

# A47 North Tuddenham to Easton Dualling

**Scheme Number: TR010038**

**Volume 9**

## **9.3 A47/A1074 Longwater Junction Impact Analysis**

The Infrastructure Planning (Examination Procedure) Rules 2010  
Rule 3(2)(b)

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September 2021

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**The Infrastructure Planning  
(Examination Procedure) Rules 2010**

**The A47 North Tuddenham to Easton  
Development Consent Order 202[x]**

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**A47/A1074 LONGWATER JUNCTION IMPACT ANALYSIS**

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## **1 INTRODUCTION**

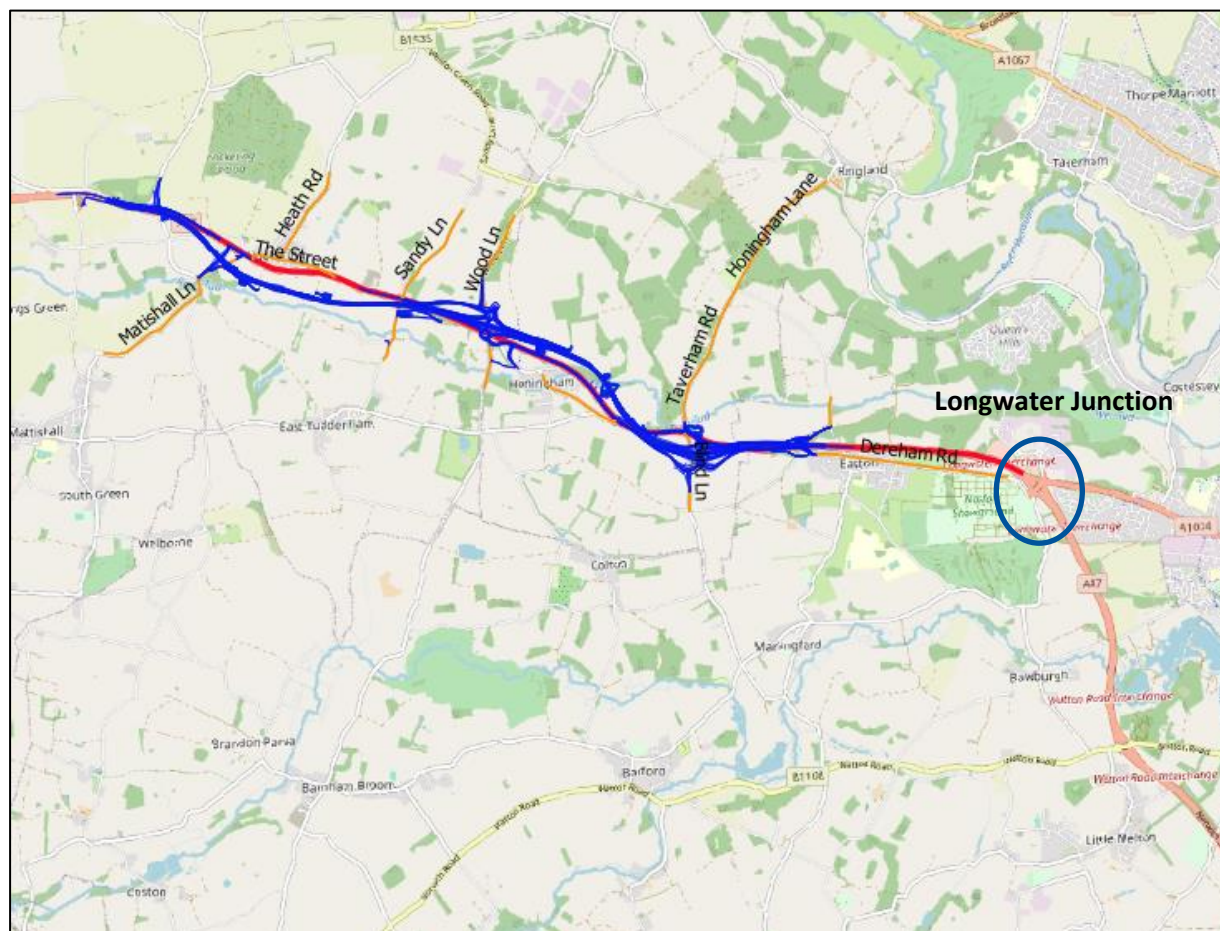
### **1.1 Purpose of this Document**

- 1.1.1 As part of the assessment of the A47 North Tuddenham to Easton dualling scheme (hereby referred to as the Scheme), potential concerns for traffic congestion at the A47/A1074 Longwater junction (hereby referred to as the Longwater junction) have been raised by Norfolk County Council. This report assesses whether the Scheme will cause any adverse traffic impacts on the Longwater junction.
- 1.1.2 This technical note provides a summary of the existing and future traffic conditions at the Longwater junction in the base scenario, the Do-Minimum scenario (DM: without the scheme) and the Do-Something scenario (DS: with the scheme). The assessment is based on the modelling results derived from Highways England's Norwich Area Transport Strategy (NATS) SATURN model for the base year of 2015 and the forecast years of 2025 and 2040. The NATS SATURN model has been used to undertake the forecasting assessment and economic appraisal of the Scheme.

