Technical note

Project:	Stoneydelph, Tamworth	**To:**	Rebecca Crowther
Subject:	Tamworth Golf Course Development	**From:**	Emma White / Harriet Cox
Date:	12 March 2015	**cc:**	

1. Introduction

The purpose of this technical note is to document the traffic impact of the planned mixed use re-development of Tamworth Golf Course at two locations, the Stoneydelph dumb-bell roundabouts off the A5 trunk road and the adjacent M42 J10. The proposed development consists of 1100 houses and 420 pupils.

JMP Consultants Limited produced a VISSIM model of the two dumb-bell roundabouts off the A5. The model was designed to replicate travelling conditions during the week in two time periods. The first period representing the morning peak between 07:45 and 09:15 with emphasis on the peak hour travel time between 08:00 and 09:00. The second time period representing the evening peak between 16:45 and 18:15 with emphasis on the peak hour travel time between 17:00 and 18:00. A 15 minute seed period was added to the AM and PM periods between 07:45 to 08:00 and 09:00 to 09:15 for the AM period and 16:45 to 17:00 and 18:00 to 18:15 for the PM period.

The model used data taken from a Manual Classification Count (MCC) taken on the 22nd April 2010, produced by an independent data collection company: Intelligent Data Collection Limited. The model extents include the B5080 Pennine Way and A5 Southbound Slip Road, the B5080 Pennine Way, A5 Northbound slip road, Centurion Way and Watling Street as shown by the red boundary in Figure 1.1.

The M42 J10 has been modelled in LinSig for the AM Peak 07:30 – 08:30 and the PM Peak 17:00-:18:00 based upon the latest scheme implemented at the M42 J10. The LinSig model includes all approaches to the junction and was provided by Amey. The location of the Stoneydelph junction and M42 J10 is shown in Figure 1.1.

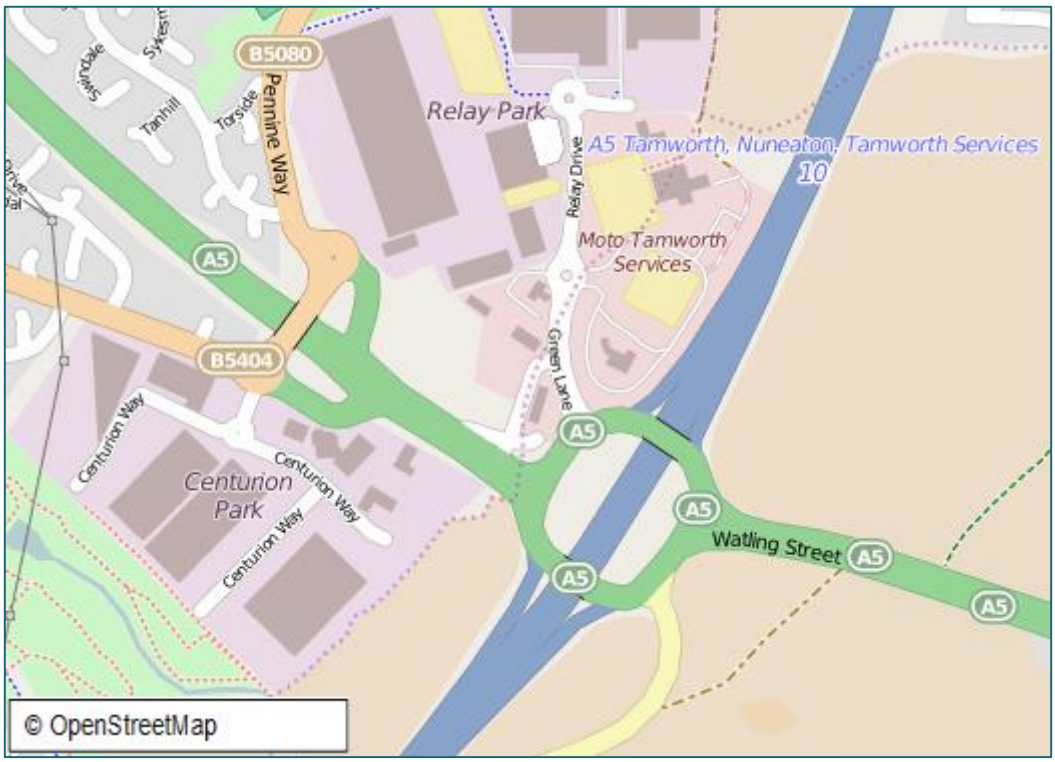

Figure 1.1 Stoneydelph Junction and M2 J10

Technical note

This technical note provides an assessment of the junction impact using both a LinSig and VISSIM traffic model, to demonstrate the level of impact development traffic could have on existing traffic operation.

2. LinSig Assessment

2.1.1. LinSig Summary

Atkins has been commissioned to utilise the M42 J10 LinSig model provided by Amey in order to assess the impact of the development traffic on the junction. The base model utilised traffic data dated 22nd July 2010 and the modelling was undertaken due to the junction experiencing queueing particularly in peak periods which was also observed during site visits. Proposed modelling was undertaken by Amey and the most recent models were provided by Amey to utilise for this study as they represent the current infrastructure as implemented on site. Figure 2.1 below shows the layout of the LinSig model.

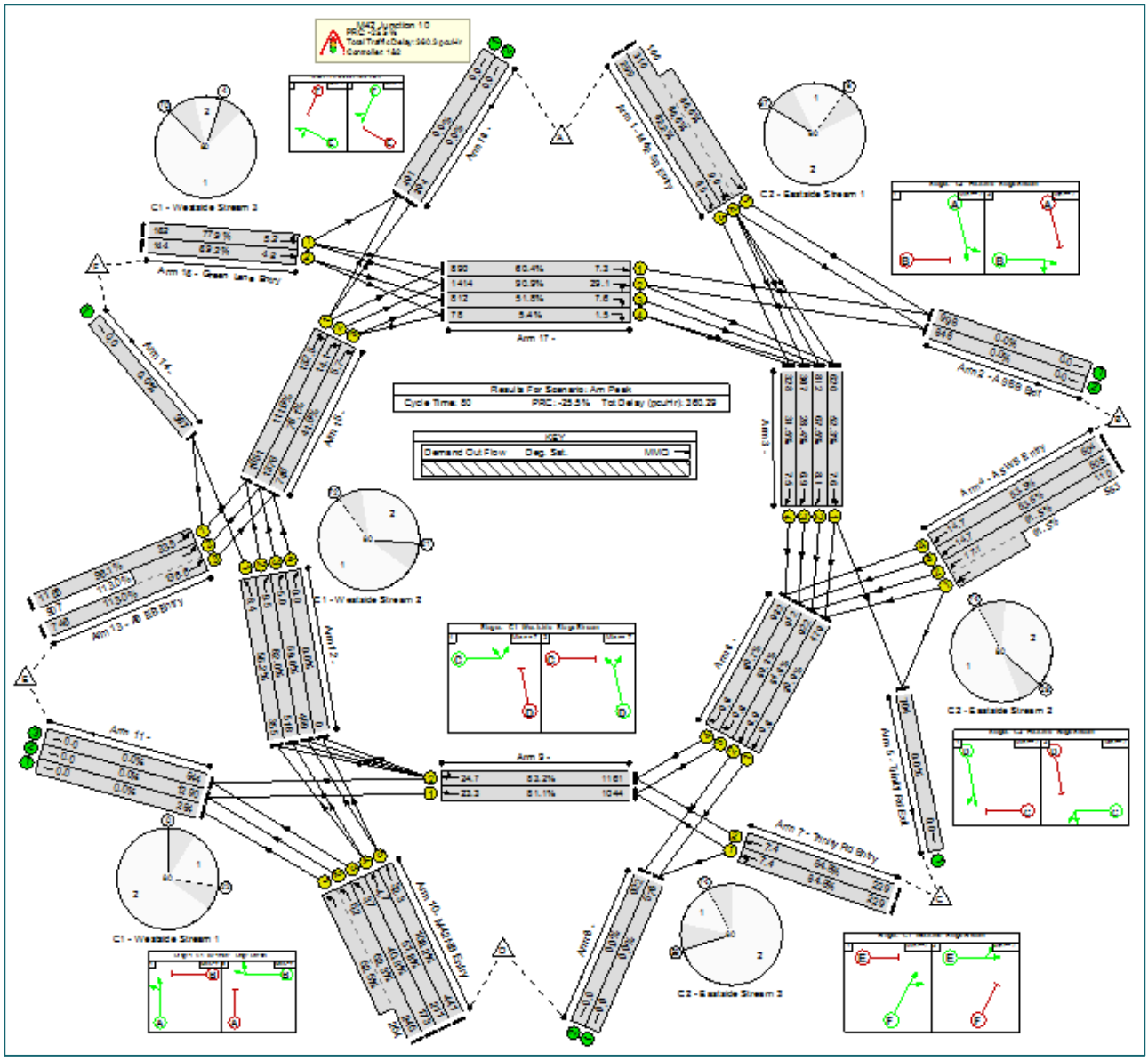

Figure 2.1 M42 J10 LinSig Link/Node Layout

The LinSig models provided have been utilised as a base model. The latest as built drawings and MOVA datasets have been reviewed to make changes to the model to more accurately reflect the latest design. The revised models have then been used to revise the traffic flows for the AM and PM Peaks (to utilise industry standard Passenger Car Units (PCUs)) and to add in the predicted development trips. Tables 2.1 and 2.2 show the base traffic flows in the LinSig models and Tables 2.3 and 2.4 show the AM Peak (0730-0830) and PM Peak (1700-1800) development flows that were added to the base traffic flows in PCUs. For a worst case assessment it was assumed that 100% of the development traffic trips (all 1100 houses and 420 pupils' trips) would be in the peak hours modelled in the LinSig.

