



**Wealden**  
District Council



## **Stage II Air Quality Review and Assessment Wealden District Council**

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**MAY 2000**

**Environment Act 1995 Part IV**

## **Stage II Review and Assessment for Wealden District Council**

### **1. Introduction**

This report forms the second stage of the statutory air quality review and assessment process for Wealden District Council. In Stage I those activities which may represent significant sources of any of the pollutants to be assessed were identified.

The following list were identified as being of possible concern:

**Part A Processes** - None

**Part B Processes** - None

**Road Sections** -

#### **Roads with more than 20,000 vehicles per day (2005) –**

High Street Uckfield (Station end)

A267 – from B2102 to the A265 Junction west of Heathfield

B2104 - Hailsham Road, from border with Eastbourne north to the junction with Glynleigh Road

A259 – Junction of A259/A27 north to junction of A259/B2095

Two sections of the A22 –

Uckfield bypass – from Maresfield bypass south to junction of A22/A26

From Eastbourne border north to Golden Cross A22/B2124 junction

#### **Roads with more than 25,000 vehicles per day (2005)**

A22 from Eastbourne border north to South Road, Hailsham junction (A295)

Stage II assessments are only required for those pollutants shown to be significant by Stage I. The aim of Stage II is to provide further screening of pollutant concentrations in local authority areas. Stage II is not intended to provide an accurate prediction of levels of current or future air quality across the whole of the authority's area. The second stage does not require a local authority to estimate every area of exceedence within its locality for each pollutant in question or to estimate the geographical extent of potential exceedence areas.

### **2. PM<sub>10</sub> Objectives**

During the Stage I air quality review and assessments all Sussex local authorities identified the pollutant PM<sub>10</sub> for further consideration. In specific cases this was due to the level of local PM<sub>10</sub> emissions in the area, but in the majority of cases this was due to the background levels of PM<sub>10</sub> reported across the South East of England. Since the Stage I assessments were completed, the DETR has carried out its Review of the National

Air Quality Strategy, to update the 1997 version, with important new developments, including the EC Air Quality Framework and Daughter Directives (DETR, 2000). One of the main changes within the Strategy Review was to revise the PM<sub>10</sub> air quality objective.

The UK National Air Quality Strategy (NAQS 1997) gave the following objective for PM<sub>10</sub> to be achieved by the end of 2005:

- 24-hour running mean of 50 µg/m<sup>3</sup>, measured as the 99th percentile

The European Union 'Daughter Directive' gives the following limit value for PM<sub>10</sub>:

- Stage 1, to be achieved by 1 January 2005: 24-hour limit value of 50 µg/m<sup>3</sup>, not to be exceeded more than 35 times a year (approximately equivalent to a 90th percentile of 50 µg/m<sup>3</sup>).

In a letter from the DETR to all local authorities concerning the review and assessment of PM<sub>10</sub>, it was stated that:

*"Local authorities in areas which are at risk of exceeding the daily EC Stage I limit value are advised to carry on with their review and assessment of PM<sub>10</sub>. Local authorities not at risk of exceeding the EC Stage I limit value might consider delaying further their review and assessment for PM<sub>10</sub> by not going beyond the first stage review, until the Government has completed its consultation on the revised PM<sub>10</sub> objective and has announced its decision."*

Projected concentrations in 2004 are expected to be lower than the EU 'Daughter Directive' Stage 1 limit values at most urban background locations, with the possible exception of central London. Concentrations at the roadside are expected to be higher than at nearby background locations. Concentrations higher than the EU Stage 1 limit value are therefore expected at the roadside of heavily trafficked roads in urban areas in 2004. Concentrations at sites with significant industrial source contributions to measured ambient PM<sub>10</sub> concentrations are also expected to be at risk of exceeding this limit value.