### **1.2 Background**

- 1.2.1 The Tuddenham scheme provides 9km of new dual carriageway, running to the south of the existing A47 at Hockering and to the north of the existing A47 at Honingham.
- 1.2.2 The North Tuddenham to Easton section of the A47 is located approximately 10-20 kilometres to the west of Norwich. This existing single carriageway forms part of the main arterial highway strategic route connecting Peterborough and Kings Lynn to Norwich.
- 1.2.3 Figure 1.1 below shows the location of the Scheme and the Longwater junction.

**Figure 1.1: Location of the scheme and the A47/A1074 Longwater Junction**



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## 2 MODELLING ASSUMPTION

### 2.1 Introduction

2.1.1 The assessment of the traffic conditions at the Longwater junction has been undertaken using Highways England's NATS model. This section summarises the NATS model structure and assumptions as well as the local context of the Longwater junction.

### 2.2 Highways England's NATS Transport Model

#### Overview

2.2.1 The NATS transport model has been adopted for the assessment of the A47 North Tuddenham to Easton Dualling scheme for the Development Consent Order (DCO) application. Details of the base and forecast model development are reported in Chapter 4 'Transport Case for the Scheme' in document 7.1 'Case for the Scheme' (**APP-140**) of the DCO submission. In summary the NATS model consists of the following components:

- A highway assignment model developed in SATURN (Version 11.3.12U);
- A public transport assignment model developed in VISUM (Version 16.010) – This has been utilised for public transport modelling purposes although it has only been partially used in the forecasting purposes; and
- A variable demand model using the Dynamic Integrated Assignment and Demand Modelling (DIADEM v6.3) software supported with a Highways England Integrated DIADEM Interface (HEIDI v5.0) front end.

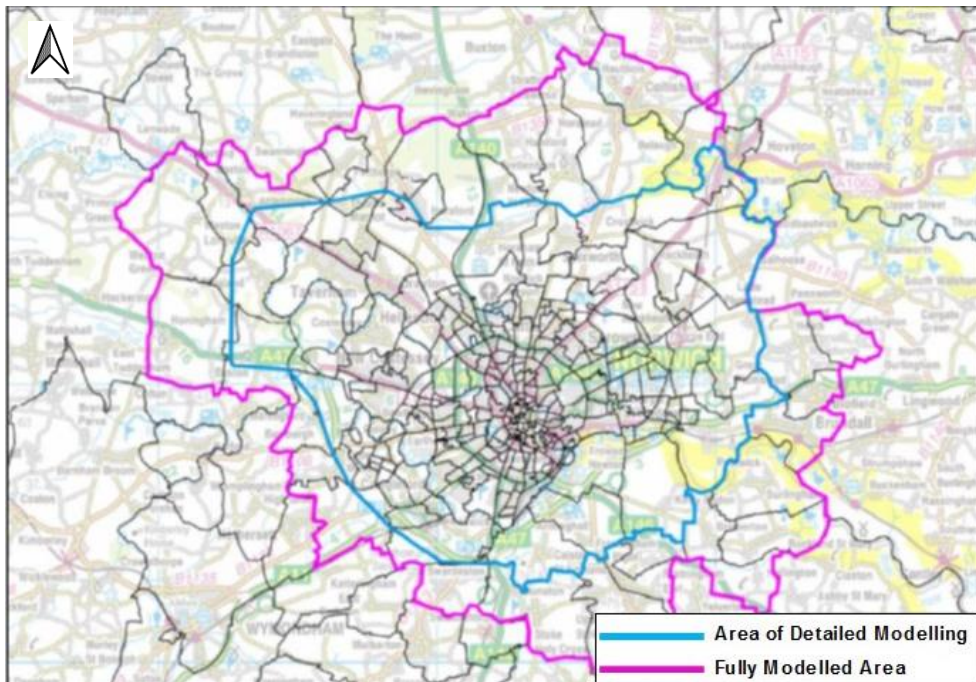
#### Modelled Area and Network

2.2.2 The model area for the DCO application stage transport model, which was agreed with Highways England, was retained from the route options study stage transport model.

2.2.3 During the route options stage, both the Fully Modelled Area (FMA) and the Area of Detailed Modelling (AoDM) have been expanded compared to the original NATS model to include the A47 Scheme Area of Influence (AoI) around North Tuddenham, Blofield and Thickthorn. This process has resulted in a new 'hybrid' model, derived from a combination of NATS and South East Regional Transport Model (SERTM) model data. The revised model area coverage is shown in Figure 2.1 and Figure 2.2 below.

