Nottingham City Council

Local Air Quality Management

Detailed Assessment

Consultation Document

May 2008

Environment and Regeneration
Noise & Pollution Control Team
Lawrence House
Talbot Street
Nottingham
NG1 5NT

Contents

Abbreviations 3

Local Air Quality Management 4
Introduction 4
Existing Air Quality Management Areas 6
Future air quality reviews and assessments and Progress Reports 7
Updating and Screening Assessment: Conclusions 9

The Detailed Assessment 10
Monitoring information 10
Continuous automatic monitoring 10
Nottingham City Continuous Automatic Monitoring Sites 10
Monitoring Data - Continuous analyser sites 12
Nitrogen dioxide diffusion tube monitoring 14
Monitoring Data - Nitrogen dioxide concentrations - diffusion tube measurement 15
Mapped monitored nitrogen dioxide concentrations – City Centre area 16
Mapped monitored nitrogen dioxide concentrations – Dunkirk area 17
Monitoring data analysis 18
Modelling Information 18
Nitrogen dioxide modelling 19
Modelled 2006 annual mean nitrogen dioxide concentrations 20
Particles, PM_{10} modelling 21
Modelled 2006 annual mean particles, PM_{10} concentrations 22
Detailed Assessment - Conclusions 23

Progressing Local Air Quality Management 23
Amendments to existing Air Quality Management Areas 23
Mapped proposed variation of AQMA No:2 – City Centre 25
Mapped proposed variation of AQMA No:3 – Dunkirk 26
What happens next? 27
Air quality action plans 27
Further assessment within of air quality within an AQMA 27
The next annual air quality report 28

References 29

Appendices

Appendix 1 Nitrogen Dioxide Diffusion Tube Information 30

Table A1.1 2006 mean nitrogen dioxide concentrations – all tubes 30

Table A1.2 2006 Bias adjustment factor details 31

Figure A1.1 Mapped diffusion tube sites 32

Appendix 2 Model Description, Methodology and Verification 33

Description 33

Model Methodology 37

Model Verification 38

Model Adjustment Factor 39

Table A2.1 Monitored and modelled nitrogen dioxide annual mean 2006 39

Table A2.2 Monitored and modelled particles, PM_{10} annual mean 2006 39

Tables and Figures

Table 1 National Air Quality Objectives 5

Table 2 Recommended timescales for submission of Assessments and Progress Reports 7

Table 3 Examples where Air Quality Objectives should/should not apply 8

Table 4 Summary of AURN continuous monitoring 2004 -2006 12

Table 5 Summary of AQMS continuous monitoring 2004 -2006 13

Table 6 Summary of CG NOx continuous monitoring 2004 -2006 13

Table 7 2006 mean nitrogen dioxide concentrations – diffusion tube measurement 15

Figure 1 2006 mapped monitored nitrogen dioxide concentrations in Dunkirk area 16

Figure 2 2006 mapped monitored nitrogen dioxide concentrations in City Centre area 17

Figure 3 Nitrogen dioxide - modelled 2006 annual mean concentrations 20

Figure 4 Particles, PM_{10} - modelled 2006 annual mean concentrations 22

Figure 5 Proposed variation of AQMA No: 2 Nitrogen dioxide – City Centre area 25

Figure 6 Proposed variation of AQMA No: 3 Nitrogen dioxide – Dunkirk area 26

Abbreviations

AADT	Annual Average Daily Traffic
ADMS	Atmospheric Dispersion Modelling System
AQAP	Air Quality Action Plan
AQMA	Air Quality Management Area
AQMS	Air Quality Monitoring Station
AQO	Air Quality Objective
AURN	Automatic Urban and Rural Network
CERC	Cambridge Environmental Research Consultants
DA	Detailed Assessment
Defra	Department for Environment Food and Rural Affairs
DT	Diffusion Tube
HGV	Heavy Goods Vehicles
LAQM	Local Air Quality Management
LAQM.PG(03)	Local Air Quality Management Policy Guidance
LAQM.PGA(05)	Local Air Quality Management Policy Guidance Addendum
LAQM.TG(03)	Local Air Quality Management Technical Guidance
LGV	Light Goods Vehicles
LSO	Local Site Operator
LTP	Local Transport Plan
NO_2	Nitrogen dioxide
NOx	Oxides of nitrogen
PM_{10}	Particles 10 microns or less in diameter
USA	Update Screening and Assessment

Local Air Quality Management

Introduction

The Environment Act 1995 Part IV introduced the requirement for a National Air Quality Strategy and the concept of Local Air Quality Management (LAQM). The Strategy has to include statements on “standards relating to the quality of air” and “objectives for the restriction of the levels at which particular substances are present in the air”. Section 82 of the Environment Act 1995 requires Local Authorities to review the air quality in their area and assess whether air quality standards and objectives prescribed in regulations will be achieved by the specified attainment date for each pollutant of concern.

Standards and objectives required by European Directives or National legislation are implemented by means of Regulations. Current European Directive limit or target values are set out in The Air Quality Standards Regulations 2007 which came into force on 15th February 2007.

For the LAQM process, Local Authorities are expected to assess air quality against the National Air Quality Objectives and time scales stated in the National Air Quality Strategy and implemented by The Air Quality (England) Regulations 2000 and amendments. See Table 1 below.

The 2000 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.’ The Strategy requires that ‘… 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.’

Where it is 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 (AQAPs).

Table 1

National Air Quality Objectives

Pollutant	Applies to	Objective	Concentration measured as	Date to be achieved by and maintained thereafter
Benzene	UK	16.25 $\mu g/m^3$	running annual mean	31 December 2003
	England & Wales	5 $\mu g/m^3$	annual average	31 December 2010
	Scotland, Northern Ireland	3.25 $\mu g/m^3$	running annual mean	31 December 2010
1,3 Butadiene	UK	2.25 $\mu g/m^3$	running annual mean	31 December 2003
Carbon monoxide	UK	10 mg/m^3	running 8-hour mean	31 December 2003
Lead	UK	0.5 $\mu g/m^3$	annual mean	31 December 2004
		0.25 $\mu g/m^3$	annual mean	31 December 2008
Nitrogen dioxide	UK	200 $\mu g/m^3$ not to be exceeded more than 18 times a year	1 hour mean	31 December 2005
	UK	40 $\mu g/m^3$	annual mean	31 December 2005
PM_{10}	UK	50 $\mu g/m^3$ not to be exceeded more than 35 times a year	24 hour mean	31 December 2004
	UK	40 $\mu g/m^3$	annual mean	31st December 2004
$PM_{2.5}$	UK (except Scotland)	25 $\mu g/m^3$ (target)	annual mean	2020
	Scotland	12 $\mu g/m^3$ (limit)	annual mean	2020
Sulphur dioxide	UK	125 $\mu g/m^3$ not to be exceeded more than 3 times a year	24 hr mean	31 December 2004
	UK	350 $\mu g/m^3$ not to be exceeded more than 24 times a year	1 hr mean	31 December 2004
	UK	266 $\mu g/m^3$ not to be exceeded more than 35 times a year	15 min mean	31 December 2005

(The Air Quality Strategy for England, Scotland, Wales and Northern Ireland Vol. 1 July 2007)

Indicative 2010 objectives for PM_{10} (from the 2000 Strategy and 2003 Addendum) have been dropped.

There is also a UK urban background exposure reduction target for $PM_{2.5}$ of a 15% cut (target) between 2010 and 2020.

Existing Air Quality Management Areas

Nottingham City Council completed its first round of review and assessment in September 2001 and subsequently declared three Air Quality Management Areas (AQMAs):

AQMA No1 – Sulphur dioxide area around the City Hospital. This has been revoked.
AQMA No 2- Nitrogen dioxide City centre area.
AQMA No 3- Nitrogen dioxide Dunkirk area.

Areas nearby AQMAs 2 and 3 have been included as part of this Detailed Assessment.

