Appendix L: Paramics Study Local Model Validation and Future Options Testing Report

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SOUTH WOKINGHAM PARAMICS STUDY

Local Model Validation and Future Options Testing Report

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South Wokingham Paramics Study

Local Model Validation and Future Options Testing Report

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1 Introduction

1.1 Introduction

1.1.1 WSP has been instructed by Wokingham Borough Council (WBC) to develop a micro-simulation model of the South Wokingham Area primarily encompassing the roundabouts at Molly Millars Lane / Finchampstead Road and Tesco, using the S-Paramics software platform.

1.1.2 The area already experiences delays and it is understood that a proposed Southern Distributor Road is likely to join at the existing Tesco roundabout approach. This, along with other strategic developments in Wokingham will likely lead to significant changes in turning movements in the area as identified using the Wokingham Strategic Traffic Model (WSTM) for future forecast years.

1.1.3 A micro-simulation traffic model has therefore been developed to assist with the design and testing of various junction layout and operational options at the existing roundabouts and the link under the railway with respect to traffic movements and access to the town centre.

1.1.4 A Base Year S-Paramics model was developed for two peak periods (8am – 9am and 5pm – 6pm) and validated to 2010 observed traffic data. This is to provide a robust tool for analysis of the various junction layouts, to enable the demonstration of likely impacts on queues and delays.

1.2 Purpose of the Report

1.2.1 This report describes the development of the 2010 Base Year S-Paramics model and describes the models' calibration and validation performance.

- Chapter 2: Data Collection
- Chapter 3: Model Development
- Chapter 4: Model Calibration
- Chapter 5: Model Validation
- Chapter 6: Summary

2 Data Collection

2.1.1 A number of traffic surveys were carried out by WBC in May 2010 and the following data was provided to WSP for calibration and validation of the S-Paramics model:

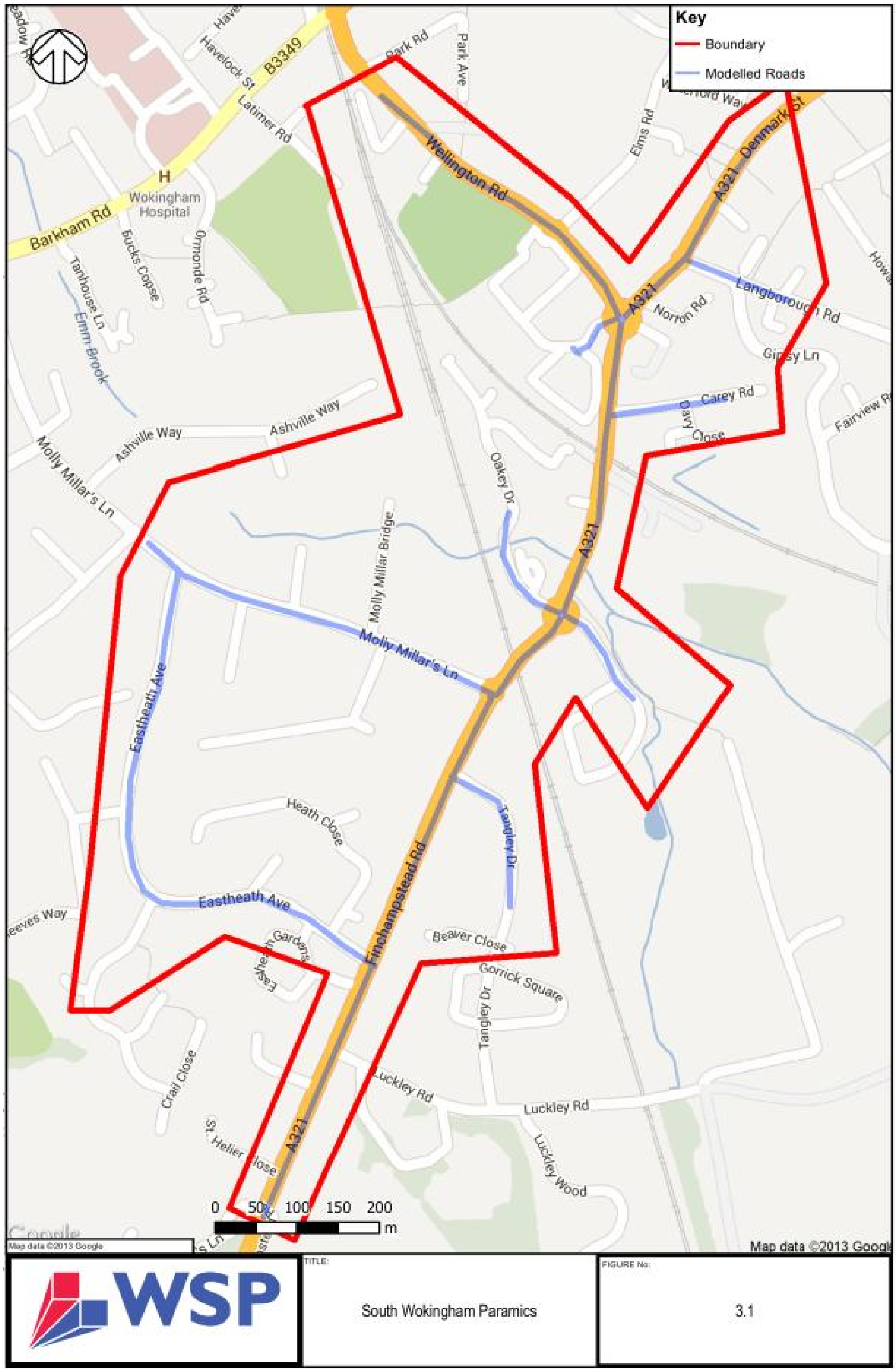
- Manual Turning Counts (MTC) at:
  - Finchampstead Road junction with Molly Millars Lane
  - Denmark Street junction with Langborough Road
  - Carnival Pool Roundabout
- Journey time surveys were undertaken by WBC in May 2010 for use in the WSTM calibration / validation Route 1 was used to validate the S-Paramics model.

3 Model Development

3.1 Network Development

3.1.1 The extent of the study area and the modelled network are is shown in Figure 3.1. The road network was coded using detailed 1:1,250 mapping provided by WBC, supplemented with information from Google Streetview and site visits, as well as local knowledge of WBC technical staff to ensure the robustness of the modelled network.

Figure 3.1. Extent of study area and modelled network



3.2 Modelled Time Periods

3.2.1 Two periods have been modelled, representing the peak hours as derived from observed traffic data. Each peak hour, detailed below, includes a 30-minute ‘warm-up’ period to enable loading of vehicles prior to the peak hour, and a 30-minute ‘cool-down’ period to allow completion of trips after the peak hour; the peak hours represented in the modelling are:

- Weekday AM – 0800-0900 hours
- Weekday PM – 1700-1800 hours

3.3 Vehicle Classifications

3.3.1 S-Paramics uses 15 different vehicle type classifications and the matrices are assigned to these as follows:

Home to work - 58.4%

Work to home – 2.2%

Home to employers business – 9.0%

Employers business to home – 0.2%

Home to leisure short – 5.5%

Leisure to home short – 1.7%

Home to leisure long – 0.6%

Leisure to home long – 0.2%

Non-home-based employers business – 4.7%

Non-home-based leisure short – 2.5%

LGVS – 7.8%

Medium weight Goods – 3.2%

HGVS – 2.8%

Coaches – 1.2%

Classifications using vehicles in excess of 3.8m in height were omitted given the height restriction in place at the rail bridge.

3.4 Signal Timings

3.4.1 There is a signal controlled pedestrian crossing to the south of the mini-roundabout on Finchampstead Road junction with Molly Millars Lane, the timings were taken from video observations from May 2010 and averaged out over the peak hours.

3.4.2 There is a signal controlled pedestrian crossing to the west of the mini-roundabout on Molly Millars Lane junction with Finchampstead Road, there were no timings or video footage of this available. Given the close proximity to the other pedestrian crossing the timings were duplicated here.

3.5 Matrix Development

3.5.1 The Zone structure includes 12 zones covering all main routes to the roundabouts at Molly Millars Lane and Tesco.

3.5.2 Zone 1 – Wellington Road

Zone 2 – Denmark Street

Zone 3 – Langborough Road

Zone 4 – Tesco

Zone 5 – Tangley Drive

Zone 6 – Finchampstead Road

Zone 7 – Molly Millars

Zone 8 – Oakey Drive

Zone 9 – Eastheath Avenue

Zone 10 – Carey Road

Zone 11 – Leisure Park

Zone 12 – Southern Distributor Road (Used in future scenarios)

3.6 Traffic counts and matrix estimation

3.6.1 Initial 2010 matrix data was taken direct from the WSTM. However, on running the Paramics model extensive queues were forming on most approaches. On processing the data it was found that turning flows would not calibrate to the observed data and the journey times were far too high to validate against the surveys.

3.6.2 After examination of the WSTM model LMVR, it was found that in the examination area of this model, the WSTM was over predicting flows. This does not affect the validation of the WSTM as the flow difference – modelled to observed (GEH) was within acceptable limits. However, it was at the high end of the allowable margin and when used within microsimulation software this difference was too much to satisfy validation criteria over a smaller more focussed network.

3.6.3 The decision was taken to use the original survey data utilised by the WSTM to create a new more refined matrix just for this model. The WSTM 2010 matrix was used as a prior matrix to inform the route choice during the estimation process.

AM WSTM 2010 Prior Traffic Matrix

	1	2	3	4	5	6	7	8	9	10	11
1		11	23	52	13	165	2	6	0	4	15
2	57		6	38	15	186	426	4	16	9	11
3	50	5		2	4	62	120	4	7	3	3
4	7	0	2		0	16	39	0	0	0	0
5	4	0	1	0		19	15	0	0	0	0
6	538	13	120	35	31		191	4	14	1	17
7	125	14	284	33	29	169		15	119	43	34
8	4	0	4	0	0	0	4		0	0	0
9	17	0	43	0	0	26	15	0		0	0
10	2	0	2	0	0	1	2	0	0		0
11	4	0	1	0	0	3	0	0	0	0	

PM WSTM 2010 Prior Traffic Matrix

	1	2	3	4	5	6	7	8	9	10	11
1		6	37	9	**3**	**477**	**14**	2	**1**	2	1
2	33		12	3	**2**	**257**	**139**	3	**35**	1	0
3	40	6		6	**3**	**37**	**132**	1	**3**	1	0
4	80	0	14		**0**	**58**	**126**	0	**0**	0	0
5	18	0	32	0		**16**	**59**	0	**0**	0	0
6	446	15	67	20	**11**		**125**	1	**11**	1	3
7	30	7	223	47	**16**	**258**		10	**30**	7	19
8	11	0	8	0	**0**	**7**	**3**		**0**	0	0
9	13	0	31	0	**0**	**12**	**37**	0		0	0
10	19	0	5	0	**0**	**1**	**57**	0	**0**		0
11	25	0	4	0	**0**	**33**	**2**	0	**0**	0	

AM 2010 Estimated Traffic Matrix

	1	2	3	4	5	6	7	8	9	10	11
1		20	50	50	11	145	2	5	0	4	11
2	79		19	40	14	180	343	4	15	10	22
3	74	14		2	4	63	101	5	7	4	6
4	9	0	2		0	13	18	0	0	0	0
5	3	0	0	0		28	8	0	0	0	0
6	471	8	89	19	47		107	2	20	0	10
7	134	12	256	31	21	124		14	127	41	28
8	6	0	3	0	0	1	2		0	0	0
9	15	0	32	0	0	38	22	0		0	0
10	2	0	2	0	0	1	1	0	0		0
11	12	0	16	0	0	7	0	0	0	0	

