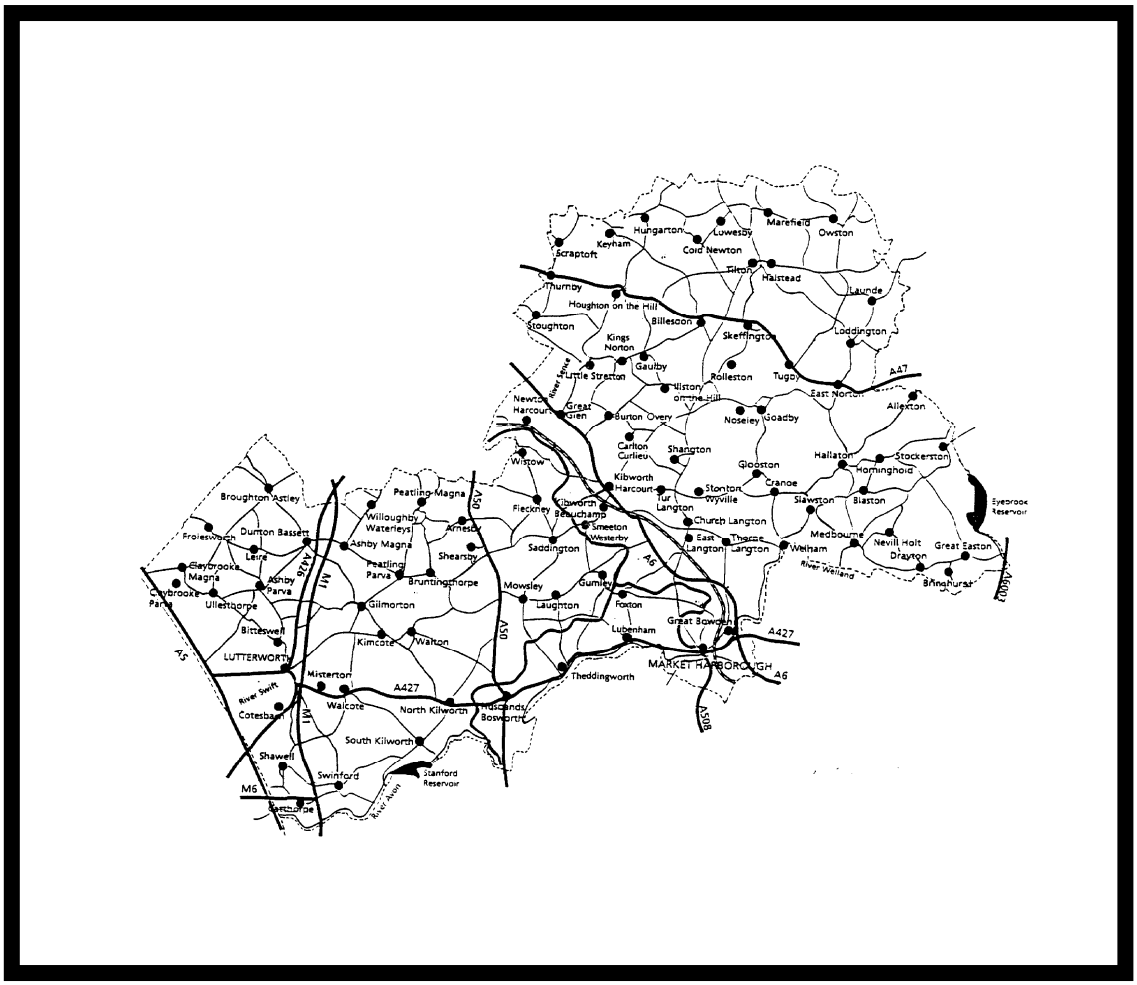
# AIR QUALITY REVIEW AND ASSESSMENT

## Results of the Assessment of Air Quality in Harborough District




January 2001

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The Environment Act 1995 introduced a new concept in assessing local air quality. The Government published the National Air Quality Strategy in March 1997, with a revised addition published in January 2000. The strategy sets out national objectives for eight pollutants for assessment, **Benzene, 1,3-Butadiene, Carbon Monoxide, Sulphur Dioxide, Lead, Particulates, Nitrogen Dioxide and Ozone**

There is a requirement for all Local Authorities to assess the existing local air quality and to predict future conditions against the National Air Quality objectives.

The Review and Assessment takes place over three phases. The First Stage is a desk top analysis of each of the seven pollutants. When this assessment indicates that the objectives are unlikely to be met by National policy alone, the Local Authority is required to undertake a more detailed Stage 2 or Stage 3 assessment for the particular pollutants. If the more detailed assessment confirms the findings of the First Stage review, and the Air Quality objectives are unlikely to be met by the prescribed year, the Local Authority may declare an Air Quality Management Area (AQMA). Once and AQMA has been declared the Local Authority has a further twelve months to carrying out monitoring and modelling and to draw up an action plan to address the local problems.

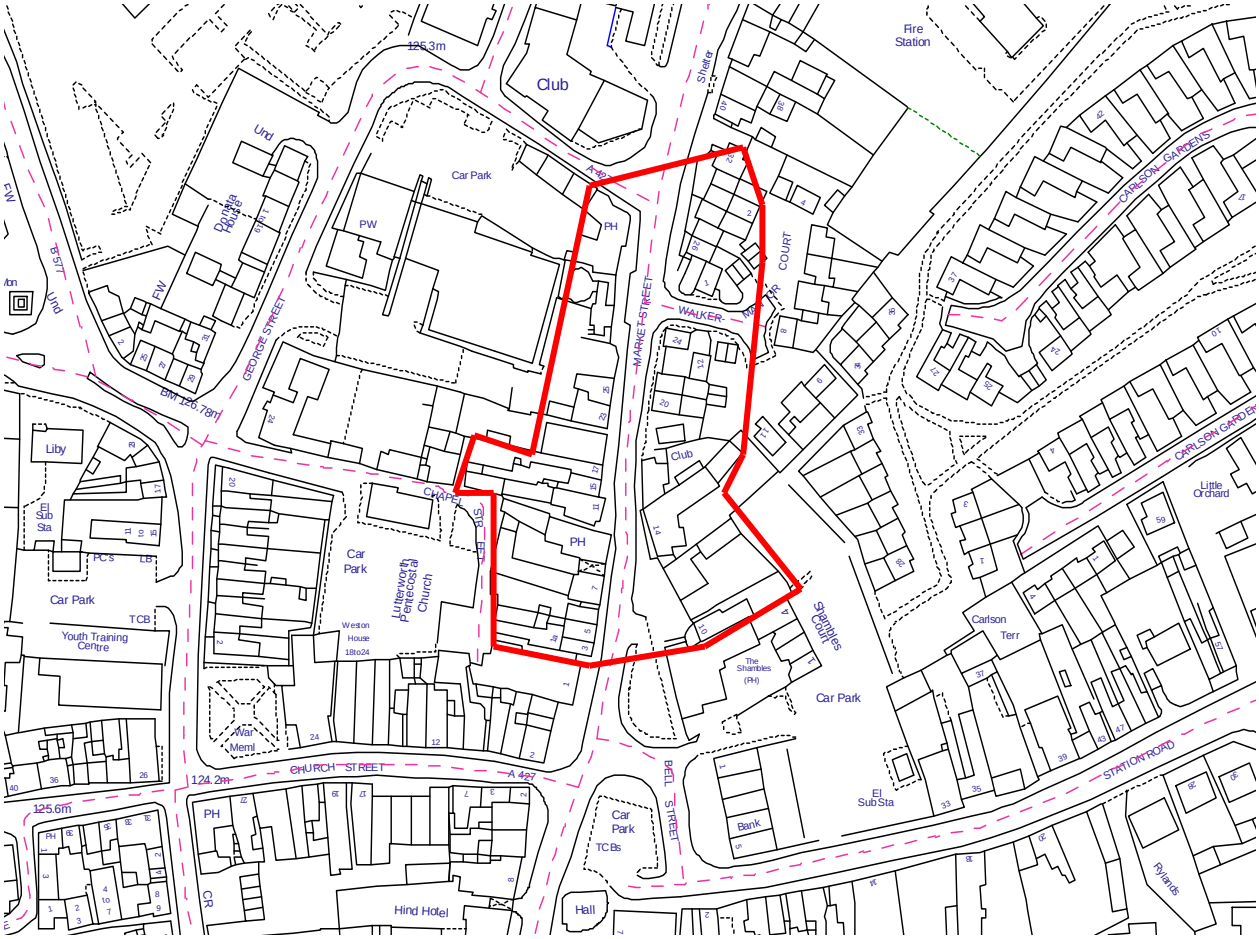
Following the First Stage review and assessment, it was concluded that it would be necessary for Harborough District Council to carry out a Second and Third Stage review on the following pollutants:

Carbon monoxide
Lead
Particulates
Nitrogen Dioxide

The Second and Third Stage review concluded that with the exception of Nitrogen Dioxide all of the National Air Quality Objectives **will** be met.

It is anticipated that the National Air Quality Objective for Nitrogen Dioxide **will not** be met in the Market Street area of Lutterworth Town Centre. It is recommended that an Air Quality Management Area is declared for this area. The proposed area is shown on the map in figure 1.

Figure 1 Proposed Air Quality Management Area for Lutterworth Town Centre.




## 1. Introduction

**1.1** This report has been prepared in accordance with the Environment Act 1995 to assess the air quality in the Harborough District. It examines the

various air pollution sources both within the District and external sources likely to have some effect.

The aims of the report are:

- To investigate present and potential future air quality in the District
- To make an assessment of air quality in relation to requirements of the National Air Quality Strategy
- To identify the principle sources of pollutant emissions affecting air quality in the Harborough district

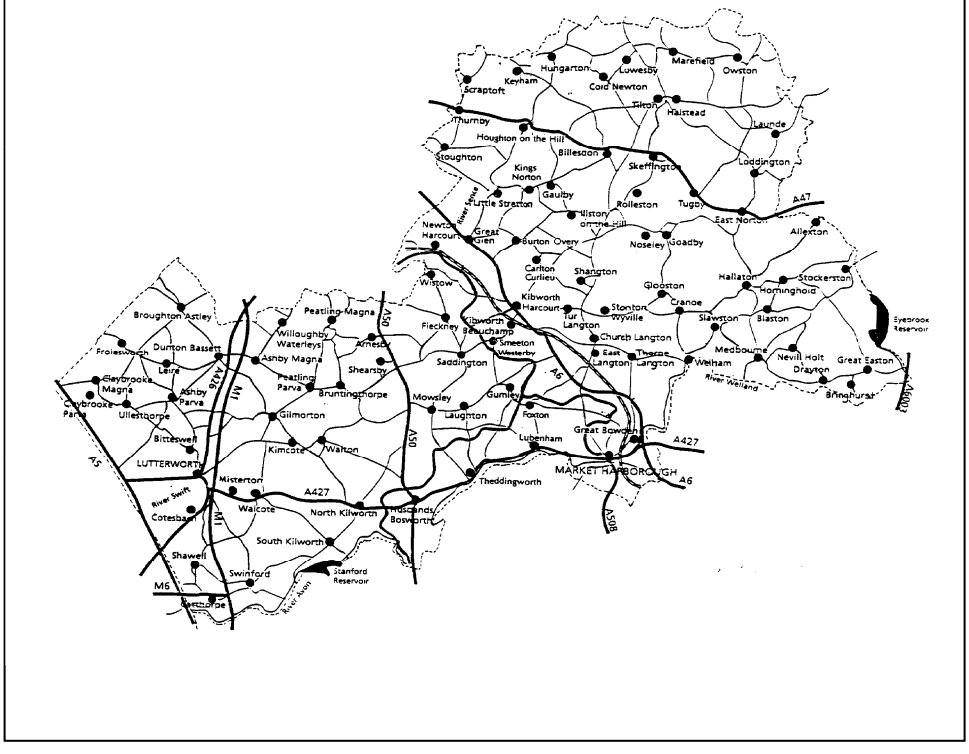
## 1.2 The Local Area

Harborough District Council covers approximately 230 square miles of Southern Leicestershire and as shown in figure one. Approximately 75,000 people live within the District a third of which are in one of the three main population centres - Market Harborough, Lutterworth and Broughton Astley. After these two settlements the population is shared between four larger villages - Fleckney, Great Glen, Kibworth, and Thurnby - and almost 90 other villages serving rural communities.

The District borders on to the suburbs of Leicester in the north and is dissected by a number of major roads, these include the M1, and a small section of the M6 and the A426 in the west, and the A6, A47 and A50 in the eastern side. These roads are a major part of the East Midlands road network and consequently are heavily used.

The good communication links have encouraged a number of industrial estates to develop, containing medium sized businesses carrying out a range of coating and spraying activities, moulding, and timber processes. In the south west of the District there is a cluster of mineral activities including sand and gravel extraction, cement batching plants and other associated products. Within Market Harborough there are two major established industries, The Harboro Rubber Company Ltd and Tungstone Batteries Ltd.

# MAP OF HARBOROUGH DISTRICT



At the extreme western side of the District is Magna Park, which is a major warehousing site, covering approximately 7.4 million sq. ft. A number of the major manufacturers within the UK are located on this site. This site attracts a great deal of traffic as most of the products are transported by road. The nearby town of Lutterworth is affected by the increase in road traffic.

# 2. The National Air Quality Strategy

## 2.1 Background

During the early part of the 1990s the Department of the Environment, Transport and the Regions (DETR) started to develop a framework for air quality control to comply with the 'EC Ambient Air Quality Assessment and Management Directive'. From this directive it was clear that member states would have to monitor levels of pollutants and draw up and implement action plans where those levels were exceeded.

When the Environment Act 1995 was published it contained a section which specifically referred to air quality and the production of a strategy. The approach was intended to be from both a national and a local level.

The Government published the first National Air Quality Strategy in 1997 and it included recommended maximum levels of eight pollutants, which were attained by the Expert Panel on Air Quality Standards (EPAQS). The levels are based on medical and scientific evidence and the strategy highlighted objectives which should be achievable by 2005. Eight pollutants were targeted and these are given below in more detail

The requirements under the Act are fairly general and in order that a systematic approach was taken a timetable was suggested by the DETR for each local authority to follow.

The guidance came in a series of publications that set out three distinct stages of assessment.

**Stage 1** A simple survey of the current situation in each District. This would include data on major pollution sources within the District and nearby to the District. It should also include details on any planned significant pollutant sources. If the Local Authority are able to identify significant sources for one or more pollutants it is then necessary to proceed to a second stage review. The suggested completion date for this stage was the end of December 1998.

**Stage 2** A further screening stage requiring more detailed information on selected sources either by monitoring or modelling using existing data. It involves estimating the maximum concentrations of air pollution within the district and assessing whether there is a significant risk of an air quality objective not being met. If there is any doubt that an air quality objective will be exceeded a third stage review should be conducted.

**Stage 3** This is a detailed study of specific locations and would possibly result in the declaration of an LAQMA and an associated Action Plan.

The approaches require more specific modelling than stage two required and enable the authority to accurately assess the likelihood of meeting the objective and so determine the location of any necessary Air Quality Management area (AQMA). Once an AQMA has been identified there are a further set of requirements to be considered. Firstly a further air quality assessment is required within twelve months, which enables an assessment of the degree to which an objective is being breached and establishes the exact sources of pollution that contribute to the increased levels. The Local Authority must also prepare a written action plan on how the air quality objective will be met. It is expected that stages two and three will be completed by June 2000 or at the latest by December 2000.

## 2.2 National Air Quality Standards

Eight key pollutants have been identified by the National Strategy for local authorities to investigate.

