Assessment of Air Quality along the A35 in Chideock, West Dorset

January 2019

Experts in air quality
management & assessment

Document Control

Client	West Dorset District Council	Principal Contact	Coralie McGown

Job Number	J3555

Report Prepared By:	Dr Imogen Heard

Document Status and Review Schedule

Report No.	Date	Status	Reviewed by
J3555A/1/F1	24 January 2019	Final	Dr Clare Beattie (Associate Director)

Air Quality Consultants Ltd
23 Coldharbour Road, Bristol BS6 7JT Tel: 0117 974 1086
1 Burwood Place, London W2 2UT Tel: 020 3873 4780
aqc@aqconsultants.co.uk

Registered Office: 12 St Oswalds Road, Bristol, BS6 7HT
Companies House Registration No: 2814570

Contents

Tables

Figures

1 Introduction

1.1 Air Quality Consultants Ltd has been commissioned by West Dorset District Council to undertake an assessment of air quality along the A35 in Chideock, as part of wider work on the Air Quality Action Plan. Measurements indicate that the annual mean nitrogen dioxide objective has been exceeded at some locations adjacent to the A35 for a number of years. The aim of this assessment is to determine the cause of these exceedances using source apportionment, in order to inform measures to be included in the update of the Air Quality Action Plan.

Background

1.2 The Air Quality Strategy (Defra, 2007) published by the Department for Environment, Food, and Rural Affairs (Defra) and Devolved Administrations, provides the policy framework for air quality management and assessment in the UK. It provides air quality standards and objectives for key air pollutants, which are designed to protect human health and the environment. It also sets out how the different sectors: industry, transport and local government, can contribute to achieving the air quality objectives. Local authorities are seen to play a particularly important role. The strategy describes the Local Air Quality Management (LAQM) regime that has been established, whereby every authority has to carry out regular reviews and assessments of air quality in its area to identify whether the objectives have been, or will be, achieved at relevant locations, by the applicable date. If this is not the case, the authority must declare an Air Quality Management Area (AQMA), and prepare an action plan which identifies appropriate measures that will be introduced in pursuit of the objectives. This assessment uses source apportionment to ascertain the sources contributing the measured exceedances, and the magnitude of reduction in emissions required to achieve the objective.

The Air Quality Objectives

1.3 The Government's Air Quality Strategy (Defra, 2007) provides air quality standards and objectives for key air pollutants, which are designed to protect human health and the environment. The 'standards' are set as concentrations below which health effects are unlikely even in sensitive population groups, or below which risks to public health would be exceedingly small. They are based purely upon the scientific and medical evidence of the effects of a particular pollutant. The 'objectives' set out the extent to which the Government expects the standards to be achieved by a certain date. They take account of the costs, benefits, feasibility and practicality of achieving the standards. It also sets out how the different sectors: industry, transport and local government, can contribute to achieving the air quality objectives. The objectives are prescribed within The Air Quality (England) Regulations 2000 (2000) and The Air Quality (England) (Amendment) Regulations 2002 (2002). Table 1 summarises the objectives which are relevant to this report.

Studies have shown associations of nitrogen dioxide in outdoor air with adverse health effects; respiratory and cardiovascular morbidity and mortality.

Table 1: Air Quality Objectives for Nitrogen Dioxide

Pollutant	Time Period	Objective
Nitrogen Dioxide	1-hour mean	200 µg/m^3 not to be exceeded more than 18 times a year
	Annual mean	40 µg/m^3

1.4 The air quality objectives only apply where members of the public are likely to be regularly present for the averaging time of the objective (i.e. where people will be exposed to pollutants). For annual mean objectives, relevant exposure is limited to residential properties, schools and hospitals. The 1-hour objective applies at these locations as well as at any outdoor location where a member of the public might reasonably be expected to stay for 1 hour or more, such as shopping streets, parks and sports grounds, as well as bus stations and railway stations that are not fully enclosed.

1.5 Measurements across the UK have shown that the 1-hour nitrogen dioxide objective is unlikely to be exceeded unless the annual mean nitrogen dioxide concentration is greater than 60 µg/m^3 (Defra, 2018). Thus exceedances of 60 µg/m^3 as an annual mean nitrogen dioxide concentration are used as an indicator of potential exceedances of the 1-hour nitrogen dioxide objective.

2 Assessment Methodology

Monitoring

2.1 Monitoring of nitrogen dioxide was carried out by West Dorset District Council along the A35 in Chideock area using seven passive diffusion tube sites in 2017. The monitoring sites are shown in Figure 1. The diffusion tubes were prepared and analysed by Gradko International Ltd using the 50% Triethanolamine (TEA) in acetone method.

