Air Quality Consultants

Maidstone Borough Council:
Review of Air Quality Management Area Maidstone

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Experts in air quality management & assessment

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Executive Summary

Air Quality Consultants Ltd has been commissioned by Maidstone Borough Council to undertake a review of the Maidstone Air Quality Management Area (AQMA). The whole Maidstone conurbation has been declared an AQMA for exceedences of the annual mean nitrogen dioxide objective.

Recent monitoring suggests that there are only relatively small areas of exceedence. A review of the AQMA in Maidstone has therefore been carried out. The assessment has been carried out using a combination of 2014 monitoring data and modelled concentrations. Concentrations of nitrogen dioxide have been modelled for 2014 using the ADMS-Roads dispersion model.

The assessment has identified that the annual mean nitrogen dioxide objective is being exceeded at locations of relevant exposure, but not as extensively as the current declared AQMA. There is therefore an opportunity to reduce the size of the AQMA to help focus on those areas with poor air quality. Any adjustment of the AQMA should take account of the uncertainty surrounding both the measured and modelled concentrations. To allow for this it is recommended that any adjustments to the AQMA should include areas within the 36 $\mu g/m^3$ contour.

There are two main options for adjustments of the AQMA. Either the revised AQMA could be based on the entire area within the 36 $\mu g/m^3$ contour across Maidstone, or it could be based on those areas within the 36 $\mu g/m^3$ contour where relevant exposure exists. This latter approach will result in a number of smaller, more discrete AQMAs. There are pros and cons to each of these approaches. A slightly wider AQMA will potentially have the advantage of helping to ensure that relevant exposure is not introduced into areas that may already be exceeding the objective without further assessment and potentially mitigation. The second approach will provide a more focussed basis for Air Quality Action Planning.

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1 Introduction

1.1 Air Quality Consultants Ltd has been commissioned by Maidstone Borough Council to undertake a review of the Maidstone Air Quality Management Area (AQMA).

1.2 The whole Maidstone conurbation has been declared an AQMA for exceedences of the annual mean nitrogen dioxide objective. Recent monitoring suggests that there are only relatively small areas of exceedence. The aim of this review is therefore to investigate whether it would be advantageous to amend the current AQMA and declare a number of smaller areas which better define the actual areas of exceedence. The review constitutes a Detailed Assessment as part of the Local Air Quality Management (LAQM) process for amending or revoking AQMA orders.

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 Review and Assessment is a long-term, on-going process, structured as a series of ‘rounds’. Local Authorities in England, Scotland and Wales have now completed the first, second, third and fourth rounds of Review and Assessment, with the fifth round well underway.

1.5 Technical Guidance for LAQM (Defra, 2009) sets out a phased approach to the Review and Assessment process. This prescribes an initial Updating and Screening Assessment (USA), which all local authorities must undertake. It is based on a checklist to identify any matters that have changed since the previous round. If the USA, or subsequent Progress Reports, identify any areas where there is a risk that the objectives may be exceeded, which were not identified in the previous round, then the Local Authority should progress to a Detailed Assessment.

1.6 The purpose of this assessment is to review the declared AQMA and that the appropriate area has been declared, and importantly, to ascertain the sources contributing to the exceedence and to calculate the magnitude of reduction in emissions required to achieve the objective.

The Air Pollutant of Concern

1.7 Nitrogen dioxide is associated with adverse effects on human health. At high levels nitrogen dioxide causes inflammation of the airways. Long-term exposure may affect lung function and increase the risk of adverse respiratory symptoms; it may also contribute to premature death. Nitrogen dioxide can enhance the response to allergens in sensitive individuals (Defra, 2007).

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 to protect human health and the environment. The 'standards' are set as concentrations below which 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 an individual 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 economic efficiency, practicability, technical feasibility and timescale. It also sets out how the different sectors: industry, transport and local government, can contribute to achieving the air quality objectives. The objectives for use by local authorities are prescribed within the Air Quality (England) Regulations, 2000, Statutory Instrument 928 (2000) and the Air Quality (England) (Amendment) Regulations 2002, Statutory Instrument 3043 (2002).

1.9 The objectives for nitrogen dioxide were to have been achieved by 2005, and continue to apply in all future years thereafter. Measurements across the UK have shown that the 1-hour nitrogen dioxide objective is unlikely to be exceeded where the annual mean concentration is below 60 $\mu g/m^3$ (Defra, 2009). Therefore, 1-hour nitrogen dioxide concentrations will only be considered if the annual mean concentration is above this level. The relevant air quality criteria for this review are provided in Table 1.

Table 1: Air Quality Criteria for Nitrogen Dioxide

Pollutant	Time Period	Objective
Nitrogen Dioxide	1-hour Mean	200 $\mu g/m^3$ not to be exceeded more than 18 times a year
	Annual Mean	40 $\mu g/m^3$

1.10 The objectives apply at locations where members of the public are likely to be regularly present and are likely to be exposed over the averaging period of the objective. Defra explains where these objectives will apply in its Local Air Quality Management Technical Guidance (Defra, 2009). The annual mean objectives for nitrogen dioxide are considered to apply at the façades of residential properties, schools, hospitals etc.; they do not apply at hotels. The 1-hour mean objective for nitrogen dioxide applies wherever members of the public might regularly spend 1-hour or more, including outdoor eating locations and pavements of busy shopping streets.

2 Assessment Methodology

Monitoring

2.1 Maidstone Borough Council operates two automatic monitoring sites measuring nitrogen dioxide concentrations; one a roadside site situated within the AQMA at the A229 Bridge Gyratory and the other a rural background site in Detling, which is outside of the study area for this assessment.

2.2 The Council also monitors nitrogen dioxide concentrations at 53 locations across the borough using passive diffusion tubes, 50 of which are within the study area for this assessment. The diffusion tubes are prepared and analysed by ESG Didcot using the 50% triethanolamine (TEA) in acetone method. It is necessary to apply an adjustment factor to the diffusion tube data to account for laboratory bias; for 2014 a bias adjustment factor of 0.88 was used (Maidstone Borough Council, 2015). The monitoring sites within the study area are shown in Figure 1.

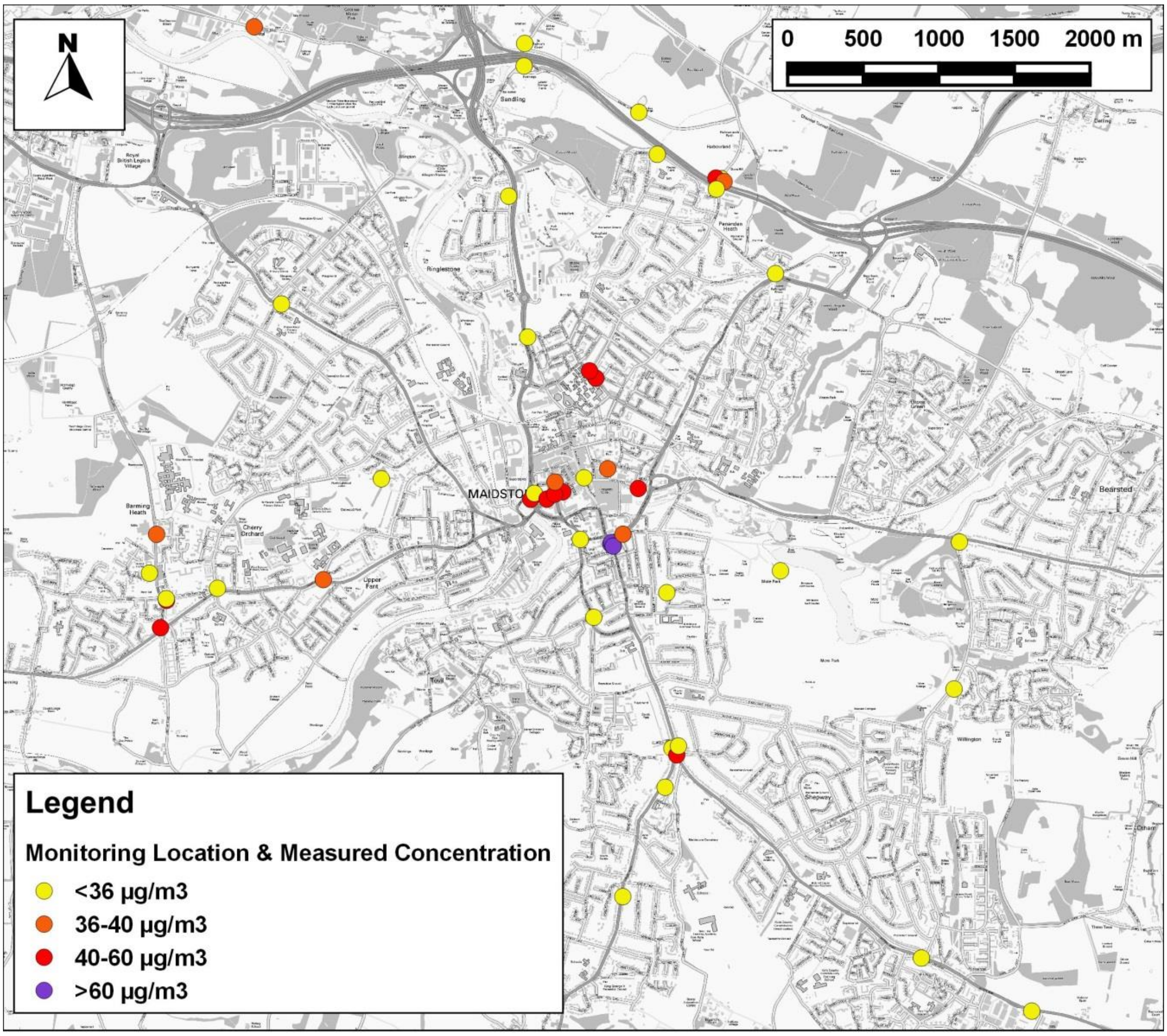

Figure 1: Monitoring Locations

Modelling

2.3 Annual mean nitrogen dioxide concentrations have been predicted using detailed dispersion modelling (using ADMS-Roads v3.4). Details of the model inputs and the model verification are provided in Appendix A2, together with the method used to derive the current and future year background nitrogen dioxide concentrations. Concentrations have been predicted across a gridded area at ground-floor (1.5 m) level, as well as at 11 specific receptors as shown in Figure 2. The professional experience of the consultants preparing the report is set out in Appendix A1.

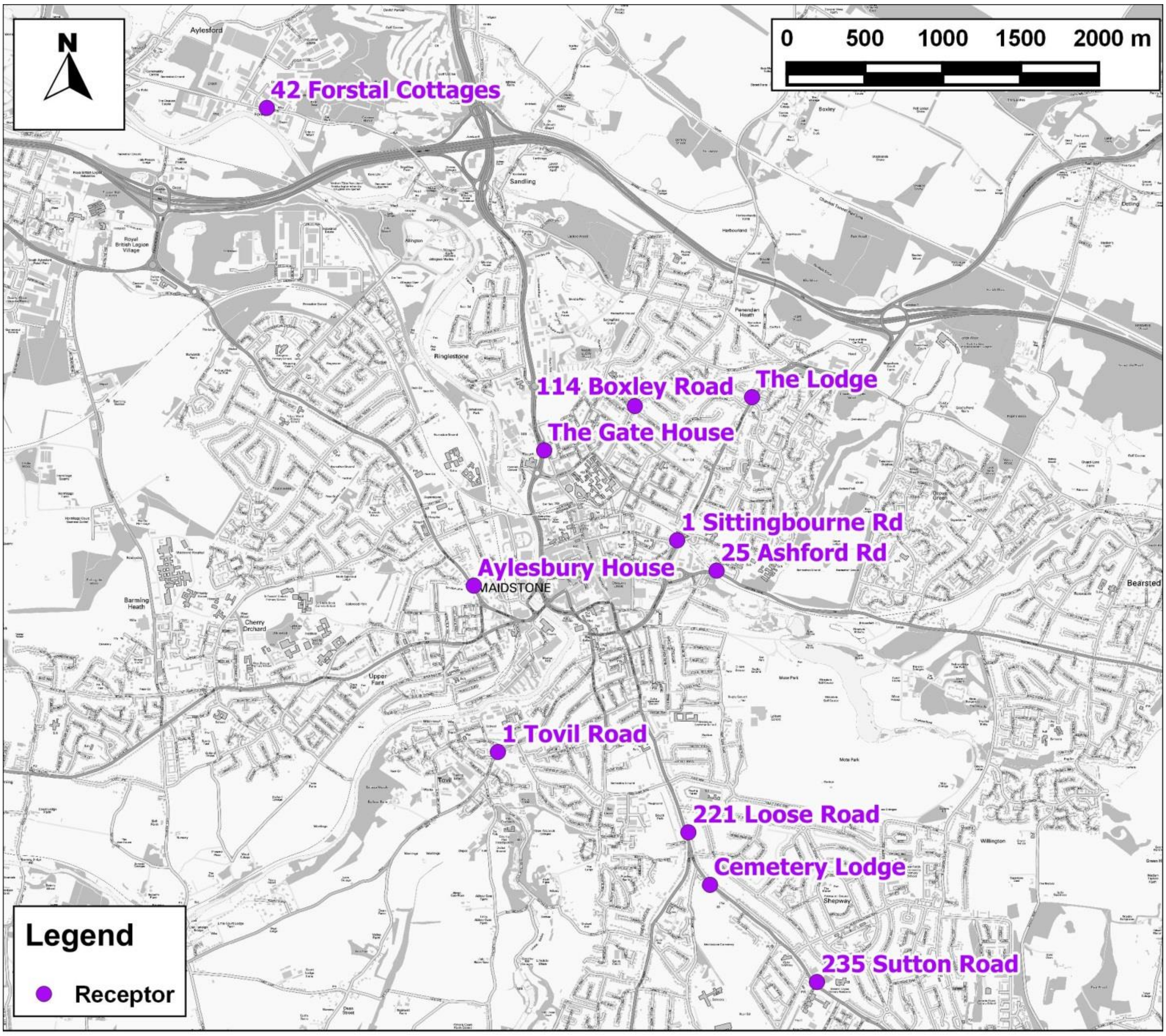

Figure 2: Selected Receptors

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, 2015) suggests that this is of the order of plus or minus 20% for diffusion tube data. The model results rely on traffic data sourced from the Department of Transport (DfT, 2015), UK Traffic Data (UK Traffic Data, 2015) and Maidstone Borough Council, 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 Gatwick Airport during 2014 will have occurred throughout the study area during 2014 and it has been assumed that the dispersion of emitted pollutants will conform to a Gaussian distribution over flat terrain. An important step in the assessment is verifying the dispersion model against measured data. By comparing the model results with measurements, and correcting for the apparent under-prediction of the model, the uncertainties can be reduced.

2.5 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 2009 to 2014 for the 50 sites within the study area are summarised in Table 2.

