	
08.15	4.2	****
08.30	4.3	****
08.45	4.4	****
09.00	4.4	****

.QUEUE AT ARM D

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE	
08.15	1.1	*
08.30	1.2	*
08.45	1.2	*
09.00	1.2	*

. QUEUEING DELAY INFORMATION OVER WHOLE PERIOD

ARM	TOTAL DEMAND	* QUEUEING * DELAY *	* INCLUSIVE QUEUEING * DELAY *

	(VEH)	(VEH/H)	(MIN)	(MIN/VEH)	(MIN)	(MIN/VEH)
A	987.0	987.0	88.5	0.09	88.5	0.09
B	678.6	678.6	168.7	0.25	169.0	0.25
C	1521.6	1521.6	251.1	0.17	251.5	0.17
D	508.2	508.2	69.3	0.14	69.3	0.14
ALL	3695.4	3695.4	577.6	0.16	578.3	0.16

* DELAY IS THAT OCCURRING ONLY WITHIN THE TIME PERIOD.
* INCLUSIVE DELAY INCLUDES DELAY SUFFERED BY VEHICLES WHICH ARE STILL QUEUEING AFTER THE END OF THE TIME PERIOD.
* THESE WILL ONLY BE SIGNIFICANTLY DIFFERENT IF THERE IS A LARGE QUEUE REMAINING AT THE END OF THE TIME PERIOD.

END OF JOB

****** ARCADY 5 run completed.

A5 Churncote AM 2017
TRL LIMITED

CAPACITIES, QUEUES AND DELAYS AT ROUNDABOUTS

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  A5 Churncote AM 2017.vai"
(drive-on-the-left) at 14:57:29 on Wednesday, 15 September 2010

.ROUNDABOUT CAPACITY AND DELAY
 ****

.RUN TITLE
 ****
  A5 Churncote RDBT Base 2017 AM

.INPUT DATA
 ****
 ARM A - A5 Oswestry
 ARM B - A488 Shrewsbury
 ARM C - A5 Telford
 ARM D - A488 Welshpool

.GEOMETRIC DATA

ARM	V (M)	E (M)	L (M)	R (M)	D (M)	PHI (DEG)	SLOPE	INTERCEPT (PCU/MIN)
ARM A	5.00	7.00	40.30	45.00	60.00	10.5	0.674	37.187
ARM B	3.65	5.90	24.70	25.00	60.00	19.5	0.571	28.489
ARM C	7.30	7.70	0.00	25.00	60.00	18.0	0.701	40.884
ARM D	3.65	7.55	20.60	30.00	60.00	29.5	0.592	31.251

V = approach half-width L = effective flare length D = inscribed circle diameter
E = entry width R = entry radius PHI = entry angle

WARNING ARM A: Effective flare length is outside normal range.
Treat capacities with increasing caution.

.TRAFFIC DEMAND DATA

TIME PERIOD BEGINS 08.00 AND ENDS 09.00
.LENGTH OF TIME PERIOD - 60 MINUTES.
LENGTH OF TIME SEGMENT - 15 MINUTES.

.DEMAND FLOW PROFILES ARE INPUT DIRECTLY.

TIME	FROM/TO	TURNING PROPORTIONS / TURNING COUNTS (PERCENTAGE OF H.V.S) ARM A	ARM B	ARM C	ARM D
08.00 - 09.00	ARM A	0.000	0.269	0.731	0.000
		0.0	345.0	936.0	0.0
		(10.0)	(10.0)	(10.0)	(10.0)
	ARM B	0.466	0.000	0.244	0.290
		199.0	0.0	104.0	124.0
		(10.0)	(10.0)	(10.0)	(10.0)
	ARM C	0.611	0.066	0.000	0.322
		749.0	81.0	0.0	395.0
		(10.0)	(10.0)	(10.0)	(10.0)
	ARM D	0.042	0.382	0.576	0.000
		32.0	290.0	438.0	0.0
		(10.0)	(10.0)	(10.0)	(10.0)

TURNING PROPORTIONS ARE CALCULATED FROM TURNING COUNT DATA
DEFAULT PROPORTIONS OF HEAVY VEHICLES ARE USED

. QUEUE AND DELAY INFORMATION FOR EACH 15 MIN TIME SEGMENT

TIME	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT)
08.00-08.15								
ARM A	21.35	24.83	0.860		0.0	5.5	69.7	
ARM B	7.12	13.04	0.546		0.0	1.2	16.5	
ARM C	20.42	33.43	0.611		0.0	1.5	22.3	

I ARM D	12.65	18.32	0.691		0.0	2.2	29.7

TIME SEGMENT	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT)
08.15-08.30								
ARM A	21.35	24.73	0.863		5.5	5.9	85.7	
ARM B	7.12	12.85	0.554		1.2	1.2	18.1	
ARM C	20.42	33.40	0.611		1.5	1.6	23.4	
ARM D	12.65	18.25	0.693		2.2	2.2	32.8	

TIME SEGMENT	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT)
08.30-08.45								
ARM A	21.35	24.73	0.863		5.9	6.0	89.3	
ARM B	7.12	12.84	0.554		1.2	1.2	18.4	
ARM C	20.42	33.39	0.611		1.6	1.6	23.5	
ARM D	12.65	18.25	0.693		2.2	2.2	33.3	

TIME SEGMENT	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT)
08.45-09.00								
ARM A	21.35	24.73	0.863		6.0	6.1	90.9	
ARM B	7.12	12.84	0.555		1.2	1.2	18.5	
ARM C	20.42	33.39	0.611		1.6	1.6	23.5	

I ARM	D	12.65	18.25	0.693		2.2	2.2	33.5

.QUEUE AT ARM A

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE	
08.15	5.5	*****
08.30	5.9	******
08.45	6.0	******
09.00	6.1	******

.QUEUE AT ARM B

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE	
08.15	1.2	*
08.30	1.2	*
08.45	1.2	*
09.00	1.2	*

.QUEUE AT ARM C

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE	
08.15	1.5	**
08.30	1.6	**
08.45	1.6	**
09.00	1.6	**

.QUEUE AT ARM D

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE	
08.15	2.2	**
08.30	2.2	**
08.45	2.2	**
09.00	2.2	**

. QUEUEING DELAY INFORMATION OVER WHOLE PERIOD

ARM	TOTAL DEMAND	* QUEUEING * DELAY *	* INCLUSIVE QUEUEING * DELAY *

	(VEH)	(VEH/H)	(MIN)	(MIN/VEH)	(MIN)	(MIN/VEH)
A	1281.0	1281.0	335.6	0.26	336.3	0.26
B	427.2	427.2	71.5	0.17	71.6	0.17
C	1225.2	1225.2	92.6	0.08	92.7	0.08
D	759.0	759.0	129.3	0.17	129.4	0.17
ALL	3692.4	3692.4	628.9	0.17	629.9	0.17

* DELAY IS THAT OCCURRING ONLY WITHIN THE TIME PERIOD.
* INCLUSIVE DELAY INCLUDES DELAY SUFFERED BY VEHICLES WHICH ARE STILL QUEUEING AFTER THE END OF THE TIME PERIOD.
* THESE WILL ONLY BE SIGNIFICANTLY DIFFERENT IF THERE IS A LARGE QUEUE REMAINING AT THE END OF THE TIME PERIOD.

END OF JOB

****** ARCADY 5 run completed.

A5 Churncote PM 2017
TRL LIMITED

CAPACITIES, QUEUES AND DELAYS AT ROUNDABOUTS

ARCADY 5.0 ANALYSIS PROGRAM
RELEASE 1.1 (MAY 2001)

FOR SALES AND DISTRIBUTION INFORMATION,
PROGRAM ADVICE AND MAINTENANCE CONTACT:
TRL SOFTWARE BUREAU
TEL: CROWTHORNE (01344) 770758, FAX: 770864
EMAIL: SoftwareBureau@trl.co.uk

Run with file:-
"g:\755633 North West Relief Road - Preferred Route\A5 Roundabouts\CHruncote RDBT REPORT\Existing\
  A5 Churncote PM 2017.vai"
(drive-on-the-left) at 14:58:31 on Wednesday, 15 September 2010

.ROUNDABOUT CAPACITY AND DELAY
 ****

.RUN TITLE
 ****
  A5 Churncote RDBT Base 2017 PM

.INPUT DATA
 ****
 ARM A - A5 Oswestry
 ARM B - A488 Shrewsbury
 ARM C - A5 Telford
 ARM D - A488 Welshpool

.GEOMETRIC DATA

ARM	V (M)	E (M)	L (M)	R (M)	D (M)	PHI (DEG)	SLOPE	INTERCEPT (PCU/MIN)
ARM A	5.00	7.00	40.30	45.00	60.00	10.5	0.674	37.187
ARM B	3.65	5.90	24.70	25.00	60.00	19.5	0.571	28.489
ARM C	7.30	7.70	0.00	25.00	60.00	18.0	0.701	40.884
ARM D	3.65	7.55	20.60	30.00	60.00	29.5	0.592	31.251

V = approach half-width L = effective flare length D = inscribed circle diameter
E = entry width R = entry radius PHI = entry angle

WARNING ARM A: Effective flare length is outside normal range.
Treat capacities with increasing caution.

.TRAFFIC DEMAND DATA

TIME PERIOD BEGINS 08.00 AND ENDS 09.00
.LENGTH OF TIME PERIOD - 60 MINUTES.
LENGTH OF TIME SEGMENT - 15 MINUTES.

.DEMAND FLOW PROFILES ARE INPUT DIRECTLY.

TIME	FROM/TO	TURNING PROPORTIONS / TURNING COUNTS (PERCENTAGE OF H.V.S) ARM A	ARM B	ARM C	ARM D
08.00 - 09.00	ARM A	0.000	0.198	0.802	0.000
		0.0	209.0	849.0	0.0
		(10.0)	(10.0)	(10.0)	(10.0)
	ARM B	0.414	0.000	0.256	0.329
		323.0	0.0	200.0	257.0
		(10.0)	(10.0)	(10.0)	(10.0)
	ARM C	0.606	0.061	0.000	0.333
		966.0	97.0	0.0	530.0
		(10.0)	(10.0)	(10.0)	(10.0)
	ARM D	0.011	0.274	0.715	0.000
		6.0	149.0	389.0	0.0
		(10.0)	(10.0)	(10.0)	(10.0)

TURNING PROPORTIONS ARE CALCULATED FROM TURNING COUNT DATA
DEFAULT PROPORTIONS OF HEAVY VEHICLES ARE USED

. QUEUE AND DELAY INFORMATION FOR EACH 15 MIN TIME SEGMENT

TIME	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT)
08.00-08.15								
ARM A	17.64	26.77	0.659		0.0	1.9	26.8	
ARM B	13.00	14.22	0.914		0.0	7.3	83.4	
ARM C	26.55	30.64	0.866		0.0	5.8	75.1	

I ARM D	9.05	15.00	0.603		0.0	1.5	20.7

I TIME	DEMAND	CAPACITY	DEMAND/	PEDESTRIAN	START	END	DELAY	GEOMETRIC DELAY
I	(VEH/MIN)	(VEH/MIN)	CAPACITY	FLOW	QUEUE	QUEUE	(VEH.MIN/	(VEH.MIN/
I			(RFC)	(PEDS/MIN)	(VEHS)	(VEHS)	TIME SEGMENT)	TIME SEGMENT)
I 08.15-08.30								
I ARM A	17.64	26.69	0.661		1.9	1.9	28.7	
I ARM B	13.00	14.13	0.920		7.3	8.8	122.4	
I ARM C	26.55	30.44	0.872		5.8	6.3	92.3	
I ARM D	9.05	14.77	0.613		1.5	1.5	22.9	

I TIME	DEMAND	CAPACITY	DEMAND/	PEDESTRIAN	START	END	DELAY	GEOMETRIC DELAY
I	(VEH/MIN)	(VEH/MIN)	CAPACITY	FLOW	QUEUE	QUEUE	(VEH.MIN/	(VEH.MIN/
I			(RFC)	(PEDS/MIN)	(VEHS)	(VEHS)	TIME SEGMENT)	TIME SEGMENT)
I 08.30-08.45								
I ARM A	17.64	26.69	0.661		1.9	1.9	29.0	
I ARM B	13.00	14.13	0.920		8.8	9.5	137.5	
I ARM C	26.55	30.41	0.873		6.3	6.5	96.8	
I ARM D	9.05	14.75	0.614		1.5	1.6	23.4	

I TIME	DEMAND	CAPACITY	DEMAND/	PEDESTRIAN	START	END	DELAY	GEOMETRIC DELAY
I	(VEH/MIN)	(VEH/MIN)	CAPACITY	FLOW	QUEUE	QUEUE	(VEH.MIN/	(VEH.MIN/
I			(RFC)	(PEDS/MIN)	(VEHS)	(VEHS)	TIME SEGMENT)	TIME SEGMENT)
I 08.45-09.00								
I ARM A	17.64	26.68	0.661		1.9	1.9	29.1	
I ARM B	13.00	14.13	0.920		9.5	9.9	145.5	
I ARM C	26.55	30.41	0.873		6.5	6.6	98.8	

I ARM D	9.05	14.74	0.614		1.6	1.6	23.6

.QUEUE AT ARM A

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE	
08.15	1.9	**
08.30	1.9	**
08.45	1.9	**
09.00	1.9	**

.QUEUE AT ARM B

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE	
08.15	7.3	*******
08.30	8.8	*********
08.45	9.5	*********
09.00	9.9	**********

.QUEUE AT ARM C

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE	
08.15	5.8	******
08.30	6.3	******
08.45	6.5	*******
09.00	6.6	*******

.QUEUE AT ARM D

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE	
08.15	1.5	*
08.30	1.5	**
08.45	1.6	**
09.00	1.6	**

. QUEUEING DELAY INFORMATION OVER WHOLE PERIOD

ARM	TOTAL DEMAND	* QUEUEING * DELAY *	* INCLUSIVE QUEUEING * DELAY *

	(VEH)	(VEH/H)	(MIN)	(MIN/VEH)	(MIN)	(MIN/VEH)
A	1058.4	1058.4	113.5	0.11	113.6	0.11
B	780.0	780.0	488.8	0.63	492.3	0.63
C	1593.0	1593.0	363.1	0.23	363.8	0.23
D	543.0	543.0	90.5	0.17	90.6	0.17
ALL	3974.4	3974.4	1055.9	0.27	1060.3	0.27

* DELAY IS THAT OCCURRING ONLY WITHIN THE TIME PERIOD.
* INCLUSIVE DELAY INCLUDES DELAY SUFFERED BY VEHICLES WHICH ARE STILL QUEUEING AFTER THE END OF THE TIME PERIOD.
* THESE WILL ONLY BE SIGNIFICANTLY DIFFERENT IF THERE IS A LARGE QUEUE REMAINING AT THE END OF THE TIME PERIOD.