PM 2010 Estimated Traffic Matrix

	1	2	3	4	5	6	7	8	9	10	11
1		16	76	8	2	341	11	2	0	2	17
2	43		39	3	2	221	125	3	30	1	0
3	65	6		8	3	37	139	1	3	1	25
4	97	0	11		0	35	86	0	0	0	0
5	15	0	22	0		25	37	0	0	0	0
6	369	12	47	11	16		80	0	16	0	4
7	45	9	237	117	17	282		25	0	17	37
8	13	0	6	0	0	4	2		0	0	0
9	11	0	21	0	0	18	55	0		0	0
10	23	0	4	0	0	1	40	0	0		0
11	41	0	21	0	0	59	4	0	0	0	

AM 2010 - Factored for profiles - Traffic Matrix (Final used in Base Model)

	1	2	3	4	5	6	7	8	9	10	11
1		30	75	75	17	218	3	8	0	6	17
2	119		29	60	21	270	515	6	23	15	33
3	111	21		3	6	95	152	8	11	6	9
4	14	0	3		0	20	27	0	0	0	0
5	5	0	0	0		42	12	0	0	0	0
6	707	12	134	29	71		161	3	30	0	15
7	201	18	384	47	32	186		21	191	62	42
8	9	0	5	0	0	2	3		0	0	0
9	23	0	48	0	0	57	33	0		0	0
10	3	0	3	0	0	2	2	0	0		0
11	18	0	24	0	0	11	0	0	0	0	

PM 2010 Factored for profiles - Traffic Matrix (Final used in Base Model)

	1	2	3	4	5	6	7	8	9	10	11
1		24	114	12	3	512	17	3	0	3	26
2	65		59	5	3	332	188	5	45	2	0
3	98	9		12	5	56	209	2	5	2	38
4	146	0	17		0	53	129	0	0	0	0
5	23	0	33	0		38	56	0	0	0	0
6	554	18	71	17	24		120	0	24	0	6
7	68	14	356	176	26	423		38	0	26	56
8	20	0	9	0	0	6	3		0	0	0
9	17	0	32	0	0	27	83	0		0	0
10	35	0	6	0	0	2	60	0	0		0
11	62	0	32	0	0	89	6	0	0	0	

4 Model Calibration

4.1 Model Calibration Process

4.1.1 Calibration of the S-Paramics model involves ensuring the model represents the on-site observed conditions by adjusting model inputs and parameters. This process involved examination of the network, checking for errors, and improving the performance of the model in terms of comparisons with observed data. These adjustments included:

- Matrix estimation to adjust the origin and destination information
- Changes to the assignment routeing and associated routeing factors
- Adjustment to gap acceptance parameters to represent observed queue lengths
- Adjustment to Headway parameters to represent observed queue lengths
- Use of hazard overrides to replicate observed lane usage

4.2 Traffic Assignment Process

4.2.1 Profiles were created from 5 minute intervals within the survey data to ensure that vehicles are released from zones in realistic platoons to give an accurate traffic peak spread over the hour.

Profile 1 – Molly Millars NB

Profile 2 – Molly Millars SB

Profile 3 – A321 WB

Profile 4 – A321 NB

Profile 5 – A321 SB

Profile 6 – A321 to Molly Millars

Profile 7 – Denmark Street SB Left

Profile 8 – Denmark Street SB Right

Profile 9 – Langborough Left

Profile 10 – Langborough Right

Profile 11 – Denmark Street NB Ahead

Profile 12 – Denmark Street NB Right

Profile 13 – Wellington Road Left

Profile 14 – Wellington Road Ahead

4.2.2 One of these profiles was assigned to each zone, where zones did not have specific survey data for a junction entering from that zone, another profile from a nearby area was used. There are 14 profiles within the model that release a percentage of the total zone demand every 5 minutes in a variable / stochastic method to allow variation between model runs.

4.2.3 The warm-up and warm-down shoulders to the modelled peak hour contain 50% of the levels of traffic within the peak hour. This is to pre-load the network with a high enough level of traffic for the model to quickly function correctly during the peak, but low enough to prevent significant queuing occurring.

4.3 Model Calibration Results

4.3.1 All available observed turning count data has been used in the process of developing the trip matrices for the S-Paramics model to improve the quality of the matrices developed. Given there is limited route choice within the model this is accepted standard practice.

4.3.2 The results of the calibration of the S-Paramics model are reported against DMRB[1] calibration criteria. The DMRB criteria must be satisfied in 85% of cases for :

- Individual Link flows within 15% for flows between 700 and 2,700 vehicles
- Individual Link flows within 100 vehicles per hour for flows < 700 vph
- Individual Link flows within 400 vehicles per hour for flows >2,700 vehicles Per hour
- GEH statistic for individual flows <5

4.3.3 The base model was run 10 times in both the AM and PM peaks. The data was extracted and the modelled flows were averaged. All 18 counts are within the DMRB criteria

4.3.4 Table 4.1 – Flow Calibration

Count	AM			PM		
	100.00			100.00		
	Modelled	**Observed**	**GEH**	**Modelled**	**Observed**	**GEH**
A321 Bridge SB	903	998	3.08	1076	1146	2.11
A321 Bridge NB	1103	1130	0.82	991	1002	0.34
A321 Finchampstead Rd (S) NB	703	743	1.49	622	631	0.36
A321 Finchampstead Rd (S) SB	589	592	0.12	1001	1038	1.16
Molly Millars EB	656	646	0.38	785	786	0.04
Molly Millars WB	556	665	4.40	484	523	1.74
Wellington Road SB	298	305	0.41	472	474	0.10
Wellington Road NB	736	823	3.12	680	729	1.87
Denmark Street (S) NB	461	493	1.48	472	509	1.68
Denmark Street (S) SB	954	956	0.07	703	743	1.47
Finchampstead Road (N) NB	990	1113	3.81	936	974	1.23
Finchampstead Road (N) SB	996	1016	0.64	994	1040	1.43
Leisure Park OUT	35	36	0.18	126	124	0.16
Leisure Park IN	74	76	0.21	83	84	0.11
Denmark Street (N) SB	715	761	1.70	461	449	0.55
Denmark Street (N) NB	58	53	0.67	43	45	0.33
Langborough Road (WB)	283	292	0.51	290	274	0.95
Langborough Road (EB)	440	468	1.30	473	509	1.62

[1] Design Manual for Roads and Bridges Volume 12a, Chapter 4: Traffic Appraisal in Urban Areas

5 Model Validation

5.1 Model Validation Process

5.1.1 Observed turning count data has been used during matrix development and model calibration. Independent observed data must be used for model validation, ATC's and journey time data were available for this process.

5.1.2 Within the WSTM validation it was judged that comparison of ATC data against adjacent MCC counts highlighted a discrepancy at many sites, whereby the ATCs were reporting a much lower traffic flow than the adjacent MCC. This was thought to have been attributed to loops being located at lane drops/gains therefore not recording accurate vehicle numbers, or issues created by vehicles queuing back over the loops. With this in mind, the MCCs have been taken forward as the more reliable dataset, as they reported higher traffic flows thus allowing a more robust model representation. As with the WSTM, ATCs have not been used for validation, only journey time data.

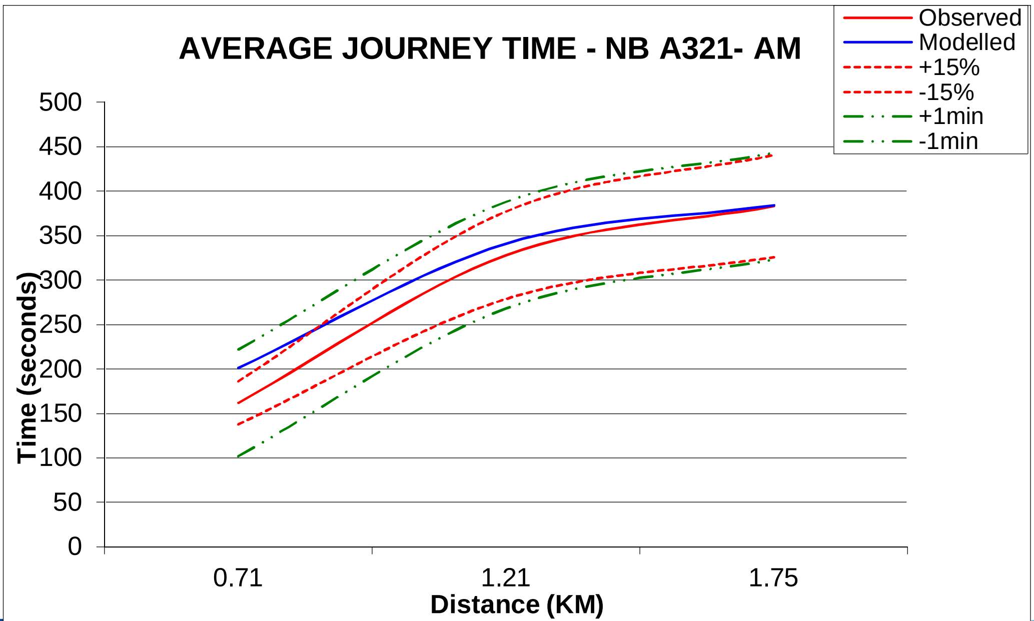
5.2 Model Validation Results

5.2.1 An assessment of validation has been made by comparing modelled journey times with the observed data obtained from WBC from May 2010. DMRB guidelines recommend that 85% or more of all journey time survey routes in each peak period should be within 15% of observed (or 1 minute if higher). The base model was run 10 times in both the AM and PM peaks. The data was extracted and the modelled journey times were averaged. All 4 journey time routes validate well within the DMRB criteria.

