# *Gloucester City Council*
# *Annual Status Report 2017*

*Bureau Veritas*

*August 2017*

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## Document Control Sheet

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# 2017 Air Quality Annual Status Report (ASR)

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

August, 2017

| | |
|---|---|
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| Date | August 2017 |

# Executive Summary: Air Quality in Our Area

## Air Quality in Gloucester

Air pollution is associated with a number of adverse health impacts. It is recognised as a contributing factor in the onset of heart disease and cancer. Additionally, air pollution particularly affects the most vulnerable in society: children and older people, and those with heart and lung conditions. There is also often a strong correlation with equalities issues, because areas with poor air quality are also often the less affluent areas[1,2].

The annual health cost to society of the impacts of particulate matter alone in the UK is estimated to be around £16 billion[3].

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.

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 the 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 $NO_2$: Barton Street AQMA (in the City centre) and Priory Road AQMA (on the A417), both declared in 2005; and Painswick Road AQMA (in the City centre, consisting of further section of Barton Street), declared in 2007.

Monitoring of $NO_2$ is completed within Gloucester using a network of diffusion tubes. In 2016 there were thirty two monitoring locations where diffusion tubes were deployed. This is an increase of seven diffusion tubes compared to 2016:

[1] Environmental equity, air quality, socioeconomic status and respiratory health, 2010
[2] Air quality and social deprivation in the UK: an environmental inequalities analysis, 2006
[3] Defra. Abatement cost guidance for valuing changes in air quality, May 2013

- DT26 – 16 London Road;
- DT27 – Gloucester Academy;
- DT28 – GL1;
- DT29 – Park End Road;
- DT30 – 126 Painswick Road;
- DT31 – 94 Barnwood Road; and
- DT32 – 26 Farriers End.

There was an increase in annual mean $NO_2$ concentrations reported at 23 out of the existing 25 monitoring sites in 2016 when compared to 2015 concentrations. Exceedances of the annual mean objective of 40µg/$m^3$ were reported at seven locations during 2016, this is reduced to six following distance correction of the results. The six exceeding sites are all located within the designated AQMAs.

## Actions to Improve Air Quality

The Gloucester City Council AQAP published in 2008 and revised in 2011 contains the actions that have been approved in relation to reducing $NO_2$ concentrations within Gloucestershire, and more specifically within the designated AQMAs. A number of these measures have now been completed and a few remaining ongoing as detailed in Table 2.2. These measures will continue to be progressed throughout 2017 and any amendments to the measures will be presented within the 2018 ASR.

The Gloucestershire Local Travel Plan has been revised[4] in 2016 and identifies the approach to managing transport demand within Gloucestershire. Air quality is significantly influenced by volume and types of traffic and therefore the Local Travel Plan is intended to be used in conjunction with air quality issues to develop a more sustainable approach to transport. It is stated within the plan that relationships are to be developed with local Districts with the aim of reducing any existing AQMAs and air pollutant concentrations as a whole, this relationship with the County Council will be developed during 2017 into 2018.

[4] Gloucestershire's Local Transport Plan 2015-2031, Gloucestershire County Council

## Conclusions and Priorities

There were no exceedances of the $NO_2$ annual mean objective monitored by the network of diffusion tubes outside of any of the existing AQMAs within Gloucester. The following has been recommended in relation to the three existing AQMAs:

- Priory Road AQMA – To remain in force due to exceedances of the annual mean objective at all three monitoring locations located within the AQMA boundary;
- Barton Street AQMA – Possibly amendment of the AQMA boundary due to concentrations below the annual mean objective being experienced in the southern section of the AQMA; and
- Painswick Road AQMA – To remain in force due to the concentration at one diffusion tube location being above the annual mean objective. All other monitoring sites are within the objective level so an emphasis should be placed on reducing emissions at this locations leading to possible revocation of the AQMA.

The revised Transport Plan has been produced by Gloucestershire County Council and contains a number of objectives relating to the improvement of air quality through changes in transport modes. Under policy LTP PD 4.9 it states that the County Councils will be working with District Councils to improve air quality. Therefore in the coming year Gloucester City Council will look to develop these relationships with the County Council and implement localised measures that can be actioned within Gloucester City Council.

## Local Engagement and How to get Involved

A number of measures designed for the public are provided on the Gloucester City Council website[5] in relation to localised improvements for air quality:

- **Car sharing** – go shopping with friends or neighbours, take a colleague to work, or join a car share club or lift share;
- **Travel smarter/ Using Public transport** – follow the link to Think Travel website - http://www.thinktravel.info/;

[5] How you can help, local air quality improvement measures, available online at http://www.gloucester.gov.uk/resident/pests-pollution-and-food-hygiene/pollution/Pages/Air-Quality-in-Gloucester.aspx

- **Switch off your engine when stationary** – if stuck in traffic or stopping more than a minute. Idling engines make sitting in jams even more unpleasant. Do not run the engine unnecessarily, drive off soon after starting (in some areas it may be an offence to leave the engine running);
- **Walking and cycling** – follow link to You Tube video on Air Pollution Exposure Experiment by Camden Council and Kings College London https://www.youtube.com/watch?v=KyxbSxpA-E4;
- **Garden bonfires contribute to poor air quality locally** – use alternative methods of disposal i.e. Hempsted Recycling Centre or sign up to the green garden waste collection service; and
- **Maintaining your vehicle** – check tuning, tyre pressure, brakes and fuel consumption – regular servicing helps keep your car efficient and saves fuel.

Other car related tips include:

- **Avoid using cars for short journeys** – combine trips or, alternatively, walk, cycle, or take a bus;
- **Lighten up** – roof rakes add drag and other unnecessary weight increases fuel consumption;
- When your tyres need replacing consider **low rolling resistance** replacements – ask your tyre fitter for advice;
- **Drive gently** – racing starts and sudden stops increase fuel consumption. Use higher gears when traffic conditions allow;
- **Steady your speed** – at around 50mph emissions will be lowest, rising dramatically above 70mph;
- **Air conditioning and on board electrical** devices increase fuel consumption – only use them when really necessary;
- **Investigate alternatives** – if you're looking for a new car there are a number of different technologies and fuels available, existing cars can also be adapted to give off lower emissions.

Information on the location of the two electric vehicle charging points within Gloucester City Council for public use can be found on the Charge your Car website[6]. In addition information on the availability of government grants for workplace and domestic property electric vehicle charge points is also presented on the air quality section of the Gloucester City Council website.

[6] Charge your Car, available online at http://www.chargeyourcar.org.uk/

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# 1 Local Air Quality Management

This report provides an overview of air quality in Gloucester City Council during 2016. It fulfils the requirements of Local Air Quality Management (LAQM) as set out in Part IV of the Environment Act (1995) 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 an exceedance is considered likely the local authority must declare an Air Quality Management Area (AQMA) and prepare an Air Quality Action Plan (AQAP) setting out the measures it intends to put in place in pursuit of the objectives. This Annual Status Report (ASR) is an annual requirement showing the strategies employed by Gloucester City Council to improve air quality and any progress that has been made.

The statutory air quality objectives applicable to LAQM in England can be found in Table E.1 in Appendix E.

# 2 Actions to Improve Air Quality

## 2.1 Air Quality Management Areas

Air Quality Management Areas (AQMAs) are declared when there is an exceedance or likely exceedance of an air quality objective. After declaration, the authority must prepare an Air Quality Action Plan (AQAP) within 12-18 months setting out measures it intends to put in place in pursuit of compliance with the objectives.

A summary of AQMAs declared by Gloucester City Council can be found in Table 2.1. Further information related to declared or revoked AQMAs, including maps of AQMA boundaries are available online at https://uk-air.defra.gov.uk/aqma/local-authorities?la_id=111. Alternatively, see Appendix D: Maps of Monitoring Locations and AQMAs, which provides for a map of air quality monitoring locations in relation to the AQMA(s).

Amendment of the Barton Street AQMA has been proposed due to concentrations at a number of diffusion tube locations being consistently below the annual mean objective of 40µg/$m^3$ (see Section 3).

## Table 2.1 – Declared Air Quality Management Areas

| AQMA Name | Date of Declaration | Pollutants and Air Quality Objectives | City / Town | One Line Description | Is air quality in the AQMA influenced by roads controlled by Highways England? | Level of Exceedance (maximum monitored/modelled concentration at a location of relevant exposure) | | Action Plan (inc. date of publication) |
|---|---|---|---|---|---|---|---|---|
| | | | | | | At Declaration | Now | |
| Painswick Road AQMA | 05/10/2007 | NO2 Annual Mean | Gloucester | An area encompassing a number of properties on either side of Painswick Road, Gloucester. | NO | In exceedance of the annual mean objective | 31.1 - 39.7 (2016) | Gloucester AQAP 2008 (2011 Review) |
| Barton Street AQMA | 08/08/2005 | NO2 Annual Mean | Gloucester | An area encompassing Barton Street, Gloucester from its junction with Trier Way/Bruton Way to the north west and Upton Street to the south east. | NO | 41 - 47 | 25.7 - 47.4 (2016) | Gloucester AQAP 2008 (2011 Review) |
| Priory Road AQMA | 08/08/2005 | NO2 Annual Mean | Gloucester | An area encompassing the junction of St Oswalds Road and Priory Road. | YES | 41 - 48 | 44.9 - 52.1 (2016) | Gloucester AQAP 2008 (2011 Review) |

☒ **Gloucester City Council confirm the information on UK-Air regarding their AQMAs is up to date**

## 2.2 Progress and Impact of Measures to address Air Quality in Gloucester

Defra's appraisal of last year's ASR concluded the following:

- *The monitoring data for 2015 indicates that the annual mean $NO_2$ objective continued to be exceeded at one monitoring site within the Barton Road AQMA and at three sites within the Priory Road AQMA. There were no measured exceedances within the Painswick Road AQMA. This suggests that, based on the monitoring data for the past three years, the authority is moving towards compliance with the annual mean objective for $NO_2$ at Painswick Road. It is recommended that careful consideration be given to including additional measures within the AQAP which could specifically target hotspots within each AQMA. Detailed consideration of source apportionment and local traffic data may help identify key emission sources and/or traffic patterns which could be specifically addressed to reduce concentrations at the identified 'hot-spots'.*
- *The council may wish to consider conducting a Detailed Assessment for the Painswick Road AQMA to establish whether it may be appropriate to consider revocation of the AQMA status.*
- *The council acknowledge that it is not currently monitoring for $PM_{2.5}$ and have no specific measures in place to reduce concentrations. It is acknowledged, that that the Public Health Outcomes Framework indictor for fraction of deaths attributable to $PM_{2.5}$ in Gloucester City is marginally below the national average but, it is recommended that the AQAP is updated to detail the impact measures are likely to have on $PM_{2.5.}$ The council's intention to liaise with the County Council's Public Health team is welcomed.*
- *Information provided in Table 2.2 of the ASR 'Progress on measures to Improve Air Quality' is limited with insufficient information on the current status of the measures detailed and no analysis of any key performance indicators or target pollution reduction. This means that it is difficult to establish which AQAP measures are active and to what extent they have been effective. It is recommended that additional information is provided within the table for all future reports.*
- *Whilst the AQMAs are sufficiently described in the text it would be useful if the report included the AQMA maps preferably also showing the location of monitoring sites relative to the AQMA boundaries.*

In relation to the comments received Gloucester City Council has taken forward a number of direct measures during the current reporting year of 2016 in pursuit of improving local air quality. Details of all measures completed, in progress or planned are set out in Table 2.2.

