Detailed Assessment of Air Quality in Dacorum

Document Control

Client	Dacorum Borough Council	**Principal Contact**	Alison King

Job Number	J640

Report Prepared By:	Dr Denise Welch

Document Status and Review Schedule

Issue No.	Report No.	Date	Status	Reviewed by
1	640/1/F1	26/10/07	Final Report	Prof. Duncan Laxen
2				
3				

Air Quality Consultants Ltd
23 Coldharbour Road, Bristol BS6 7JT Tel: 0117 974 1086
12 Airedale Road, London SW12 8SF Tel: 0208 673 4313
aqc@aqconsultants.co.uk

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

Contents

1 Introduction

1.1 Air Quality Consultants Ltd has been commissioned by Dacorum Borough Council to undertake a Detailed Assessment of air quality in three locations across the borough. In April 2006, Dacorum Borough Council completed its Updating and Screening Assessment of air quality within the Borough. Routine monitoring of nitrogen dioxide at locations within Hemel Hempstead, Apsley and Northchurch highlighted possible breaches of the 2005 annual mean objective at locations of relevant exposure. The aim of this Detailed Assessment is to determine whether the air quality objectives are being exceeded, and if so, the extent of the Air Quality Management Areas required.

Background

1.2 The Government's Air Quality Strategy for England, Scotland, Wales and Northern Ireland (Defra, 2007a) 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. 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 the current and likely future air quality in their area. The role of this process is to identify areas where it is unlikely that the air quality objectives will be achieved by the due date. These locations must be designated as AQMAs and a subsequent action plan developed in order to reduce pollutant emissions in pursuit of the objectives.

1.3 Review and Assessment is a long-term, ongoing process, structured as a series of 'rounds'. Local Authorities in England, Scotland and Wales have now completed the first round of Review and Assessment and largely completed the second round, with the third round underway.

1.4 Local Air Quality Management Technical Guidance (LAQM.TG(03)) (Defra, 2003b) sets out a phased approach to the second and third rounds of Review and Assessment. This prescribes an initial Updating and Screening Assessment (USA), which all authorities must undertake. It is based on a checklist to identify any matters that have changed since the first round. If the USA identifies any areas where there is a risk that the objectives may be exceeded, which were not identified in the first round, then the Local Authority should progress to a Detailed Assessment (DA).

1.5 The purpose of the Detailed Assessment (DA) 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 DA 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. Subsequent to the declaration of an AQMA, a Further Assessment should be carried out to confirm that the AQMA declaration is justified; that the appropriate area has been declared; to ascertain the sources contributing to the exceedence; and to calculate the magnitude of reduction in emissions required to achieve the objective. This information can be used to inform an Air Quality Action Plan, which will identify measures to improve local air quality.

1.6 This report represents a Detailed Assessment in the third round of Review and Assessment, following the findings from the Updating and Screening Assessment published in 2006.

The Air Quality Objectives

1.7 The Government has established a set of air quality standards and objectives to protect human health. 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. The objectives for use by local authorities are prescribed within the Air Quality 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.

1.8 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.

1.9 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 (Laxen and Marner, 2003). 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.

1.10 The European Union has also set limit values for nitrogen dioxide. Achievement of these values is a national obligation rather than a local one. The limit values for nitrogen dioxide are the same levels as the UK objectives, and are to be achieved by 2010 (Stationery Office, 2007). The objectives are more stringent than the limit values, thus it is appropriate to focus the assessment on the objectives.

Table 1: Relevant Air Quality Objectives

Pollutant	Time Period	Objective	To be achieved by
Nitrogen Dioxide	1-hour mean	200 µg/m^3 not to be exceeded more than 18 times a year	2005
	Annual mean	40 µg/m^3	2005

2 Assessment Methodology

Existing Air Quality

2.1 Air pollutant concentrations in the vicinity of an emission source will be related to both the source strength and the background concentration to which the local source is added. Background concentrations of nitrogen dioxide within Dacorum have been taken from the national maps of background concentrations available from the Air Quality Archive (Defra, 2007b).

2.2 This report covers areas identified within the 2006 Updating and Screening Assessment (Dacorum BC, 2006) highlighted by diffusion tube monitoring. The areas investigated in this report include London Road, Apsley; Lawn Lane, Hemel Hempstead; and High Street, Northchurch (see Figures 1, 2 and 3).

2.3 Monitoring for nitrogen dioxide is carried out within each of the three areas using passive diffusion tubes at the locations shown in Figures 1, 2 and 3, and described in Table 2. Dacorum Borough Council uses diffusion tubes prepared and analysed by Harwell Scientific Services (50% TEA in acetone). All of the data presented in this report have been adjusted to account for diffusion tube bias using the bias adjustment factor provided in the Review and Assessment Helpdesk website (version 03/07; Defra, 2007b) of 0.78 for 2006, calculated from 12 studies. A number of additional monitoring locations were established in July 2006, and as a consequence, the 12 months of monitoring data between July 2006 and June 2007 inclusive have been adjusted to 2006 annual mean equivalent concentrations. Further details of this adjustment are provided in Appendix 2.

