Air Quality Review and Assessment
Stage 4

Environmental Protection Section
Planning and Environment
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1.0 Introduction

1.1 Background to Local Air Quality Management

Good air quality is essential for our health, quality of life and the environment. Over the years the Government have introduced controls through legislation to improve air quality. However, the previous simple solutions applied to preventing the heavy smog type image prevalent in urban areas in the 50's are no longer applicable and any solution to current air quality problems requires a coherent national strategy applied flexibly at a local level.

Government experts have estimated that up to 24,000 people die prematurely each year in the United Kingdom as a result of poor air quality. We therefore, are all stakeholders in our air quality and improvements will require the participation of all members of the community as well as the specialist input from scientific and professional groups and the support of government locally, nationally and internationally.

In the early 90's the Expert Panel on Air Quality Standards (EPAQS) was set up by the Secretary of State for the Environment following the publication of the white paper 'Our Common Inheritance'. The remit of the panel was to advise on the establishment and application of Air Quality Standards based on the effects of pollutants on human health and the wider environment.

In 1995 the Environment Act introduced initiatives for the protection of air quality in the UK. Section 80 of this Act required the Secretary of State for the Environment to publish a National Air Quality Strategy. Following consultation the National Air Quality Strategy (NAQS) was published in 1997 then revised and re-issued in early 2000. This strategy bought about a change in the way local air quality is managed. All local councils are required to review and assess air quality in their areas through a process known as Local Air Quality Management (LAQM).

The Air Quality Regulations 2000 and the Air Quality (England) (Amendment) Regulations 2002 prescribe pollutant specific air quality objectives to be achieved by certain dates specific to each pollutant, ranging from 2003 to 2010. Local authorities have to consider the present and likely future quality of the air up to these dates, and to assess whether these objectives will be met.

If as the result of the review process, it appears that the air quality objectives are not, or are unlikely to be achieved in any area within the boundary of the local authority – then the local authority shall by order designate it as an 'Air Quality Management Area' (AQMA). Once such an area has been designated a more detailed assessment of the air quality in each of these areas (a stage 4 review and assessment) shall be conducted within 12 months of declaration of the AQMA. Based on the findings of the Stage 4 assessment air quality action plans to reduce air quality pollution to acceptable levels should then be developed.

2.0 Description of the District

North West Leicestershire lies in the East Midlands Region and is both the name and geographical location. The District is situated in the heart of the National Forest and lies between Leicester, Burton –on- Trent, Derby and Nottingham, and covers 105 square miles. The district is mostly rural with a large extent of industry both historically from coal mining, and more recently with East Midlands Airport and large opencast mines and quarries. The population of 88,800, mainly live in the principle towns of Coalville and Ashby-de-la Zouch, and within the large villages of Castle Donington, Kegworth and Ibstock. Three established main roads run through the District the M42/A42 between Birmingham and Nottingham, the M1 and the A50/A511 from Leicester to Burton-on-Trent.

3.0 The UK Air Quality Strategy

3.1 Statutory Requirements

The National Air Quality Strategy (NAQS) sets Air Quality Objectives for levels of exposure to those pollutants at which adverse health effects are very likely, even among vulnerable groups. These are based on the advice of the Expert Panel on Air Quality Standards (EPAQS), and on the requirements of the EC Air Quality Daughter Directive (AQDD). Assessments of the appropriate health-based standards are translated into Objectives by adding target dates for compliance and allowing for a small number of unavoidable exceedances for certain pollutants. These standards and associated specific objectives are shown in Table 3.1.

The Air Quality Regulations 2000, made under the Act, gave statutory force to the revised Air Quality Objectives. The reasons for this revision of the Objectives are:

- Changes to the state of scientific knowledge about the nature and behaviour of pollutants.
- The need to harmonise UK Legislation with the different requirements of the EC Air Quality Daughter Directive.

The Act also requires local authorities to carry out a periodic Review and Assessment of air quality in relation to these Objectives. The aims of this are:

- To identify areas of the district where national measures will not achieve the Air Quality Objectives by themselves, so local action is needed.
- To provide a basis for integrated local policy on air quality, in matters such as land use planning and traffic management.

Where the Review and Assessment identifies areas in which the Air Quality Objectives will not be met between now and the various deadlines laid down for the different pollutants, affected areas must be declared as Air Quality Management Areas (AQMA).

Table 3.1: Air Quality Objectives in the Air Quality Regulations (2000) for the purpose of Local Air Quality Management

Pollutant	Concentration Limits		Averaging Period	Objective
	μg m3	ppb		Date for objective
Benzene	16.25	5	Running annual mean	December 31st 2003
1/3-Butadiene	2.25	1	Running annual mean	December 31st 2003
Carbon monoxide	11.6	10	Running 8 hour mean	December 31st 2003
Lead	0.5	-	Annual mean	December 31st 2004
	0.25	-	Annual mean	December 31st 2008
Nitrogen dioxide	200	105	1 hour mean not to be exceeded more than 18 times a year	December 31st 2005
	40	21	Annual mean	December 31st 2005
Particles (PM10)	50	-	24 hour mean not to be exceeded more than 35 times a year	December 31st 2004
	40	-	Annual mean	December 31st 2004
Sulphur dioxide	266	100	15 minute average mean not to be exceeded more than 35 times a year	December 31st 2004
	350	132	1 hour mean not to be exceeded more than 24 times a year	December 31st 2004
	125	47	24 hour mean not to be exceeded more than 3 times a year	December 31st 2005

Notes: Conversions of ppb and ppm to (μg m^3) correct at 20^oC and 1013mb

4.0 Explanation of the National Air Quality Standards

4.1 Averaging Times

Pollutants vary in the time-scale over which they have their effects:

Benzene and 1,3-butadiene cannot be assigned a level below which there is absolutely no cancer risk. Similarly with lead, it has not proved possible to define a level in the blood below which there are no effects

Therefore the objectives for these pollutants are set at a level where the medical evidence suggests that significant health effects are likely over a long averaging period for exposure, i.e. one year.

At the other end of the scale, sulphur dioxide is noted for its acute, short term effects and so one of the three objectives for this pollutant is based on a 15 minute averaging time, in addition to 1 hour and 24 hour objectives.

Nitrogen dioxide has both acute effects at high concentrations and more subtle health effects at lower concentrations. Therefore, Objectives are set both with an hourly and a one-year averaging period.

4.2 Percentile Compliance

In the case of nitrogen dioxide, PM_{10} and sulphur dioxide, objectives are set which have relatively short averaging times. The NAQS acknowledges that it will never be possible for these pollutants to achieve one hundred percent compliance, there will always be short periods of exceedance due to weather conditions. In the case of particulates, special events such as Bonfire Night will also tend to create short-term peaks.

Allowance is made for this problem by adopting a percentile approach to limits for these pollutants.

For example, an annual 90^{th} percentile Objective is adopted for one of the Objectives for PM_{10}, which means that the Standard can be exceeded for about 10% of the days in each calendar year. Allowing for rounding, the daily maximum can therefore exceed the limit value on 35 days in each year before the objective is breached.

4.3 Running Means

Monitoring values at a single fixed point are likely to fluctuate over short periods because of variations of microclimate and nearby transient sources. Expressing the objective for some pollutants as a running mean over an appropriate time-scale therefore smoothes short-term variations out.

For example, the problem for benzene is caused by exposure over a long period, so the Objective is stated as a running annual mean of hourly values.

4.4 Exposure

The purpose of the Air Quality Objectives is to protect human health. Exceedances of the Objectives are only therefore a valid basis for further action where they occur at outdoor locations at which members of the public (not persons occupationally exposed) are regularly present for periods equal to the averaging time specified for the relevant pollutant.

Therefore, for Objectives with short averaging times (e.g. the short term Objectives for NO_2) the Review and Assessment could be focused on any near-ground, outdoor location. This is because exposures for actual people are possible there, sufficient for the Objectives to be breached.

Where objectives for pollutants are based on longer averaging times, the review and Assessment should only consider locations where a person might reasonably be expected to spend periods of exposure equivalent to the averaging time, e.g. housing, schools, hospitals or residential care establishments

5.0 Introduction to the Stage 4 Air Quality Assessment

5.1 Purpose of the Study

North West Leicestershire District Council (NWLDC) completed its stage 3 Air Quality Review and Assessment in January 2001. The results indicated that exceedences of the annual objective for nitrogen dioxide (NO_2) were likely at various locations throughout the district by 2005. As a result, six Air Quality Management Areas (AQMA) were declared in April 2001, see section 7.2 and Appendix 1. Local Authorities with a designated AQMA are required to undertake a further review of air quality. This further assessment is called a stage 4-air quality review and assessment, and is intended to develop the information that we already have.

5.2 Overview of the Approach Taken

The following summarises the general approach taken by NWLDC in completing its Stage 4 assessment.

- Consider the results of nitrogen dioxide monitoring conducted since the Stage 3 Review and Assessment.
- Conduct further modelling work, incorporating the new emission factors, to enable a prediction of air quality for 2005 for the whole district and within the AQMAs.
- To identify the improvement needed in concentrations of nitrogen dioxide within the designated AQMA.
- Consider any changes that are needed to the existing AQMAs.

The AQMAs have been declared because of nitrogen dioxide and for that reason this is the only pollutant considered in detail in this report.

5.3 Units of Concentration used and conversion to other units

All concentrations of nitrogen dioxide in this report are presented in units of $\mu g/m^3$, which is consistent with the units used in the current UK Air Quality Strategy.

5.4 Copyright of the Maps

5.5 Technical Guidance

Part IV of the Environment Act 1995, Local Air Quality Management, Technical Guidance LAQM. TG (03), DEFRA 2003, is designed to guide local authorities through the second round of the review and assessment process. Any reference to the Technical Guidance within this report relates to this document.

5.6 The Updating Screening & Assessment (USA) and Detailed Assessment

The conclusions of NWLDC Air Quality Updating and Screening Assessment (USA), June 2003 were accepted by Defra for all the pollutants. This document should be referred to if further details are required but to summarise the USA indicated that the objective for nitrogen dioxide might not be met within two of the AQMAs. AQMA 1 -Vicinity of M1 due to traffic, and AQMA 5, Diseworth Road due to the total annual throughput of cargo at East Midland Airport. The USA also concluded that the nitrogen dioxide objective would be achieved in the other four AQMAs and else where throughout the district. The USA builds upon the phased approach of the last round of review and assessment and identifies areas where the objectives will not be met. It takes into account changes that have occurred outside AQMAs, and any improvements that have been made in the methods of predicting air quality. If areas are identified as not meeting the objectives and there is relevant exposure, then it is necessary to proceed to a more detailed assessment for that particular pollutant in the area identified. Defra have accepted that the Stage 4 Report will satisfy the requirements of the detailed assessment required by the second round of review and assessment for NO_2.

6.0. Stage 4 Air Quality Review and Assessment

6.1 Background

North West Leicestershire District Council (NWLDC) has completed the first stages of its statutory Air Quality Review and Assessment. A process which was a staged approach whereby the seven pollutants in the Government's Air Quality Strategy relating to LAQM were assessed and screened as to their relative importance to air quality within the Councils area. The procedures and findings were published in *North West Leicestershire District Council, Air Quality Review and Assessment Stage 1, December 1998; and North West Leicestershire District Council, Air Quality Review and Assessment, Final Report, January 2001 (Stage 3 Report).*

The Stage 3 report assessed air quality across the whole of the district in accordance with the DETR guidance and incorporated a review and assessment of sulphur dioxide, nitrogen dioxide and PM10. The findings of this report indicated that the objective for annual average NO_2 (see table 6.1) would likely be exceeded at several locations through out the district. As a result, six Air Quality Management Areas (AQMA) were declared in April 2001, Appendix 1.

The other four pollutants (benzene, 1,3 butadine, lead and carbon monoxide) were considered at earlier stages of the review and assessment and were found to be within acceptable limits.

POLLUTANT	CONCENTRATION	MEASURED AS	DATE TO BE ACHIEVED BY
Nitrogen dioxide (NO_2)	**40µg/m3 (21ppb)** 200µg/m3 (105ppb) not to be exceeded more than 18 times a year	**Annual mean** 1 hour mean	**31st December 2005** 31st December 2005

Table 6.1: Government Objectives for NO_2, 2005.

Section 84(1) of the Environment Act 1995 requires local authorities to undertake a further assessment of air quality where an AQMA has been designated. This further assessment is called a Stage 4 air quality review and assessment and its purpose is to supplement the information already available to the authority.

The stage 4 assessment should focus on those pollutants where potential exceedances have be identified, and calculate how great an improvement is needed for each pollutant.

The following provides a check list of the requirements for the Stage 4 assessment, as given in the DEFRA guidance:

- To allow the Council to confirm the original assessment of air quality against the prescribed objectives and thus to ensure that they were right to designate the AQMA in the first place;

- To calculate more accurately how much of an improvement in air quality would be needed to deliver air quality objectives within the AQMA.

- To refine the knowledge of sources of pollution so that air quality action plans can be targeted.

- To take account of any new national policy developments which have come to light since the AQMA declaration and the Stage 3 report;

- To take account as far as possible of any new local policy developments which are likely to affect air quality by the relevant date, and which were not fully factored into the Stage 3 report.

- To carry out further monitoring in problem areas to check earlier findings.

- To confirm the other assumptions previously made on which the designation of the AQMA has been based and to check that the original designation is still valid, and does not need amending in some way;

- To respond to comments from statutory consultees in respect of the stage 3 report

7.0 Stage 4 Review and Assessment for Nitrogen Dioxide

7.1 Nitrogen Dioxide

Nitrogen dioxide is a gas formed from one nitrogen molecule and two oxygen molecules.