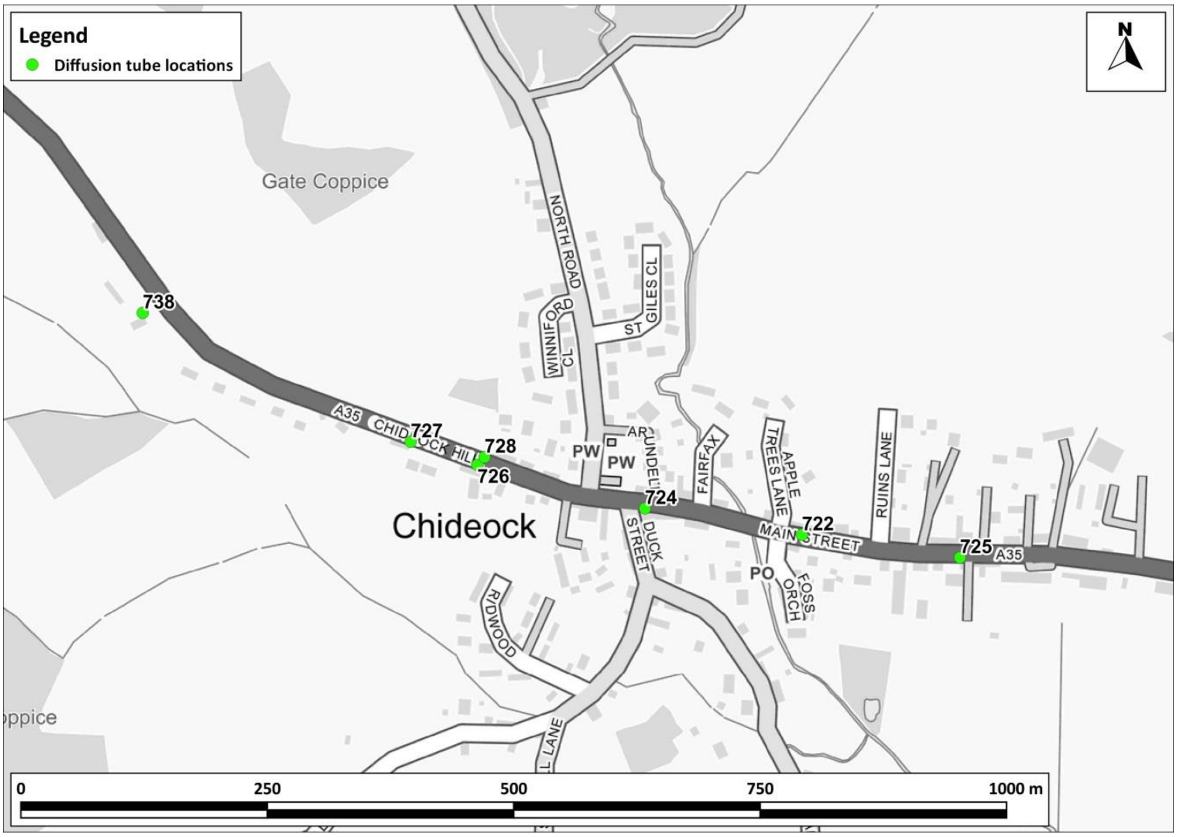

Figure 1: Monitoring Locations

Modelling

2.2 Annual mean nitrogen dioxide concentrations have been predicted using detailed dispersion modelling (ADMS-Roads v4.1). The input data used are described in Appendix A1. Vehicle emissions have been adjusted to account for increased and reduced engine-load when travelling uphill and downhill respectively, as set out in LAQM.TG16 (Defra, 2018). For the purposes of modelling, it has been assumed that receptors along parts of the A35 are within a street canyon formed by the buildings and/or high walls and trees on both sides of the roads. These canyon-like features reduce dispersion of traffic emissions, and can lead to concentrations of pollutants being higher. These sections of road have been modelled as street canyons using ADMS-Roads' advanced canyon module, with appropriate input parameters determined from plans, local mapping and photographs.

2.3 The model outputs have been verified against 2017 data from the diffusion tube monitoring sites shown in Figure 1; further details of model verification are supplied in Appendix A1.

2.4 Concentrations have been predicted at 68 specific receptors (modelled at ground-floor level) as shown in Figure 2 and Figure 3.

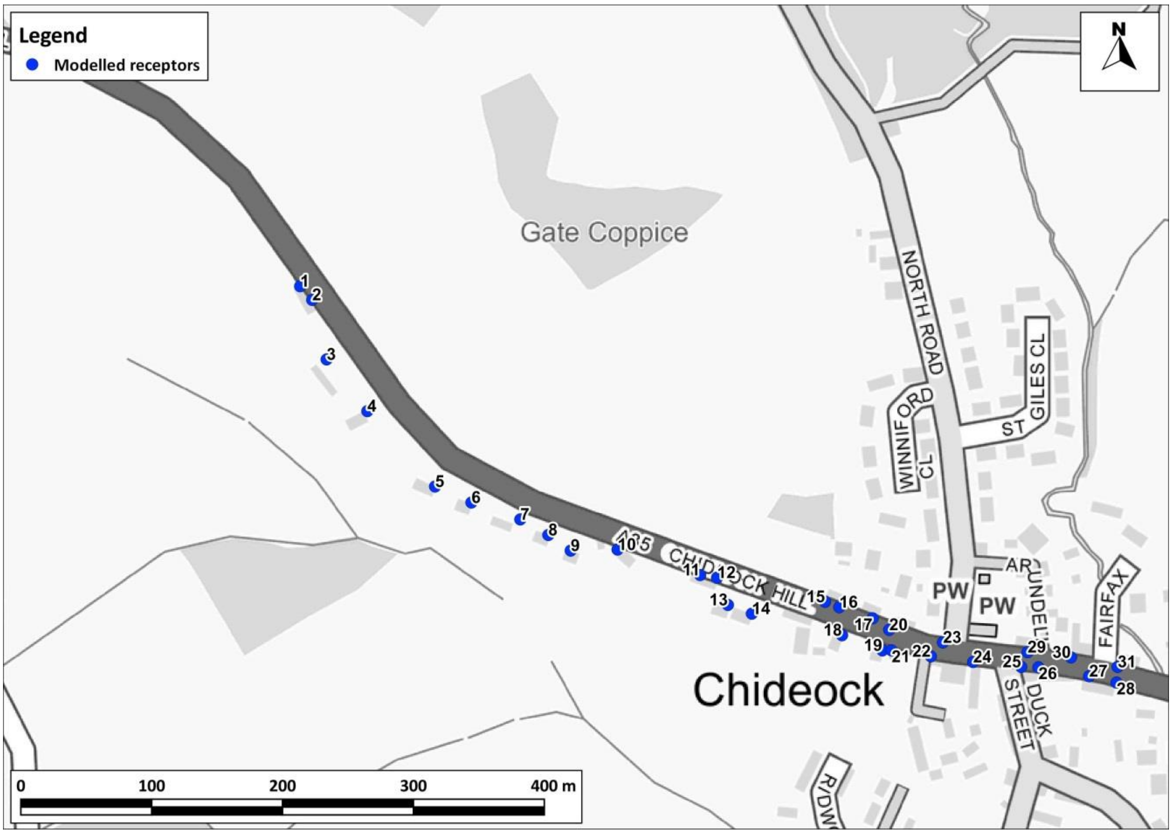

Figure 2: Receptor Locations (West)