The pollutants are linked to various health effects and an expert panel was developed to produce standards for each pollutant that would safeguard health.
The original standards, which were set, were altered by the Air Quality Regulations 2000 which were enacted on 6 April 2000. The current objectives are shown below in Table A

**Table A:** Air Quality Standards

| Pollutant | Air Quality Objective Levels | Averaging Period | Air Quality Objective Dates |
|---|---|---|---|
| Benzene | 16.25 µg/$m^3$ | running annual mean | 31st December 2003 |
| 1,3-Butadiene | 2.25 µg/$m^3$ | running annual mean | 31st December 2003 |
| Carbon Monoxide CO | 11.6 µg/$m^3$ | running 8 hour mean | 31st December 2003 |
| Lead Pb | 0.5 µg/$m^3$<br>0.25 µg/$m^3$ | annual mean<br>annual mean | 31st December 2004<br>31st December 2008 |
| Nitrogen Dioxide $NO_2$ | 200 µg/$m^3$<br>40 µg/$m^3$ | 1 hourly mean not to be exceeded 18 times a year<br>annual mean | 31st December 2005 |
| $PM_{10}$ (Particulates) | 50 µg/$m^3$<br>40 µg/$m^3$ | running 24 hour mean not to be exceeded 35 times a year<br>annual mean | 31st December 2004 |
| Sulphur Dioxide $SO_2$ | 125 µg/$m^3$<br>350 µg/$m^3$<br>266 µg/$m^3$ | 24 hour mean not to be exceeded 3 times a year<br>1 hourly mean not to be exceeded 24 times a year<br>15 minute mean not to be exceeded 35 times a year | 31st December 2004<br>31st December 2004<br>31st December 2005 |

The air quality standard for ozone has been removed from the local authority review and assessment because it is considered to be a national problem rather than a local one.

## 2.3 Consultation and Liaison

The process of review and assessment requires each local authority to widely consult on the result of it's air quality review and the list of Specified consultees is as follows:-

- The Secretary of State for the Environment, Transport and the Regions
- The Environment Agency
- All neighbouring Local Authorities
- Other relevant public bodies
- Local business groups
- Other groups the Council considers appropriate

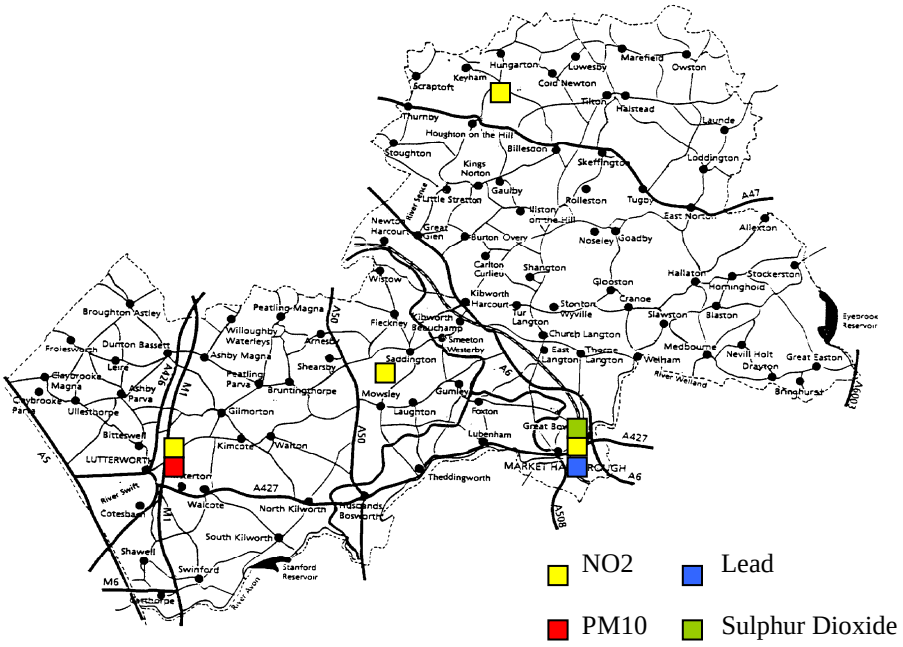
It is the intention of the Council to consult as widely as possible and to use the community forums to seek the views of people living in the district. It is also essential to include neighbouring authorities and to increase each Authority's awareness the Leicestershire and Rutland Air Quality Forum was developed. This group included air quality representatives from all the district councils and unitary authorities. It also included members from the relevant transport and planning authorities as they were responsible for providing information relating to pollution sources. The group's purpose is to exchange air quality information and consider the technical matters relating to Local Air Quality Management. In addition to this the neighbouring authorities who are not within Leicestershire will be consulted on the findings of this report.

# 3. MONITORING AND MODELLING

## 3.1 INTRODUCTION

The assessment of air quality is inevitably based on actual measured levels of pollution or estimated levels using some type of modelling system. Both types of assessment offer valuable information depending on the situation it is used and within this report there are a number of different techniques used. The following sections identify which techniques were used and give background information on the monitoring sites.

Map of monitoring locations




## 3.2 Monitoring

Three types of monitoring systems were used:-

- Passive Diffusion Tubes
- Semi automatic bubblers

- Automatic Analysers

### 3.2.1 Passive Diffusion Tubes

These are a simple and cost effective method of screening air quality in an area and they give a good general indication of average pollution concentrations. Their major use is to compare levels against the annual mean objective level. The sampler is usually a small tube coated with a substance capable of capturing the target pollutant. The tube is exposed for at least one week, more usually one month, and is sent to a laboratory, which can analyse the tube and has the necessary quality assurance system.
This method is useful for identifying local hotspots and has been used for monitoring both Nitrogen dioxide and Benzene within the district.

### 3.2.2 Automatic monitors

These methods collect pollutant samples by chemical or physical means ready for subsequent analysis in a laboratory. In the case of Sulphur dioxide a known volume of air is pumped through a chemical solution for a 24-hour period and wet chemical methods are used to establish the concentration of pollutant in the sample for that 24-hour period. This method has been used to establish Sulphur dioxide levels at the two sites marked on the map.
With regard to Lead a known quantity of air is pulled through a filter and the dust which collects is analysed for the heavy metal content. The monitoring is carried out over weekly periods and the results are directly comparable to the objective levels. The Lead monitor is positioned downwind of the Tungsten factory in Market Harborough which is a Lead process.

### 3.2.3 Automatic Monitors

Automatic monitors continuously monitor and analyse pollutant levels, providing immediate real time data. The are equipment is generally very sophisticated and expensive. The instruments are subjected to regular calibration checks to ensure that the data is reliable. Variations in pollutant levels can be seen immediately and problems with the instrumentation can also be quickly identified. There are currently two automatic monitors in the Lutterworth Air Quality Monitoring Station and they have been monitoring the Nitrogen dioxide and $PM_{10}$ levels since June 1999 .

### 3.2.4 Modelling

There are numerous air quality models ranging from simple spreadsheets to complex computer programmes. They all provide a means of calculating air pollution concentrations based on information about the pollution source and the likely atmospheric conditions. In the context of this report two different models have been used to provide information and predictions on pollution from traffic.

### 3.2.5 Design Manual For Roads and Bridges(DMRB)

This model is one of the simplest models and therefore is less accurate than the complex type. However it's main advantage is that it is easy and quick to use. It also provides sufficient information with which to decide whether a more accurate model is required. Consequently these types of models are known as screening models.
The DMRB was formulated by the former Department of Transport and gives a preliminary indication of air quality near roads. It is more suited to rural motorways and trunk roads than urban areas. This method requires details on vehicle flow, HGV mix, vehicle speed and receptor road distances. The resulting pollutant concentrations can be estimated directly with regard to the objective concentration levels.
This model was used for predicting Carbon monoxide, $PM_{10}$ and Nitrogen dioxide levels emanating from the motorways and the A426 in Lutterworth.

### 3.2.6 ADMS-URBAN

This is a multi-source dispersion model which incorporates the most up to date treatment of the meteorology of the atmosphere. The results can be calculated for specific receptor points or for whole areas in the form of a contour plot on a GIS map.
This model was used to predict the levels of Nitrogen Dioxide in the vicinity of a section of the M1 near to Lutterworth.

## 3.3 Description of the Model.

ADMS-Urban Version 1.53 is a version of the Atmospheric Dispersion Modelling System (ADMS) developed by Cambridge Environmental Research Consultants (CERC). It is a PC-based computer system that models dispersion in the atmosphere of pollutants emitted from industrial, domestic and road traffic sources. The sources that are entered into the model are treated as point, line, area or grid sources.

ADMS-Urban, can be used in conjunction with a Geographical Information System (GIS). The GIS software used is ARCVIEW.

### 3.3.1 Model Inputs

The emissions database consists of point, line, area and grid sources. Data can be entered into the model as individual sources and have emission rates entered directly from the Emission Inventory. However, road sources from the Emission Inventory required further work before they could be entered into the model.

The first step was to covert two way traffic flows into a total flow for each road segment. In order to do this road links with traffic flows in one direction were given a unique reference according to the A node and B node numbers. This unique identification could then be matched to that of another link, corresponding to the same "stretch" of road. This preparatory work was carried out using a query in Microsoft Access 97. This reduced the number of road sources significantly. Secondly it was necessary to grid some of the smaller roads to further reduce the number of sources run in the model. The method used to grid the smaller road sources is a simple script written in Arcview that splits each road up over a chosen grid matrix and then totals the emissions in that grid square. By using this method of combining two way flows and gridding smaller roads it was still possible to include all road emissions in the model. The end result is an emission database that includes point and area sources, major road links and grids that contain smaller road links added together.

In ADMS, the traffic emissions are calculated from an internal emissions database and depend on the vehicle category (light duty or heavy duty), average speed and traffic count. These parameters are entered into the model from the Leicester Emissions Database, then the emission factors and rates of key pollutants are automatically calculated. The emission factors used are from the Design Manual for Roads and Bridges (Highways Agency, 1999, Design Manual for Roads and Bridges, Volume 11, Section 3, Part 1 - Air Quality, The Stationary Office). Emissions Factors g/km included in the model are for the following pollutants:

| | |
|---|---|
| CO | Carbon monoxide |
| VOC | Volatile Organic Compounds (Hydrocarbons) |
| NOx | Total oxides of Nitrogen |
| $PM_{10}$ | Particulates |

From this database the model calculates the emission rate for each road link dependent on the vehicle speed, flow and composition. For road sources, emission rates are calculated in g/km/s.

The database built into the model also offers a facility to calculate emissions based on projected future vehicle emissions. Emission factors for all years from 1996 to 2025 are available within the database.

In order to account for changes in traffic flow throughout the day and week, a traffic profile is used in the model to represent the different vehicle flow patterns that occur at different times. This profile of time varying emission factors gives an increase or decrease in traffic flows, relative to the hourly traffic counts derived from the AADT flow (Annual Average Daily Traffic), for each hour of the day and days in the week, i.e. weekday a.m. and p.m. peaks and weekend flows. For example at 8.00am on a weekday the time varying emission factor is 1.62 times the hourly average count derived from the AADT. The traffic profile used for the ADMS-Urban model runs is a standard hourly profile for urban areas where am and p.m. peaks are shown and was provided by Cambridge Environmental Research Consultants.

### 3.3.2 Meteorological Data

For the purpose of the National Air Quality Strategy Review and Assessment, data for the meteorological year 1999 has been input into ADMS-Urban. Data for 1999 is used to assist validation of the model as there is a complete set of monitoring data for the year 1999 available. Meteorological data for 1999 is taken from a Meteorological Mast situated on a traffic island at Groby Road, Leicester. Weather data files are in standard ADMS Met. data format.

Data from Leicester Met. Mast are hourly sequential and include 7 variables:

| | |
|---|---|
| YEAR | Year |
| TDAY | Julian day number |
| THOUR | Local time (hour) |
| TOC | Near surface temperature ($^0$C) |
| U | Wind speed (m/s) |
| PHI | Wind direction (angle in degrees) |
| FTHETA0 | Near surface heat flux (w/m$^2$) *(Calculated)* |

The meteorological year 1999 is “typical” in terms of weather.

### 3.3.3 DISPERSION CALCULATIONS.

To assist in the Review and Assessment of Air Quality a series of dispersion model runs were designed to investigate air quality now and in the year 2005 and to establish if any breaches of the NAQS Objectives have or are likely to occur.

Air quality monitoring stations can only give an indication of historical pollution levels at particular geographical locations. Air quality dispersion models can give an indication of pollution levels now and in the future at any geographical location where emission data has been obtained. The model runs for the Review and Assessment of Air Quality have therefore been designed to establish whether any of the NAQS Objectives are being breached now or will be breached in 2005.

For the purpose of the modelling work, the dispersion model has been run with data for the meteorological year 1999. The purpose of running this particular year of meteorological data is to enable a process of validation of the model using monitoring data from the Leicester Air Quality Monitoring Network for the same year.

The series of dispersion model runs are carried out using both the ‘present’ (1998) emission inventory and also the ‘future’ (2005) emission inventory. The procedure for the dispersion model runs is in a series of four steps, which are as follows:

- Run annual means for the whole city as contour plots for the Met. Year 1999.
- Select receptor points around the city corresponding to monitoring sites.

- Run the model for these receptor points for the Met. Year 1999 to produce a value for every hour of 1999.

- Use the data to validate the model results by comparison with monitored data.

# 4 REVIEW AND ASSESSMENT OF BENZENE

## 4.1 INTRODUCTION

Benzene is a colourless, aromatic hydro-carbon and has a characteristically sweet odour. It is a known carcinogen and represents a risk to health that is dependent on length of exposure time. There is no absolute safe level for Benzene.

In the UK the main atmospheric source of Benzene is the combustion and distribution of petrol of which Benzene currently accounts for approximately 2% by volume. Motor vehicle exhaust emissions contain some unburned Benzene and they also contain Benzene formed from the combination of other components in the petrol during the combustion process.

Other sources of Benzene would be associated with the industrial processes, which either handle, stock or emit Benzene.

The Government and devolved administrations have adopted a running annual mean of 16.25 $\mu g/m^3$ (5ppb) for benzene. The standard should be achieved by the end of 2003.

## 4.2 THE NATIONAL PERSPECTIVE

Motor vehicles are the most important single source on a national basis accounting in 1996 for 64% of the total UK annual emission of 41 ktonnes. Petrol vehicles account for most of these emissions as diesel fuel represents only a relatively small source.

There have been a number of significant national policy developments that will contribute to reducing the ambient air concentrations of benzene.

