Report

Air Quality Updating and Screening Assessment for Norwich

A report produced for Norwich City Council

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Executive Summary

The UK Government published its strategic policy framework for air quality management in 1995 establishing national strategies and policies on air quality which culminated in the Environment Act, 1995. The Air Quality Strategy provides a framework for air quality control through air quality management and air quality standards. These and other air quality standards[a] and their objectives have been enacted through the Air Quality Regulations in 1997, 2000 and 2002[2]. The Environment Act 1995 requires Local Authorities to undertake air quality reviews. In areas where an air quality objective is not anticipated to be met, Local Authorities are required to establish Air Quality Management Areas and implement action plans to improve air quality.

The second round of air quality review and assessments has been completed by Norwich City Council. The Council are now required to proceed to the third round of review and assessment in which sources of emissions to air are reassessed to identify whether the situation has changed since the second round, and if so, what impact this may have on predicted exceedences of the air quality objectives.

The third round of review and assessment is to be undertaken in two steps, essentially following the format of the second round. The first step is an Updating and Screening Assessment, which updates the findings of the previous Review and Assessment cycle, undertaken for all pollutants identified in the Air Quality Regulations. Where a significant risk of exceedence is identified for a pollutant it will be necessary for the local authority to proceed to a Detailed Assessment the following year. Where a local authority does not need to undertake a Detailed Assessment, a progress report is required instead.

This report is an Updating and Screening Assessment for Norwich City Council as outlined in the Government's published guidance.

This Updating and Screening Assessment has concluded that Norwich City Council is not required to carry out a Detailed Review and Assessment for carbon monoxide, benzene, 1,3-butadiene, lead, nitrogen dioxide, PM_{10} or sulphur dioxide.

[a] Refers to standards recommended by the Expert Panel on Air Quality Standards. Recommended standards are set purely with regard to scientific and medical evidence on the effects of the particular pollutants on health, at levels at which risks to public health, including vulnerable groups, are very small or regarded as negligible.

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Acronyms and definitions used in this report

AADTF	**Annual Average Daily Traffic Flow**
ADMS	**an atmospheric dispersion model**
AQDD	**an EU directive (part of EU law) - Common Position on Air Quality Daughter Directives, commonly referred to as the Air Quality Daughter Directive**
AQMA	**Air Quality Management Area**
AQS	**Air Quality Strategy**
AURN	**Automatic Urban and Rural Network (Defra funded air quality monitoring network)**
base case	**In the context of this report, the emissions or concentrations predicted at the date of the relevant air quality objective (2005 for nitrogen dioxide)**
CO	**Carbon monoxide**
d.f.	**degrees of freedom (in statistical analysis of data)**
DETR	**Department of the Environment Transport and the Regions (now Defra)**
Defra	**Department for Environment, Food and Rural Affairs**
DMRB	**Design Manual for Roads and Bridges**
EA	**Environment Agency**
EPA	**Environmental Protection Act**
EPAQS	**Expert Panel on Air Quality Standards (UK panel)**
EU	**European Union**
GIS	**Geographical Information System**
kerbside	**0 to 1 m from the kerb**
Limit Value	**An EU definition for an air quality standard of a pollutant listed in the air quality directives**
n	**number of pairs of data**
NAEI	**National Atmospheric Emission Inventory**
NO_2	**Nitrogen dioxide**
NO_x	**Oxides of nitrogen**
NRTF	**National Road Traffic Forecast**
ppb	**parts per billion**
r	**the correlation coefficient (between two variables)**
receptor	**In the context of this study, the relevant location where air quality is assessed or predicted (for example, houses, hospitals and schools)**
roadside	**1 to 5 m from the kerb**
SD	**standard deviation (of a range of data)**
SEPA	**Scottish Environment Protection Agency**
SO_2	**Sulphur dioxide**
TEA	Triethanolamine
TEMPRO	**A piece of software produced by the Defra used to forecast traffic flow increases**
TEOM	**Tapered Element Oscillating Microbalance**
TEOM (Grav.)	**TEOM Measurements expressed as the equivalent value from a gravimetric monitor**
V/V	**Volume ratio**

1 Introduction to the Updating and Screening Assessment

1.1 PURPOSE OF THE UPDATING AND SCREENING ASSESSMENT

The second round of air quality review and assessments is now complete and all local authorities should have completed all necessary stages. Where the likelihood of exceedences of air quality objectives have been identified in areas of significant public exposure, an air quality management area should have been declared, followed by a Further (formerly 'Stage 4') Assessment, and the formulation of an action plan detailing measures intended to reduce or to eliminate exceedences.

Local authorities are now required to proceed to the third round of review and assessment. The updating and screening assessment reassesses sources of emissions to air to identify whether the situation has changed since the second round of review and assessment. Changes are reviewed to assess the potential impact on predicted exceedences of the air quality objectives. Such changes might include significant traffic growth on a major road, which had not been foreseen, construction of a new industrial plant with emissions to air, or significant changes in the emissions of an existing plant.

The third round of review and assessment is to be undertaken in two steps. The first step is an Updating and Screening Assessment. This Assessment updates the findings of the previous Review and Assessment cycle, undertaken for all pollutants identified in the Air Quality Regulations. Where a significant risk of exceedence is identified for a pollutant it will be necessary for the local authority to proceed to a Detailed Assessment. Where a local authority does not need to undertake a Detailed Assessment, a progress report is required instead by the following year.

1.2 STRUCTURE OF THE REPORT

The report is structured as follows:

- **Section 1** **summarises the aims of the updating and screening assessment, the approach adopted for the assessment, the pollutants and air quality objectives;**
- **Section 2** **summarises the UK Air Quality Strategy and the function of an updating and screening assessment;**
- **Section 3** **summarises the conclusions of air quality review and assessment work to date, identifies data used in support of this assessment as well as relevant background information on the Council area, and relevant emissions-to-air sources and highlights significant changes in emissions to air within the city since the last round of review and assessment;**
- **Sections 4-10** **present the review and assessment for each of the seven pollutants included in the Air Quality Regulations;**
- **Section 11** **presents conclusions and recommendations for further work, where required, for each of the seven pollutants;**

1.3 OVERVIEW OF APPROACH TAKEN

The general approach taken to this Updating and Screening Assessment was to:

- **Identify the conclusions of the last round of review and assessment for each of the seven pollutants included in the air quality regulations;**
- **Identify significant sources of emissions to air for the seven pollutants included in the air quality regulations, including major roads and industrial plant;**
- **Identify new sources not previously considered in the first and second rounds of review and assessment;**
- **Identify any sources for which emissions have changed significantly since the last round of review and assessment;**
- **Identify and interpret the significance of air quality monitoring data made available since the last round of review and assessment;**
- **Assess the risk of exceedences of the air quality objectives in locations where relative public exposure may exist using screening models and nomograms; and**
- **Where necessary, identify locations and pollutants for which further detailed assessment of air quality will be required.**

1.4 RELEVANT GUIDANCE DOCUMENTATION

This report takes into account the guidance in LAQM.TG(03)[1], published January 2003, and the update to this guidance[2], published January 2006.

1.5 POLLUTANTS CONSIDERED IN THIS REPORT

All pollutants included in the Air Quality Regulations[3] for the purposes of Review and Assessment have been considered in this report (Table 1.1).

Table 1.1 Objectives included in the Air Quality Regulations 2000 and (Amendment) Regulations 2002 for the purpose of Local Air Quality Management

Pollutant	Air Quality Objective		Date to be achieved by
	Concentration	Measured as	
Benzene			
All authorities	**16.25 μg m^{-3}**	**running annual mean**	**31.12.2003**
Authorities in England and Wales only	**5.00 μg m^{-3}**	**annual mean**	**31.12.2010**
***Authorities in Scotland and Northern Ireland only*[a]**	***3.25 μg m^{-3}***	***running annual mean***	***31.12.2010***
1,3-Butadiene	**2.25 μg m^{-3}**	**running annual mean**	**31.12.2003**
Carbon monoxide			
Authorities in England, Wales and Northern Ireland only[a]	**10.0 mg m^{-3}**	**maximum daily running 8-hour mean**	**31.12.2003**
Authorities in Scotland only	***10.0* mg m^{-3}**	***running 8-hour mean***	***31.12.2003***
Lead	**0.5 μg m^{-3}**	**annual mean**	**31.12.2004**
	0.25 μg m^{-3}	**annual mean**	**31.12.2008**
Nitrogen dioxide[b]	**200 μg m^{-3} not to be exceeded more than 18 times a year**	**1 hour mean**	**31.12.2005**
	40 μg m^{-3}	**annual mean**	**31.12.2005**
Particles (PM_{10}) (gravimetric)[c]	**50 μg m^{-3} not to be exceeded more than 35 times a year**	**24 hour mean**	**31.12.2004**
All authorities	**40 μg m^{-3}**	**annual mean**	**31.12.2004**
Authorities in Scotland only[d]	***50 μg m^{-3} not to be exceeded more than 7 times a year***	***24 hour mean***	***31.12.2010***
	18 μg m^{-3}	***annual mean***	***31.12.2010***
Sulphur dioxide	**350 μg m^{-3} not to be exceeded more than 24 times a year**	**1 hour mean**	**31.12.2004**
	125 μg m^{-3} not to be exceeded more than 3 times a year	**24 hour mean**	**31.12.2004**
	266 μg m^{-3} not to be exceeded more than 35 times a year	**15 minute mean**	**31.12.2005**

a. In Northern Ireland none of the objectives are currently in regulation. Air Quality (Northern Ireland) Regulations were consulted on in 2003

b. The objectives for nitrogen dioxide are provisional.

c. Measured using the European gravimetric transfer sampler or equivalent.

d. These 2010 Air Quality Objectives for PM_{10} apply in Scotland only, as set out in the Air Quality (Scotland) Amendment Regulations 2002.

2 The UK Air Quality Strategy

2.1 NATIONAL AIR QUALITY STANDARDS

The Government prepared the Air Quality Strategy for England, Scotland, Wales and Northern Ireland for consultation in August 1999. It was published in January 2000 (DETR, 2000)[4] with an addendum issued in February 2003. The Air Quality Strategy uses national air quality standards to enable air quality to be measured and assessed. These also provide the means by which objectives and timescales for the achievement of objectives can be set. These standards and associated specific objectives to be achieved between 2003 and 2010 are shown in Table 1.1. The table shows the standards in mass concentrations ($\mu g\ m^{-3}$ or $mg\ m^{-3}$) with the number of exceedences that are permitted (where applicable) and the equivalent percentile.

2.2 TIMESCALES TO ACHIEVE THE OBJECTIVES FOR THE POLLUTANTS IN AIR QUALITY STRATEGY

In most local authorities in the UK, objectives were (or will be) met for most of the pollutants within the timescale of the objectives shown in Table 1.1. It is important to note that the objectives for NO_2 remain provisional. The Government has recognised the problems associated with achieving the standard for ozone and this will not therefore be a statutory requirement. Ozone is a secondary pollutant and transboundary in nature and it is recognised that local authorities themselves can exert little influence on concentrations when they are the result of regional primary emission patterns.

2.3 AIR QUALITY REVIEWS – THE APPROACHES AND EXPECTED OUTCOMES

Technical Guidance has been issued in 'Review and Assessment: Technical Guidance' LAQM.TG (03)[1] to enable air quality to be monitored, modelled, reviewed and assessed in an appropriate and consistent fashion. This updating and screening assessment has considered the procedures set out in this technical guidance.

The primary objective of undertaking a review of air quality is to identify any areas that are unlikely to meet national air quality objectives and ensure that air quality is considered in local authority decision-making processes. The complexity and detail required in a review depends on the risk of failing to achieve air quality objectives and it has been proposed therefore that reviews should be carried out in two steps. Both steps of review and assessment may be necessary and every authority is expected to undertake at least a first stage review and assessment of air quality in their authority area. The steps are briefly described in Table 2.1.

Table 2.1 Brief details of steps in the third Round of the Air Quality Review and Assessment process

Level of Assessment	Objective	Approach
Updating and Screening	To identify those matters that have changed since the last review and assessment, which might lead to a risk of an air quality objective being exceeded	Use a checklist to identify significant changes that require further consideration. Where such changes are identified, than apply simple screening tools to decide whether there is sufficient risk of an exceedence of an objective to justify a Detailed Assessment
Detailed Assessment	To provide an accurate assessment of the likelihood of an air quality objective being exceeded at locations with relevant exposure. This should be sufficiently detailed to allow the designation or amendment of any necessary AQMAs	Use quality-assured monitoring and validated modelling methods to determine current and future pollutant concentrations in areas where there is a significant risk of exceeding an air quality objective.
Annual Progress reports	Local authorities should prepare annual air quality Progress Reports between subsequent rounds of reviews and assessments. The concept is that this will ensure continuity in the LAQM process.	The precise format of the progress report is left up to the local authority to decide, but guidance on what it should cover is available in LAQM.PRG(03)[5], published in 2003. It is envisaged that these Progress Reports could be useful for the compilation of annual 'state of the environment' reports that many authorities already prepare.

The current deadline for completion of updating and screening assessments is April 2006, and for detailed assessments April 2007.

2.4 LOCATIONS THAT THE REVIEW AND ASSESSMENT MUST CONCENTRATE ON

For the purpose of review and assessment, the authority should focus their work on locations where members of the public are likely to be exposed over the averaging period of the objective. Table 2.2 summarises the locations where the objectives should and should not apply.

Table 2.2 Typical locations where the objectives should and should not apply

Averaging Period	Pollutants	Objectives *should* apply at ...	Objectives should *not* generally apply at ...
Annual mean	• 1,3 Butadiene • Benzene • Lead • Nitrogen dioxide • Particulate Matter (PM_{10})	All background locations where members of the public might be regularly exposed.	Building facades of offices or other places of work where members of the public do not have regular access.
		Building facades of residential properties, schools, hospitals, libraries etc.	Gardens of residential properties.
			Kerbside sites (as opposed to locations at the building facade), or any other location where public exposure is expected to be short term
24 hour mean and 8-hour mean	• Carbon monoxide • Particulate Matter (PM_{10}) • Sulphur dioxide	All locations where the annual mean objective would apply.	Kerbside sites (as opposed to locations at the building facade), or any other location where public exposure is expected to be short term.
		Gardens of residential properties.	
1 hour mean	• Nitrogen dioxide • Sulphur dioxide	All locations where the annual mean and 24 and 8-hour mean objectives apply.	Kerbside sites where the public would not be expected to have regular access.
		Kerbside sites (e.g. pavements of busy shopping streets).	
		Those parts of car parks and railway stations etc. which are not fully enclosed.	
		Any outdoor locations to which the public might reasonably be expected to have access.	
15 minute mean	• Sulphur dioxide	All locations where members of the public might reasonably be exposed for a period of 15 minutes or longer.	

It is unnecessary to consider exceedences of the objectives at any location where public exposure over the relevant averaging period would be unrealistic. Locations should also represent non-occupational exposure.