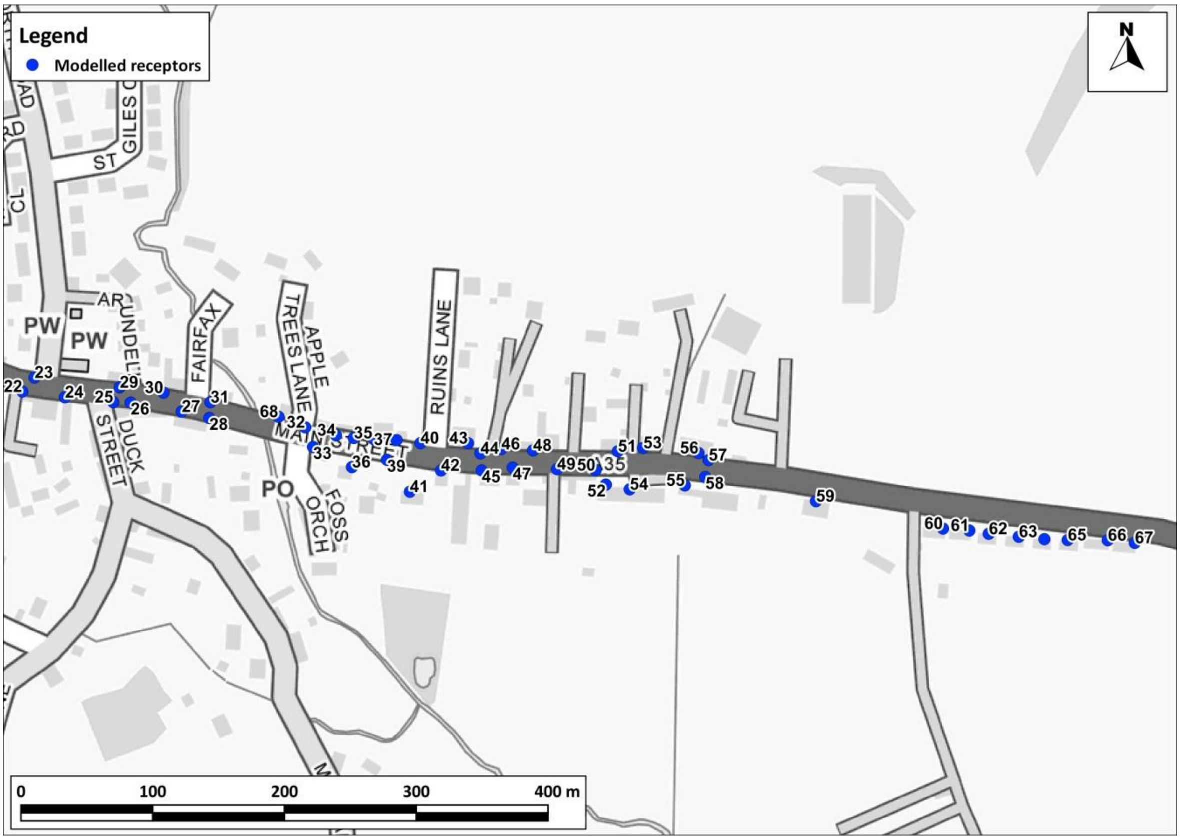

Figure 3: Receptor Locations (East)

National Background Pollution Maps

2.5 The 2019 nitrogen dioxide background concentrations across the study area have been defined using the national pollution maps published by Defra (Defra, 2019). These cover the whole country on a 1x1 grid. The backgrounds used within the detailed assessment are provided in Table 1. The derivation of background concentrations is described in Appendix A1.

Table 1: Estimated Annual Mean Background Pollutant Concentrations in 2017 (µg/m^3) [a]

Year	NO_2
2017	4.1 – 4.7
Objectives	**40**

[a] The range of values is for the different 1x1 km grid squares covering the study area.

Uncertainty

2.6 There are many components that contribute to the uncertainty of modelling predictions. The road traffic emissions dispersion model used in this assessment is dependent upon the traffic data that have been input, which will have inherent uncertainties associated with them. There are then additional uncertainties, as models are required to simplify real-world conditions into a series of algorithms.

2.7 An important stage in the process is model verification, which involves comparing the model output with measured concentrations. Because the model has been verified and adjusted, there can be reasonable confidence in the prediction of current year (2017) concentrations.

2.8 The limitations to the assessment should be borne in mind when considering the results set out in the following sections. While the model should give an overall accurate picture, i.e. one without bias, there will be uncertainties for individual receptors. The results are 'best estimates' and have been treated as such in the discussion.

3 Results

Monitoring

3.1 Monitoring data for 2013 to 2017 for the sites within the study area are summarised in Table 2.

Table 2: Summary of Nitrogen Dioxide (NO_2) Monitoring (2013-2017) [a, b]

Site No.	Site Type	Location	Annual Mean Nitrogen Dioxide Concentrations (µg/m^3) [a,b]				
			2013	2014	2015	2016	2017
722	Roadside	Main Street	19.5	26.8	16.8	19.7	19.2
724	Roadside	Duck Street	**42.9**	36.7	36.7	**47.7**	**44.0**
725	Kerbside	George Inn	27.2	26.2	23.1	25.5	24.9
726	Roadside	Village Hall	**45.4**	**41.8**	39.2	**47.8**	**43.4**
727	Roadside	Main Street	**55.3**	**53.0**	**50.0**	**58.9**	**61.8**
728	Roadside	Main Street	29.4	25.6	23.4	27.0	26.0
738	Roadside	Greenhills	-	-	-	20.5	17.4
Objective			**40**				

[a] Exceedances of the objectives are shown in bold.

[b] Data have been taken from the 2018 Air Quality Annual Status Report (West Dorset District Council, 2018).

3.2 The annual mean objective was exceeded at three of the monitoring locations in 2017 (sites 724, 726 and 727). Furthermore, the measured concentration at site 727 exceeded 60 µg/m^3 in 2017, indicating potential for the 1-hour objective to be exceeded at this location. There are no clear trends in monitoring results over the past five years.

Modelling

3.3 Annual mean nitrogen dioxide concentrations in 2017 have been predicted at ground-floor level at each of the receptors shown in Figure 2, and the results are set out in Appendix A2.

3.4 Predicted concentrations exceed the annual mean objective at 13 receptors in the centre of Chideock. These receptors are all located within street canyons, and are shown in Figure 4. The highest modelled annual mean nitrogen dioxide concentration is 61.9 µg/m^3, predicted at Receptor 26. The predicted annual mean concentrations at Receptors 25 and 26 are both greater than 60 µg/m^3, indicating potential for the 1-hour objective to be exceeded at these locations.

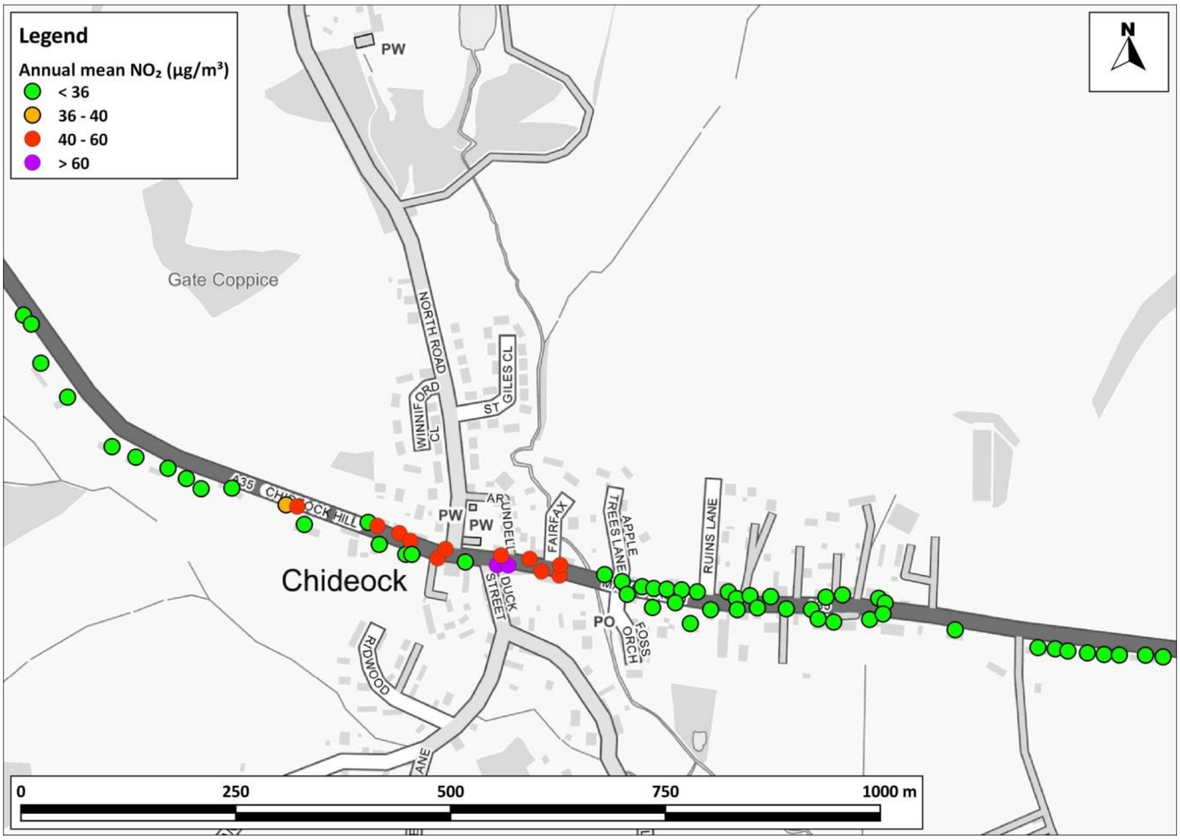

Figure 4: Annual Mean Nitrogen Dioxide Concentrations (µg/m^3) in 2017 at Ground-Floor Level