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.'

The Stage 4 Review and Assessment 2003 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 unnecessary.

Revisions to the LAQM process, by guidance from Defra, allow AQAPs to be incorporated in the Local Transport Plan (LTP). Whilst Local Authorities with AQMAs have the choice about whether to integrate their AQAPs into the LTP, the policy guidance addendum, LAQM.PGA(05) recommends that this approach should be adopted, where for example local road traffic is the major source of predicted exceedances of AQOs.

Nottingham City Council's Local Transport Plan, LTP 2005/7-2010/11 (March 2006) contains measures and actions to improve air quality. The LTP is available on http://www.nottinghamcity.gov.uk/sitemap/services/transport_and_streets/transport_planning/cdt_local_transport_plan.htm

Future Air Quality Review 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.

Defra recommends that Local Authorities carry out their LAQM duties according to the programme and timescales detailed in Table 2 below and; that local authorities should prepare annual Progress Reports between subsequent rounds of review and assessment to ensure continuity in the LAQM process. Where, following the Updating and Screening Assessments in April 2006 and 2009, it is determined that Detailed Assessments are not required, authorities will be expected to submit Progress Reports in April 2007 and 2010.

Table 2

Recommended timescales for submission of Assessments and Progress Reports

LAQM Activity	Completion Date	Which 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
Updating and Screening Assessment	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

According to the guidance LAQM.TG (03) the objective of a Detailed Assessment is “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.” Authorities should “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”.

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' and are likely to be exposed over the averaging period of the objective. Exceedances of the objectives at any location where relevant public exposure would not be realistic should not be considered. 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	

Updating and Screening Assessment June 2006: Conclusions

The Updating and Screening Assessment was undertaken following the guidance and checklist scheme recommended in LAQM.TG (03). It is available on the Nottingham City Council website: www.nottinghamcity.gov.uk/

It was concluded unnecessary to proceed to a Detailed Assessment for:

Lead, carbon monoxide, benzene, 1,3 butadiene and sulphur dioxide.

Sufficient information from continuous monitoring was available to show that Nottingham City AQMA No: 1 Sulphur dioxide required revocation. Defra concurred with this conclusion and AQMA No: 1 – sulphur dioxide was revoked by Order dated 5th April 2007. The Orders making the AQMAs and the Revocation Order for AQMA No: 1 can be viewed on the Council's website:
http://www.nottinghamcity.gov.uk/sitemap/services/environment/pollution/air_pollution/air_quality.htm

It was concluded that it was necessary to proceed to a Detailed Assessment for:

Nitrogen dioxide - for a number of roads and junctions with traffic flows meeting the guidance criteria and some of the diffusion tubes monitoring results indicate exceedance of the NO_2 annual mean objective.

Particles (PM_{10}) - for two roads that meet the criteria specified in the guidance.

Local Air Quality Management (LAQM) Reports

All of Nottingham City Council's previous Review and Assessment and LAQM reports are available on the Council's website:
http://www.nottinghamcity.gov.uk/sitemap/services/environment/pollution/air_pollution/air_quality.htm

THE DETAILED ASSESSMENT

Monitoring Information

Continuous Automatic Monitoring

Nottingham City Council undertakes continuous monitoring at a number of locations in its area. It also provides local site operators, LSOs for Defra's Automatic Urban and Rural Network, AURN site on Clinton Street East.

Monitoring locations 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). The following three describe the continuous monitoring 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 Continuous Automatic Monitoring Sites

See Appendix 1 for map locations of the continuous monitoring stations.

AURN - Clinton Street East

The AURN station is located in the city centre and classified as an 'Urban centre' site. The surrounding area comprises retail outlets and city centre business premises in an urban pedestrianised area. The nearest road, the A6008, approximately 30 metres from the site, is no longer a major through-route following completion of the City Centre Major Scheme to divert and redirect traffic around the City Centre and limit access to certain vehicles, particularly buses.

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 carbon monoxide (CO), nitric oxide (NO), nitrogen dioxide (NO_2), oxides of nitrogen (NOx), particles (PM_{10}), sulphur dioxide (SO_2) and ozone (O_3). Monitoring for CO ceased at this site in October 2007

AQMS - Queens Medical Centre, Derby Road

While the AQMS station is a mobile unit it 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 25 metres from the A52 ring road and approximately 5 metres from a minor service road and is classed as an 'Other' site.

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 O_3. Temperature, wind speed and wind direction are also measured.

CG NOx - Carter Gate NOx Station – Carter Gate

This is a fixed unit and has been 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 approximately 10 metres from the A60 and approximately 2 metres from a minor road and is classed as a 'Roadside' site.

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

LS NOx - Lace Street NOx Station – Lace Street, Dunkirk

This is a fixed unit located at Lace Street since March 2007. The site is a suburban mixed commercial/residential area of the City adjacent to the A6005 (a busy road traffic route). It is classed as a 'Roadside' site and is approximately 4 metres from the A6005 and approximately 1 metre from a minor road.

The sampling inlet for the self-contained, air-conditioned enclosure is approximately 1.5 metres high. NO, NO_2 and NOx are measured using a continuous automatic analyser. The NOx instrument at Lace Street is a Monitor Labs Europe chemiluminescence analyser similar to those located in the AQMS and at Carter Gate.

The QA/QC procedures carried out at all Local Authority sites are similar to those used for the AQMS.

Monitoring Data – Continuous Analyser Sites

The guidance recommends the monitoring data is reported over the period of a calendar year. This gives clarity of measurement period and allows results over the range of yearly weather conditions to be reported. Where this is not the case the data has been annotated.

Summaries of monitoring data are given in Tables 4, 5 and 6 below.

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

Table 4

Summary of AURN continuous monitoring - nitrogen dioxide and particles, PM_{10} data 2004 - 2006

Pollutant	2004	2005	2006
Nitrogen Dioxide (NO_2)			
Annual mean concentration ($\mu g/m^3$)	35	33	34
Annual mean AQO exceeded?	No	No	No
Maximum hourly mean ($\mu g/m^3$)			
Particles (PM_{10})			
Annual mean concentration ($\mu g/m^3$)	23	23	24
Maximum 24 hr concentration ($\mu g/m^3$)			
(No of times 24hr value exceeded)	(6)	(6)	(9)
24 hour mean AQO exceeded?	No	No	No

Table 5

Summary of AQMS continuous monitoring - nitrogen dioxide and particles, PM_{10} data 2004 - 2006

Pollutant	2004	2005	2006
Nitrogen Dioxide (NO_2)			
Annual mean concentration ($\mu g/m^3$)	37	35	35
Annual mean AQO exceeded?	No	No	No
Maximum hourly mean ($\mu g/m^3$)			
Particles (PM_{10})			
Annual mean concentration ($\mu g/m^3$)	25	25	26
Maximum 24 hr concentration ($\mu g/m^3$)			
(No of times 24hr value exceeded)	(8)	(9)	(13)
24 hour mean AQO exceeded?	No	No	No

All PM_{10} concentrations are gravimetric equivalent

Table 6

Summary of CG NOx continuous monitoring nitrogen dioxide data for 2004 – 2006

Pollutant	2004	2005	2006
Nitrogen Dioxide (NO_2)			
Annual mean concentration ($\mu g/m^3$)	NA	36	39
Annual mean AQO exceeded?	-	No	No
Maximum hourly mean ($\mu g/m^3$)	-	185	168

NA = not available, station commenced in April 2004

The LS NOx, Lace Street site was not operational during 2006

Nitrogen Dioxide (NO_2) Diffusion Tube Monitoring

Nottingham City participates in the National NO_2 diffusion tube study and has increased the number of diffusion tube monitoring sites as a result of previous rounds of the Review and Assessment process. Diffusion tubes are a simple and relatively cheap means of sampling for NO_2 at a wide range of locations. Tubes are exposed at site for a month before being sent for laboratory analysis. Appendix 1 shows a map of Nottingham City Council's current diffusion tube sites (excluding, for clarity, those co-located at continuous sites).