3 Information used to support this assessment

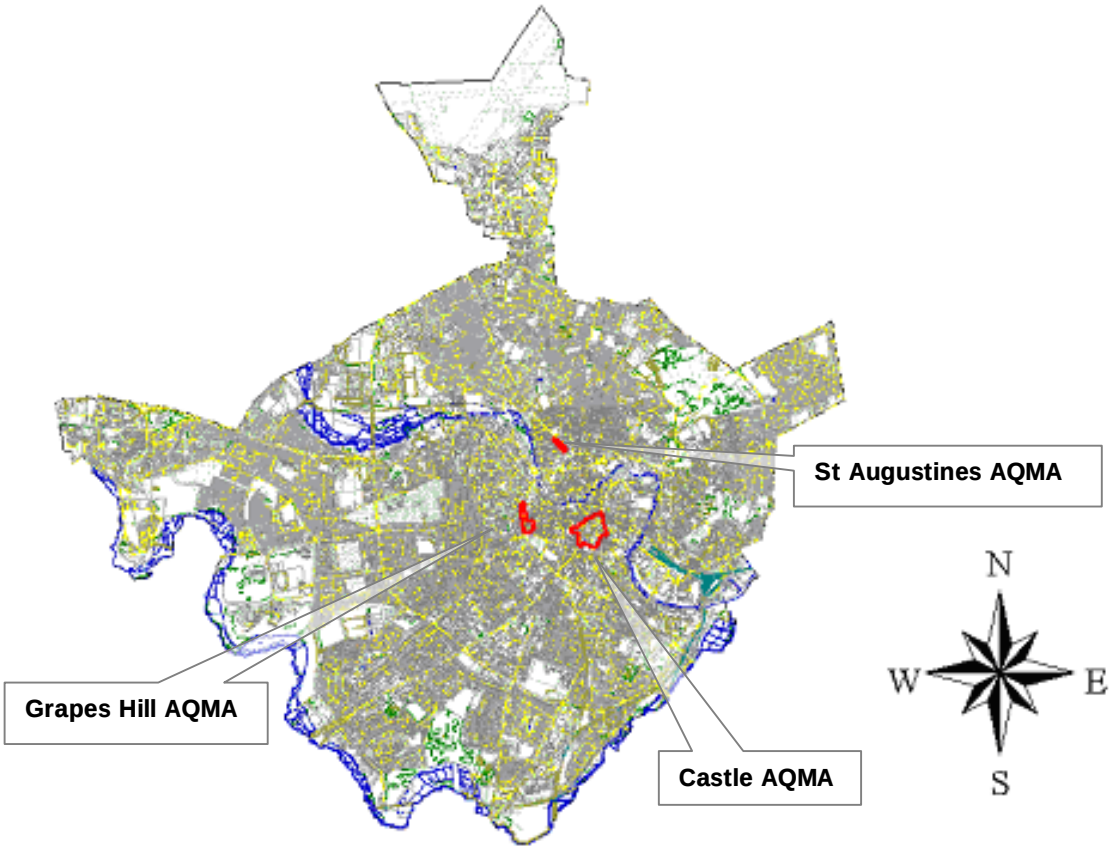
3.1 THE FIRST AND SECOND ROUNDS OF REVIEW AND ASSESSMENT OF AIR QUALITY FOR NORWICH CITY COUNCIL

Norwich City Council has completed the following review and assessments of air quality to date:

- **Stage 1 (1998), and stages 2 and 3 (1999)**
- **Stage 3 update (2002), and Stage 4 (2003)**
- **Updating and Screening Assessment (January 2004) and a progress report in 2005**

The previous assessments of the air quality in Norwich concluded that there were likely exceedances of the annual mean objective for NO_2 as a result of both industrial and traffic sources. Three AQMAs were declared in the city - Grapes Hill, Castle and St Augustines – following the stage three assessment. The location of these is illustrated by figure 3.1. The later Updating and Screening Assessment and Progress Report concluded that there was no need to make any changes to the AQMAs already in place. No action was required for any of the other pollutants considered.

Fig. 3.1 Map of existing AQMAs in Norwich



3.2 PROPOSED DEVELOPMENTS WHICH MAY AFFECT AIR QUALITY

Any new developments in the local authority or in surrounding areas that may impact on local air quality need to be considered.

3.2.1 Industry

There are no significant industrial developments currently planned in the area. No new industrial processes have started since the previous round of review and assessment.

3.2.2 Housing and redevelopment

A large retail development has been constructed at Chapelfield Road. This replaces a factory and public car park, so it is not anticipated that this will significantly impact on air quality compared with the previous land use, as it is unlikely that the number of vehicles visiting the area will change significantly.

Other new developments are also taking place on a smaller scale – new housing on the site of the former Norfolk and Norwich Hospital, the demolition and rebuilding of a multi storey car park on Duke Street and the continuing redevelopment of the Riverside area. These developments are not expected to impact on air quality once complete, since the number of vehicles visiting the sites is not expected to change, or in the case of the houses in place of the hospital, the number of visiting vehicles is expected to decrease.

3.2.3 Transport

Some minor changes to the road network have been incorporated into the design of the redevelopments mentioned in section 3.2.2. Changes have also been made to the number and location of bus routes in the area also, and a number of new park and ride sites are also now in use. The main impact of this has been on the bus station, which now has more than 1000 bus movements per day.

3.3 AIR QUALITY MONITORING

During 2005, monitoring of air quality has taken place at a number of locations in the city. There have been 3 sites in the AURN network – Norwich Centre (monitoring for the full period), Norwich Roadside (until February 2005) and Norwich Forum Roadside (from April 2005 onwards). Norwich Roadside and Norwich Forum roadside both measure NOx and NO_2, and the Norwich Centre site measures CO, PM_{10}, NOx and NO_2, O_3 and SO_2. In addition to these sites, automatic monitoring has also taken place at Norwich Airport for CO, PM_{10}, NOx and NO_2, O_3 and SO_2.

Diffusion tube monitoring has also been carried out at a number of locations within the city, with the analysis undertaken by Gradko Laboratories. A collocation study has been carried out at the Norwich Centre site to obtain a bias adjustment factor for these tubes.

Details of the site locations are included in appendix 1.

3.4 MAPS AND DISTANCES OF RECEPTORS FROM ROADS

Norwich City Council provided traffic data with details of the distance from the road of the nearest relevant receptor, and information about what type of receptor was present – commercial or residential. For roads where this information has not been provided, estimates were made based on OS landline™ data.

3.5 ROAD TRAFFIC DATA

3.5.1 Summary of traffic data provided

This section summarises the information used in this report; detailed information is given in Appendix 2. Appendix 2 lists the locations of the traffic flow and speed measurement points, flow and speed data and other relevant traffic statistics. Data were collated from a range of sources, including:

- **Data provided by Norwich City Council (from Norfolk County Council)**
- **Data held in the National Atmospheric Emissions Inventory (NAEI, 2004) where no other data were available.**

Where no average speed data were available, estimated speeds were used near receptors and junctions. Speeds slower than the national speed limits have been assigned to sections of roads in areas close to junctions.

3.5.2 Proportion of HGVs

Percentages of Cars and LGVs were available from the data provided by Norwich City Council. For other road links, the percentage of HGVs was estimated from the data held in the 2004 National Atmospheric Emissions Inventory.

3.5.3 Base year for traffic

For roads where a traffic census had been carried out, the base year was 2004. For some roads, traffic flow data was based on the SATURN model – this is a predicted 2007 flow. The base year for traffic flows from the NAEI database is 2004.

3.5.4 Traffic growth

Based on the trends observed between the 1999 and 2004 traffic censuses and the policies introduced in the Local Transport Plan, traffic flow is expected to decline, or at worst, remain constant. In light of this, it was considered that the 2004 data, and the 2007 modelled data, would be an appropriate representation of the 2005 situation.

3.5.5 Distance from the centre of the road to the kerbside and to the receptors

Road widths and the distances of receptors from the road were provided by Norwich City Council.

3.6 PART A AND B INDUSTRIAL PROCESSES

There are many part A and Part B industrial processes in Norwich, although no new processes have been identified since the last round of review and assessment.

3.7 SCREENING TOOLS

Appendix 4 includes outline details of the DMRB and other screening tools used in the assessment.

4 Updating and Screening Assessment for Carbon Monoxide

4.1 THE NATIONAL PERSPECTIVE

The main source of carbon monoxide in the United Kingdom is road transport, which accounted for 67% of total releases in 2000. Annual emissions of carbon monoxide have been falling steadily since the 1970s, and are expected to continue to do so. The automatic monitoring network recorded no exceedences of the objective in 2005 at any location across the UK.

4.2 STANDARD AND OBJECTIVE FOR CARBON MONOXIDE

The Government and the Devolved Administrations originally adopted an 8-hour running mean concentration of 11.6 mgm^{-3} as the air quality standard for carbon monoxide. A new objective was then set at a slightly tighter level of 10 mgm^{-3} as a running 8-hour mean concentration, to have been achieved by the end of 2003, bringing it into line with the second Air Quality Daughter Directive limit value.

4.3 CONCLUSIONS OF THE SECOND ROUND OF REVIEW AND ASSESSMENT FOR CARBON MONOXIDE

The Updating and Screening Assessment for 2004 concluded that the likelihood of an exceedence of the objective for CO was negligible, and the 2005 progress report concluded that this finding was still valid. No AQMAs have been declared for CO.

4.4 SCREENING ASSESSMENT OF CARBON MONOXIDE

4.4.1 Screening check list

The Technical Guidance LAQM TG(03) requires assessment of carbon monoxide to consider the following sources, data or locations:

- **Monitoring Data**
- **Very Busy Roads or junctions in built up areas**

These are described in the following sections.

4.4.2 Background Concentrations of carbon monoxide

The average background annual mean concentration for carbon monoxide estimated from the UK background maps (http://www.airqualityarchive.co.uk/archive/laqm/tools.php) and the year adjustment factors published in LAQM.TG(03) was 0.272mg m^{-3}, with a maximum concentration of 0.315mg m^{-3} in 2005.

4.4.3 Screening assessment of monitoring data

Monitoring of CO has taken place at the Norwich Centre for all of 2005, and Norwich Airport until October 2005.

The maximum running 8-hour mean measured at Norwich Centre was 2.4mg m^{-3}.
The maximum running 8-hour mean measured at Norwich Airport was 0.8mg m^{-3}.

4.4.4 Screening assessment for very busy roads

The guidance document LAQM TG(03)[1] requires assessment of CO only at 'very busy roads', or junctions in built up areas. A 'very busy' road is defined in LAQM TG(03) as a single carriageway road with a daily average traffic flow greater than 80,000 vehicles. Very busy dual carriageways and motorways have daily average traffic flows greater than 120,000 and 140,000 respectively. In addition to this, the guidance also states that these will only need to be assessed in areas where the estimated background concentration is expected to be above 1mg m^{-3}.

The maximum background concentration for Norwich is estimated at 0.315 mg m^{-3}, and based on the traffic data supplied by Norwich City Council, there are no roads that can be classified as 'very busy.'

4.5 CONCLUSIONS FOR CARBON MONOXIDE CONCENTRATIONS IN COUNCIL AREA

There are no roads that can be classified as very busy, and the monitoring data suggests that the exceedance of the objective is unlikely. A detailed assessment is therefore not required for Norwich City Council.

5 Updating and Screening Assessment for Benzene

5.1 THE NATIONAL PERSPECTIVE

The main sources of benzene emissions in the UK are petrol-engined vehicles, petrol refining, storage and the distribution and uncontrolled emissions from petrol station forecourts without vapour recovery systems. A number of policy measures already in place, or planned for future years, will continue to reduce emissions of benzene. Since January 2000, EU legislation has reduced the maximum benzene content of petrol to 1%, from a previous upper limit of 5%. The European Auto-Oil programme will further reduce emissions for cars and light-duty vehicles, and emissions of benzene from the storage and distribution of petrol are controlled by vapour recovery systems. The UK automatic monitoring network recorded no exceedances of the 2003 objective in 2003, or later years. Whilst the 2010 objectives are expected to be met at all urban background, and most roadside locations, there is the possibility for some remaining exceedances, which will require additional measures at a local level.

5.2 STANDARD AND OBJECTIVE FOR BENZENE

The Government and the Devolved Administrations have adopted a running annual mean concentration of 16.25 μgm^{-3} as the air quality standard for benzene, with an objective for the standard to have been achieved by the end of 2003. However, in light of the health advice from EPAQS and the Department of Health's Committee on Carcinogenicity of Chemicals in Food, Consumer Products and the Environment (COC) to reduce concentrations of benzene in air to as low a level as possible, additional tighter objectives have also been set. The additional objective is for an annual mean of 5 μgm^{-3} to be achieved by the end of 2010 in England and Wales.

5.3 CONCLUSIONS OF THE SECOND ROUND OF REVIEW AND ASSESSMENT FOR BENZENE

The following conclusions were given for benzene in the First and Second Stage Review and Assessment for Norwich.

- **There are no major industrial processes which have the potential, individually or cumulatively, to result in elevated levels of benzene in relevant locations in the Norwich City Council Area;**

The national policies were expected to deliver the air quality objective for benzene and hence there was no need to undertake a detailed assessment for benzene. No AQMAs have been declared for benzene.

5.4 SCREENING ASSESSMENT OF BENZENE

5.4.1 Screening check list

The Technical Guidance LAQM TG(03)[1] requires assessment of benzene to consider the following sources, data or locations:

- **Monitoring Data outside an AQMA**
- **Monitoring Data within an AQMA**
- **Very Busy Roads or Junctions in Built-up Areas**
- **New Industrial Sources**
- **Industrial sources with substantially increased emissions or new relevant exposure**
- **Petrol Stations**
- **Major Fuel Storage Depots (Petroleum only)**

These are described in the following sections.

5.4.2 Background concentrations for benzene

The average background benzene concentration in Norwich City, estimated from the UK 2003 background maps[5] was 0.61 μgm^{-3}, with a maximum concentration of 0.76 μgm^{-3}. This was well below the objective, and the projected concentrations for 2010 are even lower, with an average concentration of 0.47μgm^{-3}, and a maximum 0.592μgm^{-3}.

5.4.3 Screening assessment of monitoring data

5.4.3.1 Monitoring data outside an AQMA

Monitoring for benzene is carried out at three locations in Norwich, using diffusion tubes. The annual means measured for 2005 are detailed below:

Site Name	Site Type	Grid Ref	Annual Mean
Unthank Road	Roadside	TG 220 081	2.4μgm^{-3}.
St Augustines	Kerbside	TG 228 095	4.4μgm^{-3}.
Guildhall	Intermediate	TG 229 085	1.1μgm^{-3}.

The highest concentration measured is at the Unthank Road site, which is measuring kerbside concentrations. These are all below both the 2003 and 2010 objectives, and predictions suggest that the concentrations are likely to decrease further, so that an exceedance of the 2010 objective is unlikely.

5.4.3.2 Monitoring data within an AQMA

No AQMAs have been declared for benzene.

5.4.4 Screening assessment of very busy roads

The guidance document LAQM TG(03)[1] requires assessment of benzene only at 'very busy roads', or at junctions in built up areas, with a predicted background concentration of more than 2 μgm^{-3} (Appendix 2 Table A2.1).

The traffic flow data provided by Norwich City Council indicates that there are not roads in the area which can be classified as 'very busy,' and the background concentration is also estimated to be below the threshold.

5.4.5 Screening assessment of industrial sources

The Guidance LAQM TG(03) lists the following processes as significant potential sources of benzene:

Part A (percentage of total emissions from all UK plant in this sector to the UK total in brackets)
Petroleum processes (73)
Petrochemical processes (2)
Carbonisation processes (12)
Cement/lime manufacture (7)
Gasification processes (5)

Part B
Processes for the storage and unloading of petrol at terminals

None of the industrial plant in the area operate these processes or have the potential to emit benzene.

5.4.6 Screening assessment of Petrol Stations

There are a number of petrol stations in Norwich, which are authorised as Part B processes. The guidance requires petrol stations to be considered only if they are near a busy road, that is with more than 30,000 vehicles per day and have a throughput greater than 2 million litres. There are no petrol stations that meet these criteria, and no places where members of the public might regularly be exposed within 10m of the pumps.

