2014 Air Quality Progress Report for Nottingham City Council

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

Date July 2014

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Executive Summary

The Progress Report 2014 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 air quality objectives applicable to the Local Air Quality Management (LAQM) 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 report gives information about 2013 annual monitoring results and about new local developments that may impact on air quality. An update on the air quality aspects of the Local Transport Plans along with the implementation of the associated action plans has also been included.

During 2013 pollutant levels were measured, using automatic (continuous) and non-automatic monitoring, at a number of sites within the Nottingham City area.

The monitoring results show that none of the air quality objectives for PM_{10}, sulphur dioxide, carbon monoxide and benzene were exceeded. The 1-hour objective for nitrogen dioxide was not exceeded.

The annual mean air quality objective for nitrogen dioxide is 40 $\mu g/m^3$; levels in excess of this were measured at 2 of the 3 roadside automatic monitoring sites and at a number of nitrogen dioxide diffusion tube sites.

The report concludes that, as a consequence of the 2013 monitoring results, the Detailed Assessment 2013, and whilst awaiting completion of the two tram route extensions and ring road improvements (expected 2015) it is necessary to continue monitoring in three additional locations to gather sufficient monitoring data to inform the next stage of the LAQM process.

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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 300,800. It comprises a retail/service sector centre, urban residential, suburban residential, commercial and industrial areas, an area of large suburban parkland, and a number of smaller parks and recreational areas. The city also has two universities with over 55,000 students.

Nottingham is a major centre of commerce in the East Midlands, this together with the A453, A610, A60 and A52 road links to Greater Nottingham's suburban districts and the M1 and A1 results in large numbers of vehicles 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.

1.2 Purpose of Progress Report

Progress Reports are required in the intervening years between Updating and Screening Assessment and/or Detailed Assessment reports. Their purpose is to maintain continuity in the Local Air Quality Management (LAQM) process.

They are not intended to be as detailed as Updating and Screening Assessment Reports, or to require as much effort. However, if the Progress Report identifies a risk of not meeting an Air Quality Objective, the Local Authority (LA) should undertake a Detailed Assessment immediately, and not wait until the next round of Review and Assessment.

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.

Table 1.1 Air Quality Objectives included in Regulations for the purpose of LAQM in England

Pollutant	Air Quality Objective		Date to be achieved by
	Concentration	Measured as	
Benzene	16.25 µg/m^3	Running annual mean	31.12.2003
	5.00 µg/m^3	Annual mean	31.12.2010
1,3-Butadiene	2.25 µg/m^3	Running annual mean	31.12.2003
Carbon monoxide	10 mg/m^3	Running 8-hour mean	31.12.2003
Lead	0.50 µg/m^3	Annual mean	31.12.2004
	0.25 µg/m^3	Annual mean	31.12.2008
Nitrogen dioxide	200 µg/m^3 not to be exceeded more than 18 times a year	1-hour mean	31.12.2005
	40 µg/m^3	Annual mean	31.12.2005
Particulate Matter (PM_{10}) (gravimetric)	50 µg/m^3, not to be exceeded more than 35 times a year	24-hour mean	31.12.2004
	40 µg/m^3	Annual mean	31.12.2004
Sulphur dioxide	350 µg/m^3, not to be exceeded more than 24 times a year	1-hour mean	31.12.2004
	125 µg/m^3, not to be exceeded more than 3 times a year	24-hour mean	31.12.2004
	266 µg/m^3, not to be exceeded more than 35 times a year	15-minute mean	31.12.2005

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. All reports are available on Nottingham City Council's internet site.

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	Concluded a third stage assessment for sulphur dioxide, nitrogen dioxide and particles PM_{10} was 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 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.	

Title	Date	Outcome	AQMA Declared/ Revoked? (Date of AQMA Order/s)
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.	
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 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 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 to be undertaken following comment and assessment by Defra.** Conclusion that no further action required for PM_{10} accepted by Defra.	
Nottingham City Local Air Quality Management Progress Report	July 2008	Confirmed findings of Detailed Assessment 2008 and need to vary extent of the AQMAs.	

Title	Date	Outcome	**AQMA Declared/ Revoked?** (Date of AQMA Order/s)
2009 Air Quality Updating and Screening Assessment for Nottingham City Council	April 2009	Concluded that there was no need to undertake an additional detailed assessment because all areas of potential exceedence are being considered in the revised DA May 2008 - accepted by Defra	
Nottingham City Council Local Air Quality Management Detailed Assessment 2008 Annex 1 - Supplementary Information for Nitrogen Dioxide	October 2009	Confirmed the DA May 2008 findings - **need for amended AQMAs for annual mean NO_2.** Accepted by Defra on 31 December 2009.	
Nottingham City Council Local Air Quality Management Detailed Assessment 2009	January 2010	For clarification this is a consolidated report of DA May 2008 PM_{10} findings and DA 2008 Annex 1 NO_2 findings	**Declared/ amended** AQMA No:2 2010 (nitrogen dioxide) AQMA No:3 2010 (nitrogen dioxide) BY AQMA Variation Orders dated 22 June 2010
2010 Air Quality Progress Report for Nottingham City Council	October 2010	Concluded that there was no need to undertake a Detailed Assessment for any of the regulated pollutants - accepted by Defra	
2011 Air Quality Progress Report for Nottingham City Council	July 2011	Concluded that it was necessary to undertake a Detailed Assessment for annual mean nitrogen dioxide at two diffusion tube sites outside the existing AQMAs - accepted by Defra	
Air Quality Management	January 2012	Confirmed decision to alter the AQMA boundaries was correct. Concluded that it was necessary to broaden the scope	

Title	Date	Outcome	AQMA Declared/ Revoked? (Date of AQMA Order/s)
Areas 2010 - Further Assessment Report		of the DA being undertaken as a result of the 2011 PR findings. Report accepted by Defra	
2012 Air Quality Updating and Screening Assessment for Nottingham City Council	July 2012	Confirmed PR 2011 findings that it is necessary to undertake a Detailed Assessment for annual mean nitrogen dioxide air quality objectives outside the existing AQMAs – accepted by Defra	
2013 Progress Report for Nottingham City Council	August 2013		
2013 Detailed Assessment for Nottingham City Council	November 2013	Undertaken as a consequence of measured exceedance of annual nitrogen dioxide concentrations outside AQMAs. Results have been reported in PR 2011 and USA 2012 and the need for a Detailed Assessment confirmed by Defra.	
2014 Progress Report for Nottingham City Council	August 2014		

AQMA = Air Quality Management Area

AQO = Air Quality Objective

DA = Detailed Assessment Report

NO_2 = nitrogen dioxide

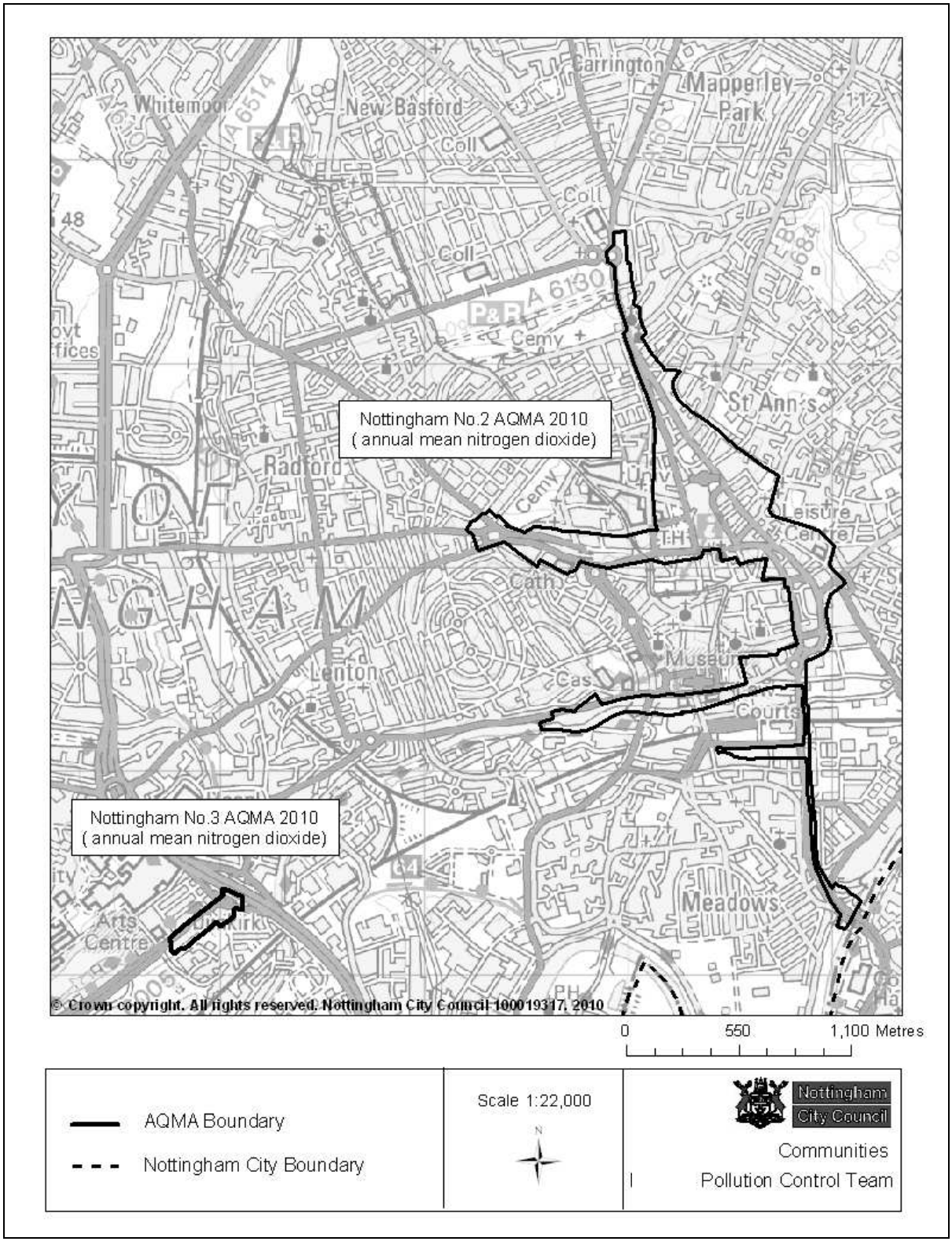
SO_2 = sulphur dioxide

PM_{10} = particles

PR = Progress Report

USA = Updating and Screening Assessment Report

Figure 1.1 Map of Air Quality Management Areas



2 New Monitoring Data

2.1 Summary of Monitoring Undertaken

2.1.1 Automatic Monitoring Sites

Nottingham City Council undertakes continuous automatic monitoring at a number of locations in its area and Defra have an Automatic Urban and Rural Network (AURN) site in the city centre. Figure 2.1 is a map showing the locations of the continuous monitoring sites.

AURN, Clinton Street East, City Centre

The AURN station is located in the city centre and classified as an 'Urban Background' (previously 'Urban Centre') site. Relevant exposure is at residential properties approximately 40 metres to the south and approximately 23 metres to the north east of the site.

Carter Gate NOx (CG NOx), Carter Gate, City Centre

This unit has been located at Carter Gate monitoring 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 which is a major traffic route and, approximately 3 metres from a busy B road. It is classed as a 'Roadside' site. There are residential properties approximately 12 metres from the unit and 8 metres away from the A60.

Lace Street NOx (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 and in-line with the facade building line.

St Andrews Road NOx (SA NOx), Off Mansfield Road, City Centre

This site was established in June 2010 following the expansion of Nottingham City Council's Air Quality Management Area No.2. The monitoring unit is located on a small residential street - St Andrews Road, approximately 13 metres from the A60 Mansfield Road. The A60 is a major traffic route through the City, and south across the River Trent.

The SA NOx is a fixed unit sited on the pavement at the boundary of a residential property. It is classed as a 'Roadside' site.

No new automatic monitoring sites have been initiated and there have been no site closures. A new DEFRA funded roadside monitoring site for the outer ring road is planned for installation and commissioning towards the end of 2014.
Details of the automatic monitoring sites e.g. location, sample inlet height etc. are given in Table 2.1.

Details of quality assurance and quality control (QA/QC) for the automatic monitoring sites are detailed in previous reports (see NCCDA2013 Appendix B).