It is unfortunate that there are no sites in Sussex with PM<sub>10</sub> monitors on the national AURN pollution monitoring network. The nearest national network sites are those in Southampton Centre and Rochester (in the Medway Towns in Kent). A report produced alongside the review of the NAQS (NETCEN, 1999) concludes that the Stage I EC Limit value is likely to be met in all but the busiest of city centres, and in particularly heavily influenced industrial areas. Both the Southampton Centre (42 µg/m<sup>3</sup>) and Rochester (41 µg/m<sup>3</sup>) sites comply with the proposed EC Stage I limit value, suggesting that Wealden will also comply with this revised target value.

This report presents assessments of PM<sub>10</sub> concentrations in the local area from potentially significant sources. The revised local air quality management technical guidance document (LAQM.TG4, 2000) advises that an annual mean PM<sub>10</sub> concentration of 28

$\mu\text{g}/\text{m}^3$  is equivalent to the EC Stage I limit value. For assessments close to roads the Highways Agency's Design Manual for Roads and Bridges has been used. For industrial locations various models have been used to make an assessment, and details are specified for individual cases. Background concentrations of  $\text{PM}_{10}$  are then added to these calculations, and have been taken from national mapping work prepared by AEA NETCEN, detailed in the Stage I report.

### 3. $\text{NO}_2$ Objectives

The assessment of concentrations of nitrogen dioxide ( $\text{NO}_2$ ) is a difficult process. Nitrogen dioxide is a secondary pollutant, that is it is not emitted directly as nitrogen dioxide but is formed through a series of chemical reactions from emissions of nitric oxide (NO) largely due to incomplete combustion of fossil fuels. For example in motor vehicle exhausts, roughly 95% of the emissions are NO with only 5% direct  $\text{NO}_2$ .

For this reason, for the purpose of review and assessment, a more reliable estimate of future concentrations may be available for  $\text{NO}_x$  rather than  $\text{NO}_2$ . Government Guidance (LAQM.TG4) therefore suggests as an interim approach that air quality objectives be compared with the following concentrations of  $\text{NO}_x$  (which due to the atmospheric chemistry involved, vary with increasing distance from the road source):

Distance from kerb	$\text{NO}_x$ ( $\mu\text{g}/\text{m}^3$ )
0 – 5 metres	108
5 – 10 metres	102
10 – 15 metres	97
15 – 20 metres	93
20 – 25 metres	90
25 – 30 metres	87
> 30 metres	85

Again close to roads these concentrations will be assessed using the Highway Agency's Design Manual for Roads and Bridges.

### 4. The Use of Dispersion Modelling in Air Quality Management

Dispersion models describe how pollutants are spread and mixed in the atmosphere. Mathematical procedures are used to calculate pollutant concentrations based on emission rate (mass of pollutant emitted over time) and dilution rate (the volume of surrounding air into which the pollutant is being mixed per unit time). In this way, dispersion models link measured air quality with emissions data, they can be used to improve emission inventories and monitoring programmes, and assist in planning control measures.

Dispersion models are one of the tools available during the management of air quality, and are particularly useful in the following areas:

- Air Pollution monitoring is a very effective tool for assessing changes in air quality over time and in ensuring that policy objectives are met. It is an expensive tool, with coverage of all sites of interest in a local authority by automatic monitors being prohibited by cost. Dispersion models are useful for 'filling in the gaps' of a monitoring programme since it is clearly impractical to monitor at every point of interest. Models therefore allow an assessment to be made of air quality in locations where no monitoring is undertaken.
- Monitoring clearly also has little or no predictive capabilities, tools are therefore needed to evaluate future policies, and make predictions of concentrations into the future. Such scenario analysis is a vital part of the air quality management process, especially in the development of air quality action plans. Stage III of the review and assessment process and further stages require the use of comprehensive validated models.
- Dispersion modelling can also be used in source attribution work. Emission inventories can show the percentage of emissions for a particular pollutant which arise from different sectors, but these may not correspond with ground level exposure to pollution. This is because road transport emissions are emitted at ground level nearest to where people are exposed, whereas emissions from tall chimney stacks are significantly diluted before they reach ground level. The important point is that in terms of ground level *concentrations* ground level sources are more important than high level sources. Again, the only way to make an assessment of this kind is through dispersion modelling.
- Another predictive use of dispersion models is in pollution forecasting, where weather forecasts can be used as an input to dispersion models. In this way it is possible to give advance warning of any possible exceedences of air quality guidelines and standards to the public.