Table 2.1 - Tamworth Base AM Peak Traffic Flows (PCU) 0730-0830

	Arm	A	B	C	D	E	F	Tot
A	M42 North	0	90	38	7	252	224	**611**
B	A5 East	152	0	113	456	857	39	**1617**
C	Trinity Rd	119	24	0	83	129	39	**394**
D	M42 South	0	451	106	0	585	5	**1147**
E	A5 West	402	1011	316	666	11	29	**2435**
F	Green Ln	81	23	31	68	57	0	**260**
Tot		**754**	**1599**	**604**	**1280**	**1891**	**336**	**6464**

Table 2.2 - Tamworth Base PM Peak Traffic Flows (PCU) 1700-1800

	Arm	A	B	C	D	E	F	Tot
A	M42 North	0	61	32	5	279	244	**621**
B	A5 East	140	0	129	326	933	45	**1573**
C	Trinity Rd	98	31	0	34	133	32	**328**
D	M42 South	0	482	126	0	1183	12	**1803**
E	A5 West	369	883	273	461	12	47	**2045**
F	Green Ln	158	94	51	169	87	0	**559**
Tot		**765**	**1551**	**611**	**995**	**2627**	**380**	**6929**

Table 2.3 - Tamworth Development AM Peak Traffic Flows (PCU) 0730-0830

	Arm	A	B	C	D	E	F	Tot
A	M42 North							**0**
B	A5 East							**0**
C	Trinity Rd					7		**7**
D	M42 South					27		**27**
E	A5 West			18	66			**84**
F	Green Ln							**0**
Tot		**0**	**0**	**18**	**66**	**34**	**0**	**118**

Table 2.4 - Tamworth Development PM Peak Traffic Flows (PCU) 1700-1800

	Arm	A	B	C	D	E	F	Tot
A	M42 North							**0**
B	A5 East							**0**
C	Trinity Rd					17		**17**
D	M42 South					60		**60**
E	A5 West			10	36			**46**
F	Green Ln							**0**
Tot		**0**	**0**	**10**	**36**	**77**	**0**	**123**

The models were then updated to incorporate changes to lane allocations for the development scenario in order to improve the operation and mitigate the impact of the development as follows:

- Provision of a two lane exit from the circulatory at Green Lane to M42 NB (previously only one lane was allocated). In order to accommodate this one less lane is available for turning traffic on the circulatory;
- A change to how the flare develops on the A5 EB approach with it moved from the middle lane to the nearside lane where less traffic will use the flare and maximise the use of the main lane; and,
- On the M42 NB approach change in the lane allocations so that the middle lane 3 can proceed towards the Service as well as turn left to the A5, lane 4 is allocated to M42 NB traffic and A5 EB traffic, and lane 5 is allocated to A5 EB and Trinity Road.

Cycle Time optimisation was run on both the AM and PM Peak flows both with and without development scenarios. The resulting optimum cycle time for the AM Peak is 78 seconds without development and 64 seconds with development. In the PM Peak the optimum cycle time is 79 seconds without development and 66 seconds with development.

The AM peak base LinSig results have been compared to the with development LinSig results and are shown in Table 2.5 below. The cells highlighted in blue operate over capacity (DOS over 100%).

Table 2.5 – M42 J10 AM Peak LinSig Results

		AM PEAK CT 78 secs			AM PEAK +Dev+Mit CT 64 secs			AM PEAK Diff		
Scheme Revised		Mean Max Queue (pcu)	Av. Delay Per PCU (s/pcu)	DOS	Mean Max Queue (pcu)	Av. Delay Per PCU (s/pcu)	DOS	Mean Max Queue (pcu)	Av. Delay Per PCU (s/pcu)	DOS
1/2+1/1	M42 SB Entry Ahead Ahead2	1.1	21.6	11.4%	1	20.8	13.2%	-0.1	-0.8	2%
1/3	M42 SB Entry Ahead	11.5	40.7	80.7%	17.2	90.7	98.1%	5.7	50	17%
3/1	circ A5 WB Entry Ahead	5.9	19.3	57.4%	9.6	20.1	77.3%	3.7	0.8	20%
3/2	circ A5 WB Entry Ahead	1.4	9.1	74.6%	6.5	12	66.0%	5.1	2.9	-9%
3/3	circ A5 WB Entry Ahead	6.4	25.5	39.0%	5.5	32.7	40.5%	-0.9	7.2	2%
3/4	circ A5 WB Entry Ahead	6.1	26.8	38.3%	4.7	33.9	35.6%	-1.4	7.1	-3%
4/1	A5 WB Entry Left Ahead	7.2	16.4	56.4%	6.4	16.1	59.0%	-0.8	-0.3	3%
4/3	A5 WB Entry Ahead	8.6	18.1	57.1%	7.6	18.1	61.2%	-1	0	4%
4/4	A5 WB Entry Ahead	8.5	17.9	56.4%	7.6	18.1	61.4%	-0.9	0.2	5%
6/1	circ Trinity Road Ahead	1.5	5.1	27.3%	1.9	4.2	35.4%	0.4	-0.9	8%
6/2	circ Trinity Road Ahead	13.4	10.1	49.2%	7.1	3.7	43.3%	-6.3	-6.4	-6%
6/3	circ Trinity Road Right	9	10.3	62.0%	8.1	7	60.2%	-0.9	-3.3	-2%
6/4	circ Trinity Road Right	8.6	9.9	60.4%	7.2	6.6	57.0%	-1.4	-3.3	-3%
7/2+7/1	Trinity Rd Entry Left Ahead	8.4	47.2	80.4%	40.7	348.3	118.4%	32.3	301.1	38%
9/1	circ M42 NB entry Ahead	9.1	5.5	66.7%	10.6	6.7	69.2%	1.5	1.2	2%
9/2	circ M42 NB entry Ahead Right	13	6.7	68.3%	10.6	7.6	68.7%	-2.4	0.9	0%
10/2+10/1	M42 NB Entry Left	9.8	74.3	92.5%	12	90.3	97.1%	2.2	16	5%
10/3	M42 NB Entry Left	3.5	47.5	54.4%	3.4	44.6	61.3%	-0.1	-2.9	7%
10/4	M42 NB Entry Ahead	14.3	166.8	101.6%	12.2	148.5	100.4%	-2.1	-18.3	-1%
10/5	M42 NB Entry Ahead	40.9	426.2	123.4%	41.4	441.1	125.3%	0.5	14.9	2%
12/1	circ A5 EB Entry Ahead	1	5.6	33.3%	1	6.9	42.6%	0	1.3	9%
12/2	circ A5 EB Entry Ahead	10.5	14.6	55.2%	2.3	14.7	35.5%	-8.2	0.1	-20%
12/3	circ A5 EB Entry Ahead	5.9	5.7	30.4%	4.6	12.6	35.1%	-1.3	6.9	5%
12/4	circ A5 EB Entry Ahead	-	-	-	4.9	12.1	38.2%	4.9	12.1	38%
13/1	A5 EB Entry Left Ahead	158.6	505.4	132.4%	162.4	396	124.1%	3.8	-109.4	-8%
13/3+13/2	A5 EB Entry Ahead	200.1	486.3	131.0%	149.1	428.1	126.6%	-51	-58.2	-4%
15/1	circ Green Lane entry Right Ahead	20.6	11.1	88.8%	3.9	3.7	43.0%	-16.7	-7.4	-46%
15/2	circ Green Lane entry Right	7.7	3	88.8%	8.5	5.4	74.7%	0.8	2.4	-14%
15/3	circ Green Lane entry Right	6.8	2	57.2%	19.9	11.3	88.3%	13.1	9.3	31%
16/1	Green Lane Entry Ahead Left	4	64	35.2%	2.1	39.3	43.6%	-1.9	-24.7	8%
16/2	Green Lane Entry Ahead	3.5	59.1	69.8%	3.5	47.4	64.7%	0	-11.7	-5%
17/1	circ M42 SB entry Ahead	8.1	8	64.0%	14.3	22.8	90.2%	6.2	14.8	26%
17/2	circ M42 SB entry Ahead	15	14.2	68.3%	3.9	13.7	23.0%	-11.1	-0.5	-45%
17/3	circ M42 SB entry Right	11.8	10.7	81.3%	3.9	9.6	47.5%	-7.9	-1.1	-34%
17/4	circ M42 SB entry Right	1.3	17.3	53.8%	4	7.5	51.9%	2.7	-9.8	-2%
Overall Junction	**PRC Over All Lanes (%)**			**-51.6**			**-40.6**			**11**
	Total Delay Over All Lanes(pcuHr)			**617**			**449**			**-168**

Table 2.5 shows that the base model is already over capacity with a negative practical reserve capacity (PRC). Both the M42 NE entry ahead and A5 EB entry have a DOS of over 100%. The lane allocation changes to the model in the AM peak with development have alleviated some of the capacity problems but the A5 EB approach is still over capacity, although the queue lengths and delays are predicted to reduce.

