ENVIRONMENTAL HEALTH SERVICES

ENVIRONMENTAL PROTECTION SECTION
MACAULAY HOUSE
5 CATTLE MARKET
LOUGHBOROUGH
LEICESTERSHIRE
LE11 3DH

REVIEW AND ASSESSMENT OF AIR QUALITY IN CHARNWOOD

Round 1, Stage 4 Report

September 2004

Executive Summary

In 2001 a review and assessment of air quality in Charnwood predicted that proximally 660 properties in the borough would be subject to breaches of national air quality objectives for the polluting gas nitrogen dioxide.

This report expands upon this report to identify what the specific sources of pollution are which are likely to cause these breaches, what the contribution of each of the sources is and the extent of the exceedences at all of the geographical areas considered to be at risk. The findings of this report will form the basis of informing the contents of an Air Quality Action Plan as well as other related policy documents such as the Local Transport Plan and the Local Development Framework.

The report concludes that on the whole the original estimates of the extent of exceedences of the air quality objective made in 2001 were overly pessimistic in terms of both the geographical and metric extent of exceedence. Air quality in Birstall is now predicted to be likely to meet the objective. Air quality in Syston and Loughborough is not considered to be as poor as originally predicted.

Road traffic is by far the main cause of the objective being exceeded. Of the contribution from road traffic a disproportionate amount comes from HGVs and buses. The total contribution of this sector of traffic to total nitrogen oxide exposure at the receptors most at risk from pollution(i.e. residential dwellings) is between 19 and 46%, cars contribute between 14 and 23%.

The report uses evidence from both historical pollution monitoring results and computer model predictions to indicate the likelihood of the air quality objective at various locations being breached. The evidence is sometimes contradictory, however by comparing and contrasting the evidence it is estimated that the objective is *very likely* to be exceeded in the very centre of Loughborough (by about 35%) and on the rest of the A6 corridor and the A512 Ashby Road (by about 7 – 14%). It is also predicted that there is *quite likely* to be an exceedence on a small part of the A6004 Epinal Way, on Ratcliffe Road and on the Melton Road in Syston. A total of approximately 420 properties are now considered to be at risk along these roads.

1.Background

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. A summary of the objectives is included below. 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. The UK Air Quality Strategy

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 exceedences for certain pollutants. These standards and associated specific objectives are shown in Table 1.

The Environment 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 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°C and 1013mb

Aims & Objectives of the Stage 4 Review and Assessment

The Department for Environment, Food & Rural Affairs (DEFRA) has issued some guidance to local authorities on the necessary remit of their stage 4 review and assessment reports. The overall objective of the report is to "allow local authorities the opportunity to supplement the information they have already gathered from their earlier review and assessment work. The further assessment should provide the technical justification for the measures an authority includes in its action plan". Specifically the guidance also goes on to state the following aims for the stage 4 report:

- to confirm their 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 the air quality objectives within the AQMA;

- to refine their knowledge of the sources of pollution so that air quality action plans can be properly targeted;

- to take account of national policy developments which may come to light after the AQMA declaration;

- to take account as far as possible of any local policy developments which are likely to affect air quality by the relevant date, and which were not fully factored into earlier calculations. These might include, for example, the implications of any new transport schemes that are likely to be implemented in the vicinity of the AQMA, or of any new major housing or commercial developments that are likely to be built by the relevant date;

- to carry out real-time monitoring where this has not been done as part of the stage 1-3 reviews and assessments;

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

- to corroborate other assumptions 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 any way;

- to respond to any comments made by statutory consultees in respect of authorities' stage 1-3 reports, particularly where these have highlighted that insufficient attention has been paid to, e.g., the validation of modelled data.

This report is a redraft of an earlier stage 4 report completed in March 2004. Following the completion of the March 04 report errors were discovered with the data used in the air quality modelling which had led to overestimations of predicted pollution levels. This report addresses these errors and provides a more comprehensive assessment of individual source contributions to air quality problems.

Specifically the following work has been undertaken within the context of this report in order to meet the aims and objectives stated above:

- Monitoring data relating to nitrogen dioxide has been re-evaluated based on the guidance in Annex1 of LAQM (TG(03) [1]
- More contemporary information about road traffic movement and traffic compositions have been obtained, including changes to traffic flows due to new developments.
- Further modelling of nitrogen dioxide in and around the existing AQMAs has been undertaken based on improved modelling approaches.
- More detailed information about the composition of the traffic fleet within the AQMAs has been extracted from traffic count data.
- Estimates of the contribution of different classes of road vehicles to NOx and NO2 levels have been derived.

Limitations of the Stage 4 report

The stage 4 review only considers nitrogen dioxide. The original stage 3 review and assessment[2]acknowledged that levels of PM10 from road traffic sources may be an issue although no substantial modelling has been undertaken to demonstrate this. The principal pollutant of concern from road traffic emissions is nitrogen dioxide and therefore any areas that may be subject to excessive PM10 concentrations from traffic will also be subject to exceedences of the nitrogen dioxide objective. The stage 3 review and assessment and an Updating and Screening assessment[3] completed in April 2003 confirmed that there are no locations that may be subject to combined traffic and other PM10 sources.

Actions that are developed through the Action Plan process to deliver solutions to projected breaches of the annual average nitrogen dioxide levels are also likely to result in controls on PM10. Solving the NO2 air quality issue is therefore also likely to address any PM10 problems, although the potential impact of these actions on PM10 emissions has been acknowledged during the production of the Action Plan.

3. Air Quality Findings to Date

In 2000 Charnwood published a stage 3 report of its 1st round review and assessment of air quality. This report concluded as follows:

1) ***There is no indication to suggest that levels of pollution of benzene, 1,3 butadiene, lead, or carbon monoxide are having or are likely to have an impact on human health within the Borough of Charnwood.***

2) ***There is evidence to suggest that levels of nitrogen dioxide will not generally breach the air quality objectives other than in close vicinity (within 10 to 20 meters) of roadside locations along the following road lengths;***
   - ***The A6 corridor through Loughborough and Birstall.***
   - ***The M1 corridor through the borough.***
   - ***Ashby Road, Alan Moss Road and the Epinal Way in Loughborough.***
   - ***Newark Road in Thurmaston***
   - ***Melton Road in Syston***

3) ***There is no current evidence that the objectives for sulphur dioxide are being breached. However, the authority remains concerned that the as yet unquantified emissions from the Great Central Railway may have a significant impact on air quality in its immediate vicinity.***

4) ***There is no current evidence that the objectives for PM_{10} will be breached. However, Charnwood Borough Council remains concerned that traffic derived PM_{10} will impact on the same areas as is predicted for traffic derived nitrogen dioxide, as may PM_{10} derived from the granite quarry at Mountsorrel***

These findings were accepted by the then Department of Environment, Transport and the Regions. As a consequence Charnwood declared three Air Quality Management Areas in Loughborough, Birstall and Syston in June 2001 on the basis that annual average nitrogen dioxide objectives would not be achieved in parts of these conurbations.

The purpose of this 1st round stage 4 report is to seek to achieve the nine aims described above in relation to the three Air Quality Management Areas that have been declared

In line with statutory requirements Charnwood has already completed a2nd round Detailed report[4] which was published earlier this year. This report does not deal with any of the issues identified in the Detailed Assessment. The Detailed Report commented in more depth on conclusions 3 and 4 of the stage 3 review and assessment regarding SO2 emissions from the Great Central Railway and PM10 emissions from the Mountsorrel quarry.

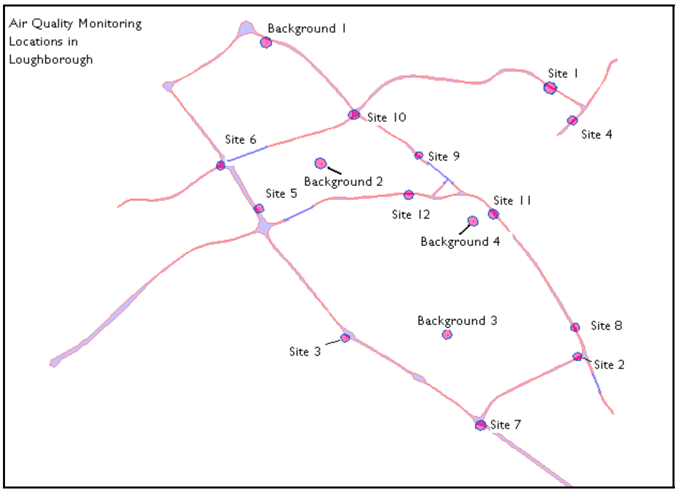
4. Monitoring Results

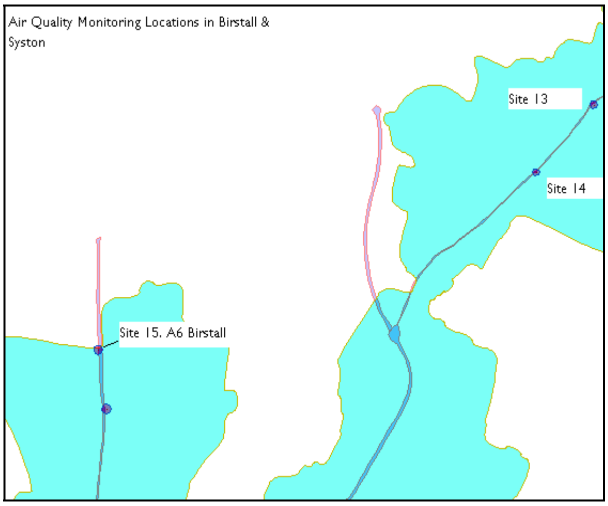
Since the completion of the stage 3 review and assessment in early 2001 Charnwood has invested in further monitoring of nitrogen dioxide focusing on the areas covered by the existing AQMAs

4.1 Continuous monitoring

One chemiluminescent nitrogen oxide monitor has been operating for a number of years within a Council owned residential complex on Durham Road in Loughborough (‘Background 1’ on the map below). The site is located approximately 20meters from the kerbside of the A6 trunk road and was chosen as a suitable monitoring location for possible human receptors of traffic pollution at the complex. The monitor is actually located just outside what was eventually designated as the Loughborough air quality management area. It has however proved a valuable tool in allowing validation of modelling data in scenarios beyond 10meters from road kerbsides and as a source of bias correction factors for our network of diffusion tubes.

Maps 1 – 2 Monitoring Locations in Charnwood





Results from the monitor are summarised below. Calculations of NO2 for the location have also been projected for 2005 and 2010 based on the factors set out in box 6.7 of Local Air Quality Management Technical Guidance LAQM. TG(03)

Table 2
NO2 data for Durham Road

Year	Annual mean	Number of exceedences of the hourly mean	% capture rate	Projected 2005 conc.	Projected 2010 conc.
2003	33.4	0	96.5	32	27.4
2002	30.4	0	97.6	28.4	24.3
2001	29	0	97.2	26.3	22.6
2000	27.3	0	34.5	24.2	20.7

4.2 Diffusion Tube Monitoring

Co-location Bias Correction

Since 2001 we have co-located a diffusion tube immediately adjacent to the inlet to the chemiluminescent analyser in order for us to evaluate the accuracy of the results we received from our diffusion tube analytical lab. Using the method outlined in LAQM TG (03) box 6.4 we have been able to develop local bias correction factors to apply to diffusion tube data from the rest of the borough. More recently we have augmented this with the additional bias correction data that has been made available on the Local Air Quality Management web resource site http://www.uwe.ac.uk/aqm/review. This indicated that our own bias correction factors were within a high degree of accuracy relative to those derived from other local authorities diffusion tube studies. This gives us a lot of confidence with the accuracy of the historical results we have obtained since 2000.
In applying bias correction factors to our data for the purposes of this report we have used national factors and only included local factors where no or limited national data exists.