Monitoring location descriptions

The tubes are mostly located at building façades at a range of sites that can be classified as roadside and urban background. Co-location of three NO_2 diffusion tubes at each of the continuous monitoring sites i.e. AURN, AQMS and CG NOx to enable 'bias correction' factors to be determined commenced in 2005. Appendix 1 shows all tube results for 2006 as well as the continuous monitoring data and calculation for the bias adjustment factor that was applied to the 2006 data.

The 2006 NO_2 annual mean diffusion tube results for tubes located at façades are shown below in Table 7.

The table is followed by Figures 1 and 2 which show mean nitrogen dioxide concentrations at the mapped locations for the continuous sites and for most of the diffusion tubes that are on the façade of buildings. All current sites where the mean is equal to or exceeds 40$\mu g/m^3$ are shown.

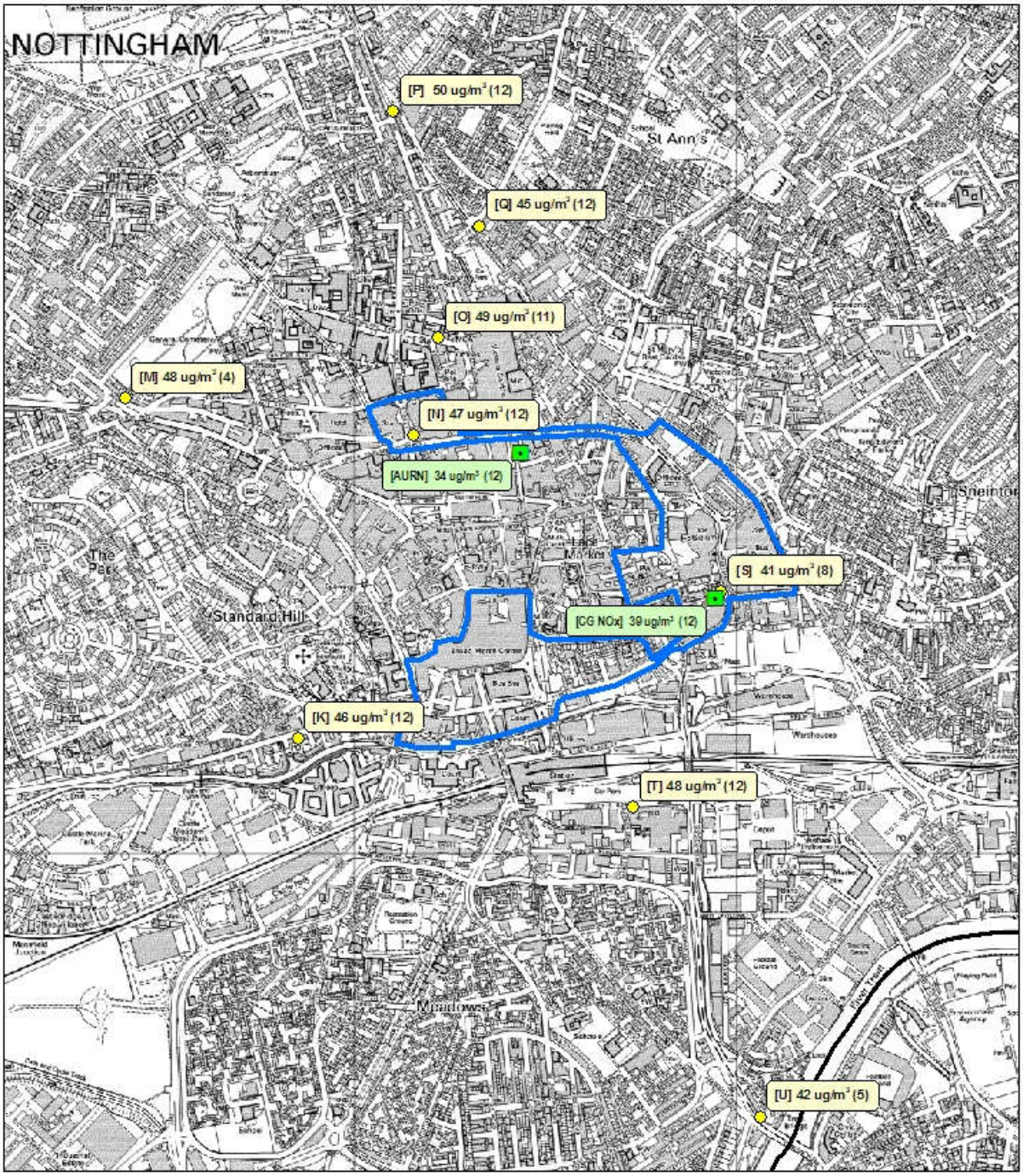
Table 7

2006 Mean Nitrogen Dioxide Concentrations - Diffusion Tube Measurement

Site Type	Tube Id	Site	Duration of Monitoring Months	Raw Data Annual Mean NO_2 $\mu g/m^3$	Bias Adjusted Annual Mean NO_2 $\mu g/m^3$
R	A	Ilkeston Road (NS)	11	30	27
UB	B	Noel Street Baths (NS)	12	26	24
R	C*	31 Clifton Blvd	9	32	29
R	D*	Sid's 8 Beeston Road	12	49	**44**
R	E	25 Beeston Road (Jan - May)	5	73	**65**
R	F*	21-23 Beeston Road (June - Dec)	7	60	**54**
R	G*	121 Beeston Road (July -Dec)	6	41	36
R	H*	82 Beeston Road (July - Dec)	6	38	34
R	I*	447 Derby Road (July - Dec)	6	28	25
R	J	328 Derby Road (July - Dec)	6	38	34
R	K*	87 Castle Boulevard	12	51	**46**
R	L*	1 Canning Terrace (Mar - Aug)	5	63	**57**
R	M*	13 Canning Terrace (Sept - Dec)	4	53	**48**
R	N*	Langtry's PH Upper Parliament St.	12	53	**47**
R	O*	YMCA Shakespeare St.	11	54	**49**
R	P*	180-182 Mansfield Road	12	56	**50**
R	Q*	High Cross Woodborough Rd	12	51	**45**
R	R	Castle PH Lower Parliament St. (Jan - April)	4	64	**58**
R	S*	20 Carter Gate (May - Dec)	8	45	**41**
R	T*	Queens Road	12	53	**48**
R	U*	Trent Bridge (Jan - Nov)	6	47	**42**
R	V	Alfreton Rd./Bentinck Rd. (Aug - Dec)	5	38	34

R = roadside UB =urban background NS = national survey * Shown on maps in Figures 1 & 2

Figure 1 2006 Nitrogen Dioxide Concentrations in City Centre Area



2006 Nitrogen Dioxide Concentrations at Continuous Monitoring and Diffusion Tube Sites

[A] 36 ug/m³ (6) [DifffusionTube Id] Mean NO_2 concentration (no of months)

[AQMS] 35 ug/m³ (12) [Continuous Monitoring Site Id] Mean NO_2 concentration (no of months)