Population Exposure

3.5 Objective exceedances are predicted at approximately 25 residential properties. Assuming that each property has, on average, two occupants, this equates to approximately 50 residents.

Air Quality Improvements Required

3.6 The degree of improvement needed in order for the annual mean nitrogen dioxide objective to be achieved is defined by the difference between the highest measured or predicted concentration and the objective level (40 µg/m^3).

3.7 In terms of describing the reduction in emissions required, it is more useful to consider nitrogen oxides (NO_x). The required reduction in local nitrogen oxides emission has been calculated in line with guidance presented in LAQM.TG16 (Defra, 2018). Table 3 sets out the required reduction in local emissions of NO_x that would be required at each of the receptor locations where an exceedance is predicted, in order for the annual mean objective to be achieved.

3.8 The highest nitrogen dioxide concentration has been predicted at Receptor 26 (61.9 µg/m^3), requiring a reduction of 21.9 µg/m^3 in order for the objective to be achieved. Table 3 shows that at this receptor a reduction of 57.8 µg/m^3 in NO_x emissions would be required in order to achieve the objective. This equates to a reduction of 44.4 % in local road traffic emissions at this receptor location.

Table 3: Improvement in Annual Mean Nitrogen Dioxide Concentrations and Nitrogen Oxides Concentrations Required in 2017 to Meet the Objective

Receptor	Required reduction in annual mean nitrogen dioxide (NO_2)		Required reduction in road nitrogen oxides (NO_x) emissions	
	µg/m^3	% of total predicted NO_2	µg/m^3	% reduction in road NO_x
12	7.1	17.6	17.5	19.2
16	12.8	32.1	32.6	31.1
17	1.8	4.4	4.3	5.6
20	13.5	33.7	34.3	32.2
22	4.8	12.0	11.8	14.0
23	2.7	6.9	6.7	8.5
25	20.6	51.6	54.2	42.8
26	21.9	54.8	57.8	44.4
27	18.7	46.9	48.9	40.3
28	16.8	42.1	43.5	37.6
29	13.1	32.8	33.4	31.6
30	10.4	25.9	26.1	26.5
31	12.9	32.3	32.9	31.2

4 Source Apportionment

4.1 In order to develop appropriate measures to improve air quality along the A35 and inform the action plan, it is necessary to identify the sources contributing to the objective exceedances within the study area. Source apportioned nitrogen dioxide concentrations have been calculated taking account of the different proportions of primary nitrogen dioxide (f-NO_2) emitted by different vehicle types. The different proportions have been largely calculated in-line with guidance provided in LAQM.TG16 (Defra, 2018).

4.2 The following categories have been included in the source apportionment:

- Background;
- Cars;
- Lights Good Vehicles (LGVs);
- Buses (PSVs);
- Rigid Heavy Goods Vehicles (R-HGVs);
- Articulated Heavy Goods Vehicles (A-HGVs); and
- Motorcycles (MCs).

4.3 Table 4 and Figure 5 show the contribution from each of the different categories to total predicted annual mean nitrogen dioxide concentrations at each of the receptors assessed.

4.4 Table 5 and Figure 6 show the percentage contributions of each category to total predicted annual mean nitrogen dioxide concentrations. In the majority of cases, emissions from cars contribute the largest proportion to the overall concentration (24-44%), followed by background contributions (8-47%). Emissions from LGVs also contribute a significant proportion to the overall concentration (17-30%).

Table 4: Contributions of Different Sources to Total Predicted Annual Mean Nitrogen Dioxide Concentrations (µg/m^3) in 2017

Receptor	Annual Mean Contribution (µg/m^3)						
	Background	MC	Car	LGV	R-HGV	A-HGV	PSV
1	4.72	0.11	12.98	9.34	2.19	1.66	1.52
2	4.72	0.11	13.54	9.80	2.26	1.71	3.57
3	4.72	0.02	2.50	1.79	0.39	0.30	0.63
4	4.72	0.03	2.78	1.98	0.43	0.34	0.70
5	4.12	0.03	2.56	1.81	0.40	0.31	0.63
6	4.12	0.03	3.12	2.22	0.49	0.38	0.78
7	4.12	0.04	3.86	2.75	0.59	0.47	0.95
8	4.12	0.03	3.35	2.37	0.52	0.40	0.83
9	4.12	0.03	2.78	1.96	0.43	0.33	0.69
10	4.12	0.04	4.76	3.40	0.73	0.56	1.17
11	4.12	0.13	16.03	11.59	2.31	1.78	3.57
12	4.12	0.15	19.44	14.14	2.80	2.14	4.27
13	4.12	0.02	2.54	1.74	0.40	0.33	0.65
14	4.12	0.02	2.35	1.60	0.38	0.31	0.60
15	4.73	0.08	11.92	8.07	1.93	1.60	2.99
16	4.73	0.13	21.96	14.99	3.32	2.73	4.99
17	4.73	0.10	16.88	11.39	2.58	2.13	3.94
18	4.73	0.03	3.48	2.32	0.57	0.47	0.90
19	4.73	0.03	3.79	2.52	0.61	0.51	0.98
20	4.73	0.13	22.29	15.20	3.34	2.75	5.02
21	4.73	0.03	4.09	2.72	0.67	0.56	1.05
22	4.73	0.10	18.30	12.37	2.78	2.29	4.22
23	4.73	0.10	17.28	11.70	2.67	2.20	4.06
24	4.73	0.05	7.56	5.06	1.23	1.02	1.92
25	4.73	0.15	25.63	17.59	3.79	3.11	5.63
26	4.73	0.15	26.18	18.05	3.88	3.18	5.75
27	4.73	0.14	24.81	16.98	3.65	3.00	5.43
28	4.73	0.15	25.23	17.21	2.89	2.45	4.19
29	4.73	0.13	22.18	15.04	3.31	2.73	4.98
30	4.73	0.12	20.93	14.25	3.11	2.56	4.68
31	4.73	0.13	23.29	15.89	2.69	2.28	3.92
32	4.73	0.08	11.80	8.01	1.44	1.24	2.16
33	4.73	0.05	8.35	5.59	1.02	0.88	1.55
34	4.73	0.07	9.65	6.52	1.19	1.03	1.82
35	4.73	0.09	13.58	9.14	1.62	1.39	2.42
36	4.73	0.03	4.31	2.86	0.54	0.46	0.83