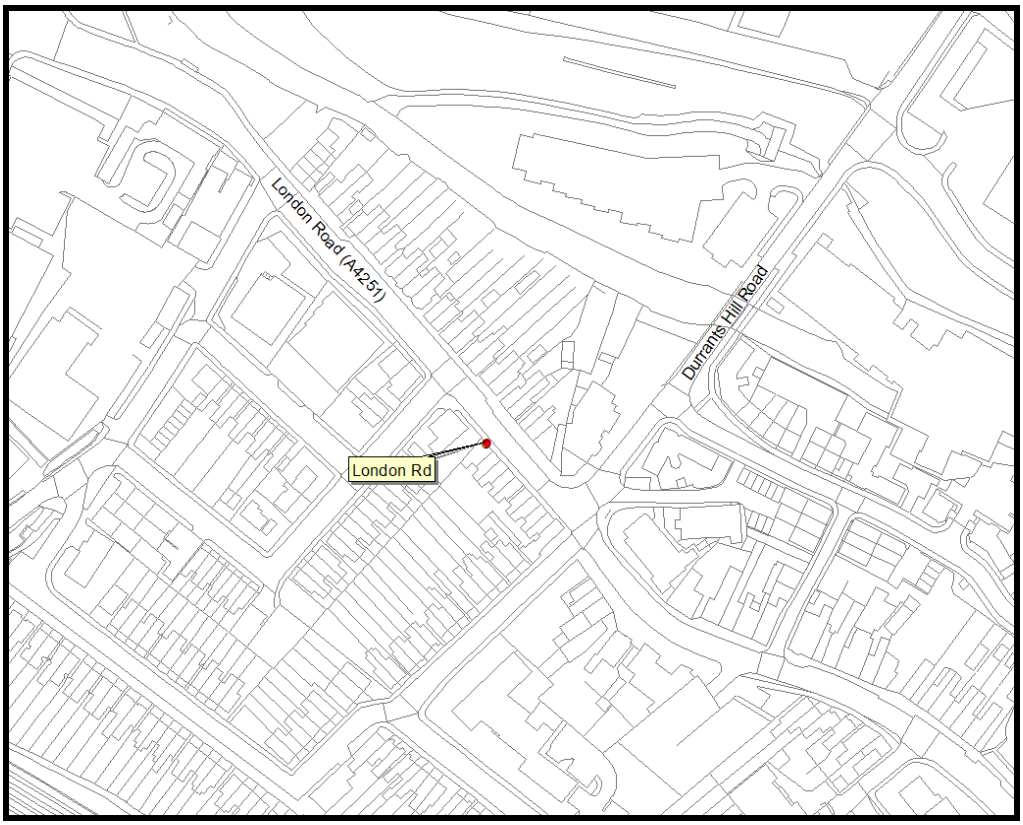

Figure 1: London Road, Apsley Study Area. Red dots show diffusion tube monitoring locations.

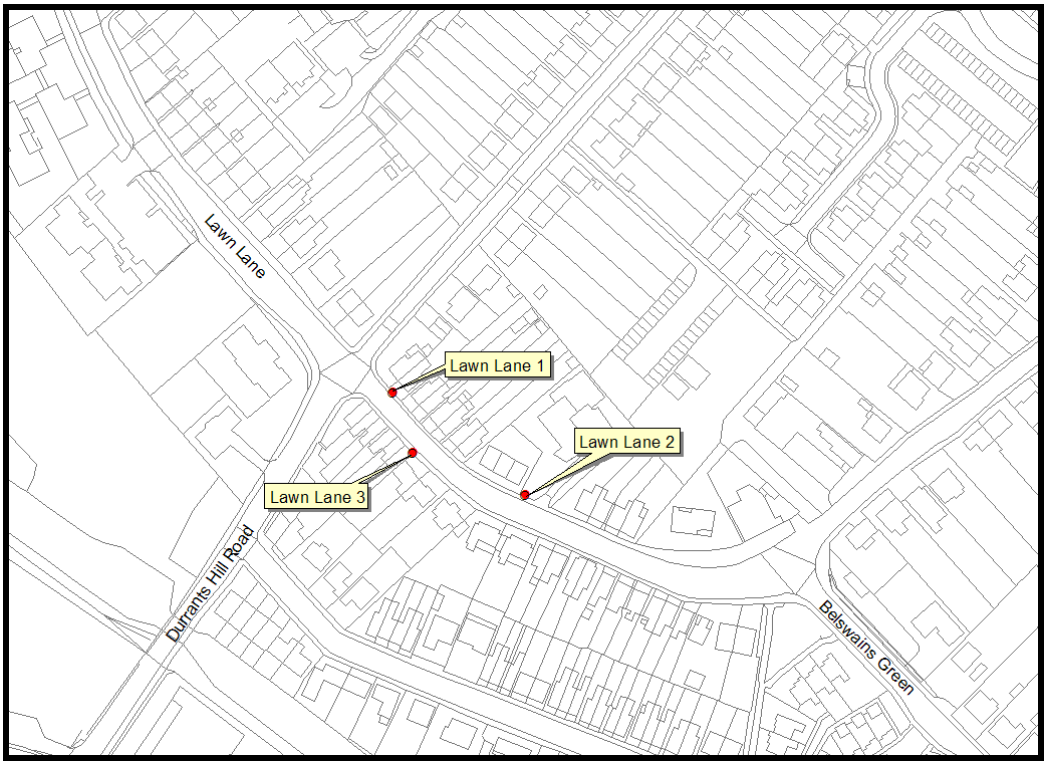

Figure 2: Lawn Lane, Hemel Hempstead Study Area. Red dots show diffusion tube monitoring locations.

