



***Gloucester City Council
Annual Status Report 2018***

Bureau Veritas





June, 2018

Move Forward with Confidence



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2018 Air Quality Annual Status Report (ASR)

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

June 2018

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Executive Summary: Air Quality in Our Area

Air Quality in Gloucester City Council

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 billion³.

Gloucester is a small city (population circa 130,000) situated on the eastern bank of the tidal River Severn and backed by the Cotswold escarpment. The prevailing winds are predominantly 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 the majority of Gloucester which 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 within Gloucester 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. In addition the local traffic within the centre of Gloucester causes rise to increased pollutant concentrations.

Three Air Quality Management Areas (AQMAs) have been declared within Gloucester due to exceedances of the 40µg/m³ 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 (in the city centre, consisting of a further section of Barton Street) declared in 2007.

Monitoring of NO₂ is completed throughout Gloucester City Council using a network of passive diffusion tubes. During 2017 there were thirty four monitoring locations

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

where diffusion tubes were deployed, this is an increase of two locations when compared to the monitoring network in 2016. The additional two locations were as follows:

- DT33 – 45 Eastern Avenue; and
- DT34 – 102 Eastern Avenue.

Out of the thirty two monitoring sites that monitored in both 2016 and 2017, twenty eight reported a decrease in concentration, three reported an increase in concentration and one site remained at the same concentration (Site 20). Exceedances of the annual mean NO₂ objective of 40µg/m³ were reported at four locations during 2017, and all four locations were within the existing 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 NO₂ concentrations. In addition to the AQAP measures, an additional six measures have been included and developed within 2017:

- Measure 12 – The introduction of air quality measures into Gloucester City Council Taxi Licensing Policy;
- Measure 13 – Promoting low emission transport within the Council's commercial fleet;
- Measure 14 – Promoting low emission transport within the Council's pool car fleet;
- Measure 15 – Introducing smart technology to measure air pollution and vehicle numbers entering Barton Street with the idea of influencing traffic movement at times of peak pollution levels;
- Measure 16 – Promoting the issue of air quality through the national Clean Air Day; and
- Measure 17 – Liaising with the planning team to develop criteria for air quality in relation to major planning applications.

All measures are presented in Table 2.2.

During 2017 the Council Cabinet gave approval for the review and update of the AQAP, this will enable the current measures to be reviewed and new measures to be proposed and included within the AQAP. The work to review and update the AQAP will begin in 2018.

Conclusions and Priorities

There were no exceedances of the NO₂ annual mean objective recorded by the network of diffusion tubes outside of any of the existing AQMAs during 2017. 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 the three monitoring sites located within the AQMA boundary;
- Barton Street AQMA – The four diffusion tubes located within the southern section of the AQMA have not exceeded the NO₂ annual mean objective of the past five years, therefore a review of the AQMA will be completed in 2018; and
- Painswick Road AQMA – To remain in force due to the concentration at one diffusion tube location being within 10% of the NO₂ annual mean objective. All other monitoring sites are within the objective level therefore a review of the AQMA will be completed in 2018.

A review and update of the existing AQAP has been approved by the Council Cabinet, this will be completed during 2018. The revised AQAP will be developed in accordance with the current LAQM template and will provide an opportunity to review the status of all three existing AQMAs.

Local Engagement and How to get Involved

A 'How can you help' section on the Gloucester City Council website (<http://www.gloucester.gov.uk/resident/pests-pollution-and-food-hygiene/pollution/Pages/Air-Quality-in-Gloucester.aspx>) provides information on a number of simple things that can be done at an individual level to help improve air quality in Gloucester:

- **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/>;
- **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>;
- **National Clean Air Day 21st of June 2018** – to get involved follow the link <https://www.cleanairday.org.uk/Default.aspx>;
- **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 racks 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.

Table of Contents

Executive Summary: Air Quality in Our Area	i
Air Quality in Gloucester City Council	i
Actions to Improve Air Quality	ii
Conclusions and Priorities	iii
Local Engagement and How to get Involved	iii
1 Local Air Quality Management	1
2 Actions to Improve Air Quality	2
2.1 Air Quality Management Areas.....	2
2.2 Progress and Impact of Measures to address Air Quality in Gloucester City Council	5
2.3 PM _{2.5} – Local Authority Approach to Reducing Emissions and/or Concentrations.....	12
3 Air Quality Monitoring Data and Comparison with Air Quality Objectives and National Compliance	13
3.1 Summary of Monitoring Undertaken	13
3.1.1 Automatic Monitoring Sites	13
3.1.2 Non-Automatic Monitoring Sites.....	13
3.2 Individual Pollutants	13
3.2.1 Nitrogen Dioxide (NO ₂).....	13
3.2.2 Particulate Matter (PM ₁₀).....	16
3.2.3 Particulate Matter (PM _{2.5})	16
3.2.4 Sulphur Dioxide (SO ₂).....	16
Appendix A: Monitoring Results	17
Appendix B: Full Monthly Diffusion Tube Results for 2017	27
Appendix C: Supporting Technical Information / Air Quality Monitoring Data QA/QC	30
Appendix D: Maps of Monitoring Locations and AQMAs	34
Appendix E: Summary of Air Quality Objectives in England	41
Glossary of Terms	42
References	43

