



Gloucester City Council LAQM Progress Report 2014



Bureau Veritas

September 2014



Move Forward with Confidence

Document Control Sheet

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Executive Summary

Part IV of the Environment Act 1995 places a statutory duty on local authorities to review and assess the air quality within their area and take account of Government Guidance when undertaking such work. This Annual Progress Report is a requirement of the Fifth Round of Review and Assessment and is a requirement for all local authorities. The Report has been prepared in accordance with Technical Guidance LAQM.TG (09) and associated tools (2010 based).

This Annual Progress Report considers all new monitoring data and assesses the data against the Air Quality Strategy (AQS) objectives. It also considers any changes that may have an impact on air quality.

Updated monitoring showed that there were no exceedences of the AQS objectives at any of the monitoring locations within Gloucester City Council.

Continuous monitoring results for 2013 indicate that both the annual mean objective and the 1-hour objective for nitrogen dioxide were met at the monitoring site, having shown a significant decrease in 2013. Results from diffusion tube sites also showed that NO₂ concentrations in 2013 significantly decreased from 2012. There were no diffusion tube sites in 2013 where the annual mean AQS objective was exceeded.

Proposed actions arising from the 2014 Annual Progress Report are as follows:

- Continue diffusion tube and continuous monitoring in the City to identify future changes in pollutant concentrations;
- Proceed to the Updating and Screening Assessment 2015.

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1 Introduction

1.1 Description of Local Authority Area

Gloucester is a small City (population circa 110,000) situated on the left bank of the tidal River Severn and backed by the Cotswold escarpment. The prevailing winds are from the southwest and follow a passage up the river, channelled by the hills in the distance to either side. The M5 motorway forms the eastern boundary of much of the City. The City is densely populated in comparison to its surrounding neighbouring District Councils (Stroud District Council, Forest of Dean District Council and Tewkesbury Borough Council) which are predominantly rural.

Gloucester is home to the Hempsted Landfill Site situated in the North West corner of the City and which benefits from an A1 environmental permit issued by the Environment Agency. 41 activities hold an environmental permit with the Council with one of these, an aluminium foundry and smelting process, being an A2 process. The majority of activities that are regulated by the Council are loading/unloading of petrol, waste oil burners and vehicle refinishers.

The main source of air pollution in the City that gives rise to concern for compliance is road traffic emissions from major roads, notably the A417, A430 and A38 which connect Gloucester with the main highway network in Gloucestershire, as well as local traffic in the centre of Gloucester.

Three Air Quality Management Areas (AQMAs) have been declared in Gloucester due to exceedences of the annual mean objective for NO₂: Barton Street AQMA (in the City centre) and Priory Road AQMA (on the A417), both declared in 2005; and Painswick Road AQMA (extension of Barton Street), declared in 2007.

1.2 Purpose of Progress Report

This report fulfils the requirements of the Local Air Quality Management (LAQM) process as set out in Part IV of the Environment Act (1995), the Air Quality Strategy (AQS) for England, Scotland, Wales and Northern Ireland 2007 and the relevant Policy and Technical Guidance documents. The LAQM process places an obligation on 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 AQMA and prepare an Air Quality Action Plan (AQAP) setting out the measures it intends to put in place in pursuit of the objectives.

Progress Reports are required in the intervening years between the three-yearly Updating and Screening Assessment reports. Their purpose is to maintain continuity in the LAQM process.

Progress Reports 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 the risk of exceedence of an AQS 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) and The Air Quality (England) (Amendment) Regulations 2002 (SI 3043). These are shown in Table 1-1. This table shows the objectives in units of micrograms per cubic metre $\mu\text{g}/\text{m}^3$ (milligrams 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 Objective 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 $\mu\text{g}/\text{m}^3$	Running annual mean	31.12.2003
	5.00 $\mu\text{g}/\text{m}^3$	Annual mean	31.12.2010
1,3-Butadiene	2.25 $\mu\text{g}/\text{m}^3$	Running annual mean	31.12.2003
Carbon monoxide	10 mg/m^3	Running 8-hour mean	31.12.2003
Lead	0.50 $\mu\text{g}/\text{m}^3$	Annual mean	31.12.2004
	0.25 $\mu\text{g}/\text{m}^3$	Annual mean	31.12.2008
Nitrogen dioxide	200 $\mu\text{g}/\text{m}^3$ not to be exceeded more than 18 times a year	1-hour mean	31.12.2005
	40 $\mu\text{g}/\text{m}^3$	Annual mean	31.12.2005
Particulate Matter (PM ₁₀) (gravimetric)	50 $\mu\text{g}/\text{m}^3$, not to be exceeded more than 35 times a year	24-hour mean	31.12.2004

Pollutant	Air Quality Objective		Date to be achieved by
	Concentration	Measured as	
	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 provides a summary of the previous reports completed by Gloucester City Council (the Council) as part of the LAQM Review and Assessment process.

Table 1-2 Summary of Previous Review and Assessment

Report	Summary
2005 AQMA declaration	Barton Street AQMA and Priory Road AQMA declared due to exceedences of the annual mean objective for NO ₂ .
2006 Updating and Screening Assessment	This report indicated that a detailed assessment was required in respect of NO ₂ at a length of Painswick Road as the annual mean objective was likely to be exceeded and an AQMA may need to be declared.
2007 AQMA declaration	Painswick Road AQMA declared due to exceedences of the annual mean objective for NO ₂ .
2007 Progress Report	This report confirmed that a detailed assessment was carried out at Painswick Road during 2006, the results of which confirmed that an AQMA was required in respect of NO ₂ as the annual mean objective had been breached for the second occasion. The Painswick Road AQMA was declared during 2007. Air Quality Action Plans for Barton Street and Priory Road were still under development in conjunction with Gloucestershire County Council Highways. A detailed assessment was recommended at the area of Barnwood Road where monitoring results showed exceedences of annual mean NO ₂ .
2008 Progress Report	This progress report incorporated the detailed assessment for Barnwood Road and the annual report on progress in respect of the Barton Street, Priory Road and Painswick Road AQMAs. The report confirmed that an AQMA is not required at the area of Barnwood Road. Further monitoring in this area was recommended. Action plans were still being developed in conjunction with Gloucestershire County Council and consideration being given to linking this document in with the Local Transport Plan.
2009 Updating and Screening Assessment	The report confirmed that levels of measured NO ₂ within the Barton Street, Priory Road and Painswick Road AQMAs were still exceeding the annual mean objective for NO ₂ . Once again it was highlighted that a further detailed assessment was required in respect of

	NO ₂ for a section of Barnwood Road. Furthermore, it was identified that a detailed assessment was required for an area of housing estate off Myers Road Industrial Estate in respect of PM ₁₀ .
2010 Progress Report	The report confirmed that levels of measured NO ₂ within the Barton Street, Priory Road and Painswick Road AQMAs were still exceeding the annual mean objective for NO ₂ . Following detailed assessments for both Barnwood Road and Myers Road it was found that levels of NO ₂ and PM ₁₀ were not breaching relevant objectives and that AQMAs were not required. The report confirmed that there were no other locations of concern at that time.
2011 Progress Report	The report confirmed that levels of measured NO ₂ within the Barton Street, Priory Road and Painswick Road AQMAs were still exceeding the annual mean objective for NO ₂ . The report confirmed that there were no other locations of concern at that time.
2012 Updating and Screening Assessment	The report confirmed that levels of measured NO ₂ within the Barton Street, Priory Road and Painswick Road AQMAs were still exceeding the annual mean objective for NO ₂ . It also outlined that it was the Council's intention to investigate the possibility of merging the Barton Street and Painswick Road AQMAs given they are in effect the same section of road and would benefit from co-ordinated solutions. Within the report it was confirmed that the Council would investigate the potential of installing a continuous analyser within the Priory Road AQMA.
2013 Progress Report	The report confirmed that levels of measured NO ₂ within the Barton Street, Priory Road and Painswick Road AQMAs were still exceeding the annual mean objective for NO ₂ . The report confirmed that there were no other locations of concern at that time. A decision was taken to cease continuous monitoring at Barton Street due to resource implications.

Maps are provided for the three existing AQMAs within Gloucester City with an additional map showing their locations within the wider City context.