5.2.2 Table 5.1: Journey Time Validation Route A321 Northbound – AM _Peak

Run	NB A321 - AM		
	46-30b	30b-4b	4b-47
Distance (KM)	0.71	1.21	1.75
Observed	162	328	383
Modelled	201	341	384
+15%	186	377	440
-15%	138	279	326
+1min	222	388	443
-1min	102	268	323

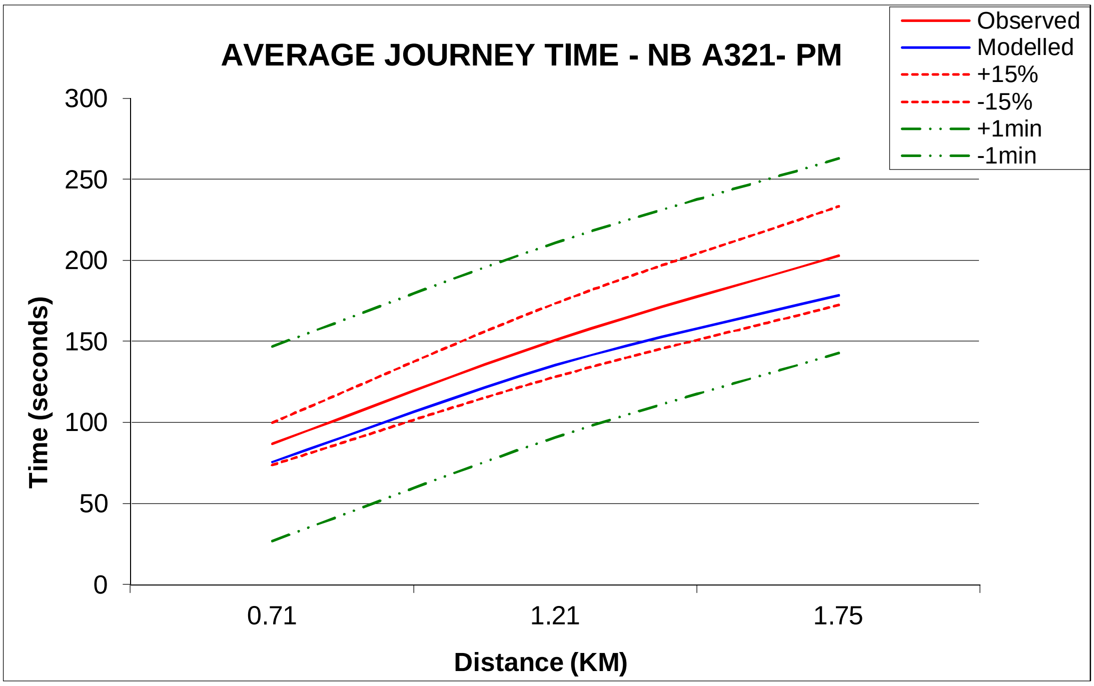
5.2.3 Graph 5.1: Journey Time Validation Route A321 Northbound – AM Peak



5.2.4 Table 5.2: Journey Time Validation Route A321 Northbound – PM Peak

Run	NB A321 - PM		
	46-30b	30b-4b	4b-47
Distance (KM)	0.71	1.21	1.75
Observed	87	151	203
Modelled	76	136	179
+15%	100	174	233
-15%	74	128	173
+1min	147	211	263
-1min	27	91	143

5.2.5 Graph 5.2: Journey Time Validation Route A321 Northbound – PM Peak



5.2.6 Table 5.3: Journey Time Validation Route A321 Southbound – AM Peak

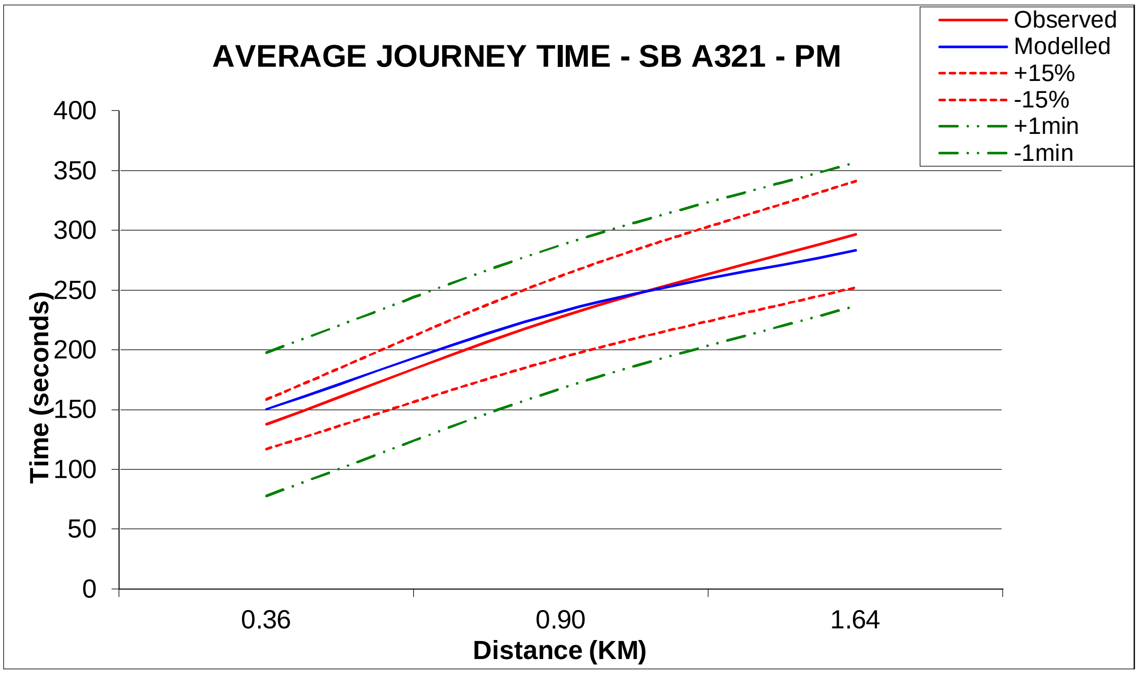
Run	SB A321 - AM		
	8-4a	4b-30a	30a-46
Distance (KM)	0.36	0.90	1.64
Observed	74	126	182
Modelled	79	133	183
+15%	85	145	209
-15%	63	107	155
+1min	134	186	242
-1min	14	66	122

5.2.7 Graph 5.3: Journey Time Validation Route A321 Southbound – AM Peak

5.2.8 Table 5.4: Journey Time Validation Route A321 Southbound – AM Peak

Run	SB A321 - PM		
	8-4a	4b-30a	30a-46
Distance (KM)	0.36	0.90	1.64
Observed	138	228	297
Modelled	151	232	284
+15%	159	262	342
-15%	117	194	252
+1min	198	288	357
-1min	78	168	237

5.2.9 Graph 5.4: Journey Time Validation Route A321 Southbound – AM Peak



5.3 Summary

5.3.1 Observed traffic survey data from 2010 that was used in creating the WSTM was also used to form matrices before estimation within the S-Paramics software. Prior matrices were used from the WSTM to help influence routing in the estimation process. The estimated matrices converged well to all of the observed data and were taken forward for modelling.

5.3.2 After calibration to the survey data within the model, validation was undertaken utilising the journey time data from 2010 also used in the WSTM. All routes validated well within the criteria set down by DMRB, indicating a high level of confidence in the models replication of flows and journey times. The base model is robust and fit for purpose.

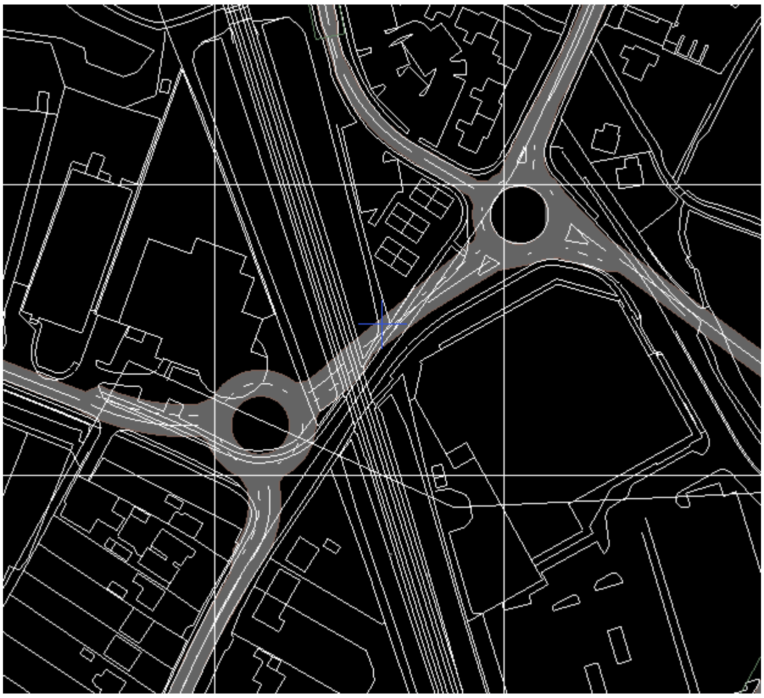
6 Future Options Testing

6.1 Layouts

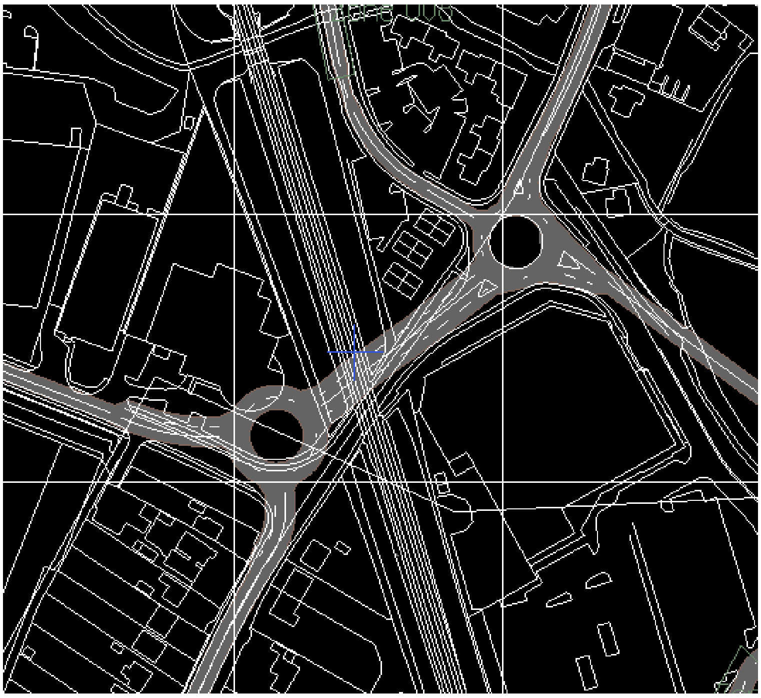
6.1.1 Four different layouts were identified for examination in future scenarios. All scenarios included provision of a new bridge under the railway. These were:

6.1.2

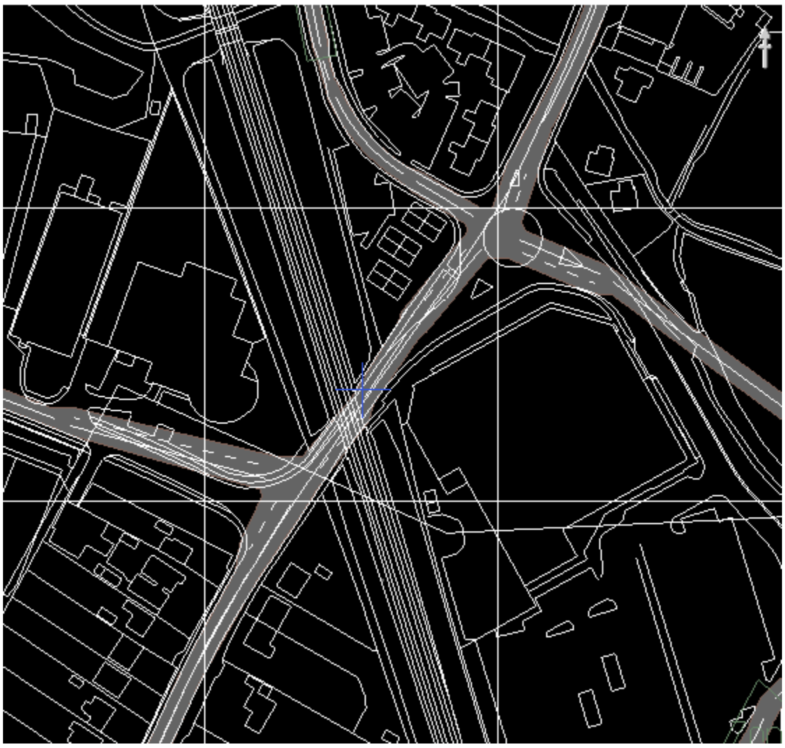
Scenario 1: A larger roundabout at the junction of Finchampstead Road with Molly Millars Lane, altering the alignment under the railway (new bridge required), but retaining the existing two way single lane arrangement under the railway.