Receptor	Annual Mean Contribution (µg/m^3)						
	Background	MC	Car	LGV	R-HGV	A-HGV	PSV
37	4.73	0.08	12.16	8.16	1.45	1.25	2.18
38	4.73	0.07	10.58	7.08	1.27	1.09	1.91
39	4.73	0.09	14.47	9.72	1.69	1.45	2.53
40	4.73	0.08	11.59	7.75	1.38	1.18	2.08
41	4.73	0.02	2.59	1.70	0.33	0.28	0.51
42	4.73	0.03	5.68	3.77	0.70	0.61	1.08
43	4.73	0.06	7.74	5.19	0.96	0.83	1.46
44	4.73	0.08	12.78	8.69	1.57	1.34	2.35
45	4.73	0.05	7.67	5.12	0.94	0.81	1.42
46	4.73	0.07	9.73	6.55	1.19	1.03	1.81
47	4.73	0.07	10.33	6.93	1.26	1.08	1.89
48	4.73	0.06	10.12	6.83	1.25	1.07	1.88
49	4.73	0.07	9.87	6.63	1.20	1.03	1.82
50	4.73	0.06	9.26	6.21	1.13	0.97	1.71
51	4.73	0.07	11.15	7.51	1.35	1.15	2.03
52	4.73	0.03	5.09	3.37	0.63	0.55	0.96
53	4.73	0.06	9.21	6.17	1.12	0.97	1.70
54	4.73	0.03	4.46	2.95	0.55	0.48	0.84
55	4.73	0.03	5.16	3.43	0.63	0.55	0.97
56	4.73	0.06	8.83	5.94	1.09	0.95	1.65
57	4.73	0.08	12.06	8.17	1.48	1.27	2.22
58	4.73	0.06	8.28	5.55	1.02	0.88	1.54
59	4.73	0.04	5.76	3.84	0.71	0.61	1.08
60	4.73	0.03	4.56	3.01	0.56	0.48	0.86
61	4.73	0.03	4.81	3.19	0.59	0.51	0.90
62	4.73	0.03	4.63	3.07	0.57	0.50	0.87
63	4.73	0.03	4.62	3.06	0.57	0.50	0.88
64	4.73	0.03	4.81	3.18	0.60	0.51	0.91
65	4.73	0.03	4.98	3.30	0.62	0.54	0.95
66	4.73	0.04	5.72	3.81	0.72	0.62	1.11
67	4.73	0.04	6.25	4.16	0.81	0.69	1.24
68	4.73	0.07	11.35	7.64	1.39	1.19	2.08
Objective	**40**						

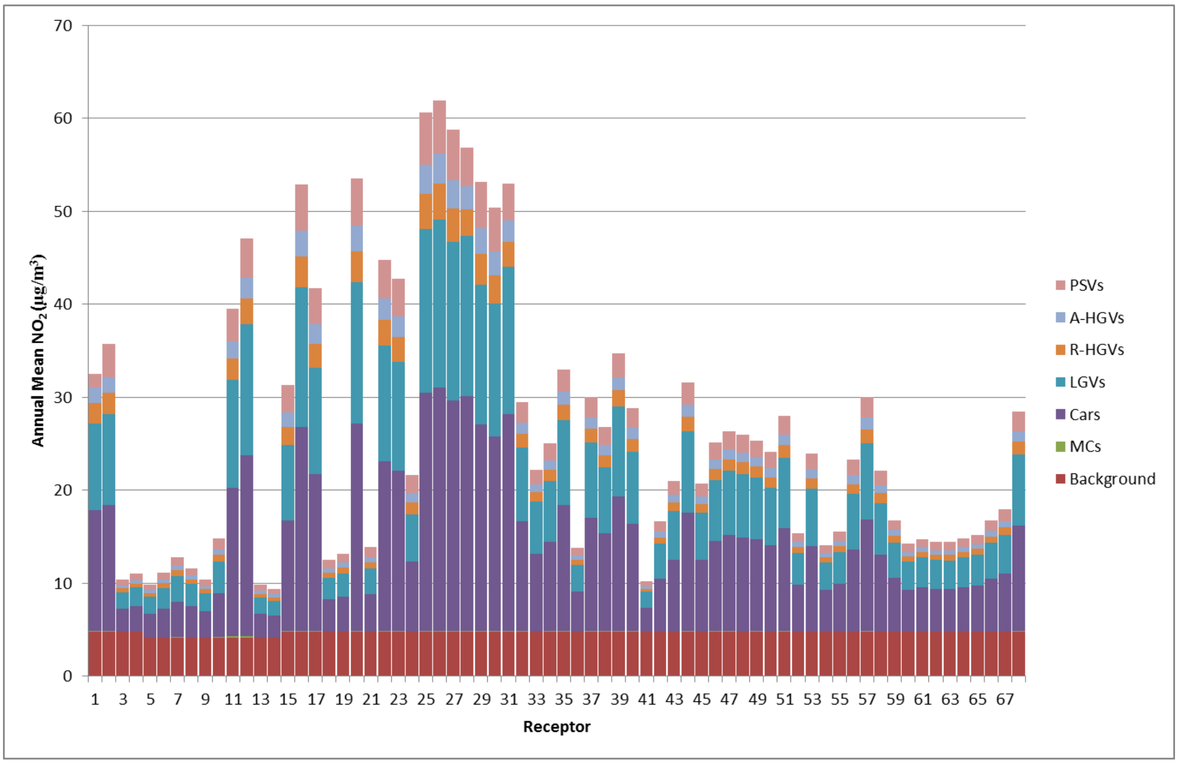

Figure 5: Contributions of Different Sources to Total Predicted Annual Mean Nitrogen Dioxide Concentration (µg/m^3) at Each Receptor in 2017

Table 5: Percentage Contributions of Different Sources to Total Predicted Annual Mean Nitrogen Dioxide Concentrations (µg/m³) in 2017