END OF JOB

****** ARCADY 5 run completed.

A5 Churncote AM 2032
TRL LIMITED

CAPACITIES, QUEUES AND DELAYS AT ROUNDABOUTS

ARCADY 5.0 ANALYSIS PROGRAM
RELEASE 1.1 (MAY 2001)

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Run with file:-
"g:\755633 North West Relief Road - Preferred Route\A5 Roundabouts\CHruncote RDBT REPORT\Existing\
  A5 Churncote AM 2032.vai"
(drive-on-the-left) at 14:57:50 on Wednesday, 15 September 2010

.ROUNDABOUT CAPACITY AND DELAY
 ****

.RUN TITLE
 ****
  A5 Churncote RDBT Base 2032 AM

.INPUT DATA
 ****
 ARM A - A5 Oswestry
 ARM B - A488 Shrewsbury
 ARM C - A5 Telford
 ARM D - A488 Welshpool

.GEOMETRIC DATA

ARM	V (M)	E (M)	L (M)	R (M)	D (M)	PHI (DEG)	SLOPE	INTERCEPT (PCU/MIN)
ARM A	5.00	7.00	40.30	45.00	60.00	10.5	0.674	37.187
ARM B	3.65	5.90	24.70	25.00	60.00	19.5	0.571	28.489
ARM C	7.30	7.70	0.00	25.00	60.00	18.0	0.701	40.884
ARM D	3.65	7.55	20.60	30.00	60.00	29.5	0.592	31.251

V = approach half-width L = effective flare length D = inscribed circle diameter
E = entry width R = entry radius PHI = entry angle

WARNING ARM A: Effective flare length is outside normal range.
Treat capacities with increasing caution.

.TRAFFIC DEMAND DATA

TIME PERIOD BEGINS 08.00 AND ENDS 09.00
.LENGTH OF TIME PERIOD - 60 MINUTES.
LENGTH OF TIME SEGMENT - 15 MINUTES.

.DEMAND FLOW PROFILES ARE INPUT DIRECTLY.

TIME	FROM/TO	TURNING PROPORTIONS / TURNING COUNTS (PERCENTAGE OF H.V.S) ARM A	ARM B	ARM C	ARM D
08.00 - 08.15	ARM A	0.000	0.242	0.758	0.000
		0.0	81.0	254.0	0.0
		(10.0)	(10.0)	(10.0)	(10.0)
	ARM B	0.483	0.000	0.229	0.288
		57.0	0.0	27.0	34.0
		(10.0)	(10.0)	(10.0)	(10.0)
	ARM C	0.580	0.089	0.000	0.330
		202.0	31.0	0.0	115.0
		(10.0)	(10.0)	(10.0)	(10.0)
	ARM D	0.044	0.409	0.547	0.000
		9.0	83.0	111.0	0.0
		(10.0)	(10.0)	(10.0)	(10.0)
08.15 - 08.30	ARM A	0.000	0.242	0.758	0.000
		0.0	81.0	254.0	0.0
		(10.0)	(10.0)	(10.0)	(10.0)
	ARM B	0.483	0.000	0.229	0.288
		57.0	0.0	27.0	34.0
		(10.0)	(10.0)	(10.0)	(10.0)
	ARM C	0.580	0.089	0.000	0.330
		202.0	31.0	0.0	115.0
		(10.0)	(10.0)	(10.0)	(10.0)
	ARM D	0.044	0.409	0.547	0.000
		9.0	83.0	111.0	0.0
		(10.0)	(10.0)	(10.0)	(10.0)

I TURNING PROPORTIONS I

TIME	FROM/TO	ARM A	ARM B	ARM C	ARM D
		TURNING COUNTS (PERCENTAGE OF H.V.S)			
08.30 - 08.45	ARM A	0.000	0.242	0.758	0.000
		0.0	81.0	254.0	0.0
		(10.0)	(10.0)	(10.0)	(10.0)
	ARM B	0.483	0.000	0.229	0.288
		57.0	0.0	27.0	34.0
		(10.0)	(10.0)	(10.0)	(10.0)
	ARM C	0.580	0.089	0.000	0.330
		202.0	31.0	0.0	115.0
		(10.0)	(10.0)	(10.0)	(10.0)
	ARM D	0.044	0.409	0.547	0.000
		9.0	83.0	111.0	0.0
		(10.0)	(10.0)	(10.0)	(10.0)
08.45 - 09.00	ARM A	0.000	0.242	0.758	0.000
		0.0	81.0	254.0	0.0
		(10.0)	(10.0)	(10.0)	(10.0)
	ARM B	0.483	0.000	0.229	0.288
		57.0	0.0	27.0	34.0
		(10.0)	(10.0)	(10.0)	(10.0)
	ARM C	0.580	0.089	0.000	0.330
		202.0	31.0	0.0	115.0
		(10.0)	(10.0)	(10.0)	(10.0)
	ARM D	0.087	0.806	0.107	0.000
		9.0	83.0	11.0	0.0
		(10.0)	(10.0)	(10.0)	(10.0)

TURNING PROPORTIONS ARE CALCULATED FROM TURNING COUNT DATA
THE TURNING PROPORTIONS USED VARY BETWEEN TIME SEGMENTS
DEFAULT PROPORTIONS OF HEAVY VEHICLES ARE USED

QUEUE AND DELAY INFORMATION FOR EACH 15 MIN TIME SEGMENT

TIME SEGMENT		DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT)
08.00-08.15									
	ARM A	22.36	23.85	0.937		0.0	10.0	113.9	
	ARM B	7.92	12.36	0.641		0.0	1.7	23.5	
	ARM C	23.23	32.95	0.705		0.0	2.3	33.0	
	ARM D	13.54	17.03	0.795		0.0	3.6	46.7	

I TIME	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT) I
I 08.15-08.30								I
I ARM A	22.36	23.70	0.943		10.0	12.3	169.7	I
I ARM B	7.92	12.06	0.656		1.7	1.8	27.1	I
I ARM C	23.23	32.89	0.706		2.3	2.4	35.4	I
I ARM D	13.54	16.94	0.799		3.6	3.8	55.5	I
I								I

I TIME	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT) I
I 08.30-08.45								I
I ARM A	22.36	23.69	0.944		12.3	13.4	192.9	I
I ARM B	7.92	12.03	0.658		1.8	1.9	28.1	I
I ARM C	23.23	32.89	0.706		2.4	2.4	35.7	I
I ARM D	13.54	16.94	0.799		3.8	3.9	57.4	I
I								I

I TIME	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT) I
I 08.45-09.00								I
I ARM A	22.36	24.08	0.929		13.4	13.3	200.2	I
I ARM B	7.92	15.34	0.516		1.9	1.1	17.1	I
I ARM C	23.23	32.86	0.707		2.4	2.4	35.9	I
I ARM D	13.54	16.92	0.800		3.9	3.9	58.1	I
I								I

I

.QUEUE AT ARM A

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE	
08.15	10.0	**********
08.30	12.3	**********
08.45	13.4	**********
09.00	13.3	**********

.QUEUE AT ARM B

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE	
08.15	1.7	**
08.30	1.8	**
08.45	1.9	**
09.00	1.1	*

.QUEUE AT ARM C

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE	
08.15	2.3	**
08.30	2.4	**
08.45	2.4	**
09.00	2.4	**

.QUEUE AT ARM D

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE	
08.15	3.6	****
08.30	3.8	****
08.45	3.9	****
09.00	3.9	****

. QUEUEING DELAY INFORMATION OVER WHOLE PERIOD

ARM	TOTAL DEMAND		* QUEUEING * DELAY *		* INCLUSIVE QUEUEING * DELAY *	
	(VEH)	(VEH/H)	(MIN)	(MIN/VEH)	(MIN)	(MIN/VEH)
A	1341.6	1341.6	676.8	0.50	680.5	0.51

I B	I 475.2	I 475.2	I 95.8	I 0.20	I 95.8	I 0.20	I	
I C	I 1393.8	I 1393.8	I 139.9	I 0.10	I 140.0	I 0.10	I	
I D	I 812.4	I 812.4	I 217.7	I 0.27	I 218.1	I 0.27	I	
I ALL	I 4023.0	I 4023.0	I 1130.2	I 0.28	I 1134.4	I 0.28	I	

* DELAY IS THAT OCCURRING ONLY WITHIN THE TIME PERIOD.
* INCLUSIVE DELAY INCLUDES DELAY SUFFERED BY VEHICLES WHICH ARE STILL QUEUEING AFTER THE END OF THE TIME PERIOD.
* THESE WILL ONLY BE SIGNIFICANTLY DIFFERENT IF THERE IS A LARGE QUEUE REMAINING AT THE END OF THE TIME PERIOD.

END OF JOB

****** ARCADY 5 run completed.

A5 Churncote PM 2032
TRL LIMITED

CAPACITIES, QUEUES AND DELAYS AT ROUNDABOUTS

ARCADY 5.0 ANALYSIS PROGRAM
RELEASE 1.1 (MAY 2001)

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Run with file:-
"g:\755633 North West Relief Road - Preferred Route\A5 Roundabouts\CHruncote RDBT REPORT\Existing\
  A5 Churncote PM 2032.vai"
(drive-on-the-left) at 14:58:50 on Wednesday, 15 September 2010

.ROUNDABOUT CAPACITY AND DELAY
 ****

.RUN TITLE
 ****
  A5 Churncote RDBT Base 2032 PM

.INPUT DATA
 ****
 ARM A - A5 Oswestry
 ARM B - A488 Shrewsbury
 ARM C - A5 Telford
 ARM D - A488 Welshpool

.GEOMETRIC DATA

ARM	V (M)	E (M)	L (M)	R (M)	D (M)	PHI (DEG)	SLOPE	INTERCEPT (PCU/MIN)
ARM A	5.00	7.00	40.30	45.00	60.00	10.5	0.674	37.187
ARM B	3.65	5.90	24.70	25.00	60.00	19.5	0.571	28.489
ARM C	7.30	7.70	0.00	25.00	60.00	18.0	0.701	40.884
ARM D	3.65	7.55	20.60	30.00	60.00	29.5	0.592	31.251

V = approach half-width L = effective flare length D = inscribed circle diameter
E = entry width R = entry radius PHI = entry angle

WARNING ARM A: Effective flare length is outside normal range.
Treat capacities with increasing caution.

.TRAFFIC DEMAND DATA

TIME PERIOD BEGINS 08.00 AND ENDS 09.00
.LENGTH OF TIME PERIOD - 60 MINUTES.
LENGTH OF TIME SEGMENT - 15 MINUTES.

.DEMAND FLOW PROFILES ARE INPUT DIRECTLY.