Scenario 2: The same as scenario 1 but with provision for a two way dual lane arrangement under the railway.



Scenario 3: Converting the two current roundabouts into signal controlled junctions, retaining the two way single lane arrangement under the railway.



Scenario 4: The same as scenario 3 but with provision for a two way dual lane arrangement under the railway.

6.1.3 Other layouts were tested prior to the selection of the chosen scenarios. These included a larger twin bridge gyratory system, tested in both one way and two way configurations. A signal junction and roundabout combination. A much larger roundabout at Molly Millars and various alignment changes and banned turn options. These were eliminated through iterative testing in the WSTM which showed substantial delays due to the increase in capacity drawing in a high number of vehicles to the routes.

6.2 Predicted Flows

6.2.1 The layouts were replicated in the WSTM and run in the AM and PM peak hours in the future year 2026 to obtain matrices useable in each scenario.

6.2.2 The signal controlled scenarios were forecast and optimised at a high level in the WSTM. The flows were taken from the model and run through the junction capacity analysis software LinSig. More accurate signal timings were obtained from LinSig and were run back into the WSTM for one more iteration to produce useable flows for the Paramics model.

6.2.3 The updated flows produced from the WSTM were used to gain growth factors to be applied to the validated 2010 matrices from the Paramics base model. This was done by modelling the scenarios in the WSTM in 2010 and 2026, and subtracting the 2010 matrices for each scenario from the corresponding 2026 forecast matrix to give a factor. These growth factors were then applied to the 2010 Paramics matrices.

6.2.4 The base model was then copied and the layout altered for each scenario. In scenario 3 and 4 where signal timings were required these were added to the layouts utilising the same signal timings obtained through the LinSig software analysis in the previous step. Each of the factored growth matrices were then added to the corresponding scenario ready for testing.

6.2.5 It is noted that in the forecast scenarios predicted by the WSTM, dual lane running between the two junctions appears to draw more traffic into the area than the same single lane running scenario. This is likely because there is slightly more storage capacity between the two junction and so the assignment fills this capacity by routing more vehicles through the area.

7 Results

7.1 Initial Modelling

7.1.1 It was observed in running the models that in every scenario there were queues on all approaches. This was due to an increase in around 1000 vehicles or more in the future scenarios, which considering there was delay in the 2010 base model was unsurprising given the relatively small increase in capacity that the different scenario options offers.

7.1.2 Accepting that the future scenarios all had delays, the future models were run five times in both peak hours to produce reliable data that was then averaged and processed to attempt to establish which scenario offered the greatest benefit, in terms of the lowest relative delay to the corridor.

7.1.3 A Do Nothing scenario was also run as a baseline for comparison. It created no difference in flows from that of the Scenario 1 layout.

Table 8.1 - Average delay on all approaches to the two junctions.

Scenario	Seconds			Minutes			Total Vehicles	
	AM	PM	TOTAL	AM	PM	TOTAL	AM	PM
1 - Roundabouts - Single Lane	872	665	1537	15	11	26	4144	4434
2 - Roundabouts - Dual Lane	1134	1180	2314	19	20	39	4312	4641
3 - Signals - Single Lane	1237	1818	3055	21	30	51	3811	4148
4 - Signals - Dual Lane	1364	1354	2719	23	23	45	4129	4196
Do Nothing	898	724	1622	15	12	27	4144	4434

7.1.4 Table 8.1 shows that both signal scheme scenarios have more associated delay than the worst performing roundabout scheme which is the dual lane Scenario 2. This is due to any signal scheme creating an inherent delay to a network that did not previously have signals, through vehicles receiving delays at red signals while balancing of opposing flows occurs. It seems that the opposing flows through the area are relatively well balanced anyway and the addition of any signal control without any extra gains in additional stopline capacity, merely serves to increase delay while spreading it evenly over all approaches. The order of preference is 1, 2, 4, 3.

7.1.5 The dual lane roundabout scheme of Scenario 2 is shown to offer less delay than either Scenario 3 or 4 but has 168 more vehicles in the AM and 207 more vehicles in the PM over that of the single lane scheme of Scenario 1. This is due to the WSTM filling the extra capacity of the dual lane storage with more vehicles and where more capacity may have a year one benefit this is eroded over time by the attractiveness of the route.

7.1.6 The single lane roundabout scheme of Scenario 1 is shown to have a small benefit over the Do Nothing scenario in both the AM and PM peaks.

7.2 Carnival Pool Modelling

7.2.1 After further examination of the models running it was noticed that in every scenario, traffic queues were extending into the Tesco junction from delay caused further downstream at the Carnival Pool Roundabout. There was a relatively high proportion of right turning vehicles exiting the Denmark Street approach (Originating in Denmark Street and Langborough Road) and heading either to the Leisure Park or Wellington Road. These right turning vehicles caused the vehicles on Finchampstead Road heading north to give way for long periods of time and severely restricted the capacity at this stopline.

7.2.2 After investigations within WBC it was found that there are currently no traffic improvement schemes proposed at the Carnival Pool Roundabout that would offer an improvement to the modelled situation.

7.2.3 The decision was taken to model the future scenarios with a theoretical improvement that solved the issue at the Carnival Pool Roundabout. This was to try to understand if this was removed, which scenario offered the greatest relative benefits.

Table 8.2 - Average delay on all approaches to the two junctions – Excluding delays created by the Carnival Pool Roundabout.

Scenario	Seconds			Minutes			Total Vehicles	
	AM	PM	TOTAL	AM	PM	TOTAL	AM	PM
1 - Roundabouts - Single Lane	622	652	1274	10	11	21	4144	4434
2 - Roundabouts - Dual Lane	860	710	1570	14	12	26	4312	4641
3 - Signals - Single Lane	1228	1758	2986	20	29	50	3811	4148
4 - Signals - Dual Lane	922	978	1900	15	16	32	4129	4196
Do Nothing	898	724	1622	15	12	27	4144	4434

7.2.4 Table 8.2 shows that across all scenarios an improvement scheme to allow more vehicles to cross the stopline at Finchampstead Road into the Carnival Pool Roundabout has the effect of reducing the delay to the corridor.

7.2.5 Both Scenario 1 and now Scenario 2 (the roundabout schemes), offer a benefit over the Do Nothing scenario.

7.2.6 It is shown by this modelling that a traffic scheme to improve the Carnival Pool Roundabout, with particular attention focussed on the Finchampstead Road approach, would have a beneficial effect on any scheme being progressed in the future. This highlights the area as a future pinch point and an improvement scheme should be considered.

7.2.7 The relative benefits of the scenarios when compared to each other remain the same and the order of preference is 1, 2, 4, 3 as before.

7.3 Pedestrians and Cyclists

7.3.1 It was concluded that given there is no traffic scheme available to improve the Carnival Pool Roundabout that the greatest benefit was offered by Scenario 1.

7.3.2 Scenario 1 was examined for progression in more detail, specifically in relation to the pedestrian and cycle movements and potential desire lines through the area. The current layout sees many pedestrians not using the signal crossings provided on Molly Millars Lane and Finchampstead Road, but instead crossing the road at the point under the bridge. This can be seen by the well-worn footway tracks along the verge adjoining the bridge and the plentiful pedestrians attempting to cross as shown in Figure 8.3 below. Obviously this is a desire line for pedestrians utilising Tesco from the industrial area on Molly Millars Lane. With future development planned around the area nearby Tesco this is likely to increase.

Figure 8.3 – Google Street View of worn verge on Finchampstead Road NB and pedestrian desire line in use.

7.3.3 The idea to look at the Scenario 1 roundabout scheme in more detail led to the need to allow for provision of non-motorised-users (NMU) movement across the road at this point. As this was likely to create more delay it was thought that including Scenario 2 in the appraisal would be prudent in-case having two lanes helped to contain the queues at the pedestrian crossing more effectively.

Table 8.3 - Average delay on all approaches to the two junctions – Including signalised pedestrian crossing for Scenario 1 and 2.

Scenario	Seconds			Minutes			Total Vehicles	
	AM	PM	TOTAL	AM	PM	TOTAL	AM	PM
1 - Roundabouts - Single Lane	931	742	1673	16	12	28	4144	4434
2 - Roundabouts - Dual Lane	1155	1252	2407	19	21	40	4312	4641
3 - Signals - Single Lane	1237	1818	3055	21	30	51	3811	4148
4 - Signals - Dual Lane	1364	1354	2719	23	23	45	4129	4196

7.3.4 Table 8.3 shows that with signalised pedestrian crossings in place the delay is increased by two minutes in Scenario 1 and one minute in Scenario 2.

7.3.5 While NMU safety is paramount, to maintain any benefits to traffic delay in the Scenario 1 improvement scheme it is suggested consideration is given to an uncontrolled crossing at the point of the desire line. Safety could be maximised by opposing NMUs with only one way traffic per lane crossed with a pedestrian refuge area between the lanes, this should be at least 2.0m in width to allow for cycles and long enough to cater for numerous NMUs next to each other, perhaps 4.0m or 5.0m. Visibility should be good with the new bridge scheme with wide footways and no obscured views from bridge walls as per the current situation.

8 Conclusion

8.1.1 As the turning movements at the roundabouts are relatively well balanced in the forecast years, any provision of traffic signals creates extra delay on all approaches in comparison to that of the priority roundabout schemes. This affects many vehicles and has the net effect of an overall increase in delay which is reflected in the results.

8.1.2 Traffic signals are useful in balancing uneven flows to get the most throughput from of a congested junction, it is safer to add multiple conflicting lanes within a smaller footprint than a roundabout of similar capacity. However, both signal schemes, Scenario 3 and Scenario 4, were constrained by land boundaries to the same number of approach lanes / flare lanes and could not offer an improvement over the priority schemes of Scenario 1 and Scenario 2.

8.1.3 The two scenarios with the lowest delay, Scenario 1 and Scenario 2, each attracted differing levels of traffic depending on the layout used in the WSTM. It may be expected that the dual lane scheme offers greater benefits due to the increase in storage capacity between the junctions. However, due to the increased capacity attracting more vehicles to use the route, any benefits initially created by the spare capacity at opening year are quickly eroded to the point of being worse in the forecast year.

8.1.4 A single lane configuration does the opposite and discourages vehicles using the route as much in the future and keeps total delay to a minimum. Even taking into consideration the greater number of vehicles present in the dual lane scenarios the delay is still proportional and a single lane configuration is optimal.

8.1.5 Scenario 1 – Two roundabouts linked by single lanes running two-way under the bridge, is the best scenario in terms of traffic delay. Delay is increased and benefit eroded by including provision for pedestrians and cyclists in the form of a signalised crossing at the desire line towards the centre of the bridge. It is suggested that consideration be given to an uncontrolled crossing with a large central refuge area at the mid-point between the two junctions where the road is single lane. This ensures NMU's only ever oppose one lane of one-way traffic at a time. It would be possible to utilise larger splitter islands at the roundabout for these movements, but as this would require NMU's to cross two lanes of traffic at the junction approaches and also anticipate which vehicles will exit the roundabouts this is not recommended for safety reasons.

8.1.6 General delays were observed in every scenario modelled and one specific cause of this was identified as the Finchampstead Road entrance to the Carnival Pool Roundabout. There was a high level of right turning vehicles coming from Langborough Road and Denmark Street and heading to Wellington Road or the Leisure Park. The vehicles opposed the Finchampstead Road northbound movement and led to long pauses in this traffic progressing through the roundabout due to giving way to the circulatory movements. This created long delays which tailed back to block the exit from the Tesco junction / roundabout for sections of the AM peak hour and to a greater degree in the PM peak hour.