List of Tables

Table 2.1 – Declared Air Quality Management Areas.....3
 Table 2.2 – Progress on Measures to Improve Air Quality8
 Table A.1 – Details of Non-Automatic Monitoring Sites17
 Table A.2 – Annual Mean NO₂ Monitoring Results.....20
 Table B.1 – NO₂ Monthly Diffusion Tube Results - 201727
 Table C.1 – AURN Monitoring Stations Used for Annualisation32
 Table C.2 – Diffusion Tube Short Term to Long Term Monitoring Data Adjustment..33
 Table C.3 – NO₂ Fall-Off With Distance Calculations33

List of Figures

Figure A.1 – Trends in Annual Mean NO₂ Concentrations: Priory Road AQMA22
 Figure A.2 – Trends in Annual Mean NO₂ Concentrations: Barton Street AQMA.....23
 Figure A.3 – Trends in Annual Mean NO₂ Concentrations: Painswick Road AQMA .24
 Figure A.4 – Trends in Annual Mean NO₂ Concentrations: Outside of AQMAs25
 Figure A.5 – Trends in Annual Mean NO₂ Concentrations: New Monitoring Sites.....26
 Figure D.1 – NO₂ Diffusion Tube Monitoring Locations: Priory Road AQMA.....34
 Figure D.2 – NO₂ Diffusion Tube Monitoring Locations: Barton Street AQMA.....35
 Figure D.3 – NO₂ Diffusion Tube Monitoring Locations: Painswick Road AQMA36
 Figure D.4 – NO₂ Diffusion Tube Monitoring Locations: St Pauls.....37
 Figure D.5 – NO₂ Diffusion Tube Monitoring Locations: M538
 Figure D.6 – NO₂ Diffusion Tube Monitoring Locations: Barnwood/Elmbridge39
 Figure D.7 – NO₂ Diffusion Tube Monitoring Locations: Farriers End40

1 Local Air Quality Management

This report provides an overview of air quality Gloucester City Council during 2017. 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 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 AQMAs, including maps of AQMA boundaries are available online at <http://www.gloucester.gov.uk/resident/pests-pollution-and-food-hygiene/pollution/Pages/Air-Quality-in-Gloucester.aspx>.

Alternatively, see Appendix D: Maps of Monitoring Locations and AQMAs, which provides for a map of air quality monitoring locations in relation to the AQMAs.

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		
						At Declaration		Now		Name	Date of Publication	Link
Painswick Road AQMA	05/10/07	NO2 Annual Mean	Gloucester	An area encompassing a number of properties on either side of Painswick Road, Gloucester.	NO	48	µg/m ³	38.3	µg/m ³	Gloucester AQAP 2008 (2011 Review)	2011	http://www.gloucester.gov.uk/resident/pests-pollution-and-food-hygiene/pollution/Pages/Air-Quality-in-Gloucester.aspx
Barton Street AQMA	08/08/05	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	µg/m ³	48.1	µg/m ³	Gloucester AQAP 2008 (2011 Review)	2011	http://www.gloucester.gov.uk/resident/pests-pollution-and-food-hygiene/pollution/Pages/Air-Quality-in-Gloucester.aspx

Gloucester City Council

Priory Road AQMA	08/08/05	NO2 Annual Mean	Gloucester	An area encompassing the junction of St Oswalds Road and Priory Road.	NO	41 - 48	µg/m ³	48.3	µg/m ³	Gloucester AQAP 2008 (2011 Review)	2011	http://www.gloucester.gov.uk/resident/pests-pollution-and-food-hygiene/pollution/Pages/Air-Quality-in-Gloucester.aspx
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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 City Council

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

"The report is well structured and provides most of the information specified in the Guidance, using the latest ASR report Template. The following commentary is provided to help inform future reports:

- 1. The latest ASR report has highlighted the continuation of the current AQMAs with monitoring results above or close to objective levels for each AQMA.*
- 2. The results have highlighted that there is evidence of some reductions in area of exceedances, but the highest pollution levels in each AQMA have not significantly reduced over the last 5 years.*
- 3. The majority of the measures from the 2008 AQAP appear to have been completed, although there has not been a clear statement within the current ASR table to confirm the status of measures from the original AQAP table that are no longer listed.*
- 4. The Painswick Road AQMA has now reached compliance with the objectives, however, we agree for the time being that it should remain with current monitoring in place, until such time that pollution levels drop significantly below objective levels.*
- 5. The report makes clear that until the construction measures surrounding the central transport hub are completed, that installed traffic management systems cannot be fully operative. This is likely to affect the control of traffic in these areas.*
- 6. As there is no clear evidence that pollution levels are falling significantly within the two remaining AQMAs, we consider that Action Plan measures for these AQMAs should be reviewed.*
- 7. 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'.*
- 8. The report was initially rejected due to insufficient detail being provided within Table 2.2 This has continued to show that it is difficult to establish which AQAP measures are active and to what extent they have been effective. It is important*

for all future reports, that the ASR Table 2.2 reflects the status of all active measures within the Action Plan, and they are updated annually.”