Figure 1-3 Painswick Road AQMA

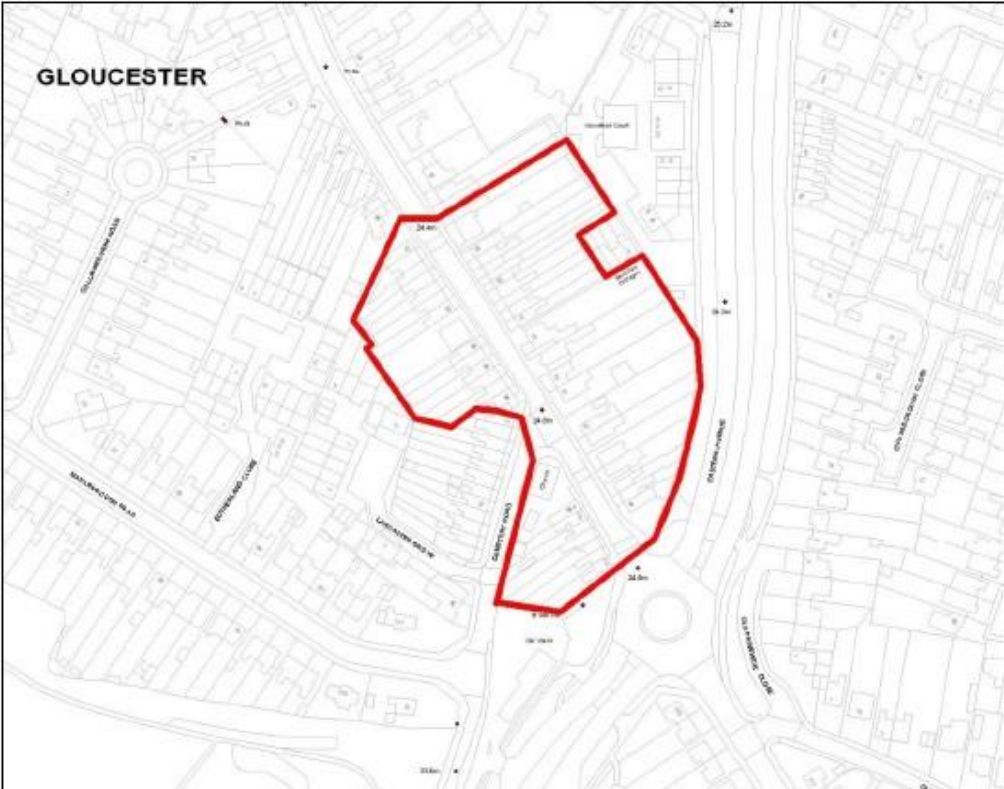
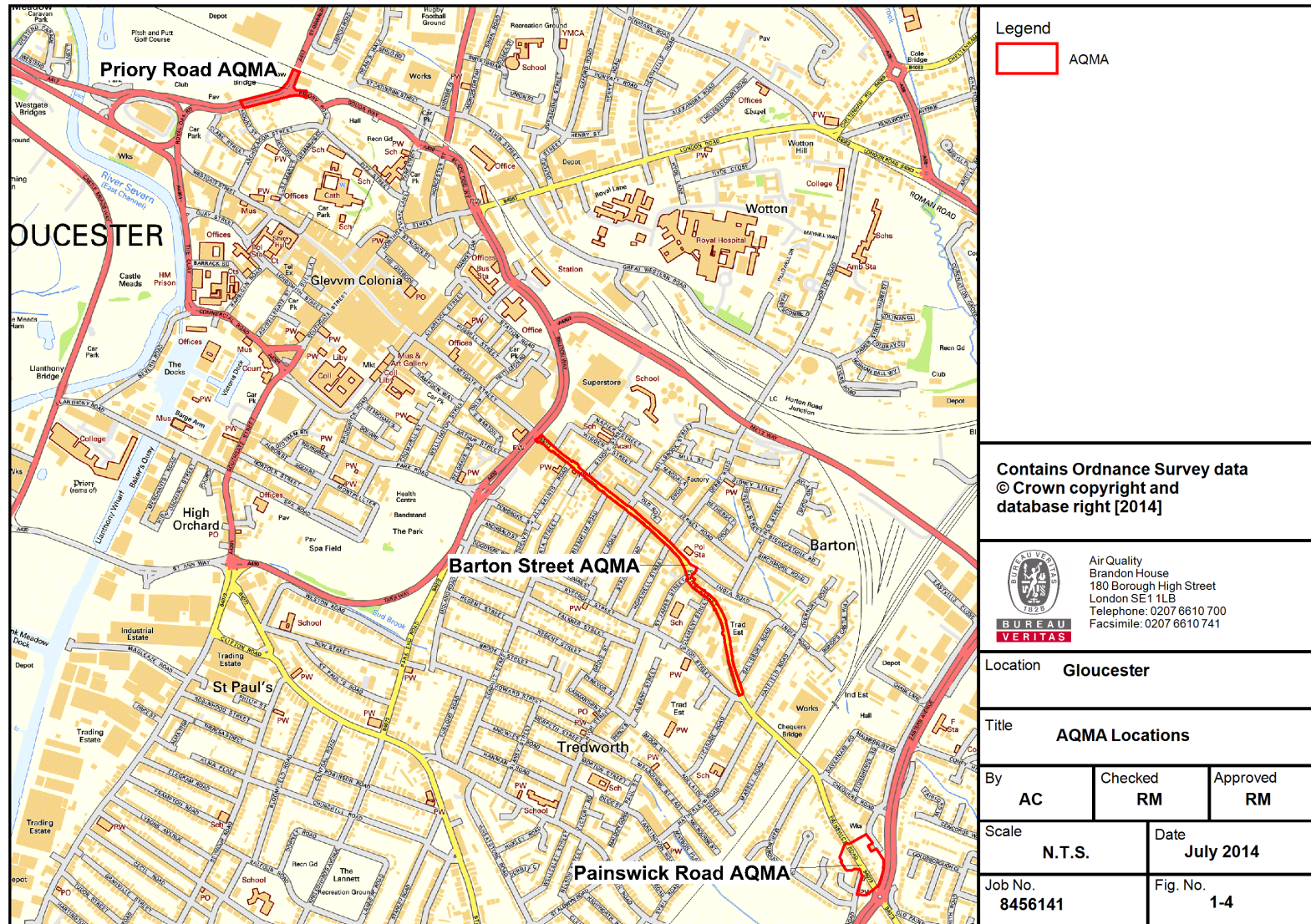



Figure 1-4 Map of Gloucester City showing locations of AQMAs



<p>Legend</p> <p> AQMA</p>		
<p>Contains Ordnance Survey data © Crown copyright and database right [2014]</p>		
<p> Air Quality Brandon House 180 Borough High Street London SE1 1LB Telephone: 0207 6610 700 Facsimile: 0207 6610 741</p>		
Location		Gloucester
Title		
AQMA Locations		
By	Checked	Approved
AC	RM	RM
Scale		Date
N.T.S.		July 2014
Job No.		Fig. No.
8456141		1-4

2 New Monitoring Data

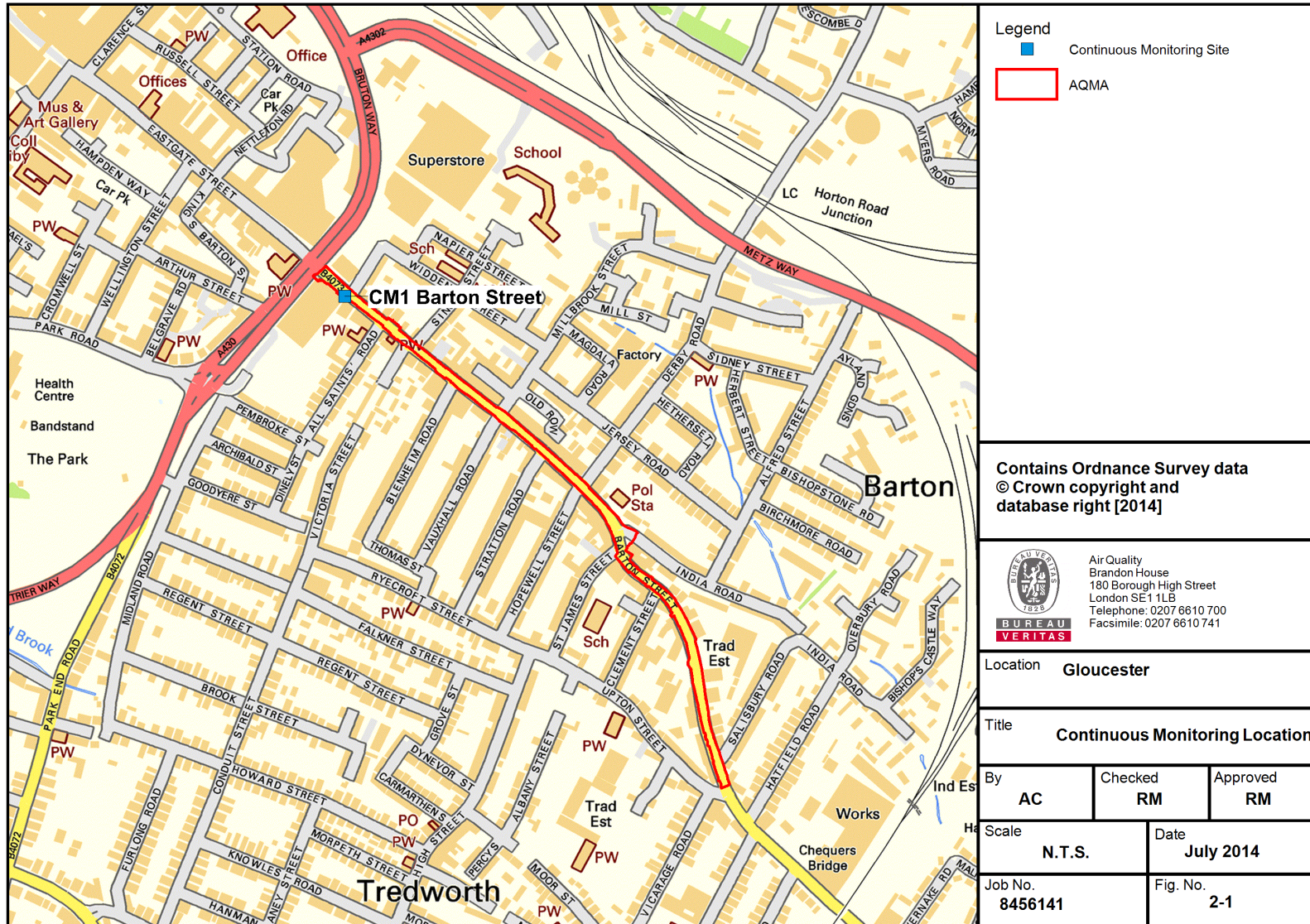
2.1 Summary of Monitoring Undertaken

2.1.1 Automatic Monitoring Sites

Gloucester City Council operated one automatic monitoring station in 2013 measuring nitrogen dioxide using a chemiluminescence analyser at B4073 Barton Street, Barton, Gloucester within the Barton Street AQMA. The station had operated since 2010 and was managed by Gloucestershire County Council until 2012 when Gloucester City Council took over responsibility for its operation. The site was closed in January 2014.

Further details of this monitoring station are provided in Table 2-1 and the location is shown in Figure 2-1 and Figure 2-2.

Figure 2-1 Map of Continuous Monitoring Sites



Legend

- Continuous Monitoring Site
- AQMA

Contains Ordnance Survey data
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 database right [2014]

Air Quality
 Brandon House
 180 Borough High Street
 London SE1 1LB
 Telephone: 0207 6610 700
 Facsimile: 0207 6610 741

Location **Gloucester**

Title **Continuous Monitoring Locations**

By AC	Checked RM	Approved RM
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Scale N.T.S.	Date July 2014
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Job No. 8456141	Fig. No. 2-1
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Figure 2-2 Photograph of Automatic Monitoring Site



Table 2-1 Details of Automatic Monitoring Sites

Site ID	Site Name	Site Type	X OS Grid Reference	Y OS Grid Reference	Pollutants Monitored	In AQMA?	Monitoring Technique	Relevant Exposure? (Y/N with distance from monitoring site to relevant exposure)	Distance to Kerb of Nearest Road	Does this Location Represent Worst-Case Exposure?
CM1	Barton Street	Roadside	383690	218102	NO ₂	Yes	Chemiluminescence	Y (2m)	4m	Yes