AQMA No:2

Scale 1:14,000

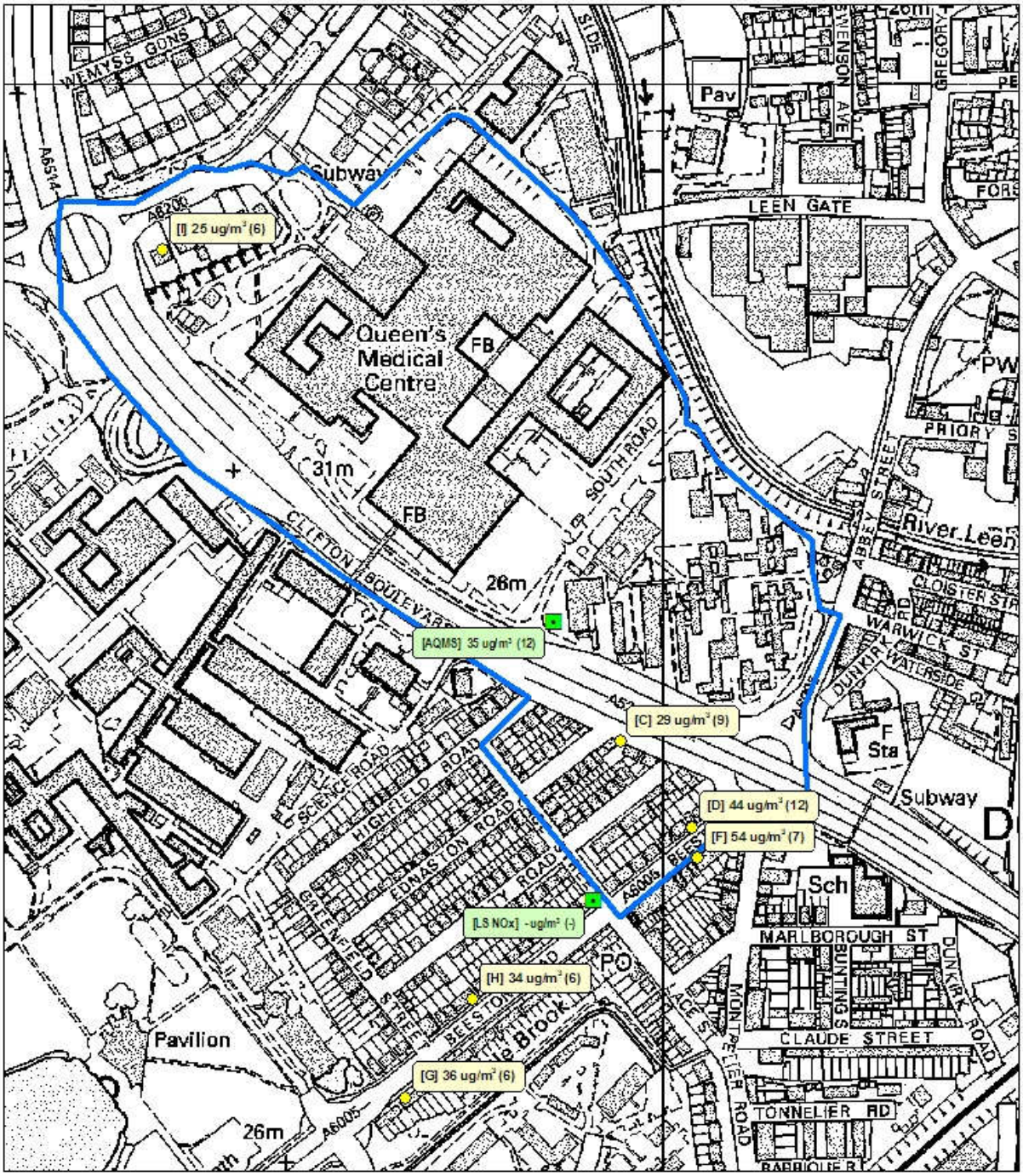
N

Nottingham City Council

Environment & Regeneration
Environmental Health
Noise & Pollution Control Team

This map is reproduced from Ordnance Survey material with the permission of Ordnance Survey on behalf of the Controller of Her Majesty's Stationery Office © Crown copyright. Unauthorised reproduction infringes Crown copyright and may lead to prosecution or civil proceedings. Nottingham City Council 100019317. 2008.

Figure 2 2006 Nitrogen Dioxide Concentrations in Dunkirk Area



2006 Nitrogen Dioxide Concentrations at Continuous Monitoring and Diffusion Tube Sites

[A] 36 ug/m³ (6) [DifffusionTube Id] Mean NO_2 concentration (no of months)

[AQMS] 35 ug/m³ (12) [Continuous Monitoring Site Id] Mean NO_2 concentration (no of months)

AQMA No:3

Scale 1:4,500

N

Nottingham City Council

Environment & Regeneration
Environmental Health
Noise & Pollution Control Team

This map is reproduced from Ordnance Survey material with the permission of Ordnance Survey on behalf of the Controller of Her Majesty's Stationery Office © Crown copyright. Unauthorised reproduction infringes Crown copyright and may lead to prosecution or civil proceedings. Nottingham City Council 100019317. 2008.

Monitoring Data Analysis

The 2005 and 2006 continuous monitoring results for all three sites i.e. AURN, AQMS, CG NOx show that the nitrogen dioxide annual mean AQO of 40 $\mu g/m^3$ and hourly AQO of 200 $\mu g/m^3$ were not exceeded. This is also true for 2004 for the AURN and AQMS sites.

The NO_2 diffusion tube results show that the annual mean objective of 40$\mu g/m^3$ was exceeded at some sites mainly within existing AQMAs or where traffic flows have significantly altered as a result of traffic schemes such as Turning Point. It is difficult to draw conclusions about exceedance of the objective at diffusion tube sites where the results relate to less than nine months data.

Appendix 1 Table A1.1 which shows all diffusion tube results, including those measurements made away from building facades, highlights the considerable difference in NO_2 levels when comparing façade concentrations with those nearer to the kerbside at the same site e.g. 31 Clifton Boulevard – at façade = 29 $\mu g/m^3$, at street light 12 metres away from the façade = 40 $\mu g/m^3$.

Particles, PM_{10} are measured at the AURN and the AQMS sites and the results given in Tables 4 and 5 respectively show that neither the annual mean nor the 24 hour AQOs were exceeded in the years 2004 to 2006.

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 the Atmospheric Dispersion Modelling System (ADMS) 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 version 2.2

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.

Comprehensive validation of the model has been carried out by CERC and others. See the CERC website www.cerc.co.uk for further information on this subject. Verification work was carried out by Nottingham City and a model adjustment factor derived. See Appendix 2

ADMS-Urban v2.2 was used to model 2006 nitrogen dioxide annual means and percentiles for comparison with monitored data and with the Air Quality Objectives. The model was also used for PM_{10} predictions although from the findings of the Update Screening and Assessment only 2 roads in the City Centre met the criteria for further assessment.

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

Appendix 2 contains a description of model inputs and outputs. Information is also given regarding the data used for nitrogen dioxide and PM_{10} modelling and the model verification work undertaken.