The comments made within the appraisal report, as shown above, have been taken into account for the completion of the 2018 ASR.

Gloucester City Council has taken forward a number of direct measures during the current reporting year of 2017 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 2008 Gloucester Air Quality Action Plan. The Council Cabinet have approved a review and update of the AQAP, this process is to begin within 2018.

Progression on the measures during 2017 was as follows:

- Measure 2 – Works are continuing on the construction of the new bus station, these are set to be completed within 2018;
- Measures 5, 6 and 7 – Completion of the Thinktravel Transition Year Project with a report issued by Gloucestershire County Council: Thinktravel Smarter Choices Evaluation;
- Measure 12 – Consultation to take place to alter taxi licensing conditions;
- Measure 13 – The entire fleet of refuse collection vehicles has been replaced with more efficient vehicles during 2017;
- Measure 14 – Improvement in the age and standard of vehicles used for council business. Pool vehicles are to be utilised by all staff from January 2018;
- Measure 15 – Consultation with Gloucestershire Highways and private companies to implement possible ANPR and pollutant monitoring on Barton Street;
- Measure 16 – Organisation of events to promote air quality within Gloucester on national Clean Air Day (21st June 2018); and
- Measure 17 – Liaison with the planning team to develop some criteria for air quality in relation to development applications received.

The Thinktravel Smarter Choices evaluation report was completed in July 2017 with the aim of the report to quantify the success of previous measures, identify key areas for improvement and to inform future funding opportunities. An analysis of 1,124 travel diaries within Gloucester and Tewkesbury showed an overall shift away from the use of private car as a single occupant in the order of 7%, to car sharing, cycling and walking. For work trips, there is a shift away from the use of the private car as a single occupant of 4% predominantly to cycling, walking and other modes of transport.

A quantification study has not been completed in relation to the possible reduction of NO₂ emissions, but through improvements in pedestrian and cycle wayfinding, the installation of new cycle stands across Gloucester, and the installation of electric charging points, it is hoped that more individuals will move away from sole occupancy vehicle use.

Further details on Thinktravel including local cycle and walking maps, information on public transport and workplace travel plans can be found online at <https://www.thinktravel.info/>,

Whilst the measures stated above and in Table 2.2 will help to contribute towards compliance, Gloucester City Council anticipates that further additional measures to be developed within the review and update of the current AQAP will be required in subsequent years to achieve compliance and enable the revocation of the three existing AQMAs.

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	Works are ongoing
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

Gloucester City Council

					There are no planned improvements in Gloucester for the foreseeable 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. The evaluation report was produced in July 2017 to form an evidence base to inform future funding opportunities.	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 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. The evaluation report was produced in July 2017 to form an evidence base to inform future funding opportunities.	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 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. The evaluation report was produced in July 2017 to form an evidence base to inform future funding opportunities.	Completed	No further funding is available at this time.

Gloucester City Council

8	Greater restriction and better timing of deliveries	Freight and Delivery Management	Route Management Plans/ Strategic routing strategy for HGV's	Gloucestershire County Council	2011 - 2014	On-going	Number of HGVs on named roads	< 0.2µg/m ³	Currently deliveries are banned from 8-9am and 5-6pm	On-going	No further update available at this time
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/m ³	Continued promotion and information on council website.	On-going	Met with Stagecoach at the end of 2017 and their bus fleet is reviewed and renewal scheduled as a result of the age of the vehicle on a countywide basis
10	Upgrade existing bus fleet	Vehicle Fleet Efficiency	Vehicle Retrofitting programmes	Bus companies	2011	On-going	Number of buses retrofitted	< 0.2µg/m ³	On-going	On-going	No further update available at this time
11	Reduce illegal parking	Traffic Management	UTC, Congestion management, traffic reduction	Gloucestershire County Council	2011	On-going	Reduction in illegal parking and less parking on city centre roads.	< 0.2µg/m ³	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.
12	Introduce air quality measures into Gloucester City Council Taxi Licensing Policy	Promoting Low Emission Transport	Taxi Licensing conditions	Gloucester City Council	2018	On-going	Improvement in age and euro standard of vehicles within the taxi fleet		Cabinet report taken and approval granted to initiate consultation to alter taxi licensing conditions	On-going	Gloucester City Council Taxi Licensing Committee hold the final decision to approve the proposed changes
13	Amey Fleet	Promoting Low Emission Transport	Company Vehicle Procurement - Prioritising uptake of low emission vehicles	Gloucester City Council/ Amey	2018	Completed	Improvements in age and euro standard of vehicles within Amey fleet		Entire recycling fleet renewed in January 2016. Entire fleet of refuse vehicles renewed in April 2017.	On-going	-

