Lower Thames Crossing

9.15 Localised Traffic Modelling Appendix K - Five Bells & Pitsea Hall Forecasting Report

Infrastructure Planning (Examination Procedure) Rule 2010

Volume 9

DATE: August 2023
DEADLINE: 3

Planning Inspectorate Scheme Ref: TR010032
Examination Document Ref: TR010032/EXAM/9.15

VERSION: 1.0

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1 Introduction

1.1 Purpose of document

1.1.1 The purpose of this document is to present the modelling results of the Five Bells and Pitsea Hall junction models.

1.2 Modelling software

1.2.1 The junction assessment has been undertaken using Junctions 9 – ARCADY (the Roundabout Module) for roundabouts.

1.3 The Project

1.3.1 The A122 Lower Thames Crossing (the Project) would provide a connection between the A2 and M2 in Kent, south-east of Gravesend, crossing under the River Thames through a tunnel, before joining the M25 south of junction 29. The Project route is presented in Plate 1.1 .

1.3.2 The A122 would be approximately 23km long, 4.25km of which would be in tunnel. On the south side of the River Thames, the Project route would link the tunnel to the A2 and M2. On the north side, it would link to the A13, M25 junction 29 and the M25 south of junction 29. The tunnel entrances would be located to the east of the village of Chalk on the south of the River Thames and to the west of East Tilbury on the north side.

1.3.3 Junctions are proposed at the following locations:

a. New junction with the A2 to the south-east of Gravesend

b. Modified junction with the A13/A1089 in Thurrock

c. New junction with the M25 between junctions 29 and 30

1.3.4 To align with NPSNN policy and to help the Project meet the Scheme Objectives, it is proposed that road user charges would be levied in line with the Dartford Crossing. Vehicles would be charged for using the new tunnel.

1.3.5 The Project route would be three lanes in both directions, except for:

a. link roads

b. stretches of the carriageway through junctions

c. the southbound carriageway from the M25 to the junction with the A13/A1089, which would be two lanes

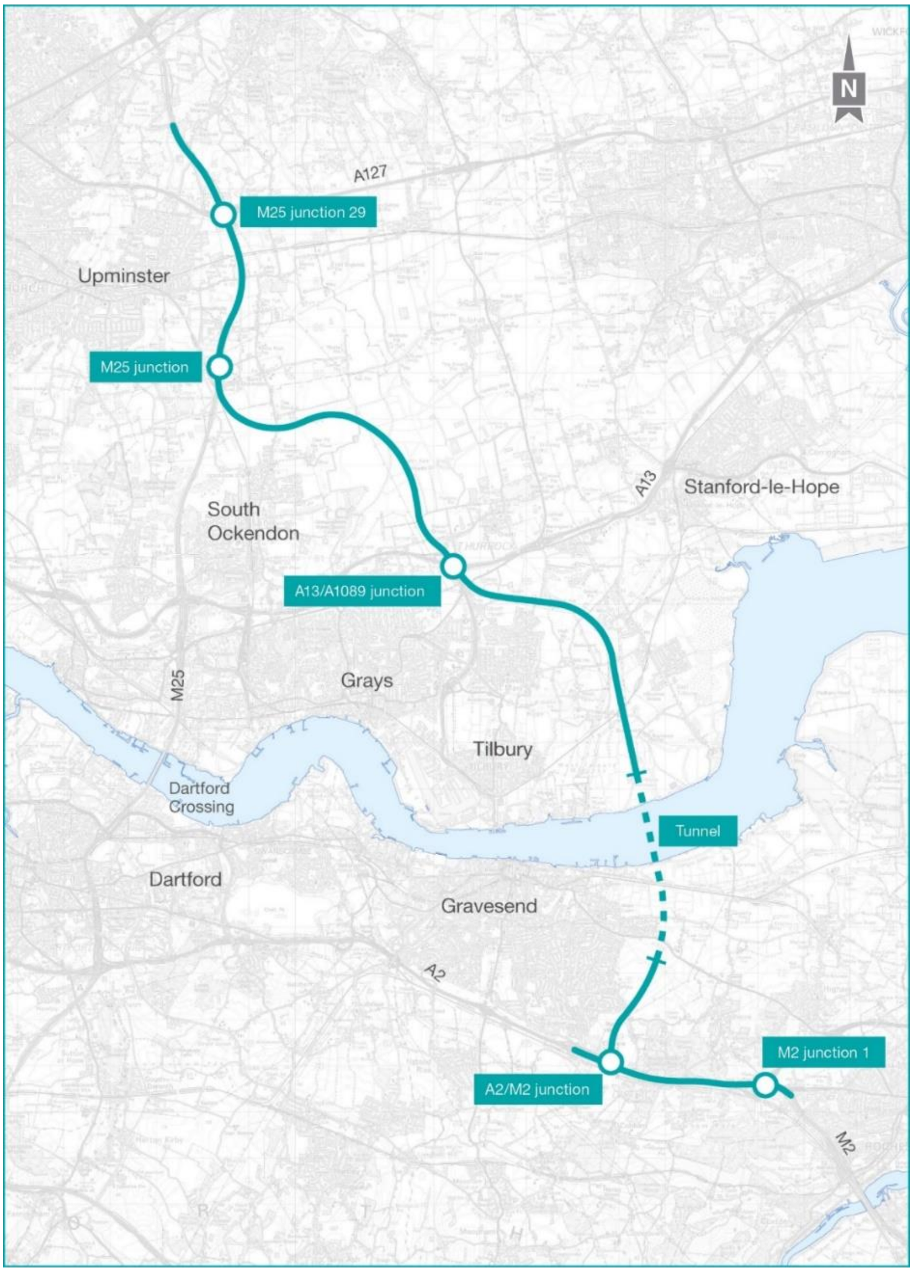
1.3.6 In common with most A-roads, the A122 would operate with no hard shoulder but would feature a 1m hard strip on either side of the carriageway. It would also feature technology including stopped vehicle and incident detection, lane control, variable speed limits and electronic signage and signalling. The A122 design outside of the tunnel would include emergency areas. The tunnel would include a range of enhanced systems and response measures instead of emergency areas.

