2009 Air Quality Updating and Screening Assessment for

Nottingham City Council

In fulfillment of Part IV of the Environment Act 1995
Local Air Quality Management

April 2009

Local Authority Officer	Richard Taylor

Department	Environment & Regeneration
Address	Environmental Health Noise & Pollution Control Team Lawrence House Talbot Street Nottingham NG1 5NT
Telephone	0115 9156408
e-mail	richard.taylor@nottinghamcity.gov.uk

Report Reference number	NCCUSA2009
Date	30 April 2009

Executive Summary

This report fulfils the requirements of the Local Air Quality Management process as set out in Part IV of the Environment Act (1995), the Air Quality Strategy for England, Scotland, Wales and Northern Ireland 2007 and the relevant Policy and Technical Guidance documents. All local authorities are required to regularly review and assess air quality in their areas, and to determine whether or not specified air quality objectives are likely to be achieved.

The air quality objectives applicable to the Local Air Quality Management process in England are set out in the Air Quality (England) Regulations 2000 (SI 928) and the Air Quality (England) (Amendment) Regulations 2002 (SI 3043).

This Updating and Screening Assessment has considered new monitoring results, and whether there have been significant changes in road traffic; other transport; industrial processes; and commercial and domestic sources of pollution since the last Review and Assessment report.

During 2008 air quality was measured, using automatic (continuous) and non-automatic monitoring, at a number of sites within the Nottingham City area.

The monitoring results showed that no exceedences of the air quality objectives for PM_{10}, sulphur dioxide, carbon monoxide and benzene were measured.

The annual mean air quality objective for nitrogen dioxide is 40 $\mu g/m^3$; levels in excess of this were measured at the 2 roadside automatic monitoring sites and at a number of diffusion tube sites, both within and outside the existing Air Quality Management Areas No.2 and No.3.

Monitoring within Air Quality Management Area No.3 also identified sites where the nitrogen dioxide annual mean air quality objective was not exceeded.

The 1-hour objective for nitrogen dioxide (200 $\mu g/m^3$ - not to be exceeded more than 18 times a year) was not exceeded.

The nitrogen dioxide data are consistent with results reported in previous Review and Assessments and therefore confirm that the proposals in the Detailed Assessment May 2008, for alterations to be made to the existing Air Quality Management Areas, are appropriate.

The work undertaken taken for this report has not identified any likely adverse air quality impacts from local developments, air and rail transport, industrial installations, commercial/domestic combustion, fugitive emissions, residential and commercial sources or road transport outside the existing (proposed amended) Air Quality Management Areas. No new or significantly changed sources since the last report have been identified.

The 2008 monitoring data presented in this USA shows that exceedence of the nitrogen dioxide annual mean Air Quality Objective occurred at a number of sites but that no new sites of potential exceedence of the Air Quality Objectives have been identified.

The sites of exceedence have been previously reported in the Updating and Screening Assessment 2006 which led to the preparation of the Detailed Assessment May 2008 report.

Nottingham City Council - England

The conclusion of the Detailed Assessment was that the Air Quality Management Areas needed amendment. The proposals being: AQMA No.2 - City Centre - to extend it to the north and north-west of the city centre and remove the south-west part (no relevant public exposure); and in AQMA No.3 - Dunkirk to re-align the boundary to extend it to the south-west and exclude the QMC hospital.

Delay in the production of the Detailed Assessment meant that it was not submitted to Defra until May 2008 and while a response has been received, the report has not been approved by Defra and further work is required to address the issues raised.

Consequently there is no need to proceed to an additional Detailed Assessment as a result of these findings since the areas of exceedence are considered in the Detailed Assessment May 2008 that Nottingham City Council is currently working on.

Table of contents

1	**Introduction**	**6**
1.1	Description of Local Authority Area	6
1.2	Purpose of Report	6
1.3	Air Quality Objectives	7
1.4	Summary of Previous Review and Assessments	8
2	**New Monitoring Data**	**10**
2.1	Summary of Monitoring Undertaken	10
2.2	Comparison of Monitoring Results with AQ Objectives	16
3	**Road Traffic Sources**	**23**
3.1	Narrow congested streets with residential properties close to the kerb	23
3.2	Busy streets where people may spend 1-hour or more close to traffic	23
3.3	Roads with high flow of buses and/or HGVs.	23
3.4	Junctions and busy roads	24
3.5	New roads constructed or proposed since the last round of review and assessment	24
3.6	All roads with significantly changed traffic flows.	24
3.7	Bus and coach stations	24
4	**Other Transport Sources**	**25**
4.1	Airports	25
4.2	Railways (diesel and steam trains)	25
4.3	Ports (shipping)	25
5	**Industrial Sources**	**26**
5.1	New or Proposed Industrial Installations	26
5.2	Major fuel (petrol) storage depots	26
5.3	Petrol stations	26
5.4	Poultry farms	27
6	**Commercial and Domestic Sources**	**28**
6.1	Biomass combustion – Individual Installations	28
6.2	Biomass combustion – Combined Impacts	28
6.3	Domestic Solid-Fuel Burning	28
7	**Fugitive or Uncontrolled Sources**	**29**
8	**Conclusions and Proposed Actions**	**30**
8.1	Conclusions from New Monitoring Data	30
8.2	Conclusions from Assessment of Sources	30

8.3 Proposed Actions 30

9 References 32

Appendices i

Appendix A Nitrogen Dioxide Diffusion Tube and PM_{10} Adjustment Information ii

Appendix B QA/QC Data for Automatic and Non-Automatic Sites vii

1 Introduction

1.1 Description of Local Authority Area

The City of Nottingham covers an area of 7,470 hectares and has a population of approximately 288,700 (Key Facts, 2009). The City boundaries contain urban residential, suburban residential, commercial and industrial areas, and an area of large suburban parkland.

Geographically the Nottingham City area is made up of the River Trent valley basin which extends outside the City's southern boundary to Rushcliffe Borough Council and southwest to Broxtowe Borough Council. Whilst to the north of the river the land rises to form a ridge running from the south west near Lenton north east to Mapperley. North and north-west of this ridge the land forms a large basin through which the River Leen flows.

Throughout the 18th and early 19th Centuries the City was dominated by the textile industry which has reduced significantly. Industry is now diverse ranging from some heavy industry through to biotechnology. Currently the Council regulates, 1 Part A2 and 70 Part B 'permitted installations' under the Pollution Prevention and Control Act 1999. There are 11 Part A1 installations permitted by the Environment Agency. The whole of the City is subject to Smoke Control Orders, the smoke control programme having been completed in 1991.

Nottingham is a major centre of commerce in the East Midlands, this together with the A453, A610 and A52 road links to the M1 and A1 results in large volumes of traffic entering the City via a number of primary arterial routes. Significant numbers of people commute into the City for work, and visit for tourism, leisure and entertainment.

The City Centre is mainly retail and service sector/office use with two large shopping centres; Victoria Centre and Broadmarsh to the north and south, each of which has a bus station. The centres are connected by busy pedestrianised areas. The railway station is located approximately 200 metres south of the Broadmarsh bus station.

The Tram (Light Rapid Transit System) links the transport centres with the northern suburbs and 'park and ride' sites providing an integrated transport system.

In Nottingham City Council's area road traffic is the principal source of the air pollutants to which the air quality objectives cited in the Air Quality (England) Regulations 2000 (SI 928) apply. Large industrial sources also contribute, but to a lesser degree.

1.2 Purpose of Report

This report fulfils the requirements of the Local Air Quality Management process as set out in Part IV of the Environment Act (1995), the Air Quality Strategy for England, Scotland, Wales and Northern Ireland 2007 and the relevant Policy and Technical Guidance documents. The LAQM process requires all local authorities to regularly review and assess air quality in their areas, and to determine whether or not the air quality objectives are likely to be achieved. Where exceedences are considered likely, the local authority must then declare an Air Quality Management Area (AQMA) and prepare an Air Quality Action Plan (AQAP) setting out the measures it intends to put in place in pursuit of the objectives.

1.3 Air Quality Objectives

The air quality objectives applicable to LAQM **in England** are set out in the Air Quality (England) Regulations 2000 (SI 928), The Air Quality (England) (Amendment) Regulations 2002 (SI 3043), and are shown in Table 1.1. This table shows the objectives in units of micrograms per cubic metre $\mu g/m^3$ (milligrammes per cubic metre, mg/m^3 for carbon monoxide) with the number of exceedences in each year that are permitted (where applicable).

Table 1.1 Air Quality Objectives included in Regulations for the purpose of Local Air Quality Management in England.

Pollutant	Air Quality Objective		Date to be achieved by
	Concentration	Measured as	
Benzene			
	16.25 $\mu g/m^3$	Running annual mean	31.12.2003
	5.00 $\mu g/m^3$	Running annual mean	31.12.2010
1,3-Butadiene	2.25 $\mu g/m^3$	Running annual mean	31.12.2003
Carbon monoxide	10.0 mg/m^3	Running 8-hour mean	31.12.2003
Lead	0.5 $\mu g/m^3$	Annual mean	31.12.2004
	0.25 $\mu g/m^3$	Annual mean	31.12.2008
Nitrogen dioxide	200 $\mu g/m^3$ not to be exceeded more than 18 times a year	1-hour mean	31.12.2005
	40 $\mu g/m^3$	Annual mean	31.12.2005
Particles (PM_{10}) (gravimetric)	50 $\mu g/m^3$, not to be exceeded more than 35 times a year	24-hour mean	31.12.2004
	40 $\mu g/m^3$	Annual mean	31.12.2004
Sulphur dioxide	350 $\mu g/m^3$, not to be exceeded more than 24 times a year	1-hour mean	31.12.2004
	125 $\mu g/m^3$, not to be exceeded more than 3 times a year	24-hour mean	31.12.2004
	266 $\mu g/m^3$, not to be exceeded more than 35 times a year	15-minute mean	31.12.2005

1.4 Summary of Previous Review and Assessments

Table 1.2 below gives details of the previous rounds of Review and Assessment (R&A) and a brief outline of the conclusions of the reports.

