City of Nottingham

Local Air Quality Management

Detailed Assessment v1a
October 2004

City Development
Pollution Control Section
Lawrence House
Talbot Street
Nottingham
NG1 5NT

Contents

Introduction	3
Future air quality reviews and assessments and Progress Reports	6
Updating and Screening Assessment: Conclusions	7
The Detailed Assessment	7
Detailed Assessment - Monitoring Information	9
Monitoring location descriptions	9
Nottingham City Monitoring Sites	9
Monitoring Data - Automatic sites	11
Monitoring Data - Nitrogen dioxide diffusion tubes	12
Detailed Assessment - Modelling Information	15
Detailed Assessment Sulphur Dioxide	17
Sulphur dioxide - Predicted 2005 maximum 15 minute mean (99.9%ile) concentrations Fig.2	18
Detailed Assessment Nitrogen Dioxide	19
Nitrogen dioxide - Predicted 2005 annual mean concentrations Fig.3	20
Nitrogen dioxide - Predicted 2005 annual mean concentrations Fig.4	21
Nitrogen dioxide - Predicted 2005 annual mean concentrations Fig.5	22
Conclusions	23
What happens next?	24
Appendices	
Appendix 1 Locations of Automatic Monitoring Stations	25
Appendix 2 Major sources of NOx used in model	26
Appendix 3 Major Roads (NOx) used in model	27
Appendix 4 Model Description, Methodology and Verification	28
Description	28
Model Methodology	33
Model Verification	34
Model Adjustment	36
References	38

Local Air Quality Management

Introduction

The Environment Act 1995 Part IV introduced the concept of Local Air Quality Management. Section 82 of this Act required Local Authorities to review the air quality in their area and assess whether the Air Quality Standards and Objectives will be achieved by the prescribed date for each pollutant of concern. The Air Quality (England) Regulations 2000 (as amended) details the objectives for seven substances, to be achieved by 2005, see Table 1.

The Regulations provide that ‘achievement or likely achievement of the Air Quality Objectives is to be determined by reference to the quality of the air at locations which are situated outside of buildings… … and where members of the public are regularly present.’ It continues ‘… local authorities should have regard to those locations where members of the public are likely to be regularly present and are likely to be exposed over the averaging period of the objective.’

The initial review and assessment process comprised three stages, each with increasing depth of investigation, designed to ensure only those pollutants which are predicted to exceed the Air Quality Objectives by the due date were assessed in the next stage. The reasons for proceeding to each subsequent stage of the review and assessment had to be clearly demonstrated, supported and in accordance with Government guidance.

Where it has been determined that an Air Quality Objective will not be achieved by the specified date, Section 83 of the Environment Act 1995 requires Local Authorities to designate Air Quality Management Areas (AQMAs) by Order and formulate and publish corresponding Air Quality Action Plans (AQAP’s). The AQAP must specify what actions a Local Authority intends to take 'in pursuit of the air quality objectives', including a timetable for implementing the plan.

Table 1

The Air Quality (England) Regulations 2000 (as amended)

Substance	***Air quality objective levels***	***Air quality objective dates***
Benzene	16.25 micrograms per cubic metre or less, when expressed as a running annual mean 5 micrograms per cubic metre or less, when expressed as an annual mean	31st December 2003 31st December 2010
1,3 - Butadiene	2.25 micrograms per cubic metre or less, when expressed as a running annual mean	31st December 2003
Carbon monoxide	10 milligrams per cubic metre or less, when expressed as a maximum daily running 8 hour mean	31st December 2003
Lead	0.5 micrograms per cubic metre or less, when expressed as an annual mean 0.25 micrograms per cubic metre or less, when expressed as an annual mean	31st December 2004 31st December 2008
Nitrogen dioxide	200 micrograms per cubic metre, when expressed as an hourly mean, not to be exceeded more than 18 times a year 40 micrograms per cubic metre or less, when expressed as an annual mean	31st December 2005 31st December 2005
PM_{10}	50 micrograms per cubic metre or less, when expressed as a 24 hour mean, not to be exceeded more than 35 times a year 40 micrograms per cubic metre or less, when expressed as an annual mean	31st December 2004 31st December 2004
Sulphur dioxide	125 micrograms per cubic metre or less, when expressed as a 24 hour mean, not to be exceeded more than 3 times a year 350 micrograms per cubic metre or less, when expressed as an hourly mean, not to be exceeded more than 24 times a year 266 micrograms per cubic metre or less, when expressed as a 15 minute mean, not to be exceeded more than 35 times a year	31st December 2004 31st December 2004 31st December 2005

Nottingham City Council completed its first round of reviews and assessments in September 2001 and consequently declared three Air Quality Management Areas; one for sulphur dioxide, and two for nitrogen dioxide.

Section 84(1) of the Environment Act 1995 requires authorities to carry out a further assessment of existing and likely future air quality in an AQMA. LAQM.TG(03) advises 'The intention is that this further assessment will be used to define the relative contribution of different sources within the areas of exceedance, so as to allow a focused action plan to be prepared.'

However, the Stage 4 Review and Assessment (03) concluded that the Air Quality Objectives in the three declared Air Quality Management Areas would be met by the due dates (mainly because of measures introduced by the Local Transport Plan) and the preparation of specific Air Quality Action Plans was therefore unnecessary.

The administrative framework LAQM.PG (03) Policy Guidance and LAQM.TG (03) Technical Guidance were published in February 2003 and advised Local Authorities to follow the guidance on the recommended phased approach to the review and assessment process set out in LAQM.TG (03) which was that the next round should be carried out in two steps:

i. An **Updating and Screening Assessment** (USA) for identifying those aspects that have changed since the first round of reviews and assessments; and
ii. A **Detailed Assessment** of those pollutants and specific locations that are identified in the USA as requiring further work.

The Detailed Assessment should conclude by identifying:

i. Whether an existing Air Quality Management Area (AQMA) needs to be amended or revoked,
ii. Whether any further AQMAs need to be designated,
iii. That there isn't a need to designate any further AQMAs.

Future air quality reviews and assessments and Progress Reports

The Government and devolved administrations recognise that Local Air Quality Management is fundamental to helping it achieve the Air Quality Objectives (AQOs) in the Air Quality (England) Regulations 2000 (as amended), many of which reflect legally binding EU limit values. It therefore recommends Local Authorities carry out their LAQM duties according to the timescales detailed in Table 2 below.

DEFRA recommends that local authorities should prepare annual air quality Progress Reports between subsequent rounds of reviews and assessments to ensure continuity in the LAQM process. It is also requested that monitoring data be reported over the period of a calendar year. Thus the Progress Reports due by the end of April 2005 and April 2008 will report data gathered during 2004 and 2007 respectively. Where, following the Updating and Screening Assessments in April 2003, 2006 and 2009, it is determined that Detailed Assessments are not required, authorities will be expected to submit Progress Reports in April 2004, 2007 and 2010.

Table 2

Recommended timescales for submission of reviews and assessments and Progress Reports

LAQM Activity	Completion Date	Which Authorities?
Detailed Assessment	End of April 2004	Those authorities which have identified the need for one in their April 2003 USA
Progress Report	End of April 2005	All Authorities
USA	End of April 2006	All Authorities
Detailed Assessment	End of April 2007	Those authorities which identified the need for a DA in their April 2006 USA
Progress Report	End of April 2007	Those authorities which identified that there was no need for a DA in their April 2006 USA
Progress Report	End of April 2008	All authorities
USA	End of April 2009	All authorities
Detailed Assessment	End of April 2010	Those authorities which have identified the need for one in their April 2009 USA
Progress Report	End of April 2010	Those authorities which identified that there was no need for a DA in their April 2009 USA

Updating and Screening Assessment: Conclusions

The Updating and Screening Assessment (2003) was undertaken following the guidance and checklist scheme recommended in LAQM.TG(03).
It was concluded unnecessary to proceed to a Detailed Assessment for;

Lead
Carbon monoxide
Benzene
1,3 butadiene
Particles (PM_{10})

It was concluded necessary to proceed to a Detailed Assessment for;

Sulphur dioxide - in the vicinity of the Nottingham Main-line Station.
(The Updating and Screening Assessment (2003) determined that the AQOs for sulphur dioxide would be met in all other areas of the City including the City Hospital).