More detail on these measures can be found in the Gloucester Air Quality Action Plan[7]. Key completed measures from the AQAP are:

- Reduced bus emissions - replacement by March 2009 of the fleet (bus service no. 1) with Euro-4 compliant vehicles by the bus operator Stagecoach.
- Completion of the Gloucester South West bypass (2007) that will allow traffic to skirt Gloucester on the western side.
- Parking enforcement has been significantly increased by Gloucester City Council along with road signs along the length of Barton Street.

Emphasis has been placed on engaging the public through measures that can be undertaken at a local level, as described in the Executive Summary above and provided within the air quality section of the Gloucester City Council website. These measures will continue to be promoted to engage the public in promoting simple measures that can be carried out on a daily basis.

Work will continue in conjunction with LSTF (Local Sustainable Transport Fund) team to promote sustainable travel, encourage local trips to be made by other modes rather than private car thus promoting the use of alternative modes and alternative routes.

Whilst the measures stated above and in Table 2.2 will help to contribute towards compliance, Gloucester City Council anticipates that further additional measures not yet prescribed will be required in subsequent years to achieve compliance and enable the revocation of the three existing AQMAs.

[7] Gloucester Air Quality Action Plan 2008 (2001 Review)

## Table 2.2 – Progress on Measures to Improve Air Quality

| Measure No. | Measure | EU Category | EU Classification | Organisations involved and Funding Source | Planning Phase | Implementation Phase | Key Performance Indicator | Reduction in Pollutant / Emission from Measure | Progress to Date | Estimated / Actual Completion Date | Comments / Barriers to implementation |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Enforce the existing HGV ban on Painswick Road North/Chequers Bridge/Barton Street except for buses and access | Freight and Delivery Management | Route Management Plans/ Strategic routing strategy for HGV's | Gloucestershire Police | 2011 - 2015 | On-going | Number of HGVs on named roads | 0.2 - 1µg/m3 | HGV ban continues to be enforced | On-going | - |
| 2 | Improve Bus Service | Transport Planning and Infrastructure | Public transport improvements- interchanges stations and services | Gloucester City Council, Gloucestershire Highways and bus companies | 2015-2031 | On-going | New bus station Improved transport facilities Increased mode share of sustainable travel Improved greenhouse gas emission quality | 0.2 - 1µg/m3 | Demolition of existing site and tree removal complete. Construction underway. | 2018 | no update |
| 3 | Variable Message Signs (VMS) | Traffic Management | Other | Gloucestershire County Council | 2011 - 2016 | - | Number of VMS signs | > 0.2µg/m3 | Currently no funding available | - | No funding identified |
| 4 | Improvements/Control of the signals | Traffic Management | UTC, Congestion management, traffic reduction | Gloucestershire County Council | A new county maintenance contract was procured in 2017. | - | N/A | < 0.2µg/m3 | No planned improvements for the foreseeable future. | - | Construction of the Central Transport Hub is affecting the network of signals around the inner ring road from Hare Lane to Gloucester Park. This means the network |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | There are no planned improvements in Gloucester for the forseeable future. | | | | | | cannot currently operate at maximum efficiency. The SCCT network will be looked at as a whole once construction is complete. |
| 5 | Promote alternatives through a 'TravelSmart' intervention | Promoting Travel Alternatives | Other | Gloucestershire County Council | Completed | Completed | Increased walking and cycling | > 0.2 dependant on size of scheme | The Thinktravel Transition Year project has come to an end. An evaluation is underway. | Completed | No further funding is available at this time. |
| 6 | Promote the use of alternative modes through School Travel Plans | Promoting Travel Alternatives | School Travel Plans | Gloucestershire County Council<br><br>There is no longer a school travel plan team, although LSTF are running a project in some schools, the future of this measure is subject to funding. | Completed | Completed | Increased walking and cycling | > 1µg/m3 | The Thinktravel Transition Year project has come to an end. An evaluation is underway. | Completed | No further funding is available at this time. |
| 7 | Promote the use of alternative modes and alternative routes through Business / Employer Travel Plans | Promoting Travel Alternatives | Workplace Travel Planning | Gloucestershire County Council<br><br>However there is no longer a travel plan team in place. | 2011 | Completed | Change in % transport used | 0.2 - 1µg/m3 | The Thinktravel Transition Year project has come to an end. An evaluation is underway. | Completed | No further funding is available at this time. |
| 8 | Greater restriction and better timing of deliveries | Freight and Delivery Management | Route Management Plans/ Strategic routing | Gloucester City Council | 2011 - 2014 | On-going | Number of HGVs on named roads | < 0.2µg/m3 | Currently deliveries are banned from 8-9am and 5-6pm | On-going | No further update available at this time |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | strategy for HGV's | | | | | | | | |
| 9 | Encourage bus company to buy new vehicles to provide the bus services | Vehicle Fleet Efficiency | Promoting Low Emission Public Transport | Gloucester City Council and Gloucestershire County Council | 2011 | On-going | Number of new vehicles | < 0.2µg/m3 | Continued promotion and information on council website. | On-going | No further update available at this time |
| 10 | Upgrade existing bus fleet | Vehicle Fleet Efficiency | Vehicle Retrofitting programmes | Bus companies | 2011 | On-going | Number of buses retrofitted | < 0.2µg/m3 | On-going | On-going | No further update available at this time |
| 11 | Reduce illegal parking | Traffic Management | UTC, Congestion management, traffic reduction | Gloucester County Council | 2011 | On-going | Reduction in illegal parking and less parking on city centre roads. | < 0.2µg/m3 | Controlled zones established and Civil Enforcement Officer's in place to enforce zones. | On-going | Reviewing outcomes and will prioritise next steps - possibly an assessment of roads outside the restricted zones. |

## 2.3 $PM_{2.5}$ – Local Authority Approach to Reducing Emissions and/or Concentrations

As detailed in Policy Guidance LAQM.PG16 (Chapter 7), local authorities are expected to work towards reducing emissions and/or concentrations of $PM_{2.5}$ (particulate matter with an aerodynamic diameter of 2.5µm or less). There is clear evidence that $PM_{2.5}$ has a significant impact on human health, including premature mortality, allergic reactions, and cardiovascular diseases.

Currently there is no monitoring of $PM_{2.5}$ or $PM_{10}$ completed within Gloucester City Council, therefore no concentration values can be reported or estimated using the method described in Box 7.7 of LAQM.TG(16).

The current Defra 2016 background maps for Gloucester City Council (2013 based[8]) show that all background concentrations of $PM_{2.5}$ are far below the 2020 annual mean AQS objective for $PM_{2.5}$. The highest concentration is predicted to be 11.7µg/$m^3$ within the 1 x 1km grid square with the centroid grid reference of 386500, 218500. This is an area that contains a number of junctions on the A417 to the east of Gloucester.

The Public Health Outcomes Framework data tool[9] compiled by Public Heath England quantifies the mortality burden of $PM_{2.5}$ within England on a county and local authority scale. The 2015 fraction of mortality attributable to $PM_{2.5}$ pollution across England is 4.7%, and in contrast the fraction within Gloucester City Council is slightly lower than the National average at 4.5%.

LAQM.TG(16) Table A.1 Action toolbox presents a list of measures that can be implemented to help reduce concentrations of $PM_{2.5}$.

Where required Gloucester City Council will review any proposed actions to be implemented with the County Council Public Health team to consider the potential impact of the actions and whether any further action is required.

[8] Defra Background Mapping data for local authorities (2013-based), available online at https://uk-air.defra.gov.uk/data/laqm-background-maps?year=2013
[9] Public Health Outcomes Framework, Public Health England. data tool available online at http://www.phoutcomes.info/public-health-outcomes-framework#page/0/gid/1000043/pat/6/par/E12000009/ati/102/are/E06000028

# 3 Air Quality Monitoring Data and Comparison with Air Quality Objectives and National Compliance

## 3.1 Summary of Monitoring Undertaken

This section sets out what monitoring has taken place and how it compares with objectives.

### 3.1.1 Automatic Monitoring Sites

Gloucester City Council did not carry out any automatic monitoring of pollutants in 2016.

### 3.1.2 Non-Automatic Monitoring Sites

Gloucester City Council undertook non- automatic (passive) monitoring of $NO_2$ at thirty two sites during 2016, this is an increase of seven sites compared to 2015. Monitoring at the additional seven diffusion tube locations began at the start of the July monitoring period in 2016.

Table A.1 in Appendix A shows the details of the sites.

Maps showing the location of the monitoring sites are provided in Appendix D. Further details on Quality Assurance/Quality Control (QA/QC) for the diffusion tubes, including bias adjustments and any other adjustments applied (e.g. “annualisation” and/or distance correction), are included in Appendix C.

## 3.2 Individual Pollutants

The air quality monitoring results presented in this section are, where relevant, adjusted for bias, “annualisation” and distance correction. Further details on adjustments are provided in Appendix C.