It is anticipated that these policies will deliver the air quality objective by the end of 2003. Only authorities with major industrial processes, which handle or emit large quantities of benzene should need to progress further than a Stage 1 assessment. (Local Air Quality Management Guidance Note LAQM. TG4(00): Pollutant Specific Guidance)

## 4.3 INFORMATION USED FOR THE FIRST STAGE REVIEW AND ASSESSMENT

The following information has been obtained :

- Benzene monitoring data for two sites within the District

- Details of published information available on Benzene levels
- Details of relevant Part A and Part B processes within the District (Appendix 1)
- Planned developments within the District
- Details of any significant sources outside the District

## 4.4 FINDINGS OF THE FIRST STAGE REVIEW AND ASSESSMENT

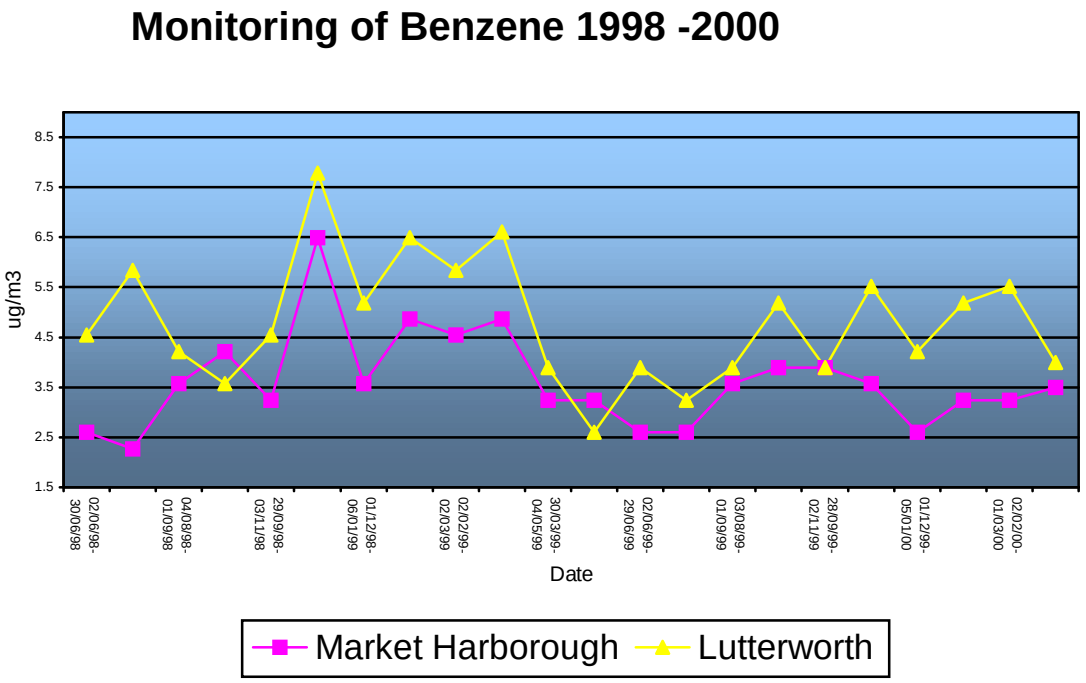
It is anticipated that the national policies will deliver the Air Quality Objectives for benzene by 2003. It is expected that even the busiest roadside locations will not exceed the objective level. There are no major industrial processes in Harborough District which have the potential to emit large quantities of benzene. Government guidance advises that due to tighter controls of emissions from petrol stations these should not be regarded as significant sources.

Passive sampling using diffusion tubes has been undertaken at two locations in the district and the results are summarised in table 4.1

Table 4.1

| March 1999 – April 2000 | | | |
|---|---|---|---|
| Location | Mean Value ($\mu g/m^3$) | Max. Value ($\mu g/m^3$) | Corrected 2003 Mean Value ($\mu g/m^3$) |
| Market Harborough Leicester Road | 3.265 | 3.893 | 1.839 |
| Lutterworth Market Street | 4.253 | 5.514 | 2.396 |

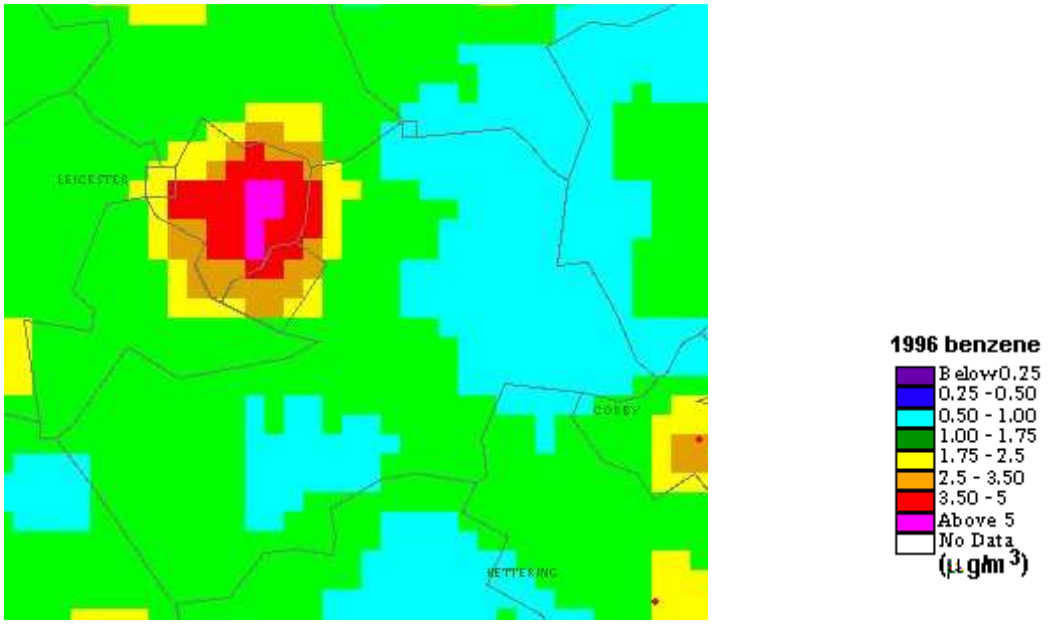
These results are for 100% data capture.
The corrected 2003 result for the area is 1 $\mu g/m^3$




The estimated annual mean background benzene concentration for 1996 have been mapped for the UK by NETCEN. (www.aeat.co.uk/netcen/airqual)

These estimates indicate that the levels of benzene throughout the district are well below the Air Quality Objectives.

Fig. 4.2 Background Concentrations for Benzene 1996.




## 4.5 CONCLUSIONS

The corrected background concentrations of Benzene in the District are shown to be < 1.5 μg/$m^3$ , which is well below the 2003 objective of 16.25 μg/$m^3$.

The monitoring results give the highest corrected running annual mean for 2003 as 2.396 μg/$m^3$ which is below the Air Quality Objective

Currently there are no plans for any process involving the use of Benzene within the District or near the District.

Many of the petrol stations have recently been modified and have installed vapour recovery systems which reduce the amount of evaporated benzene released and this will increase towards the year 2005.

**It is very unlikely that the objective for Benzene will be exceeded by the year 2003 therefore a Stage 3 of the Review and Assessment for benzene will not be required.**

# 5 REVIEW AND ASSESSMENT OF 1,3-BUTADIENE

## 5.1 INTRODUCTION

1,3-Butadiene is a colourless, flammable hydro-carbon with a pungent odour used mainly in industrial processes. It is very similar to Benzene in that it is a known carcinogen and the risk to human health is related to the length of exposure.

It is released as a product of incomplete combustion, although it is not present in either petrol or diesel prior to combustion.

The gas is fairly reactive and has a lifetime of approximately 4 hours so it should be considered as a local rather than a trans-boundary pollutant.

The Government and devolved administrations have adopted a maximum running annual mean of 2.25μg/$m^3$ as an air quality standard for 1,3-Butadiene, with an objective for the standard to be achieved by the end of 2003.

## 5.2 THE NATIONAL PERSPECTIVE

1,3-Butadiene in the atmosphere is mainly derived from the combustion of petrol and other materials. It is formed during the combustion process from olefins in the fuel. It is also an important industrial chemical which is kept in bulk at a few sites throughout the UK.

The UK national atmospheric inventory for 1,3-Butadiene showed that in 1995 67% of national annual emissions arose from petrol vehicles and 13% arose from industrial processes.

It is anticipated that as the number of vehicles equipped with three way catalysts increases the emissions of 1,3-Butadiene will decreases though to some degree the increase in the use of diesel as a road vehicle fuel will counter this. However it is the anticipated view of Government that national policies will ensure that the Air Quality Objective for 1,3-Butadiene will be met by the end of 2003.

## 5.3 INFORMATION USED FOR THE FIRST STAGE REVIEW AND ASSESSMENT

The following information has been obtained :

- Details of published information available on 1,3-Butadiene

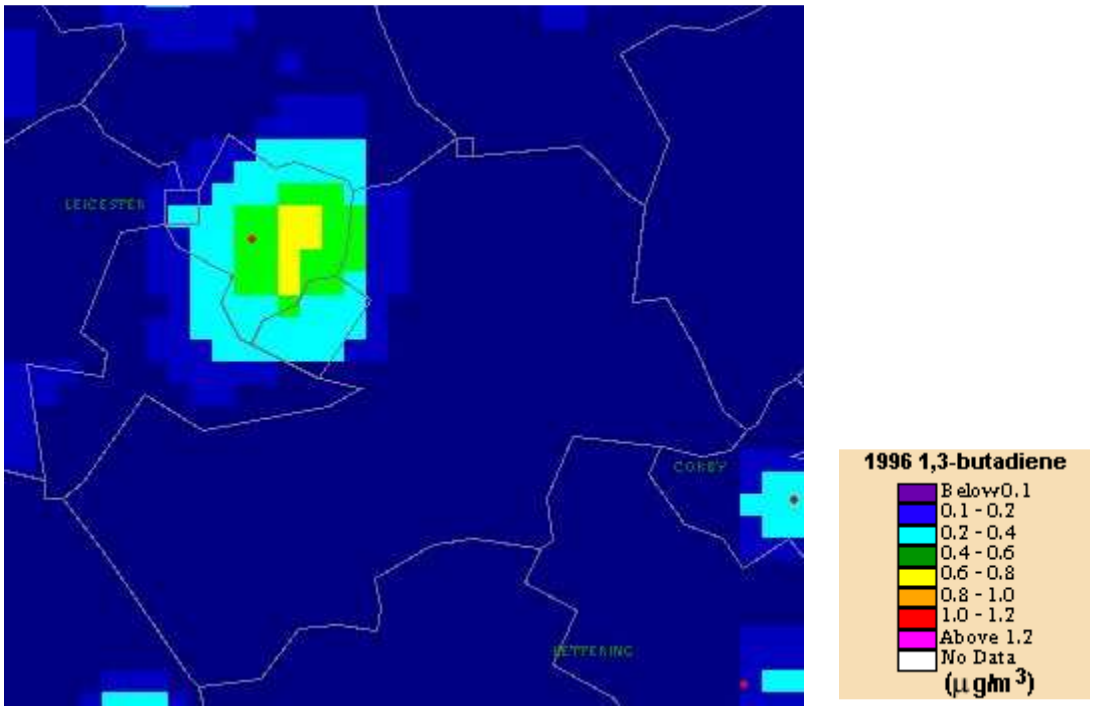
- Details of relevant Part A and Part B processes within the District (Appendix 1)
- Planned developments within the District
- Details of any significant sources outside the District

## 5.4 FINDINGS OF THE FIRST STAGE REVIEW AND ASSESSMENT

It is anticipated that even next to the busiest or most congested roads the Air Quality Objective for 1,3-Butadiene will be met.

The estimated annual mean background level for 1,3-Butadiene for 1996 has been mapped for the UK by NETCEN (www.aeat.co.uk/netcen/airqual)

Fig 5.1 Background figures for 1,3 – butadiene 1996




It can be seen that the levels within the District vary between 0.1 and 0.2µg/m$^3$ as taken from the 1995 national emissions inventory.

The corrected estimated background concentration for 2003 is below 0.1µg/$m^3$

There are no current or planned processes either within the Harborough District or neighbouring districts with significant 1,3-Butadiene emissions.

## 5.5 CONCLUSIONS FOR 1,3-BUTADIENE

The corrected background concentrations of Benzene in the District are shown to be < 0.1µg/$m^3$ which is well below the objective of 2.25µg/$m^3$ by 2003.

It is likely that the atmospheric concentrations will fall as the emissions from petrol engines continue to fall.

Currently there are no plans for any process with significant 1,3-Butadiene emissions either within the District or within a neighbouring district.

**It is very unlikely that the objective for 1,3-Butadiene will be exceeded by the year 2003 therefore a Stage 3 Review and Assessment for 1,3-Butadiene will not be required.**

# 6 REVIEW AND ASSESSMENT OF SULPHUR DIOXIDE

## 6.1 INTRODUCTION

Sulphur dioxide is the principal pollutant associated with acid deposition usually after oxidation to sulphuric acid. It is derived from the combustion of fossil fuels. Concentrations throughout Europe have declined during the last fifty years because of the general move away from the use of coal as a domestic heating fuel.

High concentrations of sulphur dioxide can still occur in less developed European countries and exceptionally high local concentrations do occur throughout Europe where there are specific combustion processes.

Air pollution episodes with sharp increases in smoke and sulphur dioxide have been associated with acute effects on health. The best known example was the London smog in the 1950's which lasted of several days. During this episode an estimated 4,000 deaths were recorded mainly amongst the elderly and sick, together with a steep rise in respiratory ailments.

The health effects of sulphur dioxide are that it produces bronchio-constriction which has as increased effect on asthmatic patients.

The Government and the devolved administrations have adopted three objectives for sulphur dioxide which are dependant the length of time members of the public might reasonably expected to be exposed to the pollutant:

- 350µg/m³ as a 1 hour mean, not to be exceeded more than 24 times per year, to be achieved by the end of 2004

- 125µg/m³ as a 24 hour mean, not to be exceeded more than 3 times per year, to be achieved by the end of 2004

- 266µg/m³ as a 15 minute mean, not to be exceeded by more than 35 times per year, to be achieved by the end of 2005.

## 6.2 THE NATIONAL PERSPECTIVE

In the UK emissions of sulphur dioxide are principally as a result of the combustion of fossil fuels. Non nuclear power stations account for more than 65% of the total UK emissions and other industrial combustion processes account for a further 16%. Vehicles and road transport are not a significant source and contribute less than 2% of the total emissions. In the urban areas in the UK sulphur dioxide levels have shown a marked decline since the 1960's. Urban and rural levels are now very similar as are summer and winter levels. This coincides with the reduction in use of domestic coal and fuel oil. It is anticipated that only in areas where

domestic coal burning is still widespread, will the 1hour and 24 hour objectives be exceeded.

Where there is a local combustion plant, the 15 minute objective is currently being exceeded throughout the UK.

## 6.3 INFORMATION USED FOR THE FIRST STAGE REVIEW AND ASSESSMENT

The following information has been obtained:

- Monitoring data from the two sites within the District
- Details on published information on background levels
- Details of relevant Part A and Part B Processes
- Information on the existence of, or planned combustion processes with a thermal rating >5MW using sulphur dioxide rich fuels
- Details of any significant sources outside the District

## 6.4 FINDINGS OF THE FIRST STAGE REVIEW AND ASSESSMENT

Monitoring for sulphur dioxide has been undertaken for several years at two locations in the District using 8 port bubblers. These were used as a screening tool and sited at urban background locations.

The corrected measured daily average sulphur dioxide concentration can be used as a direct comparison to the 24-hour mean objective.

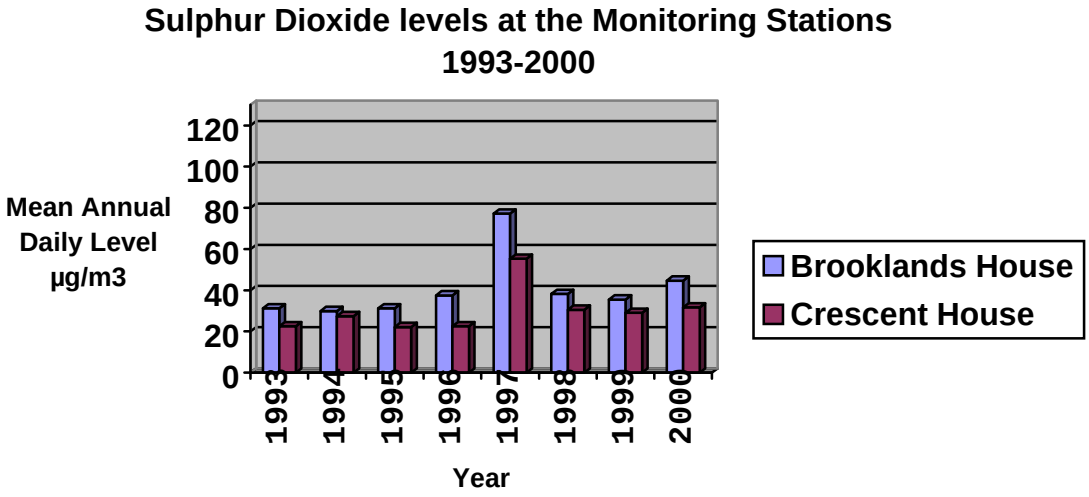
The relationship between the daily average maximum sulphur dioxide concentrations and the 1-hour mean and 15-minute mean is uncertain and is dependant on meteorological conditions and the impact of individual point sources.