Table 3
Local and national bias correction factors obtained for diffusion tubes exposed in Charnwood

Year	Local factor	National factor*	Factor used
2003	1.047	1.02 (2 datasets)	1.029 (+ 2.9%)
2002	1.079	1.0 (9 datasets)	1.0 neutral
2001	1.015	none	1.015 (+1.5%)

*correct at 2/3/04

Not all of these results are presented within this report but are available on the Councils website at http://www.charnwood.gov.uk/17/2415.html

4.3 Diffusion tube monitoring within existing AQMAs

Following the declaration of the three AQMAs in 2001 the number of diffusion tube monitoring sites were increased within these areas. Monitoring of nitrogen dioxide using diffusion tubes takes place at the following locations:

4.3.1 In the Loughborough AQMA

Description	Co-ordinates	Site type
1.RATCLIFFE RD,LOUGHBOROUGH	SK54072040	roadside
2.SHELTHORPE RD,LOUGHBOROUGH	SK54241866	roadside
3.FOREST RD,LOUGHBOROUGH	SK52831878	roadside
4.NOTTINGHAM RD,LOUGHBOROUGH	SK54212019	roadside
5.HAYDON RD, LOUGHBOROUGH	SK52311962	roadside
6.ALAN MOSS RD/EPINAL WAY, LOUGHBOROUGH	SK52081990	roadside
7.EPINAL WAY / LING RD		roadside
8.LEICESTER RD,LOUGHBOROUGH (2)		roadside
9.DERBY RD, LOUGHBOROUGH	SK53281996	roadside
10.ALAN MOSS RD/A6	SK52892022	roadside
11.HIGH ST,LOUGHBOROUGH	SK53731958	roadside
12.ASHBY RD, LOUGHBOROUGH	SK53221970	roadside

4.3.2 In the Syston AQMA

Description	Co-ordinates	Site type
13.MELTON RD TOWN CENTRE,SYSTON	SK62761167	roadside
14.MELTON RD/ADJ ST PETERS RD, SYSTON	SK62341121	roadside

4.3.3 In the Birstall AQMA

Description	Co-ordinates	Site type
15.BIRSTALL A6	SK59179980	roadside

Due to logistical constraints not all of these sites are representative of receptor exposure. In other words not all are located at positions which will provide data which is representative of what levels of air quality a human resident living in these areas will be exposed to over a year. The relative locations of the diffusion tube monitoring points, the pollution generating road links and the nearest receptor locations (i.e. the façade of the nearest domestic property to the road) are outlined below

Table 4 Relationship of the locations of diffusion tube monitoring sites, relevant road links and receptors

Monitoring Location	Distance from kerb to monitoring point (meters)	Distance from kerb to nearest receptor (m)	Representative of receptor exposure (✓ or ✕)
Loughborough			
Leicester Road /Shelthorpe Rd	2.8	8.9	✕
Nottingham Rd	2	2	✓
Ratcliffe Rd	2.3	2.3	✓
Alan Moss Rd / A6 (Derby Road)	1.8	11.3	✕
Haydon Rd / Epinal Way	8.3	7.2	✓
Forest Rd / Epinal Way	6.3	6.3	✓
Alan Moss Rd / Epinal Way	1.4	14.7	✕
Leicester Rd	1.5	18	✕
Derby Rd	2	2	✓
High St	2.7	2.6	✓
Ashby Rd	1.8	3.5	✓
Epinal Way / Ling Road	1.6	13	✕
Syston			
Melton Rd / Barkby Rd	4.4	4.4	✓
Melton Rd / St Peters St	2.2	5.3	✓ / ✕
Birstall			
A6 Loughborough Rd	4.6	7.5	✓ / ✕

✓ - Good Representation of receptor exposure
✕ - Poor representation of receptor exposure
✓ / ✕ - Marginal representation of receptor exposure

Forward calculations of predicted air quality levels at each of these diffusion tube monitoring locations can be made by firstly applying the appropriate bias correction factor outlined in table 3, and then by applying a further correction factor based on the forward predictions contained in LAQM TG(03) boxes 6.6 and 6.7 for annual average NO2 concentrations in 2005 and 2010.

Table 5
Predictions of annual average NO2 levels in 2005 at AQMA monitoring locations based on bias corrected forward calculations from historical monitoring data

Monitoring Year	2000	2001	2002	2003	Highest
Loughborough					
Ratcliffe Rd	28.4	33.8	37.3	45.6	45.6
Leicester Road /Shelthorpe Road	28.5	38.6	36.7	40.4	40.4
Forest Road / Epinal Way	No data	29.6	27.9	41.4	41.4
Nottingham Road	26.4	30.1	34.4	40.8	40.8
Haydon Road / Epinal Way	No data	25.3	30.7	42.7	42.7
Alan Moss Rd / Epinal Way	No data	29.2	33.0	41.9	41.9
Epinal Way / Ling Rd	No data	No data	No data	39.9	39.9
Leicester Rd	No data	38.4	39.2	42.4	42.4
Derby Rd	No data	36.8	39.2	46.2	46.2
Alan Moss Rd/ Derby Rd	No data	34.1	39.0	48.8	48.8
High St	41.4	47.9	53.8	70.8	70.8
Ashby Rd	No data	36.0	36.7	50.9	50.9
Syston					
Melton Rd Town Centre	23.7	28.1	29.8	38.5	38.5
Melton Rd / St Peters St	No data	30.6	34.9	43.1	43.1
Birstall					
A6	No data	33.2	33.1	45.6	45.6

Note: figures in red show calculations that indicate a projected breach of the 2005 air quality objective. The monitoring locations highlighted in bold are those which we consider to be representative of actual pollution exposure by human receptors.

4.4 Quality Assurance/ Quality Control of Monitoring data

All QA / QC procedures are in accordance with LAQM TG(03).

The continuous analyser is a Monitor Labs MLr9841B which is an approved type tested unit. It is maintained and serviced by ETI Casella every 6 months including the supply of calibration gases and consumables. Full maintenance records are kept. Calibration gases comply with the procedures stated in the Urban Network Operators Handbook other than it uses a zero air generator rather than gas from a zero air gas cylinder.

Data ratification is undertaken every two months by members of the Environmental Protection Team using Envidas software to filter out data that falls outside set parameters. The analyser self calibrates using a BS reference gas daily. Officers of the Team manually calibrate every two weeks in accordance with manufactures instructions. Full records are kept of any equipment malfunctions and as part of the ratification process the data is scrutinised in order to establish possible causes of peaks or objective breaches.

Diffusion tubes are supplied and analysed by Gradco Ltd using the 20% TEA in water technique. The lab are UKAS accredited and participates in the Workshop Analysis Scheme for Proficiency (WASP) inter laboratory QA/QC for which they have consistently ‘good’ results. ‘Good’ in this case means less than 2 standard deviations from the actual value of the doped tubes and is the highest standard available under WASP. The storage and handling of tubes by Charnwood is carried out in accordance with the procedures contained in the UK NO2 Survey Instruction Manual. All exposure times are recorded and copies provided to the lab with the exposed tubes. One blank tube is retained for the duration of each monitoring period to check for contamination.

4.5 Conclusions

In the absence of kerbside real time monitoring data much reliance has had to be placed on data obtained from the diffusion tube network around the borough. Forward projections based on historical data up until 2003 suggests that there will be no air quality problems within Charnwood other than on the A6 corridor through Loughborough (Derby Road, High Street & Leicester Road). The monitoring locations on the north (Derby Road) and south (Leicester Road) sections of this route were predicted to be up to around 39 microgrammes per cubic meter, whilst the location in the centre of the town (High Street) was predicted to be higher still and is the only location to be consistently predicted to be above the objective based on this method.

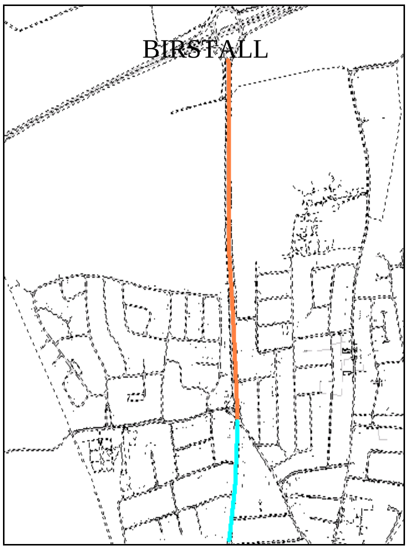
The picture changes substantially when forward projections using 2003 data is used. Now 13 out of the 15 locations are projected to breach the objective in 2005. This is because 2003 was a particularly bad year for air quality, as has been experienced across the whole of the UK. Notwithstanding, DEFRA have declared that concentrations measured in 2003 were not considered exceptional, and DEFRA has advised that these data should be included in the review and assessment decision making process.

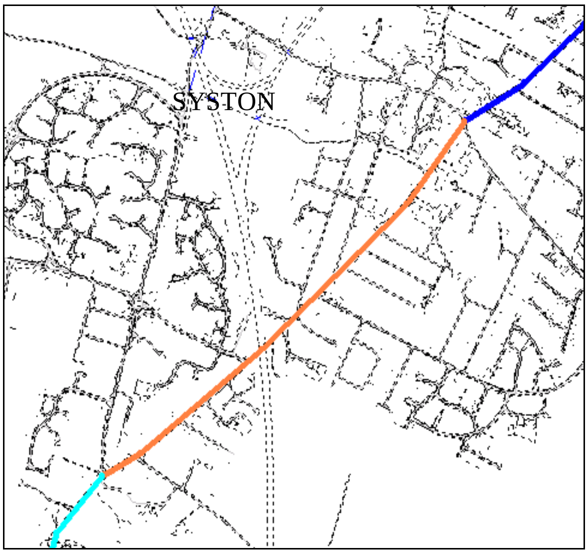
It therefore seems ***likely*** that based on historical monitoring data the A6 corridor though Loughborough will be subject to breaches of the 2005 objective.
There also is good evidence that breaches of the objective are ***likely*** next to other roads in the borough, particularly Ratcliffe Road, parts of Epinal Way and Ashby Road in Loughborough.