### 3.2.1 Nitrogen Dioxide ($NO_2$)

Table A.2 in Appendix A compares the ratified and adjusted monitored $NO_2$ annual mean concentrations for the past 5 years with the air quality objective of 40µg/$m^3$.

For the diffusion tubes, the full 2016 dataset of monthly mean values is provided in Table B.2.

Data capture for nine of the diffusion tubes were below 75% and therefore annualisation (short term to long term adjustment) was completed using data from background automatic monitoring stations within 50 miles of Gloucester City Council.

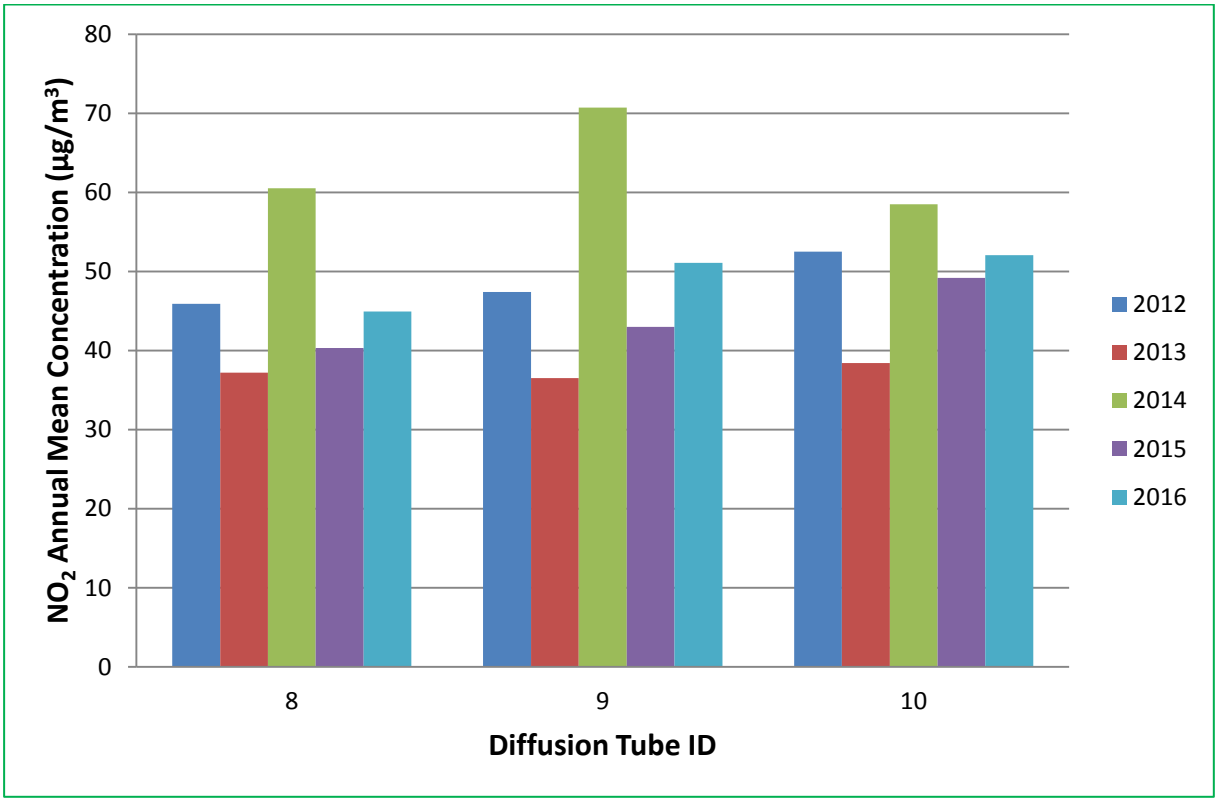
The $NO_2$ results for 2016 have been bias adjusted using a national bias adjustment factor of 0.94. Full details of the bias adjustment and QA/QC procedure are provided in Appendix C.

The analysis of the 2016 monitoring data is completed below in relation to the designated AQMAs within Gloucester City Council. The concentrations presented have not been corrected for distance.

Priory Road AQMA

There are three diffusion tube locations within the Priory Road AQMA, sites 8, 9 and 10. In previous years site 9 has been a triplicate location of diffusion tubes but this was reduced to a duplicate site in June 2016. The annual mean at the discontinued third diffusion tube was annualised and a triplicate average was calculated for 2016.

**Figure 3.1 – Diffusion Tube Monitoring Data within Priory Road AQMA**




The $NO_2$ concentration at the three monitoring locations within the Priory Road AQMA exceeded the annual mean objective of 40µg/m$^3$ in 2016. All locations have

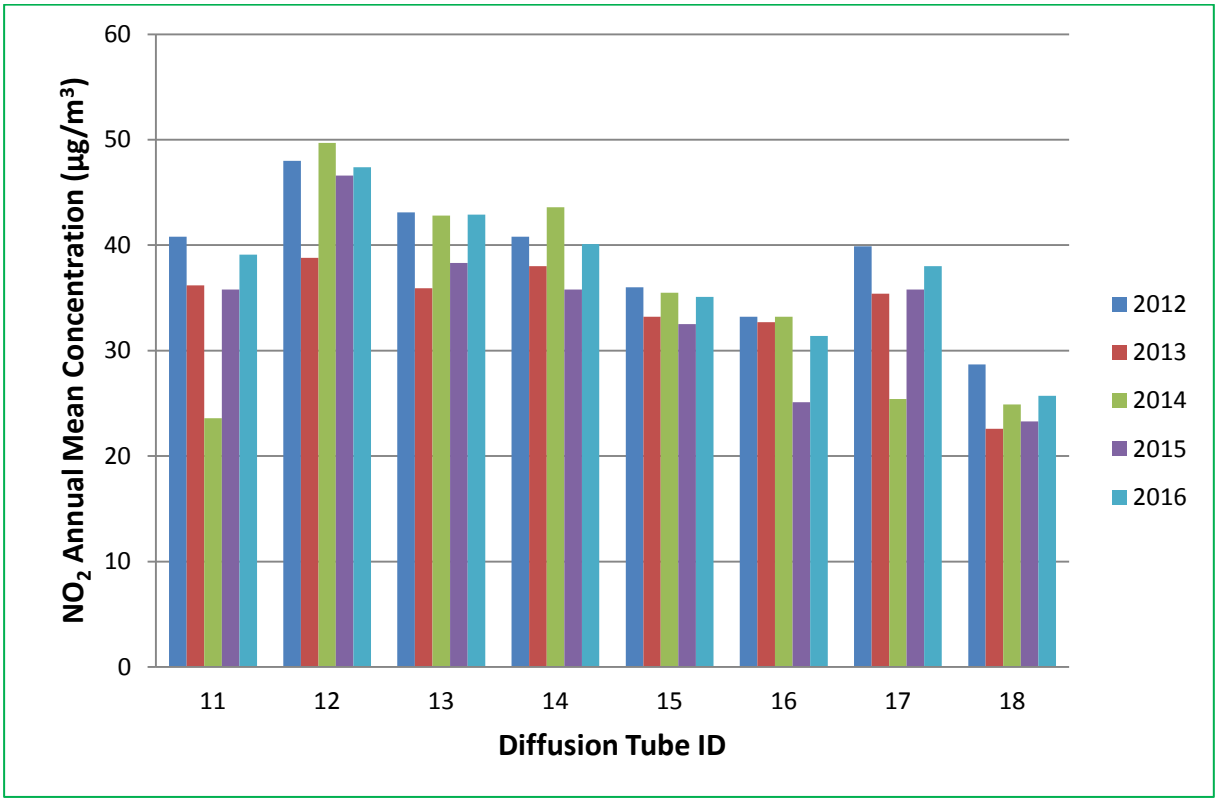
exceeded this objective in the previous 5 years, apart from in 2013 where all three diffusion tube locations reported concentrations below 40µg/m$^3$.

At the three locations concentrations are higher in 2016 when compared to 2015, however 2014 still remains the peak year for $NO_2$ concentrations. Due to the continual high concentrations that are in exceedance of the annual mean objective, the AQMA should remain in force.

Barton Street AQMA

There are eight diffusion tube locations within the Barton Street AQMA, all sites had a data capture of 75% or more therefore annualisation was not required at any location.