TIME	FROM/TO	TURNING PROPORTIONS / TURNING COUNTS (PERCENTAGE OF H.V.S) ARM A	ARM B	ARM C	ARM D
08.00 - 08.15	ARM A	0.000	0.193	0.807	0.000
		0.0	53.0	222.0	0.0
		(10.0)	(10.0)	(10.0)	(10.0)
	ARM B	0.426	0.000	0.220	0.354
		89.0	0.0	46.0	74.0
		(10.0)	(10.0)	(10.0)	(10.0)
	ARM C	0.591	0.087	0.000	0.322
		250.0	37.0	0.0	136.0
		(10.0)	(10.0)	(10.0)	(10.0)
	ARM D	0.007	0.313	0.681	0.000
		1.0	45.0	98.0	0.0
		(10.0)	(10.0)	(10.0)	(10.0)
08.15 - 08.30	ARM A	0.000	0.193	0.807	0.000
		0.0	53.0	222.0	0.0
		(10.0)	(10.0)	(10.0)	(10.0)
	ARM B	0.426	0.000	0.220	0.354
		89.0	0.0	46.0	74.0
		(10.0)	(10.0)	(10.0)	(10.0)
	ARM C	0.591	0.087	0.000	0.322
		250.0	37.0	0.0	136.0
		(10.0)	(10.0)	(10.0)	(10.0)
	ARM D	0.007	0.313	0.681	0.000
		1.0	45.0	98.0	0.0
		(10.0)	(10.0)	(10.0)	(10.0)

TURNING PROPORTIONS

TIME	FROM/TO	ARM A	ARM B	ARM C	ARM D
08.30 - 08.45					
	ARM A	0.000	0.193	0.807	0.000
		0.0	53.0	222.0	0.0
		(10.0)	(10.0)	(10.0)	(10.0)
	ARM B	0.426	0.000	0.220	0.354
		89.0	0.0	46.0	74.0
		(10.0)	(10.0)	(10.0)	(10.0)
	ARM C	0.591	0.087	0.000	0.322
		250.0	37.0	0.0	136.0
		(10.0)	(10.0)	(10.0)	(10.0)
	ARM D	0.007	0.313	0.681	0.000
		1.0	45.0	98.0	0.0
		(10.0)	(10.0)	(10.0)	(10.0)
08.45 - 09.00					
	ARM A	0.000	0.193	0.807	0.000
		0.0	53.0	222.0	0.0
		(10.0)	(10.0)	(10.0)	(10.0)
	ARM B	0.426	0.000	0.220	0.354
		89.0	0.0	46.0	74.0
		(10.0)	(10.0)	(10.0)	(10.0)
	ARM C	0.591	0.087	0.000	0.322
		250.0	37.0	0.0	136.0
		(10.0)	(10.0)	(10.0)	(10.0)
	ARM D	0.007	0.313	0.681	0.000
		1.0	45.0	98.0	0.0
		(10.0)	(10.0)	(10.0)	(10.0)

TURNING COUNTS
(PERCENTAGE OF H.V.S)

TURNING PROPORTIONS ARE CALCULATED FROM TURNING COUNT DATA
THE TURNING PROPORTIONS USED VARY BETWEEN TIME SEGMENTS
DEFAULT PROPORTIONS OF HEAVY VEHICLES ARE USED

QUEUE AND DELAY INFORMATION FOR EACH 15 MIN TIME SEGMENT

TIME SEGMENT	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT)
08.00-08.15								
ARM A	18.35	25.83	0.711		0.0	2.4	33.2	
ARM B	13.98	13.82	1.011		0.0	15.2	146.2	
ARM C	28.19	30.08	0.937		0.0	10.6	122.3	
ARM D	9.64	14.10	0.684		0.0	2.1	28.1	

TIME SEGMENT	ARM	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT)
08.15-08.30									
	ARM A	18.35	25.71	0.714		2.4	2.4	36.4	
	ARM B	13.98	13.71	1.020		15.2	23.7	293.9	
	ARM C	28.19	29.84	0.945		10.6	13.0	179.6	
	ARM D	9.64	13.77	0.700		2.1	2.2	32.9	
08.30-08.45									
	ARM A	18.35	25.70	0.714		2.4	2.5	36.9	
	ARM B	13.98	13.70	1.020		23.7	30.8	409.6	
	ARM C	28.19	29.78	0.946		13.0	14.2	204.8	
	ARM D	9.64	13.71	0.703		2.2	2.3	34.2	
08.45-09.00									
	ARM A	18.35	25.70	0.714		2.5	2.5	37.1	
	ARM B	13.98	13.70	1.020		30.8	37.2	510.8	
	ARM C	28.19	29.76	0.947		14.2	15.0	219.6	
	ARM D	9.64	13.69	0.704		2.3	2.3	34.8	

I

.QUEUE AT ARM A

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE	
08.15	2.4	**
08.30	2.4	**
08.45	2.5	**
09.00	2.5	**

.QUEUE AT ARM B

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE	
08.15	15.2	***************
08.30	23.7	************************
08.45	30.8	*******************************
09.00	37.2	*************************************

.QUEUE AT ARM C

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE	
08.15	10.6	**********
08.30	13.0	************
08.45	14.2	**************
09.00	15.0	***************

.QUEUE AT ARM D

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE	
08.15	2.1	**
08.30	2.2	**
08.45	2.3	**
09.00	2.3	**

. QUEUEING DELAY INFORMATION OVER WHOLE PERIOD

ARM	TOTAL DEMAND		* QUEUEING * DELAY *		* INCLUSIVE QUEUEING * DELAY *	
	(VEH)	(VEH/H)	(MIN)	(MIN/VEH)	(MIN)	(MIN/VEH)
A	1101.0	1101.0	143.5	0.13	143.6	0.13

I	B	I 838.8	I 838.8	I 1360.4	I 1.62	I 1411.0	I 1.68	I
I	C	I 1691.4	I 1691.4	I 726.3	I 0.43	I 730.0	I 0.43	I
I	D	I 578.4	I 578.4	I 130.0	I 0.22	I 130.2	I 0.23	I
I	ALL	I 4209.6	I 4209.6	I 2360.3	I 0.56	I 2414.9	I 0.57	I

* DELAY IS THAT OCCURRING ONLY WITHIN THE TIME PERIOD.
* INCLUSIVE DELAY INCLUDES DELAY SUFFERED BY VEHICLES WHICH ARE STILL QUEUEING AFTER THE END OF THE TIME PERIOD.
* THESE WILL ONLY BE SIGNIFICANTLY DIFFERENT IF THERE IS A LARGE QUEUE REMAINING AT THE END OF THE TIME PERIOD.

END OF JOB

****** ARCADY 5 run completed.

A5 Churncote RDBT 2017 NWRR AM (17DSAM)
TRL LIMITED

CAPACITIES, QUEUES AND DELAYS AT ROUNDABOUTS

ARCADY 5.0 ANALYSIS PROGRAM
RELEASE 1.1 (MAY 2001)

FOR SALES AND DISTRIBUTION INFORMATION,
PROGRAM ADVICE AND MAINTENANCE CONTACT:
TRL SOFTWARE BUREAU
TEL: CROWTHORNE (01344) 770758, FAX: 770864
EMAIL: SoftwareBureau@trl.co.uk

Run with file:-
"g:\755633 North West Relief Road - Preferred Route\A5 Roundabouts\New Work April 2010\90ICD\DIRECT\
Without Seg lane\A5 Churncote RDBT 2017 NWRR AM (17DSAM).vai"
(drive-on-the-left) at 11:47:55 on Monday, 26 July 2010

.ROUNDABOUT CAPACITY AND DELAY
****

.RUN TITLE
****
A5 Churncote RDBT 2017 NWRR AM (17DSAM) DIRECT

.INPUT DATA
****
ARM A - A458 Shrewsbury
ARM B - A5 Telford
ARM C - A458 Welshpool
ARM D - A5 Oswestry
ARM E - NWRR

.GEOMETRIC DATA

ARM	V (M)	E (M)	L (M)	R (M)	D (M)	PHI (DEG)	SLOPE	INTERCEPT (PCU/MIN)
ARM A	3.65	9.00	22.80	20.00	90.00	30.0	0.503	33.863
ARM B	7.30	10.60	22.60	15.00	90.00	24.0	0.628	48.441
ARM C	3.60	10.55	27.00	20.00	90.00	24.0	0.545	38.204
ARM D	5.00	10.70	27.50	20.00	90.00	31.0	0.575	42.409

ARM E	3.65	9.00	35.00	20.00	90.00	30.0
	0.526	36.575				

V = approach half-width L = effective flare length D = inscribed circle diameter
E = entry width R = entry radius PHI = entry angle

WARNING ARM E: Effective flare length is outside normal range.
Treat capacities with increasing caution.

.TRAFFIC DEMAND DATA

TIME PERIOD BEGINS 08.00 AND ENDS 09.00
.LENGTH OF TIME PERIOD - 60 MINUTES.
LENGTH OF TIME SEGMENT - 15 MINUTES.

.DEMAND FLOW PROFILES ARE INPUT DIRECTLY.

TURNING PROPORTIONS
TURNING COUNTS
(PERCENTAGE OF H.V.S)

TIME	FROM/TO	ARM A	ARM B	ARM C	ARM D	ARM E
08.00 - 08.15	ARM A	0.000	0.176	0.215	0.348	0.262
		0.0	19.0	23.3	37.7	28.3
		(10.0)	(10.0)	(10.0)	(10.0)	(10.0)
	ARM B	0.043	0.000	0.257	0.544	0.156
		13.9	0.0	83.2	176.4	50.6
		(10.0)	(10.0)	(10.0)	(10.0)	(10.0)
	ARM C	0.249	0.554	0.000	0.016	0.181
		48.3	107.3	0.0	3.1	35.1
		(10.0)	(10.0)	(10.0)	(10.0)	(10.0)
	ARM D	0.159	0.826	0.001	0.000	0.015
		49.1	255.5	0.2	0.0	4.5
		(10.0)	(10.0)	(10.0)	(10.0)	(10.0)
	ARM E	0.180	0.404	0.221	0.195	0.000
		19.1	42.8	23.4	20.6	0.0
		(10.0)	(10.0)	(10.0)	(10.0)	(10.0)
08.15 - 08.30	ARM A	0.000	0.176	0.215	0.348	0.262
		0.0	19.0	23.3	37.7	28.3
		(10.0)	(10.0)	(10.0)	(10.0)	(10.0)
	ARM B	0.043	0.000	0.257	0.544	0.156
		13.9	0.0	83.2	176.4	50.6
		(10.0)	(10.0)	(10.0)	(10.0)	(10.0)
	ARM C	0.249	0.554	0.000	0.016	0.181
		48.3	107.3	0.0	3.1	35.1
		(10.0)	(10.0)	(10.0)	(10.0)	(10.0)
	ARM D	0.159	0.826	0.001	0.000	0.015
		49.1	255.5	0.2	0.0	4.5

		(10.0)	(10.0)	(10.0)	(10.0)	(10.0)
	ARM E	0.180	0.404	0.221	0.195	0.000
		19.1	42.8	23.4	20.6	0.0
		(10.0)	(10.0)	(10.0)	(10.0)	(10.0)

TURNING PROPORTIONS
TURNING COUNTS
(PERCENTAGE OF H.V.S)

TIME	FROM/TO	ARM A	ARM B	ARM C	ARM D	ARM E
08.30 - 08.45						
	ARM A	0.000	0.176	0.215	0.348	0.262
		0.0	19.0	23.3	37.7	28.3
		(10.0)	(10.0)	(10.0)	(10.0)	(10.0)
	ARM B	0.043	0.000	0.257	0.544	0.156
		13.9	0.0	83.2	176.4	50.6
		(10.0)	(10.0)	(10.0)	(10.0)	(10.0)
	ARM C	0.249	0.554	0.000	0.016	0.181
		48.3	107.3	0.0	3.1	35.1
		(10.0)	(10.0)	(10.0)	(10.0)	(10.0)
	ARM D	0.159	0.826	0.001	0.000	0.015
		49.1	255.5	0.2	0.0	4.5
		(10.0)	(10.0)	(10.0)	(10.0)	(10.0)
	ARM E	0.180	0.404	0.221	0.195	0.000
		19.1	42.8	23.4	20.6	0.0
		(10.0)	(10.0)	(10.0)	(10.0)	(10.0)
08.45 - 09.00						
	ARM A	0.000	0.176	0.215	0.348	0.262
		0.0	19.0	23.3	37.7	28.3
		(10.0)	(10.0)	(10.0)	(10.0)	(10.0)
	ARM B	0.043	0.000	0.257	0.544	0.156
		13.9	0.0	83.2	176.4	50.6
		(10.0)	(10.0)	(10.0)	(10.0)	(10.0)
	ARM C	0.249	0.554	0.000	0.016	0.181
		48.3	107.3	0.0	3.1	35.1
		(10.0)	(10.0)	(10.0)	(10.0)	(10.0)
	ARM D	0.159	0.826	0.001	0.000	0.015
		49.1	255.5	0.2	0.0	4.5
		(10.0)	(10.0)	(10.0)	(10.0)	(10.0)
	ARM E	0.180	0.404	0.221	0.195	0.000
		19.1	42.8	23.4	20.6	0.0
		(10.0)	(10.0)	(10.0)	(10.0)	(10.0)

TURNING PROPORTIONS ARE CALCULATED FROM TURNING COUNT DATA
THE TURNING PROPORTIONS USED VARY BETWEEN TIME SEGMENTS
DEFAULT PROPORTIONS OF HEAVY VEHICLES ARE USED

QUEUE AND DELAY INFORMATION FOR EACH 15 MIN TIME SEGMENT

I TIME	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT) I
I 08.00-08.15								I
I ARM A	7.22	15.81	0.457		0.0	0.8	11.9	I
I ARM B	21.62	38.48	0.562		0.0	1.3	18.5	I
I ARM C	12.92	22.89	0.564		0.0	1.3	18.3	I
I ARM D	20.62	27.74	0.743		0.0	2.8	38.7	I
I ARM E	7.07	16.74	0.422		0.0	0.7	10.4	I
I								I

I TIME	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT) I
I 08.15-08.30								I
I ARM A	7.22	15.69	0.460		0.8	0.8	12.6	I
I ARM B	21.62	38.44	0.562		1.3	1.3	19.1	I
I ARM C	12.92	22.83	0.566		1.3	1.3	19.3	I
I ARM D	20.62	27.68	0.745		2.8	2.9	42.6	I
I ARM E	7.07	16.61	0.426		0.7	0.7	11.0	I
I								I

I TIME	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT) I
I 08.30-08.45								I
I ARM A	7.22	15.69	0.460		0.8	0.8	12.7	I
I ARM B	21.62	38.44	0.562		1.3	1.3	19.2	I
I ARM C	12.92	22.83	0.566		1.3	1.3	19.4	I
I ARM D	20.62	27.68	0.745		2.9	2.9	43.1	I
I ARM E	7.07	16.61	0.426		0.7	0.7	11.0	I