1.3.7 The A122 would be classified as an 'all-purpose trunk road' with green signs. For safety reasons, walkers, cyclists, horse riders and slow-moving vehicles would be prohibited from using it.

1.3.8 The Project would include adjustment to a number of local roads. There would also be changes to a number of Public Rights of Way used by walkers, cyclists and horse riders. Construction of the Project would also require the installation and diversion of a number of utilities, including gas mains, overhead electricity powerlines and underground electricity cables, as well as water supplies and telecommunications assets and associated infrastructure.

1.3.9 The Project has been developed to avoid or minimise significant effects on the environment. Some of the measures adopted include landscaping, noise mitigation, green bridges, floodplain compensation, new areas of ecological habitat and two new parks.

Plate 1.1 Lower Thames Crossing route



1.4 Structure of this report

1.4.1 The report summarises the methodology of the modelling process including:

a. Chapter 2: Study area

b. Chapter 3: Model development

c. Chapter 4: Modelling results

d. Chapter 5: Conclusions.

2 Study area

2.1.1 The Five Bells junction is located on the A13 at the eastern boundary of Thurrock with Essex. The Pitsea Hall junction is the next intersection to the east of Five Bells.

2.1.2 Their exact location is shown in Plate 2.1.

Plate 2.1 Junction locations

3 Model development

3.1 Network

3.1.1 ARCADY modelling has been carried out using standard industry practice and guidelines. Geometric measurements were undertaken using Ordnance Survey Base AutoCAD drawings and assisted with Google Satellite imagery.

3.1.2 The Five Bells model covers three roundabouts:

a. A176/ B1464

b. A176/ High Road

c. A176/ B1420

3.1.3 There are three types of roundabout within the Junctions 9 software:

a. Standard roundabout – is neither of the other two types.

b. Mini roundabout – small roundabout (central island diameter <4m) with traversable painted central circle/dome central island.

c. Large/grade separated roundabout – roundabout with diameter >130m or that connects with a dual carriageway/motorway

3.1.4 All three junctions in the Five Bells model were defined as a ‘standard roundabout’.

3.1.5 In the Pitsea Hall model there are two roundabouts:

a. High Road/ Broadway Link

b. Broadway Link/ Pitsea Hall

3.1.6 The first of these roundabouts was defined as a ‘standard roundabout’ while the second was defined as a ‘large roundabout’.

3.1.7 All geometrical measurements were taken from Ordnance Survey mapping, including:

a. V – Approach road half-width (m)

b. E – Entry width (m)

c. l’ – Effective flare length (m)

d. R – Entry radius (m)

e. D – Inscribed circle diameter (m)

f. PHI – Conflict (entry) angle (deg)

g. Entry-to-exit separation (m)

3.1.8 Neither model has controlled (i.e. signalised or zebra) pedestrian crossings included. Signalised crossings are present on two arms of junction 1 at the Pitsea Hall junction, but have not been included as they are outside of the model extents.