**Figure 3.2 – Diffusion Tube Monitoring Data within Barton Street AQMA**



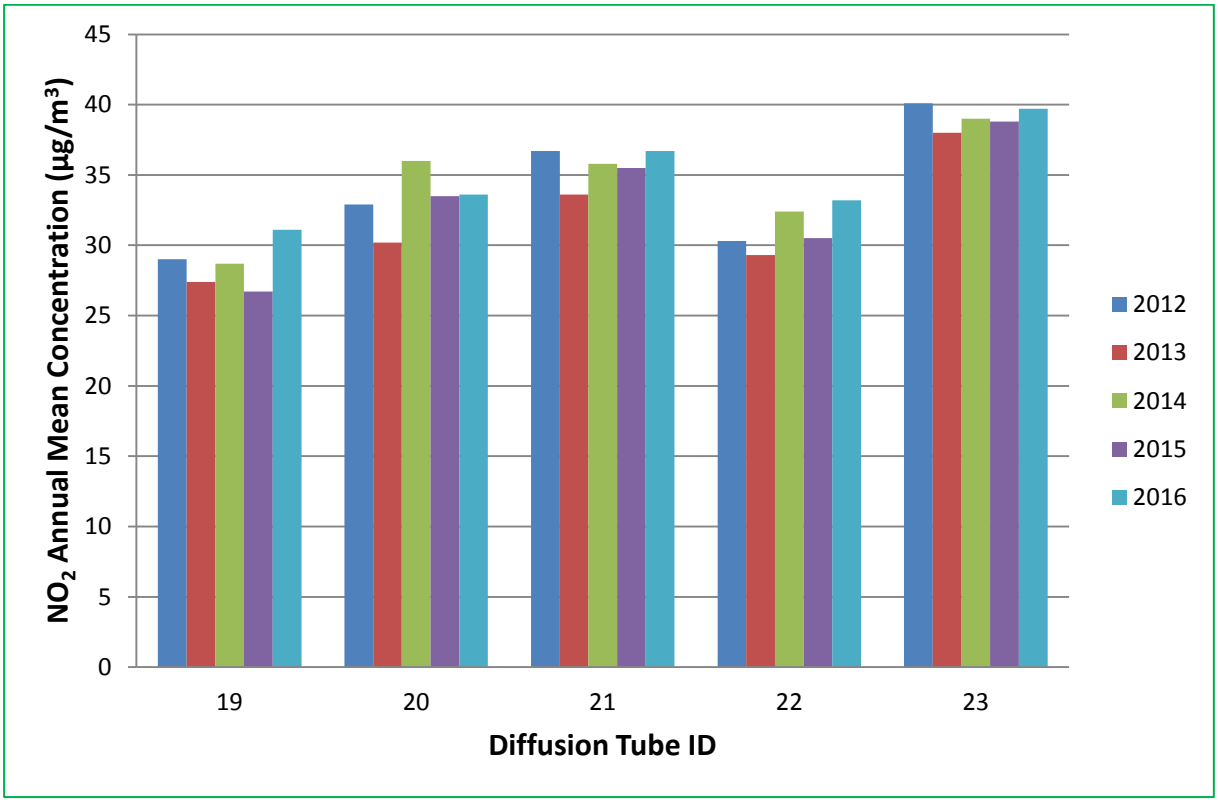

The 2016 $NO_2$ concentration at three monitoring locations (12, 13 and 14) within the Barton Street AQMA exceeded the annual mean objective of 40µg/m$^3$; all other diffusion tube locations have exceeded this objective in previous years. The concentrations recorded in 2016 were higher than 2015 concentrations at all eight monitoring locations. Tubes 15 to 18 have not reported an exceedance of the annual mean objective in the past 5 years. These sites are located in the southern area of the AQMA, east of St James Street. Due to these sites consistently complying with

the objective level, further investigation into the $NO_2$ concentrations in this area is to be made with the possibility of amending the boundaries of the current AQMA.

Painswick Road AQMA

There are five diffusion tube locations within the Barton Street AQMA, all sites had a data capture of 75% or more therefore annualisation was not required at any location.

**Figure 3.3 - Diffusion Tube Monitoring Data within Painswick Road AQMA**

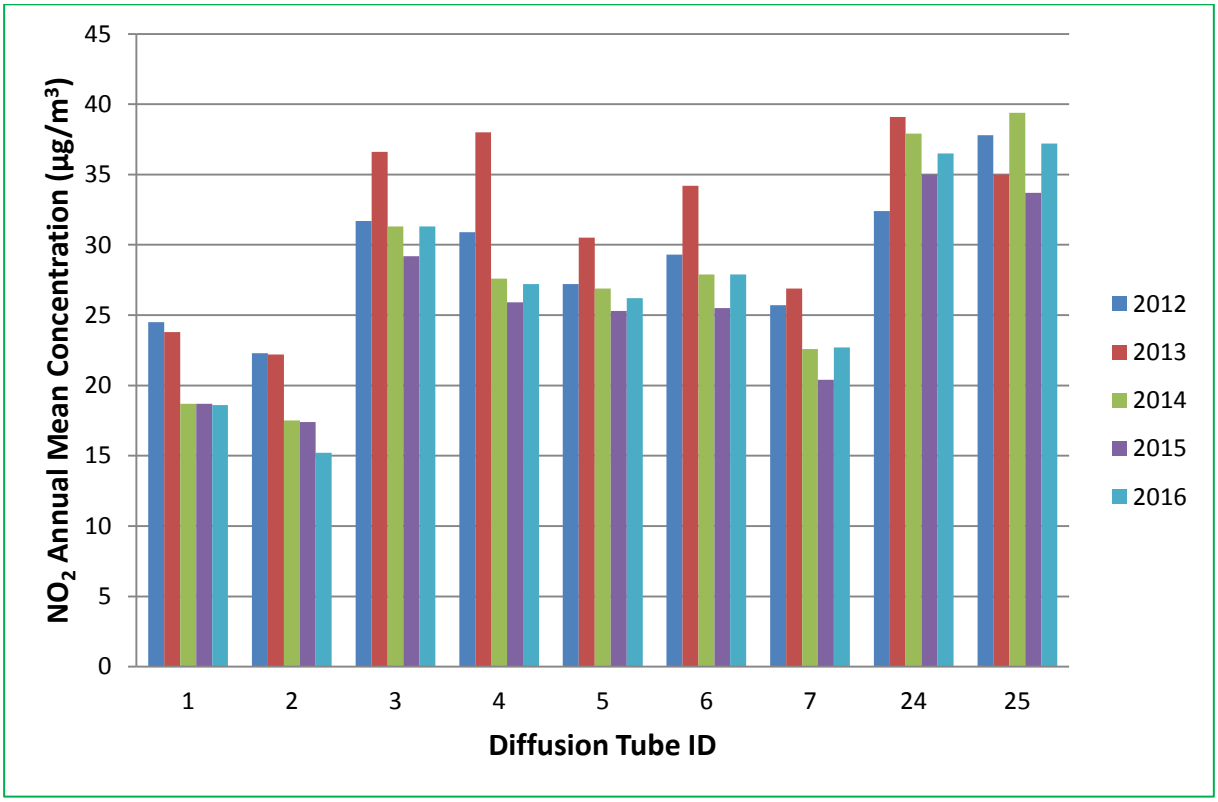



There were no exceedances of the 40µg/m$^3$ annual mean objective during 2016 at the five monitoring locations within the Painswick Road AQMA. The concentrations at all sites increased between 2015 and 2016 but have remained relatively constant across all sites. At site 22 the 2016 concentration of 33.2µg/m$^3$ was the highest recorded within the last five years. Within the past five years there has only been one exceedance of the objective at any of the five sites; 40.1µg/m$^3$ at site 23 in 2012. Although there has only been one exceedance over the past five years, three out of the five sites consistently recorded concentrations above, or close to 35µg/m$^3$. Due to this the AQMA should remain in place but the monitoring locations reviewed to ensure that complete monitoring coverage of the AQMA is maintained.

Diffusion Tubes Outside of Existing AQMAs

There are nine diffusion tube locations located outside of the existing AQMAs that have been monitoring for a number of years. Site 1 had a data capture of less than 75%  and therefore this site was annualised.

**Figure 3.4 – Diffusion Tube Monitoring Data outside of Existing AQMAs**

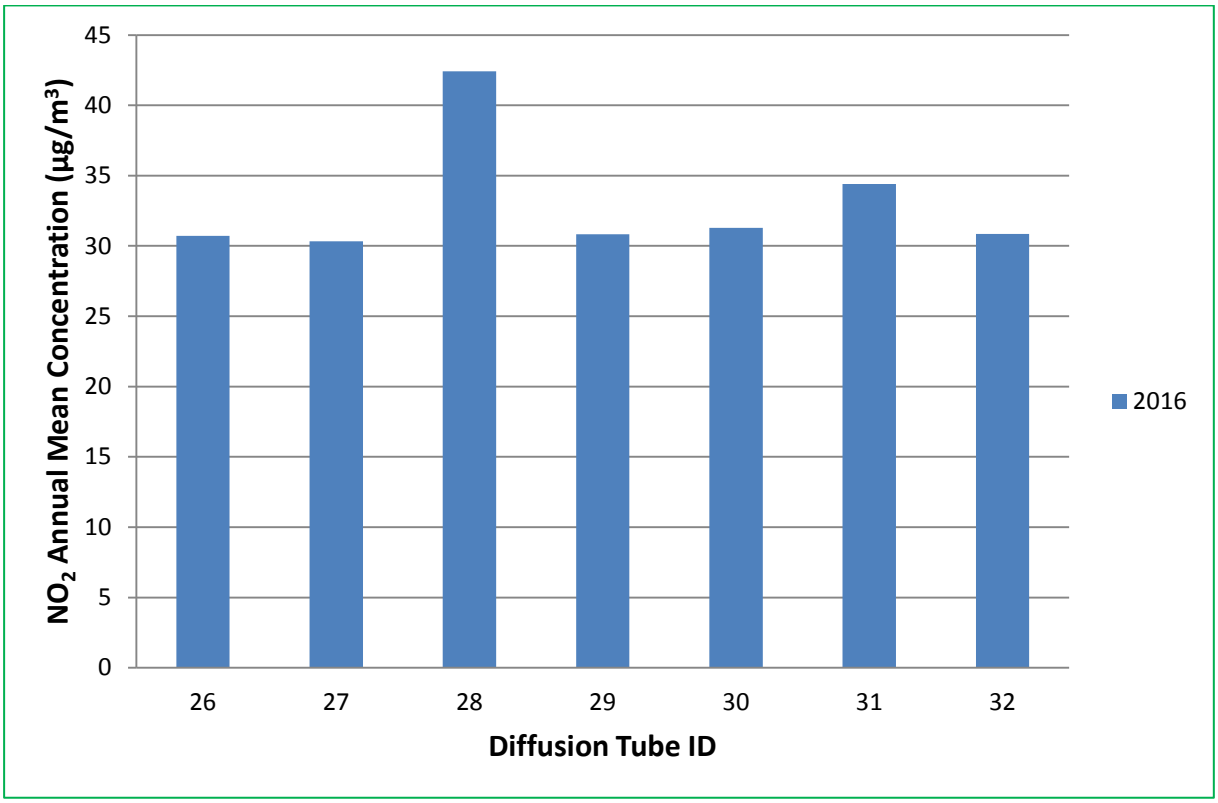



There were no exceedances of the $NO_2$ annual mean objective during 2016 at any of the nine monitoring sites outside of the existing AQMAs, furthermore there has not been an exceedance at any site for the past 5 years. In comparison to 2015 concentrations, seven sites experienced an increase in concetrations and 2 sites experienced a decrease. Due to all monitoring locations reporting concentrations below the annual mean objective an AQMA does not need to be designated within any of the monitored areas. Monitoring should continue at all locations and concentrations will be examined in 2017 to ascertain if $NO_2$ concentrations increase or decrease.

New Diffusion Tube Locations for 2016

There were seven new diffusion tube locations established in 2016, these all began monitoring in July 2016. Due to the monitoring beginning in July 2016 all seven of the monitoring sites have been annualised because of data capture being below 75%.