Gloucester City Council

14	Pool Vehicles	Promoting Low Emission Transport	Company Vehicle Procurement - Prioritising uptake of low emission vehicles	Gloucester City Council	2018	Completed	Improvement in age and euro standard of vehicles used for council business use		Pool vehicles utilised by all staff from January 2018	Completed	-
15	Smart City Pilot- Smart technology measuring air pollution and vehicle numbers entering Barton Street with the idea of influencing traffic movement at times of peak pollution levels	Traffic Management	UTC, Congestion management, traffic reduction	Gloucester City Council/ Gloucestershire County Council	2018	On-going	% of vehicles travelling through Barton Street AQMA		Liaison with Private Company and Gloucestershire Highways to implement technology	On-going	Use of Gloucestershire Highways assets, linking the technology to our highways traffic light system
16	Air Quality Action Day	Public Information	Other	Gloucester City Council	2018	On-going			Will be organising a proactive day to promote AQ in Gloucester on the 21st June 2018	On-going	-
17	Improvement in Planning Application Validation Requirements	Policy Guidance and Development Control	Air Quality Planning and Policy Guidance	Gloucester City Council	2018	On-going	Increase in air quality assessments being received with the submission of applications for major developments		Liaison with Planning Department to provide criteria for air quality in relation to major developments. Applications are not validated until all information is received.	On-going	-

Note – A review and update to the 2008 AQAP was approved by the Council Cabinet in 2017, this process will begin in 2018 and the action plan measures will be updated following this.

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 PM₁₀ 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 2017 background maps for Gloucester City Council (2015 based⁴) 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 10.4µg/m³ within the 1 x 1km grid square with the centroid grid reference of 380500, 213500. This is an area to the south of Gloucester that contains the A38.

The Public Health Outcomes Framework data tool⁵ compiled by Public Health England quantifies the mortality burden of PM_{2.5} within England on a county and local authority scale. The 2016 fraction of mortality attributable to PM_{2.5} pollution across England is 5.3%, and in contrast the fraction within Gloucester City Council is fractionally higher than the National average at 5.4%.

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.

⁴ Defra Background Mapping data for local authorities (2015-based), available online at <https://uk-air.defra.gov.uk/data/lagm-background-maps?year=2015>

⁵ 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 during 2017.

3.1.2 Non-Automatic Monitoring Sites

Gloucester City Council undertook non- automatic (passive) monitoring of NO₂ at thirty four sites during 2017, this is an increase of two sites when compared to 2016. Monitoring at the additional two sites (sites 33 and 34) began in May 2017.

Table A.1 in Appendix A presents 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 and “annualisation”. Further details on adjustments are provided in Appendix C.

3.2.1 Nitrogen Dioxide (NO₂)

Table A.2 in Appendix A compares the ratified and adjusted monitored NO₂ annual mean concentrations for the past 5 years with the air quality objective of 40µg/m³.

For diffusion tubes, the full 2017 dataset of monthly mean values is provided in Table B.1.

Data capture for four of the diffusion tubes was below 75%, therefore annualisation (short-term to long-term adjustment) has been completed in line with LAQM.TG(16)

using data from background automatic monitoring stations within 50 miles of the diffusion tube locations.

The NO₂ results for 2017 have been bias adjusted using a national bias adjustment factor of 0.89. Full details of the bias adjustment and QA/QC monitoring procedures are provided in Appendix C.

The annual mean NO₂ concentration was not greater than 60µg/m³ at any diffusion tube monitoring site, as per LAQM.TG(16) guidance, it is unlikely there were any exceedances of the NO₂ 1-hour mean objective at any monitoring site.

The analysis of the 2017 monitoring data is completed below in relation to the designated AQMAs within Gloucester City Council. The concentrations presented have not been distance corrected.

Please note that the ID numbers of the diffusion tube monitoring sites have changed from those presented within the 2017 ASR.

Priory Road AQMA

Monitored concentrations are presented in Figure A.1.

There are three diffusion tube locations within the Priory Road AQMA, sites 23, 24 and 25. Previously site 24 has been a triplicate location of diffusion tubes, but this was reduced to a duplicate site in June 2016.

The NO₂ concentration at the three monitoring locations within the Priory Road AQMA exceeded the annual mean objective of 40µg/m³ in 2017. All locations have exceeded this objective for the previous five years, apart from in 2013 where all three diffusion tube locations reported concentrations below 40µg/m³.