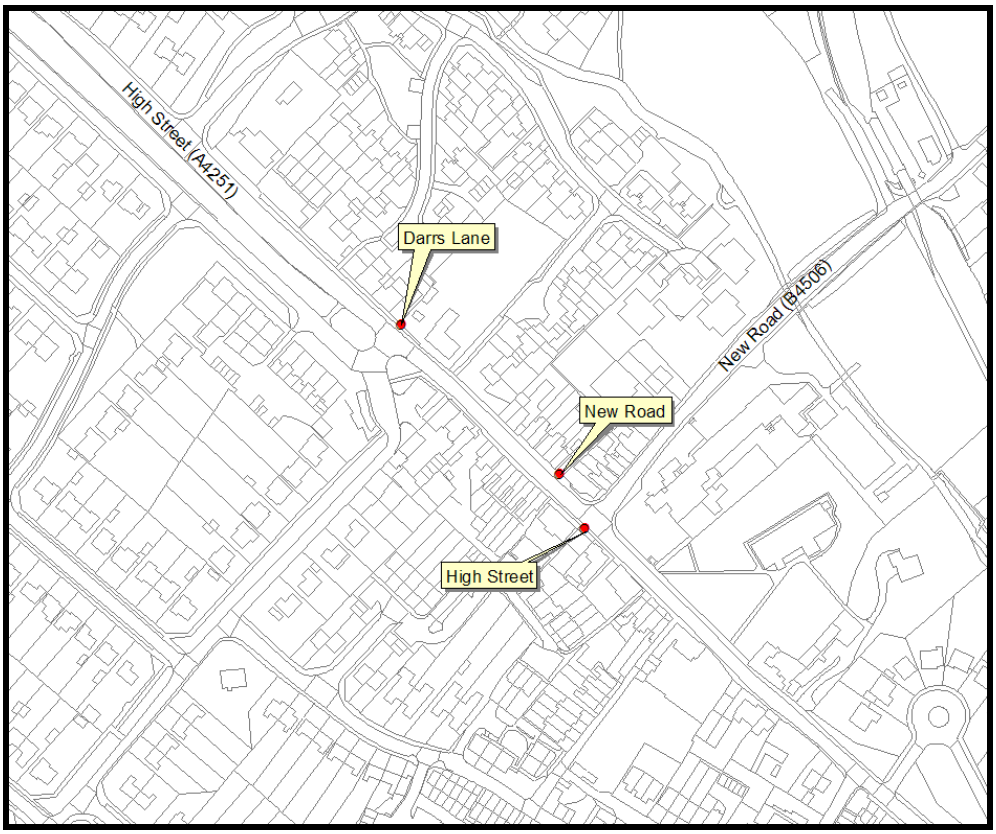

Figure 3: High Street, Northchurch Study Area. Red dots show diffusion tube monitoring locations.

Table 2: Monitoring Locations

Site Description	Site Type
Apsley	
London Road	Roadside (Façade)
Hemel Hempstead	
Lawn Lane 1	Roadside
Lawn Lane 2	Roadside
Lawn Lane 3	Roadside (Façade)
Northchurch	
Darrs Lane	Roadside
New Road	Roadside (Façade)
High Street	Roadside

Modelling

2.4 Annual mean concentrations of nitrogen dioxide during 2006 have been modelled using the Atmospheric Dispersion Modelling System for Roads (ADMS Roads). ADMS Roads is one of the dispersion models accepted for modelling within the Government's Technical Guidance (Defra, 2003b). The model has been run using a full year of meteorological data for 2006 from the meteorological station in Luton. Concentrations have been modelled for diffusion tube monitoring locations (Figures 1, 2 and 3). They have also been modelled for locations surrounding the diffusion tube locations, where exceedences of the air quality objective have been predicted. The modelling methodology, and the input data utilised are described in Appendix 3. The model has been verified against the diffusion tube measurements and adjusted accordingly. Further details of model verification and adjustment are also supplied in Appendix 3.

Uncertainty

2.5 There is an element of uncertainty 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-predictions or under-predictions. All of the measurements presented have an intrinsic margin of error. Defra (2007d) suggest that this is of the order of plus or minus 20% for diffusion tube data and plus or minus 10% for automatic measurements. The model results rely on traffic count data, which have been factored for the appropriate assessment year, and thus 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 during each year, the vehicle fleet within the study area will conform to the national (UK) average composition; it has been assumed the emissions per vehicle conform to the factors published in DMRB 11.3; it has been assumed that wind conditions measured in Luton during 2006 were representative of wind conditions in Dacorum during 2006; and it has been assumed that the subsequent 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 the measured data. By comparing the model results with measurements, data have been corrected for any systematic under- or over-prediction.

2.6 The UK Government's Air Quality Expert Group (AQEG) has published a draft report on trends in primary nitrogen dioxide in the UK (AQEG, 2006). This examines evidence that shows that while NOx emissions have fallen in line with predictions made a decade previously, the composition of NOx has, in some urban environments, changed. This may have caused nitrogen dioxide levels at some locations to fall less rapidly than was expected. The latest guidance from Defra has been followed regarding NOx to NO_2 relationships (Defra, 2007c).

2.7 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. Clearly in future years the uncertainties are likely to be greater than they are now. The results are 'best estimates' and have been treated as such in the discussion.

3 Results

3.1 Monitoring data for the sites identified in Figures 1, 2 and 3 are presented in Table 3. The results indicate that the annual mean nitrogen dioxide objective is being exceeded at all roadside locations alongside London Road, Apsley, at all roadside locations alongside Lawn Lane, Hemel Hempstead, and at one of the roadside monitoring locations alongside the High Street, Northchurch all of which are representative of relevant exposure.

