Detailed Assessment of Air Quality at Four Elms Hill, Chattenden for Medway Council

November 2016

Experts in air quality management & assessment

Document Control

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Medway Council confirms that it accepts the recommendations made in this report.

1 Introduction

1.1 Air Quality Consultants Ltd has been commissioned by Medway Council to undertake a Detailed Assessment of air quality near Four Elms Hill in Chattenden. In 2016, Medway Council completed an Annual Status Report for air quality, which concluded that a Detailed Assessment was required as a result of measured exceedences of the nitrogen dioxide annual mean objective along Four Elms Hill in Chattenden.

1.2 The aim of this Detailed Assessment is to determine whether the annual mean nitrogen dioxide objective is exceeded at relevant locations and, if so, the extent of exceedences and the boundary of the Air Quality Management Area (AQMA) required. Where this study has determined the requirement for an AQMA to be declared, the source contributions to exceedences of the annual mean nitrogen dioxide objective have been quantified, via a Source Apportionment Study. The reduction in emissions required to meet the annual mean nitrogen dioxide objective will also be assessed at receptor locations where the highest concentrations are predicted.

Background

1.3 The Air Quality Strategy for England, Scotland, Wales and Northern Ireland (Defra, 2007) sets out a framework for air quality management, which includes a number of air quality objectives. National and international measures are expected to achieve these objectives in most locations, but where areas of poor air quality remain, air quality management at a local scale has a particularly important role to play. Part IV of the Environment Act 1995 requires local authorities to periodically review and assess air quality in their areas. The role of this process is to identify areas where it is unlikely that the air quality objectives will be achieved. These locations must be designated as AQMAs and a subsequent Air Quality Action Plan (AQAP) developed in order to reduce pollutant emissions in pursuit of the objectives.

1.4 Local Authorities in England are required to produce Annual Status Reports (ASR) detailing progress of Action Plan measures, air quality monitoring data and screening of changes to pollutant emissions within its administrative area.

1.5 Technical Guidance for Local Air Quality Management (LAQM.TG(16)) (Defra, 2016a) sets out a streamlined approach to the Review and Assessment process. This prescribes the submission of a single Annual Status Report (ASR) which all local authorities in England and Scotland must submit each year by the 30th June. It should identify new non-compliant areas and report progress made within existing AQMA's. When an exceedence has been identified, the local authority can either use the "Fast Track Option" and immediately declare an AQMA, or obtain further information and/or data before deciding on the declaration of an AQMA.

1.6 The purpose of the Detailed Assessment is to determine whether an exceedence of an air quality objective is likely and the geographical extent of that exceedence. If the outcome of the Detailed Assessment is that one or more of the air quality objectives are likely to be exceeded, then an Air Quality Management Area (AQMA) must be declared, and an Air Quality Action Plan put in place to identify measures to improve air quality within the AQMA. In order to inform the Action Plan process, source apportionment should be undertaken to ascertain the sources contributing the exceedences and the magnitude of reduction in emissions required to achieve the objective should also be calculated.

1.7 This report represents a Detailed Assessment following the findings of Medway Council's ASR published in 2016, which concluded that there were measured exceedences of the annual mean nitrogen dioxide objective at locations of relevant exposure (Medway Council, 2016). The diffusion tube NAS17 was set up in 2015, and measured an annual mean nitrogen dioxide concentration of 52 µg/m^3 during that year. As such, the ASR concluded that Medway Council would carry out a Detailed Assessment for the area surrounding that diffusion tube in order to determine the extent of the exceedences.

The Air Quality Objectives

1.8 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 (Stationery Office, 2000) and The Air Quality (England) (Amendment) Regulations 2002 (Stationery Office, 2002). Table 1 summarises the objectives which are relevant to this report. Appendix 1 provides a brief summary of the health effects of nitrogen dioxide.

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

1.9 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.

1.10 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, 2016a). Thus exceedences of 60 µg/m^3 as an annual mean nitrogen dioxide concentration are used as an indicator of potential exceedences of the 1-hour nitrogen dioxide objective.

2 Assessment Methodology

Monitoring

2.1 Medway Council operates two automatic sites measuring nitrogen dioxide, PM_{10} and $PM_{2.5}$ concentrations. The automatic monitor located in Rochester Stoke also measures concentrations of sulphur dioxide and ozone. These automatic monitors are not located within the study area. In addition, Medway Council monitors concentrations of nitrogen dioxide at 27 passive diffusion tubes sites. Two of these diffusion tubes are located along Four Elms Hill. The monitoring sites and study area are shown in Figure 1. Diffusion tubes were prepared and analysed by Environmental Services Group (ESG) using the 50% TEA in acetone method. It is necessary to adjust diffusion tube data to account for laboratory bias; for 2015, a bias adjustment factor of 0.81 was used (Medway Council, 2016).

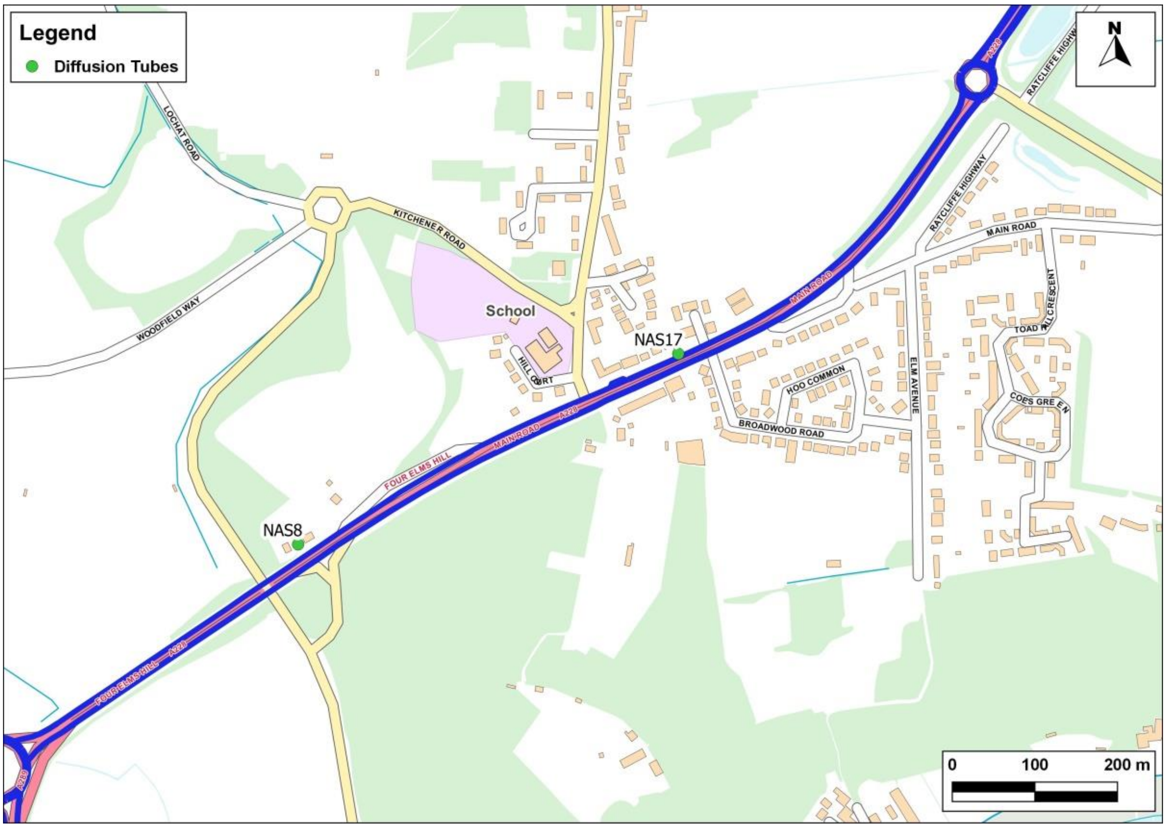

Figure 1 Detailed Assessment Study Area and Monitoring Locations. Roads explicitly included in the model shown in blue.

