Technical Note

Project:	Cyber Parks Phase 2 Paramics Modelling		
Subject:	Paramics Model Development and Review		
Date:	01/10/2019	Project No.:	5188770

Document history

Revision	Purpose description	Origin-ated	Checked	Reviewed	Authorised	Date
Rev 0.1	Draft	EM	JML	MA		01/10/2019

Client signoff

Client	
Project	Cyber Parks Phase 2 Paramics Modelling
Project No.	5188770

1. Introduction

The purpose of this Technical Note is to document the process used to develop the Paramics Discovery model of the Cyber Parks Phase 2 scheme, and the subsequent sensitivity testing carried out to review and understand the modelling results. This Note aims to build on the information contained in the Phase 1 report.

2. Phase 2 Model Development

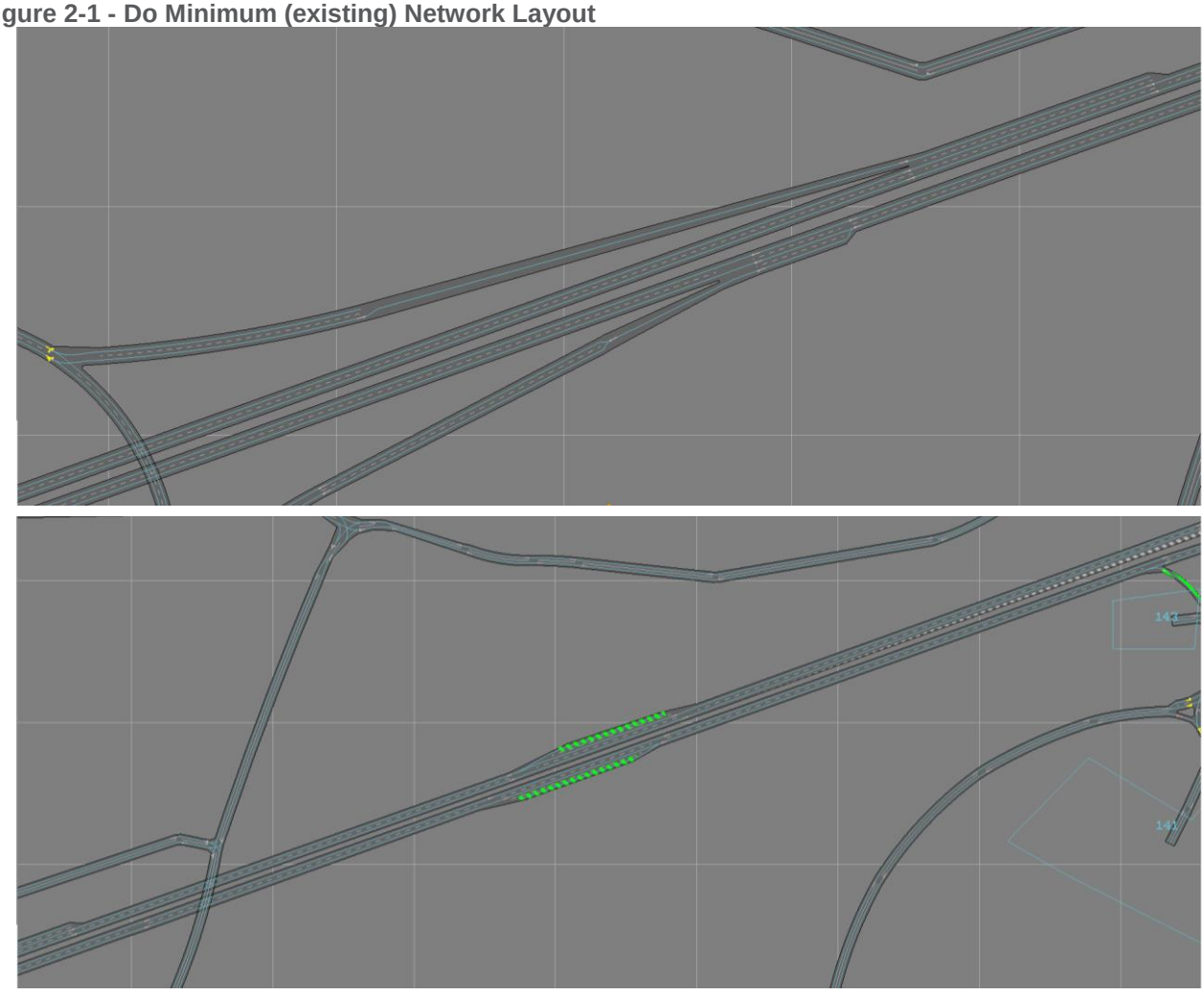
2.1. Introduction

This chapter details the steps undertaken to build the Phase 2 Paramics Discovery model. In this, the Phase 2 model assumes the construction of the Phase 1 scheme has been completed, and therefore acts as a continuation of the scheme. The Phase 2 Do Minimum models for 2021 and 2031 assume no further development following the completion of Phase 1.