Receptor	Annual Mean Contribution (µg/m³)						
	Background	MC	Car	LGV	R-HGV	A-HGV	PSV
1	14.5	0.3	39.9	28.7	6.7	5.1	4.7
2	13.2	0.3	37.9	27.4	6.3	4.8	10.0
3	45.5	0.2	24.2	17.3	3.8	2.9	6.1
4	43.0	0.2	25.3	18.1	4.0	3.1	6.4
5	41.8	0.3	25.9	18.4	4.1	3.1	6.4
6	37.0	0.3	28.1	19.9	4.4	3.4	7.0
7	32.2	0.3	30.2	21.5	4.6	3.7	7.4
8	35.4	0.3	28.8	20.4	4.5	3.4	7.1
9	39.8	0.2	26.9	19.0	4.1	3.2	6.6
10	27.8	0.3	32.2	23.0	4.9	3.8	7.9
11	10.4	0.3	40.6	29.3	5.8	4.5	9.0
12	8.7	0.3	41.3	30.1	5.9	4.6	9.1
13	42.0	0.2	25.9	17.7	4.1	3.3	6.7
14	43.9	0.2	25.1	17.0	4.0	3.3	6.4
15	15.1	0.2	38.1	25.8	6.2	5.1	9.6
16	9.0	0.2	41.6	28.4	6.3	5.2	9.4
17	11.3	0.2	40.4	27.3	6.2	5.1	9.4
18	37.8	0.2	27.8	18.6	4.6	3.7	7.2
19	35.9	0.2	28.8	19.1	4.7	3.9	7.4
20	8.8	0.2	41.7	28.4	6.2	5.1	9.4
21	34.2	0.2	29.5	19.6	4.8	4.0	7.6
22	10.6	0.2	40.9	27.6	6.2	5.1	9.4
23	11.1	0.2	40.4	27.4	6.2	5.2	9.5
24	21.9	0.2	35.0	23.5	5.7	4.7	8.9
25	7.8	0.2	42.3	29.0	6.3	5.1	9.3
26	7.6	0.2	42.3	29.2	6.3	5.1	9.3
27	8.1	0.2	42.2	28.9	6.2	5.1	9.2
28	8.3	0.3	44.4	30.3	5.1	4.3	7.4
29	8.9	0.2	41.8	28.3	6.2	5.1	9.4
30	9.4	0.2	41.5	28.3	6.2	5.1	9.3
31	8.9	0.2	44.0	30.0	5.1	4.3	7.4
32	16.1	0.3	40.1	27.2	4.9	4.2	7.3
33	21.3	0.2	37.7	25.2	4.6	4.0	7.0
34	18.9	0.3	38.6	26.1	4.8	4.1	7.3
35	14.4	0.3	41.2	27.7	4.9	4.2	7.3
36	34.4	0.2	31.3	20.8	3.9	3.4	6.0

Receptor	Annual Mean Contribution (µg/m³)						
	Background	MC	Car	LGV	R-HGV	A-HGV	PSV
37	15.8	0.3	40.5	27.2	4.8	4.2	7.3
38	17.7	0.3	39.6	26.5	4.8	4.1	7.1
39	13.6	0.2	41.7	28.0	4.9	4.2	7.3
40	16.4	0.3	40.3	26.9	4.8	4.1	7.2
41	46.6	0.2	25.5	16.8	3.2	2.8	5.0
42	28.5	0.2	34.2	22.7	4.2	3.7	6.5
43	22.5	0.3	36.9	24.8	4.6	4.0	7.0
44	15.0	0.2	40.5	27.5	5.0	4.3	7.5
45	22.8	0.2	37.0	24.7	4.5	3.9	6.9
46	18.8	0.3	38.7	26.1	4.8	4.1	7.2
47	18.0	0.3	39.3	26.4	4.8	4.1	7.2
48	18.2	0.2	39.0	26.3	4.8	4.1	7.2
49	18.7	0.3	38.9	26.1	4.7	4.1	7.2
50	19.7	0.2	38.5	25.8	4.7	4.0	7.1
51	16.9	0.2	39.8	26.8	4.8	4.1	7.3
52	30.8	0.2	33.1	21.9	4.1	3.5	6.3
53	19.7	0.2	38.4	25.8	4.7	4.1	7.1
54	33.7	0.2	31.8	21.0	3.9	3.4	6.0
55	30.5	0.2	33.3	22.1	4.1	3.5	6.3
56	20.3	0.3	38.0	25.6	4.7	4.1	7.1
57	15.8	0.3	40.2	27.2	4.9	4.2	7.4
58	21.4	0.3	37.5	25.1	4.6	4.0	7.0
59	28.2	0.3	34.4	22.9	4.2	3.7	6.5
60	33.3	0.2	32.0	21.2	3.9	3.4	6.0
61	32.1	0.2	32.6	21.6	4.0	3.4	6.1
62	32.8	0.2	32.2	21.3	4.0	3.4	6.1
63	32.9	0.2	32.1	21.2	4.0	3.4	6.1
64	32.0	0.2	32.5	21.5	4.0	3.5	6.2
65	31.2	0.2	32.8	21.8	4.1	3.5	6.3
66	28.2	0.3	34.2	22.7	4.3	3.7	6.6
67	26.4	0.2	34.9	23.2	4.5	3.9	6.9
68	16.6	0.2	39.9	26.8	4.9	4.2	7.3
Objective	**40**						

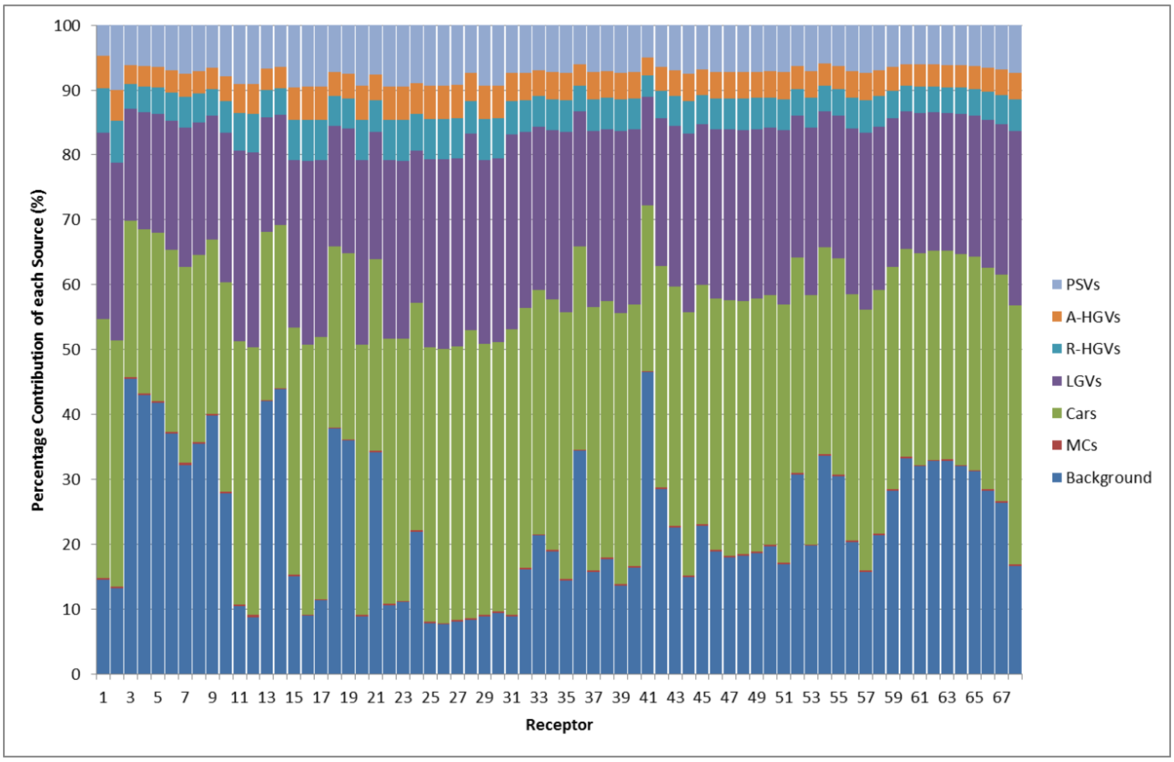

Figure 6: Percentage Contributions of Different Sources to Total Predicted Annual Mean Nitrogen Dioxide Concentrations (µg/m^3) at Each Receptor in 2017

5 Conclusions

5.1 An assessment has been carried out for nitrogen dioxide along the A35 in Chideock using a combination of monitoring data and modelled concentrations. Concentrations of nitrogen dioxide have been modelled for 2017 using the ADMS-Roads dispersion model. The model has been verified against measurements made at seven nitrogen dioxide diffusion tube monitoring locations which lie adjacent to the road network included in the model.