Table 3: Annual Mean Nitrogen Dioxide Concentrations (µg/m^3) Measured using Diffusion Tubes

Site	Representative of Relevant Exposure?	2006[a]
London Road, Apsley	Yes	**63.3**[b]
Lawn Lane 1, Hemel Hempstead	No	**50.8**
Lawn Lane 2, Hemel Hempstead	No	**40.9**[b]
Lawn Lane 3, Hemel Hempstead	Yes	**60.2**[b]
Darrs Lane, Northchurch	No	29.8[b]
New Road, Northchurch	Yes	38.5[b]
High Street, Northchurch	Yes	**43.2**

[a] Bias adjusted using a bias adjustment factor of 0.78, taken from the database of factors provided on the Review and Assessment Helpdesk website (spreadsheet version 09/07).
[b] Annual mean equivalent concentration (see Appendix 2)

3.2 Concentrations predicted for each of the monitoring locations have been used for model verification purposes, and this is presented in Appendix 3. To determine the extent of any area of exceedence, concentrations have been predicted by modelling over a wider area around each of

the monitoring locations. Modelled concentration contours for each of the study areas are presented in Figures 4, 5 and 6 for 2006. Contours representing the 40µg/m^3 objective are illustrated in red. Contours representing 36µg/m^3 (i.e. representing 40µg/m^3 minus 1 standard deviation for the model) are illustrated in pink.

3.3 Figure 4 illustrates that the closest properties to London Road, within the study area, were experiencing concentrations which exceeded the annual mean nitrogen dioxide objective in 2006. This is a result of congestion around the junction, and is exacerbated by the canyon-effect just north of the junction. Further north of the area shown in Figure 4, there are no further residential properties prior to the roundabout, and further south the area becomes retail and commercial, with traffic flowing much more freely.

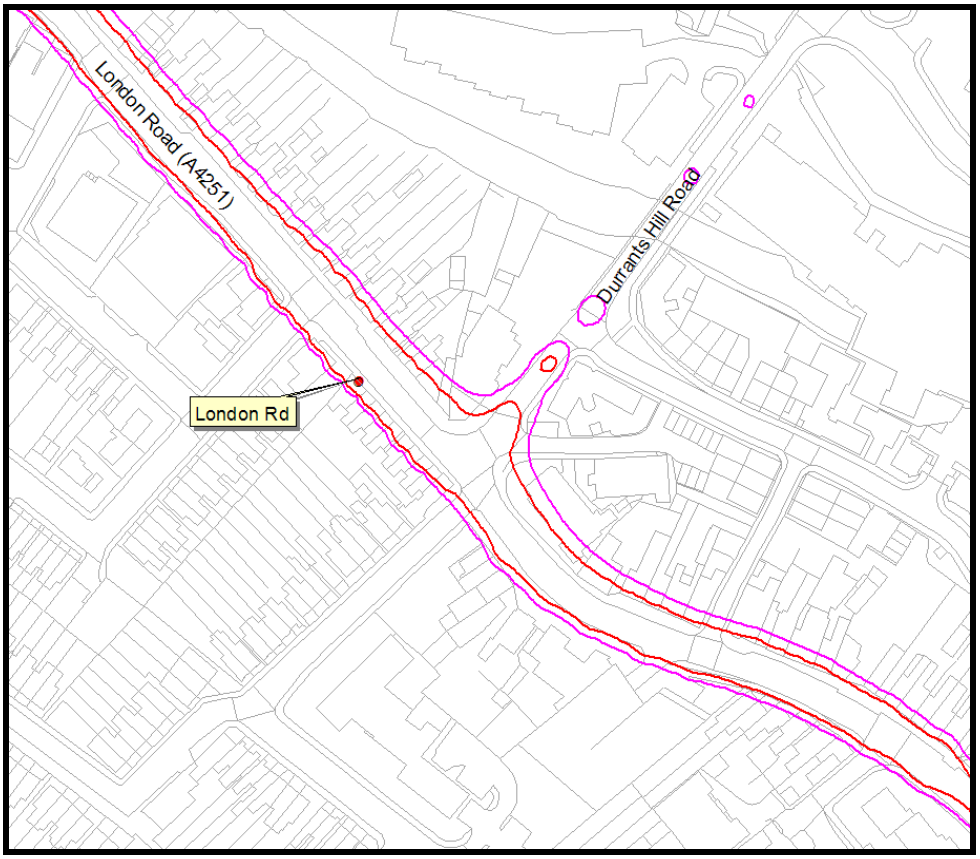

Figure 4: Modelled Annual Mean Nitrogen Dioxide Concentrations in 2006 (µg/m^3) along London Road, Apsley. The Red Line Represents the 40 µg/m^3 Contour, whilst the Pink Line Represents the 36 µg/m^3 Contour.

3.4 Figure 5 illustrates that the closest properties to Lawn Lane, within the study area, were experiencing concentrations which exceeded the annual mean nitrogen dioxide objective in 2006. Queuing traffic within the canyon east of the traffic lights at the junction with Durrants Hill Road is a contributory factor to the elevated concentrations. Further north of the area shown in Figure 5, residential properties are set back from the road, and lie outside of the area of exceedence. East of

the junction with Belswain Green, properties are also set further back from the kerb and lie beyond the predicted 40 µg/m^3 contour.