Nitrogen Dioxide Modelling

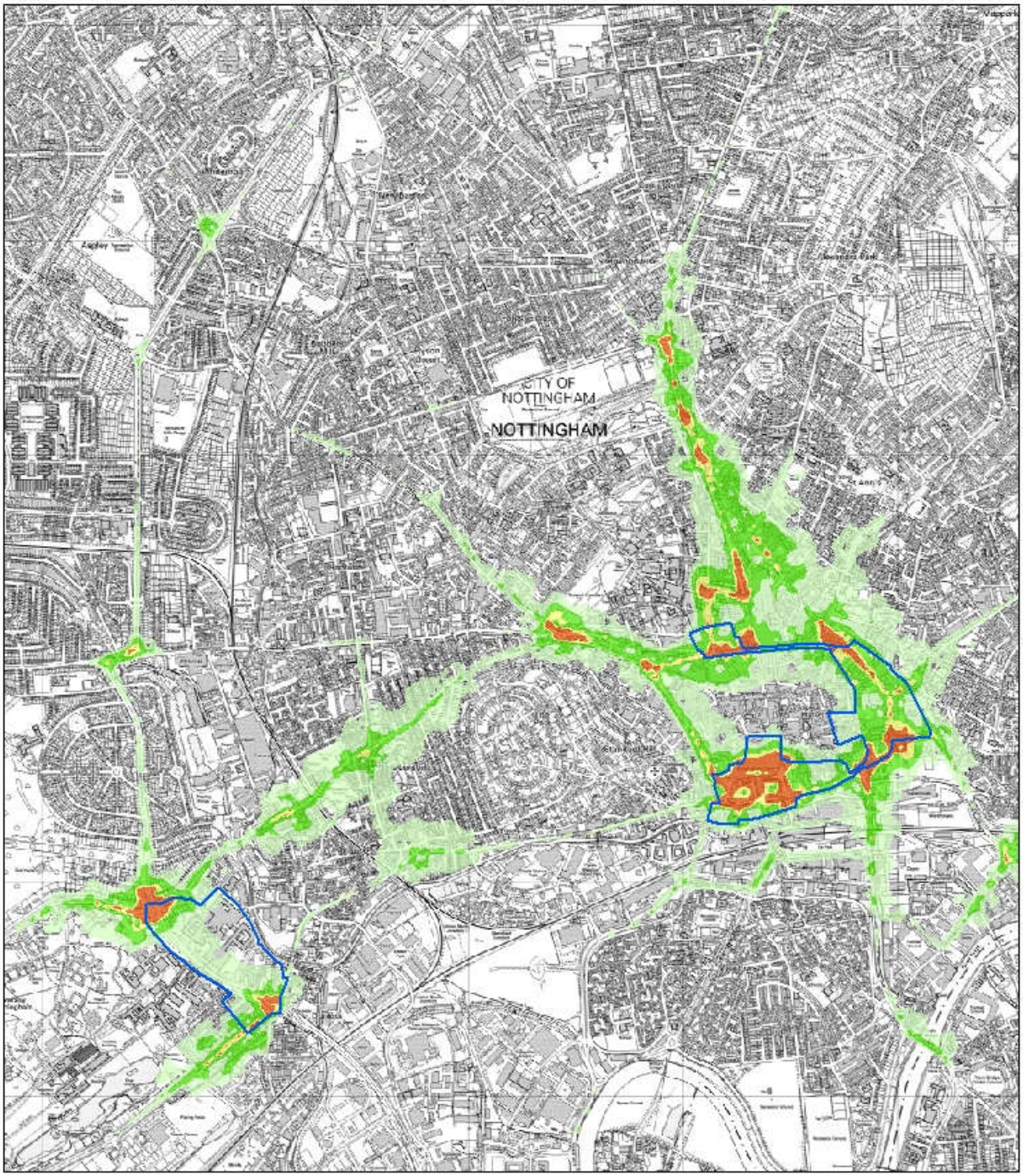
The Updating and Screening Assessment 2006 process identified a number of roads and junctions and areas in the vicinity of the existing AQMAs for further assessment. The roads include major arterial routes and the inner and outer ring roads.

Since the last detailed assessment (October 2004) a number of major transport schemes have resulted in changes to some road layout/flows used in previous modelling. Where possible the altered layouts and known traffic flows have been used but where necessary estimates of AADTs (annual average daily traffic flows) and speeds have been provided by the Transport Projects Section.

Figure 3 shows the predicted nitrogen dioxide 2006 annual mean concentrations for most of the City including the City Centre and Dunkirk areas. Modelling results (not shown) also indicated the hourly AQO was not exceeded.

The modelling predicts that the annual mean Air Quality Objective for nitrogen dioxide may not have been met in all locations with relevant exposure during 2006 and consequently may not be met in the future. It is likely that this is mainly due to the changes to traffic flows referred to earlier.

Figure 3 Modelled 2006 Annual Mean Nitrogen Dioxide Concentrations



Nottingham City - 2006 Modelled Annual Mean Nitrogen Dioxide Concentrations

NO_2 ug/m^3

- 24 - 35
- 35 - 37
- 37 - 39
- 39 - 40
- 40 - 48

Existing AQMAs

Scale 1:25,000

N

Nottingham City Council

Environment & Regeneration
Environmental Health
Noise & Pollution Control Team

This map is reproduced from Ordnance Survey material with the permission of Ordnance Survey on behalf of the Controller of Her Majesty's Stationery Office © Crown copyright. Unauthorised reproduction infringes Crown copyright and may lead to prosecution or civil proceedings.
Nottingham City Council 100019317. 2008.

Particles, PM_{10} Modelling

The USA 2006 identified two road links that meet the guidance criteria for this pollutant in terms of roads with high flow of buses and/or HGVs i.e. having bus flows greater than 20% of the AADT flow and relevant exposure with 10 metres of the road. From the traffic data provided by Nottingham City Council's Transport Projects team, the flow of HGVs on these two links is in excess of 2000 vehicles per day and there are residents close by. Changes in City Centre traffic flows as a result of specific traffic schemes such as Turning Point (see Progress Report 2005 and USA 2006) may have led to these links meeting the criteria.

Having updated the emissions inventory the opportunity was taken to assess PM_{10} levels over the same area of the City as that covered for the nitrogen dioxide modelling.

The model output for PM_{10} annual mean shown below Figure 4 suggests that the annual mean were not exceeded in 2006 at either of the identified roads that met the guidance criteria. Modelling results (not shown) also indicated that there was not an exceedance of the annual mean or 24 hour PM_{10} AQOs at any relevant location.

No significant changes that would affect PM_{10} levels are forecast therefore it is reasonable to expect the PM_{10} Air Quality Objectives will continue to be met in the future.

Figure 4 Modelled 2006 Annual Mean Particles, PM_{10} Concentrations



Nottingham City Centre - 2006 Modelled Annual Mean Particles, PM_{10} Concentrations

PM_{10} ug/m^3

- 22 - 23.5
- 23.5 - 24
- 24 - 26
- 26 - 29

Roads - bus/HGV flows greater than 20% AADT

Scale 1:3,500

N

Nottingham City Council

Environment & Regeneration
Environmental Health
Noise & Pollution Control Team

This map is reproduced from Ordnance Survey material with the permission of Ordnance Survey on behalf of the Controller of Her Majesty's Stationery Office © Crown copyright. Unauthorised reproduction infringes Crown copyright and may lead to prosecution or civil proceedings. Nottingham City Council 100019317. 2008.

Detailed Assessment Conclusions

Nitrogen dioxide

The Detailed Assessment indicates that the nitrogen dioxide annual mean AQO of 40μg/m^3 is likely to be met in the Nottingham City area. However there are parts of the City, mostly near existing AQMAs, where modelling (and diffusion tube results) suggest that the objective is being exceeded at locations with relevant exposure of members of the public.

The continuous monitoring results for 2004 -2006 show that both the nitrogen dioxide annual mean AQO and hourly AQO of 200μg/m^3 were not exceeded. The 2006 modelling results did not indicate exceedance of the hourly objective.

While it is not necessary to declare any new Air Quality Management Areas for nitrogen dioxide it is necessary to modify both of the existing AQMAs to reflect the findings of the modelling and diffusion tube monitoring in respect of the nitrogen dioxide annual mean air quality objective.

Particles, PM_{10}

The Detailed Assessment of the 2004 -2006 monitoring and 2006 modelling results show that the annual mean Air Quality Objectives of 40μgm^{-3} by 31.12.2005 and 24 hour mean of 50 μgm^{-3} not to be exceeded more than 35 times; have been and are likely to continue to be met at locations of 'relevant exposure' in the Nottingham City area.

It is not necessary to declare any Air Quality Management Areas for this pollutant.

Progressing Local Air Quality Management.

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.

Proposed Air Quality Management Areas Variations

Nottingham No:2 Air Quality Management Area – Nitrogen Dioxide

The current AQMA is located in the City centre. It is proposed to amend the area as shown in Figure 5 below. The amendment extends the AQMA to the north and north-west where there are residential properties and removes a bus depot and the Ice Arena.