Models therefore have many roles in air quality management and should be seen as essential for testing new policies or developments that affect air quality.

#### **4.1 Distribution of Pollutants**

Before considering different modelling approaches it is useful to consider the character of air pollution. There can be many thousands of individual sources in an area which can be stationary or mobile. The pattern of emissions can be very complex both spatially and temporally. Vehicle emissions in particular can be very difficult to predict given the range of different vehicle types and driving patterns. The concentration of a pollutant at any point is made up from very local sources, other sources throughout the region, other sources from around the UK and also an element which is transboundary in origin.

For the purposes of modelling, sources are often split into three categories:

- Line sources - such as roads, railways, runways etc

- Point sources - such as chimney stacks
- Area sources - such as domestic emissions, fugitive dust emissions

Some models are able to model each of these types of source and combine the output, whilst others deal specifically with one source type.

Today most models come in the form of computer programs, although there are some which are paper based. This has simplified the undertaking of calculations, and has allowed the production of visually more appealing output. One disadvantage of this is that non-specialists could now easily use models, but not be entirely sure of what they are producing. The "Garbage in/Garbage out" principle still holds.

## **4.2 Meteorology**

Meteorology determines how quickly emissions are diluted; hence an essential input to dispersion models is meteorological data that must be representative of the area of interest. Models differ significantly in both their meteorological input requirements and the way in which they interpret the data to predict dispersion. Traditional dispersion models used a stability class approach to describe the state of the atmosphere. More recent models aim to calculate variables which better represent the state of the atmosphere. These variables are not routinely measured but need to be calculated from more basic parameters. Several models therefore use "meteorological pre-processors" to estimate these variables for direct input to the models.

For ground level sources such as roads, the conditions which lead to the highest concentrations are those where the wind speed is low and the atmosphere is stable. Conversely, for an elevated source (e.g. a chimney stack) the conditions which typically lead to high ground level concentrations are unstable conditions, where the plume is rapidly mixed downwards. Peak concentrations are therefore determined by very different meteorological conditions depending on the nature of the source. The source of emission is clearly important, but meteorology determines the final concentration of a pollutant.

From the point of view of air quality management it is often those situations that are most difficult to model about which information is required. Examples include busy town and city centre streets where dispersion is complex, or areas where the terrain is complex and may affect pollutant dispersion.

Particular models have been recommended for use in Stage II air quality assessments by the DETR in their Pollution Specific Guidance note (LAQM.TG4). These are discussed below.

## **4.3 DMRB (Design Manual for Roads and Bridges, Volume 11)**

The model was developed by the Transport Research Laboratory for the initial assessment of the air quality impact of existing or planned road schemes, and it includes a

method for estimating vehicle emissions from light and heavy duty vehicles up to the year 2020. In its simplest form the model comprises a series of look up tables based on outputs from a Gaussian dispersion model. The latest revision was issued in May 1999, when the model was adapted to predict National Air Quality Objectives, and to take account of background pollutant concentrations separately.

The model uses the following as input data:

- Hourly vehicle flow
- Proportion of light and heavy goods vehicles
- Vehicle speeds,
- Year
- Distance to receptor
- Background concentration

The model initially gives annual mean concentrations of carbon monoxide, oxides of nitrogen, hydrocarbons and PM<sub>10</sub>, but converts these to National Air Quality Strategy objectives.

A spreadsheet version of the model has been provided free of charge by the operators of the Modelling Helpline for local authorities (Stanger Science and Environment) and this version (January 2000) has been used in this assessment.