It can be assumed that the 15-minute air quality objective is unlikely to be exceeded if the maximum daily mean concentration is less than 80μg/m³, and the 1-hour mean will not likely be exceeded if the maximum daily mean concentration is less than 67 μg/m³. (LAQM.TG4 (00), Pollutant Specific Guidance).

If taken in isolation, the results for 1997 would indicate that there is a significant problem with sulphur dioxide. However when taken in context with all of the other results it was decided that they were not sufficiently significant to warrant a Third Stage Review and Assessment.

With the exception of the 1997 monitoring results, the maximum daily mean concentration is 44.63µg/m³ which indicates that the 15-minute and 1-hour Air Quality Objectives for sulphur dioxide will not be exceeded.

Fig 6.1 Sulphur Dioxide Monitoring Results



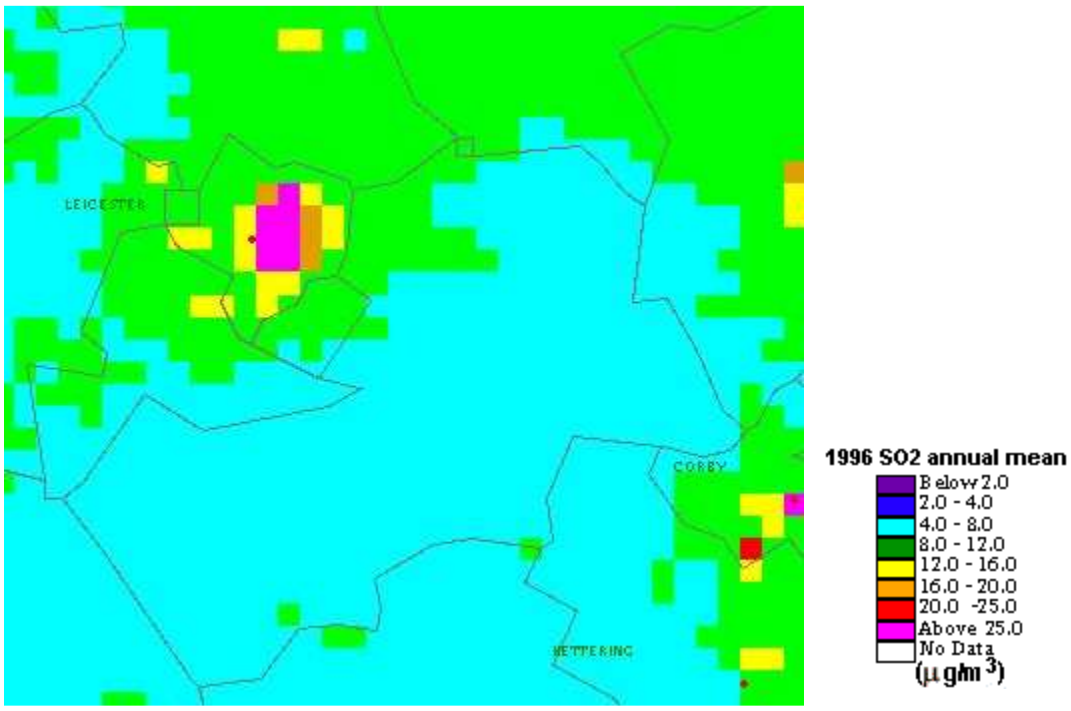

There are no current part A and B Processes within the District which provide significant sources of sulphur dioxide. In the surrounding districts there are processes that emit sulphur dioxide however the size and location of the sites were assessed and it was concluded that the emissions would not significantly affect the District.

A number of power stations situated in the Trent Valley to the North-West of the District have been identified as potential emitters of large quantities of sulphur dioxide. However an assessment of the Environment Agency published information on these Part A Processes indicates that the concentration of pollutants emitted would not be significant to the District.

The combustion plants located within the District appear to be well below 5 MW power rating and would not have a significant influence on the overall concentrations of sulphur dioxide.

The estimated annual mean background sulphur dioxide concentrations for 1996 have been mapped for the UK by NETCEN (www.aeat.co.uk/netcen/airqual)

Fig 6.2 Annual Mean Background Concentrations for Sulphur Dioxide for 1996




For the purpose of the Review and Assessment it can be assumed that the background annual mean sulphur dioxide concentration at the end of 2004 will be half of the 1996 value. (LAQM.TG4(00) – Pollutant Specific Guidance). Consequently the estimated background concentration for the District in 2004 would be in the region of 2 –6 µg/m³ which compare favourably with the air quality objective.

## 6.5 CONCLUSIONS FOR SULPHUR DIOXIDE

Generally the sulphur dioxide levels throughout the District appear to be relatively low and below the air quality objective

There are no local sources that would have a significant effect on the local concentrations of sulphur dioxide.

**It is very unlikely that the objectives for sulphur dioxide will be exceeded by the years 2004 and 2005, therefore a Stage 3 of the Review and Assessment will not be required.**

# 7 REVIEW AND ASSESSMENT OF CARBON MONOXIDE

## 7.1 INTRODUCTION

Carbon Monoxide (CO) is a colourless, odourless gas which is formed by the incomplete combustion of organic substances or those that are essentially carbon such as coke. Complete combustion in the presence of Oxygen leads to the formation of Carbon Oxide, whereas if there is a light deficiency of Oxygen some Carbon Monoxide is formed. Most combustion processes will produce some Carbon Monoxide and the concentration produced will clearly depend on the efficiency of combustion.

The most important general exposures of individuals to the gas come from cigarettes and vehicles. Combustion systems in vehicles are designed to operate most efficiently when there is sufficient air to oxidise the carbon in the fuel. When the engine is cold or badly tuned, or when the engine is idling or moving slowly, it will depart from this optimal condition and produce more Carbon Dioxide. Thus where weather conditions are not a factor high concentrations are likely near to busy roads where traffic queuing is common. The Carbon Dioxide is rapidly dispersed, once emitted, as distance from the road is increased. Therefore it is mainly a local pollutant rather than a trans-boundary pollutant and over a period of months the photochemical reaction will destroy high concentrations.

It is likely that the people at risk from exposure to high levels of Carbon Monoxide are those who already have a disease affecting the delivery of Oxygen to the heart or brain. The foetus, young people and the elderly are also likely to be at risk.

The Government and devolved administrations have adopted an 8-hour running mean of 11.6mg/m3 (10ppm) as an air quality standard for carbon monoxide (CO), with an objective for the standard to be achieved as a maximum 8-hour running mean by the end on 2003.

## 7.2 THE NATIONAL PERSPECTIVE

The main source of carbon monoxide in the UK is road transport, in particular petrol-engined vehicles and this accounts for about 75% of emissions.

The UK national network of monitoring sites has shown considerable variation in the measured concentrations which is largely dependent on meteorological conditions. Some exceedances have been recorded at roadside locations. Agreements have recently been reached to further reduce emissions as part of the Auto-Oil programme the result of which will be that the air quality objectives will be met by the end of 2003.

## 7.3 INFORMATION USED FOR THE FIRST STAGE REVIEW AND ASSESSMENT

The following information was obtained:

- Traffic flow data for the main roads in the District (Appendix 2)
- Details of published information on likely background Carbon Monoxide levels

- Details of relevant Part A and Part B authorised processes (Appendix 1)

- Planned developments within the District

- Details of any significant sources of Carbon Monoxide in neighbouring areas

## 7.4 FINDINGS OF THE FIRST STAGE REVIEW AND ASSESSMENT

In general the District is likely to have low levels of background Carbon Monoxide, much below the standard that has been set.

However due to the high traffic flows on the M1 it is possible that in localised areas exceedances of the National Air Quality Standard may occur.

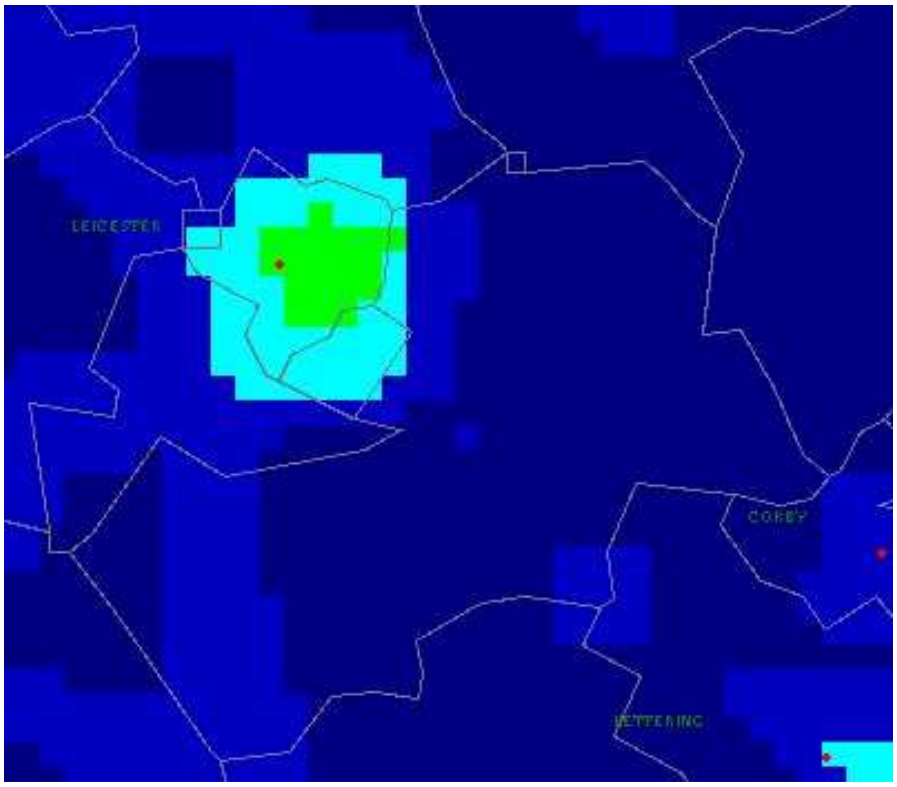
For this reason it was felt necessary to undertake a second stage review by using the Design Manual for Roads & Bridges (DMRB) calculation for predicting any possible exceedance in the air quality standard.

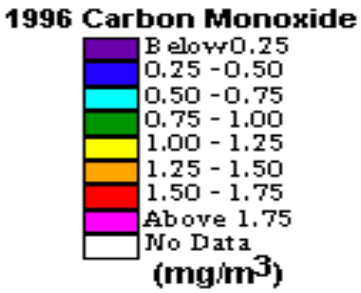
## 7.5 SECOND STAGE REVIEW AND ASSESSMENT

The second stage review is based on the use of the *Design Manual for Roads and Bridges* (DMRB) as a simple screening tool.

The published annual mean background carbon monoxide concentration for 1996 has been estimated at 0.2mg/m3.
(www.aeat.co.uk/netcen/airqual)

Figure 7.1 Background Concentration of Carbon Monoxide for 1996




The corrected background concentration for 2003 is 0.11mg/m3, based on the predicted reduction in road traffic emissions.

The correlation between the annual average and the 8-hour mean is poor, however for the purpose of this assessment it can be assumed that the maximum 8-hour mean is equivalent to 10 times the annual mean. From this information it can be estimated that the background maximum 8-hour mean is 1.1mg/m3 (10 times the estimated annual mean).

The combined daily road traffic figures for the M1 junction 19, and the M6 junction 1 is in excess of 140,000 vehicles per day. The results of the DMRB calculation estimate that at the closest significant receptor, the annual mean carbon monoxide concentration would be 0.14mg/$m^3$ with an estimated 8-hour mean concentration of 1.4mg/$m^3$

## 7.6 CONCLUSION

The general background concentrations for carbon monoxide within the District are likely to be in the region of 0.11mg/$m^3$ which is well below the Air Quality Objective value of 11.6mg/$m^3$.

There are no point sources in the District or surrounding area whose emissions of carbon monoxide would have a significant impact on the background concentrations.

**It is very unlikely that the objectives for carbon monoxide will be exceeded by the year 2003, therefore a Stage 3 of the Review and Assessment will not be required.**

# 8 REVIEW AND ASSESSMENT OF LEAD

## 8.1 INTRODUCTION

Direct human exposure to lead can occur through the inhalation of particulate lead in ambient air or through the ingestion of lead contaminated food or water.

Although normally only a small fraction of total lead intake occurs through inhalation, lead in air may also contribute to exposure indirectly for example through deposition in dust on crops.

Once lead has been absorbed into the body it can be stored in a number of organs where it does not really do much damage. However, a small proportion of lead, round 2%, is found in the blood system and it is this lead that can cause health problems. The most significant health problem is the effect it has on the central nervous system and in particular on the developing brain of a child.

The Government and the devolved administrations have adopted an annual mean of 0.5 ug/m3 as an air quality standard for lead, with an objective for the standard to be met by the end of 2004. In addition, a lower air quality objective of 0.25 ug/$m^3$ is to be achieved by 2008.

## 8.2 THE NATIONAL PERSPECTIVE

As a result of an agreement between the European Parliament and the Environment Council on the Directive on the Quality of Petrol and Diesel Fuels there has been a ban on the sale of leaded petrol in the UK since 1st January 2000. Emissions of lead are now restricted to a variety of industrial applications, for example the manufacture of batteries, pigments in paints and glazes, alloys, radiation shielding, tank lining and piping.

The UK national network of monitoring sites had recorded a significant decline in the levels of lead measured at the urban background and kerbside sites over the period 1994-98 and it is anticipated that this level will fall lower with the removal of lead in petrol.

Existing national policies are expected to deliver the air quality objectives in both 2004 and 2008. Only local authorities with significant industrial sources, which have the potential to release elevated levels of lead in relevant locations, are expected to proceed beyond the First Stage review and assessment.