Nitrogen dioxide is formed to a small extent directly in combustion processes. However, most nitrogen based combustion products are emitted as nitric oxide (NO). Nitric oxide is relatively unstable and is relatively rapidly oxidised to nitrogen dioxide in air. Nitrogen dioxide and nitric oxide are collectively referred to as nitrogen oxides (NOx). All combustion processes produce NOx emissions, largely in the form of nitric oxide, which is converted to nitrogen dioxide, mainly as a result of reaction with ozone in the atmosphere. It is nitrogen dioxide that is associated with adverse effects upon human health. The principal source of nitrogen oxides is road transport, which accounted for about 49% of total UK emissions in 2000. The contribution of road transport to nitrogen oxides emissions has declined significantly in recent years as a result of various national policy measures and further reductions are expected up until 2010 and beyond. Other significant sources of nitrogen oxides emissions include the electricity supply industry and other industrial and commercial sectors, which accounted for about 24% and 23% respectively in 1999.

The principal health effects of nitrogen dioxide relate to impaired lung performance from changes in structure and function and suspected hyper reactivity to allergens (causes of allergic responses). Effects are reversible; however, ongoing exposure may lead to poorer lung function later in life. Exposure to high concentrations for short periods is considered more toxic than low concentration exposure for long periods.

7.2 Conclusions of Stage 3 Review and Assessment

The methods used in the third stage Review and Assessment were based on statutory Guidance Note LAQM. G1 (00), *Framework for the Review and Assessment of Air Quality*. The assessment comprised of detailed investigations using monitoring; and dispersion modelling of the whole district and selected hotspots, to predict areas where the objective for nitrogen dioxide would likely to be exceeded.

The Stage 3 Assessment concluded that it is likely that the air quality objective for annual mean NO_2 (40µg/m ^{3}) may not be achieved at various locations throughout the District. As noted previously six Air Quality Management Areas were declared on 23rd April 2001 for $NO_{2,}$ as detailed in Table 7.1 below and depicted in Appendix 1

Studies suggest that in general achieving the annual mean of 40µg/m^3 is more demanding than achieving the hourly objective. If the annual mean is achieved, it is likely that the hourly objective will also be achieved.

AQMA		Description
Number	**Name**	
1	*Vicinity of M1*	***Residential properties within 150m of the M1*** • 7 isolated properties in Long Whatton • 12 properties in Copt Oak • 3 isolated farms
2	*Kegworth A6*	***Residential properties with frontages within 10m of A6*** • Approx. 60 properties
3	*A511*	***Residential properties with frontages within 10m of A511*** • 9 properties Sinope and Hoo Ash • 3 properties Broomleys Road • 45 properties Bardon Road • 4 properties Bardon Hill
4	*Belvoir Road, Coalville*	4 residential flats and pedestrian area between High Street junction and disused railway line
5	*Castle Donington, Diseworth Road*	• 3 properties
6	*Vicinity of A50*	• 1 property

Table 7.1 AQMAs declared in April 2001

8.0 Monitoring

Since the Stage 3 review and assessment the number of diffusion tubes has been increased from 21 to 24 at various sites throughout the district, a summary of the results is presented in Table 8.1 below. For more detailed results refer to Appendix 2, and Appendix 3 for a map showing the distribution of the NO_2 monitoring sites. In addition to the diffusion tube network a chemiluminescent continuos monitor has been commissioned within the boundaries of the AQMA at Kegworth to validate the results of the Stage 3 report (OS Grid Reference 448819 326625).

8.1 QA/QC of monitoring data

8.1.1 Continuous Monitor

The real time monitor was purchased from Enviro Technology and is an API M200A NO_x analyser. A service agreement is in place for the analyser. If the analyser malfunctions an engineer is called out immediately to minimise data loss. Every six months the equipment is serviced and calibrated by the manufacturer at which time preventative maintenance checks and reviews of the entire system and its operation are conducted.

The analyser performs an internal automatic daily calibration to check on instrument performance. An officer of NWLDC visits the site every fortnight, and a manual two-point (zero/span) calibration in accordance with the manufacturer specifications is conducted and filters are changed. The results of the calibration are forwarded to Enviro Technology to ensure continuity.

The data from the monitor is currently downloaded and processed by Enviro Technology and then e-mailed directly to NWLDC.

8.1.2 Diffusion Tube Network

Diffusion tubes are a relatively basic method of monitoring nitrogen dioxide. They will not register short-term pollution episodes of a few hours or days, hence can not be used to give a direct indication of whether the hourly standard for NO_2 has been exceeded. However, they are inexpensive and so can be deployed at a relatively large number of sites. The results of which can be averaged over a calendar year to estimate whether the annual objective has been exceeded.

The diffusion tubes are sent to Casella Stanger and Gradko International Analytical Laboratories conduct the analysis. Gradko International is a UKAS recognised laboratory for the provision and analysis of diffusion tubes, and the analysis is performed in accordance with guidelines set out by the UK Nitrogen Dioxide Diffusion Tube Network. The diffusion tubes are prepared using the 50% TEA in acetone method and generally have a margin of error +/- 1.67%. Appendix 3 shows the distribution of the 24 NO_2 tubes across the district.

Table 8.1 shows the results for the NO_2 tubes throughout the district for 2002, the texts highlighted in yellow are the tubes, which are located within AQMAs. A breakdown of the raw tube data can be seen in Appendix 2. Figures 8.1 and 8.2 below show the tube data for 2002 and the predicted concentrations for 2005, the columns in yellow are the tubes, which are located in the AQMAs.

8.1.3 Bias adjustment

The bias for diffusion tubes can be corrected in a number of ways. A recent study looked at results from diffusion tube co-location studies carried out by a number of local authorities. The results of the Gradko tubes 50% TEA in acetone showed no evidence of a seasonal pattern, with a default adjustment of 1.36. The use of the default adjustment will produce annual mean diffusion tube results that are close to the true concentration. The report also indicates that for Gradko 50% TEA in acetone the collocation study to determine the annual bias adjustment factor can be based on 6 months of data.

An NO_2 tube was placed alongside the real-time monitor at Kegworth. This co-location arrangement allows a bias adjustment to be determined for the district. It should be noted that a problem with the monitor meant that only 9 months of data was collected during 2002. However, the Technical Guidance indicates that 9 months worth of data is acceptable as it takes account seasonal variations in the bias. The calculation for the bias adjustment is shown in Box 1, see Appendix 4, for the results of the co-location study.

Box 1. Bias adjustment for Nitrogen dioxide based on 9 months of data

$$\text{Bias adjustment A} = \frac{\text{Mean annual chemiluminesence concentration (CM)}}{\text{Mean annual diffusion tube concentration (DM)}}$$

Bias adjustment A = 37.25/33.36 = 1.1166

From the co-location study it can be concluded that the tubes underread by 10.04%. Therefore, the diffusion tube annual mean results have been multiplied by 1.1166 and are given in table 8.1.

The adjusted measured concentrations have been projected forward to 2005 using the factors detailed in the Technical Guidance to predict future concentrations and are detailed in table 8.1 and Appendix 4.

Tube number	Location	Bias adjusted (Micrograms) 2002	2005 prediction (Micrograms) based on 2002 bias adjusted values
1	Coalville Belvoir	26.37	24.28
2	Coalville Jackson	28.23	25.98
3	Coalville Oxford St.	28.09	25.56
4	Coalville Abbotts Oak	23.79	21.65
5	Bardon Rd C/V	32.77	30.17
6	All Saints Coalville	28.52	26.25
7	Measham, High	28.05	25.82
8	Boundary	20.28	18.67
9	Ashby Marlborough	22.27	20.50
10	Ashby Market St.	26.62	24.50
11	Ashby A42	26.90	24.76
12	C/Don High St	31.98	29.44
13	C/Don E.M.A	20.09	18.49
14	C/Don Stat. Rd.	28.19	25.95
15	CD Dise	23.37	
16	Kegworth A6	37.35	34.38
17	Whatton Rd Keg	24.40	22.46
18	Keg Molehill Fm	**43.73**	**40.25**
19	M1 Long Whatton	30.85	28.40
20	M1 Long Wh'n West	27.50	25.32
21	Copt Oak	31.70	29.18
22	Charley	24.16	22.24
23	Broom	38.63	35.56
24	Sinope	22.95	21.12

Table 8.1 Bias adjusted annual average concentrations between January 2002 and December 2002 in NWLDC and predictions for 2005. (Figures shown in red are those that exceed the annual average objective and the text highlighted in yellow are tubes in AQMAs)

Based on the above assessment the only monitoring location, which is likely to breach the annual mean objective in 2005, is location 18, Molehill Farm, which is an AQMA.

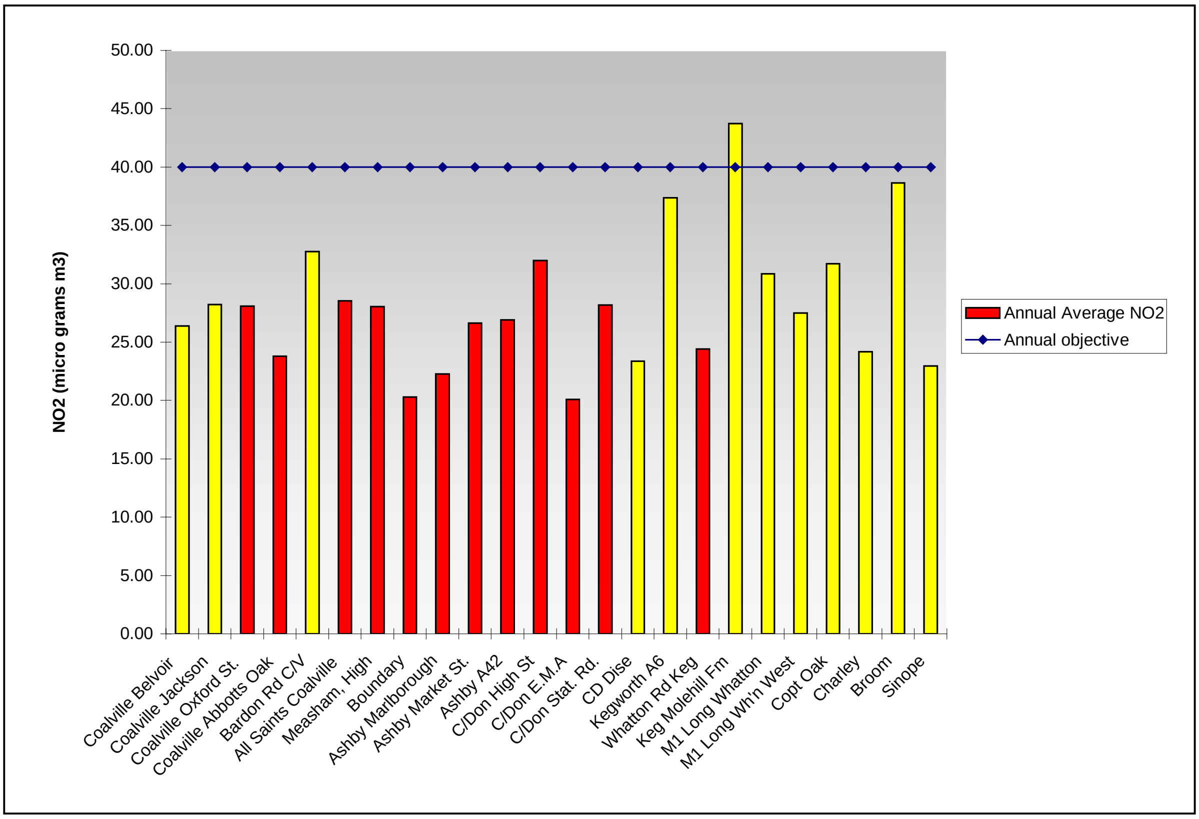


Figure 8.1: Annual Mean concentrations of NO_2 tubes throughout the District for 2002, bias adjusted

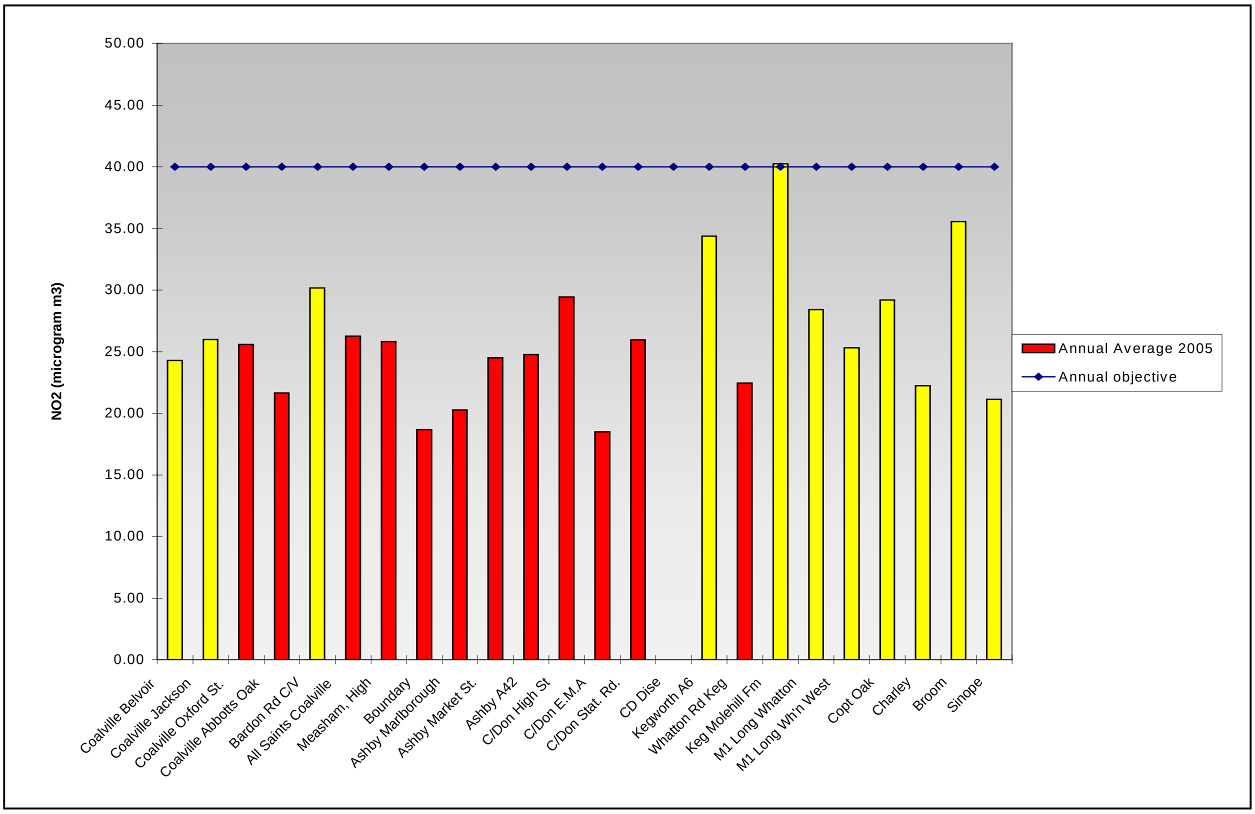


Figure 8.2: Annual Mean Concentrations of NO_2 tubes throughout the District, corrected for 2005

9.0 Dispersion Modelling

High quality equipment is expensive to acquire and to run, therefore the number of places which data can be collected in inevitably restricted. Also, even the most sophisticated pollution analyses can only give a snap shot of the situation over a particular period of time at one specific location. Computer-based atmospheric dispersion models are available and are constantly being developed and refined. These take data about emissions and the weather and predict the distribution of pollutants over space and time in the area being modelled.