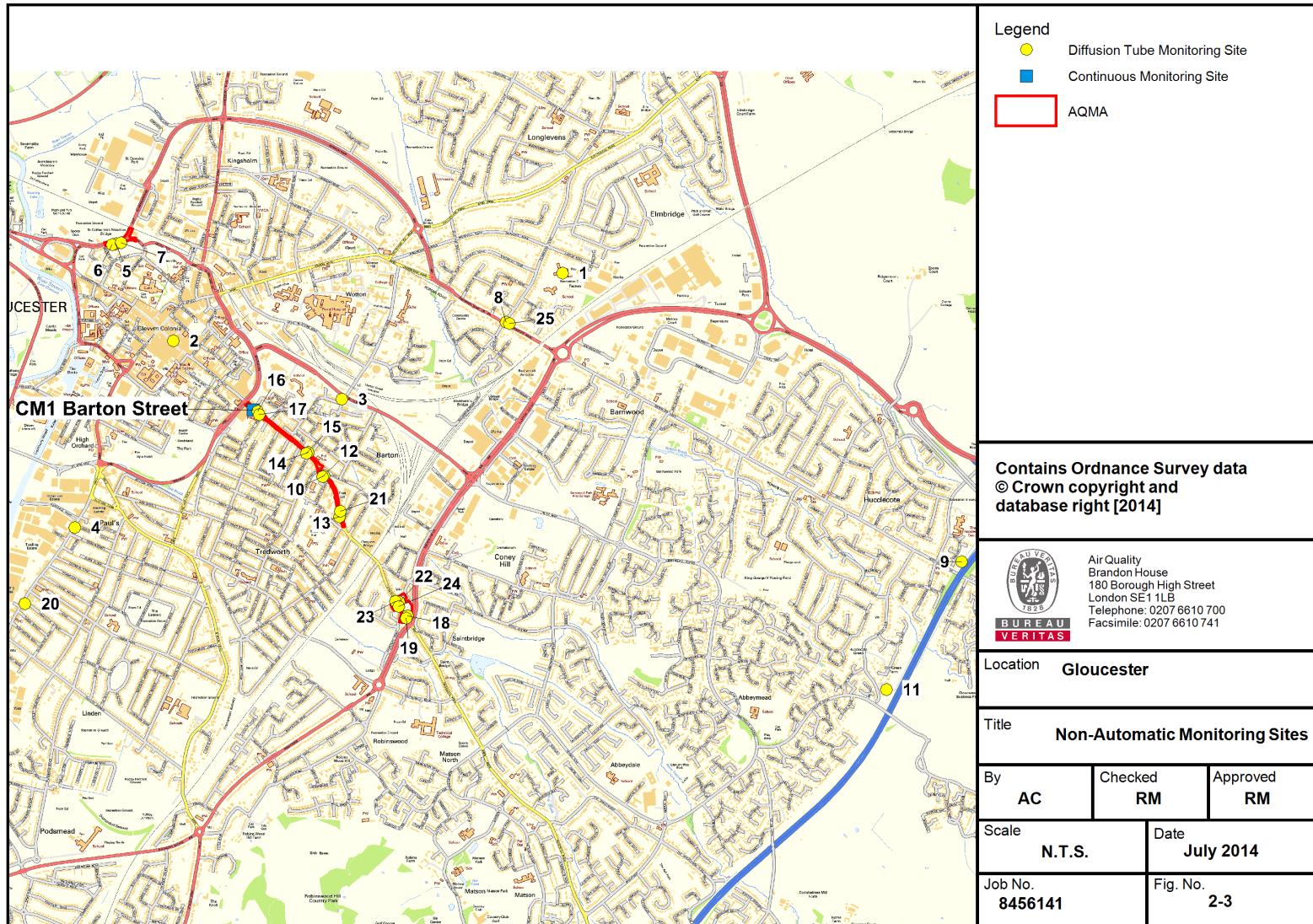
2.1.2 Non-Automatic Monitoring Sites

Gloucester City Council undertook monitoring using passive NO₂ diffusion tubes at 25 sites in 2013. This includes one set of triplicate tubes installed at 56 Priory Road within Priory Road AQMA (not co-located).

There has been no change in diffusion tube locations from monitoring in previous years.

The details of the NO₂ monitoring network are shown in Table 2.2 and Figure 2.3.

Figure 2-3 Map of Non-Automatic Monitoring Sites



Legend

- Diffusion Tube Monitoring Site
- Continuous Monitoring Site
- AQMA

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 Air Quality
Brandon House
180 Borough High Street
London SE1 1LB
Telephone: 0207 6610 700
Facsimile: 0207 6610 741

Location **Gloucester**

Title **Non-Automatic Monitoring Sites**

By AC	Checked RM	Approved RM
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Scale N.T.S.	Date July 2014
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Job No. 8456141	Fig. No. 2-3
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Table 2-2 Details of Non- Automatic Monitoring Sites

Site ID	Site Name	Site Type*	X OS Grid Reference	Y OS Grid Reference	Pollutants Monitored	In AQMA?	Triplicate Tube or Monitoring Co-located with a Continuous Analyser (Y/N)	Relevant Exposure?	Distance to Kerb of Nearest Road (m)	Does this Location Represent Worst-Case Exposure?
1	Elmbridge Junior School	UB	385430	218870	NO ₂	N	N	Y (1m)	N/A	N
2	Gloucester Guildhall	UB	383243	218489	NO ₂	N	N	N	N/A	N
3	79 Millbrook Street	R	384190	218160	NO ₂	N	N	Y (<1m)	1.0m	Y
4	59 Bristol Rd (façade)	R	382690	217440	NO ₂	N	N	Y (1m)	<1m	Y
5	56 Priory Road	R	382921	219034	NO ₂	Y (Priory Road AQMA)	Y (triplicate)	Y (<1m)	5.0m	Y
6	46 Priory Road	R	382898	219029	NO ₂	Y (Priory Road AQMA)	N	Y (<1m)	5.0m	Y
7	66 Priory Road	R	382950	219040	NO ₂	Y (Priory Road AQMA)	N	Y (<1m)	6.0m	Y
8	53 Barnwood Road	R	385113	218595	NO ₂	N	N	Y (<1m)	1.5m	Y
9	35 Buscombe Gardens	R	387670	217250	NO ₂	N	N	Y (<1m)	20m to M5	N
10	Opp 248 Barton St	R	384090	217731	NO ₂	Y (Barton Street AQMA)	N	Y (<1m)	2.5m	N
11	12 Orchard Park, Green Lane	UB	387250	216530	NO ₂	N	N	Y (<1m)	N/A	N
12	246 Barton Street	R	384081	217725	NO ₂	Y (Barton Street AQMA)	N	Y (<1m)	1.5m	Y
13	316 Barton Street	R	384175	217501	NO ₂	Y (Barton Street AQMA)	N	Y (<1m)	2.4m	Y
14	219A Barton St	R	384000	217863	NO ₂	Y (Barton Street AQMA)	N	Y (1m)	1.7m	Y

Site ID	Site Name	Site Type*	X OS Grid Reference	Y OS Grid Reference	Pollutants Monitored	In AQMA?	Triplicate Tube or Monitoring Co-located with a Continuous Analyser (Y/N)	Relevant Exposure?	Distance to Kerb of Nearest Road (m)	Does this Location Represent Worst-Case Exposure?
15	196 Barton Street	R	383989	217857	NO ₂	Y (Barton Street AQMA)	N	Y (1m)	2.0m	Y
16	99 Barton Street	R	383717	218094	NO ₂	Y (Barton Street AQMA)	N	Y (1m)	1.4m	Y
17	124 Barton Street	R	383726	218074	NO ₂	Y (Barton Street AQMA)	N	Y (1m)	1.5m	Y
18	97 Painswick Road	R	384558	216946	NO ₂	Y (Painswick Road AQMA)	N	Y (1m)	5.1m	Y
19	106 Painswick Road	R	384550	216932	NO ₂	Y (Painswick Road AQMA)	N	Y (1m)	3.5m	Y
20	157 Bristol Rd	R	382410	217013	NO ₂	N	N	Y (1m)	6.5m	Y
21	301 Barton St	R	384182	217533	NO ₂	Y (Barton Street AQMA)	N	Y (1m)	4.8m	Y
22	65 Painswick Rd	R	384512	217023	NO ₂	N	N	Y (1m)	5.4m	Y
23	76 Painswick	R	384490	217027	NO ₂	Y	N	Y (1m)	3.7m	Y
24	88 Painswick Road	R	384509	216998	NO ₂	Y (Painswick Road AQMA)	N	Y (1m)	3.8m	Y
25	61 Barnwood Road	R	385130	218585	NO ₂	N	N	Y (1m)	4.6m	Y

* R – Roadside, UB – Urban Background

2.2 Comparison of Monitoring Results with Air Quality Objectives

2.2.1 Nitrogen Dioxide

There are two Air Quality Objectives for NO₂, namely:

- the annual mean of 40µg/m³, and
- the 1-hour mean of 200µg/m³ not to be exceeded more than 18 times a year.

Automatic Monitoring Data

The Council monitored NO₂ at one location during 2013. This was the roadside site at Barton Street.

The monitoring data can be seen in Table 2-3 and Table 2-4 below. Full details of the QA/QC procedure are provided in Appendix A.

Data capture was lower than in the previous year, however annualisation was not required as data capture was above 75 %. As data capture was below 90%, the 99.8th percentile has also been reported for the hourly objective for this site.

Results for 2013 indicate that both the annual mean objective and the 1-hour objective were not exceeded at the monitoring site.

Figure 2.3 shows the trend in NO₂ concentrations from 2010 through to 2013 at the monitoring site. This shows that the site had remained above the annual mean objective until 2012; following this, concentrations showed a significant reduction in 2013. This is consistent with the diffusion tube results, which also showed significantly lower concentrations in 2013 when compared to previous year.

Table 2-3 Results of Automatic Monitoring for NO₂: Comparison with Annual Mean Objective

Site ID/Name	Site Type	Within AQMA?	Valid Data Capture for Monitoring Period, %	Valid Data Capture 2013, %	Annual Mean Concentration (µg/m ³)					
					2008	2009	2010	2011	2012	2013
CM1 / Barton Street	Roadside	Yes	80.1	80.1	-	-	46	44	44	37.2

In **bold**, exceedence of the NO₂ annual mean AQS objective of 40 µg/m³

Figure 2-4 Trends in Annual Mean NO₂ Concentrations Measured at Automatic Monitoring Sites

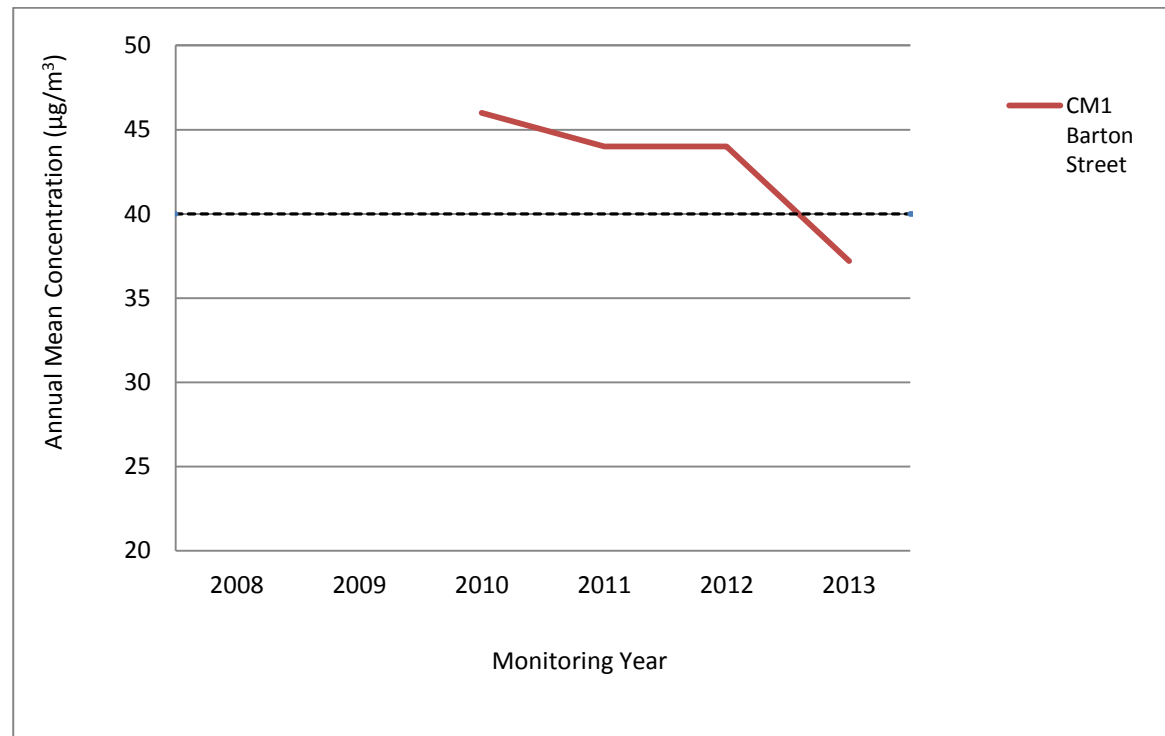


Table 2-4 Results of Automatic Monitoring for NO₂: Comparison with 1-hour Mean Objective

Site ID	Site Type	Within AQMA?	Valid Data Capture for Monitoring Period %	Valid Data Capture 2013 %	Number of Hourly Means > 200µg/m ³					
					2008	2009	2010	2011	2012	2013
CM1 / Barton Street	Roadside	Yes	80.1	80.1	-	-	0	0	0	0 (108.9)

If the period of valid data is less than 90%, the 99.8th percentile of hourly means is included in brackets
 In **bold**, exceedence of the NO₂ 1-hour mean AQS objective (200 µg/m³ not to be exceeded more than 18 times a year)

Diffusion Tube Monitoring Data

The NO₂ diffusion tube data are summarised in Table 2.5. The full dataset (monthly mean values) are included in Appendix A.