Figure 2.1 Map showing Automatic Monitoring Sites and AQMAs

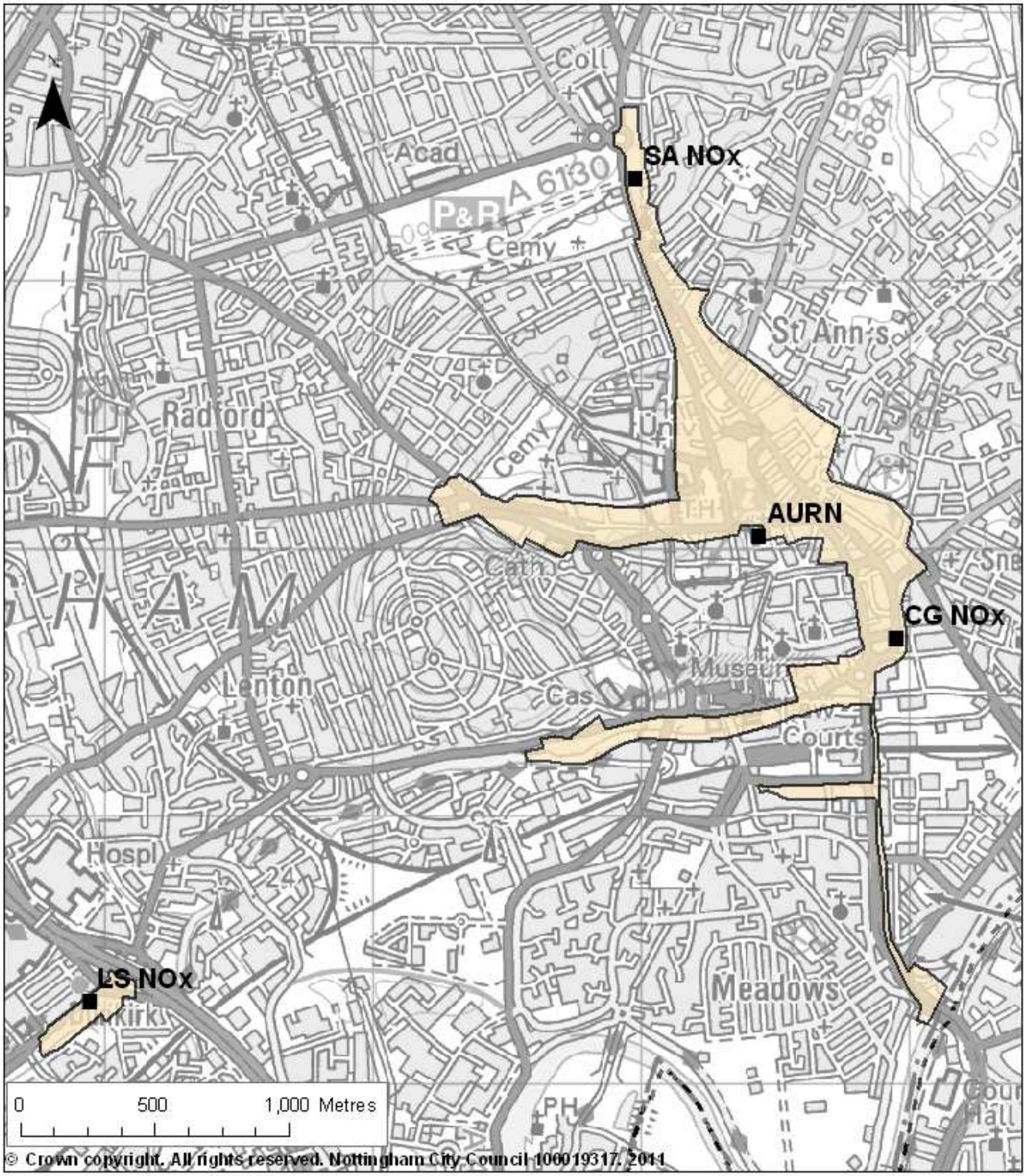


Table 2.1 Details of Automatic Monitoring Sites

Site Name & Location	Site Type	Inlet height	OS Grid Ref		Pollutants Monitored	Monitoring Technique	In AQMA?	Relevant Exposure? (Y/N with distance (m) to relevant exposure)	Distance to kerb of nearest road	Does this location represent worst-case exposure?
AURN Clinton St East.	Urban Background	3m	457437	340049	$PM_{2.5}$	FDMS	N	Y (0m)	35m	N
					PM_{10}	FDMS				
					NO_2 NO NOx	Chemi-luminescence				
					O_3	Ultra Violet Absorption (UVA)				
					SO_2	Ultra Violet Fluorescence (UVF)				
CG NOx Carter Gate	Roadside	2.5m	457946	339668	NO_2 NO NOx	Chemi-luminescence	Y	Y (12m)	4m	Y
LS NOx Lace St.	Roadside	1.5m	454941	338315	NO_2 NO NOx	Chemi-luminescence	Y	Y (0m)	9m (main rd.) 1m (minor rd.)	Y
SA NOx St Andrews Rd	Roadside	1.7m	456967	341382	NO_2 NO NOx	Chemi-luminescence	Y	Y (0m)	13m (main rd.) 2m (minor rd.)	Y

2.1.2 Non-Automatic Monitoring Sites

Nitrogen Dioxide (NO_2) Diffusion Tube Monitoring

Nottingham City has diffusion tubes sited at a number of locations and are shown on the map - Figure 2.2. During 2013 diffusion tubes were placed within and near AQMAs No.2 and 3 and in other areas where there may be 'hot spots' due to road and/or traffic changes. They were also co-located in triplicate with continuous monitors at the CG NOx, LS NOx and SA NOx sites. At the start of 2014 some tubes were relocated to locations identified in the Detailed Assessment 2013 where modelling predicted the annual mean Air Quality Objective may be exceeded.

The diffusion tubes were placed on building façades of residential properties at sites classified as 'roadside'. Table 2.2 gives details e.g. location, sample inlet height etc of non-automatic monitoring sites.

The tubes are exposed for a month before being sent for laboratory analysis by Gradko International, Hampshire. The laboratory is United Kingdom Accreditation Service (UKAS) accredited; is assessed annually for compliance to ISO 17025 and participates in a number of proficiency schemes.

See Appendix A for details of:

- the tube type and the laboratory that supplies and analyses the tubes
- diffusion tube QA/QC and the bias adjustment factor that has been applied to the annual mean NO_2 diffusion tube data.
- Nottingham City Council's diffusion tube and continuous monitoring 2013 co-location study including comparison with the reference method.

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 ESG, Bretby for analysis.

The equipment is audited twice a year by AEA, Oxfordshire. The sample flow is calibrated and adjusted as required; the system is leak checked and preventative maintenance performed.

The geographical location of the AURN site is shown on Page 15 Figure 2.1.

Figure 2.2 Map Showing Diffusion Tube Monitoring Sites

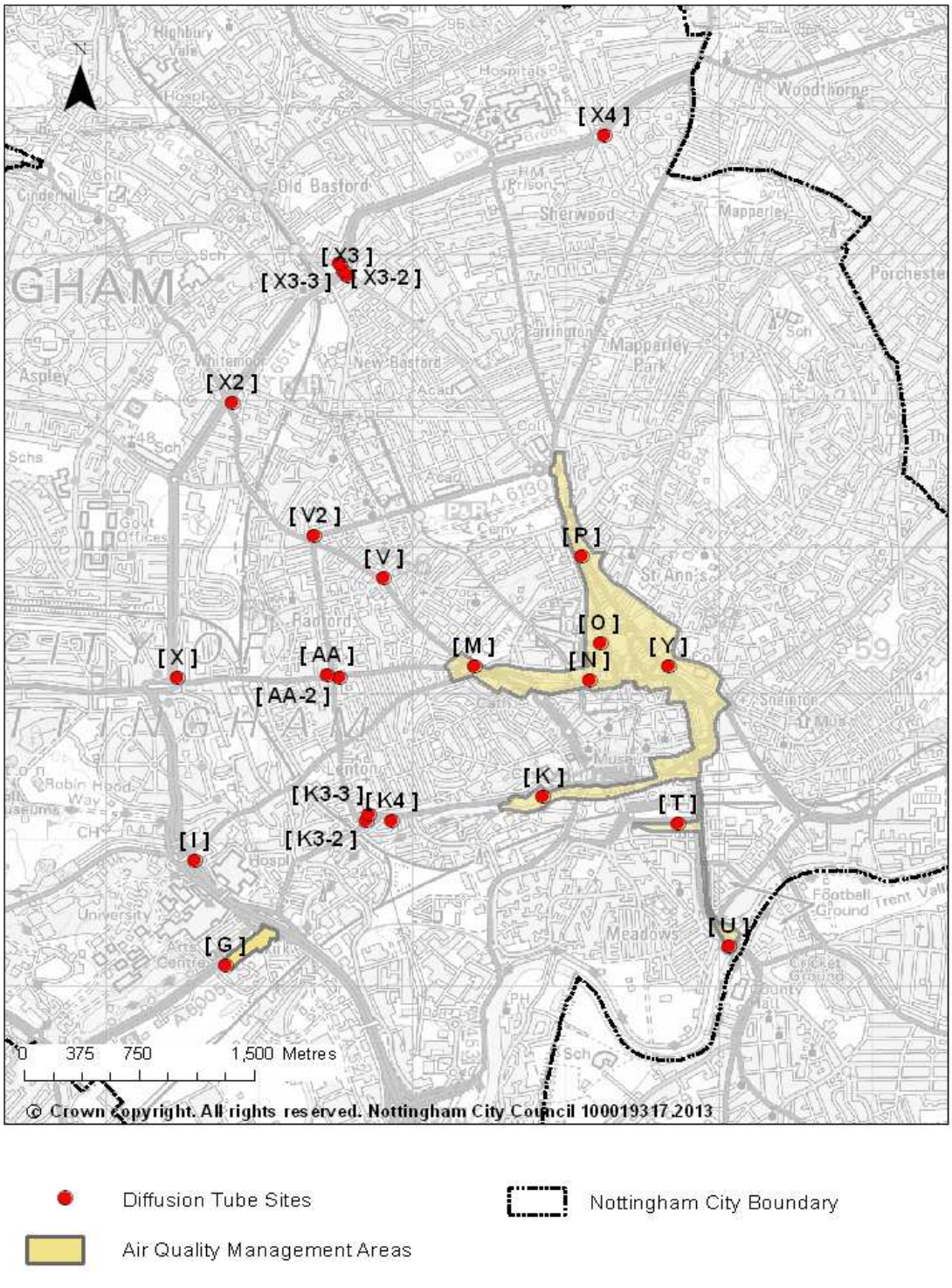


Table 2.2 Details of Non-Automatic Monitoring Sites

Site Id & Street		Site Type	OS Grid Ref		Site Height (m)	Pollutant Monitored	In AQMA ?	Relevant Exposure? Y/N (distance (m) to relevant exposure)	Distance to kerb of nearest road (m)	Worst-case Location?
G	Beeston Rd	R	454782	338146	1.5	NO_2	Y	Y (0m)	9	Y
I	Derby Rd	Su	454577	338860	1.5	NO_2	N	Y (0m)	25	Y
X	Western Blvd	R	454466	340111	1.5	NO_2	N	Y (0m)	16	Y
X2	Wilkinson St	R	455823	341993	2	NO_2	N	Y (0m)	18	Y
X3	Nottingham Rd (1) 413	R	455573	342860	2	NO_2	N	Y (0m)	8	Y
X3-2	Nottingham Rd (2) 419	R	455543	342894	1.5	NO_2	N	Y (0m)	7	Y
X3-3	Highland Crt	R	455521	342944	2.3	NO_2	N	Y (0m)	4	Y
X4	Danethorpe Vale	R	457250	343815	1.7	NO_2	N	Y (0m)	15	Y
AA	Ilkeston Rd	R	455446	340132	3	NO_2	N	Y (0m)	3	Y
AA-2	Rayner Crt	R	455519	340114	3	NO_2	N	Y (0m)	3	Y
V	Bentinck Rd	R	455808	340799	1.9	NO_2	N	Y (0m)	6	Y
V2	Gregory Blvd	R	455358	341086	3	NO_2	N	Y (0m)	10	Y
K4	Castle Gardens	R	455870	339133	2.5	NO_2	N	Y (0m)	3	Y
K3-2	Castle Blvd (2) 309	R	455693	339137	3	NO_2	N	Y (0m)	4	Y
K3-3	Sherwin Rd	R	45511	339181	1.5	NO_2	N	Y (0m)	5	Y
K	Castle Boulevard (1) 87	R	456852	339303	2.5	NO_2	Y	Y (0m)	4	Y
M	Canning Terrace	R	456399	340191	2.5	NO_2	Y	Y (0m)	4	Y
N	Upp. Parliament. St	R	457154	340095	2.5	NO_2	Y	Y (0m)	4	Y
O	Shakespeare St	R	457221	340351	2.5	NO_2	Y	Y (0m)	2	Y
P	Mansfield Road	R	457103	340944	2.5	NO_2	Y	Y (0m)	4	Y
Y	Beck Street	R	457673	340194	2.5	NO_2	Y	Y (0m)	3	Y
U(U2)	Trent Bridge PH	R	458051	338328	2.5	NO_2	Y	Y (0m)	5	Y
T	Queens Road	R	457729	339122	2.5	NO_2	Y	Y (0m)	2	Y

Site	Site Type	OS Grid Ref		Site Height (m)	Pollutant Monitored	In AQMA?	Relevant Exposure? Y/N (distance (m) to relevant exposure)	Distance to kerb of nearest road	Worst-case Location?
AURN Clinton St East.	UB	457437	340049	3	Benzene	N	N/A	35m	N

R = Roadside UB = Urban Background

Pollutant monitored - NO_2 by passive diffusion tube, benzene by pumped diffusion tube

Throughout 2013 NO_2 diffusion tubes were located in triplicate at the CG NOx, LS NOx and SA NOx continuous monitoring sites – Table 2.1 above gives the sites' details. The resultant concentrations have been used to determine the bias adjustment factor – see appendix A for further information.

2.2 Comparison of Monitoring Results with Air Quality Objectives

Nottingham City Council's 2013 automatic (continuous) and non-automatic monitoring data are given in subsections 2.2.1 to 2.2.4. Comparison with Air Quality Objectives (AQOs) has been made and where a relevant AQO has been exceeded the figure is highlighted in bold type.

2.2.1 Nitrogen Dioxide, NO_2

Information is shown for both continuous and diffusion tube 2013 nitrogen dioxide monitoring results. Exceedences of the NO_2 annual mean AQO (i.e. greater than 40μg/m^{-3}) were measured at two of the three roadside automatic sites and nine diffusion tube sites, two of which are not in the existing AQMAs.