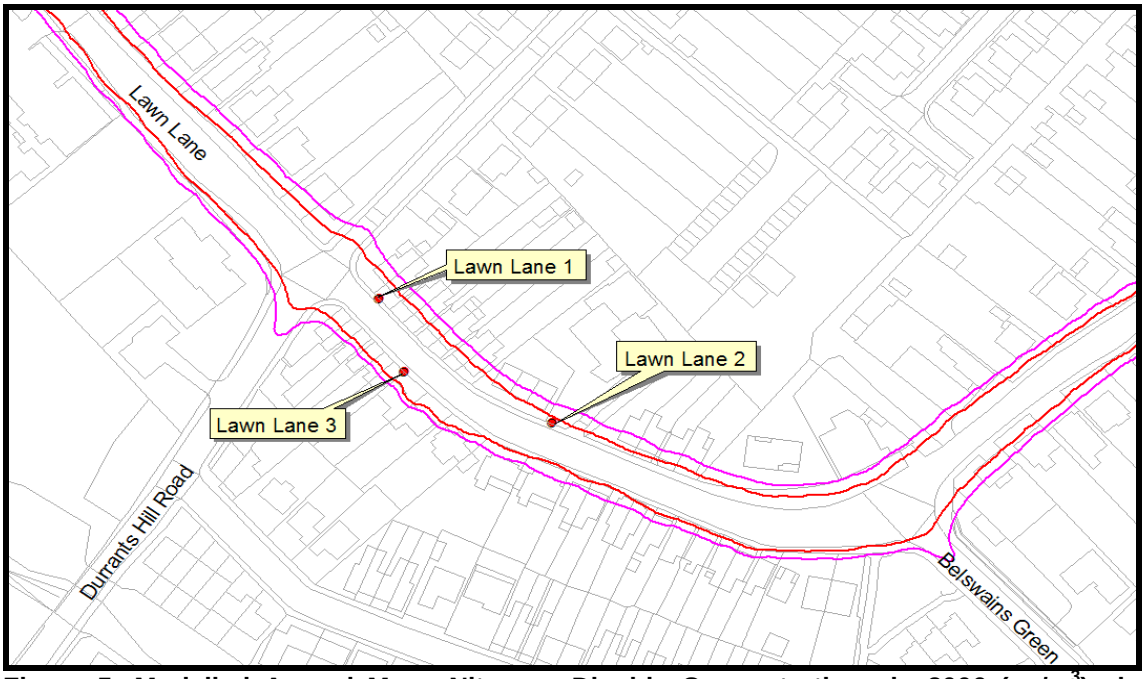

Figure 5: Modelled Annual Mean Nitrogen Dioxide Concentrations in 2006 (µg/m^3) along Lawn Lane, Hemel Hempstead. The Red Line Represents the 40 µg/m^3 Contour, whilst the Pink Line Represents the 36 µg/m^3 Contour.

3.5 Figure 6 illustrates that the closest properties to the High Street, Northchurch, close to the junction with New Road, were experiencing concentrations which exceeded the annual mean nitrogen dioxide objective in 2006. This is in part due to the traffic slowing for the junction, and also due to congestion caused by a narrowing of the road due to parked vehicles alongside the northeast bound carriageway just past New Road, and a bus stop just beyond this. Further north of the area shown in Figure 6, residential properties are set much further back from the road, and traffic becomes less congested. South of the area shown in Figure 6, there are fewer residential properties located at the back of kerb, and traffic is again less congested.