Modelling

2.2 Annual mean nitrogen dioxide concentrations have been predicted using detailed dispersion modelling (ADMS-Roads v4.1). The model outputs have been verified against the monitoring data described in paragraph 2.1. Details of the model inputs and the model verification are provided in Appendix A2, together with the method used to derive the current background nitrogen dioxide concentrations. Concentrations have been predicted for a grid of receptors across the study area to allow concentration isopleths to be plotted. In addition, concentrations have been predicted at a number of worst-case receptor locations (Figures 2, 3 and 4). The worst-case receptors have been modelled at ground floor level (1.5 m).

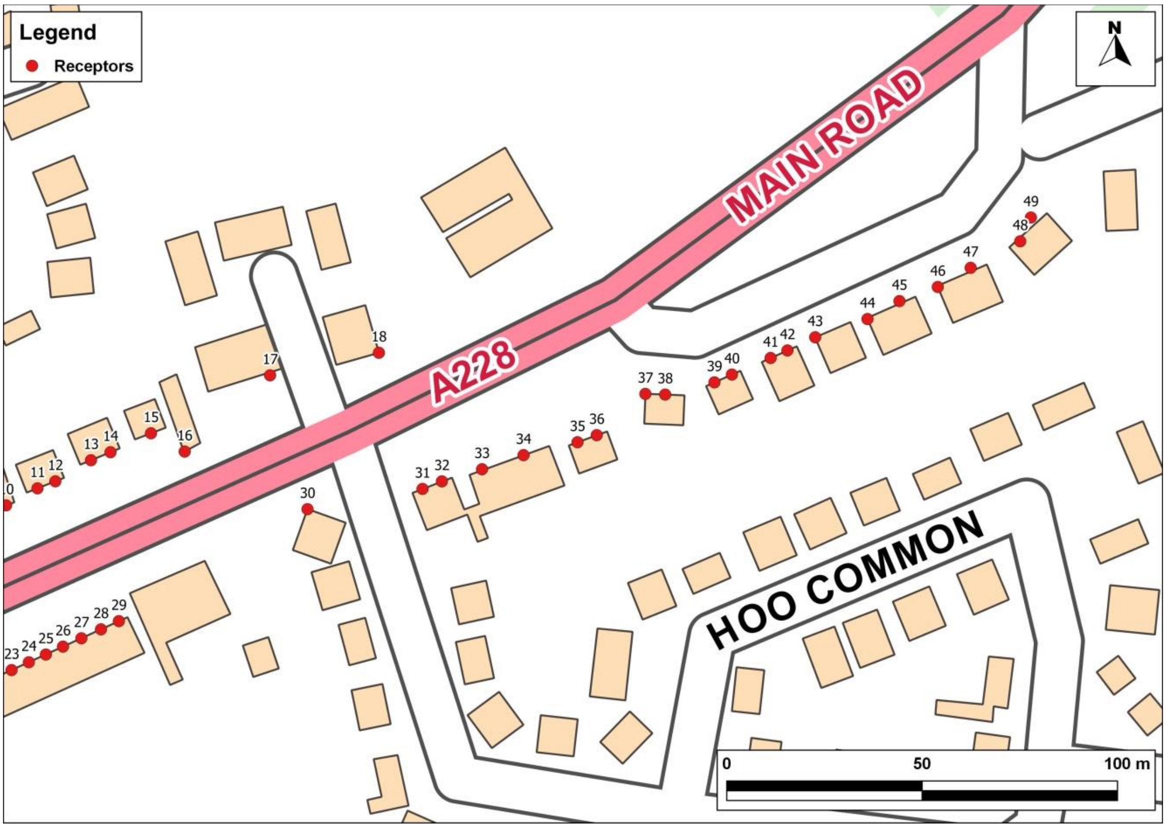

Figure 2 **Specific Receptor Locations - East**

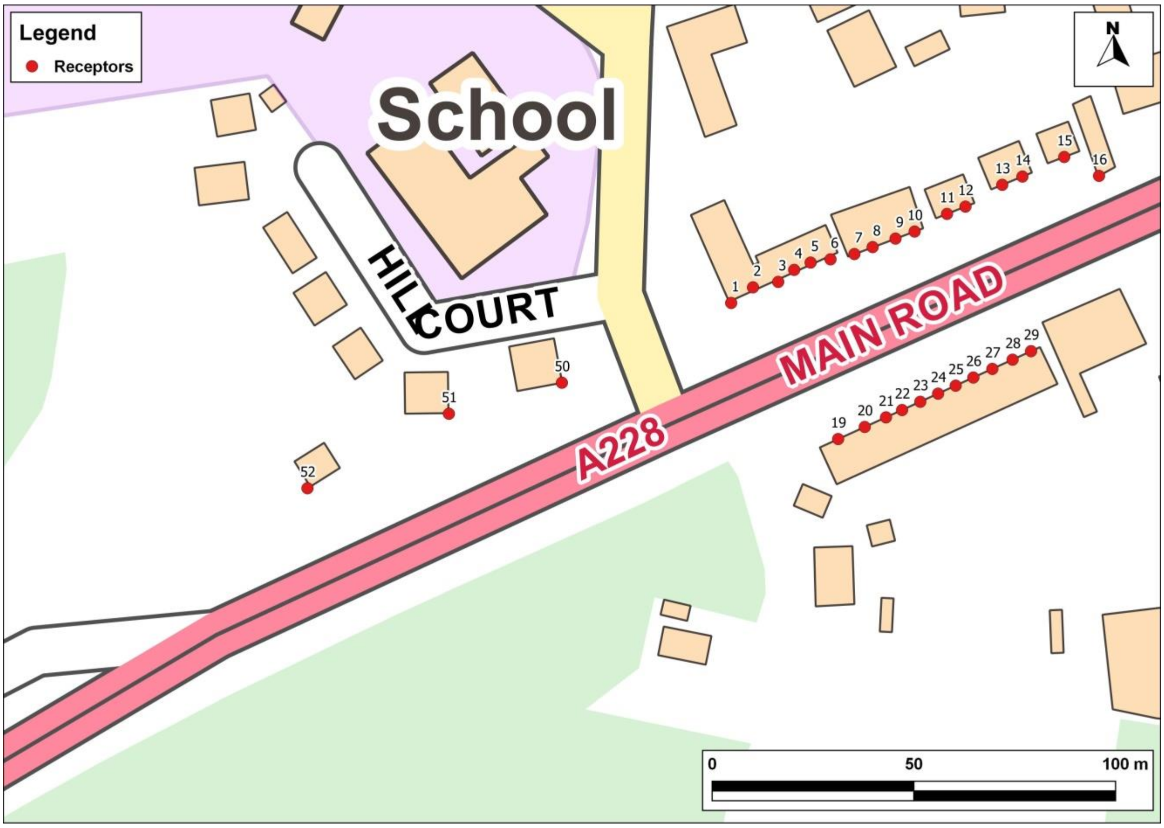

Figure 3 Specific Receptor Locations - Centre

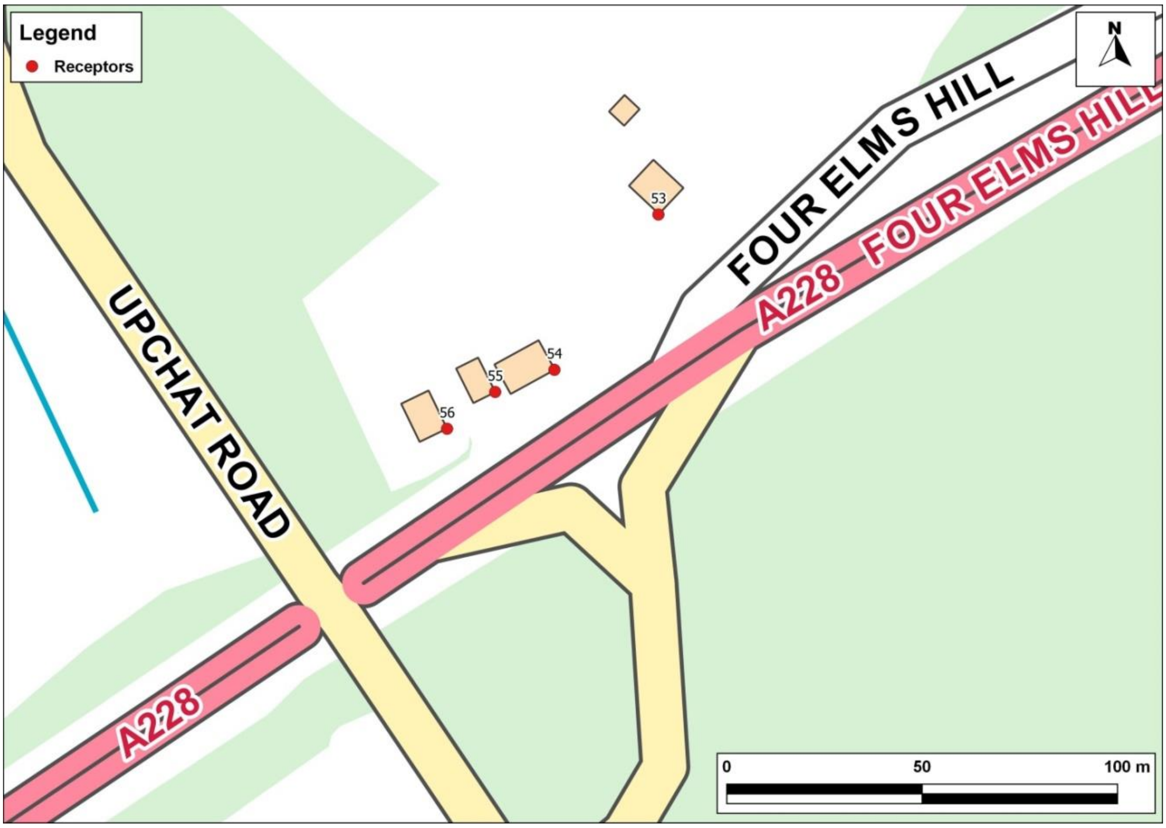

Figure 4 Specific Receptor Locations - West

Traffic Data

2.3 Traffic data for the assessment have been determined from the interactive web-based map provided by the Department for Transport (DfT, 2016). Further details of the traffic data used in this assessment are provided in Appendix A2.

Uncertainty

2.4 Uncertainty is inherent in all measured and modelled data. All values presented in this report are the best possible estimates, but uncertainties in the results might cause over- or under-predictions. All of the measured concentrations presented have an intrinsic margin of error. Defra (2016a) suggests that this is of the order of plus or minus 20% for diffusion tube data and plus or minus 10% for automatic measurements.

2.5 The model results rely on traffic data determined from the interactive web-based map provided by the Department for Transport (DfT, 2016), and any uncertainties inherent in these data will carry into this assessment. There will be additional uncertainties introduced because the modelling has simplified real-world processes into a series of algorithms. For example: it has been assumed that wind conditions measured at Southend Airport during 2015 will have occurred throughout the study areas during 2015; and it has been assumed that the dispersion of emitted pollutants will conform to a Gaussian distribution over flat terrain.

2.6 An important step in the assessment is verifying the dispersion model against the measured data. By comparing the model results with measurements, and correcting for the apparent under-prediction of the model, the uncertainties can be reduced (see Appendix A2).