## 8.3 INFORMATION USED FOR THE FIRST STAGE REVIEW AND ASSESSMENT

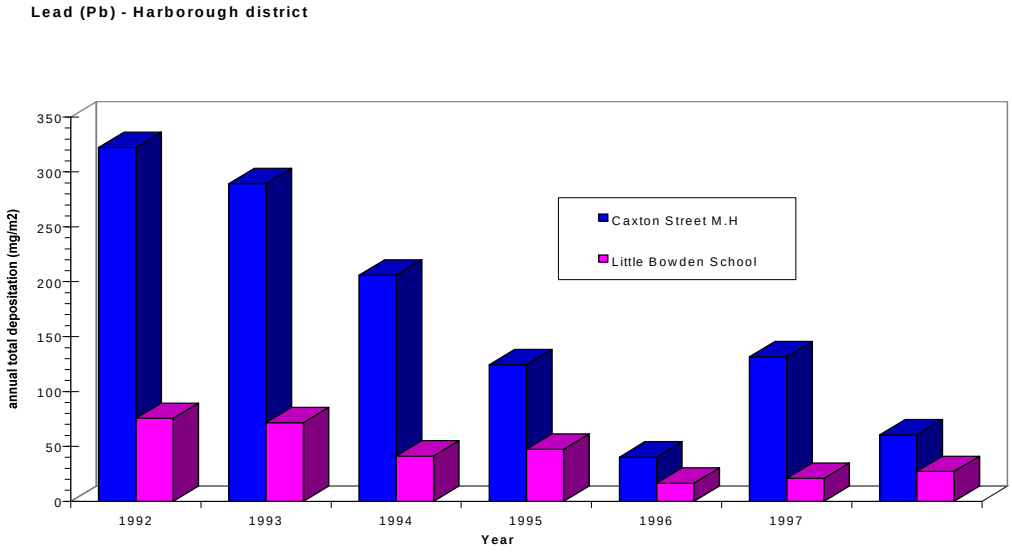
The following information was obtained:

- Monitoring data from the two sites at Market Harborough

- Details of published information on likely background lead levels
- Details of relevant Part A and Part B Authorised Processes (Appendix 1)
- Planned development within the District
- Details of any significant sources of lead in neighbouring areas

## 8.4 FINDINGS OF THE FIRST STAGE REVIEW AND ASSESSMENT

The First Stage review identified that in general the District is likely to have background lead levels well within the standards set by the air quality objectives. Monitoring under taken at two sites within the local authority show results indicative with the national perspective, with the results showing a steady decline between 1992 and 1998.




The monitoring was carried out using deposit gauges and used as an initial screening process of the general air quality in the area.

However, due to the presence of a battery plant, authorised under Part A of the Environmental Protection Act 1990, it was felt that there could be a possibility that local levels of lead could be elevated sufficiently to cause exposure problems for the public at relevant locations.

The First Stage review concluded that it was necessary to conduct a Second Stage review which may eventually lead to a Third Stage review. This review will only be conducted on the local area immediately surrounding the factory site.

## 8.5 SECOND STAGE REVIEW AND ASSESSMENT

The estimated annual mean background lead concentrations for 1996 have been mapped for the UK by NETCEN. (www.aeat.co.uk/netcen/airqual)

The 1996 background concentration of lead in the District is estimated to be in the range of 0.005 –0.05 ug/$m^3$ . It can be reasonably be assumed that the background annual mean lead level for 2004 and 2008 will be half of the 1996 value.

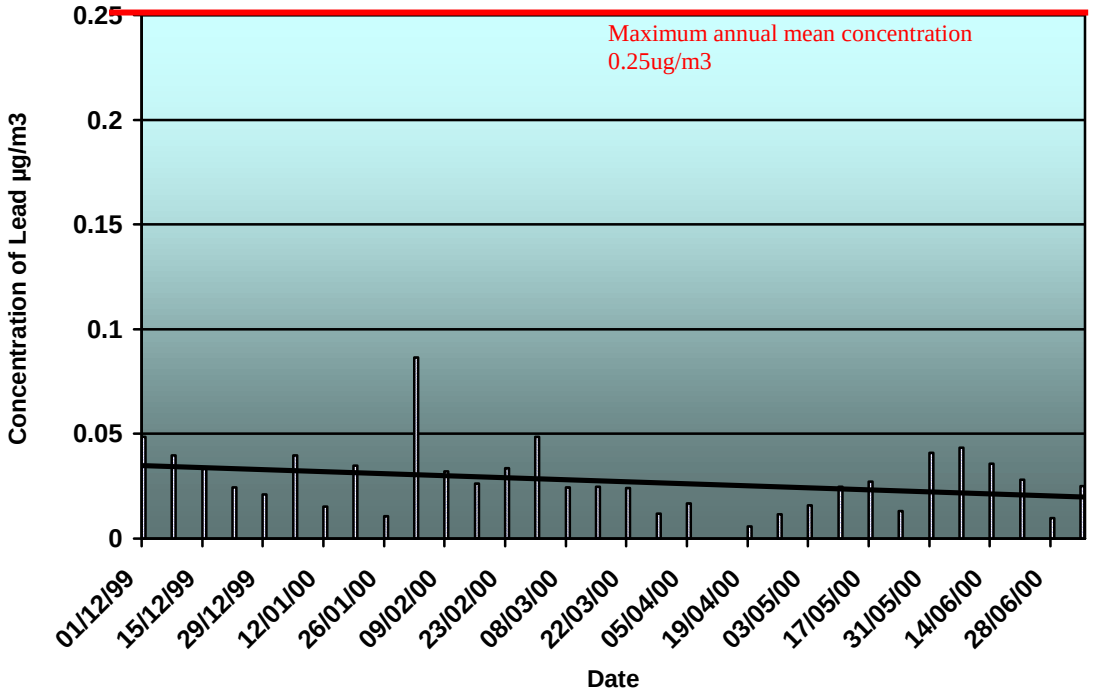
In 1999, the Department of Environment, Transport and the Regions (DETR) commissioned a 12 month study to determine the ambient concentrations of lead in the local vicinity of a wide-variety of industrial processes.

The location of the battery manufacturing plant in Market Harborough is in close proximity to domestic dwellings and consequently as part of this study, a Partisol 2000 sampler was installed in a domestic garden as a location representative to maximum public exposure to lead from the plant.

It is reasonable to assume that as far as road traffic emissions are concerned the influence on lead levels recorded at the site are negligible. This is due to the fact that EC legislation which came into force on the 1st January 2000, prohibits the use of leaded petrol in Member States. It can be reasonable to assume that as there are no other lead emitters in the vicinity of the battery plant, all the lead monitored is specific to the plant.

Graph 8.2 Lead Monitoring Results

## Lead levels from the continuous monitor at Caxton Street




Whist the monitoring has not been carried out for a complete 12- month period, the results indicate that there will not be any exceedances of the Air Quality Objective for the years 2004 and 2008.

### 8.6 CONCLUSION

The estimated background concentrations of lead in the District are well below the Air Quality Objective value.

The continuous monitoring station in Market Harborough does not indicate that there will be an exceedance of the Air Quality Objective due to emissions from the Part A Process.

There are no other point sources in the District or in the surrounding area that would have a significant impact on the background concentrations of lead.

The continuous monitoring station in Market Harborough does not indicate that there will be an exceedance of the Air Quality Objective due to emissions from the Part A Process.

There are no other point sources in the District or in the surrounding area that would have a significant impact on the background concentrations of lead.

**It is very unlikely that the objectives for lead will be exceeded by the years 2004 and 2008, therefore a Stage 3 of the Review and Assessment will not be required.**

# 9 REVIEW AND ASSESSMENT OF $PM_{10}$

## 9.1 INTRODUCTION

The ability of a particle to remain suspended in the air depends essentially on its size, shape and density. These same properties determine where

in the human respiratory tract a particle comes to rest when inhaled. Generally spherical particles below about 10μm diameter have the greatest likelihood of reaching the deepest parts of the lungs, where the air spaces or alveoli are situated and carry out the essential processes of respiration.

Particles up to 20μm may be deposited in the nose and throat and airways to the lungs. Almost all particles larger than 7μm are deposited in the nose and throat and only 20-30% of particles between 1 and 7 μm are deposited in the lung's air spaces, although about 60% of very fine particles below 0.1 μm are deposited in air spaces. Clearly the potential damage which can result is related to the distance the particle travel and it's subsequent size.

There is an established link between respiratory or cardiovascular ill-health and exposure to fine particles.

The Government and the devolved administrations have adopted two air quality objectives for fine particles ($PM_{10}$), which are equivalent to the EU Stage 1 Limit Values. The objectives are 40 μg/m³ as the annual mean, and 50 μg/$m^3$ as the fixed 24-hour mean to be exceeded no more than 35 days per year, to be achieved by the end of 2004.

## 9.2 THE NATIONAL PERSPECTIVE

There are a number of emission sources that contribute to the overall $PM_{10}$ concentrations.

- **Primary Combustion Particles** – these are particles emitted directly from combustion processes such as road traffic, power generation, industrial combustion processes etc. These particles are generally less than 2.5μg and often below 1μg in diameter.

- **Secondary Particles** – these are particles formed in the atmosphere following their release in the gaseous phase. These include sulphates and nitrates, formed from emissions of $SO_2$ and $NO_X$; these particles are generally less than 2.5μg in diameter

- **"Course" or "other" particles** – the "course" or "other" particles comprise of emissions from a wide range of non-combustion sources. These include re-suspended dust from road traffic, construction and mineral extraction processes, the wind blown dusts and soils and sea salt. These particles are generally greater than 2.5μg in diameter.

During the Review and Assessment it is important to have regard the source of the particulates as the expected reduction in particle emissions in future years is different for each type of source.

Emissions from road vehicles will be governed by legislative changes to vehicle emission standards, whilst secondary particles will largely by controlled by changes to legislative changes effecting power generation and control of emissions of sulphur dioxide and oxides of nitrogen in industry and transport generally. Emissions of the coarse particles are largely uncontrolled and they are not anticipated to decline in future years.

It is anticipated that through national and international policies and legislative changes, emissions from road transport and industrial processes will generally be controlled. $PM_{10}$ data from the monitoring sites within the Automatic Urban and Rural Networks indicates that with the exception of a kerbside site in London, the annual mean objective will be met. However the Government advise that with existing national policy measures and atypical meteorology, exceedances of the national air quality objectives might be found in the following areas:

- areas adjacent to busy road
- areas in the vicinity of industrial plant or which have significant uncontrolled or fugitive emissions (e.g. Quarry processes)

## 9.3 INFORMATION USED FOR THE FIRST STAGE REVIEW AND ASSESSMENT

The following information has been obtained:

- Details of published information on likely background levels
- Details of traffic flows throughout the district
- Details of relevant Part A and Part B Authorised Processes within the District
- Details of any other significant sources either with the district or in neighbouring districts.

## 9.4 FINDING OF THE FIRST STAGE REVIEW AND ASSESSMENT

The first stage review of $PM_{10}$ indicated that there was not one point source of particulate emission in the district which would cause the National Air Quality standards to be breached.

However generally throughout the area, the road network contains a number of sites where the predicted traffic flows are greater than 25,000 vehicles per day.

For these reasons it was felt necessary to progress to at least a second stage review of $PM_{10}$s.

Particulates were one of the pollutants for which there was very little monitoring data available for the district. Consequently in May 1999, a TEOM (Tapered element oscillating microbalance) analyser was installed in the centre of Lutterworth at a roadside location .

The second stage review examines the results of the monitoring and uses the Design Manual for Roads and Bridges (DMRB) to predict possible exceedances of the National Air Quality standards.

## 9.5 SECOND STAGE REVIEW AND ASSESSMENT

The focus of Harborough District Council's second stage review and assessment will be around the control of emissions at a local level as the district council has more direct control over local emission sources.

### Details of published information on likely background levels

The concentration of secondary particles for 1996 falls within the range of 12.6 and 13.1µg/$m^3$ with an average of 12.8µg/$m^3$
(www.aeat.co.uk/netcen/airqual)

### Details of traffic flows throughout the district

For the purpose of the review it is recommended that roads with a daily average traffic flow of less than 5000 vehicles per day should be disregarded. Data on traffic flows around the District were available from the Highways Agency.

The potential significance of $PM_{10}$ emissions from road traffic is dependent on a number of factors –

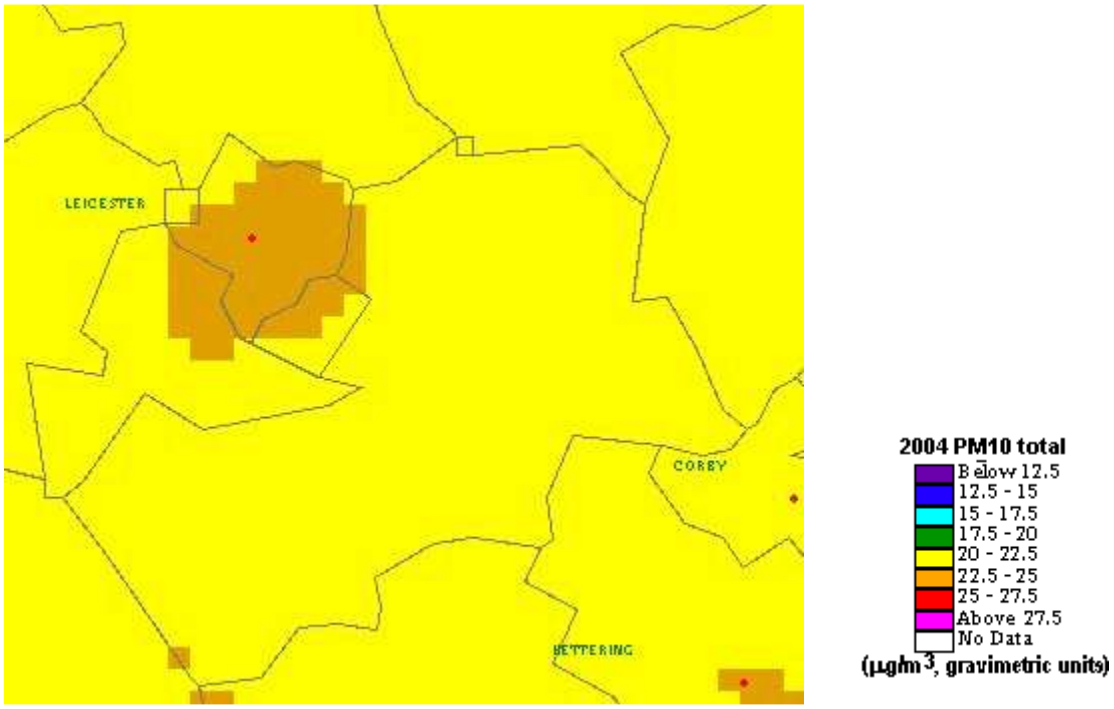
- background concentration
- traffic flow
- speed
- % of Heavy Goods Vehicles

The impact of traffic emissions decreases rapidly with an increased distance from the kerbside.

The first stage review highlighted potential exceedances of $PM_{10}$ at major roads with a flow greater than 25,000 vehicles per day. DMRB assessments were subsequently carried out at the closest significant receptor for the M1 Junction 20 (Lutterworth) and the M1 Junction 19 (M6)

Local background monitoring data was not available consequently the total particulate concentrations for 2004 and the secondary particulate concentrations for 1996 were obtained from the Internet map (www.aeat.co.uk/netcen/airqual/)

**Fig 9.1 Total Background Particulate Concentrations for 2004**




The details of background levels shown in figure 9.1 estimate the total concentrations for 2004 to range between 21.4µg/$m^3$ and 22.7µg/$m^3$ with an average of 21.7µg/$m^3$.

Using the Design Manual for Roads and Bridges the annual mean concentrations of $PM_{10}$ were estimated at the closest significant receptors.

Table 9.1 Estimated Annual Mean Background Concentrations.

| Location | Measured Results 1999-00 | Modelled results for Objective year | Air Quality Standard |
|---|---|---|---|

| | Annual Mean 24hr Mean | Annual Mean 24hr Mean | 50µg/m$^3$ not to be exceeded more than 35 times a year as a 24 hour mean |
|---|---|---|---|
| M1 Junction 20 | | 23.23µg/m$^3$ 41.58µg/m$^3$ | |
| M1 Junction 19 & M6 Junction 1 | | 22.07µg/m$^3$ 39.5µg/m$^3$ | 40µg/m$^3$ as an annual mean.<br><br>Standards to be achieved by 2004 |

It can generally be assumed that provided that the local area is not subjected to the influence of point source industrial stack emissions, the 1hour mean (99.8th percentile) objective is unlikely to be exceeded in 2005 if the annual mean objective is not breached. (LAQM.TG4(00) Pollutant Specific Guidance).