The results also show that the 1-hour AQO was not exceeded at any site as no 1-hour means above 200μg/m^3 were recorded at the continuous sites, and there were no diffusion tube concentrations greater than 60μg/m^3.

Automatic Monitoring Data

CG NOx and SA NOx sites are located in the Nottingham No.2 AQMA 2010 whilst LS NOx is within the Nottingham No.3 AQMA 2010. These three continuous monitoring stations are close to residential properties and were all initiated as a result of previous rounds of Review & Assessment.

In 2013 the nitrogen dioxide annual mean AQO concentration of 40 μg/m^3 was met at the LS NOx site, and exceeded at the CG NOx and SA NOx roadside sites - see Table 2.3.

Table 2.3 Results of 2013 Automatic Monitoring for NO_2: Comparison with Annual Mean Objective

Site ID	Site Type	Within AQMA?	Data Capture %	Annual Mean Concentration (µg/m^3)
AURN	UB	N	96.6	37.1
CG NOx	R	Y	97.8	**44.0**
LS NOx	R	Y	89	38.2
SA NOx	R	Y	92	**42.7**

1 January 2013 – 31 December 2013 ratified data

R = Roadside UB = Urban Background

Automatic Monitoring Nitrogen Dioxide Trend Data

The trends in annual mean nitrogen dioxide levels for those automatic sites with more than 5 or more years of data, i.e. AURN, CG NOx and LS NOx, are shown in Figures 2.3 A – D.

Figure 2.3 A shows that at the AURN the overall trend has been a decrease in annual mean NO_2 concentrations over the 13 years that it has been operational. However on closer examination the graph shows that after the most noticeable decrease between 1998 and 2000, NO_2 levels were relatively steady between 2001 and 2009 with minor year on year variations with concentrations no greater than 36µg/m^3.

While the 2010 value represents a significant increase in the annual mean concentration (possibly attributable to the extreme meteorological conditions that occurred in the last few months of 2010); since 2009 the general trend is upward and increasing NO_2 concentrations.

Figure 2.3A

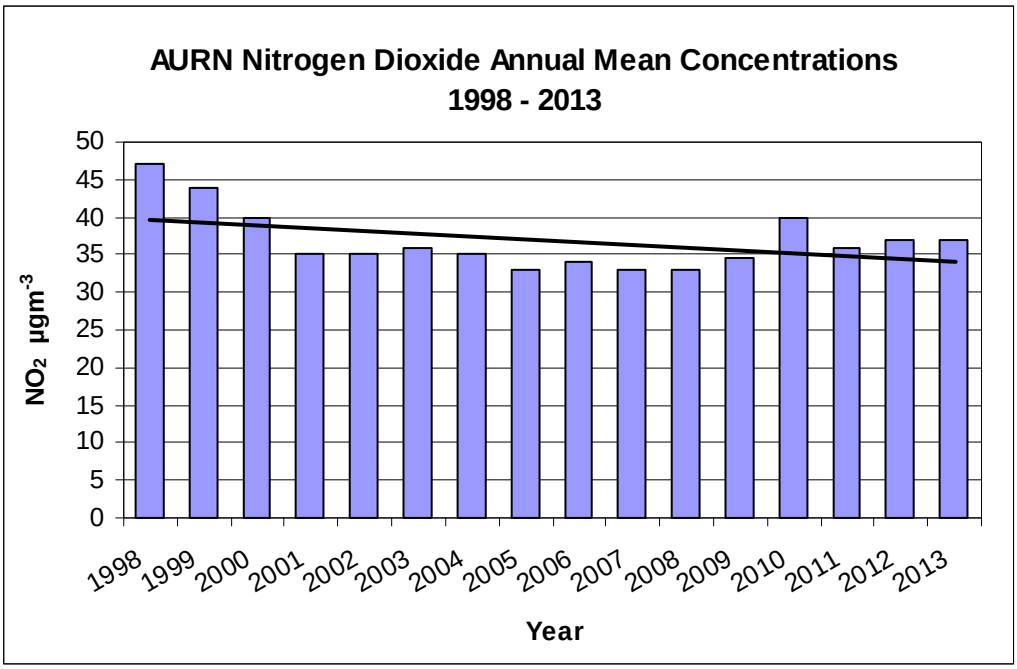


Figure 2.3 B shows that at the CG NOx roadside site the overall trend is increasing annual mean nitrogen dioxide concentrations that slightly exceed the annual mean NO_2 AQO. There is little year on year change for 2010 to 2013.

Figure 2.3 B

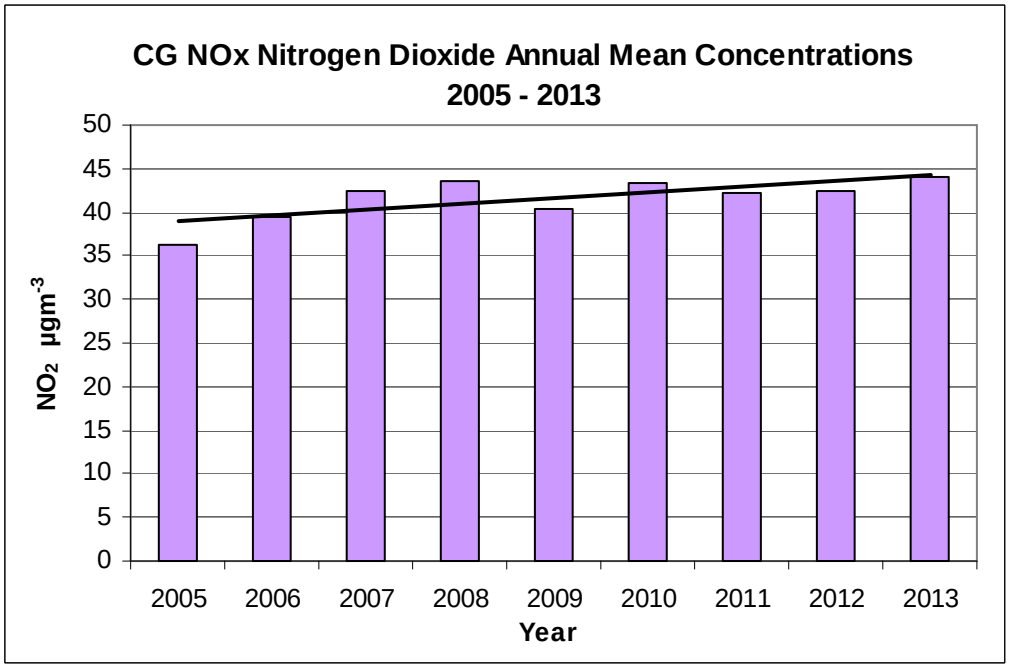


Figure 2.3 C shows that at the LS NOx roadside site in contrast to the AURN and CG NOx the overall trend is slightly decreasing annual mean nitrogen dioxide concentrations that vary between just exceeding and being just below the annual mean NO_2 AQO.

Figure 2.3 C

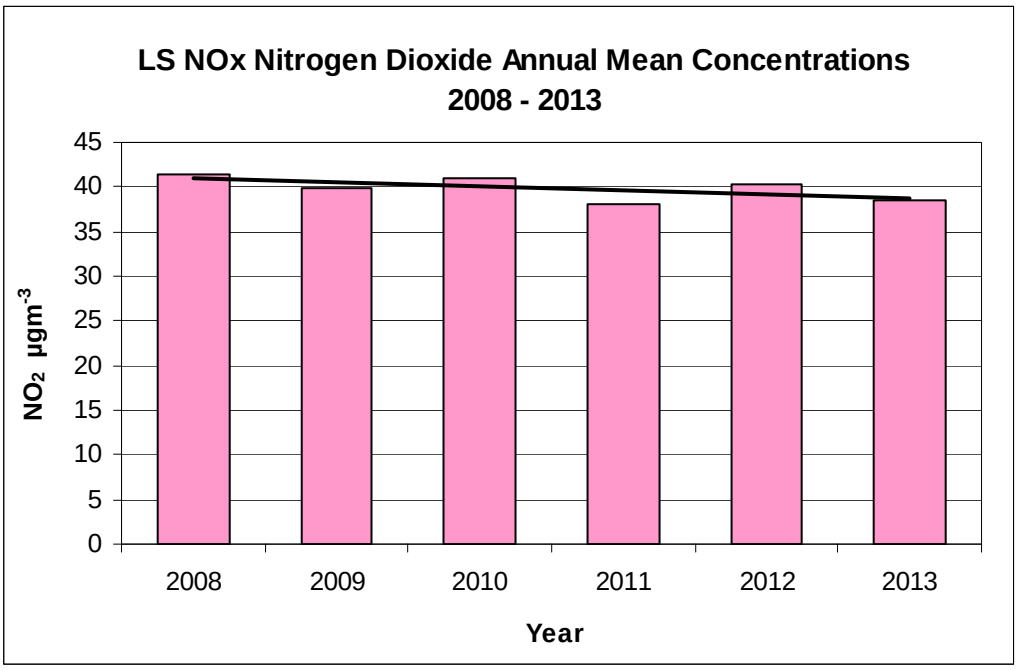


Figure 2.3 D

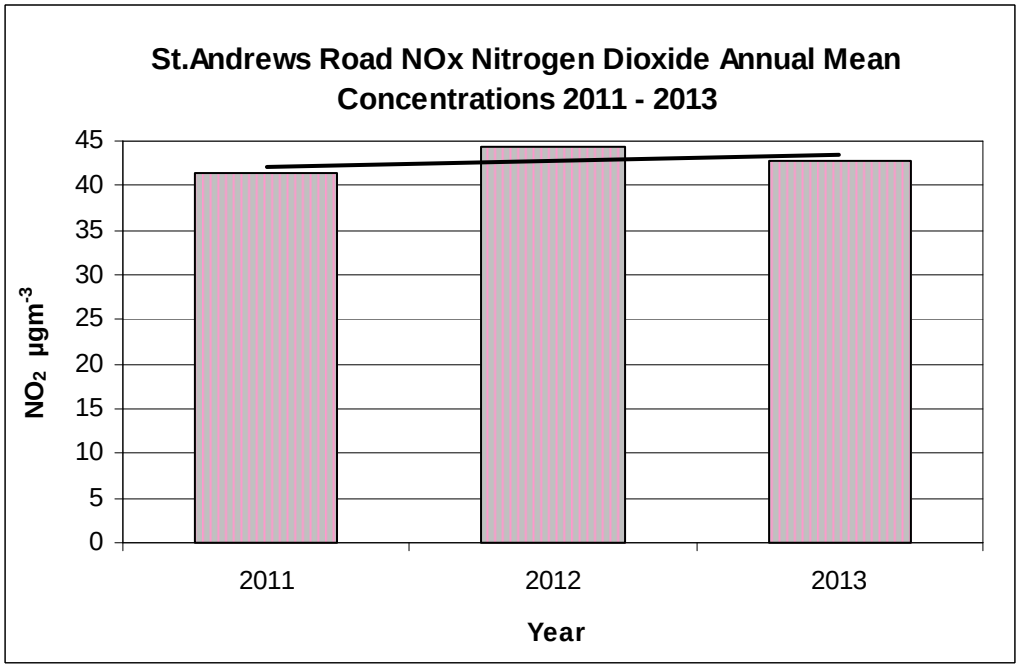


Table 2.4 Results of Automatic Monitoring for NO_2: Comparison with 1-hour Mean Objective

Site ID	Site Type	Within AQMA?	Data Capture %	Number of Hourly Means > 200µg/m^3
AURN	UB	N	96.6	0
CG NOx	R	Y	97.8	0
LS NOx	R	Y	89.0	0
SA NOx	R	Y	92.1	0

No exceedences of the 1-hour AQO were recorded in 2013 at any of Nottingham City's automatic monitoring sites.

Diffusion Tube Monitoring Data

The annual mean NO_2 AQO was exceeded at 9 diffusion tube sites. The data is shown in Table 2.5 and exceedences of the AQO are highlighted in bold type. The 2 rows that are shaded i.e. AA and K4 highlight sites where exceedences of the AQO were measured and which are not within AQMAs.