2.7 The limitations to the assessment should be borne in mind when considering the results set out in the following sections. Whilst 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 outcomes that have been drawn.

3 Results

Monitoring

3.1 Monitoring data for the two diffusion tube sites within the study area (Figure 1) are summarised in Table 2. Monitoring at these two locations commenced in 2015, thus only one year of data is available to date.

Table 2: Annual Mean Nitrogen Dioxide Concentrations Measured in 2015 (µg/m^3)

Site	Site Type	Site Description	2015[a]
NAS8	Roadside	Joy Lodge, Four Elms Hill	31.0
NAS17	Kerbside	Lamp post Wainscott, Four Elms Hill	**52.0**
Objective			**40**

[a] As reported in Medway Council Annual Status Report (Medway Council, 2016). Data have been bias adjusted by the Council using the ESG, 50% TEA in acetone national factor (0.81).

3.2 The annual mean objective was exceeded at the monitoring location NAS17 in 2015. The majority of the diffusion tubes are attached to lamp posts or sign posts on the pavements and are therefore expected to measure higher concentrations than at the façades of the properties. There are no measured concentrations exceeding 60 µg/m^3, and thus exceedences of the 1-hour mean objective are unlikely.

Modelling

3.3 Predicted annual mean nitrogen dioxide concentrations in 2015 at each of the receptor locations shown in Figures 2, 3 and 4, are set out in Table A3-1 in Appendix A3 and shown on Figure 5. Predicted concentrations exceed the annual mean objective at Receptors 1 – 10, 16, 18 – 27, 30, 50 and 54. The receptors where no exceedences are predicted are located further away from the road. Details on the predicted concentrations at all receptor locations are presented in Appendix A3.

3.4 The highest modelled annual mean nitrogen dioxide concentration is 48.3 µg/m^3, predicted at Receptor 16 which is located at 1A Four Elms Hill, adjacent to diffusion tube NAS17 where the exceedance was measured in 2015. There are no predicted annual mean concentrations above 60 µg/m^3, and thus exceedences of the 1-hour mean objective are unlikely.

3.5 An isopleth map of the modelled annual mean nitrogen dioxide concentrations at ground-floor level is presented in Figure 6. This shows that the annual mean objective is likely to be exceeded alongside Four Elms Hill, at an approximate distance of up to 10 m from the roadside.

3.6 The isopleth shows the 40 µg/m³ contour in red, as well as the 36 µg/m³ contour in blue. There is some uncertainty surrounding both the measured and modelled concentrations. It is therefore recommended that an AQMA is declared to include, as a minimum, those residential properties which lie within the 36 µg/m³ contour, in order to be precautionary.