Table 2: Summary of Nitrogen Dioxide (NO_2) Monitoring (2009-2014) [a b]

Site Name	Site Type	Location	2009	2010	2011	2012	2013	2014
Automatic Monitor - Annual Mean (µg/m^3)								
A229	Roadside	Bridge Gyratory, Maidstone	**46**	**56**	**53.5**	**43.2**	**48.1**	**46.9**
Objective			**40**					
Automatic Monitor - No. of Hours > 200 µg/m^3								
A229	Roadside	Bridge Gyratory, Maidstone	3	0	0	0	0	2
Objective			**18**					
Diffusion Tubes - Annual Mean (µg/m^3)								
Maid 03 [c]	Roadside	Bridge Gyratory (Fairmeadow AQ Station)	**45**	**48**	**44.4**	38.4	**43.8**	**43.8**
Maid 10	Motorway	Grange Lane South	34	34	32.3	29.3	34.5	29.8
Maid 11	Motorway	Boarley Lane	32	28	32.3	26.6	28.8	29.4
Maid 12	Motorway	Grange Lane North	32	28	32.3	26.5	27.9	29.3
Maid 14	Suburban	Boxley Close	33	36	33.1	28.5	32.5	29.1
Maid 18	Roadside	Bell Meadow	29	31	29.4	24.6	31.4	25.4
Maid 19	Roadside	196 Loose Rd	28	29	28.8	25.6	27.1	26.8
Maid 20	Roadside	Sheals Cresent	32	33	29.4	29.2	31.6	29.7
Maid 21	Roadside	Tonbridge Road	35	37	33.8	31.8	39.8	39.9
Maid 22	Kerbside	A20 London Road	35	36	32.5	30.6	31.7	29.5
Maid 26	Roadside	Drakes PH	39	35	39	32.4	30.6	34.9
Maid 27	Roadside	High Street (JPs Bar)	**42**	**41**	**44.9**	38.1	37.8	**44.1**
Maid 29	Roadside	Knightrider Street	39	40	37.5	28.6	33.5	32.0
Maid 36	Roadside	37 High Street	**43**	**42**	**46.3**	**39.4**	**42.3**	**46.5[a]**

Site Name	Site Type	Location	2009	2010	2011	2012	2013	2014
Maid 41	Roadside	Amberleigh, Harbourland Close	**42**	37	**41.7**	35.7	35.9	**40.7**
Maid 44	Roadside	Well Road (façade between No.3 & 4)	**43**	**46**	**41.2**	**41.1**	**43.5**	**42.3**
Maid 45	Urban Background	Mote Park	20	25	22	21.1	22.3	17.7
Maid 46	Urban Background	Scrubbs Lane (Oakwood Park)	19	18	16.3	18.0	17.2	15.0[a]
Maid 49	Roadside	454 Tonbridge Road	**41**	**41**	**43.1**	**39.4**	**43.2**	**42.4**
Maid 50	Roadside	157 Chatham Road Springfield	27	28	24.2	23.0	**24.9**	22.9
Maid 51	Roadside	121 Boxley Road	**44**	**49**	**44**	**40.5**	**46.5**	**42.9**
Maid 52	Roadside	565 & 567 Tonbridge Road	**48**	**47**	**48**	**42.0**	**46.0**	**44.7**
Maid 53	Roadside	Wheatsheaf PH	**59**	**60**	**60.2**	**53.5**	**61.7**	**50.5**
Maid 56	Roadside	243 Loose Road	35	30	30.4	27.7	27.6	36.8
Maid 57	Roadside	29A Forstal Road Cottages, Forstal Road	38	**42**	39.9	36.4	**41.0**	38.7
Maid 58	Roadside	R & J Carpets, Upper Stone Street	**94**	**90**	**85.7**	**81.0**	**92.3**	**86.6[a]**
Maid 59	Roadside	Harts, Upper Stone Street	**87**	**71**	**70**	**61.5**	**69.8**	**78.3[a]**
Maid 63	Roadside	Façade 8 Harbourland Cottages	40	39	**40.7**	35.5	35.6	38.6
Maid 68	Roadside	Burger King (King Street side)	-	-	**43.8**	35.3	39.9	36.1
Maid 69	Roadside	34 Church Street	-	-	31.5	24.2	25.8	26.1
Maid 70	Roadside	92 King Street	-	-	**47.9**	37.8	35.2	**43.2**
Maid 71	Roadside	Flowerpot PH, Sandling Road	-	-	33.9	31.1	32.3	30.0
Maid 74	Roadside	Chilterns Hundreds PH	-	-	38.1	32.3	34.3	35.6
Maid 76	Roadside	1 Willington Street	-	-	30.5	29.8	28.3	26.9
Maid 77	Roadside	161 Willington Street	-	-	22.4	24.6	30.0	24.9
Maid 78	Roadside	355 Loose Road	-	-	24	26.3	26.5	27.6
Maid 79	Roadside	523 Loose Road	-	-	27.1	26.4	30.0	26.1

Site Name	Site Type	Location	2009	2010	2011	2012	2013	2014
Maid 80	Kerbside	Well Road/Wheeler Street	-	-	-	**41.6**	39.0	**41.9**
Maid 81	Kerbside	The Pilot PH	-	-	**84.8**	**87.3**	**81.7**	**74.8**[a]
Maid 82	Roadside	Lamppost by Argos, High Street	-	-	37.3	39.2	**42.1**	**42.3**
Maid 84	Roadside	384 & 382 Tonbridge Road	-	-	-	26.6	31.9	29.5
Maid 85	Roadside	439 & 441 Tonbridge Road	-	-	-	25.4	31.0	30
Maid 86	Roadside	20 & 18 Mote Road	-	-	-	33.2	37.9	39.4
Maid 87 [c]	Roadside	1 Neville Close, Maidstone	-	-	-	-	34.9	31.8
Maid 88	Urban Background	42 Downs View Road, Maidstone	-	-	-	-	25.6	26.6
Maid 89	Roadside	Briarwood Cottage, Sutton Road A274, Maidstone	-	-	-	-	27.4	29.3
Maid 90	Roadside	Pudding Lane, Medway Street, Maidstone	-	-	-	-	35.8	37.2
Maid 91	Urban Background	Old Nurses Home, Hermitage Lane, Maidstone	-	-	-	-	-	19.7[a]
Maid 92	Roadside	Hunton House, Hermitage Lane, Maidstone	-	-	-	-	**43.4**	37.3
Maid 93	Roadside	St Andrews Road/Fountain Lane, Maidstone	-	-	-	-	35.2	30.2
Objective			**40**					

[a] Exceedences of the objectives are shown in bold

[b] Data have been taken from the 2015 Updating and Screening Assessment (Maidstone Borough Council, 2015).

[c] Average of triplicate diffusion tubes.

[d] Data annualised by Council.

3.2 Most of the measured annual mean concentrations were below the objective in 2014, implying that the declared AQMA probably should be amended to cover only those areas where exceedences are occurring. Concentrations are very high along the A229 Upper Stone Street, with concentrations above 60 µg/m^3, indicating that the 1-hour objective may also be exceeded here.

Elsewhere, the objective is generally only exceeded by a small margin, and it is likely that relevant receptors, which will mostly be set back further from the road, will experience concentrations below the objective.

Modelling

3.3 Predicted annual mean nitrogen dioxide concentrations in 2014 at each of the receptor locations shown in Figure 2 are set out in Table 3. Predicted concentrations exceed the annual mean objective at Receptors 2, 5, and 11.

Table 3: Modelled Annual Mean Nitrogen Dioxide Concentrations at Specific Receptors

Receptor	Location	Concentration (µg/m^3) [a]
1	42 Forstal Cottages	31.4
2	1 Sittingbourne Rd	**42.0**
3	1 Tovil Road	26.4
4	114 Boxley Road	31.2
5	221 Loose Road	**40.9**
6	235 Sutton Road	29.1
7	25 Ashford Rd	32.6
8	Aylesbury House	39.7
9	Cemetery Lodge	32.2
10	The Gate House	**51.1**
11	The Lodge	37.1
Objective		**40**

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

3.4 Isopleth maps of the modelled annual mean nitrogen dioxide concentrations at ground-floor level are presented in Figure 3 to Figure 17. The isopleths show the 40 µg/m^3 contour in red, as well as the 36 µg/m^3 contour in orange.

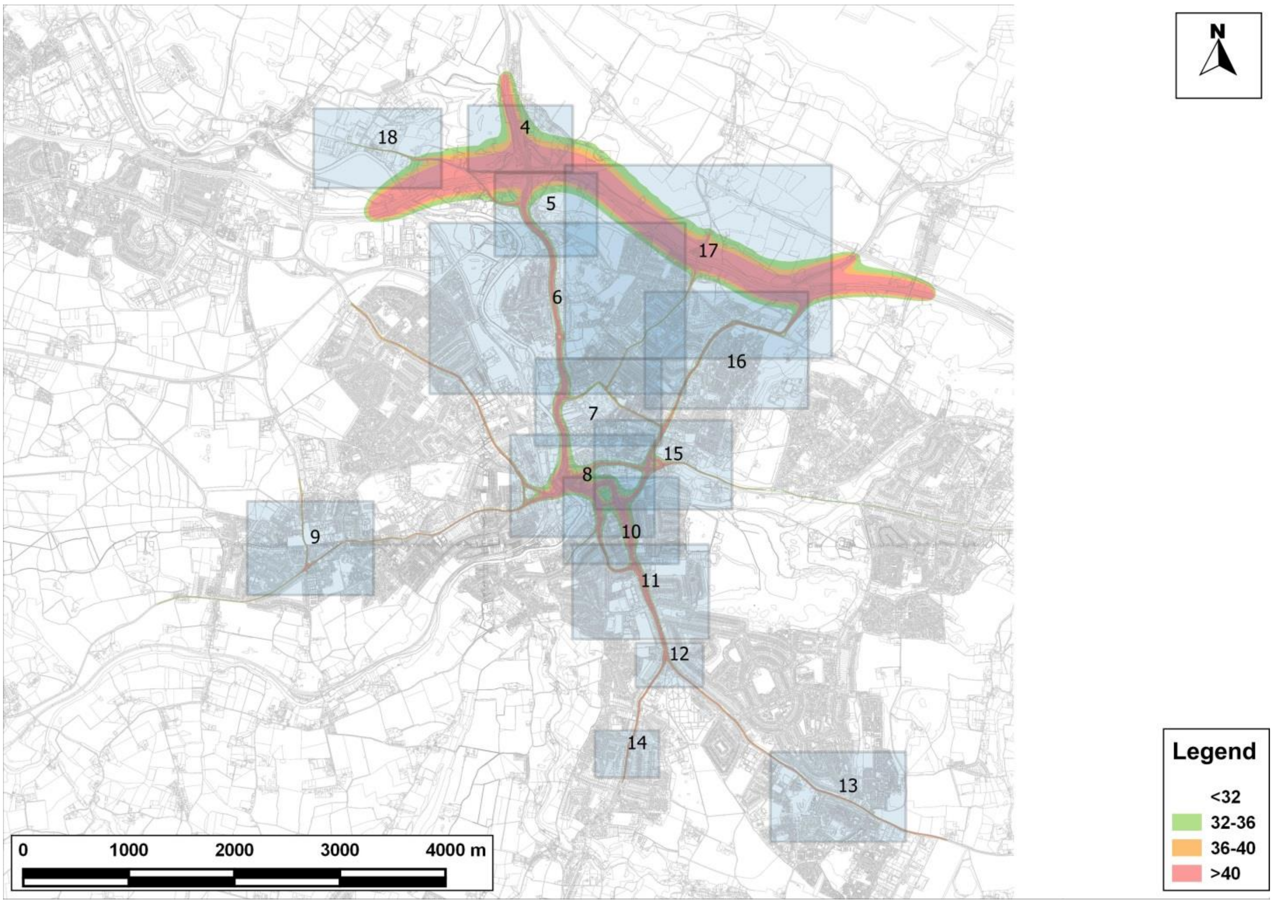

Figure 3: Map showing Modelled Network and Locations of Detailed Figures. Also shown are the Modelled Concentrations

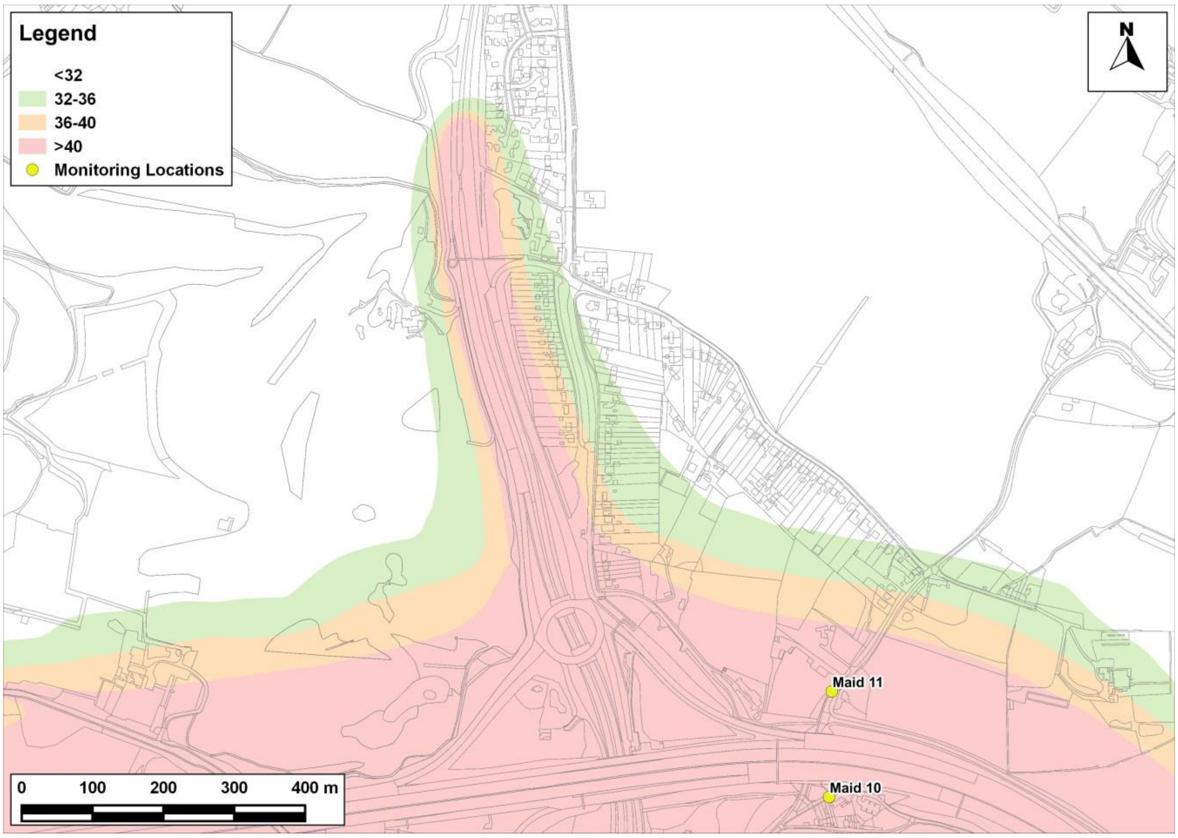

Figure 4: Extent of the Modelled 40 μg/m^3 Contour (red) and 36 μg/m^3 Contour (orange) of Annual Mean Nitrogen Dioxide Concentrations in 2014 (modelled at 1.5 m) at Junction 6 of the M20.