5.4.7 Screening assessment of Fuel Storage Depots

There are no major fuel storage depots in the city council area.

5.5 CONCLUSIONS FOR BENZENE IN COUNCIL AREA

The monitoring data suggests that an exceedance of the 2003 and 2010 objectives for benzene is unlikely. There are no roads in Norwich that can be classified as 'very busy' with relevant exposure according to the criteria in the guidance. There are also no petrol stations that meet the criteria for assessment, and no petrol storage depots.

Norwich City Council is not required to carry out a Detailed Assessment for benzene.

6 Updating and Screening Assessment for 1,3-Butadiene

6.1 THE NATIONAL PERSPECTIVE

The main source of 1,3-butadiene in the United Kingdom is emissions from motor vehicle exhausts. 1,3-butadiene is also an important industrial chemical and is handled in bulk at a small number of industrial premises. Maximum running annual mean concentrations of 1,3-butadiene measured at all urban background/centre and roadside locations in the national network are all well below the 2003 objective of 2.25 µgm^{-3}. The increasing numbers of vehicles equipped with three way catalysts will significantly reduce emissions of 1,3-butadiene in future years. Recently agreed further reductions in vehicle emissions and improvements to fuel quality are expected to further reduce emissions of 1,3-butadiene from vehicle exhausts.

6.2 STANDARD AND OBJECTIVE FOR 1,3-BUTADIENE

The Government and the Devolved Administrations have adopted a maximum running annual mean concentration of 2.25 µgm^{-3} as an air quality standard for 1,3-butadiene. The objective is for the standard to have been achieved by the end of 2003.

6.3 CONCLUSIONS OF THE SECOND ROUND OF REVIEW AND ASSESSMENT FOR 1,3-BUTADIENE

Previous rounds of review and assessment for Norwich City concluded that:

- **There are no major industrial sources of 1,3 butadiene**

Emissions from vehicles were also expected to decrease. A detailed assessment for 1,3-butadiene was not required. No AQMAs have been declared for 1,3-butadiene.

6.4 SCREENING ASSESSMENT OF 1,3-BUTADIENE

6.4.1 Screening check list

The Technical Guidance LAQM TG(03) requires assessment of 1,3-butadiene to consider the following sources, data or locations:

- **Monitoring Data**
- **New Industrial Sources**
- **Existing Industrial Sources with Significantly Increased Emissions, or new relevant exposure**

These are described in the following sections.

6.4.2 Background concentrations for 1,3-Butadiene

The average background 1,3-butadiene concentration for 2005 estimated from the UK background maps[5] and the year adjustment factors was 0.19 µgm^{-3} with a maximum concentration of 0.24 µgm^{-3}.

6.4.3 Screening assessment of monitoring data

No monitoring of 1,3-butadiene has been undertaken in Norwich, or in any neighbouring authorities.

6.4.4 Screening assessment of industrial sources

The Guidance LAQM TG(03) lists the following processes as significant potential sources of 1,3-butadiene:

Part A (percentage of total emissions from all UK plant in this sector to the UK total in brackets)
Petroleum processes (2)
Petrochemical processes (95)
Organic chemical manufacture (3)

Part B
Rubber processes

None of the above processes was identified in the City or in adjacent authorities, or is believed to have the potential to emit 1,3-butadiene.

6.5 CONCLUSIONS FOR 1,3-BUTADIENE CONCENTRATIONS IN COUNCIL AREA

Estimated background concentrations indicate that the objective for 1,3-butadiene was achieved by the end of 2003, and the 2005 values show that the standard is continuing to be met. There are no significant industrial sources that have the potential to emit 1,3-butadiene.

Consequently, Norwich City Council is not required to carry out a Detailed Assessment for 1,3-butadiene.

7 Updating and Screening Assessment for Lead

7.1 THE NATIONAL PERSPECTIVE

The agreement reached between the European Parliament and the Environment Council on the Directive on the Quality of Petrol and Diesel Fuels (part of the Auto-Oil Programme) led to the ban on sales of leaded petrol in the United Kingdom with effect from 1 January 2000. Emissions of lead are now restricted to a variety of industrial activities, such as battery manufacture, pigments in paints and glazes, alloys, radiation shielding, tank lining and piping.

Detailed assessments of the potential impact of lead emissions from industrial processes have been undertaken by the Government and the Devolved Administrations, based upon both monitoring and sector analysis studies. The former has included a 12-month monitoring survey in the vicinity of 30 key industrial sites in the UK, which has been used to supplement information already provided from the non-automatic monitoring networks. These monitoring data have generally indicated no exceedances of the 2004 or 2008 objectives, although locations in proximity to non-ferrous metal production and foundry processes were deemed to be at risk.

7.2 STANDARD AND OBJECTIVE FOR LEAD

The Government and the Devolved Administrations adopted an annual mean concentration of 0.5 μgm^{-3} as the air quality standard for lead, with an objective for the standard to have been achieved by the end of 2004. In addition, a lower air quality objective of 0.25 μgm^{-3} has also been set to be achieved by the end of 2008.

7.3 CONCLUSIONS OF THE SECOND ROUND OF REVIEW AND ASSESSMENT FOR LEAD

The following conclusions were given for lead in the First and Second Stage Review and Assessment for Norwich.

- **The first round of review and assessment identified one point source of potential lead emissions. The second stage review indicated that this was not significant.**
- **The second round identified no new industrial sources and concluded that the risk of exceedance of the air quality objective was negligible.**

No AQMAs have been declared for lead.

7.4 SCREENING ASSESSMENT OF LEAD

7.4.1 Source checklist

The Technical Guidance LAQM TG(03) requires assessment of lead to consider the following sources, data or locations:

- **Monitoring Data**
- **New Industrial Sources**
- **Existing Industrial Sources with Significantly Increased Emissions or new relevant exposure**

These are described in the following sections.

7.4.2 Screening assessment of monitoring data

No monitoring of lead has been undertaken in Norwich.

Annual average data for lead in 2001 at National monitoring sites were generally below the 2004 and 2008 objectives with the exception of one monitoring station (not near Norwich) located in an industrial area (0.419 μgm^{-3} which is within the 2004 objective but higher than the 0.25 μgm^{-3} objective for the end of 2008).

7.4.3 Screening assessment of industrial sources

The Guidance LAQM TG(03) lists the following processes as significant potential sources of lead:

Part A (percentage of total emissions from all UK plant in this sector to the UK total in brackets)
Iron and steel (37)
Non-ferrous metals (23)
Manufacture of organic chemicals (35)

Part B
Non-ferrous metal furnaces
Electrical furnaces
Blast cupolas
Aluminium processes
Zinc Processes
Copper processes
Lead glass manufacture

There are no new potential sources of lead in the Norwich City Council area that have not been considered in previous reviews. Anglia Lead was considered in the first round of Review and Assessment, and considered not to be a significant source. No existing sources have reported significant increases in emissions, and no new receptors have been located in the vicinity of these sources.

7.5 CONCLUSIONS FOR LEAD CONCENTRATIONS IN COUNCIL AREA

Emissions of lead from industrial processes in and around Norwich district are not likely to exceed the objectives for lead to be achieved in 2004 and 2008.

The Council is not required to carry out a Detailed Review and Assessment for lead.

8 Updating and Screening Assessment for Nitrogen Dioxide

8.1 THE NATIONAL PERSPECTIVE

The principal source of NO_x emissions is road transport, which accounted for about 40% of total UK emissions in 2003. Major roads carrying large volumes of high-speed traffic (such as motorways and other primary routes) are a predominant source, as are conurbations and city centres with congested traffic. Within most urban areas, the contribution of road transport to local emissions will be much greater than for the national picture.

Meeting the annual mean objective for 2005, and the corresponding limit value in 2010, is considerably more demanding than achieving the 1-hour objective. By 2005, the annual mean objective was being achieved at all urban background locations outside of London, but being exceeded more widely at roadside sites throughout the UK in close proximity to busy road links. Projections for 2010 indicate that the EU limit value may still be exceeded at urban background sites in inner London, and at roadside locations in other cities.

8.2 STANDARDS AND OBJECTIVES FOR NITROGEN DIOXIDE

The Government and the Devolved Administrations have adopted two Air Quality Objectives for nitrogen dioxide, as an annual mean concentration of 40 μgm^{-3}, and a 1-hour mean concentration of 200 $\mu g\ m^{-3}$ not to be exceeded more than 18 times per year. The objectives were to be achieved by the end of 2005.

8.3 CONCLUSIONS OF THE FIRST AND SECOND ROUNDS OF REVIEW AND ASSESSMENT FOR NITROGEN DIOXIDE

The following conclusions were given for nitrogen dioxide in the first round of review and assessment reports for Norwich:

- **There were likely to be some exceedences of the annual mean objective for NO_2 in some areas of Norwich.**
- **This had been predicted in the stage 3 and 4 review and assessment reports. The detailed modelling led to the declaration of 3 AQMAs.**

Since there were no significant changes identified in the last Updating and Screening Assessment, no detailed assessment for NO_2 was required in round 2. The three AQMAs were in the Grapes Hill, St Augustine's and Castle Meadow area of the city. These are illustrated in fig 3.1.

8.4 SCREENING ASSESSMENT OF NITROGEN DIOXIDE

8.4.1 Screening checklist

The Technical Guidance LAQM TG(03)[1] requires assessment of nitrogen dioxide to consider the following sources, data or locations:

- **Monitoring data outside an AQMA**
- **Monitoring data within an AQMA**
- **Narrow congested streets with residential properties close to the kerb**
- **Junctions**
- **Busy streets where people may spend 1-hour or more close to traffic**
- **Roads with high flow of buses and/or HGVs**
- **New roads constructed or proposed since last round of review and assessment**
- **Roads with significantly changed traffic flows or new, relevant exposure**

- Ø Bus Stations
- Ø New industrial sources
- Ø Industrial sources with substantially increased emissions or new relevant exposure
- Ø Aircraft

These are evaluated in the following sections.

8.4.2 Background concentrations for nitrogen dioxide

The estimated average background nitrogen dioxide concentration for 2005 was 28.9μgm^{-3} with a maximum concentration of 38.1μgm^{-3} near Grapes Hill and Chapel Field Road.

8.4.3 Screening assessment of monitoring data

8.4.3.1 Automatic monitoring data

Automatic monitoring data in Norwich was available in 2005 at three sites – Norwich Centre, Norwich Forum Roadside, and Norwich airport. These sites are all outside of the designated AQMAs. The Norwich Centre site is classified as an 'urban background' location, and the Norwich Forum site monitors roadside concentrations. More details of the measurements made, and the site locations are included in Appendix 1.

Data across the whole of 2005 is only available for the Norwich Centre site, which is part of DEFRA's Automatic Urban and Rural Network (AURN). This is an 'urban centre' site, measuring the background concentrations within the city. The Norwich Forum Roadside site replaced the old Norwich Roadside site, and began operation in April 2005. This is also an AURN site, measuring roadside concentrations. The Norwich Airport site is operated by Norwich City Council, and data is ratified by netcen to the same standard as the AURN sites. This measures background concentrations, but data from this site was only available until 26th October 2005.

A period adjustment calculation (detailed in the LAQM.TG(03) guidance) has been carried out for the two sites with less than one year's data. Data over the full 2005 period from Cambridge Roadside, and Norwich Centre have been used to calculate the ratios applied to the data from the other sites. These calculations are summarised in tables 8.1 and 8.2 below.

Table 8.1 Period Adjustment of data from Norwich Airport

Site	Period mean (01/01/2005-26/10/2005) µg m^{-3}	Annual Mean µg m^{-3}	Ratio
Norwich Centre	21.00	22.54	1.07
Cambridge Roadside	42.90	43.22	1.01
Average ratio			1.04
Norwich Airport	17.00	17.69	

Table 8.2 Period Adjustment of data from Norwich Forum Roadside

Site	Period mean (08/04/2005-31/12/2005) µg m^{-3}	Annual Mean µg m^{-3}	Ratio
Norwich Centre	21.75	22.54	1.04
Cambridge Roadside	42.42	43.42	1.02
Average ratio			1.03
Norwich Forum Roadside	33.80	34.81	

Table 8.3 Summary of automatic NO_2 data

Site Name	Type	Annual Mean
Norwich Centre	Urban Centre	22.5
Norwich Forum Roadside	Roadside	34.8
Norwich Airport	Background	17.7

This monitoring data at all of these sites has been ratified up until October 2005, and data from the rest of the year remains provisional. Decisions made based upon this data should be viewed with caution and reviewed at the next review and assessment report as required. However, the measured concentrations at all of these sites are below the standard of 40 µg m^{-3}, and it is therefore unlikely that the ratified data will show an exceedance.

8.4.3.2 Diffusion tube monitoring data

Diffusion tube monitoring has taken place at 33 locations in Norwich over 2005. Monitors have been set up in locations inside the existing AQMAs, and at other locations across the city. The diffusion tubes are analysed by Gradko , using the 50% TEA in acetone preparation method.

Three of the diffusion tubes have been co-located with the Norwich Centre site on St Georges Street. Using the mean concentrations measured by the three diffusion tubes, along with the concentration measured by the automatic monitor, it has been possible to calculate a bias adjustment factor of 0.969+/-0.066 using the netcen spreadsheet (available from http://www.airqualityarchive.co.uk/archive/laqm/tools.php). The recommended factor published by UWE (available from http://www.uwe.ac.uk/aqm/review/index.html) using results from this laboratory in 2005 was 1.18. This is higher than the factor calculated using the local co-location study. However, since the diffusion tube precision in Norwich was good, it has been decided that the local factor is more suitable for use in this study.

Concentrations measured at locations inside of the AQMAs are detailed in table 8.4.

Table 8.4 Annual Mean Nitrogen Dioxide Concentrations at sites within the AQMAs, μgm^{-3} (2005)

Site Name	Site type	Grid Ref	AQMA	2005 Annual Mean (measured)	Bias Correction Factor	2005 Annual Mean (bias corrected)*
Upper King St	Roadside	TG 233 086	Castle	36.8	0.969	35.7
Cattlemarket	Kerbside	TG 232 084	Castle	44.6	0.969	43.2
Castlemeadow (Mid)	Roadside	TG 231 085	Castle	48.5	0.969	47.0
Castlemeadow/Shire Hall	Roadside	TG 232 085	Castle	46.8	0.969	45.3
St Augustines	Kerbside	TG 228 095	St Augustines	52.6	0.969	51.0
Grapes Hill - Lower	Roadside	TG 224 087	Grapes Hill	28.4	0.969	27.5
Grapes Hill - Upper	Intermediate	TG 223 086	Grapes Hill	24.4	0.969	23.6
Wellington Lane - Lower	Intermediate	TG 224 087	Grapes Hill	33.5	0.969	32.4
Wellington Lane - Upper	Intermediate	TG 224 087	Grapes Hill	37.1	0.969	35.9
Johnson Place	Roadside	TG 224 084	Grapes Hill	41.8	0.969	40.5

* measured exceedances of the 2005 annual mean objective of 40$\mu g\ m^{-3}$ are shown in bold text

Of the ten monitoring sites set up within the AQMAs, five have measured concentrations greater than 40μgm^{-3}. Four of the sites within the Grapes Hill AQMA, however, have measured concentrations significantly below the objective. The remaining site within this area has recorded a concentration above the objective. This tube, however, is mounted on a lamppost in the middle of the road. The nearest residential receptors are on Johnson Place (outside of the AQMA), approximately 30m from the measurement location. Since the only tube recording a concentration exceeding the objective within this AQMA does not represent relevant public exposure, it may be possible to revoke this AQMA.

Concentrations measured outside of the AQMAs are detailed in table 8.5.