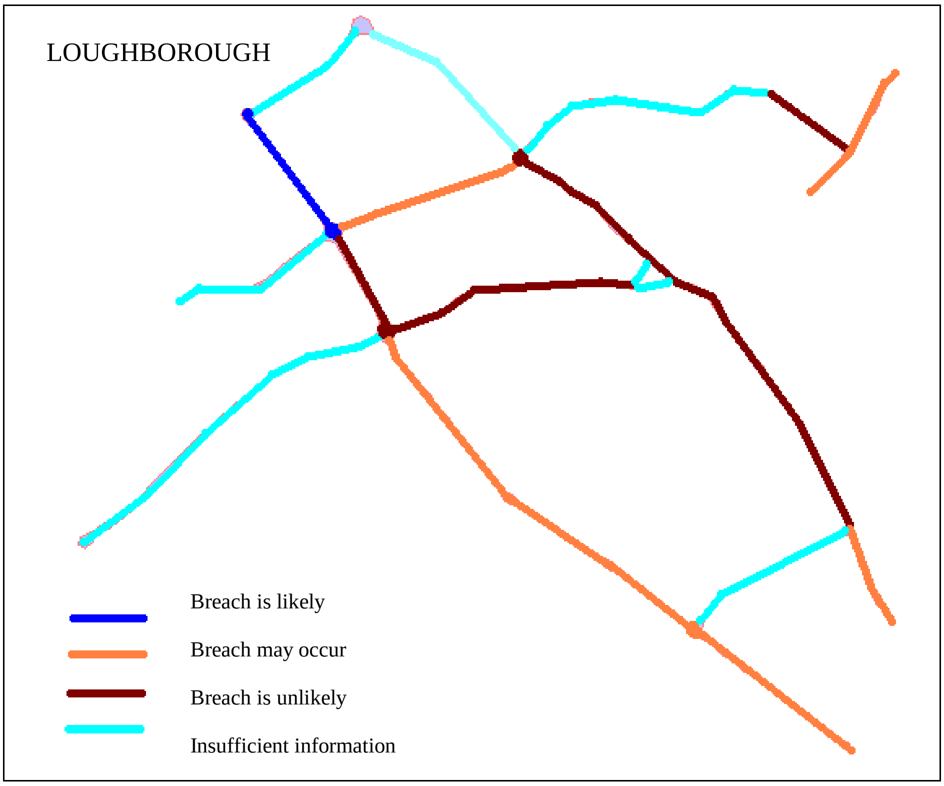
Evidence based solely from forward projections from 2003 monitoring data indicate that there is also the possibility of breaches on Nottingham Road, the major part of Epinal Way and the southern section of the A6 Leicester Road in Loughborough. The same applies to Melton Road in Syston and the A6 in Birstall.

Maps 3-5 summarise our predictions of the likelihood of emissions from each of the key road links in the borough causing a breach of the annual mean objective for nitrogen dioxide at properties along their respective lengths based on forward projections from historical monitoring information.

Maps 3 – 5 Predicted NAQ Objective breaches based on historical pollution monitoring data







5. Modelling Results

Charnwood Borough Council commissioned Leicester City Council to undertake its air quality modelling work using the Airviro air quality model

5.1 The AIRVIRO Dispersion Model.

5.1.1 Description of the Model

AIRVIRO version 2.4 is a Swedish dispersion model, originally developed by INDIC, but now distributed, supported, and further developed by the Swedish Meteorological and Hydrological Institute (SMHI). The model is capable of grid, Gaussian, or canyon dispersion calculations. The model operates on a UNIX workstation, and includes modules for data collection, dispersion calculations and an emissions database. Dispersion calculations are performed in the Dispersion Module, using meteorological data collected from the Leicester meteorological mast together with emissions data from the emissions database. Emission sources for modelling using AIRVIRO are defined as point (e.g. industrial and commercial buildings), line (roads), or area (residential estates, or large industrial) sources.

The Leicester AIRVIRO model can be run on either a City or County map, zooming into a smaller area where greater detail is required. Emissions from sources within the entire selected map area are used for the dispersion calculations: even where the zoom function has been used to select a smaller area for any subsequent post modelling display.

5.1.2 Model Inputs

1. Traffic Data

The following road traffic data relating to all of the key road links within and contributing to the three AQMAs in Charnwood were input into the model:

Unique road link reference number.

Road name and number.

6 point easting and northing reference point of the start and end point of each road link.

Average traffic speed of each link. No data was available from any of the local traffic agencies about flow speeds. The data used was therefore based on a best estimate using local knowledge of vehicle flow rates and fluctuations

Predicted annual average daily traffic (AADT) flow on each link in 2005. Detailed traffic growth factors were provided by Leicestershire County Council to allow AADT predictions to be made for all roads based on the original count year, the type of road in question (urban or rural, A or minor road) and the vehicle type (light or heavy). Calculations for 2005 traffic flows were based on these factors.

Road type description. Hourly emissions for each link of a length of road are used by AIRVIRO for dispersion calculations. Hourly traffic flows are derived from the calculated annual average daily flows by applying a default flow pattern for a particular road type used to classify the link under consideration. Each link therefore had to be given a particular road type description. Given that a good quantity of data had been obtained about hourly flow rates and vehicle classifications, a number of road type descriptions were developed which matched the characteristics of all of the links of interest. Hourly flows are multiplied by a pollutant specific emission factor for each vehicle type included in the model database to obtain an emission rate at different speeds (in steps of 10 km per hour). The emission factors used obtained from AEA Technology and are based on predictions for 2005 made in 2002.

For the 31 road links in the borough that were the subject of the stage 4 review, seven road type classifications adopted were as follows:

Local road (two peaks)
Inner urban minor road
Local road inbound
Local road outbound
Non urban trunk road
Ring Road low HGV
Commercial area road

No area of the borough have any particularly complex canyon configurations or complex junctions. Therefore no special alterations needed to be made to the modelling process to account for this.

2. Point Source Data

An inventory of emissions from point sources from industrial and commercial locations was compiled as part of the stage 3 review and assessment. These sources were evaluated at the time in terms of their likely ability to contribute to breaches of the air quality objectives and those considered likely to have an impact were included in the original stage 3 model run. It became apparent from this that none of the point sources included in the model had any influence on the annual average nitrogen dioxide levels in the AQMAs and would not cause or contribute to any other breaches of the objectives. Given that there has been no significant change to these point sources since the stage 3 review they were not included in the stage 4 modelling runs.

3. Other significant sources

The stage 3 review and assessment concluded that no other individual sources of nitrogen dioxide are significantly contributing to the air quality burden in the AQMAs. This situation has not changed and so no other source of nitrogen dioxide has been included in the model other than predicted background levels (see section 5).

4. Meteorological Data

The meteorological data used was for 2001 and was taken from the Leicester meteorological mast which is approximately 4 miles north west of Leicester city centre and 1 mile south of Charnwoods southern boundary.

5. Background Concentrations

A background value of 25 μg/m^3 NOx was added to modelled concentration before converting the total concentration to NO2. The source of the background data was the Harwell AURN monitoring station, selected as most appropriate after discussion with the monitoring helpline run by NETCEN on behalf of DEFRA.

6. Verification, Adjustment & Uncertainty

Two verification methodologies have been used as part of the stage 4 review process. Charnwood has little real time monitoring data, although there is a relative abundance of diffusion tube data. Most of the local authorities in Leicestershire have adopted the verification methodology used by Leicester City Council for this very reason and so given that this methodology is relatively mature and in order to be consistent with neighbouring local authorities the Leicester verification methodology was used. However it is recognised that this may be a source of error in providing an accurate picture of air quality in Charnwood, which is more of a mixed urban / rural area than that of Leicester city. Therefore a further verification exercise was carried out using bias corrected diffusion tube data obtained from within Charnwood.

Leicester Verification Methodology

- Roadside

The validation methodology was from "Air Quality Management Areas: Turning Reviews Into Action" published by NSCA[5]. The document is undated, but is believed to have been published in 2000. Alternative methods are included in TG(03), but the guidance accepts that this method is appropriate. The NSCA method was used in the interests of consistency, as this was used for Charnwoods Stage 3 modelling.

A correction factor of 1.6 was calculated by comparing the modelled and monitored results at 6 *roadside* locations in Leicester for the meteorological year (2001) used for the dispersion calculations (model runs). Following the approach outlined in NSCA guidance document, the monitored and modelled annual mean values were compared at each of the roadside monitoring stations. A factor was derived at each of the stations, which represented the systematic error in the model prediction. An average correction factor of 1.6 was calculated and this was used to correct the raw model output, to bring it in line with the measured values. By plotting measured and the corrected-modelled values, a best fit line was then produced. The equation of this line was then used to give a final correction to the modelled data, and give a better fit between modelled and measured data. Further details of the data used to obtain the correction factor is available in the stage 3 report and will not be repeated here.

The recommended uncertainty is +/- 2 standard deviations. For these roadside results this is an uncertainty of +/- 2 μg/m^3. Thus using this methodology;

> Modelled values of < 38μg/m^3 are ***very unlikely*** to exceed the 40 μg/m^3 annual average NO2 objective.
> Modelled values between 38 and 42 μg/m^3 ***may*** exceed the objective.
> Modelled values > 42 μg/m^3 are ***very likely*** to exceed the objective.

The NSCA methodology recommends that AQMAs include the uncertainty region, i.e. predicted values above 38 µg/m^3 should be considered as a predicted exceedence. ***Therefore based on this methodology any areas predicted by the model within a 10meter distance of kerbside to be in exceedence of 38 µg/m^3 have been considered as a predicted model exceedence.***

- Background

The NSCA approach had also been adopted for modelling the background sites in the stage 3 review and assessment. In contrast to the roadside sites, the model over predicts at the background sites (namely those greater than 10 meters from kerbside), and is more precise at estimating the monitored values. ***The outcome from the stage 3 modelling suggested that no background sites beyond 10 meters would exceed the objectives within the recommended uncertainty parameters***. Details of the background modelling results are contained in the stage 3 report and will not be repeated here.

Charnwood Roadside Verification Methodology

The validation methodology from "Air Quality Management Areas: Turning Reviews Into Action" was applied to data from 9 roadside diffusion tube sites within Charnwoods existing AQMAs. The meteorological data and bias corrected tube results were both from 2001.

The correction factor applied based on the methodology was 1.5 which was calculated from a simple comparison of averages of all tube data used, and the modelled value at each point. However the standard deviation of the differences between the observed and modelled data is 3.5. Using the recommended uncertainty of +/- 2 standard deviations this gives an uncertainty of +/- 7 µg/m^3. Thus using this methodology;

Modelled values of < 33µg/m^3 are ***very unlikely*** to exceed the 40 µg/m^3 annual average NO2 objective. Modelled values between 33 and 47 µg/m^3 ***may*** exceed the objective. Modelled values > 47 µg/m^3 are ***very likely*** to exceed the objective.

Therefore based on the NSCA methodology any areas predicted by the model within a 10meter distance of kerbside to be in exceedence of 33 µg/m^3 should be considered as a predicted model exceedence.

Due to the relatively high standard deviations produced by the Charnwood Roadside verification methodology the Leicester Verification Method was considered the more likely to produce accurate results. This method was therefore used for the remaining two existing AQMA model runs. The model outputs are pictured in Appendix 1

5.2 Model Predictions at Key Receptor Locations

Various representative residential properties on the roads highlighted from the stage 3 review and assessment were identified as being those at a greatest risk of exceeding the air quality objectives. Particular attention was paid to determining the predicted 2005 nitrogen dioxide levels at these in order to allow a clear quantitative estimate to be made of the required reduction in nitrogen dioxide levels that need to be achieved. Estimates were also made of 2005 concentrations at existing diffusion tube locations. These locations are intended to be retained and so there is a longer term value in seeing how well the modelled results compare against the monitored values in 2005.