Table 1.2 Previous Review and Assessment Reports

Title	Date	Outcome	AQMA Declared/ Revoked? (Date of AQMA Order/s)
City of Nottingham Air Quality Review & Assessment First & Second Stage	April 2000	Third stage assessment for sulphur dioxide, nitrogen dioxide and particulates,PM_{10} necessary. No further assessment of 1,3 Butadiene, benzene, carbon monoxide and lead required.	-
City of Nottingham Air Quality Review & Assessment Second & Third Stage Report	Sept 2001	Areas of the city where unlikely to meet air quality objectives for nitrogen dioxide or sulphur dioxide. Proposed 1 AQMA for SO_2 and 2 AQMAs for NO_2	**Declared** AQMA No:1 (Sulphur dioxide) (2002) AQMA No:2 (Nitrogen dioxide) (2002) AQMA No:3 (Nitrogen dioxide) (2002)
City of Nottingham Local Air Quality Management Stage Four Review & Assessment of Nottingham's Air Quality Management Areas	July 2003	Determined that AQOs for sulphur dioxide – hospital chimney and nitrogen dioxide – traffic sources, unlikely to be exceeded by 'due dates' therefore no Air Quality Action Plans needed	-
City of Nottingham Local Air Quality Management Updating and Screening Assessment	October 2003	Necessary to proceed to a Detailed Review and Assessment for nitrogen dioxide with respect to a number of roads and for sulphur dioxide in the vicinity of the Nottingham Main-line Station.	-
City of Nottingham Local Air Quality Management Detailed Assessment	August 2004	Sulphur dioxide 15-minute mean AQO likely to be met at locations of 'relevant exposure' at Nottingham Mainline Station. Nitrogen dioxide annual mean AQO likely to be met. Concluded insufficient monitoring data available to allow revocation of any of the AQMAs.	-

Nottingham City Council - England

Title	Date	Outcome	AQMA Declared/ Revoked? (Date of AQMA Order/s)
City of Nottingham Local Air Quality Management Progress Report	April 2005	Concluded that SO_2 monitoring data sufficient to propose revocation of AQMA No:1 (Sulphur dioxide). Necessary to maintain AQMAs No 2 & 3 (nitrogen dioxide)	-
Nottingham City Council Local Air Quality Management Updating and Screening Assessment:	June 2006	Necessary to proceed to a Detailed Assessment for PM_{10} for 2 roads in the city centre and for nitrogen dioxide for a number of roads and junctions based on guidance criteria and some diffusion tube data. AQMA No:1 (Sulphur dioxide) to be revoked - agreed by Defra	**Revoked** AQMA No:1 2002 (Sulphur dioxide) (5 April 2007)
****** Nottingham City Council Local Air Quality Management Detailed Assessment Consultation Document	May 2008	**Proposed amendments to existing AQMAs No.2 & No.3 for nitrogen dioxide.** **Further work for nitrogen dioxide being undertaken following comment and assessment by Defra** Conclusion that no further action required for PM_{10} accepted by Defra	-
Nottingham City Council Local Air Quality Management Progress Report	July 2008	Concluded that there was no need to undertake a detailed assessment - accepted by Defra	-

All reports are available on Nottingham City Council's internet site: http://www.nottinghamcity.gov.uk

******This Detailed Assessment is currently being revised; further work is being undertaken with advice from the R & A helpdesk before re-submission to Defra.

AQMAs No.2 and No.3 are shown on the map of monitoring sites - see Figure 2.1 (page 10)

2 New Monitoring Data

2.1 Summary of Monitoring Undertaken

2.1.1 Automatic Monitoring Sites

Nottingham City Council undertakes continuous monitoring at a number of locations in its area and Defra have an AURN site in the city centre. Figure 2.1 is a map of the locations of the continuous and diffusion tube monitoring sites and also shows the existing Air Quality Management Areas (AQMAs).

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 types such as buses. Relevant exposure is at residential properties approximately 40 metres to the South and approximately 23 metres to the North East.

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 nitric oxide (NO), nitrogen dioxide (NO_2), oxides of nitrogen (NOx), particles ($PM_{2.5}$), sulphur dioxide (SO_2) and ozone (O_3). Benzene is measured using continuous pumped diffusion tubes. Black Smoke is measured on a near real time basis using a continuous aethalometer; prior to December 2008 it was measured using a manual 8-port sampler.

Particles PM_{10} was measured from site initiation in 1996 until December 2008. Carbon monoxide (CO) monitoring ceased in October 2007.

CG NOx, Carter Gate, City Centre

This unit has been located at Carter Gate monitoring NOx since December 2003 and monitoring SO_2 since May 2007. The site is a suburban mixed commercial/residential area of the City adjacent to the A60. It is approximately 10 metres from the A60 which is a major traffic route and approximately 3 metres from a busy B road and is classed as a 'Roadside' site. There are residential properties approximately 12 metres from the unit and 8 metres away from the A60.

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. The site also measures SO_2 using a continuous analyser which was relocated from a discontinued site.

AQMS, Queens Medical Centre (QMC), Clifton Boulevard, Dunkirk

The AQMS station has been in its current location at the QMC hospital since March 2002. 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. It is in a suburban, mixed industrial/commercial/residential area of the City and is approximately 11 metres from the nearest relevant exposure.

Nottingham City Council - England

The self-contained, air-conditioned station has a sampling inlet approximately 2.5 metres high and has continuous automatic analysers that measure NO, NO_2, NOx, PM_{10}, SO_2, CO and O_3.

LS NOx, Lace Street, Dunkirk

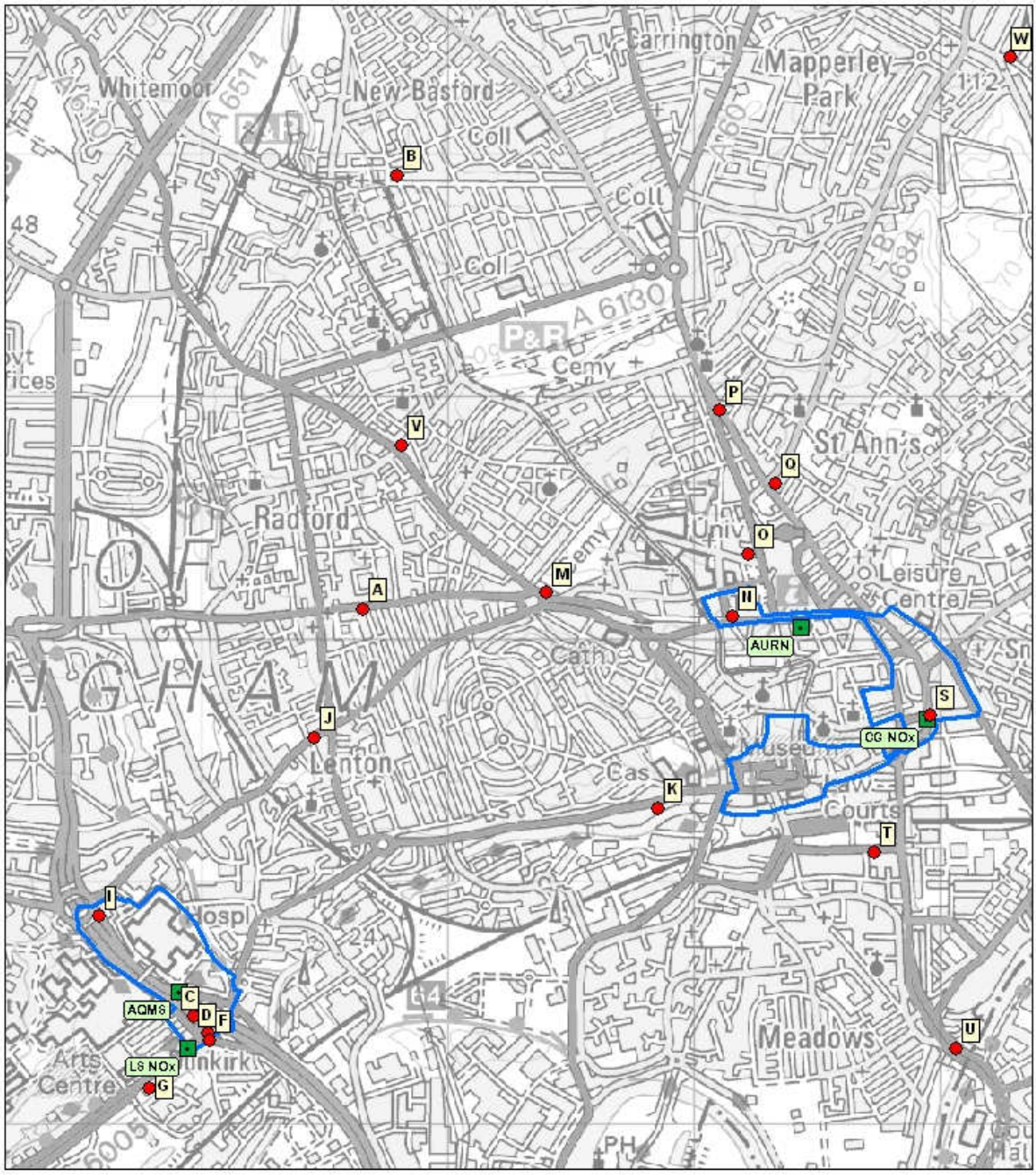
This is a fixed unit located at Lace Street since March 2007. The site is a suburban, mixed commercial/residential area of the City adjacent to the A6005, a busy road traffic route. It is approximately 4 metres from the A6005 and 1 metre from a minor road and is classed as a 'Roadside' site. The unit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

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.