Plate 3.1 Five Bells roundabout model

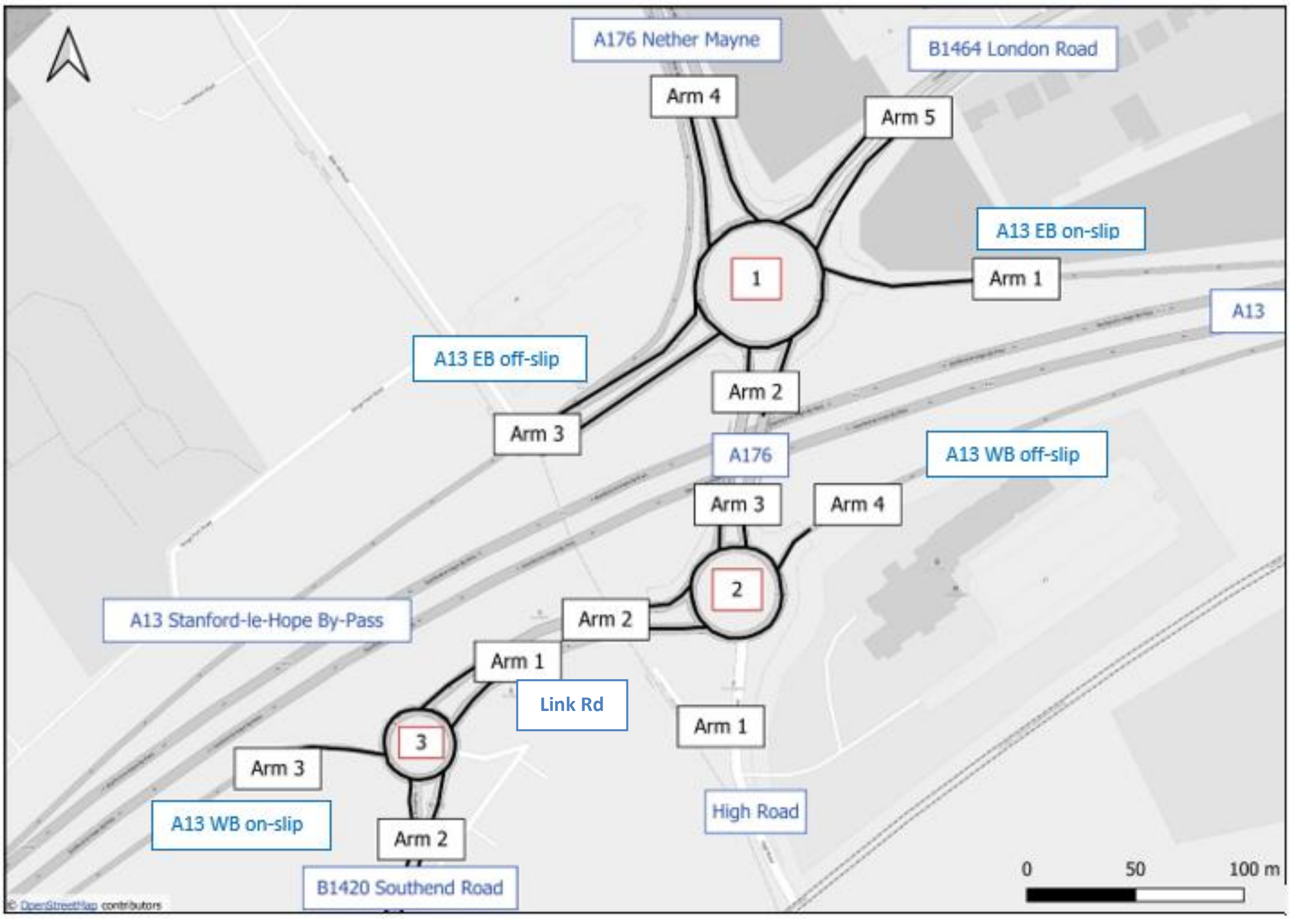


Table 3.1 Geometrical measurements for Five Bells model roundabouts

Junction	Arm (number and name)	V - Approach road half-width (m)	E - Entry width (m)	l' - Effective flare length (m)	R - Entry radius (m)	D - Inscribed circle diameter (m)	PHI - Conflict (entry) angle (deg)	Exit only
1	1 – A13 EB on-slip	-	-	-	-	-	-	✓
	2 – A176	7.22	8.37	2.2	12.3	68.9	63.0	
	3 – A13 EB off-slip	3.44	9.21	8.7	135.0	68.9	37.0	
	4 – A176 Nether Mayne	6.00	7.99	5.4	18.4	68.9	38.0	