However, it should be noted that some queues and delays have increased to levels that are not realistic for example the A5 EB entry DoS of 131% and 127%. The reason some of the outputs are unrealistic is because when the DoS reaches 0.9 (90%) the delays increase exponentially as shown in Figure 2.2 below.

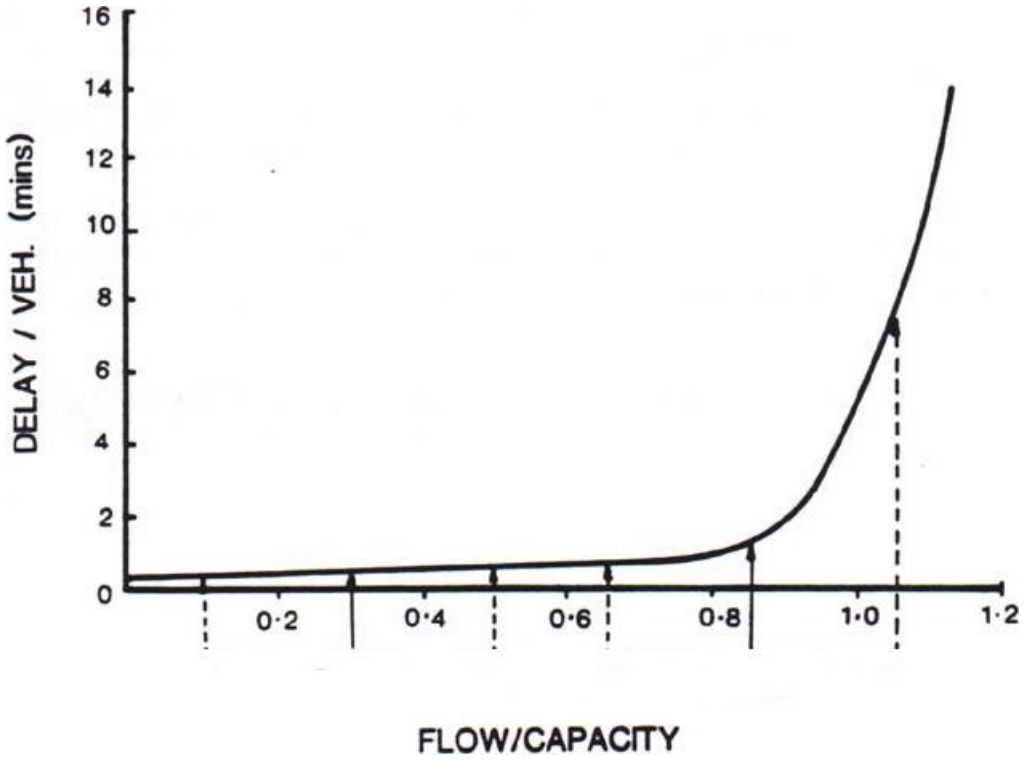

Figure 2.2 Delays/Flows (RFC)

The PM peak base LinSig results have been compared to the with development LinSig results and are shown in Table 2.7.

Table 2.6 – M42 J10 PM Peak LinSig Results

Scheme Revised		PM PEAK CT 79 secs			PM PEAK+Dev+Mit CT 66 secs			PM PEAK Diff		
		Mean Max Queue (pcu)	Av. Delay Per PCU (s/pcu)	DOS	Mean Max Queue (pcu)	Av. Delay Per PCU (s/pcu)	DOS	Mean Max Queue (pcu)	Av. Delay Per PCU (s/pcu)	DOS
1/2+1/1	M42 SB Entry Ahead Ahead2	0.9	21.9	8.1%	0.7	18.2	8.3%	-0.2	-3.7	0.2%
1/3	M42 SB Entry Ahead	14.9	53.7	89.8%	12.6	46.8	88.9%	-2.3	-6.9	-0.9%
3/1	circ A5 WB Entry Ahead	5.9	20.5	58.3%	5.6	22.1	74.1%	-0.3	1.6	15.8%
3/2	circ A5 WB Entry Ahead	1.3	7.7	67.7%	3.1	16.3	56.2%	1.8	8.6	-11.5%
3/3	circ A5 WB Entry Ahead	7.6	19.8	43.5%	5	11.4	41.9%	-2.6	-8.4	-1.6%
3/4	circ A5 WB Entry Ahead	6.8	21.1	40.0%	5.4	13.7	39.2%	-1.4	-7.4	-0.8%
4/1	A5 WB Entry Left Ahead	6.7	17.5	50.1%	6.7	18	55.4%	0	0.5	5.3%
4/3	A5 WB Entry Ahead	9.7	20.4	62.2%	8.9	20.7	67.1%	-0.8	0.3	4.9%
4/4	A5 WB Entry Ahead	10.1	20.7	63.5%	9.2	20.9	67.8%	-0.9	0.2	4.3%
6/1	circ Trinity Road Ahead	1.3	4.2	21.3%	2.1	6	37.2%	0.8	1.8	15.9%
6/2	circ Trinity Road Ahead	0.6	2.1	37.8%	3.8	4.7	35.8%	3.2	2.6	-2.0%
6/3	circ Trinity Road Right	10.5	7.4	61.6%	9.4	11.9	73.2%	-1.1	4.5	11.6%
6/4	circ Trinity Road Right	9.7	7.1	59.9%	8.6	11.7	71.1%	-1.1	4.6	11.2%
7/2+7/1	Trinity Rd Entry Left Ahead	28.6	280.2	11.9%	6.4	36.1	71.6%	-22.2	-244.1	59.7%
9/1	circ M42 NB entry Ahead	17.9	20.7	85.5%	15.7	24.1	92.1%	-2.2	3.4	6.6%
9/2	circ M42 NB entry Ahead Right	17.9	21.4	84.9%	16.1	25.6	92.5%	-1.8	4.2	7.6%
10/2+10/1	M42 NB Entry Left	11.3	40.9	85.1%	10.3	36	85.6%	-1	-4.9	0.5%
10/3	M42 NB Entry Left	9	40.9	73.9%	8.9	38.8	79.2%	-0.1	-2.1	5.3%
10/4	M42 NB Entry Ahead	6	35.1	57.4%	4.3	28.1	49.5%	-1.7	-7	-7.9%
10/5	M42 NB Entry Ahead	8	38.2	68.4%	7.1	33.4	69.8%	-0.9	-4.8	1.4%
12/1	circ A5 EB Entry Ahead	1.1	5.9	34.4%	1.2	6.9	39.9%	0.1	1	5.5%
12/2	circ A5 EB Entry Ahead	11.1	20.3	52.2%	2.2	16.4	28.2%	-8.9	-3.9	-24.0%
12/3	circ A5 EB Entry Ahead	8.1	20.2	37.9%	4.7	15.2	29.4%	-3.4	-5	-8.5%
12/4	circ A5 EB Entry Ahead	-	-	-	7.4	15.4	48.2%	7.4	15.4	48%
13/1	A5 EB Entry Left Ahead	102.3	359	120.1%	101.3	277.8	114.9%	-1	-81.2	-5.2%
13/3+13/2	A5 EB Entry Ahead	124.7	353.9	120.1%	86.5	296.1	115.9%	-38.2	-57.8	-4.2%
15/1	circ Green Lane entry Right Ahead	19.6	11.7	88.5%	4.7	4.4	42.5%	-14.9	-7.3	-46.0%
15/2	circ Green Lane entry Right	9	4.4	66.7%	8	4.2	67.3%	-1	-0.2	0.6%
15/3	circ Green Lane entry Right	5	1.9	28.1%	19	13.5	90.1%	14	11.6	62.0%
16/1	Green Lane Entry Ahead Left	30.9	329.5	115.2%	10.6	115.1	96.7%	-20.3	-214.4	-18.5%
16/2	Green Lane Entry Ahead	11.6	118.9	96.5%	32	341.3	116.7%	20.4	222.4	20.2%
17/1	circ M42 SB entry Ahead	9.3	9.8	71.1%	15.7	18.1	88.3%	6.4	8.3	17.2%
17/2	circ M42 SB entry Ahead	18	20.4	90.5%	5.7	14.8	44.6%	-12.3	-5.6	-45.9%
17/3	circ M42 SB entry Right	11.4	14.1	51.2%	5.5	9.3	53.0%	-5.9	-4.8	1.8%
17/4	circ M42 SB entry Right	2.1	16.9	9.1%	8.6	12.5	53.5%	6.5	-4.4	44.4%
Overall Junction	**PRC Over All Lanes (%)**			**-33.5**			**-29.7**			**3.8**
	Total Delay Over All Lanes(pcuHr)			**340**			**290**			**-50**

Table 2.7 shows that the base model is already over capacity with a negative practical reserve capacity (PRC). The A5 EB and Green Lane approaches result in a DoS of over 100%. However, the changes to the model in the PM Peak with development and mitigation have alleviated some of the capacity problems for particularly at the A5 EB approach and result in an improvement in conditions even with the development flows.