## **5. Investigation of Sources Identified in Stage 1**

Each of the individual sources of concern identified in the Stage I assessment are reviewed here, and an assessment of whether or not concentrations will meet the National Air Quality Strategy objectives is given.

### **5.1 Road Sections**

The local air quality management technical guidance note on pollution monitoring (LAQM.TG1, 2000) states that where diffusion tube data are used in a Stage 2 review and assessment to make a decision about whether or not to proceed further, details should be given of a number of influencing factors:

- Criteria for sampler location
- Record keeping for sampler locations
- Procedures for tube handling and exposure
- Timetable for sample exposure

Details of these are given in Appendix 1

Paragraph 6.37 of technical guidance note LAQM.TG4 states that local authorities should be confident in the performance of their analytical laboratory. During 1997 analytical laboratory performance testing was carried out by AEA/NETCEN who run the national

nitrogen dioxide diffusion tube survey. For each of the twelve months of the survey, a solution of known strength and a solution doped diffusion tube were also sent to each participating laboratory for analysis. Performance scores based around process control statistics were then assigned to each analysis. During 1997 there was a problem with February's analysis across all laboratories, and hence these were removed from the overall results. Those laboratories not performing satisfactorily were notified of their poor performance. The tubes used in Wealden are analyzed by Kent Scientific Services, a quality assured laboratory to ISO 9001 and UKAS accredited. This means that we can be confident that the results of the tube analysis are accurate.

## 6. Results and Recommendations

The following list were identified as being of possible concern from the Stage I review and assessment:

**Part A Processes** - None

**Part B Processes** - None

**Road Sections** -

### **Roads with more than 20,000 vpd (2005) –**

High Street Uckfield (Station end)

A267 – from B2102 to the A265 Junction west of Heathfield

B2104 - Hailsham Road, from border with Eastbourne north to the junction with Glynleigh Road

A259 – Junction of A259/A27 north to junction of A259/B2095

Two sections of the A22 –

Uckfield bypass – from Maresfield bypass south to junction of A22/A26

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A22 from Eastbourne border north to South Road, Hailsham junction (A295)

These sources have been assessed against the air quality targets, using the DMRB model and it has been found that in all cases the anticipated levels of NO<sub>2</sub> do not exceed the air quality targets set for 2005. In addition the A22 has also been assessed using the DMRB screening tool for compliance with the air quality standard for PM<sub>10</sub> in 2004, again the standard is not likely to be exceeded.

The calculations for this work are set out in Appendix III to this review. In addition the results from DMRB calculations have been compared with existing monitoring data from diffusion tubes within Wealden. The monitoring data has been corrected for the year 2005 in accordance with LAQM.TG4 and demonstrates that it is likely that the calculations undertaken using the DMRB model appear reasonable in most cases.

Set out below are the results of the modelling and corrected monitoring data, compared with the Air Quality Standard prescribed for the purpose of this assessment.

Consideration of NO <sub>2</sub>			
Road Section	Modelled Value for 2005	Measured Value Corrected for 2005	Air Quality Standard (ppb)
A22 (Polegate)	18.9	Not Measured	21
A22 (Hailsham)	19.8	Not Measured	21
A22 (North of Boship)	18.9	17.9	21
A259	No Receptor	13.8	21
Uckfield High Street	Traffic Flow falls below threshold for assessment by 2005	12	21
B2104	15.9	17.3	21
A267	11.5	12.6	21
Maresfield Bypass	No Receptor	13.7	21
Consideration of PM <sub>10</sub>			
A22 PM <sub>10</sub> (North of Boship)	27.23	Not Measured	28
A22 PM <sub>10</sub> (Polegate)	27.56	Not Measured	28
A22 PM <sub>10</sub> (Hailsham)	27.51	Not Measured	28

The results of the measurement and modelling undertaken, coupled with the fact that there are no receptors along two stretches of road that were identified in Stage I, indicate that the Air Quality within Wealden will meet the objectives.