3.7 No exceedences of 60 µg/m³ as an annual mean nitrogen dioxide concentration have been identified at locations of relevant exposure, and thus exceedences of the 1-hour objective are unlikely.

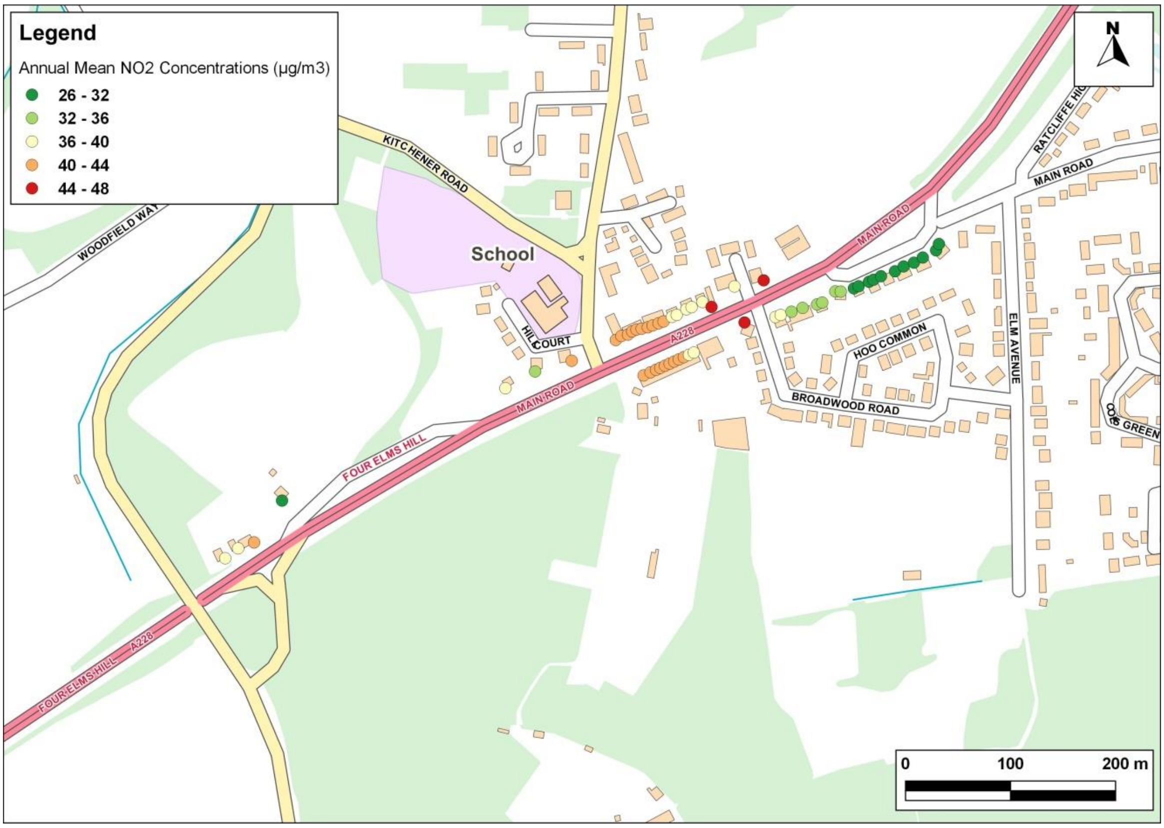

Figure 5 Annual Mean Nitrogen Dioxide Concentrations Modelled at Receptor Locations in 2015 (modelled at 1.5 m).

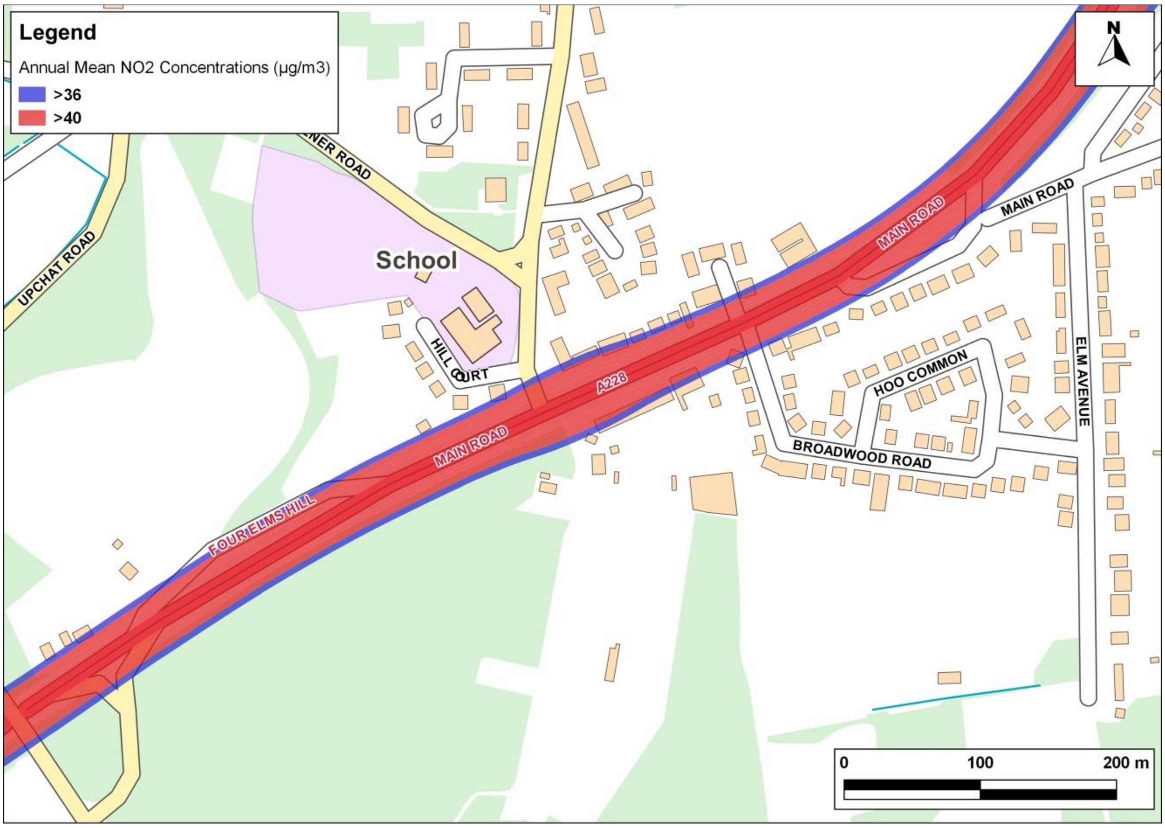

Figure 6 Extent of the Modelled 40μg/m³ Contour (red) and 36 μg/m³ Contour (blue) of Annual Mean Nitrogen Dioxide Concentrations in 2015 (modelled at 1.5 m).

Population Exposure

3.8 Objective exceedences are predicted at approximately 24 residential properties. Assuming that each property has on average two occupants, this equates to approximately 48 residents.

4 Source Apportionment

4.1 The traffic sources contributing to the objective exceedences have been identified. These data can be used to help develop an appropriate Action Plan and to inform future traffic management decisions. They have been calculated in line with guidance provided in LAQM.TG(16) (Defra, 2016a).