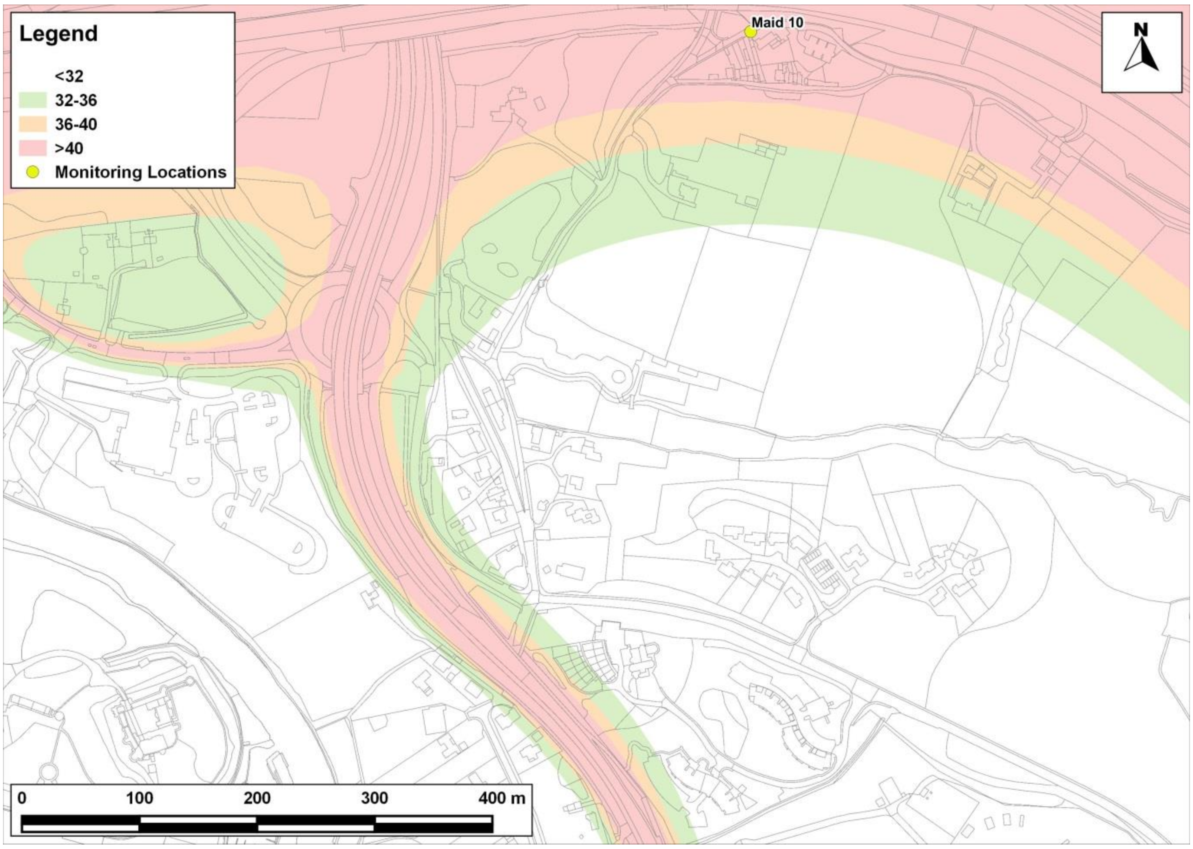

Figure 5: Extent of the Modelled 40 μg/m^3 Contour (red) and 36 μg/m^3 Contour (orange) of Annual Mean Nitrogen Dioxide Concentrations in 2014 (modelled at 1.5 m) to the South of Junction 6 of the M20.

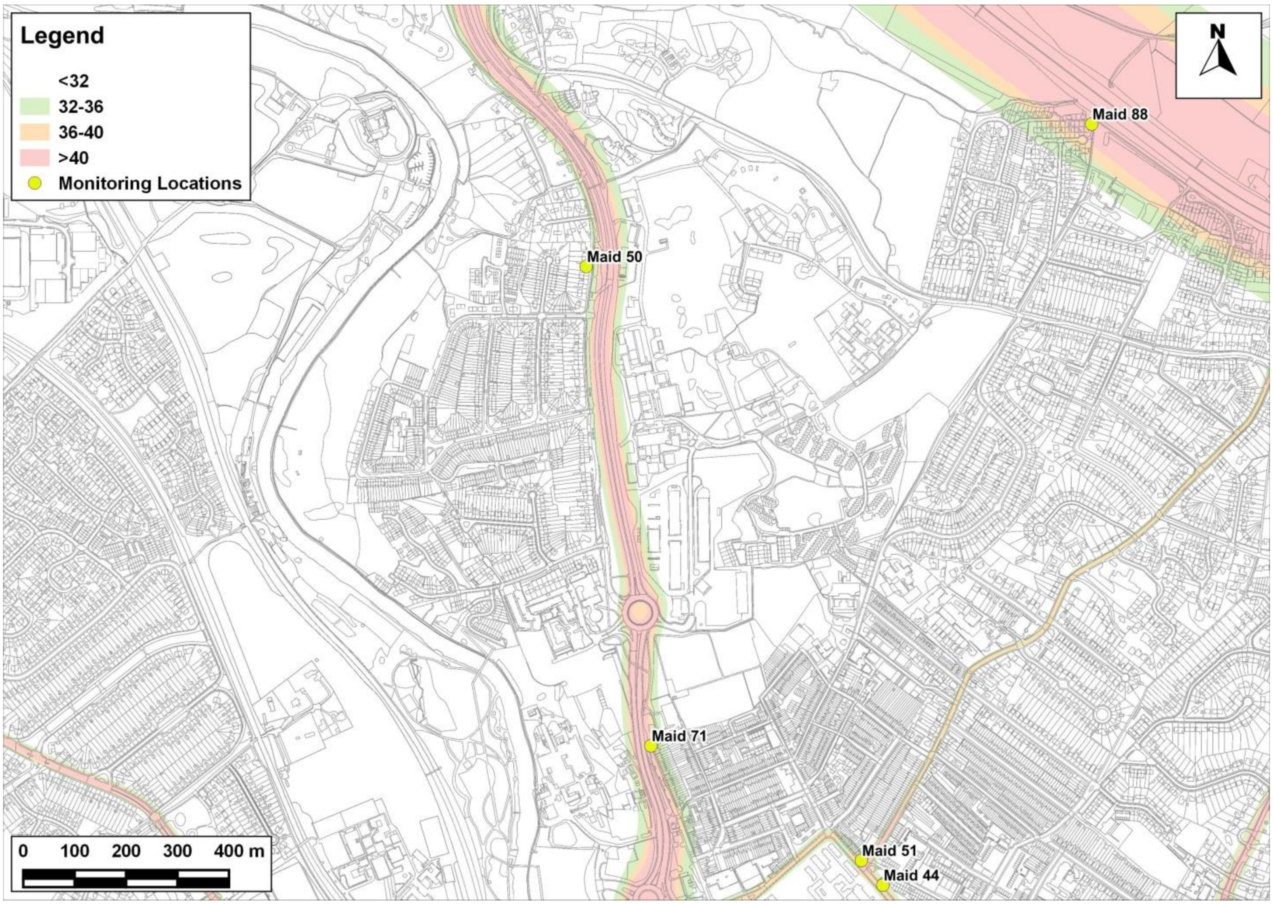

Figure 6: Extent of the Modelled 40 μg/m^3 Contour (red) and 36 μg/m^3 Contour (orange) of Annual Mean Nitrogen Dioxide Concentrations in 2014 (modelled at 1.5 m) along the A229.

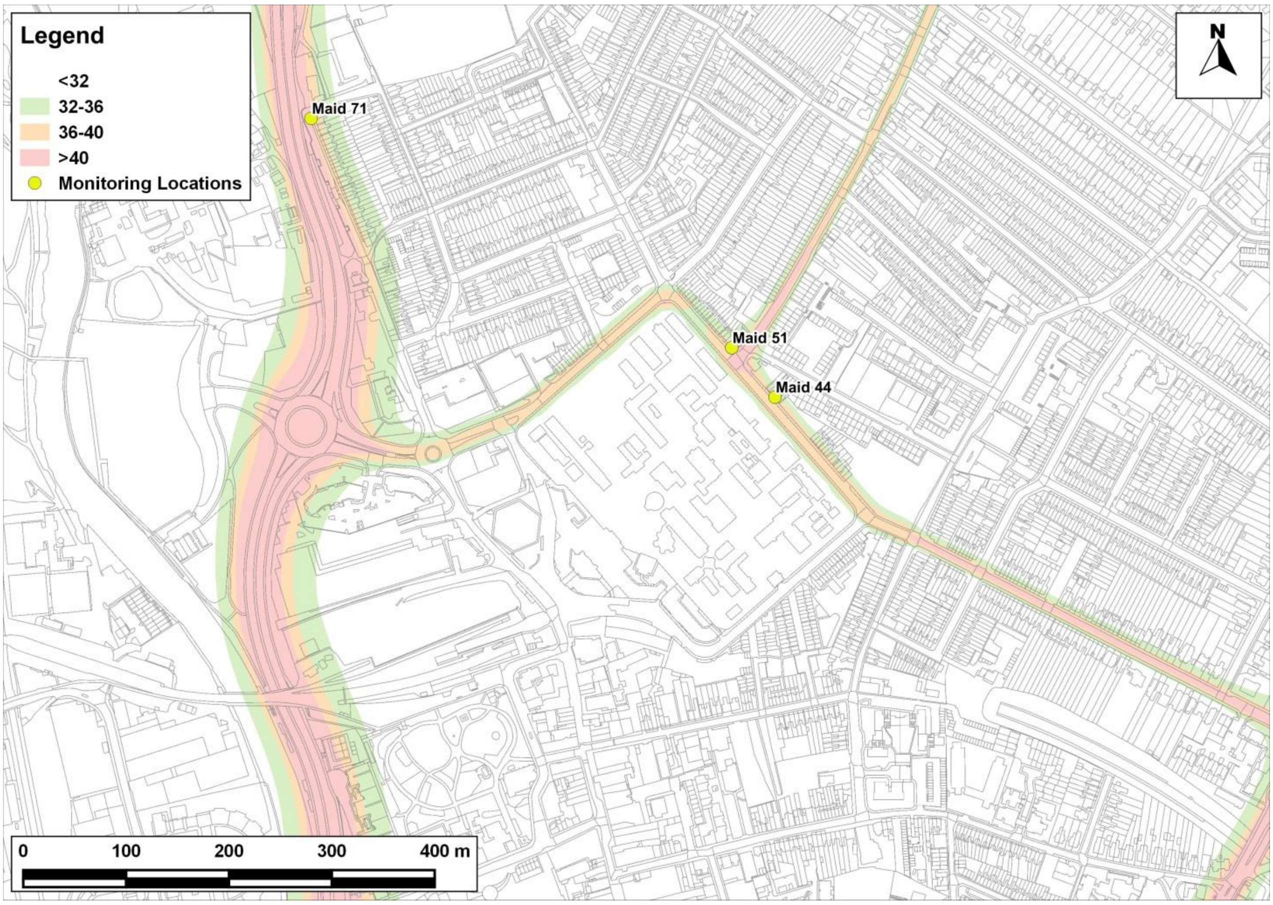

Figure 7: Extent of the Modelled 40 μg/m³ Contour (red) and 36 μg/m³ Contour (orange) of Annual Mean Nitrogen Dioxide Concentrations in 2014 (modelled at 1.5 m) North of Maidstone Town Centre.

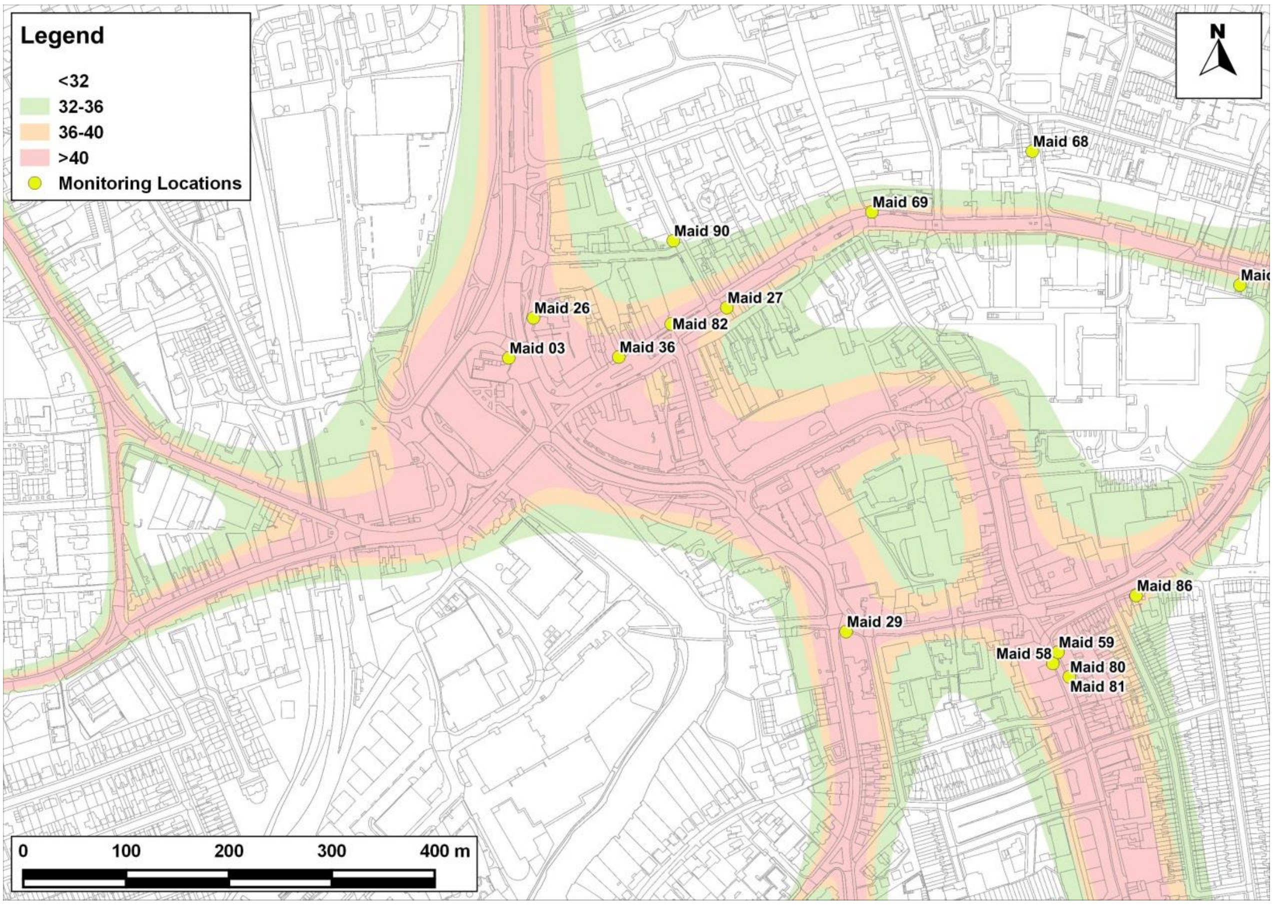

Figure 8: Extent of the Modelled 40 μg/m^3 Contour (red) and 36 μg/m^3 Contour (orange) of Annual Mean Nitrogen Dioxide Concentrations in 2014 (modelled at 1.5 m) in Maidstone Town Centre.