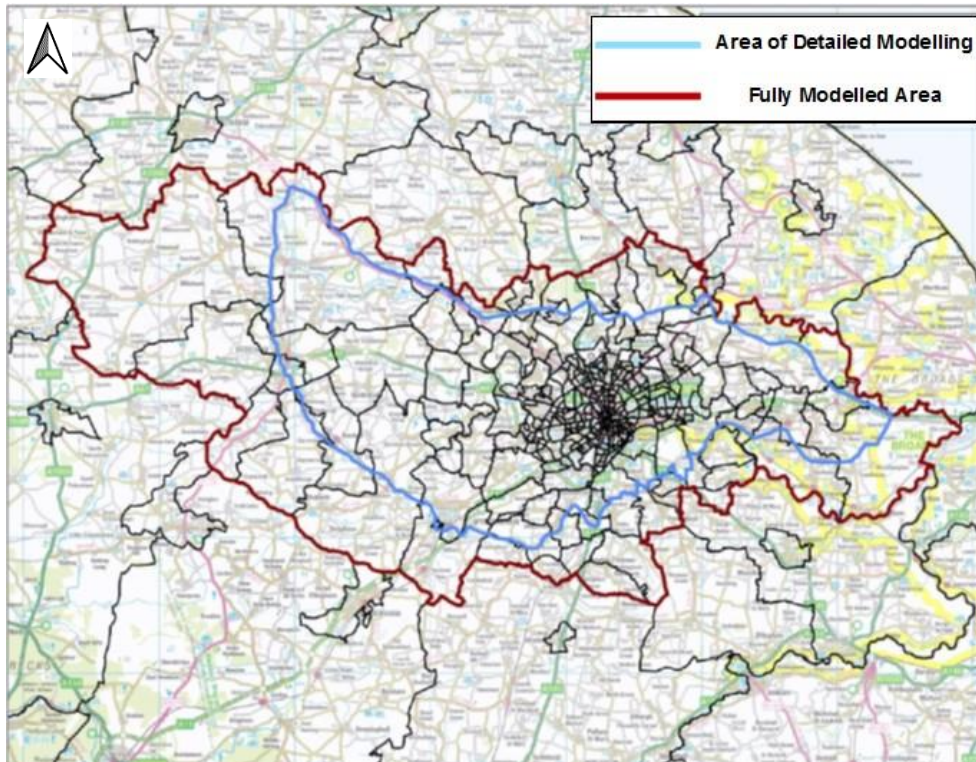


**Figure 2.1: Original NATS Model Fully Modelled Area and Area of Detailed Modelling**



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**Figure 2.2: Hybrid NATS Model Fully Modelled Area and Area of Detailed Modelling**



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## **Modelled Time Periods**

2.2.4 The assignment model covers a single peak hour across three time periods in a weekday of a neutral month. The modelled time periods are:

- AM Peak hour (08:00 to 09:00)
- Inter Peak (IP) Average hour (10:00 to 16:00)
- PM Peak hour (17:00 to 18:00)

## **User Class Segmentation**

2.2.5 The updated NATs highway assignment model includes the following 5 user classes:

- Car Employer's Business
- Car Commuting
- Car Other
- Large Goods Vehicle (LGV)
- Heavy Goods Vehicle (HGV)

## **Core Scenarios**

2.2.6 Following consultation with Highways England, it was agreed that for the DCO applications each A47 RIS scheme in the Norwich area will be classified as "near certain". Therefore, the A47 schemes should appear in the DM network (except where they are the scheme being appraised). Then each scheme will be assessed by comparing the respective Do Minimum (DM) scenario against the common Do Something (DS) scenario. Table 2-1 below highlights the combination of DM and DS network for the Tuddenham scheme appraisal.

2.2.7 In July 2019 the Preferred Route Announcement (PRA) was issued for the Norwich Western Link (NWL) with an estimated start of construction in late 2022 and estimated opening year in 2025. Regardless of its PRA status, it was agreed with Highways England that for the purpose of DCO application, both 'with' and 'without' NWL should be considered as part of this assessment.

2.2.8 In the 'with NWL' DM scenario, it is assumed that the existing A47/Wood Lane junction would become an at-grade roundabout with which the NWL link would tie in.

2.2.9 Table 2-1 and Table 2-2 below highlight the combination of DM and DS network for the Tuddenham scheme appraisal under both 'with' and 'without' NWL.



**Table 2-1: DM/DS Network Assumptions – ‘With NWL’**

Scenario	Appraisal	Schemes Included				
		Thickthorn	Blofield	Tuddenham	NWL	Other Non – RIS DM Schemes
DM	Tuddenham	Y	Y	N	Y	Y
DS	Tuddenham	Y	Y	Y	Y	Y