4.2 Figure 7 and Table A3-2 in Appendix A3 set out the relative contributions of traffic emissions. The following categories have been included in the source apportionment:

- Regional Background (Reg Bkgd);
- Local Background (Local Bkgd)
- Motorcycles (MCL);
- Cars;
- Light Goods Vehicles (LGV);
- Buses;
- Rigid Heavy Goods Vehicles (Rigid); and
- Articulated Heavy Good Vehicles (Artic).

4.3 The 56 receptor locations identified previously identified have been used to provide an overview of source contributions. Table A3-2 in Appendix A3 and Figure 7 show that the most significant component at all receptors is the regional and local (combined) ambient background concentration, followed by emissions from cars (although not shown, diesel cars will have a greater contribution than petrol cars).

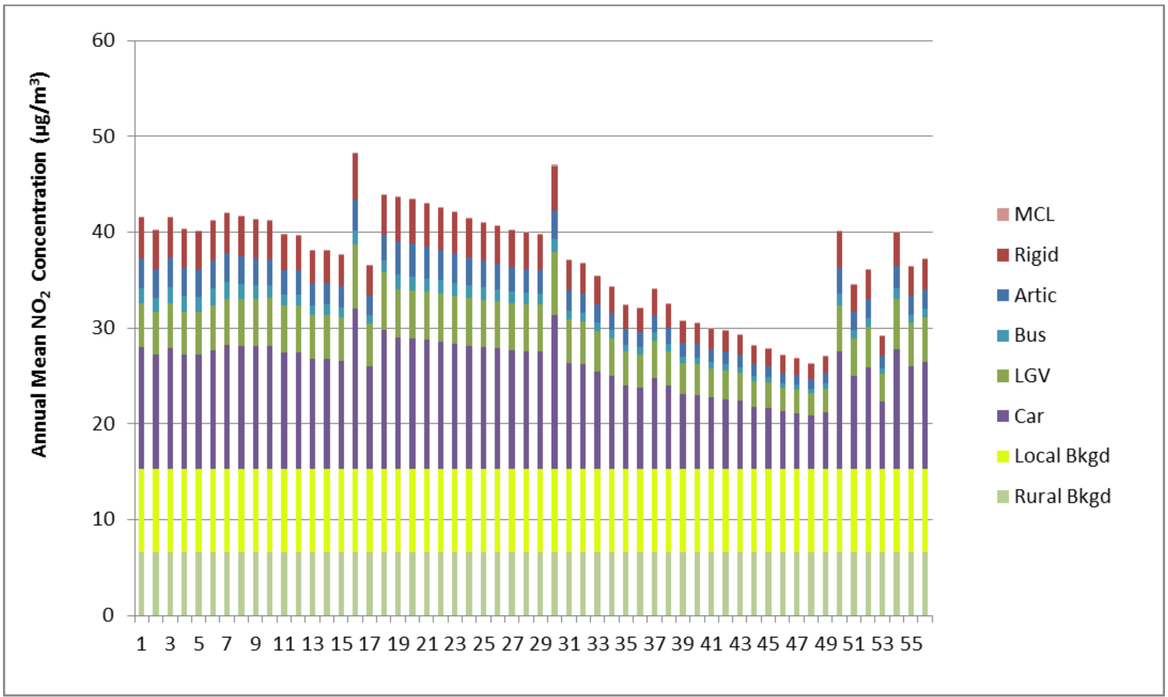

Figure 7: Relative Contribution of Each Source Type to the Total Predicted Annual Mean Nitrogen Dioxide Concentration at Receptor Locations (µg/m^3)

Air Quality Improvements Required

4.4 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). The highest nitrogen dioxide concentration was predicted at receptor R16 (48.3 µg/m^3), requiring a reduction of 8.3 µg/m^3 in order for the objective to be achieved.

4.5 In terms of describing the reduction in emissions required, it is more useful to consider nitrogen oxides (NOx). The required reduction in local nitrogen oxides emission has been calculated in line with guidance presented in LAQM.TG(16) (Defra, 2016a). Table 3 sets out the required reduction in local emissions of NOx that would be required at the seven receptor locations where the greatest exceedences are predicted, in order for the annual mean objective to be achieved.

3.15 Table 3 shows that at receptor 16, where the highest annual mean concentrations was predicted, a reduction of 28.7% in local road traffic emissions would be required in order to achieve the objective. This is followed by a required reduction of 25.2% in local road traffic at receptor 30, located on the other side of the road from receptor 16. These two locations are where the highest reduction is required in order to achieve the objective. At receptor locations 18 to 22, located along the southern side of Four Elms Hill, reductions ranging from 11.1 to 15.9% would be required to achieve the objective. At all other selected receptor locations in the study area where an exceedance was predicted, a reduction of less than 10% in local road traffic would be required to achieve the objective.

Table 3: Improvement in Annual Mean Nitrogen Dioxide Concentrations and Nitrogen Oxides Concentration Required in 2015 to Meet the Objective

Receptor	Required reduction in annual mean nitrogen dioxide concentration (μg/m^3)	Required reduction in emissions of oxides of nitrogen from local roads (%)
16	8.3	28.7
30	7.0	25.2
18	4.0	15.9
19	3.8	15.0
20	3.5	14.0
21	3.1	12.6
22	2.7	11.1

5 Conclusions and Recommendations

5.1 A Detailed Assessment has been carried out for nitrogen dioxide along Four Elms Hill in Chattenden. This area was identified as being at risk of exceeding the annual mean air quality objective for nitrogen dioxide in Medway Council's 2016 ASR.

5.2 The Detailed Assessment has been carried out using a combination of monitoring data and modelled concentrations. Concentrations of nitrogen dioxide have been modelled for 2015 using the ADMS-Roads dispersion model. The model has been verified against measurements made at the two nitrogen dioxide diffusion tube monitoring locations which lie adjacent to the road network included in the model.

5.3 The assessment has identified that the annual mean nitrogen dioxide objective is being exceeded at a number of relevant locations alongside Four Elms Hill. No exceedences of 60 $\mu g/m^3$ as an annual mean nitrogen dioxide concentration have been identified at locations of relevant exposure, and thus exceedences of the 1-hour objective are unlikely.

5.4 There is some uncertainty surrounding both the measured and modelled concentrations. It is therefore recommended that an AQMA is declared to include, as a minimum, those residential properties that lie within the 36 $\mu g/m^3$ contour to be precautionary.

5.5 It is also recommended that Medway Council continues monitoring nitrogen dioxide at the existing monitoring locations, and expand the network where possible, in particular at locations of relevant exposure.

5.6 Source apportionment of the local traffic emissions has been undertaken. This shows that ambient background concentrations contribute the largest proportion to the overall concentration, followed by emissions from cars.

5.7 A reduction in traffic emissions along Four Elms Hill would result in a decrease in the concentrations of nitrogen dioxide. Reductions in vehicle emissions from local traffic of up to 28.7 % would be required to achieve the annual mean nitrogen dioxide objective where the highest concentrations are predicted to occur.

6 References

Defra, 2007. The Air Quality Strategy for England, Scotland, Wales and Northern Ireland, July 2007.

Defra, 2016a. Local Air Quality Management: Technical Guidance LAQM.TG(16).