Nitrogen dioxide - for a number of roads that were predicted to have an annual mean of between 36-40 ugm^{-3} using the original DMRB emission factors.

The Detailed Assessment

The Regulations and LAQM.TG(03) make clear that likely exceedances of the objectives should be assessed in relation to '*the quality of the air at locations which are situated outside of buildings or other natural or man-made structures, above or below ground, and where members of the public are regularly present*'. Reviews and assessments should thus be focussed on those locations where members of the public are likely to **be regularly present and are likely to be exposed over the averaging period of the objective**, and **not** consider exceedances of the objectives at any location **where relevant public exposure would not be realistic**. See Table 3.

When assessing likely exposure with respect to the long-term objectives LAQM.TG(03) cites 'in the case of the 24-hour objectives, a relevant location

would be one where members of the public may be exposed for 8 hours or more in a day, while for the annual mean objectives this might be where people are exposed for a cumulative period of 6 months in a year'.

Table 3

Examples of where the Air Quality Objectives should/should not apply.

Averaging Period	***Objectives should apply at***	***Objectives should generally not apply at***
Annual mean	All locations where members of the public might be regularly exposed. Facades of residential properties, schools, hospitals, libraries	Building facades of offices or other places of work. Gardens of residential properties. Kerbside sites or locations where public exposure is likely to be short term.
24-hour mean, 8-hour mean	All locations where the annual mean objective would apply. Gardens of residential properties.	Kerbside sites or any other location where public exposure is expected to be short term.
1-hour mean	All locations where the annual mean and 24 and 8-hour mean objectives apply. Kerbside sites (e.g. pavements of busy shopping streets). Those parts of car parks, bus stations and railway stations etc. which are not fully enclosed, where the public might reasonably be expected to spend 1-hour or more. Any outdoor locations to which the public might reasonably be expected to spend 1-hour or longer.	Kerbside sites where the public would not be expected to have regular access.
15-mean	All locations where members of the public might reasonably be exposed for a period of 15 minutes or longer	

Detailed Assessment - Monitoring Information

Monitoring assists in demonstrating whether or not there is a significant risk of a prescribed Air Quality Strategy objectives being exceeded at a relevant location. It can also demonstrate that an AQO is being met.

Nottingham City Council undertakes automatic monitoring in a number of locations and provides local site operators, LSOs for DEFRA's Automatic Urban and Rural Network, AURN site on Clinton Street East.

Monitoring location descriptions

To assist in identifying a monitoring locality and its appropriateness for use in air quality assessments eight site types are described by LAQM.TG(03), three site types describe the locations in Nottingham;-

Urban centre	An urban location representative of typical population exposure in towns or city centres.
Roadside	A site between 1m of the kerbside of a busy road and the back of the pavement. Typically this will be within 5m of the road, but could be up to 15m.
Other	Any special source-orientated or location category covering monitoring undertaken in relation to specific emission sources

Nottingham City Monitoring Sites

See Appendix 1 for locations of monitoring stations.

AURN – Clinton Street East

The AURN station is located in the city centre. It is classed as an '**Urban centre'** site. The surrounding area comprises retail outlets and city centre business premises in an urban pedestrian area. The nearest road, the A6008, is a major through-route approximately 30 metres from the site.

The monitoring equipment is housed in a self-contained, air-conditioned fixed unit, the manifold inlet is approximately 3 metres high and has continuous automatic analysers that measure CO, NO, NO_2, NOx, PM_{10}, SO_2 and ozone.

AQMS – Queens Medical Centre, Derby Rd

The AQMS station is a mobile unit and has been in its current location since March 2002. The site is a suburban mixed industrial/commercial/residential area of the City adjacent to the A52. It is classed as an '**Other'** site. It is 25 metres from the A52 ring road and approximately 5 metres from a minor service road.

The self-contained, air-conditioned station has a sampling inlet approximately 2.5 metres high and has continuous automatic analysers that measure CO, NO, NO_2, NOx, PM_{10}, SO_2 and ozone. Temperature, wind speed and wind direction are also measured.

Carter Gate NOx Station – Carter Gate

This is a fixed unit located at Carter Gate since December 2003. The site is a suburban mixed commercial/residential area of the City adjacent to the A60. It is classed as a '**Roadside'** site and is approximately 10 metres from the A60 and approximately 2 metres from a minor road.

The sampling inlet for the self-contained, air-conditioned enclosure is approximately 2.5 metres high. NO, NO_2 and NOx are measured using an continuous automatic analyser.

City Hospital SO_2 Station – City Hospital, Edwards Lane

This is a fixed unit located at the City Hospital since March 2003. The site is a suburban residential area of the City. It is classed as an '**Other'** site

The unit is approximately 100 metres from the coal fired boiler plant in an area where modelling predicts the greatest ground level concentrations will occur. The sampling inlet for the self-contained, air-conditioned is approximately 1.5 metres high. The continuous automatic analyser measures SO_2.

Monitoring Data

Monitoring results are preferably reported on a calendar year basis, for clarity of the measurement period and to allow monitoring over the full range of yearly weather conditions. However a minimum of 6 months covering winter/summer may be reported. The short-term 6 month measurements for 2004 have been adjusted to estimate the long term 12 month average using the methodology detailed in LAQM.TG(03) Box A1.3.

Summaries of monitoring data are given in Tables 4 and 5. The AQMS monitoring results for the period from July 2002 - May 2003 and a full 12 months of monitoring to encompass seasonal effects on air quality are shown in Table 5.

See Nottingham City Council's Second and Third Stage Review and Assessment 2001 - Technical Annexe for further information on the types of monitoring equipment operated and the QA/QC procedures used.

Table 4

Summary of AURN automatic monitoring data for 2000- 2004

- nitrogen dioxide and sulphur dioxide

Pollutant of Concern	**2000**	**2001**	**2002**	**2003**	**2004***
Nitrogen Dioxide (NO_2)					
Annual mean concentration (ug/m3)	40	36	34	36	36 (39)
No. of exceeds of annual mean AQO	1	0	0	0	0
No of exceeds of hourly mean AQO	0	0	0	0	0
Sulphur Dioxide (SO_2)					
No of exceeds of 15-min mean AQO	0	0	0	0	0
No of exceeds of hourly mean AQO	0	0	0	0	0
No of exceeds of daily mean AQO	0	0	0	0	0

* based on 6 months monitoring data ( ) adjusted to estimate 12 month average

Table 5

Summary of AQMS, Carter Gate, CG and City Hospital, CH automatic monitoring data for 2002-2004

Pollutant of Concern	2002-2003 AQMS	2003 AQMS	2004* AQMS	2004* CG	2004* CH
Nitrogen Dioxide (NO_2)					
Annual mean concentration (ug/m3)	42	**	37(40)	**	NA
No. of exceeds of annual mean AQO	1	**	0 (1)	**	NA
No of exceeds of hourly mean AQO	0	**	0	**	NA
Sulphur Dioxide (SO_2)					
No of exceeds of 15-min mean AQO	0	0	0	NA	**
No of exceeds of hourly mean AQO	0	0	0	NA	**
No of exceeds of daily mean AQO	0	0	0	NA	**

* based on 6 months monitoring data ( ) adjusted to estimate 12 month average

** low data capture rate <40% , CG data capture rate at 90%+ from June 2004

NA = not appropriate

Nitrogen Dioxide Diffusion Tubes

Nottingham City participates in the national NO_2 diffusion tube study and has recently increased the number of diffusion tube monitoring sites. It has also commenced co-location of diffusion tubes with the AURN, AQMS and Carter Gate automatic analysers to enable 'bias correction' to be determined. There is currently insufficient data from the co-location studies to determine 'bias corrected' with any confidence. However a bias correction technique has been applied to the diffusion tube results following consultation with DEFRA (Table 6 and 7). There should be sufficient data to report fully on the results of diffusion tube monitoring and 'bias' in the 2005 Progress Report.