Since May 1999 roadside monitoring has been undertaken in Lutterworth Town Centre using a TEOM analyser.

Data from this monitoring station was used to supplement the DMRB calculation for the closest significant receptors in Lutterworth Town Centre.

The measured annual mean $PM_{10}$ levels for 1999 was 24.24µg/m³ using the TEOM analyser. The results from the TEOM confirm that there have been no exceedances of the 24hour mean objective (Appendix 3) shows the results of the monitored $PM_{10}$ levels in Lutterworth.

TEOM analysers are widely used throughout the UK to monitor $PM_{10}$ levels. However, recent research indicates that the TEOM under-estimates the results compare to other monitors available. This is due to the fact that the filter of the TEOM is held at higher temperatures, and this can lead to the loss of the volatile components of the particulates collected. To counter this the Airborne Particles Expert Group (APEG) have recommended a correction multiplier of 1.3 to all measured TEOM concentrations. (LAQM.TG4(00)).

This is probably an over simplification of the situation, however for the purpose of this report this correction factor has been applied to all the measured concentrations.

The DMRB results show that the estimated annual mean $PM_{10}$ concentration for 2004 in Lutterworth would be 27.18µg/m$^3$ (corrected) with a 90th percentile figure of 48.65 µg/m$^3$ (corrected). The 90th percentile equates to approximately to 35 exceedances of the 24 hour daily mean.

It is accepted that if the estimated annual background concentration for 2004 does not exceed 28µg/m³, it is not necessary to proceed with a Third Stage Review and Assessment. (LAQM.TG4(00))

**Sources of uncontrolled emissions of $PM_{10}$s**

In the district there are a number of Environmental Protection Act Part B processes which could be potential sites for emitting uncontrolled releases of $PM_{10}$, however in line with the guidance in LAQM.TG4(00), there are no relevant locations within close proximity of these sites. Consequently it has been determined that the likelihood of the air quality objectives being exceeded is negligible and should not form part of the assessment.

## 9.6 CONCLUSIONS

The estimated annual mean background levels for $PM_{10}$ for the District are below the Air Quality Objectives of 40µg/m³.

The corrected estimated background concentration for Lutterworth is marginally below 28µg/m³.

There are no point sources in the District that would have a significant impact on the overall background concentrations of $PM_{10}$.

**The risk of the air quality objectives being exceeded are negligible, however it is proposed that a further second stage review will be undertaken in 12 months time to confirm that there is no requirement to proceed to a third stage review and assessment**

# 10 REVIEW AND ASSESSMENT OF NITROGEN DIOXIDE

## 10.1 INTRODUCTION

Nitrogen Oxides ($No_x$) are formed during high temperature combustion processes from the oxidation of Nitrogen in the air or fuel. The major oxides to come out of these reactions are Nitric Oxide (NO) and Nitrogen Dioxide ($NO_2$).

Initially Nitric Oxide is initially the predominate gas, however complex reactions take place in the atmosphere in the presence of oxidants such as ozone ($O_3$) to produce Nitrogen Dioxide ($NO_2$).

It is Nitrogen Dioxide which is associated with adverse effects on human health and at relatively high concentrations the pollutant can cause inflammation of the airways. Long term exposure to Nitrogen Dioxide may effect lung function and may also enhance the response to allergens in sensitive individuals.

Nitrogen Oxides have a lifetime of approximately 1 day by which they are usually converted to Nitric Acid ($HNO_3$). The Nitric Acid is in turn removed from the atmosphere by direct deposition to the ground or transfer to aqueous droplets (i.e. clouds or rainwater) thereby contributing to acid deposition.

Nitrogen Oxides are also a precursor of ozone.

The Government and devolved administrations have adopted an annual mean of 40μg/m³, and a 1-hour mean of 200 μg/m³ not to be exceeded more than 35 times a year as air quality standards for nitrogen dioxide to be achieved by the end of 2005.

## 10.2 THE NATIONAL PERSPECTIVES

Road transport is thought to account for about 50% of the total UK emissions of $NO_x$ the electricity supply industry for about 20% and the industrial and the commercial sectors for about 17%.

National policies and European directives are expected to reduce the emissions of $NO_x$ by 2005, however in areas in close proximity to major roads it is anticipated that without additional measures the air Quality Objectives for nitrogen dioxide will not be met.

It is anticipated that the annual mean objective for nitrogen dioxide will be more demanding to achieve than the 1-hour objective. It is therefore excepted that provided there is not a large stationary source, if the annual mean objective is met it is unlikely that the 1-hour objective will be exceeded.

## 10.3 INFORMATION USED FOR THE FIRST STAGE REVIEW AND ASSESSMENT.

- Monitoring data from the five sites within the District currently monitoring for $NO_2$
- Details of published information on likely background levels

- Details of relevant Part A and Part B Authorised Processes within the District (Appendix 1)
- Details of traffic flows throughout the District
- Planned development within the District
- Details of any other significant sources within the District

## 10.4 FINDING OF THE FIRST STAGE REVIEW AND ASSESSMENT

The results of passive monitoring using diffusion tubes situated throughout the District, show that generally the levels of nitrogen dioxide do not exceed the Air Quality Objectives. However one of the sites, a kerbside site in Lutterworth, continually had levels greater than 50µg/m³. Whilst it is appreciated that the accuracy of the diffusion tubes is relatively poor, these results highlight the potential of this site to exceed the Air Quality Objective.

The estimated annual mean background concentrations of $NO_x$ for 2005 have been mapped for the UK by NETCEN (www.aeat.co.uk/netcen/airquel)

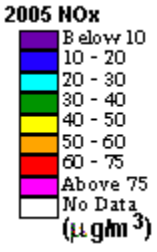
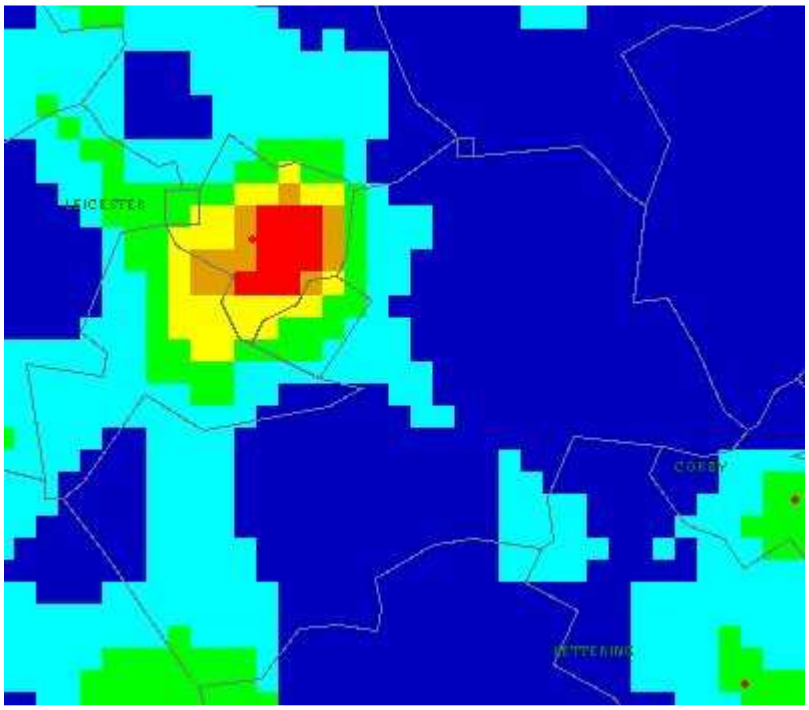


Fig 10.1 Estimate annual NOx Concentrations for 2005



The estimated levels show for the majority of the District the concentrations are below 30µg/m³, with the exception of the Lutterworth area where the concentrations are estimated to be below 40µg/m³.

Traffic data shows there are a number of routes within the District with an annual average daily traffic flow of greater than 20,000 vehicles. This figure is given as a benchmark which implies that any road with a traffic flow over this figure is likely to require a Stage 2 Review and Assessment. (LAQM TG4 (00) Pollutant Specific Guidance).

The major source of Nitrogen Dioxide in the District are emissions from road vehicles, there are no significant point sources in the area, or in the surrounding areas that would have an impact on the overall levels of Nitrogen Dioxide.

The result of the Stage 1 Review and Assessment found that it would be necessary to carry out a Stage 2 review and possibly a Stage 3 review.

## 10.5 FINDINGS OF THE STAGE 2 AND STAGE 3 REVIEW AND ASSESSMENT

Passive monitoring using diffusion tubes has been undertaken throughout the district since 1997. The results from diffusion tubes are not very accurate however they provide a useful screening tool to indicate possible exceedances of the Air Quality Objectives.

Table 10.1

| Site | 1997 Mean μg/m³ | 1998 Mean μg/m³ | 1999 Mean μg/m³ |
|---|---|---|---|
| Brooklands Market Harborough *background* | 12.7 | 12.08 | 11.08 |
| Council Office Market Harborough *Intermediate* | 14.7 | 14.4 | 12.9 |
| Market Street Lutterworth *Kerbside* | 30.3 | 32.66 | 31.9 |
| Bushby *Background* | 17.1 | 12.75 | 11.83 |
| Mowsley *Rural* | 10.33 | 12.0 | 10.91 |

Where the annual average NO2 exceeds 30μg/m³ at least a Stage 2 review and assessment should be undertaken (LAQM.TG4(00)).

As a result of the conclusions of the Stage 1 Review and Assessment, a monitoring station was situated in Market Street in Lutterworth to continuously monitor $NO_x$ and $NO_2$. Monitoring from this site commenced in May 1999.

The location of the monitoring station was selected as a “worse case” situation. The monitor is at a Kerbside location at the narrowest point of the main road through the town. Figure 10.5 shows the location of the monitor.

The information obtained from the monitoring station is used in conjunction with the estimated background concentration for 2005.

The automatic analyser measures both annual mean background NOx and NO2. It is recommended that for a Stage 2 review it is more appropriate to use the measured data for $NO_x$ rather than $NO_2$. The

measured data needs to be corrected to 2005 before it is combined with the estimated background concentration. The correction factors used have been derived from the estimated reduction in road traffic emissions.

For 1999 the measured annual daily mean was 185.36 µg/m³. The 1999 data is corrected to estimate the 2005 background NOx concentrations

The estimated 2005 concentration of NOx is:

185.36µg/m³ X (0.63/0.86)
= 135.78µg/m³

The relationship between annual $NO_2$ and $NO_x$ concentrations have been derived from an analysis of monitoring data at the UK automatic monitoring sites.

Where the dominant source of NOx is road transport, the relationship changes with increasing distance from the kerbside, this is due to the limited oxidation capacity of the atmosphere when the NOx levels are high. This relationship between annual mean NOx and annual mean NO2 can be calculated using the formula:

$Y = 3.3931x^{0.5278}$

Where:
Y = Annual mean $NO_2$, µg/m³
X = Annual mean NOx, µg/m³

Consequently in the vicinity of the automatic analyser, the estimated annual mean $NO_2$ kerbside concentration for 2005 is **45.32µg/m³.**

This procedure was repeated using data collated for the year 2000, with the resulting estimated annual mean concentration decreasing slightly to **43.9µg/m³.**

As previously highlighted there is a rapid reduction in the levels of Nitrogen Dioxide with an increasing distance from the kerbside. In an attempt to estimate the extent of the possible exceedance of the Air Quality Objectives, the DMRB model was used to determine the reduction of the Nitrogen Dioxide level with the increasing distance from the road.

The result of this calculation shows that where the distance from the centre of the road to the receptor increases in distance the estimated annual concentration of Nitrogen Dioxide falls to approximately **34µg/m³.**

This indicates that the possible exceedance of the annual mean Air Quality Objective for $NO_2$ is limited to the area of Lutterworth Town Centre where the distance from the centre of the road and the closest receptor is at it's narrowest point.

It has been recognised that the relationship between the annual mean and the 99.8th percentile of 1-hour (equivalent to 18 exceedances per year) is subject to the varying weather conditions in any one year. It can be assumed that where road traffic emissions are the dominant influence, the 99.8th percentile will not exceed 3.5 times the annual mean at kerbside sites. (LAQM TG4 (00))

In view of this it can be reasonably predicted that the Air Quality Objective for the 1-hour mean value, will not be exceeded in 2005. This is supported by the monitored data for 1999, as there are no exceedances of this objective (figure 10.3).

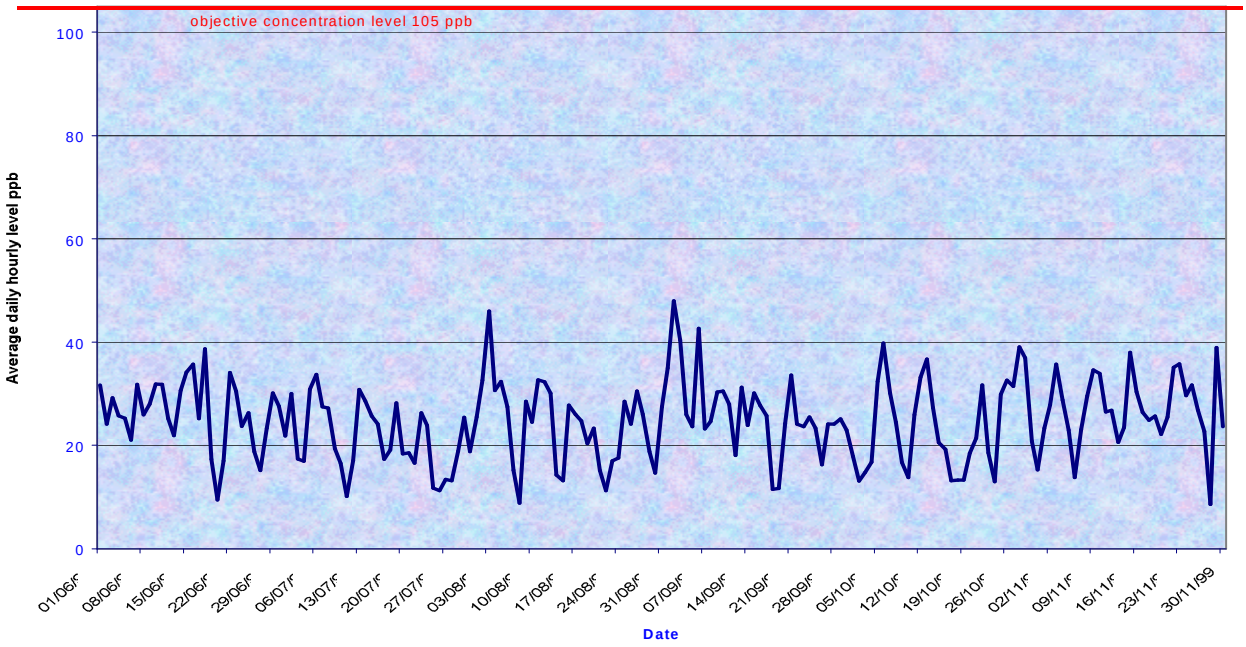
As a comparison, using the DMRB as a screening tool, the estimated annual average was determined for the High Street in Lutterworth.

The Stage 1 review identified roads with an annual average daily flow of over 20,000 vehicles.