9.1 Description of the ADMS-Urban Dispersion Model

Detailed information about the dispersion modelling and modelling verification methodologies used is given in NWLDC Stage 3 Report – *Air Quality Review and Assessment, 2001* (Parts 2.3 – 2.5 and Appendix 4). This information is not repeated here, except where supplementary information is required.

NWLDC commissioned Leicester City Council to conduct its modelling work using the model ADMS-URBAN Version 1.6. Leicester City also provided guidance and assistance on the modelling methodology. ADMS-Urban Version 1.6 is a version of the Atmospheric Dispersion Modelling System (ADMS) developed by Cambridge Environmental Research consultants (CERC). This version of ADMS is similar to ADMS-Urban 1.53, but includes further model developments and improvements made by CERC.

In conjunction with the dispersion model, the emission inventory package EMIT 2.0 (Emission Inventory Toolkit), also developed by CERC, has been used to manage the emission database for NWLDC. EMIT is a database tool for storing, manipulating and assessing emissions data from a variety of sources. EMIT can hold data from explicit sources such as major roads, rail and industrial sources (point and area). In addition, EMIT can hold data from sources that may be too small to be considered explicitly, and are treated as average emissions on a $1km^2$ grid. Source data held in this way represent minor road, commercial and domestic sources.

EMIT 2.0 is supplied with the new National Atmospheric Emission Inventory emission factors (DEFRA February 2002) and national traffic forecasts. The EMIT database has road traffic emission factors, including the new NOx factors published by DEFRA in February 2002, in addition to predicted compositions for future years, compiled by NETCEN, TRL and Stanger. It is designed for developing; maintaining and reporting on all emissions to air and emissions data can be exported to ADMS-Urban to be used for dispersion modelling. NWLDC emission inventory data is stored in EMIT in this way and uses the new DEFRA emission factors to calculate road traffic emissions and is then exported into ADMS-Urban for dispersion modelling.

The key feature of ADMS-Urban is that it can be used in conjunction with a Geographical Information System (GIS). The GIS software used is ESRI UK's desktop GIS, ARCVIEW. The two programs are fully integrated, and model output pollution contour plots, can be directly overlaid on many types of digital ordnance survey maps. Results can be calculated for specific receptor points (for example a monitoring station), plotted as time series graphs, or for whole areas in the form of a contour plot on a GIS map. Further detail on ADMS-Urban and the emission inventory can be sought by referring to NWLDC Stage 3 Report.

9.2 Model Runs

The model was run using the method as described in NWLDC Stage 3 Report of the Air Quality Review and Assessment 2001. Annual mean runs were undertaken for the whole district for the years 2002 and 2005 for nitrogen dioxide. The receptor points to run in the model correspond to all the diffusion tube monitoring locations around the district. Nitrogen dioxide receptor point runs were undertaken for the years 2002 and 2005 to assess if the statutory objectives are likely to be met. All the receptor points are run for every hour of meteorological data file being used. The results are exported to Microsoft Excel for data interpretation and manipulation. Table 9.1 below shows the ordnance survey grid references of the receptor points used in the model runs, corresponding to the locations of the nitrogen dioxide tubes and the real time monitoring station.

Location	**Grid Easting**	**Grid Northing**
Coalville Belvoir	442351	314293
Coalville Jackson	442309	314205
Coalville Oxford St.	443279	314121
Coalville Abbotts Oak	444841	314639
Bardon Rd C/V	444189	313169
All Saints Coalville	444689	314627
Measham, High	433451	312207
Boundary	433358	318972
Ashby Marlborough	435386	317692
Ashby Market St.	435835	316778
Ashby A42	436340	315837
C/Don High St	444493	327304
C/Don E.M.A	444477	326735
C/Don Stat. Rd.	444784	328125
CD Dise	444355	326311
Kegworth A6	448818	326625
Whatton Rd Keg	448070	326249
Keg Molehill Fm	447445	326476
M1 Long Whatton	446941	323769
M1 Long Wh'n West	447022	323763
Copt Oak	448122	313068
Charley	448513	313572
Broom	443659	313997
Sinope	440169	315266

Table 9.1 List of receptor points corresponding to monitoring sites

9.3 Meteorological Data

For the purpose of the dispersion modelling undertaken, data for the meteorological year 2002 has been input into ADMS-Urban. Data for 2002 corresponds to the 2002 traffic database also used in the model and is used to assist verification of the model, using monitored data from this year.

Meteorological data for 2002 is taken from a Meteorological Mast situated on a traffic island at the intersection of Groby Road with the Western Distributor Road, Leicester.

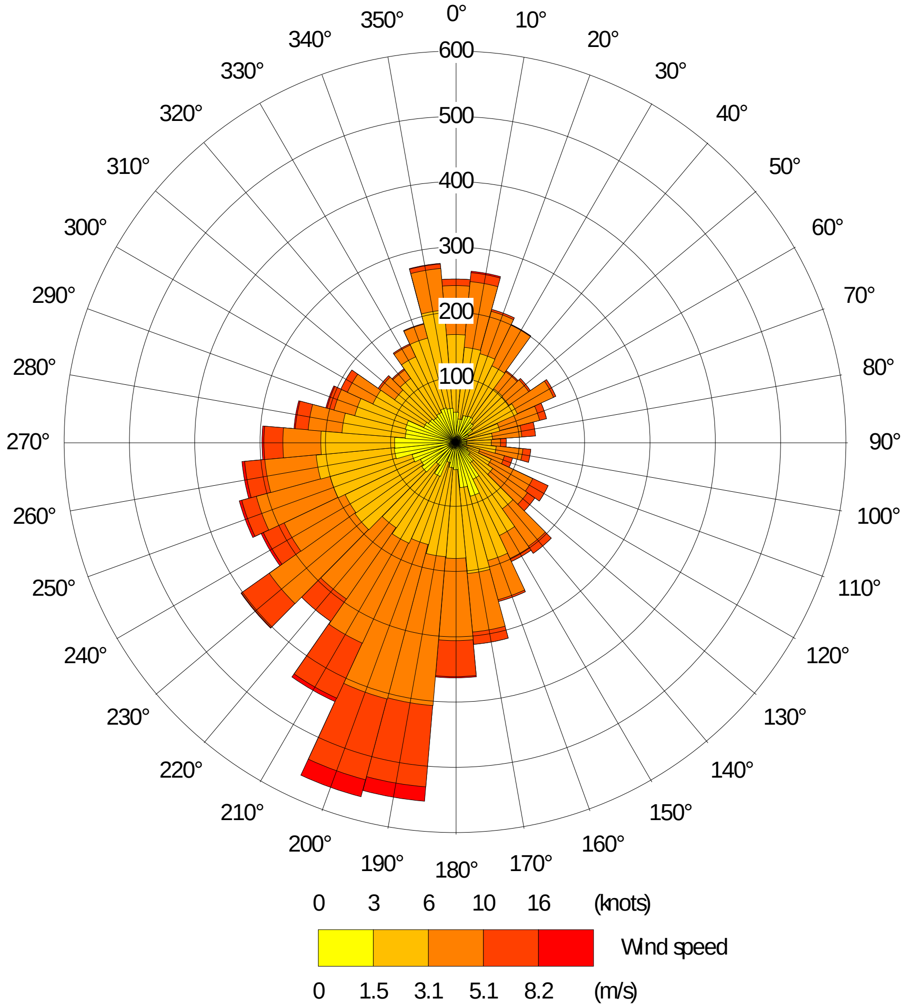
Data from the Leicester Met. Mast is hourly sequential and includes 8 variables:

YEAR	Year
TDAY	Julian Day Number
THOUR	Local time (hour)
TOC	Near surface temperature (^{o}C)
U	Wind speed (m/s)
PHI	Wind direction (angle in degrees)
FTHETA0	Near surface heat flux (w/m^2) *(Calculated)*
CL	Cloud Cover (oktas) *(Calculated)*

The meteorological year 2002 is "typical" in terms of weather. Simple statistics shown below in Table 9.2 show an annual average mean wind speed of 3 m/s and the prevailing wind direction being south westerly as shown by the wind rose below.

Table 9.2: Summary of Meteorological Data for 2002, Groby Road Met. Mast

Parameter	Average	Max	Date and Time Max Occurred	Min	Date and Time Min Occurred
Temperature °9	10.7	33.1	29th July, 4pm	-8.25	2nd January, 4am
Wind Speed m/s	3.0	11.7	9th March, 3pm	0.08	14th July, 7am
Wind Direction °	193	360	-	0	-



9.4 The Relationship between NOx and NO_2: Treatment of atmospheric chemistry by the model.

To model the chemical reactions in the atmosphere, ADMS –Urban uses a scheme called The Generic Reaction Set. The Generic Reaction Scheme uses a set of chemical reactions to model interactions of NO, NO2, VOCs and O3 in the atmosphere. For a detailed description of how the model deals with atmospheric chemistry reference should be made to the Air Quality Review and Assessment, Final Report 2001 - Appendix 4.

9.5 Background Corrections

A background correction for nitrogen dioxide model predictions, which is added on to model results, is taken from a convenient rural nitrogen dioxide monitoring site, in this case Harwell in Oxfordshire. The reason this site was chosen is because the data set was good quality and there was sufficient data capture for the year 2002. The site also lies upwind of the prevailing wind direction from Harwell towards NWLDC so gives a good representation of what may be advected into the Leicestershire area. For the 2002 runs this data can be used in its current form. In the case of the 2005 runs correction factors to estimate NO_2 concentrations in 2005 are applied to the 2002 data. The correction factor of 0.892 is taken from Box 6.6, Section 6.27 of Technical Guidance.

9.6 Verification of the dispersion modelling

During the Stage 3 process the validation methodology adopted was that used by and relevant to Leicester City Council. However, a validation factor should be relevant to the area being considered, i.e. NWLDC is predominately rural. The validation factor for the model has thus been determined using the results from the real time NO_2 monitor located at Kegworth.

(i) Systematic Error

Systematic error, or model adjustment is where the model shows a more or less consistent degree of over or under estimation which can be identified and allowed for interpreting its out put.

During the modelling work conducted by Leicester City Council for the Stage 3 Report, it was noted that the model was subject to a systematic error in predicting values. There was a tendency to over predict at background stations not directly affected by road traffic, whilst at roadside locations the model would under-predict. As noted above the systematic error for the Stage 4 Assessment has been determined using the data from the real time NO_2 monitor at Kegworth, as it is more relevant to the area being considered.

In interpreting the modelling results across the entire mapped area it is necessary to take account of this systematic error. Direct comparison of the monitored values with the model prediction at the monitoring station allowed a correction factor to be calculated:

Box 2: Estimated systematic error adjustment: annual mean NO_2

Adjustment Factor = monitored annual mean/modelled annual mean

Adjustment Factor = 37.35/33.6

Adjustment Factor = 1.11

It can be concluded that the model is under predicting. A model adjustment factor of 1.11 has therefore been applied to the model for 2002.

The output of the model has been verified using 2002 as the base year. The predicted annual mean NO_2 for each NO_2 tube has been determined from the model, and a comparison made with the results obtained from the corresponding bias adjusted NO_2 tubes, see Section 9.0 for further details. There is no definite pattern – however, the model is generally under predicting when compared to the tube data in the AQMAs, with the exception being those tubes located in the M1 AQMA, where the model is over predicting.

The 2002 base year has then been adjusted for 2005 accordingly. The background data used for the 2005 prediction of annual NO_2 has also been factored for 2005.

(ii) Random Error

After the systematic error has been accounted for there is still additional uncertainty of the adjusted results, which arise from random errors, that is errors that can not be easily quantified, together with assumptions or inaccuracies in input data.

Local Authorities should be aware of these additional uncertainties but are not expected to take account of them by further adjusting their modelling results. However, these uncertainties are useful in assisting the authority in its decision as to the extent of the boundary of an AQMA.

It is not possible to determine the standard deviation of the model (SDM) using the methodology outlined in the NCSA Guidance Note, ‘Turning Reviews into Action’, as there are simply not enough points to plot on a graph. However, it is recognised that even limited monitoring data can be used to improve the validation process, hence the approach detailed in the Technical Guidance has been used to calculate the SDM. Box A3.8 of the Technical Guidance details the NSCA U values for assessing uncertainty. For the purpose of this assessment a stock U value of 0.1 for the NO_2 annual average air quality objective has been used.