2.2. Phase 2 Improvements

The aim of the Phase 2 scheme is to alleviate congestion on the A40 eastbound between the M5 J11 and the Arle Court Roundabout. In addition, the scheme looks at improving accessibility to the A40 eastbound from the M5 and surrounding area by addressing congestion caused by heavy traffic flows currently experienced on the A40 eastbound on-slip, particularly in the AM peak hour (08:00 – 09:00). The existing merge is formed of a single lane taper. The existing network layout reflecting the Do Minimum (DM) model scenario is shown in Figure 2-1 below.

Figure 2-1 - Do Minimum (existing) Network Layout

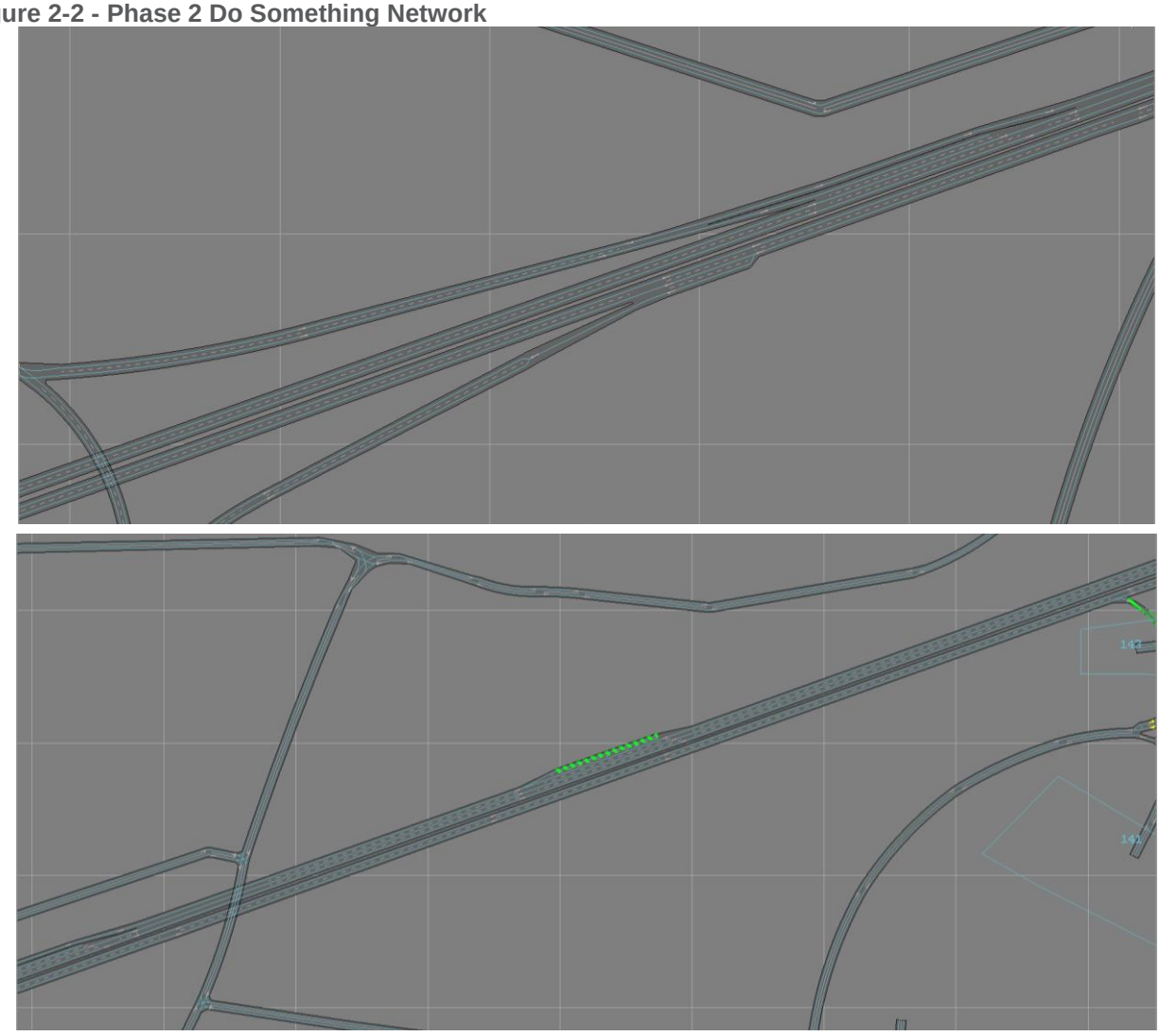


The following changes were applied to the existing Phase 1 Do Something (DS) 3 model to develop the Phase 2 DS model:

- A40 eastbound mainline between M5 J11 and the Arle Court Roundabout widened from 2 lanes to 3 using existing space between the east and west mainlines;
- The A40 westbound layby removed; and
- M5 J11 two lane slip road onto the A40 eastbound currently narrows to form a single lane before merging with the mainline. With the scheme, it maintains two lanes all the way until it meets the mainline, with the right-hand lane of the slip road merging with the main line and the left-hand slip lane becoming the new lane gain.

In order to accurately implement these changes, a CAD drawing of the scheme was input into Paramics to correctly align the new road layouts and widths. Signpost distances, visibilities and speed limits on the A40 eastbound on-slip were set to be consistent with the Do Minimum model, this was to ensure that no routing choices were being made based on these factors alone. The new Phase 2 network layout can be seen in Figure 2-2.

Figure 2-2 - Phase 2 Do Something Network



2.3. Model Runs & Results