**Figure 3.5 – Diffusion Tube Monitoring Data for New Locations**




Of the seven new diffusion tube lcoations there was one exceedance of the $NO_2$ annual mean objective, at site 28. The location of site 28 was not representative of exposure and therefore the fall-off with distance calculator was used to estimate the $NO_2$ concentration at the nearest location with relevant exposure. Following this process the concentration fell to 27.6µg/m$^3$. Therefore there are no exceedances of the annual mean objective at relevant exposure locations. Monitoring should be continued at the new locations so that a full year's data set can be analysed and annual means calculated without the use of annualisation. Further comments can be made on the concentrations within the 2018 ASR.

The annual mean $NO_2$ concentration was not greater than 60µg/m$^3$ at any non-automatic monitoring site. Therefore exceedances of the 1-hour mean objective is unlikely at all monitoring locations.

# Appendix A: Monitoring Results

## Table A.1 – Details of Non-Automatic Monitoring Sites

| Site ID | Site Name | Site Type | X OS Grid Ref | Y OS Grid Ref | Pollutants Monitored | In AQMA? | Distance to Relevant Exposure (m) (1) | Distance to kerb of nearest road (m) (2) | Tube collocated with a Continuous Analyser? | Height (m) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Gloucester Guildhall | Urban Background | 383243 | 218489 | $NO_2$ | NO | 0 | 106.7 | NO | 5 |
| 2 | Elmbridge Road Junior School | Urban Background | 385430 | 218870 | $NO_2$ | NO | 9.5 | 101.6 | NO | 2.6 |
| 3 | 79 Millbrook St | Roadside | 384190 | 218160 | $NO_2$ | NO | 0 | 1 | NO | 2.6 |
| 4 | 57 Bristol Rd (façade) | Roadside | 382690 | 217440 | $NO_2$ | NO | 0 | 4.8 | NO | 2.5 |
| 5 | 157 Bristol Rd | Roadside | 382410 | 217013 | $NO_2$ | NO | 0 | 7 | NO | 2.6 |
| 6 | 35 Buscombe Gardens | Roadside | 387670 | 217250 | $NO_2$ | NO | 0 | 26.8 | NO | 2.6 |
| 7 | 12 Caravan Site | Urban Background | 387250 | 216530 | $NO_2$ | NO | 0 | 49.2 | NO | 2.5 |
| 8 | 46 Priory Rd | Roadside | 382898 | 219029 | $NO_2$ | YES | 0 | 4.5 | NO | 2.45 |
| 9 | 56 Priory Rd | Roadside | 382921 | 219034 | $NO_2$ | YES | 0 | 4.4 | NO | 2.54 |
| 10 | 66 Priory Rd | Roadside | 382950 | 219040 | $NO_2$ | YES | 0 | 5.4 | NO | 2.65 |
| 11 | 99 Barton St | Roadside | 383717 | 218094 | $NO_2$ | YES | 0 | 2 | NO | 2.5 |
| 12 | 124 Barton St | Roadside | 383726 | 218074 | $NO_2$ | YES | 0 | 1.5 | NO | 2.6 |
| 13 | 196 Barton St | Roadside | 383989 | 217857 | $NO_2$ | YES | 0 | 2.5 | NO | 2.6 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | (Lamppost) | | | | | | | | | |
| 14 | 219A Barton St (post) | Roadside | 384000 | 217863 | $NO_2$ | YES | 0 | 2 | NO | 2.6 |
| 15 | 240 Barton St | Roadside | 384081 | 217725 | $NO_2$ | YES | 0 | 1.9 | NO | 2.6 |
| 16 | Opp 250 Barton Street | Roadside | 384090 | 217731 | $NO_2$ | YES | 0.3 | 1.7 | NO | 2.6 |
| 17 | 316 Barton St | Roadside | 384175 | 217501 | $NO_2$ | YES | 0 | 2.3 | NO | 2.6 |
| 18 | 301 Barton St | Roadside | 384182 | 217533 | $NO_2$ | YES | 0 | 4.3 | NO | 2.7 |
| 19 | 65 Painswick Rd | Roadside | 384512 | 217023 | $NO_2$ | YES | 0 | 4.5 | NO | 2.54 |
| 20 | 76 Painswick Rd | Roadside | 384490 | 217027 | $NO_2$ | YES | 0 | 3.5 | NO | 2.7 |
| 21 | 88 Painswick Rd | Roadside | 384509 | 216998 | $NO_2$ | YES | 0 | 3.5 | NO | 2.5 |
| 22 | 97 Painswick Rd | Roadside | 384558 | 216946 | $NO_2$ | YES | 0 | 4.6 | NO | 2.57 |
| 23 | 106 Painswick Rd | Roadside | 384550 | 216932 | $NO_2$ | YES | 0 | 2.9 | NO | 2.7 |
| 24 | 53 Barnwood Rd | Roadside | 385113 | 218595 | $NO_2$ | NO | 0 | 2.3 | NO | 2.53 |
| 25 | 61 Barnwood Rd | Roadside | 385130 | 218585 | $NO_2$ | NO | 0 | 5 | NO | 2.6 |
| 26 | 16 London Rd | Roadside | 383653 | 218787 | $NO_2$ | NO | 5.5 | 3.4 | NO | 2.5 |
| 27 | Gloucester Academy | Roadside | 384967 | 216252 | $NO_2$ | NO | 23 | 3 | NO | 2.5 |
| 28 | GL1 | Roadside | 383619 | 218162 | $NO_2$ | NO | 27 | 2 | NO | 2.5 |
| 29 | Park End Road | Roadside | 383238 | 217349 | $NO_2$ | NO | 16 | 3 | NO | 2.5 |
| 30 | 126 Painswick Rd | Roadside | 384607 | 216841 | $NO_2$ | NO | 6 | 2 | NO | 2.5 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 31 | 94 Barnwood Rd | Roadside | 385499 | 218350 | $NO_2$ | NO | 10 | 2 | NO | 2.5 |
| 32 | 26 Farriers End | Roadside | 380958 | 214385 | $NO_2$ | NO | 8 | 2.3 | NO | 2.5 |

**Notes:**

(1) 0m if the monitoring site is at a location of exposure (e.g. installed on/adjacent to the façade of a residential property).

(2) N/A if not applicable.

## Table A.2 – Annual Mean $NO_2$ Monitoring Results

| Site ID | Site Type | Monitoring Type | Valid Data Capture for Monitoring Period (%) (1) | Valid Data Capture 2016 (%) (2) | $NO_2$ Annual Mean Concentration ($\mu g/m^3$) (3) | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | 2012 | 2013 | 2014 | 2015 | 2016 |
| 1 | Urban Background | Diffusion Tube | 100 | 100 | 24.5 | 23.8 | 18.7 | 18.7 | 18.6 |
| 2 | Urban Background | Diffusion Tube | 50 | 50 | 22.3 | 22.2 | 17.5 | 17.4 | 15.2 |
| 3 | Roadside | Diffusion Tube | 100 | 100 | 31.7 | 36.6 | 31.3 | 29.2 | 31.3 |
| 4 | Roadside | Diffusion Tube | 100 | 100 | 30.9 | 38 | 27.6 | 25.9 | 27.2 |
| 5 | Roadside | Diffusion Tube | 100 | 100 | 27.2 | 30.5 | 26.9 | 25.3 | 26.2 |
| 6 | Roadside | Diffusion Tube | 83 | 83 | 29.3 | 34.2 | 27.9 | 25.5 | 27.9 |
| 7 | Urban Background | Diffusion Tube | 100 | 100 | 25.7 | 26.9 | 22.59 | 20.4 | 22.7 |
| 8 | Roadside | Diffusion Tube | 100 | 100 | **45.9** | 37.2 | **60.5** | **40.3** | **44.9** |
| 9 | Roadside | Diffusion Tube | 91 / 91 / 100 | 91 / 91 / 41 | **47.4** | 36.5 | **70.7** | **43** | **51.1** |
| 10 | Roadside | Diffusion Tube | 100 | 100 | **52.5** | 38.4 | **58.5** | **49.2** | **52.1** |
| 11 | Roadside | Diffusion Tube | 100 | 100 | **40.8** | 36.2 | 23.58 | 35.8 | 39.1 |
| 12 | Roadside | Diffusion Tube | 100 | 100 | **48** | 38.8 | **49.7** | **46.6** | **47.4** |
| 13 | Roadside | Diffusion Tube | 92 | 92 | **43.1** | 35.9 | **42.8** | 38.3 | **42.9** |
| 14 | Roadside | Diffusion Tube | 100 | 100 | **40.8** | 38 | **43.6** | 35.8 | **40.1** |
| 15 | Roadside | Diffusion | 83 | 83 | 36 | 33.2 | 35.5 | 32.5 | 35.1 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Tube | | | | | | | |
| 16 | Roadside | Diffusion Tube | 83 | 83 | 33.2 | 32.7 | 33.2 | 25.1 | 31.4 |
| 17 | Roadside | Diffusion Tube | 100 | 100 | 39.9 | 35.4 | 25.4 | 35.8 | 38 |
| 18 | Roadside | Diffusion Tube | 100 | 100 | 28.7 | 22.6 | 24.9 | 23.3 | 25.7 |
| 19 | Roadside | Diffusion Tube | 83 | 83 | 29 | 27.4 | 28.7 | 26.7 | 31.1 |
| 20 | Roadside | Diffusion Tube | 100 | 100 | 32.9 | 30.2 | 36 | 33.5 | 33.6 |
| 21 | Roadside | Diffusion Tube | 83 | 83 | 36.7 | 33.6 | 35.8 | 35.5 | 36.7 |
| 22 | Roadside | Diffusion Tube | 92 | 92 | 30.3 | 29.3 | 32.4 | 30.5 | 33.2 |
| 23 | Roadside | Diffusion Tube | 100 | 100 | **40.1** | 38 | 39 | 38.8 | 39.7 |
| 24 | Roadside | Diffusion Tube | 100 | 100 | 32.4 | 39.1 | 37.9 | 35 | 36.5 |
| 25 | Roadside | Diffusion Tube | 100 | 100 | 37.8 | 35 | 39.4 | 33.7 | 37.2 |
| 26 | Roadside | Diffusion Tube | 50 | 25 | - | - | - | - | 30.7 |
| 27 | Roadside | Diffusion Tube | 100 | 50 | - | - | - | - | 30.3 |
| 28 | Roadside | Diffusion Tube | 100 | 50 | - | - | - | - | **42.4** |
| 29 | Roadside | Diffusion Tube | 100 | 50 | - | - | - | - | 30.8 |
| 30 | Roadside | Diffusion Tube | 83 | 42 | - | - | - | - | 31.3 |
| 31 | Roadside | Diffusion Tube | 100 | 50 | - | - | - | - | 34.4 |
| 32 | Roadside | Diffusion Tube | 83 | 42 | - | - | - | - | 30.9 |

☒ **Diffusion tube data has been bias corrected**

☒ **Annualisation has been conducted where data capture is <75%**

☐ **If applicable, all data has been distance corrected for relevant exposure - distance corrected values for relevant sites are presented in Table B.1**

**Notes:**

Exceedances of the $NO_2$ annual mean objective of 40µg/$m^3$ are shown in **bold**.