TIME SEGMENT	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT)
08.45-09.00								
ARM A	7.22	15.69	0.460		0.8	0.8	12.7	
ARM B	21.62	38.44	0.562		1.3	1.3	19.2	
ARM C	12.92	22.83	0.566		1.3	1.3	19.5	
ARM D	20.62	27.68	0.745		2.9	2.9	43.3	
ARM E	7.07	16.61	0.426		0.7	0.7	11.1	

.QUEUE AT ARM A

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE	
08.15	0.8	*
08.30	0.8	*
08.45	0.8	*
09.00	0.8	*

.QUEUE AT ARM B

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE	
08.15	1.3	*
08.30	1.3	*
08.45	1.3	*
09.00	1.3	*

.QUEUE AT ARM C

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE	
08.15	1.3	*
08.30	1.3	*
08.45	1.3	*

09.00	1.3	*

.QUEUE AT ARM D

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE	
08.15	2.8	***
08.30	2.9	***
08.45	2.9	***
09.00	2.9	***

.QUEUE AT ARM E

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE	
08.15	0.7	*
08.30	0.7	*
08.45	0.7	*
09.00	0.7	*

. QUEUEING DELAY INFORMATION OVER WHOLE PERIOD

ARM	TOTAL DEMAND		* QUEUEING * DELAY *		* INCLUSIVE QUEUEING * DELAY *	
	(VEH)	(VEH/H)	(MIN)	(MIN/VEH)	(MIN)	(MIN/VEH)
A	433.2	433.2	49.9	0.12	49.9	0.12
B	1297.2	1297.2	76.0	0.06	76.0	0.06
C	775.2	775.2	76.4	0.10	76.5	0.10
D	1237.2	1237.2	167.7	0.14	167.9	0.14
E	424.2	424.2	43.5	0.10	43.5	0.10
ALL	4167.0	4167.0	413.6	0.10	413.8	0.10

* DELAY IS THAT OCCURRING ONLY WITHIN THE TIME PERIOD.
* INCLUSIVE DELAY INCLUDES DELAY SUFFERED BY VEHICLES WHICH ARE STILL QUEUEING AFTER THE END OF THE TIME PERIOD.
* THESE WILL ONLY BE SIGNIFICANTLY DIFFERENT IF THERE IS A LARGE QUEUE REMAINING AT THE END OF THE TIME PERIOD.

END OF JOB

****** ARCADY 5 run completed.

A5 Churncote RDBT 2017 NWRR PM (17DSPM)
TRL LIMITED

CAPACITIES, QUEUES AND DELAYS AT ROUNDABOUTS

ARCADY 5.0 ANALYSIS PROGRAM
RELEASE 1.1 (MAY 2001)

FOR SALES AND DISTRIBUTION INFORMATION,
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TRL SOFTWARE BUREAU
TEL: CROWTHORNE (01344) 770758, FAX: 770864
EMAIL: SoftwareBureau@trl.co.uk

Run with file:-
"g:\755633 North West Relief Road - Preferred Route\A5 Roundabouts\New Work April 2010\90ICD\DIRECT\
Without Seg lane\A5 Churncote RDBT 2017 NWRR PM (17DSPM).vai"
(drive-on-the-left) at 11:52:46 on Monday, 26 July 2010

.ROUNDABOUT CAPACITY AND DELAY
****

.RUN TITLE
****
A5 Churncote RDBT 2017 NWRR PM (17DSPM) DIRECT

.INPUT DATA
****
ARM A - A458 Shrewsbury
ARM B - A5 Telford
ARM C - A458 Welshpool
ARM D - A5 Oswestry
ARM E - NWRR

.GEOMETRIC DATA

ARM	V (M)	E (M)	L (M)	R (M)	D (M)	PHI (DEG)	SLOPE	INTERCEPT (PCU/MIN)
ARM A	3.65	9.00	22.80	20.00	90.00	30.0	0.503	33.863
ARM B	7.30	10.60	22.60	15.00	90.00	24.0	0.628	48.441
ARM C	3.65	10.55	27.00	20.00	90.00	24.0	0.546	38.384
ARM D	5.00	10.70	27.50	20.00	90.00	31.0	0.575	42.409

ARM E	3.65	9.00	35.00	20.00	90.00	30.0	0.526	36.575

V = approach half-width L = effective flare length D = inscribed circle diameter
E = entry width R = entry radius PHI = entry angle

WARNING ARM E: Effective flare length is outside normal range.
Treat capacities with increasing caution.

.TRAFFIC DEMAND DATA

TIME PERIOD BEGINS 17.00 AND ENDS 18.00
.LENGTH OF TIME PERIOD - 60 MINUTES.
LENGTH OF TIME SEGMENT - 15 MINUTES.

.DEMAND FLOW PROFILES ARE INPUT DIRECTLY.

TURNING PROPORTIONS
TURNING COUNTS
(PERCENTAGE OF H.V.S)

TIME	FROM/TO	ARM A	ARM B	ARM C	ARM D	ARM E
17.00 - 17.15	ARM A	0.000	0.291	0.278	0.383	0.049
		0.0	48.6	46.4	64.0	8.2
		(10.0)	(10.0)	(10.0)	(10.0)	(10.0)
	ARM B	0.022	0.000	0.305	0.593	0.079
		9.5	0.0	129.5	251.8	33.7
		(10.0)	(10.0)	(10.0)	(10.0)	(10.0)
	ARM C	0.175	0.634	0.000	0.009	0.182
		23.7	85.9	0.0	1.3	24.6
		(10.0)	(10.0)	(10.0)	(10.0)	(10.0)
	ARM D	0.144	0.846	0.001	0.000	0.009
		34.3	201.6	0.2	0.0	2.3
		(10.0)	(10.0)	(10.0)	(10.0)	(10.0)
	ARM E	0.219	0.377	0.271	0.133	0.000
		29.4	50.7	36.4	18.0	0.0
		(10.0)	(10.0)	(10.0)	(10.0)	(10.0)
17.15 - 17.30	ARM A	0.000	0.291	0.278	0.383	0.049
		0.0	48.6	46.4	64.0	8.2
		(10.0)	(10.0)	(10.0)	(10.0)	(10.0)
	ARM B	0.022	0.000	0.305	0.593	0.079
		9.5	0.0	129.5	251.8	33.7
		(10.0)	(10.0)	(10.0)	(10.0)	(10.0)
	ARM C	0.175	0.634	0.000	0.009	0.182
		23.7	85.9	0.0	1.3	24.6
		(10.0)	(10.0)	(10.0)	(10.0)	(10.0)
	ARM D	0.144	0.846	0.001	0.000	0.009
		34.3	201.6	0.2	0.0	2.3

		(10.0)	(10.0)	(10.0)	(10.0)	(10.0)
	ARM E	0.219	0.377	0.271	0.133	0.000
		29.4	50.7	36.4	18.0	0.0
		(10.0)	(10.0)	(10.0)	(10.0)	(10.0)

TURNING PROPORTIONS
TURNING COUNTS
(PERCENTAGE OF H.V.S)

TIME	FROM/TO	ARM A	ARM B	ARM C	ARM D	ARM E
17.30 - 17.45						
	ARM A	0.000	0.291	0.278	0.383	0.049
		0.0	48.6	46.4	64.0	8.2
		(10.0)	(10.0)	(10.0)	(10.0)	(10.0)
	ARM B	0.022	0.000	0.305	0.593	0.079
		9.5	0.0	129.5	251.8	33.7
		(10.0)	(10.0)	(10.0)	(10.0)	(10.0)
	ARM C	0.175	0.634	0.000	0.009	0.182
		23.7	85.9	0.0	1.3	24.6
		(10.0)	(10.0)	(10.0)	(10.0)	(10.0)
	ARM D	0.144	0.846	0.001	0.000	0.009
		34.3	201.6	0.2	0.0	2.3
		(10.0)	(10.0)	(10.0)	(10.0)	(10.0)
	ARM E	0.219	0.377	0.271	0.133	0.000
		29.4	50.7	36.4	18.0	0.0
		(10.0)	(10.0)	(10.0)	(10.0)	(10.0)
17.45 - 18.00						
	ARM A	0.000	0.291	0.278	0.383	0.049
		0.0	48.6	46.4	64.0	8.2
		(10.0)	(10.0)	(10.0)	(10.0)	(10.0)
	ARM B	0.022	0.000	0.305	0.593	0.079
		9.5	0.0	129.5	251.8	33.7
		(10.0)	(10.0)	(10.0)	(10.0)	(10.0)
	ARM C	0.175	0.634	0.000	0.009	0.182
		23.7	85.9	0.0	1.3	24.6
		(10.0)	(10.0)	(10.0)	(10.0)	(10.0)
	ARM D	0.144	0.846	0.001	0.000	0.009
		34.3	201.6	0.2	0.0	2.3
		(10.0)	(10.0)	(10.0)	(10.0)	(10.0)
	ARM E	0.219	0.377	0.271	0.133	0.000
		29.4	50.7	36.4	18.0	0.0
		(10.0)	(10.0)	(10.0)	(10.0)	(10.0)

TURNING PROPORTIONS ARE CALCULATED FROM TURNING COUNT DATA
THE TURNING PROPORTIONS USED VARY BETWEEN TIME SEGMENTS
DEFAULT PROPORTIONS OF HEAVY VEHICLES ARE USED

QUEUE AND DELAY INFORMATION FOR EACH 15 MIN TIME SEGMENT

I TIME	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT) I
I 17.00-17.15								I
I ARM A	11.15	17.67	0.631		0.0	1.7	23.3	I
I ARM B	28.30	36.84	0.768		0.0	3.2	44.6	I
I ARM C	9.03	20.98	0.430		0.0	0.7	10.8	I
I ARM D	15.89	31.48	0.505		0.0	1.0	14.7	I
I ARM E	8.97	20.85	0.430		0.0	0.7	10.8	I
I								I

I TIME	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT) I
I 17.15-17.30								I
I ARM A	11.15	17.61	0.633		1.7	1.7	25.3	I
I ARM B	28.30	36.78	0.769		3.2	3.3	48.7	I
I ARM C	9.03	20.87	0.433		0.7	0.8	11.3	I
I ARM D	15.89	31.44	0.505		1.0	1.0	15.2	I
I ARM E	8.97	20.79	0.431		0.7	0.8	11.3	I
I								I

I TIME	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT) I
I 17.30-17.45								I
I ARM A	11.15	17.61	0.633		1.7	1.7	25.6	I
I ARM B	28.30	36.78	0.769		3.3	3.3	49.3	I
I ARM C	9.03	20.87	0.433		0.8	0.8	11.4	I
I ARM D	15.89	31.44	0.505		1.0	1.0	15.3	I
I ARM E	8.97	20.79	0.431		0.8	0.8	11.3	

TIME SEGMENT	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT)
17.45-18.00								
ARM A	11.15	17.61	0.633		1.7	1.7	25.7	
ARM B	28.30	36.78	0.769		3.3	3.3	49.5	
ARM C	9.03	20.87	0.433		0.8	0.8	11.4	
ARM D	15.89	31.44	0.505		1.0	1.0	15.3	
ARM E	8.97	20.79	0.432		0.8	0.8	11.3	

.QUEUE AT ARM A

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE	
17.15	1.7	**
17.30	1.7	**
17.45	1.7	**
18.00	1.7	**

.QUEUE AT ARM B

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE	
17.15	3.2	***
17.30	3.3	***
17.45	3.3	***
18.00	3.3	***

.QUEUE AT ARM C

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE	
17.15	0.7	*
17.30	0.8	*
17.45	0.8	*

18.00	0.8 *

.QUEUE AT ARM D

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE
17.15	1.0 *
17.30	1.0 *
17.45	1.0 *
18.00	1.0 *

.QUEUE AT ARM E

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE
17.15	0.7 *
17.30	0.8 *
17.45	0.8 *
18.00	0.8 *

. QUEUEING DELAY INFORMATION OVER WHOLE PERIOD

ARM	TOTAL DEMAND		* QUEUEING * DELAY *		* INCLUSIVE QUEUEING * DELAY *	
	(VEH)	(VEH/H)	(MIN)	(MIN/VEH)	(MIN)	(MIN/VEH)
A	669.0	669.0	99.8	0.15	99.9	0.15
B	1698.0	1698.0	192.2	0.11	192.3	0.11
C	541.8	541.8	44.9	0.08	45.0	0.08
D	953.4	953.4	60.5	0.06	60.5	0.06
E	538.2	538.2	44.8	0.08	44.8	0.08
ALL	4400.4	4400.4	442.2	0.10	442.5	0.10

* DELAY IS THAT OCCURRING ONLY WITHIN THE TIME PERIOD.
* INCLUSIVE DELAY INCLUDES DELAY SUFFERED BY VEHICLES WHICH ARE STILL QUEUEING AFTER THE END OF THE TIME PERIOD.
* THESE WILL ONLY BE SIGNIFICANTLY DIFFERENT IF THERE IS A LARGE QUEUE REMAINING AT THE END OF THE TIME PERIOD.