Table 2.5 Results of 2013 NO_2 Diffusion Tubes

Site ID		Site Type	Within AQMA 2010?	Data Capture 2013 %	2013 Annual mean NO_2 concentration - Bias Adjusted (Bias adjustment factor =0.95) ($\mu g/m^3$)
G	Beeston Road	R	Y	100	40
I	Derby Road	Su	N	100	33
X	Western Boulevard	R	N	100	33
X2	Wilkinson Street	R	N	100	32
X3	Nottingham Road (1)	R	N	100	37
X3-2	Nottingham Road (2)	R	N	100	36
X3-3	Highland Court	R	N	100	35
X4	Danethorpe Vale	R	N	92	30
AA	Ilkeston Road	R	N	100	**44**
AA-2	Rayner Court	R	N	100	31
V	Bentinck Road	R	N	92	38
V2	Gregory Boulevard	R	N	92	32
K4	Castle Gardens	R	N	100	**49**
K3-2	Castle Boulevard (2)	R	N	92	28
K3-3	Sherwin Road	R	N	92	31
K	Castle Boulevard (1)	R	Y	92	40
M	Canning Terrace	R	Y	100	**53**
N	Upper Parliament St	R	Y	100	**53**
O	Shakespeare St	R	Y	100	**45**
P	Mansfield Road	R	Y	92	**51**
Y	Bloomsbury Court	R	Y	100	**43**
U(U2)	Trent Bridge PH	R	Y	92	**42**
T	Queens Rd	R	Y	100	**49**

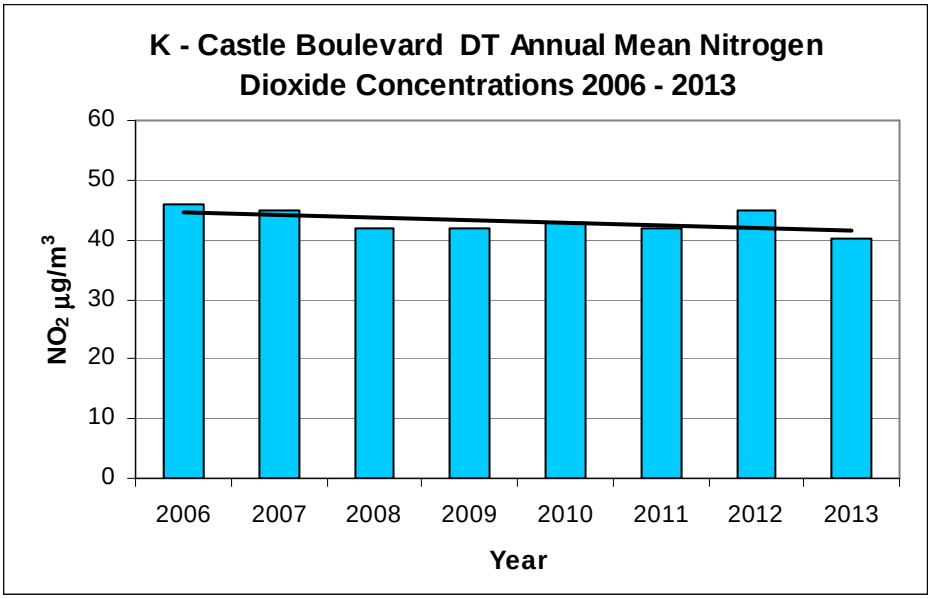
R =Roadside Su=Suburban

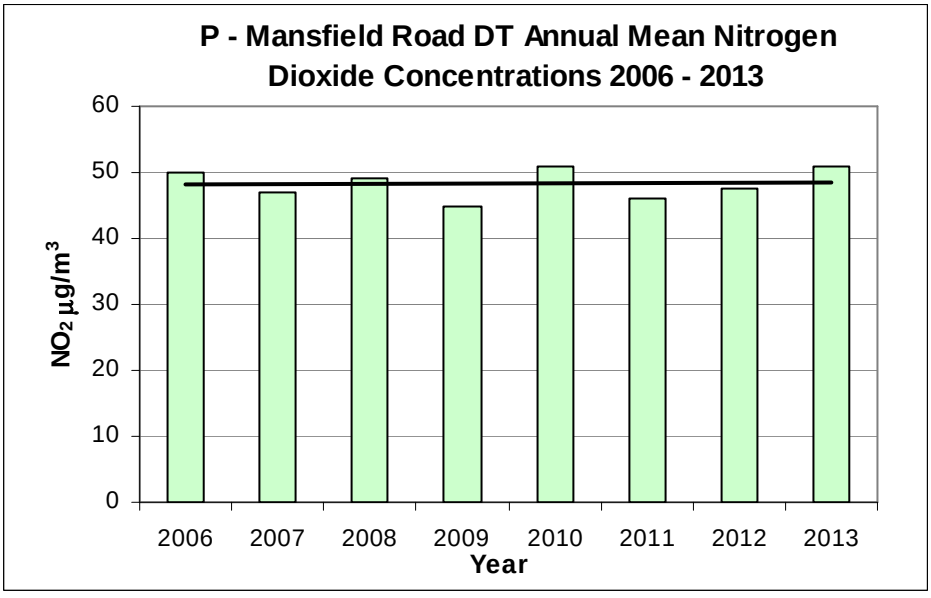
Diffusion Tube Nitrogen Dioxide Trend Data

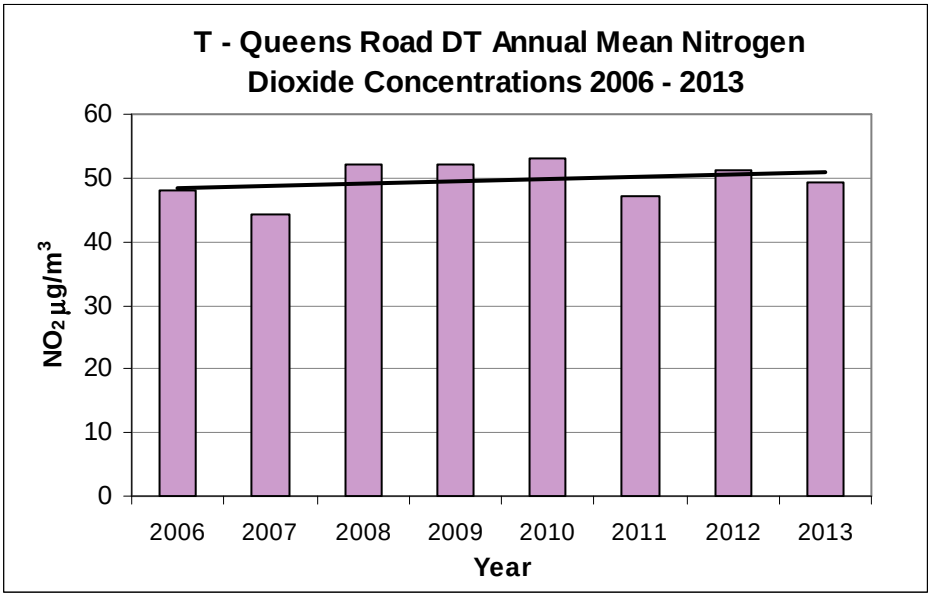
Figure 2.4 shows trends at 3 diffusion tube sites where measurements have been made for at least five years - all are within the AQMAs and all consistently measure exceedences of the NO_2 annual mean AQO.

While there are differences in the trends at the individual sites it is evident that generally NO_2 concentrations are relatively steady throughout the 8 years' data shown. At sites P and K there have not been any significant changes in measured levels whilst at Queens Rd (T) concentrations have increased slightly since 2006.

Figure 2.4







2.2.2 Particulate Matter (PM_{10})

The AURN station is the only site at which PM_{10} is measured in Nottingham City Council's area.

Table 2.6 Results of PM_{10} Automatic Monitoring

PM_{10} TEOM FDMS monitoring commenced in 2009. The 2013 results are given in the table.

Site ID		Within AQMA?	Data Capture for full calendar year 2013 %	Annual mean concentration (µg/m³) PM_{10} TEOM FDMS 2013	Number of times the daily mean >= 54 µg/m³ (i.e. AQ Index = High or very high) 2013
AURN	Urban Background	N	94.3%	21.1	10

12 months data 01/01/2013 to 31/12/2013 ratified data

The PM10 trend data is shown in Figure 2.5 below.

Figure 2.5 PM_{10} Trend Data

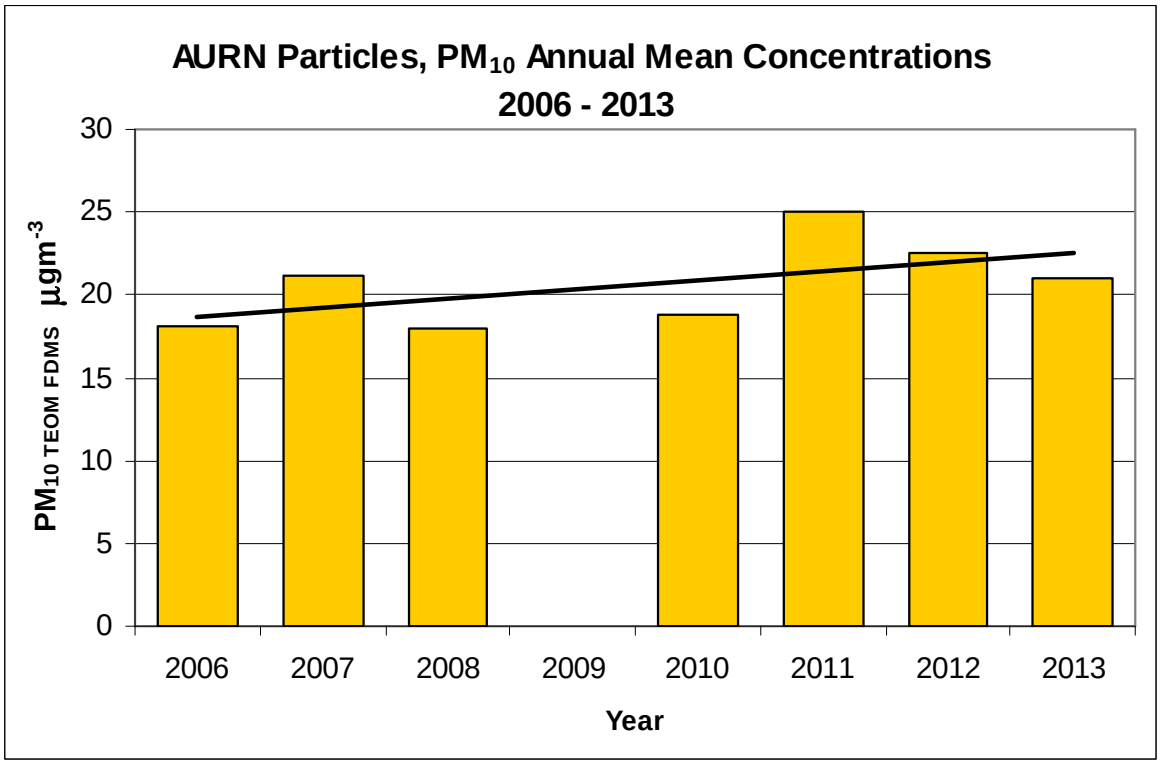


Table 2.7 Results of $PM_{2.5}$ Automatic Monitoring

$PM_{2.5}$ monitoring at AURN was initiated in 2009 and the 2013 results are given in the table - currently there are no LAQM AQOs for this pollutant.

Site ID		Within AQMA	Data Capture for full calendar year 2013 %	Annual mean concentration (µg/m^3) $PM_{2.5\ TEOM\ FDMS}$ 2013	Number of times the daily mean >= 54 µg/m^3 (i.e. AQ Index = High or very high) 2013
AURN	Urban Background	N	97.9%	12.2	4

12 months data 01/01/2013 to 31/12/2013 ratified data

2.2.3 Sulphur Dioxide (SO_2)

Sulphur dioxide was monitored at the AURN during 2013. No exceedences of any of the objectives were recorded and levels were low.

Table 2.8 Results of SO_2 Automatic Monitoring: Comparison with Objectives

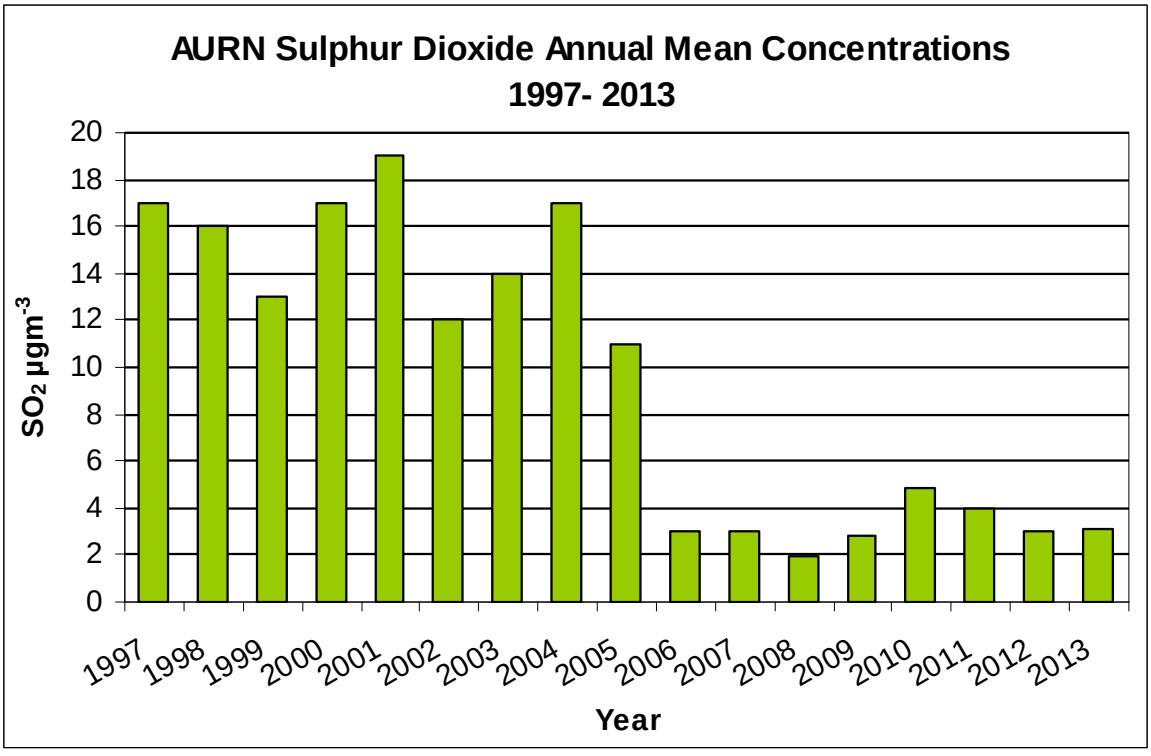
Site ID	Location	Within AQMA	Data Capture 2013 %	Number of Exceedences of:		
				15-minute Objective (266 µg/m^3)	1-hour Objective (350 µg/m^3)	24-hour Objective (125 µg/m^3)
AURN	Clinton Street E	N	93.3	0	0	0

12 months ratified data 1 January 2013 – 31 December 2013

Sulphur Dioxide Trend Data

Figure 2.6 shows the trend for annual mean sulphur dioxide concentrations (there is no relevant AQO for this).