Concentrations at the three sites have reduced in 2017 when compared to 2016, and 2014 still remains the peak year for NO₂ concentrations. Due to the continued high concentrations that are in exceedance of the annual mean objective, the AQMA should remain in force.

Barton Street AQMA

Monitored concentrations are presented in Figure A 2.

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.

The 2017 NO₂ concentration at one monitoring site (site 14) within the Barton Street AQMA exceeded the annual mean objective of 40µg/m³; this is a reduction of two when compared to 2016. The concentrations recorded in 2017 decreased at all monitoring sites apart from site 14 where a slight increase was experienced.

Concentrations continue to be lower at the southern end of the AQMA at site 10, 11, 16 and 17. Site 17 remains within 10% of the annual mean, and there have been a number of exceedances of the objective within the past five years, therefore at the current time the AQMA should remain in force.

Painswick Road AQMA

Monitored concentrations are presented in Figure A.3.

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

There were no exceedances of the 40µg/m³ annual mean objective during 2017 at the five monitoring locations within the Painswick Road AQMA. The concentrations at all sites decreased between 2016 and 2017 and have remained relatively constant across all sites. The highest concentration recorded was at site 9 (38.3µg/m³), this is within 10% of the annual mean objective. The site is located at the southern end of the AQMA close to the roundabout with the A38 where traffic decelerates and there can be congestion during peak times.

Within the past five years there have not been any exceedances of the annual mean objective at any of the five sites. Although there has not been any exceedances over the past five years, site 9 has been within 10% of the objective for the past five years. Due to this the AQMA should remain in place, but a review to the boundary of the AQMA is to be completed and the monitoring locations reviewed to ensure that complete monitoring coverage of the AQMA is maintained.

Diffusion Tubes Outside of Existing AQMAs

Monitored concentrations are presented in Figure A.4.

There are nine diffusion tube monitoring sites located outside of the existing AQMAs that have been monitoring for a number of years. Site 21 had a data capture of less than 75% and therefore this site was annualised.

There were no exceedances of the NO₂ annual mean objective during 2017 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 2016 concentrations, seven sites experienced a decrease in concentration, one site experienced an increase, and one site recorded the same concentration in 2017 as in 2016. Due to all monitoring locations reporting concentrations below the annual mean objective, no further AQMAs need to be designated within Gloucester City Council.

New Diffusion Tube Locations (2016 and 2017)

Monitored concentrations are presented in Figure A.5.

There were seven new diffusion tube locations established in 2016 that began monitoring in July 2016 (sites 26-32, and two new locations established in 2017 that began monitoring in May 2017 (site 33 and 34). Due to monitoring beginning in May 2017 at sites 33 and 34, both sites were annualised due to data capture being below 75%, in addition site 26 was also annualised.

There were no exceedances of the NO₂ annual mean objective at any of the nine new diffusion tube locations that have been introduced since 2016. Concentrations at site 28 (36.8µg/m³) and site 34 (38.7µg/m³) were within 10% of the annual mean objective, therefore the fall-off with distance calculator has been used to estimate the NO₂ concentration at the nearest location with relevant exposure.

Following this process the concentrations fell to 24.2µg/m³ at site 28 and 29.7µg/m³ at site 34. Therefore there are no exceedances of the annual mean objective at relevant exposure locations. Monitoring is to continue at these locations so trend analysis over a long term period can be completed.

3.2.2 Particulate Matter (PM₁₀)

Gloucester City Council does not carry out any routine monitoring of PM₁₀.

3.2.3 Particulate Matter (PM_{2.5})

Gloucester City Council does not carry out any routine monitoring of PM_{2.5}.

3.2.4 Sulphur Dioxide (SO₂)

Gloucester City Council does not carry out any routine monitoring of SO₂.

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	57 Bristol Rd (façade)	Roadside	382690	217440	NO2	NO	0	4.8	NO	2.5
2	157 Bristol Rd	Roadside	382410	217013	NO2	NO	0	7	NO	2.6
3	35 Buscombe Gardens	Roadside	387670	217250	NO2	NO	0	26.8	NO	2.6
4	12 Caravan Site	Urban Background	387250	216530	NO2	NO	0	49.2	NO	2.5
5	97 Painswick Rd	Roadside	384558	216946	NO2	YES	0	4.6	NO	2.57
6	65 Painswick Rd	Roadside	384512	217023	NO2	YES	0	4.5	NO	2.54
7	76 Painswick Rd	Roadside	384490	217027	NO2	YES	0	3.5	NO	2.7
8	88 Painswick Road	Roadside	384509	216998	NO2	YES	0	3.5	NO	2.5
9	106 Painswick Rd	Roadside	384550	216932	NO2	YES	0	2.9	NO	2.7
10	301 Barton St	Roadside	384182	217533	NO2	YES	0	4.3	NO	2.7
11	Opp 250 Barton St	Roadside	384090	217731	NO2	YES	0.3	1.7	NO	2.6
12	219A Barton St (post)	Roadside	384000	217863	NO2	YES	0	2	NO	2.6