Results for year 2013 have been bias adjusted using the national bias adjustment factor. Three months of data were not available in 2013; these were October, November and December. Nine sites had to be annualised as there were fewer than 9 months data capture. Full details of the annualisation, bias adjustment and QA/QC procedure are provided in Appendix A.

There were no sites in 2013 where the annual mean AQS objective was exceeded.

Figures 2.5 through to 2.8 show the trend in NO₂ concentration for the sites located in Gloucester City Council. There are no clear trends evident at the monitoring sites over 2008-2013. The concentrations peaked in 2008 at the majority of sites. Majority of sites also showed an increase in concentrations in 2010 and 2012. Concentrations reduced significantly in 2013 at most sites.

Table 2-5 Results of NO₂ Diffusion Tubes 2013

Site ID	Site Name	Site Type	Within AQMA?	Triplicate or Co-located Tube	Full Calendar Year Data Capture 2013 (Number of Months)	2013 Annual Mean Concentration (µg/m ³) - Bias Adjustment factor = 0.95
1	Elmbridge Junior School	UB	N	N	4	22.2 ^a
2	Gloucester Guildhall	UB	N	N	4	23.8 ^a
3	79 Millbrook Street	R	N	N	5	36.6 ^a
4	59 Bristol Rd (façade)	UB	N	N	7	38.0 ^a
20	157 Bristol Rd	R	N	N	9	30.5
9	35 Buscombe Gardens	R	N	N	9	34.2
11	12 Orchard Park, Green Lane	UB	N	N	9	26.9
6	46 Priory Road	R	Y (Priory Road AQMA)	N	8	37.2 ^a
5	56 Priory Road	R	Y (Priory Road AQMA)	triplicate	9	36.5
7	66 Priory Road	R	Y (Priory Road AQMA)	N	6	38.4 ^a
16	99 Barton Street	R	Y (Barton Street AQMA)	N	9	36.2
17	124 Barton Street	R	Y (Barton Street AQMA)	N	9	38.8
15	196 Barton Street	R	Y (Barton Street AQMA)	N	9	35.9
14	219A Barton St	R	Y (Barton Street AQMA)	N	9	38.0
12	246 Barton Street	R	Y (Barton Street AQMA)	N	9	33.2
10	Opp 248 Barton St	R	Y (Barton Street AQMA)	N	8	32.7 ^a
21	301 Barton St	R	Y (Barton Street AQMA)	N	9	22.6

Site ID	Site Name	Site Type	Within AQMA?	Triplicate or Co-located Tube	Full Calendar Year Data Capture 2013 (Number of Months)	2013 Annual Mean Concentration ($\mu\text{g}/\text{m}^3$) - Bias Adjustment factor = 0.95
13	316 Barton Street	R	Y (Barton Street AQMA)	N	9	35.4
22	65 Painswick Rd	R	N	N	9	27.4
23	76 Painswick	R	N	N	9	30.2
24	88 Painswick Road	R	Y (Painswick Road AQMA)	N	9	33.6
18	97 Painswick Road	R	Y (Painswick Road AQMA)	N	9	29.3
19	106 Painswick Road	R	Y (Painswick Road AQMA)	N	9	38.0
8	53 Barnwood Road	R	N	N	8	39.1 ^a
25	61 Barnwood Road	R	N	N	8	35.0 ^a

^a Results were annualised in accordance with the methodology laid out in TG(09) Box 3.2.
In **bold**, exceedence of the NO₂ annual mean AQS objective of 40 $\mu\text{g}/\text{m}^3$

Table 2-6 Results of NO₂ Diffusion Tubes (2008 to 2013)

Site ID	Site Type	Within AQMA?	Annual Mean Concentration (µg/m ³) - Adjusted for Bias					
			2008 (Bias Adjustment Factor = 0.87)	2009 (Bias Adjustment Factor = 0.79)	2010 (Bias Adjustment Factor = 0.77)	2011 (Bias Adjustment Factor = 0.85)	2012 (Bias Adjustment Factor =1.01)	2013 (Bias Adjustment Factor = 0.95)
1	UB	N	21.2	17.9	19.9	21.7	22.3	22.2 ^a
2	UB	N	21.6	20.2	22.2	20.1	24.5	23.8 ^a
3	R	N	36.0	33.0	32.4	29.2	31.7	36.6 ^a
4	R	N	34.3	29.7	30.0	28.6	30.9	38.0 ^a
20	R	N	31.5	27.8	27.9	25.7	27.2	30.5
9	R	N	33.7	29.6	29.9	29.0	29.3	34.2
11	UB	N	28.1	24.6	26.0	22.6	25.7	26.9
6	R	Y (Priory Road AQMA)	48.7	44.9	43.2	43.0	45.9	37.2 ^a
5	R	Y (Priory Road AQMA)	53.2	51.7	48.6	45.4	47.4	36.5
7	R	Y (Priory Road AQMA)	57.8	52.6	55.8	49.1	52.5	38.4 ^a
16	R	Y (Barton Street AQMA)	42.2	36.7	48.2	37.2	40.8	36.2
17	R	Y (Barton Street AQMA)	52.6	48.6	40.7	46.2	48	38.8
15	R	Y (Barton Street AQMA)	44.6	35.3	43.3	39.9	43.1	35.9
14	R	Y (Barton Street AQMA)	42.5	35.2	43.3	35.2	40.8	38.0
12	R	Y (Barton Street AQMA)	42.4	38.4	37.2	32.1	36	33.2
10	R	Y (Barton Street AQMA)	33.2	30.6	33.9	27.6	33.2	32.7 ^a
21	R	Y (Barton Street AQMA)	28.3	27.9	27.1	24.1	28.7	22.6
13	R	Y (Barton Street AQMA)	44.2	38.5	40.1	36.6	39.9	35.4
22	R	N	33.3	29	31.5	26.8	29	27.4
23	R	N	38.6	35	33.7	32.4	32.9	30.2
24	R	Y (Painswick Road AQMA)	44.3	37.4	37.6	36.9	36.7	33.6
18	R	Y (Painswick Road AQMA)	36.6	32.7	32.2	29.6	30.3	29.3

Site ID	Site Type	Within AQMA?	Annual Mean Concentration ($\mu\text{g}/\text{m}^3$) - Adjusted for Bias					
			2008 (Bias Adjustment Factor = 0.87)	2009 (Bias Adjustment Factor = 0.79)	2010 (Bias Adjustment Factor = 0.77)	2011 (Bias Adjustment Factor = 0.85)	2012 (Bias Adjustment Factor = 1.01)	2013 (Bias Adjustment Factor = 0.95)
19	R	Y (Painswick Road AQMA)	49.9	41.1	41	40.9	40.1	38.0
8	R	N	38.3	38.2	39.1	37.3	32.4	39.1 ^a
25	R	N	45.0	40.0	43.0	38.2	37.8	35.0 ^a

^a Results were annualised in accordance with the methodology laid out in TG(09) Box 3.2.
 In **bold**, exceedence of the NO₂ annual mean AQS objective of 40 $\mu\text{g}/\text{m}^3$

Figure 2-5 Trends in Annual Mean Nitrogen Dioxide Concentrations Measured at Diffusion Tube Monitoring Sites

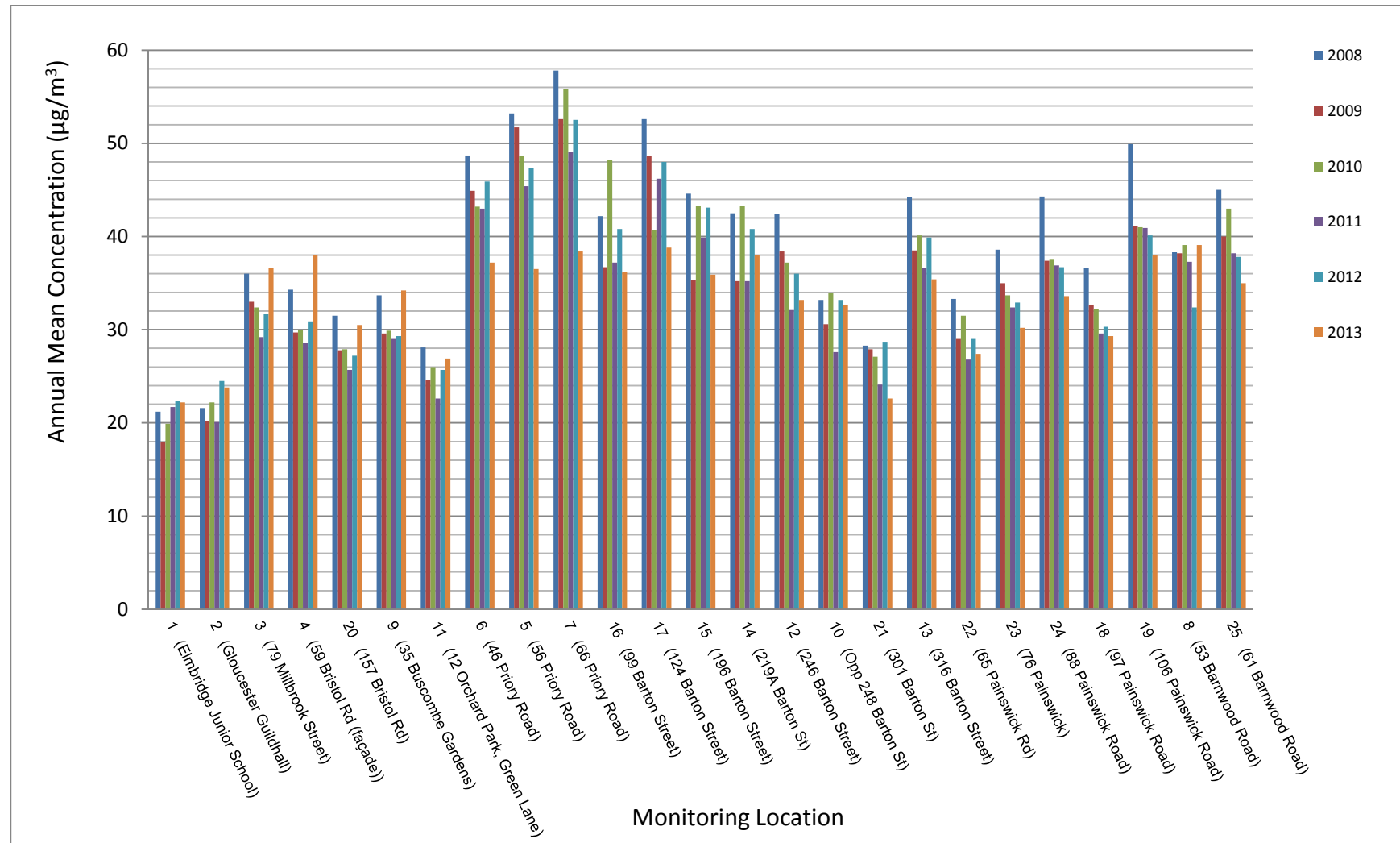


Figure 2-6 Trends in Annual Mean Nitrogen Dioxide Concentrations Measured at Diffusion Tube Monitoring Sites in Barton Street AQMA