Figure 2.6



2.2.4 Benzene

The benzene annual mean AQO is 5µg/m^3 and as can be observed from the results given in Table 2.8 the 2013 annual mean benzene concentration was low and the objective was not exceeded.

Table 2.9 Results of Benzene Pumped Tube Monitoring: Annual Mean

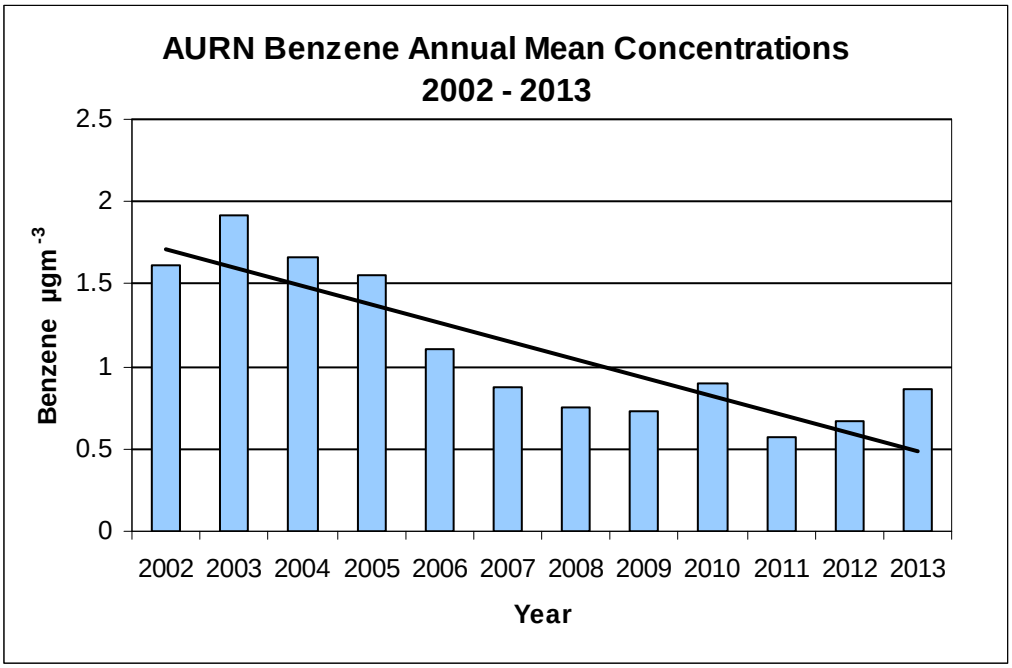
Site ID	Location	Within AQMA?	Data Capture 2013 %	2013 Annual mean concentration Benzene (µg/m^3)
AURN	Clinton Street East	N	96.1	0.85

12 months ratified data – 01/01/2013 to 31/12/2013

Benzene Trend Data

Figure 2.7 shows that there is a general downward trend in measured levels of benzene at this site but that there was an increase in 2010 and 2013. Whilst concentrations have been low throughout there is a noticeable reduction that is evident from 2006 onwards. This coincided with the implementation of the Turning Point North traffic management scheme.

Figure 2.7

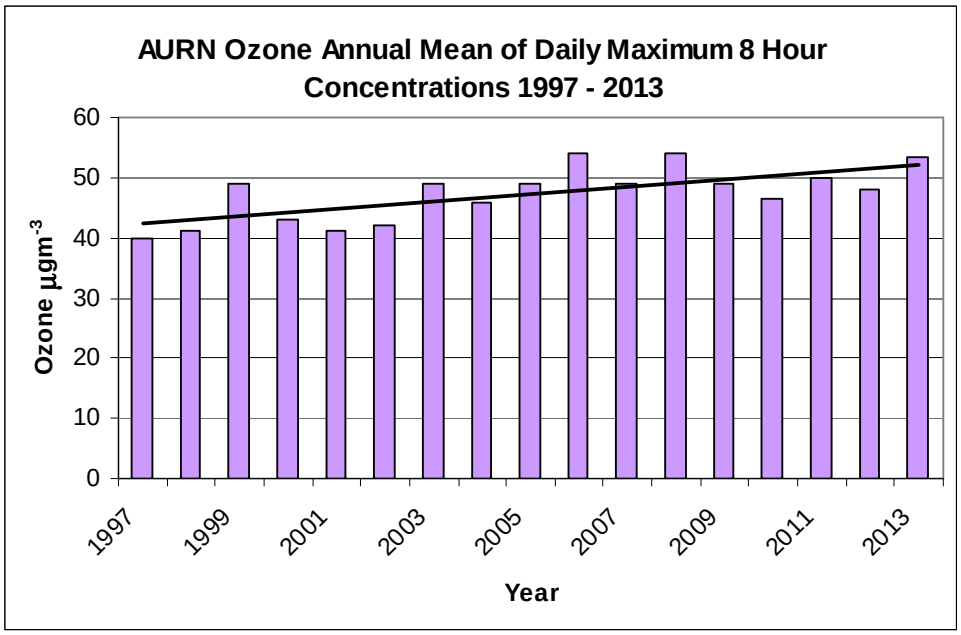


2.2.5 Other Pollutants Monitored

Ozone

Ozone has been monitored at the AURN since 1997. The trend for the daily maximum 8 hour yearly data at this site is shown in Figure 2.8. The general trend shows increasing ozone levels between 1997 and 2013, but with significant annual variation.

Figure 2.8



2.2.6 Summary of Compliance with AQS Objectives

Nottingham City Council has measured concentrations of nitrogen dioxide above the annual mean objective, at relevant locations outside of the AQMAs, in the years 2010, 2011, 2012 and 2013.

Additional monitoring is being undertaken in the three locations where the Detailed Assessment (2013) predicted the NO_2 annual mean AQO will be exceeded:

- around the junction of the Outer Ring Road (A6514) with Nottingham Road (B682) which is in a residential/commercial area approximately 3.5km to the north west of the City centre
- in the vicinity of the roundabout where Castle Boulevard (A6005) meets Abbey Bridge (A6005) - a mainly residential area approximately 1.7km southwest of the City centre.
- in the vicinity of the junction where Ilkeston Road (A609) meets Radford Boulevard/ Lenton Boulevard (A613) - a residential/commercial area approximately 2km west of the City centre.

3 New Local Developments

The following have been considered for possible new local developments that may affect air quality:

- Road Traffic Sources – see 3.1 below
- Other Transport Sources – none identified
- Industrial Sources – see 3.3 below
- Commercial and Domestic Sources – see 3.4 below
- New Developments with Fugitive or Uncontrolled Sources – none identified

3.1 Road Traffic Sources

Nottingham City Council confirms that there are no new road traffic sources that have not been previously identified and assessed in previous rounds of the review and assessment process.

There are a series of junction improvements and carriageway alterations currently being made to the A52 outer ring road designed to reduce congestion and queuing at peak times. The air quality impact of these alterations will be assessed in the next report.

There continues to be considerable congestion and queuing at peak times along arterial routes and junctions coincident with the NET tram expansion and ring road improvements.

3.2 Other Transport Sources

Nottingham City Council confirms that there are no other transport sources that have not been previously identified and assessed in previous rounds of the review and assessment process.

3.3 Industrial Sources

A planning proposal and application was received (13/03051/PMFUL3) to develop the former Blenheim Gardens Allotments, Blenheim Lane (an area of former allotments) for an Energy from Waste Facility, manufacturing, research and development and energy generation. The application was granted with conditions on the 18th June 2014.

Please follow this link to view the EIA and committee reports:- http://committee.nottinghamcity.gov.uk/documents/s8079/Blenheim%20allotments.pdf

The EIA concluded that emissions from the process and ancillary activity would not lead to a breach of the Air Quality Objectives.

3.4 Commercial and Domestic Sources

Nottingham City Council confirms that there are no new commercial or domestic sources with significant emissions.

3.5 New Developments with Fugitive or Uncontrolled Sources

Nottingham City Council confirms that there are no new developments with fugitive or uncontrolled sources in its area nor have previous rounds of Review and Assessment identified such sources.

4 Implementation of Action Plans

Table 4.1 Action Plan Progress - City Centre Air Quality Management Area Action Plan Update May 2013

No	Measure	Focus	Lead authority	Planning phase	Implementation phase	Indicator	Target NO_2 annual emission reduction in the AQMA	Progress to date	Progress in last 12 months	Estimated completion date	Comments relating to emission reductions
1	**Connecting Eastside - Phase 2**	Cranbrook St/Bellar Gate bus priority route and local access	City Council	2006-2014	2014-16	Bus use Public transport accessibility	< 1µg/m^3	Preliminary design complete. £5m City Deal funding secured.	Detailed design progressing with scheme, alongside related Broadmarsh scheme	2016	Traffic redistribution within AQMA area. Will increase public transport accessibility to Eastside of the City and thus support sustainable regeneration.
2	**Primary Pedestrian Routes**	Increased priority for pedestrians across inner ring road junctions	City Council	Annual programme	2011-16	Pedestrian footfall	< 1µg/m^3	Shared surface treatment, public realm and pavement widening from Carlton Street to Cranbrook Street. Routes implemented as	Works ongoing, ERDF funding secured for additional works at Carrington Street,	2016	Will encourage more walking and modal change from car. Increased walking and cycling

No	Measure	Focus	Lead authority	Planning phase	Implementation phase	Indicator	Target NO_2 annual emission reduction in the AQMA	Progress to date	Progress in last 12 months	Estimated completion date	Comments relating to emission reductions
		and upgraded routes from City Centre through regeneration areas.						part of Connecting Eastside Phase 1. City Deal funding secured for George Street, Broad Street, Heathcoat Street and Connecting Eastside Phase 2.	Derby road, Carlton Road and Friars Lane due for completion by Dec 15.		through improved public realm works.
3	**Commuter cycle routes**	On road cycle route improvements includes road space reallocation, cycle lanes and advanced stop lines at junctions	City Council	Annual programme	2014-18	Cycling trips	< 1µg/m^3	£250k allocated per year in LTP. Hucknall Rd scheme completed in 2009 and Strelley Route in 2010. Clifton route completed. Outstanding elements of Strelley and Hucknall Road completed.	Other routes in development as part of LTP3 implementation plan. Cycle Ambition bid has secured £6.1m funding. Additional funding secured through the Cycle Safety	2018	Will encourage more cycling and modal change from car.

No	Measure	Focus	Lead authority	Planning phase	Implementation phase	Indicator	Target NO_2 annual emission reduction in the AQMA	Progress to date	Progress in last 12 months	Estimated completion date	Comments relating to emission reductions
4	**Travel Plans**	Travel plans and business support package for employers.	City Council	Annual programme	2011-Ongoing	Travel plans	1μg/m^3	Local Plan requires travel plan for all large-scale development schemes. Travel plan advice and business support package available to employers.	Business support continuing linked to WPL implementation including grants for business to improve cycling facilities and car park management.	Ongoing	Discourages car use for commuting journeys. Will encourage modal change to more sustainable modes and car sharing.
5	**Smarter Choices**	Encouraging and supporting travel using sustainable modes	City Council	Annual programme	2011-2016	Congestion Public transport use Pedestrian footfall Cycling trips	1μg/m^3	Smarter travel/low carbon business support package being funded through the Local Sustainable Transport Fund until 2016.	Funding package established and schemes implemented this year include Workplace Challenge based around	2016	Discourages car use for commuting journeys. Will encourage modal change to more sustainable modes and car sharing.

No	Measure	Focus	Lead authority	Planning phase	Implementation phase	Indicator	Target NO_2 annual emission reduction in the AQMA	Progress to date	Progress in last 12 months	Estimated completion date	Comments relating to emission reductions
									active travel to work. Funding for business support package now secured until March 2016.		
6	**Station Redevelopment**	Rail capacity improvements and development of modern transport interchange	City Council / Network Rail/ East Midlands Trains	2006-11	2010-14	Congestion Public transport use	1μg/m^3	Station hub now largely complete.	Funding package finalised. Advanced highway and public realm improvements underway. Work on multi-storey car park complete. Concourse and hub now substantially	Summer 2014	Will reduce congestion and encourage modal change.

No	Measure	Focus	Lead authority	Planning phase	Implementation phase	Indicator	Target NO_2 annual emission reduction in the AQMA	Progress to date	Progress in last 12 months	Estimated completion date	Comments relating to emission reductions
									completed, pending tram stop as part of NET expansion		
7	**NET Phase Two**	Tram network extensions to Clifton and Chilwell via Beeston	City Council	2006-11	2011-14	Tram use Congestion	1-2 $\mu g/m^3$	Tram extension now underway. Substantial amount of works and major structures now complete	Construction now largely completed, with initial testing to begin shortly.	Early 2015	Will encourage modal change from car and thus reduce congestion as well as supporting sustainable development.
8	**NET Future Phases**	Other tram network extensions linked to sustainable urban extensions	City Council	2011-16	Post 2019	Tram use Congestion	2 $\mu g/m^3$	Consideration of NET future phases included in LTP3. Subject to preliminary design and economic assessment.	NET future phases and infrastructure requirements being explored linked to the consideration of new developme	Post 2019	Will encourage modal change from car and thus reduce congestion as well as supporting sustainable development

No	Measure	Focus	Lead authority	Planning phase	Implementation phase	Indicator	Target NO_2 annual emission reduction in the AQMA	Progress to date	Progress in last 12 months	Estimated completion date	Comments relating to emission reductions
									nts through the development plan process.		
9	**Workplace Parking Levy**	Employers charged for commuter car parking provision (>10 spaces). Revenue generated to fund significant public transport improvements	City Council	2006-12	2012 - Ongoing	Congestion Public transport use	< 1-2 $\mu g/m^3$	Business case agreed by DfT. Examination in public completed. Scheme order approved.	Scheme commencement of licensing commenced October 2011. WPL charging commenced April 2012.	Ongoing	Fiscal measure to discourage commuting by car coupled with significant improvements to public transport alternatives.
10	**Park and Ride**	Expansion of Park and Ride capacity	City and County Councils	2011-14	2008-14	Public transport use	< 1$\mu g/m^3$	New sites and expansion of other sites linked to sustainable urban extensions.	Two large sites to be delivered as part of NET Phase Two	Early 2015	Reduced congestion from fewer vehicle movements.