13	99 Barton St	Roadside	383717	218094	NO2	YES	0	2	NO	2.5
14	124 Barton St	Roadside	383726	218074	NO2	YES	0	1.5	NO	2.6
15	196 Barton St (Lamppost)	Roadside	383989	217857	NO2	YES	0	2.5	NO	2.6
16	240 Barton Street	Roadside	384081	217725	NO2	YES	0	1.9	NO	2.6
17	316 Barton St	Roadside	384175	217501	NO2	YES	0	2.3	NO	2.6
18	79 Millbrook Road	Roadside	384190	218160	NO2	NO	0	1	NO	2.6
19	61 Barnwood Rd	Roadside	385130	218585	NO2	NO	0	5	NO	2.6
20	53 Barnwood Rd	Roadside	385113	218595	NO2	NO	0	2.3	NO	2.53
21	Elmbridge Road Junior School	Urban Background	385430	218870	NO2	NO	9.5	101.6	NO	2.6
22	Gloucester Guildhall	Urban Background	383243	218489	NO2	NO	0	106.7	NO	5
23	46 Priory Rd	Roadside	382898	219029	NO2	YES	0	4.5	NO	2.45
24	56 Priory Rd (Duplicate)	Roadside	382921	219034	NO2	YES	0	4.4	NO	2.54
25	66 Priory Rd	Roadside	382950	219040	NO2	YES	0	5.4	NO	2.65
26	16 London Rd	Roadside	383560	218775	NO2	NO	30	2.7	NO	2.5
27	Gloucester Academy	Roadside	384967	216252	NO2	NO	23	3	NO	2.5
28	GL1	Roadside	383619	218162	NO2	NO	27	2	NO	2.5
29	Park End Cross Roads	Roadside	383238	217349	NO2	NO	16	3	NO	2.5
30	126 Painswick Rd	Roadside	384607	216841	NO2	NO	6	2	NO	2.5

31	94 Barnwood Rd	Roadside	385499	218350	NO2	NO	10	2	NO	2.5
32	26 Farriers End	Roadside	380958	214385	NO2	NO	8	2.3	NO	2.5
33	45 Eastern Avenue	Roadside	384638	217325	NO2	NO	19	1.3	NO	2.5
34	102 Eastern Avenue	Roadside	384671	217296	NO2	NO	7.5	1.4	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 NO₂ Monitoring Results

Site ID	Site Type	Monitoring Type	Valid Data Capture for Monitoring Period (%) ⁽¹⁾	Valid Data Capture 2017 (%) ⁽²⁾	NO ₂ Annual Mean Concentration (µg/m ³) ⁽³⁾				
					2013	2014	2015	2016	2017
1	Roadside	Diffusion Tube	100	100	38.0	27.6	25.9	27.2	25.0
2	Roadside	Diffusion Tube	100	100	30.5	26.9	25.3	26.2	23.9
3	Roadside	Diffusion Tube	100	100	34.2	27.9	25.5	27.9	24.0
4	Urban Background	Diffusion Tube	100	100	26.9	22.6	20.4	22.7	19.6
5	Roadside	Diffusion Tube	100	100	29.3	32.4	30.5	33.2	29.6
6	Roadside	Diffusion Tube	100	100	27.4	28.7	26.7	31.1	26.4
7	Roadside	Diffusion Tube	100	100	30.2	36.0	33.5	33.6	32.1
8	Roadside	Diffusion Tube	92	92	33.6	35.8	35.5	36.7	35.2
9	Roadside	Diffusion Tube	100	100	38.0	39.0	38.8	39.7	38.3
10	Roadside	Diffusion Tube	100	100	22.6	24.9	23.3	25.7	24.0
11	Roadside	Diffusion Tube	100	100	32.7	33.2	25.1	31.4	27.8
12	Roadside	Diffusion Tube	100	100	38.0	43.6	35.8	40.1	36.5
13	Roadside	Diffusion Tube	100	100	36.2	23.6	35.8	39.1	35.0
14	Roadside	Diffusion Tube	100	100	38.8	49.7	46.6	47.4	48.1
15	Roadside	Diffusion Tube	100	100	35.9	42.8	38.3	42.9	39.3
16	Roadside	Diffusion Tube	92	92	33.2	35.5	32.5	35.1	33.0
17	Roadside	Diffusion Tube	100	100	35.4	25.4	35.8	38.0	35.2
18	Roadside	Diffusion Tube	83	83	36.6	31.3	29.2	31.3	30.2
19	Roadside	Diffusion Tube	100	100	35.0	39.4	33.7	37.2	34.1
20	Urban Background	Diffusion Tube	100	100	39.1	37.9	35.0	36.5	36.5