As with Phase 1, the models were consistent with the Systra modelling for economics outputs guidance. For the 2021 model, a total of 30 fixed-seed runs were carried out, and a total of 40 were run for the 2031 models. The 2021 results were filtered based on a +/- 10% difference from the mean journey time across all runs, and the 2031 was filtered using a +/- 15% difference, with those outside of these criteria removed from further analysis.

2.3.1. Journey Times

As with the Phase 1 report, journey times for two key routes through the network were calculated for the AM and PM single validated peak hours (08:00 – 09:00 and 17:00 – 18:00 respectively). These were:

- **Route 1** – A40 between the A40 Elmbridge Roundabout and the A40 / Princess Elizabeth Way Roundabout: and
- **Route 2** – A4013 Princess Elizabeth Way between the A40 / A4013 roundabout and the A4019 / A4013 / Kingsditch Lane Roundabout.

The results are shown in Table 2-1 through to Table 2-4 below.

Table 2-1 - 2021 AM Journey Time Comparison

Route	Direction	2021 AM (08:00 – 09:00) Journey Time		
		Do Minimum	Do Something	Difference (s)
1	Eastbound	00:06:31	00:06:20	-11
	Westbound	00:06:23	00:06:23	0
2	Northbound	00:06:06	00:06:05	-1
	Southbound	00:05:46	00:05:41	-5

Table 2-2 - 2021 PM Journey Time Comparison

Route	Direction	2021 PM (17:00 – 18:00) Journey Time		
		Do Minimum	Do Something	Difference (s)
1	Eastbound	00:08:06	00:07:25	-41
	Westbound	00:05:43	00:05:43	0
2	Northbound	00:05:46	00:05:41	-5
	Southbound	00:07:05	00:07:06	1

The Phase 2 2021 modelling results show a reduction in journey time on Route 1 eastbound in both the AM and PM peak hours. This follows expectations as this is the key movement the Phase 2 scheme aims to address. Both peak hours also experience a minor reduction in travel time on Route 2 southbound. This may be due to Phase 2 improving the progression of flow on A40 eastbound through Cheltenham, meaning the roundabout with Princess Elizabeth Way and the A40 may also be less congested. Understandably there has been no change to Route 1 westbound as this movement is not impacted by the scheme.