$NO_2$ annual means exceeding 60µg/$m^3$, indicating a potential exceedance of the $NO_2$ 1-hour mean objective are shown in **bold and underlined.**

(1) Data capture for the monitoring period, in cases where monitoring was only carried out for part of the year.

(2) Data capture for the full calendar year (e.g. if monitoring was carried out for 6 months, the maximum data capture for the full calendar year is 50%).

(3) Means for diffusion tubes have been corrected for bias. All means have been "annualised" as per Boxes 7.9 and 7.10 in LAQM.TG16 if valid data capture for the full calendar year is less than 75%. See Appendix C for details.

# Appendix B: Full Monthly Diffusion Tube Results for 2016

## Table B.1 – $NO_2$ Monthly Diffusion Tube Results - 2016

| Site ID | $NO_2$ Mean Concentrations (µg/m$^3$) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual Mean | | |
| | | | | | | | | | | | | | Raw Data | Bias Adjusted (0.94) and Annualised (1) | Distance Corrected to Nearest Exposure (2) |
| 1 | 24.9 | 17.2 | 21.2 | 17.9 | 16.4 | 15.3 | 11.8 | 14.1 | 15.2 | 25.4 | 26.1 | 31.8 | 19.8 | 18.6 | - |
| 2 | 23.2 | 17.3 | 16.6 | 14.5 | 12.4 | - | - | - | 17.1 | - | - | - | 16.9 | 15.2 | - |
| 3 | 37.91 | 33.59 | 34.86 | 27.24 | 29.81 | 30.86 | 24.43 | 22.14 | 27.07 | 41.23 | 47.19 | 43.83 | 33.3 | 31.3 | - |
| 4 | 36.34 | 29.33 | 27.85 | 27.99 | 26.38 | 25.25 | 20.22 | 20.5 | 26.28 | 29.06 | 38.95 | 38.67 | 28.9 | 27.2 | - |
| 5 | 35.46 | 29.03 | 30.78 | 23.11 | 22.19 | 22.59 | 21.17 | 20.61 | 25.1 | 29.86 | 35.39 | 39.59 | 27.9 | 26.2 | - |
| 6 | 36.79 | 25.75 | 25.85 | 27.12 | 22.35 | 23.39[3] | 20.16 | 31.19 | - | 34.74 | 33.38 | 39.44 | 29.7 | 27.9 | - |
| 7 | 28.57 | 19.83 | 24.77 | 21.75 | 21.59 | 17.96 | 15.41 | 24.9 | 20.46 | 28.52 | 31.11 | 34.88 | 24.1 | 22.7 | - |
| 8 | 56.51 | 51.18 | 38.55 | 37.68 | 38.03 | 46.53 | 39.87 | 38.22 | 47.39 | 53.05 | 62.88 | 63.8 | 47.8 | 44.9 | - |
| 9 | 64.97 | 52.01 | 47.41 | 45.86 | 52.16 | - | 50.7 | 45.9 | 51.09 | 55.45 | 60 | 70.32 | 54.2 | 50.9 | - |
| 9 | 53.97 | 55.78 | 51.5 | 49.32 | 52.77 | - | 53.78 | 46.03 | 52.78 | 59.34 | 64.21 | 60.38 | 54.5 | 51.3 | - |
| 9 | 63.15 | 53.84 | 46.53 | 48.08 | 56.4 | - | - | - | - | - | - | - | 53.6 | 46.4 | - |
| 10 | 61.45 | 57.43 | 46.17 | 51.34 | 61.54 | 51.7 | 48.21 | 45.72 | 53 | 59.63 | 64.06 | 64.42 | 55.4 | 52.1 | - |
| 11 | 43.44 | 39.71 | 37.68 | 37.55 | 44.49 | 43.25 | 33.58 | 36.96 | 34.43 | 47.9 | 53.09 | 47.14 | 41.6 | 39.1 | - |
| 12 | 59.36 | 47.17 | 45.91 | 50.19 | 45.18 | 45.44 | 52.25 | 48.29 | 48.28 | 49.5 | 56.87 | 57.01 | 50.5 | 47.4 | - |
| 13 | 57.48 | 41.29 | 41.7 | 39.79 | 50.36 | 41.63 | 42.31 | 39.19[3] | 45.42 | 41.72 | 46.62 | 53.13 | 45.6 | 42.9 | - |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 14 | 45.84 | 35.31 | 40 | 42.53 | 48.01 | 39.94 | 31.88 | 33.79 | 38.55 | 49.89 | 58.86 | 46.96 | 42.6 | 40.1 | - |
| 15 | 46.26 | 38.88 | 38.21 | 34.29 | 36.09 | 33.81 | 30.88 | - | 32.96 | 35.92 | 45.59 | - | 37.3 | 35.1 | - |
| 16 | - | 27.33 | 37.42 | 28.67 | - | 25.28 | - | 31.6 | 26.74 | 41.02 | 43.37 | 39.38 | 33.4 | 31.4 | - |
| 17 | 54.77 | 44.81 | 39.4 | 35.03 | 37.92 | 32.74 | 36.69 | 33.52 | 36.18 | 39.7 | 44.41 | 50.02 | 40.4 | 38.0 | - |
| 18 | 34.48 | 24.78 | 29.81 | 26.11 | 25.9 | 23.39 | 17.2 | 20.02 | 22.74 | 33.97 | 34.51 | 35.32 | 27.4 | 25.7 | - |
| 19 | 36.85 | 26.62 | 35.56 | 28.34 | 31.62 | 27.18 | - | - | 23.84 | 37.32 | 42.03 | 41.78 | 33.1 | 31.1 | - |
| 20 | 43.67 | 37.17 | 33.02 | 33.76 | 30.9 | 30.17 | 31.49 | 28.77 | 31.31 | 37.16 | 47.74 | 44.25 | 35.8 | 33.6 | - |
| 21 | 48.99 | 39.02 | - | 36.92 | 35.76 | 32.76 | 37.87 | 32.37 | 36.2 | 39.98 | 50.52 | - | 39.0 | 36.7 | - |
| 22 | 41.22 | 33.37 | 33.39 | - | 34.69 | 31.96 | 23.71 | 35.7 | 29.71 | 40.74 | 39.5 | 44.58 | 35.3 | 33.2 | - |
| 23 | 56.55 | 41.94 | 39.66 | 40.87 | 36.96 | 37.97 | 42.87 | 35.7 | 36.89 | 40.06 | 47.91 | 49.96 | 42.3 | 39.7 | - |
| 24 | 42.68 | 37.47 | 35.97 | 35.71 | 42.67 | 34.13 | 28.05 | 29.91 | 33.85 | 44.24 | 53.82 | 47.1 | 38.8 | 36.5 | - |
| 25 | 43.43 | 39.73 | 41.77 | 37.23 | 37.66 | 36.14 | 27.94 | 31.38 | 33.42 | 48.25 | 51.12 | 47.23 | 39.6 | 37.2 | - |
| 26 | - | - | - | - | - | - | 45.7 | - | - | - | 38.5 | 37.17 | 40.5 | 30.7 | 28.8 |
| 27 | - | - | - | - | - | - | 29.04 | 28.53 | 26 | 35.75 | 38.5 | 37.17 | 32.5 | 30.3 | 22.0 |
| 28 | - | - | - | - | - | - | 32.47 | 34.19 | 41.76 | 47.33 | 57.23 | 59.68 | 45.4 | 42.4 | 27.6 |
| 29 | - | - | - | - | - | - | 18.86 | 24.35 | 28.44 | 41.51 | 43.51 | 41.48 | 33.0 | 30.8 | 24.4 |
| 30 | - | - | - | - | - | - | 23.13 | - | 34.24 | 36.48 | 44.33 | 46.33 | 36.9 | 31.3 | 27.0 |
| 31 | - | - | - | - | - | - | 30.94 | 30.86 | 30.69 | 39.97 | 47.04 | 41.7 | 36.9 | 34.4 | 28.6 |
| 32 | - | - | - | - | - | - | - | 23.86 | 32.04 | 35.15 | 40.63 | 47 | 35.7 | 30.9 | 25.2 |

☐ **Local bias adjustment factor used**

☒ **National bias adjustment factor used**

☒ **Annualisation has been conducted where data capture is <75%**

**Notes:**

Exceedances of the $NO_2$ annual mean objective of 40µg/$m^3$ are shown in **bold**.

$NO_2$ annual means exceeding 60µg/$m^3$, indicating a potential exceedance of the $NO_2$ 1-hour mean objective are shown in **bold and underlined.**

(1) See Appendix C for details on bias adjustment and annualisation.

(2) Distance corrected to nearest relevant public exposure.