For the automatic monitoring sites referred to above the following information is given in the appendices:

- Details of the correction applied to the PM_{10} monitoring data using the Volatile Correction Model (VCM) - Appendix A
- Details of QA/QC - Appendix B.

Figure 2.1 **Monitoring Sites**



Nottingham City Council Monitoring Sites - 2007

- Diffusion Tube Sites
- Continuous monitoring sites
- Existing AQMAs

Scale 1:22,000

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.

Table 2.1 Details of Automatic Monitoring Sites

Site Name	Site Type	OS Grid Ref	Pollutants Monitored	In AQMA ?	Relevant Exposure? *(Y/N with distance (m) to relevant exposure)*	Distance to kerb of nearest road *(N/A if not applicable)*	Worst-case Location ?
AURN Clinton St	Urban centre	X 457437 Y 340049	NO_2, NO, NOx, SO_2, O3, PM_{10},	N	Y (0m)	35m	N
CG NOx Carter Gate	Roadside	X 457946 Y 339668	NO_2, NO, NOx, SO_2	Y	Y (12m)	4m	Y
AQMS Clifton Blvd	Other	X 454907 Y 338548	NO_2, NO, NOx, SO_2, O3, PM_{10}, CO	Y	Y (11m)	9m (main rd) 2m (minor rd)	N
LS NOx Lace St	Roadside	X 454941 Y 338315	NO_2, NO, NOx,	N*	Y (0m)	9m (main rd 1m (minor rd)	Y

*Located 6.5m away from the south west boundary of AQMA No:3

Monitoring Site closed since the last Updating and Screening Assessment (USA) report

The sulphur dioxide continuous monitoring station at the City Hospital was de-commissioned when AQMA No.1 – sulphur dioxide was revoked in April 2007.

The analyser was re-located to the CG NOx unit - the SO_2 monitoring results for 2008 at this site are shown in Table 2.6 below.

2.1.2 Non-Automatic Monitoring

Nitrogen Dioxide (NO_2) Diffusion Tube Monitoring

Nottingham City participates in the UK NO_2 diffusion tube network and has diffusion tubes sited at a number of locations including tubes co-located with continuous monitors at the AURN, CG NOx and LS NOx sites. Tubes have been exposed in and near AQMAs No.2 and 3 and in other areas where there may be 'hot spots' due to road and/or traffic changes.

Most of the tubes are placed on building façades of residential properties at sites mainly classified as 'roadside'; two of the three network sites are 'urban background'. The tubes are exposed for a month before being sent for laboratory analysis.

The geographical locations of the tube sites (excluding, for clarity, those co-located at continuous sites) are shown in Figure 2.1.

See Appendix A for:

- details of the tube type and the laboratory that supplies and analyses the tubes
- details of the bias adjustment factor that has been applied to the annual mean NO_2 diffusion tube data.
- details of Nottingham City Council's diffusion tube and continuous monitoring 2008 co-location study including comparison with the reference method.

See Appendix B for:

- details of diffusion tube QA/QC

Benzene Pumped Tube Monitoring

Benzene is measured at the AURN, as part of the Non-Automatic Hydrocarbon Network, using a controlled flow pumped tube sampler. The 2 tubes are changed every two weeks and returned to the National Physics Laboratory for analysis.

The apparatus is audited twice a year by the NPL. The sample flow is calibrated and adjusted as required; the system is leak checked and preventative maintenance performed. The audit calibrations are used to convert the collected amount on each tube into a concentration.

Black Smoke

Between January and November 2008 black smoke was measured at the AURN using a manual 8-port sampler. Ambient air is drawn into the sampler at a constant flow rate and suspended particulate matter is collected onto a filter paper. The timed valve exposes a fresh filter paper every 24 hours. The concentration of black smoke is then determined by the filter paper's reflectance. The papers were returned to the National Physics Laboratory for analysis.

Currently no data is available on the air quality website and therefore no further details about black smoke measurement are given in this report.

Table 2.2 Details of Non-Automatic Monitoring Sites

Site Name & Id		Site Type*	OS Grid Ref X Y	Pollutants Monitored	In AQMA?	Relevant Exposure? *(Y/N with distance (m) to relevant exposure)*	Distance to kerb of nearest road *(N/A if not applicable)*	Worst-case Location ?
Diffusion Tube								
C	Clifton Boulevard	R	454963 338447	NO_2	Y	Y (0)	13	Y
D	Beeston Road (1)	R	455024 338375	NO_2	Y	Y (0)	4	Y
F	Beeston Road (2)	R	455028 338349	NO_2	N	Y (0)	4	Y
G	Beeston Road (4)	R	454782 338146	NO_2	N	Y (0)	9	Y
H	Beeston Road (3)	R	454838 338230	NO_2	N	Y (0)	7	Y
I	Derby Road (1)	R	454577 338860	NO_2	Y	Y (0)	25	Y
J	Derby Road (2)	R	455453 339595	NO_2	N	Y (0)	12	Y
K	Castle Boulevard	R	456852 339303	NO_2	N	Y (0)	4	Y
M	Canning Terrace	R	456399 340191	NO_2	N	Y (0)	4	Y
N	Upper Parliam't St.	R	457154 340095	NO_2	Y	Y (0)	4	Y
O	Shakespeare St.	R	457221 340351	NO_2	N	Y (0)	2	Y
P	Mansfield Road	R	457103 340944	NO_2	N	Y (0)	4	Y
Q	Woodborough Rd	R	457329 340643	NO_2	N	Y (0)	2	Y
S	Carter Gate	R	457961 339687	NO_2	Y	Y (0)	7	Y
T	Queen's Road	R	457729 339122	NO_2	N	Y (0)	2	Y
U	Trent Bridge	R	458051 338328	NO_2	N	Y (0)	5	Y
V	Bentinck Rd	R	455808 340799	NO_2	N	Y (0)	6	Y
A	Ilkeston Road	R	455653 340126	NO_2	N	Y (0)	6	Y
W	Ransom Drive	UB	458287 342399	NO_2	N	Y (5m)	3	N
B	Noel Street Baths	UB	455795 341911	NO_2	N	Y (22m)	2	N
Other								
AURN Clinton St		UC	457437 340049	benzene, black smoke	N	Y (0m)	35	N

* R = roadside UB = urban background UC = urban centre

2.2 Comparison of Monitoring Results with AQ Objectives

The 2008 results of the automatic and non-automatic monitoring undertaken by Nottingham City Council are shown in Tables 2.3a -2.7 below. Comparison with the Air Quality Objectives (AQO) has been made and where the relevant AQO has been exceeded the figure is highlighted in bold type.

The data shows that all exceedences relate to the nitrogen dioxide annual mean AQO and all are at sites where there are residential properties nearby (i.e. relevant public exposure).

When the DA May 2008 referred to earlier (Section 1.4) has been agreed with Defra, the LS NOx and a number of the diffusion tube sites showing exceedence will be within the amended AQMAs.

At both AURN and AQMS sites the annual mean PM_{10} levels were considerably below the AQO value and the 24-hour AQO was not exceeded at either site.

Similarly there were no exceedences of the sulphur dioxide and benzene AQOs.

2.2.1 Nitrogen Dioxide

Data is shown below for both continuous and diffusion tube nitrogen dioxide monitoring results. The monitoring data shows that the 1-hour AQO was not exceeded - no automatic site recorded more than 18 1-hour means above 200$\mu g/m^3$ and no diffusion tube concentrations were greater than 60 $\mu g/m^3$.

However the annual mean at a number of sites (automatic and diffusion tube) was greater than 40$\mu g/m^3$.

The majority of the sites where the annual mean AQO was exceeded are within existing AQMAs or will be within the proposed amended AQMAs.

Automatic Monitoring Data

The nitrogen dioxide annual mean concentration was exceeded at the CG NOx and LS NOx roadside sites – Table 2.3a. These sites were initiated as a result of previous rounds of Review & Assessment; CG NOx is within AQMA No.2 whilst the LS NOx is very close to the south-west boundary of AQMA No.3 - both stations are located close to residential properties.

Figures 2.2 and 2.3 below show maps of the locations of monitoring sites in respect of the AQMAs and the annual mean 2008 NO_2 concentrations.

No exceedences of the 1-hour AQO were recorded –Table 2.3b.

Table 2.3a Results of 2008 Automatic Monitoring for Nitrogen Dioxide: Comparison with Annual Mean Objective

Site ID	Location	Within AQMA?	Proportion of year with valid data %	2008 Annual mean concentrations NO_2 ($\mu g/m^3$)
AURN	Clinton Street East	N	97.8	33
CG NOx	Carter Gate	Y	98.3	**44**
AQMS	QMC, Clifton Blvd.	Y	92.7	35
LS NOx	Lace Street	N	93.9	**41**

12 months ratified data – 01/01/2008 to 31/12/08

Table 2.3b Results of 2008 Automatic Monitoring for Nitrogen Dioxide: Comparison with 1-hour Mean Objective

Site ID	Location	Within AQMA?	Proportion of year with valid data %	2008 Maximum 1 hour mean NO_2 ($\mu g/m^3$)
AURN	Clinton Street East	N	97.8	233 6 occurrences >=200$\mu g/m^3$
CG NOx	Carter Gate	Y	98.3	179
AQMS	QMC, Clifton Blvd.	Y	92.7	151
LS NOx	Lace Street	N	93.9	237 4 occurrences >=200$\mu g/m^3$

12 months ratified data – 01/01/2008 to 31/12/08

Diffusion Tube Monitoring Data

The annual mean NO_2 AQO was exceeded at a number of diffusion tube sites. The data is shown in Table 2.4a and exceedences of the AQO are highlighted in bold type.