8.1.7 The modelling has highlighted that the Carnival Pool Roundabout becomes a pinch point in the future year and it is recommended that a scheme to alleviate this is investigated, whether that be a change to the Langborough Road access or a scheme at the roundabout itself has not been examined.

Appendices

APPENDIX A – Model Zone Plan

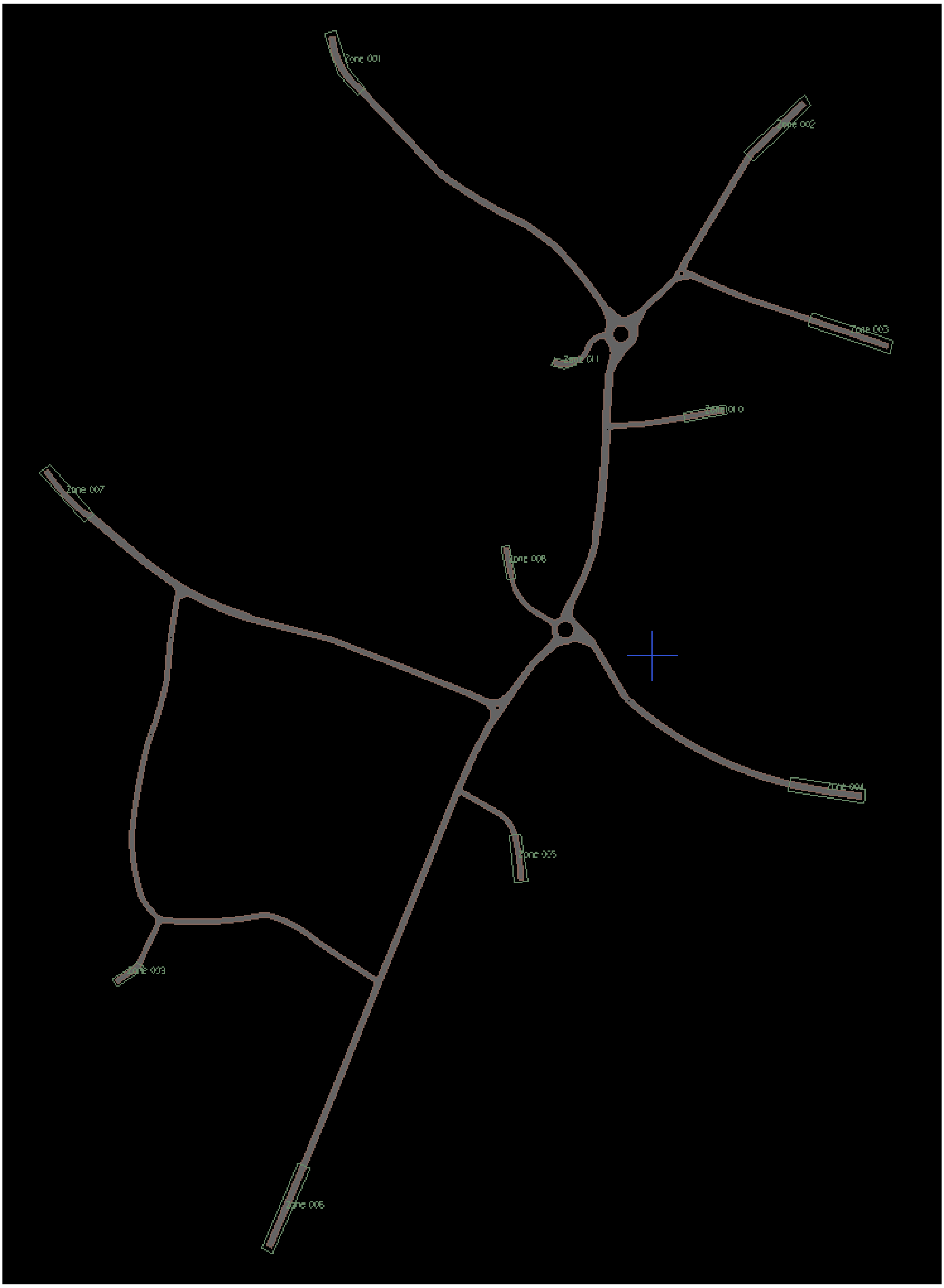
APPENDIX B – Model Calibration Results

APPENDIX C – Surveys

APPENDIX D – Journey Time Routes

APPENDIX A

S-Paramics Model Zone Plan



APPENDIX B

Model Calibration Results

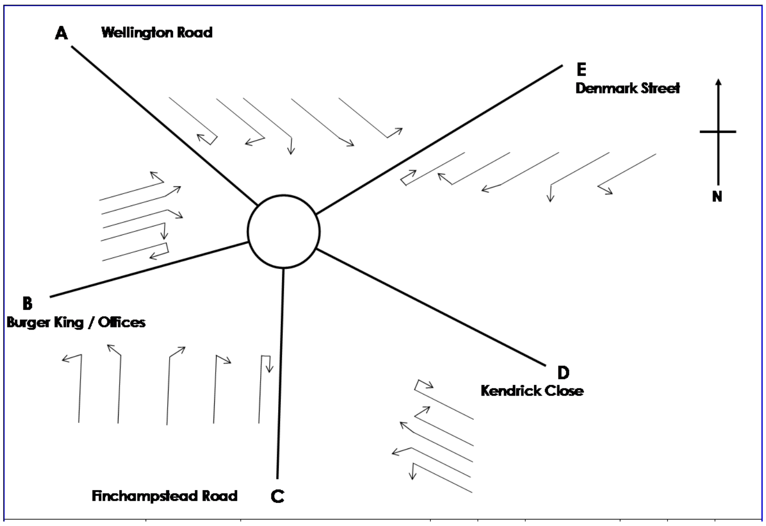
BASE AM	run-001	run-002	run-003	run-004	run-005	run-006	run-007	run-008	run-009	run-010	Average
A321 Bridge SB	906	894	906	906	895	900	899	907	905	911	**903**
A321 Bridge NB	1119	1116	1097	1097	1101	1097	1098	1103	1102	1095	**1103**
A321 Finchampstead Rd (S) NB	719	723	698	690	709	709	694	709	692	687	**703**
A321 Finchampstead Rd (S) SB	592	581	598	586	587	591	588	587	586	594	**589**
Molly Millars EB	657	652	654	656	650	656	659	653	656	664	**656**
Molly Millars WB	561	558	550	554	554	561	550	558	555	561	**556**
Wellington Road SB	299	292	299	299	296	300	298	301	298	297	**298**
Wellington Road NB	744	751	730	729	742	732	732	736	735	729	**736**
Denmark Street (S) NB	464	462	456	460	465	462	456	458	464	459	**461**
Denmark Street (S) SB	957	953	954	957	943	949	955	958	958	953	**954**
Finchampstead Road (N) NB	998	1010	979	984	999	986	978	986	990	986	**990**
Finchampstead Road (N) SB	999	987	997	1004	983	991	1000	1000	1001	996	**996**
Leisure Park OUT	35	34	35	35	35	35	34	36	35	35	**35**
Leisure Park IN	75	74	75	75	72	76	72	74	73	76	**74**
Denmark Street (N) SB	716	716	714	721	708	715	707	724	713	713	**715**
Denmark Street (N) NB	58	58	57	60	60	56	58	57	59	57	**58**
Langborough Road (WB)	282	282	284	284	282	280	289	279	287	285	**283**
Langborough Road (EB)	444	440	436	442	443	443	437	438	442	437	**440**

BASE PM	run-011	run-012	run-013	run-014	run-015	run-016	run-017	run-018	run-019	run-020	Average
A321 Bridge SB	1080	1075	1068	1076	1081	1065	1067	1063	1090	1093	**1076**
A321 Bridge NB	983	992	993	986	991	1000	993	989	997	990	**991**
A321 Finchampstead Rd (S) NB	611	622	620	621	626	627	622	619	629	622	**622**
A321 Finchampstead Rd (S) SB	999	995	988	1006	1006	1001	1002	1001	1006	1007	**1001**
Molly Millars EB	785	784	788	782	786	788	785	784	787	781	**785**
Molly Millars WB	485	486	490	476	488	476	474	475	497	492	**484**
Wellington Road SB	474	467	474	471	473	472	470	473	469	476	**472**
Wellington Road NB	682	679	686	676	684	683	666	673	684	682	**680**
Denmark Street (S) NB	469	468	476	472	471	474	470	469	474	474	**472**
Denmark Street (S) SB	700	707	680	711	705	698	706	712	705	710	**703**
Finchampstead Road (N) NB	933	934	950	935	936	944	920	922	947	938	**936**
Finchampstead Road (N) SB	992	994	974	1004	997	990	994	1000	995	1004	**994**
Leisure Park OUT	128	125	127	125	123	125	127	127	126	125	**126**
Leisure Park IN	83	85	84	83	83	81	83	81	83	84	**83**
Denmark Street (N) SB	458	460	441	471	466	457	464	467	459	465	**461**
Denmark Street (N) NB	42	43	43	45	42	43	42	44	42	42	**43**
Langborough Road (WB)	292	293	287	286	289	288	290	292	292	290	**290**
Langborough Road (EB)	471	468	476	473	473	475	472	469	477	477	**473**

APPENDIX C

Surveys

Table 1: AM and PM peak - Turning Flows, Wellington Road / Denmark Street / Finchampstead Road



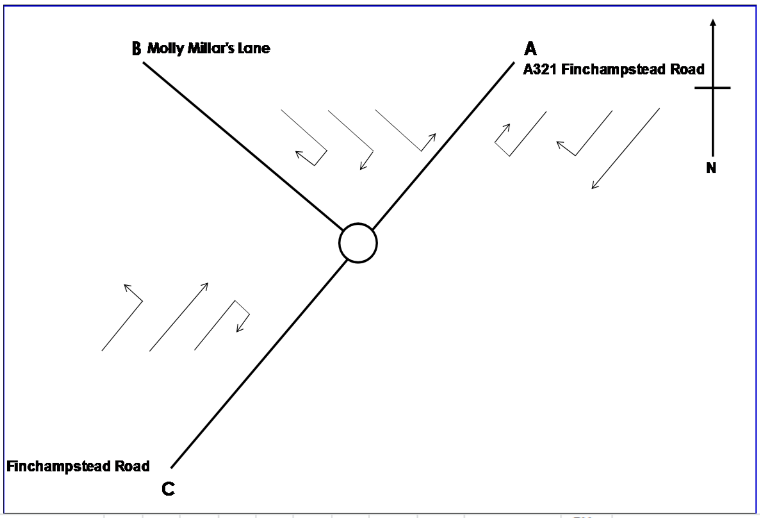
Observed, veh AM

Jct Node Number	1037			TO ARM							
			Road name	A	B	C	D	E	F	G	Total
				1003	4001	4404		1008			
FROM ARM	A	1003	Wellington Road	1	11	220	1	72			305
	B	4001	Burger King / Offices	12	0	16	1	7			36
	C	4404	Finchampstead Road	663	38	0	0	412			1113
	D		Kendrick Close	1	0	2	0	0			
	E	1008	Denmark Street	146	27	778	3	2			956
	F							0			
	G										
	Total			823	76	1016		493			2410