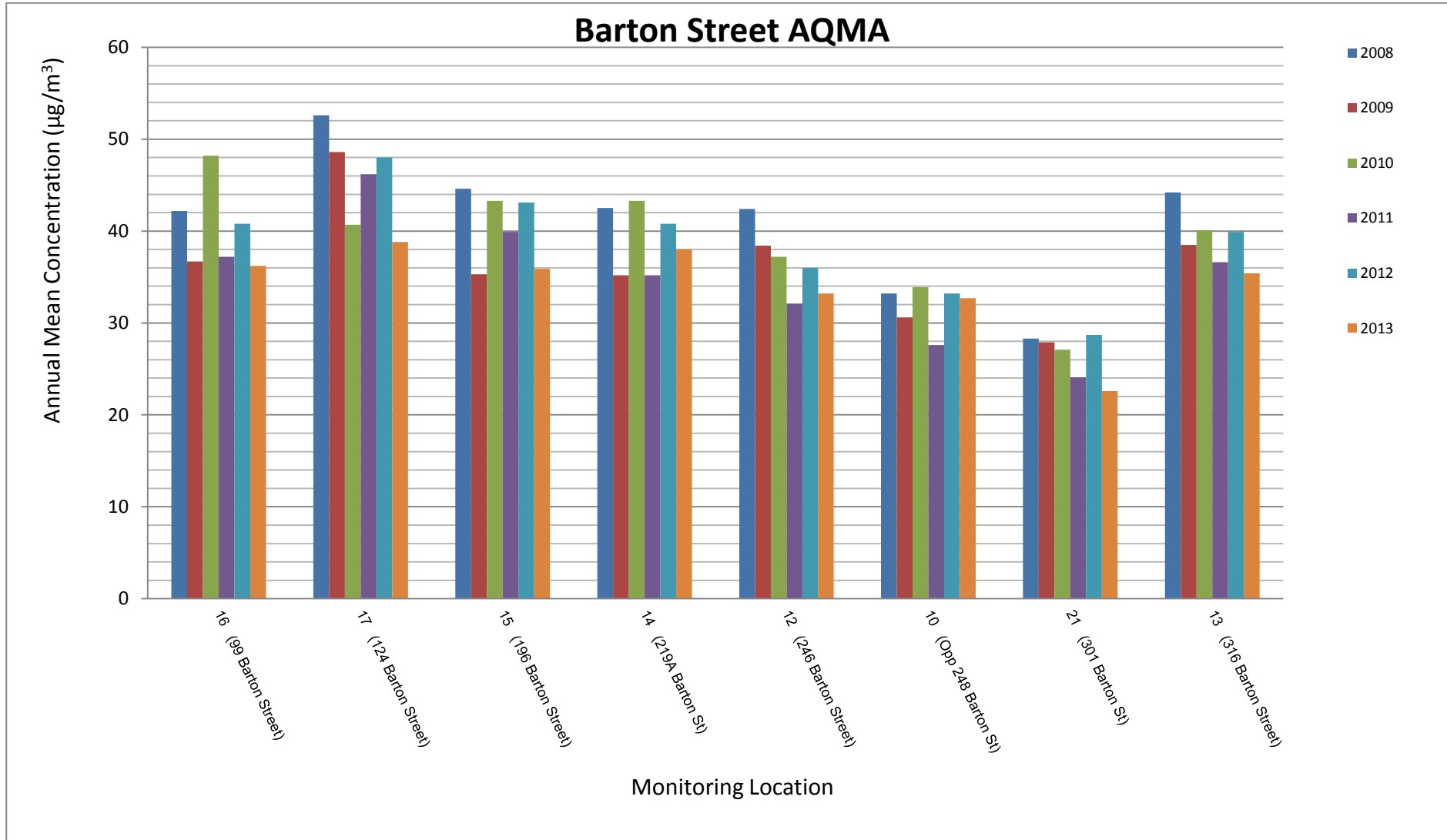


Figure 2-7 Trends in Annual Mean Nitrogen Dioxide Concentrations Measured at Diffusion Tube Monitoring Sites in Priory Road AQMA

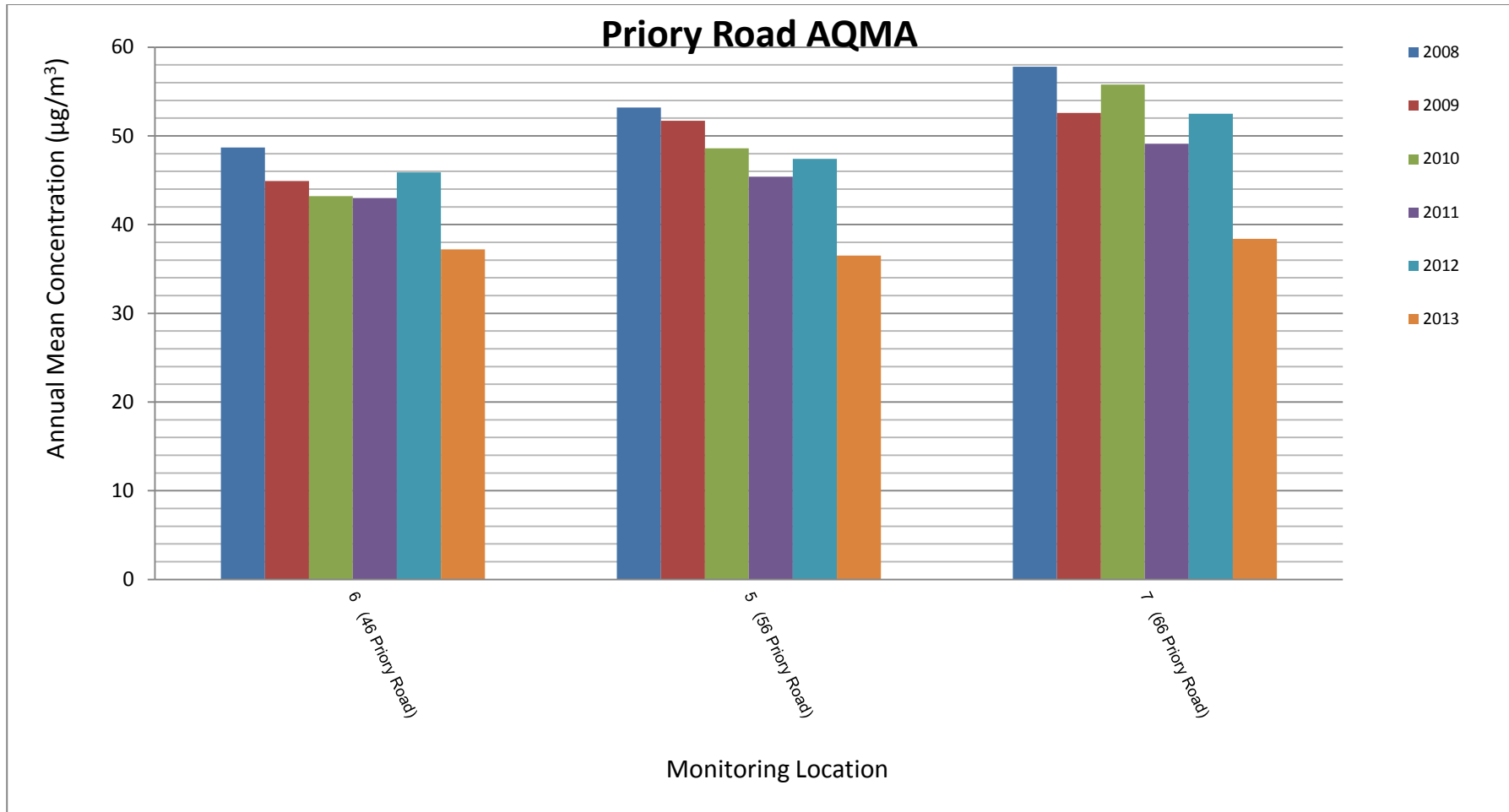
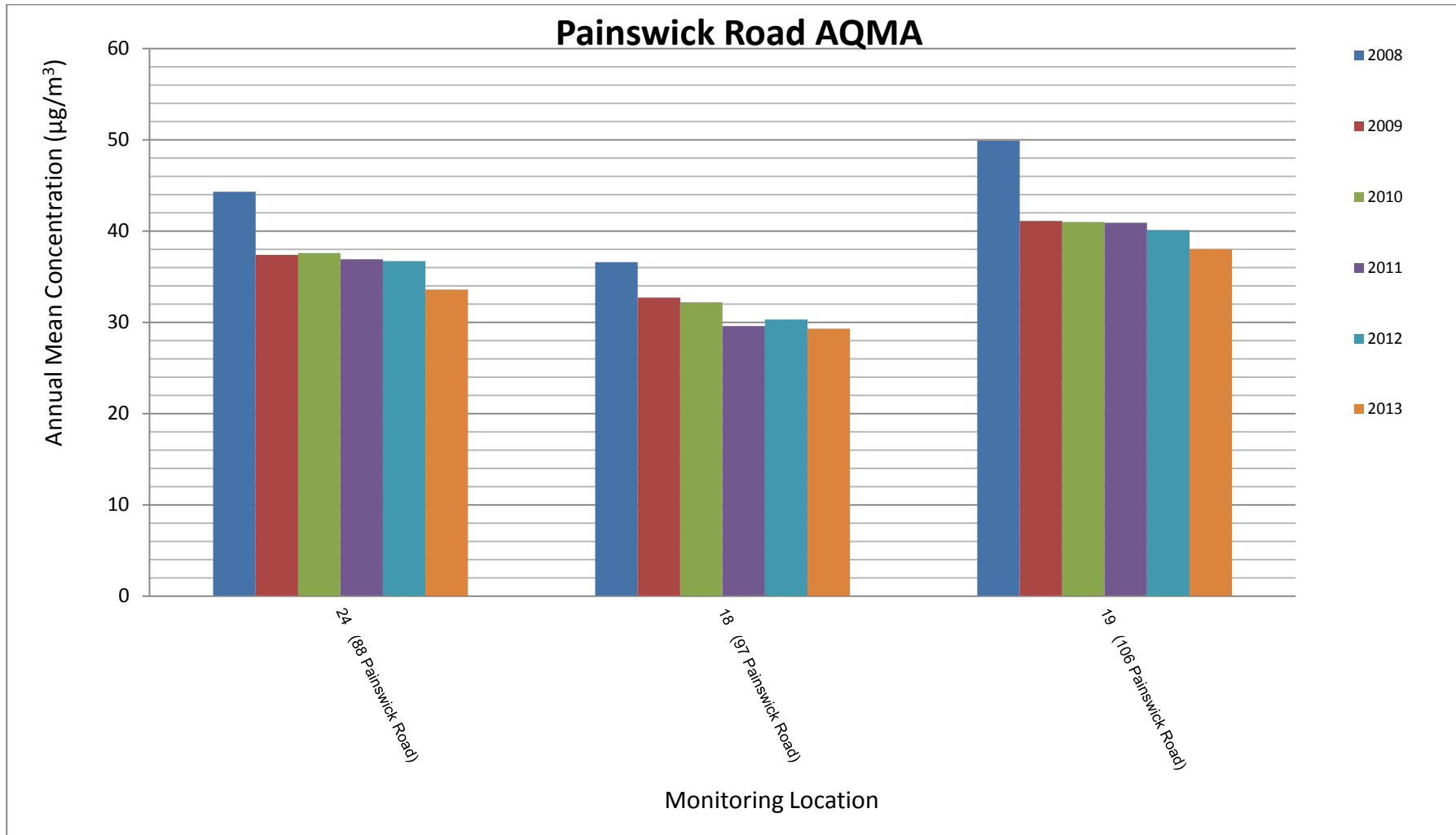