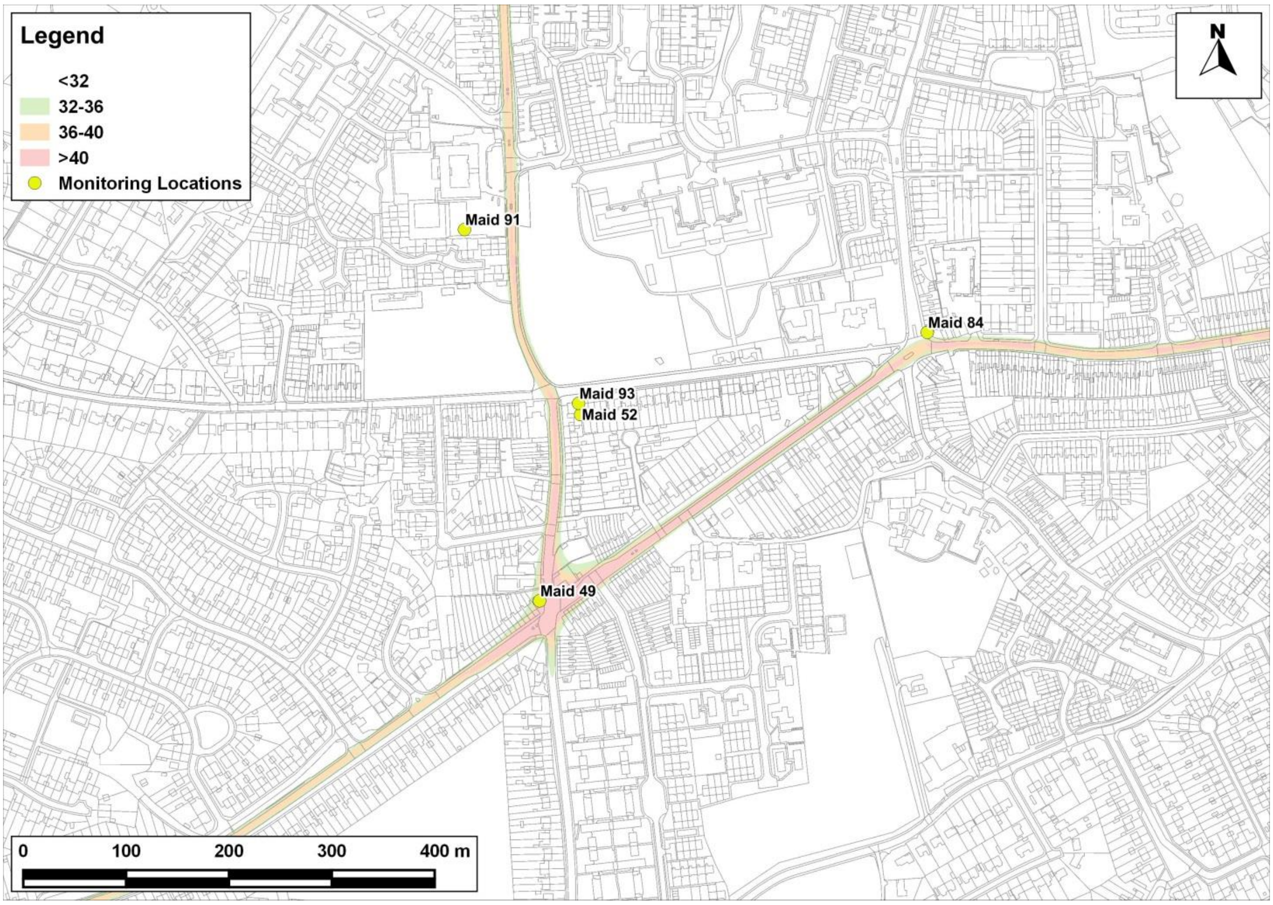

Figure 9: Extent of the Modelled 40 μg/m^3 Contour (red) and 36 μg/m^3 Contour (orange) of Annual Mean Nitrogen Dioxide Concentrations in 2014 (modelled at 1.5 m) along the A26 Tonbridge Road.

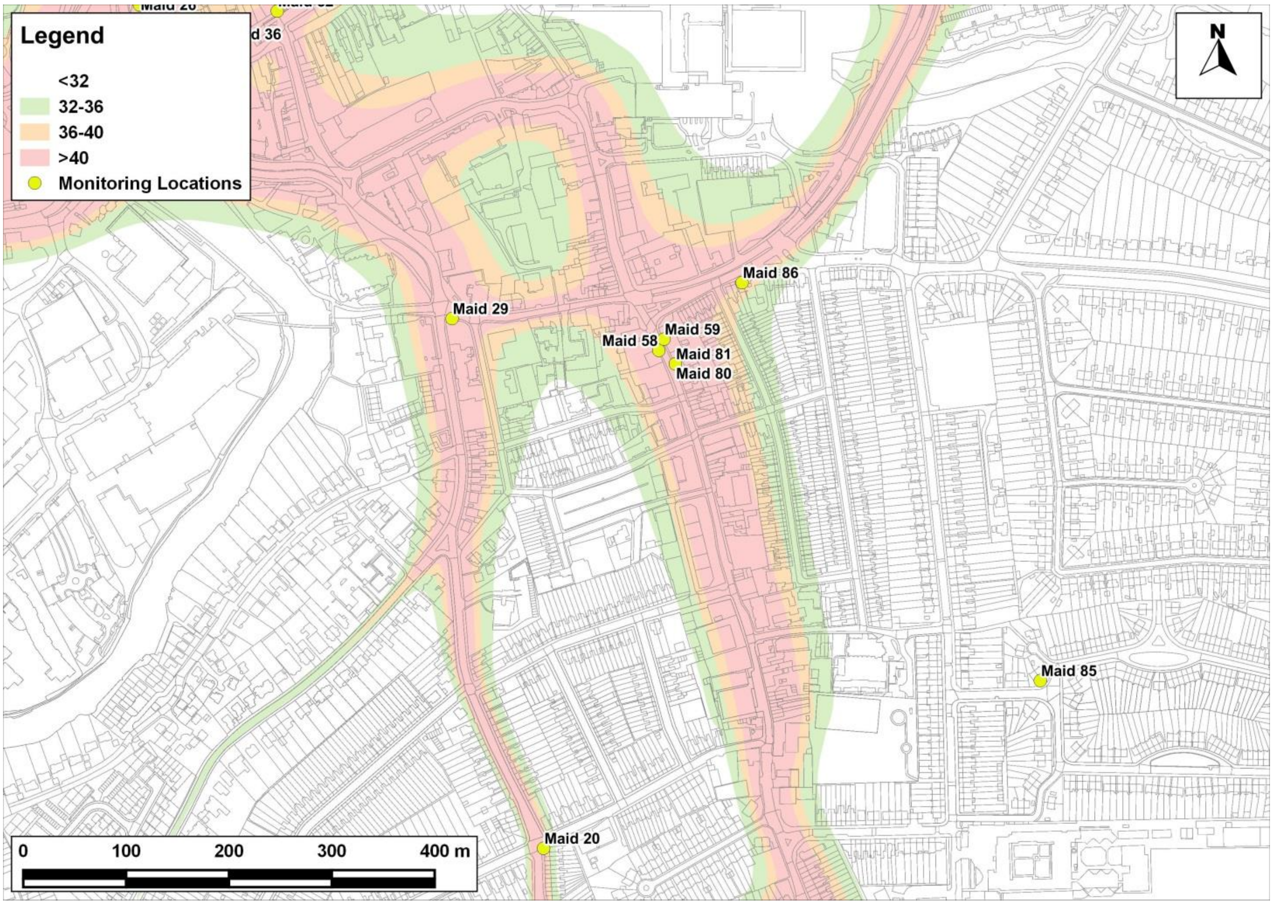

Figure 10: Extent of the Modelled 40 μg/m³ Contour (red) and 36 μg/m³ Contour (orange) of Annual Mean Nitrogen Dioxide Concentrations in 2014 (modelled at 1.5 m) South of Maidstone Town Centre.

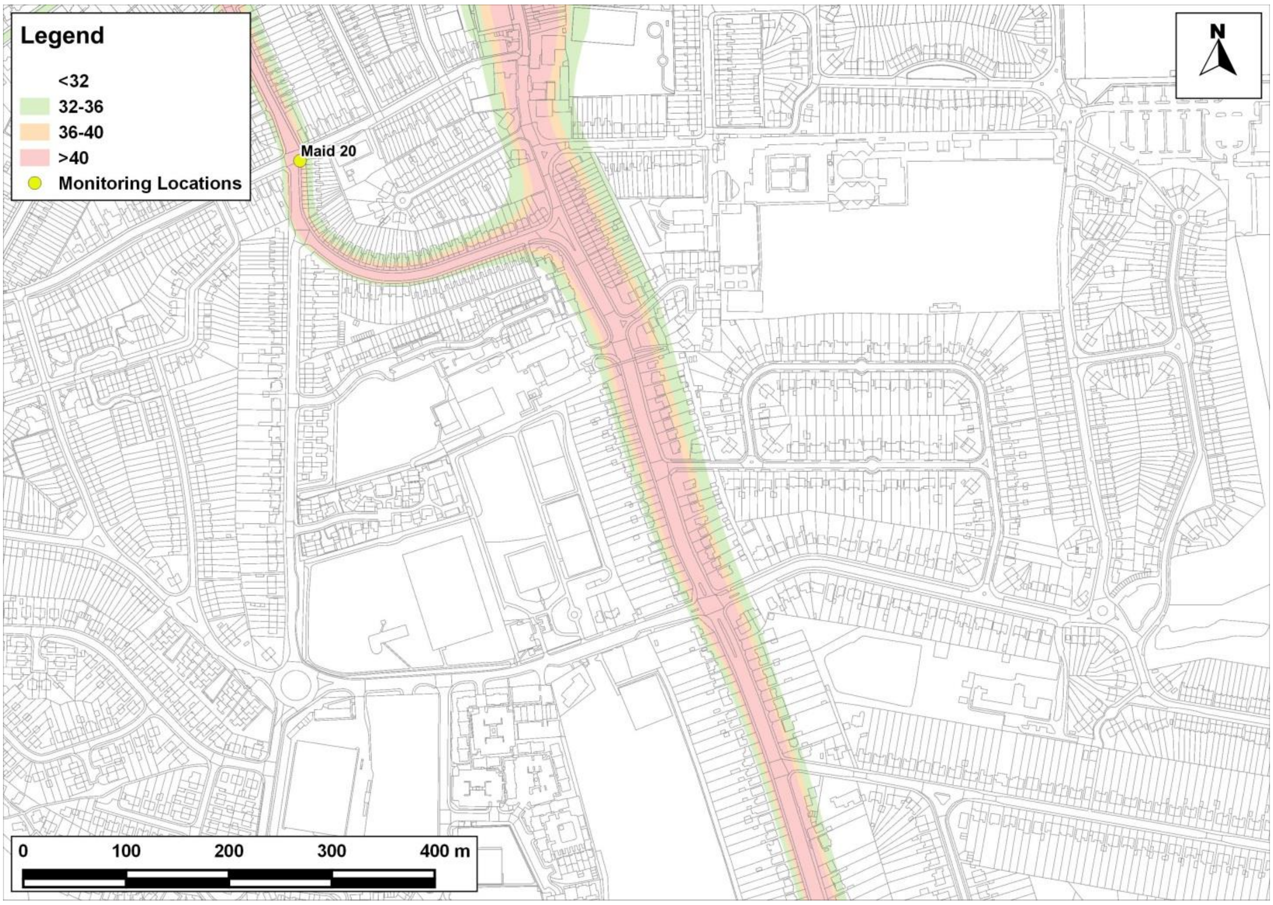

Figure 11: Extent of the Modelled 40 μg/m^3 Contour (red) and 36 μg/m^3 Contour (orange) of Annual Mean Nitrogen Dioxide Concentrations in 2014 (modelled at 1.5 m) along the A229 South of Maidstone Town Centre.