Overall, the LinSig modelling shows that the existing conditions is already over capacity, but the mitigation of changing the lane allocations on the A5 EB and M42 NB approaches and downstream circulatory to the M42 NB alleviate some of the problems and in both peaks, reducing the total delay and increasing the PRC.

3. VISSIM Assessment

3.1. Base Model Development

Base Models were constructed by JMP Consultants Limited using Vissim version 5.30 to replicate the travel conditions at Peak travel times on the A5 and the grade separated junction with the B5080 at Stoneydelph, Tamworth. The grade separated junction consists of dumbbell roundabouts with the north side providing access for the B5080 Pennine Way and A5 southbound slip road, and the south side providing access to the B5080 Pennine Way, A5 northbound slip road, Centurion Way and Watling Street. The travel times used in the model cover the morning peak hours from 0800 to 0900 and evening peak hours from 1700 to 1800. The models contained a 15 minute seed period prior to the peak travel times to populate the network and a 15 minute seed cool down period after the peak travel time to allow vehicles to exit the network. Atkins made no changes to the model received from JMP Consultants Limited other than adding in predicted development traffic. Analysis was conducted on the traffic count data received from JMP Consultants Limited and a comparison between base traffic count and development traffic were made. JMP Consultants Limited calibrated and validated the model for the 2010 base traffic conditions.

Manual Classification Counts were conducted by Intelligent Data Collection Limited on Thursday 22nd April 2010 at the following locations:

- B5080 Pennine Way and A5 southbound slip road; and,
- B5080 Pennine Way, A5 northbound slip road, Centurion Way and Watling Street.

Turning counts were made in 15 minute intervals during the peak periods, with two types of vehicles included in the model, Lights and Heavy Goods Vehicles (HGV). Stick diagrams illustrating the traffic flow in vehicles were constructed from the VISSIM models, for each 15 minute time period in the base model shown in Figure 3.1 and 3.2 for the AM and PM peaks respectively.