Figure 2-8 Trends in Annual Mean Nitrogen Dioxide Concentrations Measured at Diffusion Tube Monitoring Sites in Priory Road AQMA



2.2.2 Particulate Matter (PM₁₀)

No PM₁₀ monitoring was undertaken by Gloucester City Council in 2013.

2.2.3 Sulphur Dioxide (SO₂)

No monitoring of sulphur dioxide was undertaken by Gloucester City Council.

2.2.4 Benzene

No monitoring of benzene was undertaken by Gloucester City Council.

2.2.5 Summary of Compliance with AQS Objectives

Gloucester City Council has examined the results from monitoring in the City. Concentrations are all below the objectives, therefore there is no need to proceed to a Detailed Assessment.

3 New Local Developments

3.1 Road Traffic Sources

LAQM requires local authorities to consider the following:

- Narrow congested streets with residential properties close to the kerb;
- Busy streets where people may spend one hour or more close to traffic;
- Roads with a high flow of buses and/or HGVs;
- Junctions;
- New roads constructed since the last Updating and Screening Assessment;
- Roads with significantly changed traffic flows; and
- Bus or coach stations.

Gloucester City Council confirms that of the above categories there have been no new or newly identified which have not previously been considered in previous rounds of review and assessment.

3.2 Other Transport Sources

LAQM requires local authorities to consider the following:

- Airports;
- Locations where diesel or steam trains are regularly stationary for periods of 15 minutes or more, with relevant exposure within 15m;
- Locations with a large number of movements of diesel locomotives and long term relevant exposure within 30m; and
- Shipping ports.

Gloucester City Council confirms that of the above categories there have been no new or newly identified sources which have not been considered in previous rounds of review and assessment.

3.3 Industrial Sources

LAQM requires local authorities to consider the following:

- Industrial Installations: new or proposed;
- Industrial installations: existing where emissions have increased substantially or relevant exposure introduced;
- Major fuel storage depots;
- Petrol stations; and
- Poultry farms.

Gloucester City Council confirms that of the above categories there have been no new or newly identified sources which have not been considered in previous rounds of review and assessment.

3.4 Commercial and Domestic Sources

LAQM requires local authorities to consider the following:

- Biomass combustion plant – individual installations;
- Areas where the combined impact of several biomass combustion sources may be relevant; and
- Areas where domestic solid fuel burning may be relevant.

Gloucester City Council confirms that of the above categories there have been no new or newly identified sources which have not been considered in previous rounds of review and assessment.

3.5 New Developments with Fugitive or Uncontrolled Sources

LAQM requires local authorities to consider the following:

- Landfill sites;
- Quarries;
- Unmade haulage roads on industrial sites;
- Waste transfer stations; and

- Any other potential sources of fugitive particulate emissions.

Gloucester City Council confirms that of the above categories there have been no new or newly identified sources which have not been considered in previous rounds of review and assessment.

Gloucester City Council confirms that there are no new or newly identified local developments which may have an impact on air quality within the Local Authority area.

The Council confirms that all the following have been considered:

- **Road traffic sources**
- **Other transport sources**
- **Industrial sources**
- **Commercial and domestic sources**
- **New developments with fugitive or uncontrolled sources.**

4 Local / Regional Air Quality Strategy

The six local authorities of Gloucestershire work actively work together, to seek air quality improvements, through the Gloucestershire Pollution Group (GPG) which is a sub-committee of the Gloucestershire Chief Environmental Health Officers Group.

Future funding mechanisms, for the routine requirements of local air quality management and for the implementation of initiatives, will be best achieved through a collaborative approach. Future proposed revisions of the national Air Quality Strategy, national air quality objectives and the introduction of newly regulated pollutants are best addressed through the work of this Group.

The development of a County-wide Air Quality Strategy for Gloucestershire provides an important framework for maintaining good air quality and improving upon poor air quality over the years ahead. As the pressures of large-scale developments, housing growth and road-building increases, so too does the need for maintaining the quality of the environment and the health and well-being of the public and communities served by the six local authorities of Gloucestershire.

Community planning and sustainability planning processes underway within the local authorities and the county will need to take account of local air quality, for the benefit of communities now and in future across Gloucestershire. The need to address climate change will require integration with plans to improve air quality locally across the County.

The Air Quality Strategy was initially drawn up in 2004 by the University West of England at Frenchay, Bristol on behalf of the GPG. This document was revised in 2011 through consultation with Gloucestershire Highways at the County Council.

The 2011 Strategy emphasises the importance of cooperation between local authorities and other bodies and agencies that have the ability to affect air quality across Gloucestershire. Inter-departmental work within a local authority is also encouraged, in particular between Environmental Health, Land-Use Planning, Transport Planning, Economic Development and Regeneration, Sustainable Development and Community Planning, and Education Services.

5 Planning Applications

There was only one application granted approval in 2013 that might have implications in respect of air quality.

Planning Application 11/00107/FUL – 254 residential dwellings with additional business space, Former Gloscat Buildings, Brunswick Road, Gloucester

This development saw the demolition of an inner city art college and associated buildings which are to be replaced with a complex that will contain 254 residential units and retail units. The application was supported by an Environmental Statement. The development was permitted with conditions. Subsequent applications associated with the development referred to specific conditions.

A qualitative assessment of the air quality impacts during the construction phase has determined that the impact of dust and PM₁₀ releases will be “minor adverse” after good site practice and mitigation measures have been implemented,.

Concentrations of NO₂ and PM₁₀ predicted using DMRB model were below the objectives at worst-case receptor locations.

Summary of Applications:

Planning Reference /Decision	Location	Description	Additional Information
11/00107/FUL Grant Consent 3yrs	Former Gloscat Buildings, Brunswick Road, Gloucester	Demolition of existing buildings and construction of 10 blocks on the Greyfriars site (land to the north west of Brunswick Road) and 5 blocks on the Media site (land to the south east of Brunswick Road) comprising 254 residential dwellings; 350 m ² of A3 use (restaurant/café) on the Greyfriars site; 1335 m ² of D1 and D2 uses (medical/educational) on the Media site, 367 m ² of retail use on the Media site and 490 m ² of business use on the Media site; 207 car parking spaces total; improvements to highway network.	Environmental Statement submitted as part of the proposal.

6 Air Quality Planning Policies

Air quality is a material consideration in determining planning applications. Poor air quality can have detrimental impacts on health and the amenity of users of land in terms of odour, dust and nuisance.

The planning system has a key role in protecting people from unacceptable risks to their health and in providing an adequate protection to the amenity value of land. These considerations must, however, be balanced against other aims of the planning system such as to secure economic regeneration and provide adequate levels of housing.

The National Planning Policy Framework is a key part of the government's reforms to make the planning system less complex and more accessible. It vastly simplifies the number of policy pages about planning. The framework acts as guidance for local planning authorities and decision-takers, both in drawing up plans and making decisions about planning applications. Previous guidance documents such as PPG 23: Planning and Pollution Control, have been repealed.

There is no Supplementary Planning Guidance (SPG) for air quality matters currently available to the City but this will be progressed during 2014/2015 and links into one of the measures we seek to implement as part of our air quality action plans.

7 Local Transport Plans and Strategies

The Local Transport Plan for Gloucestershire (LTP3) sets out the transport strategy for the County from 2011 to 2026.

The document sets out its vision for transport in the future as: "**Providing a safe and sustainable transport network within Gloucestershire**" where **safe** means a transport network that people feel safe and secure using and **sustainable** means a transport network that is both environmentally and financially sustainable.

Everybody relies on there being a safe and sustainable transport system. Businesses use the transport system to bring their raw materials then deliver their products to the customer. People use the transport system to get to work, shops, schools and colleges, or healthcare facilities. Despite this key role, a working transport system is taken for granted, until problems caused by, for example: flooding, snow, volcanic ash or strike action, disrupt the network.

LTP3 explains how partners can deliver a safe and sustainable transport system in Gloucestershire within the financial limits that are likely to exist over the period covered by LTP3.

Gloucestershire County Council applied to and were successful in obtaining Local Sustainable Transport Fund money from the Department for Transport (DfT) to the sum of almost £5 million pounds. This money will go towards delivering a project that is primarily aimed at supporting economic growth between Gloucester City and Cheltenham and reducing carbon emissions from traffic. A key theme of the project is the promotion of cycling, walking, car sharing and use of public transport along with support for car clubs and electric car charging points.

8 Climate Change Strategies

The Gloucester City Council Climate Change Strategy was published in 2010 and recognises that although climate change is a global issue, tackling it begins closer to home. The Strategy received cross party support with a commitment to manage its estate as a service provider and in a community leadership role to influence the activities within the city that contribute towards climate change.

Our objectives are as followed:

- To increase public awareness of climate change, and of what people and the organisations they represent can do to lessen their impacts upon the climate and how they can adapt to a changed climate;
- To maximise the reduction in greenhouse gas emissions over the strategy period and where possible exceed government and regional targets;
- To increase the amount of electricity that is generated in Gloucester from low carbon or renewable sources to a minimum of 11% by 2010 in line with regional planning guidance for the South West;
- To enable Gloucester, its citizens and biodiversity to adapt to the changes brought about by climate change to ensure the maintenance of a high quality life; and
- To reduce emissions from the City Council's estate by 10% in the year 2010 and as such sign up to the 2010 campaign.

One of the measures employed to achieve our objectives was the development of a 'Green Travel Plan' to tackle the carbon footprint of an organisation that employs over 350 people and has a large portfolio of assets fuelled by non renewable energy sources.