Using a U value for the annual mean NO_2 concentration of 0.1, the SDM and therefore the uncertainty of the line of exceedance would be:

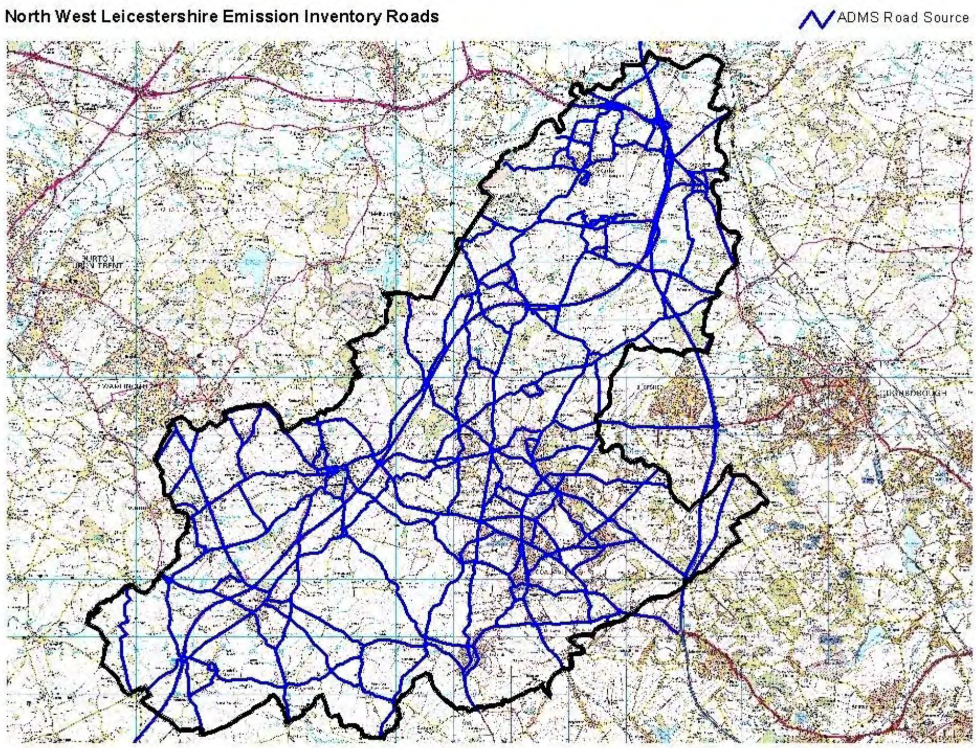
SDM = 0.1 x 40 = 4µg/m3.

Therefore, the line showing 36µg/m^3 (40 – 1SDM) can be used when deciding upon the boundary of an AQMA.

9.7 Modelling for the Stage 4 Assessment

The AQMAs were declared on the basis that it was *likely* that the air quality objective for annual mean NO_2 (40µg/m ^{3}) may not be achieved at various locations throughout the District by 2005, because of the contribution of NO_2 from traffic. All roads which were predicted to be above the 36µg/m^3 (i.e. 40µg/m^3 – 1SDM) but below the 40µg/m^3 at relevant locations in 2005 were incorporated into AQMAs.

The year modelled as the current year is 2002, and predictions have been made for 2005. The model requires traffic count information as annual average daily traffic (AADT) flows, average speeds and percentage heavy vehicles for each road link/section. Also a set of time varying emission factors are required to reflect the change in traffic flows throughout the day. Where possible the data used was from counts taken in 2002. Where earlier count information has been used it has been factored using local traffic area forecast factors supplied by Leicestershire County Council, which estimate that traffic will increase by approximately 2% per year. Similarly the 2002 flows were factored by 2% per year to predict the 2005 predicted flows. Map 2 below shows which roads are included in the emission inventory.



Map 2: Roads included in NWLDC Emissions Inventory

Most of the traffic data did not include speed information. Generally the speed limit was assumed to be the average speed. The model can not account for congestion so although congested roads were noted, specific information relating to congestion does not exist in the emissions inventory.

For the Stage 3 Review and Assessment the AADT flows for the Ashby area were based on predictions on account of the proposed Ashby by-pass to be opened in 2002. This has since been opened, and a number of traffic counts have been conducted by the County Council for the main streets in Ashby, these have been included in the updated emissions inventory.

Since the stage 3 Review and Assessment the Government and the Devolved Administrations have recently released new road traffic emissions factors. These factors reflect the expected higher NOx emissions in future years from road transport. As noted above these factors have been used for the Stage 4 Review and Assessment.

9.8 Modelling for East Midlands Airport

Considerable work was involved to try and predict the emissions from the airport and their influence on future ground level pollutant concentrations around the airport both by the NWLDC for its Stage 3 Report and EMA for their Environmental Statement for the proposed runway extension. For consistency the same approach to modelling has been followed for the Stage 4 Report. The methodology has not been repeated here, NWLDC Stage 3 Report should be referred to if further detail is required.

10.0 Modelling and Monitoring within the AQMA and Comparison with the Relevant Air Quality Objectives

10.1 AQMA 1 - Vicinity of M1

10.1.1 Monitoring Results - AQMA 1

There are 5 diffusion tubes located within this AQMA, numbers, 18, 19, 20, 21 and 22. Tube 18 (Molehill Farm) is located in the vicinity of a single farmhouse. The tube is located *35m* from the centre line of the M1, which is set in a cutting, and *112m* from the A453. It is the only tube throughout the whole district, which exceeded the objective in 2002, at 43.73$\mu g/m^3$. When this result is projected forward to 2005 a predicted concentration of 40.25$\mu g/m^3$ is obtained.

Tubes 19 (Long Whatton) and 20 (Long Whatton West) are positioned *23m* and *112m* respectively, from an elevated section of the M1. The tube closer to the M1 shows a slightly higher annual mean concentration (30.85$\mu g/m^3$) than the tube positioned further away (27.50$\mu g/m^3$), however, both are below the government objective, and are predicted to remain so when projected forward to 2005.

Tube 21 (Copt Oak) is positioned *61m* from the M1, and is set at an elevated location on the B587 which forms a bridge over the M1. The predicted annual mean concentration for this tube in 2005 is 29.18$\mu g/m^3$; this is again below the government objective.

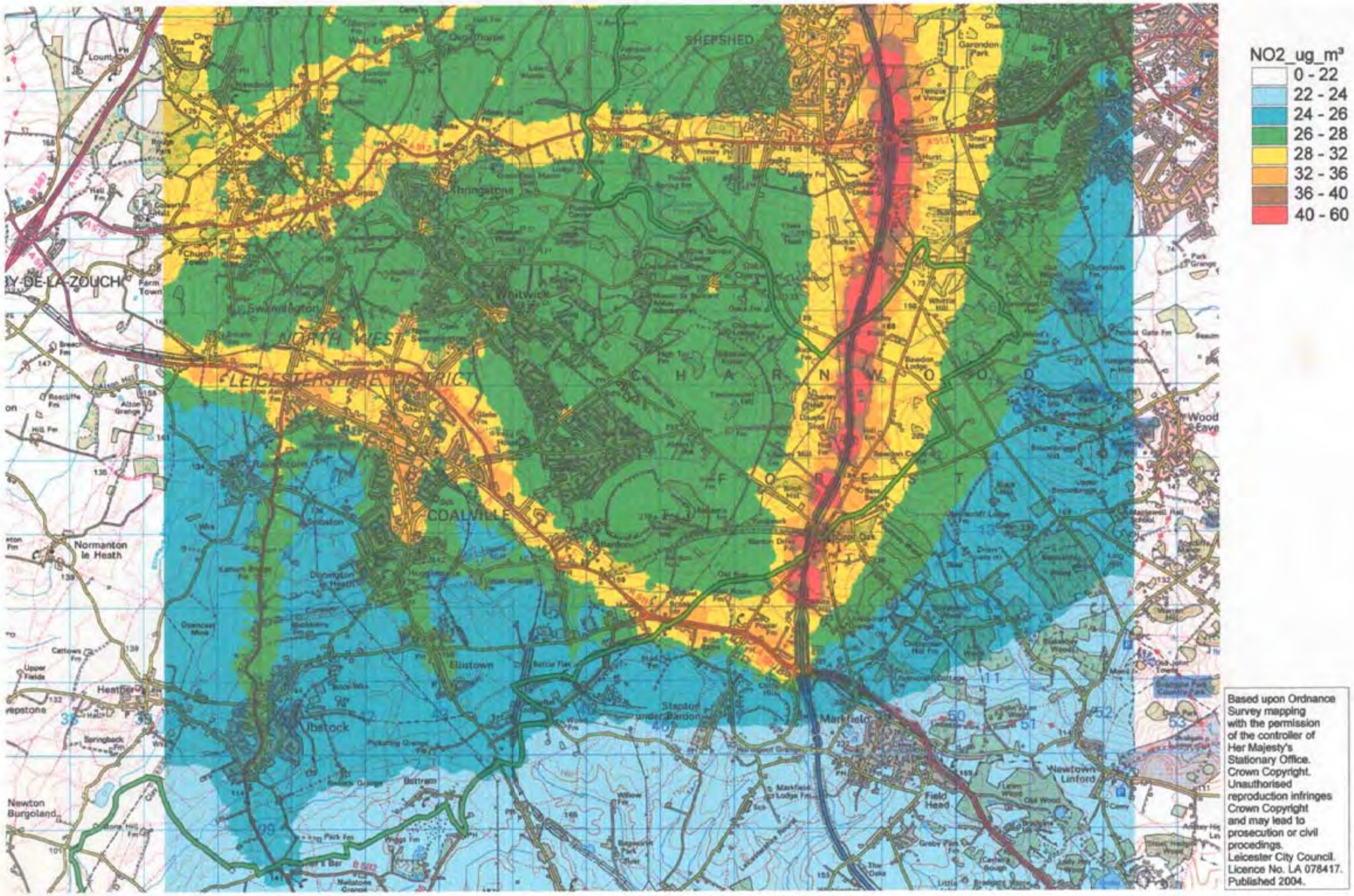
Tube 22 (Charley) is located close to a block of residential properties, which are *175m* from the M1, and both are at a similar altitude. The predicted annual mean concentration for this tube in 2005 is 22.24$\mu g/m^3$; this is again below the government objective.

10.1.2 Modelling Results - AQMA 1

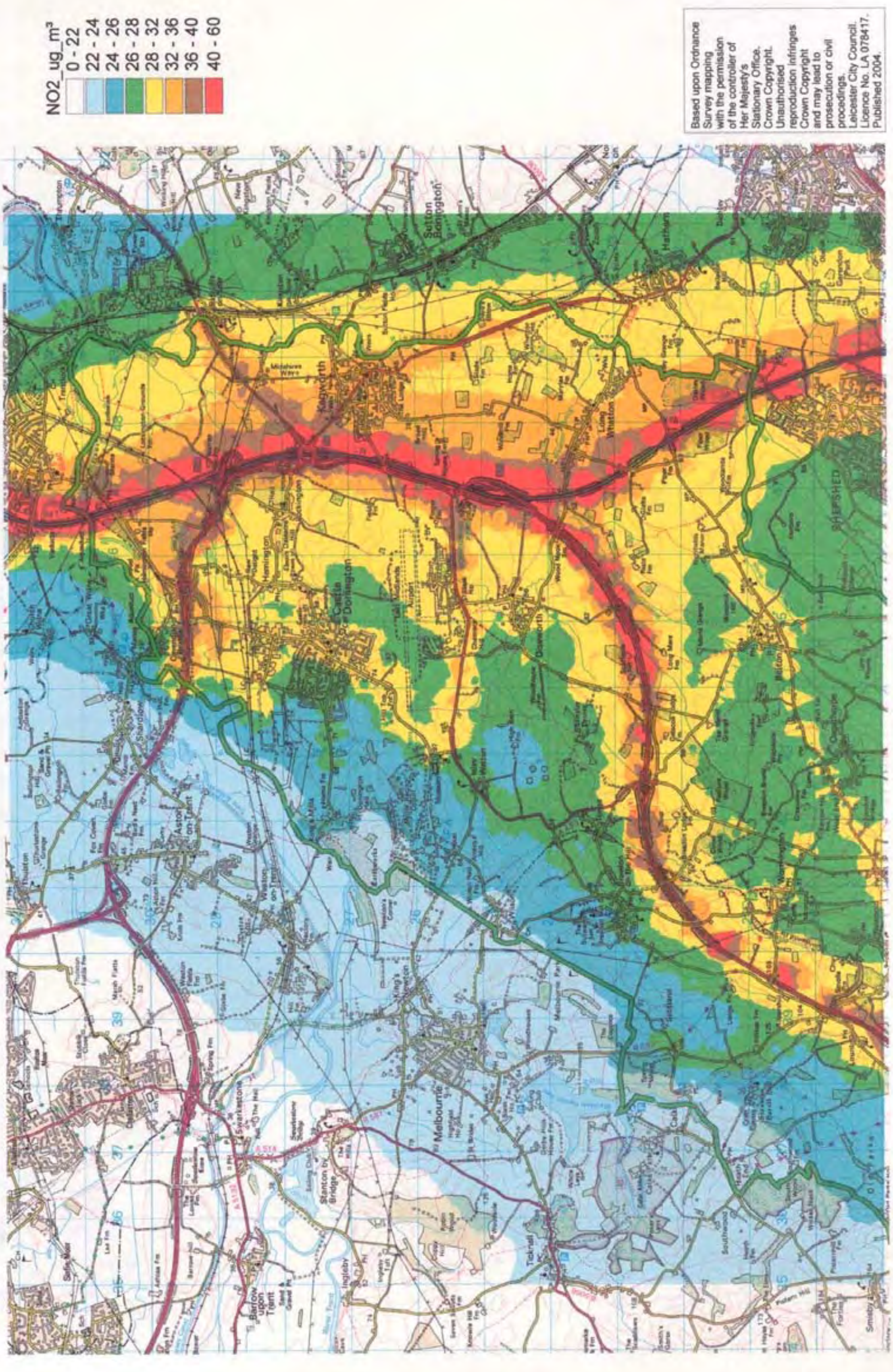
The model has predicted that certain areas alongside the M1 will exceed the 2005 objective for NO_2 as indicated in red on Map 3 and Map 4. NO_2 tubes have been positioned at relevant receptors where it was predicted that levels would exceed the 2005 objective. Appendix 5 details the predicted modelled concentrations of NO_2 at these receptor locations. The predicted levels at four of the receptor locations in this AQMA are in excess of the objective. These are receptor locations 18, 19, 20 and 21. The other receptor location in this AQMA is 22, which is predicted to be below the objective in 2005.