No	Measure	Focus	Lead authority	Planning phase	Implementation phase	Indicator	Target NO_2 annual emission reduction in the AQMA	Progress to date	Progress in last 12 months	Estimated completion date	Comments relating to emission reductions
11	**A52 Ring Road upgrading**	Upgrading of Ring Road Radcliffe to Clifton Bridge as recommended in the A52 MMS	Highways Agency	Post 2014	Post 2019	Congestion	< 1μg/m^3	Feasibility being considered as part of Growth Point programme. Requires prioritisation through Regional Funding Allocations process.	Sustainable urban extensions and infrastructure requirements identified through Aligned Core Strategy process	Post 2019	Reduced congestion by increasing capacity of ring road around the south of the conurbation.
12	**"Linkbus" Electric Network**	Purchase of electric vehicles to operate Linkbus services	NCC	2010	2011-2015	Public transport use	< 1μg/m^3	Green Bus Funding secured from DfT. Funding is now being rolled out to rest of linkbus network after initial trial on Centrelink service (2012). Will see full link network using electric vehicles by 2015	First phases of services are now in place, including rollout to the Medilink Service and four Locallink services. Worklinks conversion to take place in	2016	Reduce carbon emissions from public transport vehicles. Encourage public transport use

No	Measure	Focus	Lead authority	Planning phase	Implementation phase	Indicator	Target NO_2 annual emission reduction in the AQMA	Progress to date	Progress in last 12 months	Estimated completion date	Comments relating to emission reductions
									August 2014		
13	**Electric vehicle charging infra-structure**	Charging point at employment and interchange sites	City Council	2009-10	2011-13	Availability of charging points	< 1μg/m^3	Plugged in Places funding secured for the installation of a number of electric vehicle charging points at key employment sites. Roll out completed in 2013.	Further funding bid round from Office of Low Emission Vehicles (OLEV) announced. Considering developing a bid to expand offer	2013 (Complete)	Will encourage modal change from car.
14	**Better Bus Areas Programmes**	Funding to improve bus services and operations within the city	City council	2012/13	2013 – 2018	Public transport use	< 1μg/m^3	Funding secured for Capital projects regarding Better Bus Area. Now in design phase for scheme.	Funding confirmed, now initiating design for various elements	2018	Will encourage modal shift from the car and improve public transport offer.
15	**Broadmarsh / Turning Point South**	Funding for alterations to	City Council	2014-15	2018	Pedestrian Footfall	< 1μg/m^3	Funding secured through Growth Fund announcement	Funding secured through Growth	2018	Traffic redistribution within AQMA area.

No	Measure	Focus	Lead authority	Planning phase	Implementation phase	Indicator	Target NO_2 annual emission reduction in the AQMA	Progress to date	Progress in last 12 months	Estimated completion date	Comments relating to emission reductions
	Scheme	traffic flow to Collins Street / Canal Street and alterations to surrounding highway network							Fund announcement. Assessment of impacts and initial design works taking place.		Increased priority for buses without significant traffic displacement impacts.
16	**City Car Club**	Introduction of eight on-street Car Club hire points in the City Centre	City Council	2011-13	2014	Congestion	< 1μg/m^3	Funding to introduce car club secured through LSTF. City Car Club introduced in early 2014. Includes a hybrid demonstration vehicle.	Scheme comprises a business incentive package alongside a residential element for the scheme.	Ongoing	Reduced congestion encouraging a shift from private use of vehicles to a pooled resource

For the above table - under the heading '**Target NO_2 annual emission reduction in the AQMA**' a value of < 1μg/m^3 indicates that whilst the individual measure may have a negligible impact, it is likely to contribute to overall emissions reduction.

5 Conclusions and Proposed Actions

5.1 Conclusions from New Monitoring Data

The 2013 monitoring results show that there were no exceedences of the Air Quality Objectives for PM_{10}, sulphur dioxide and benzene. This is consistent with findings reported in previous Review & Assessment reports.

The trend information for sulphur dioxide and benzene show that although 2013 annual mean concentrations were higher than in previous years, generally concentrations have been reducing with a significant decrease in measured levels since 2006.

Exceedences of the nitrogen dioxide annual mean AQO were measured at three automatic sites and nine diffusion tube sites. Whilst most of these sites are within AQMAs - two of the diffusion tube sites are not. These two tubes are on or adjacent to residential properties where there is relevant public exposure.

The trend information shows that, since start up in 2005, the nitrogen dioxide annual mean AQO has been exceeded at the CG NOx within No.2 AQMA in most years and that there was a gradual increase in levels for the first 4 years.

In contrast the trend at the AURN urban background site has been decreasing concentrations that have levelled out for the last few years with no exceedences of the nitrogen dioxide annual mean AQO measured since 2004.

The results show that exceedences of the annual mean nitrogen AQO continue to be measured at sites within the existing AQMAs consequently they should not be revoked.

Following the 2013 Detailed Assessment locations were identified where monitoring is required to determine whether exceedance of the annual mean nitrogen AQO at relevant locations is occurring. These monitoring sites have been established and data will be available in January 2015 to inform the LAQM process.

5.2 Conclusions relating to New Local Developments

Although planning permission has been granted for the Energy from Waste plant in Bulwell, the site has yet to be developed. Emissions from the plant will be considered in future reports.

5.3 Other Conclusions

A number of measures in the LTP2 Air Quality Action Plan have been carried through into the LTP 3 AQAP and progress with these will continue to be reported in future LAQM reports.

The NET (Nottingham Express Transit) Phase 2 – the tram network extensions have the potential to impact positively on air quality by encouraging modal change from cars and reduce congestion.

Together with Line One, NET will provide tram based Park & Ride sites near all three M1 junctions into Nottingham.

Twenty of the 30 largest employers in Greater Nottingham will be within 800m of a tram stop once the network is complete - with around 55,000 commuters within reach of the system. NET Phase Two will increase the number of passenger journeys across the extended tram system to an estimated 20 million a year and will take approximately three million car journeys off Nottingham's roads.

Construction work on the new lines has started and passenger services across the extended tram network should be fully operational by the middle of 2015. Congestion has temporarily increased where the route is coincident with arterial roads and junctions and is likely to have contributed to the increased levels of NO2 measured in AQMA 2 and 3.

Air quality issues will be an integral part of the ongoing work being undertaken by Nottingham City Council to develop and implement the Local Development Framework for land use planning.

5.4 Proposed Actions

Following the Detailed Assessment 2013 additional monitoring was instigated at three additional locations outside the AQMAs to determine levels/verify the predictions made by the DA modelling, this will inform the next air quality report.

The additional monitoring is being undertaken:

- around the junction of the Outer Ring Road (A6514) with Nottingham Road (B682) which is in a residential/commercial area approximately 3.5km to the north west of the City centre

- in the vicinity of the roundabout where Castle Boulevard (A6005) meets Abbey Bridge (A6005) - a mainly residential area approximately 1.7km west of the City centre.

- in the vicinity of the 'Priory Island' roundabout where Woodside Road meets Derby Road.

Exceedences of the annual mean nitrogen AQO were measured at sites within the existing AQMAs consequently the AQMAs should not be revoked and it is appropriate to maintain their current boundaries.

5.5 What Happens Next?

The next steps that Nottingham City Council will take to fulfil its LAQM duties are:

- submit this 2014 Progress Report to Defra

- undertake an Updating and Screening Assessment by 30 April 2016 in accordance with the Review and Assessment timescales outlined in the LAQM Policy Guidance (PG09).

- Nottingham City Council in partnership with Nottinghamshire County Council, Nottinghamshire's District Councils, other stakeholders and partners will review and revise the Nottinghamshire Air Quality Strategy to identify and promote further measures to reduce emissions and improve air quality.

6 References

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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

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Nottingham City Council
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Nottingham City Council
Local Air Quality Management: Detailed Assessment for Nitrogen Dioxide November 2013

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: Diffusion Tube Data Adjustment and QA/QC Information

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

A -1 NO_2 Diffusion Tube Bias Adjustment Factor

Diffusion tubes are affected by several sources of interference which can cause substantial under or overestimation (often referred to as "bias") of NO_2 concentrations compared to the chemiluminescent analyser (defined within Europe as the reference method).

Consequently Local Authorities using diffusion tubes in their Review and Assessment work are required to quantify the "bias" of their diffusion tube measurements and apply an appropriate bias adjustment factor to the annual mean if required.

The guidance advises that Local Authorities can either:

1. Carry out their own co-location study (in which the accuracy of the diffusion tubes is quantified by exposure alongside an automatic chemiluminescence analyser), and use the results to calculate a bias adjustment factor i.e. locally-derived bias adjustment factors**.**

2. Use a combined bias adjustment factor, based on the result of many co-location studies (using the same laboratory and tube prepa
3. ration method) i.e. national bias adjustment factors.

Throughout 2013 triplicate diffusion tubes were co-located at the 3 automatic analyser roadside sites – CG NOx, LS NOx and SA NOx. Nottingham City Council's co-location data has been entered in the National Bias Adjustment Spreadsheet.

Bias adjustment factors determined from Local Authority co-location studies throughout the UK have been collated by the Local Air Quality Management Helpdesk.

The bias adjustment database is available at: http://laqm.defra.gov.uk/bias-adjustment-factors/national-bias.html

Table A -1 on the next page shows the national bias adjustment factors for Gradko diffusion tubes using 20% TEA in water. The overall factor for 24 studies is 0.95.

The 3 tables following Table A-1 i.e. A-1a, A-1b and A-1c – CG NOx, LS NOx and SA NOx sites respectively show the data that was entered into the National Bias Adjustment Spreadsheet (the most recent version is March 2013) and the resultant bias adjustment factors.

Table A-1 National Bias Adjustment Factor Data

National Diffusion Tube Bias Adjustment Factor Spreadsheet — Spreadsheet Version Number: 03/14

Follow the steps below **in the correct order** to show the results of **relevant** co-location studies
Data only apply to tubes exposed monthly and are not suitable for correcting individual short-term monitoring periods
Whenever presenting adjusted data, you should state the adjustment factor used and the version of the spreadsheet
This spreadsheet will be updated every few months: the factors may therefore be subject to change. This should not discourage their immediate use.

This spreadsheet will be updated at the end of June 2014

The LAQM Helpdesk is operated on behalf of Defra and the Devolved Administrations by Bureau Veritas, in conjunction with contract partners AECOM and the National Physical Laboratory.

Spreadsheet maintained by the National Physical Laboratory. Original compiled by Air Quality Consultants Ltd.

Step 1: Select the Laboratory that Analyses Your Tubes from the Drop-Down List

If a laboratory is not shown, we have no data for this laboratory.

Step 2: Select a Preparation Method from the Drop-Down List

If a preparation method is not shown, we have no data for this method at this laboratory.