The Gloucester City Green Travel Plan 2011 – 2015 promotes and identifies ways to encourage a range of sustainable transport modes other than single user private car. The plan aims to assist with reducing congestion, reducing pollution and improving health.

9 Implementation of Action Plans

The AQMAs for Barton Street, Priory Road and Painswick Road all have the same two key aims which are as follows –

- 1) To reduce traffic levels through re-directing traffic; and
- 2) To seek moving people towards more sustainable transport methods

At the start of 2012 the action plans were reviewed by the City Council in light of a changing picture in the level of resource available at Gloucestershire County Council Highways and the reality that a number of the proposals were not realistic options given their cost and difficulty to implement.

With the awarding of Local Sustainable Transport Money to the sum of £5 million which is to be shared between Gloucester City and Cheltenham this was viewed as an opportunity to revisit the AQAP in conjunction with the project team with a practical approach.

This resulted in the Barton Street AQAP being reviewed in the 3rd quarter of 2012/2013 with a new document issued in December 2012. This has yet to be submitted formally to DEFRA for approval subject to ongoing discussions regarding options. This is still the case. The review has in effect stripped out the more unrealistic options and focussed attention on what practically can be delivered within the boundaries of what the LSTP project is trying to achieve.

It is our intention to carry out the same process for both Priory Road and Painswick Road so that we have 3 AQAPs that are practically achievable having regard to the current year on year reduction of Local Authority budgets.

Due to resource issues AQAPs were not progressed during 2013/2014. With levels of NO_x recorded as having reduced again consideration will be given as to the level of resource we commit to reviewing our AQAPs and to what measures we identify for implementation.

Table 9.1 Barton Street Action Plan Progress

Measure	Focus	Lead Authority	Planning Phase	Implementation Phase	Indicator	Target Annual Emission Reduction in the AQMA	Progress to Date	Progress in Last 12 Months	Estimated Completion Date
Barton Street Air Quality Management Area (as amended July 2011)									
Installation of Green Infrastructure	<ul style="list-style-type: none"> • Installation of trees on Barton Street • Green 'living walls' to be installed on blank facades on Barton Street • Work with local businesses to encourage installation of 'living walls' on frontages • Installation of green removable screens • Securing s.106 planning contribution monies to put towards this measure 	City Council	2013	2014/2015	Reduction in measured NO ₂	N/A	Discussions commenced with internal colleagues	←	December 2015

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Improve Bus Fleet Emissions	<ul style="list-style-type: none"> Secure commitment from primary travel operator in area to prioritise fleet replenishment to those vehicles using Barton Street 	City Council	2013/2014	2015	<ul style="list-style-type: none"> Number of vehicles cleaned and greened Reduction in measured NO₂ 	N/A	Discussions with County Council regarding joint meeting	←	March 2015
Promotion of Sustainable Travel	<ul style="list-style-type: none"> Work in conjunction with LSTF team to promote sustainable travel in Barton Street corridor Promote Barton Street in LSTF programme of events 	County Council	2013	2014/2015	<ul style="list-style-type: none"> Number of residents/businesses engaged Reduction in the number of through journeys 	N/A	N/A		Duration of Action Plan
Introduction of Variable Messaging Signs	<ul style="list-style-type: none"> Identify suitable location for VMS Carry out an appraisal of cost effectiveness If viable, design key nudge messages 	County Council	2013/2014	2014/2015	<ul style="list-style-type: none"> Reduction in the number of through journeys Reduction in levels of NO₂ 	N/A	Appraisal exercise being carried out	←	September 2013
Increase Planning	<ul style="list-style-type: none"> Develop air quality 	City Council	2013	2014	<ul style="list-style-type: none"> Level of s.106 money secured 	N/A	Already raising air	←	Duration of Action Plan

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Contributions	guidance note for applicants to support NPPF				<ul style="list-style-type: none"> Number of measures implemented utilising s.106 money 		quality as a material planning consideration and in discussions about how we can produce air quality guidance alongside local plan.		
Increased Restrictions on Delivery Times	<ul style="list-style-type: none"> Extend restrictions to loading/unloading on Barton Street Work with local businesses to develop delivery plans to overcome extended restrictions 	County Council	2014	2015	<ul style="list-style-type: none"> Reduction in the number of cases of illegal parking due to deliveries Number of businesses with delivery plans in place 	N/A	None	N/A	December 2013
Removal of Directional Signage to Painswick	<ul style="list-style-type: none"> Remove single sign located at Trier Way/Barton Street junction 	County Council	2013	2013	<ul style="list-style-type: none"> Reduction in the number of through journeys 	N/A	Sign removed	←	June 2013
Installation of Green Infrastructure	<ul style="list-style-type: none"> Installation of trees on Barton Street Green 'living walls' to be installed on 	City Council	2013	2014/2015	Reduction in measured NO ₂	N/A	Discussions commenced with internal colleagues	←	December 2015

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	<p>blank facades on Barton Street</p> <ul style="list-style-type: none">• Work with local businesses to encourage installation of 'living walls' on frontages• Installation of green removable screens• Securing s.106 planning contribution monies to put towards this measure								
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Table 9.2 Priory Road Action Plan Progress

Measure	Focus	Lead Authority	Planning Phase	Implementation Phase	Indicator	Target Annual Emission Reduction in the AQMA	Progress to Date	Progress in Last 12 Months	Estimated Completion Date
Priory Road Air Quality Management Area (as amended July 2011)									
Re-timing traffic signals on Priory Road, St Oswalds Road and Worcester Street	Deter traffic using this route	County Council	Not under consideration	Not under consideration	N/A	N/A	N/A	N/A	Not being taken forward
Traffic management measures in the city centre and western waterfront	As above	As above	As above	As above	As above	As above	As above	As above	As above
Improvements to junctions on the A40 Gloucester	Reduce traffic using through east/west routes including St	As above	As above	As above	As above	As above	As above	As above	As above

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Northern Bypass	Oswalds Road								
Variable Messaging Signs	<ul style="list-style-type: none"> Identify suitable location for VMS Carry out an appraisal of cost effectiveness If viable, design key nudge messages 	County Council	2013/2014	2014/2015	<ul style="list-style-type: none"> Reduction in the number of through journeys Reduction in levels of NO₂ 	N/A	Appraisal exercise being carried out for Barton St and learning to be considered for other AQMAs	←	2015
Prohibit traffic turning right out of Priory Road and from St Oswalds Road into Priory Road	Divert traffic and avoid congestion	County Council	Not under consideration	Not under consideration	N/A	N/A	N/A	N/A	Not being taken forward
Replacement of St Oswalds park and ride site with alternative	Avoid traffic coming into City Centre and travelling through AQMA to reach P&R	County Council	Not under consideration	Not under consideration	N/A	N/A	N/A	N/A	Not being taken forward

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Physical barrier between houses in AQMA and St Oswalds Road	Protect properties from poor air	City Council	Not under consideration	Not under consideration	N/A	N/A	N/A	N/A	Not being taken forward
Planting between houses in AQMA and St Oswalds Road	To act as a sponge in respect of pollutants	City Council	Not under consideration	Not under consideration	N/A	N/A	N/A	N/A	Not being taken forward
Demolition of 13 houses in AQMA	To remove receptors from this area	City Council	Not under consideration	Not under consideration	N/A	N/A	N/A	N/A	Not being taken forward
Install secondary glazing and mechanical ventilation using air from the rear of the 13 houses	To prevent the ingress of poor air and force ventilation of cleaner air	City Council	Not under consideration	Not under consideration	N/A	N/A	N/A	N/A	Not being taken forward

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Dispersal of pollutants from under railway bridge by pump and stack method	To remove pollutants from an area vulnerable to build up and with a high footfall	City Council	Not under consideration	Not under consideration	N/A	N/A	N/A	N/A	Not being taken forward
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Table 9.3 Painswick Road Action Plan Progress

Measure	Focus	Lead Authority	Planning Phase	Implementation Phase	Indicator	Target Annual Emission Reduction in the AQMA	Progress to Date	Progress in Last 12 Months	Estimated Completion Date
Painswick Road Air Quality Management Area (as amended July 2011)									
Variable Messaging Signs (VMS)	<ul style="list-style-type: none"> Identify suitable location for VMS Carry out an appraisal of cost effectiveness If viable, design key nudge messages 	County Council	2013/2014	2014/2015	<ul style="list-style-type: none"> Reduction in the number of through journeys Reduction in levels of NO₂ 	N/A	Appraisal exercise being carried out for Barton St and learning to be considered for other AQMAs	←	2015
Removal of Directional Signage to Painswick	<ul style="list-style-type: none"> Remove single sign located at Trier Way/Barton Street junction 	County Council	2013	2013	<ul style="list-style-type: none"> Reduction in the number of through journeys 	N/A	Sign removed	←	June 2013

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Enforce existing HGV ban on Painswick Road	To prevent large vehicles travelling through AQMA as a through route	County Council	2014	2015	<ul style="list-style-type: none"> Reduction in the number of through journeys Reduction in levels of NO₂ 	N/A	Awaiting parking enforcement review	←	2015
Alter signage to allow traffic from Chequers Lane onto Eastern Avenue	To prevent cueing traffic at roundabout with Eastern Avenue	County Council	Not under consideration	Not under consideration	N/A	N/A	N/A	N/A	Not being taken forward
Signalise Painswick Road / Eastern Avenue	Link VMS to continuous analyser for real-time messaging	County Council	Not under consideration	Not under consideration	N/A	N/A	N/A	N/A	Not being taken forward
Encourage	<ul style="list-style-type: none"> Secure commitment from 	City Council	2013/2014	2015	<ul style="list-style-type: none"> Number of vehicles cleaned and 	N/A	Discussions with County Council	←	March 2015

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travel operators to replace/clean bus fleet travelling through AQMA	primary travel operator in area to prioritise fleet replenishment to those vehicles using Barton Street				<ul style="list-style-type: none"> greened Reduction in measured NO₂ 		regarding joint meeting		
Reduce illegal parking on Painswick Road	To prevent illegally parked vehicles exacerbate congestion	County Council	2014	2015	<ul style="list-style-type: none"> Reduction in the number of through journeys Reduction in levels of NO₂ 	N/A	Awaiting parking enforcement review	←	2015
Promote alternative travel options through a travel smart intervention	<ul style="list-style-type: none"> Work in conjunction with LSTF team to promote sustainable travel in Painswick Road corridor Promote Painswick Road in LSTF programme of events 	County Council	2013	2014/2015	<ul style="list-style-type: none"> Number of residents/businesses engaged Reduction in the number of through journeys 	N/A	N/A		Duration of Action Plan

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<p>Promote the use of alternative modes of travel through school travel plans</p>	<ul style="list-style-type: none"> • Work in conjunction with LSTF team to promote sustainable travel in Painswick Road corridor • Promote Painswick Road in LSTF programme of events 	<p>County Council</p>	<p>2013</p>	<p>2014/2015</p>	<ul style="list-style-type: none"> • Number of residents/businesses engaged • Reduction in the number of through journeys 	<p>N/A</p>	<p>N/A</p>		<p>Duration of Action Plan</p>
<p>Promote the use of alternative modes of travel through business / employer travel plans</p>	<ul style="list-style-type: none"> • Work in conjunction with LSTF team to promote sustainable travel in Painswick Road corridor • Promote Painswick Road in LSTF programme of events 	<p>County Council</p>	<p>2013</p>	<p>2014/2015</p>	<ul style="list-style-type: none"> • Number of residents/businesses engaged • Reduction in the number of through journeys 	<p>N/A</p>	<p>N/A</p>		<p>Duration of Action Plan</p>

10 Conclusions and Proposed Actions

10.1 Conclusions from New Monitoring Data

The review of 2013 monitoring data has identified no exceedences of the AQS Objectives at any of the Gloucester City Council's diffusion tube or continuous monitoring locations.