Table 6

NO_2 results comparison – no bias correction
*= chemiluminescent analyser results

Month	Ilkeston Rd	Perth St	Noel St	Ransom Dr	QMC	Beeston Rd	Derby Rd	Sh St	AURN	Carter Gate	O.R Bias
Jan	31	37	25	28	43.2*				39.3*		
Feb	42	40	27	19	42.9*				44.2*		
Mar	27	25	27	15	42.9*				42.9*		
Apr	34	38	27	16	34.4*				38.9*	41.6*	
May	34	34	22	20	38.7 30.3*	57	55	60	46 34.1*	49.3 49.3*	1.209
Jun	22	29	13	8	26.0 27.5*	46	47	48	34.4 24.3*	41.0 39.5*	1.131
Jul	27	31	19	8	26.3 29.0*	45	37	49	35.7 28.7*	41.0 35.2*	1.105
Aug	28	31	21	3	34.7 30.0*	50	43	61	38.3 33.2*	44.0 35.8*	1.179
Sep	29	34	24	14	36.7 27.9*	54	40	60	36.3 29.5*	48.3 37.7*	1.275

Table 7

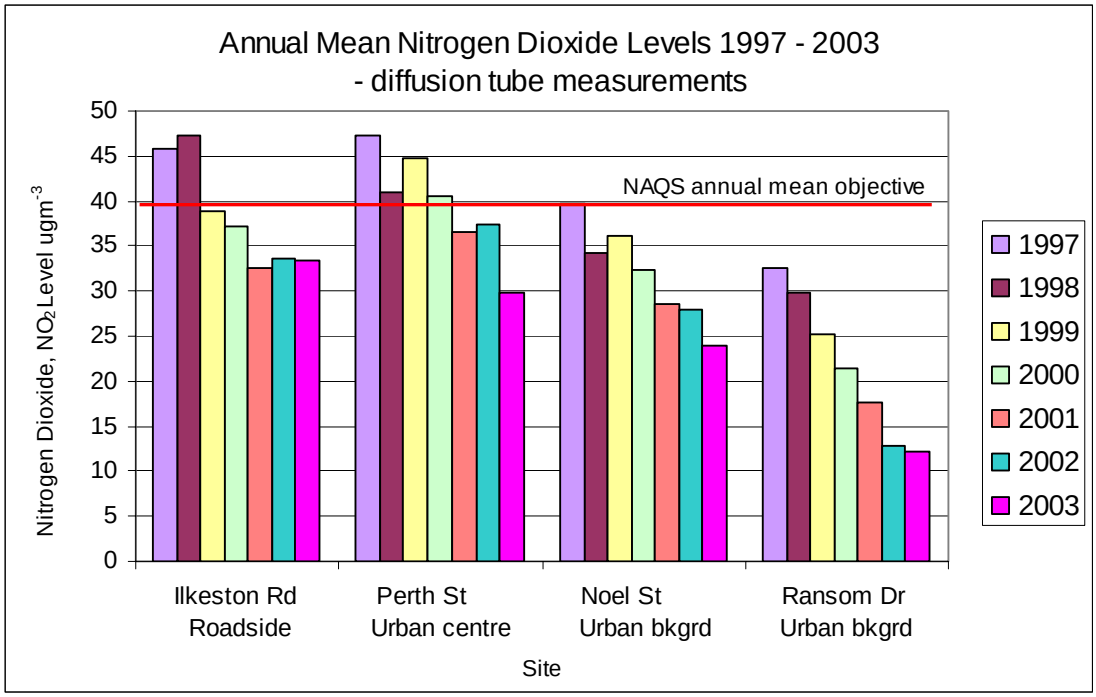
NO_2 diffusion tube results – with orthogonal regression bias correction (for individual months)

Month	Ilkeston Rd	Perth St	Noel St	Ransom Dr	QMC	Beeston Rd	Derby Rd	Sh St	AURN	Carter Gate
May	28.1	28.1	18.2	6.6	32.0	47.1	45.5	49.6	38.0	40.8
Jun	19.5	25.6	11.5	7.1	23.0	40.7	41.6	42.4	31.6	36.3
Jul	24.4	28.1	17.2	7.2	23.8	40.7	33.5	44.3	32.3	37.0
Aug	23.7	26.3	17.8	2.5	29.4	42.4	36.5	51.7	32.5	37.3
Sep	22.7	26.7	18.8	11.0	28.8	42.4	31.4	47.1	28.5	37.9

The results show widely varying ‘bias’ over the 5 month period and it is not possible to determine diffusion tube bias with confidence.

The annual mean results for the national sites for 1997-2003 are reported in Figure 1 and show that there has been a general downward trend in NO_2 levels over the last six years.

Figure 1



Detailed Assessment - Modelling Information

Dispersion models enable the user to predict the concentration of a substance at distances remote from the point of emission. Nottingham City used Atmospheric Dispersion Modelling System Urban 2, ADMS Urban 2 by Cambridge Environmental Research Consultants, CERC to model emissions from a variety of sources and to predict pollutant concentrations over its geographical area for future years.

ADMS-Urban is an advanced dispersion model. Information can be input on road traffic, traffic composition, flows and speeds; industrial and domestic sources, background pollutant data and meteorology. The model can be used for predicting concentrations for single point sources or for complex urban areas. The output can be displayed as contour plots and allows concentrations at specific locations to be predicted.

ADMS-Urban modelling was used for sulphur dioxide and nitrogen dioxide 2004 and 2005 predictions. The model was used to predict both annual means and percentiles for comparison with the Air Quality Objectives.

An emission inventory of road or rail traffic information, area and industrial sources was used in the model runs. Meteorology and monitored background pollutant concentrations from an AURN rural site were also incorporated.

A brief outline of the information required for the model input is given below. Appendix 4 contains a more detailed description of model inputs and outputs. Specific information is given regarding the data used for the sulphur dioxide and nitrogen dioxide modelling and the model verification work undertaken.

Emissions Inventory

Nottingham City has compiled a number of emissions inventories during the LAQM process. The emission inventory data used for the Detailed Assessment modelling was updated and amended as necessary. The inventories are stored as part of the ADMS –Urban program.

Point source emissions **-** point sources for example chimneys, usually serve boiler plant or large industrial processes. The information compiled for the inventory was calculated from data supplied by site operators using either;

i. direct measurement of pollutant concentrations in the stack gases or
ii. estimate of pollutant emissions, based upon the type of fuel and consumption.

Area source emissions - area source emission data were obtained from the National Atmospheric Emissions Inventory at http//www.aeat.co.uk/netcen/airqual/.

Line source emissions - the term 'line source' is used for emissions from motor vehicles and trains.

Rail ‘traffic’ information was obtained from Midland Mainline/Central Trains.

With respect to road traffic, Nottingham City has a traffic/transport model and traffic flows have been obtained from either the traffic model or traffic counts. The majority of the information was gathered and supplied by Nottingham City Council's Transportation Teams and Pollution Control Section.

Meteorology

ADMS-Urban requires detailed meteorological information. The Watnall station near Nottingham ceased measuring meteorological data with the required parameters in 1995. Special data sets called Numerical Weather Prediction, NWP have been complied by the Meteorological Office for the Nottingham City area.

Background Pollutant Concentrations

A pollutant's concentration at a given location and time is a combination of local emissions from point, line and area sources and those transported from distant sources. The emissions from distant sources contribute to the background concentration, i.e. the concentration of a pollutant that would be measured in the absence of local sources.

Pollutants Identified by Updating and Screening Assessment 2003 requiring Detailed Assessment

Sulphur Dioxide

The Updating and Screening Assessment 2003 process identified the Nottingham Main Line Station as a location with the potential for 'regular outdoor exposure' of members of the public to sulphur dioxide and therefore the requirement to undertake a Detailed Assessment for sulphur dioxide in the vicinity of the Station.

The Mainline station comprises a high level entrance/booking hall area with the train platforms located at a lower level. The majority of the platforms enjoy weather protection/canopy for a large portion of their length (200 of 300 metres).