Nottingham No:3 Air Quality Management Area – Nitrogen Dioxide

This AQMA is located in the Dunkirk area of the City. It is proposed to amend the area as shown in Figure 6. The amendment extends the AQMA along a road to incorporate the residential properties that border it and modifies the area around a major junction. The amendment also removes the QMC Hospital campus from the AQMA (three years of continuous monitoring at the site has shown that neither of the nitrogen dioxide objectives have been exceeded).

Figure 5 Proposed Variation of AQMA No: 2 Nitrogen Dioxide – City Centre Area

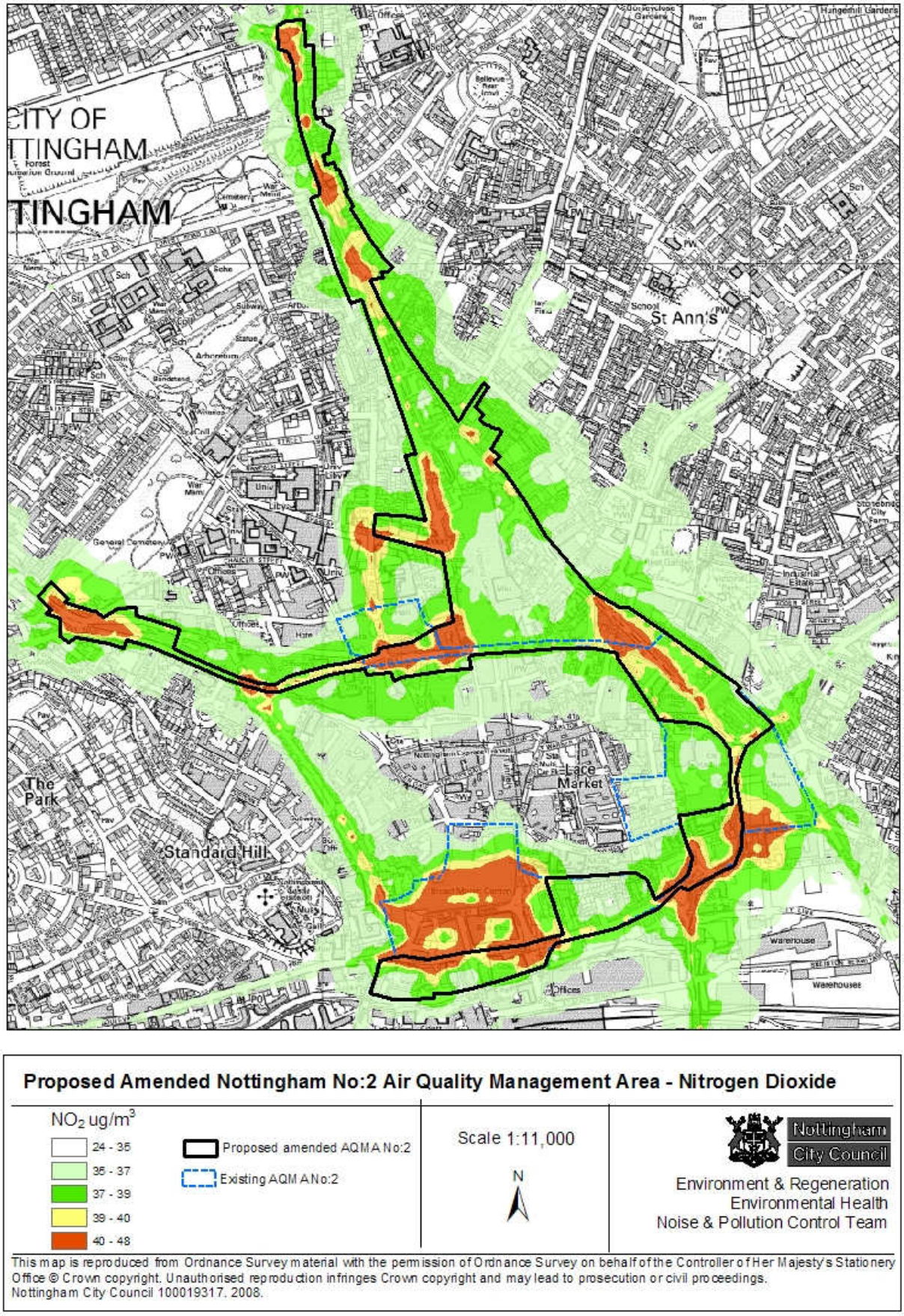
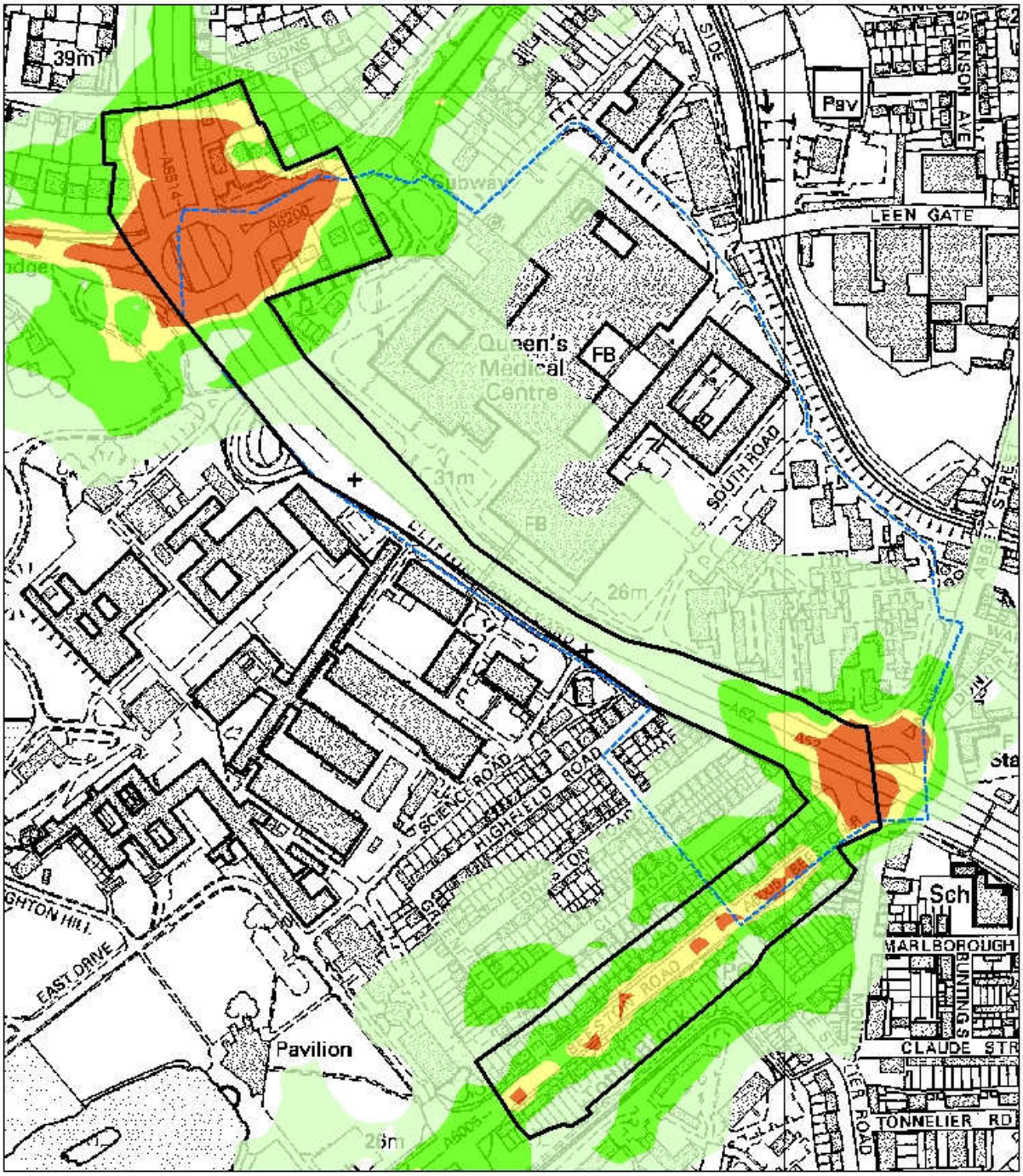


Figure 6 Proposed Variation of AQMA No: 3 Nitrogen Dioxide – Dunkirk Area



What Happens Next

As required by the guidance, LAQM. PG(03), Nottingham City Council will consult all relevant statutory consultees, local stakeholders, businesses and members of the public on the draft Detailed Assessment and the proposed amendments to the AQMAs. This will be undertaken within the next 2 months.