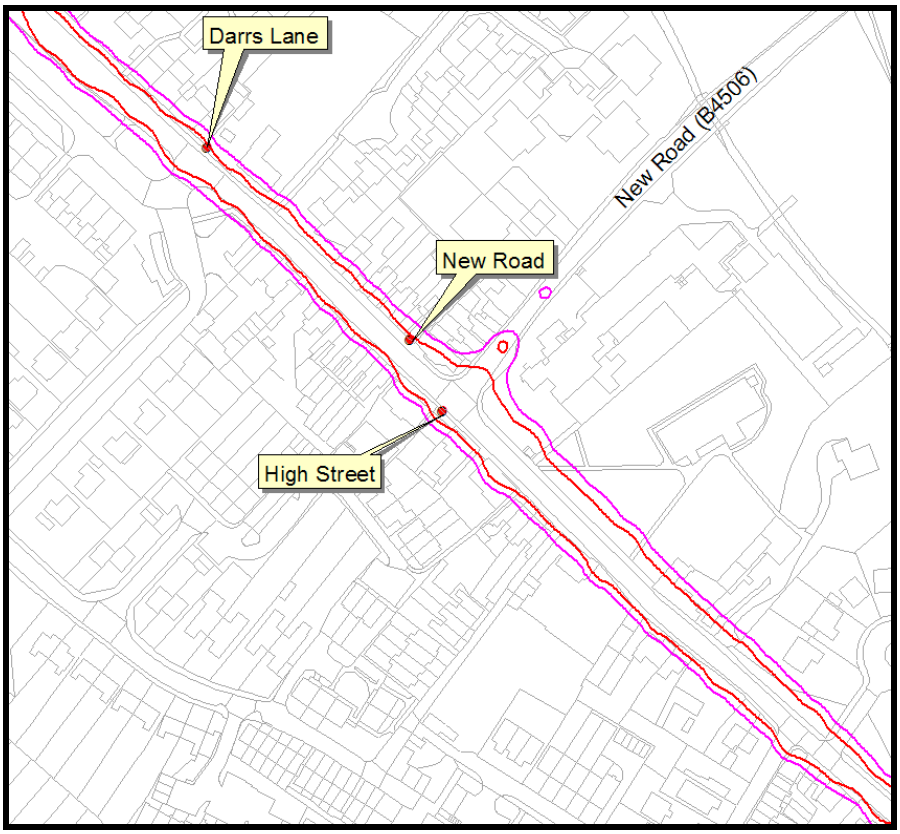

Figure 6: Modelled Annual Mean Nitrogen Dioxide Concentrations in 2006 (µg/m^3) along the High Street, Northchurch. The Red Line Represents the 40 µg/m^3 Contour, whilst the Pink Line Represents the 36 µg/m^3 Contour.

3.6 No exceedences of 60 µg/m^3 as an annual mean nitrogen dioxide concentration have been identified at any location relevant to the 1-hour objective within any of the three study areas and thus exceedences of the 1-hour objective are unlikely.

4 Conclusions and Recommendations

4.1 A Detailed Assessment of air quality has been carried out for properties located alongside the A4251 London Road in Apsley, Lawn Lane in Hemel Hempstead and the A4251 High Street in Northchurch. These areas were identified as being at risk of exceeding the annual mean air quality objective for nitrogen dioxide in the Updating and Screening Assessment (Dacorum BC, 2006).

4.2 The Detailed Assessment has been carried out using a combination of monitoring data and modelled concentrations. Concentrations of pollutants have been modelled for 2006 using the dispersion model ADMS Roads, and the model results verified against monitoring carried out.

4.3 Monitoring data for the majority of the diffusion tube sites are not representative of a whole calendar year, with many diffusion tubes only being established mid-2006. However, 2006 annual mean equivalent concentrations have been derived, and exceedences are indicated. Future Further Assessment work within each of the study areas will consider a 12-month data set, and will clarify whether the boundaries of the Air Quality Management Areas to be declared remain justified.

4.4 Concentrations have been modelled alongside the roads in these three locations. Predicted concentrations within each of the study areas show exceedences at most of the properties located closest to the main roads.

4.5 As a result of the modelling and monitoring undertaken in each of the three study areas, the following recommendations are made:

1. Air Quality Management Areas (AQMA) should be declared for the nitrogen dioxide annual mean objective for residential properties alongside London Road, Apsley; Lawn Lane, Hemel Hempstead and High Street, Northchurch that lie within the predicted 36 µg/m^3 contour as shown in Figures 4, 5 and 6.

2. Additional monitoring should be established to further inform the model verification process and assist in the identification of the full extent of the AQMA boundary.

3. Traffic counts should be carried out for the junctions of London Road and Durrants Hill Road, Lawn Lane and Durrants Hill Road, Lawn Lane and Belswains Green, and High

Street and New Road to allow more accurate modelling to be carried out for the Further Assessment.

4.6 The recommended extent of the AQMAs is based on the 36µg/m^3 contour and is thus somewhat precautionary. The local authority may wish to declare a larger area, although this will be even more precautionary.

5 References

Air Quality Expert Group, 2006. Trends in Primary Nitrogen Dioxide in the UK. Draft report for comment. August 2006.

Dacorum BC, 2006. Updating and Screening Assessment, April 2006.

Defra, 2003a. The Air Quality Strategy for England, Scotland, Wales and Northern Ireland: Addendum. February 2003.

Defra, 2003b. Review & Assessment: Technical Guidance LAQM.TG(03).

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

Defra, 2007b. Air Quality Archive via the internet www.airquality.co.uk.

Defra, 2007c. Air Quality Review and Assessment Helpdesk website. Available at: www.uwe.ac.uk/aqm/review/

Defra, 2007d. National Atmospheric Emissions Inventory. www.naei.org.uk.

Defra, 2007e. FAQ - Is there a new NO_x to NO_2 calculator available to allow for the recent increase in primary NO_2 from traffic? Available at www.uwe.ac.uk/aqm/review

DETR, 1997. National Road Traffic Forecasts (Great Britain). Available at http://www.dft.gov.uk/stellent/groups/dft_econappr/documents/page/dft_econappr_610548.pdf

DfT, 2007a. Annual Average Daily Traffic Flows available at http://www.dft-matrix.net/

DfT, 2007b. TEMPRO (Version 5) System. Available at www.tempro.org.uk

Laxen and Marner, 2003. Analysis of the Relationship Between 1-Hour and Annual Mean Nitrogen Dioxide at UK Roadside and Kerbside Monitoring Sites. Available from Defra, 2007a.

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

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

Stationery Office, 2007. The Air Quality Standards Regulations, 2007 (No. 64).

6 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.
PM_{10}	Small airborne particles, more specifically particulate matter less than 10 micrometers in aerodynamic diameter.
NO_2	Nitrogen dioxide.
$\mu g/m^3$	Microgrammes per cubic metre.

7 Appendix 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, 2003a).

8 Appendix 2 – Adjustment to Annual Mean Equivalent

8.1 Additional diffusion tube monitoring locations were established at a number of locations in July 2006. As a result, data for this site do not represent a full calendar year. Therefore, in accordance with the guidance in LAQM.TG(03), the data have been adjusted to an annual mean, based on the ratio of concentrations during the monitoring period (12 months; July 2006 – June 2007) to those

over the 2006 calendar year at three sites where long-term data are available. The St Albans Fleetville, Three Rivers Rickmansworth and North Hertfordshire Breechwood Green sites have been used for this purpose because they have reliable long-term datasets and are urban background sites, as recommended in LAQM.TG(03) (Defra, 2003b).