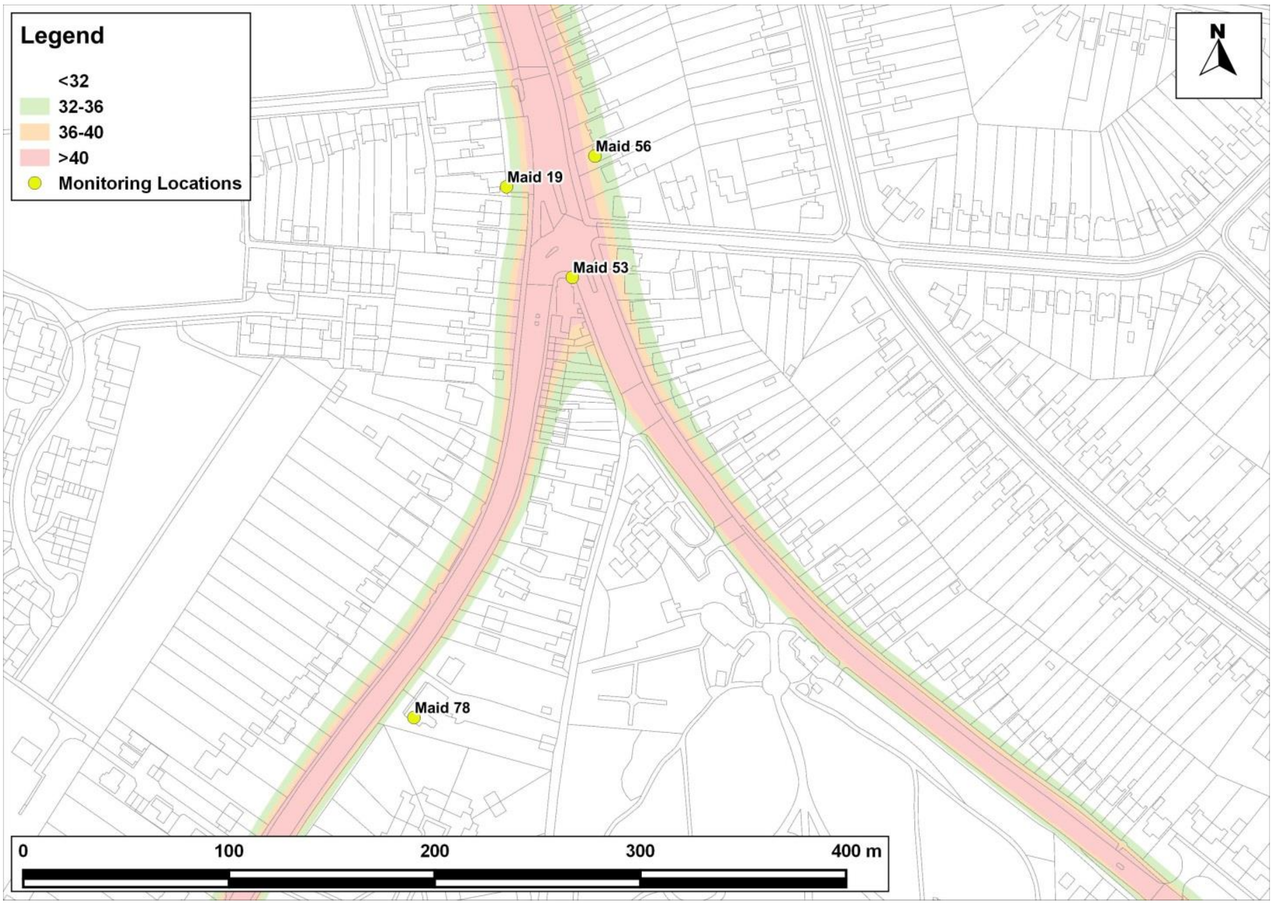

Figure 12: Extent of the Modelled 40 μg/m^3 Contour (red) and 36 μg/m^3 Contour (orange) of Annual Mean Nitrogen Dioxide Concentrations in 2014 (modelled at 1.5 m) at the junction of the A229 and the A274.

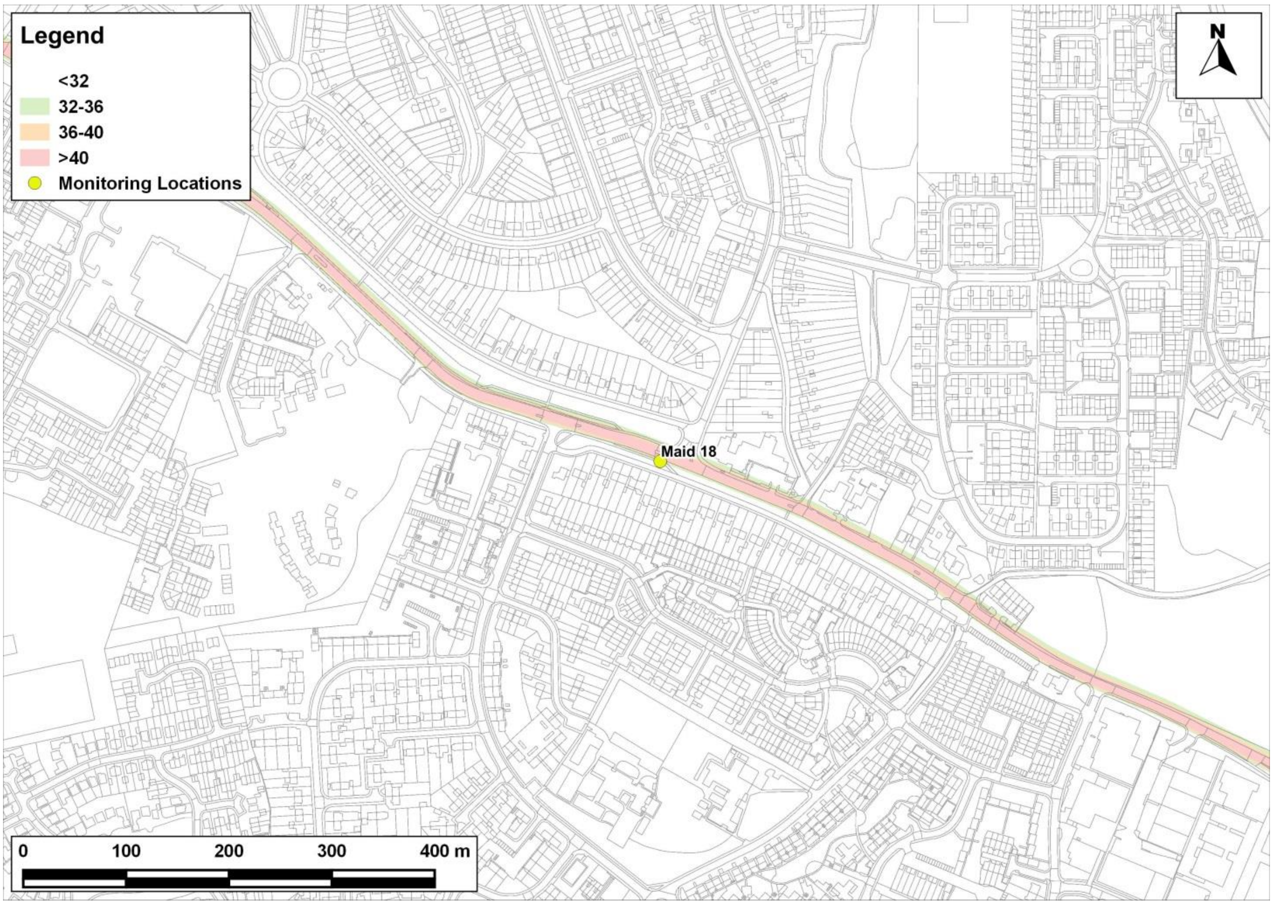

Figure 13: Extent of the Modelled 40 $\mu g/m^3$ Contour (red) and 36 $\mu g/m^3$ Contour (orange) of Annual Mean Nitrogen Dioxide Concentrations in 2014 (modelled at 1.5 m) along the A274.

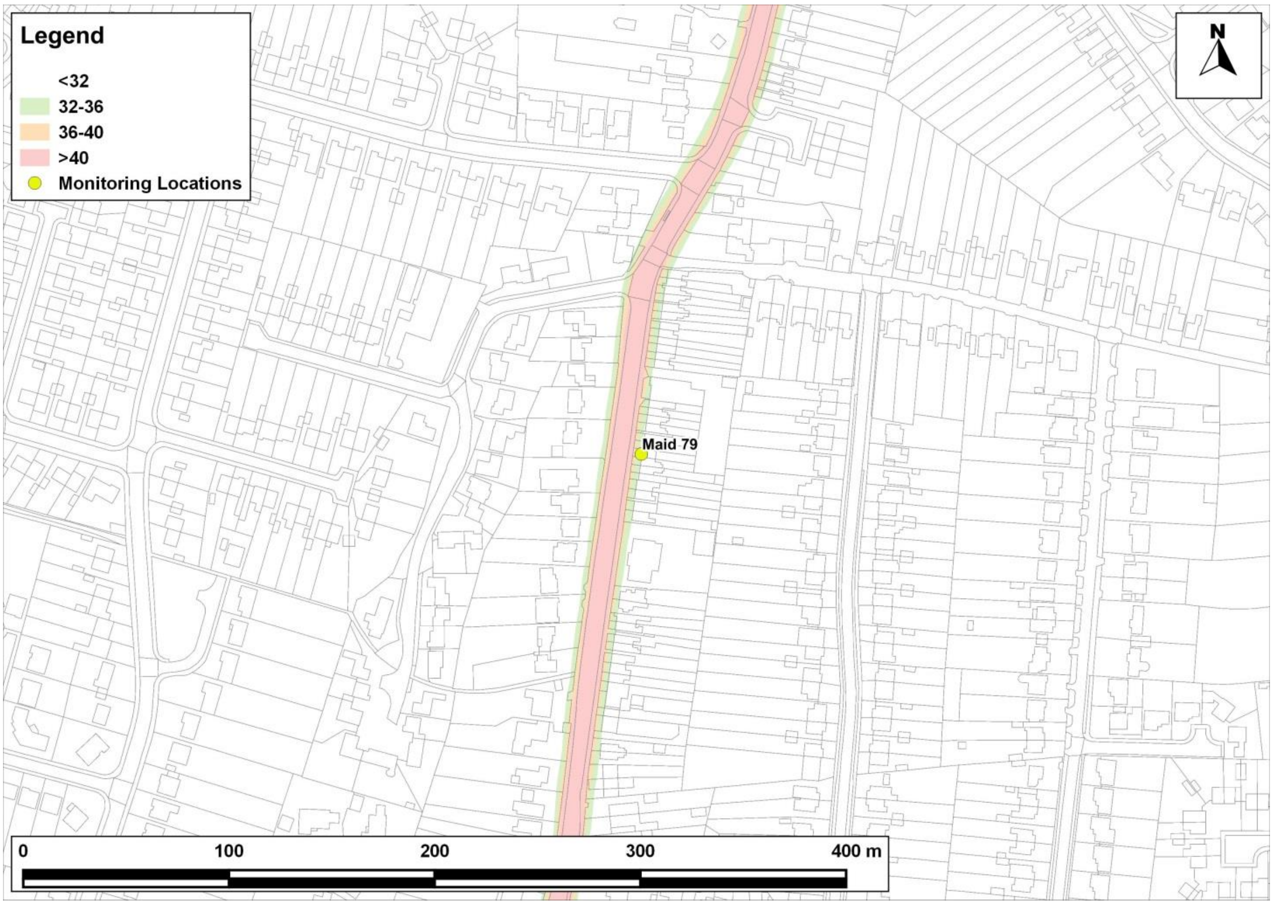

Figure 14: Extent of the Modelled 40 μg/m^3 Contour (red) and 36 μg/m^3 Contour (orange) of Annual Mean Nitrogen Dioxide Concentrations in 2014 (modelled at 1.5 m) along the A2229 South of Maidstone.

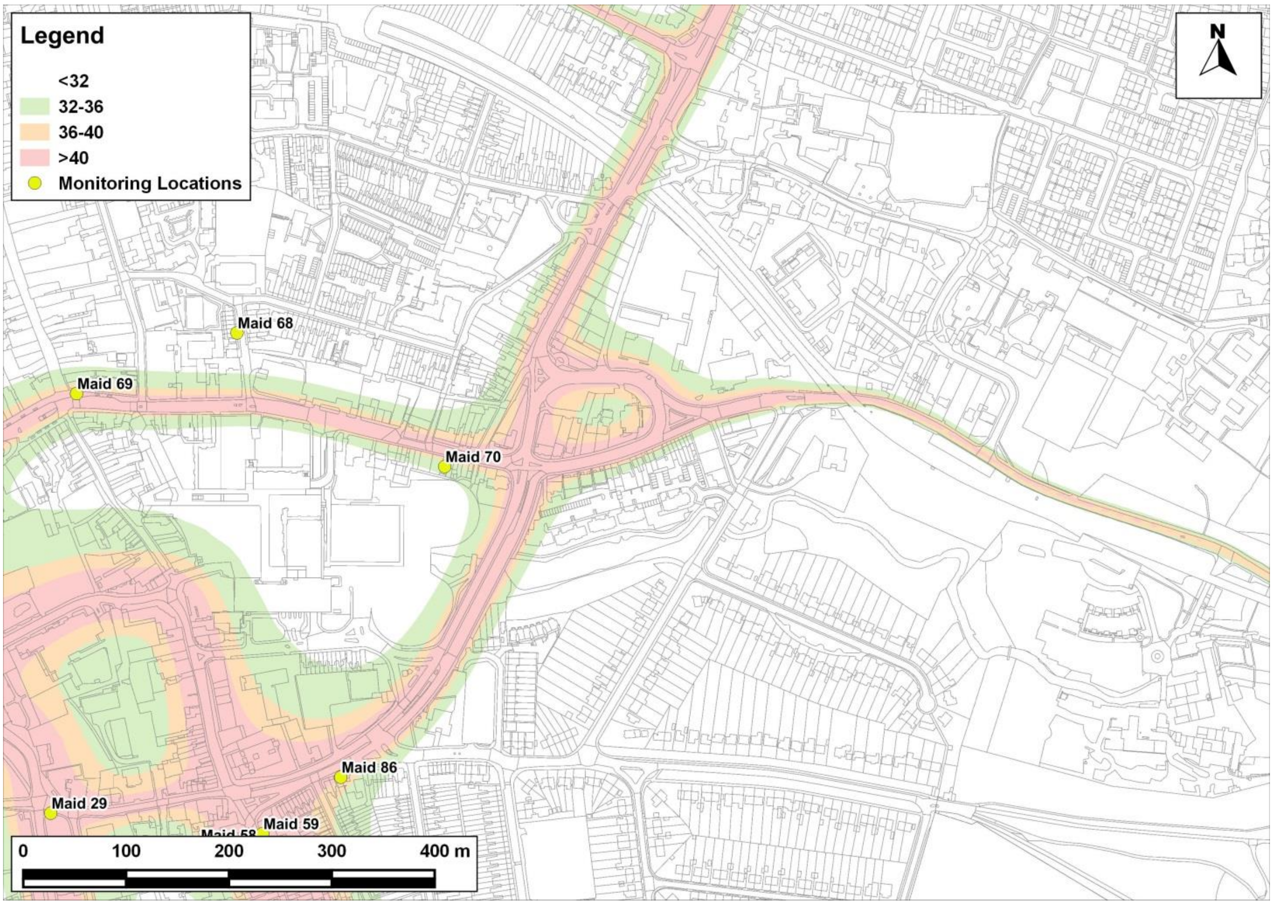

Figure 15: Extent of the Modelled 40 μg/m^3 Contour (red) and 36 μg/m^3 Contour (orange) of Annual Mean Nitrogen Dioxide Concentrations in 2014 (modelled at 1.5 m) to the East of Maidstone Town Centre.