Observed, veh PM

Jct Node Number	1037			TO ARM							
			Road name	A	B	C	D	E	F	G	Total
				1003	4001	4404		1008			
FROM ARM	A	1003	Wellington Road	1	17	386	3	67			474
	B	4001	Burger King / Offices	41	0	63	0	20			124
	C	4404	Finchampstead Road	574	41	5	3	351			974
	D		Kendrick Close	0	0	4	0	5			
	E	1008	Denmark Street	113	26	602	0	2			743
	F										
	G										
	Total			729	84	1040		465			2315

Table 2: AM and PM peak - Turning Flows, Molly Millars Lane / Finchampstead Road



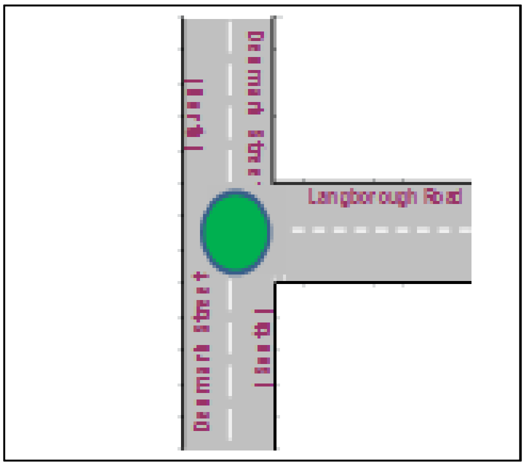
Observed, veh AM

Jct Node Number	1108			TO ARM							
			Road name	A	B	C	D	E	F	G	Total
				1440	1109	4418					
FROM ARM	A	1440	A321 Finchampstead Road	0	549	449					998
	B	1109	Molly Miller's Lane	502	1	143					646
	C	4418	Finchampstead Road	628	115	0					743
	D										
	E										
	F										
	G										
	Total			1130	665	592					2387

Observed, veh PM

Jct Node Number	1108			TO ARM							
			Road name	A	B	C	D	E	F	G	Total
				1440	1109	4418					
FROM ARM	A	1440	A321 Finchampstead Road	1	406	739					1146
	B	1109	Molly Miller's Lane	487	0	299					786
	C	4418	Finchampstead Road	514	117	0					631
	D										
	E										
	F										
	G										
	Total			1002	523	1038					2563

Table 3: AM and PM peak - Turning flows, Denmark Street / Langborough Road



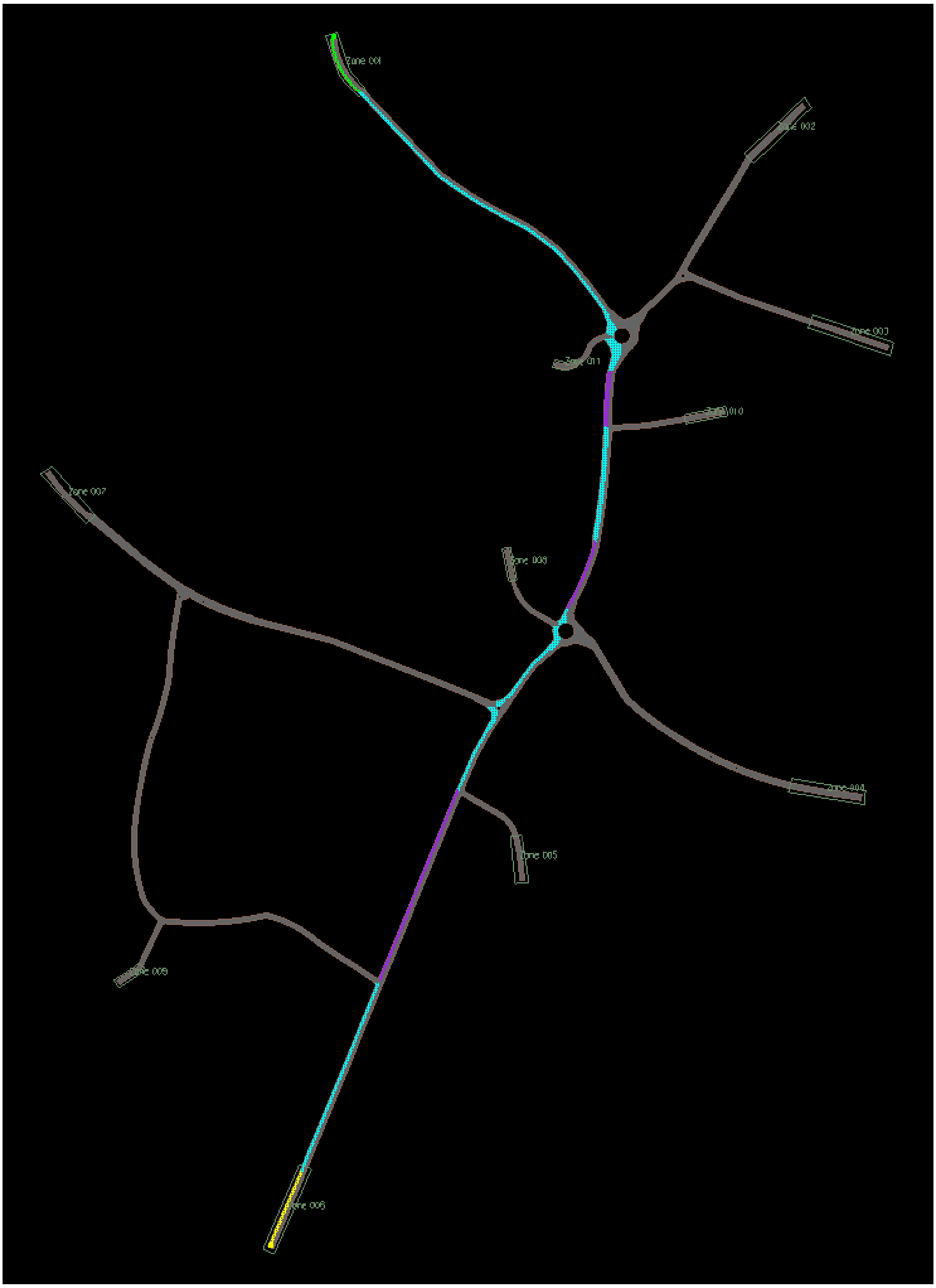
Observed. veh		AM									
Jct Node Number		1088		TO ARM							
			Road name	A	B	C	D	E	F	G	Total
				1090	1087	4018					
FROM ARM	A	1090	Denmark Street (North)	0	742	19					761
	B	1087	Denmark Street (South)	39	0	449					488
	C	4018	Langborough Road	14	278	0					292
	D										
	E										
	F										
	G										
	Total			53	1020	468					1541

Observed. veh		PM									
Jct Node Number		1088		TO ARM							
			Road name	A	B	C	D	E	F	G	Total
				1090	1087	4018					
FROM ARM	A	1090	Denmark Street (North)	0	410	39					449
	B	1087	Denmark Street (South)	39	0	470					509
	C	4018	Langborough Road	6	268	0					274
	D										
	E										
	F										
	G										
	Total			45	678	509					1232