The results obtained were as follows;

Table 6. Model Predictions at Key Receptors

Location	Predicted 2005 annual average
74 Ratcliffe Road, Loughborough	34.9
1 Shearers Court, Loughborough	37.7
114 Derby Road, Loughborough	**42.1**
3 Brisco Avenue, Loughborough	**40.9**
1 Haydon Road, Loughborough	**45.4**
70 Ashby Road, Loughborough	**42.5**
5 Leicester Road, Loughborough	38.5
166 Leicester Road, Loughborough	**41.2**
85 Saltersgate Road, Birstall	36.6
1257 Melton Road, Syston	37.5
1110 Melton Road, Syston	**45.1**
1121 Melton Road, Syston	**43.9**

Table 7 Model Predictions at diffusion tube locations

Site	Predicted 2005 annual average
Ratcliffe Rd	34.1
Leicester Road /Shelthorpe Road	36.8
Forest Road / Epinal Way	31.2
Nottingham Road	36.7
Haydon Road / Epinal Way	**45**
Alan Moss Rd / Epinal Way	**41.6**
Epinal Way / Ling Rd	
Leicester Rd	**40.5**

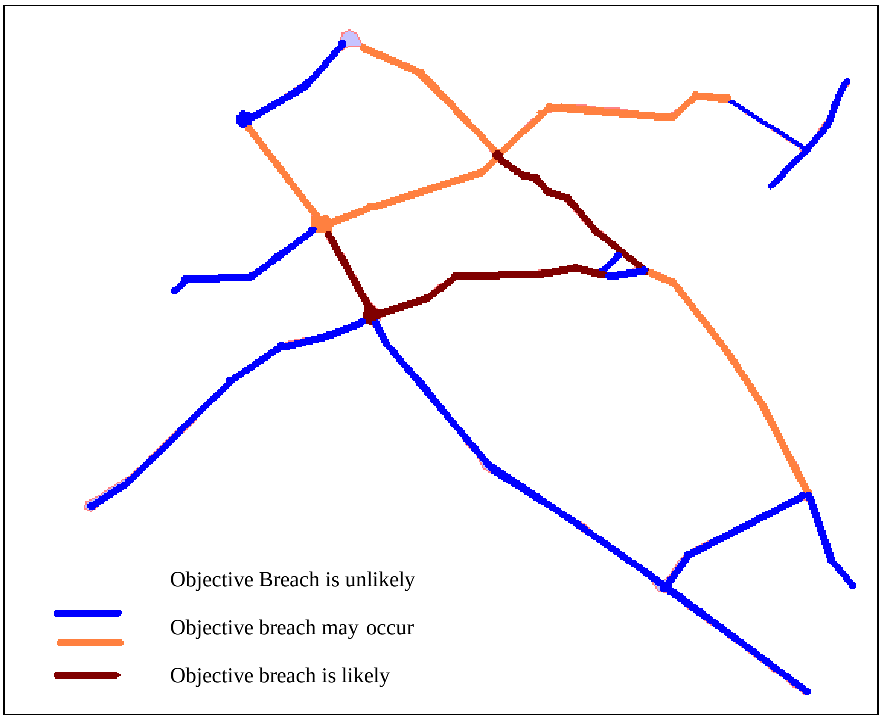
Derby Rd	**44.4**
Alan Moss Rd/ Derby Rd	**42.5**
High St	38.3
Ashby Rd	**42.5**
Syston	
Melton Rd Town Centre	37.5
Melton Rd / St Peters St	**44.6**
Birstall	
A6	**41.5**

Sites highlighted in **bold** are representative of receptor exposure.
2005 predictions highlighted in **bold** are model exceedences of the 2005 objective

5.3 Conclusions

Based on the modelling outputs and using the certainty descriptions used in part 6 of this part of the report the maps below provide a summary of the likelihood of emissions from each of the key road links in the borough causing a breach of the annual mean objective for nitrogen dioxide at properties along their respective lengths.

Maps 6 – 9 Predicted NAQ Objective breaches based on model outputs


Objective Breach is unlikely
Objective breach may occur
Objective breach is likely

6. Source Apportionment

6.1 Vehicle Class Use of Key Roads in the Borough

The predicted breaches of the annual mean air quality objective in 2005 are attributable solely to emissions from road transport in the borough allied with background levels of nitrogen dioxide imported into the borough and generated from other diffuse sources such as domestic and commercial heating plant within the borough.

Only by understanding the breakdown of the traffic composition on each road within the AQMA will it be possible to establish which sectors of the national traffic fleet contribute how much to the air pollution load.

Traffic count information from sites within the AQMAs has been regularly obtained from both the Highways Agency and from Leicestershire County Council over the last few years as well as from reports submitted in support of planning applications. These counts have come in various formats from AM/PM peak counts, through to 12 or 16 hour classified counts and continuous non-classified counts.

The most contemporary information relating to each of the roads contained within the existing AQMAs have been assessed in order to understand the key contributions that each sector of the traffic fleet are likely to make to air quality.

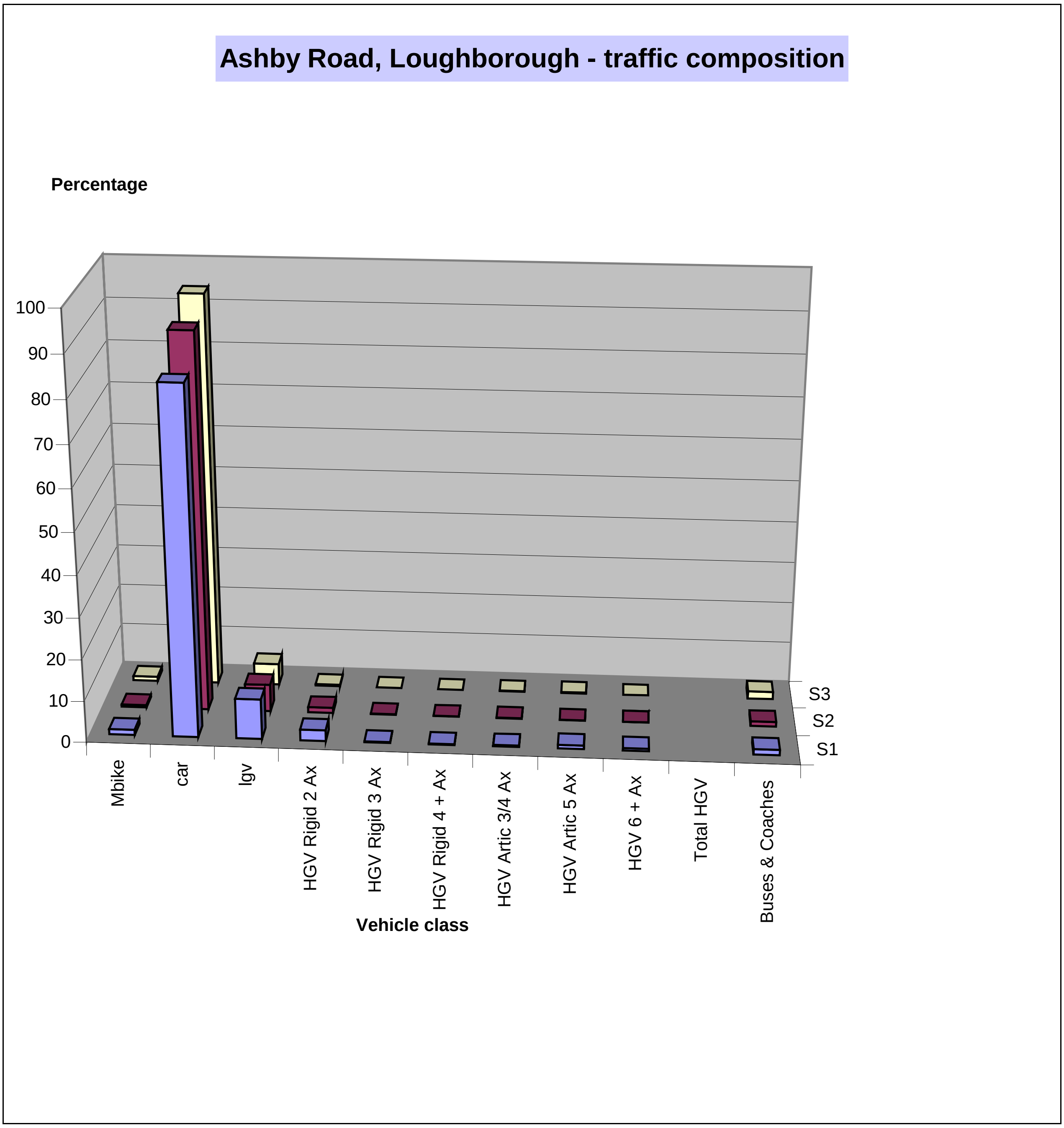
The following part of the report contains a summary of the traffic composition of those key roads either within or contributing to the movement of traffic within the relevant AQMAs in Charnwood. Given the considerable amount of data about traffic movements that was available it was necessary to establish a means of filtering the information in order to obtain the most representative data sets. All data obtained from the various sources has therefore been reviewed taking into consideration the following issues. Having considered these, the dataset that is most representative has been used to undertake this traffic source apportionment study.

1. *How contemporary is the information?*. Data gathered during or after 2001 was preferred for most of the borough. However given that the Epinal Way Extension in Loughborough was completed in June 2003 this was expected to have a significant impact on the main arterial routes to the south of the town. Therefore only data obtained after June 2003 has been used for these routes.
2. *How detailed is the information and what type of traffic count method was used?* In order to obtain meaningful information for source apportionment the greater the number of vehicle classes included in each count, the better.
3. *Over what timeframe was the data obtained?* Clearly the longer the count period the more likely the data will be to be truly representative of the 'actual' annual average daily traffic flow of the road in question. By the same token traffic flows vary throughout the year due to various factors