Junction	Arm (number and name)	V - Approach road half-width (m)	E - Entry width (m)	l' - Effective flare length (m)	R - Entry radius (m)	D - Inscribed circle diameter (m)	PHI - Conflict (entry) angle (deg)	Exit only
	5 – B1464 London Road	3.50	7.88	45.0	11.5	68.9	23.0	
2	1 – High Rd	2.99	7.36	35.9	10.4	50.0	31.0	
	2 – Link Rd	7.02	7.61	5.8	17.0	50.0	21.5	
	3 – A176	7.28	8.02	3.1	13.4	50.0	70.0	
	4 – A12 WB off-slip	6.06	9.23	59.8	19.7	50.0	0.0	
3	1 – Link Rd	7.45	7.73	1.0	19.7	40.0	0.0	
	2 – B1420 Southend Road	4.16	6.76	15.1	26.6	40.0	19.5	
	3 – A13 WB on-slip	-	-	-	-	-	-	✓

Plate 3.2 A13/ Pitsea Hall roundabout model

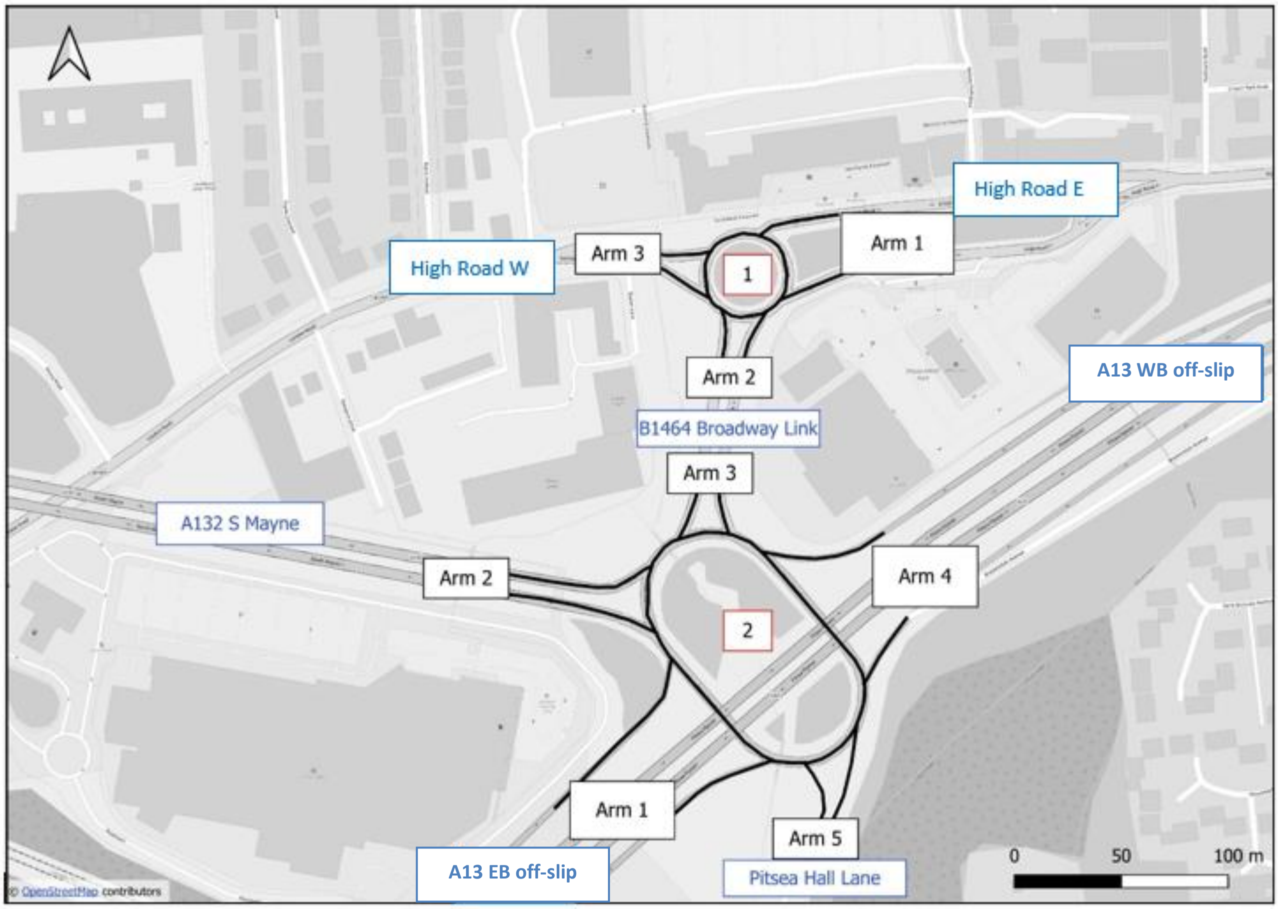


Table 3.2 Geometrical measurements for Pitsea Hall model roundabouts

Junction	**Arm** (number and name)	V - Approach road half-width (m)	E - Entry width (m)	l' - Effective flare length (m)	R - Entry radius (m)	D - Inscribed circle diameter (m)	PHI - Conflict (entry) angle (deg)	Exit only
1	1 – High Road E	9.19	9.86	15.4	20.3	48.7	19.5	
	2 – B1464 Broadway Link	6.41	6.89	5.1	35.0	48.7	17.0	
	3 – High Road W	5.87	7.86	2.2	15.9	48.7	0.0	
2	1 – A13 EB off-slip	5.85	6.29	1.8	20.5	72.0	29.0	
	2 – A132 S Mayne	6.81	6.81	0.0	16.3	72.0	0.0	
	3 – B1464 Broadway Link	8.35	8.35	0.0	17.8	72.0	52.0	
	4 – A13 WB off-slip	5.00	8.72	30.0	61.9	72.0	0.0	
	5 – Pitsea Hall Lane	4.00	7.19	16.3	19.1	72.0	42.0	

Table 3.3 Large roundabout data for Pitsea Hall model

Junction	Arm	Circulating flow (PCU/hr)	Entry-to-exit separation (m)
2	1	0	61.30
	2	0	0.00
	3	0	0.00
	4	0	76.00
	5	0	0.00

3.2 Traffic demand matrices

3.2.1 The hourly matrices were prepared using the actual flows from the Lower Thames Area Model (LTAM). Run ID CM45 was used for the Do Minimum scenario (without the Project) and run ID CS67 for the Do Something scenario (with the Project).