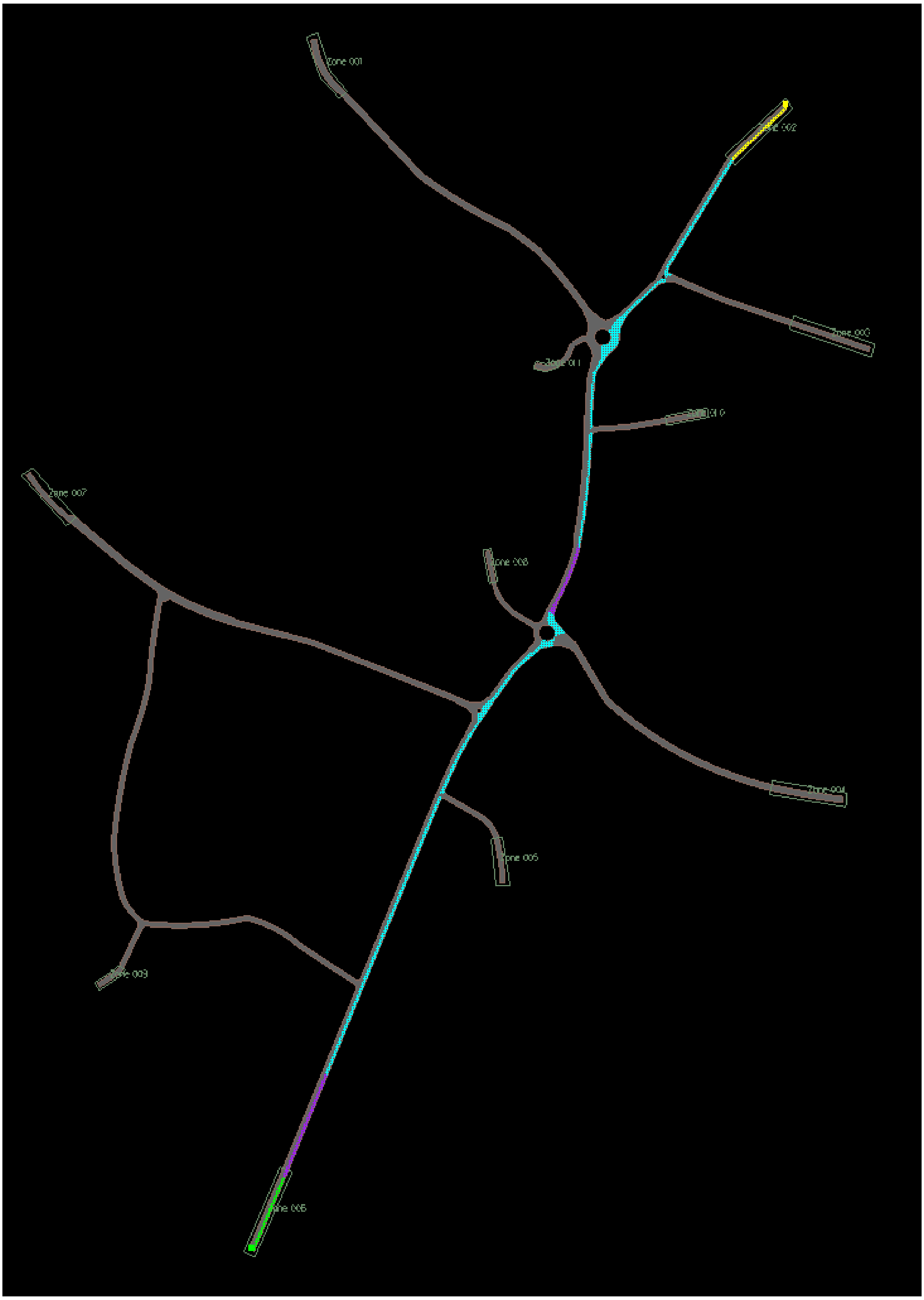
APPENDIX D

Journey Time Routes

A321 NB



A321 SB



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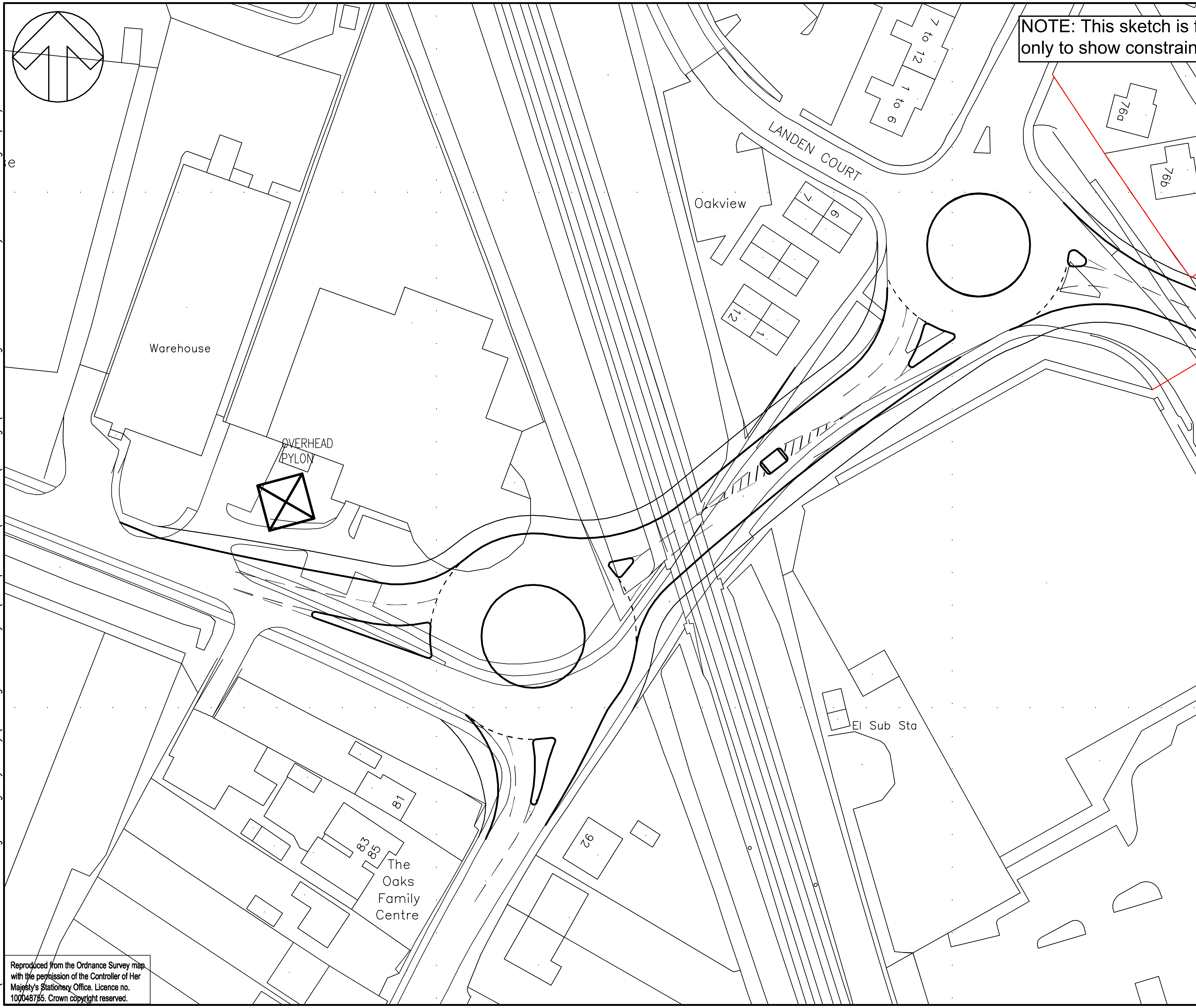

WOKINGHAM BOROUGH COUNCIL

TITLE: South Wokingham Paramics Study
Single Lane Configuration

FIGURE No: SK01

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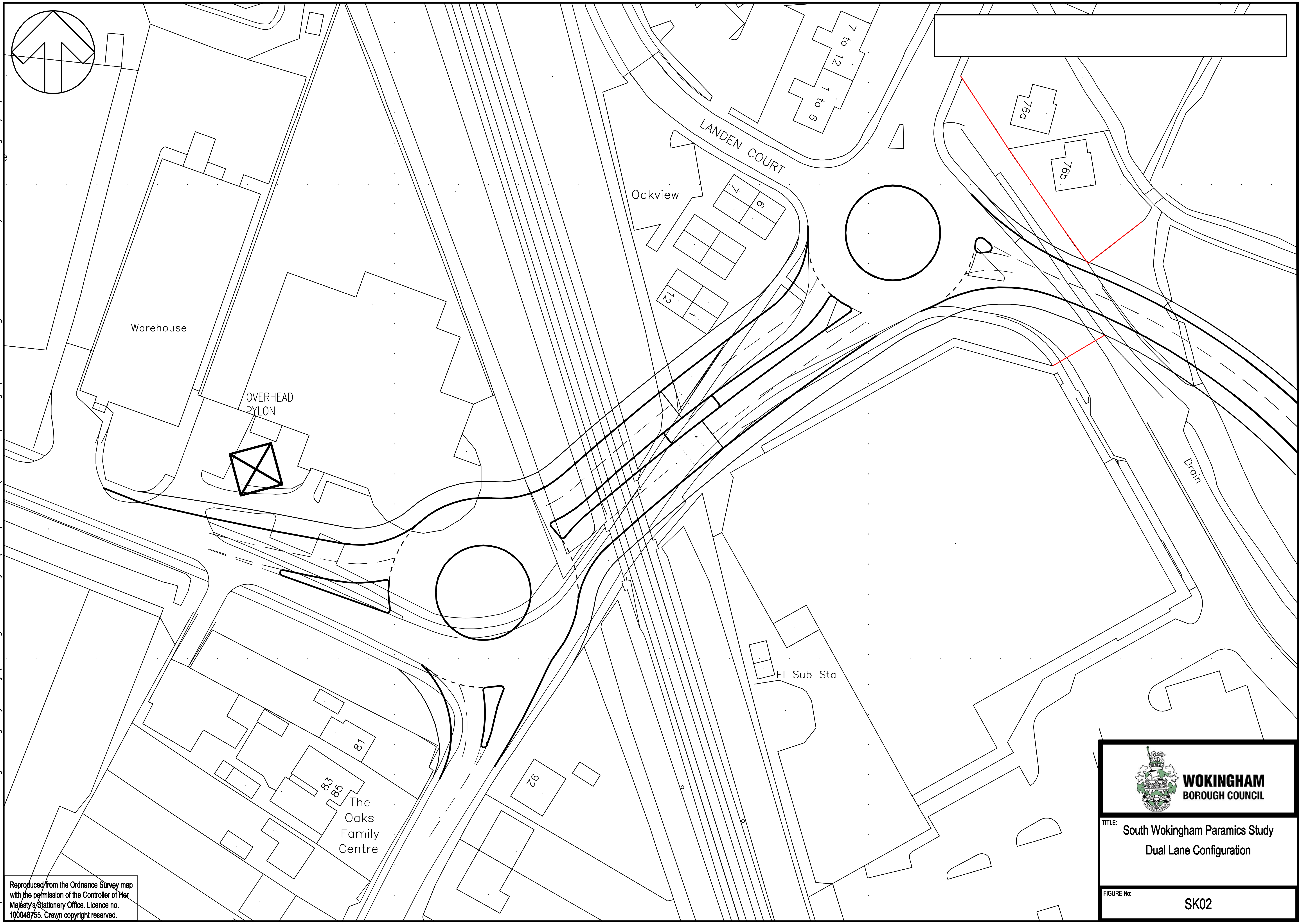

WOKINGHAM BOROUGH COUNCIL

TITLE: South Wokingham Paramics Study
Dual Lane Configuration

FIGURE No: SK02

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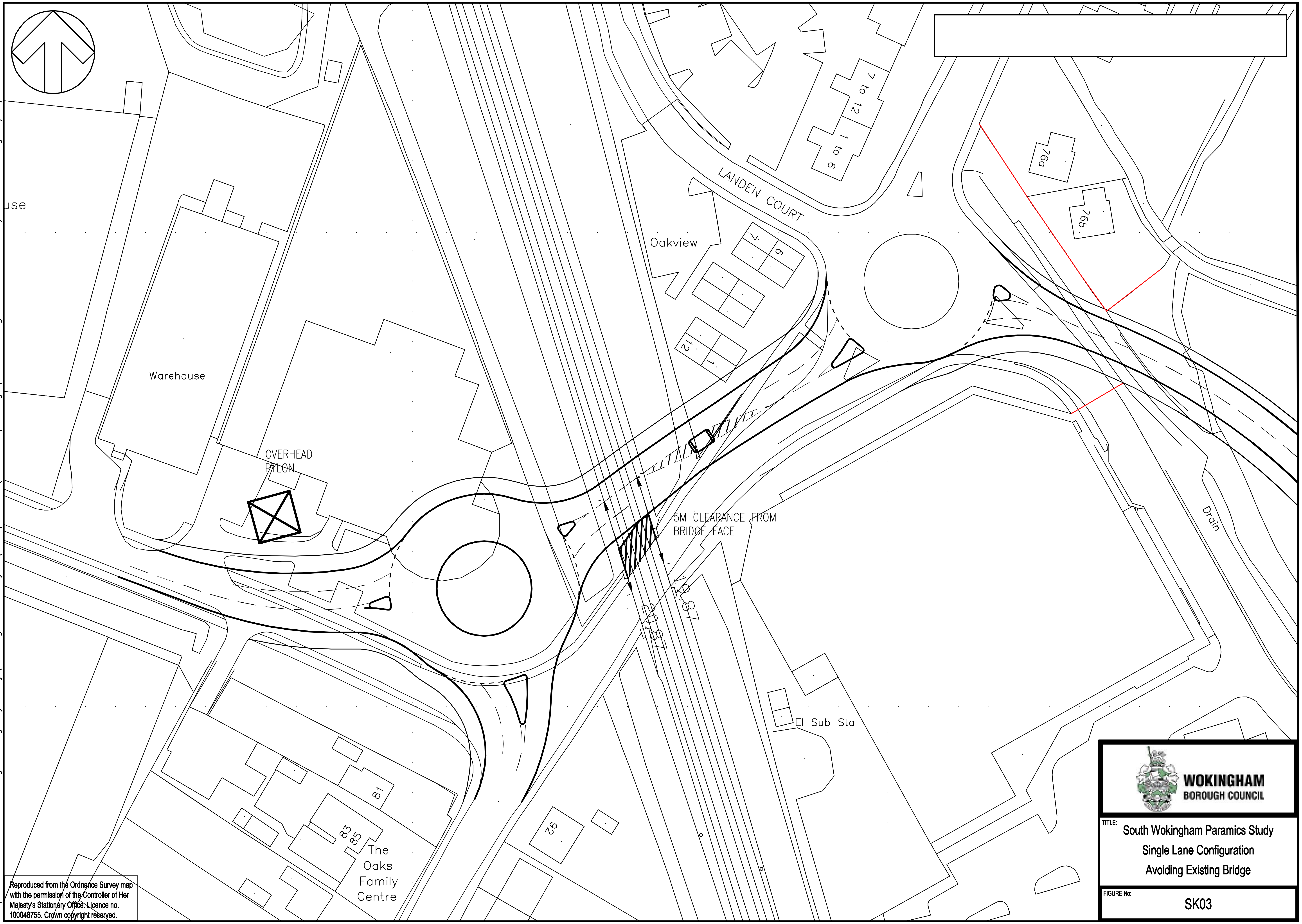