(3) Data highlighted in red has been removed from the annual mean due to the diffusion tube containing a spider/insect/

## Table B.2 – Short Term to Long Term Monitoring Data Adjustment (2016)

| Site ID | Unadjusted Diffusion Tube Mean (µg/m$^3$) | Annualisation Factor Bristol St Pauls | Annualisation Factor Cwmbran | Annualisation Factor Leamington Spa | Average Annualisation Factor | Annualised & Bias Adjusted (0.94) Concentration (µg/m$^3$) |
|---|---|---|---|---|---|---|
| 2 | 16.9 | 0.958 | 0.952 | 0.976 | 0.962 | 15.2 |
| 9 | 53.6 | 0.909 | 0.903 | 0.949 | 0.920 | 46.4 |
| 26 | 40.5 | 0.845 | 0.785 | 0.793 | 0.808 | 30.7 |
| 27 | 32.5 | 1.018 | 0.996 | 0.965 | 0.993 | 30.3 |
| 28 | 45.4 | 1.018 | 0.996 | 0.965 | 0.993 | 42.4 |
| 29 | 33.0 | 1.018 | 0.996 | 0.965 | 0.993 | 30.8 |
| 30 | 36.9 | 0.93 | 0.891 | 0.885 | 0.902 | 31.3 |
| 31 | 36.9 | 1.018 | 0.996 | 0.965 | 0.993 | 34.4 |
| 32 | 35.7 | 0.95 | 0.906 | 0.9 | 0.919 | 30.9 |

# Appendix C: Supporting Technical Information / Air Quality Monitoring Data QA/QC

## New Developments within Gloucester City Council

A number of planning applications have been received during 2016 that have the potential to influence pollutant concentrations within Gloucester City:

- The University of Gloucestershire – Development of a new Business School and Growth Hub building at the University of Gloucestershire's Oxstalls campus.
- Land at Bakers Quay – A mixed use regeneration comprising re-use of buildings and new build to accommodate residential, employment, retail and leisure uses and an education centre. Together with public transport facilities, improvements to the road network including a new bridge over the canal and associated landscaping, car parking and servicing.
- St Gobain, Bristol Road – A residential development for over 200 housing units together with public open space, new vehicular access and remediation of the land.
- St Ann Way – Redevelopment of a shopping centre in Gloucester to include a number of new stores and the redevelopment of existing stores.

Traffic volumes are predicted to increase within Gloucester City, partly due to the above planning applications, and these have the potential to increase pollutant concentrations of both $NO_2$ and $PM_{10}$. The continual process of assessing planning applications that are submitted will continue and air quality impacts will be assessed on a case by case basis.

## Diffusion Tube Bias Adjustment Factors

The diffusion tube data has been corrected using a bias adjustment factor, which is an estimate of the difference between diffusion tube concentrations and continuous monitoring data, the latter assumed to be a more accurate method of monitoring. The Defra LAQM.TG(16) provides guidance with regard to the application of a bias adjustment factor to correct diffusion tube monitoring. Triplicate co-location studies

can be used to determine a local bias factor based on the comparison of diffusion tube results with data taken from $NO_x/NO_2$ continuous analysers. Alternatively, the national database of diffusion tube co-location surveys provides bias factors for the relevant laboratory and preparation method.

With regard to the application of a bias adjustment factor for diffusion tubes, Defra LAQM.TG(16) and the LAQM Helpdesk[10] recommend the use of a local bias adjustment factor where available and relevant to diffusion tube sites.

Gloucester City Council does not operate any continuous monitoring within the District and therefore a co-location study is not available to derive a local bias factor, thus the national bias adjustment factor spreadsheet[11] has been used.

Diffusion tube data for Gloucester City Council is supplied and analysed by Gradko using the 20% triethanolamine (TEA) in water preparation method. The national bias adjustment factor for Gradko 20% TEA in water is 0.94 for the year 2016 (based on 21 studies, version 03/17) as derived from the national bias adjustment factor spreadsheet.

For previous data, years 2012 to 2015, the bias adjustment factors have been taken from the Council's previous LAQM annual reports. The factors used were 0.85 (2011), 1.01 (2012), 0.95 (2013), 0.91 (2014) and 0.91 (2015).

### Short-term to Long-term Data Adjustment

In regards to the 2016 diffusion tube data set, annualisation was required at nine locations due to data capture being below 75%. Annualisation has been completed in line with Box 7.10 within Defra LAQM.TG(16), full working details are provided in Table B.2.

In completing the annualisation procedure, data has been taken from three automatic monitoring sites that are within 50 miles of the diffusion tube sites that have been annualised; Bristol St Pauls, Cwmbran and Leamington Spa. These sites form part of the national Automatic Urban and Rural Network (AURN) and are background

[10] Laqm.defra.gov.uk
[11] National Diffusion Tube Bias Adjustment Factor Spreadsheet version 03/17 available at https://laqm.defra.gov.uk/bias-adjustment-factors/national-bias.html

monitoring sites. As such, they are not influenced by local sources of air pollution such as road traffic emissions at roadside monitoring sites.

## QA/QC of Diffusion Tube Monitoring

The diffusion tubes for 2016 were supplied and analysed by Gradko using the 20% TEA in water preparation method. All results have been bias adjusted and annualised where required before being presented in Table A.2.

Gradko is a UKAS accredited laboratory and participates in the new AIR-PT Scheme (a continuation of the Workplace Analysis Scheme for Proficiency (WASP)) for $NO_2$ tube analysis and the Annual Field Inter-Comparison Exercise. These provide strict performance criteria for participating laboratories to meet, thereby ensuring $NO_2$ concentrations reported are of a high calibre. The lab follows the procedures set out in the Harmonisation Practical Guidance In the latest available AIR-PT results, AIR-PT AR 0012 (January to February 2016), AIR-PT AR013 (April to May 2016), AIR-PT AR015 (July to August 2016), AIR-PT AR016 (September to October 2016) and AIR-PT AR01 (October to November 2016). Gradko has scored 100% on all results. The percentage score reflects the results deemed to be satisfactory based upon the z-score of $< \pm 2$. All local Authority co-location studies in 2016 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%).

## Fall-off Distance Correction of Diffusion Tube Monitoring Sites

The $NO_2$ concentrations at diffusion tube sites 26 to 32 have been corrected for distance to the closest relevant receptor using the Defra $NO_2$ Fall off With Distance Calculator[12]. Only these sites have been distance corrected as all other sites represent relevant exposure at the location of the diffusion tube, or due to the site being a background location and the diffusion tube is located at a considerable distance from the nearest road source.

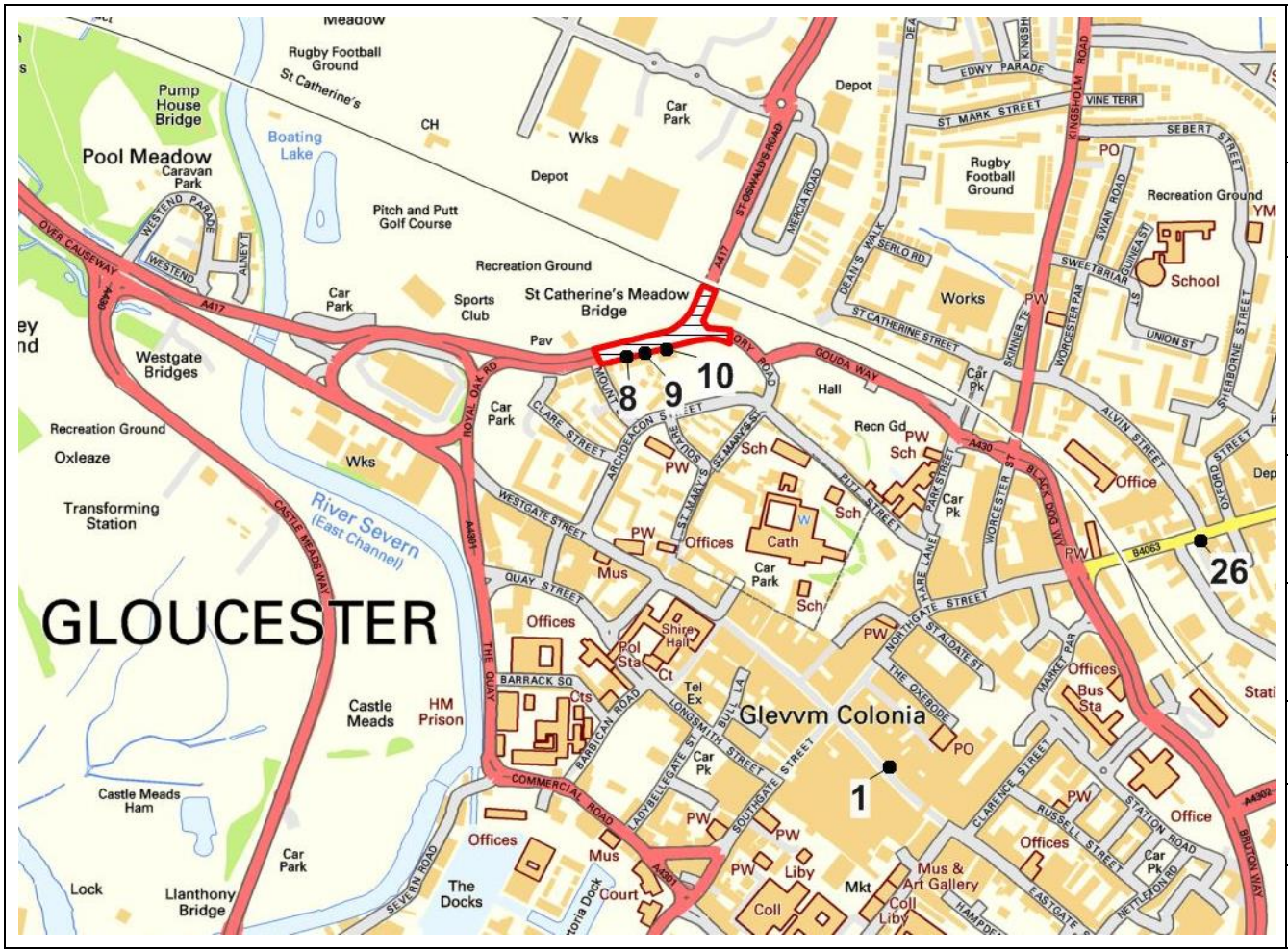
Of the six sites where distance correction has been completed, before the correction one site (28) was in exceedance of the $NO_2$ annual mean objective and no other sites were within 10% of the objective. Following correction site 28 fell below the annual

[12] Defra $NO_2$ fall off with Distance Calculator, available online at https://laqm.defra.gov.uk/tools-monitoring-data/no2-falloff.html

mean objective to a concentration of 27.6µg/m$^3$. Although the concentration was measure to be above 40µg/m$^3$ by the diffusion tube, the concentration at the closest relevant receptor location was far below 40µg/m$^3$, therefore further detailed investigation of this location is not required at this time.