Defra, 2016b. LAQM Support Website Available at: http://laqm.defra.gov.uk/

DfT, 2016. Annual Average Daily Flows. Available at: http://www.dft.gov.uk/traffic-counts/cp.php

Medway Council, 2016. 2016 Annual Status Report.

Stationery Office, 2000. Air Quality Regulations, 2000, Statutory Instrument 928.

Stationery Office, 2002. Air Quality (England) (Amendment) Regulations, 2002, Statutory Instrument 3043.

7 Glossary

Standards A nationally defined set of concentrations for nine pollutants below which health effects do not occur or are minimal.

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, taking into account costs, benefits, feasibility and practicality. There are also vegetation-based objectives for sulphur dioxide and nitrogen oxides.

Exceedence A period of time where the concentration of a pollutant is greater than the appropriate air quality objective.

AQMA Air Quality Management Area

ADMS Roads Atmospheric Dispersion Modelling System for Roads.

NO_X Nitrogen oxides (taken as NO + NO_2)

NO Nitric Oxide

NO_2 Nitrogen dioxide.

$\mu g/m^3$ Microgrammes per cubic metre.

Roadside A site sampling between 1 m of the kerbside of a busy road and the back of the pavement. Typically this will be within 5 m of the road, but could be up to 15 m (Defra, 2009).

HDV Heavy Duty Vehicle

LDV Light Duty Vehicle

MCL Motorcycles

AADT Annual Average Daily Traffic flows

A1 Appendix 1 – Summary of Health Effects of Nitrogen Dioxide

Table A1.1: Summary of Health Effects of Nitrogen Dioxide

Pollutant	Main Health Effects
Nitrogen Dioxide	Short-term exposure to high concentrations may cause inflammation of respiratory airways. Long term exposure may affect lung function and enhance responses to allergens in sensitised individuals. Asthmatics will be particularly at risk (Defra, 2007).

A2 Appendix 2 – Dispersion Modelling Methodology

Meteorological Data

A2.1 The model has been run using a full year of meteorological data for 2015 from the meteorological station near Southend Airport.

Background Concentrations:

A2.2 Background concentrations of nitrogen dioxide have been taken from the national maps of background concentrations published by Defra (Defra, 2016b). The background concentrations used in the modelling are presented in Table A2.1.

Table A2.1: Background Concentrations (µg/m^3)

	NOx	NO_2
2015	21.7	15.3

Traffic Data

A2.3 The ADMS Roads model requires the user to provide various input data, including the Annual Average Daily Traffic (AADT) flow, the proportion of heavy duty vehicles (HDVs), road characteristics (including road width and street canyon height, where applicable), and the vehicle speed.

A2.4 Annual Average Daily Traffic (AADT) flows, and the flows split into a number of vehicle classes, have been sourced from the Department for Transport traffic counts (DfT, 2016). Traffic speeds have been estimated from local speed restrictions and take account of the proximity to junctions. The traffic data used in this Detailed Assessment are presented in Table A2.2.

Table A2.2: Summary of AADT Flows (2015)

	MCL	Cars	LGV	BUS	HGV	Total
Four Elms Hill (Count Point 56827)	412	26110	4146	184	1751	32419
A289 Hasted Road (Count Point 70381)	376	35861	7042	60	3312	46591
A289 Wulfure Way (Count Point 70385)	384	31991	6153	161	2314	40842

Model Verification

A2.5 Most nitrogen dioxide (NO_2) is produced in the atmosphere by 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 road-NO_X concentration during 2015 at the two diffusion tube monitoring sites described in Table 2, which lie alongside Four Elms Hill.

A2.6 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 for the diffusion tube sites was calculated from the measured NO_2 concentration and the predicted background NO_2 concentration using the NO_X from NO_2 calculator available on the LAQM Support website (Defra, 2016b).

A2.7 An adjustment factor was determined as the slope of the best fit line between the 'measured' road contribution and the model derived road contribution, forced through zero (Figure A2.1). This factor was then applied to the modelled road-NO_X concentration for each receptor to provide adjusted modelled road-NO_X concentrations. The total nitrogen dioxide concentrations were then determined by combining the adjusted modelled road-NO_X concentrations with the predicted background NO_2 concentration within the NO_X from NO_2 calculator.

A2.8 An adjustment factor of 5.6747 has been applied to all modelled nitrogen dioxide data.

A2.9 The results imply that the model was under-predicting the road-NO_X contribution. This is a common experience with this and most other models.

A2.10 Figure A2.2 compares adjusted modelled total NO_2 at each of the monitoring sites, to measured total NO_2, and shows a relationship close to 1:1.

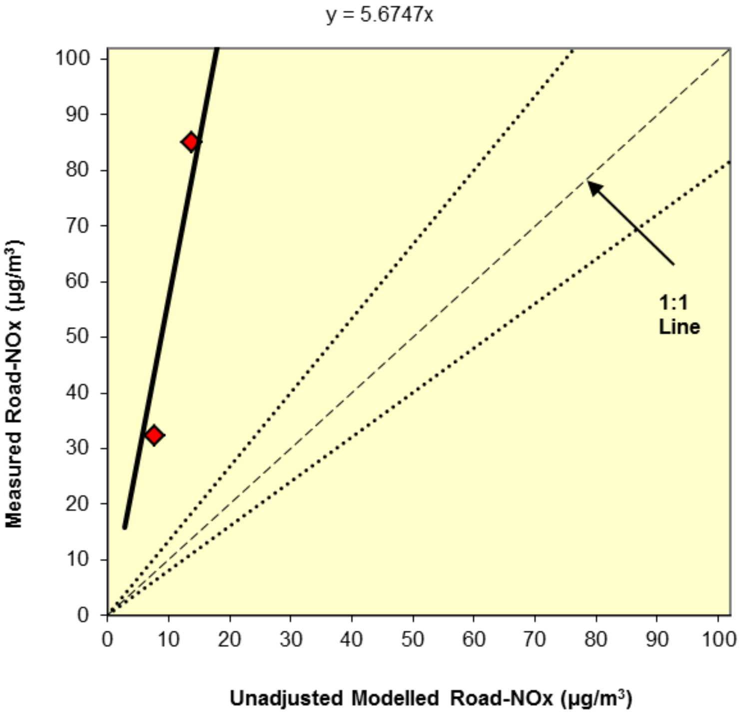

Figure A2.1: Comparison of Measured Road-NO_X to Unadjusted Modelled Road NO_X Concentrations

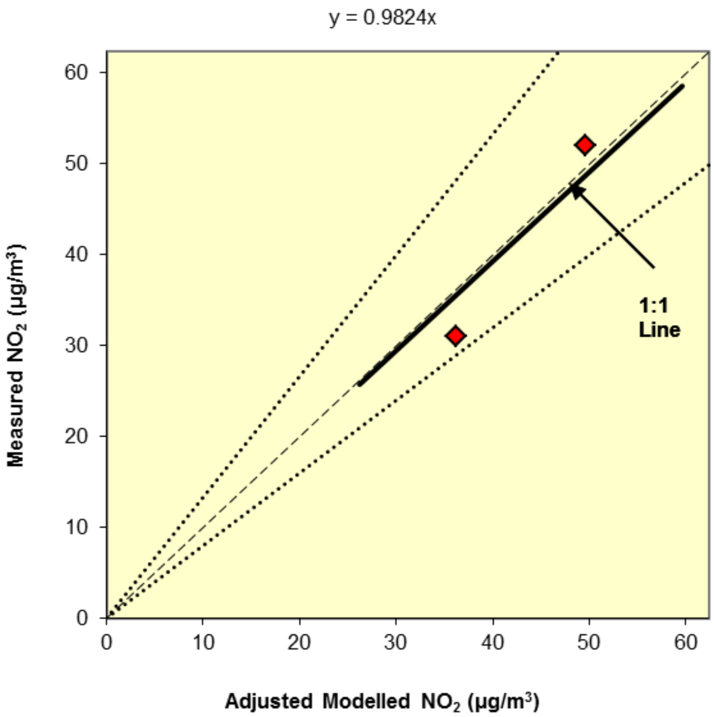

Figure A2.2: Comparison of Measured Total NO_2 to Adjusted Modelled Total NO_2 Concentrations