**Table 2-2: DM/DS Network Assumptions – ‘Without NWL’**

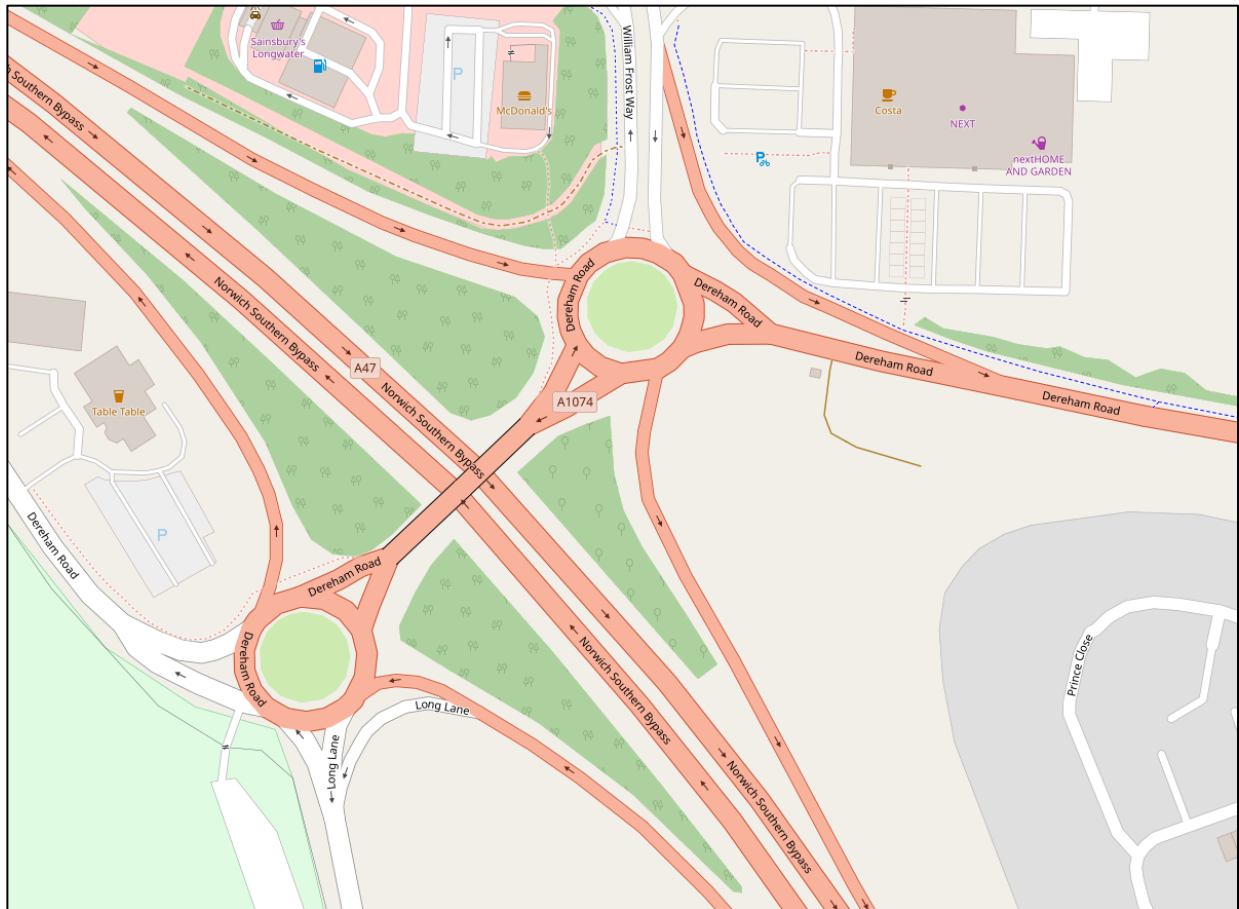
Scenario	Appraisal	Schemes Included				
		Thickthorn	Blofield	Tuddenham	NWL	Other Non – RIS DM Schemes
DM	Tuddenham	Y	Y	N	N	Y
DS	Tuddenham	Y	Y	Y	N	Y

## 2.3 The Local Context

2.3.1 Figure 2.3 shows the layout of the Longwater junction and its location relative to the Tuddenham scheme. From figures 1.1 and 2.3 it can be seen that:

- The junction is located in a predominantly rural area, just south of Longwater village
- The junction is not within the boundaries of the proposed Scheme
- It is a full grade separated junction with twin dumbbell arrangement layout
- The A1074 Dereham Road connects the village of Easton to Norwich city centre via the junction
- Longwater Retail Park and Costessey Park & Ride can be accessed via the junction

**Figure 2.3: Existing Layout of the A47/A0174 Longwater Junction**



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### 3 EXISTING AND FUTURE TRAFFIC CONDITION

#### 3.1 Base Year Validation

3.1.1 Tables 3-1 to 3-3 outline the results of the 2015 NATS models strategic validation in the vicinity of the Longwater junction. The locations of the validation counts are shown in Figure 3.1.

**Table 3-1: NATS Strategic Validation - AM**

Description	Dir.	Observed	Modelled	Diff	%Diff	GEH	DMRB	PASS
Dereham Road	WB	738	755	17	2%	0.6	1	Pass
Dereham Road	EB	725	760	35	5%	1.3	1	Pass
A47 mainline (east of Longwater Jct)	EB	2240	1973	-267	-12%	5.8	1	Pass
A47 mainline (east of Longwater Jct)	WB	1671	1189	-482	-29%	12.7	0	Fail
A47 mainline (west of Longwater Jct)	EB	1519	1467	-52	-3%	1.3	1	Pass
A47 mainline (west of Longwater Jct)	WB	1036	1086	49	5%	1.5	1	Pass