8.2 The annual mean nitrogen dioxide concentrations and the period means for each of the three monitoring sites from which adjustment factors have been calculated are presented in Table A2.1. The overall factor of 1.084 has been applied to all concentrations measured with diffusion tubes exposed for the period July 2006 – June 2007, to give the 2006 annual mean equivalent concentration.

Table A2.1: Data used for the Adjustment of Monitoring Data to 2006 Annual Mean[a]

Period Mean Concentration ($\mu g/m^3$)	St Albans Fleetville	Three Rivers Rickmansworth	N. Herts Breechwood Green	Overall Factor
2006	25.4	32.7	16.5	-
July 2006 – June 2007	22.9	29.8	15.8	-
Adjustment Factor	**1.109**	**1.097**	**1.044**	**1.084**

[a] Data taken from the Hertfordshire and Bedfordshire Air Pollution Monitoring Network website; www.hertsbedsair.org.uk.

9 Appendix 3 – Dispersion Modelling Methodology

9.1 Annual mean concentrations of nitrogen dioxide during 2006 have been modelled using the Atmospheric Dispersion Modelling System for Roads (ADMS Roads). ADMS Roads if one of the dispersion models accepted for modelling within the Government's Technical Guidance (Defra, 2003b).

Meteorological Data:

9.2 The model has been run using a full year of meteorological data for 2006 from the meteorological station at Luton, which is approximately 15 km north-east of the three study areas.

Horizontal Road Alignment:

9.3 Road alignment was based around Ordnance Survey road centreline data. Each carriageway of each road was entered into the model separately, where data were available. Those roads not explicitly included have been accounted for via the background component of the modelled results.

Traffic Data:

9.4 The Department for Transport has recently made all UK 2005 traffic count data accessible via an interactive web-based map (DfT, 2007a). AADT flows, and the proportions of HDVs, for London Road, Apsley and High Street, Northchurch have been determined from this map, as these provided more recent count data than were available from the Council. Data are not available from the DfT website for Lawn Lane, and therefore the most recent count data available (2004) were used. The 2005 AADT data taken from the DfT website, and the 2004 count data for Lawn Lane have been factored forwards using growth factors derived from National Road Traffic Forecast (NRTF) factors (DETR, 1997), adjusted to local conditions using the TEMPRO System v5 (DfT, 2007b), to the assessment year of 2006. Traffic count data are not available for any minor road within the study area. In these cases, a flow has been estimated based on local knowledge. The flows entered into the model for each study area are presented in Table A4.1.

Table A4.1: Summary of Traffic Flows used in Assessment[a]

	2006	
	LGV AAHT	HDV AAHT
London Road, Apsley	580.0	12.5
Durrants Hill Road, Apsley	204.0	4.4
Lawn Lane westbound, Hemel Hempstead	249.2	18.8
Lawn Lane eastbound, Hemel Hempstead	227.3	17.0
Durrants Hill Road, Hemel Hempstead	204.2	4.2
Deaconsfield Road, Hemel Hempstead	82.5	0.8
Belswains Green, Hemel Hempstead	204.2	4.2
High Street, Northchurch west of New Road	358.2	14.9
High Street, Northchurch, east of New Road	507.5	14.1
New Road, Northchurch	144.9	3.5

[a] AAHT – Annual Average Hourly Traffic flow. When multiplied by 24 these give Annual Average Daily Traffic (AADT) flows.

Background Concentrations:

9.5 Background concentrations of nitrogen dioxide have been taken from the national maps of background concentrations available from the Air Quality Archive (Defra, 2007b).

Model Verification:

9.6 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 annual mean road-NOx concentrations during 2006 at the diffusion tube monitoring locations within each of the study areas.

9.7 The model outputs of road-NOx (i.e. the component of total NOx coming from road traffic) have been compared with the 'measured' road-NOx, within each of the study areas. Total measured NOx was calculated from the measured NO_2 concentrations at each of the monitoring locations using the recently updated NOx from NO_2 calculator[1] available on the Air Quality Archive website (Defra, 2007b). The measured road-NOx contribution was then calculated as the difference between the total and the background value.

9.8 Weighted primary adjustment factors were then determined as the inverse of the slope of the best fit line between the calculated (measured) road contribution and the model derived road contribution, and forced through zero. Each diffusion tube measurement was weighted according to its perceived relative accuracy – concentrations based on 12 months of monitoring carried out during 2006 have been given a weighting of one, whilst those concentrations which represent a 2006 annual mean equivalent concentration estimates were given half the weighting. The primary adjustment factor for each study area was applied to each modelled road-NOx concentration within that study area to provide adjusted modelled road-NOx concentrations. The appropriate background concentration was added to these concentrations to determine the adjusted total modelled NOx concentration. The road contribution to the total annual mean nitrogen dioxide concentration was then determined from these adjusted modelled concentrations, following the method set out by Defra (2003b), taking into account the most recent guidance (Defra, 2007e):

$$NO_2 \text{ (road)} = NOx \text{ (road)} \times (-0.0719 * LN(NOx(total))) + 0.6248$$

9.9 The total nitrogen dioxide concentration was then determined by adding the background NO_2 concentration to this calculated road contribution. A weighted secondary adjustment factor was

[1] http://www.airquality.co.uk/archive/laqm/tools/NOxfromNO2calculator2007.xls

finally calculated as the inverse of the slope of the best fit line applied to the adjusted data and forced through zero.