Map 3

Coalville and surrounding area - M1 AQMA (southern section)   Annual Mean Nitrogen Dioxide 2005   Correction Factor Applied



Map 4
Kegworth and surrounding area - M1 AQMA (northern section)   Annual Mean Nitrogen Dioxide 2005   Correction Factor Applied



10.1.3 Comparison of Monitoring data with Modelled data for AQMA 1, 2005 Objective

AQMA 1 – Vicinity of the M1

Receptor Location name & number	Predicted NO_2 Annual Mean for 2005 µg/m^3	
	Monitored	**Modelled**
18 Kegworth Molehill Farm	40.25	58.9
19 M1 Long Whatton	28.40	58.22
20 M1 Long Whatton West	25.32	48.98
21 Copt Oak	29.18	45.71
22 Charley	22.24	37.27

Table 10.1 Comparison of predicted monitored and modelled annual mean NO_2 for 2005 based on 2002 data AQMA 1 (red indicates breaches of the 2005 objective)

Monitored predictions for 2005 based on bias adjusted 2002 data are indicating that the only relevant receptor in this AQMA that is likely to exceed the objective of 40µg/m^3 is Molehill Farm. All the other monitoring locations in this AQMA are significantly below the objective. However, the modelling has predicted that four of the five-receptor locations are likely to exceed the objective.

It is our opinion that monitoring data provides a more accurate indication of the actual situation rather than the predictive data obtained by modelling. A comparison of the two data sets shows that the computer modelled predictions are significantly greater than the monitored data which has been projected forward using the correction factors detailed in the Technical Guidance. Further discourse in AQMA 2 below.

Further examination of historical data, also indicates that monitoring location 18 is the only tube which regularly exceeds the 2005 annual objective of 40µg/m^3.

10.2 AQMA 2 – Kegworth A6

10.2.1 Monitoring Results - AQMA 2

This is a trunk road through a large village fronted by shops and houses, many with facades within 10m of the kerbside. As noted previously there is a real-time monitor and an NO_2 tube located within the boundaries of this AQMA at a façade location 9m from the highway, and this is where the co-location exercise for the bias adjustment of the tube data was conducted.

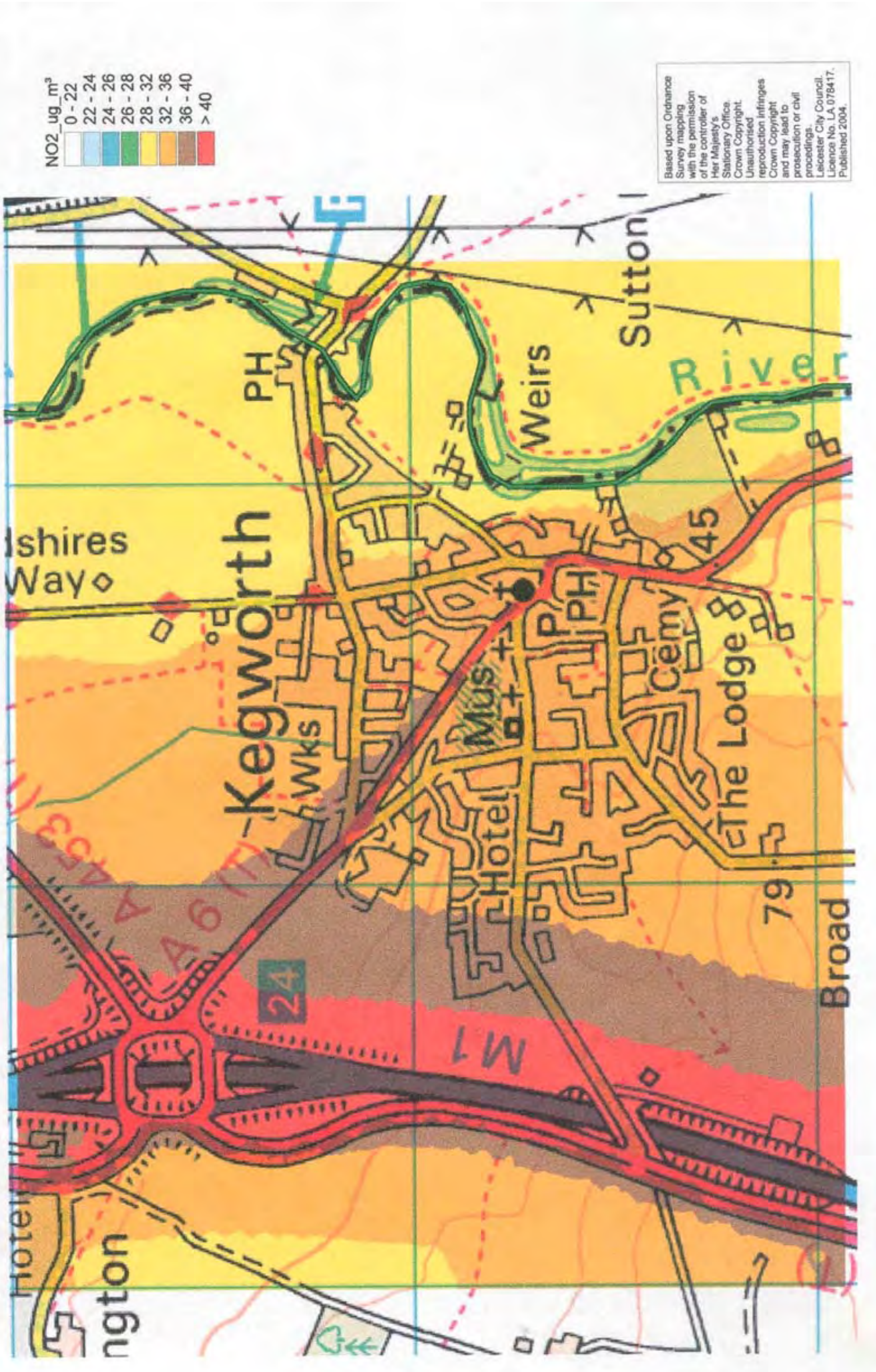
Results from this real time monitoring station showed that the annual mean NO_2 for 2002 was 37.25μg/m^3, this is close to the government objective of 40μg/m^3. However, when this is projected forward to 2005, a concentration of 34.38μg/m^3 is obtained.

The government objective for the 1-hour mean is 200μg/m^3 and is not to be exceeded more than 18 times in a year. The hourly objective at Kegworth was breached on only two separate occasions during 2002, with the maximum peak 1-hour mean recorded as 620.75μg/m^3, at 1800hours on 3rd November 2002, and 253.8μg/m^3 recorded on 30th September at 1100hours. The third highest hourly peak average was recorded in July 2002 at 138.4μg/m^3. It should be noted that the rest of the mean hourly average readings were significantly below the current objective, therefore, it is concluded that both of the government objectives for NO_2 were achieved in 2002.

10.2.2 Modelling Results - AQMA 2

Map 5 shows results of the modelling in the vicinity of this AQMA. The M1 is positioned to the west of Kegworth and appears to be affecting the air quality of this village. The A6 is a main arterial road flowing through the centre of the village and is also depicted in red, indicating that levels of NO_2 on the road are above the 2005 objective. Receptor location 16 is relevant to this AQMA and is indicating that NO_2 will be marginally below the objective in 2005 at 38.93μg/m^3. This site is *9m* from the road and is representative of other relevant receptors in this AQMA.

Map 5
Kegworth Air Quality Management Area   Annual Mean Nitrogen Dioxide 2005   Correction Factor Applied



10.2.3 Comparison of Monitoring data with Modelled data for AQMA 2, 2005 Objective

Receptor Location name & number	Predicted NO_2 Annual Mean for 2005 $\mu g/m^3$	
	Monitored	**Modelled**
16 Kegworth A6	34.38	38.93

Table 10.2: Comparison of predicted monitored and modelled annual mean NO_2 for 2005

As detailed in section 8.1 the real time monitor is situated in this AQMA and it is the site where the co-location exercise was conducted. It can therefore be assumed that the predicted monitored levels for 2005 are the most accurate for the whole of the district. Again the model has predicted that the concentrations of NO_2 in 2005 will be greater than the predictions obtained from projecting the 2002 monitored levels forward to 2005. Both modelled and monitored concentrations for 2005 are expected to be below the Government objective of 40$\mu g/m^3$.

10.3 AQMA 3 – A511

10.3.1 Monitoring Results - AQMA 3

This AQMA stretches along the length of the A511 from its point at Sinope on the western side of Coalville to Bardon on the eastern side of Coalville. At this point the boundary of NWLDC meets that of Hinckley and Bosworth Borough Council (HBBC). A check with HBBC reveals that the continuation of the A511 into their district has not resulted in an AQMA being declared.

There are 3 tubes located within the boundaries of this AQMA. Tube 24 is located at Sinope, close to a block of residential properties. The predicted annual mean concentration for this tube in 2005 is 21.12$\mu g/m^3$, which is below the government objective.

Tubes 5 (Bardon Road) and 23 (Broomleys) are located within the section of the AQMA where the A511 flows through a predominantly residential stretch, hence the declaration of the AQMA. The mean annual concentration projected forwards to 2005 for these tubes are 30.17$\mu g/m^3$ and 35.56$\mu g/m^3$, respectively, which is again below the government objective.

Tube 23 is situated at the junction where Broomleys Road crosses the A511, and is *5m* from the façade of the nearest residential property. Concentrations will be slightly lower at the building façade and guidance indicates that an adjustment factor of 0.90 can be applied to the tube data to estimate the concentration at the façade. Applying this correction factor a level of 32$\mu g/m^3$ for 2005 is predicted at the closest residential property to this NO_2 tube.

in order to improve road safety and assist in reducing traffic congestion the method to control the flow of traffic was changed from a roundabout to traffic lights at the end of 2002. The levels at this tube will continue to be monitored closely to see if this has any noticeable impact on the levels of NO_2 in this area.

10.3.2 Modelling Results - AQMA 3

This AQMA follows the route of a section of the A511. Maps 6, 7 and 8 show the results of the modelling.

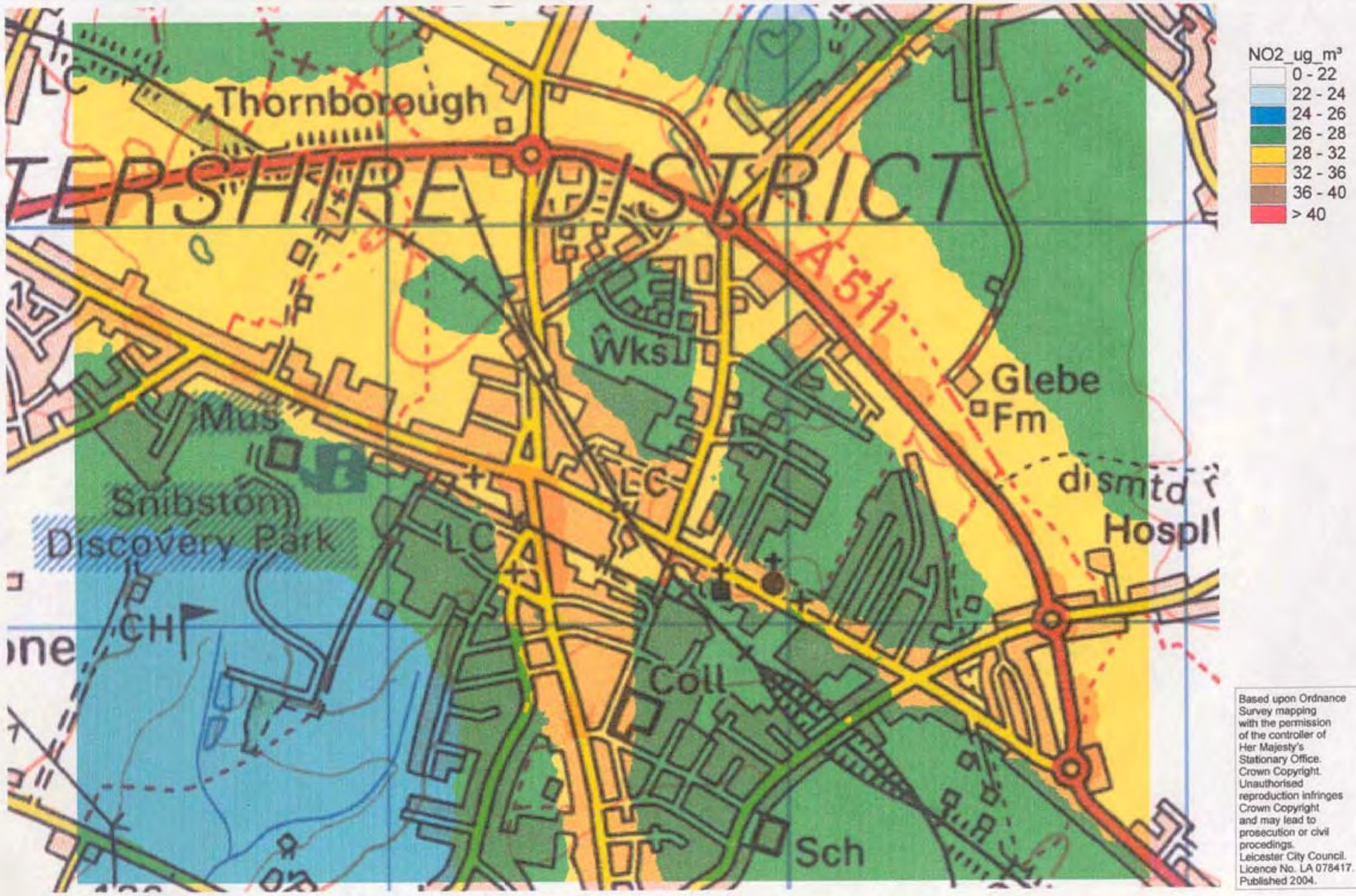
Map 6 shows the Sinope section of this AQMA, the A511 is depicted in red as it is predicted that the levels of NO_2 will be above the objective on the road itself. It is evident that the levels will not be above the objective as you move away from the road. Receptor location 24 (Sinope) is representative of all relevant receptors along this stretch of the A511, the concentration of NO_2 in 2005 at this receptor is predicted to be 33.17$\mu g/m^3$ and hence below the current objective.