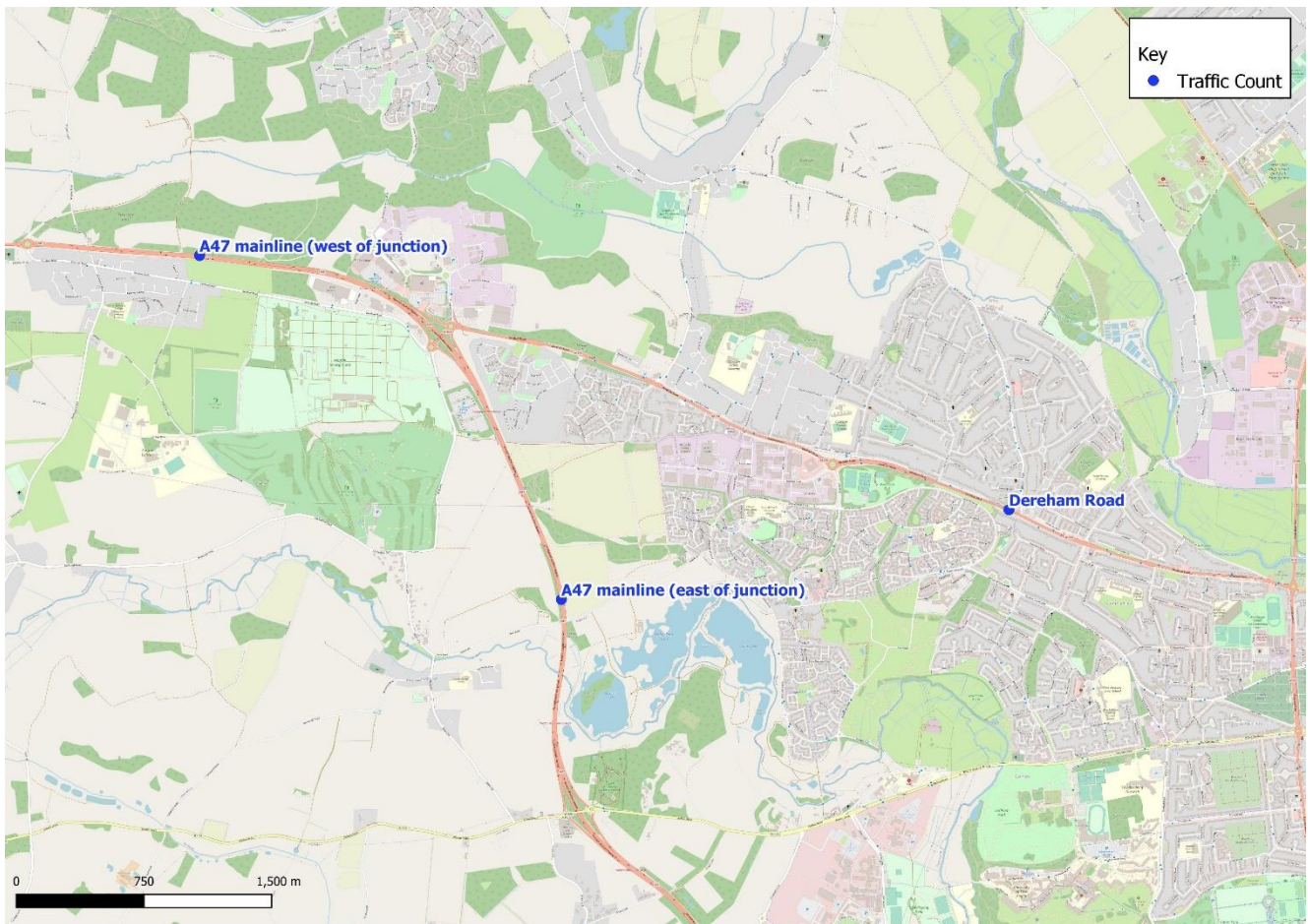
**Table 3-2: NATS Strategic Validation - IP**

Description	Dir.	Observed	Modelled	Diff	%Diff	GEH	DMRB	PASS
Dereham Road	WB	766	814	49	6%	1.7	1	Pass
Dereham Road	EB	783	833	51	6%	1.8	1	Pass
A47 mainline (east of Longwater Jct)	EB	1280	1073	-207	-16%	6.0	0	Fail
A47 mainline (east of Longwater Jct)	WB	1321	1022	-299	-23%	8.7	0	Fail
A47 mainline (west of Longwater Jct)	EB	874	965	91	10%	3.0	1	Pass
A47 mainline (west of Longwater Jct)	WB	894	938	44	5%	1.4	1	Pass

**Table 3-3: NATS Strategic Validation - PM**

Description	Dir.	Observed	Modelled	Diff	%Diff	GEH	DMRB	PASS
Dereham Road	WB	855	870	14	2%	0.5	1	Pass
Dereham Road	EB	887	971	85	10%	2.8	1	Pass
A47 mainline (east of Longwater Jct)	EB	1808	1880	72	4%	1.7	1	Pass
A47 mainline (east of Longwater Jct)	WB	2248	1789	-459	-20%	10.2	0	Fail
A47 mainline (west of Longwater Jct)	EB	1177	1427	249	21%	6.9	0	Fail
A47 mainline (west of Longwater Jct)	WB	1491	1442	-49	-3%	1.3	1	Pass

**Figure 3.1: Count Data Locations**



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- 3.1.2 Analysis of the validation results, presented above, indicates that the model passes Department for Transport's Transport Analysis Guidance<sup>1</sup> (TAG) criteria along Dereham Road and the A47 mainline to the west of the junction. This is with the exception of the PM peak, where the A47 mainline to the west of the junction eastbound movement is slightly higher than the observed flow by around 250 vehicles.
- 3.1.3 On the A47 mainline, located to the east of the junction, the model fails TAG criteria in the westbound direction with modelled flows around 500-300 vehicles less than the observed flow. However, approaching the Longwater Junction in the eastbound direction on the A47 mainline, the model passes TAG criteria in the AM and PM peaks.