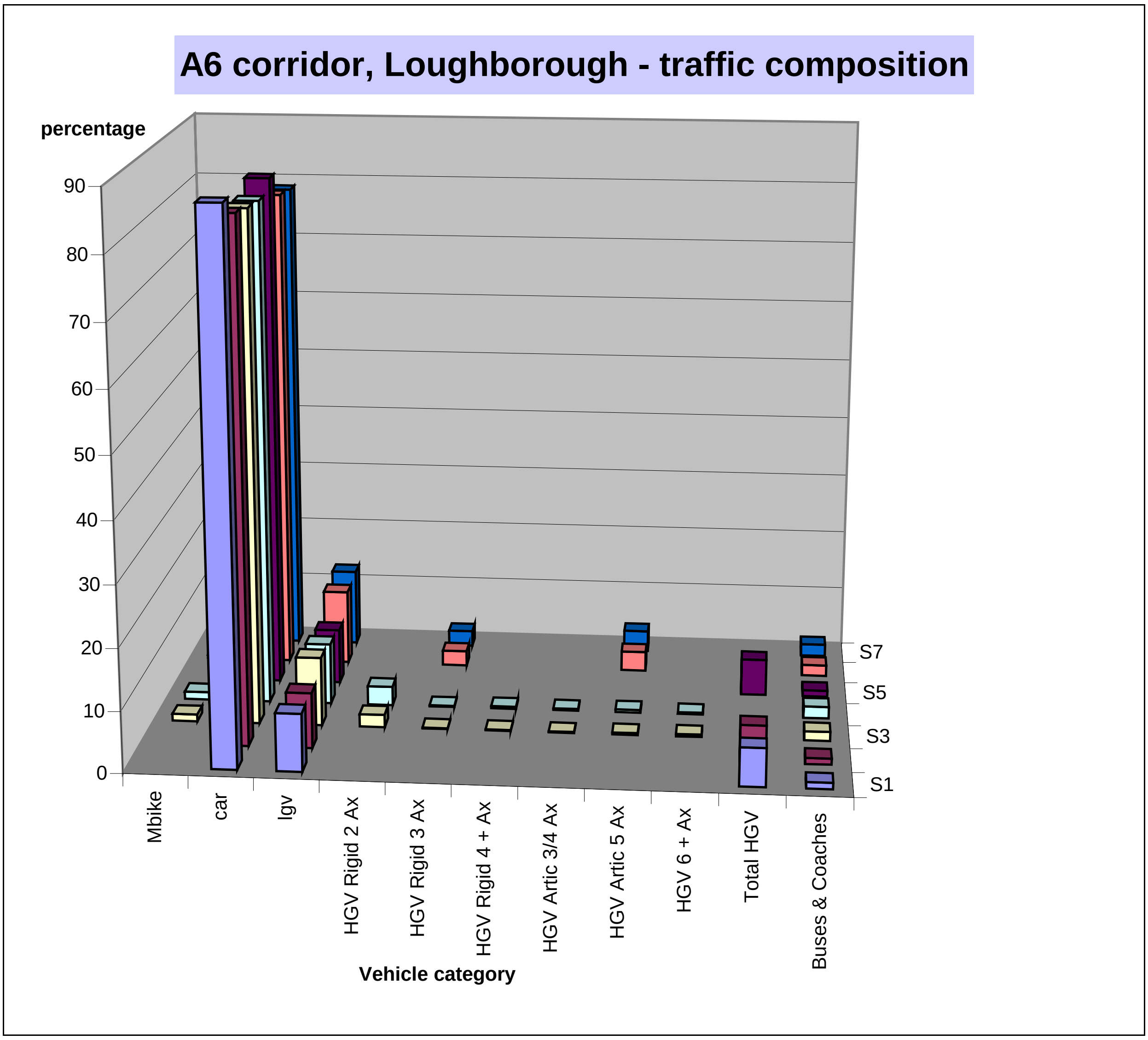
such as school and bank holidays and so monitoring in some months of the year (neutral months) are considered more likely to produce accurate reflections of the true traffic flows than others. Where possible only data from neutral months (namely April, May, June, September and October) has been used.

The graphs in the following section of the report provide a percentage breakdown of the traffic classification on each section of the roads within the Loughborough and Syston AQMAs.

Graphs 1-5 Traffic Composition in and around roads in the Loughborough AQMA

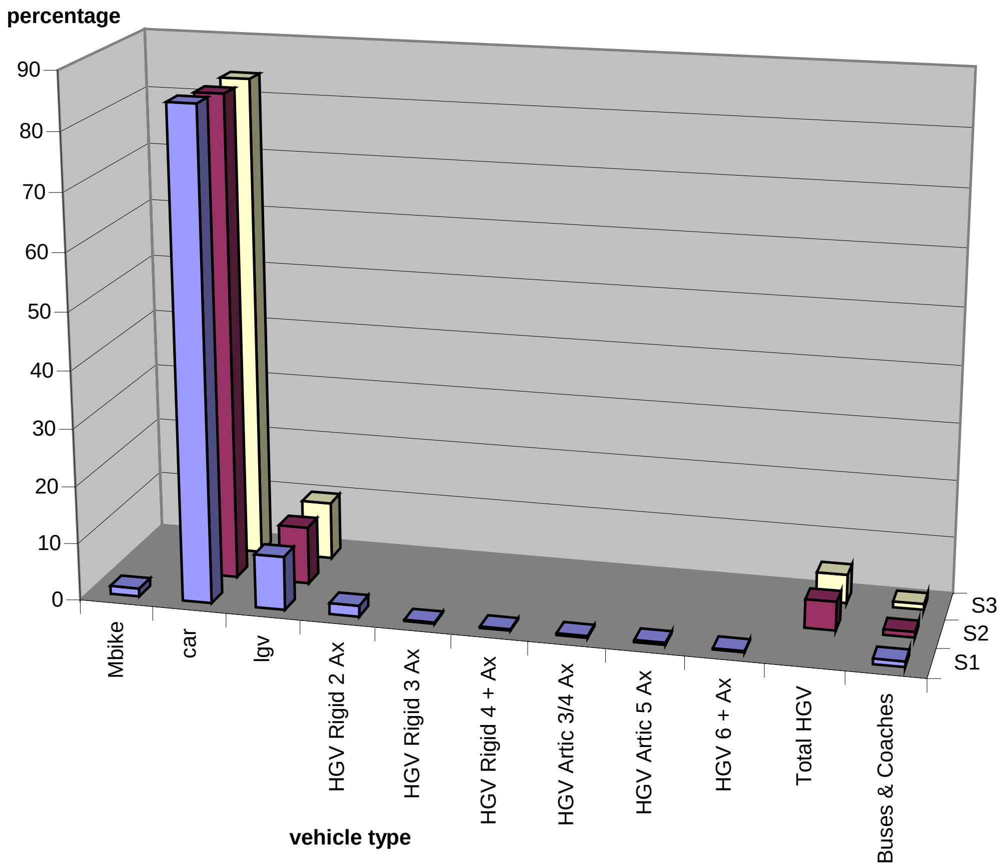


S1 = M1 junction 23 to Old Ashby Road
S2 = Epinal Way to Broad Street
S3 = Broad Street to Green Lane

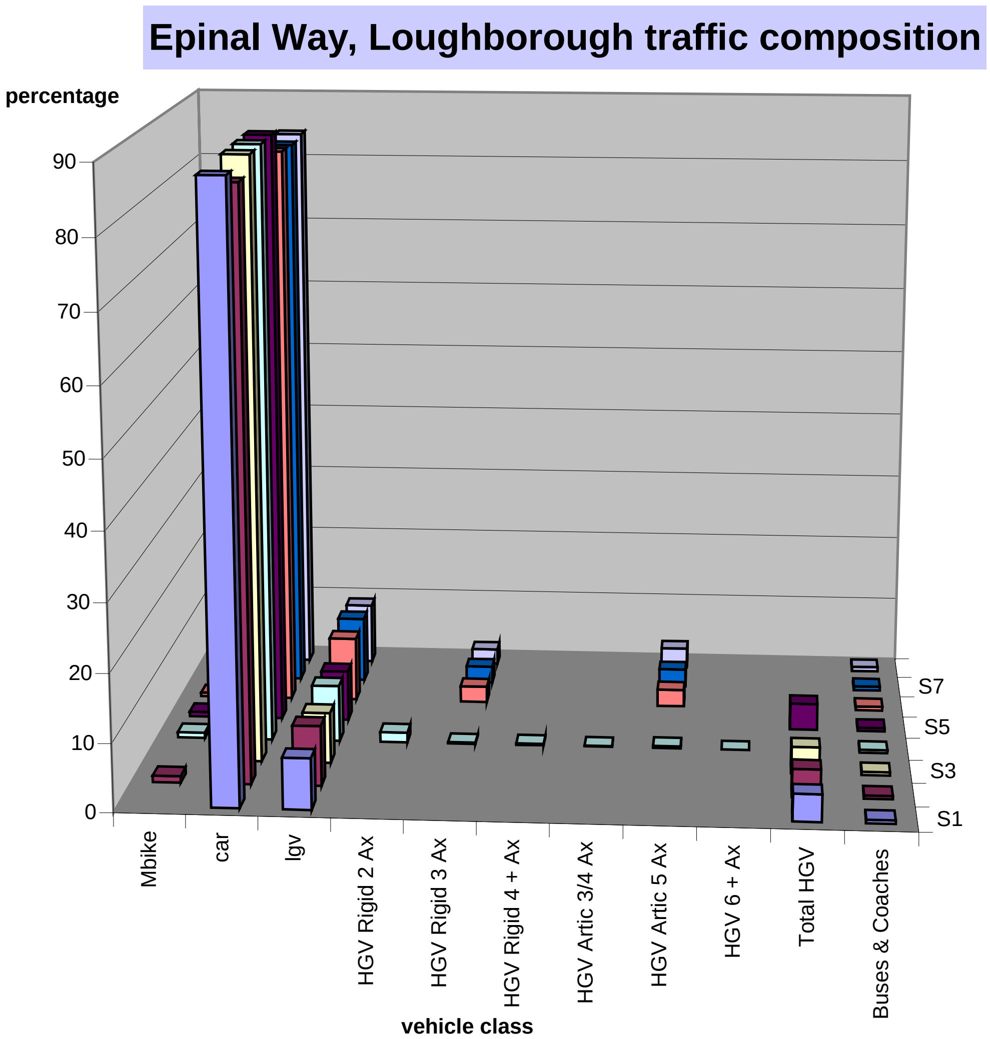


S1 = Derby Road (Bishop Meadow Rd to Alan Moss Rd)
S2 = Derby Road (Alan Moss Road to Bridge St)
S3 = The Rushes / Swan Street
S4 = High Street
S5 = Leicester Road (Southfield Road to King Street)
S6 = Leicester Road (King Street to Shelthorpe Road)
S7 = Leicester Road (Shelthorpe Road to Quorn)

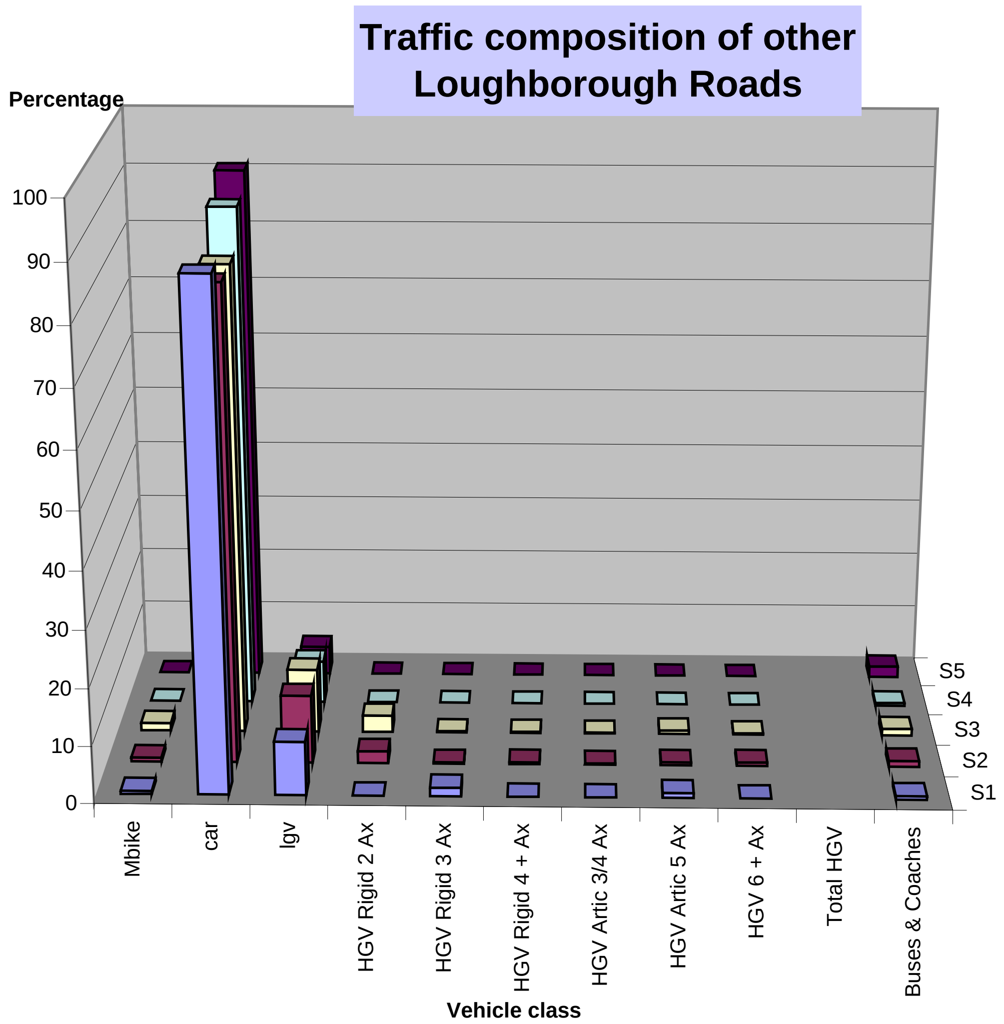
Nottingham Road, Loughborough traffic composition