Table 8.5 Annual Mean Nitrogen Dioxide Concentrations at sites outside the AQMAs μgm^{-3} (2005)

Site Name	Site Type	Grid Ref	2005 Annual Mean (measured)	Bias Correction Factor	2005 Annual Mean (bias corrected)*
Earlham Rd	Roadside	TG 191 082	38.3	0.969	37.1
Colman Rd	Intermediate	TG 207 084	33.4	0.969	32.4
Vulcan Rd	Roadside	TG 222 117	39.4	0.969	38.2
Heartsease Lane	Roadside	TG 252 100	28.9	0.969	28.0
Tombland	Kerbside	TG 233 088	42.6	0.969	41.3
St Vedast St	Kerbside	TG 235 086	42.2	0.969	40.9
Eastbourne Pl.	Kerbside	TG 236 085	35.7	0.969	34.6
Riverside	Kerbside	TG 238 084	50.2	0.969	48.6
St Stephens St (mid)	Kerbside	TG 229 081	46.0	0.969	44.5
St Stephens St (top)	Intermediate	TG 228 080	38.4	0.969	37.2
Victoria St.	Kerbside	TG 227 079	35.1	0.969	34.0
Ipswich Rd	Kerbside	TG 225 074	29.2	0.969	28.3
Unthank Rd	Kerbside	TG 220 081	34.5	0.969	33.5
Bignold School	Roadside	TG 225 080	24.2	0.969	23.4
Chapel Field/Wessex	Roadside	TG 227 080	33.8	0.969	32.8

Site Name	Site Type	Grid Ref	2005 Annual Mean (measured)	Bias Correction Factor	2005 Annual Mean (bias corrected)*
St					
Chapel Field/Crescent	Roadside	TG 226 081	36.2	0.969	35.1
Theatre St	Kerbside	TG 227 083	38.0	0.969	36.8
Exchange St.	Kerbside	TG 230 087	39.6	0.969	38.4
St Georges 1	Intermediate	TG 230 089	24.2	0.969	23.4
St Georges 2	Intermediate	TG 230 089	22.7	0.969	22.0
St Georges 3	Intermediate	TG 230 089	23.0	0.969	22.3
28 Guildhall	Intermediate	TG 229 085	27.6	0.969	26.8
29 Ber St 1	Roadside	TG 234 078	29.5	0.969	28.6

*** measured exceedances of the 2005 annual mean objective of 40μg m^{-3} are shown in bold text**

The Bignold School site only has measurements for three months, so this result is not considered further. Of the remaining 21 sites, threehave measured annual means above the objective of 40μgm^{-3}.

The diffusion tube at the Tombland site measured 41.3μgm^{-3}. However, it is situated on a busy road near the Cathedral with commercial premises, public houses and restaurants along both sides of the road. Since there are no residential properties at this site, there is no relevant public exposure. The situation is similar at Riverside and St Vedast Street, where the objective was also exceeded, but the buildings in the area are commercial premises, public houses, restaurants and nightclubs. St Stephen's Street is one of the city's main shopping streets, with a number of large department stores along the road. These are also not relevant receptors for the annual mean objective.

Since the objective has not been exceeded at any relevant locations outside of the AQMAs, no action is needed relating to the assessment of the monitoring data.

8.4.4 Screening assessment of road traffic sources

Traffic flow data were taken from the NAEI 2004 roads database and from traffic count data for roads in Norwich for 2004, and modelled traffic count data for 2007 supplied by the Council (Appendix 2). For screening purposes, appropriate receptor distances based on the closest property where public exposure was likely and annual average speeds for the road were used. Norwich City Council's traffic planners predict that traffic in the city is likely to decrease between 2004 and 2010, or at worst, remain the same. 2004 figures have therefore been used for all years assessed, as a worst-case assessment.

Table 8.6 shows nitrogen dioxide concentrations in 2005 calculated using DMRB for major roads in the area. The roads have been assessed using both information from the NAEI traffic database, and data provided by Norwich City Council. Other roads for which the Council provided data have also been assessed. There is one 'street canyon' in the area – St Augustines. The contribution to the NO_2 concentration of the traffic has been doubled in order to take this into consideration.

Although monitoring data has shown a number of exceedances, the DMRB screening model indicates that the annual mean objective for NO_2 is unlikely to have been exceeded alongside any road in the city in 2005. This maybe because the model takes into account the distances to the nearest receptors, whereas the monitoring data often measures kerbside concentrations, or due to the lack of reliable information about traffic speeds, queuing and congestion.

Table 8.6 Estimated nitrogen dioxide concentrations near roads in Norwich in 2005

Source	Road name	Distance from link centre to receptor (m)	AADT (combined, veh/day)	Annual average speed (km/h)	Total % HDV	NO_2 (mg/m^3)
NAEI	Sweet Briar Road	5	27898	30	7.72	32.45
NAEI	Thorpe Road	5	17256	30	3.32	26.59
NAEI	Pitt Street	5	16893	30	2.24	27.47
NAEI	Carrow Road	5	10862	30	4.23	25.89
NAEI	Martineau Lane	5	35322	30	4.16	29.25
NAEI	Chartwell Road	5	29685	30	3.62	29.43
NAEI	Daniels Road	5	21280	30	4.46	29.60
NAEI	Barn Road	5	33260	30	2.37	29.09
NAEI	Riverside rd/barrak st	5	16230	30	3.96	29.26
NAEI	King St	5	23106	30	3.48	28.08
NAEI	Drayton Road	5	16642	30	2.57	27.14
NAEI	Boundary Road	5	25459	30	7.44	32.16
NAEI	St Stephen's Road	5	22191	30	5.93	30.89
NAEI	Mile Cross Road	5	23300	30	3.00	27.87
NAEI	Drayton Road	5	10551	30	3.12	25.32
NAEI	Dereham Road	5	9227	30	3.80	25.53
NAEI	Sprowston Road	5	14810	30	3.52	27.57
NAEI	Thorpe Road	5	6201	30	5.98	24.41

Source	Road name	Distance from link centre to receptor (m)	AADT (combined, veh/day)	Annual average speed (km/h)	Total % HDV	NO_2 (mg/m^3)
NAEI	St Crispin Road	5	24813	30	2.29	28.32
NAEI	Bull Close Road	5	12678	30	1.63	26.07
NAEI	Newmarket Road	5	22127	30	6.19	31.08
NAEI	Barrett Road	5	15917	30	3.27	26.37
NAEI	Grapes Hill	5	31651	30	3.22	30.06
NAEI	Mile Cross Road	5	13114	30	2.91	24.83
NAEI	Barrack St	5	24075	30	2.23	27.09
NAEI	Newmarket Road	5	15355	30	6.28	30.06
NAEI	Colman Road	5	21812	30	6.51	29.92
NAEI	Aylsham Road	5	19453	30	3.22	26.33
NAEI	Ipswich Road	5	14971	30	5.16	26.97
NAEI	Ipswich Road	5	10607	30	4.99	27.13
NAEI	Aylsham Road	5	13434	30	3.36	26.00
NAEI	Queens Road	5	22264	30	3.95	30.41
NAEI	Riverside Rd (nr station)	5	13373	30	2.80	25.31
NAEI	Dereham Road	5	15387	30	3.94	28.85
NAEI	Dereham Road	5	22157	30	5.77	28.12
NAEI	Thorpe Road	5	11497	30	2.91	25.93
NAEI	A1242	5	10010	30	4.40	25.60
NAEI	Lakenham Road	5	17457	30	4.29	28.95
NAEI	Heartease Lane	5	17598	30	6.07	28.56
NAEI	Bracondale	5	24995	30	4.49	28.51
NAEI	A146	5	28009	30	4.04	28.45
Council	Colman Road	15	21812	30	6.50	29.12
Council	Newmarket Road	9	15355	30	6.30	29.17
Council	Ipswich Road	7	10607	20	5.00	27.35
Council	Grapes Hill	11	31651	20	3.20	29.21
Council	St Stephens Road	8	22191	30	5.90	30.11
Council	St Crispins Road	9	24813	35	2.30	27.15
Council	Barn Road	25	33260	30	2.40	25.89
Council	Barrack Street	7	24075	20	2.20	28.11
Council	Pitt Street	15	16893	20	2.20	26.28
Council	Pitt Street	15	16893	20	2.24	26.31
Council	Boundary Rd	8	25459	20	7.44	33.16
Council	Chapelfield Rd (St Stephens rbt)	10	30401	25	3.50	29.07
Council	St Stephens Road	8	21523	30	5.90	30.01
Council	Guardian Rd	14	25981	40	5.60	28.61
Council	St Augustines	5.5	17550	20	2.80	34.92
Council	Pitt Street	7	17519	20	2.80	27.96
Council	Castle Meadow	8.5	2001	10	100.00	37.52
Council	Dereham Road	28	29198	25	6.53	28.06
Council	Norwich Road	20	8502	20	2.38	23.85
Council	Red Lion Steet	8	3625	20	52.40	33.18
Council	Farmers Avenue	6	9741	10	2.64	26.62
Council	Cattlemarket Street	7	26209	25	1.30	27.03
Council	Rouen road	8	6603	20	0.91	23.38
Council	Bracondale	8.5	30777	20	2.95	29.32
Council	King Street	8	25157	20	1.98	27.85
Council	Mile End Road	11	21364	30	4.51	28.44
Council	Unthank Road (outside ORR)	10	6088	30	0.00	22.68
Council	Chapelfield Road - Johnson Place	15	32125	20	3.30	28.61
Council	Riverside Road	8	13244	20	5.05	28.56
Council	POW at St Vedast	9	9522	30	5.06	25.95
Council	St Vedast Street	5	5233	20	1.09	23.12
Council	POW at Eastbourne Place	9	14575	30	6.46	29.01
Council	Eastbourne Place	4	3933	20	0.00	22.36
Council	Tombland	5	15259	30	8.44	31.13
Council	St Stephens Street	12	7136	15	20.90	32.12

As part of this assessment, the following items from the checklist have been considered:

- **Narrow congested properties with residential properties close to the kerb – none have been identified**
- **Busy streets where people may spend 1-hour or more close to traffic – the main shopping areas have been included in the above assessment (Chapelfield Road) and no exceedances of the annual mean objective or the 1-hour mean have been predicted.**
- **Roads with high flow of buses and/or HGVs – Castle Meadow and Red Lion Street have flows of HDVs of 100 and 52% respectively. No exceedances have been predicted.**

- New roads constructed or proposed since the last round of review and assessment – no new roads have been constructed. The only major changes to the road network have been the introduction of new bus lanes. This has been included in the traffic data provided, and therefore considered in the above assessment.
- Roads with significantly changed traffic flows or new, relevant exposure – changes to the traffic flows since the last round of review and assessment have been considered in the above screening assessment.

8.4.5 Busy Junctions

Annual average NO_2 concentrations near busy road junctions in the district have been estimated for 2005 using DMRB (Table 8.7). The junctions assessed have relatively high combined traffic flows from both of the road links, or, in the case of the Red Lion Street/ Farmers Avenue junction, a high flow of HDVs.

The DMRB screening model indicates that the 2005 annual mean objective for NO_2 is unlikely to have been exceeded at receptors near busy road junctions (see Table 8.7). However, there are a number of sources of error in the values calculated due to uncertainties in the speeds used, and lack of information about queuing and congestion.

Table 8.7 Estimated nitrogen dioxide concentrations near road junctions in Norwich, 2005

Receptor number	Name	AADT	Distance from receptor	Annual Average Speed (km/h)	% HDV	NO_2 *
						Annual mean mg/m^3
1	Mile End Road	21364	18	20	4.5	31.75
	Newmarket Road	22127	32	20	6.19	
2	Red Lion	3625	17	20	52.4	34.79
	Farmers Avenue	9741	6	10	2.6	
3	Colman Road	21812	12	20	6.5	30.90
	Unthank Road	6088	10	20	0	
4	Barn Road	33260	25	20	2.3	32.95
	Dereham Road	15387	10	20	3.9	
5	King Street	25157	10	20	2	29.13
	Rouen Road	6603	10	20	0.9	

8.4.6 Screening assessment of industrial sources

The Guidance LAQM TG(03)[1] lists the following processes as significant potential sources of nitrogen dioxide:

Part A (percentage of total emissions from all UK plant in this sector to the UK total in brackets)
Iron and steel (19)
Petroleum processes (16)
Combustion processes (34)
Cement/lime manufacture (9)
Carbonisation (6)
Gasification (4)
Inorganic chemicals (4)

Part B
Glass manufacture

No new industrial sources have started operating in the district since the last round of review and assessment. There are no Part A processes in Norwich City or in adjoining authorities reporting significant emissions of nitrogen oxides to the Environment Agency.

Several Part B processes are present in the area however these processes are not associated with glass manufacture.

8.4.7 Screening assessment of other transport sources

Bus Stations : The number of bus movements at Norwich bus station is estimated to be around 1200 movements per day, as the bus stations now caters for buses from the Park and Ride sites around the city. Buses enter and leave the site on both Queen's Street and Surrey Street. Traffic count data indicates that approximately half of the buses travel along each of the roads. The assessment of Queens Street using data from the NAEI traffic database indicates that there are no likely exceedences of the objective for NO_2 along this road. No traffic data has been collected for Surrey Street, although there are currently no residential properties within 10m of the bus station.

A new housing development is being planned for the vacant plot close to the east side of the bus station, but it is not yet clear how close the houses will be to the site. The access routes for the bus station will remain on the streets they are now, so that it is unlikely that the bus station will affect these houses. This will need to be considered further once more is known about the new development.

Airports: Norwich Airport had 550,000 passengers and lifted 78 tonnes of freight in 2005. This is well below the threshold of 5 mppa (million passengers per annum) equivalent. This source therefore does not need to be considered further.

8.5 CONCLUSIONS FOR NITROGEN DIOXIDE CONCENTRATIONS IN COUNCIL AREA

There are no significant industrial sources of nitrogen dioxide in Norwich. The DMRB screening tool indicates that nitrogen dioxide levels at sites of relevant exposure alongside the district's roads are unlikely to exceed the 2005 annual mean objective. Diffusion tube data, however, does show exceedences, but the only relevant locations are within existing AQMAs. Norwich City Council is not required to proceed to a detailed assessment for NO_2.

9 Updating and Screening Assessment for Sulphur Dioxide

9.1 THE NATIONAL PERSPECTIVE

The main source of sulphur dioxide in the United Kingdom is power stations, which accounted for 69% of emissions in 2004. There are also significant emissions from other industrial combustion sources. Emissions from domestic sources fell by 34% in 2002-2003, but these can still have a significant effect locally. Road transport currently accounts for less than 1% of emissions.

Local exceedences of the objectives (principally the 15-minute mean objective) may occur in the vicinity of small combustion plant (less than 20 MW), which burn coal or oil, in areas where solid fuels are the predominant form of domestic heating, and in the vicinity of major ports.

9.2 STANDARD AND OBJECTIVE FOR SULPHUR DIOXIDE

The Government and the Devolved Administrations have adopted a 15-minute mean of 266 µgm^{-3} as an air quality standard for sulphur dioxide, with an objective for the standard not to be exceeded more than 35 times in a year by the end of 2005.

Additional objectives have also been set which are equivalent to the EU limit values specified in the First Air Quality Daughter Directive. These are for a 1-hour mean objective of 350 µgm^{-3}, to be exceeded no more than 24 times per year, and a 24-hour objective of 125 µgm^{-3}, to be exceeded no more than 3 times per year, to be achieved by the end of 2004.