<sup>1</sup>Available on-line at: <https://www.gov.uk/guidance/transport-analysis-guidance-tag>



- 3.1.4 Overall, the analysis shows that a good strategic link level validation has been achieved along the major corridors. As the Longwater junction is outside of the Scheme section no local data was collected as part of the 2015 model development. Therefore the 2015 NATs model validation has been undertaken at a strategic link-based level without any detailed local area assessment of the Longwater junction.

## 3.2 Base Year

- 3.2.1 Table 3-4 below shows the existing traffic flows, delays and the volume over capacity ratios (V/C%) in the 2015 Base Year NATS model for the approach links to the junction.
- 3.2.2 The V/C% is an indicator of the likely performance of a junction. According to DMRB<sup>2</sup> guidance, in general a V/C ratio of 85% or less is advised.
- 3.2.3 A V/C of 100% and above is considered as overcapacity.
- 3.2.4 As it can be seen from this assessment, in the Base Year the junction is operating well below the capacity with the V/C ratio for all links under the advised 85% threshold.

**Table 3-4: Base Year 2015 SATURN Assessment Junction Results**

Base	Modelled Flow (Veh)				V/C (%)			Delay (Seconds)		
	AM	IP	PM	AADT	AM	IP	PM	AM	IP	PM
A47 NB Off Slip	478	420	740	6606	34	28	46	4	3	3
A47 NB on Slip	374	336	393	4659	22	20	23	3	3	3
A47 SB Off Slip	354	348	355	4558	32	30	39	4	4	5
A47 SB On Slip	860	456	808	8298	48	26	44	3	3	3
A47 Mainline NB	711	602	1049	9520	19	16	28	0	0	0
A47 Mainline SB	1113	617	1072	11002	36	18	33	0	0	0
Long Lane	52	113	213	1568	3	6	12	0	0	0
Dereham Rd Easton West	129	142	170	1885	13	14	18	4	4	5
William Frost Way	626	421	550	6521	47	31	42	4	4	4
Dereham Rd Easton East	994	700	965	10849	78	55	72	13	7	11

## 3.3 Core Scenario with NWL

- 3.3.1 Tables 3-5 to 3-8 show the results for the 2025 and 2040 DM and DS future year 'with NWL' scenarios respectively.
- 3.3.2 It is noticeable that some of the approaches show a reduction in modelled flow between the base year and 2025 forecast year. This reduction is primarily due to the presence of the NWL in both the DM and DS scenarios. The NWL diverts traffic around Norwich and therefore causes a reduction in traffic using the eastern section of the Tuddenham scheme.

<sup>2</sup> See guidance documents DMRB Volume 6 Section 2 Part 6 TD 42/95



- 3.3.3 Table 3-5 indicates that in the 2025 DM scenario, all approaches at the junction are still operating well below the available capacity, with the exception of Dereham Road Easton East (88%) which slightly exceeds the 85% threshold in the AM peak.
- 3.3.4 From Table 3-6 only minor changes in V/C and delay can be seen compared to the DM scenario. In line with the DM scenario Dereham Road Easton East (AM peak 88%) is the only approach arm which exceeds the 85% threshold.

**Table 3-5: 2025 DM with NWL SATURN Assessment Junction Results**

2025 DM	Modelled Flow (Veh)				V/C (%)			Delay (Seconds)		
With NWL	AM	IP	PM	AADT	AM	IP	PM	AM	IP	PM
A47 NB Off Slip	451	471	843	7170	31	33	56	13	13	15
A47 NB on Slip	254	238	250	3180	15	14	15	3	3	3
A47 SB Off Slip	280	252	283	3458	24	23	35	4	4	6
A47 SB On Slip	1051	507	829	9330	57	29	45	3	3	3
A47 Mainline NB	730	667	938	9683	19	17	24	0	0	0
A47 Mainline SB	1056	674	956	10855	37	20	29	0	0	0
Long Lane	55	171	246	2068	3	10	14	0	0	0
Dereham Rd Easton West	166	171	177	2223	17	17	18	4	4	5
William Frost Way	599	327	389	5321	16	9	11	3	3	3
Dereham Rd Easton East	959	586	869	9683	88	39	59	13	4	5

**Table 3-6: 2025 DS with NWL SATURN Assessment Junction Results**

2025 DS	Modelled Flow (Veh)				V/C (%)			Delay (Seconds)		
With NWL	AM	IP	PM	AADT	AM	IP	PM	AM	IP	PM
A47 NB Off Slip	426	458	798	6867	30	32	53	13	13	15
A47 NB on Slip	340	316	333	4235	21	19	21	3	3	3
A47 SB Off Slip	387	346	393	4768	33	32	46	4	4	7
A47 SB On Slip	957	495	802	8864	55	29	46	3	3	3
A47 Mainline NB	954	855	1378	13002	25	23	35	0	0	0
A47 Mainline SB	1427	827	1323	14190	47	24	40	0	0	0
Long Lane	64	196	276	2357	4	11	15	0	0	0
Dereham Rd Easton West	171	171	182	2252	17	17	19	4	4	5
William Frost Way	597	332	393	5364	17	10	12	3	3	3
Dereham Rd Easton East	926	616	878	9801	88	42	60	14	4	5