Map 7 shows the Coalville section of this AQMA. The A511 is depicted in red as the concentrations of NO_2 are predicted to be in excess of 40$\mu g/m^3$. The levels will not be above the objective away from the road. Receptor location 23 (Broomleys) is situated within this stretch of this AQMA its exact location is shown in Appendix 1 and is located next to a busy junction with Broomleys Road. As noted above the roundabout at this junction (as depicted in map 7) was replaced with traffic lights in the latter part of 2002 in an attempt to reduce accidents and assist pedestrians and cyclists. This receptor location is a roadside location predicted to have an annual average of 32.63$\mu g/m^3$ in 2005, which is below the objective.

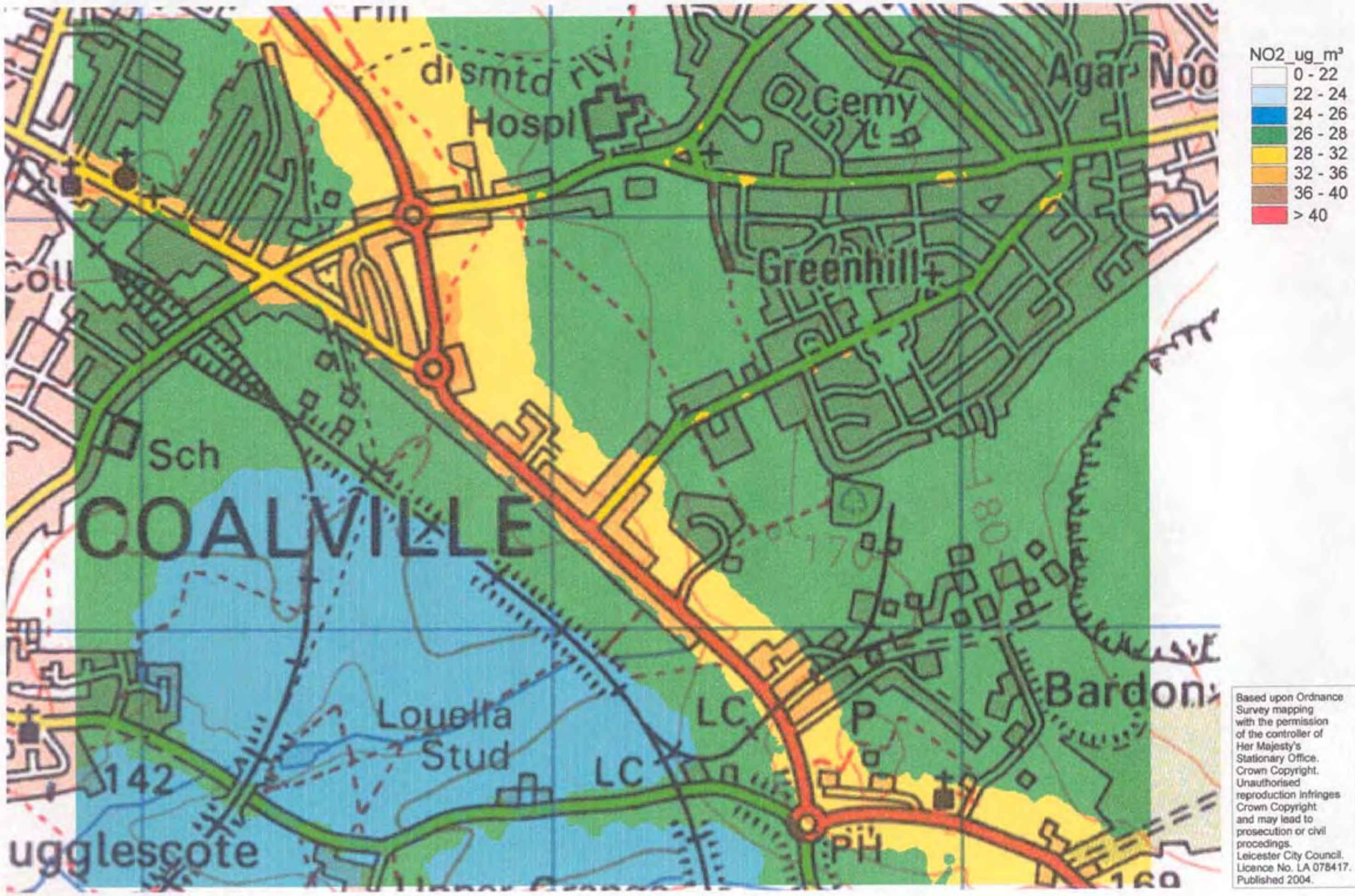
Map 8 depicts the Bardon Road section of the A511 AQMA. Receptor location 5 (Bardon Road) is sited in this stretch of the AQMA and is predicted to have an annual mean of 34.47$\mu g/m^3$ in 2005. The modelling does not show any breaches of the objective at relevant receptors for this stretch of the A511 AQMA.

Map 6
A511 Air Quality Management Area (Sinope section)   Annual Mean Nitrogen Dioxide 2005   Correction Factor Applied

Map 7
A511 (Coalville section) and Belvoir Road Air Quality Management Areas Annual Mean Nitrogen Dioxide 2005 Correction Factor Applied



Map 8
A511 Air Quality Management Area (Bardon section) **Annual Mean Nitrogen Dioxide 2005** **Correction Factor Applied**



10.3.3 Comparison of Monitoring data with Modelled data for AQMA 3, 2005 Objective

Receptor Location name & number	Predicted NO_2 Annual Mean for 2005 $\mu g/m^3$	
	Monitored	**Modelled**
5 Bardon Road	30.17	34.47
23 Broomleys	35.56 (32^F)	32.63
24 Sinope	21.12	33.17

Table 10.3 Comparison of predicted monitored and modelled annual mean NO_2 for 2005 (^{F} = Façade concentration)

Predictions for 2005 from both modelling work and the bias adjusted 2002 monitored data are indicating that none of the NO_2 tubes situated at relevant receptor locations in this AQMA are likely to exceed the 2005 objective of 40μg/m^3.

10.4 AQMA 4 – Belvoir Road, (Coalville)

10.4.1 Monitoring Results - AQMA 4 - Belvoir Road AQMA, (Coalville)

The top end of Belvoir Road close to the junction with High Street and Ashby Road is part of the central shopping area of Coalville. The road is narrow and fronted with shops; four of which have residential flats above them.

Tubes 1 (Belvoir Road) and 2 (Jackson Road) are located within the boundaries of this AQMA. Historically tube number 1 showed the highest concentrations of NO_2 in the District. However, the latest data for NO_2 shows a decrease in pollution, with concentrations of NO_2 monitored at this tube being consistently below the 2005 objective (see Appendix 2). The predicted mean annual average for tube number 1 in 2005 is 24.28μg/m^3 and 28.23μg/m^3 for tube number 2, both well below the government objective.

An element of reduction in pollution in this AQMA is likely to be linked to the reconfiguration of the memorial square junction; traffic calming along Ashby Road and re-timing of the traffic light sequencing. All have improved congestion problems within this AQMA, and hence appear to have had a positive affect on the air quality.

10.4.2 Modelling Results - AQMA 4 - Belvoir Road AQMA, (Coalville)

Map 7 also shows modelling which has been conducted for the Belvoir Road AQMA. There are two receptor locations in this AQMA numbers, 1 and 2; the predicted concentrations of NO_2 in 2005 are 30.76μg/m^3 and 28.48μg/m^3 respectively. Levels of NO_2 are not predicted to be above the objective on the road itself, evidently the 2005 objective is predicted to be achieved in this AQMA.

10.4.3 Comparison of Monitoring data with Modelled data for AQMA 4, 2005 Objective

Receptor Location name & number	Predicted NO_2 Annual Mean for 2005 $\mu g/m^3$	
	Monitored	**Modelled**
1 Coalville Belvoir	24.28	30.76
2 Coalville Jackson	25.98	28.48

Table 10.4 Comparison of predicted monitored and modelled annual mean NO_2 for 2005

Predictions for 2005 from both modelling work and the bias adjusted 2002 monitored data are indicating that none of the NO_2 tubes situated at relevant receptor locations in this AQMA are likely to exceed the 2005 objective of $40\mu g/m^3$.

10.5 AQMA 5 – Castle Donington, Diseworth Road

10.5.1 Monitoring Results - AQMA 5- Castle Donington, Diseworth Road

Diffusion tube number 15 (Diseworth) is located at the boundary of this AQMA bordering East Midlands Airport (EMA). The runway is the main source of pollution from EMA. The tube is 196m from the runway and is closer than the nearby residential properties, which are approximately 263m distant. The predicted annual mean concentration at this site for 2005 is $21.51\mu g/m^3$.

It is not possible to apply the bias adjustment to this tube as this particular AQMA was declared in relation to NO_2 emissions associated with aircraft activities at EMA. The bias adjustment mentioned previously in this report is essentially for use where the source of NO_2 is from road traffic.

EMA also have their own network of NO_2 tubes and share the data with this Authority see table 10.2 and Figure 10.1. EMAs tubes are supplied by Casella Stanger and are prepared using the 10% TEA in water method. Three of the EMA tubes, tubes 5, 6, and 3, are closest to the AQMA. The mean annual averages of all three tubes are significantly below the government objective, and correlate well with that operated by the council. The only tube on the EMA site to show an exceedance is tube number 1, which is located well within the boundary of the airport away from residential properties.

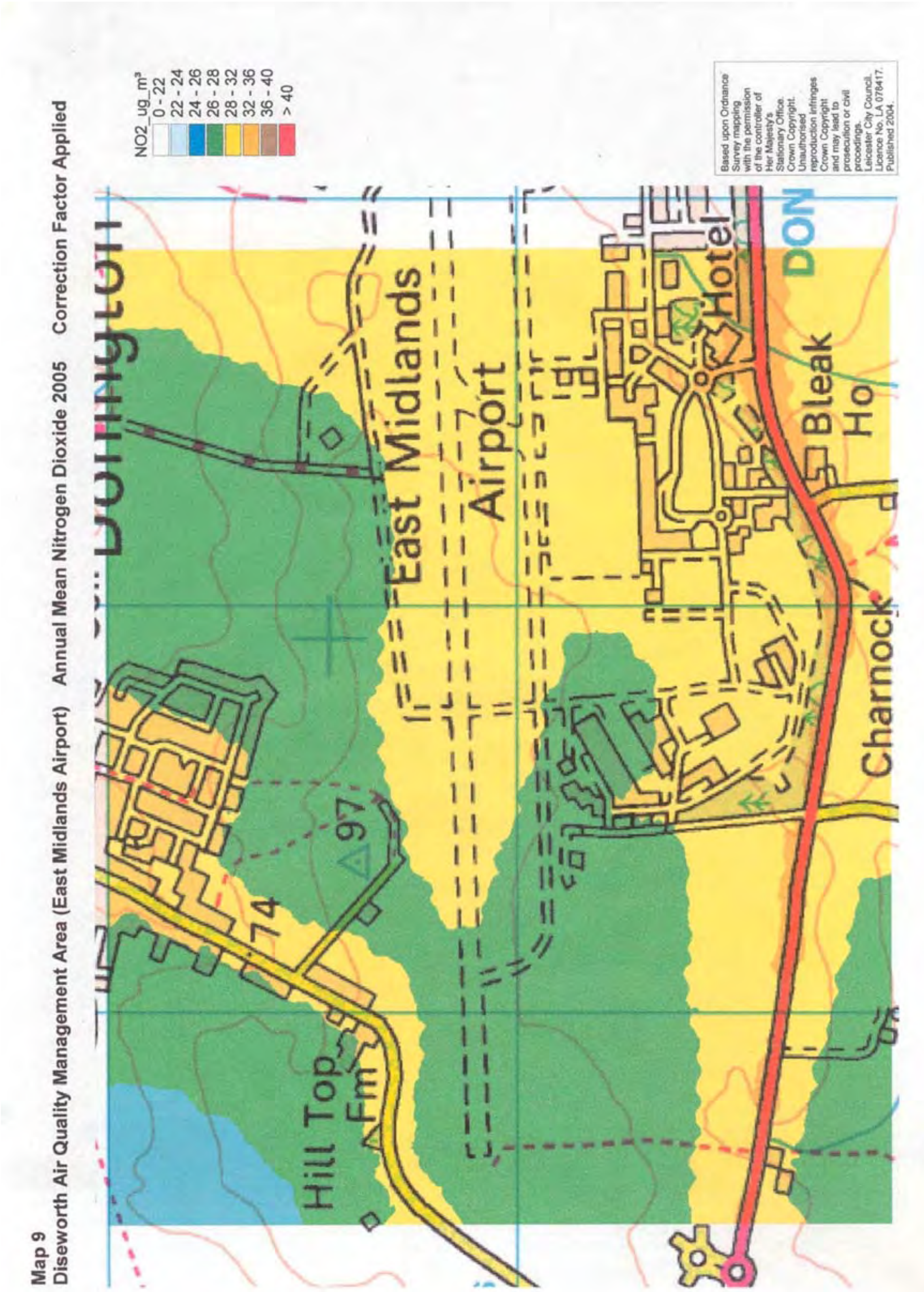
Tube Number	Location	Annual Average
1	Stand 15	**43.58**
2	Crash gate 27 ILS	28.33
3	Crash gate 4	24.68
4	Central IRVR	29.22
5	Western perimeter fence	23.09
6	Western perimeter fence (b)	25.40
7	Ambassador Rd	27.94

Table 10.2: Annual Average NO_2 for tubes at EMA, for 2002. (Data supplied by EMA)

Since the declaration of this AQMA, NWLDC in conjunction with EMA have purchased a real-time NO_2 monitor from Eti-Casella. The monitor was commissioned in July 2003. Initial results support the 2002 tube data in that the levels of NO_2 are below the 2005 objective, with the raw average from August to November 2003 being 30.05μg/m^3

10.5.2 Modelling Results - AQMA 5- Castle Donington, Diseworth Road

Map 9 shows modelling for this AQMA, which was declared because of activity levels at EMA. The correction factor has been applied and the results of the modelling are indicating that in 2005 concentrations of NO_2 at this receptor location will be 27.75μg/m^3. It should be noted that the correction factor that has been applied was derived for road traffic and may not be appropriate for emissions for airports. However, when comparing this value with the projected monitored value for 2005 (21.51μg/m^3) the results are not significantly different. Hence, as airports are a diffuse source the correction factor has been applied.