3.2.2 Matrices were produced for both peaks (AM and PM) in 2030 (the opening year) and 2045. Do Minimum (without the Project) as well as Do Something (with the Project) scenarios were created. The AM peak hour in LTAM is 07:00 – 08:00 and the PM peak hour is 17:00 – 18:00.

3.2.3 HGV percentage matrices were developed and input into the Junctions 9 software.

4 Junction modelling results

4.1.1 This chapter details the modelling assessment at each junction identified for the study. Base year models were not developed due to the lack of available data. The 2030 and 2045 forecast flows were taken directly from the LTAM Do Minimum (DM) (the scenario in which the Project is not built and includes changes to the road network and planned development that is forecast to go ahead whether the Project is built or not) and Do Something (DS) (the same assumptions as do the do minimum scenario, but with the addition of the Project) models.

4.1.2 As part of the assessment, reference has been made to the predicted queue (in PCUs), delay (in seconds), RFC (Ratio of flow to capacity) and Level of Service (LOS).

4.1.3 The RFC describes the maximum traffic flow which can be handled by an arm at a junction. A RFC value of 1.0 means that demand and capacity are equal and very little additional traffic would be able to enter the junction from that arm within the modelled time period.

4.1.4 Generally, a RFC value of below 0.85 is considered as showing that the arm operating with spare capacity and a RFC value of above 1.0 is considered as being over capacity resulting in traffic delays. A RFC value between 0.85 and 1.0 is referenced as operating near to / at capacity.