S1 = Nottingham Road (Cotes to Ratcliffe Road)
S2 = Nottingham Road (Ratcliffe Road to Queens Road)
S3 = Nottingham Road (Queens Road to Sparrow Hill)

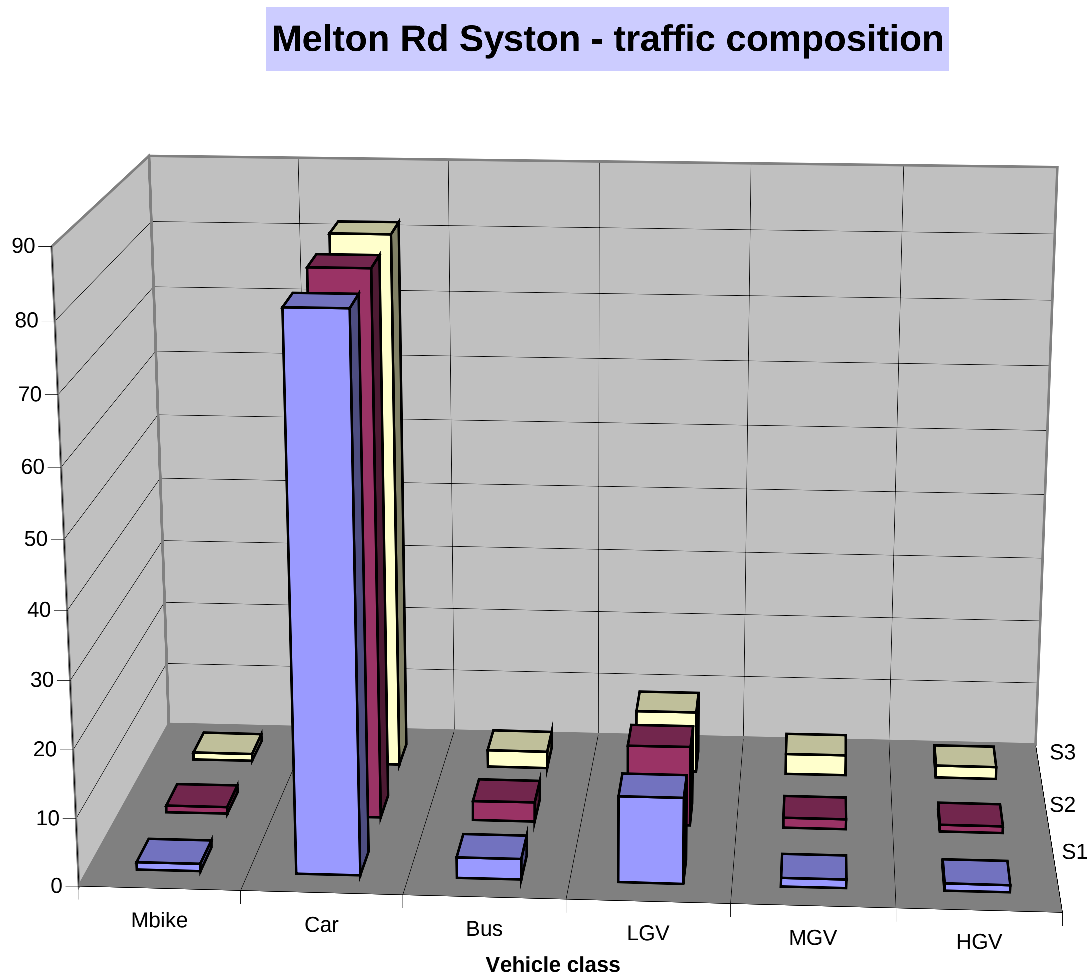


S1 = Warwick Way
S2 = Epinal Way (Warwick Way to Alan Moss Road)
S3 = Epinal Way (Alan Moss Road to Ashby Road)
S4 = Epinal Way (Ashby Road to Forest Road)
S5 = Epinal Way (Forest Road to Shelthorpe Road)
S6 = Epinal Way Extension (Shelthorpe Road to Beaumont Road)
S7 = Epinal Way Extension (Beaumont Road to Woodthorpe)
S8 = Epinal Way Extension (Woodthorpe to Quorn)



S1 = Shelthorpe Road
S2 = Alan Moss Road
S3 = Ratcliffe Road
S4 = Belton Road
S5 = Broad Street

Graph 6 Traffic Composition on the roads in and around the Syston AQMA



S1 = Melton Road (Parkstone Road to Barkby Road)
S2 = Melton Road (Barkby Road to Wanlip Road)
S3 = Melton Road (south of Wanlip Road)

6.2 Vehicle Classes & NOx Contribution

Some understanding of the impact of each of the classifications of road traffic on emissions is necessary in order to start the process of establishing what impact any proposed amendments to the road transport network will have on air quality.

Looking at the key receptor locations referred to in section 5 of this report, modelling runs were used to predict the contribution of each main class of vehicle to the total NOx exposure at each receptor.

The outcomes were as follows:

Table 8 Traffic class contributions of NOx at key exposure locations

		% NOx contribution from:			
Receptor	Predicted Annual average NO2 (2005)	Background levels	Cars & motorbikes	LGVs	HGVs & Buses
Loughborough					
74 Ratcliffe Rd	34.6	54.8	14.7	3.5	27
1 Shearers Ct	37.7	49.1	17.7	5.1	28.1
114 Derby Rd	42.1	34.3	22.9	6.2	36.6
3 Brisco Av	40.9	42.9	16.8	4.8	35.5
1 Haydon Rd	45.4	47.5	16.5	5.3	30.6
70 Ashby Rd	42.5	59.5	18.3	2.9	19.3
5 Leicester Rd	38.5	35	16	5.2	43.8
166 Leicester Rd	41.2	32.9	15.5	5.5	46.1
Birstall					
85 Saltersgate Rd	36.6	35.3	13.7	5.6	45.3
Syston					
1257 Melton Rd	37.5	46.8	20.4	4.7	28.1
1110 Melton Rd	45.1	47.2	19.6	4.7	28.5
1121 Melton Rd	43.9	47.2	19.6	4.7	28.5

HGVs and buses contribute disproportionately to the NOx levels compared to their total traffic fleet composition. Therefore roads with even moderately high quantities of these vehicles, experience substantial increases in NOx emissions.

7. Commentary on Results

Neither air quality modelling or monitoring can be considered to provide absolute proof of compliance with air quality objectives. Both are subject to errors and uncertainties which need to be minimised before they can be used to inform decisions about air quality. Therefore none of the results outlined in this report should be considered in isolation as conclusive evidence of compliance or non compliance with air quality objectives.

This part of the report is concerned with commenting on the separate evidence obtained from the review and assessment process and pulling together the different findings to reach a conclusion on which further actions can be based.

7.1 Monitoring Data

Comparisons between real time and diffusion tube data suggest that our diffusion tube network provides relatively accurate results. Forward calculations of air quality in 2005 based on diffusion tube data collected up to and including 2002 give a picture that suggests that breaches of the annual average nitrogen dioxide objective are unlikely at all locations other than on High Street, Loughborough.

However the picture changed dramatically when the results for 2003 were subject to the same analysis. Forward projections of data from 2003 produced estimates that 13 of the 15 existing monitoring sites within existing AQMAs would exceed the 2005 annual average objective for nitrogen dioxide. There may be some questions about how representative of true air quality trends the 2003 results are. We are confident that the results for 2003 are relatively accurate, however air quality in 2003 was generally poorer right across the country which suggests that the main contributing factor was the prevailing meteorological conditions throughout the year. Diffusion tube sites in Charnwood in 2003 recorded on average a 24% increase in nitrogen dioxide from 2002 results, while the increase at background monitoring locations alone was 23%. Again this suggests that the poorer air quality covered wide geographical areas rather than being attributable to increased emissions from specific local sources such as individual roads. Similar trends were recorded at both the Leicester and Nottingham AUN stations, providing more evidence of the wide scale nature of the deterioration in air quality in 2003. We consider that the results and forward projections made from 2003 data must be seen in context. In other words predicted breaches of the air quality objectives based *solely* on this data should be treated with caution, whereas if this is supported by other evidence then it may be considered as more robust.

7.2 Modelling Data

The modelling results partially re-confirm what the stage 3 modelling suggested – namely that air quality with 10 meters of a number of the main arterial routes in the borough are likely to breach the 2005 air quality objective for nitrogen dioxide. The Charnwood Roadside verification model suggests that all main roads will be in breach, however the high uncertainty value of this method makes it untrustworthy.

The Leicester Validation Method has a lower uncertainty value and we consider it to be more trustworthy. This predicts that the A6 corridor in Loughborough, is likely to be in breach of the air quality objective, along with a length of the Epinal Way and Ashby Road. The model also indicates a likelihood of a breach on Melton Road in Syston.

On many routes the modelling is far more optimistic than the original stage 3 predictions. The A6 in Birstall is no longer considered likely to breach the objective, nor are Ratcliffe Road, Nottingham Road, Shelthorpe Road or most of the Epinal Way in Loughborough. Remaining routes ***may*** be likely to breach the objective.

7.3 Monitoring & Modelling Correlation

On the whole there was a reasonable correlation between the predictions derived by the monitoring and modelling methods. However there is a clear disparity between the predictions produced for Loughborough town centre (High Street & 5 Leicester Road). This is a very congested section of the road network and modelling is only able to calculate for smooth traffic flows. It cannot accurately calculate emissions from static and stop / start driving behaviour. We consider that the consistently high monitoring data for this stretch of the road network is a more accurate representation of the true air quality than the relatively low model predictions.

There is also significant disparity between monitoring and modelling based predictions on the Epinal Way route between Alan Moss Road and Ashby Road. Here the model over predicts compared to the monitoring results. Again we consider the monitoring results to be more accurate. This area is relatively open and the topography is more likely to promote effective dispersion of traffic emissions than the model is capable of accounting for.