Step 3: Select a Year from the Drop-Down List

If a year is not shown, we have no data[2]

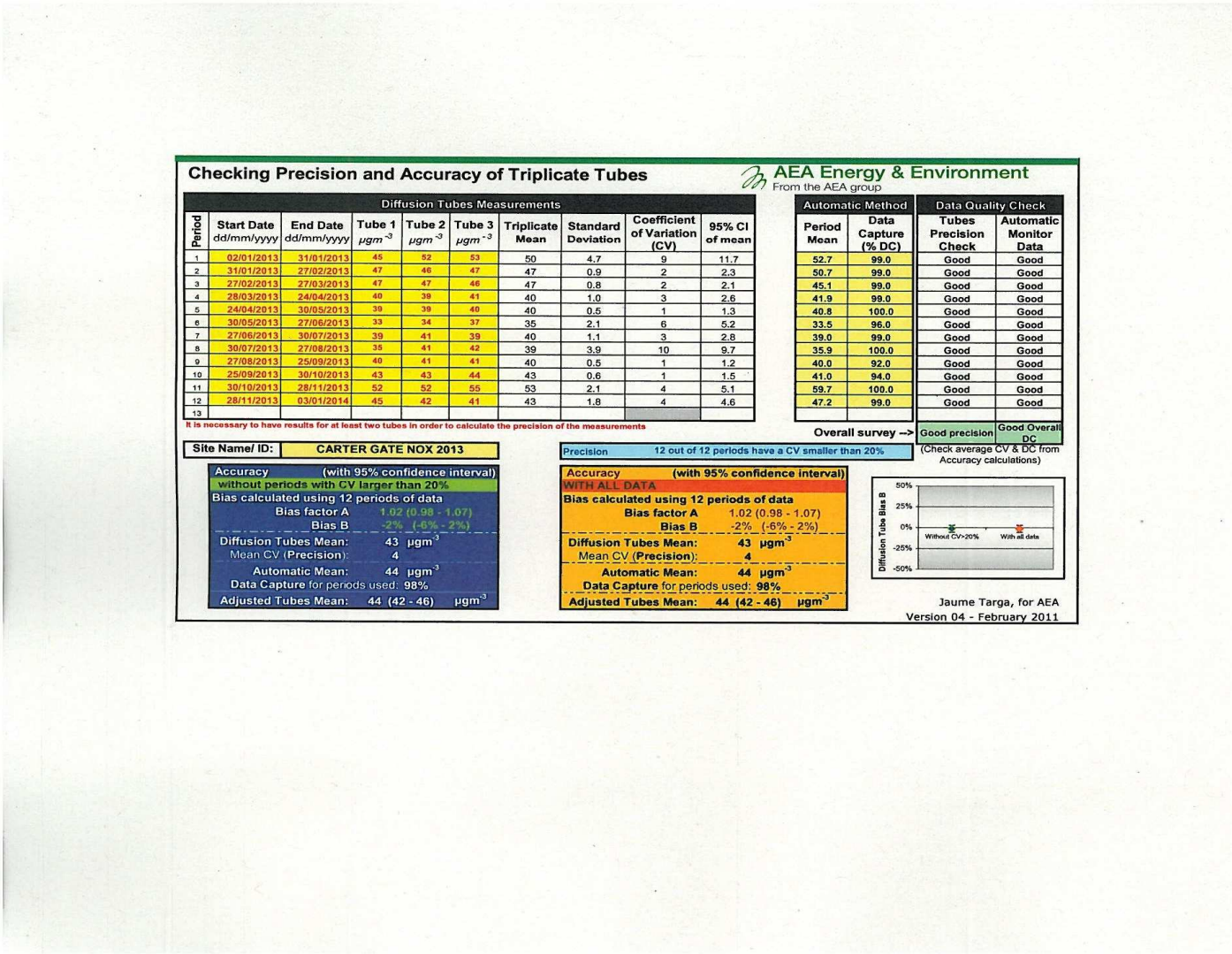
Step 4:

Where there is only one study for a chosen combination, you should use the adjustment factor shown with caution. Where there is more than one study, use the overall factor[3] shown in blue at the foot of the final column.

If you have your own co-location study then see footnote[4]. If uncertain what to do then contact the Local Air Quality Management Helpdesk at LAQMHelpdesk@uk.bureauveritas.com or 0800 0327953

Analysed By[1]	Method (To undo your selection, choose (All) from the pop-up list)	Year[5] (To undo your selection, choose (All))	Site Type	Local Authority	Length of Study (months)	Diffusion Tube Mean Conc. (Dm) (µg/m³)	Automatic Monitor Mean Conc. (Cm) (µg/m³)	Bias (B)	Tube Precision[6]	Bias Adjustment Factor (A) (Cm/Dm)
Gradko	20% TEA in water	2013	R	Cheshire West and Chester	12	39	41	-4.4%	G	1.05
Gradko	20% TEA in Water	2013	R	Dudley MBC	12	38	31	23.1%	G	0.81
Gradko	20% TEA in Water	2013	UB	Dudley MBC	10	25	25	-1.7%	G	1.02
Gradko	20% TEA in Water	2013	R	Dudley MBC	11	41	39	5.4%	G	0.95
Gradko	20% TEA in water	2013	R	East Herts Council	10	35	30	19.4%	G	0.84
Gradko	20% TEA in water	2013	R	Fareham Borough Council	9	34	34	2.0%	G	0.98
Gradko	20% TEA in water	2013	R	Fareham Borough Council	12	42	45	-6.2%	G	1.07
Gradko	20% TEA in water	2013	R	Gateshead Council	11	34	37	-8.7%	G	1.10
Gradko	20% TEA in water	2013	R	Gateshead Council	11	35	33	6.3%	G	0.94
Gradko	20% TEA in water	2013	R	Gateshead Council	10	33	32	2.1%	G	0.98
Gradko	20% TEA in water	2013	R	Borough Council of King's Lynn & West Norfolk	12	29	26	12.5%	G	0.89
Gradko	20% TEA in water	2013	R	Gedling Borough Council	10	37	35	7.2%	G	0.93
Gradko	20% TEA in water	2013	R	The Highland Council	12	24	21	14.1%	G	0.88
Gradko	20% TEA in Water	2013	R	Dudley MBC	12	52	59	-12.0%	P	1.14
Gradko	20% TEA in water	2013	R	NOTTINGHAM CITY COUNCIL	12	43	44	-2.2%	G	1.02
Gradko	20% TEA in water	2013	R	NOTTINGHAM CITY COUNCIL	10	41	39	6.4%	G	0.94
Gradko	20% TEA in water	2013	R	NOTTINGHAM CITY COUNCIL	11	43	42	1.9%	G	0.98
Gradko	20% TEA in water	2013	R	Brighton & Hove City Council	11	62	60	1.9%	G	0.98
Gradko	20% TEA in water	2013	R	Brighton & Hove City Council	11	41	30	37.5%	G	0.73
Gradko	20% TEA in water	2013	KS	Marylebone Road Intercomparison	12	101	81	25.8%	G	0.80
Gradko	20% TEA in Water	2013	R	Brighton & Hove City Council	9	54	45	19.6%	G	0.84
Gradko	20% TEA in water	2013	R	Wiltshire Council	12	40	36	10.1%	G	0.91
Gradko	20% TEA in water	2013	R	Wiltshire Council	11	41	37	11.6%	G	0.90
Gradko	20% TEA in water	2013	R	Wiltshire Council	12	39	49	-20.0%	G	1.25
Gradko	20% TEA in water	2013		Overall Factor[3] (24 studies)				Use		0.95

Table A-1a CG NOx Bias Adjustment



Checking Precision and Accuracy of Triplicate Tubes

AEA Energy & Environment
From the AEA group

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	02/01/2013	31/01/2013	45	52	53	50	4.7	9	11.7
2	31/01/2013	27/02/2013	47	46	47	47	0.9	2	2.3
3	27/02/2013	27/03/2013	47	47	46	47	0.8	2	2.1
4	28/03/2013	24/04/2013	40	39	41	40	1.0	3	2.6
5	24/04/2013	30/05/2013	39	39	40	40	0.5	1	1.3
6	30/05/2013	27/06/2013	33	34	37	35	2.1	6	5.2
7	27/06/2013	30/07/2013	39	41	39	40	1.1	3	2.8
8	30/07/2013	27/08/2013	35	41	42	39	3.9	10	9.7
9	27/08/2013	25/09/2013	40	41	41	40	0.5	1	1.2
10	25/09/2013	30/10/2013	43	43	44	43	0.6	1	1.5
11	30/10/2013	28/11/2013	52	52	55	53	2.1	4	5.1
12	28/11/2013	03/01/2014	45	42	41	43	1.8	4	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		Data Quality Check	
Period Mean	Data Capture (% DC)	Tubes Precision Check	Automatic Monitor Data
52.7	99.0	Good	Good
50.7	99.0	Good	Good
45.1	99.0	Good	Good
41.9	99.0	Good	Good
40.8	100.0	Good	Good
33.5	96.0	Good	Good
39.0	99.0	Good	Good
35.9	100.0	Good	Good
40.0	92.0	Good	Good
41.0	94.0	Good	Good
59.7	100.0	Good	Good
47.2	99.0	Good	Good
Overall survey -->		Good precision	Good Overall DC

(Check average CV & DC from Accuracy calculations)

Site Name/ ID: CARTER GATE NOX 2013

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

Accuracy (with 95% confidence interval) without periods with CV larger than 20%
Bias calculated using 12 periods of data
Bias factor A 1.02 (0.98 - 1.07)
Bias B -2% (-6% - 2%)
Diffusion Tubes Mean: 43 µgm^{-3}
Mean CV (Precision): 4
Automatic Mean: 44 µgm^{-3}
Data Capture for periods used: 98%
Adjusted Tubes Mean: 44 (42 - 46) µgm^{-3}

Accuracy (with 95% confidence interval) WITH ALL DATA
Bias calculated using 12 periods of data
Bias factor A 1.02 (0.98 - 1.07)
Bias B -2% (-6% - 2%)
Diffusion Tubes Mean: 43 µgm^{-3}
Mean CV (Precision): 4
Automatic Mean: 44 µgm^{-3}
Data Capture for periods used: 98%
Adjusted Tubes Mean: 44 (42 - 46) µgm^{-3}

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Version 04 - February 2011

Table A-1b LS NOx Bias Adjustment

Checking Precision and Accuracy of Triplicate Tubes

AEA Energy & Environment
From the AEA group

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	02/01/2013	31/01/2013	46	48	44	46	2.0	4	5.1
2	31/01/2013	27/02/2013	49	49	46	48	1.5	3	3.7
3	27/02/2013	27/03/2013	47	46	43	45	1.7	4	4.3
4	28/03/2013	24/04/2013	36	34	36	36	1.0	3	2.6
5	24/04/2013	28/05/2013	32	37	29	33	4.1	13	10.3
6	28/05/2013	27/06/2013	34	34	31	33	1.9	6	4.7
7	27/06/2013	30/07/2013	40	41	42	41	1.1	3	2.8
8	30/07/2013	27/08/2013	39	37	39	38	1.0	3	2.6
9	27/08/2013	25/09/2013	37	37	36	37	0.5	1	1.1
10	25/09/2013	30/10/2013	38	40	36	38	1.8	5	4.5
11	30/10/2013	28/11/2013	50	53	51	51	1.7	3	4.3
12	28/11/2013	03/01/2014	40	42	42	41	0.9	2	2.1
13									

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

Automatic Method		Data Quality Check	
Period Mean	Data Capture (% DC)	Tubes Precision Check	Automatic Monitor Data
47.8	99.0	Good	Good
43.7	100.0	Good	Good
38.7	96.0	Good	Good
34.1	99.0	Good	Good
33.9	99.0	Good	Good
25.4	87.0	Good	Good
31.5	98.0	Good	Good
34.6	39.0	Good	or Data Capture
36.8	48.0	Good	or Data Capture
35.2	100.0	Good	Good
53.6	99.0	Good	Good
43.2	99.0	Good	Good
		Overall survey -->	Good precision / Poor Overall DC

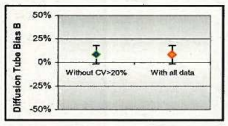
(Check average CV & DC from Accuracy calculations)

Site Name/ ID: LACE STREET 2013

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

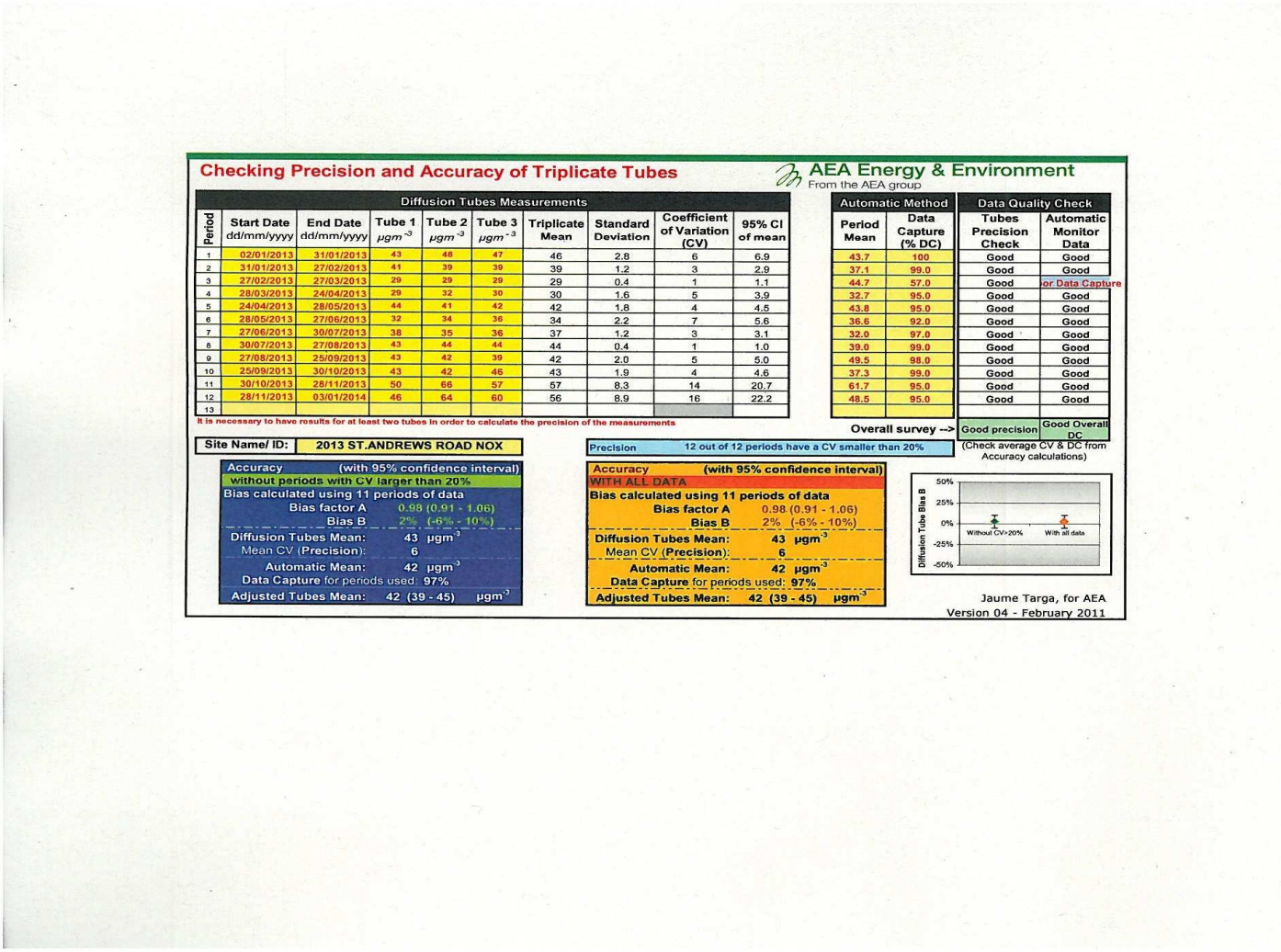
Accuracy (with 95% confidence interval) without periods with CV larger than 20%	
Bias calculated using 10 periods of data	
Bias factor A	0.94 (0.86 - 1.04)
Bias B	6% (-3% - 16%)
Diffusion Tubes Mean:	41 µgm^{-3}
Mean CV (Precision):	5
Automatic Mean:	39 µgm^{-3}
Data Capture for periods used:	98%
Adjusted Tubes Mean:	39 (35 - 43) µgm^{-3}