5.2 The assessment has identified that the annual mean nitrogen dioxide objective is being exceeded at a number of relevant locations alongside the A35. Two exceedances of 60 $\mu g/m^3$ as an annual mean nitrogen dioxide concentration have been identified at locations of relevant exposure, and thus exceedances of the 1-hour mean objective are also possible.

5.3 Source apportionment of the local traffic emissions has been undertaken. This shows that, in the majority of cases, emissions from cars contribute the largest proportion to the overall concentration, followed by background contributions. Emissions from LGVs also contribute a significant proportion to the overall concentration.

5.4 A reduction in traffic emissions along the A35 would result in a decrease in the concentrations of nitrogen dioxide. Reductions in vehicle emissions from local traffic of up to 44.4% would be required to achieve the annual mean nitrogen dioxide objective where the highest concentrations are predicted to occur.

6 References

AQC (2018) *Calibrating Defra's Background NOx and NO2 Maps against 2016 and 2017 Measurements*, [Online], Available: http://www.aqconsultants.co.uk/AQC/media/Reports/2016-Background-Map-Calibration-News-F2.pdf.

Defra (2007) *The Air Quality Strategy for England, Scotland, Wales and Northern Ireland*, Defra.

Defra (2018) *Review & Assessment: Technical Guidance LAQM.TG16 February 2018 Version*, Defra, Available: https://laqm.defra.gov.uk/documents/LAQM-TG16-February-18-v1.pdf.

Defra (2019) *Defra Air Quality Website*, [Online], Available: http://laqm.defra.gov.uk/.

DfT (2017) *DfT Automatic traffic Counters Table TRA0305-0307*, Available: https://www.gov.uk/government/statistical-data-sets/tra03-motor-vehicle-flow.

DfT (2019) *Annual Average Daily Flows*, Available: http://www.dft.gov.uk/matrix/.

The Air Quality (England) (Amendment) Regulations, 2002, Statutory Instrument 3043 (2002), HMSO.

The Air Quality (England) Regulations, 2000, Statutory Instrument 928 (2000), HMSO.

West Dorset District Council (2018) *2018 Air Quality Annual Status Report*.

7 Glossary

AADT	Annual Average Daily Traffic
ADMS-Roads	Atmospheric Dispersion Modelling System model for Roads
AQC	Air Quality Consultants
AQMA	Air Quality Management Area
Defra	Department for Environment, Food and Rural Affairs
DfT	Department for Transport
EFT	Emission Factor Toolkit
Exceedance	A period of time when the concentration of a pollutant is greater than the appropriate air quality objective. This applies to specified locations with relevant exposure
HMSO	Her Majesty’s Stationery Office
HGV	Heavy Goods Vehicle
kph	Kilometres Per hour
LAQM	Local Air Quality Management
LDV	Light Duty Vehicles (<3.5 tonnes)
$\mu g/m^3$	Microgrammes per cubic metre
MC	Motorcycle
NO	Nitric oxide
NO_2	Nitrogen dioxide
NO_x	Nitrogen oxides (taken to be NO_2 + NO)
Objectives	A nationally defined set of health-based concentrations for nine pollutants, seven of which are incorporated in Regulations, setting out the extent to which the standards should be achieved by a defined date. There are also vegetation-based objectives for sulphur dioxide and nitrogen oxides
Standards	A nationally defined set of concentrations for nine pollutants below which health effects do not occur or are minimal
TEA	Triethanolamine – used to absorb nitrogen dioxide

8 Appendices

A1 Dispersion Modelling Methodology

Model Inputs

A1.1 Predictions have been carried out using the ADMS-Roads dispersion model (v4.1). The model requires the user to provide various input data, including emissions from each section of road, and the road characteristics (including road width, street canyon width, street canyon height and porosity, where applicable). Vehicle emissions have been calculated based on vehicle flow, composition and speed data using the EFT (Version 7.0) published by Defra (2019). Vehicle emissions have been adjusted to account for increased and reduced engine-load when travelling uphill and downhill respectively, as set out in LAQM.TG16 (Defra, 2018).

A1.2 Hourly sequential meteorological data from Yeovilton for 2017 have been used in the model. The Yeovilton meteorological monitoring station is located approximately 33 km to the northeast of Chideock. It is deemed to be the nearest monitoring station representative of meteorological conditions in the study area.

A1.3 AADT flows have been provided by Highways England and vehicle fleet composition data have been determined from the interactive web-based map provided by DfT (2019). Traffic speeds have been estimated based on professional judgement, taking account of the road layout, speed limits and the proximity to a junction. Diurnal and monthly flow profiles for the traffic have been derived from the national profiles published by DfT (2017).

Table A1.1: Summary of Traffic Data used in the Assessment (AADT Flows) [a]

Road Link	AADT	% Motor Cycle	% Car	% LDV	% Rigid HDV	% Articulated HDV	% Bus/ Coach
A35	16,463	1.3	79.2	15.7	1.6	1.7	0.6

A1.4 Figure A1.1 shows the road network included within the model and defines the study area.

Figure A1.1: Modelled Road Network

Background Concentrations

A1.5 The background pollutant concentrations across the study area have been defined using the national pollution maps published by Defra (2019). These cover the whole country on a 1x1 km grid and are published for each year from 2013 until 2030. The background maps for 2017 have been calibrated against concurrent measurements from national monitoring sites (AQC, 2018).

Model Verification

A1.6 In order to ensure that ADMS-Roads accurately predicts local concentrations, it is necessary to verify the model against local measurements.

A1.7 Most nitrogen dioxide (NO_2) is produced in the atmosphere by a reaction of nitric oxide (NO) with ozone. It is therefore most appropriate to verify the model in terms of primary pollutant emissions of nitrogen oxides (NO_x = NO + NO_2). The model has been run to predict the annual mean NO_x concentrations during 2017 at the seven diffusion tube monitoring sites in Chideock. Concentrations have been modelled at the heights of the diffusion tubes.

A1.8 The model output of road-NO_x (i.e. the component of total NO_x coming from road traffic) has been compared with the 'measured' road-NO_x. Measured road-NO_x has been calculated from the measured NO_2 concentrations and the predicted background NO_2 concentration using the NO_x from NO_2 calculator (Version 5.1) available on the Defra LAQM Support website (Defra, 2019).