4.1.5 The LOS is a concept derived from the Highway Capacity Manual (2010) by the USA Transportation Research Board. It rates performance based upon thresholds of average delay on an A to F grading as follows for unsignalized junctions:

a. LOS A – average delay of 0 to 10 seconds (free-flow condition)

b. LOS B – average delay of 10 to 15 seconds (reasonably free-flow condition)

c. LOS C – average delay of 15 to 25 seconds (stable flow condition)

d. LOS D – average delay of 25 to 35 seconds (approaching unstable flow condition)

e. LOS E – average delay of 35 to 50 seconds (unstable flow condition)

f. LOS F – average delay over 50 seconds (breakdown flow condition)

4.1.6 A LOS E is considered to be at capacity, while a LOS F is considered to be over capacity.

4.1.7 Reported queues in the results tables are in PCUs, and 1 PCU is equivalent to 5.75m.

4.1.8 The results for the Five Bells junction are shown in Table 4.1 and Table 4.2 for forecast year 2030 and 2045 respectively. At Five Bells, most arms operate within capacity, with and without the Project in both forecast years, except the A176 (N) arm at the northern roundabout with Bells Hill Road. The A176 (N) is predicted to be over capacity in both forecast years without the Project but traffic conditions on this arm are predicted to improve slightly with the Project as traffic decreases on this arm in the DS (with Project) scenario.

4.1.9 The results for the Pitsea Hall junction are shown in Table 4.3 and Table 4.4 or forecast year 2030 and 2045 respectively. The Pitsea Hall junction operates within capacity in 2030 with and without the Project but the junction is predicted to operate over capacity in 2045, with and without the Project.

4.1.10 In 2045, the A13 EB off-slip approach is over capacity in both the DM and DS scenarios with queues extending to and onto the A13 mainline respectively. In the DM scenario the queue is predicted to be approximately 400m long and would stretch back to the beginning of the A13 off-slip road. In the DS the queue is predicted to be approximately 510m long, which would extend onto the A13 mainline.

4.1.11 The Broadway Link (N) approach is also over capacity in 2045 without the Project. However, traffic conditions on this approach are predicted to improve with the Project as flows are lower.

Table 4.1 Five Bells results 2030

Junction	Arm name	2030 DM										2045 DS									
		AM					PM					AM					PM				
		Flow (PCU)	Queue (PCU)	Delay (s)	RFC	LOS	Flow (PCU)	Queue (PCU)	Delay (s)	RFC	LOS	Flow (PCU)	Queue (PCU)	Delay (s)	RFC	LOS	Flow (PCU)	Queue (PCU)	Delay (s)	RFC	LOS
1 - Bells Hill Rd - A176	1 - A13 EB on-slip	Exit Only																			
	2 - A176 (S)	882	1	3.82	0.50	A	1,019	1.5	4.98	0.61	A	725	0.8	3.36	0.43	A	1,192	2.5	7.06	0.72	A
	3 - A13 EB off-slip	713	0.3	4.54	0.24	A	1,052	1	7.75	0.48	A	768	0.4	4.42	0.26	A	1,058	1.3	10.20	0.56	B
	4 - A176 (N)	1,510	44.6	90.59	1.03	F	1,178	4.5	12.96	0.82	B	1,335	11.2	29.22	0.93	D	1,065	4.3	13.70	0.81	B
	5 - B1464 (N-E)	379	0.6	5.58	0.39	A	454	0.7	5.14	0.41	A	485	0.9	6.27	0.47	A	500	0.9	5.91	0.47	A
2 - A176 - High Rd	1 - High Rd (S)	0	0	0	0	A	0	0	0	0	A	0	0	0	0	A	0	0	0	0	A
	2 - A176 (W)	575	0.5	2.62	0.31	A	702	0.6	2.86	0.38	A	549	0.4	2.44	0.29	A	893	0.9	3.41	0.47	A
	3 - A176 (N)	1,387	3.3	8.21	0.76	A	921	1.1	4.06	0.52	A	1,300	2.9	7.46	0.73	A	894	1.1	3.90	0.50	A
	4 - A13 WB off-slip	782	1.2	4.90	0.52	A	742	0.7	3.06	0.4	A	512	0.5	3.48	0.33	A	688	0.6	2.86	0.36	A
3 - A176 - B1420	1 - A176 (E)	1,862	3.9	7.22	0.79	A	1,346	1.5	3.62	0.58	A	1,636	2.6	5.25	0.71	A	1,283	1.3	3.39	0.56	A
	2 - B1420 (S)	576	1.1	6.14	0.51	A	704	1.3	6.11	0.56	A	550	1	5.58	0.49	A	895	2.5	9.36	0.71	A
	3 - A13 WB on-slip	Exit Only																			