**Table 3-7: 2040 DM with NWL SATURN Assessment Junction Results**

2040 DM	Modelled Flow (Veh)				V/C (%)			Delay (Seconds)		
With NWL	AM	IP	PM	AADT	AM	IP	PM	AM	IP	PM
A47 NB Off Slip	563	604	1040	9023	39	42	69	14	14	16
A47 NB on Slip	284	266	235	3423	17	16	14	3	3	3
A47 SB Off Slip	307	272	331	3825	30	29	48	5	5	8
A47 SB On Slip	1126	665	1009	11176	61	37	54	3	3	3
A47 Mainline NB	850	847	1152	11927	22	22	29	0	0	0
A47 Mainline SB	1182	843	1093	12806	41	26	35	0	0	0

2040 DM	Modelled Flow (Veh)				V/C (%)			Delay (Seconds)		
With NWL	AM	IP	PM	AADT	AM	IP	PM	AM	IP	PM
Long Lane	64	217	250	2416	4	12	14	0	0	0
Dereham Rd Easton West	228	220	212	2862	22	22	24	4	4	5
William Frost Way	692	388	453	6228	20	12	15	3	3	3
Dereham Rd Easton East	946	700	1014	10839	104	51	75	112	5	7

**Table 3-8: 2040 DS with NWL SATURN Assessment Junction Results**

2040 DS	Modelled Flow (Veh)				V/C (%)			Delay (Seconds)		
With NWL	AM	IP	PM	AADT	AM	IP	PM	AM	IP	PM
A47 NB Off Slip	507	567	901	8177	35	39	60	13	14	15
A47 NB on Slip	384	383	399	5025	24	24	27	3	3	3
A47 SB Off Slip	456	396	473	5573	42	40	63	5	5	9
A47 SB On Slip	1048	637	960	10588	61	38	56	3	3	3
A47 Mainline NB	1285	1171	1780	17418	34	31	46	0	0	0
A47 Mainline SB	1637	1115	1644	17780	56	33	52	0	0	0
Long Lane	97	258	315	2998	5	14	17	0	0	0
Dereham Rd Easton West	229	216	212	2836	22	21	26	4	4	6
William Frost Way	695	411	497	6524	22	13	17	3	3	3
Dereham Rd Easton East	901	702	1042	10790	105	53	81	139	5	9

3.3.5 Table 3-7 and Table 3-8 above show the forecasted delays and V/Cs in the 2040 DM and DS scenarios respectively.

3.3.6 In line with the 2025 results, analysis of these tables shows no major differences in junction performance between the DM and DS scenarios. However, Dereham Road Easton East is overcapacity, with a V/C of over 100%, during the AM peak in both the DM and DS scenarios.

3.3.7 The V/C on this approach is forecasted to increase by only 1% between the DM and DS scenarios, whereas the corresponding delay increases by 27 seconds.

3.3.8 When V/C exceeds 100%, it leads to relatively large increases in delays generated from a small increase in V/C. It is therefore preferable to keep V/C ratios within the 85% threshold to avoid large increases in delay and maintain reserve capacity.

### 3.4 Core Scenario without NWL

3.4.1 Table 3 9 to Table 3 12 show the results for the 2025 and 2040 DM and DS future year 'without NWL' scenarios respectively.

- 3.4.2 In the 'without NWL' scenario, a greater volume of traffic will travel along the eastern section of the Scheme as the alternative NWL route is not available. This leads to an increase in A47 mainline traffic at the Longwater junction. Traffic demand will also increase on Dereham Road Easton East and thus increase the background congestion in the DM 'without NWL' scenario. Whereas in the 'with' NWL scenario traffic demand to/from the north west of Norwich will be routed away from the Longwater junction, thus reducing the overall congestion levels on Dereham Road Easton East.
- 3.4.3 The comparison of the 'without NWL' DM and DS scenarios follows a similar trend to the 'with NWL' assessment, with the majority of approach links still operating below the 85% threshold. However, in the DM scenario Dereham Road Easton approach is operating close to capacity in 2025 (V/C 96%) and overcapacity in 2040 (V/C 107%).
- 3.4.4 Similar to the 'with NWL scenario', there is a slight increase in V/C ratio in the DS scenario (2025: 102%, 2040 110%). As explained in section 3.3 above, SATURN calculates a relatively large increase in delay when V/C ratios are above 100%.