A3 Appendix 3 – Detailed modelling results

Table A3-1: Modelled Annual Mean Nitrogen Dioxide Concentrations at Specific Receptor Locations in 2015

Receptor	OS Grid coordinates		Height	2015 (µg/m^3)[a]
	X	Y		
1	575852	171816	1.5 m	**41.6**
2	575858	171820	1.5 m	**40.2**
3	575864	171822	1.5 m	**41.6**
4	575868	171825	1.5 m	**40.3**
5	575872	171826	1.5 m	**40.2**
6	575877	171827	1.5 m	**41.2**
7	575883	171829	1.5 m	**42.0**
8	575887	171830	1.5 m	**41.7**
9	575893	171832	1.5 m	**41.4**
10	575898	171834	1.5 m	**41.2**
11	575906	171839	1.5 m	39.8
12	575910	171840	1.5 m	39.8
13	575919	171846	1.5 m	38.2
14	575924	171848	1.5 m	38.2
15	575935	171853	1.5 m	37.8
16	575943	171848	1.5 m	**48.3**
17	575965	171867	1.5 m	36.6
18	575993	171873	1.5 m	**44.0**
19	575879	171783	1.5 m	**43.8**
20	575885	171786	1.5 m	**43.5**
21	575891	171788	1.5 m	**43.1**
22	575895	171790	1.5 m	**42.7**
23	575899	171792	1.5 m	**42.1**
24	575904	171794	1.5 m	**41.5**
25	575908	171796	1.5 m	**41.1**
26	575912	171798	1.5 m	**40.7**
27	575917	171800	1.5 m	**40.3**
28	575922	171802	1.5 m	**40.0**
29	575927	171805	1.5 m	39.8

Receptor	OS Grid coordinates		Height	2015 (µg/m³)[a]
	X	Y		
30	575975	171833	1.5 m	**47.0**
31	576004	171838	1.5 m	37.2
32	576009	171840	1.5 m	36.8
33	576020	171843	1.5 m	35.5
34	576030	171847	1.5 m	34.4
35	576044	171850	1.5 m	32.4
36	576049	171852	1.5 m	32.1
37	576061	171863	1.5 m	34.1
38	576066	171863	1.5 m	32.5
39	576079	171866	1.5 m	30.8
40	576083	171868	1.5 m	30.6
41	576093	171872	1.5 m	30.0
42	576098	171874	1.5 m	29.7
43	576105	171877	1.5 m	29.3
44	576118	171882	1.5 m	28.2
45	576126	171887	1.5 m	27.9
46	576136	171890	1.5 m	27.1
47	576145	171895	1.5 m	26.9
48	576157	171902	1.5 m	26.3
49	576160	171908	1.5 m	27.0
50	575810	171797	1.5 m	**40.2**
51	575775	171787	1.5 m	34.6
52	575747	171771	1.5 m	36.2
53	575534	171664	1.5 m	29.2
54	575508	171624	1.5 m	**40.1**
55	575493	171618	1.5 m	36.5
56	575480	171609	1.5 m	37.3
Objective				**40**

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

Table A3-2: Predicted Annual Mean Nitrogen Dioxide Concentrations (2015) and the Contribution of Each Source Type to the Total

Receptor	Annual Mean Concentration (µg/m^3)								
	Reg Bkgd	Local Bkgd	Car	LGV	MCL	Artic	Rigid	Bus	Total
1	6.6	8.7	12.7	4.7	0.1	3.2	4.2	1.5	26.4
2	6.6	8.7	12.0	4.4	0.1	3.0	4.0	1.5	25.0
3	6.6	8.7	12.6	4.7	0.1	3.1	4.2	1.7	26.4
4	6.6	8.7	12.0	4.5	0.1	2.9	3.9	1.6	25.1
5	6.6	8.7	11.9	4.5	0.1	2.9	3.9	1.6	24.9
6	6.6	8.7	12.5	4.7	0.1	3.0	4.1	1.7	26.0
7	6.6	8.7	12.9	4.9	0.1	3.0	4.2	1.7	26.8
8	6.6	8.7	12.9	4.9	0.1	2.9	4.1	1.6	26.4
9	6.6	8.7	12.8	5.0	0.1	2.8	4.0	1.4	26.1
10	6.6	8.7	12.8	5.0	0.1	2.8	3.9	1.3	26.0
11	6.6	8.7	12.2	4.8	0.1	2.5	3.7	1.2	24.6
12	6.6	8.7	12.2	4.9	0.1	2.5	3.6	1.2	24.5
13	6.6	8.7	11.5	4.6	0.1	2.3	3.4	1.1	22.9
14	6.6	8.7	11.5	4.6	0.1	2.3	3.4	1.0	22.9
15	6.6	8.7	11.3	4.6	0.1	2.2	3.3	1.0	22.5
16	6.6	8.7	16.7	6.8	0.2	3.2	4.8	1.4	33.1
17	6.6	8.7	10.8	4.4	0.1	2.0	3.1	0.9	21.3
18	6.6	8.7	14.6	5.9	0.1	2.7	4.1	1.2	28.8
19	6.6	8.7	13.8	5.0	0.1	3.5	4.6	1.5	28.5
20	6.6	8.7	13.6	5.0	0.1	3.4	4.6	1.5	28.2
21	6.6	8.7	13.5	5.0	0.1	3.3	4.5	1.4	27.8
22	6.6	8.7	13.3	5.0	0.1	3.2	4.4	1.4	27.4
23	6.6	8.7	13.1	5.0	0.1	3.1	4.2	1.4	26.9
24	6.6	8.7	12.9	5.0	0.1	2.9	4.1	1.3	26.3
25	6.6	8.7	12.7	4.9	0.1	2.8	3.9	1.3	25.8
26	6.6	8.7	12.6	4.9	0.1	2.7	3.8	1.2	25.4
27	6.6	8.7	12.5	4.9	0.1	2.6	3.8	1.2	25.0
28	6.6	8.7	12.4	4.9	0.1	2.5	3.7	1.2	24.7
29	6.6	8.7	12.3	4.9	0.1	2.5	3.6	1.1	24.5
30	6.6	8.7	16.1	6.5	0.2	3.0	4.6	1.4	31.8