Map 9
Diseworth Air Quality Management Area (East Midlands Airport)   Annual Mean Nitrogen Dioxide 2005   Correction Factor Applied
NO2_ug_m³
0 - 22
22 - 24
24 - 26
26 - 28
28 - 32
32 - 36
36 - 40
> 40
Based upon Ordnance Survey mapping with the permission of the controller of Her Majesty's Stationary Office. Crown Copyright. Unauthorised reproduction infringes Crown Copyright and may lead to prosecution or civil procedings. Leicester City Council. Licence No. LA 078417. Published 2004.
East Midlands
Airport
Hotel
Bleak
Ho
Charnock
Hill Top
Fm
97
74
DON

10.5.3 East Midlands Airport (EMA)

Aircraft are significant sources of nitrogen dioxide emissions, especially during take off.

In August 2000, EMA submitted a planning application to extend the runway by 190m from the current length of 2890m to a total length of 3080m. The planning application remains undetermined and EMA now wishes to pursue the application through to determination. Since the submission of the original planing application in August 2000 and NWLDC Stage 3 Report it has been recognised by EMA that the growth in air traffic has been significantly greater than was forecast. The principal reason for this additional growth is the introduction to EMA of ‘low cost services.

In order to establish whether the increase of air traffic has had a negative impact in the levels of NO_2 surrounding EMA a more detailed analysis of the historical tube data has been undertaken. Tube number 15 (Castle Donington, Diseworth) is located in the AQMA but was only established in April 2001 after declaration of the AQMA. Tube number 13 (Castle Donington, EMA) is located approximately 1km in a northerly direction form the AQMA and dates back to April 1998. Appendix 6 shows the monthly results for each tube. In summary it does not appear that the increase in air traffic is reflected by the results of the monthly tube data.

10.5.4 Comparison of Monitoring data with Modelled data for AQMA 5, 2005 Objective

AQMA 5 – Castle Donington, Diseworth Road

Receptor Location name & number	Predicted NO_2 Annual Mean for 2005 $\mu g/m^3$	
	Monitored	**Modelled**
15 Diseworth	21.51	27.75

Table 10.5, Comparison of predicted monitored and modelled annual mean NO_2 for 2005

Predictions for 2005 from both modelling work and the bias adjusted 2002 monitored data are indicating that the levels of NO_2 at relevant receptor locations in this AQMA are significantly below the 2005 objective of $40\mu g/m^3$.

10.6 AQMA 6 – Vicinity of the A50

10.6.1 Monitoring Results - AQMA 6 -Vicinity of the A50

There is no monitoring data available for this AQMA, for 2002. An NO_2 tube was commissioned in May 2003. The initial results are detailed below in Table 10.6 and are indicating that concentrations of NO_2 at the residential property are significantly below the current objective, with an average of $28.08\mu g/m^3$.

Month	NO_2 (μg/m^3)
May	29.86
June	29.58
July	24.90
August	16.91
September	39.94
October	27.27

Table 10.6: Raw results of NO_2 tube located in A50 AQMA, 2003.

Using the correction factors detailed in the Box 6.6 of the Technical Guidance, it is possible to determine an approximate indication of the predicted levels of NO_2 within this AQMA for 2005 as detailed below.

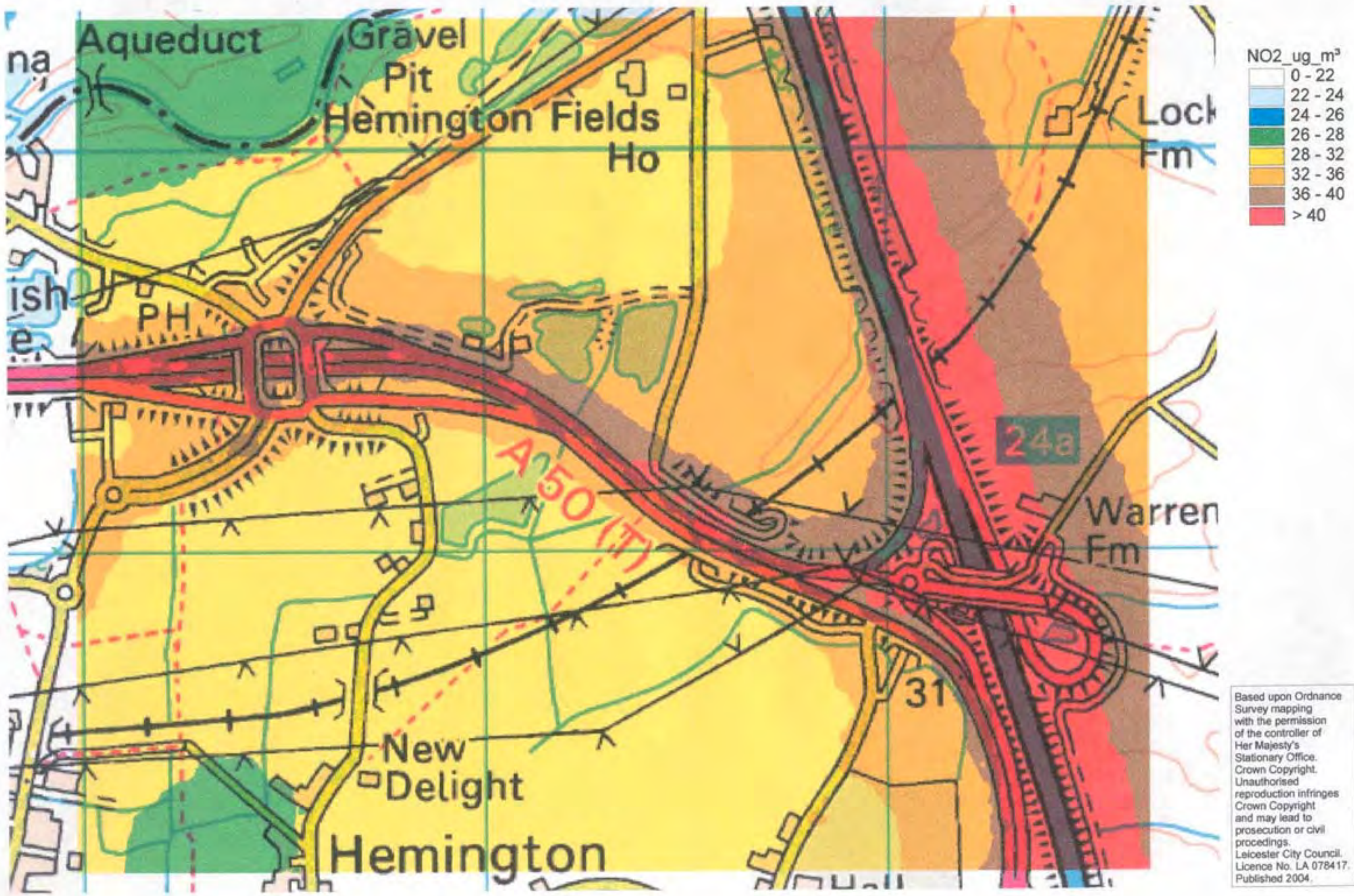
- *2003 to 2005 correction factor => 0.892/0.941*

Based on 6 months monitoring data for 2003 the predicted NO_2 levels within this AQMA for 2005 are 26.62μg/m^3.

10.6.2 Modelling Results - AQMA 6 -Vicinity of the A50

The AQMA was declared because modelling work from the stage 3 Review and Assessment concluded that the objective for NO_2 would be breached at a residential property, which is, located approximately *45m* from the A50 and *39m* from the slip road leading onto the A50. Map10 shows the output of modelling conducted for the purpose of this report. The results of the modelling are indicating that the residential property is situated in an area where levels of NO_2 for 2005 are expected to be in the region of between 32μg/m^3 and 40μg/m^3. A receptor run has been done for the bungalow and predicts that the annual mean NO_2 in 2005 will be 32μg/m^3.

Map 10
A50 Air Quality Management Area **Annual Mean Nitrogen Dioxide 2005** **Correction Factor Applied**



10.6.3 Comparison of Monitoring data with Modelled data for AQMA 6, 2005 Objective

Receptor Location name & number	**Predicted NO_2 Annual Mean for 2005 $\mu g/m^3$**	
The Bungalow	**Monitored (based on 2003 raw data)**	**Modelled**
	28.08	32

Table 10.7, Comparison of predicted monitored and modelled NO_2 for 2005

As noted previously there are no monitoring results for this AQMA for 2002. However, a tube was commissioned in May 2003 and initial results are indicating that concentrations of NO_2 at the residential property are significantly below the current objective. Modelling work has also predicted that the levels of NO2 at the residential property will be below the 2005 objective.

10.7 Monitoring outside AQMAs

There are 12 tubes across the district, which are situated outside any AQMA, and in 2002 all exhibited annual average concentrations well below the 40$\mu g/m^3$ objective.

It should be noted that tube number 10 is located in the centre of the busy market town of Ashby de la Zouch, on Market Street. This street is one of the main shopping areas in Ashby and use to be heavily congested with traffic, however, since the completion of the Ashby by pass at the beginning of 2002 the volume of traffic using this route appears to have decreased. This is reflected in the results of tube number 10 where levels of monitored NO_2 have correspondingly fallen and are now well below the government objective.

10.8 Hourly Objective for Nitrogen Dioxide

There is no straightforward way to project future exceedances of the 1-hour objective. However, a recent study analysed the relationship between the 1-hour and the annual mean NO_2 at UK roadside and kerbside monitoring sites. In light of the analysis presented in this report, it is suggested that local authorities could reliably base decisions on likely exceedances of the 1-hour objective for NO_2 alongside busy streets using an annual mean of 60$\mu g/m^3$ and above. It can therefore be concluded that the hourly objective will not be breached throughout the district as none of the NO_2 tubes show an annual mean above 60$\mu g/m^3$.

11.0 Improvements needed in Air Quality

11.1 The improvement that is needed – general points

An important stage in the Stage 4 Review and Assessment process is to identify the improvements needed in air quality, when there are exceedances of the UK air quality objectives.

It should be noted that Local Authorities do not need to attempt to improve air quality beyond the air quality objective that is being exceeded. However, it is recognised that once an Air Quality Management Area (AQMA) has been declared a Local Authority should be confident that concentrations of the pollutants for which it was declared should be significantly below the objective before revoking an AQMA.

11.2 AQMAs the conclusions from monitoring and modelling

NWLDC identified six AQMAs on the basis of the stage 3 Review and Assessment where it was considered likely that the annual mean objective for nitrogen dioxide would not be achieved. These are detailed in Appendix 1.