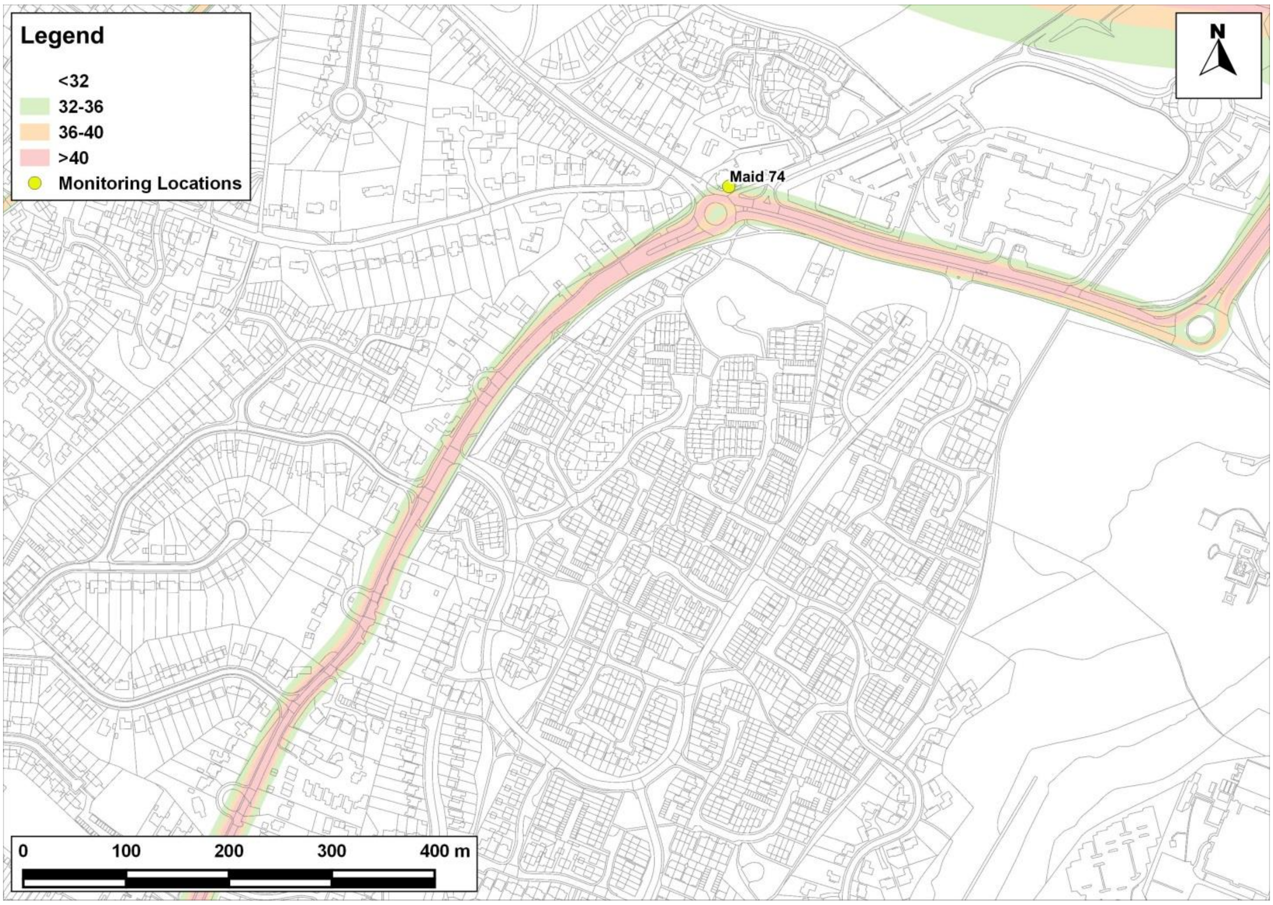

Figure 16: Extent of the Modelled 40 μg/m^3 Contour (red) and 36 μg/m^3 Contour (orange) of Annual Mean Nitrogen Dioxide Concentrations in 2014 (modelled at 1.5 m) along the A249 Bearsted Road

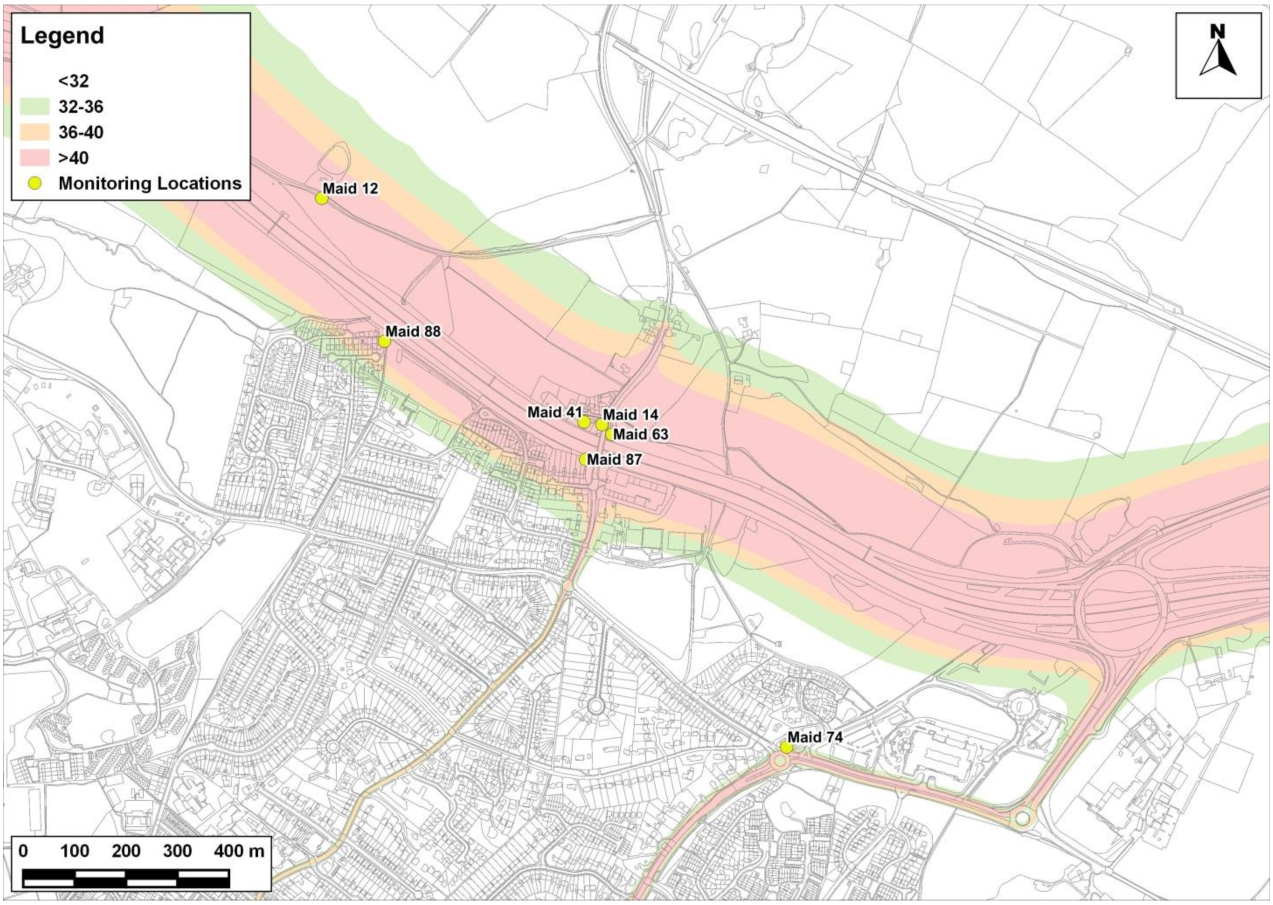

Figure 17: Extent of the Modelled 40 μg/m^3 Contour (red) and 36 μg/m^3 Contour (orange) of Annual Mean Nitrogen Dioxide Concentrations in 2014 (modelled at 1.5 m) along the M20

Figure 18: Extent of the Modelled 40 µg/m^3 Contour (red) and 36 µg/m^3 Contour (orange) of Annual Mean Nitrogen Dioxide Concentrations in 2014 (modelled at 1.5 m) north of the M20 along Forstal Road

3.5 Contains Ordnance Survey data © Crown copyright and database right 2016. Additional data sourced from third parties, including public sector information licensed under the Open Government Licence v1.0. Ordnance Survey licence number 100046099. Figure 4 to Figure 18show that the annual mean objective is likely to be exceeded at locations adjacent to the M20, at locations around the gyratory system in Maidstone town centre, as well as Hayle Road and Upper Stone Street. Exceedences are also predicted at Sheal's Crescent, where the model may be overpredicting, and along the A229 south of Maidstone town centre. There are some locations where there are measured exceedences of the objective (for example diffusion tubes 44 and 51 alongside the prison), which do not appear to be relevant for the annual mean objective. The model is not predicting exceedences at this location and care must be taken to ensure that concentrations in this area are carefully reviewed.

3.6 The model is likely to have over predicted concentrations at various locations along the M20. In some locations the motorway is in a cutting, for example around Boxley Road/ Harbourland Close and it is considered that in this location, monitoring should be used to define the AQMA. Based on monitoring, there are only likely to be exceedences at this location to the north of the M20, and this should be considered within the AQMA declaration.

3.7 Along Forstal Road, the model appears to be underpredicting concentrations. Monitoring at Forstal Road Cottages over the last 6 years suggests concentrations approaching and in some cases exceeding the annual mean nitrogen dioxide objective. It is recommended that this location is included within the AQMA as there was an exceedence of the objective in 2014 (although not in 2015).

3.8 There is some uncertainty surrounding both the measured and modelled concentrations. It is therefore recommended that any amendments to the AQMA include, as a minimum, those residential properties which lie within the 36 $\mu g/m^3$ contour (except near the M20 – see above). This will reduce the possibility of having to change the AQMA boundary as a result of annual variations in concentrations.

4 Source Apportionment

4.1 The sources contributing to the objective exceedences have been identified. The data presented here 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(09) (Defra, 2009).

4.2 Figure 5 and Table 4 set out the relative contributions of traffic emissions. The following categories have been included in the source apportionment:

- Ambient Background (Bkgd);
- Motorcycles (MCL);
- Cars;
- Light Goods Vehicles (LGV);
- Buses; and
- Heavy Goods Vehicles (HGV).

4.3 The eleven receptor locations identified previously have been used to provide an overview of source contributions. Table 4 and Figure 5 show that the most significant component at all receptors is the ambient background concentration, followed by emissions from cars (although not shown, diesel cars will be more important than petrol cars. At Receptors 4, 5 and 10 a higher contribution is from HGVs than at other locations, while at Receptors 6, 8 and 9 buses contribute a more significant proportion to the overall concentration.

Table 4: Predicted Annual Mean Nitrogen Dioxide Concentrations (2014) and the Contribution of Each Source Type to the Total

Receptor	Annual Mean Concentration (µg/m^3)						
	Background	MCL	Car	LGV	Bus	HGV	Total
1	19.2	0.1	6.8	2.8	0.2	2.2	31.4
2	19.2	0.0	12.1	4.6	2.3	3.8	42.0
3	15.1	0.0	6.0	2.2	1.1	2.0	26.4
4	18.2	0.0	8.0	0.7	0.3	4.0	31.2
5	15.2	0.1	12.7	6.0	2.4	4.6	40.9
6	14.2	0.0	7.0	3.4	2.1	2.4	29.1
7	18.6	0.0	8.2	2.9	1.1	1.7	32.6
8	19.6	0.0	10.7	3.9	2.9	2.6	39.7
9	14.9	0.0	8.1	3.9	2.4	2.9	32.2
10	19.4	0.1	16.6	6.4	1.3	7.3	51.1
11	17.5	0.0	10.8	4.4	1.3	3.1	37.1
Receptor	% Contribution to Total						
	Background	MCL	Car	LGV	Bus	HGV	Total
1	61.3	0.2	21.6	9.1	0.7	7.1	100.0
2	45.6	0.1	28.8	10.9	5.6	9.0	100.0
3	57.1	0.1	22.7	8.3	4.3	7.6	100.0
4	58.4	0.0	25.5	2.4	0.9	12.8	100.0
5	37.2	0.1	31.0	14.6	5.8	11.3	100.0
6	48.7	0.1	23.9	11.8	7.1	8.4	100.0
7	57.2	0.1	25.0	9.0	3.3	5.3	100.0
8	49.4	0.1	27.0	9.7	7.2	6.5	100.0
9	46.4	0.1	25.1	12.2	7.3	8.9	100.0
10	38.1	0.2	32.5	12.6	2.5	14.2	100.0
11	47.3	0.1	29.1	11.7	3.5	8.3	100.0

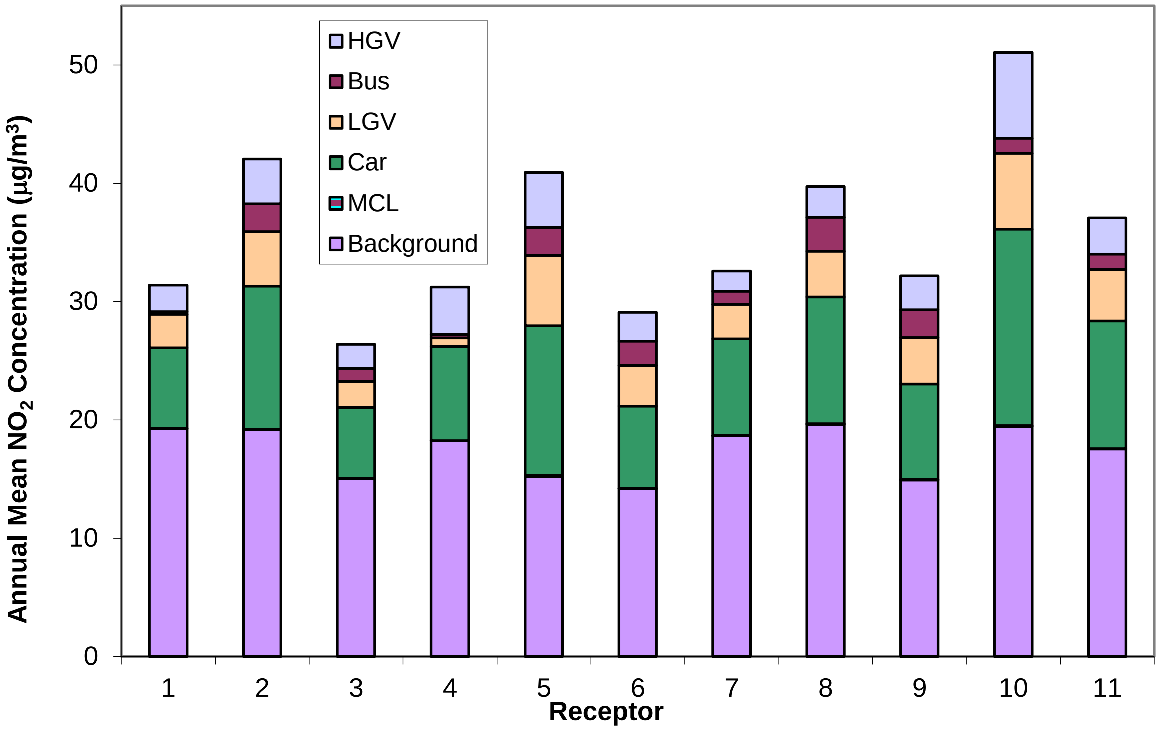

Figure 5: Relative Contribution of Each Source Type to the Total Predicted Annual Mean Nitrogen Dioxide Concentration at Receptor Locations (µg/m³)

5 Conclusions and Recommendations

5.1 A review of the AQMA in Maidstone has been carried out. The assessment has been undertaken using a combination of 2014 monitoring data and modelled concentrations. Concentrations of nitrogen dioxide have been modelled for 2014 using the ADMS-Roads dispersion model. The model has been verified against measurements made at a number of nitrogen dioxide diffusion tube monitoring locations across Maidstone 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 locations of relevant exposure, but not as extensively as the current declared AQMA. There is therefore an opportunity to reduce the size of the AQMA to help focus on those areas with poor air quality. Any adjustment of the AQMA should take account of the uncertainty surrounding both the measured and modelled concentrations. To allow for this it is recommended that any adjustments to the AQMA should include areas within the 36 $\mu g/m^3$ contour

5.3 There are two main options for adjustments of the AQMA. Either the revised AQMA could be based on the entire area within the 36 $\mu g/m^3$ contour across Maidstone, or it could be based on those areas within the 36 $\mu g/m^3$ contour where relevant exposure exists. This latter approach will result in a number of smaller, more discrete AQMAs. There are pros and cons to each of these approaches. A slightly wider AQMA will potentially have the advantage of helping to ensure that relevant exposure is not introduced into areas that may already be exceeding the objective without further assessment and potentially mitigation. The second approach will provide a more focussed basis for Air Quality Action Planning.