END OF JOB

****** ARCADY 5 run completed.

A5 Churncote RDBT 2017 NWRR SUN (17DS)
TRL LIMITED

CAPACITIES, QUEUES AND DELAYS AT ROUNDABOUTS

ARCADY 5.0 ANALYSIS PROGRAM
RELEASE 1.1 (MAY 2001)

FOR SALES AND DISTRIBUTION INFORMATION,
PROGRAM ADVICE AND MAINTENANCE CONTACT:
TRL SOFTWARE BUREAU
TEL: CROWTHORNE (01344) 770758, FAX: 770864
EMAIL: SoftwareBureau@trl.co.uk

Run with file:-
"g:\755633 North West Relief Road - Preferred Route\A5 Roundabouts\New Work April 2010\90ICD\DIRECT\
Without Seg lane\A5 Churncote RDBT 2017 NWRR SUN (17DS).vai"
(drive-on-the-left) at 17:27:53 on Friday, 3 September 2010

.ROUNDABOUT CAPACITY AND DELAY
****

.RUN TITLE
****
A5 Churncote RDBT 2017 NWRR SUN

.INPUT DATA
****
ARM A - A458 Shrewsbury
ARM B - A5 Telford
ARM C - A458 Welshpool
ARM D - A5 Oswestry
ARM E - NWRR

.GEOMETRIC DATA

ARM	V (M)	E (M)	L (M)	R (M)	D (M)	PHI (DEG)	SLOPE	INTERCEPT (PCU/MIN)
ARM A	3.65	9.00	22.80	20.00	90.00	30.0	0.503	33.863
ARM B	7.30	10.60	22.60	15.00	90.00	24.0	0.628	48.441
ARM C	3.60	10.55	27.00	20.00	90.00	24.0	0.545	38.204
ARM D	5.00	10.70	27.50	20.00	90.00	31.0	0.575	42.409

I ARM E I	3.65	I 9.00	I 35.00	I 20.00	I 90.00	I 30.0 I 0.526 I 36.575 I

V = approach half-width L = effective flare length D = inscribed circle diameter
E = entry width R = entry radius PHI = entry angle

WARNING ARM E: Effective flare length is outside normal range.
Treat capacities with increasing caution.

.TRAFFIC DEMAND DATA

TIME PERIOD BEGINS 08.00 AND ENDS 09.00
.LENGTH OF TIME PERIOD - 60 MINUTES.
LENGTH OF TIME SEGMENT - 15 MINUTES.

.DEMAND FLOW PROFILES ARE INPUT DIRECTLY.

TURNING PROPORTIONS
TURNING COUNTS
(PERCENTAGE OF H.V.S)

TIME	FROM/TO	ARM A	ARM B	ARM C	ARM D	ARM E
08.00 - 09.00	ARM A	0.000	0.223	0.267	0.292	0.217
		0.0	71.0	85.0	93.0	69.0
		(10.0)	(10.0)	(10.0)	(10.0)	(10.0)
	ARM B	0.028	0.000	0.322	0.574	0.076
		38.0	0.0	431.0	769.0	102.0
		(10.0)	(10.0)	(10.0)	(10.0)	(10.0)
	ARM C	0.111	0.772	0.000	0.006	0.111
		93.0	645.0	0.0	5.0	93.0
		(10.0)	(10.0)	(10.0)	(10.0)	(10.0)
	ARM D	0.086	0.865	0.004	0.000	0.044
		78.0	782.0	4.0	0.0	40.0
		(10.0)	(10.0)	(10.0)	(10.0)	(10.0)
	ARM E	0.127	0.365	0.375	0.133	0.000
		40.0	115.0	118.0	42.0	0.0
		(10.0)	(10.0)	(10.0)	(10.0)	(10.0)

TURNING PROPORTIONS ARE CALCULATED FROM TURNING COUNT DATA
DEFAULT PROPORTIONS OF HEAVY VEHICLES ARE USED

. QUEUE AND DELAY INFORMATION FOR EACH 15 MIN TIME SEGMENT

TIME SEGMENT	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN) (RFC)	DEMAND/ CAPACITY	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT)
08.00-08.15								

I ARM A	5.30	16.56	0.320	0.0	0.5	6.8
I ARM B	22.33	39.76	0.562	0.0	1.3	18.5
I ARM C	13.93	24.67	0.565	0.0	1.3	18.3
I ARM D	15.07	28.64	0.526	0.0	1.1	15.9
I ARM E	5.24	18.94	0.277	0.0	0.4	5.5

I TIME SEGMENT	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT) I
I 08.15-08.30								
I ARM A	5.30	16.48	0.322		0.5	0.5	7.0	
I ARM B	22.33	39.74	0.562		1.3	1.3	19.1	
I ARM C	13.93	24.63	0.566		1.3	1.3	19.3	
I ARM D	15.07	28.58	0.527		1.1	1.1	16.6	
I ARM E	5.24	18.86	0.278		0.4	0.4	5.7	

I TIME SEGMENT	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT) I
I 08.30-08.45								
I ARM A	5.30	16.48	0.322		0.5	0.5	7.1	
I ARM B	22.33	39.74	0.562		1.3	1.3	19.2	
I ARM C	13.93	24.63	0.566		1.3	1.3	19.4	
I ARM D	15.07	28.58	0.527		1.1	1.1	16.6	
I ARM E	5.24	18.86	0.278		0.4	0.4	5.8	

I TIME	DEMAND	CAPACITY	DEMAND/	PEDESTRIAN	START	END	DELAY	GEOMETRIC DELAY I
I	(VEH/MIN)	(VEH/MIN)	CAPACITY	FLOW	QUEUE	QUEUE	(VEH.MIN/	(VEH.MIN/ I
I			(RFC)	(PEDS/MIN)	(VEHS)	(VEHS)	TIME	SEGMENT) TIME SEGMENT) I
I 08.45-09.00								I
I ARM A	5.30	16.48	0.322		0.5	0.5	7.1	I
I ARM B	22.33	39.74	0.562		1.3	1.3	19.2	I
I ARM C	13.93	24.63	0.566		1.3	1.3	19.4	I
I ARM D	15.07	28.58	0.527		1.1	1.1	16.7	I
I ARM E	5.24	18.86	0.278		0.4	0.4	5.8	I
I								I

.QUEUE AT ARM A

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE	
08.15	0.5	
08.30	0.5	
08.45	0.5	
09.00	0.5	

.QUEUE AT ARM B

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE	
08.15	1.3	*
08.30	1.3	*
08.45	1.3	*
09.00	1.3	*

.QUEUE AT ARM C

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE	
08.15	1.3	*
08.30	1.3	*
08.45	1.3	*
09.00	1.3	*

.QUEUE AT ARM D

TIME SEGMENT ENDING	NO. OF VEHICLES

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE	
08.15	1.1	*
08.30	1.1	*
08.45	1.1	*
09.00	1.1	*

.QUEUE AT ARM E

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE
08.15	0.4
08.30	0.4
08.45	0.4
09.00	0.4

. QUEUEING DELAY INFORMATION OVER WHOLE PERIOD

ARM	TOTAL DEMAND		* QUEUEING * DELAY *		* INCLUSIVE QUEUEING * DELAY *	
	(VEH)	(VEH/H)	(MIN)	(MIN/VEH)	(MIN)	(MIN/VEH)
A	318.0	318.0	28.0	0.09	28.0	0.09
B	1339.8	1339.8	75.9	0.06	76.0	0.06
C	835.8	835.8	76.5	0.09	76.5	0.09
D	904.2	904.2	65.8	0.07	65.8	0.07
E	314.4	314.4	22.8	0.07	22.8	0.07
ALL	3712.2	3712.2	269.0	0.07	269.1	0.07

* DELAY IS THAT OCCURRING ONLY WITHIN THE TIME PERIOD.
* INCLUSIVE DELAY INCLUDES DELAY SUFFERED BY VEHICLES WHICH ARE STILL QUEUEING AFTER THE END OF THE TIME PERIOD.
* THESE WILL ONLY BE SIGNIFICANTLY DIFFERENT IF THERE IS A LARGE QUEUE REMAINING AT THE END OF THE TIME PERIOD.

END OF JOB

****** ARCADY 5 run completed.

A5 Churncote RDBT 2032 NWRR AM (32DSAM)
TRL LIMITED

CAPACITIES, QUEUES AND DELAYS AT ROUNDABOUTS

ARCADY 5.0 ANALYSIS PROGRAM
RELEASE 1.1 (MAY 2001)

FOR SALES AND DISTRIBUTION INFORMATION,
PROGRAM ADVICE AND MAINTENANCE CONTACT:
TRL SOFTWARE BUREAU
TEL: CROWTHORNE (01344) 770758, FAX: 770864
EMAIL: SoftwareBureau@trl.co.uk

Run with file:-
"g:\755633 North West Relief Road - Preferred Route\A5 Roundabouts\New Work April 2010\90ICD\DIRECT\
Without Seg lane\A5 Churncote RDBT 2032 NWRR AM (32DSAM).vai"
(drive-on-the-left) at 12:02:44 on Monday, 26 July 2010

.ROUNDABOUT CAPACITY AND DELAY
****

.RUN TITLE
****
A5 Churncote RDBT 2032 NWRR AM (32DSAM) DIRECT

.INPUT DATA
****
ARM A - A458 Shrewsbury
ARM B - A5 Telford
ARM C - A458 Welshpool
ARM D - A5 Oswestry
ARM E - NWRR

.GEOMETRIC DATA

I ARM	V (M)	E (M)	L (M)	R (M)	D (M)	PHI (DEG)	SLOPE	INTERCEPT (PCU/MIN)
ARM A	3.65	9.00	22.80	20.00	90.00	30.0	0.503	33.863
ARM B	7.30	10.60	22.60	15.00	90.00	24.0	0.628	48.441
ARM C	3.65	10.55	27.00	20.00	90.00	24.0	0.546	38.384
ARM D	5.00	10.70	27.50	20.00	90.00	31.0	0.575	42.409

ARM E	3.65	9.00	35.00	20.00	90.00	30.0	0.526	36.575

V = approach half-width L = effective flare length D = inscribed circle diameter
E = entry width R = entry radius PHI = entry angle

WARNING ARM E: Effective flare length is outside normal range.
Treat capacities with increasing caution.

.TRAFFIC DEMAND DATA

TIME PERIOD BEGINS 08.00 AND ENDS 09.00
.LENGTH OF TIME PERIOD - 60 MINUTES.
LENGTH OF TIME SEGMENT - 15 MINUTES.

.DEMAND FLOW PROFILES ARE INPUT DIRECTLY.

TURNING PROPORTIONS
TURNING COUNTS
(PERCENTAGE OF H.V.S)

TIME	FROM/TO	ARM A	ARM B	ARM C	ARM D	ARM E
08.00 - 08.15	ARM A	0.000	0.207	0.206	0.332	0.256
		0.0	25.4	25.3	40.8	31.5
		(10.0)	(10.0)	(10.0)	(10.0)	(10.0)
	ARM B	0.062	0.000	0.260	0.517	0.161
		23.2	0.0	97.9	194.9	60.5
		(10.0)	(10.0)	(10.0)	(10.0)	(10.0)
	ARM C	0.270	0.525	0.000	0.016	0.189
		56.3	109.3	0.0	3.3	39.4
		(10.0)	(10.0)	(10.0)	(10.0)	(10.0)
	ARM D	0.212	0.775	0.000	0.000	0.012
		70.9	258.5	0.1	0.0	4.0
		(10.0)	(10.0)	(10.0)	(10.0)	(10.0)
	ARM E	0.217	0.346	0.225	0.212	0.000
		24.2	38.6	25.1	23.7	0.0
		(10.0)	(10.0)	(10.0)	(10.0)	(10.0)
08.15 - 08.30	ARM A	0.000	0.207	0.206	0.332	0.256
		0.0	25.4	25.3	40.8	31.5
		(10.0)	(10.0)	(10.0)	(10.0)	(10.0)
	ARM B	0.062	0.000	0.260	0.517	0.161
		23.2	0.0	97.9	194.9	60.5
		(10.0)	(10.0)	(10.0)	(10.0)	(10.0)
	ARM C	0.270	0.525	0.000	0.016	0.189
		56.3	109.3	0.0	3.3	39.4
		(10.0)	(10.0)	(10.0)	(10.0)	(10.0)
	ARM D	0.212	0.775	0.000	0.000	0.012
		70.9	258.5	0.1	0.0	4.0

		(10.0)	(10.0)	(10.0)	(10.0)	(10.0)
	ARM E	0.217	0.346	0.225	0.212	0.000
		24.2	38.6	25.1	23.7	0.0
		(10.0)	(10.0)	(10.0)	(10.0)	(10.0)

TURNING PROPORTIONS
TURNING COUNTS
(PERCENTAGE OF H.V.S)

TIME	FROM/TO	ARM A	ARM B	ARM C	ARM D	ARM E
08.30 - 08.45						
	ARM A	0.000	0.207	0.206	0.332	0.256
		0.0	25.4	25.3	40.8	31.5
		(10.0)	(10.0)	(10.0)	(10.0)	(10.0)
	ARM B	0.062	0.000	0.260	0.517	0.161
		23.2	0.0	97.9	194.9	60.5
		(10.0)	(10.0)	(10.0)	(10.0)	(10.0)
	ARM C	0.270	0.525	0.000	0.016	0.189
		56.3	109.3	0.0	3.3	39.4
		(10.0)	(10.0)	(10.0)	(10.0)	(10.0)
	ARM D	0.212	0.775	0.000	0.000	0.012
		70.9	258.5	0.1	0.0	4.0
		(10.0)	(10.0)	(10.0)	(10.0)	(10.0)
	ARM E	0.217	0.346	0.225	0.212	0.000
		24.2	38.6	25.1	23.7	0.0
		(10.0)	(10.0)	(10.0)	(10.0)	(10.0)
08.45 - 09.00						
	ARM A	0.000	0.207	0.206	0.332	0.256
		0.0	25.4	25.3	40.8	31.5
		(10.0)	(10.0)	(10.0)	(10.0)	(10.0)
	ARM B	0.062	0.000	0.260	0.517	0.161
		23.2	0.0	97.9	194.9	60.5
		(10.0)	(10.0)	(10.0)	(10.0)	(10.0)
	ARM C	0.270	0.525	0.000	0.016	0.189
		56.3	109.3	0.0	3.3	39.4
		(10.0)	(10.0)	(10.0)	(10.0)	(10.0)
	ARM D	0.212	0.775	0.000	0.000	0.012
		70.9	258.5	0.1	0.0	4.0
		(10.0)	(10.0)	(10.0)	(10.0)	(10.0)
	ARM E	0.217	0.346	0.225	0.212	0.000
		24.2	38.6	25.1	23.7	0.0
		(10.0)	(10.0)	(10.0)	(10.0)	(10.0)