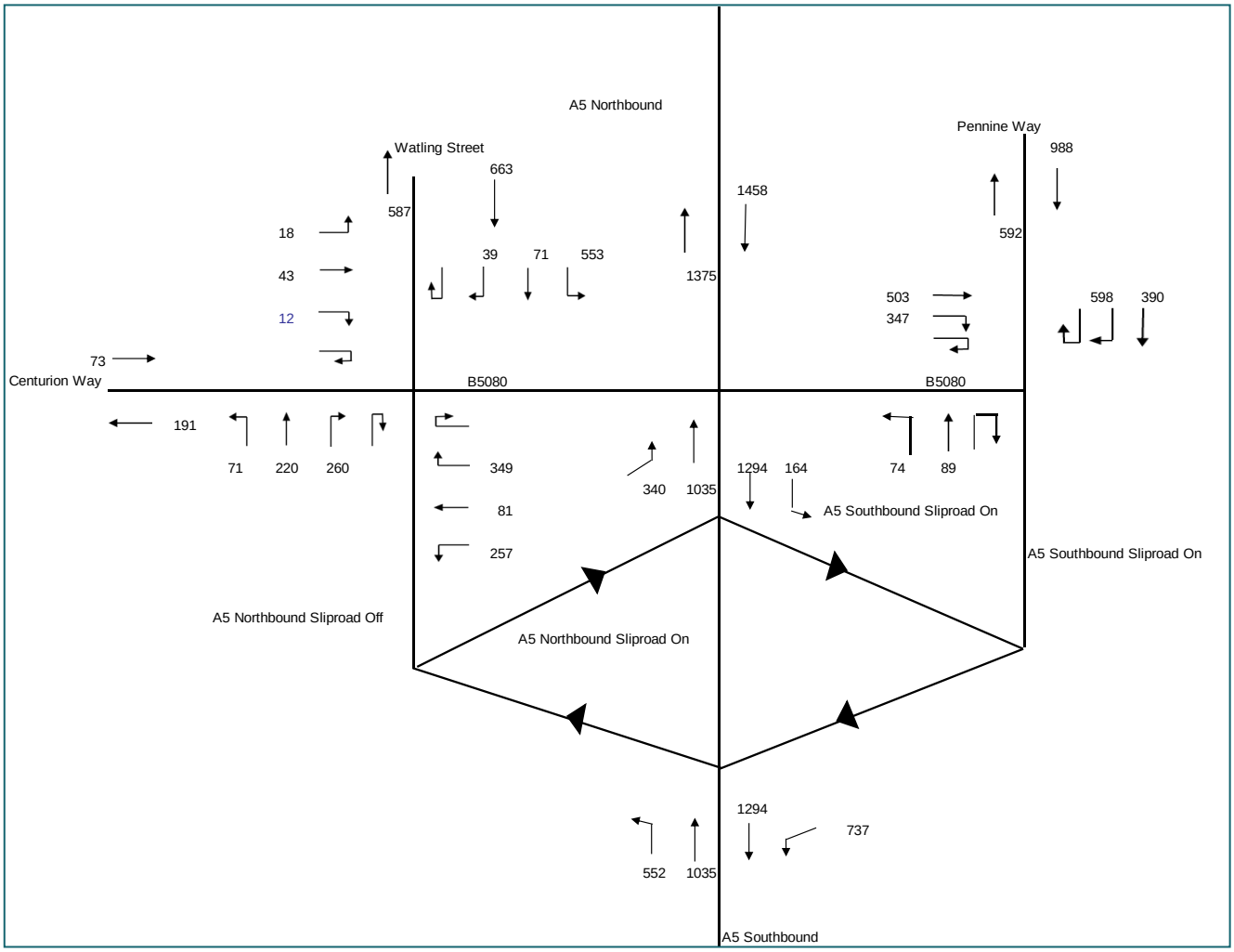

Figure 3.1 - Traffic Flows AM Peak 0800-0900

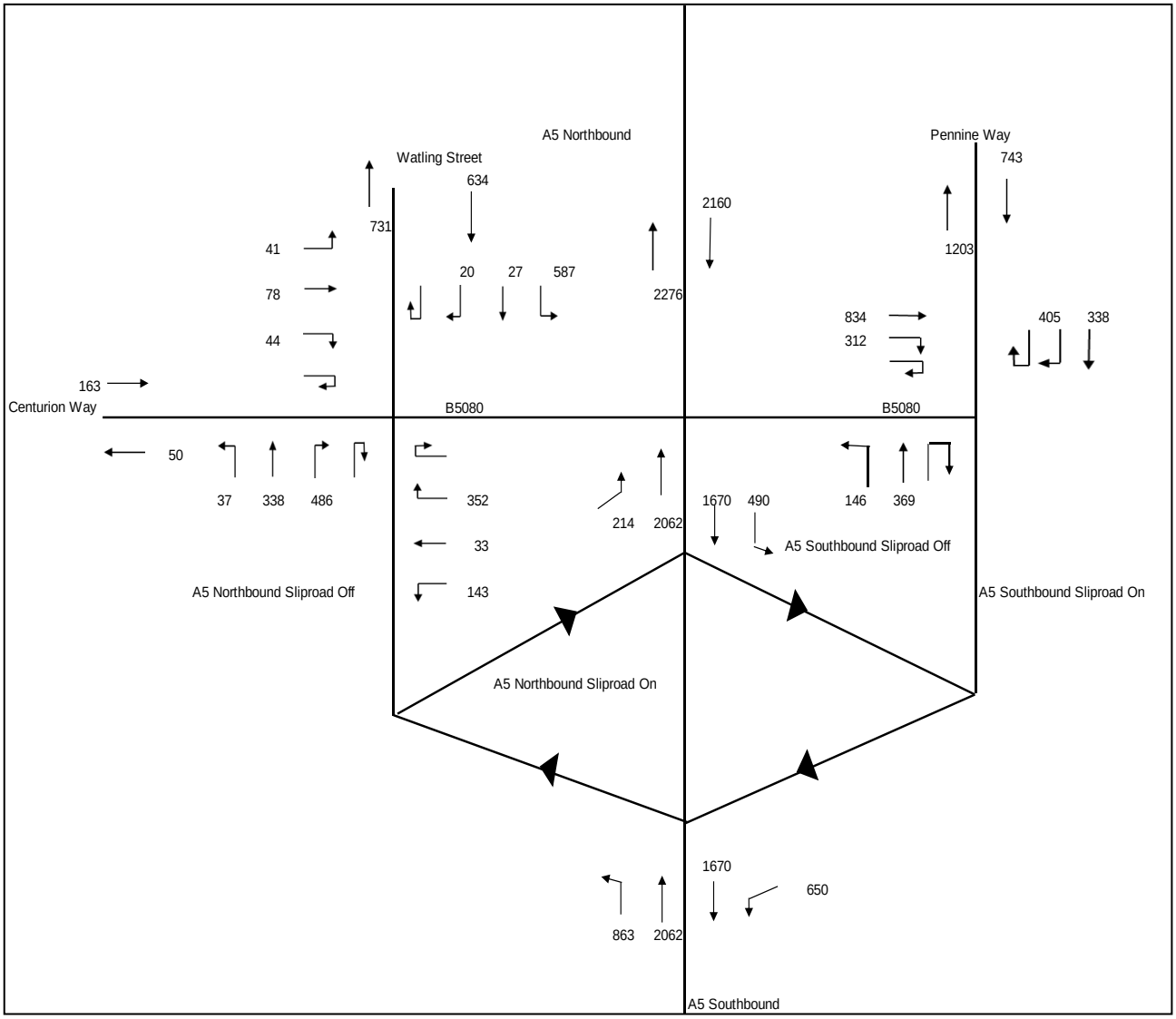

Figure 3.2 - Traffic Flows PM Peak 1700-1800

In order to utilise a more recent version of VISSIM, the base models have been rerun using version 5.40 and summarised using Atkins spreadsheets (as the JMP output summaries were not provided).

3.2. Base Model Results

AM Peak

Junction Performance

A summary of the overall junction analysis results for the Existing AM peak hour model is shown in Table 3.1 below. The table shows the summary performance for each movement within the peak hour assessed.

Table 1 provides information on modelled and observed flow differences, average and maximum queue lengths and average delays. The Level of Service (LOS) indicator has also been included in order to provide a quick reference to junction performance.

The LOS is an American concept derived from their Highway Capacity Manual (2000). It rates performance based upon delay thresholds on an A to F grading as follows:

- LOS A – 0 to 10 seconds;
- LOS B – 10 to 20 seconds (10 to 15 seconds for unsignalised);
- LOS C – 20 to 35 seconds (15 to 25 seconds for unsignalised);
- LOS D – 35 to 55 seconds (25 to 35 seconds for unsignalised);
- LOS E – 55 to 80 seconds (35 to 50 seconds for unsignalised); and,
- LOS F – Over 80 seconds (over 50 seconds for unsignalised).

Any junctions operating at LOS E or F are highlighted in light blue. A LOS E is considered to be at capacity whilst a LOS F is considered to be over capacity.

Table 3.1 – Tamworth Base AM Peak Summary of Junction Performance

Description	Turn	Direction	Flows			Queue Length (m)		Delay (secs)	LOS†
			Model	Mod-Cnt	%Diff*	Max	Average	Average	
North Roundabout	Pennine Way to A5 SB on	N-S	397	7	1.8%	155.6	1.0	8.2	A
	Pennine Way to B5080	N-SW	601	3	0.5%	155.6	1.0	8.3	A
	Pennine Way to Pennine Way	N-N	0	0	0.0%	155.6	1.0	0.0	A
	A5 SB off to B5080	S-SW	74	0	0.0%	24.6	0.0	12.4	B
	A5 SB off to Pennine Way	S-N	90	1	1.1%	24.6	0.0	11.2	B
	A5 SB off to A5 SB on	S-S	0	0	0.0%	24.6	0.0	0.0	A
	B5080 to Pennine Way	SW-N	514	11	2.2%	79.7	0.2	5.6	A
	B5080toA5 SB on	SW-S	353	6	1.7%	79.7	0.2	6.8	A
	B5080 to B5080	SW-SW	0	0	0.0%	79.7	0.2	0.0	A
	ALL	**All**	**2030**	**29**	**1.4%**	**155.6**	**0.4**	**7.6**	**A**
South Roundabout	Watling Street to Centurion Way	W-SW	39	0	0.0%	148.1	1.3	9.9	A
	Watling StreettoB5080	W-NE	562	9	1.6%	148.1	1.3	10.8	B
	Watling Street to A5 NB on	W-SE	68	-3	-4.2%	148.1	1.3	6.8	A
	Watling Street to Watling Street	W-NW	0	0	0.0%	148.1	1.3	0.0	A
	B5080 to A5 NB on	NE-SE	258	1	0.4%	31.2	0.2	3.6	A
	B5080 to Centurion Way	NE-SW	81	0	0.0%	31.2	0.2	3.7	A
	B5080 to Watling Street	NE-NW	336	-13	-3.7%	31.2	0.2	3.7	A
	B5080 to B5080	NE-NE	0	0	0.0%	31.2	0.2	0.0	A
	A5 NB off to Centurion Way	SE-SW	74	3	4.2%	103.0	1.3	7.3	A
	A5 NB off to Watling Street	SE-NW	225	5	2.3%	103.0	1.3	8.2	A
	A5 NB off to B5080	SE-NE	262	2	0.8%	103.0	1.3	7.9	A
	A5 NB off to A5 NB on	SE-SE	0	0	0.0%	103.0	1.3	0.0	A
	Centurion Way to Watling Street	S-NW	17	-1	-5.6%	18.4	0.0	6.8	A
	Centurion Way to B5080	S-NE	42	-1	-2.3%	18.4	0.0	7.7	A
	Centurion Way to A5 NB on	S-SE	11	-1	-8.3%	18.4	0.0	7.3	A
	Centurion Way to Centurion Way	S-SW	0	0	0.0%	18.4	0.0	0.0	A
	ALL	**All**	**1975**	**1**	**0.1%**	**148.1**	**0.7**	**7.3**	**A**
OVERALL TOTAL			**4005**	**30**	**0.8%**	**155.6**	**0.6**	**7.5**	**A**

Table 3.1 indicates that overall the junction operates well within capacity with an overall LOS of A. All movements operate within capacity.

Network Performance

The average and standard deviations values for various network performance parameters of the AM Peak are summarised in Table 3.2 below.

Table 3.2 – Tamworth Base AM Peak Network Performance

Measure	Average	Std Dev
Remaining Vehicles in Network	72	9
Processed Vehicles	4804	62
Total Distance Traveled (mi)	3768	46
Total Travel Time (h)	77.4	1.4
Total Network Delay (h)	11.6	0.8
Average Travel Time (mins)	0.95	0.01
Average Delay Time (mins)	0.14	0.01
Total Stopped Delay (h)	0.3	0.1
Average Stopped Delay (s)	0.2	0.0
Number of Stops	414.6	53.8
Average Number of Stops	0.08	0.01
Average Network Speed (mph)	30.2	0.3

The network performance indicates that vehicles suffer an average delay of around 8 seconds. The standard deviation of the 16 random seeds indicates that there is little variation between seeds.

Random seed number 10 is the closest to the average in terms of network delay and vehicle throughput.

PM Peak

Junction Performance

A summary of the overall junction analysis results for the Existing PM Peak hour model is shown in Table 3.3 below. The table shows the summary performance for each movement within the peak hour assessed.