5.4 Monitoring on Upper Stone Street suggests that in addition to the annual mean objective, the hourly objective may also be exceeded in this area. Consideration should be given to whether exposure relevant to the hourly objective exists at this location, as this objective may also need to be included within the adjusted AQMA.

5.5 It is also recommended that Maidstone Borough Council continues monitoring nitrogen dioxide at the existing monitoring locations, and expand the network where possible, particularly into areas where the model is suggesting exceedences where there is currently no monitoring. The monitoring results can then be used to inform future Review and Assessment Reports and Air Quality Action Planning.

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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
Exceedence	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
HDV	Heavy Duty Vehicles (> 3.5 tonnes)
HGV	Heavy Goods Vehicle
IAQM	Institute of Air Quality Management
LAQM	Local Air Quality Management
LDV	Light Duty Vehicles (<3.5 tonnes)
µg/m^3	Microgrammes per cubic metre
NO	Nitric oxide
NO_2	Nitrogen dioxide
NOx	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 Professional Experience

Prof. Duncan Laxen, BSc (Hons) MSc PhD MIEnvSc FIAQM

Prof Laxen is the Managing Director of Air Quality Consultants, a company which he founded in 1993. He has over forty years' experience in environmental sciences and has been a member of Defra's Air Quality Expert Group and the Department of Health's Committee on the Medical Effects of Air Pollution. He has been involved in major studies of air quality, including nitrogen dioxide, lead, dust, acid rain, PM_{10}, $PM_{2.5}$ and ozone and was responsible for setting up the UK's urban air quality monitoring network. Prof Laxen has been responsible for appraisals of all local authorities' air quality Review & Assessment reports and for providing guidance and support to local authorities carrying out their local air quality management duties. He has carried out air quality assessments for power stations; road schemes; ports; airports; railways; mineral and landfill sites; and residential/commercial developments. He has also been involved in numerous investigations into industrial emissions; ambient air quality; indoor air quality; nuisance dust and transport emissions. Prof Laxen has prepared specialist reviews on air quality topics and contributed to the development of air quality management in the UK. He has been an expert witness at numerous Public Inquiries, published over 70 scientific papers and given numerous presentations at conferences. He is a Fellow of the Institute of Air Quality Management.

Dr Clare Beattie, BSc (Hons) MSc PhD CSci MIEnvSc MIAQM

Dr Beattie is a Principal Consultant with AQC, with more than fourteen years' relevant experience. She has been involved in air quality management and assessment, and policy formulation in both an academic and consultancy environment. She has prepared air quality review and assessment reports, strategies and action plans for local authorities and has developed guidance documents on air quality management on behalf of central government, local government and NGOs. Dr Beattie has appraised local authority air quality assessments on behalf of the UK governments, and provided support to the Review and Assessment helpdesk. She has also provided support to the integration of air quality considerations into Local Transport Plans and planning policy processes. She has carried out numerous assessments for new residential and commercial developments, including the negotiation of mitigation measures where relevant. Clare also works closely with Defra and is currently managing the Defra Air Quality Grant Appraisal contract. She is the Secretary of the Institute of Air Quality Management.

Kieran Laxen, MEng (Hons) AMIEnvSc MIAQM

Mr Laxen is a Senior Consultant with AQC with over seven years' experience in the field of air quality management and assessment. Previously having two years' experience in scientific research on internal combustion engines, he now works in the field of air quality. He is involved in a wide range of development projects, most of which have involved use of ADMS modelling methodologies for biomass boilers, CHP plant and roads, and is also competent in the assessment of construction dust. He has pioneered the use of OpenAir software within the Company, which is used to analyse air quality monitoring data, and is responsible for routine calibration of air quality monitoring stations, together with data ratification. He is a Member of the Institute of Air Quality Management.

Caroline Odbert, BA (Hons) MSc MIEnvSc MIAQM

Ms Odbert is a Senior Consultant with AQC with over eight years' relevant experience. She is involved in the preparation of air quality assessments for a range of development projects. She has been responsible for a wide range of air quality projects covering impact assessments for new residential and commercial developments, local air quality management, ambient air quality monitoring of nitrogen dioxide and sulphur dioxide and the assessment of nuisance odours. She has extensive modeling experience for road traffic and has worked with a variety of clients to provide expert air quality services and advice, including local authorities, planners, developers and process operators. She is a Member of the Institute of Air Quality Management.

Ricky Gellatly, BSc (Hons) AMIEnvSc AMIAQM

Mr Gellatly is a Senior Consultant with AQC with over four years' relevant experience. Prior to joining AQC he worked as an air quality consultant at Odournet UK Ltd. He has also worked as an oceanographer, and holds a first class degree in meteorology and oceanography from the University of East Anglia. He has undertaken air quality assessments for a wide range of projects, assessing many different pollution sources using both qualitative and quantitative methodologies, with most assessments having included dispersion modelling (using a variety of models). He has assessed road schemes, energy from waste facilities, anaerobic digesters, poultry farms, urban extensions, rail freight interchanges, energy centres, waste handling sites, sewage works and shopping and sports centres, amongst others. He also has experience in ambient air quality monitoring, the analysis and interpretation of air quality monitoring data, monitoring and assessment of nuisance odours and the monitoring and assessment of construction dust.

Full CVs are available at www.aqconsultants.co.uk.

A2 Modelling Methodology

Background Concentrations

A2.1 The background pollutant concentrations across the study area have been defined using the national pollution maps published by Defra (2015). These cover the whole country on a 1x1 km grid and are published for each year from 2011 until 2030. The maps include the influence of emissions from a range of different sources; one of which is road traffic. There is evidence that the current 'official' emissions factors published by Defra may over-predicted the rate at which road traffic emissions of nitrogen oxides will fall in the future. The maps currently in use were verified against measurements made during 2011 at a large number of automatic monitoring stations and so there can be reasonable confidence that the maps are representative of conditions during 2011. Similarly, there is reasonable confidence that the reductions which Defra predicts from other sectors (e.g. rail) will be achieved.

A2.2 In order to calculate background nitrogen dioxide and nitrogen oxides concentrations in 2014, it is assumed that there was no reduction in the road traffic component of backgrounds between 2011[1] and 2014. This has been done using the source-specific background nitrogen oxides maps provided by Defra (2015). For each grid square, the road traffic component has been held constant at 2011 levels, while 2014 values have been taken for the other components. Nitrogen dioxide concentrations have then been calculated using the background nitrogen dioxide calculator which Defra (2015) publishes to accompany the maps. The result is a set of 'adjusted 2014 background' concentrations.

A2.3 As an additional step, the 'adjusted 2014 background' mapped nitrogen dioxide values have been plotted against national background measurements made as part of the AURN (Defra, 2015d) during 2014 (see Figure A2.1). Based on the 40 sites with more than 75% data capture for 2014, the maps show an almost 1:1 relationship, being just 0.2% different. Thus no further adjustment has been applied.

[1] This approach assumes that there has been no reduction in emissions per vehicle, but that traffic volumes have remained constant. This is not the same as the assumption made for dispersion modelling, in which emissions per vehicle are held constant while traffic volumes are assumed to change year on year. This discrepancy is unlikely to influence the overall conclusions of the assessment.

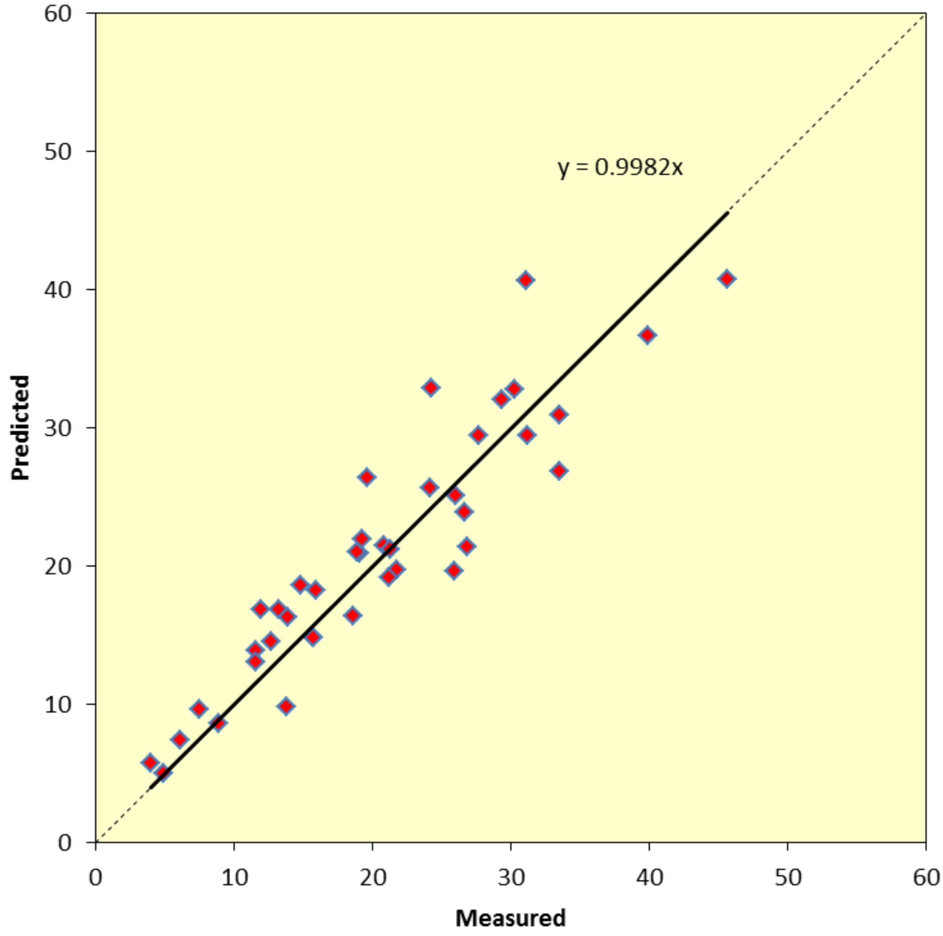

Figure A2.1: Predicted Mapped versus Measured NO_2 Concentrations at AURN Background Sites in 2014

Model Inputs

Road Traffic

A2.4 Predictions have been carried out using the ADMS-Roads dispersion model (v3.4). The model requires the user to provide various input data, including emissions from each section of road, and the road characteristics (including road width and street canyon height, where applicable). Vehicle emissions have been calculated based on vehicle flow, composition and speed data using the Emission Factor Toolkit (Version 6.0.2) published by Defra (2015). For nitrogen dioxide, future-year concentrations have been predicted once using year-specific emission factors from the EFT, and once using emission factors for 2014[2], which is the year for which the model has been verified.

2 i.e. combining current-year emission factors with future-year traffic data.

A2.5 The model has been run using the full year of meteorological data that correspond to the most recent set of nitrogen dioxide monitoring data (2014). The meteorological data have been taken from the monitoring station located at Gatwick Airport, which is considered suitable for this area.

A2.6 For the purposes of modelling, it has been assumed that a street canyon is formed by the buildings along parts of the B2012 Well Road and Lower Boxley Road. This road has a number of canyon-like features, which reduce dispersion of traffic emissions, and can therefore lead to concentrations of pollutants being higher here than they would be in areas with greater dispersion.

A2.7 AADT flows and vehicle fleet composition data have sourced from the Department of Transport (DfT, 2015), UK Traffic Data (UK Traffic Data, 2015) and Maidstone Borough Council. Traffic speeds have been estimated based on professional judgement, taking account of the road layout, speed limits and the proximity to a junction. The traffic data used in this assessment are summarised in Table A2.1.