Information received from the local rail operator detailed typical operating scenarios for the two classes of locomotive operating from the station. Of the two classes only the older High Speed Trains are required to operate one of their locomotive units for periods which can exceed 15 minutes. The rail operator has advised that there are typically 12 occasions Monday to Saturday and five occasions on Sunday when a locomotive is stationary with its engine running for more than 15-minutes.

In the case of the HST's the length of the train results in the 'heat mode' engine being adjacent to the open platform at some distance from the covered platform area and main building. Thus although there is a potential for 'regular outdoor exposure' it is not in a location generally frequented by members of the public.

Complex modelling predicts a maximum 99.9^{th} percentile concentration of 235 $u gm^{-3}$ (which includes a 6 $u gm^{-3}$ background contribution). This is lower than the 15-minute AQO of 266 $u gm^{-3}$ and it is therefore concluded that the Air Quality Objectives for sulphur dioxide will be met in all locations at the mainline station (Figure 2).

Figure

Sulphur Dioxide - Predicted 2005 Maximum 15 Minute Mean (99.9%ile) Concentrations

Nottingham Main Line Station



Nitrogen Dioxide

Major point sources emitting NOx included in the model runs are shown in Appendix 2

The Updating and Screening Assessment 2003 process identified a number of roads predicted to have an annual mean of between 36-40 ugm^{-3} (using the original DMRB emission factors). The roads include major arterial routes and the inner and outer ring roads and roads explicitly modelled are shown in Appendix 3.

Parts of Nottingham City Centre are undergoing redevelopment which are either in progress or planned for completion before December 2005. They are subject to major transport schemes resulting in changes to some road layout/flows used for the Updating & Screening Assessment 2003. Where possible the altered layouts and traffic flows (from the traffic model) have been incorporated into the Detailed Assessment NO_2 modelling.

Figures 3 to 5 show the 2005 predicted nitrogen dioxide annual mean concentrations for the City Centre and the Dunkirk areas. The areas in Figures 3 and 5 are significant because they cover those parts of the City where Air Quality Management Areas have been declared. Figure 4 relates to one of the redevelopment areas referred to above.

The modelling predicts that the Air Quality Objectives for nitrogen dioxide will be met in all locations with relevant exposure.

Figure 2

Nitrogen Dioxide - Predicted 2005 Annual Mean Concentrations

City Centre 1



0 100 200 300 400 500 Metres

Nitrogen Dioxide Concentrations

- 22 - 35 ug/m3
- 35 - 37 ug/m3
- 37 - 39 ug/m3
- 39 - 40 ug/m3
- 40 - 44 ug/m3

Figure 3

Nitrogen Dioxide - Predicted 2005 Annual Mean Concentrations

City Centre 2

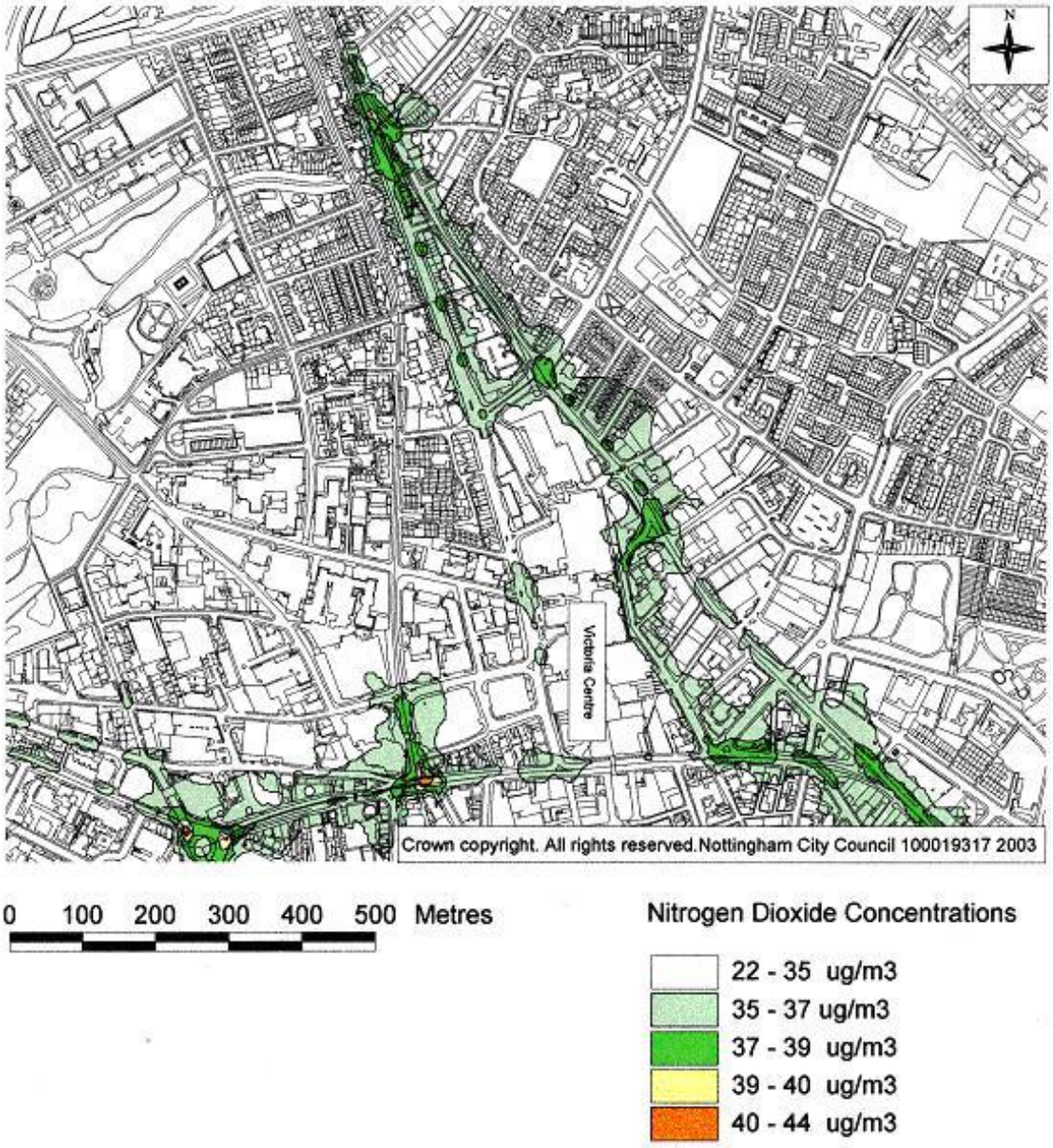
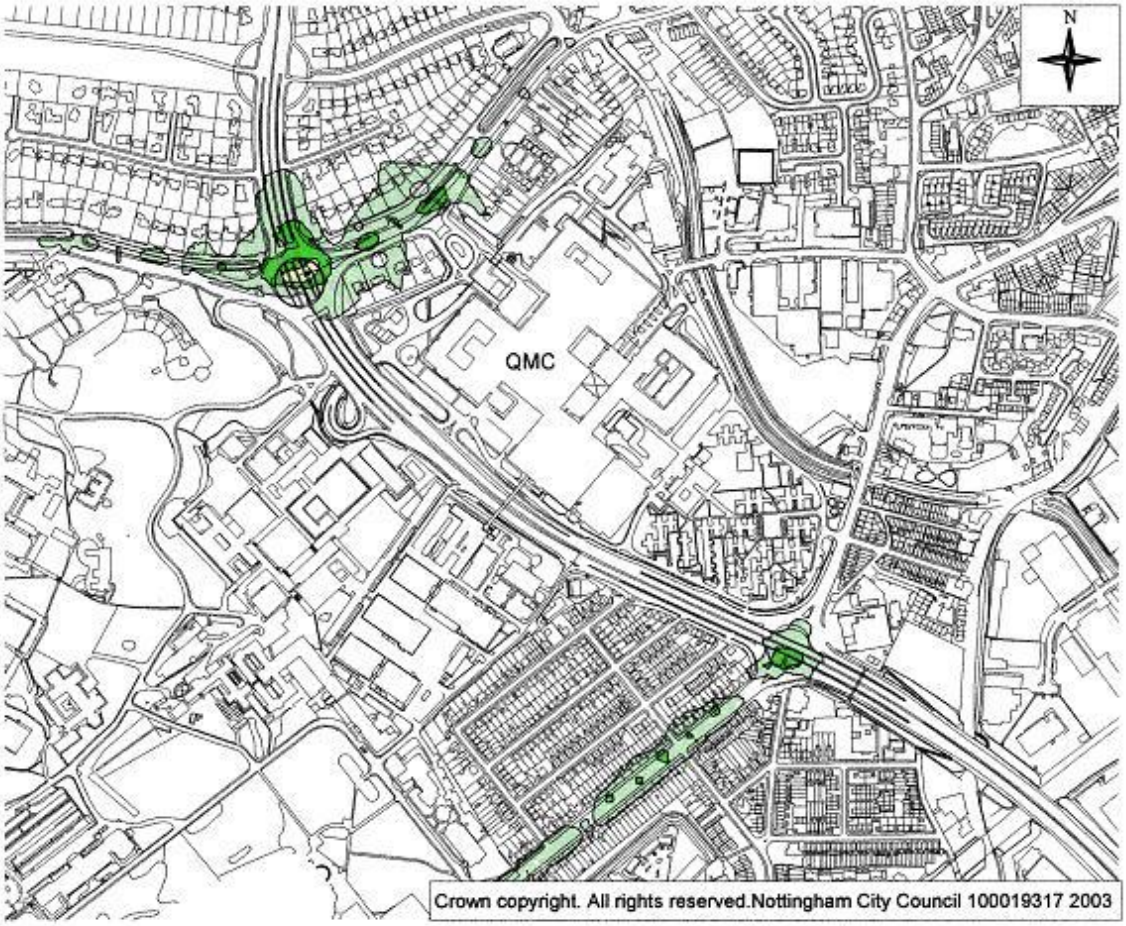