Table 3.3 – Tamworth Base PM Peak Summary of Junction Performance

Description	Turn	Direction	Flows				Pass Criteria		Queue Length (m)		Delay (secs)	LOS†
			Model	Count	Mod-Cnt	%Diff*	GEH	Accept	Max	Average	Average	
North Roundabout	Pennine Way to A5 SB on	N-S	343	338	5	1.5%	0.27	✓	121.5	0.9	6.7	A
	Pennine Way to B5080	N-SW	406	405	1	0.2%	0.05	✓	121.5	0.9	7.0	A
	Pennine Way to Pennine Way	N-N	0	0	0	0.0%	0.00	✓	121.5	0.9	0.0	A
	A5 SB off to B5080	S-SW	120	146	-26	-17.8%	2.25	✓	91.8	0.2	9.2	A
	A5 SB off to Pennine Way	S-N	370	369	1	0.3%	0.05	✓	91.8	0.2	10.8	B
	A5 SB off to A5 SB on	S-S	0	0	0	0.0%	0.00	✓	91.8	0.2	0.0	A
	B5080 to Pennine Way	SW-N	846	834	12	1.4%	0.41	✓	302.1	2.5	9.5	A
	B5080toA5 SB on	SW-S	311	312	-1	-0.3%	0.06	✓	302.1	2.5	9.4	A
	B5080 to B5080	SW-SW	0	0	0	0.0%	0.00	✓	302.1	2.5	0.0	A
	ALL	**All**	**2397**	**2404**	**-7**	**-0.3%**	**0.14**		**302.1**	**1.2**	**8.8**	**A**
South Roundabout	Watling Street to Centurion Way	W-SW	20	20	0	0.0%	0.00	✓	204.1	4.3	14.7	B
	Watling StreettoB5080	W-NE	591	587	4	0.7%	0.16	✓	204.1	4.3	13.1	B
	Watling Street to A5 NB on	W-SE	27	27	0	0.0%	0.00	✓	204.1	4.3	7.1	A
	Watling Street to Watling Street	W-NW	0	0	0	0.0%	0.00	✓	204.1	4.3	0.0	A
	B5080 to A5 NB on	NE-SE	144	143	1	0.7%	0.08	✓	31.5	0.1	2.7	A
	B5080 to Centurion Way	NE-SW	33	33	0	0.0%	0.00	✓	31.5	0.1	3.8	A
	B5080 to Watling Street	NE-NW	350	352	-2	-0.6%	0.11	✓	31.5	0.1	5.4	A
	B5080 to B5080	NE-NE	0	0	0	0.0%	0.00	✓	31.5	0.1	0.0	A
	A5 NB off to Centurion Way	SE-SW	36	37	-1	-2.7%	0.17	✓	227.6	3.3	11.0	B
	A5 NB off to Watling Street	SE-NW	344	338	6	1.8%	0.32	✓	227.6	3.3	11.3	B
	A5 NB off to B5080	SE-NE	490	486	4	0.8%	0.18	✓	227.6	3.3	14.3	B
	A5 NB off to A5 NB on	SE-SE	0	0	0	0.0%	0.00	✓	227.6	3.3	0.0	A
	Centurion Way to Watling Street	S-NW	42	41	1	2.4%	0.16	✓	35.3	1.5	23.5	C
	Centurion Way to B5080	S-NE	77	78	-1	-1.3%	0.11	✓	35.3	1.5	26.3	D
	Centurion Way to A5 NB on	S-SE	44	44	0	0.0%	0.00	✓	35.3	1.5	23.3	C
	Centurion Way to Centurion Way	S-SW	0	0	0	0.0%	0.00	✓	35.3	1.5	0.0	A
	ALL	**All**	**2199**	**2186**	**13**	**0.6%**	**0.28**		**227.6**	**2.3**	**11.8**	**B**
OVERALL TOTAL			**4596**	**4590**	**6**	**0.1%**	**0.1**		**302.1**	**1.9**	**10.3**	**B**

Table 3.3 indicates that overall the junctions operate well within capacity with an overall LOS of B. There is one movement that operates close to capacity with a LOS of D between Centurion way and the B5080.

Network Performance

The average and standard deviations values for various network performance parameters of the PM Peak are summarised in Table 3.4 below.

Table 3.4– Tamworth Base PM Peak Network Performance

Measure	Average	Std Dev
Remaining Vehicles in Network	97	12
Processed Vehicles	6664	58
Total Distance Traveled (mi)	5211	48
Total Travel Time (h)	108.0	2.5
Total Network Delay (h)	22.2	2.0
Average Travel Time (mins)	0.96	0.02
Average Delay Time (mins)	0.20	0.02
Total Stopped Delay (h)	1.1	0.3
Average Stopped Delay (s)	0.6	0.2
Number of Stops	882.5	218.6
Average Number of Stops	0.13	0.03
Average Network Speed (mph)	30.0	0.6

The network performance indicates that vehicles suffer an average delay of 20 seconds. The standard deviation of the 16 random seeds indicates that there is little variation between seeds.

Random seed number 30 is the closest to the average in terms of network delay and vehicle throughput.

Summary

In summary, the analysis indicates that the junctions operate well within capacity in both peaks with no problems. The models are considered fit for the purpose of assessing the impact of the development.

3.3. Development Proposed Scenario

Model Development

The base models have been utilised and no changes have been made other than to add in the predicted development trips. The with development traffic flows for the AM and PM peaks are shown in Figures 3.3 and 3.4 respectively.