TURNING PROPORTIONS ARE CALCULATED FROM TURNING COUNT DATA
THE TURNING PROPORTIONS USED VARY BETWEEN TIME SEGMENTS
DEFAULT PROPORTIONS OF HEAVY VEHICLES ARE USED

QUEUE AND DELAY INFORMATION FOR EACH 15 MIN TIME SEGMENT

I TIME	DEMAND	CAPACITY	DEMAND/	PEDESTRIAN	START	END	DELAY	GEOMETRIC DELAYI
I	(VEH/MIN)	(VEH/MIN)	CAPACITY	FLOW	QUEUE	QUEUE	(VEH.MIN/	(VEH.MIN/ I
I			(RFC)	(PEDS/MIN)	(VEHS)	(VEHS)	TIME	SEGMENT) TIME SEGMENT) I
I 08.00-08.15								
I ARM A	8.21	15.69	0.523		0.0	1.1	15.3	
I ARM B	24.11	37.95	0.635		0.0	1.7	24.7	
I ARM C	13.89	21.73	0.639		0.0	1.7	24.4	
I ARM D	22.23	26.49	0.839		0.0	4.8	62.5	
I ARM E	7.44	15.32	0.486		0.0	0.9	13.3	
I								

I TIME	DEMAND	CAPACITY	DEMAND/	PEDESTRIAN	START	END	DELAY	GEOMETRIC DELAYI
I	(VEH/MIN)	(VEH/MIN)	CAPACITY	FLOW	QUEUE	QUEUE	(VEH.MIN/	(VEH.MIN/ I
I			(RFC)	(PEDS/MIN)	(VEHS)	(VEHS)	TIME	SEGMENT) TIME SEGMENT) I
I 08.15-08.30								
I ARM A	8.21	15.52	0.529		1.1	1.1	16.5	
I ARM B	24.11	37.90	0.636		1.7	1.7	25.9	
I ARM C	13.89	21.65	0.641		1.7	1.8	26.3	
I ARM D	22.23	26.40	0.842		4.8	5.1	74.4	
I ARM E	7.44	15.11	0.492		0.9	1.0	14.2	
I								

I TIME	DEMAND	CAPACITY	DEMAND/	PEDESTRIAN	START	END	DELAY	GEOMETRIC DELAYI
I	(VEH/MIN)	(VEH/MIN)	CAPACITY	FLOW	QUEUE	QUEUE	(VEH.MIN/	(VEH.MIN/ I
I			(RFC)	(PEDS/MIN)	(VEHS)	(VEHS)	TIME	SEGMENT) TIME SEGMENT) I
I 08.30-08.45								
I ARM A	8.21	15.52	0.529		1.1	1.1	16.7	
I ARM B	24.11	37.90	0.636		1.7	1.7	26.1	
I ARM C	13.89	21.65	0.642		1.8	1.8	26.5	
I ARM D	22.23	26.40	0.842		5.1	5.2	76.7	
I ARM E	7.44	15.10	0.493		1.0	1.0	14.4	

TIME SEGMENT	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT)
08.45-09.00								
ARM A	8.21	15.51	0.529		1.1	1.1	16.7	
ARM B	24.11	37.90	0.636		1.7	1.7	26.1	
ARM C	13.89	21.65	0.642		1.8	1.8	26.6	
ARM D	22.23	26.39	0.842		5.2	5.2	77.7	
ARM E	7.44	15.10	0.493		1.0	1.0	14.5	

.QUEUE AT ARM A

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE	
08.15	1.1	*
08.30	1.1	*
08.45	1.1	*
09.00	1.1	*

.QUEUE AT ARM B

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE	
08.15	1.7	**
08.30	1.7	**
08.45	1.7	**
09.00	1.7	**

.QUEUE AT ARM C

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE	
08.15	1.7	**
08.30	1.8	**
08.45	1.8	**

09.00	1.8	**

.QUEUE AT ARM D

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE	
08.15	4.8	*****
08.30	5.1	*****
08.45	5.2	*****
09.00	5.2	*****

.QUEUE AT ARM E

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE	
08.15	0.9	*
08.30	1.0	*
08.45	1.0	*
09.00	1.0	*

. QUEUEING DELAY INFORMATION OVER WHOLE PERIOD

ARM	TOTAL DEMAND		* QUEUEING * DELAY *		* INCLUSIVE QUEUEING * DELAY *	
	(VEH)	(VEH/H)	(MIN)	(MIN/VEH)	(MIN)	(MIN/VEH)
A	492.6	492.6	65.2	0.13	65.2	0.13
B	1446.6	1446.6	102.9	0.07	102.9	0.07
C	833.4	833.4	103.9	0.12	104.0	0.12
D	1333.8	1333.8	291.4	0.22	291.9	0.22
E	446.4	446.4	56.4	0.13	56.4	0.13
ALL	4552.8	4552.8	619.8	0.14	620.5	0.14

* DELAY IS THAT OCCURRING ONLY WITHIN THE TIME PERIOD.
* INCLUSIVE DELAY INCLUDES DELAY SUFFERED BY VEHICLES WHICH ARE STILL QUEUEING AFTER THE END OF THE TIME PERIOD.
* THESE WILL ONLY BE SIGNIFICANTLY DIFFERENT IF THERE IS A LARGE QUEUE REMAINING AT THE END OF THE TIME PERIOD.

END OF JOB

****** ARCADY 5 run completed.

A5 Churncote RDBT 2032 NWRR PM (32DSPM)
TRL LIMITED

CAPACITIES, QUEUES AND DELAYS AT ROUNDABOUTS

ARCADY 5.0 ANALYSIS PROGRAM
RELEASE 1.1 (MAY 2001)

FOR SALES AND DISTRIBUTION INFORMATION,
PROGRAM ADVICE AND MAINTENANCE CONTACT:
TRL SOFTWARE BUREAU
TEL: CROWTHORNE (01344) 770758, FAX: 770864
EMAIL: SoftwareBureau@trl.co.uk

Run with file:-
"g:\755633 North West Relief Road - Preferred Route\A5 Roundabouts\New Work April 2010\90ICD\DIRECT\
Without Seg lane\A5 Churncote RDBT 2032 NWRR PM (32DSPM).vai"
(drive-on-the-left) at 12:01:04 on Monday, 26 July 2010

.ROUNDABOUT CAPACITY AND DELAY
****

.RUN TITLE
****
A5 Churncote RDBT 2032 NWRR PM (32DSPM) DIRECT

.INPUT DATA
****
ARM A - A458 Shrewsbury
ARM B - A5 Telford
ARM C - A458 Welshpool
ARM D - A5 Oswestry
ARM E - NWRR

.GEOMETRIC DATA

ARM	V (M)	E (M)	L (M)	R (M)	D (M)	PHI (DEG)	SLOPE	INTERCEPT (PCU/MIN)
ARM A	3.65	9.00	22.80	20.00	90.00	30.0	0.503	33.863
ARM B	7.30	10.60	22.60	15.00	90.00	24.0	0.628	48.441
ARM C	3.65	10.55	27.00	20.00	90.00	24.0	0.546	38.384
ARM D	5.00	10.70	27.50	20.00	90.00	31.0	0.575	42.409

ARM E	3.65	9.00	35.00	20.00	90.00	30.0	0.526	36.575

V = approach half-width L = effective flare length D = inscribed circle diameter
E = entry width R = entry radius PHI = entry angle

WARNING ARM E: Effective flare length is outside normal range.
Treat capacities with increasing caution.

.TRAFFIC DEMAND DATA

TIME PERIOD BEGINS 17.00 AND ENDS 18.00
.LENGTH OF TIME PERIOD - 60 MINUTES.
LENGTH OF TIME SEGMENT - 15 MINUTES.

.DEMAND FLOW PROFILES ARE INPUT DIRECTLY.

TURNING PROPORTIONS
TURNING COUNTS
(PERCENTAGE OF H.V.S)

TIME	FROM/TO	ARM A	ARM B	ARM C	ARM D	ARM E
17.00 - 17.15	ARM A	0.000	0.271	0.274	0.414	0.041
		0.0	54.7	55.4	83.6	8.2
		(10.0)	(10.0)	(10.0)	(10.0)	(10.0)
	ARM B	0.046	0.000	0.294	0.579	0.082
		19.9	0.0	127.9	252.2	35.5
		(10.0)	(10.0)	(10.0)	(10.0)	(10.0)
	ARM C	0.180	0.634	0.000	0.009	0.177
		26.2	92.5	0.0	1.3	25.9
		(10.0)	(10.0)	(10.0)	(10.0)	(10.0)
	ARM D	0.130	0.867	0.000	0.000	0.003
		32.7	218.1	0.1	0.0	0.7
		(10.0)	(10.0)	(10.0)	(10.0)	(10.0)
	ARM E	0.213	0.387	0.292	0.109	0.000
		32.5	59.1	44.7	16.6	0.0
		(10.0)	(10.0)	(10.0)	(10.0)	(10.0)
17.15 - 17.30	ARM A	0.000	0.271	0.274	0.414	0.041
		0.0	54.7	55.4	83.6	8.2
		(10.0)	(10.0)	(10.0)	(10.0)	(10.0)
	ARM B	0.046	0.000	0.294	0.579	0.082
		19.9	0.0	127.9	252.2	35.5
		(10.0)	(10.0)	(10.0)	(10.0)	(10.0)
	ARM C	0.180	0.634	0.000	0.009	0.177
		26.2	92.5	0.0	1.3	25.9
		(10.0)	(10.0)	(10.0)	(10.0)	(10.0)
	ARM D	0.130	0.867	0.000	0.000	0.003
		32.7	218.1	0.1	0.0	0.7

		(10.0)	(10.0)	(10.0)	(10.0)	(10.0)
	ARM E	0.213	0.387	0.292	0.109	0.000
		32.5	59.1	44.7	16.6	0.0
		(10.0)	(10.0)	(10.0)	(10.0)	(10.0)

TURNING PROPORTIONS
TURNING COUNTS
(PERCENTAGE OF H.V.S)

TIME	FROM/TO	ARM A	ARM B	ARM C	ARM D	ARM E
17.30 - 17.45						
	ARM A	0.000	0.271	0.274	0.414	0.041
		0.0	54.7	55.4	83.6	8.2
		(10.0)	(10.0)	(10.0)	(10.0)	(10.0)
	ARM B	0.046	0.000	0.294	0.579	0.082
		19.9	0.0	127.9	252.2	35.5
		(10.0)	(10.0)	(10.0)	(10.0)	(10.0)
	ARM C	0.180	0.634	0.000	0.009	0.177
		26.2	92.5	0.0	1.3	25.9
		(10.0)	(10.0)	(10.0)	(10.0)	(10.0)
	ARM D	0.130	0.867	0.000	0.000	0.003
		32.7	218.1	0.1	0.0	0.7
		(10.0)	(10.0)	(10.0)	(10.0)	(10.0)
	ARM E	0.213	0.387	0.292	0.109	0.000
		32.5	59.1	44.7	16.6	0.0
		(10.0)	(10.0)	(10.0)	(10.0)	(10.0)
17.45 - 18.00						
	ARM A	0.000	0.271	0.274	0.414	0.041
		0.0	54.7	55.4	83.6	8.2
		(10.0)	(10.0)	(10.0)	(10.0)	(10.0)
	ARM B	0.046	0.000	0.294	0.579	0.082
		19.9	0.0	127.9	252.2	35.5
		(10.0)	(10.0)	(10.0)	(10.0)	(10.0)
	ARM C	0.180	0.634	0.000	0.009	0.177
		26.2	92.5	0.0	1.3	25.9
		(10.0)	(10.0)	(10.0)	(10.0)	(10.0)
	ARM D	0.130	0.867	0.000	0.000	0.003
		32.7	218.1	0.1	0.0	0.7
		(10.0)	(10.0)	(10.0)	(10.0)	(10.0)
	ARM E	0.213	0.387	0.292	0.109	0.000
		32.5	59.1	44.7	16.6	0.0
		(10.0)	(10.0)	(10.0)	(10.0)	(10.0)

TURNING PROPORTIONS ARE CALCULATED FROM TURNING COUNT DATA
THE TURNING PROPORTIONS USED VARY BETWEEN TIME SEGMENTS
DEFAULT PROPORTIONS OF HEAVY VEHICLES ARE USED

QUEUE AND DELAY INFORMATION FOR EACH 15 MIN TIME SEGMENT

I TIME	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT) I
I 17.00-17.15								I
I ARM A	13.45	16.40	0.820		0.0	4.1	52.4	I
I ARM B	29.03	35.45	0.819		0.0	4.3	57.9	I
I ARM C	9.73	19.93	0.488		0.0	0.9	13.6	I
I ARM D	16.77	30.63	0.547		0.0	1.2	17.3	I
I ARM E	10.20	19.66	0.519		0.0	1.1	15.2	I
I								I