Figure 4

Nitrogen Dioxide - Predicted 2005 Annual Mean Concentrations

Dunkirk Area including Queen's Medical Centre (QMC)



Conclusions

The Detailed Assessment 2004 concluded the following;

Sulphur dioxide

The Detailed Assessment predicts that the 15-minute mean Air Quality Objective of 266 *u*gm^{-3} not to be exceeded more than 35 times a year by 31.12.2005 is likely to be met at locations of 'relevant exposure' at Nottingham Mainline Station.

Nitrogen dioxide

The Detailed Assessment predicts that the annual mean Air Quality Objective of 40 *u*gm^{-3} by 31.12.2005 is likely to be met at locations of 'relevant exposure' in the Nottingham City area.

It is not therefore necessary to declare any new Air Quality Management Areas.

Amendments to the existing Air Quality Management Areas

The Environment Act 1995 Section 83 (2) states 'An order under this section may, as a result of a subsequent air quality review,-

(a) be varied by a subsequent Order; or

(b) be revoked by such an Order,

if it appears on that subsequent Air Quality Review that the Air Quality Standards and Objectives **are being achieved**, and are likely throughout the relevant period to be achieved, **within the designated area**.

Monitoring, where available, has not been for a sufficiently long period or of sufficiently high capture rate to demonstrate that the Air Quality Standards and Objectives are being achieved. It is therefore necessary to continue monitoring within the AQMAs. **However, it is not appropriate at this time to revoke any of the Air Quality Management Areas.**

Air Quality Actions Plans

Complex modelling carried out as part of the Detailed Assessment predicts that the Air Quality Objectives for sulphur dioxide and nitrogen dioxide will be

met at all relevant locations by the due dates 2004/2005. **It is not therefore necessary to prepare any Air Quality Action Plans.**

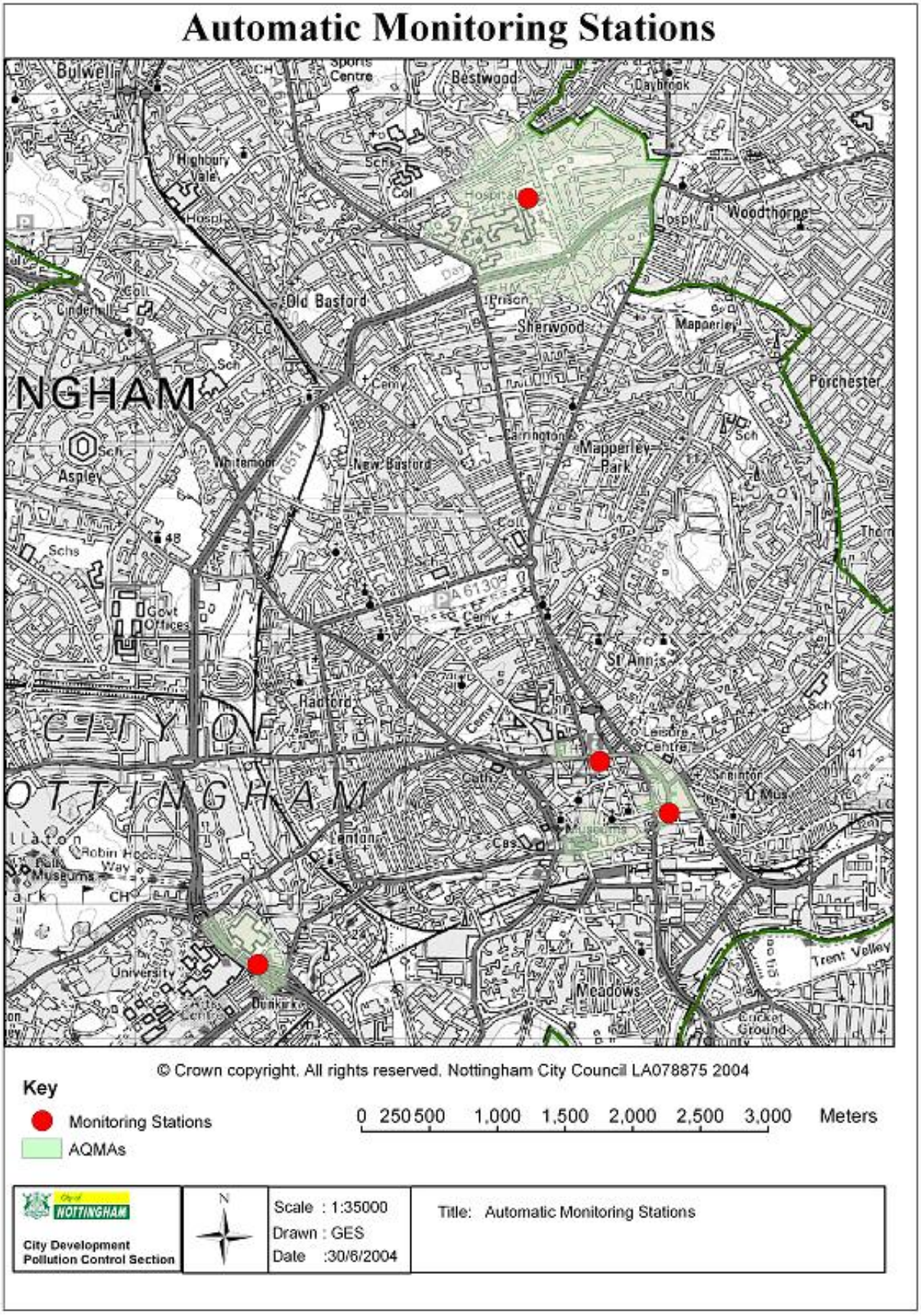
What happens next?

The administrative framework LAQM.PG (03) Policy Guidance and LAQM.TG (03) Technical Guidance published in February 2003 advised Local Authorities to follow the guidance on the recommended phased approach to the review and assessment process set out in LAQM.TG (03).
This new review and assessment process replaces the former 3-4 stage review and assessment process. See Table 3.