The table is followed by Figures 2.2 and 2.3 which show maps of the monitoring sites' annual mean NO_2 concentrations and their locations in respect of the AQMAs. All sites where exceedence was measured are displayed.

Table 2.4a Results of Nitrogen Dioxide Diffusion Tubes

Site ID	Location	Within AQMA?	Data Capture 2008 %	2008 Annual mean concentrations NO_2 ($\mu g/m^3$) Adjusted for bias
C	Clifton Boulevard	Y	100	31
D	Beeston Road (1)	Y	100	**47**
F	Beeston Road (2)	N	100	**55**
G	Beeston Road (4)	N	100	**45**
H	Beeston Road (3)	N	100	38
I	Derby Road (1)	Y	100	33
J	Derby Road (2)	N	100	34
K	Castle Boulevard	N	100	**42**
M	Canning Terrace	N	100	**49**
N	Upper Parliament St.	Y	100	**52**
O	Shakespeare St.	N	100	**51**
P	Mansfield Road	N	100	**49**
Q	Woodborough Road	N	100	**48**
S	Carter Gate	Y	100	**44**
T	Queen's Road	N	100	**52**
U	Trent Bridge	N	75*	**51**
V	Bentinck Rd	N	100	35
A	Ilkeston Road	N	92	26
W	Ransom Drive	N	92	5
B	Noel Street Baths	N	100	22

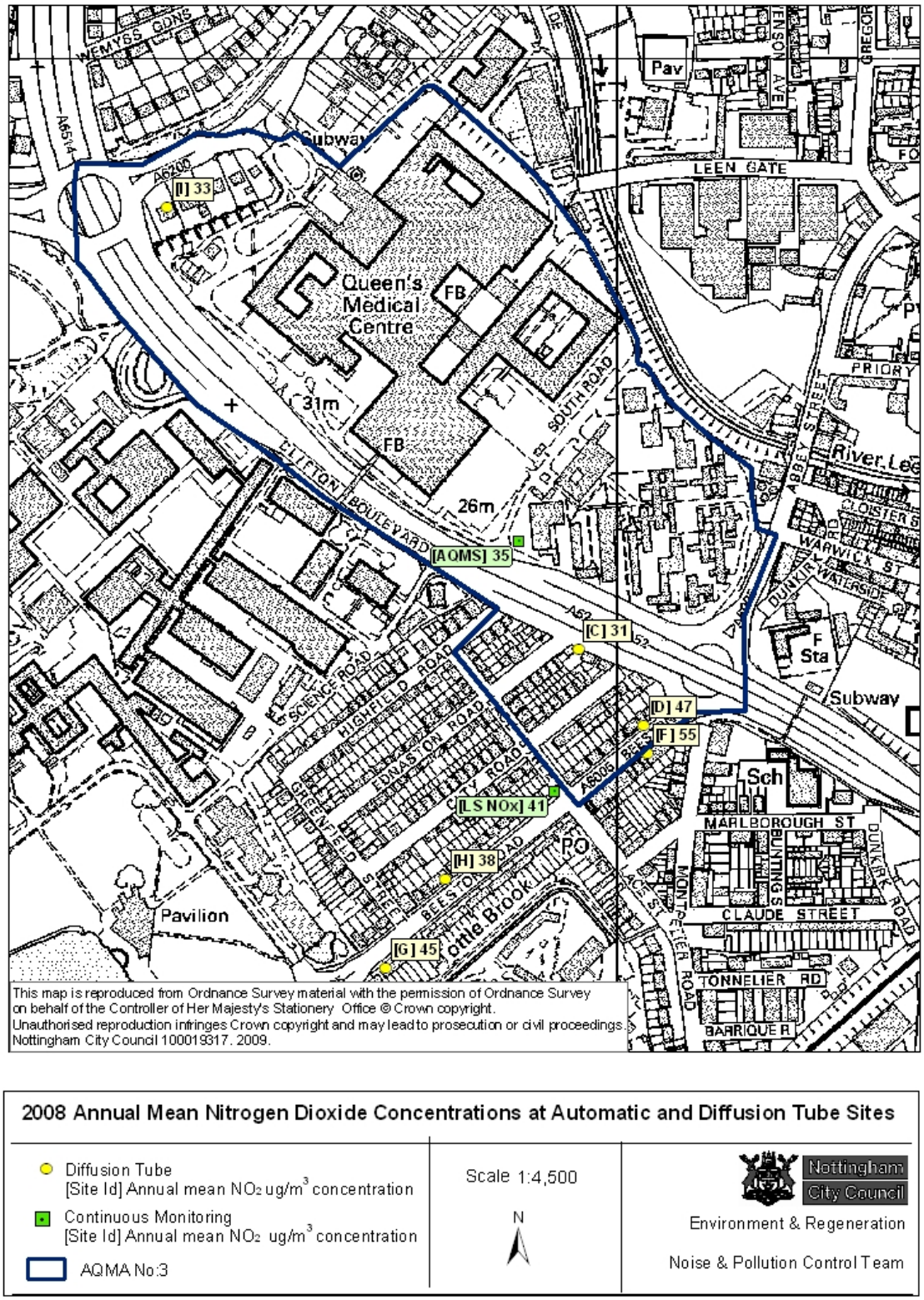
Bias adjustment factor applied = 0.81 (3mths) and 0.92 (9mths) R&A national figures

From January to March the tube preparation method used was 10% triethanolamine (TEA) in water whilst from April 2008 it was 20% TEA in water. This has been accounted for in the calculation of the bias adjusted annual mean values.

The annual means shown in Table 2.4a are based on 12 months' data, January to December 2008.

The monthly unbiased diffusion tube NO_2 concentrations are given in Appendix A -Table A-2.

Figure 2.2 2008 Annual Mean Nitrogen Dioxide Concentrations in the Dunkirk Area



2008 Annual Mean Nitrogen Dioxide Concentrations at Automatic and Diffusion Tube Sites

- Diffusion Tube [Site Id] Annual mean NO_2 ug/m^3 concentration
- Continuous Monitoring [Site Id] Annual mean NO_2 ug/m^3 concentration
- AQMA No:3

Scale 1:4,500

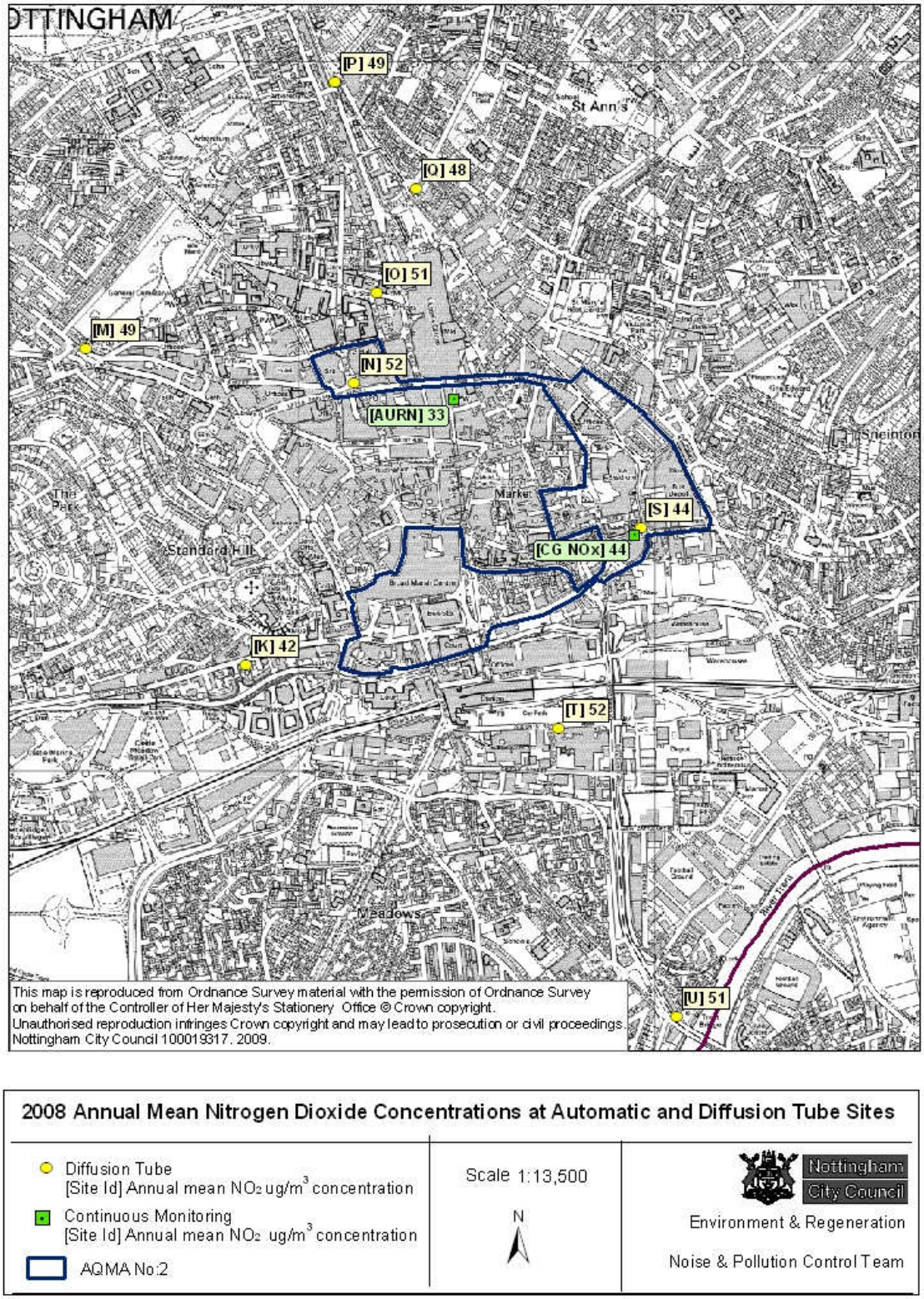
N

Nottingham City Council

Environment & Regeneration

Noise & Pollution Control Team

Figure 2.3 2008 Annual Mean Nitrogen Dioxide Concentrations in the City Centre Area



2.2.2 PM_{10}

Automatic Monitoring Data

Whilst there is relevant public exposure at both sites where PM_{10} is measured i.e. AURN and AQMS, neither of the PM_{10} AQ objectives were exceeded.