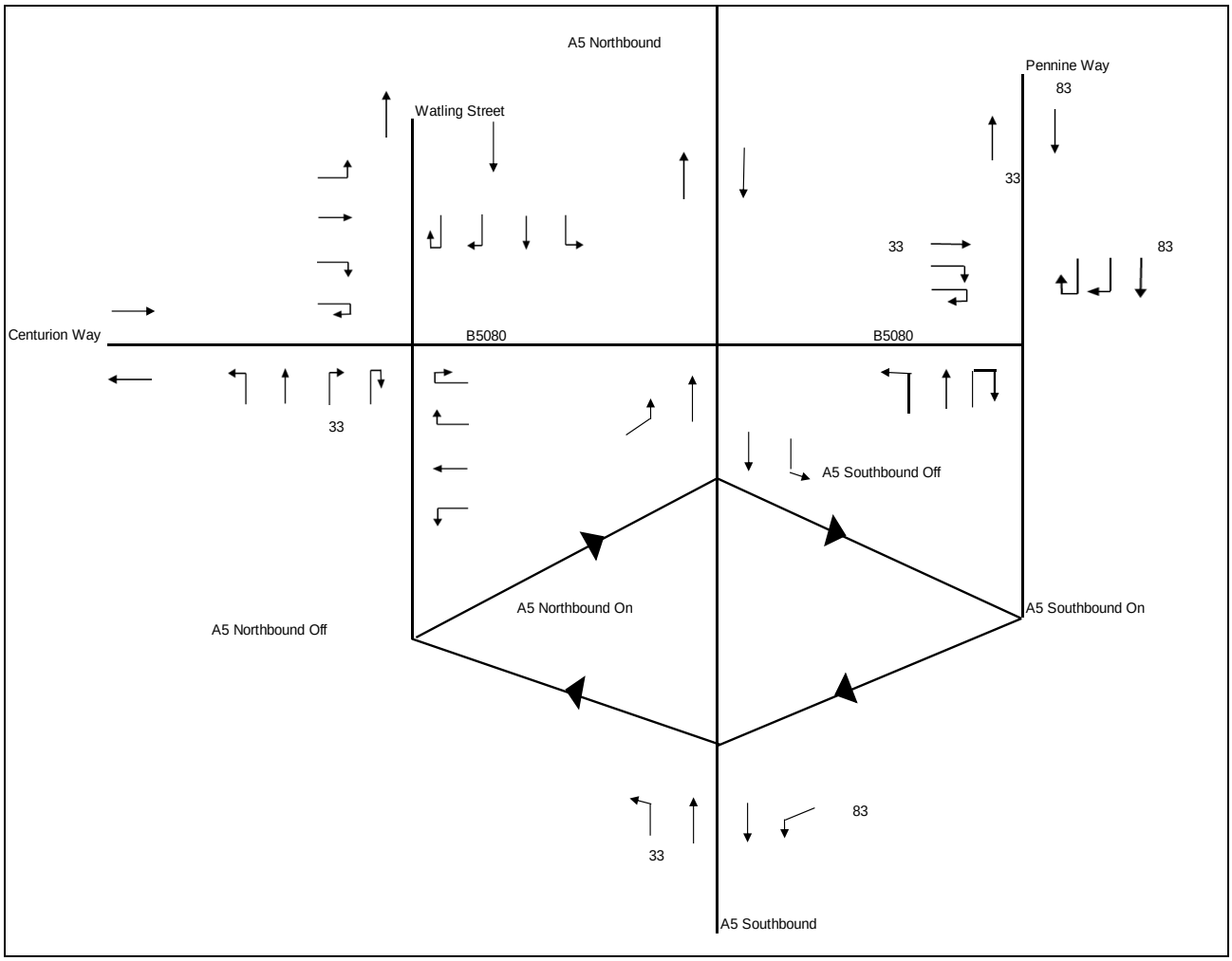

Figure 3.3 Development Traffic Flow 0800-0900

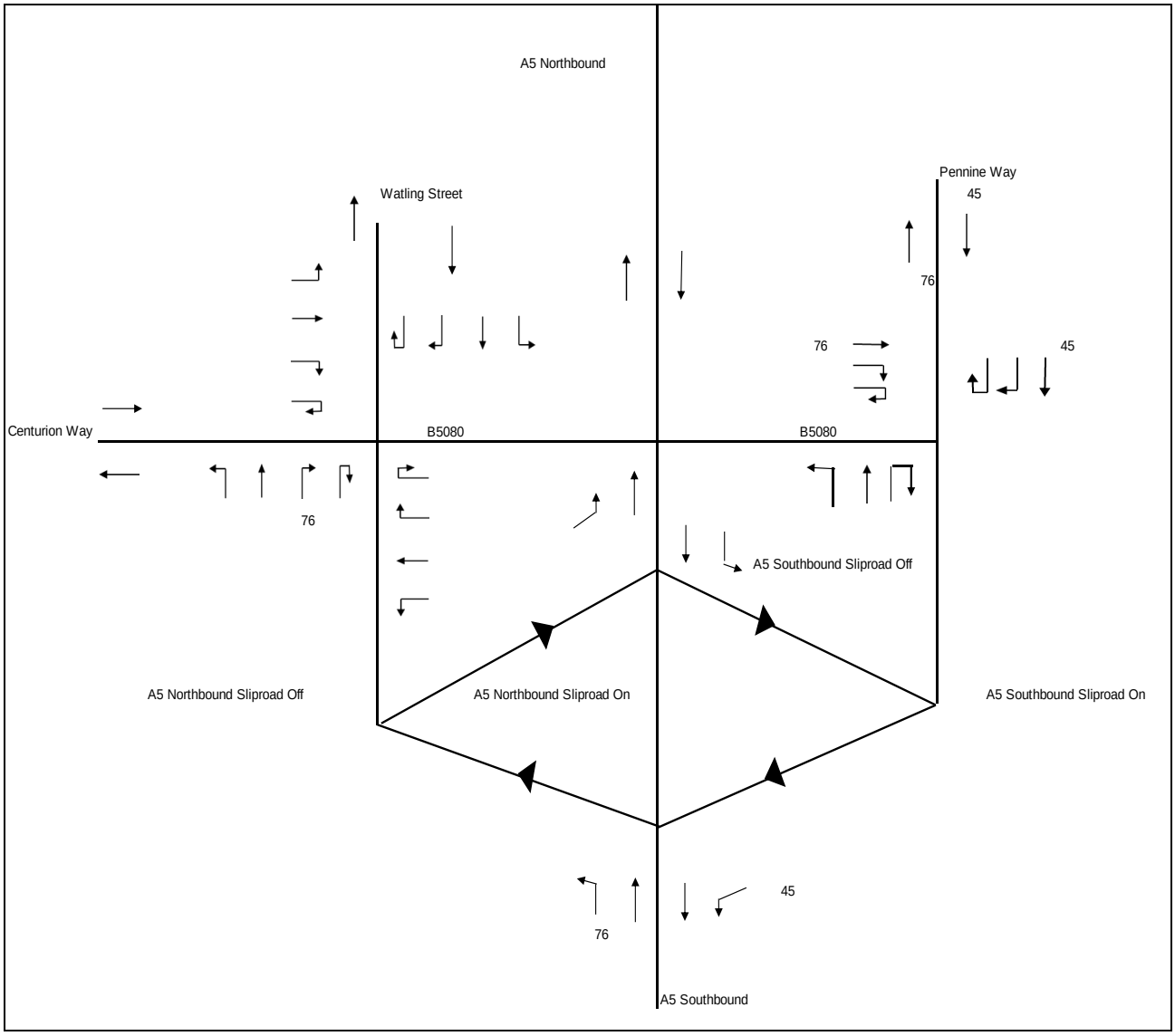

Figure 3.4 Development Traffic Flow 1700-1800

Atkins created a new vehicle class for the development traffic to add to the VISSIM model, using vehicle type number 9100 for cars and vehicle type number 9200 for Heavy Goods Vehicles.

All development trips were added to the peak hour for the 1100 houses and 420 pupils.

3.4. Comparison Results

AM Peak

Junction Performance

The AM peak Base results for junction performance for each movement in terms of vehicles, maximum and average queue lengths (m), average delay (s) and LOS have been compared to the AM peak Development results and are shown in Table 3.5. The light blue shaded cells represent the optimum performer.

Table 3.5 shows that the development traffic has increased the max queue length, average queue length and delay time during the AM peak times, however this is to be expected. Nevertheless, as the increases are very

minor, the junctions still predicted to operate well within capacity with an overall LOS of A for the AM peak time.

Table 3.5 – Tamworth AM Peak Junction Performance Comparison

Junction	Movement	Direction	Flows		Max QL(m)		Avg QL(m)		Delay (secs)		LOS	
			Base	Dev	Base	Dev	Base	Dev	Base	Dev	Base	Dev
North Roundabout	Pennine Way to A5 SB on	N-S	397	***475***	***156***	162	***1.0***	1.8	***8.2***	9.7	***A***	A
	Pennine Way to B5080	N-SW	***601***	600	***156***	162	***1.0***	1.8	***8.3***	9.8	***A***	A
	Pennine Way to Pennine Way	N-N	***0***	***0***	***156***	162	***1.0***	1.8	***0.0***	***0.0***	***A***	***A***
	A5 SB off to B5080	S-SW	***74***	***74***	25	***14***	0.0	***0.0***	***12.4***	12.4	***B***	B
	A5 SB off to Pennine Way	S-N	***90***	***90***	25	***14***	0.0	***0.0***	11.2	***11.1***	B	***B***
	A5 SB off to A5 SB on	S-S	***0***	***0***	25	***14***	0.0	***0.0***	***0.0***	***0.0***	***A***	***A***
	B5080 to Pennine Way	SW-N	514	***546***	***80***	114	***0.2***	0.3	***5.6***	5.9	***A***	A
	B5080toA5 SB on	SW-S	***353***	352	***80***	114	***0.2***	0.3	***6.8***	7.2	***A***	A
	B5080 to B5080	SW-SW	***0***	***0***	***80***	114	***0.2***	0.3	***0.0***	***0.0***	***A***	***A***
	ALL	**All**	2030	***2137***	***156***	162	***0.4***	0.7	***7.6***	8.5	***A***	A
South Roundabout	Watling Street to Centurion Way	W-SW	***39***	***39***	148	***136***	***1.3***	1.7	***9.9***	10.5	***A***	B
	Watling StreettoB5080	W-NE	***562***	***562***	148	***136***	***1.3***	1.7	***10.8***	11.4	***B***	B
	Watling Street to A5 NB on	W-SE	***68***	***68***	148	***136***	***1.3***	1.7	***6.8***	7.0	***A***	A
	Watling Street to Watling Street	W-NW	***0***	***0***	148	***136***	***1.3***	1.7	***0.0***	***0.0***	***A***	***A***
	B5080 to A5 NB on	NE-SE	***258***	257	31	***31***	***0.2***	***0.2***	***3.6***	3.6	***A***	A
	B5080 to Centurion Way	NE-SW	***81***	80	31	***31***	***0.2***	***0.2***	3.7	***3.6***	A	***A***
	B5080 to Watling Street	NE-NW	***336***	***336***	31	***31***	***0.2***	***0.2***	***3.7***	3.8	***A***	A
	B5080 to B5080	NE-NE	***0***	***0***	31	***31***	***0.2***	***0.2***	***0.0***	***0.0***	***A***	***A***
	A5 NB off to Centurion Way	SE-SW	***74***	***74***	***103***	124	***1.3***	1.3	***7.3***	7.4	***A***	A
	A5 NB off to Watling Street	SE-NW	***225***	***225***	***103***	124	***1.3***	1.3	***8.2***	8.3	***A***	A
	A5 NB off to B5080	SE-NE	262	***294***	***103***	124	***1.3***	1.3	***7.9***	8.6	***A***	A
	A5 NB off to A5 NB on	SE-SE	***0***	***0***	***103***	124	***1.3***	1.3	***0.0***	***0.0***	***A***	***A***
	Centurion Way to Watling Street	S-NW	17	***18***	18	***15***	0.0	***0.0***	***6.8***	7.0	***A***	A
	Centurion Way to B5080	S-NE	***42***	***42***	18	***15***	0.0	***0.0***	***7.7***	8.1	***A***	A
	Centurion Way to A5 NB on	S-SE	***11***	***11***	18	***15***	0.0	***0.0***	7.3	***7.2***	A	***A***
	Centurion Way to Centurion Way	S-SW	***0***	***0***	18	***15***	0.0	***0.0***	***0.0***	***0.0***	***A***	***A***
	ALL	**All**	1975	***2006***	148	***136***	***0.7***	0.8	***7.3***	7.6	***A***	A
OVERALL TOTAL			4005	***4143***	***156***	162	***0.6***	0.8	***7.5***	8.1	***A***	A

Network Performance

The AM peak network performance results have been compared to the AM peak development network performance results and are shown in Table 3.6.