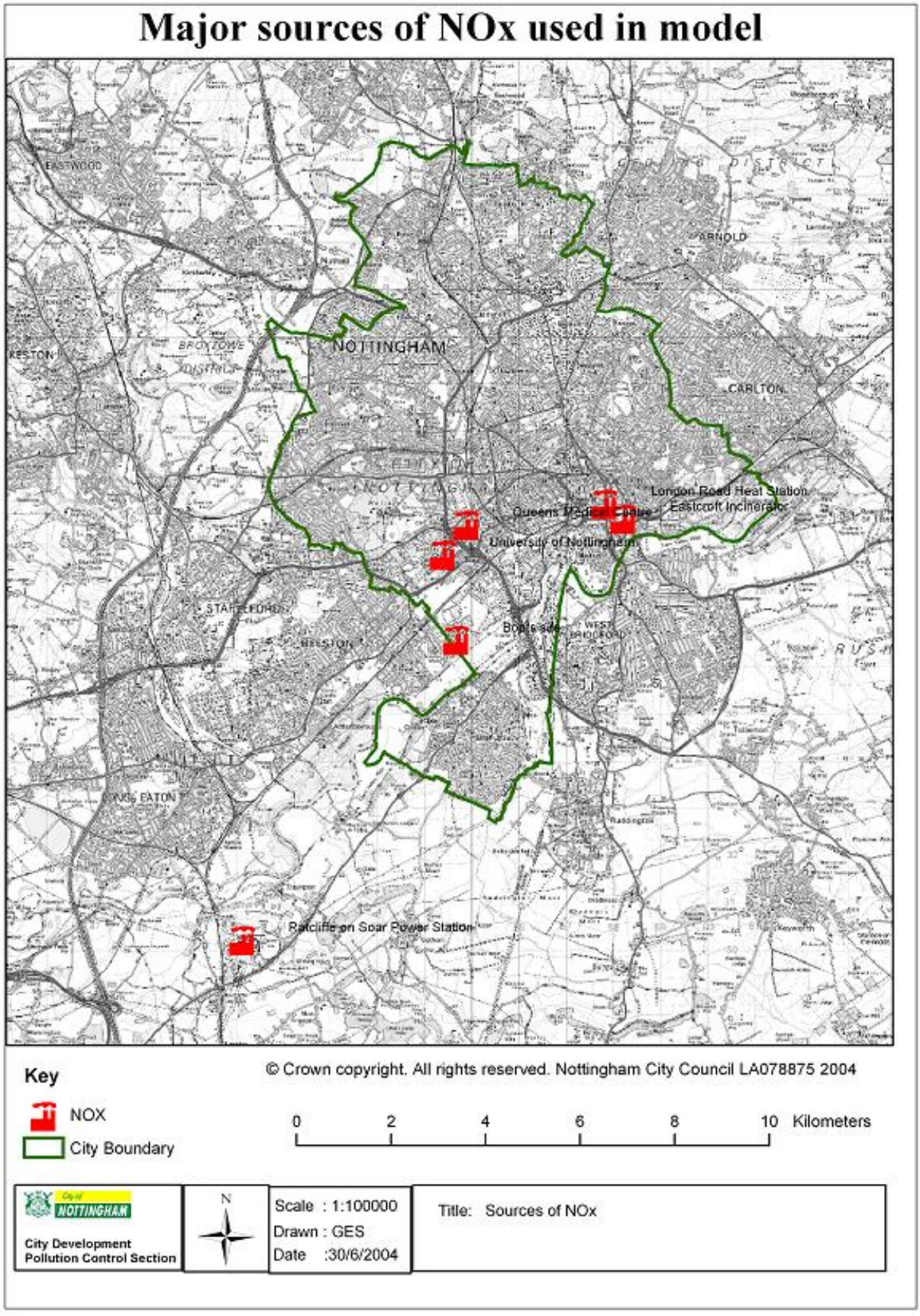
DEFRA recommends that local authorities prepare annual air quality Progress Reports between subsequent rounds of reviews and assessments to ensure continuity in the LAQM process and that monitoring data is reported over the period of a calendar year.

The next step in the Local Air Quality Management process is for a Progress Report to be completed and submitted to DEFRA for the end of April 2005.

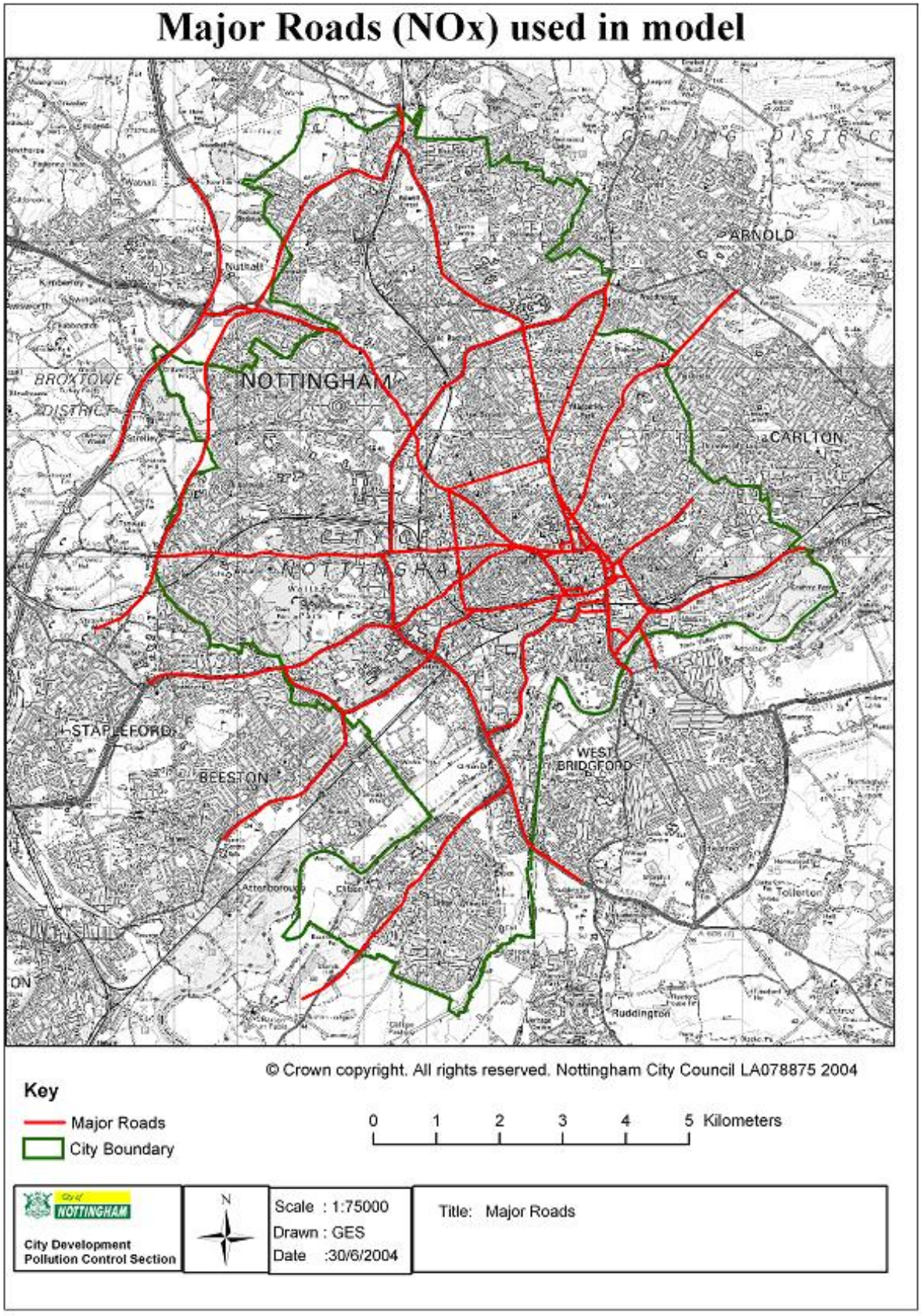
Appendix 1


Automatic Monitoring Stations
Bulwell
Bestwood
Daybrook
Highbury Vale
Hospl
Woodthorpe
Old Basford
Sherwood
Mapperley
Porchester
NGHAM
Aspley
Whitemoor
New Basford
Carrington
Mapperley Park
Schs
Govt Offices
St Ann's
Radford
CITY OF
OTTINGHAM
Leisure Centre
Robin Hood Way
Museums
University
Dunkirk
Lenton
Meadows
Trent Valley
Cricket Ground
© Crown copyright. All rights reserved. Nottingham City Council LA078875 2004
Key
Monitoring Stations
AQMAs
0 250 500 1,000 1,500 2,000 2,500 3,000 Meters
NOTTINGHAM
City Development
Pollution Control Section
N
Scale : 1:35000
Drawn : GES
Date :30/6/2004
Title: Automatic Monitoring Stations