The annual and 24-hour mean PM_{10} figures shown in Tables 2.5a & b below are gravimetric equivalent. The AURN figure is provided by the network as $PM_{10\ TEOM\ FDMS}$. The AQMS figure has been corrected to TEOM FDMS using the Volatile Correction Model (VCM) - see Appendix A

Table 2.5a Results of PM_{10} Automatic Monitoring: Comparison with Annual Mean Objective

Site ID	Location	Within AQMA?	2008 Data Capture %	2008 Annual mean concentrations $PM_{10\ TEOM\ FDMS}$ ($\mu g/m^3$)
AURN	Clinton Street East	N	90.1	18
AQMS	QMC, Clifton Blvd.	Y	94.3	21

12 months ratified data – 01/01/2008 to 31/12/08

Table 2.5b Results of PM_{10} Automatic Monitoring: Comparison with 24-hour Mean Objective

Site ID	Location	Within AQMA?	2008 Data Capture %	2008 Maximum 24-hour mean $PM_{10\ FDMS\ TEOM}$ ($\mu g/m^3$)	Number of exceedences of 24-hour mean i.e. >=50 $\mu g/m^3$
AURN	Clinton Street East	N	90.1	85	8
AQMS	QMC, Clifton Blvd.	Y	94.3	90	9

12 months ratified data – 01/01/2008 to 31/12/08

2.2.3 Sulphur Dioxide

Sulphur dioxide levels were low at the AURN, CG NOx and AQMS sites and there were no exceedences of the SO_2 AQ objectives – Table 2.6 below.

Table 2.6 Results of SO_2 Automatic Monitoring: Comparison with 15-minute, 1-hour and 24-hour Mean Objectives

Site ID	Location	Within AQMA?	Data Capture 2008 %	2008 Maximum 15-minute mean SO_2 ($\mu g/m^3$)	2008 Maximum 1-hour mean SO_2 ($\mu g/m^3$)	2008 Maximum 24-hour mean SO_2 ($\mu g/m^3$)
AURN	Clinton Street East	N	98.6	396 1 occurrence >=266$\mu g/m^3$	170	14
CG NOx	Carter Gate	Y	96.9	69	40	16
AQMS	QMC, Clifton Blvd.	Y	98.4	32	32	19

12 months ratified data – 01/01/2008 to 31/12/08

2.2.4 Carbon Monoxide

Carbon monoxide levels at the AQMS were low and there was no exceedence of the carbon monoxide running 8-hour mean AQ objective.

Table 2.7 Results of CO Automatic Monitoring: Comparison with Running 8-hour Mean Objective

Site ID	Location	Within AQMA?	Data Capture 2008 %	2008 Maximum daily 8 hour mean CO ($\mu g/m^3$)
AQMS	QMC, Clifton Blvd.	Y	98.6	3.4

12 months ratified data – 01/01/2008 to 31/12/08

2.2.5 Benzene

Non-Automatic Monitoring Data

Benzene levels at the AURN were low and there were no exceedences of the Benzene AQ objectives.

Table 2.8 Results of Benzene Pumped Tube Monitoring: Comparison with Annual Mean Objectives

Site ID	Location	Within AQMA?	Data Capture 2008 %	2008 Annual mean concentration Benzene ($\mu g/m^3$)
AURN	Clinton Street East	N	100	0.74

12 months ratified data – 01/01/2008 to 31/12/08

3 Road Traffic Sources

3.1 Narrow Congested Streets with Residential Properties Close to the Kerb

No streets were identified that meet the specified criteria; which are outside traffic related AQMAs and that have not been previously assessed.

Nottingham City Council confirms that there are no new/newly identified congested streets with a flow above 5,000 vehicles per day and residential properties close to the kerb, that have not been adequately considered in previous rounds of Review and Assessment.

3.2 Busy Streets Where People May Spend 1-hour or More Close to Traffic

In the Second and Third Stage Review and Assessment busy street locations where people may regularly be for an hour or more were considered in detail. No new exposure in existing areas or exposure in new areas has been identified.

Nottingham City Council confirms that there are no new/newly identified busy streets where people may spend 1 hour or more close to traffic.

3.3 Roads with a High Flow of Buses and/or HGVs.

Roads with high flows of buses/HGVs have been considered in previous rounds of review and assessment. Since the last USA our Turning Point traffic management scheme has led to altered traffic flows around the city centre. This has resulted in 2 additional road links that have greater than 20% buses/HGVs and flows in excess of 2,500 vehicles per day, where there is relevant exposure.

These road links are within the proposed amended AQMA 2 – Nitrogen Dioxide – City Centre outlined in the Detailed Assessment 2008 that is the subject of discussions with Defra.

Nottingham City Council has assessed newly identified road(s) with high flows of buses or HGVs in a busy street where people may spend 1 hour or more close to traffic that it has not previously assessed, and concluded that because these are within the proposed extension to an existing AQMA (see DA May 2008) it will not be necessary to proceed to a Detailed Assessment.

3.4 Junctions

Junctions meeting the criteria specified in the guidance LAQM.TG(09) have been previously assessed and those of concern are within the existing or proposed amended AQMAs (see DA May 2008).

Nottingham City Council confirms that there are no new/newly identified busy junctions/busy roads.

3.5 New Roads Constructed or Proposed Since the Last Round of Review and Assessment

Nottingham City Council confirms that there are no new/proposed roads.

3.6 Roads with Significantly Changed Traffic Flows

Since the last USA our Turning Point traffic management scheme has altered traffic flows around the city centre. This has resulted in 5 road links that have greater than 25% increases in traffic (between 2006 and 2007) with flows in excess of 10,000 vehicles per day. 3 of these are within the proposed amended AQMA 2 – Nitrogen Dioxide – City Centre outlined in the Detailed Assessment 2008 that is currently the subject of discussions with Defra. The other 2 are not in locations with relevant exposure.

Nottingham City Council has assessed new/newly identified roads with significantly changed traffic flows, and concluded that because these are within the proposed extension to an existing AQMA (see DA May 2008) that it will not be necessary to proceed to a Detailed Assessment.

3.7 Bus and Coach Stations

Bus and coach stations were assessed in previous rounds of Review and Assessment

Nottingham City Council confirms that there are no relevant bus stations in the Local Authority area.

4 Other Transport Sources

4.1 Airports

Nottingham City Council confirms that there are no airports in the Local Authority area.

4.2 Railways (Diesel and Steam Trains)

4.2.1 Stationary Trains

Nottingham City Council confirms that there are no locations where diesel or steam trains are regularly stationary for periods of 15 minutes or more, with potential for relevant exposure within 15m.

4.2.2 Moving Trains

Nottingham City Council confirms that there are no locations with a large number of movements of diesel locomotives, and potential long-term relevant exposure within 30m.

4.3 Ports (Shipping)

Nottingham City Council confirms that there are no ports or shipping that meet the specified criteria within the Local Authority area.

5 Industrial Sources

5.1 Industrial Installations

5.1.1 New or Proposed Installations for which an Air Quality Assessment has been carried out

Nottingham City Council confirms that there are no new or proposed industrial installations for which planning approval has been granted within its area or nearby in a neighbouring authority.

5.1.2 Existing Installations where Emissions have Increased Substantially or New Relevant Exposure has been Introduced

Nottingham City Council confirms that there are no industrial installations with substantially increased emissions or new relevant exposure in their vicinity within its area or nearby in a neighbouring authority.

5.1.3 New or Significantly Changed Installations with No Previous Air Quality Assessment

Nottingham City Council confirms that there are no new or proposed industrial installations for which planning approval has been granted within its area or nearby in a neighbouring authority.

5.2 Major Fuel (Petrol) Storage Depots

There are no major fuel (petrol) storage depots within the Local Authority area.

5.3 Petrol Stations

Petrol stations were assessed in previous rounds of Review and Assessment (First & Second Stage Report) and there are no new petrol stations that have an annual throughput greater than 2000m^3.

Nottingham City Council confirms that there are no petrol stations meeting the specified criteria**.**

5.4 Poultry Farms

Nottingham City Council confirms that there are no poultry farms meeting the specified criteria.

6 Commercial and Domestic Sources

6.1 Biomass Combustion – Individual Installations

Currently the use of biomass in the Nottingham City area is minimal. Several planning applications have been received for individual installations. These are for biomass burners in public sector buildings; none are in the 50kW to 20 MW category and they will not need to be regulated under the Pollution Prevention and Control Act 1999. The air quality assessments provided so far for these boilers suggest they will not have a significant impact on air quality in the areas in which they are to be located.

Nottingham City Council has assessed the biomass combustion plant, and concluded that it will not be necessary to proceed to a Detailed Assessment.

6.2 Biomass Combustion – Combined Impacts

Very limited information is available on small combustion installations including domestic use of wood burners and solid fuel. Nottingham City Council is of the opinion that the current level of biomass combustion is so low that it can be considered that there is no significant impact on air quality. This aspect will be kept under review.

Nottingham City Council has assessed the biomass combustion plant, and concluded that it will not be necessary to proceed to a Detailed Assessment.