**Table 3-9: 2025 DM without NWL SATURN Assessment Junction Results**

2025 DM	Modelled Flow (Veh)				V/C (%)			Delay (Seconds)		
Without NWL	AM	IP	PM	AADT	AM	IP	PM	AM	IP	PM
A47 NB Off Slip	444	473	836	7142	31	33	55	13	13	15
A47 NB on Slip	346	317	344	4293	21	19	21	3	3	3
A47 SB Off Slip	327	336	384	4482	31	32	48	4	4	7
A47 SB On Slip	1050	519	840	9435	57	30	46	3	3	3
A47 Mainline NB	837	770	1127	11293	22	20	29	0	0	0
A47 Mainline SB	1176	755	1135	12324	41	22	35	0	0	0
Long Lane	58	185	262	2223	3	10	15	0	0	0
Dereham Rd Easton West	162	169	174	2190	16	17	19	4	4	5
William Frost Way	604	332	392	5383	17	10	12	3	3	3
Dereham Rd Easton East	1033	652	947	10601	96	45	65	24	4	6

**Table 3-10: 2025 DS without NWL SATURN Assessment Junction Results**

2025 DS	Modelled Flow (Veh)				V/C (%)			Delay (Seconds)		
Without NWL	AM	IP	PM	AADT	AM	IP	PM	AM	IP	PM
A47 NB Off Slip	429	469	804	6969	30	33	53	13	13	15
A47 NB on Slip	397	384	476	5307	24	23	30	3	3	3
A47 SB Off Slip	411	411	513	5641	38	39	64	4	5	9
A47 SB On Slip	1038	537	811	9433	58	31	47	3	3	3
A47 Mainline NB	1055	924	1478	14095	28	25	40	0	0	0
A47 Mainline SB	1380	863	1418	14569	47	25	43	0	0	0
Long Lane	68	201	294	2453	4	11	16	0	0	0
Dereham Rd Easton West	189	191	213	2545	19	19	25	4	4	6
William Frost Way	605	350	404	5542	18	11	14	3	3	3
Dereham Rd Easton East	1066	729	1029	11469	102	50	71	74	5	6

**Table 3-11: 2040 DM without NWL SATURN Assessment Junction Results**

2040 DM	Modelled Flow (Veh)				V/C (%)			Delay (Seconds)		
Without NWL	AM	IP	PM	AADT	AM	IP	PM	AM	IP	PM
A47 NB Off Slip	551	591	975	8702	38	41	64	14	14	16
A47 NB on Slip	325	347	313	4333	20	21	20	3	3	3
A47 SB Off Slip	306	372	368	4603	31	40	53	5	5	9
A47 SB On Slip	1129	682	1020	11336	62	39	55	3	3	3
A47 Mainline NB	1061	1004	1388	14385	28	27	35	0	0	0
A47 Mainline SB	1276	950	1263	14343	45	29	41	0	0	0
Long Lane	109	236	294	2827	6	13	16	0	0	0
Dereham Rd Easton West	225	217	211	2825	22	22	25	4	4	6
William Frost Way	698	407	454	6381	21	13	15	3	3	3
Dereham Rd Easton East	963	751	1072	11412	107	57	79	166	5	8

**Table 3-12: 2040 DS without NWL SATURN Assessment Junction Results**

2040 DS	Modelled Flow (Veh)				V/C (%)			Delay (Seconds)		
Without NWL	AM	IP	PM	AADT	AM	IP	PM	AM	IP	PM
A47 NB Off Slip	520	583	935	8425	36	40	62	14	14	16
A47 NB on Slip	399	467	500	5947	26	29	33	3	3	3
A47 SB Off Slip	474	465	557	6343	48	50	79	5	6	14
A47 SB On Slip	1067	687	986	11064	63	40	58	3	3	3
A47 Mainline NB	1377	1276	1787	18444	37	35	48	0	0	0
A47 Mainline SB	1740	1155	1767	18754	60	35	56	0	0	0
Long Lane	137	271	322	3241	8	15	18	0	0	0
Dereham Rd Easton West	270	249	242	3284	26	25	32	4	5	7
William Frost Way	700	420	469	6518	24	15	18	3	3	3
Dereham Rd Easton East	916	842	1172	12172	110	65	89	214	6	11

## 4 CONCLUSION

- 4.1.1 In conclusion, the analysis shows that in general the Longwater junction will operate under capacity.
- 4.1.2 This is with the exception of the Dereham Road Easton East approach link, which in the AM peak is forecasted to operate slightly over the 85% threshold in 2025 DM (88%) and overcapacity in 2040 DM (104%) in the 'with NWL' DM core scenario.
- 4.1.3 In comparison, congestion is forecast to increase in the 'without NWL' DM scenario on Dereham Road Easton East (V/C: 2025 96%, 2040 107%). The capacity and delay issues on this approach are therefore due to the forecasted growth in the 'without NWL' background traffic. In the 'with NWL' scenario traffic demand to/from the north west of Norwich will be routed away from the Longwater junction, thus reducing the overall congestion levels on Dereham Road Easton East.
- 4.1.4 In summary there is a slight worsening of traffic conditions on Dereham Road Easton East in the DS scenario. Overall, excluding Dereham Road Easton East, the comparison of the forecasted delays and V/Cs shows no significant change in junction performance between the DM and DS scenarios.
- 4.1.5 Therefore, it is concluded from the modelling assessment that the Tuddenham scheme will not cause any significant material impact on the Longwater junction. However, overall lower levels of congestion along Dereham Road Easton East are forecasted in the 'with NWL' scenario.
- 4.1.6 In the event that the Norwich Western Link scheme is not delivered, Highways England will continue to work with Norfolk County Council to maintain Longwater Junction's operational performance.