8. Conclusions

Conclusions about the need to declare individual roads as Air Quality Management Areas were based on the following criteria:

1. Does modelling of receptors or representative monitoring locations along the road indicate an exceedence of 38 μg/m^3 nitrogen dioxide in 2005?
2. Do forward projections of nitrogen dioxide based on data collected before 2003 and related to receptor locations indicate an exceedence of 38 μg/m^3 nitrogen dioxide in 2005?
3. Do forward projections of nitrogen dioxide based on data collected during 2003 and related to receptor locations indicate an exceedence of 38 μg/m^3 nitrogen dioxide in 2005?
4. Are there any receptors within 10 meters of the kerbside?

Where all three of the criteria 1 to 3 were met the road was considered VERY LIKELY to breach the air quality objective.

Where two of the criteria 1 to 3 were met the road was considered QUITE LIKELY to breach the air quality objective.

Where only criteria 3 was met the road was considered QUITE UNLIKELY to breach the air quality objective.

Where none of the first three criteria were met, or where criteria 4 applied the road was considered VERY UNLIKELY to breach the air quality objective.

The conclusions of the Detailed Review and Assessment are therefore that:

1. There is evidence to suggest that levels of nitrogen dioxide will not generally breach the air quality objectives other than in close vicinity (within 10 meters) of roadside locations.

2. Receptors within 10 meters of kerbside of the following road lengths in Charnwood are VERY LIKELY to be subject to a breach of the 2005 air quality objective for annual average levels of nitrogen dioxide:

- ***In Loughborough:***
    - ***The A6 corridor from Alan Moss Road to Shelthorpe Road.***
    - ***The A512 Ashby Road between Epinal Way and Ashby Square.***

3. Receptors within 10 meters of kerbside of the following road lengths in Charnwood are QUITE LIKELY to be subject to a breach of the 2005 air quality objective for annual average levels of nitrogen dioxide:

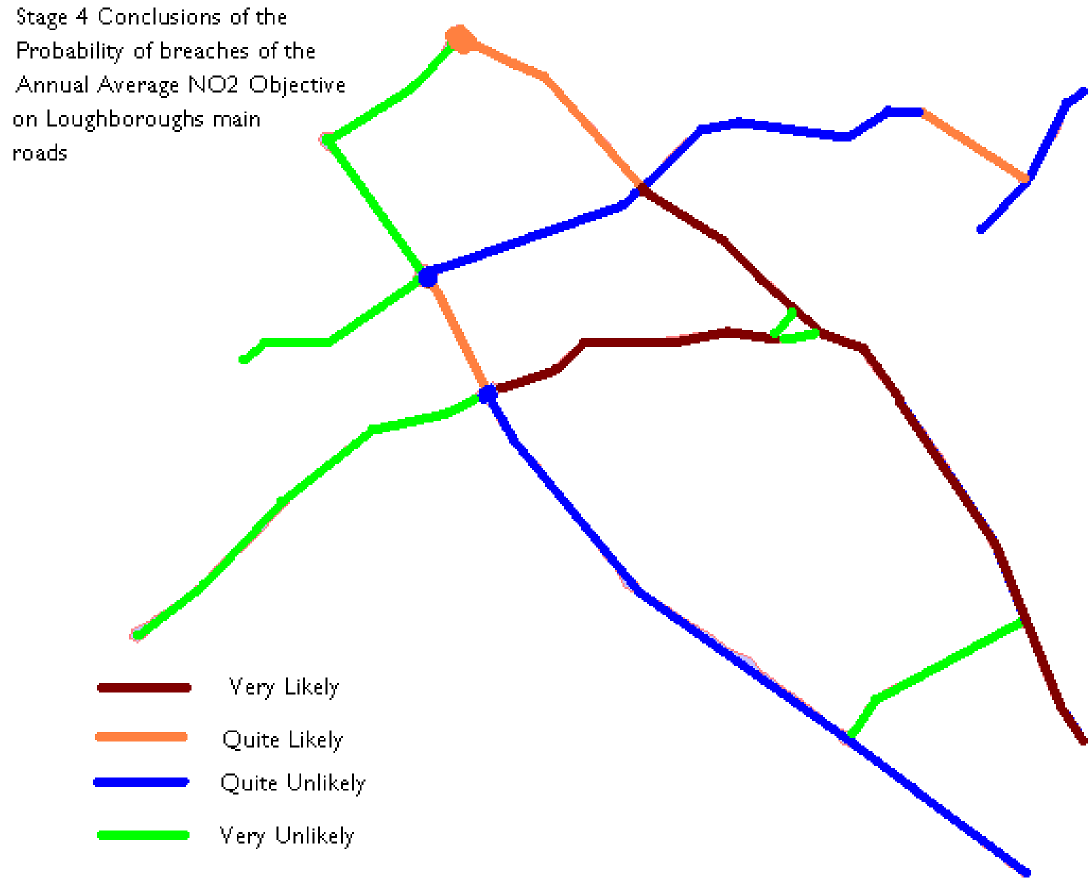
- ***In Loughborough:***
    - ***The A6 corridor (Derby Road) from Bishop Meadow Road to Alan Moss Road.***
    - ***Ratcliffe Road.***

    - ***The A6006 Epinal Way between Alan Moss Road and Ashby Road***
- ***In Syston, the Melton Road from High Street to Fosseway***

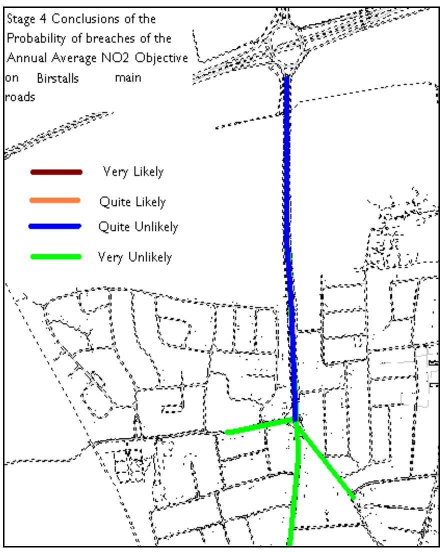
4. Receptors within 10 meters of kerbside of the following road lengths in Charnwood are QUITE UNLIKELY to be subject to a breach of the 2005 air quality objective for annual average levels of nitrogen dioxide:

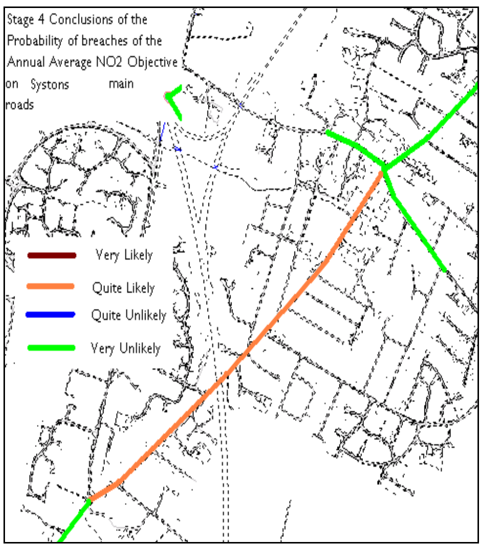
- ***In Loughborough:***
    - ***The A6006 Epinal Way from Ashby Road to Park Road***
    - ***The Epinal Way Extension***
    - ***Belton Road***
    - ***Nottingham Road***
    - ***The A6 (Leicester Road) from Southfields Road to the Quorn roundabout.***
- ***In Birstall, the A6 corridor from the A46 to Sibson Road.***

5. No other roads are considered to be at risk of breaching the objective.



Maps 10 – 12 Estimated Likelihood of roads in Charnwood causing breaches of NAQ objectives at nearby residential properties





7.5 Numbers of Receptors Affected and Air Quality Improvements Needed to Meet NAQ Objectives

In respect of the roads considered to be ***very likely*** and ***quite likely*** to be subject to breaches of the air quality objective the following reductions in annual average NO2 concentrations at the nearest receptor points are estimated to be necessary to meet the 2005 objective.

Table 9 Predicted Extent of NAQ Objective Breaches and the Number of Properties Affected

Road Length	Estimated Number of Receptors Affected within 10m of kerbside	Estimated Reduction in NO2 required (μg/m^3)
A6 Derby Road (Belton Rd to Bridge St)	80	6
A6 High Street	19	15
A6 Leicester Road (Southfields Road to Shelthorpe Road	24	3
Ashby Rd (Epinal Way to Ashby Square)	100	6
Derby Road (Bishop Meadow Rd to Belton Rd)	30	3
Ratcliffe Road	100	2
Melton Road, Syston	60	4
Epinal Way (Alan Moss Road to Ashby Road)	4	5

9. Recommendation

That the Charnwood Borough Council revise the areas recommended by the 2001 Air Quality Review and Assessment to be covered by Air Quality Management Areas.

1. The revisions should reduce the existing Loughborough Air Quality Management Area so that it covers land within the following highways including all publicly owned land within 10 meters of the kerbside of each;

   Leicester Road (Shelthorpe Road to Southfields Road)
   High Street
   Swan Street
   The Rushes
   Derby Road (Bridge Street to Bishop Meadow Road)
   Epinal Way (Alan Moss Road to Ashby Road)
   Ashby Road (Greenclose Lane to Epinal Way)
   Ratcliffe Road

   In addition the residential land of all the following addresses along those road lengths described above;
   Leicester Road – All properties
   High Street – All properties
   Swan Street – All properties
   The Rushes – All properties
   Derby Road – All properties
   Ratcliffe Road – All properties

Alan Moss Road	numbers 117 – 123 (odd)
	numbers 154 & 156
Haydon Road	numbers 1 & 2
Ashby Road	numbers 31 to 75 (odd), 217 & 219
	numbers 12 – 48, 62 – 108, 216 (even)