6.3 Domestic Solid-Fuel Burning

Domestic solid fuel use was considered in the Review and Assessment Second and Third Stage Report and no areas where significant coal/smokeless fuel burning takes place were identified.

Nottingham City Council confirms that there are no areas of significant domestic fuel use in the Local Authority area.

7 Fugitive or Uncontrolled Sources

No locations where there are or are potential significant fugitive/uncontrolled dust sources have been identified.

Nottingham City Council confirms that there are no potential sources of fugitive particulate matter emissions in the Local Authority area.

8 Conclusions and Proposed Actions

8.1 Conclusions from New Monitoring Data

The 2008 monitoring data confirms findings reported in previous Review & Assessment reports.

There were no exceedences of the air quality objectives for PM_{10}, sulphur dioxide, carbon monoxide and benzene.

Exceedences of the nitrogen dioxide annual mean air quality objective were measured at two roadside automatic monitoring sites and a number of diffusion tubes sites; both within and outside existing Air Quality Management Areas.

Monitoring within AQMA No.3 also identified sites where the nitrogen dioxide annual mean AQO was not exceeded.

The 1-hour objective was not exceeded at the continuous monitoring sites and no annual mean diffusion tube nitrogen dioxide concentration was greater than 60 $\mu g/m^3$ which also indicates this objective was unlikely to be exceeded.

The nitrogen dioxide data are consistent with previous results and therefore confirm that the proposals in the DA May 2008, for alterations to be made to the existing AQMAs, are appropriate.

8.2 Conclusions from Assessment of Sources

The work undertaken taken for this report has not identified any likely adverse air quality impacts from local developments, air and rail transport, industrial installations, commercial/domestic combustion, fugitive emissions, residential and commercial sources or road transport outside the existing (proposed amended) AQMAs.

No new or significantly changed sources since the last report have been identified.

8.3 Proposed Actions

The monitoring data presented in this USA have shown that exceedence of the nitrogen dioxide annual mean Air Quality Objective occurred at a number of sites but no new sites of potential exceedence of the Air Quality Objectives have been identified.

There is no need to proceed to a Detailed Assessment because the sites of exceedence have been previously reported and are covered in the subsequent DA May 2008.

The Detailed Assessment May 2008 was undertaken following the USA 2006 and identified the need for the AQMAs to be amended. The proposals are: to extend AQMA 2 - to the north and north-west of the city centre and remove the south-west part (no relevant public exposure); in AQMA 3 – Dunkirk to re-align the boundary to extend it to the south west and exclude the QMC hospital.

Nottingham City Council - England

Delay in the production of the DA 2008 meant that it was not submitted to Defra until May 2008. Comments were received from Defra in September 2008. Further work has been undertaken on this DA and there is on-going liaison with the R & A helpdesk but the report is not yet complete.

The next course of action will be to complete the Detailed Assessment and submit it. Once Defra's approval has been obtained the AQMAs will be amended.

In 2010 a Progress report will be submitted to comply with the next round of R & A process.

9 References

AEA Energy & Environment (Feb 2008) **Diffusion Tubes for Ambient NO_2 Monitoring: Practical Guidance for Laboratories and Users Issue 1a**

AEA Technology (2005)
Local Site Operators' Manual

Air Quality (England) Regulations 2000 (SI 928),

Department for the Environment, Food and Rural Affairs (February 2009) **Local Air Quality Management Technical Guidance LAQM.TG (09))**

Department for the Environment, Food and Rural Affairs (2007) **The Air Quality Strategy for England, Scotland, Wales and Northern Ireland 2007**

ENVITECH Ltd. (January 2007)
Enview 2000 Software Manager Version 5

Harrison D., (June 2006) **UK Equivalence Programme for Monitoring of Particulate Matter Bureau Veritas Report No. Bureau Veritas/AQ/AD202209/DH/2396,**

Nottingham City Council (April 2009) **Key Facts for Nottingham and Greater Nottingham** - **Last updated: 6th April 2009**

Nottingham City Council (2000 - 2008) **Previous Review and Assessment Reports:**

City of Nottingham
Air Quality Review & Assessment First & Second Stage April 2000

City of Nottingham
Air Quality Review & Assessment Second & Third Stage Report 2001

City of Nottingham
Local Air Quality Management: Stage Four Review & Assessment of Nottingham's Air Quality Management Areas July 2003

City of Nottingham
Local Air Quality Management: Updating and Screening Assessment October 2003

City of Nottingham
Local Air Quality Management: Detailed Assessment August 2004

City of Nottingham
Local Air Quality Management: Progress Report April 2005

Nottingham City Council
Local Air Quality Management: Updating and Screening Assessment June 2006

Nottingham City Council
Local Air Quality Management: Detailed Assessment Consultation Document May 2008

Nottingham City Council - England

Nottingham City Council
Local Air Quality Management: Progress Report July 2008

Nottingham City Council Website **http://www.nottinghamcity.gov.uk**

The Air Quality (England) (Amendment) Regulations 2002 (SI 3043)

The Pollution Prevention and Control Act 1999

Appendices

Appendix A: Nitrogen Dioxide Diffusion Tube and PM_{10} Adjustment information

Appendix B: QA/QC Data for Automatic and Non-Automatic Sites

Appendix A: Nitrogen Dioxide Diffusion Tube and PM_{10} Adjustment information

Diffusion Tube Preparation, Supply and analysis

Since April 2008 Nottingham City Council's diffusion tubes have been supplied and analysed by Gradko International, Hampshire. The tubes are prepared using a 20% solution of triethanolamine (TEA) in de-ionised water. The tubes are exposed on site for one month before being returned for laboratory analysis.

Prior to April 2008, the Council used tubes that were 10% TEA in water, supplied and analysed by Bureau Veritas, Glasgow (contract to the end of March 2008).

However in 2007, the Nottinghamshire Environmental Protection Working Group (NEPWG) of which Nottingham City Council is a member took the decision to harmonise the tube preparation method and supplier for all associate Local Authorities. The advantages of this approach are: considerable cost savings due to bulk ordering; the ability to utilise co-location studies and the comparison of results across the County.

Diffusion Tube Bias Adjustment Factors

The R&A Helpdesk Database 2008 bias adjustment factor for Gradko 20% TEA in water tubes = 0.92. This figure is the average of 11 studies and was taken from Spreadsheet Version Number: 03/09.

Diffusion tube precision was good for 9 of the11 studies used to derive the national bias adjustment factor. Tube precision is categorised as 'good' "where the coefficient of variation (CV) of triplicate diffusion tubes for eight or more periods during the year is less than 20%, and the average CV of all monitoring periods is less than10%". (LAQM.TG(09))

The R&A Helpdesk Database 2008 bias adjustment factor for Casella/../Bureau Veritas 10% TEA in water tubes = 0.81. This figure is the average of 10 studies and was taken from Spreadsheet Version Number: 03/09 (NCC data removed as it was erroneously included).

Diffusion tube precision was good for 8 of the10 studies used to derive this national bias adjustment factor.

The bias adjusted annual means shown in Table 2.4a are based on 12 months data, January to December 2008 using the following calculation:

Ave Jan to Mar 10% TEA NO_2 x 0.81 = Y
Ave Apr to Dec 20% TEA NO_2 x 0.92 = Z

Annual mean NO_2 = (Y x 0.25) + (Z x 0.75)

i.e. 25% of 10% TEA value + 75% of 20% TEA value

Example

Y = 37 x 0.81 = 29.97
Z = 35 x 0.92 = 32.20

Annual mean NO_2 = (29.97 x 0.25) + (32.2 x 0.75) = 31.6 $\mu g/m^3$

Factor from Local Co-location Studies

Throughout 2008 triplicate diffusion tubes were co-located at 3 continuous analyser sites.

Table A-1 gives the bias adjustment factors for our co-location study for the 3 sites; the figures in the table have been calculated from 9 months' ratified data (April to December 2008) and the averaged bias adjustment factor = 0.91.

Nottingham City Council's co-location data has been entered in the R & A Database site but is not shown for the 20% TEA in water studies.

Table A-1 Nottingham City Council's Bias Adjustment Factor

Site	Site Type	*Cm NO_2 $\mu g/m^3$	*Dm NO_2 $\mu g/m^3$	Bias Adjustment Factor, A	*Data Capture % Cm	*Data Capture % Dm	Precision (CoV) %
AURN, Clinton St East	Urban Centre	32	36	0.89	98	100	5
CG NOx, Carter Gate	Roadside	42	44	0.95	98	100	8
LS NOx, Lace Street	Roadside	40	46	0.88	94	100	5
Averaged bias adjustment factor				0.91			

* 9 months data April to December 2008

Cm = chemiluminescence (continuous) analyser measurement

Dm = diffusion tube measurement (average of 3 tubes)

Bias Adjustment Factor =Cm/Dm

CoV = Coefficient of variation

Discussion of Choice of Factor Used

The 2008 national bias adjustment factors were 0.81 & 0.92 whilst the local bias adjustment factor = 0.91. The national figures were used for the diffusion tube data because by applying them proportionately the full 12 months data could be used.

The local factor was for 9 months and related only to 20% TEA in water tubes; also a reasonable estimation of a bias adjustment factor for 10% TEA tubes could not be made using 3 months of data.