A1.9 An adjustment factor has been determined as the slope of the best-fit line between the 'measured' road contribution and the model derived road contribution, forced through zero (Figure A1.2). The calculated adjustment factor of 2.424 has been applied to the modelled road-NO_x concentration for each receptor to provide adjusted modelled road-NO_x concentrations.

A1.10 The total nitrogen dioxide concentrations have then been determined by combining the adjusted modelled road-NO_x concentrations with the predicted background NO_2 concentration within the NO_x to NO_2 calculator. Figure A1.3 compares final adjusted modelled total NO_2 at each of the monitoring sites to measured total NO_2.

A1.11 The results imply that the model has under predicted the road-NO_x contribution. This is a common experience with this and most other road traffic emissions dispersion models.

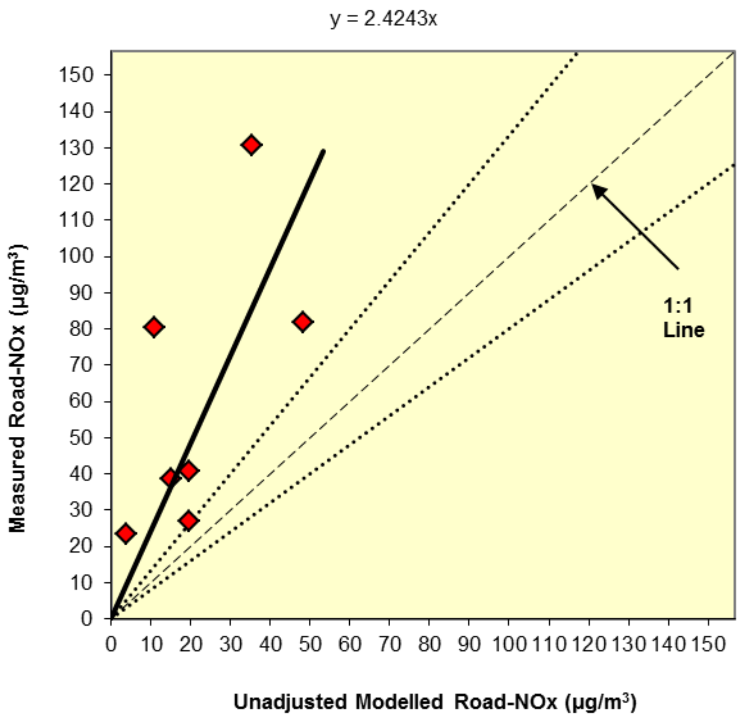

Figure A1.2: Comparison of Measured Road NOx to Unadjusted Modelled Road NOx Concentrations. The dashed lines show ± 25%.

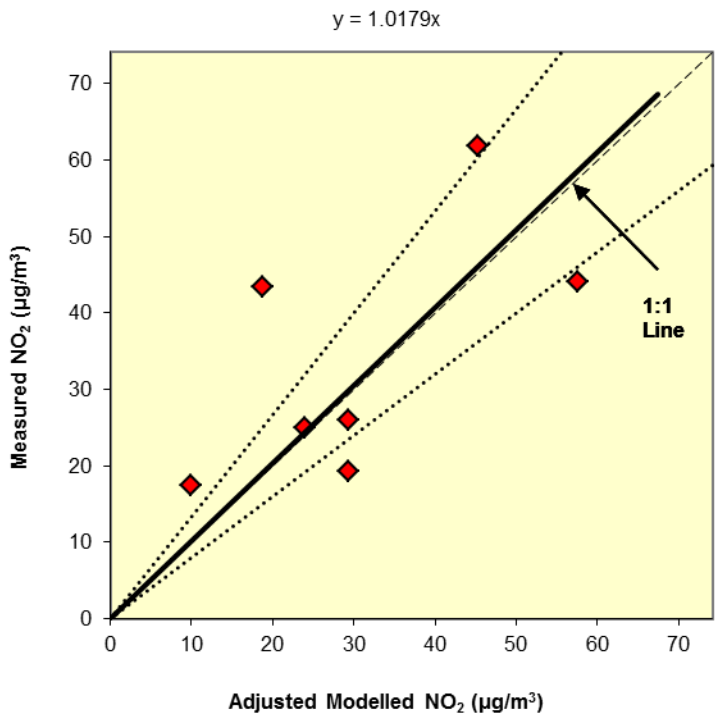

Figure A1.3: Comparison of Measured Total NO_2 to Final Adjusted Modelled Total NO_2 Concentrations. The dashed lines show ± 25%.

Model Post-processing

A1.12 The model predicts road-NO_x concentrations at each receptor location. These concentrations have been adjusted using the adjustment factor set out above, which, along with the background NO_2, has been processed through the NO_x to NO_2 calculator available on the Defra LAQM Support website (Defra, 2019). The traffic mix within the calculator has been set to “All non-urban UK traffic”, which is considered suitable for the study area. The calculator predicts the component of NO_2 based on the adjusted road-NO_x and the background NO_2.

A2 Modelled Results

A2.1 Annual mean nitrogen dioxide concentrations in 2017 at ground-floor level at each of the modelled receptors are presented in Table A2.1.

Table A2.1: Modelled Annual Mean Nitrogen Dioxide Concentrations at Specific Receptors

Receptor	Height (m)	2017 (µg/m^3)[a]
1	1.5	32.5
2	1	35.7
3	1	10.4
4	1.5	11.0
5	1.5	9.9
6	1.5	11.1
7	1.5	12.8
8	1.5	11.6
9	1.5	10.3
10	1.5	14.8
11	1.5	39.5
12	1.5	**47.1**
13	2.5	9.8
14	3.5	9.4
15	1.5	31.3
16	1	**52.8**
17	2	**41.8**
18	2.5	12.5
19	2.5	13.2
20	1.5	**53.5**
21	1.5	13.8
22	1.5	**44.8**
23	1.5	**42.7**
24	1.5	21.6
25	1.5	**60.6**
26	1.5	**61.9**
27	1.5	**58.7**
28	1.5	**56.8**
29	1.5	**53.1**
30	1	**50.4**
31	1	**52.9**
32	1.5	29.4

Receptor	Height (m)	2017 (µg/m^3)[a]
33	1.5	22.2
34	2	25.0
35	2	33.0
36	1.5	13.8
37	2	30.0
38	2.5	26.7
39	1.5	34.7
40	2	28.8
41	2	10.2
42	1.5	16.6
43	1.5	21.0
44	1.5	31.5
45	1.5	20.7
46	1.5	25.1
47	1.5	26.3
48	1.5	25.9
49	1.5	25.3
50	1.5	24.1
51	1.5	28.0
52	1.5	15.4
53	1.5	23.9
54	1.5	14.0
55	1.5	15.5
56	1.5	23.2
57	1.5	30.0
58	1.5	22.1
59	1.5	16.8
60	1.5	14.2
61	1.5	14.7
62	1.5	14.4
63	1.5	14.4
64	1	14.8
65	1	15.1
66	1	16.7
67	0.5	17.9
68	1	28.4
Objective		**40**

[a] Values in bold are exceedances of the objective.