I TIME	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT) I
I 17.15-17.30								I
I ARM A	13.45	16.32	0.824		4.1	4.4	64.1	I
I ARM B	29.03	35.31	0.822		4.3	4.5	66.0	I
I ARM C	9.73	19.76	0.492		0.9	1.0	14.3	I
I ARM D	16.77	30.57	0.549		1.2	1.2	18.1	I
I ARM E	10.20	19.58	0.521		1.1	1.1	16.1	I
I								I

I TIME	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT) I
I 17.30-17.45								I
I ARM A	13.45	16.32	0.824		4.4	4.5	66.6	I
I ARM B	29.03	35.31	0.822		4.5	4.5	67.5	I
I ARM C	9.73	19.75	0.493		1.0	1.0	14.5	I
I ARM D	16.77	30.57	0.549		1.2	1.2	18.1	I
I ARM E	10.20	19.58	0.521		1.1	1.1	16.2	I

TIME SEGMENT	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT)
17.45-18.00								
ARM A	13.45	16.32	0.824		4.5	4.5	67.7	
ARM B	29.03	35.31	0.822		4.5	4.6	68.1	
ARM C	9.73	19.75	0.493		1.0	1.0	14.5	
ARM D	16.77	30.57	0.549		1.2	1.2	18.2	
ARM E	10.20	19.58	0.521		1.1	1.1	16.2	

.QUEUE AT ARM A

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE	
17.15	4.1	****
17.30	4.4	****
17.45	4.5	****
18.00	4.5	*****

.QUEUE AT ARM B

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE	
17.15	4.3	****
17.30	4.5	****
17.45	4.5	*****
18.00	4.6	*****

.QUEUE AT ARM C

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE	
17.15	0.9	*
17.30	1.0	*
17.45	1.0	*

18.00	1.0 *

.QUEUE AT ARM D

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE
17.15	1.2 *
17.30	1.2 *
17.45	1.2 *
18.00	1.2 *

.QUEUE AT ARM E

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE
17.15	1.1 *
17.30	1.1 *
17.45	1.1 *
18.00	1.1 *

. QUEUEING DELAY INFORMATION OVER WHOLE PERIOD

ARM	TOTAL DEMAND		* QUEUEING * DELAY *		* INCLUSIVE QUEUEING * DELAY *	
	(VEH)	(VEH/H)	(MIN)	(MIN/VEH)	(MIN)	(MIN/VEH)
A	807.0	807.0	250.8	0.31	251.4	0.31
B	1741.8	1741.8	259.6	0.15	259.9	0.15
C	583.8	583.8	56.8	0.10	56.9	0.10
D	1006.2	1006.2	71.7	0.07	71.7	0.07
E	612.0	612.0	63.7	0.10	63.8	0.10
ALL	4750.8	4750.8	702.7	0.15	703.7	0.15

* DELAY IS THAT OCCURRING ONLY WITHIN THE TIME PERIOD.
* INCLUSIVE DELAY INCLUDES DELAY SUFFERED BY VEHICLES WHICH ARE STILL QUEUEING AFTER THE END OF THE TIME PERIOD.
* THESE WILL ONLY BE SIGNIFICANTLY DIFFERENT IF THERE IS A LARGE QUEUE REMAINING AT THE END OF THE TIME PERIOD.

END OF JOB

****** ARCADY 5 run completed.

A5 Churncote RDBT 2032 NWRR SUN (32DS)
TRL LIMITED

CAPACITIES, QUEUES AND DELAYS AT ROUNDABOUTS

ARCADY 5.0 ANALYSIS PROGRAM
RELEASE 1.1 (MAY 2001)

FOR SALES AND DISTRIBUTION INFORMATION,
PROGRAM ADVICE AND MAINTENANCE CONTACT:
TRL SOFTWARE BUREAU
TEL: CROWTHORNE (01344) 770758, FAX: 770864
EMAIL: SoftwareBureau@trl.co.uk

Run with file:-
"g:\755633 North West Relief Road - Preferred Route\A5 Roundabouts\New Work April 2010\90ICD\DIRECT\
Without Seg lane\A5 Churncote RDBT 2032 NWRR SUN (32DS).vai"
(drive-on-the-left) at 17:30:20 on Friday, 3 September 2010

.ROUNDABOUT CAPACITY AND DELAY
****

.RUN TITLE
****
A5 Churncote RDBT 2032 NWRR SUN

.INPUT DATA
****
ARM A - A458 Shrewsbury
ARM B - A5 Telford
ARM C - A458 Welshpool
ARM D - A5 Oswestry
ARM E - NWRR

.GEOMETRIC DATA

ARM	V (M)	E (M)	L (M)	R (M)	D (M)	PHI (DEG)	SLOPE	INTERCEPT (PCU/MIN)
ARM A	3.65	9.00	22.80	20.00	90.00	30.0	0.503	33.863
ARM B	7.30	10.60	22.60	15.00	90.00	24.0	0.628	48.441
ARM C	3.60	10.55	27.00	20.00	90.00	24.0	0.545	38.204
ARM D	5.00	10.70	27.50	20.00	90.00	31.0	0.575	42.409

I ARM E I	3.65 I	9.00 I	35.00 I	20.00 I	90.00 I	30.0 I 0.526 I 36.575 I

V = approach half-width L = effective flare length D = inscribed circle diameter
E = entry width R = entry radius PHI = entry angle

WARNING ARM E: Effective flare length is outside normal range.
Treat capacities with increasing caution.

.TRAFFIC DEMAND DATA

TIME PERIOD BEGINS 08.00 AND ENDS 09.00
.LENGTH OF TIME PERIOD - 60 MINUTES.
LENGTH OF TIME SEGMENT - 15 MINUTES.

.DEMAND FLOW PROFILES ARE INPUT DIRECTLY.

TURNING PROPORTIONS
TURNING COUNTS
(PERCENTAGE OF H.V.S)

TIME	FROM/TO	ARM A	ARM B	ARM C	ARM D	ARM E
08.00 - 09.00	ARM A	0.000	0.223	0.267	0.292	0.217
		0.0	71.0	85.0	93.0	69.0
		(10.0)	(10.0)	(10.0)	(10.0)	(10.0)
	ARM B	0.028	0.000	0.322	0.574	0.076
		38.0	0.0	431.0	769.0	102.0
		(10.0)	(10.0)	(10.0)	(10.0)	(10.0)
	ARM C	0.111	0.772	0.000	0.006	0.111
		93.0	645.0	0.0	5.0	93.0
		(10.0)	(10.0)	(10.0)	(10.0)	(10.0)
	ARM D	0.086	0.865	0.004	0.000	0.044
		78.0	782.0	4.0	0.0	40.0
		(10.0)	(10.0)	(10.0)	(10.0)	(10.0)
	ARM E	0.127	0.365	0.375	0.133	0.000
		40.0	115.0	118.0	42.0	0.0
		(10.0)	(10.0)	(10.0)	(10.0)	(10.0)

TURNING PROPORTIONS ARE CALCULATED FROM TURNING COUNT DATA
DEFAULT PROPORTIONS OF HEAVY VEHICLES ARE USED

. QUEUE AND DELAY INFORMATION FOR EACH 15 MIN TIME SEGMENT

TIME SEGMENT	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN) (RFC)	DEMAND/ CAPACITY	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT)
08.00-08.15								

ARM A	6.89	15.26	0.451	0.0	0.8	11.6
ARM B	25.91	38.66	0.670	0.0	2.0	28.6
ARM C	14.81	22.85	0.648	0.0	1.8	25.4
ARM D	16.24	27.75	0.585	0.0	1.4	20.0
ARM E	6.30	17.92	0.352	0.0	0.5	7.8

TIME SEGMENT	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT)
08.15-08.30								
ARM A	6.89	15.16	0.454		0.8	0.8	12.3	
ARM B	25.91	38.62	0.671		2.0	2.0	30.2	
ARM C	14.81	22.79	0.650		1.8	1.8	27.3	
ARM D	16.24	27.67	0.587		1.4	1.4	21.0	
ARM E	6.30	17.81	0.354		0.5	0.5	8.1	

TIME SEGMENT	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT)
08.30-08.45								
ARM A	6.89	15.16	0.454		0.8	0.8	12.4	
ARM B	25.91	38.62	0.671		2.0	2.0	30.4	
ARM C	14.81	22.79	0.650		1.8	1.8	27.5	
ARM D	16.24	27.67	0.587		1.4	1.4	21.2	
ARM E	6.30	17.81	0.354		0.5	0.5	8.2	

I TIME	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAYI (VEH.MIN/ TIME SEGMENT) I
I 08.45-09.00 I								
I ARM A I	6.89	15.16	0.454		0.8	0.8	12.4	
I ARM B I	25.91	38.62	0.671		2.0	2.0	30.4	
I ARM C I	14.81	22.79	0.650		1.8	1.8	27.6	
I ARM D I	16.24	27.67	0.587		1.4	1.4	21.2	
I ARM E I	6.30	17.81	0.354		0.5	0.5	8.2	
I I								

.QUEUE AT ARM A

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE	
08.15	0.8	*
08.30	0.8	*
08.45	0.8	*
09.00	0.8	*

.QUEUE AT ARM B

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE	
08.15	2.0	**
08.30	2.0	**
08.45	2.0	**
09.00	2.0	**

.QUEUE AT ARM C

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE	
08.15	1.8	**
08.30	1.8	**
08.45	1.8	**
09.00	1.8	**

.QUEUE AT ARM D

TIME SEGMENT ENDING	NO. OF VEHICLES

	IN QUEUE	
08.15	1.4	*
08.30	1.4	*
08.45	1.4	*
09.00	1.4	*

.QUEUE AT ARM E

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE	
08.15	0.5	*
08.30	0.5	*
08.45	0.5	*
09.00	0.5	*

. QUEUEING DELAY INFORMATION OVER WHOLE PERIOD

ARM	TOTAL DEMAND (VEH)	TOTAL DEMAND (VEH/H)	* QUEUEING * DELAY * (MIN)	* QUEUEING * DELAY * (MIN/VEH)	* INCLUSIVE QUEUEING * DELAY * (MIN)	* INCLUSIVE QUEUEING * DELAY * (MIN/VEH)
A	413.4	413.4	48.8	0.12	48.8	0.12
B	1554.6	1554.6	119.6	0.08	119.7	0.08
C	888.6	888.6	107.8	0.12	107.9	0.12
D	974.4	974.4	83.4	0.09	83.5	0.09
E	378.0	378.0	32.3	0.09	32.3	0.09
ALL	4209.0	4209.0	392.0	0.09	392.2	0.09

* DELAY IS THAT OCCURRING ONLY WITHIN THE TIME PERIOD.
* INCLUSIVE DELAY INCLUDES DELAY SUFFERED BY VEHICLES WHICH ARE STILL QUEUEING AFTER THE END OF THE TIME PERIOD.
* THESE WILL ONLY BE SIGNIFICANTLY DIFFERENT IF THERE IS A LARGE QUEUE REMAINING AT THE END OF THE TIME PERIOD.

END OF JOB

****** ARCADY 5 run completed.

Technical Note

Date	09 October 2010
Job Number	R115168
Job Name	A5 Shropshire Core Strategy EiP
Subject	Churncote Roundabout, Shropshire

Introduction

The content of this technical note outlines JMP's review commentary with regards to a report compiled by Mouchel entitled "Shrewsbury North Western Relief Road: Churncote Roundabout A5/ A458 Junction Proposed Alterations Report" forwarded on 23rd September 2009.

The report was submitted on behalf of Shropshire County Council in support of proposals for the development of the Shrewsbury North West Relief Road (SNWRR). The specific focus of the report is to provide modelling evidence to support alterations to the existing A5/ A458 'Churncote' Roundabout to entail increasing the footprint of the junction up to 90m ICD and provision of an additional 5th arm approach to the circulatory to provide a direct link between the A5 and SNWRR.

JMP's review of the report focussed upon two technical areas namely:

- Review of the proposed ARCADY junction model testing of the proposed scheme; and
- Review of the submitted junction design drawings in accordance with current standards.

Our comments with regards to the above are set out below:

Review of Submitted Modelling

Shropshire Council submitted an ARCADY model of the Churncote Roundabout based on the proposed 5-arm roundabout design. The effectiveness and future operation of the proposed 5 armed junction scheme (Do Something) was tested against the future operation of the junction assuming no changes to the existing arrangement (Do Minimum).

'Do Minimum' Model Analysis

The results of 2032 'Do Minimum' ARCADY model testing is shown in Table 1 below.

Table 1: 2032 ARCADY Results (Mouchel Calculation)

Arm	AM (0845-0900)			PM (1745-1800)		
	RFC	Queue (Veh)	Delay (Veh/Min)	RFC	Queue (Veh)	Delay (Veh.Min)
A, A5(N)	0.929	13.3	200.2	0.714	2.5	37.1
B, A458 (E)	0.516	1.1	17.1	1.020	37.2	510.8
C, A5(S)	0.707	2.4	35.9	0.947	15.0	219.6
D, A458(W)	0.800	3.9	58.1	0.704	2.3	34.8

'Do Something' Model Analysis

It should also be noted that there are differences in the arms definition between the Mouchel's report and Mouchel's model specification. For consistency and comparison purpose we followed the definition provided within the model.