Table 4.2 Five Bells results 2045

Junction	Arm name	2045 DM										2045 DS									
		AM					PM					AM					PM				
		Flow (PCU)	Queue (PCU)	Delay (s)	RFC	LOS	Flow (PCU)	Queue (PCU)	Delay (s)	RFC	LOS	Flow (PCU)	Queue (PCU)	Delay (s)	RFC	LOS	Flow (PCU)	Queue (PCU)	Delay (s)	RFC	LOS
1 - Bells Hill Rd - A176	1 - A13 EB on-slip	Exit Only																			
	2 - A176 (S)	1,019	1.4	4.61	0.58	A	1,134	1.9	5.61	0.66	A	875	1.1	4.28	0.52	A	1,273	3.2	8.32	0.76	A
	3 - A13 EB off-slip	802	0.5	5.49	0.32	A	1,022	1	7.94	0.48	A	803	0.5	5.37	0.32	A	1,103	1.7	12.40	0.62	B
	4 - A176 (N)	1,539	107.1	203.85	1.13	F	1,336	12.8	33.46	0.94	D	1,304	28.2	70.14	1	F	1,125	11	34.20	0.93	D
	5 - B1464 (N-E)	485	1.1	7.17	0.51	A	478	0.9	6.35	0.48	A	585	1.6	9.16	0.61	A	605	1.7	9.63	0.64	A
2 - A176 - High Rd	1 - High Rd (S)	0	0	0	0	A	0	0	0	0	A	0	0	0	0	A	0	0	0	0	A
	2 - A176 (W)	726	0.6	2.94	0.39	A	760	0.7	3.13	0.42	A	822	0.7	2.83	0.4	A	1,035	1.2	3.78	0.54	A
	3 - A176 (N)	1,434	3	7.71	0.74	A	1,123	1.8	5.23	0.63	A	1,204	2.2	6.03	0.67	A	1,018	1.4	4.51	0.57	A
	4 - A13 WB off-slip	696	0.9	4.25	0.46	A	847	1	4.05	0.5	A	329	0.3	2.86	0.2	A	647	0.6	3.04	0.36	A
3 - A176 - B1420	1 - A176 (E)	1,837	3.1	6.03	0.74	A	1,596	2.3	4.83	0.69	A	1,479	1.9	4.29	0.63	A	1,427	1.7	3.91	0.62	A
	2 - B1420 (S)	727	1.6	7.06	0.6	A	762	2	8.61	0.66	A	823	1.4	5.59	0.57	A	1,036	5.2	17.00	0.84	C
	3 - A13 WB on-slip	Exit Only																			

Table 4.3 Pitsea Hall results 2030

Junction	Arm name	2030 DM										2030 DS									
		AM					PM					AM					PM				
		Flow (PCU)	Queue (PCU)	Delay (s)	RFC	LOS	Flow (PCU)	Queue (PCU)	Delay (s)	RFC	LOS	Flow (PCU)	Queue (PCU)	Delay (s)	RFC	LOS	Flow (PCU)	Queue (PCU)	Delay (s)	RFC	LOS
1 - High Rd - Broadway Link	1 - High Rd (E)	438	0.2	1.80	0.18	A	534	0.3	1.89	0.23	A	326	0.2	1.68	0.14	A	537	0.3	1.88	0.23	A
	2 - Broadway Link (S)	752	0.7	2.89	0.39	A	526	0.4	2.50	0.28	A	709	0.6	2.93	0.38	A	518	0.4	2.48	0.27	A
	3 - High Rd (W)	543	0.5	2.92	0.33	A	638	0.6	2.91	0.36	A	495	0.4	2.77	0.29	A	623	0.5	2.89	0.36	A
2 - A13 - Broadway Link	1 - A13 EB off-slip	436	4.3	34.34	0.81	D	469	0.5	3.67	0.33	A	432	2.1	16.12	0.66	C	420	0.4	3.44	0.29	A
	2 - A132 S Mayne	1,060	1.3	4.11	0.56	A	1,496	2.2	4.81	0.68	A	736	0.6	2.80	0.37	A	1,472	2	4.58	0.67	A
	3 - Broadway Link (N)	799	1	4.07	0.49	A	934	5.4	19.87	0.85	C	569	0.4	2.32	0.28	A	920	4.3	15.99	0.82	C
	4 - A13 WB off-slip	1,625	4	8.10	0.80	A	826	0.8	3.03	0.43	A	1,521	1.2	2.55	0.53	A	806	0.8	3.10	0.43	A
	5 - Pitsea Hall Lane	0	0	0	0	A	0	0	0	0	A	0	0	0	0	A	0	0	0	0	A