Table A2.1: Summary of Traffic Data used in the Assessment (AADT Flows)

Road Link	AADT	%MCL	%Car	%LGV	%Bus	%HGV
M20 WB West of J6	63,121	0.6	74.3	13.3	0.3	11.5
M20 EB West of J6	69,116	0.5	72.7	15.8	0.3	10.7
M20 WB East of J6	54,469	0.8	73.4	15.0	0.6	10.2
M20 EB East of J6	62,394	0.9	71.9	15.5	0.4	11.2
M20 WB East of J7	37,748	0.7	69.9	15.5	0.4	13.5
M20 EB East of J7	36,697	0.6	68.4	16.6	0.5	14.0
A249 NB North of M20	22,484	0.7	73.4	17.2	0.2	8.4
A249 SB North of M20	19,156	0.8	75.3	16.1	0.3	7.5
A249 NB South of M20	9,001	0.6	83.7	12.3	0.9	2.5
A249 SB South of M20	9,227	0.5	84.3	12.6	0.7	1.9
Boxley Road	8,605	0.0	95.0	0.0	0.0	5.0
A229 North of M20	67,940	0.9	79.9	15.0	0.3	3.9
Forstal Road	9,258	1.7	83.3	12.4	0.2	2.4
A229 NB South of M20	17,781	1.3	83.7	11.5	0.2	3.3
A229 SB South of M20	19,645	1.3	81.8	13.2	0.5	3.3
A20 London Road NB	7,527	0.9	84.1	11.6	1.6	1.8
A20 London Road SB	8,869	0.9	84.1	11.6	1.6	1.8
A26 Tonbridge Road WB (East of B2246)	6,825	0.8	81.8	14.2	0.8	2.3
A26 Tonbridge Road EB (East of B2246)	6,709	1.1	83.1	13.0	0.9	1.8
A26 Tonbridge Road (West of B2246)	13,534	1.0	82.5	13.6	0.9	2.0
B2246 Fountain Lane	15,068	0.3	93.0	3.9	0.8	2.0
Farleigh Lane	6,157	0.3	91.2	5.7	0.8	2.0
Bridge Gyratory (Broadway to Fairmeadow)	32,920	0.9	84.1	11.6	1.6	1.8
Bridge Gyratory (Fairmeadow to High Street	32,572	0.9	83.7	12.0	1.6	1.7
Bridge Gyratory (High Street to Broadway)	32,920	0.9	84.1	11.6	1.6	1.8
Fairmeadow NB	20,426	1.0	84.1	12.0	0.2	2.7
Fairmeadow NB	20,078	1.1	83.5	12.7	0.2	2.6

Road Link	AADT	%MCL	%Car	%LGV	%Bus	%HGV
High Street/King Street	1,833	0.1	47.5	13.9	37.7	0.8
Bishop's Way NB	22,715	0.9	84.1	12.1	0.2	2.7
Bishop's Way SB	20,864	0.9	84.6	11.1	0.3	3.2
Mill Street	1,541	0.1	58.3	11.6	28.1	1.8
A229 Mill Street	26,632	1.0	82.3	12.8	1.2	2.7
Palace Avenue/Lower's Stone Street	21,716	0.8	82.7	12.7	1.2	2.6
Knightrider Street	8,668	0.7	87.2	10.2	1.0	1.0
Wat Tyler Way NB	6,789	0.7	86.6	9.6	1.3	1.8
Wat Tyler Way SB	11,178	0.6	83.7	10.7	1.5	3.5
A229 College Road	27,150	0.7	84.0	11.5	1.1	2.7
B2010 College Road/Tovil Hill	5,900	0.7	84.0	11.5	1.1	2.7
A229 Hayle Road/Sheal's Crescent	12,339	1.0	77.8	15.1	2.7	3.4
Upper Stone Street	32,659	1.0	81.9	13.2	1.0	2.9
A229 Loose Road NB	16,787	0.9	80.3	15.0	1.0	2.8
A229 Loose Road SB	15,319	1.0	80.7	14.3	1.1	3.0
A274 Sutton Road	17,732	1.0	79.4	15.1	1.7	2.8
A229 Loose Road South of Sutton Road	17,663	0.7	81.7	12.2	1.5	3.9
A20 Ashford Road WB	6,282	0.8	85.9	11.3	0.6	1.4
A20 Ashford Road EB	6,353	0.7	85.7	11.9	0.5	1.2
A249 Albion Place NB	9,001	0.6	83.7	12.3	0.9	2.5
A249 Albion Place SB	9,227	0.5	84.3	12.6	0.7	1.9
B2012 Holland Road/Well Road	7,967	0.8	93.5	3.4	0.5	1.8
B2012 Staceys Street/Lower Boxley Road	6,023	0.6	93.7	3.4	0.5	1.8

A2.8 Diurnal flow profiles for the traffic have been derived from the national diurnal profiles published by DfT (2011).

A2.9 Figure A2.2 shows the road network included within the model and defines the study area.

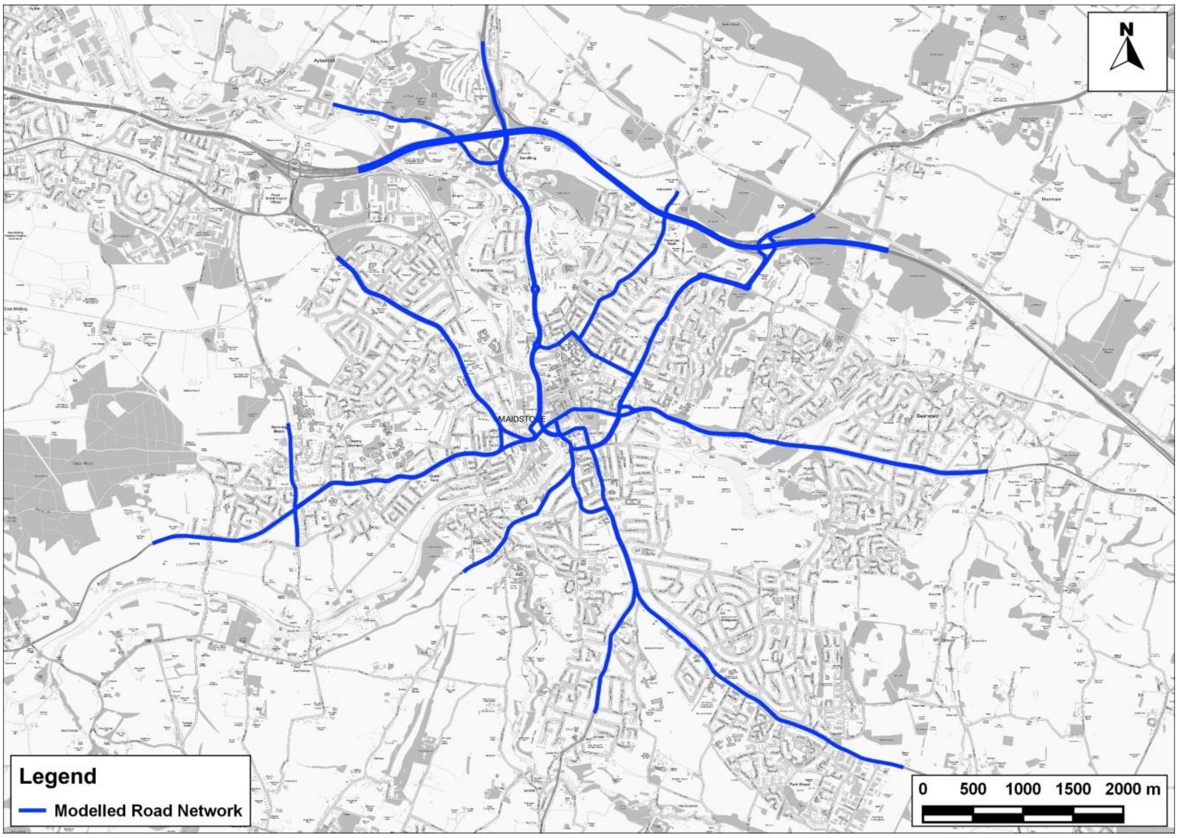

Figure A2.2: Modelled Road Network

Model Verification

A2.10 In order to ensure that ADMS-Roads accurately predicts local concentrations, it is necessary to verify the model against local measurements. Modelled road-NOx contributions from all roads other than motorways have been adjusted based on local measurements. Motorway contributions have not been adjusted as the model performed well when modelling the motorway section, confirmed by a comparison of the modelled road-NOx and measured concentration at diffusion tube site Maid 63, suggesting a verification factor for motorway road-NOx of less than 1. In practice, no adjustment has been applied. This has led to modelled concentrations close to the M20 being significantly over predicted.

A2.11 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 (NOx = NO + NO_2). The model has been run to predict the annual mean NOx concentrations during 2014 at 15 of the roadside diffusion tube monitoring sites.

A2.12 The model output of road-NOx (i.e. the component of total NOx coming from road traffic) has been compared with the ‘measured’ road-NOx. Measured road-NOx has been calculated from the measured NO_2 concentrations and the predicted background NO_2 concentration using the NOx from NO_2 calculator (Version 4.1) available on the Defra LAQM Support website (Defra, 2015).

A2.13 A primary 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 A2.3). This factor has then been applied to the modelled road-NOx concentration for each receptor to provide adjusted modelled road-NOx concentrations. The total nitrogen dioxide concentrations have then been determined by combining the adjusted modelled road-NOx concentrations with the predicted background NO_2 concentration within the NOx to NO_2 calculator. A secondary adjustment factor has finally been calculated as the slope of the best-fit line applied to the adjusted data and forced through zero (Figure A2.4).

A2.14 The following primary and secondary adjustment factors have been applied to all non-motorway modelled nitrogen dioxide data:

- Primary adjustment factor : 3.119
- Secondary adjustment factor: 1.010

A2.15 The results imply that the model has under predicted the road-NOx contribution. This is a common experience with this and most other models. The final NO_2 adjustment is minor.

A2.16 Figure A2.5 compares final adjusted modelled total NO_2 at each of the monitoring sites to measured total NO_2, and shows a 1:1 relationship.

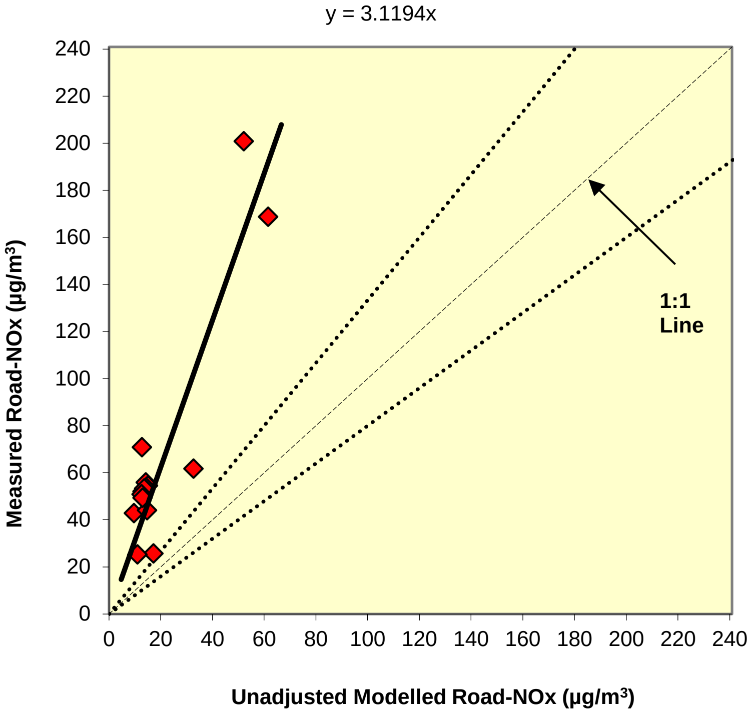

Figure A2.3: Comparison of Measured Road NOx to Unadjusted Modelled Road NOx Concentrations. The dashed lines show ± 25%.

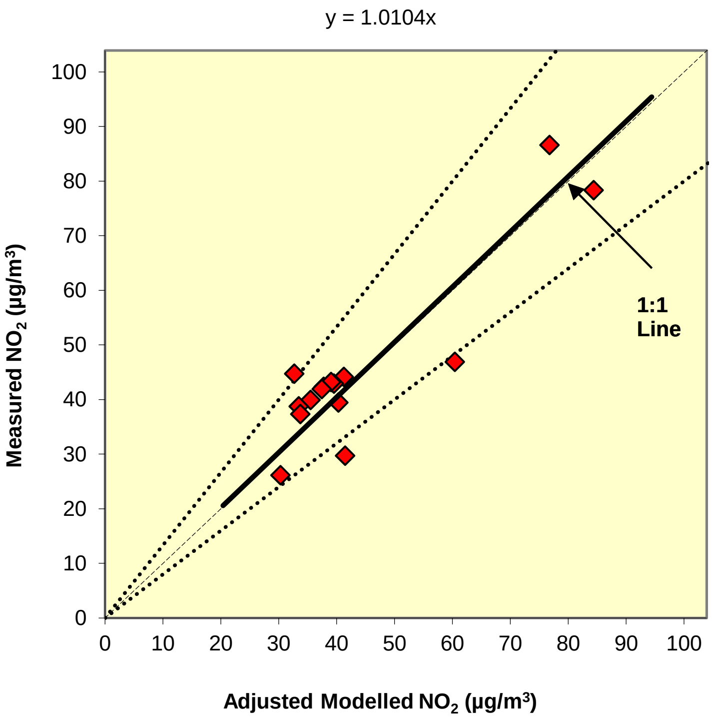

Figure A2.4: Comparison of Measured Total NO_2 to Primary Adjusted Modelled Total NO_2 Concentrations. The dashed lines show ± 25%.

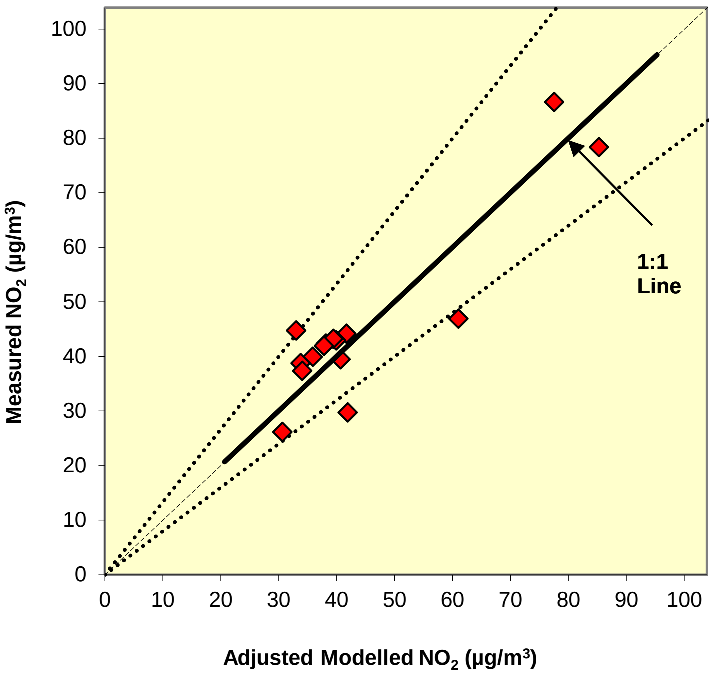

Figure A2.5: Comparison of Measured Total NO_2 to Final Adjusted Modelled Total NO_2 Concentrations. The dashed lines show ± 25%.

A2.17 Table A2.2 presents primary adjustment factors at each of the monitoring locations included within the verification. These figures have been used to derive the overall primary and secondary adjustment factors outlined in paragraph A2.14.

Table A2.2: Primary Adjustment Factors used in the Model Verification Process

Monitoring site	Measured Concentration (μg/m^3)	Primary Adjustment Factor
Maid 03	46.9	1.88
Maid 20	29.7	1.48
Maid 21	39.9	3.88
Maid 27	44.1	3.60
Maid 44	42.3	3.99
Maid 51	42.9	3.72
Maid 52	44.7	5.52
Maid 57	38.7	4.40
Maid 58	86.6	3.85
Maid 59	78.3	2.74
Maid 70	43.2	3.89
Maid 79	26.1	2.26
Maid 80	41.9	4.00
Maid 86	39.4	2.96
Maid 92	37.3	3.78

Model Post-processing

A2.18 The model predicts road-NOx concentrations at each receptor location. These concentrations have then been adjusted using the primary adjustment factor, which, along with the background NO_2, has been processed through the NOx to NO_2 calculator available on the Defra LAQM Support website (Defra, 2015). The traffic mix within the calculator has been set to “All other urban UK traffic”, which is considered suitable for the study area. The calculator predicts the component of NO_2 based on the adjusted road-NOx and the background NO_2. This has then been adjusted by the secondary adjustment factor to provide the final predicted concentrations.