Table 2: Junction Arm Definition

Road Name	Arm Name (Report)	Arm Name (Arcady Model)
SNWRR	Arm A	Arm E
A458 East to Bicton	Arm B	Arm A
A5 (T) South to Telford	Arm C	Arm B
A458 (T) West to Welshpool	Arm D	Arm C
A5 (T) North to Oswestry	Arm E	Arm D

JMP has undertaken a review of the geometrical parameters that form the inputs for the submitted ARCADY models. Mouchel have tabulated their calculations of the geometric parameters used within the submitted models and these are presented in Table 3 below:

Table 3 : Proposed Roundabout's Geometry (By Mouchel)

ARM	V - Half Width (m)	E - Entry Width (m)	L - Flare Length (m)	R - Entry Radii (m)	ICD (m)	Phi - Entry Angle (degree)
ARM A - A458 E	3.65	9.00	22.80	20.00	90.00	30.00
ARM B - A5 S	7.30	10.60	22.60	15.00	90.00	24.00
ARM C - A458 W	3.60	10.55	27.00	20.00	90.00	24.00
ARM D - A5 N	5.00	10.70	27.50	20.00	90.00	31.00
ARM E - NWRR	3.65	9.00	35.00	20.00	90.00	30.00

JMP has carried out independent measurements of the geometrical parameters based upon the submitted design drawings to identify if any discrepancies were apparent that may impact upon the operational results presented within the models. JMP's calculated geometric parameters are presented in Table 4 below:

Table 4 : Review of geometrical parameters by JMP using the proposed drawing

ARM	V - Half Width (m)	E - Entry Width (m)	L - Flare Length (m)	R - Entry Radii (m)	ICD (m)	Phi - Entry Angle (degree)
ARM A - A458 E	3.65	9.00	21.79	20.00	90.00	29.00
ARM B - A5 S	7.30	10.60	25.00	15.00	90.00	45.00
ARM C - A458 W	3.60	10.55	36.48	20.00	90.00	32.00
ARM D - A5 N	5.00	10.70	34.25	20.00	90.00	48.00
ARM E - NWRR	3.65	9.00	29.57	20.00	90.00	38.00

It is clear from the table that the junction 'Half Width', 'Entry Width', 'Entry Radii' and 'ICD' parameters match in both cases but there are substantial differences in the 'Flare Lengths' and the 'Entry Angle' parameters calculated.

Results obtained from ARCADY are sensitive to flare length parameters used for each entry arm, and even one unit difference in the flare length may lead to a substantial difference in the outputs which may in turn lead to an overestimation or underestimation of the effective capacity of the junction approach arms. As shown within the tables, the modelled flare lengths utilised by Mouchel are greater for Arm E (NWRR) and significantly lower for Arms B, C, and D.

The entry angle 'Phi' is not a less sensitive parameter compared to flare length but if the difference in entry angle is more than 10 degrees it may affect the results. As shown, this is the case for arms 'B', and 'D'.

JMP has re-run the model with the JMP calculated geometric parameters and compared our results against the model results attached within the Mouchel report. Two assessment years have been produced to test the future operation of the junction. The results of these assessments as compared to the original Mouchel modelling outputs are presented in tables 5 and 6 below:

Table 5: 2032 ARCADY Results (Mouchel Calculation)

Arm	AM (0845-0900)			PM (1745-1800)		
	RFC	Queue (Veh)	Delay (Veh.Min)	RFC	Queue (Veh)	Delay (Veh.Min)
A	0.529	1.1	16.7	0.824	4.5	67.7
B	0.636	1.7	26.1	0.822	4.6	68.1
C	0.642	1.8	26.6	0.493	1.0	14.5
D	0.842	5.2	77.7	0.549	1.2	18.2
E	0.493	1.0	14.5	0.521	1.1	16.2

Table 6: 2032 ARCADY Results with JMP Calculation

Arm	AM (0845-0900)			PM (1745-1800)		
	RFC	Queue (Veh)	Delay (Veh.Min)	RFC	Queue (Veh)	Delay (Veh.Min)
A	0.536	1.1	17.2	0.836	4.9	72.9
B	0.680	2.1	31.7	0.878	7	104.1
C	0.610	1.6	23.3	0.467	0.9	13.1
D	0.861	6	89.7	0.563	1.3	19.3
E	0.527	1.1	16.6	0.558	1.3	18.8

As shown above, there are differences between the two sets of modelling outputs. In respect of the Highways principle concerns, the revised modelling undertaken by JMP appears to demonstrate that the two A5 approaches to the junction (arms B & D) operate in excess of the theoretical threshold of 0.85 RFC, albeit with relatively limited levels of queuing. It should also be recognised that this represents there is considerable amount of benefit from the junction improvement proposal when compared against the 'Do Minimum' option testing.

Review of Submitted Junction Design Drawings

The proposed design was audited against the Design Manual for Roads and Bridges (DMRB) Volume 6 Section 2 Part 3 TD 16/07 '*Geometric Design of Roundabouts*' to see if there was any departure from standards.

Detailed in the following section are the mandatory paragraphs taken from TD16/07 and any departures identified related to each paragraph. The design comments are identified as follows:

- Major departures - which affect the layout of the roundabout;
- Minor departures - which can be resolved with design development;
- Future issues - which will need to be addressed later in the design;
- Departures which are not applicable and;
- Points where the design meets standards.

Major Departures

Paragraph 7.8

The width of the circulatory carriageway must be between 1.0 and 1.2 times the maximum entry width, excluding any overrun area.

The widest entry to the proposed roundabout measures 11 meters. This should then equate to a minimum circulatory width of 11m and a maximum of 13.2 meters. In places, the proposed design has a minimum circulatory width of 9 meters and a maximum of 14 meters. If this design was to be implemented, then it would require a departure from standards due to the measurements at the entry points compared to those on the circulatory are not at a minimum 1.0 times the widest point or at its maximum 1.2 times the widest point.

Paragraph 7.24

Lane widths at the give way line (measured along the normal to the nearside kerb, as for entry width) must be not less than 3m or more than 4.5m, with the 4.5m value being appropriate at single lane entries and values of 3 to 3.5m appropriate at multilane entries.

The lane widths have been measured on all approaches and a departure from standards is required on more than one entry arm. The A458 West to Welshpool (Arm D) is a proposed 3 lane entry arm onto the proposed roundabout. The total width for this arm is 14m which consists of two lanes at 4m each with a third lane at 3m wide. The A5 South to Telford (Arm C) is a proposed two lane entry onto the proposed roundabout and has an entry width of 11m. This equates to lanes widths of 6m and 5m.

Paragraph 7.25

On a single carriageway approach to a Normal Roundabout, the entry width must not exceed 10.5m. On a dual carriageway approach to a Normal Roundabout, the entry width must not exceed 15m.

Entry arms D & E are both single carriageway approach and are both 11m at the entry width. This would be a departure from standards due to the width exceeding that set out in the paragraph above.

Paragraph 8.50

If, as part of an improvement scheme, changes are proposed to lane assignments on a roundabout approach and circulatory carriageway, the designer must review the safety and capacity of the overall roundabout layout, including analysis of swept paths through entries and around the central island.

The design has been checked using AutoTrack with a maximum legal articulated lorry. The test showed that the design fails in several locations.

Minor Departures

Paragraph 8.28

The use of right pointing arrows on lane dedication signs or as markings on the road is not permitted on roundabout approaches (except at mini-roundabouts). This is to avoid confusing drivers, particularly those from overseas, over which way to proceed around the roundabout. Where a right hand lane is dedicated to a specific destination, it should be associated with an ahead arrow on the approach. A right pointing arrow may be used on the circulatory carriageway.

No lane destinations shown. There are no lane designation markings. The entry lanes on the roundabout do not indicate which lane on the circulatory the driver is supposed to use. This could lead to side swipe accidents as drivers compete for lane space.

Future Issues

Paragraph 5.2

A dropped kerb and tactile paving must be provided at any crossing.

There are two crossings located on the design. One across the A5 North and one across the proposed SNWRR. Whilst the design shows no tactile paving, JMP assumes that these will be included.

Paragraph 8.24

In England, the provision of road lighting at roundabouts must be considered in accordance with DMRB 8.3.

To be determined.

Paragraph 8.37

The design of landscaping within the highway limits must be carried out in consultation with appropriate specialists. The designer must develop clear objectives for the design and must consider the long-term maintenance implications of the scheme. Where the responsibility for maintenance is passed to a third party, such as a local council, maintenance standards must be agreed. If a third party wishes to enhance the standard of planting or landscaping at roundabouts, for example, using special floral displays, this must only be with the agreement of the Overseeing Organisation, and must not compromise visibility or safety. Further advice is given in DMRB Volume 10.

To be determined.

Paragraph 5.26

Materials used on the roundabout and its approaches must have suitable skidding and deformation resistance. Irregular surface features must be avoided.

To be determined as no materials have been specified.

Paragraph 8.36

Materials with appropriate skid resistance must be used for road markings at roundabouts. Details of the requirements for these are given in Clause 1212 of MCHW 1.

To be determined. As above.

Issues with No Impact

Paragraph 5.11

Zigzag markings are a requirement at Zebra, Pelican, Puffin, Toucan and Equestrian crossing, but must not be used where the crossing is part of a Signalised Roundabout.

Zigzag marking are not required as the proposed crossings are not controlled.

Paragraph 7.18

The profile dimensions of the overrun area must comply with The Highways (TrafficCalming) Regulations (1999) and Traffic Advisory Leaflet TAL 12/93 'Overrun Area'.

This is not applicable to the proposed design due to the size of the internal diameter being more than 18 meters.

Paragraph 8.11

Drivers approaching a roundabout with a Zebra crossing across the entry must be able to see the full width of the crossing so they can see whether there are any pedestrians wishing to cross. For a signal controlled crossing, the driver must also be able to see at least one signal head. The desirable minimum stopping sight distance for the design speed of the link.

Not applicable.

Paragraph 8.12

At the give way line, drivers must be able to see the full width of a pedestrian crossing (whether signal-controlled, zebra or informal) across the next exit if it is within 20m of the give way line on that arm (crossings should not be sited between 20m and 60m from the give way line). See Figure 8/6.

Not Applicable.

Design Complies with Standards

Paragraph 7.56

The entry path radius must be checked for all turning movements. It must not exceed 70m at Compact Roundabouts in urban areas (where the speed limit and the design speed within 100m of the give way line on any approach do not exceed 40mph and 70kph respectively). At all other roundabout types, the entry radius must not exceed 100m.

No departure is required as the current arrangement complies with the above paragraph.

Paragraph 8.4

Drivers of all vehicles approaching the give way line must be able to see objects of height between 0.26m and 2m on the full width of the circulatory carriageway for the visibility distance given. The visibility must be checked from the centre of the nearside lane at a distance of 15m back from the give way line.

No departure is required as the current arrangement complies with the above paragraph.

Paragraph 8.5

Drivers of all vehicles approaching the give way line must be able to see the full width of the circulatory carriageway to their right, from the centre of the offside lane at the give way line for the visibility distance given.

No departure is required as they current arrangement complies with the above paragraph.

Paragraph 8.6

Visibility to the right must also be checked from the centre of the offside lane at a distance of 15m back from the give way line.

No departure is required as the current arrangement complies with the above paragraph.

Paragraph 8.7

The envelope of visibility must be obtained from a driver's eye height of between 1.05m and 2m to an object height of between 1.05 and 2m.

No departure is required as they current arrangement complies with the above paragraph.

Paragraph 8.9

Drivers on the circulatory carriageway must be able to see the full width of the circulatory carriageway ahead of them for the visibility distance given. This visibility must be checked at a distance of 2m in from the central island. The envelope of visibility must be obtainable from a driver's eye height of between 1.05m and 2m to an object height of between 1.05m and 2m.

No departure is required as they current arrangement complies with the above paragraph.

Conclusion

The roundabout design does not comply with the current DMRB standards. Given that the land take required to bring the design in line with standards is not substantially larger than the land take already proposed then it is likely that the design can be amended to meet standards. However, this remains to be demonstrated by Shropshire Council.

Next Steps and Further Modelling Requirements

As part of the upcoming Shropshire Core Strategy submission, Shropshire County Council has identified a package of required improvement schemes to be delivered on junctions on the A5 in the vicinity of Shrewsbury in order to accommodate projected growth in traffic levels up to the end of the plan period in 2026. These schemes were initially identified through evidence base testing undertaken by the Highways Agency in June 2010 and detailed in the key technical appendix document prepared by JMP and submitted in support of the Core Strategy.

The package of measures identified for the A5 includes the upgrade of a number of existing priority roundabout junctions to signalised arrangements including the A5/ A458 Churncote roundabout. The package of measures were designed to enable additional levels of traffic to be managed along the corridor as the introduction of signals enable control of flows across the entire corridor thus ensuring that no one junction is overloaded with continuous heavy traffic arrivals. As part of this package, the identified scheme at Churncote was to replace the existing four armed roundabout with a four armed signalised crossroads arrangement. It was assumed that the SNWRR would not link directly into the A5 via a fifth arm at Churncote but would instead link into the A458 Welshpool Road to the east of the junction.

JMP recognise that the presented scheme offered by Mouchel for an upgraded five arm roundabout at Churncote offers an alternative to the scheme identified within the Core Strategy supporting evidence base document for the A5. Whilst the submitted ARCADY models do enable accurate analysis of the future operation of the A5 Churncote improvement scheme on a standalone basis and are therefore appropriate to further inform the junction design process, they have limitations given the fact that ARCADY cannot accurately demonstrate the impact that the introduction of the five-armed priority scheme may have on A5 junctions downstream of Churncote.

Before final agreement can be reached in relation to any alternative five-armed design scheme for Churncote, JMP would recommend that the proposed scheme is tested within the A5 VISSIM corridor model previously developed to identify wider A5 corridor improvements to demonstrate that the scheme as presented will not detrimentally impact upon levels of queuing and delay at other locations along the A5.

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