Table 4.4 Pitsea Hall results 2045

Junction	Arm name	2045 DM										2045 DS									
		AM					PM					AM					PM				
		Flow (PCU)	Queue (PCU)	Delay (s)	RFC	LOS	Flow (PCU)	Queue (PCU)	Delay (s)	RFC	LOS	Flow (PCU)	Queue (PCU)	Delay (s)	RFC	LOS	Flow (PCU)	Queue (PCU)	Delay (s)	RFC	LOS
1 - High Rd - Broadway Link	1 - High Rd (E)	439	0.2	1.83	0.19	A	594	0.4	1.99	0.26	A	330	0.2	1.71	0.14	A	546	0.3	1.91	0.24	A
	2 - Broadway Link (S)	928	0.9	3.38	0.47	A	564	0.4	2.57	0.30	A	932	0.9	3.41	0.48	A	555	0.5	2.68	0.30	A
	3 - High Rd (W)	594	0.6	3.3	0.37	A	676	0.6	3.04	0.39	A	573	0.5	3.06	0.35	A	653	0.6	3.02	0.38	A
2 - A13 - Broadway Link	1 - A13 EB off-slip	438	69.1	444.67	1.39	F	489	0.7	4.61	0.39	A	423	88.8	591.9	1.60	F	456	0.6	4.31	0.36	A
	2 - A132 S Mayne	1,066	1.5	4.79	0.60	A	1,668	3.3	6.61	0.77	A	834	0.9	3.64	0.47	A	1,608	2.8	5.81	0.74	A
	3 - Broadway Link (N)	787	0.9	3.89	0.48	A	1,018	64.2	179.5	1.12	F	644	0.5	2.64	0.34	A	859	6.2	25.06	0.87	D
	4 - A13 WB off-slip	1,825	3.2	5.88	0.76	A	968	1.1	3.82	0.53	A	1,869	1.7	3.02	0.63	A	924	0.8	2.95	0.45	A
	5 - Pitsea Hall Lane	0	0	0	0	A	0	0	0	0	A	0	0	0	0	A	0	0	0	0	A

5 Conclusions

5.1.1 The assessment indicates that Five Bells generally operates within capacity except for the A176 (N) approach which is predicted to be over capacity with and without the Project in both forecast years, although marginally better in the DS.

5.1.2 At Pitsea Hall, in 2030 the junction is predicted to operate within capacity with queues not extending onto the A13 mainline, both with and without the Project. However, junction performance would worsen in 2045 where the A13 EB off-slip approach would operate over capacity with queues extending close to the A13 mainline, without the Project and onto the mainline with the Project.

References

Transport for London (September 2021). Traffic Modelling Guidelines Version 4.0.

https://content.tfl.gov.uk/traffic-modelling-guidelines.pdf

Transportation Research Board of the National Academies of Sciences, Engineering, and Medicine, United States (2010) – Highway Capacity Manual

Glossary

Term	Explanation
ARCADY	A design and assessment tool used to predict capacities and queues at roundabouts
DCO	Development Consent Order - Means of obtaining permission for developments categorised as Nationally Significant Infrastructure Projects (NSIPs)
Do Minimum	A future year scenario which includes changes to the road network and planned development that is forecast to go ahead, but not the Lower Thames Crossing.
Do Something	A future year scenario which includes changes to the road network and planned development that is forecast to go ahead, and the Lower Thames Crossing.
EB	Eastbound
GEH	A formula used to compare two traffic volumes, named after its originator, Geoff E. Havers. It is similar to a chi-squared test.
HGV	Heavy Goods Vehicle
Junctions 9	Transport Research Laboratory's industry-standard package for the modelling of roundabout and priority junctions
LGV	Light Goods Vehicle
LOS	Level of Service is a concept derived from the Highway Capacity Manual (2000) by the USA Transportation Research Board. It rates performance based upon average delay per arriving vehicle on an A to F grading
NB	Northbound
OS	Ordnance Survey
PCU	Passenger Car Unit is a vehicle unit or car unit used to measure the rate of traffic flow
RFC	Ratio of flow to capacity
SATURN	Simulation and Assignment of Traffic to Urban Networks
SB	Southbound
TAG	Transport Analysis Guidance published by the Department for Transport
TfL	Transport for London - The integrated body responsible for London's transport system
WB	Westbound

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