Table A-2 2008 Diffusion Tube Unbiased Monthly Nitrogen Dioxide Concentrations (μg/m^3)

Site Id	Location	10% TEA in Water			20% TEA in Water								Jan-Mar Average NO_2 μg/m^3	Apr-Dec Average NO_2 μg/m^3	Data capture %
		Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec			
C	Clifton Boulevard	24	49	38	41	40	32	28	25	38	22	42	43	37	35	100
D	Beeston Road (1)	46	65	58	66	50	52	45	45	45	38	66	56	56	51	100
F	Beeston Road (2)	59	75	56	61	71	61	64	56	53	68	50	71	63	62	100
G	Beeston Road (4)	87	54	90	52	37	39	38	38	36	47	47	53	77	43	100
H	Beeston Road (3)	40	52	37	44	36	43	38	37	43	44	45	48	43	42	100
I	Derby Road (1)	29	45	45	44	26	38	30	27	36	39	42	42	40	36	100
J	Derby Road (2)	40	51	38	41	32	33	32	30	42	36	42	43	43	37	100
K	Castle Boulevard	42	60	50	54	48	47	42	40	45	42	40	53	51	46	100
M	Canning Terrace	42	63	54	63	61	64	43	39	64	51	54	63	53	56	100
N	Upper Parliament St.	49	67	62	59	72	57	54	44	59	60	56	63	59	58	100
O	Shakespeare St.	44	58	56	59	54	61	52	49	60	57	69	64	53	58	100
P	Mansfield Road	36	64	48	62	71	53	52	44	58	45	61	59	49	56	100
Q	Woodborough Road	43	66	52	61	59	51	52	48	64	45	53	56	54	54	100
S	Carter Gate	36	61	58	56	45	48	42	42	54	43	53	59	52	49	100
T	Queen's Road	45	78	57	63	65	49	55	51	69	51	53	65	60	58	100
U	Trent Bridge	-	-	-	59	70	50	45	34	58	34	50	56	-	51	75
V	Bentinck Rd	29	48	48	36	31	46	34	27	43	38	45	46	42	38	100
A	Ilkeston Road	26	39	-	33	25	27	23	22	33	31	35	28	33	29	92
W	Ransom Drive	4	4	7	7	6	5	4	3	-	5	8	9	5	6	92
B	Noel Street Baths	18	33	25	26	20	20	17	20	22	27	31	33	25	24	100

PM Monitoring Adjustment

The Air Quality Objective for PM_{10} is quoted as a gravimetric measurement and reflects the European standard for the determination of PM_{10}. The UK Equivalence Programme for Monitoring of Particulate Matter Report found that in order to meet the equivalence criteria, AURN TEOM units would have to be retro-fitted with the Filter Dynamic Measurement System (FDMS). This provides particulate matter (PM) measurements that closely correlate with gravimetric PM mass concentrations, as measured with the EU Reference Sampler. The FDMS system accounts for volatile PM that may not be detected by earlier (non equivalent) TEOM models.

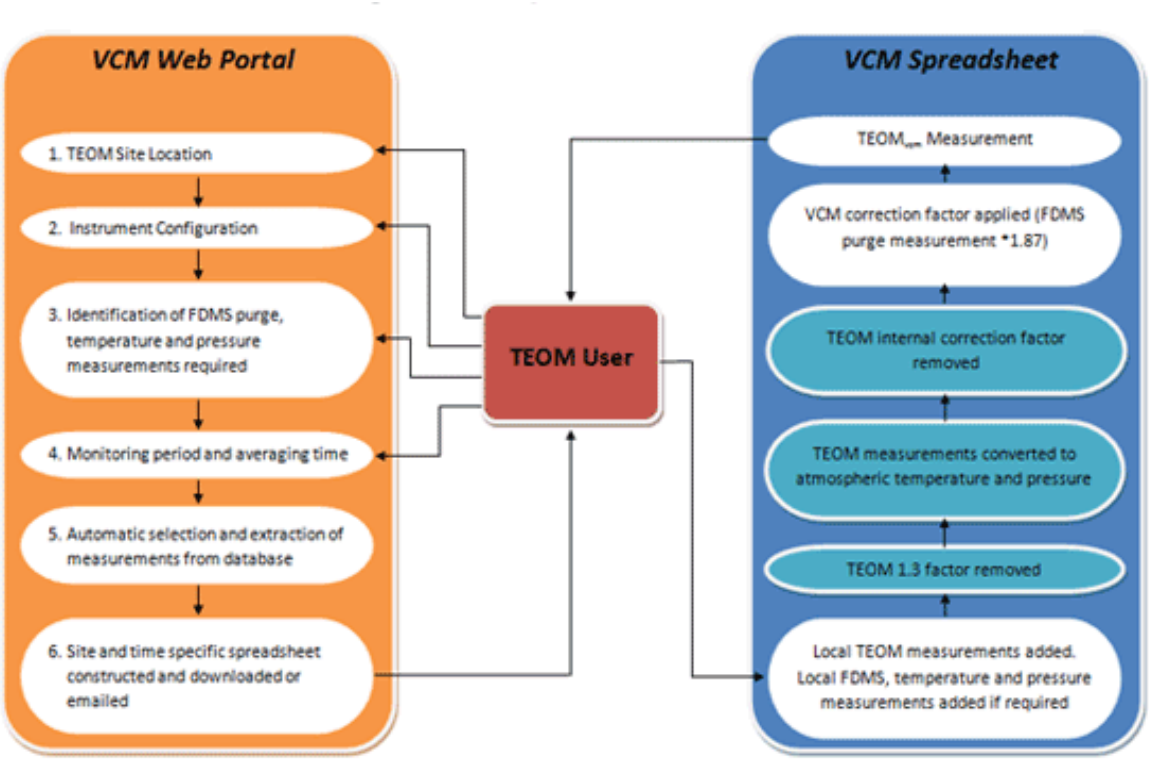
Alternatively, the Volatile Correction Model (VCM) to correct non-FDMS TEOM measurements has been developed to allow the continued use of existing TEOM systems, used extensively by Local Authorities, without the necessity of expensive FDMS upgrade.

ERG, King's College, London has developed a VCM web portal (funded by Defra) - www.volatile-correction-model.info/. The following information about the Volatile Correction Model VCM is taken from the web site.

It has been designed for users of TEOM PM_{10} measurements and allows the correction of TEOM measurements for the loss of volatile components of particulate matter that occur due to the high sampling temperatures employed by this instrument. The resulting corrected measurements have been demonstrated as equivalent to the gravimetric reference equivalent.

The VCM works by using the volatile particulate matter measurements provided by nearby FDMS instruments (within 130 km) to assess the loss of PM_{10} from the TEOM; this value is then added back onto the TEOM measurements.

Flow chart describing data manipulation in the VCM web portal:



The information shown below is taken from LAQM. TG(09) and outlines the steps taken to apply the VCM model

Box 3.4: Application of the Volatile Correction Model

A VCM web portal is available through the national air quality archive at www.volatile-correction-model.info/Default.aspx. This allows local authorities to download geographically specific correction factors to apply to the TEOM PM_{10} results.

There are a number of steps that need to be taken to apply the VCM, as the default settings for the TEOMs used in the UK contain a "US EPA correction factor" and are reported at standard temperature and pressure (STP).

Step 1: Remove the default "US EPA correction factor" from the measured TEOM PM_{10} data.

TEOM instruments, as supplied by the manufacturer, include a default US EPA adjustment that is embedded into the software. This adjustment factor is:

Reported TEOM PM_{10} (µg/m³) = (TEOM PM_{10} at STP (µg/m³) * 1.03) + 3 µg/m³

The TEOM PM_{10} concentration at STP, with the US EPA adjustment factor removed, is given by:

$$TEOM_{STP}\,PM_{10} = \frac{TEOM\,PM_{10} - 3}{1.03}$$

Step 2: Correct the measurements to atmospheric temperature and pressure

The TEOM is configured to report measurements at a standard temperature (25°C) and a standard pressure (1 atm). This differs from the European position, which reports at ambient conditions and this difference therefore increases uncertainty in the comparison with the European reference method. By using measurements of ambient temperature and pressure, the temperature and pressure correction can be removed from the TEOM measurements at STP to provide an ambient temperature and pressure TEOM measurement ($TEOM_{ATP}$) using the following equation:

$$TEOM_{ATP}\,PM_{10} = \left[\frac{TEOM\,PM_{10} - 3}{1.03}\right] x\ \frac{1}{P}\ x\ \frac{T + 273}{273}$$

Where P = ambient pressure in atmospheres and T = ambient temperature in °C

Step 3: The Regional Purge Concentration

The regional purge concentration is the mean of up to three of the nearest Automatic Urban and Rural Network (AURN) FDMS instruments within the model domain. Current evidence suggests that the model domain extends to approximately 130 km from the measurement site. This is multiplied by 1.87 to account for the additional loss of volatile material from the TEOM filter, which is maintained at 50°C, compared to the FDMS filter, which is maintained at 30°C. This factor has been derived from TEOM and FDMS co-location studies.

Step 4: The calculating the $TEOM_{VCM}$ concentration

Steps 1 and 3 can be combined into the equation below.

$$TEOM_{VCM}\,PM_{10} = \left\{\left[\frac{TEOM\,PM_{10} - 3}{1.03}\right] x\ \frac{1}{P}\ x\ \frac{T + 273}{273}\right\} - 1.87\ x\ Regional\ Purge\ Concentration$$

These calculations will be undertaken by the VCM web portal to provide a time series of daily or hourly correction factors that can then be applied to TEOM PM_{10} measurements as they are recorded by the instrument.

Nottingham City Council's AQMS PM_{10} data have been corrected using the Volatile Correction Model web portal which allows the user to input the requisite information; the calculation of the corrected hourly or daily PM_{10} data is done automatically and is then available as a downloadable Microsoft Excel spreadsheet.

Appendix B: QA/QC Data for Automatic and Non-Automatic Sites

QA/QC of Automatic Monitoring

Quality Control, Maintenance, Calibration

AURN Site

The analysers at the AURN site are subject to a four weekly calibration regime. The calibrations are undertaken by a trained local site operator (LSO) and conducted in accordance with the Local Site Operators' Manual. Nottingham City has 3 trained LSOs who are audited as to their performance on an on-going basis.