Accuracy (with 95% confidence interval) WITH ALL DATA	
Bias calculated using 10 periods of data	
Bias factor A	0.94 (0.86 - 1.04)
Bias B	6% (-3% - 16%)
Diffusion Tubes Mean:	41 µgm^{-3}
Mean CV (Precision):	5
Automatic Mean:	39 µgm^{-3}
Data Capture for periods used:	98%
Adjusted Tubes Mean:	39 (35 - 43) µgm^{-3}



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Version 04 - February 2011

Table A-1c SA NOx Bias Adjustment



Checking Precision and Accuracy of Triplicate Tubes

AEA Energy & Environment
From the AEA group

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	02/01/2013	31/01/2013	43	48	47	46	2.8	6	6.9
2	31/01/2013	27/02/2013	41	39	39	39	1.2	3	2.9
3	27/02/2013	27/03/2013	29	29	29	29	0.4	1	1.1
4	28/03/2013	24/04/2013	29	32	30	30	1.6	5	3.9
5	24/04/2013	28/05/2013	44	41	42	42	1.8	4	4.5
6	28/05/2013	27/06/2013	32	34	36	34	2.2	7	5.6
7	27/06/2013	30/07/2013	38	35	36	37	1.2	3	3.1
8	30/07/2013	27/08/2013	43	44	44	44	0.4	1	1.0
9	27/08/2013	25/09/2013	43	42	39	42	2.0	5	5.0
10	25/09/2013	30/10/2013	43	42	46	43	1.9	4	4.6
11	30/10/2013	28/11/2013	50	66	57	57	8.3	14	20.7
12	28/11/2013	03/01/2014	46	64	60	56	8.9	16	22.2
13									

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

Automatic Method		Data Quality Check	
Period Mean	Data Capture (% DC)	Tubes Precision Check	Automatic Monitor Data
43.7	100	Good	Good
37.1	99.0	Good	Good
44.7	57.0	Good	or Data Capture
32.7	95.0	Good	Good
43.8	95.0	Good	Good
36.6	92.0	Good	Good
32.0	97.0	Good	Good
39.0	99.0	Good	Good
49.5	98.0	Good	Good
37.3	99.0	Good	Good
61.7	95.0	Good	Good
48.5	95.0	Good	Good
	Overall survey -->	Good precision	Good Overall DC

(Check average CV & DC from Accuracy calculations)

Site Name/ ID: 2013 ST.ANDREWS ROAD NOX

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

Accuracy (with 95% confidence interval) without periods with CV larger than 20%	
Bias calculated using 11 periods of data	
Bias factor A	0.98 (0.91 - 1.06)
Bias B	2% (-6% - 10%)
Diffusion Tubes Mean:	43 µgm^{-3}
Mean CV (Precision):	6
Automatic Mean:	42 µgm^{-3}
Data Capture for periods used:	97%
Adjusted Tubes Mean:	42 (39 - 45) µgm^{-3}

Accuracy (with 95% confidence interval) WITH ALL DATA	
Bias calculated using 11 periods of data	
Bias factor A	0.98 (0.91 - 1.06)
Bias B	2% (-6% - 10%)
Diffusion Tubes Mean:	43 µgm^{-3}
Mean CV (Precision):	6
Automatic Mean:	42 µgm^{-3}
Data Capture for periods used:	97%
Adjusted Tubes Mean:	42 (39 - 45) µgm^{-3}

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Version 04 - February 2011

Table A1-d Factors from Local Co-location Studies

Site	Site Type	**Bias Adjustment Factor, A** (from Tables A -1a,1 b & 1c)
CG NOx, Carter Gate	Roadside	1.02
LS NOx, Lace Street	Roadside	0.94
SA NOx, Carter Gate	Roadside	0.98
	Average	0.98

Discussion of Choice of Factor to Use

The national 2013 bias adjustment factor for Gradko tubes 20% TEA in water = 0.95 (based on 24 sites – 22 of which are roadside).

The locally derived factor = 0.98 (based on 3 roadside sites).

In deciding which factor to use, note has been taken of the TG(09) guidance. This advises that the most important aspects to be considered when deciding which bias-adjustment factor to use are:

- Tube exposure time (1 week, 2 weeks, 1 month)
- Length of the monitoring study
- QA/QC of the chemiluminescence analyser
- QA/QC of diffusion tubes
- Siting of the co-location study
- Siting of other tubes in the survey

Taking these into consideration then either the local or national factor could be used.

However because generally the inclusion of a greater number of studies means the resultant factor is a more reliable figure, the decision was made to use the national factor.

Use of the local factor to adjust the diffusion tube data would lead to slightly higher nitrogen dioxide values.

The 2013 diffusion tube unadjusted monthly nitrogen dioxide concentrations are given in Table A–2 after subsection A-2 diffusion tube QA/QC information.

A-2 QA/QC for Diffusion Tube Monitoring

Gradko International supply and analyse Nottingham City Council's diffusion tubes. The organisation is UKAS accredited and is assessed annually for compliance to ISO 17025 and participates in other proficiency schemes.

Gradko have confirmed that their procedures 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

Gradko participate in a number of QA/QC monitoring systems to demonstrate satisfactory performance including the Workplace Analysis Scheme for Proficiency (WASP) programme to ensure uniformity in data throughout the year.

The Workplace Analysis Scheme for Proficiency (WASP)

The Workplace Analysis Scheme for Proficiency (WASP) is an independent analytical proficiency-testing (PT) scheme, operated by the Health and Safety Laboratory (HSL). WASP offers a number of test samples designed to test the proficiency of laboratories undertaking analysis of chemical pollutants in workplace and ambient air. One such sample is the WASP NO2 test sample type that is distributed to participants in a quarterly basis.

WASP NO2 PT forms an integral part of the UK NO2 Network's QA/QC, and is a useful tool in assessing the analytical performance of laboratories supplying diffusion tubes to Local Authorities for use in the context of Local Air Quality Management (LAQM). With consent from the participating laboratories, HSL provides summary

proficiency testing data to the LAQM Helpdesk for hosting on the web-pages at http://laqm.defra.gov.uk/diffusion-tubes/qa-qc-framework.html.

Information about the WASP scheme, how the testing is carried out along with the calculation of results and final scores can be found in the **Summary of Laboratory Performance in WASP NO2 Proficiency Testing Scheme for Rounds 117-124**. **LAQM Helpdesk – March 2014** (http://laqm.defra.gov.uk/documents/LAQM-WASP-Rounds-117-124-(April-2012--March-2014)-NO2-report.pdf).

Defra and the Devolved Administrations advise that diffusion tubes used for Local Air Quality Management should be obtained from laboratories that have demonstrated satisfactory performance in the WASP scheme.

Gradko International's WASP performance for the 2013 rounds (rounds 120 – 123) was 100% (results shown below in an extract from the Summary).

Extract taken from **Table 1: Laboratory summary performance for WASP NO2 PT rounds 120 - 123**

"The following table lists those UK laboratories undertaking LAQM activities that have participated in recent HSL WASP NO2 PT rounds and the percentage (%) of results submitted which were subsequently determined to be **satisfactory** based upon a z-score of $\leq \pm 2$ as defined above (see the full summary referenced above for detailed information)."

WASP Round	WASP R120	WASP R121	WASP R122	WASP R123
Round conducted in the period	January – March 2013	April – June 2013	July – September 2013	October – December 2013
Gradko International [2]	100 %	100 %	100 %	100 %

Precision vs Accuracy (Bias)

A further aspect of QA/QC for a laboratory is the reproducibility of results i.e. precision. Precision should not be confused with accuracy. Diffusion tube precision can be

described as the ability of a measurement to be consistently reproduced, i.e. how similar the results of duplicate or triplicate tubes are to each other.

Accuracy represents the ability of the measurement to represent the 'true' value, which for the monitoring results, is defined as the results from the automatic analysers. When averaged over a number of sets of results bias can be evident. This represents the overall tendency of the diffusion tubes to depart from the 'true' value, i.e. to systematically over-or under-read when compared against the reference method.

Once identified, bias can be adjusted for to improve the accuracy of diffusion tube results. This is done using bias adjustment factors which have been found to be specific to a laboratory and tube preparation method. See Appendix A subsection A-1 above.

Unlike bias, poor precision cannot be adjusted for. It can only be improved by careful handling of the tubes in both the laboratory and the field.

The LAQM website provides a link to the summary of precision results for individual laboratories - **Summary of Diffusion Tube Precision 2008-2013**. It can be downloaded as a PDF from http://laqm.defra.gov.uk/diffusion-tubes/precision.html.

The precision rating for Gradko for 2013 was 'good'. This precision reflects the laboratory's performance/consistency in preparing and analysing the tubes, as well as the subsequent handling of the tubes in the field.

Table A-2 2013 Diffusion Tube Monthly Unadjusted Nitrogen Dioxide Concentrations (μg/m^3)

Site Id	Location	Site Type	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Raw Mean μg/m^3
G	Beeston Road	R	48	50	47	38	41	30	39	36	37	40	52	41	41.6
I	Derby Road	R	39	40	37	30	29	30	35	30	34	32	42	37	34.6
X	Western Boulevard	R	37	40	31	29	31	28	33	33	34	34	51	38	34.9
X2	Wilkinson Street	R	38	37	32	26	30	24	33	33	38	31	42	40	33.7
X3	Nottingham Road (1)	R	25	44	48	36	40	35	41	41	40	34	47	42	39.4
X3-2	Nottingham Road (2)	R	43	42	36	34	33	27	39	39	35	39	49	38	37.8
X3-3	Highland Court	R	40	40	45	34	31	31	35	32	32	35	50	38	36.9
X4	Danethorpe Vale	R	37	36	27	24	32		28	33	31	27	36	39	31.8
V	Bentinck Road	R	40	41	36	32	37	36		40	39	37	55	42	39.5
AA-2	6 Rayner Court	R	35	37	32	30	31	25	29	28	31	32	45	38	32.8
AA	Ilkeston Road	R	53	59	55	50	35	42	47	43	40	28	52	47	45.9
V2	Gregory Boulevard	R	38	38	31	28		27	34	31	35	32	46	35	34.1
K4	Castle Gardens	R	58	56	51	45	35	41	62	37	51	51	75	60	51.8
K3-2	Castle Boulevard (2)	R	33	31	35	28		24	27	24	27	30	39	31	29.9
51K3-3	Sherwin Road	R	33	37	52	21		25	26	27	29	33	38	35	32.4
K	Castle Boulevard	R	54	54	37	44	20	40	43		39	42	50	41	42.2
M	Canning Terrace	R	55	73	75	57	30	63	58	53	49	38	66	46	55.3
N	Upper Parliament St	R	53	58	71	47	30	50	68	56	49	67	58	62	55.8
O	Shakespeare St	R	52	54	55	45	26	22	57	49	49	52	55	46	46.8
P	Mansfield Road	R	67	59	69	51		44	49	47	43	55	57	47	53.5
Y	Bloomsbury Court	R	47	60	61	48	24	31	51	39	48	26	57	47	44.9
U	Trent Bridge PH	R	46	50	53	33	19	34	46	49	47	48	58		43.9
T	Queens Rd	R	57	56	44	43	22	40	60	53	52	60	81	55	51.9

Appendix B: QA/QC Information for 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 filters for the TEOMs and FDMSs and cleans the TEOM heads approximately every 12 weeks when requested by the Central Management and Co-ordination Unit (CMCU). All work undertaken is done in accordance with the Local Site Operator's Manual,

The equipment is fully serviced every six months. In 2013 this was undertaken by EnviroTechnology Services plc, Gloucester.

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

CG NOx, LS NOx and SA NOx Sites

At Nottingham City Council's CG NOx, LS NOx and SA 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.

The equipment is fully serviced every six months EnviroTechnology Services plc, Gloucester.

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.

CG NOx, LS NOx and SA NOx Sites

Calibration gases used in the CG NOx, LS NOx and SA 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 is continuously interrogated by Bureau Veritas the Central Management and Co-ordination Unit (CMCU). 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 http://uk-air.defra.gov.uk.

CG NOx, LS NOx and SA NOx Sites

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

Throughout 2013, data from the CG NOx, LS NOx and SA NOx sites was polled remotely directly from the analysers and collected as 15 minute averages using Envista ARM data collection software. The data have been scaled and converted into hourly (or other values) using the Envista ARM data management system

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 is carried out and 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.