31	6.6	8.7	11.1	4.5	0.1	2.1	3.2	0.9	21.9
32	6.6	8.7	10.9	4.5	0.1	2.1	3.1	0.9	21.6
33	6.6	8.7	10.2	4.2	0.1	1.9	2.9	0.9	20.2
34	6.6	8.7	9.7	4.0	0.1	1.8	2.7	0.8	19.1
35	6.6	8.7	8.7	3.6	0.1	1.6	2.5	0.7	17.2
36	6.6	8.7	8.5	3.5	0.1	1.6	2.4	0.7	16.8
37	6.6	8.7	9.6	3.9	0.1	1.8	2.7	0.8	18.8
38	6.6	8.7	8.8	3.6	0.1	1.6	2.5	0.7	17.3
39	6.6	8.7	7.9	3.2	0.1	1.5	2.2	0.7	15.6
40	6.6	8.7	7.8	3.2	0.1	1.4	2.2	0.6	15.3
41	6.6	8.7	7.5	3.1	0.1	1.4	2.1	0.6	14.7
42	6.6	8.7	7.3	3.0	0.1	1.4	2.1	0.6	14.5
43	6.6	8.7	7.1	2.9	0.1	1.3	2.0	0.6	14.1
44	6.6	8.7	6.5	2.7	0.1	1.2	1.8	0.5	12.9
45	6.6	8.7	6.4	2.6	0.1	1.2	1.8	0.5	12.6
46	6.6	8.7	6.0	2.5	0.1	1.1	1.7	0.5	11.9
47	6.6	8.7	5.9	2.4	0.1	1.1	1.7	0.5	11.6
48	6.6	8.7	5.6	2.3	0.1	1.0	1.6	0.5	11.1
49	6.6	8.7	6.0	2.5	0.1	1.1	1.7	0.5	11.8
50	6.6	8.7	12.3	4.8	0.1	2.7	3.8	1.2	24.9
51	6.6	8.7	9.7	3.9	0.1	1.9	2.8	0.8	19.3
52	6.6	8.7	10.6	4.3	0.1	2.0	3.0	0.9	20.9
53	6.6	8.7	7.0	3.0	0.1	1.3	2.0	0.6	13.9
54	6.6	8.7	12.6	5.2	0.1	2.3	3.5	1.0	24.8
55	6.6	8.7	10.8	4.5	0.1	2.0	3.0	0.9	21.3
56	6.6	8.7	11.2	4.7	0.1	2.1	3.1	0.9	22.1
Receptor	**% Contribution to Total**								
	Reg Bkgd	**Local Bkgd**	**Car**	**LGV**	**MCL**	**Artic**	**Rigid**	**Bus**	**Total**
1	15.8	20.9	30.5	11.2	0.2	7.6	10.2	3.6	100
2	16.3	21.6	29.9	11.0	0.2	7.4	9.9	3.7	100
3	15.8	20.9	30.3	11.2	0.2	7.5	10.0	4.1	100
4	16.3	21.5	29.8	11.1	0.2	7.3	9.8	4.1	100
5	16.4	21.6	29.7	11.1	0.2	7.2	9.7	4.1	100

6	15.9	21.1	30.2	11.3	0.2	7.2	9.8	4.2	100
7	15.6	20.7	30.8	11.6	0.2	7.2	9.9	4.0	100
8	15.8	20.8	30.9	11.8	0.2	7.1	9.8	3.7	100
9	15.9	21.0	31.0	12.0	0.2	6.8	9.6	3.4	100
10	15.9	21.1	31.1	12.1	0.3	6.7	9.5	3.3	100
11	16.5	21.8	30.7	12.1	0.3	6.4	9.2	3.0	100
12	16.5	21.9	30.8	12.2	0.3	6.3	9.1	2.9	100
13	17.2	22.8	30.1	12.0	0.3	6.0	8.8	2.8	100
14	17.2	22.8	30.2	12.1	0.3	6.0	8.8	2.7	100
15	17.4	23.0	30.0	12.1	0.3	5.9	8.7	2.7	100
16	13.6	18.0	34.6	14.0	0.3	6.6	9.9	3.0	100
17	18.0	23.8	29.5	12.0	0.3	5.6	8.4	2.5	100
18	14.9	19.7	33.1	13.5	0.3	6.2	9.4	2.8	100
19	15.0	19.9	31.4	11.5	0.2	8.0	10.6	3.4	100
20	15.1	20.0	31.4	11.6	0.2	7.9	10.5	3.4	100
21	15.3	20.2	31.3	11.6	0.2	7.7	10.4	3.3	100
22	15.4	20.4	31.2	11.7	0.2	7.5	10.2	3.3	100
23	15.6	20.6	31.2	11.8	0.2	7.3	10.0	3.2	100
24	15.8	20.9	31.1	11.9	0.2	7.0	9.8	3.1	100
25	16.0	21.2	31.0	12.0	0.3	6.8	9.6	3.1	100
26	16.2	21.4	31.0	12.1	0.3	6.6	9.5	3.0	100
27	16.3	21.6	30.9	12.2	0.3	6.5	9.3	2.9	100
28	16.4	21.7	30.9	12.3	0.3	6.4	9.2	2.9	100
29	16.5	21.8	30.9	12.3	0.3	6.3	9.1	2.8	100
30	14.0	18.5	34.2	13.9	0.3	6.4	9.7	2.9	100
31	17.7	23.4	29.9	12.2	0.3	5.6	8.5	2.5	100
32	17.8	23.6	29.7	12.1	0.3	5.6	8.4	2.5	100
33	18.5	24.5	28.9	11.8	0.3	5.4	8.2	2.4	100
34	19.1	25.3	28.2	11.5	0.3	5.3	8.0	2.4	100
35	20.3	26.8	26.8	11.0	0.3	5.0	7.6	2.3	100
36	20.5	27.1	26.6	10.9	0.3	5.0	7.5	2.2	100
37	19.3	25.5	28.0	11.5	0.3	5.2	7.9	2.3	100
38	20.2	26.7	26.9	11.0	0.3	5.0	7.6	2.3	100
39	21.3	28.2	25.6	10.5	0.2	4.8	7.2	2.1	100

40	21.5	28.4	25.4	10.4	0.2	4.7	7.2	2.1	100
41	21.9	29.0	24.9	10.2	0.2	4.6	7.0	2.1	100
42	22.1	29.3	24.7	10.1	0.2	4.6	6.9	2.1	100
43	22.4	29.6	24.3	10.0	0.2	4.5	6.9	2.0	100
44	23.3	30.9	23.2	9.6	0.2	4.3	6.5	1.9	100
45	23.6	31.2	23.0	9.4	0.2	4.3	6.5	1.9	100
46	24.2	32.0	22.2	9.1	0.2	4.1	6.2	1.8	100
47	24.5	32.4	21.9	9.0	0.2	4.1	6.2	1.8	100
48	25.0	33.0	21.3	8.8	0.2	4.0	6.0	1.8	100
49	24.3	32.2	22.1	9.1	0.2	4.1	6.2	1.8	100
50	16.3	21.6	30.7	12.0	0.2	6.7	9.5	2.9	100
51	19.0	25.1	28.1	11.4	0.3	5.5	8.1	2.4	100
52	18.2	24.0	29.3	12.0	0.3	5.6	8.3	2.5	100
53	22.5	29.8	24.1	10.2	0.2	4.6	6.7	1.9	100
54	16.4	21.7	31.4	13.1	0.3	5.9	8.8	2.5	100
55	18.0	23.8	29.5	12.3	0.3	5.5	8.2	2.4	100
56	17.6	23.3	29.9	12.5	0.3	5.6	8.4	2.4	100