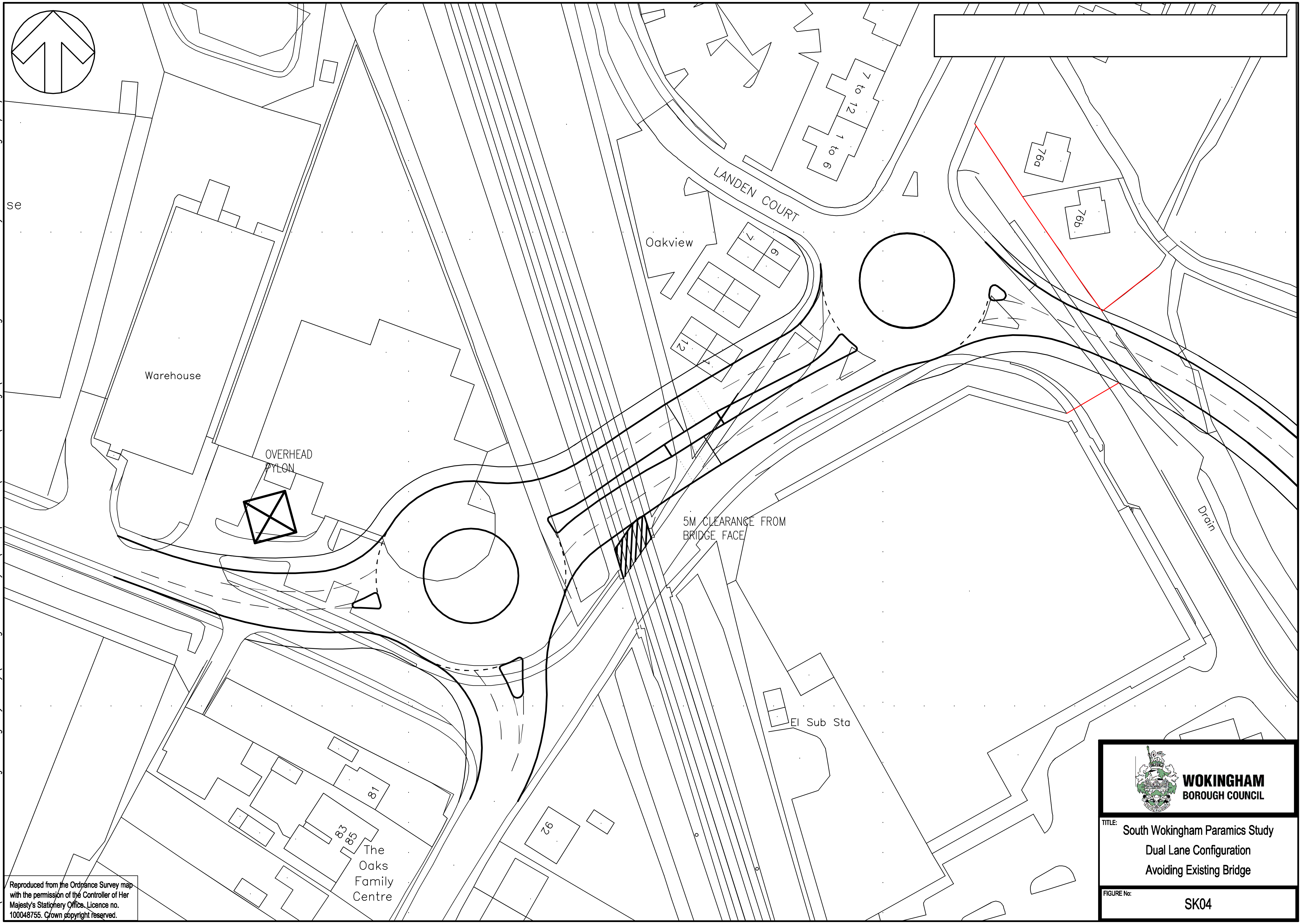

WOKINGHAM BOROUGH COUNCIL

TITLE: South Wokingham Paramics Study
Dual Lane Configuration
Avoiding Existing Bridge

FIGURE No: SK04

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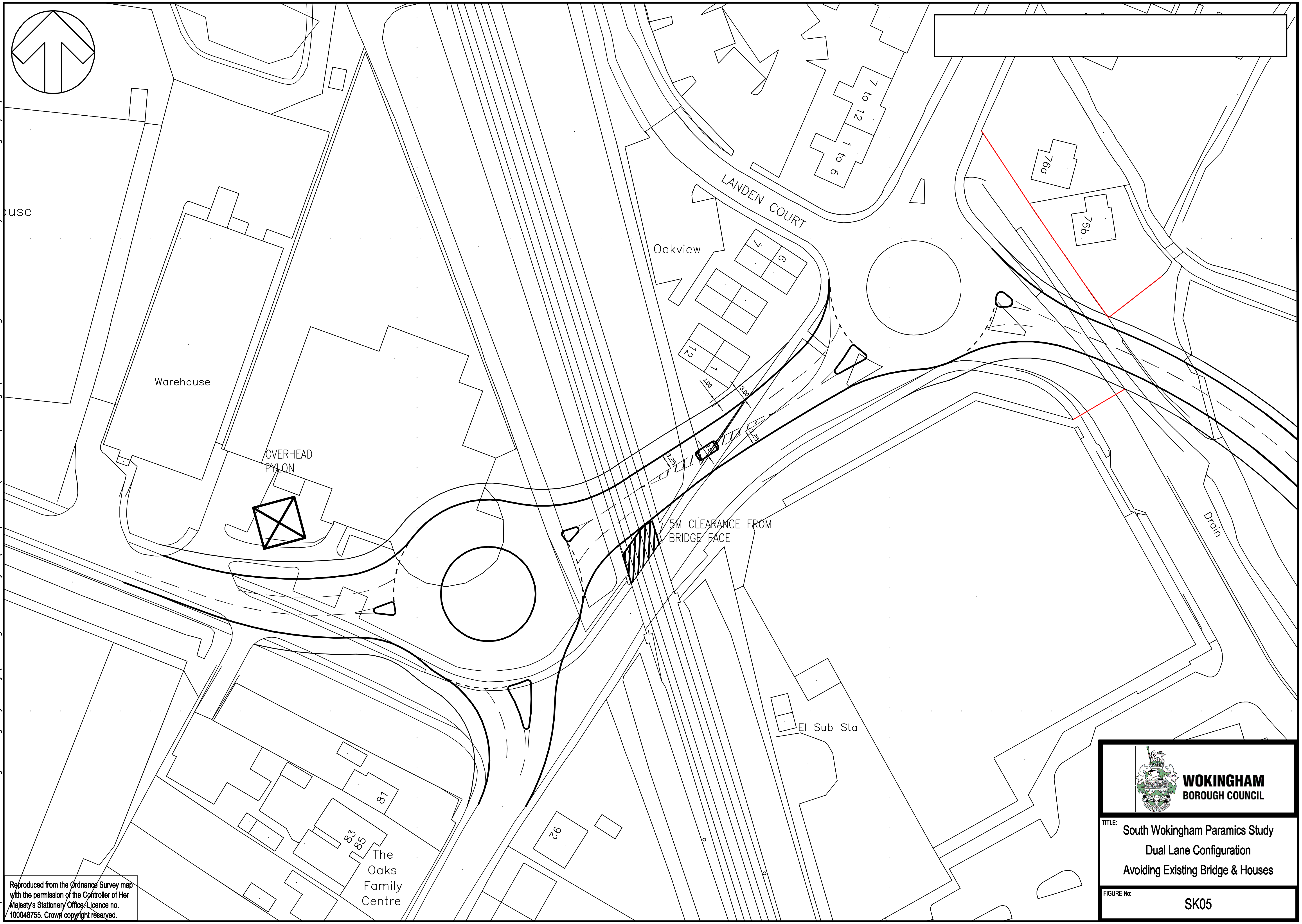

WOKINGHAM BOROUGH COUNCIL

TITLE: South Wokingham Paramics Study
Dual Lane Configuration
Avoiding Existing Bridge & Houses

FIGURE No: SK05

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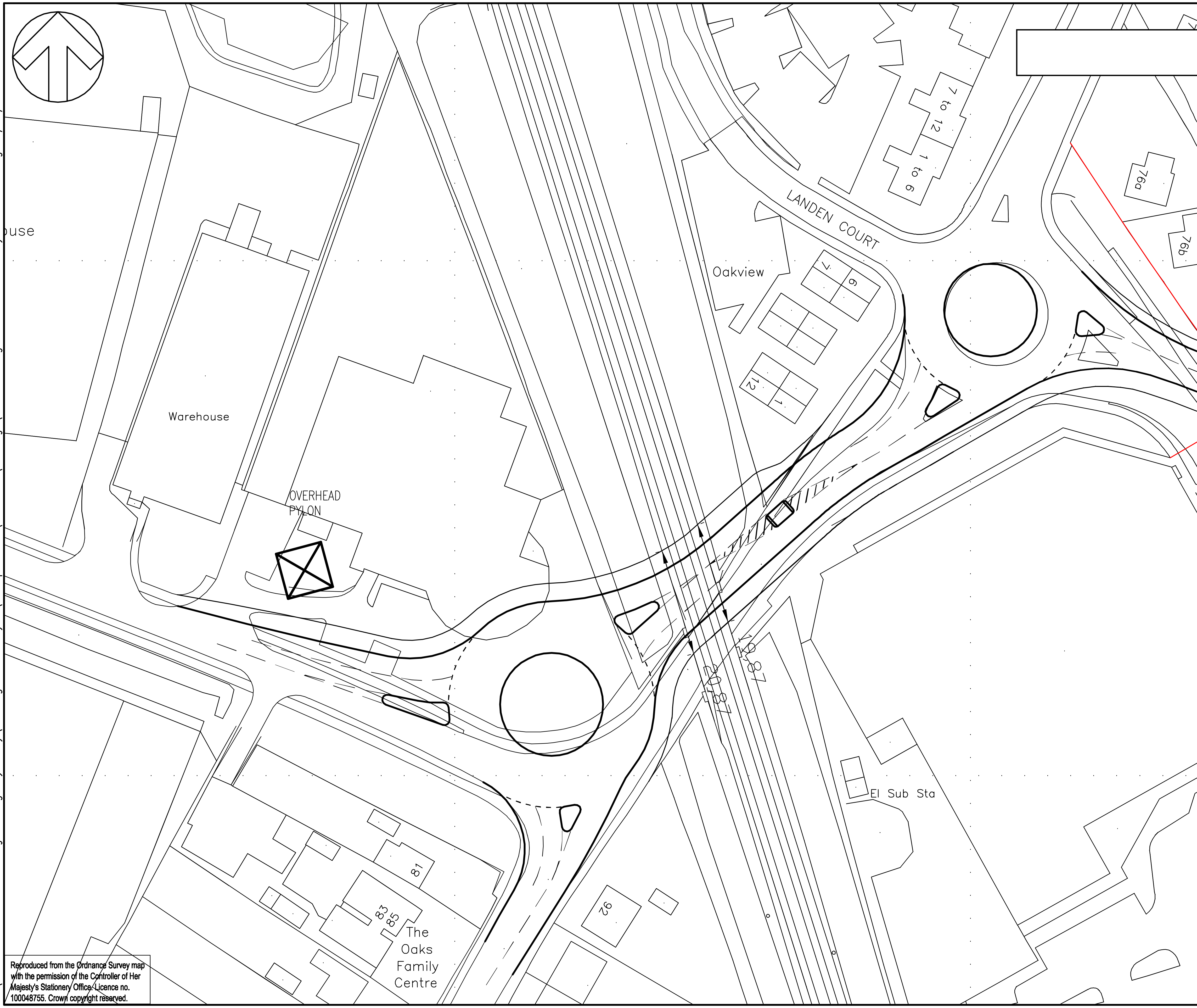

WOKINGHAM BOROUGH COUNCIL

TITLE:

South Wokingham Paramics Study
Single Lane Configuration
Avoiding Tesco Land

FIGURE No:

SK06