9.10 The following primary and secondary adjustment factors have been applied to all modelled nitrogen dioxide data within each of the study areas:

London Road, Apsley

Primary adjustment factor : 10.66

Secondary adjustment factor: N/A – verification based on one monitoring site only.

Lawn Lane, Hemel Hempstead

Primary adjustment factor : 6.78

Secondary adjustment factor: 0.99

High Street, Northchurch

Primary adjustment factor : 12.32

Secondary adjustment factor: 0.98

9.11 The results imply that the model was under-predicting the road-NOx contribution. This is a common experience with this and most other models. The final NO_2 adjustments are minor. Figures A3.1 and A3.2 compare the modelled concentrations within the Lawn Lane, Apsley and High Street, Northchurch diffusion tube locations, after all adjustments have been made, to the measured concentrations at these locations.

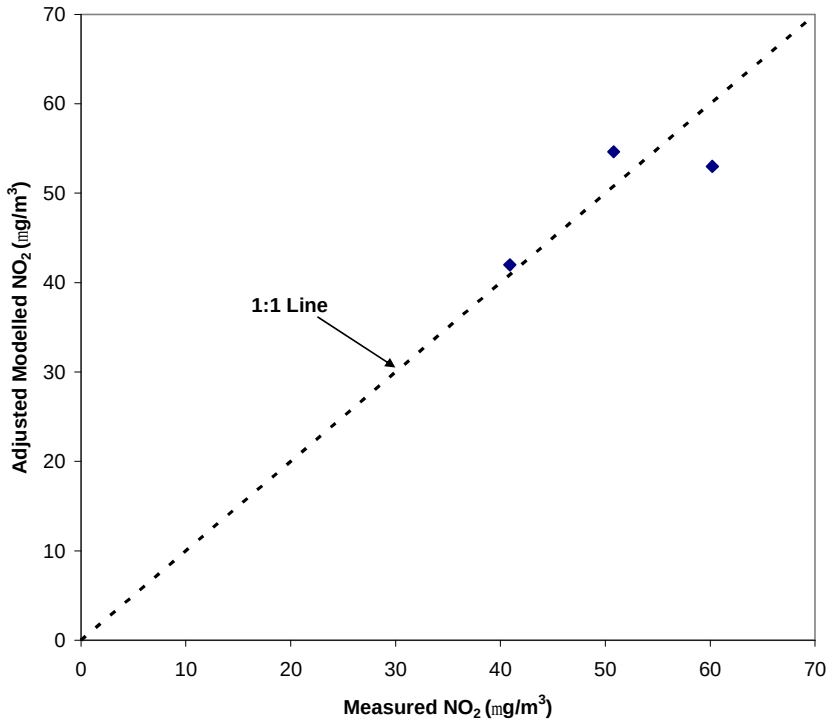

Figure A3.1: Comparison of Measured NO_2 to Fully Adjusted Modelled NO_2 Concentrations – Lawn Lane, Hemel Hempstead

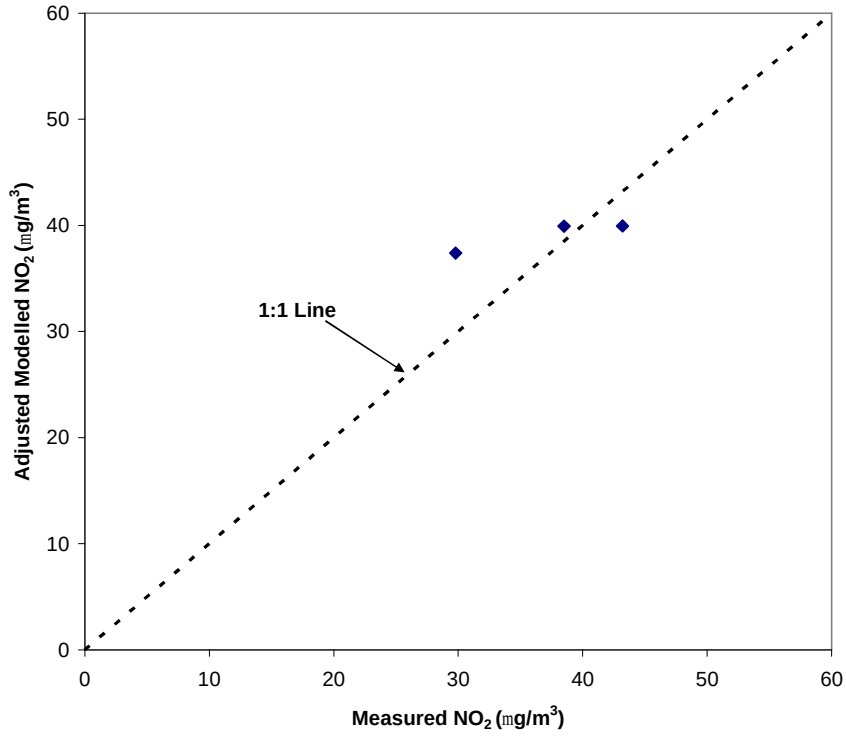

Figure A3.2: Comparison of Measured NO_2 to Fully Adjusted Modelled NO_2 Concentrations – High Street, Northchurch