The LSO changes the TEOM and FDMS filters and cleans the TEOM head approximately every 12 weeks (or when the TEOM filter loading is > than 90%) in accordance with the Local Site Operators Manual.

The equipment is fully serviced every six months. In 2008 this was undertaken by Signal Ambitech, Faringdon.

The site is audited by AEA Energy & Environment on a six monthly basis.

AQMS, CG NOx and LS NOx Sites

At Nottingham City Council's, AQMS, CG NOx and LS NOx sites calibrations are carried out fortnightly. The calibrations, using zero air and span gases, are undertaken by the same LSOs as those for the AURN site and are conducted using the same principles and procedures as given in the AURN LSO Manual.

At the AQMS site, the LSO changes the TEOM filter and cleans the TEOM head every 4 weeks.

The equipment is fully serviced every six months by Casella ETi, Bedford.

Calibration Gas Traceability

AURN Site

Calibration gases used in the AURN are supplied by AIR Liquide who have demonstrated compliance with relevant quality control procedures in the preparation of gas mixtures. The gas mixtures are certified by AEA Energy & Environment.

AQMS, CG NOx and LS NOx Sites

Calibration gases used in the AQMS, CG NOx, and LS NOx monitoring sites are supplied by AIR Liquide who have demonstrated compliance with relevant quality control procedures in the preparation of gas mixtures. The gases are supplied with a certificate of analysis.

Data Collection and Processing

AURN Site

The AURN station's data logger is interrogated on an hourly basis by Bureau Veritas the Central Management and Co-ordination Unit (CMCU). The Odessa data logger records information for most of the analysers operating at the site (black smoke equipment and benzene tubes are operated by the National Physic Laboratory (NPL)). The data obtained is validated by CMCU and passed to the Data Dissemination Unit (DDU).

Information about the AURN station and available data can be found on the internet at www.airquality.co.uk

AQMS, CG NOx and LS NOx Sites

For Nottingham City Council's sites all data collection, validation and ratification is carried out by the Council's Noise & Pollution Control team.

Throughout 2008 data from the AQMS, CG NOx and LS NOx sites was polled remotely (AQMS data logger, CG NOx & LS NOx analysers) and collected as 15 minute averages using Enview 2000 data collection software. The data has been scaled and converted into hourly or other values using the Enview 2000 Data Management System (Enview automatically saves a copy of the raw data).

Enview 2000 is a Windows XP/2000/NT/98, client-server application which can be used for supervisory control, management and analysis of data. The software allows users to remotely view, analyse, report and distribute environmental quality data. Manipulation of raw data to verified data can be conducted in a structured approach.

Data validation involves screening the scaled values to identify unusual measurements, errors due to equipment failure etc. and flagging them for further investigation.

Data ratification is carried at approximately 2 monthly intervals. This involves looking at the data more closely and includes:

- examination of calibration records to ensure correct application of calibration factors;
- examination of data for other pollutants and monitoring sites to highlight any anomalies;
- deletion of data shown from chart or other records to be spurious, for example, spikes generated by the analyser;
- correction of any baseline drift as indicated by examination of daily automatic calibration records.

Once this process has been carried out and data has been verified, amended or rejected as appropriate the data is ratified. This final data set is used for the R & A process.

Nottingham City Council - England

QA/QC of Diffusion Tube Monitoring

Gradko International (diffusion tube supplier and analyst) is UKAS accredited; is assessed annually for compliance to ISO 17025 and participates in other proficiency schemes.

Gradko confirmed that:

- their procedures have been amended to follow the guidance issued on behalf of Defra (AEA Energy & Environment, Feb 2008) relating to the preparation, extraction, analysis and calculation procedures for passive NO_2 diffusion tubes

also

- that most of these procedures were in force before the guidance was introduced and any amendments necessary in achieving compliance were minimal.

Gradko also participate in a number of QA/QC monitoring systems to demonstrate satisfactory performance:

- The Workplace Analysis Scheme for Proficiency **(WASP)** programme to ensure uniformity in data throughout the year. Only laboratories that are in the WASP scheme are used for analysing tubes from the National Nitrogen Dioxide Diffusion Tube Network.

- The monthly field inter-comparison exercise with other laboratories to enable assessment of bias and precision undertaken by AEA Energy & Environment.

- An external QC scheme to check solutions run by AEA Energy & Environment.

WASP

This involves monthly analysis of doped tubes, allowing assessment of overall uniformity of data throughout the year. Performance scores i.e. Z-score are assigned to the reported analysis results, on the basis of their difference from the known concentration of the analyte and the actual standard deviations.

Z-score Results are classified as follows:

Satisfactory	< +/- 2
Questionable (warning)	> +/-2 – < +/- 3
Unsatisfactory	> +/-3

Each participating laboratory's results are analysed by AEA Energy & Environment and combined to give an annual relative standard deviation. If this value is greater than + 15% of the Performance Target then the laboratory's performance for the year in the WASP scheme will be deemed unsatisfactory. Only laboratories that remain in the WASP scheme are used for analysing tubes from the National NO_2 diffusion tube non-automatic network.

Table B-1 below shows 2008 WASP performance results.

Table B-1 Gradko 2008 WASP NO_2 Diffusion Tube Performance Results

All data supplied by Gradko International April 2008

Date	WASP Round Number	NO_2 Reference Value μg NO_2	NO_2 Measured Value μg NO_2	Z Score	Laboratory Performance
Jan 2008	100	1.36	1.34	-0.1	Satisfactory
		1.47	1.50	0.2	Satisfactory
Mar 2008	101	0.92	0.95	0.2	Satisfactory
		1.86	1.85	0	Satisfactory
Jul 2008	102	1.37	1.42	0.3	Satisfactory
		2.28	2.21	-0.2	Satisfactory
Jan 2009	104	2.02	1.85	-0.7	Satisfactory
		1.22	1.21	-0.1	Satisfactory

Annual Field Intercomparison

Each participating laboratory is asked to provide a number (typically 3) diffusion tubes for exposure, plus one travel blank. The tubes are exposed at a suitable location for a period of around one month, before being returned to the laboratories for analysis. The exposure site will be co-located with a chemiluminescent analyser. Laboratories are expected to perform within 20% of the reference concentration (usually that obtained by the chemiluminescent analyser).

The 2008 Gradko results of AEA Energy & Environment Intercomparison NO_2 diffusion tube network exercise are given in Table B-2 below. The results show that both precision and accuracy were good for this laboratory.

Table B-2 2008 Gradko / AEA Energy & Environment Intercomparison NO_2 diffusion tube network

All data supplied by Gradko International

Checking Precision and Accuracy of Triplicate Tubes

Diffusion Tubes Measurements									
Period	Start Date dd/mm/yyyy	End Date dd/mm/yyyy	Tube 1 µgm^{-3}	Tube 2 µgm^{-3}	Tube 3 µgm^{-3}	Triplicate Mean	Standard Deviation	Coefficient of Variation (CV)	95% CI of mean
1	03/01/08	30/01/08	146.8	145.9	149.9	148	2.1	1	5.2
2	30/01/08	27/02/08	120.2	116.2	121.0	119	2.6	2	6.3
3	27/02/08	02/04/08	114.4	114.0	115.8	115	0.9	1	2.3
4	02/04/08	30/04/08	121.4	119.0	121.9	121	1.5	1	3.8
5	30/04/08	29/05/08	119.7	116.4	113.2	116	3.3	3	8.1
6	29/05/08	03/07/08	89.9	106.0	113.6	103	12.1	12	30.1
7	03/07/08	01/08/08	123.6	137.9	116.9	126	10.8	9	26.7
8	01/08/08	03/09/08	136.5	133.5	132.1	134	2.2	2	5.6
9	03/09/08	01/10/08	91.4	90.2	99.8	94	5.3	6	13.1
10	01/10/08	29/10/08	114.2	132.5	110.3	119	11.8	10	29.4
11	29/10/08	03/12/08	105.0	107.6	103.7	105	2.0	2	4.9
12	03/12/08	07/01/09	106.2	107.0	103.5	106	1.9	2	4.6
13									

It is necessary to have results for at least two tubes in order to calculate the precision of the measurements

Automatic Method	
Period Mean	Data Capture (% DC)
130	99.4
138	98.7
117	99.2
120	99.4
100	95
106	99.6
126	99.4
128	98.4
108	99.4
138	99
90	99.2
88	99.5

Data Quality Check	
Tubes Precision Check	Monitor Data Capture
Good	Good
Good	Good
Good	Good
Good	Good
Good	Good
Good	Good
Good	Good
Good	Good
Good	Good
Good	Good
Good	Good
Good	Good
0	Good Overall DC

(Check average CV & DC from Accuracy calculations)

Site Name/ ID:	Gradko 20% TEA/water - F.I. 2008

Precision	12 out of 12 periods have a CV smaller than 20%

Accuracy (with 95%	
without periods with CV larger than 20%	
Bias calculated using 12 periods of data	
Bias factor A	0.99 (0.92 - 1.07)
Bias B	1% (-7% - 9%)
Diffusion Tu	117 µgm^{-3}
Mean CV (Pr	4
Automatic M	116 µgm^{-3}
Data Ca	99%
Adjusted Tu	116 (108 - 125) µgm^{-3}

Accuracy (with 95% confidence interval)	
WITH ALL DATA	
Bias calculated using 12 periods of data	
Bias factor A	0.99 (0.92 - 1.07)
Bias B	1% (-7% - 9%)
Diffusion Tub	117 µgm^{-3}
Mean CV (Pre	4
Automatic Me	116 µgm^{-3}
Data Cap	99%
Adjusted Tub	116 (108 - 125) µgm^{-3}

Without CV>2C	With all data
2%	2%
7.9%	7.9%

Jaume Targa
jaume.targa@
Version 03 - N