9.3 CONCLUSIONS OF THE SECOND ROUND OF REVIEW AND ASSESSMENT FOR SULPHUR DIOXIDE

The First and Second Stage Review and Assessment report for Norwich City concluded that:

- **There are no significant sources of sulphur dioxide in the Norwich area, or in adjacent local authority areas.**

No AQMAs have been declared for SO_2 in Norwich.

9.4 SCREENING ASSESSMENT OF SULPHUR DIOXIDE

9.4.1 Source checklist

The Technical Guidance LAQM TG(03) requires assessment of sulphur dioxide to consider the following sources, data or locations:

- **Monitoring data outside an AQMA**
- **Monitoring data within an AQMA**
- **New industrial sources**
- **Industrial sources with substantially increased emissions, or new relevant exposure**
- **Areas of domestic coal burning**
- **Small boilers (>5MW (thermal)) burning coal or oil**
- **Shipping**
- **Railway Locomotives**

These are evaluated in the following sections.

9.4.2 Background concentrations for sulphur dioxide

The estimated average background sulphur dioxide concentration for 2001 was 2.76μgm^{-3} with a maximum concentration of 6.63 μgm^{-3}.

9.4.3 Screening assessment of monitoring data

Monitoring of SO_2 in 2005 took place at the Norwich Centre and Norwich Airport sites. Table 9.1 summarises the results from these sites.

Site	Maximum 15 minute mean	Maximum hourly mean	Maximum daily mean
Norwich Centre	74	51	26
Norwich Airport	59	45	30

The measured concentrations for 2005 are well below all of the objectives at both sites, although the Norwich Airport measurements do not cover the full year.

9.4.4 Screening assessment of industrial sources

The Guidance LAQM TG(03)[1] lists the following processes as significant potential sources of sulphur dioxide:

Part A (percentage of total emissions from all UK plant in this sector to the UK total in brackets)
Iron and steel (9)
Petroleum processes (15)
Combustion processes (45)
Cement/lime manufacture (3)
Carbonisation (10)
Non-ferrous metals (7)
Ceramic Production (9)

Part B
Combustion plant 20-50 mwth
Furnaces 20-50 mwth
Copper processes
Refractory goods
Glass manufacture
Roadstone coating

No potential industrial sources of SO_2 have been identified in previous rounds of review and assessment. No new sources have been identified since the last round.

9.4.5 Small Boilers

No small boilers meeting the criteria specified in the guidance have been identified in the Norwich area.

9.4.6 Domestic coal burning

There are no data for domestic coal burning available but NAEI activity statistics indicate that coal solid fuel use continues to decline throughout the area. Norwich City Council advise that it is unlikely that there are any areas with 100 houses using these fuels in a 500 m square.

9.4.7 Screening assessment of other transport Sources

Shipping : There are no shipping movements in the district.

Railways : No locations were identified within the district where locomotives are stationary for prolonged periods. The main line at Norwich Station is electrified.

9.5 CONCLUSIONS FOR SULPHUR DIOXIDE CONCENTRATIONS IN COUNCIL AREA

There are no significant industrial or domestic sources of sulphur dioxide in Norwich.

Norwich City Council is not required to carry out a Detailed Review and Assessment for sulphur dioxide.

10 Updating and Screening Assessment for PM_{10}

10.1 THE NATIONAL PERSPECTIVE

National UK emissions of primary PM_{10} have been estimated as totalling 141,000 tonnes in 2003. Of this total, around 27% was derived from road transport sources. It should be noted that, in general, the emissions estimates for PM_{10} are less accurate than those for the other pollutants with prescribed objectives, especially for sources other than road transport.

The Government established the Airborne Particles Expert Group (APEG) to advise on sources of PM_{10} in the UK and current and future ambient concentrations. Their conclusions were published in January 1999 (APEG, 1999). APEG concluded that a significant proportion of the current annual average PM_{10} is due to the secondary formation of particulate sulphates and nitrates, resulting from the oxidation of sulphur and nitrogen oxides. These are regional scale pollutants and the annual concentrations do not vary greatly over a scale of tens of kilometres. There are also natural or semi-natural sources such as wind-blown dust and sea salt particles. The impact of local urban sources is superimposed on this regional background. Such local sources are generally responsible for winter episodes of hourly mean concentrations of PM_{10} above 100 $\mu g\ m^{-3}$ associated with poor dispersion. However, it is clear that many of the sources of PM_{10} are outside the control of individual local authorities and the estimation of future concentrations of PM_{10} are in part dependent on predictions of the secondary particle component.

10.2 STANDARD AND OBJECTIVE FOR PM_{10}

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 in the first Air Quality Daughter Directive. The objectives are 40 μgm^{-3} as the annual mean, and 50 μgm^{-3} as the fixed 24-hour mean to be exceeded on no more than 35 days per year, to have been achieved by the end of 2004. In addition there is an objective of 50 μgm^{-3} as the fixed 24-hour mean to be exceeded on no more than 7 days per year and 20 μgm^{-3} as the annual mean to be achieved by the end of 2010. The objectives are based upon measurements carried out using the European gravimetric transfer reference sampler or equivalent.

It should be noted that the objectives for 2010, based on the Stage 2 EU Limit Values have not been included in the Air Quality Regulations for England, and local authorities are not currently required to assess against them. In addition, they were the subject of the European Commission's recent review of the First Daughter Directive.

The Commission is currently consulting on a new consolidated Directive on Ambient Air Quality, which is likely to see changes to the above Limit Values, though the nature of these changes cannot be confirmed at this time.

10.3 CONCLUSIONS OF THE SECOND ROUND OF REVIEW AND ASSESSMENT FOR PM_{10}

The following conclusions were given for PM_{10} in the First and Second Stage Review and Assessment report for Norwich:

- The first round of review and assessment concluded that there was not a significant risk of exceeding the PM_{10} objective.
- The Updating and Screening Assessment for 2002/2003 concluded that the 2004 objectives were unlikely to be exceeded, but predictions indicated that the 2010 objectives were likely to be exceeded in a number of locations.

A detailed assessment was not required. No AQMAs have been declared for PM_{10}.

10.4 SCREENING ASSESSMENT OF PM_{10}

10.4.1 Checklist for PM_{10}

The Technical Guidance LAQM TG(03)[1] requires assessment of PM_{10} to consider the following sources, data or locations:

- **Monitoring data outside an AQMA**
- **Monitoring data within an AQMA**
- **Junctions**
- **Roads with high flow of buses and/or HGVs**
- **New roads constructed or proposed since last round of review and assessment**
- **Roads close to the objective during the last round of review and assessment**
- **Roads with significantly changed traffic flows, or new relevant exposure**
- **New industrial sources**
- **Industrial sources with substantially increased emissions, or new relevant exposure**
- **Areas with domestic solid fuel burning**
- **Quarries, landfill sites, opencast coal, handling of dusty cargoes at ports etc**
- **Aircraft**

These are evaluated in the following sections.

10.4.2 Background concentrations for PM_{10}

The estimated average background PM_{10} concentration for 2005 was 23.7 μgm^{-3} in Norwich City with a maximum concentration of 26.3 μgm^{-3}.

10.4.3 Screening assessment of monitoring data

Monitoring of PM_{10} has taken place at both the Norwich Centre, and the Norwich Airport monitoring sites. Both of these sites use TEOM analysers. The measured concentrations have been corrected by a factor of 1.3 to make them equivalent to measurements made with a gravimetric analyser. Results of the monitoring are summarised in table 10.1.

Table 10.1 Summary of PM_{10} Monitoring data

Site	Period Mean	Maximum Daily Mean	Number of exceedances of daily mean objective
Norwich Centre	16.9	44.2	0
Norwich Airport	22.1	58.5	4

The Norwich Centre site recorded no exceedances of the 2004 objectives, and by using the methodology in the Guidance, the projected value for 2010 is 16.18, which is below the 20μgm^{-3} limit value. The Norwich Airport site was only in operation until October. However, the only nearby site suitable for the calculation of a ratio to adjust the result to reflect the full year is Norwich Centre. The guidance recommends using data from 2-4 local sites, so it has not been possible to estimate the annual mean at this site or to project the values forward to 2010. However, the mean value over the period monitored is well below the 2004 objective, and there were only 4 exceedences in of the 24 hour objective. It is therefore unlikely that the 2004 standards were breached in 2005 at this site.

10.4.4 Screening assessment of road traffic sources

Traffic flow data were taken from the NAEI roads database, 2004 traffic count data and 2007 modelled traffic data provided by the Council (Appendix 2). For screening purposes, appropriate receptor distances based on the closest property where public exposure was likely and annual average speeds for the roads were used. For road data from the NAEI database, a default speed of 30km/h and a default receptor distance of 5m has been used. Traffic is not predicted to grow in Norwich City between 2004 and 2010.

Table 10.2 shows predicted PM_{10} annual mean concentrations and predicted annual exceedences of the 24-hour mean in 2004 and 2010 calculated using DMRB for roads in Norwich.

Table 10.2 Modelled annual mean PM_{10} concentrations and 24 hour exceedances alongside roads in Norwich

Source	Road name	Receptor Distance (m)	AADT combined veh/day	Annual average speed (km/h)	Total %HDV	Annual mean 2005 (µg m^{-3})	Annual mean 2010 (µg m^{-3})	24 hour mean exceedances 2005	24 hour mean exceedances 2010
NAEI	Sweet Briar Road	5	27898	30	7.72	31.0	26.2	32	16
NAEI	Thorpe Road	5	17256	30	3.32	27.9	24.3	20	11
NAEI	Pitt Street	5	16893	30	2.24	28.0	24.5	21	11
NAEI	Carrow Road	5	10862	30	4.23	27.0	23.7	18	10
NAEI	Martineau Lane	5	35322	30	4.16	29.5	25.3	26	13
NAEI	Chartwell Road	5	29685	30	3.62	29.0	25.1	24	13
NAEI	Daniels Road	5	21280	30	4.46	29.4	25.4	25	13
NAEI	Barn Road	5	33260	30	2.37	29.0	25.2	24	13
NAEI	Riverside rd/barrak st	5	16230	30	3.96	30.1	26.5	28	16
NAEI	King St	5	23106	30	3.48	28.4	24.6	22	12
NAEI	Drayton Road	5	16642	30	2.57	27.7	24.4	20	11
NAEI	Boundary Road	5	25459	30	7.44	30.4	25.8	29	14
NAEI	St Stephen's Road	5	22191	30	5.93	30.1	25.8	28	14
NAEI	Mile Cross Road	5	23300	30	3.00	28.6	25.0	23	12
NAEI	Drayton Road	5	10551	30	3.12	27.0	24.1	18	10
NAEI	Dereham Road	5	9227	30	3.80	27.0	24.0	18	10
NAEI	Sprowston Road	5	14810	30	3.52	27.8	24.4	20	11
NAEI	Thorpe Road	5	6201	30	5.98	26.0	23.2	15	8
NAEI	St Crispin Road	5	24813	30	2.29	28.5	24.8	22	12
NAEI	Bull Close Road	5	12678	30	1.63	27.2	24.0	18	10
NAEI	Newmarket Road	5	22127	30	6.19	30.2	25.8	28	14
NAEI	Barrett Road	5	15917	30	3.27	27.8	24.2	20	11
NAEI	Grapes Hill	5	31651	30	3.22	29.8	25.7	27	14
NAEI	Mile Cross Road	5	13114	30	2.91	27.2	24.1	18	10
NAEI	Barrack St	5	24075	30	2.23	28.0	24.4	21	11
NAEI	Newmarket Road	5	15355	30	6.28	29.5	25.4	26	13
NAEI	Colman Road	5	21812	30	6.51	29.5	25.1	26	13
NAEI	Aylsham Road	5	19453	30	3.22	28.1	24.6	21	11
NAEI	Ipswich Road	5	14971	30	5.16	27.8	24.1	20	10
NAEI	Ipswich Road	5	10607	30	4.99	27.8	24.5	20	11
NAEI	Aylsham Road	5	13434	30	3.36	27.2	24.0	18	10
NAEI	Queens Road	5	22264	30	3.95	29.5	25.5	26	14
NAEI	Riverside Rd (nr station)	5	13373	30	2.80	27.2	23.9	18	10
NAEI	Dereham Road	5	15387	30	3.94	28.9	25.1	23	13
NAEI	Dereham Road	5	22157	30	5.77	28.5	24.4	22	11
NAEI	Thorpe Road	5	11497	30	2.91	26.9	23.9	17	10
NAEI	A1242	5	10010	30	4.40	26.8	23.6	17	9
NAEI	Lakenham Road	5	17457	30	4.29	29.0	25.2	24	13
NAEI	Heartease Lane	5	17598	30	6.07	30.4	26.4	29	16
NAEI	Bracondale	5	24995	30	4.49	29.0	24.9	24	12
NAEI	A146	5	28009	30	4.04	29.0	24.9	24	12

Source	Road name	Receptor Distance (m)	AADT combined veh/day	Annual average speed (km/h)	Total %HDV	Annual mean 2005 (µg m^{-3})	Annual mean 2010 (µg m^{-3})	24 hour mean exceedances 2005	24 hour mean exceedances 2010
Council	Colman Road	15	21812	30	6.50	28.5	24.7	22	12
Council	Newmarket Road	9	15355	30	6.30	28.5	24.7	22	12
Council	Ipswich Road	7	10607	20	5.00	27.8	24.3	20	11
Council	Grapes Hill	11	31651	20	3.20	29.3	25.2	25	13
Council	St Stephens Road	8	22191	30	5.90	29.2	25.1	25	13
Council	St Crispins Road	9	24813	35	2.30	27.6	24.3	19	11
Council	Barn Road	25	33260	30	2.40	26.9	23.9	17	10
Council	Barrack Street	7	24075	20	2.20	28.7	24.9	23	12
Council	Pitt Street	15	16893	20	2.20	27.4	24.2	19	10
Council	Pitt Street	15	16893	20	2.24	27.4	24.2	19	10
Council	Boundary Rd	8	25459	20	7.44	31.5	26.4	34	16
Council	Chapelfield Rd	10	30401	25	3.50	29.0	25.1	24	13
Council	St Stephens Road	8	21523	30	5.90	29.1	25.1	24	13
Council	Guardian Rd	14	25981	40	5.60	28.0	24.4	21	11
Council	St Augustines	6	17550	20	2.80	28.5	24.8	22	12
Council	Pitt Street	7	17519	20	2.80	28.4	24.8	22	12
Council	Castle Meadow	9	2001	10	100.00	34.4	27.2	46	18
Council	Dereham Road	28	29198	25	6.53	28.0	24.4	21	11
Council	Norwich Road	20	8502	20	2.38	25.8	23.2	14	8
Council	Red Lion Steet	8	3625	20	52.40	30.6	25.5	30	14
Council	Farmers Avenue	6	9741	10	2.64	27.8	24.3	20	11
Council	Cattlemarket Street	7	26209	25	1.30	28.0	24.6	21	11
Council	Rouen road	8	6603	20	0.91	25.6	23.1	14	8
Council	Bracondale	9	30777	20	2.95	29.4	25.3	25	13
Council	King Street	8	25157	20	1.98	28.5	24.9	22	12
Council	Mile End Road	11	21364	30	4.51	28.3	24.6	22	12
Council	Unthank Road (outside ORR)	10	6088	30	0.00	25.2	22.9	13	8
Council	Chapelfield Road - Johnson Place	15	32125	20	3.30	28.8	25.0	23	12
Council	Riverside Road	8	13244	20	5.05	28.5	24.7	22	12
Council	POW at St Vedast	9	9522	30	5.06	26.7	23.7	17	10
Council	St Vedast Street	5	5233	20	1.09	25.4	23.0	13	8
Council	POW at Eastbourne Place	9	14575	30	6.46	28.4	24.7	22	12
Council	Eastbourne Place	4	3933	20	0.00	25.0	22.8	12	8
Council	Tombland	5	15259	30	8.44	29.6	25.3	26	13
Council	St Stephens Street	12	7136	15	20.90	30.4	25.5	29	14

The DMRB model indicates 46 exceedences of the 2004 daily mean objective alongside Castle Meadow, which is significantly more than the 35 exceedances permitted. Traffic along this road is restricted to buses and taxis only, so this road has a high proportion of HDVs. However, the nearest receptor is a commercial building, which is therefore not relevant for the 24-hour mean objective. The model does not indicate any exceedances of the 24 hour, or annual mean objectives at any other location.