Table 3.6 – AM Peak Network Performance Comparison

Measure	Base	Dev
Remaining Vehicles in Network	***72***	77
Processed Vehicles	***4804***	4911
Total Distance Traveled (mi)	***3768***	3843
Total Travel Time (h)	***77***	80
Total Network Delay (h)	***12***	13
Average Travel Time (mins)	***1.0***	1.0
Average Delay Time (mins)	***0.1***	0.2
Total Stopped Delay (h)	***0.3***	0.4
Average Stopped Delay (s)	***0.2***	0.3
Number of Stops	***414.6***	438.4
Average Number of Stops	***0.1***	0.1
Average Network Speed (mph)	30.2	***29.8***

Table 3.6 shows that the network performance comparison is consistent with the other measures in that the base traffic model performs better than the development traffic model with fewer delays and faster travel times, however, these differences are not significant as the increases are very minor.

PM Peak

Junction Performance

The Base PM Peak results for junction performance for each movement in terms of vehicles, maximum and average queue lengths (m), average delay (s) and LOS have been compared to the Development PM Peak results and are shown in Table 3.7. It should be noted that the results for the Base PM peak have been based on 15 random seeds as RS45 was deemed to be a statistical outlier where unrealistic congestion occurred.

Table 3.7 – PM Peak Junction Performance Comparison

Junction	Movement	Direction	Flows		Max QL(m)		Avg QL(m)		Delay (secs)		LOS	
			Base	Dev	Base	Dev	Base	Dev	Base	Dev	Base	Dev
North Roundabout	Pennine Way to A5 SB on	N-S	343	***387***	***122***	156	***0.9***	1.2	***6.7***	7.5	***A***	A
	Pennine Way to B5080	N-SW	***406***	***406***	***122***	156	***0.9***	1.2	***7.0***	7.7	***A***	A
	Pennine Way to Pennine Way	N-N	***0***	***0***	***122***	156	***0.9***	1.2	***0.0***	***0.0***	***A***	***A***
	A5 SB off to B5080	S-SW	120	***121***	92	***88***	***0.2***	0.3	***9.2***	9.3	***A***	A
	A5 SB off to Pennine Way	S-N	***370***	***370***	92	***88***	***0.2***	0.3	***10.8***	11.2	***B***	B
	A5 SB off to A5 SB on	S-S	***0***	***0***	92	***88***	***0.2***	0.3	***0.0***	***0.0***	***A***	***A***
	B5080 to Pennine Way	SW-N	846	***919***	***302***	326	***2.5***	6.9	***9.5***	10.5	***A***	B
	B5080toA5 SB on	SW-S	***311***	***311***	***302***	326	***2.5***	6.9	***9.4***	10.2	***A***	B
	B5080 to B5080	SW-SW	***0***	***0***	***302***	326	***2.5***	6.9	***0.0***	***0.0***	***A***	***A***
	ALL	**All**	2397	***2513***	***302***	326	***1.2***	2.8	***8.8***	9.6	***A***	A
South Roundabout	Watling Street to Centurion Way	W-SW	***20***	***20***	***204***	210	***4.3***	17.5	***14.7***	26.0	***B***	D
	Watling StreettoB5080	W-NE	***591***	590	***204***	210	***4.3***	17.5	***13.1***	21.9	***B***	C
	Watling Street to A5 NB on	W-SE	***27***	***27***	***204***	210	***4.3***	17.5	***7.1***	11.4	***A***	B
	Watling Street to Watling Street	W-NW	***0***	***0***	***204***	210	***4.3***	17.5	***0.0***	***0.0***	***A***	***A***
	B5080 to A5 NB on	NE-SE	144	***145***	32	***23***	0.1	***0.1***	***2.7***	2.8	***A***	A
	B5080 to Centurion Way	NE-SW	***33***	***33***	32	***23***	0.1	***0.1***	***3.8***	5.3	***A***	A
	B5080 to Watling Street	NE-NW	***350***	***350***	32	***23***	0.1	***0.1***	***5.4***	7.6	***A***	A
	B5080 to B5080	NE-NE	***0***	***0***	32	***23***	0.1	***0.1***	***0.0***	***0.0***	***A***	***A***
	A5 NB off to Centurion Way	SE-SW	***36***	***36***	***228***	380	***3.3***	9.4	***11.0***	16.6	***B***	C
	A5 NB off to Watling Street	SE-NW	***344***	343	***228***	380	***3.3***	9.4	***11.3***	16.7	***B***	C
	A5 NB off to B5080	SE-NE	490	***565***	***228***	380	***3.3***	9.4	***14.3***	21.7	***B***	C
	A5 NB off to A5 NB on	SE-SE	***0***	***0***	***228***	380	***3.3***	9.4	***0.0***	***0.0***	***A***	***A***
	Centurion Way to Watling Street	S-NW	***42***	***42***	35	***33***	***1.5***	2.2	***23.5***	29.0	***C***	D
	Centurion Way to B5080	S-NE	***77***	***77***	35	***33***	***1.5***	2.2	***26.3***	34.4	***D***	D
	Centurion Way to A5 NB on	S-SE	***44***	***44***	35	***33***	***1.5***	2.2	***23.3***	30.0	***C***	D
	Centurion Way to Centurion Way	S-SW	***0***	***0***	35	***33***	***1.5***	2.2	***0.0***	***0.0***	***A***	***A***
	ALL	**All**	2199	***2271***	***228***	380	***2.3***	7.3	***11.8***	17.9	***B***	C
OVERALL TOTAL			4596	***4784***	***302***	380	***1.9***	5.7	***10.3***	13.6	***B***	B

Table 3.7 shows that the development traffic increased the maximum and average queue length as expected, however, these increases do not have a major effect on the junctions. The development traffic did increase the LOS to D on three more movements, all on the south roundabout at Centurion Way to Watling Street and Centurion Way to A5 northbound increased from a LOS C to LOS D. A bigger increase resulted at the junction from Watling Street to Centurion Way which increases from a LOS B to LOS D. However, the overall LOS has not increased and still operates with an overall LOS of B, indicating the development traffic does not result in the need for mitigating measures.

Network Performance

The PM Peak Base network performance results have been compared to the PM Peak Development network performance results and are shown in Table 3.8 below.

Table 3.8 –PM Peak Network Performance Comparison

Measure	Base	Dev
Remaining Vehicles in Network	***97***	102
Processed Vehicles	***6664***	6780
Total Distance Traveled (mi)	***5211***	5298
Total Travel Time (h)	***108***	116
Total Network Delay (h)	***22***	29
Average Travel Time (mins)	***1.0***	1.0
Average Delay Time (mins)	***0.2***	0.2
Total Stopped Delay (h)	***1.1***	1.7
Average Stopped Delay (s)	***0.6***	0.9
Number of Stops	***882.5***	1448.1
Average Number of Stops	***0.1***	0.2
Average Network Speed (mph)	30.0	***28.4***

Table 3.8 shows that the network performance comparison is consistent with the other measures in that the base model performs better than the development model with fewer delays and faster travel times. This is to be expected and the delays are not significant.

4. Summary and Conclusions

The technical note documents the traffic impact of the planned mixed use re-development of Tamworth Golf Course at two locations in isolation, the Stoneydelph dumb-bell roundabouts off the A5 trunk road and the adjacent M42 J10.

The LinSig model was provided by Amey and represents the junction with recent improvements. The existing conditions assessment shows that the M42 J10 is over capacity in both peaks already with the M42 NB and A5 EB approaches with a DoS over 100% in the AM peak. In the PM peak the A5 EB and Green Lane approaches are over capacity with a DoS of over 100%. Adding the development traffic along with the mitigation of changing the lane allocations on the A5 EB, M42 NB and exit to the M42 NB to two lanes does help to alleviate the capacity issues in both peaks, reducing the total delay and increasing the PRC. Therefore, the proposed changes to the lane allocations are considered sufficient to mitigate the impact of the development. Nevertheless, it should be noted that the junction is still predicted to operate over capacity in both peaks.

The VISSIM model of the Stoneydelph junctions was calibrated and validated by JMP Consultants Limited. Atkins have then added a development vehicle classification for the development vehicles in order to isolate them in the assessment.

The VISSIM modelling results show both the AM and PM peak hours are impacted by the development traffic but this is to be expected and the differences between the AM and PM Peak delays to the AM and PM development delays are not significant. The AM and PM development traffic still operates within the operating capacity. The AM development traffic results in an overall LOS of A and the PM development traffic an overall LOS of B.

Overall the Tamworth Golf Course re-development traffic has a small effect on the base traffic operation at the A5 Stoneydelph junctions and does not result in the need for mitigating measures. However, the impact at M42 J10 is more notable as the junction is already overcapacity and small flow increases have an exponential impact in the LinSig model.

In conclusion the small amount of development traffic is predicted to have little impact at Stoneydelph and can be mitigated at the M42 J10 by changing the line markings on the A5 EB and M42 NB approaches and downstream circulatory towards the M42 NB.