## **References**

DETR (1998) LAQM.TG4 - Pollutant Specific Review and Assessment, HMSO.

DETR (2000) The United Kingdom National Air Quality Strategy.

DETR (1999) Review and Assessment of PM<sub>10</sub> by Local Authorities - Letter from Dr Brian Hackland to all local authorities in England 12 March 1999.

DETR (1999) Review of the United Kingdom National Air Quality Strategy.

AEA (1998) Nitrogen Dioxide Diffusion Tube Survey Report – 1998, AEAT report 4565.

## **Appendix I**

### **Nitrogen Dioxide Diffusion Tube Survey Details**

## **Extract From AEA Report 3675 - UK Nitrogen Dioxide Diffusion Tube Network Instruction Manual**

### **LOCATION OF MONITORING SITES**

This section gives information about the general location of the monitoring site. The network will take data from a minimum of 4 sites in each local/unitary authority area. One site will be close to a busy road (kerbside site), one at a distance of 20-30 m from a busy road (intermediate site) and two sites at a distance of at least 50 m from a busy road (urban background sites). Sites should be located in areas where people are normally present in daily life. The network is primarily designed to monitor general urban air pollution, rather than that from specific industrial sources, and hence, locations where industrial sources predominate should not be included.

The immediate area around sampler location must be open, allowing free circulation of air around the tube. Ideally, samplers would be placed at breathing height, but in order to reduce theft of tubes, it is recommended that tubes are placed at a height 2-4 m, and in all cases no higher than 5 m.

### **DETAILED SITING OF THE SAMPLER**

Diffusion tubes must be held vertically with the open end downwards during sampling. Generally a permanent clip e.g. Terry clip or plastic clip, is mounted so that the tubes can be changed easily (see Figure 2). The clip and spacer (see below) may be simply mounted at the monitoring site with PVC tape, double sided tape, or cable tie as appropriate.

It is important that the open end of the tube is exposed to free circulation of air. Also, certain surfaces may act as absorbers for NO<sub>2</sub> leading to a thin layer of reduced atmospheric concentrations immediately adjacent to the surface. For these reasons tubes must not be mounted directly adjacent to surfaces. A spacer block of at least 5 cm must be used between the surface and the tube. A small block of wood or plastic can be used as the spacer. The open end of the tube must be located below the lower surface of the spacer.

When tubes are mounted to the side of a building then ideally, the tube with spacer block should be mounted on some projection from the building face of 0.5 - 1 m. If this is not possible, then mounting the spacer block directly to the side of the building may be acceptable, providing that it is not placed in any form of recess (to avoid the possibility of sampling stagnant air). Also, to avoid sampling in an area of higher than usual turbulence, the tube should not be located on the corner of a building.

Care must be taken to avoid any very localised sources, or sinks of NO<sub>2</sub>, or disturbances to the air flow. For example, close proximity (less than 10 m) to the following must be avoided:

- heater flues (particularly low level balanced flues)

- trees and other vegetation
- air conditioning outlets
- extractor vents
- underground ventilation shafts

This network is intended to provide data over the long term. Hence, it is important that, as far as possible, the general area surrounding the site location remains substantially unchanged. Areas designated for redevelopment or subject to new road construction or traffic management schemes must be avoided.

### **Near-road site (Kerbside)**

This site should reflect the “worst case scenario” - the maximum concentration of NO<sub>2</sub> to which people may be regularly exposed, even if only for short periods, close to a busy main road. The road with maximum traffic flow within the area may not produce the highest ambient concentrations, if it is situated in an open area, for instance a dual carriage way. Higher concentrations may be observed at a less busy road which has tall buildings on either side (the street canyon effect), for instance in a town centre. In general, unless data from other sources exists, local knowledge will be required to select the most appropriate site. Local and unitary authorities may discuss this individually with NETCEN if they require further guidance.