The model indicates that the annual mean objective for 2004 is likely to have been met at all of the roadside locations assessed.

The predictions for 2010 indicate that the annual mean objective of 20μgm^{-3} will not be met at any roadside locations in the city, and that the 24 hour mean objective is also unlikely to be met.

The following items from the checklist for PM_{10} have also been considered:

- **Roads with a high flow of buses and/or HGVs – Castle Meadow (100% HDVs) and Red Lion Street (52% HDVs) were both considered in the above screening assessment for road transport sources.**
- **New roads constructed or proposed since the last round of review and assessment – no new roads have been constructed. The only major changes to the road network have been the introduction of new bus lanes. This has been included in the traffic data provided, and therefore considered in the above assessment.**
- **Roads close to the objective during the last round of review and assessment – there were no roads that were close to the objective during the last round of review and assessment.**
- **Roads with significantly changed traffic flows or new, relevant exposure – changes to the traffic flows since the last round of review and assessment have been considered in the above screening assessment**

10.4.5 Busy Junctions

Annual average PM_{10} concentrations and daily mean exceedances at receptors near busy road junctions in the city have been estimated for 2005 and 2010 using DMRB (Table 10.3 and 10.4).

The DMRB screening model indicates that the annual mean objective of 50 μgm^{-3} for PM_{10} was met in 2005. However, there were two locations where there were more than the permitted 35 exceedences of the 24 hour objective – the junctions of Red Lion Street and Farmers Avenue, and Barn Road and Dereham Road. The nearest receptors to both of these junctions are commercial properties, so these exceedance therefore does not need to be investigated further.

Table 10.3 Modelled annual mean PM_{10} concentrations and 24 hour exceedences at busy junctions in Norwich for 2005

Receptor number	Road Names	AADT	Distance from receptor (m)	Annual Average Speed (km/h)	% HDV	PM_{10}	
						Annual mean mg/m^3	Daily Mean Exceedances
1	Mile End Road	21364	18	20	4.5	31.35	33
	Newmarket Road	22127	32	20	6.19		
2	Red Lion Street	3625	17	20	52.4	33.26	41
	Farmers Avenue	9741	6	10	2.6		
3	Colman Road	21812	12	20	6.5	30.78	30
	Unthank Road	6088	10	20	0		
4	Barn Road	33260	25	20	2.3	32.95	37
	Dereham Road	15387	10	20	3.9		
5	King Street	25157	10	20	2	30.17	28
	Rouen Road	6603	10	20	0.9		

The predictions for 2010 (Table 10.4) indicate that the annual mean objective of 20μgm^{-3} is unlikely to be met at any of the junctions assessed, and that the number of daily mean exceedances is also likely to be much greater than the target of seven per year.

Table 10.4 Modelled annual mean PM_{10} concentrations and 24 hour exceedences at busy junctions in Norwich for 2010

Receptor number	Name	AADT	Distance from receptor (m)	Annual Average Speed (km/h)	% HDV	PM10	
						Annual mean mg/m3	Daily Mean Exceedances
1	Mile End Road	21364	18	20	4.5	26.16	15
	Newmarket Road	22127	32	20	6.19		
2	Red Lion	3625	17	20	52.4	27.23	18
	Farmers Avenue	9741	6	10	2.6		
3	Colman Road	21812	12	20	6.5	25.86	15
	Unthank Road	6088	10	20	0		
4	Barn Road	33260	25	20	2.3	27.19	18
	Dereham Road	15387	10	20	3.9		
5	King Street	25157	10	20	2	28.07	21
	Rouen Road	6603	10	20	0.9		

10.4.6 Screening assessment of industrial sources

The Guidance LAQM TG(03)[1] lists the following processes as significant potential sources of PM_{10}:

Part A (percentage of total emissions from all UK plant in this sector to the UK total in brackets)

Iron and steel (61)
Petroleum processes (4)
Combustion processes (13)
Cement/lime manufacture (7)
Carbonisation (2)
Gasification (4)
Non-ferrous metals (4)
Fertilizer production

Part B
Combustion plant 20-50 mwth
Furnaces 20-50 mwth
Coal and coke processes
Quarry Process
Roadstone coating
Rubber processes
China and clay processes
Coating powder
Coil coating

No industrial processes with the potential to emit PM_{10} were identified during previous rounds of review and assessment, and no new processes have been identified. None of the existing processes have reported substantially increased emissions.

10.4.7 Quarries and landfill sites

There are no operating quarries or landfill sites with relevant locations for public exposure within 200m.

10.4.8 Domestic solid fuel burning

There are no data for domestic coal burning available for the district but solid fuel use continues to decline throughout the area. Norwich City Council have advised that it is unlikely that there are any areas with 50 houses using these fuels in a 500 m square.

10.4.9 Screening assessment of other transport sources

Norwich Airport had 550,000 passengers and lifted 78 tonnes of freight in 2005. This is well below the threshold of 10 mppa (million passengers per annum) equivalent. This source therefore does not need to be considered further.

10.5 CONCLUSIONS FOR PM_{10} CONCENTRATIONS IN COUNCIL AREA

The DMRB screening model indicates that the annual mean objective of 40 μgm^{-3} for PM_{10} has been met in 2005, but the number of 24-hour mean exceedences was higher than 35 at three locations – Castle Meadow, the junction of Red Lion Street and Farmer's Avenue, and the junction of Barn Road and Dereham Road. There are no relevant receptors at any of these locations.

The 2010 annual mean may exceed 20 μgm^{-3} at relevant locations in 2010 due, in part, to the background contribution predicted by the NAEI for PM_{10} being higher than the objective throughout most of the city. Daily mean objectives in 2010 are also likely to be widely exceeded at roadside locations.

11 Conclusions

11.1 CARBON MONOXIDE

The monitoring data from locations in Norwich indicates that ambient concentrations of CO are well below the objectives set. There are no roads in the district with relevant exposure which can be classified as 'very busy' according to the criteria in the guidance. Consequently, Norwich City Council is not required to carry out a Detailed Review and Assessment for carbon monoxide.

11.2 BENZENE

There are no roads in Norwich that can be classified as 'very busy' according to the criteria in the guidance. There are no petrol stations with a throughput greater than 2 million litres and with relevant exposure within 10m of the pumps. Norwich City Council is not required to carry out a Detailed Review and Assessment for benzene.

11.3 1,3-BUTADIENE

Estimated background concentrations indicate that the 2003 objective for 1,3-butadiene is being achieved in Norwich. There are no significant industrial sources that have the potential to emit 1,3-butadiene. Consequently, Norwich City Council is not required to carry out a Detailed Review and Assessment for 1,3-butadiene.

11.4 LEAD

Emissions of lead from industrial processes in and around Norwich are not likely to exceed the objectives for lead to be achieved in 2004 and 2008. The Council is not required to carry out a Detailed Review and Assessment for lead.

11.5 NITROGEN DIOXIDE

There are no significant industrial sources of nitrogen dioxide in Norwich district. The DMRB screening tool indicates that nitrogen dioxide levels at sites of relevant exposure alongside the district's roads are unlikely to have exceeded the 2005 annual mean limit value. Diffusion tube measurements in 2005 showed some exceedances of the objective. Most of these were within the existing AQMAs, whilst others were located at sites with no relevant receptors. Consequently Norwich City Council is not required to carry out a Detailed Review and Assessment for nitrogen dioxide.

11.6 SULPHUR DIOXIDE

There are no significant industrial or domestic sources of sulphur dioxide in Norwich City. Norwich City Council is not required to carry out a Detailed Review and Assessment for sulphur dioxide.

11.7 PM_{10}

The DMRB screening model indicates that the annual mean objective of 40 μgm^{-3} for PM_{10} was met in 2005 at roadside locations. The number of 24-hour mean exceedances, however, was higher than 35 at a number of locations, although no relevant receptors are affected.

The 2010 annual mean may exceed 20 μgm^{-3} at relevant locations in 2010 due, in part, to the background contribution predicted by the NAEI for PM_{10} being higher than the objective. Daily mean objectives in 2010 are also likely to be widely exceeded at roadside locations.

11.8 SUMMARY AND RECOMMENDATIONS

A Detailed Assessment is not required for benzene, 1,3-butadiene, carbon monoxide, lead, nitrogen dioxide, PM_{10} or sulphur dioxide.

12 References

1. Part IV of the Environment Act 1995. Local Air Quality Management. Technical Guidance LAQM.TG(03) January 2003.

2. LAQM.TG(03) – Update. January 2006

3. The Air Quality Regulations (2000) and The Air Quality (England) Amendment Regulations 2002.

4. DETR (2000) The Air Quality Strategy for England, Scotland, Wales and Northern Ireland. Department f the Environment, Transport and the Regions. Cm 4548, SE 2000/3, NIA 7

5. Part IV of the Environment Act 1995. Local Air Quality Management. Progress Report Guidance. LAQM.PRG(03). 2003

6. Air Quality Review and Assessment, Stage one and stage two. 1999, AEA Technology plc, Report AEAT-5334/20615014 Issue 2

7. Maps of Estimated Ambient Air Pollution in 2001 and Projections for Other Years. http://www.airquality.co.uk/archive/laqm/tools.php

8. Design Manual For Roads and Bridges, Highways Agency, 2003

9. EA (1998b) Guidance for estimating the air quality impact of stationary sources. Guidance Note 24. Environment Agency

Appendices

CONTENTS

Appendix 1
Detailed Monitoring data

CONTENTS

A1.1 Monthly average NO_2 concentrations (2005)

Site	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1 Earlham Rd	28.5	37.9	42.1	39.9	37.4	41.2	38.4	36.4	42.5	37.1	35.3	43.1
2 Colman Rd	30.7	41.4	38.5	35.2	32.3	29.8	32.1	28.6	33.6	27.6	36.2	34.8
3 Vulcan Rd	37.9	43.1	46.3	44.3	33.2	40.7	28.8	35.8	44.9	45.9	39.3	32.5
4 Heartsease	22.8	40.0	35.0	29.8	23.1		20.9	27.1		32.3		
5 Tombland	40.9	38.8	44.9	43.5	41.6	40.6	41.0	39.0	46.8	42.5	46.5	45.7
C St Vedast St	34.3	47.3	51.9	43.5	40.2	34.7	38.8	35.3	45.7	43.8	46.4	44.3
B Eastbourne Pl.	38.5	39.8	40.9	39.1	31.8	31.9	30.3	33.9	34.1	35.2	35.8	37.2
A Riverside	54.9	51.9	54.5	51.5	47.6	54.1	42.4	44.5	53.7	46.2	50.5	50.0
7 St Stephens St (mid)	42.6	45.6	48.6	51.9	41.3	42.5					47.7	47.5
8 St Stephens St (top)	37.1	45.0	50.2	47.2	35.6	41.4	19.5	32.5	40.1	37.8	38.0	36.7
9 Victoria St.	28.9	40.9	39.6	37.0	32.0	35.0	33.9	30.5	34.2	33.8	37.4	37.9
10 Ipswich Rd	26.4	49.2	31.2	33.2	20.8	22.5	35.1	18.4	27.7	28.1	28.5	29.4
11 Unthank Rd	35.1	38.2	37.1	41.0	29.6	32.0	20.0	31.6	36.9	35.5	37.3	40.0
12 Bignold School	21.4	25.6	25.5									
13 Chapel Field/Wessex St	22.7	37.7	39.7	38.5	29.3	33.8	33.8	30.6	36.7	39.6	29.4	34.1
14 Chapel Field/Crescent	27.1	40.9	42.1	42.5	31.1	35.7	32.9	28.0	39.0	40.4	37.7	36.9
17 Theatre St	37.7	46.8	50.3	36.0	27.8	29.2	42.7	32.1	36.8	36.2	37.2	42.9
19 Exchange St.	41.9	42.0	42.2	42.1	34.9	38.5	47.5	32.5	40.6	39.5	36.3	37.9
20 St Georges 1	23.2	28.5	29.3	25.5	16.9	18.7	32.6	17.0	21.2	24.6	26.0	26.8
21 St Georges 2	24.9	26.7	29.0	26.4	16.6	18.2	14.3	15.3	21.3	25.5	27.2	27.6
22 St Georges 3	26.5	27.4	31.8	25.9	17.3	19.0	14.7	16.5	23.0	18.7	26.1	29.6
28 Guildhall	22.2	34.6	34.7	28.6	24.2	21.4	20.1	24.8	29.1	25.3	33.7	33.0
29 Ber St 1	28.2	29.1	36.7	31.1	23.9	24.1		24.5	29.1	26.0	34.6	36.9
D Upper King St	36.1	37.0	37.7	39.1	31.8	30.0	31.7	32.4	37.5	34.2	49.8	44.6
6 Cattlemarket	41.9	43.8	54.7	47.5	39.7	41.5	41.5	43.7	50.5	45.2	42.8	42.7
18 Castlemeadow (Mid)	49.8	57.8	60.0	52.3	45.6	45.3	27.2	47.9	50.5	46.2	51.2	48.4
E Castlemeadow/Shire Hall	44.9	44.4	52.1	47.9	46.1	46.3	51.3	36.3	48.4	51.3	47.9	44.2
23 St Augustines	43.5	50.9	56.7	56.8	47.9	52.1	50.8	51.3	57.0	54.6	57.4	52.3
24 Grapes Hill - Lower	24.4	31.2	31.8		26.3	30.1	24.7	23.0	30.2	34.3	25.1	31.1
25 Grapes Hill - Upper	23.7	28.5	30.0	28.5	19.6	19.3	16.9	15.5	24.3	27.1	28.1	30.9
26 Wellington Lane - Lower	31.2	34.8	41.3	38.0	28.7	35.1	27.6	27.3	33.9	33.5	36.2	34.0
27 Wellington Lane - Upper	33.8	43.7	44.0	40.9	30.8	30.1	34.1	31.6	39.9	37.3	38.6	40.3
15 Johnson Pl	34.2	30.6	48.5	48.4	38.3	46.1	32.8	39.5	47.3	47.8	43.4	44.2

Notes :

1. **All concentrations are µg m^{-3} expressed as NO_2 .**
2. **This data has not been bias adjusted**

A 1.2.1 Air Pollution Report for Norwich Centre

NORWICH CENTRE
01 January to 31 December 2005

These data are provisional from 01/10/2005 and may be subject to further quality control

Small grassed open space on edge of city centre.