Appendix 2


Major sources of NOx used in model
NOTTINGHAM
ARNOLD
CARLTON
KEYSTON
EASTWOOD
London Road Heat Station
Eastcroft Incinerator
University of Nottingham
Boots site
Ratcliffe on Soar Power Station
Key
NOX
City Boundary
© Crown copyright. All rights reserved. Nottingham City Council LA078875 2004
0 2 4 6 8 10 Kilometers
City Development
Pollution Control Section
N
Scale : 1:100000
Drawn : GES
Date :30/6/2004
Title: Sources of NOx

Appendix 3


Major Roads (NOx) used in model
ARNOLD
Nuthall
BROXTOWE
DISTRICT
NOTTINGHAM
CARLTON
CITY OF
NOTTINGHAM
STAPLEFORD
BEESTON
WEST
BRIDGFORD
Attenborough
Clifton
Tollerton
Ruddington
© Crown copyright. All rights reserved. Nottingham City Council LA078875 2004
Key
Major Roads
City Boundary
0 1 2 3 4 5 Kilometers
City of NOTTINGHAM
City Development
Pollution Control Section
N
Scale : 1:75000
Drawn : GES
Date :30/6/2004
Title: Major Roads

Appendix 4
Model Description, Methodology and Verification

Model Description

Dispersion models enable the user to predict the concentration of a substance at distances remote from the point of emission. Nottingham City used ADMS Urban 2 by CERC to model emissions from a variety of sources and to calculate pollutant concentrations over a geographical area.

In order to model an emission, its dispersion, dilution and consequent concentration at a given location, specific information is required - the input to the model. It performs complex calculations using this information to predict a concentration - the output of the model.

Model Input

Meteorology

A number of factors have a direct bearing on the concentration of an emitted substance at any given point:-

i. The initial height of discharge/release
ii. The temperature and velocity of the release
iii. The wind speed and direction
iv. Atmospheric stability

The release height, velocity and temperature of an emission may be readily determined.

Wind direction, wind speed and the degree of turbulence determine where an emission is directed, how quickly it travels and how much mixing with the ambient air occurs, i.e. its dispersion and dilution. The degree of turbulence is indirectly derived from cloud cover, the height of the mixing layer, the time of day, and the time of year.
Weather varies from season to season, day to day and hour to hour. A dispersion model requires this time varying information and meteorological data specific for the geographical area being modelled so that pollutant concentrations can be more accurately predicted.

Meteorological data may be provided as: -

i. Hourly sequential - wind speed, direction, cloud cover, date, time of day, temperature and possibly precipitation or
ii. Statistical data comprising wind speed, direction, surface sensible heat flux, boundary layer depth and precipitation.

Choice of meteorological data

Nottingham NWP data is hourly sequential data interpolated specifically for this area, reflecting local conditions. Nottingham 1999 NWP data has previously been compared with: Watnall weather station - statistical data for 1986 -1995 and Wittering weather station - 1997, 1998 and 1999 hourly sequential data and determined to be representative (See Stage 2/3 Technical Annexe 2002). It has been assumed that 2000 NWP data is similarly representative.

Nottingham NWP 1999 and 2000 was used for model verification.

For the 2004 and 2005 pollutant concentration predictions, Nottingham NWP 2000 data was used.

Topographical Information - Surface roughness

Buildings, hills and undulations cause friction and turbulence as the wind moves over land. Turbulence effects the dispersion of an emission. The amount of friction that topographical features cause is described by the parameter ‘surface roughness’. Values for surface roughness vary from 1.0 for Cities and woodlands, to 0.5 for parkland and open suburbia, to 0.02 for open grassland. In ADMS Urban only one value may be chosen for the modelled area.

Nottingham City is characterised by low rise suburban housing, parks, fields and a relatively small ‘high rise’ core. A value of 1.0 was therefore used.

Emission sources

ADMS Urban can deal with four different types of emission sources, point, line, area and volume. The first three adequately describe emission sources that occur in Nottingham City.

Point Sources (metres)

The emission occurs from a specific point. A point source is usually a chimney, which for non-combustion processes may also be called a 'stack'. Stack height i.e. the height of the point of emission above ground level and stack diameter i.e the internal diameter of chimney are required. In a chimney with multiple flues the aggregated diameter is used.

Area Sources (square kilometres)

An area source is usually a large building or process with emissions occurring in a number of locations over the area. It may also be a large geographical area such as a housing estate where small emissions occur from a large number of point sources which are thus impracticable to model discreetly but collectively emit a significant quantity of a substance and can be included when defined as an area source.

Line Sources (metres or kilometres)

A line source is usually a road, where a large number of discrete moving point sources can be modelled as a continuous emission along the length of a road. The following information is required:

Physical parameters - road width and road/segment length.

Traffic volume and average speed - traffic speed affects the emission rate and composition of exhaust gases. Annual average daily traffic flows and some average speed data was obtained from Nottingham City Transportation Section. Other average speeds were found by timed journeys or estimated. The model allows one speed to be specified per line source. Therefore where it is known that vehicle speeds vary along a given road the road was divided into segments. The average speed was determined for each segment.

Traffic type/mix - emissions vary between classes of vehicle e.g. Heavy goods vehicles, HGVs and cars and light goods, LGVs. The model requires the vehicle split between LGV and HGV classes. The percentage vehicle split was obtained from the City Development Transportation Section.

Emission factor (grammes per kilometre) - the model has the capacity for either the 1999 and 2003 DMRB emission factors to be used. These factors are derived from the UK emissions factors database http://www.rsk.co.uk/ukefd/.

Pollutant Characteristics

The model is pre-programmed with the characteristics of a number of common pollutants including sulphur dioxide, nitric oxide, nitrogen dioxide and particles PM_{10}. If the emission is not gaseous the model allows the user to specify the size of the particle emitted.

Background Pollutant Concentrations

ADMS Urban models a pollutant source discreetly. To predict the pollutant's concentration it is necessary to add the pollutants background concentration to the modelled concentration. Background concentrations from the rural AURN station sited at Rochester were used in model predictions.

Rate of pollutant emission

Each process emits pollutants at a given rate which can vary. In the case of sulphur dioxide from a coal-fired combustion plant it depends upon the sulphur content of the coal and the rate at which the fuel is burned. For point sources this rate was obtained from data supplied by the plant operator. In the case of line sources and area sources, from data derived from the statistical analysis of national data sets.

Emission temperature

The temperature of an emission affects its thermal buoyancy. If an emission is ‘hot’ it acts like an extension to a chimney or stack increasing the effective height of discharge.

For point sources the emission temperature was obtained from data supplied by process operators. For area sources it was considered to be the same as the ambient air temperature. It is not a required input parameter for line sources.

Chemistry

The Air Quality Objectives refer to nitrogen dioxide whereas the emissions from most combustion sources are in the form of nitric oxide, NO. As the nitric oxide travels downwind it is oxidised by ozone, O_3 to nitrogen dioxide, NO_2. The reaction depends upon the amount of ozone present and meteorological conditions (Fisher BE et al 1999).

Therefore to predict NO_2 concentrations it is necessary for any screening model or computer model to take into account this chemical reaction. A number of methods are available including:-

i. The use of a constant conversion factor,
ii. The use of surrogate statistics to represent NO_x conversion to NO_2,
iii. The use of photochemical models.

The ADMS Urban 2 model uses a 'Generic Reaction Set' (GRS). GRS models important reactions involving nitrogen, VOCs and ozone and is a 'Photochemical' model that makes direct predictions of NO_2 concentrations (Carruthers et al 1996, 1997).