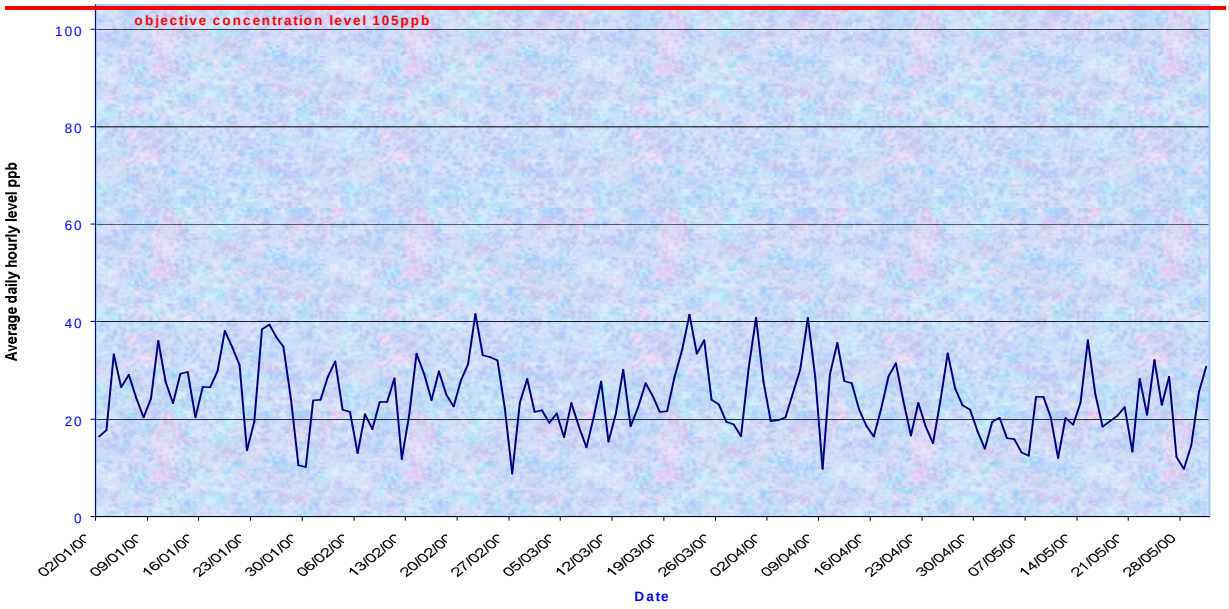
The DMRB was used as a screening tool to determine the estimated annual Nitrogen Dioxide concentrations in 2005 at the closest significant receptor at the Junction 20 of the M1. A second assessment was carried out for the M1 Junction 19and the M6 Junction 1. The background concentrations for NOx were taken from the published NETCEN maps.

Figure 10.3

**Nitrogen Dioxide levels at the Lutterworth Air Quality Monitoring Station for the first six month period (1.6.99-31.12.99)**




**Nitrogen Dioxide levels at the Lutterworth Air Quality Monitoring Station for the second six month period (01.12.99-31.05.00)**



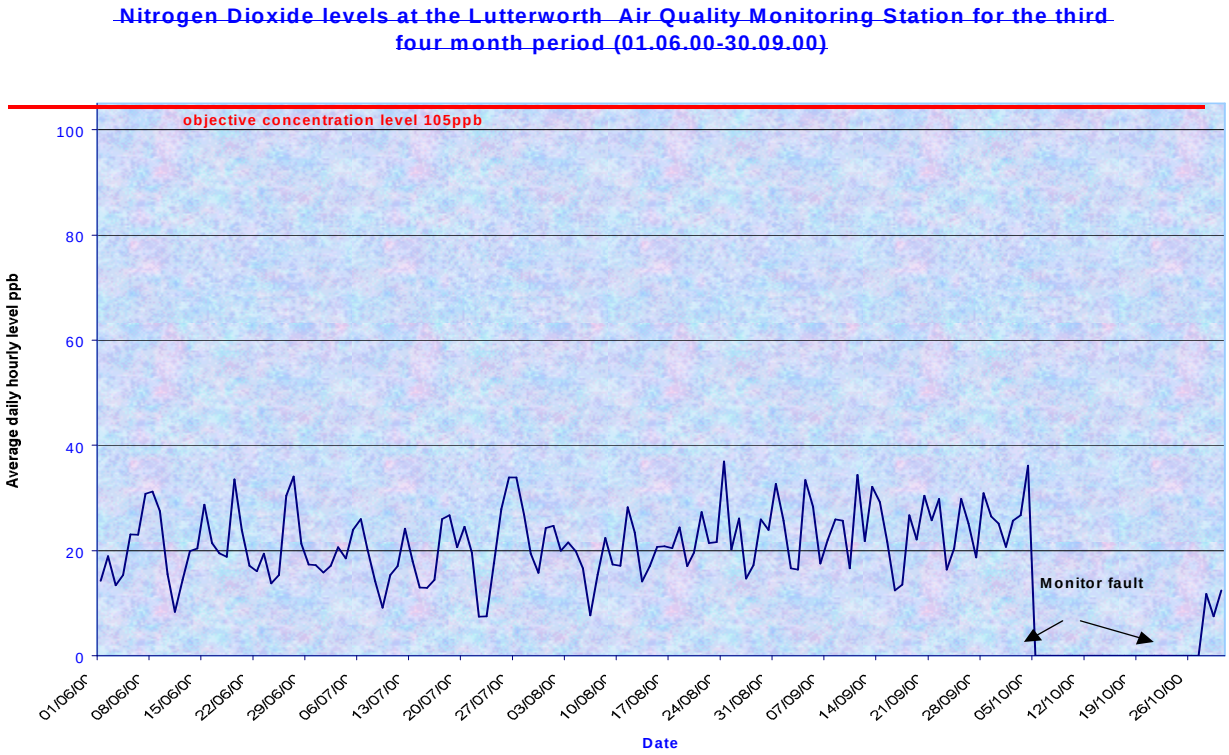



Table 10.2 Results of the DMRB Modelling

| | M1 Junction 20 | Junction 19 + M6 Junction 1 |
|---|---|---|
| NOx contribution from all roads µg/m³ | 55.71 | 12.90 |
| Background NOx µg/m³ | 28.40 | 32.20 |
| Total contribution µg/m³ | 84.11 | 45.10 |
| **Conversion to Annual Mean NO2 µg/m³** | **35.20** | **25.16** |

The results for the DMRB model indicated that at the significant receptors there would not be any exceedances of the Air Quality Objectives in 2005.

## 10.6 CONCLUSION FOR NITROGEN DIOXIDE

The Stage 1 review identified several road links where the number of vehicles exceeded 20,000 per year.

The results of the diffusion tube survey identified a potential problem with the annual average Nitrogen Dioxide levels in Lutterworth Town Centre.

The estimated levels from the published maps indicate that for the majority of the District the concentrations are below 30µg/m³, with the exception of the Lutterworth area where the concentrations are estimated to be below 40µg/m³.

The DMRB estimate of the concentrations of Nitrogen Dioxide indicated that at the closest receptor there would not be an exceedance of the Air Quality Objective for the M1 and the M6.

The ADMS model run for the M1 running through the District supported the estimated concentrations of the DMRB calculations.

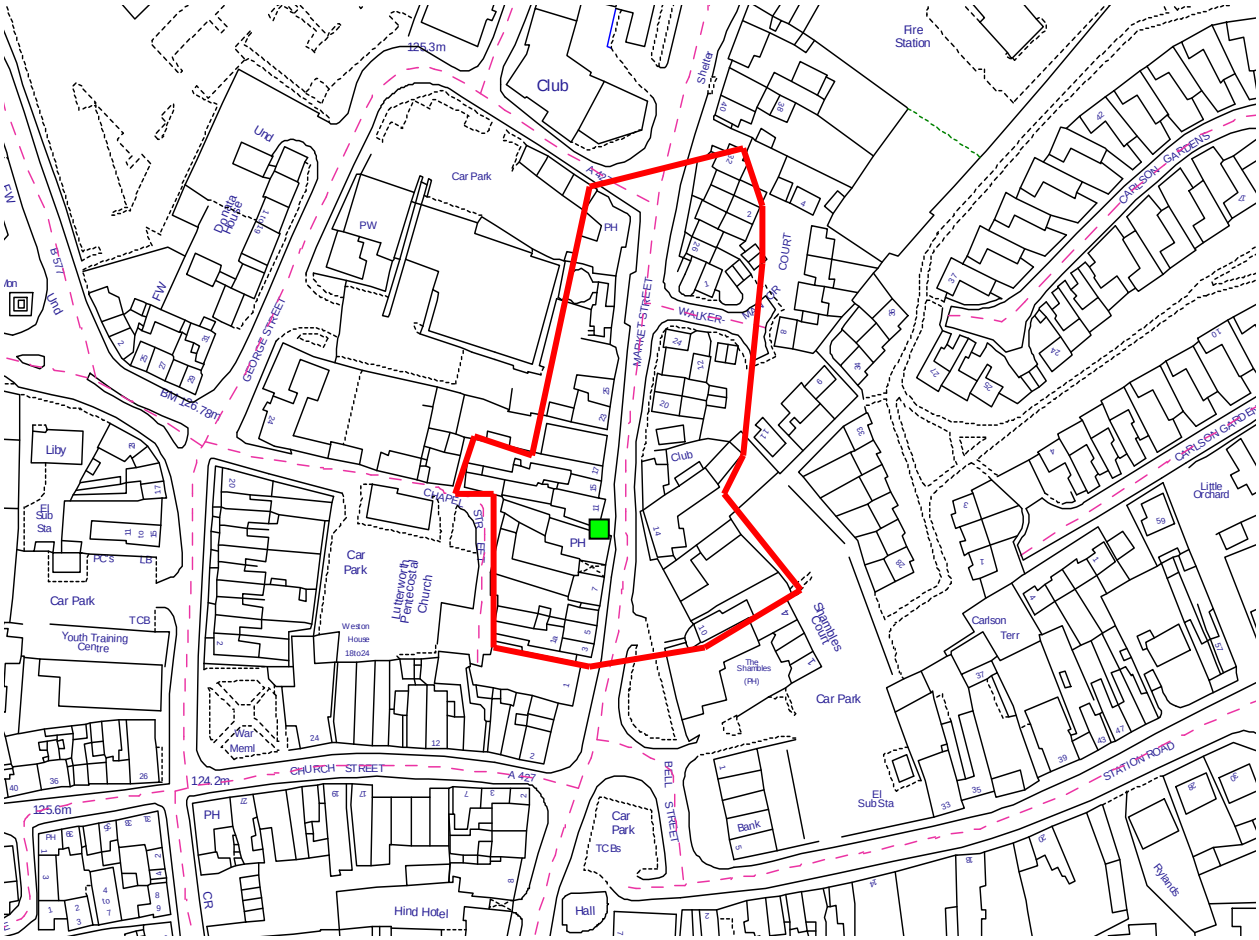
The results of the automatic analyser in Lutterworth Town Centre predict possible exceedances of the annual objective in the Market Street in Lutterworth. As there is an exceedance of the Air Quality Objective and Air Quality Management Area should be declared for this area. Figure 10.5 shows the possible extent of the Air Quality Management Area.

The predictions of the DMRB calculations for the High Street in Lutterworth do not anticipate an exceedance of the Sir Quality Objective, however further monitoring and modelling of this stretch of road will be undertaken in the next 12 month period to confirm these findings.

**There is a predicted exceedance of the Air Quality Objective for annual mean Nitrogen Dioxide concentration in the vicinity of the automatic analyser in Market Street Lutterworth.**

**An Air Quality Management Area should be declared in all areas where the exceedance coincides with housing or other residential accommodation, schools or hospitals**

Figure 10. 5 Proposed Air Quality Management Area for Lutterworth Town Centre.




Location of the Automatic Air Quality Monitoring Station

## REFERENCES

1 Environment Act 1995, Part IV

2 Air Quality (England) Regulations (S.I. 2000 No. 928)

3 The Air Quality Strategy for England, Scotland, Wales and Northern Ireland. January 2000

4 Framework for Review and Assessment of Air Quality. Local Air Quality Management Guidance Note LAQM.G1(00). Department of the Environment Transport and the Regions (DETR).

5 Review and Assessment: Monitoring Air Quality. Local Air Quality Management Guidance Note LAQM. TG1(00). DETR

6 Review and Assessment: Estimating Emissions. Local Air Quality Management Guidance Note LAQM. TG2(00). DETR

7 Review and Assessment: Selection and Use of Dispersion Models. Local Air Quality Management Guidance Note LAQM. TG3(00). DETR

8 Review and Assessment : Pollution Specific Guidance. Local Air Quality Management Guidance Note LAQM. TG4(00). DETR.

9 Reports of the Expert Panel on Air Quality Standards (EPAQS):
Nitrogen dioxides
Lead
Particulates
Benzene
1,3-Butadiene
Sulphur dioxide

10. Design Manual for Roads and Bridges Volume II Section 3 Part 1 Air Quality. The Highways Agency 1999 (as amended)

## GLOSSARY OF TERMS

**ADMS-Urban** – A new generation multi-source dispersion model which has been developed to deal with pollution for many sources.

**Action Plan –** Once an Air Quality Management Area has been declared and Action Plan must be drawn up to improve the air quality in that area.

**Air Quality Management Area (AQMA) –** A defined area in which it is anticipated that the air quality Objectives will not be met.

**Air Quality Objectives** – these are policy targets generally expressed as a maximum ambient concentration to be achieved, either with or without exception or with a number of permitted exceedences, within a specified timescale.

**Air Quality Standard –** the standards are the concentrations of pollutants in the atmosphere which can broadly be taken to achieve a certain level of environmental quality. The standards are based on assessment of each pollutant on human health, including the effects on sensitive sub-groups.

**Automatic Pollution Analyser** – A unit for accurately monitoring the level of a particular pollutant and sending the results to a central point.

**Background concentrations –** concentration of a particular pollutant which cannot be attributed to a local source.

**CO –** Carbon monoxide

**$CO_2$** – Carbon dioxide

**DETR –** Department of Environment Transport and the Regions

**Diffusion tubes –** A simple, inexpensive monitoring tool. It has poor accuracy and only gives a monthly average result therefore misses short-term pollution peaks. Useful survey tool.

**Dispersion modelling** – A computer programme which inputs emission inventory data and meteorological data and predict the distribution of pollutants in the atmosphere.

**DMRB –** Design Manual for Roads and Bridges: A simple screening model to obtain an initial impression of the concentration levels which are likely to occur.

**Emissions Inventory** – A list of point sources which emit pollutants into the atmosphere

**EPAQS** – The Expert Panel on Air Quality Standards: The UK group of scientists appointed by the Government to set standards for the maximum acceptable levels of pollutants in the UK atmosphere.

**LAQM** – Local Air Quality Management: a tool which Local Authorities may make use of for tackling local pollution hot-spots, often caused by road transport.

**µg/m³** - micrograms per metre cubed

**National Air Quality Strategy (NAQS) –** Government published documents which sets out the objectives for eight pollutants

**NETCEN –** National Environmental Technology Centre.

**NO –** Nitric Oxide

**$NO_2$** – Nitrogen Dioxide

**$NO_X$** – Oxides of Nitrogen

**Part A Process –** Large emitters of pollution which are regulated by the Environment Agency

**Part B Process –** Small scale emitters of pollution which are regulated by the local authority.

**Particulates –** Very small particles which are suspended in the atmosphere. They are usually invisible and can be breathed in

**Percentile** – The percentage of items in a set of data lying above or below a particular value

**$PM_{10}$ -** Particulate matter of a size 10µm or less.

**ppb** – Parts per billion

**ppm** – Parts per million

**Primary pollutant** – These particles are emitted directly by combustion processes and are generally less than 2.5µm and are less than 1µm/m³.