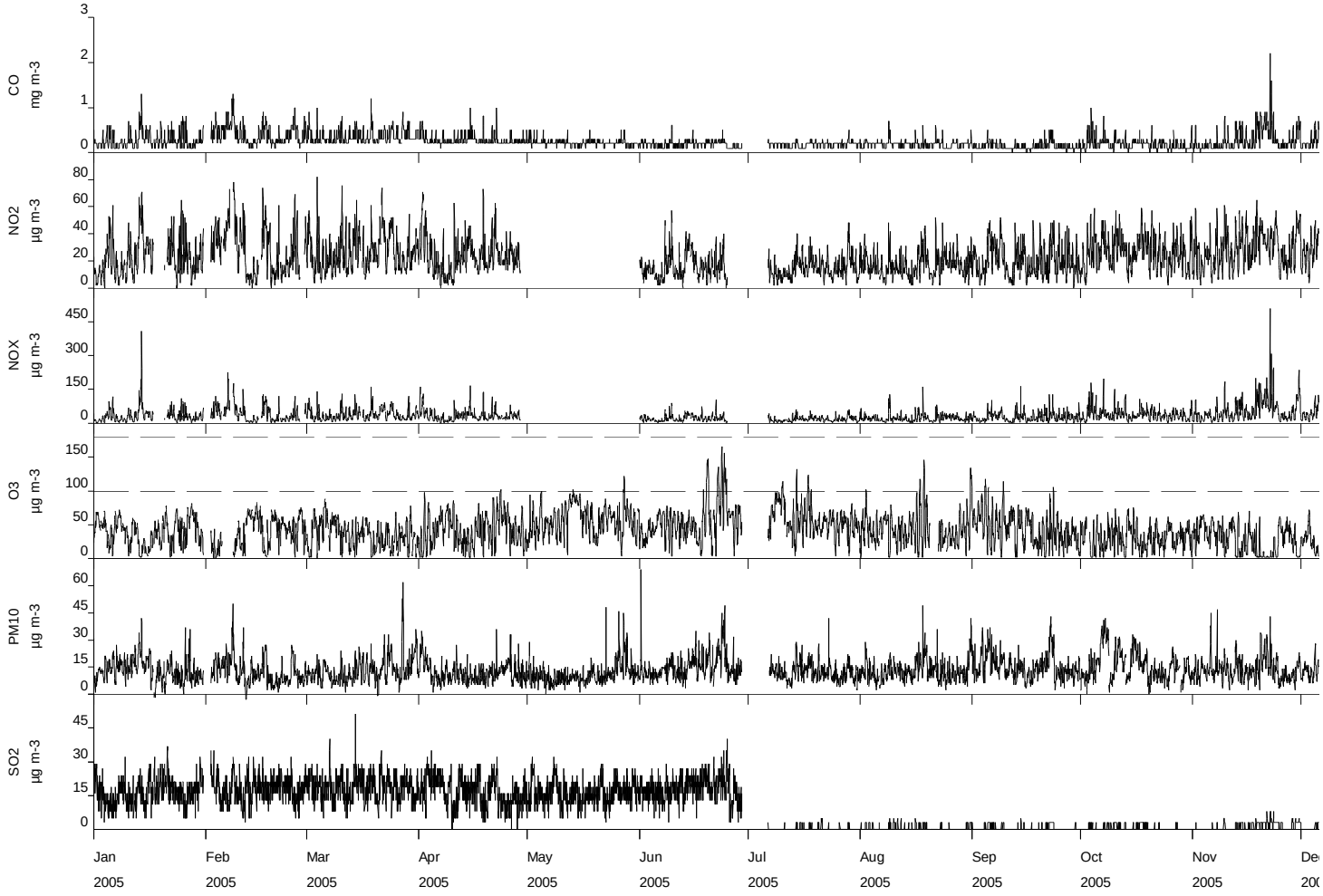
POLLUTANT	CO	NO_2	NO_X	O_3	PM_{10}+	SO_2
Number Very High	0	0	-	0	0	0
Number High	0	0	-	0	0	0
Number Moderate	0	0	-	162	0	0
Number Low	8516	7281	-	8164	8486	33360
Maximum 15-minute mean	3.0 mg m^{-3}	92 µg m^{-3}	693 µg m^{-3}	172 µg m^{-3}	181 µg m^{-3}	74 µg m^{-3}
Maximum hourly mean	2.7 mg m^{-3}	82 µg m^{-3}	510 µg m^{-3}	166 µg m^{-3}	69 µg m^{-3}	51 µg m^{-3}
Maximum running 8-hour mean	2.4 mg m^{-3}	73 µg m^{-3}	376 µg m^{-3}	147 µg m^{-3}	50 µg m^{-3}	32 µg m^{-3}
Maximum running 24-hour mean	1.8 mg m^{-3}	59 µg m^{-3}	244 µg m^{-3}	114 µg m^{-3}	35 µg m^{-3}	26 µg m^{-3}
Maximum daily mean	1.5 mg m^{-3}	50 µg m^{-3}	177 µg m^{-3}	105 µg m^{-3}	34 µg m^{-3}	26 µg m^{-3}
Average	0.2 mg m^{-3}	23 µg m^{-3}	35 µg m^{-3}	41 µg m^{-3}	13 µg m^{-3}	9 µg m^{-3}
Data capture	96.9 %	83.1 %	83.1 %	93.6 %	96.5 %	96.9 %

+ PM_{10} instrument is a TEOM
All mass units are at 20'C and 1013mb
NO_X mass units are NO_X as NO_2

Pollutant	Air Quality (England) Regulations 2000 and (Amendment) Regulations 2002	Exceedences	Days
Carbon Monoxide	Running 8-hour mean > 10.0 mg m^{-3}	0	0
Nitrogen Dioxide	Annual mean > 40 µg m^{-3}	0	-
Nitrogen Dioxide	Hourly mean > 200 µg m^{-3}	0	0
Nitrogen Oxides (NO_2)	Annual mean > 30 µg m^{-3}	1	-
Ozone	Running 8-hour mean > 100 µg m^{-3}	96	14
PM_{10} Particulate Matter (Gravimetric)	Daily mean > 50 µg m^{-3}	0	0
PM_{10} Particulate Matter (Gravimetric)	Annual mean > 40 µg m^{-3}	0	-
Sulphur Dioxide	15-minute mean > 266 µg m^{-3}	0	0
Sulphur Dioxide	Hourly mean > 350 µg m^{-3}	0	0
Sulphur Dioxide	Daily mean > 125 µg m^{-3}	0	0
Sulphur Dioxide	Annual mean > 20 µg m^{-3}	0	-

Produced by netcen on behalf of defra

Norwich Centre Air Monitoring Hourly Mean Data for 01 January to 31 December 2005



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A1.2.2 Site Description and picture for the Norwich Centre AURN site

Site Description

The monitoring station is within a self-contained, air-conditioned housing located within the South south western corner of a central Norwich public garden. The nearest road is located approximately 12 metres away at St George's Street although traffic flow is free flowing and very light (1 or 2 vehicles per minute observed off peak). The manifold inlet is approximately 3 metres high. The surrounding area is generally open and comprises of residential and light industrial premises.

Site address:
Friars Quay, off Colegate, Norwich.

OS Grid Reference: TG230089
Site Type: Urban Centre
Start Date: 24/07/1997
Pollutants Measured: O3,CO,SO2,PM10,NOx

Picture

(http://www.stanger.co.uk/siteinfo/MonitoringSite.asp?ID=71#, 2005)

A1.3 Air Pollution Report for Norwich Forum Roadside

NORWICH FORUM ROADSIDE
01 January to 31 December 2005

These data are provisional from 01/10/2005 and may be subject to further quality control

Monitoring station is within the City Hall, 5 metres from a 2-lane urban street. Traffic flow is moderate and is subject to occasional queuing.

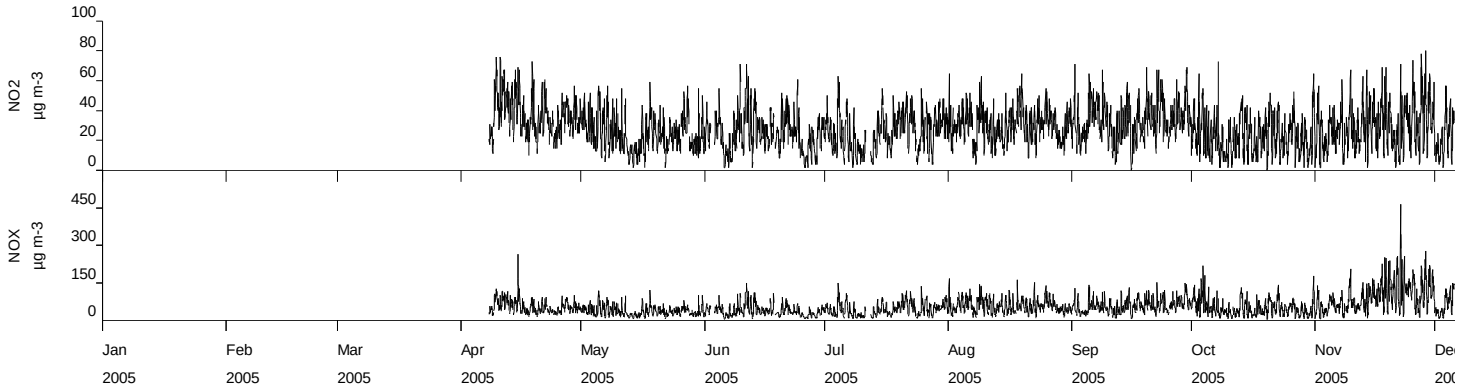
POLLUTANT	NO_2	NO_X
Number Very High	0	-
Number High	0	-
Number Moderate	0	-
Number Low	6143	-
Maximum 15-minute mean	183 µg m^{-3}	657 µg m^{-3}
Maximum hourly mean	82 µg m^{-3}	594 µg m^{-3}
Maximum running 8-hour mean	72 µg m^{-3}	377 µg m^{-3}
Maximum running 24-hour mean	57 µg m^{-3}	262 µg m^{-3}
Maximum daily mean	54 µg m^{-3}	228 µg m^{-3}
Average	28 µg m^{-3}	57 µg m^{-3}
Data capture	70.2 %	70.2 %

All mass units are at 20'C and 1013mb
NO_X mass units are NO_X as NO_2

Pollutant	Air Quality (England) Regulations 2000 and (Amendment) Regulations 2002	Exceedences	Days
Nitrogen Dioxide	Annual mean > 40 µg m^{-3}	0	-
Nitrogen Dioxide	Hourly mean > 200 µg m^{-3}	0	0
Nitrogen Oxides (NO_2)	Annual mean > 30 µg m^{-3}	1	-

Produced by netcen on behalf of Defra

Norwich Forum Roadside Air Monitoring Hourly Mean Data for 01 January to 31 December 2005



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A1.3.1 Site description of the Norwich Forum Roadside Site

Site Description

The monitoring station is within the City Hall, approximately 5 metres from a 2-lane urban street. Traffic flow is moderate, consisting of approximately 4,000 vpd, and is subject to occasional queuing. The manifold inlet is approximately 4 metres high and is mounted close to the building facade. The surrounding area comprises retail outlet and business premises.

Site address:
City Hall, St Peters Street, Norwich NR2 1NH

OS Grid Reference: TG228 084
Site Type: Roadside
Start Date: April 2005
Pollutants Measured: NOx

A1.4 Air Pollution Report for Norwich Airport

NORWICH AIRPORT 2
01 January to 31 December 2005

These data are provisional from 01/09/2005 and may be subject to further quality control

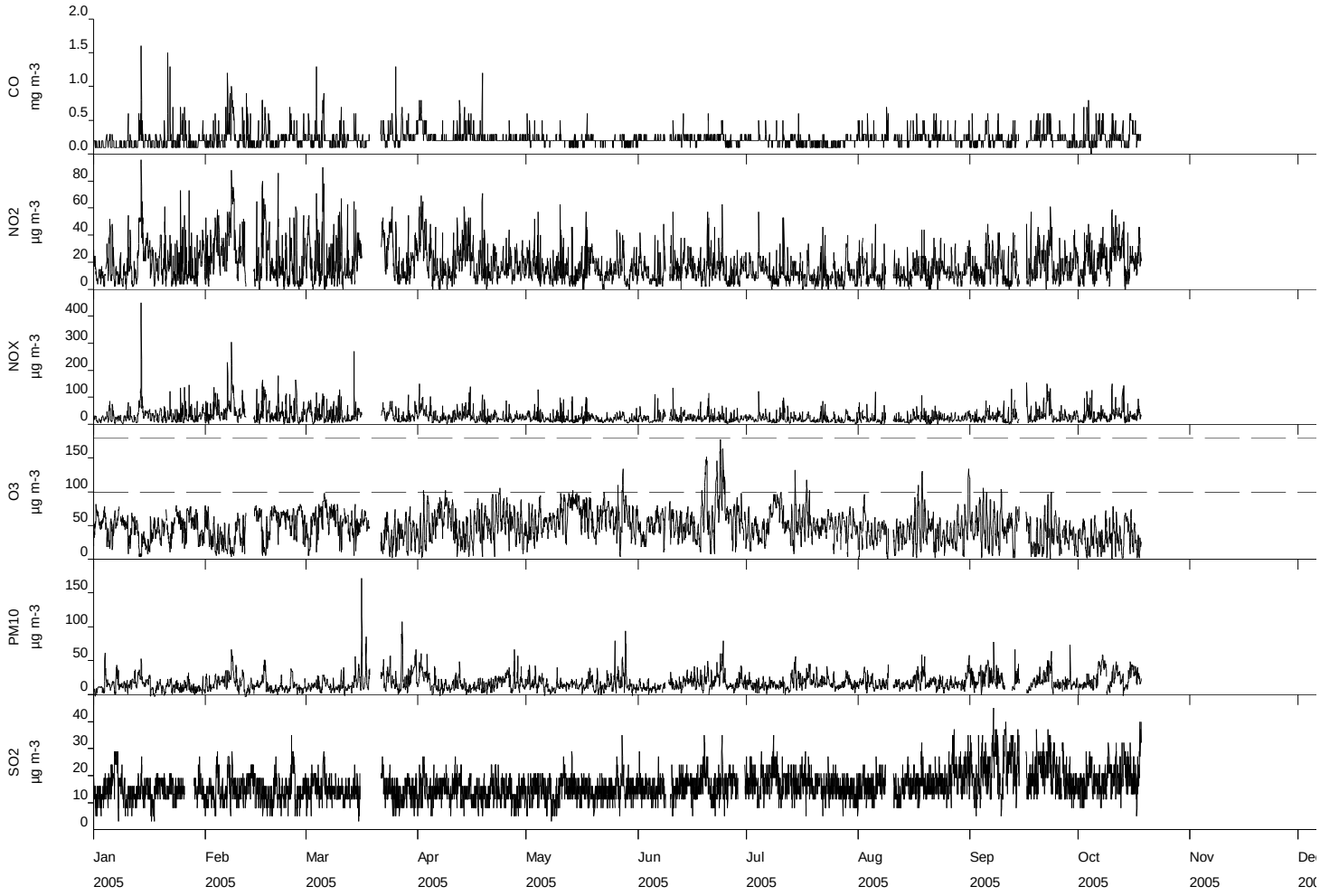
POLLUTANT	CO	NO_2	NO_X	O_3	PM_{10}+	SO_2
Number Very High	0	0	-	0	0	0
Number High	0	0	-	0	0	0
Number Moderate	0	0	-	143	0	0
Number Low	6764	6513	-	6573	6694	25924
Maximum 15-minute mean	3.0 mg m^{-3}	139 µg m^{-3}	565 µg m^{-3}	5196 µg m^{-3}	288 µg m^{-3}	59 µg m^{-3}
Maximum hourly mean	1.6 mg m^{-3}	96 µg m^{-3}	449 µg m^{-3}	178 µg m^{-3}	172 µg m^{-3}	45 µg m^{-3}
Maximum running 8-hour mean	0.8 mg m^{-3}	74 µg m^{-3}	233 µg m^{-3}	159 µg m^{-3}	89 µg m^{-3}	36 µg m^{-3}
Maximum running 24-hour mean	0.6 mg m^{-3}	68 µg m^{-3}	141 µg m^{-3}	131 µg m^{-3}	48 µg m^{-3}	31 µg m^{-3}
Maximum daily mean	0.6 mg m^{-3}	66 µg m^{-3}	138 µg m^{-3}	116 µg m^{-3}	45 µg m^{-3}	30 µg m^{-3}
Average	0.2 mg m^{-3}	17 µg m^{-3}	28 µg m^{-3}	49 µg m^{-3}	17 µg m^{-3}	16 µg m^{-3}
Data capture	77.2 %	74.3 %	74.3 %	75.9 %	76.5 %	74.9 %

+ PM_{10} instrument is a TEOM
All mass units are at 20'C and 1013mb
NO_X mass units are NO_X as NO_2

Pollutant	Air Quality (England) Regulations 2000 and (Amendment) Regulations 2002	Exceedences	Days
Carbon Monoxide	Running 8-hour mean > 10.0 mg m^{-3}	0	0
Nitrogen Dioxide	Annual mean > 40 µg m^{-3}	0	-
Nitrogen Dioxide	Hourly mean > 200 µg m^{-3}	0	0
Nitrogen Oxides (NO_2)	Annual mean > 30 µg m^{-3}	0	-
Ozone	Running 8-hour mean > 100 µg m^{-3}	88	13
PM_{10} Particulate Matter (Gravimetric)	Daily mean > 50 µg m^{-3}	4	4
PM_{10} Particulate Matter (Gravimetric)	Annual mean > 40 µg m^{-3}	0	-
Sulphur Dioxide	15-minute mean > 266 µg m^{-3}	0	0
Sulphur Dioxide	Hourly mean > 350 µg m^{-3}	0	0
Sulphur Dioxide	Daily mean > 125 µg m^{-3}	0	0
Sulphur Dioxide	Annual mean > 20 µg m^{-3}	0	-

Produced by netcen on behalf of Norwich CC

Norwich Airport 2 Air Monitoring Hourly Mean Data for 01 January to 31 December 2005



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A1.4.1 Site description of the Norwich Airport Site

Site Description

The airport site was on the South boundary of Norwich Airport, to the East of the freight building, and approximately 25m from the terminal apron. It is well away from busy roads or other local sources of pollution.