Table 2-3 - 2031 AM Journey Time Comparison

Route	Direction	2031 AM (08:00 – 09:00) Journey Time		
		Do Minimum	Do Something	Difference (s)
1	Eastbound	00:09:16	00:09:09	-7
	Westbound	00:07:36	00:07:26	-10
2	Northbound	00:06:52	00:06:46	-6
	Southbound	00:06:11	00:06:13	3

Table 2-4 - 2031 PM Journey Time Comparison

Route	Direction	2031 PM (17:00 – 18:00) Journey Time		
		Do Minimum	Do Something	Difference (s)
1	Eastbound	00:12:30	00:12:39	9
	Westbound	00:06:51	00:06:35	-17
2	Northbound	00:06:55	00:07:15	20
	Southbound	00:09:01	00:08:41	-19

The 2031 AM results show similar improvements to journey time as with the 2021 model, however also shows a small improvement to Route 1 westbound. On the other hand, the 2031 PM peak results show an unexpected increase in journey time on Route 1 eastbound. This could be a result of the Phase 2 improvements increasing vehicle accessibility to the A40, meaning vehicles reach other areas in the network more quickly, potentially leading to congestion peaking at different times than previously.

2.3.2. Queue Routes

Average and maximum queue lengths for each approach arm to the Arle Court Roundabout were calculated to further understand the impact of the Phase 2 improvements on congestion. As documented in the Phase 1 report, the average queue length **is** the weighted average queue for the entry arm assessed across all lanes**.** The maximum queue is the extent of queuing from the most congested individual lane of the approach The queue results can be seen in Table 2-5 through to

Table **2-8** below.

Table 2-5 - 2021 AM Queue Route Comparison

Approach	2021 AM (08:00 – 09:00) Queue Results (m)					
	Do Minimum		Do Something		Difference	
	Average	Maximum	Average	Maximum	Average	Maximum
Fiddler's Green Lane	32	56	33	49	0	-7
A40 East	72	217	72	222	0	5
Hatherley Lane	46	131	46	125	1	-5
A40 West	55	209	60	176	5	-33
B4063	42	86	40	76	-2	-10

Table 2-6 - 2021 PM Queue Route Comparison

	2021 PM (17:00 – 18:00) Queue Results (m)					
	Do Minimum		Do Something		Difference	
Approach	Average	Maximum	Average	Maximum	Average	Maximum
Fiddler's Green Lane	45	76	37	63	-8	-14
A40 East	71	221	72	223	1	2
Hatherley Lane	45	120	47	130	2	9
A40 West	85	314	114	274	29	-40
B4063	44	78	42	76	-2	-2

The 2021 queue results for both the AM and PM peak hours show an overall reduction trend in queueing on the approach arms to the Arle Court roundabout. The most significant change is to maximum queues on the A40 West (eastbound) approach. This is in line with the Phase 2 scheme, where the additional lane on the A40 eastbound was anticipated to improve journeys in this direction. Despite maximum queue lengths decreasing, the average queue length was shown to increase on this approach for both the AM and PM models. This may reflect some traffic reassignment associated with the scheme, allowing more vehicles to reach the roundabout in less time, meaning the average queue length increases, although the time spent in the queue is reduced.

Table 2-7 - 2031 AM Queue Route Comparison

	2031 AM (08:00 – 09:00) Queue Results (m)					
	Do Minimum		Do Something		Difference	
Approach	Average	Maximum	Average	Maximum	Average	Maximum
Fiddler's Green Lane	139	227	136	230	-3	3
A40 East	86	256	79	244	-7	-12
Hatherley Lane	73	243	65	207	-8	-36
A40 West	117	479	90	305	-27	-174
B4063	96	224	93	203	-4	-22

Table 2-8 - 2031 PM Queue Route Comparison

	2031 PM (17:00 – 18:00) Queue Results (m)					
	Do Minimum		Do Something		Difference	
Approach	Average	Maximum	Average	Maximum	Average	Maximum
Fiddler's Green Lane	100	163	130	193	30	30
A40 East	80	242	88	254	8	12
Hatherley Lane	92	246	142	359	50	113
A40 West	154	522	287	742	133	219
B4063	73	152	132	265	59	113

The 2031 queue results in the AM peak hour show a positive improvement to queueing at the Arle Court Roundabout, with the greatest impact on the A40 eastbound approach as expected from the Phase 2 scheme. On the other hand, the 2031 PM peak shows a significant disbenefit to queueing at Arle Court for all approaches, with the A40 eastbound arm performing notably worse. It is unclear why these results are so extreme, but could possibly be accounted for by the increased capacity on the A40 eastbound from the new lane. This could lead to vehicles reaching other areas of the network, which may already be sensitive to traffic, in less time and thus causing congestion and blocking back at Arle Court.