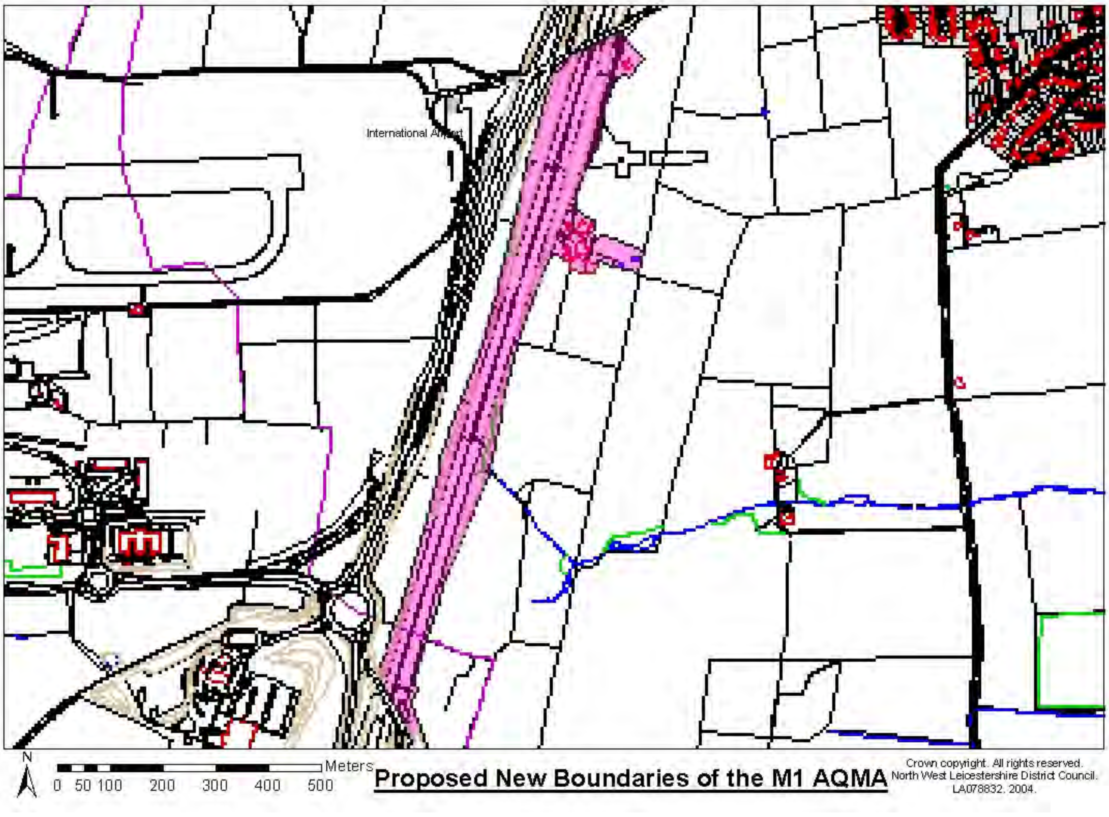
Further monitoring and modelling work has been conducted in each of the AQMAs to confirm the designation of the AQMA and to check that the original designation is still valid, and does not need amending in some way. The conclusions of both the monitoring and modelling work are considered below for each AQMA.

AQMA 1- Vicinity of M1 – contains 22 residential properties, which are within 150m of the M1. Modelled predictions show that the objective is unlikely to be met at 4 of the receptor locations (i.e. the NO_2 tubes) within this designated AQMA. The diffusion tube data based on 2002 indicates that tube 18 positioned in the vicinity of Mole Hill Farm (which is the closest property to the M1) is expected to exceed the 2005 objective. Comparison of the diffusion tube data with the modelled predictions suggests that the model may overestimate nitrogen dioxide concentrations in the vicinity of the M1.

Based on current findings it is recommended that the receptor locations in the vicinity of tubes 19, 20, 21 and 22 be removed from the original AQMA and the AQMA as a whole being reduced and re-defined as detailed in Map 11. This will allow a clear focus on the hot spot locations and provide a better indication of where resources need to be allocated in terms of equipment and overall effort.

A decision has been made not to use the procedure detailed in Section 9.6 (ii) of this report to set the proposed new boundaries of the AQMA as it has been concluded that modelling work may have over predicted the levels of NO_2 in the vicinity of the M1. Instead, the approach used in NWLDC Stage 3 Report has been used and a cautionary distance of 150m from the M1 has been used to define the extent of the AQMA. To avoid having to draw artificial precise lines to set the length of the AQMA the natural boundaries of the road layout have been used.

It can be concluded that in the case of diffusion tube number 18 concentrations of 40.25μg/m^3 are predicted for 2005 hence a marginal improvement is required if the 40μg/m^3 objective is to be met.



Map 11. Proposed Boundaries of the M1 AQMA

AQMA 2 - Kegworth A6 – contains 60 residential properties. Both modelling and monitoring data indicate that nitrogen dioxide levels are expected to be less than the 40μg/m^3 objective.

However, it should be noted that based on 10 months of monitoring data for 2003 the annual average to date is 41.28μg/m^3. Using the corrections factors in the Technical Guidance the estimated annual average for 2005 is 39.1μg/m^3. (41.28 x (0.892/0.941).

,
At this stage it is therefore, recommended that this AQMA is retained and continued to be monitored closely.

AQMA 3 - A511 – stretches along the length of the A511 from its point at Sinope on the western side of Coalville to Bardon on the eastern side of Coalville, the majority of which composes the Coalville bypass, and includes all residential properties with frontages within 10m of the A511. Both the modelled data and the 2002 monitoring data prediction for 2005 indicate that nitrogen dioxide concentrations are expected to be less than the 40μg/m^3 objective at relevant receptors. *No improvement is needed in this AQMA and so the AQMA should be revoked.*

AQMA 4 - Belvoir Road, Coalville - is part of the central shopping area of Coalville. Both the modelled data and the 2002 monitoring data prediction for 2005 indicate that nitrogen dioxide concentrations are expected to be less than the 40μg/m^3 objective. Owing to peak traffic flows within this AQMA note is made of the fact that modelling work has predicted the maximum peak hour concentration of NO_2 for this AQMA to be significantly below the 200μg/m^3 objective, at 127.06μg/m^3. This indicates that the 1-hour mean objective will also be achieved. In addition to this as detailed in section 10.2.1, if the annual mean is not above 60μg/m^3 it can be reliably assumed that the hourly objective will not be breached. *No improvement is needed in this AQMA and so the AQMA should be revoked.*

AQMA 5 - Castle Donington, Diseworth Road – contains 3 residential properties. Predictions for 2005 from both modelling work and the bias adjusted 2002 diffusion tube data at relevant receptor locations in this AQMA are significantly below the 2005 objective. *No improvement is needed in this AQMA and so the AQMA should be revoked.*

However, it is recognised that EMA wishes to pursue the planning application to extend the runway through to determination. Real time monitoring will continue to be conducted in this AQMA and this area will continue to be a focus in the on going process of Air Quality Review and Assessment.

AQMA 6 - Vicinity of A50 – This AQMA contains 1 isolated property, which is approximately *39m* from the slip road leading onto the A50. Modelling has predicted that concentrations of NO_2 in 2005 will be below 40μg/m^3, and, although monitoring data is limited the results from the diffusion tube is indicating that concentrations are significantly below the 2005 objective. *As modelling and initial monitoring data are indicating that concentrations of NO_2 are significantly below the objective, no* *improvement in air quality in this AQMA is needed and so this AQMA should be revoked.*

12.0 Sources of Nitrogen dioxide and Relative Contribution

Source apportionment is the process whereby the contributions from individual sources of pollution are determined. In local air quality terms, the relevant sources could include traffic, industrial, commercial and domestic activities etc. Having identified the most important source or sources, options can then be identified, considered and assessed to reduce the individual contributions of pollutants to ambient concentrations.

A detailed emissions inventory for NWLDC was compiled at Stage 3 Review and Assessment, which included point sources (industrial and commercial buildings), line sources (roads and the runway at East Midlands Airport) and area sources (areas of housing). Data was collected or calculated for time varying emissions of NOx, PM10 SO_2 and VOCs. Full details of the scope of the inventory can be found in Section 2.4 of NWLDC Stage 3 Air Quality Review and Assessment 2001. This information is not repeated in detail here, except where supplementary information is required.

Table 12.1 below details the relative contribution of key pollutants within the Emissions Inventory (tonnes/year), which have been determined using the ADMS-Urban Dispersion Model.

Source	NOx		NO2	
	2002	**2005**	**2002**	**2005**
Grid	122.243	122.243		
Point	16.9875	16.9875	2473	2.47338
Road	3038.16	2346.9	226874	175.255
Runways / Taxiing etc	56.8	56.8	4.24	4.24
Takeoff (volume)	1.6	1.6	0.24	0.24
Total	**3177.391**	**2486.131**	**229347**	**178**

Table 12.1 Relative contributions of key pollutants for NWLDC

Nitrogen oxides (NOx) emissions mainly consist of nitric oxide, which is then converted to nitrogen dioxide in a series of oxidation reactions in the atmosphere. Nationally the principal source of nitrogen oxides is road transport, which accounted for 49% of the total UK emissions in 2000. It is predicted that emissions from road traffic in NWLDC will account for 92% of NOx in 2005, which is significantly above the national average. This provides a clear indication that where an AQMA is declared for NO_2 road traffic is highly likely to be the cause.

By examining the emissions inventory more closely, the relative proportions of heavy and light vehicles within the fleet can be determined as detailed in Table 12.2 and Table 12.3 below. This has been determined for the whole network and for the individual AQMAs, where traffic information is available.

	Heavy (HGV and buses)	Light (cars and LGV)
% contribution to road traffic emissions: whole network	12	88

Table 12.2 source apportionment within the traffic fleet

	AQMA	Heavy (HGV and buses)	Light (cars and LGV)
% contribution to road traffic emissions	Number 1 *Vicinity of the M1*	19	81
% contribution to road traffic emissions	Number 2 *Kegworth A6*	12	88
% contribution to road traffic emissions	Number 3 *A511*	12	88
% contribution to road traffic emissions	Number 4 *Coalville*	5	95

Table 12.3 Source Apportionment within four AQMAs

The above rudimentary source apportionment exercise provides an indication of the traffic fleet that will be effecting the levels of NO_2 within four of the 6 AQMAs, in 2005. It is worth noting that HGVs generally only make up between 5% and 12% of the vehicles in the AQMAs, however it is recognised that they have a larger impact regarding air quality, which will be of significance when developing Action Plans.

It is also worth noting that any improvements of a technological nature which impact on NOx emissions (Euro I, Euro II engines etc) will have a significant effect on levels of nitrogen dioxide for 2005 and beyond.

12.1 Summary of Source Apportionment

- The primary source of NOx emission in NWLDC is from road traffic

- NOx emissions from point and area sources in NWLDC have a relatively small impact on NO2 levels within the district.

13.0 Changes to Air Quality Management Areas

Policy Guidance LAQM PG(03), paragraph 1.52 states that those authorities that are undertaking further assessments within AQMAs (formerly known as a Stage 4) as a result of the first round of review and assessments at the same time as undertaking the second round of review and assessments will also use the further assessment results to determine whether an existing AQMA needs amending or revoking, reference should also be made to NWLDC – *Air Quality Updating and Screening Assessment* – June 2003.

This section highlights the implications of this Stage 4 assessment for NWLDC and explains any changes that may be needed to the extent of the current AQMAs. Table 13.1 below summaries any changes that might be needed.

AQMA	**Location**	**Changes recommended to the AQMAs**
No. 1	M1	Re- define boundaries as detailed in Map 11
No. 2	Kegworth A6	No change recommended
No. 3	A511	Revoke
No. 4	Belvoir Road, Coalville	Revoke
No. 5	Castle Donington, Diseworth Road	Revoke
No. 6	Vicinity of A50	Revoke

Table 13.1: Summary of changes to the Air Quality Management Areas in NWLDC as a result of this Stage 4 Assessment.

14.0 Multi- Modal Study

The Governments 10 Year transport plan – 'Transport 2010- The Ten Year Plan' – was announced on 20 July 2000. It sets out the Governments long-term strategy for delivering a quicker, safer, more reliable and environmentally friendly transport system, setting out what can be achieved over the next 10 years. Full details of the report can be found on the Department of Transport, Local Government and the Regions website – www.dtfgov.uk.

Multi-Modal studies form an important part of the Government's 10-year strategy. Of these, the 'North/South Movements on the M1 corridor in the East Midlands March 2002'considers the development of a long-term strategy for the M1 corridor (junctions 21 – 30) and the A453 corridor (M1 to Nottingham). The study has produced long-term strategies for the M1 and the A453 corridors aimed at improving road, rail and other public transport links.

After considering this Multi-Modal study Transport Secretary Alistar Darling announced on 10th December 2002 a billion-pound package, which supports the findings of the study, some of which may improve the air quality in NWLDC as detailed below:

- Improvements at M1 J24 and links between A453 and A50
- Bypass for Kegworth – Leicestershire County Council has been asked to develop more detailed proposals for the Kegworth by pass and submit appraisals and funding bids to the Department of Transport in due course.
- A package of measures on the M1, including widening, junction improvements and providing climbing lanes.
- Work to encourage a mode switch from the M1 motorway
- Reopening of the Castle Donington Railway Line, to have a local and airport feeder role.

14.1 Recommendations of the Multi-Modal Study in relation to the retained AQMAs.

AQMA 1 – M1

This AQMA is a result of traffic using the M1 and the A453. Solutions to reduce the current levels of NO_2 will therefore only be achieved by methods to reduce the levels of congestion on these roads. The package of measures recommended by Multi Modal study and accepted by the Department of Transport *may* help to improve congestion and hence reduce the current levels of NO_2 within this AQMA.

AQMA 2 – Kegworth

Development of the Kegworth bypass will have a positive affect on the air quality within this AQMA. The Multi Modal study concluded that over 60% of the traffic travelling along the A6 at Kegworth does not have a journey end within the village but is traffic passing through Kegworth to/from M1 Junction 24. Removal of through traffic from the A6 would significantly reduce the levels of NO_2 within the AQMA.

15.0 The next steps

15.1 The Air Quality Action Plan

Where an AQMA has been declared the next step is to develop an Air Quality Action Plan (AQAP), to assist in the delivery of the UK's air quality objectives. AQAPs provide the mechanism by which authorities, in collaboration with national agencies and others, will state their intentions for working towards the air quality objectives.

Implementation of the recommendations of the Multi Modal study are beyond the control of the Environmental Protection Section of NWLDC. It is crucial that in developing an action plan to improve air quality in NWLDC a partnership is established with Transport Planners, Leicestershire County Council, the Highways Authority and other interested bodies.

Policy Guidance LAQM PG (03), states that where the AQMA designation arises primarily because of transport pollution, local authorities will have the freedom to integrate their action plans into their Local Transport Plans (LTPs). Therefore, in preparing their action plans now, authorities can look towards integrating them within their LTP at its next substantial review, which is due to take place by 2005. This approach will support closer alignment of councils' transport and air quality policies and the involvement of all relevant expertise in tackling problems. NWLDC intends to follow the approach detailed in LAQM PG (03) although it is anticipated that a separate action plan will be developed to ensure that the profile of air quality is raised throughout the Local Authority in accordance with the Air Quality Strategy.