After consultation and acceptance by Defra of the report and varied AQMAs proposals, the Detailed Assessment will be finalised. Nottingham City Council is then expected to make the Orders for the amended Air Quality Management Areas within four months following submission of the finalised report to Defra.

Air Quality Actions Plans

Following the designation of AQMAs, the Guidance requires the preparation of an air quality action plan. For the existing AQMAs, Nottingham City Council has integrated the required AQAP into its Local Transport Plan (LTP) which is available on the Council's website and this approach will be continued.

Further Assessment of Air Quality within an AQMA

Section 84 (1) of the Environment Act 1995 requires Local Authorities to undertake a further assessment of existing and likely future air quality in an AQMA. Section 84 (2) requires the further assessment to be made within twelve months of designating (or varying) the AQMA. There is also a requirement to consult on the further assessment and make it available to the public.

In respect of the variation of an AQMA, the guidance states that 'If there is only to be a minor extension to an existing AQMA order, such as the encompassing of a few further buildings or inclusion of a road junction, as long as the authority has access to substantial information about the area of extension or can reliably extrapolate from information it has about the area originally designated, Defra, ….. would not expect that authority to have to undertake an extensive further assessment.' A more comprehensive assessment is expected if the order is varied by a more substantial change, for example going from a few streets to a whole borough designation.

The Next Annual Air Quality Report

Defra recommends that local authorities prepare annual air quality 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. According to the timetable shown in Table 2 the next step in the Local Air Quality Management process was for a Progress Report to be completed and submitted to Defra by the end of April 2008. However the delay in producing the detailed assessment report has led to a setback in this process for Nottingham City Council.

The intention is for a Progress Report to be submitted to Defra within the next 2 months. For clarity and to avoid duplication it is intended that the Progress Report will incorporate the required further assessment within the AQMAs.

References

Defra (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 (2000)**The Air Quality Strategy for England, Scotland, Wales and Northern Ireland**

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 (2004) **Local Air Quality Management: Detailed Assessment.**

Nottingham City Council (2005) **Local Air Quality Management: Progress Report**

Nottingham City Council (2006) **Local Air Quality Management: Updating and Screening Assessment.**

Nottingham City Council (March 2006) **Local Transport Plan, LTP 2005/7-2010/11**

The Air Quality (England) Regulations 2000

The Environment Act 1995

Websites

www.cerc.co.uk

http://www.nottinghamcity.gov.uk/sitemap/services/environment/pollution/air_pollution/air_quality.htm

http://www.nottinghamcity.gov.uk/sitemap/services/transport_and_streets/transport_planning/cdt_local_transport_plan.htm

Appendix 1

Table A1.1 2006 Mean Nitrogen Dioxide Concentrations - All Diffusion Tubes

Site Type	Tube Id	Site	Duration of Monitoring Months	Raw Data Annual Mean NO_2 $\mu g/m^3$	Bias Adjusted Annual Mean NO_2 $\mu g/m^3$
R	A	Ilkeston Road Façade (NS)	11	30	**27**
UB	B	Noel Street Baths Façade (NS)	12	26	**24**
UB	W	Ransom Drive Garden (NS)	12	9	**8**
R		31 Clifton Blvd. (Street light)	12	44	**40**
R	C	31 Clifton Blvd Façade (Reloc'd April)	9	32	**29**
R	D	Sid's 8 Beeston Road	12	49	**44**
R	E	25 Beeston Road (Jan - May)	5	73	**65**
R	F	21-23 Beeston Road (Reloc'd June)	7	60	**54**
R		121 Beeston Road (Jan – June)	6	52	**47**
R	G	121 Beeston Road Façade (July -Dec)	6	41	**36**
R		82 Beeston Road Street Light (Jan - June)	6	63	**57**
R	H	82 Beeston Road Façade (July - Dec)	6	38	**34**
R		447 Derby Road Garden (Jan - June)	6	49	**44**
R	I	447 Derby Road Façade (July - Dec)	6	28	**25**
R		Derby Road "B" (Jan - March)	3	43	**39**
R		328 Derby Road Sign Post, "C" (Jan - Jun)	6	50	**45**
R	J	328 Derby Road Facade, "C" (Jul - Dec)	6	38	**34**
R	K	87 Castle Boulevard Façade	12	51	**46**
R	L	1 Canning Terrace (March - Aug)	5	63	**57**
R	M	13 Canning Terrace (Reloc Sept - Dec T Point)	4	53	**48**
R	N	Langtrys PH Upper. Parliament St. Façade	12	53	**47**

R	O	YMCA Shakespeare St. Façade	11	54	**49**
R	P	180-182 Mansfield Road Façade	12	56	**50**
R	Q	High Cross Woodborough Rd Façade	12	51	**45**
R	R	Castle PH Lower Parliament St. (Jan -April)	4	64	**58**
R	S	20 Carter Gate Façade (May - Dec)	8	45	**41**
R	T	Queens Road Façade	12	53	**48**
R	U	Trent Bridge Façade (Jan - Nov)	5	47	**42**
R		Alfreton Rd. / Bentinck Rd. Street Light (Jan -July)	7	51	**46**
R	V	Alfreton Rd. / Bentinck Rd. (Aug - Dec)	5	38	**34**

R = roadside UB =urban background NS = national survey

Table A1.2 2006 Bias Adjustment Factor Details

Continuous Analyser and Diffusion Tube Annual Mean Nitrogen Dioxide Concentrations at Co-Located Sites

Site / Site Type	Cm NO_2 $\mu g/m^3$	Dm NO_2 $\mu g/m^3$	Bias Adjustment Factor, A	Data Capture %	Precision (CoV) %
AURN Urban Centre	35.3	39.2	0.900	95.2	7.3
AQMS Other	34.8	37.4	0.930	95.6	11.0
Carter Gate Roadside	38.8	44.7	0.870	92.1	9.3
Averaged Bias Adjustment factor, A	-	-	0.900	-	-