21	Urban Background	Diffusion Tube	42	42	22.2	17.5	17.4	15.2	17.6
22	Roadside	Diffusion Tube	92	92	23.8	18.7	18.7	18.6	17.3
23	Roadside	Diffusion Tube	100	100	37.2	60.5	40.3	44.9	42.8
24	Roadside	Diffusion Tube	100	100	36.5	70.7	43.0	51.1	48.3
25	Roadside	Diffusion Tube	100	100	38.4	58.5	49.2	52.1	46.7
26	Roadside	Diffusion Tube	25	25	-	-	-	30.7	30.4
27	Roadside	Diffusion Tube	100	100	-	-	-	30.3	24.5
28	Roadside	Diffusion Tube	83	83	-	-	-	42.4	36.8
29	Roadside	Diffusion Tube	100	100	-	-	-	30.8	26.6
30	Roadside	Diffusion Tube	100	100	-	-	-	31.3	32.5
31	Roadside	Diffusion Tube	100	100	-	-	-	34.4	28.9
32	Roadside	Diffusion Tube	100	100	-	-	-	30.9	29.9
33	Roadside	Diffusion Tube	100	67	-	-	-	-	34.5
34	Roadside	Diffusion Tube	100	67	-	-	-	-	38.7

Diffusion tube data has been bias corrected

Annualisation has been conducted where data capture is <75%

Notes:

Exceedances of the NO₂ annual mean objective of 40µg/m³ are shown in **bold**.

NO₂ annual means exceeding 60µg/m³, indicating a potential exceedance of the NO₂ 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.