Model Outputs

The model calculates pollutant concentrations in a defined study area. ADMS Urban was used in conjunction with ArcView for defining output grids for contour plots and specifying receptor points.
ArcView is a Geographical Information System, GIS and can be used to overlay a map with the predicted concentration data produced by ADMS.

Pollutant concentrations are determined as the amount of a substance in a given volume, usually one cubic metre, of air.

In addition to specifying an area of interest it is necessary to specify short term or long term averaging.

Short term averaging gives a concentration output for each line of meteorological data e.g. a concentration at each point for hour 1, hour 2, etc.

Long term averaging gives one output value at each location averaged over the whole of the input meteorological data set. Percentiles of pollutant concentrations can be calculated using long term averaging.

ADMS allows several percentiles to be calculated during a single model run. The percentiles chosen were appropriate for the Air Quality Objective being modelled, for example, for SO_2 the 15-minute mean of no more than 35 exceedances of a concentration of 266 ugm^{-3} equates to the 99.9^{th} percentile.

Model Methodology
Sulphur Dioxide Modelling Information

Modelling was carried out for emissions from idling locomotive units at the Nottingham Mainline Station. The following information was used in the model to predict the 99.9^{th}%ile, 15-minute maximum ground level concentrations of SO_2 for 2005, arising from idling locomotives. It is based on typical operating procedure data supplied by Midland Trains:

Emission height = 2.5 m (above adjacent platform)
Exhaust diameter = 0.4 m
Exit velocity = 4 m/s (heat), 2.8 m/s (idle)
Temperature = 330 ^oC (heat), 120^oC (idle)
SO_2 emission (loco on 'heat' setting) = $8.7x10^{-2}$ g/s
SO_2 emission (loco on 'idle' setting) = $1.8x10^{-2}$ g/s
Surface Roughness = 1m
Minimum Monin-Obukov length = 30m
Meteorological data = Nottingham NWP 2000
Background pollutant concentration = 15 *u*gm^{-3} (obtained from the Nottingham AURN site and assumed to be representative of the urban background concentration of sulphur dioxide).

Nitrogen Dioxide Modelling Information

Long term modelling was used to predict the ground level annual mean for NO_2.

Surface Roughness = 1m

Minimum Monin-Obukov length = 30m

GRS chemistry

Meteorology = Nottingham NWP 2000

Background pollutant concentrations - hourly averaged data from Rochester AURN for the year 2000 was used. This was adjusted for 2005, in accordance with the method given in LAQM.TG (O3) – Box 6.7 - NO_2 and Box 6.8 - NOx. No alterations were made to the ozone data.

Emissions data - the following data was used:

Roads – LGV and HGV traffic flows for 2005 calculated from 2003 AADT or 2006 traffic model data supplied by the Nottingham City Council's Transportation Section and the average speed for each link.

2003 DMRB emission factors for 'urban' roads.

Hourly diurnal traffic flow factors for weekdays, Saturday and Sunday derived from City wide automatic traffic count data that had been previously supplied.

Point – the parameters and emissions supplied by the operators or reasonable assumed values.

Area – the 2000 NOx values for 'Commercial, Institutional and Residential Combustion' from the NAEI. No corrections were made for 2005 based on the assumption that this category was unlikely to alter significantly.

Model Verification

In order to have confidence in the model predictions verification work was undertaken. Verification involves comparison between modelled and monitored pollutant concentrations.

Model verification studies were included as part of the Stage 2 and 3 Review and Assessment process and are detailed in that report. However since then

an improved version of ADMS Urban has been developed and the 2003 DMRB emission factors are now available. Therefore further model verification has been undertaken.

Sulphur Dioxide

Sulphur dioxide (SO_2) concentrations at the mainline station have not been verified separately. The idling locomotives were considered point sources and Nottingham City relied upon the validation studies undertaken by CERC (Carruthers et al 1996, 1997). This is in accordance with the advice given in LAQM. TG (O3) as no appropriate monitoring is available.

Nitrogen Dioxide

LAQM.TG(03) suggests model verification utilising data from roadside monitoring equipment. Nottingham City has only recently commissioned a roadside monitoring site (Carter Gate) and has insufficient monitoring data with which to carry out the calculations, furthermore calculations based on non-roadside monitoring result in significantly higher concentrations.

Model verification was therefore conducted in the manner adopted for the Stage 2 and 3 Review and Assessment. This entailed modelling historical scenarios, comparing model predictions with monitored concentrations and deriving an adjustment factor for the difference between monitored and modelled concentrations.

Long term modelling was used to predict the NO_2 annual means for comparison with monitored data using the following parameters:

Surface Roughness = 1m
Minimum Monin-Obukov length = 30m
GRS chemistry
Meteorology = Nottingham NWP 1999 and 2000
Background pollutant concentrations - the hourly averaged NO2, NOx and O3 data from Rochester AURN for 1999 or 2000 as appropriate.

Emissions data - the following data was used:

Roads – LGV and HGV traffic flows for 1999 calculated from 1997 AADT data were the same as used for the Stage 2 and 3 Review and Assessment. LGV and HGV traffic flows for 2000 were calculated from 2003 AADT data. All AADT data and the necessary adjustment factors were supplied by the Transportation Section.

The average speed for each link was kept constant for all the modelling studies.

1999 DMRB emission factors for 'all' roads

Point – the parameters and emissions supplied by the operators or reasonable assumed values.

Area – the 2000 NOx values for 'Commercial, Institutional and Residential Combustion' from the NAEI for both years. No corrections were made for 1999.

Model Adjustment

Table 1 Monitored and Modelled Annual Mean Nitrogen Dioxide 1999 and 2000

NO_2 ugs/m^3 Annual Mean	Monitored	Modelled	Percentage difference	Monitored/ modelled ratio
1 AURN 2000	40	38.7	- 3.3	1.03
2 AURN 1999	44	41	- 7.3	1.07
Monitored data capture rates were greater than 90%				
Average			-5.3	1.05

Table 1 shows the monitored and modelled values for the nitrogen dioxide annual means.

Comparison of monitored levels with the model results showed that that the model under predicted results by 3% for 2000 and 7% for 1999. Therefore a correction factor was calculated to apply to the model predictions for future years.

Correction factor = monitored concentrations/modelled concentrations;

AURN 2000 NO_2 Annual mean 40.0 *u*gs/m^3 divided by 38.7 *u*gs/m^3 = 1.03

AURN 1999 NO_2 Annual Mean 44.0 *u*gs/m^3 divided by 41.0 *u*gs/m^3 = 1.07

The model results were multiplied by 1.05 (average adjustment factor) to give the predicted 2005 nitrogen dioxide concentrations for comparison with the air quality objectives.

References

CERC (1999**) Atmospheric Emissions Inventory and Dispersion Modelling Study for Nottinghamshire.**

Department of Environment (1997) **The United Kingdom National Air Quality Strategy**, The Stationary Office, London

Department for Environment Food and Rural Affairs (2003) Part IV of the Environment Act 1995, Local Air Quality Management: Policy Guidance LAQM.PG (03)

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

DETR (1997) Part IV The Environment Act 1995 - **The United Kingdom National Air Quality Strategy**, Department of Environment Transport and the Regions, London

DETR (2000) **The Air Quality Strategy for England, Scotland, Wales and Northern Ireland**, Department of the Environment, Transport and the Regions, London

DETR **Air and Environment Quality** [on line] Available at: http://www.environment.detr.gov.uk/airq/aqinfo.htm

NETCEN **The UK National Air Quality Information Archive** [on line] Available at: http://www.aeat.co.uk/NETCEN/airqual

Nottingham City Council (2000) **Air Quality Review and Assessment. First and Second Stage.**

Nottingham City Council (2002) **Air Quality Review and Assessment. Second and Third Stage.**

Nottingham City Council (2003) **Air Quality Review and Assessment: Fourth Stage.**

Nottingham City Council (2003) **Local Air Quality Management: Updating and Screening Assessment.**

Nottingham City Council and Nottinghamshire County Council, Joint Strategy (1999) **Local Transport Plan for Greater Nottingham** - Provisional Plan 2000/01 - 2004/05