2. No revisions should be made to the existing Syston Air Quality Management Area.

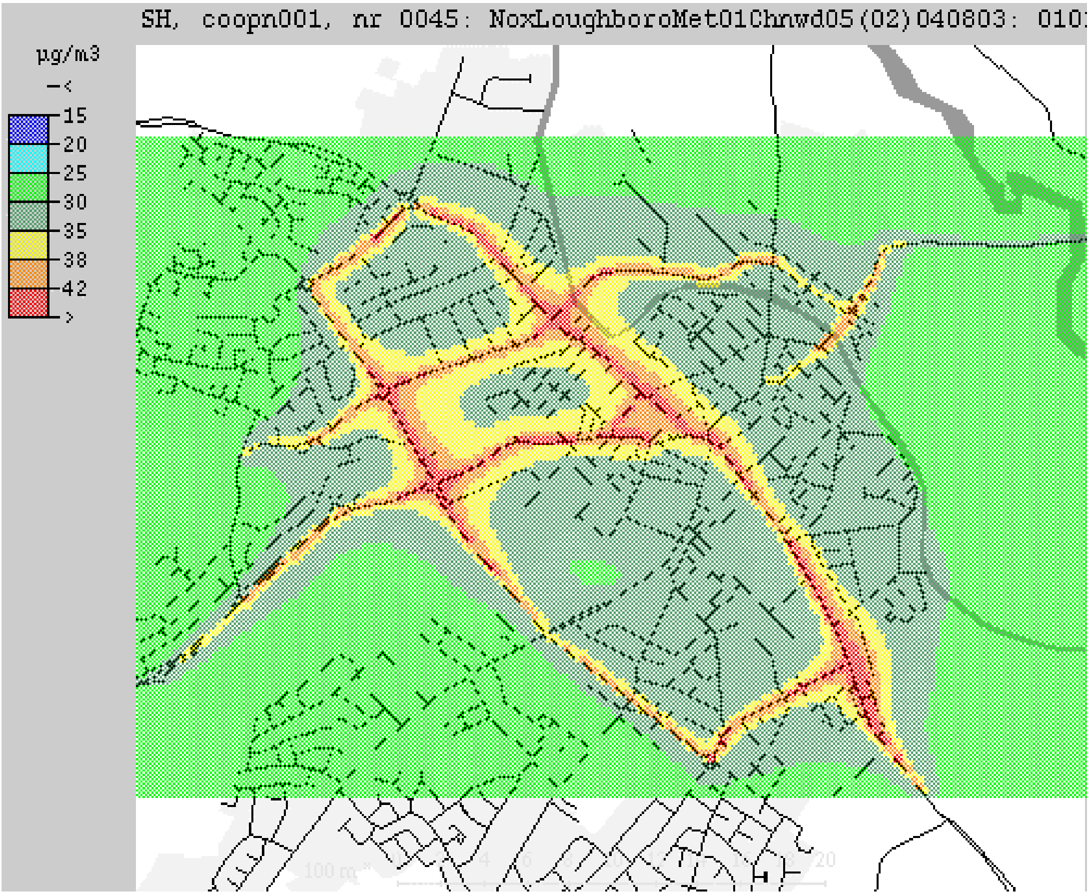
3. The existing Birstall Air Quality Management Area should be revoked.

Appendix 1

Modelling Outputs for the Loughborough Air Quality Management Area

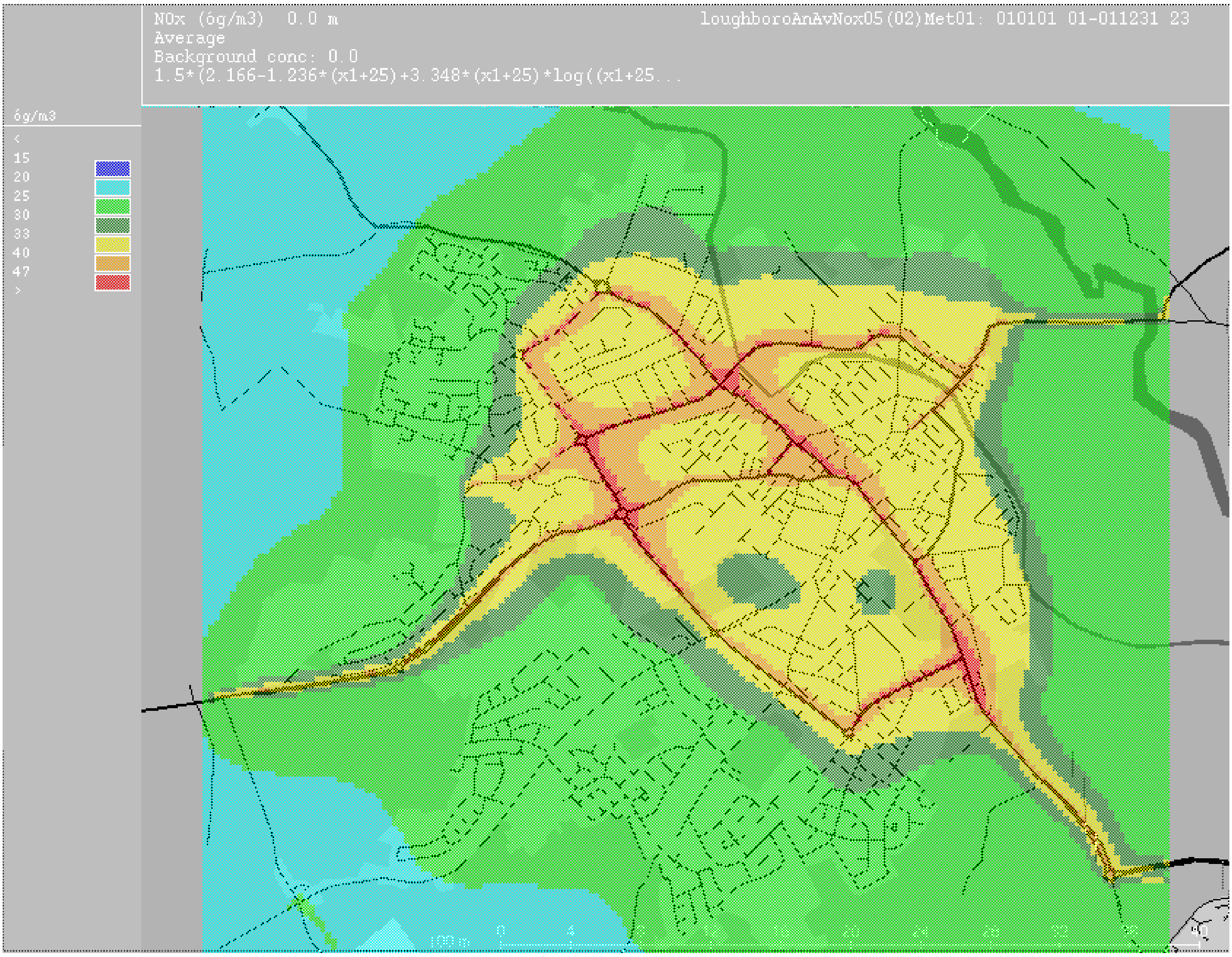
Leicester Verification Method

Annual average NO2 for Loughborough (µg/m^3), predicted for 2005
Met year: 2001. Database: Chnwd05. Emission factors for 2005, released 2002.
Includes background NOx (converted to NO2) of 25 µg/m^3, source Harwell.
Verified using Leicester real-time data. Correction factor: 1.6. Uncertainty: +/- 2 µg/m^3, (2 standard deviations) .Values only apply to areas within 10m of kerbside
Rundate Sept 04



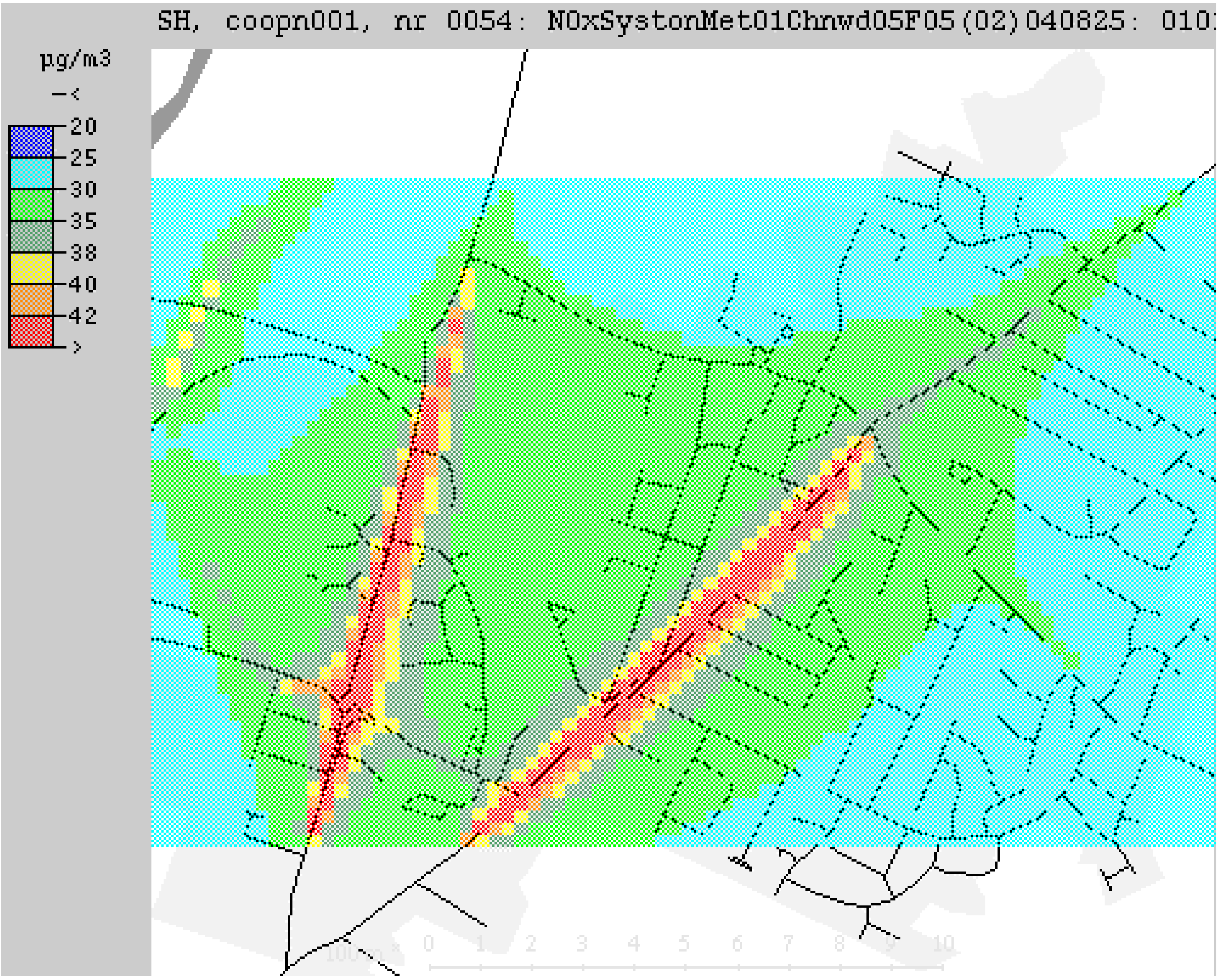
Charnwood Verification Method

Annual average N02, Met year 2001, 2005 database (emission factors released 2002) Includes background of 25 µg/m3 NOx based on Harwell Data and a correction factor of 1.5 based on validation from Charnwood bias corrected diffusion tube roadside monitoring. Uncertainty: +/- 7 µg/m^3, (2 standard deviations). Values only apply to areas within 10m of kerbside. Background added as NOx before converting total values to NO2*)*



Modelling Outputs for the Syston Air Quality Management Area

Annual average N02, Met year 2001, 2005 database (emission factors released 2002) Includes background of 25 µg/m3 NOx based on Harwell Data and a correction factor of 1.6 based on validation from Leicester City Council roadside monitoring. Uncertainty: +/- 2 µg/m^3, (2 standard deviations). Values only apply to areas within 10m of kerbside. Background added as NOx before converting total values to NO2*)***



Modelling Outputs for the Birstall Air Quality Management Area

Annual average N02, Met year 2001, 2005 database (emission factors released 2002) Includes background of 25 µg/m3 NOx based on Harwell Data and a correction factor of 1.6 based on validation from Leicester City Council roadside monitoring. Uncertainty: +/- 2 µg/m^3, (2 standard deviations). Values only apply to areas within 10m of kerbside. Background added as NOx before converting total values to NO2)