Site Type: Background
Grid Ref: TG 218 130
Pollutants Measured: CO, NOx, PM10, O3, SO2

A1.5 Monthly Average benzene concentrations (μg m^{-3}, 2005)

	Unthank Rd	St Augustines	Guildhall
January	3.29	6.50	1.56
February	4.08	6.59	1.96
March	3.44	6.27	1.59
April	1.49	3.20	0.80
May	1.62	3.02	0.77
June	1.74	2.85	0.69
July	1.14	2.39	0.56
August	1.88	3.32	0.88
September	1.81	3.90	0.84
October	1.69	3.27	0.78
November	3.00	5.67	1.35
December	3.05	6.28	1.57

Appendix 2
Detailed Traffic Flow Data

CONTENTS

Table A2.1 Road classifications in LAQM TG(03)

Very busy roads	Single carriageway roads with daily average traffic flows which exceed 80,000 vehicles per day. Dual carriageway (2 or 3-lane) roads with daily average traffic flows which exceed 120,000 vehicles per day. Motorways with daily average traffic flows which exceed 140,000 vehicles per day.
Busy Roads	Roads with more than 30,000 vehicles per day.

A 2.2a Traffic Flow Data from the NAEI Data Warehouse

Explanation of the data fields:	
Rd_no	**Number of the road**
x	**Grid reference Easting**
y	**Grid reference Northing**
All_vehicles	**AADF Total**
CAR	**AADF Cars**
BUS	**AADF Buses**
LGV	**AADF Light Goods Vehicles**
HGVr	**AADF rigid HGVs**
HGVa	**AADF articulated HGVs**
Moto	**AADF Motorcycles**
MB	**Built-up motorway**
MN	**Non built-up motorway**
PB	**Built-up primary road**

A 2.2b Traffic Flow Data from the NAEI Data Warehouse (2004 data)

Road No.	X	Y	All Vehicles	Car	Bus	LDV	HGVr	HGVa	Moto
A140	620613	310011	27898	21495	149	3995	1262	743	254
A1242	624960	308301	17256	14772	265	1711	253	55	200
A1067	622885	309289	16893	14062	65	1947	278	36	505
A1242	624420	308055	10862	9032	237	1224	183	40	146
A1054	624180	307125	35322	29825	381	3678	711	379	348
A1042	623919	311198	29685	24288	86	3904	659	331	417
A140	621913	306934	21280	17928	186	2191	518	245	212
A147	622542	309128	33260	28592	157	3270	517	114	610
A147	624062	309185	16230	13532	270	1705	340	32	351
A147	623890	307654	23106	20214	117	1807	516	170	282
A1067	621035	310714	16642	13786	166	2149	224	38	279
A140	620965	311155	25459	19224	117	3972	1212	564	370
A11	622657	307818	22191	18636	677	1884	511	129	354
A1024	621710	310188	23300	18671	270	3520	374	54	411
A1067	622480	309895	10551	8615	146	1522	166	17	85
A1074	621150	309220	9227	7465	163	1134	157	31	277
A1151	623560	310540	14810	12642	388	1364	129	4	283
A1242	624085	308395	6201	5011	257	698	100	14	121
A147	622974	309260	24813	21388	83	2406	408	76	452
A1151	623358	309400	12678	10679	71	1562	122	14	230
A11	621553	307003	22127	18581	417	1908	632	321	268
A146	623631	306500	15917	13554	136	1728	320	65	114
A147	622402	308840	31651	26650	485	3498	429	106	483
A1024	621854	310674	13114	9993	109	2392	260	13	347
A147	623535	309408	24075	20387	76	2802	382	80	348
A11	621890	307225	15355	12956	649	1297	268	48	137
A140	620742	308067	21812	17565	88	2586	798	534	241
A140	621834	311397	19453	16242	304	2268	285	37	317
A140	622137	305974	14971	12261	229	1692	379	164	246
A1056	622475	307315	10607	8946	332	998	163	34	134
A140	622515	309985	13434	11129	206	1639	211	34	215
A147	622949	307931	22264	18949	574	2141	256	49	295
A147	624000	308160	13373	11742	129	1167	209	36	90
A1074	622180	308950	15387	12495	374	1965	211	22	320
A1074	619821	309448	22157	17438	348	3063	650	281	377
A1242	624563	308167	11497	9671	120	1299	186	28	193
A1242	624370	308150	10010	8207	194	1177	209	37	186
A146	622325	306700	17457	15052	88	1470	558	103	186
A1042	625250	309950	17598	14462	145	1807	700	224	260
A1054	624120	307280	24995	21271	214	2155	777	132	446
A146	623975	306700	28009	24013	151	2598	729	252	266

Table 2.3 Traffic flow data for roads in Norwich supplied by Norwich City Council (2004 counts, and modelled data for 2007)

Road Number	Road Name	Closest distance to receptor on link (m)	Receptor type	kph	AADT	HDV	% HDV
A140	Colman Rd	15	res	30	21,812	1420	6.5%
A11	Newmarket Rd	9	res	30	15,355	965	6.3%
A1056	Ipswich Rd	7	res	20	10,607	529	5.0%
A147	Grapes Hill	11	res	20	31,651	1020	3.2%
A11	St Stephens Rd	8	res	30	22,191	1317	5.9%
A147	St Crispins Rd	9	res	35	24,813	567	2.3%
A147	Barn Rd	25	com	30	33,260	788	2.4%
A147	Barrack St	7	res	20	24,075	538	2.2%
A1067	Pitt Street	15	com	20	16,893	379	2.2%
A140	Boundary Rd	8	res	20	25,459	1893	7.4%
	Chapelfield Rd (St Stephens rbt)	10	res	25	30,401	1063	3.5%
	St Stephens Road	8	res	30	21,523	1260	5.9%
	Guardian Rd	14	res	40	25,981	1459	5.6%
A1067	St Augustines	5.5	res	20	17,550	490	2.8%
A1067	Pitt Street	7	com	20	17,519	499	2.8%
	Castle Meadow	8.5	com	10	2,001	2001	100.0%
	Dereham Road	28	res	25	29,198	1907	6.5%
	Norwich Road	20	res	20	8,502	202	2.4%
	Red Lion Steet	8	com	20	3,625	1898	52.4%
	Farmers Avenue	6	com	10	9,741	257	2.6%
	Cattlemarket Street	7	res	25	26,209	342	1.3%
	Rouen road	8	res	20	6,603	60	0.9%
	Bracondale	8.5	res	20	30,777	909	3.0%
	King Street	8	res	20	25,157	499	2.0%
	Mile End Road	11	res	30	21,364	963	4.5%
	Unthank Road (outside ORR)	10	res	30	6,088	0	0.0%
	Chapelfield Road - Johnson Place	15	res	20	32,125	1060	3.3%
	Riverside Road	8	res	20	13,244	670	5.1%
	POW at St Vedast	9	com	30	9,522	482	5.1%
	St Vedast Street	5	com	20	5,233	57	1.1%
	POW at Eastbourne Place	9	com	30	14,575	941	6.5%
	Eastbourne Place	4	com	20	3,933	0	0.0%
	Tombland	5	com	30	15,259	1288	8.4%
	St Stephens Street	12	com	15	7,136	1488	20.9%

Note: The receptor type refers to whether the nearest receptor is commercial (com) or residential (res). Norwich City Council transport planners do not expect any traffic growth between 2004 and 2010, so that the traffic counts and modelled data are suitable for assessing the traffic related pollutants for 2005 and 2010.

Appendix 3
Checklists

CONTENTS

Updating and Screening Assessment Summary Checklist for Carbon Monoxide

Item	Response
A) Monitoring data	Monitoring data indicates no exceedance of the objective for CO in Norwich
B) Very busy roads or junctions in built-up areas	No 'very busy roads,' and background concentration is below the threshold

Updating and Screening Assessment Summary Checklist for Benzene

Item	Response
A) Monitoring data outside an AQMA	Benzene diffusion tubes indicated no exceedance of benzene at any of the monitoring locations
B) Monitoring data within an AQMA	No AQMAs for benzene in area
C) Very busy roads or junctions in built up areas	No 'very busy roads' and background concentration is below the threshold
D) New industrial sources.	None present
E) Industrial sources with substantially increased emissions, or new relevant exposure	None present
F) Petrol stations	None meeting the criteria with relevant exposure
G) Major fuel storage depots (petrol only)	None

Updating and Screening Assessment Summary Checklist for 1,3-butadiene

Item	Response
A) Monitoring data	None – background maps indicate below the objective
B) New industrial sources.	None present
C) Industrial sources with substantially increased emissions, or new relevant exposure	None present

Updating and Screening Assessment Summary Checklist for Lead

Item	Response
A) Monitoring data	None
B) New industrial sources.	None
C) Industrial sources with substantially increased emissions, or new relevant exposure	None

Updating and Screening Assessment Summary Checklist for Nitrogen Dioxide

Item	Response
A) Monitoring data outside an AQMA	Marginal exceedances at some kerbside locations with no relevant receptors
B) Monitoring data within an AQMA	Some exceedances within the 3 AQMAs
C) Narrow congested streets with residential properties close to the kerb	DMRB indicates no exceedences
D) Junctions.	DMRB indicates no exceedences
E) Busy streets where people may spend 1-hour or more close to traffic	DMRB indicates no exceedences
F) Roads with high flow of buses and/or HGVs.	Castle Meadow and Red Lion Street (100% and 52.4% respectively) assessed – DMRB indicates no exceedances
G) New roads constructed or proposed since the previous round of R&A	No major road changes (except for new park and ride stations)
H) Roads with significantly changed traffic flows, or new relevant exposure	DMRB indicates no exceedances
I) Bus Stations	There are more than 1000 bus movements per day, but there are currently no residential properties within 10m of the bus station.
J) New industrial sources.	None present
K) Industrial sources with substantially increased emissions, or new relevant exposure	None present
L) Aircraft	Norwich Airport is below the 5mppa threshold.

Updating and Screening Assessment Summary Checklist for Sulphur Dioxide

Item	Response
A) Monitoring data outside an AQMA	Monitoring data indicates no exceedances of any of the objectives
B) Monitoring data within an AQMA	No AQMAs declared for SO2
C) New industrial sources.	None present
D) Industrial sources with substantially increased emissions, or new relevant exposure	None present
E) Areas of domestic coal burning	Not relevant
F) Small Boilers > 5 MW (thermal).	None identified
G) Shipping	Not relevant
H) Railway Locomotives	Not relevant – Norwich mainline is electric

Updating and Screening Assessment Summary Checklist for PM_{10}

Item	Response
A) Monitoring data outside an AQMA	Monitoring data indicates no exceedances
B) Monitoring data within an AQMA	No AQMAs declared for PM_{10}
C) Busy roads and junctions in Scotland	Not in Scotland
D) Junctions.	Junctions assessed using DMRB – exceedances of the 24-hour mean objective at 2 locations.
E) Roads with high flow of buses and/or HGVs.	Castle Meadow (buses and taxis only) and Red Lion Street assessed – exceedences of the 24 hour mean objective are indicated, but with no relevant receptors
F) New roads constructed or proposed since last round of R&A	No major road changes (except for new park and ride stations)
G) Roads with significantly changed traffic flows, or new relevant exposure.	All roads assessed using DMRB with up to date traffic data.
H) Roads close to the objective	All roads assessed using DMRB with up to date traffic data. There were no roads close to the

during the second round of Review and Assessment	objective in the last updating and screening assessment
I) New industrial sources.	None present
J) Industrial sources with substantially increased emissions, or new relevant exposure	None present
K) Areas of domestic solid fuel burning	None present
L) Quarries / landfill sites / opencast coal / handling of dusty cargoes at ports etc.	None present
M) Aircraft	Norwich Airport falls below the 10mpppa threshold

Appendix 4

Descriptions of selected models and tools

CONTENTS

Simple screening models[a]

1. Design Manual for Roads and Bridges (DMRB) - This screening method was formulated by the former Department of Transport. The method gives a preliminary indication of air quality near roads. The DMRB method requires information on vehicle flow, HDV mix, vehicle speed and receptor-road distances. It contains a useful database of vehicular emission factors for future years.

The method adopts the annual mean concentration as the base statistic. Background pollutant levels are included explicitly in the calculations by adding an amount to the annual mean traffic contribution using the Air Quality Archive (paragraph 6.09) or default values The model also estimates, from the annual mean PM_{10} prediction, the number of days where the PM_{10} concentration exceeds the 50$\mu g\ m^{-3}$ daily mean objective. The latest version of the DMRB nomogram (1.02, dated February 2003) has been used for this assessment. Details of the road layout cannot be specified.

2. Guidance for Estimating the Air Quality Impact of Stationary Sources (GSS); this guide provides precalculated dispersion results for stack emissions expressed as nomograms, was published by the Environment Agency (EA) in 1998. The nomograms are based on a large number of computations using ADMS. They cover 10 stack heights, 4 categories of surface roughness, 3 averaging times and 3 climate types. The predicted pollutant concentrations are comparable with the prescribed air quality objectives. The model is limited to a range of stack heights and exit velocities, and cannot treat building wake effects or non-buoyant source releases.

Where such point sources needed to be assessed, the netcen point source spreadsheet, based on this methodology has been used. This is available from http://www.airquality.co.uk/archive/laqm/tools.php.

[a] **The information on simple screening models has been taken from LAQM.TG(03) Review and Assessment: *Selection and use of dispersion models*.**