# Appendix D: Maps of Monitoring Locations and AQMAs

## Figure D.1 – Map of Non-Automatic Monitoring Sites:Priory Road AQMA




**Legend**

- Diffusion Tube Location
- AQMA Boundary



Air Quality
Bureau Veritas
5th Floor
66 Prescott Street
London, E1 8HG

| | |
|---|---|
| **Location** | **Gloucester City Council** |
| **Title** | **$NO_2$ Diffusion Tubes – Priory Road AQMA** |
| **By** PB | **Approved** JC |
| **Scale** Not To Scale | **Job Ref** 6446650 |
| **Date** June 2017 | **Figure No.** **D.1** |

## Figure D.2 – Map of Non-Automatic Monitoring Sites: Barnwood/Elmbridge


**Legend**

● Diffusion Tube Location



Air Quality
Bureau Veritas
5th Floor
66 Prescott Street
London, E1 8HG

**Location**

**Gloucester City Council**

**Title**

**$NO_2$ Diffusion Tubes – Barnwood/Elmbridge**

| By | Approved |
|---|---|
| PB | JC |
| **Scale** | **Job Ref** |
| Not To Scale | 6446650 |
| **Date** | **Figure No.** |
| June 2017 | **D.2** |

## Figure D.3 – Map of Non-Automatic Monitoring Sites: Barton Street AQMA


**Legend**

- Diffusion Tube Location
- AQMA Boundary



Air Quality
Bureau Veritas
5th Floor
66 Prescott Street
London, E1 8HG

**Location**

**Gloucester City Council**

**Title**

**$NO_2$ Diffusion Tubes – Barton Street AQMA**

| By | Approved |
|---|---|
| PB | JC |
| **Scale** | **Job Ref** |
| Not To Scale | 6446650 |
| **Date** | **Figure No.** |
| June 2017 | **D.3** |

## Figure D.4 – Map of Non-Automatic Monitoring Sites: St Paul's


**Legend**

● Diffusion Tube Location



Air Quality
Bureau Veritas
5th Floor
66 Prescott Street
London, E1 8HG

**Location**

**Gloucester City Council**

**Title**

**$NO_2$ Diffusion Tubes – St Paul's**

| By | Approved |
|---|---|
| PB | JC |
| **Scale** | **Job Ref** |
| Not To Scale | 6446650 |
| **Date** | **Figure No.** |
| June 2017 | **D.4** |

## Figure D.5 – Map of Non-Automatic Monitoring Sites: M5


**Legend**

● Diffusion Tube Location



Air Quality
Bureau Veritas
5th Floor
66 Prescott Street
London, E1 8HG

**Location**

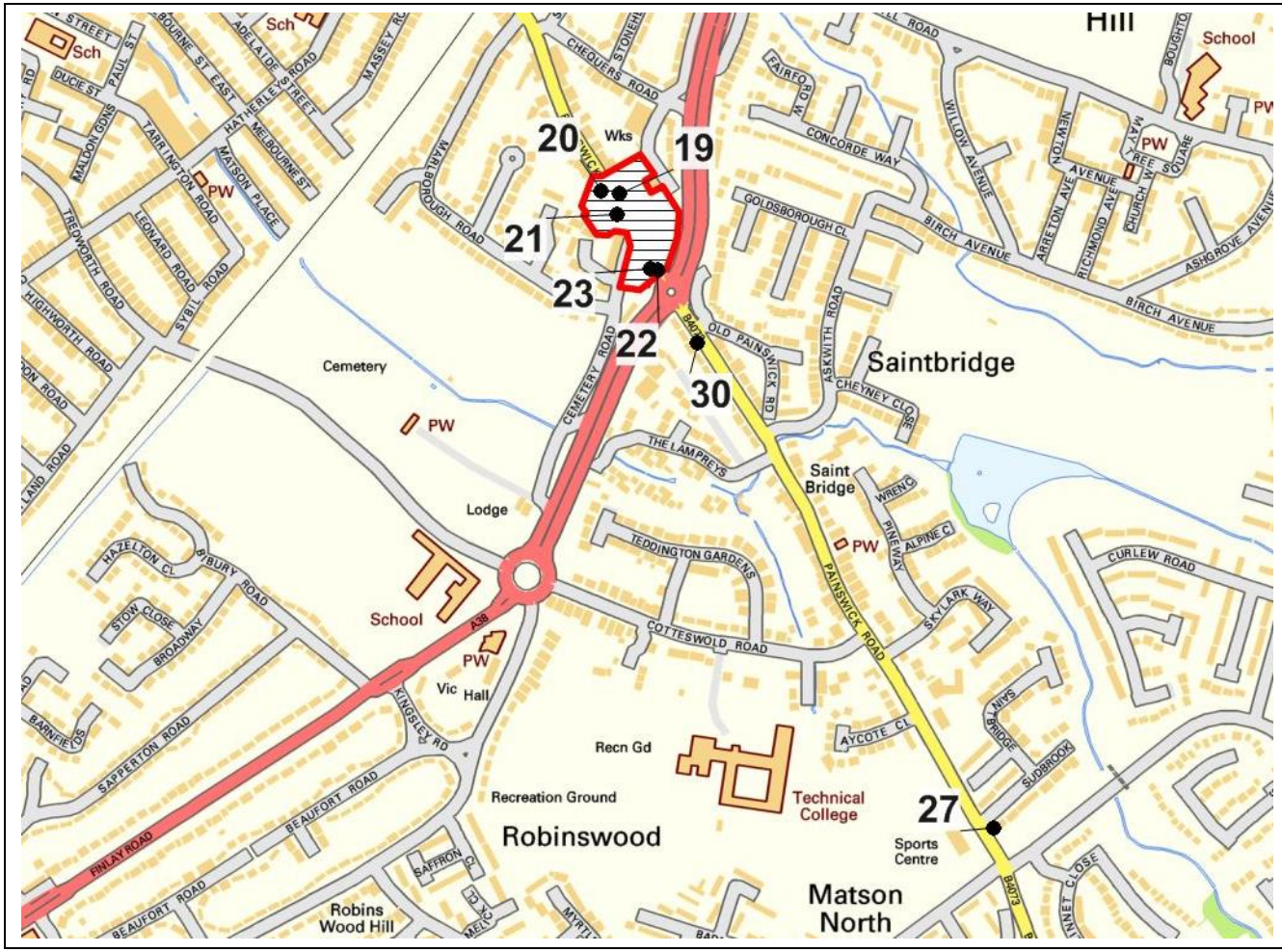
**Gloucester City Council**

**Title**

**$NO_2$ Diffusion Tubes – M5**

| By | Approved |
|---|---|
| PB | JC |
| **Scale** | **Job Ref** |
| Not To Scale | 6446650 |
| **Date** | **Figure No.** |
| June 2017 | **D.5** |

## Figure D.6 – Map of Non-Automatic Monitoring Sites: Painswick Road AQMA




**Legend**

- Diffusion Tube Location
- AQMA Boundary



Air Quality
Bureau Veritas
5th Floor
66 Prescott Street
London, E1 8HG

**Location**

**Gloucester City Council**

**Title**

**$NO_2$ Diffusion Tubes – Painswick Road AQMA**

| By | Approved |
|---|---|
| PB | JC |
| **Scale** | **Job Ref** |
| Not To Scale | 6446650 |
| **Date** | **Figure No.** |
| June 2017 | **D.6** |

## Figure D.7 – Map of Non-Automatic Monitoring Sites: Farriers End


**Legend**

● Diffusion Tube Location



Air Quality
Bureau Veritas
5th Floor
66 Prescott Street
London, E1 8HG

**Location**

**Gloucester City Council**

**Title**

**$NO_2$ Diffusion Tubes – Farriers End**

| By | Approved |
|---|---|
| PB | JC |
| **Scale** | **Job Ref** |
| Not To Scale | 6446650 |
| **Date** | **Figure No.** |
| June 2017 | **D.7** |

# Appendix E: Summary of Air Quality Objectives in England

### Table E.1 – Air Quality Objectives in England

| Pollutant | Air Quality Objective[13] | |
|---|---|---|
| | Concentration | Measured as |
| Nitrogen Dioxide ($NO_2$) | 200 µg/m$^3$ not to be exceeded more than 18 times a year | 1-hour mean |
| | 40 µg/m$^3$ | Annual mean |
| Particulate Matter ($PM_{10}$) | 50 µg/m$^3$, not to be exceeded more than 35 times a year | 24-hour mean |
| | 40 µg/m$^3$ | Annual mean |
| Sulphur Dioxide ($SO_2$) | 350 µg/m$^3$, not to be exceeded more than 24 times a year | 1-hour mean |
| | 125 µg/m$^3$, not to be exceeded more than 3 times a year | 24-hour mean |
| | 266 µg/m$^3$, not to be exceeded more than 35 times a year | 15-minute mean |

[13] The units are in microgrammes of pollutant per cubic metre of air (µg/m$^3$).

# Glossary of Terms

| Abbreviation | Description |
|---|---|
| AQAP | Air Quality Action Plan - A detailed description of measures, outcomes, achievement dates and implementation methods, showing how the local authority intends to achieve air quality limit values' |
| AQMA | Air Quality Management Area – An area where air pollutant concentrations exceed / are likely to exceed the relevant air quality objectives. AQMAs are declared for specific pollutants and objectives |
| ASR | Air quality Annual Status Report |
| Defra | Department for Environment, Food and Rural Affairs |
| LAQM | Local Air Quality Management |
| $NO_2$ | Nitrogen Dioxide |
| $NO_x$ | Nitrogen Oxides |
| $PM_{10}$ | Airborne particulate matter with an aerodynamic diameter of 10µm (micrometres or microns) or less |
| $PM_{2.5}$ | Airborne particulate matter with an aerodynamic diameter of 2.5µm or less |
| QA/QC | Quality Assurance and Quality Control |

# References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