12 Months data January 2006 to December 2006

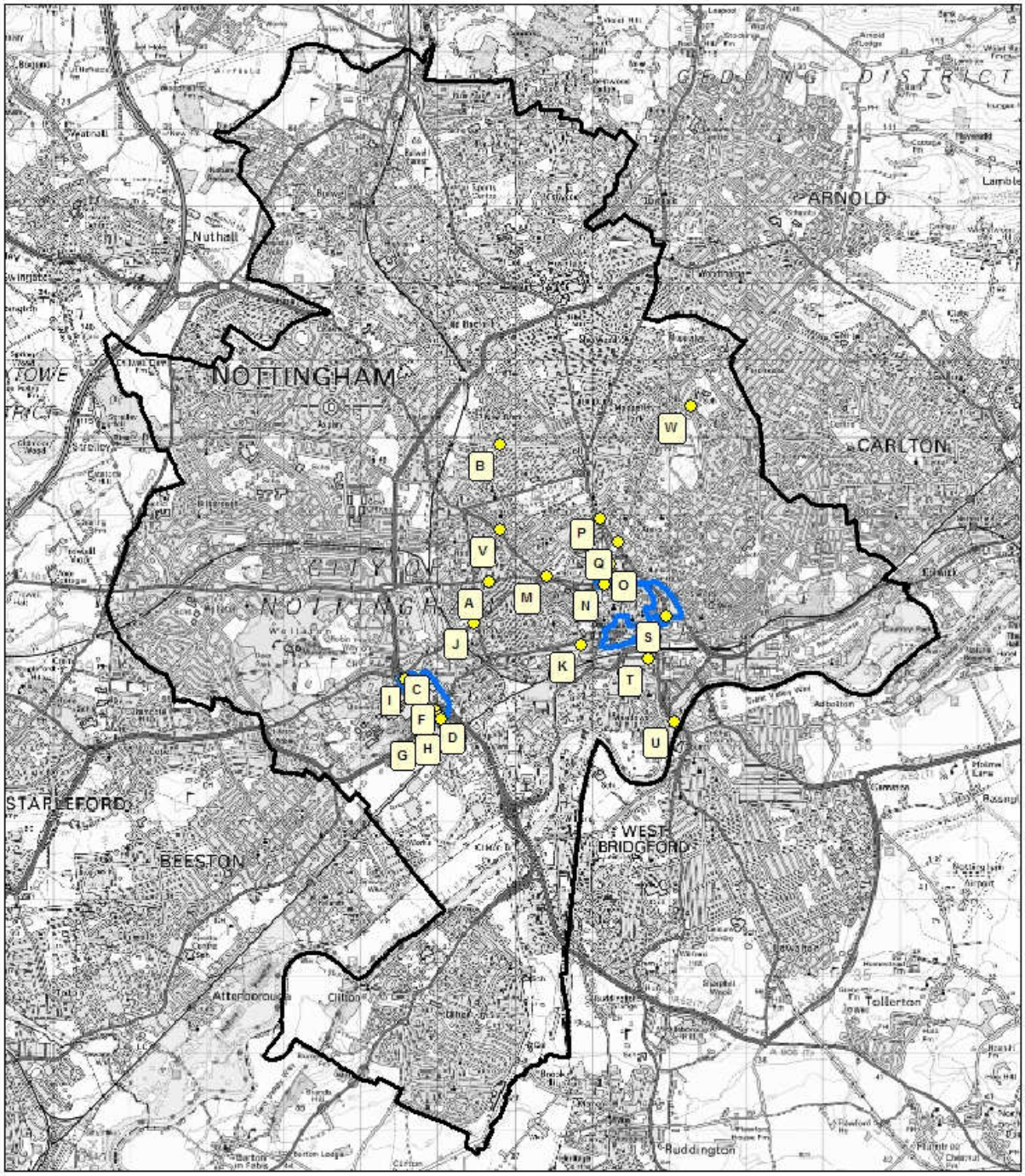
Cm = chemiluminescence (continuous) analyser measurement

Dm = diffusion tube measurement

Bias adjustment factor, A = Cm/Dm

CoV = Coefficient of variation

Figure A1.1 Mapped Diffusion Tube Sites



2006 - Diffusion Tube Monitoring Sites

A — Diffusion Tube Id (see Table A1.1)

AQMAs

Nottingham City boundary

Scale 1:69,500

N

Nottingham City Council
Environment & Regeneration
Environmental Health
Noise & Pollution Control Team

This map is reproduced from Ordnance Survey material with the permission of Ordnance Survey on behalf of the Controller of Her Majesty's Stationery Office © Crown copyright. Unauthorised reproduction infringes Crown copyright and may lead to prosecution or civil proceedings. Nottingham City Council 100019317. 2008.

Appendix 2

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.

Meteorological data

Watnall weather station located approximately 8 miles north of the City measures all the required parameters for ADMS-Urban. Therefore 2006 meteorological data from this station 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, percentage vehicle split and some average speed data was obtained from Nottingham City Council's Transport Projects 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 vehicles, (LGVs). The model requires the vehicle split between LGV and HGV classes.

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 a number of parameters including 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 ArcGIS 9.2 for defining output grids for contour plots and specifying receptor points.

ArcGIS 9.2 is a Geographical Information System, GIS and can be used to overlay the predicted concentration data produced by ADMS Urban on a map.

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

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 PM_{10} the 24 hour mean of no more than 35 exceedances of a concentration of 50$\mu g/m^3$ equates to the 90.1th percentile.

Modelling Methodology

Long term modelling was used to predict:

i) annual mean NO_2 concentrations
ii) the 99.8 percentile for NO_2 (i.e. equivalent to 18 exceedances)
iii) annual mean PM_{10} concentrations and
iv) the 90.1th percentile of the 24 hour daily PM_{10} (i.e. equivalent to 18 exceedances)

The following parameters and data were used to model nitrogen dioxide and PM_{10} concentrations.

Surface Roughness = 1m
Minimum Monin-Obukov length = 30m
GRS chemistry
Meteorology = Watnall 2006 - (hourly sequential data)
Background pollutant concentrations - hourly averaged data from the Rochester AURN for the year 2006 was used and included NO_2, NOx, O_3, SO_2, PM_{10}.

Emissions data

Roads – LGV and HGV traffic flows for 2006 calculated from 2006 AADT supplied by the Nottingham City Council's Transport Projects Section and the average speed for each link either supplied or determined previously for earlier modelling work. 2003 DMRB emission factors for 'urban' roads.

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

Area – the 2006 NOx values for 'Commercial, Institutional and Residential Combustion' from the NAEI for both years. These were adjusted from 2000 to 2006 using the methodology described in the guidance

Model Verification – ADMS Urban V2.2

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 undertaken as part of the Stage 2 and 3 Review and Assessment 2001 and the Detailed Assessment October 2004 and are detailed in that report. However since then an updated version of ADMS Urban has been developed so further model verification has been undertaken.

All the parameters described in the modelling methodology above were used for the nitrogen dioxide and PM_{10} verification work.

Model verification was carried out in a similar way to that used for the Stage 2 and 3 Review and Assessment 2001 and the Detailed Assessment 2004. This entailed modelling the year 2006, good quality monitoring data was available and comparison between model predictions with monitored concentrations at the three continuous monitoring sites was possible. An adjustment factor for the difference between monitored and modelled concentrations was then derived.

Tables A2.1 and A2.2 below show the monitored and modelled values for the 2006 nitrogen dioxide and PM_{10} annual means respectively.

Model Adjustment Factor

Table A2.1 Monitored and Modelled Nitrogen Dioxide Annual Mean 2006

Monitoring Station - Site type	Annual Mean NO_2 μg/m^3 **Monitored**	Annual Mean NO_2 μg/m^3 Modelled	Monitored /modelled ratio
AURN 2006 – urban centre	33.6	36.6	0.92
AQMS - other	35.3	38.3	0.92
Carter Gate 2006 - roadside	39.4	40.6	0.97
Averaged Model Adjustment Factor			0.937

Monitored data capture rates were greater than 90%

Comparison of monitored levels with the model results showed that the model over predicted levels, therefore an adjustment factor was calculated.

Model adjustment factor = monitored concentrations/modelled concentrations;

e.g. AURN 2006 NO_2 annual mean 33.6 μg/m^3 divided by 36.6 μg/m^3 = 0.92

The model results were multiplied by 0.937 (the averaged adjustment factor) to give the predicted 2006 nitrogen dioxide concentrations for comparison with the air quality objectives.

Table A2.2 Monitored and Modelled Particles, PM_{10} Annual Mean 2006

Monitoring Station - Site type	Annual Mean Monitored NO_2 μg/m^3	Annual Mean Modelled NO_2 μg/m^3	Monitored/ modelled ratio
AURN 2006 – urban centre	24	23.1	1.04

Monitored data capture rates were greater than 90%

Although the model under-predicted PM_{10} levels by approx 4% no adjustment was made to the modelled PM_{10} predicted concentrations shown in Figure 4 because the predicted levels were considerably below the annual mean AQO of 40 μg/m^3.