**Running mean** – A mean or series of means calculated for overlapping time periods.

**Secondary pollutant –** These particles are those which are formed in the atmosphere from chemical reactions and include sulphates and nitrates formed from the reactions of emissions of $SO_2$ and $NO_X$. These secondary particles are generally less than 2.5μm but the size could vary depending on humidity.

**$SO_2$** – Sulphur dioxide

**TEOM –** Tapering Element Oscillating Balance: An instrument for measuring concentrations of particulates by changes in the resonant frequency of an element on which the particle collection filter is mounted

**VOC's –** Volatile Organic Compounds

**Appendix 1- Part A and Part B Processes**

| Process | Company Name and Address | Emissions | Map Ref. |
|---|---|---|---|
| Lead Process (Part A) | Tungstone Batteries Ltd. Mkt. Harborough | Pb | 746 874 |
| Concrete | Hanson Premix Mkt. Harborough | $PM_{10}$ | 742 878 |
| Concrete | Lafarge Concrete Products Shawell | $PM_{10}$ | 536 804 |
| Concrete | Lafarge Readymix Ltd Dunton Basset | $PM_{10}$ | 534 804 |
| Concrete | Lafarge Readymix Ltd Shawell | $PM_{10}$ | 535 805 |
| Concrete | Lafarge Concrete Products Shawell | $PM_{10}$ | 535 806 |
| Painting | Clarkes of Great Glen Kibworth | $PM_{10}$ , VOC | 672 925 |
| Rubber | The Harboro Rubber Company Ltd Mkt. Harborough | $PM_{10}$ , VOC | EPA 11 |
| Treatment of Animal Matter | Croda Colloids Ltd Mkt. Harborough | $PM_{10}$ , $NH_4$, HCL, $H_2S$ | 722 895 |
| Painting | Wallon Bruntingthorpe | $PM_{10}$ , VOC | 605 886 |
| Painting | King Trailer Ltd Mkt. Harborough | $PM_{10}$ | 745 878 |
| Coating of Metal | G M Contractors North Kilworth | $PM_{10}$ , VOC | 622 836 |
| Foundary | Follsain Wearparts Lutterworth | VOC, $SO_2$, $NO_x$, CO | 546 852 |
| Coating Manufacture | Applied Finishes Ltd Fleckney | $PM_{10}$ , VOC | 650 925 |
| Wood Based Products | Whitmores Timber Co Ltd Claybrooke Magna | $PM_{10}$ | 450 875 |
| Odourisation of Natural | Transco | $CH_4$ | Not available |

| | | | |
|---|---|---|---|
| Gas | Mkt. Harborough | | |
| Odourisation of Natural Gas | Transco Tur Langton | $CH_4$ | Not available |
| Concrete | Lafarge Readymix Ltd. Shawell | $PM_{10}$ | Mobile plant |
| Petrol Vapour Recovery | Esso Service Station Mkt. Harborough | Bu, B Pb VOC | |
| Petrol Vapour Recovery | Lutterworth Ford Lutterworth | Bu, B Pb VOC | |
| Petrol Vapour Recovery | Texaco Star Lutterworth | Bu, B Pb VOC | |
| Petrol Vapour Recovery | Ellwoods Garage Mkt. Harborough | Bu, B Pb VOC | |
| Petrol Vapour Recovery | Market Service Station, Mkt. Harborough | Bu, B Pb VOC | |
| Petrol Vapour Recovery | Save Service Station, Mkt., Harborough | Bu, B Pb VOC | |
| Petrol Vapour Recovery | Sainsbury's Supermarket Mkt. Harborough | Bu, B Pb VOC | |
| Petrol Vapour Recovery | Esso Service Station Nth Kilworth | Bu, B Pb VOC | |
| Petrol Vapour Recovery | Thurnby Garage Thurnby | Bu, B Pb VOC | |
| Petrol Vapour Recovery | Gees Motors Lutterworth | Bu, B Pb VOC | |
| Petrol Vapour Recovery | Texaco Star Mkt. Harborough | Bu, B Pb VOC | |
| Petrol Vapour Recovery | Walcote Service Station Walcote | Bu, B Pb VOC | |
| Waste Oil Burner | Western Avenue Garage, Mkt. Harborough | VOC | |

(See next page for key)

Key:

PM10 = Particulates

NH4 = Ammonia
HCL = Hydrochloric Acid
H2S = Hydrogen Sulphide
VOC = Volatile Organic Compounds
SO2 = Sulphur Dioxide
NOX = Oxides of Nitrogen
CO = Carbon Monoxide
Bu = 1,3-butadiene
B = Benzene

**Appendix 2 – Manual Traffic Counts for "A" and "B" Class Roads within the District.**

## "A" Class Roads

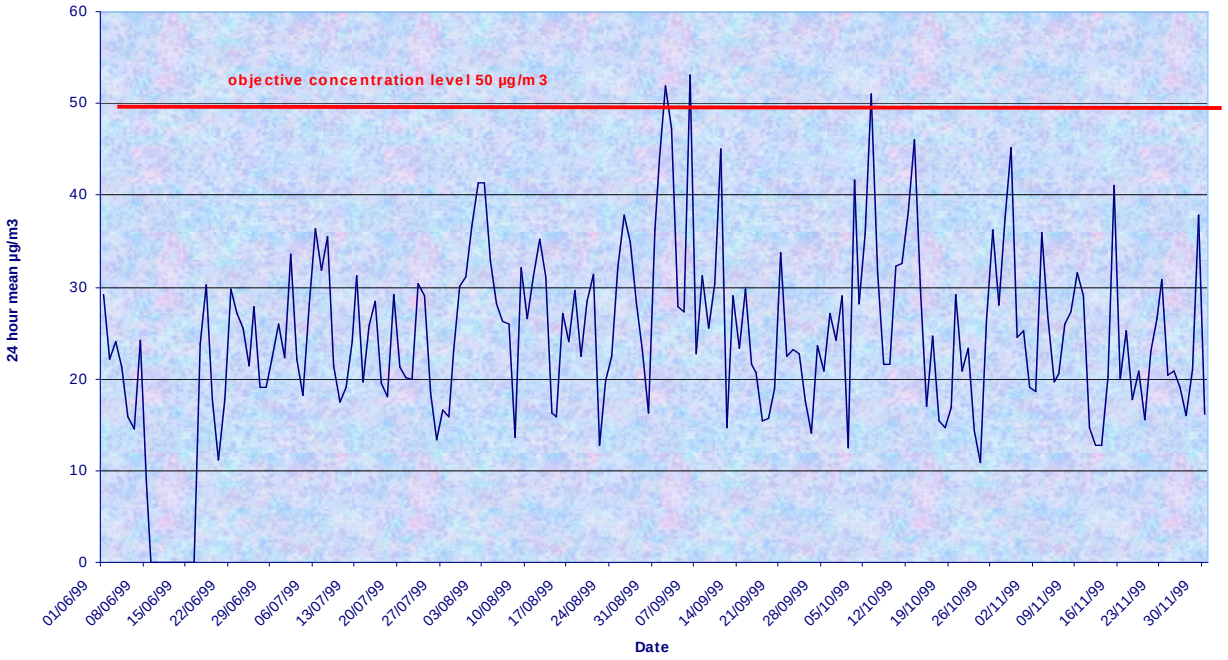
| Loc. No | Date | 1988 Low | 1988 High | 2005 Low | 2005 High |
|---|---|---|---|---|---|
| 1 | 11/4/97 | 70610.7432 | 71233.1669 | 81686.6299 | 86334.6007 |
| 2 | 23/9/97 | 27919.9102 | 28166.0211 | 32303.3361 | 34137.2175 |
| 3 | 6/4/98 | 5254.96438 | 5254.96438 | 6079.99379 | 6369.01683 |
| 4 | 29/9/96 | 16198.3356 | 16477.8851 | 18741.4743 | 19971.1967 |
| 5 | 24/6/96 | 9843.48852 | 10013.3666 | 11388.9162 | 12136.2003 |
| 6 | 8/5/97 | 4289.76185 | 4327.57562 | 4963.25446 | 5245.02165 |
| 7 | 20/9/96 | 10101.5576 | 10275.8894 | 11687.5021 | 12454.3779 |
| 8 | 29/4/97 | 9872.51055 | 9959.53562 | 11422.4947 | 12070.9572 |
| 9 | 12/5/98 | 7796.0863 | 7796.0863 | 9020.07185 | 9448.8566 |
| 10 | 6/9/95 | 12508.5261 | 12825.3461 | 14472.3647 | 15544.3195 |
| 11 | 8/10/97 | 7624.95583 | 7692.16896 | 8822.0739 | 9322.90878 |
| 12 | 19/9/97 | 6975.56403 | 7037.05284 | 6070.72758 | 8528.90804 |
| 13 | 23/6/97 | 5546.20851 | 5595.09771 | 6416.96324 | 6781.25842 |

## "B" Class Roads

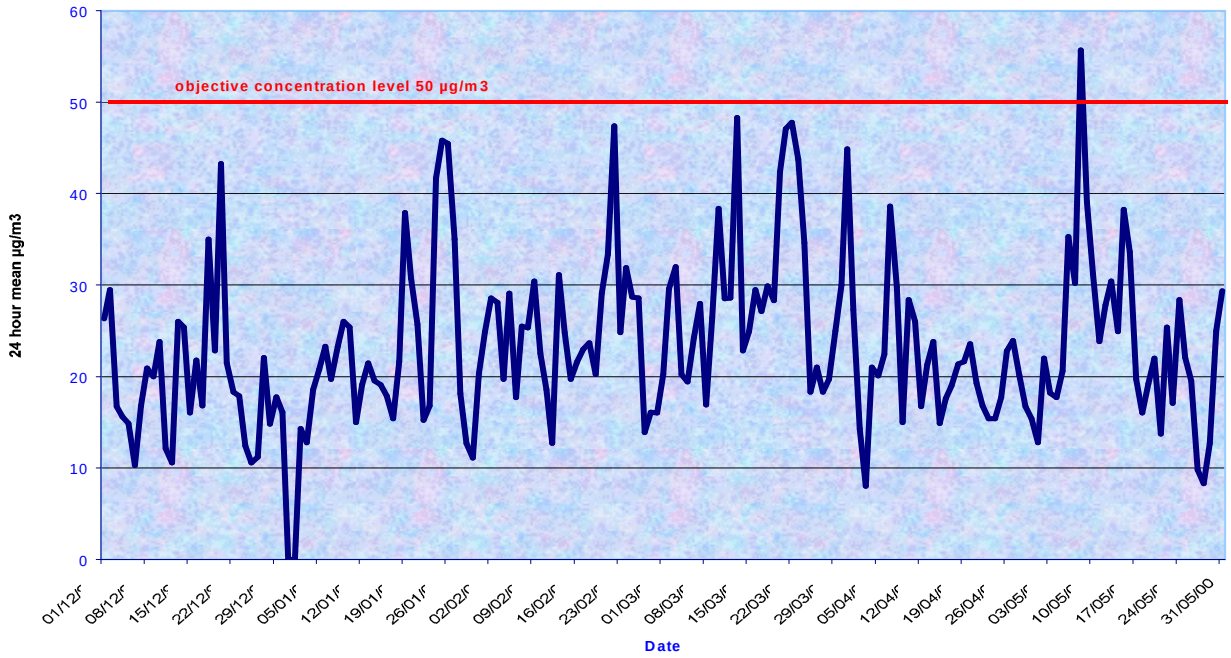
| Loc. No | Date | 1988 Low | 1988 High | 2005 Low | 2005 High |
|---|---|---|---|---|---|
| A | 21/10/97 | 2030.32731 | 2048.22442 | 2349.0887 | 2482.448 |
| B | 7/10/97 | 11469.1036 | 11570.2025 | 13269.7529 | 14023.0854 |
| C | 23/4/98 | 2926.35616 | 2926.35616 | 3385.79408 | 3546.74367 |

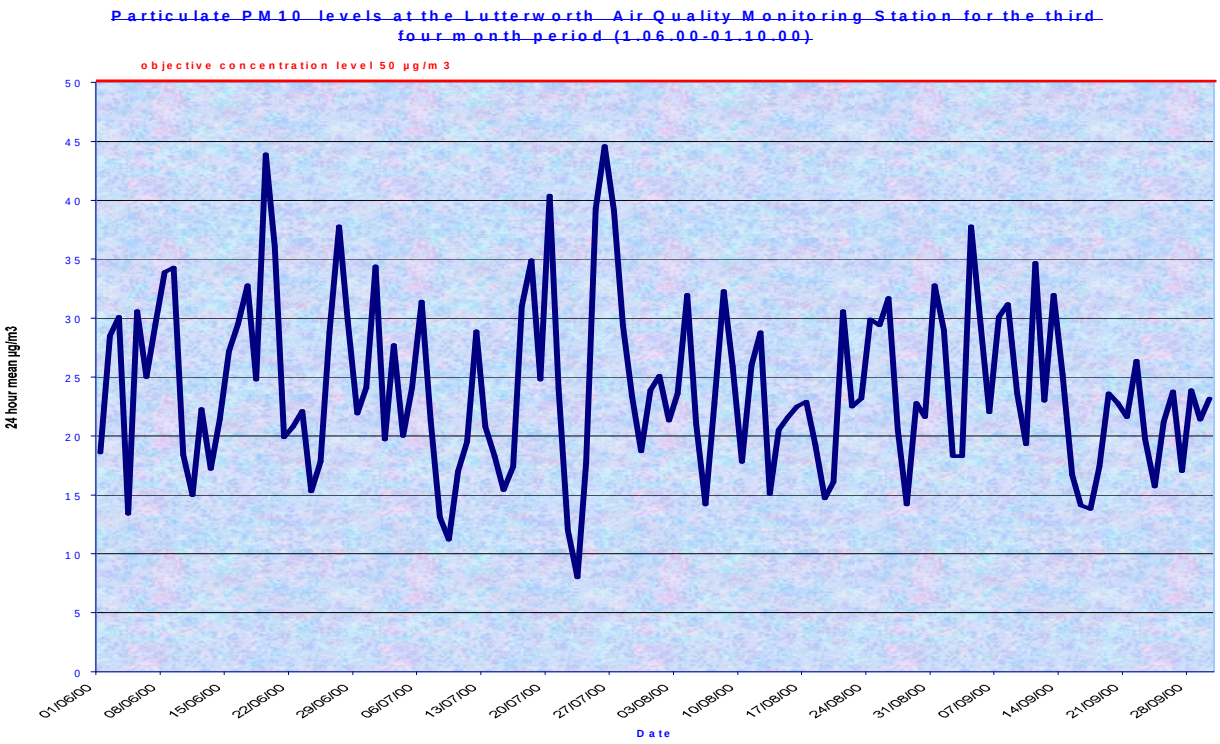
**Appendix 3.**

**Particulate PM10 levels at the Lutterworth Air Quality Monitoring Station for the first six month period (1.6.99-31.12.99)**




**Particulate PM10 levels at the Lutterworth Air Quality Monitoring Station for the second six month period (1.12.99-31.05.00)**




Particulate PM10 levels at the Lutterworth Air Quality Monitoring Station for the third four month period (1.06.00-01.10.00)
objective concentration level 50 µg/m3
24 hour mean µg/m3
0
5
10
15
20
25
30
35
40
45
50
01/06/00
08/06/00
15/06/00
22/06/00
29/06/00
06/07/00
13/07/00
20/07/00
27/07/00
03/08/00
10/08/00
17/08/00
24/08/00
31/08/00
07/09/00
14/09/00
21/09/00
28/09/00
Date

## Appendix 4 Modelled $NO_2$ Emissions for 2005