Continuous monitoring results for 2013 indicate that both the annual mean objective and the 1-hour objective for nitrogen dioxide were met at the monitoring site. This site had remained above the annual mean objective until 2012; following this, concentrations showed a significant reduction in 2013. This is consistent with diffusion tube results, which also showed significantly lower concentrations in 2013 when compared to previous year. There were no diffusion tube sites in 2013 where the annual mean AQS objective was exceeded.

10.2 Proposed Actions

Proposed actions arising from the 2014 Annual Progress Report are as follows:

- Continue diffusion tube and continuous monitoring in the City to identify future changes in pollutant concentrations;
- Proceed to the Updating and Screening Assessment 2015.

11 References

- AEA (2008) *Diffusion Tubes for Ambient NO₂ Monitoring: Practical Guidance for Laboratories and Users*. Report to Defra and the Devolved Administrations.
- Atkins (2012) *Barton Street AQMA Feasibility Report*. Report for Gloucestershire County Council.
- Department for Environment, Food and Rural Affairs (Defra) (2009) *Local Air Quality Management Technical Guidance LAQM.TG(09)*.
- Gloucester City Council (2012) *Updating and Screening Assessment*.
- Gloucester City Council (2013) *Annual Progress Report*.
- Gloucestershire County Council (2011) *Gloucestershire's Local Transport Plan 2011-26*.
- Gloucestershire Pollution Group (2011) *A County-wide Air Quality Strategy for Gloucestershire*.

12 Appendices

Appendix A: Quality Assurance / Quality Control (QA/QC) Data

Appendix A: QA:QC Data

Diffusion Tube Bias Adjustment Factors

The diffusion tubes are supplied and analysed by Gradko utilising the 20% triethanolamine (TEA) in water preparation method. A bias adjustment of 0.95 for the year 2013 (based on 24 studies) has been derived from the national bias adjustment calculator¹.

For previous data, years 2008 to 2012, the bias adjustment factors have been taken from the Council's previous LAQM annual reports. The factors used were 0.87 (2008), 0.79 (2009), 0.77 (2010), 0.85 (2011) and 1.01 (2012).

Discussion of Choice of Factor to Use

Data have been corrected using a bias adjustment factor, which is an estimate of the difference between diffusion tube concentrations and continuous monitoring, the latter assumed to be a more accurate method of monitoring. The technical guidance LAQM.TG (09) provides guidance with regard to the application of a bias adjustment factor to correct diffusion tubes. Triplicate co-location studies can be used to determine a local bias factor based on the comparison of diffusion tube results with data from NO_x / NO₂ continuous analysers. Alternatively, the national database of diffusion tube co-location surveys provides bias factors for the relevant laboratory and preparation method.

As no co-location studies have been carried out by Gloucester City Council in 2013 the national bias adjustment factor was used to adjust the diffusion tube data.

The national bias adjustment factor was also used in the previous years.

Short to Long Term Adjustment – Diffusion Tubes

Annualisation was required for a number of diffusion tube monitoring sites; this is shown in the table below.

¹ National Diffusion Tube Bias Adjustment Factor Spreadsheet, version 06/14 published in June 2014.

Diffusion Tube ID	Diffusion Tube Name	Bristol St Paul's Annualisation Factor	Cwmbran Annualisation Factor	Oxford St Ebbes Annualisation Factor	Average Annualisation Factor	Bias Unadjusted Annual Mean Concentration ($\mu\text{g}/\text{m}^3$)	Bias Adjusted & Annualised Annual Mean Concentration ($\mu\text{g}/\text{m}^3$)
1	Elmbridge Junior School	1.025	1.059	1.035	1.040	22.5	22.2
2	Gloucester Guildhall	1.041	1.182	1.104	1.109	22.6	23.8
3	79 Milbrook Street	0.997	0.956	1.012	0.988	39.0	36.6
4	59 Bristol Road	1.191	1.179	1.102	1.157	34.6	38.0
6	46 Priory Road	1.036	1.028	1.023	1.029	38.1	37.2
7	66 Priory Road	0.956	0.954	0.969	0.960	42.2	38.4
10	Opp 248 Barton Street	1.155	1.164	1.105	1.141	30.2	32.7
8	53 Barnwood Road	1.116	1.146	1.084	1.115	36.9	39.1
25	61 Barnwood Road	1.043	1.028	1.021	1.031	35.7	35.0

Diffusion Tube Precision

Diffusion tube precision was assessed during 2013 at the 56 Priory Road site where triplicate tubes were sited. The calculated tube precision was good as shown in figure below.

Adjustment of DUPLICATE or TRIPLICATE Tubes

From the AEA group

Diffusion Tubes Measurements										Data Quality Check
Period	Start Date	End Date	Tube 1	Tube 2	Tube 3	Triplicate Average	Standard Deviation	CV	95% CI mean	Diffusion Tubes Precision Check
	dd/mm/yyyy	dd/mm/yyyy	μgm^{-3}	μgm^{-3}	μgm^{-3}					
1	02/01/2013	30/01/2013	43.0	42.3	48.6	44.6	3.45	7.74	8.58	Good
2	30/01/2013	27/02/2013	45.3	42.1	39.0	42.1	3.15	7.48	7.83	Good
3	27/02/2013	27/03/2013	42.7	43.2	37.5	41.1	3.16	7.67	7.84	Good
4	27/03/2013	24/04/2013	52.0	43.2	43.2	46.1	5.08	11.01	12.62	Good
5	24/04/2013	29/05/2013	27.4	27.8	26.4	27.2	0.72	2.65	1.79	Good
6	29/05/2013	26/06/2013	28.8	29.6	31.9	30.1	1.61	5.35	4.00	Good
7	26/06/2013	31/07/2013	23.6	28.3	24.9	25.6	2.43	9.48	6.03	Good
8	31/07/2013	04/09/2013	40.0	40.7	42.1	40.9	1.07	2.61	2.66	Good
9	04/09/2013	02/10/2013	48.4	46.8	47.5	47.6	0.80	1.69	1.99	Good
10	02/10/2013	30/10/2013								
11	30/10/2013	04/12/2013								
12	04/12/2013	08/01/2014								
13										

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

Site Name/ ID:

Joumo Tarqo, for AEA
Version 04 - February 2011

Adjusted measurement (95% confidence level)
Without periods with CV larger than 20%

Bias calculated using 0 periods of data

Tube Precision:
Bias factor A:
Bias B:

Information about tubes to be adjusted

Diffusion Tube average: 38 μgm^{-3}

Average Precision (CV): 6

Adjusted Tube average: μgm^{-3}

Adjusted measurement (95% confidence level)
with all data

Bias calculated using 0 periods of data

Tube Precision:
Bias factor A:
Bias B:

Information about tubes to be adjusted

Diffusion Tube average: 38 μgm^{-3}

Average Precision (CV): 6

Adjusted Tube average: μgm^{-3}

QA/QC of Automatic Monitoring

Air Quality Data Management (AQDM) carry out the QA/QC for the Barton Street monitoring station.

QA/QC of Diffusion Tube Monitoring

Gradko International Ltd is a UKAS accredited laboratory and participates in the Workplace Analysis Scheme for Proficiency (WASP) for NO₂ diffusion tube analysis and the Annual Field Inter-Comparison Exercise. These provide strict performance criteria for participating laboratories to meet, thereby ensuring NO₂ concentrations reported are of a high calibre. The lab follows the procedures set out in the Harmonisation Practical Guidance. In the latest available WASP results, rounds 120 through to 123 (January to December 2013) Gradko International have scored 100%. The percentage score reflects the results deemed to be

satisfactory based upon the z-score of $< \pm 2$. Based on 24 studies, 96% of all local Authority co-location studies in 2013 were rated as 'good' (tubes are considered to have "good" precision where the coefficient of variation of duplicate or triplicate diffusion tubes for eight or more periods during the year is less than 20%).

Monthly Diffusion Tube Results

Site Ref	NO ₂ Concentrations µg/m ³												COUNT	AVERAGE
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
1		35.5	21.2		17.9	15.2							4	22.5
2			22.5	25.6	25.7	16.7							4	22.6
3		53.9	42.0	44.8				26.3	27.8				5	39.0
4	34.2	50.5			42.6	29.9	25.7	26.0	33.2				7	34.6
5	43.0	45.3	42.7	52.0	27.4	28.8	23.6	40.0	48.4				9	39.0
5	42.3	42.1	43.2	43.2	27.8	29.6	28.3	40.7	46.8				9	38.2
5	48.6	39.0	37.5	43.2	26.4	31.9	24.9	42.1	47.5				9	37.9
6	36.1	39.1	40.7	40.2	33.7	35.7		34.2	44.9				8	38.1
7	45.7	47.4	48.8	52.1	26.6	32.3							6	42.2
8	37.3		41.4	39.5	50.9	31.2	19.2	32.5	43.2				8	36.9
9	31.8	48.7	32.0	38.1	51.2	29.6	30.8	24.4	37.4				9	36.0
10	33.5	43.2		29.2	35.1	29.0	14.1	25.2	32.2				8	30.2
11	27.3	44.8	28.7	28.2	43.1	22.6	11.8	19.3	29.0				9	28.3
12	33.1	49.4	39.0	38.5	37.1	35.0	14.3	30.5	37.6				9	34.9
13	36.5	52.3	43.5	43.1	32.3	38.2	11.4	35.8	42.7				9	37.3
14	36.7	47.0	40.3	43.2	49.9	40.0	19.8	35.0	48.2				9	40.0
15	35.6	50.1	41.1	43.2	38.4	37.8	18.0	33.2	42.6				9	37.8
16	42.2	49.6	40.4	39.0	40.4	36.5	20.1	30.6	44.2				9	38.1
17	37.7	40.5	47.4	34.7	40.7	47.2	17.2	44.9	57.5				9	40.9
18	31.1	41.5	31.2	32.6	39.3	30.5	15.8	23.6	31.7				9	30.8
19	30.8	54.0	48.8	48.5	42.2	42.2	19.8	36.3	37.5				9	40.0
20	36.6	47.5	33.9	35.1	29.7	27.6	23.3	24.7	30.9				9	32.1
21	25.0	34.7	25.6	27.7	27.4	19.7	10.2	18.9	24.6				9	23.8
22	26.8	39.2	27.5	32.8	41.3	27.7	13.3	21.4	29.2				9	28.8
23	32.2	44.0	34.0	36.9	34.4	30.7	13.3	27.0	33.3				9	31.8

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24	32.7	47.5	41.4	41.3	38.3	38.7	13.2	30.3	34.5				9	35.3
25	32.5	35.8	39.3	44.9	41.0		17.3	33.7	41.1				8	35.7