The diffusion tube should be sited between *1-5 m from the kerb edge*, and mounted ideally either on a lamp post or road sign on the pavement, or on the face of a building adjoining the pavement. Measurements from kerbside sites will only be representative over a very small area, as NO<sub>2</sub> concentrations close to sources vary considerably, even over short distances.

### **Intermediate site**

Many people in the local/unitary authority area may live within 20 to 30m of busy roads. NO<sub>2</sub> concentrations in these areas will be lower than at the kerbside, as the emissions from traffic on the main road will be diluted, and there will be fewer vehicle emissions in the immediate vicinity. However, NO<sub>2</sub> concentrations in such areas will still be higher than typical urban “background” concentrations, at locations away from busy roads. This is the case particularly in large cities. The intermediate site is designed to measure NO<sub>2</sub> concentrations at such locations.

The ideal location for the intermediate site is on a relatively quiet road or in a quiet area such as a school, public building or housing estate, between *20-30 m from a busy major road*, but in line of sight to this road.

### **Urban background sites**

At distances of more than 50m from a busy road, it is anticipated that NO<sub>2</sub> concentrations will have been diluted to the local urban background concentration. Hence, measurements made in this type of location are likely to be representative of a fairly large area, and can be reliably compared with similar locations in other urban areas.

Urban background sites must be located **>50 m from any busy road**. Examples of typical urban background sites are on lampposts or street signs in quiet residential areas, schools or other public buildings, either close to the town centre or in suburbs bordered by a busy arterial road. When street furniture is used, even on quiet roads, the sampler must be more than 1 m from the kerb.

## **INSTRUCTIONS FOR EXPOSING DIFFUSION TUBES**

On the exposure date detailed in the UK NO<sub>2</sub> Network monitoring calendar the following procedures should be followed:

- Remove tubes from the refrigerator and transport to site in a snap seal bag. Travel blanks, where applicable, should be identified and their code numbers noted on the exposure details form provided by your analytical laboratory.
- Transport tubes for exposure to monitoring sites, with travel blanks if appropriate, and exposure details form.
- At each site, select a tube. Record its ID number, and the site at which it is to be exposed on the exposure details form.
- With the absorbent end cap uppermost, remove the bottom end cap and clip the tube into the holder. Ensure the sampler is mounted vertically with its open end downwards
- Record the date and time of the start of the exposure period on the exposure details form, and make a note of any site irregularities (for example building/road works, traffic diversions).
- Keep the end caps in the bag, for use when the exposure period is completed.

On the appropriate date, the samplers will need to be changed and a new batch of tubes identified for exposure. The following procedures should be followed:

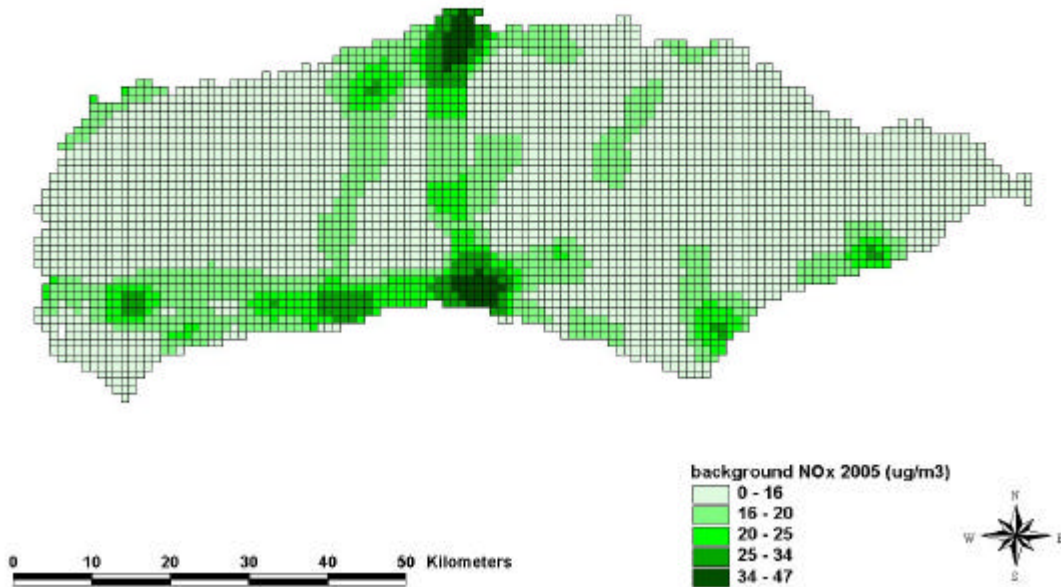
- Transport the new batch of unexposed tubes to site, together with the end caps from the last batch, any travel blanks as appropriate, and exposure details forms for both batches.
- At each site, remove the exposed tube from sample holder and replace end cap tightly.
- Record the time and date of the end of the exposure period on the exposure details form, against the appropriate tube number.
- Make a note of any site irregularities (building/road works, traffic diversions), also anything which might affect the tube, (for example the tube found on the ground, insects or moisture inside the tube) on the form.
- Select a new tube for exposure. Remove its end cap and place it open end down in the holder, as above. Record tube ID details, date and time.

When visiting sites, it is recommended that the operator takes some spare tube end caps, also some spare mounting clips and spacer blocks to replace any missing or damaged.

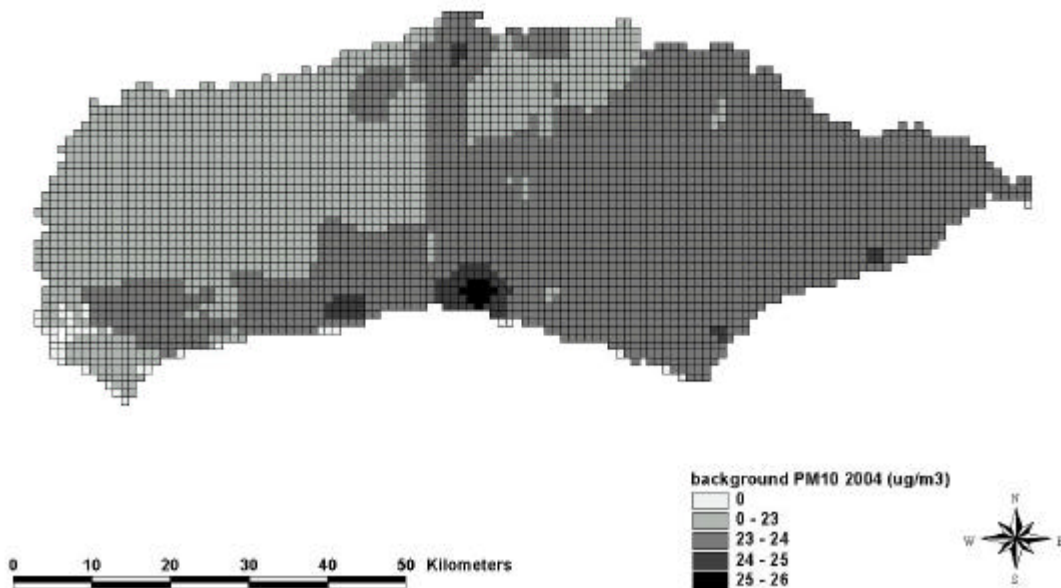
## **Appendix II**

### **Background Air Pollutant Concentrations**

### Background NOx Concentration (2005) ug/m3



### Background PM10 Concentration (2004) ug/m3



## **Appendix III**

### **Design Manual for Roads and Bridges Results**

(If you wish to see the results from the DMRB spreadsheet please contact me at the address shown below and I will gladly send you a hard copy of the results by post)

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