Figure A.1 – Trends in Annual Mean NO₂ Concentrations: Priory Road AQMA

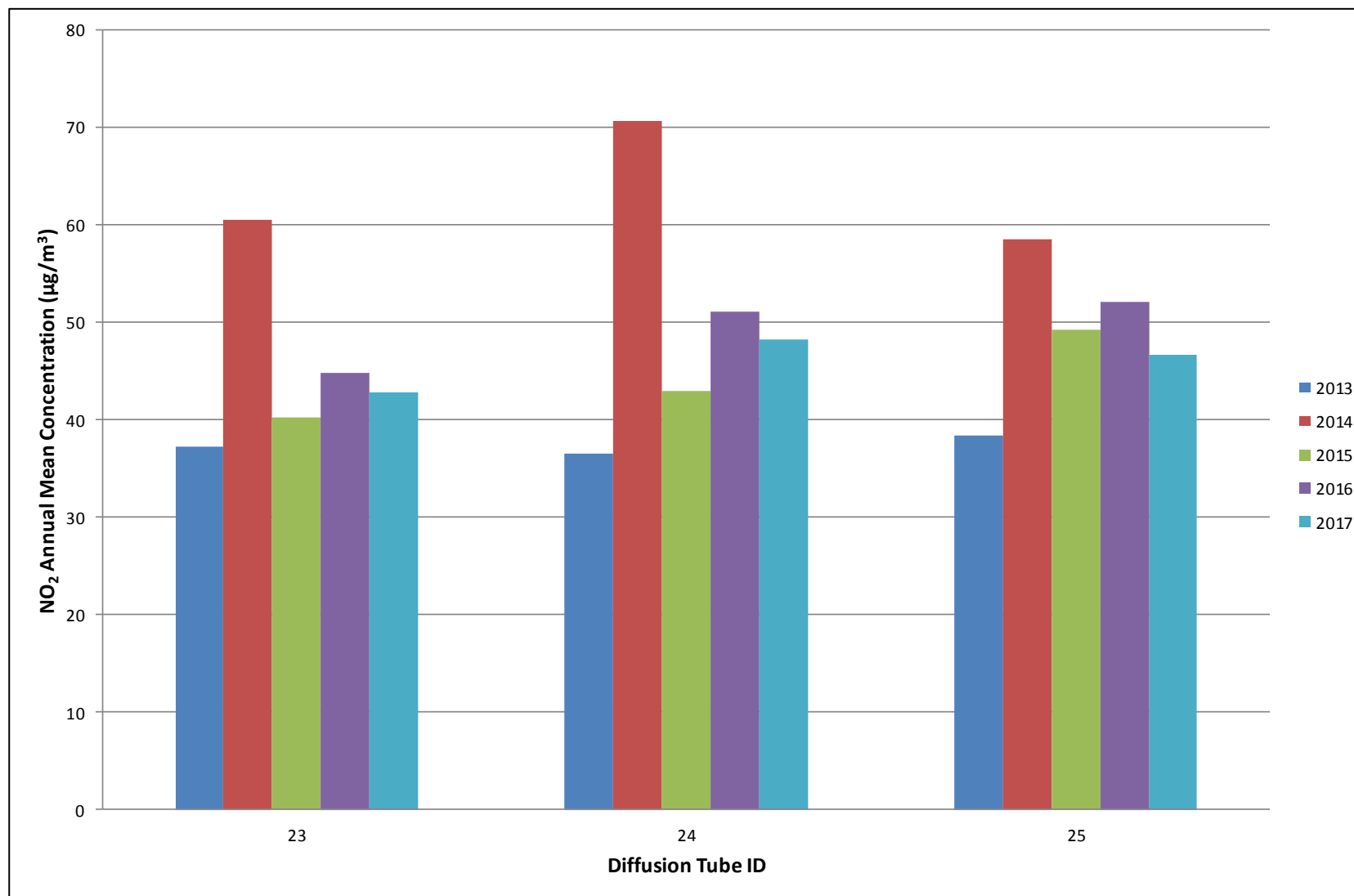


Figure A 2 – Trends in Annual Mean NO₂ Concentrations: Barton Street AQMA

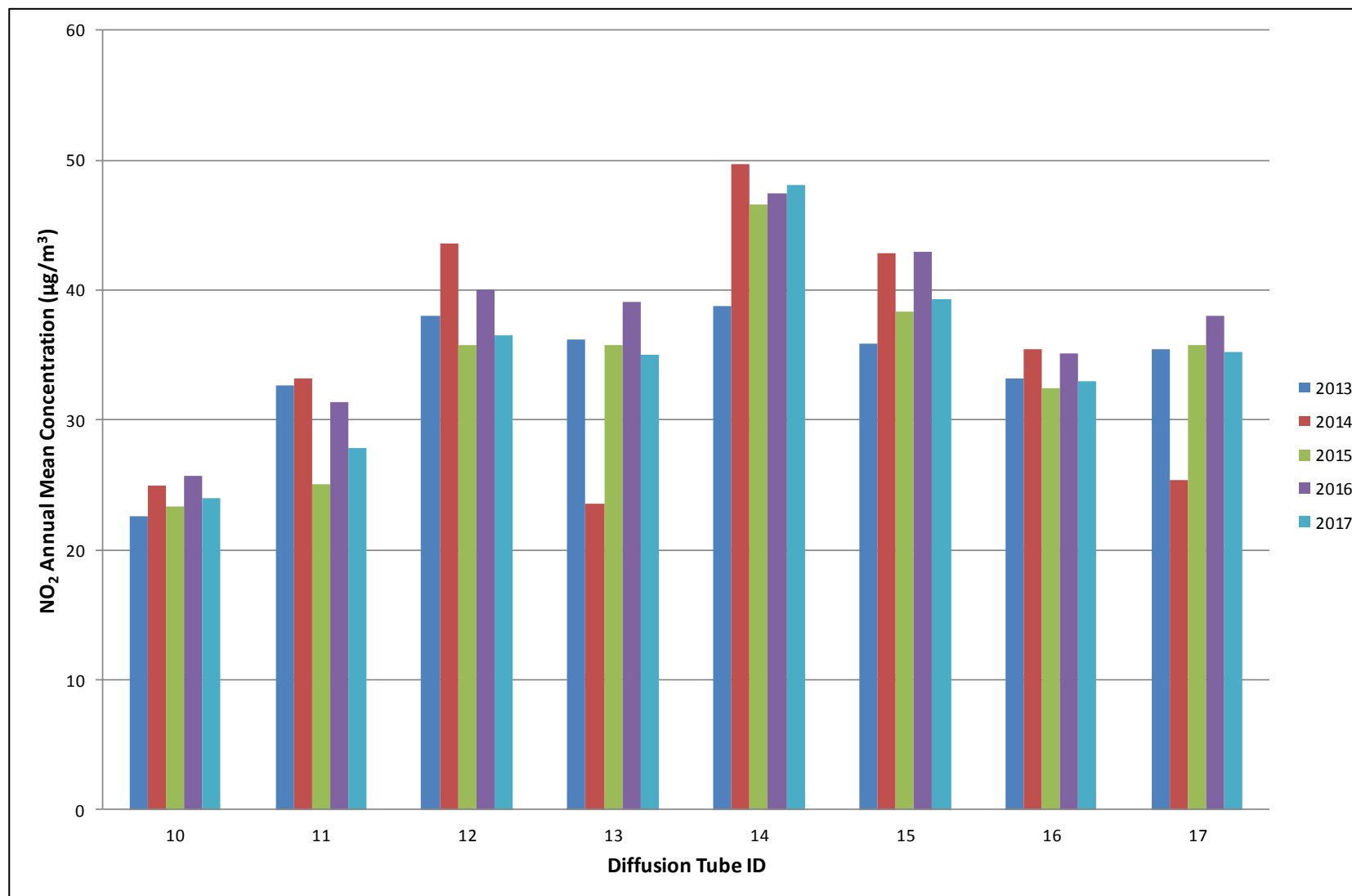


Figure A.3 – Trends in Annual Mean NO₂ Concentrations: Painswick Road AQMA

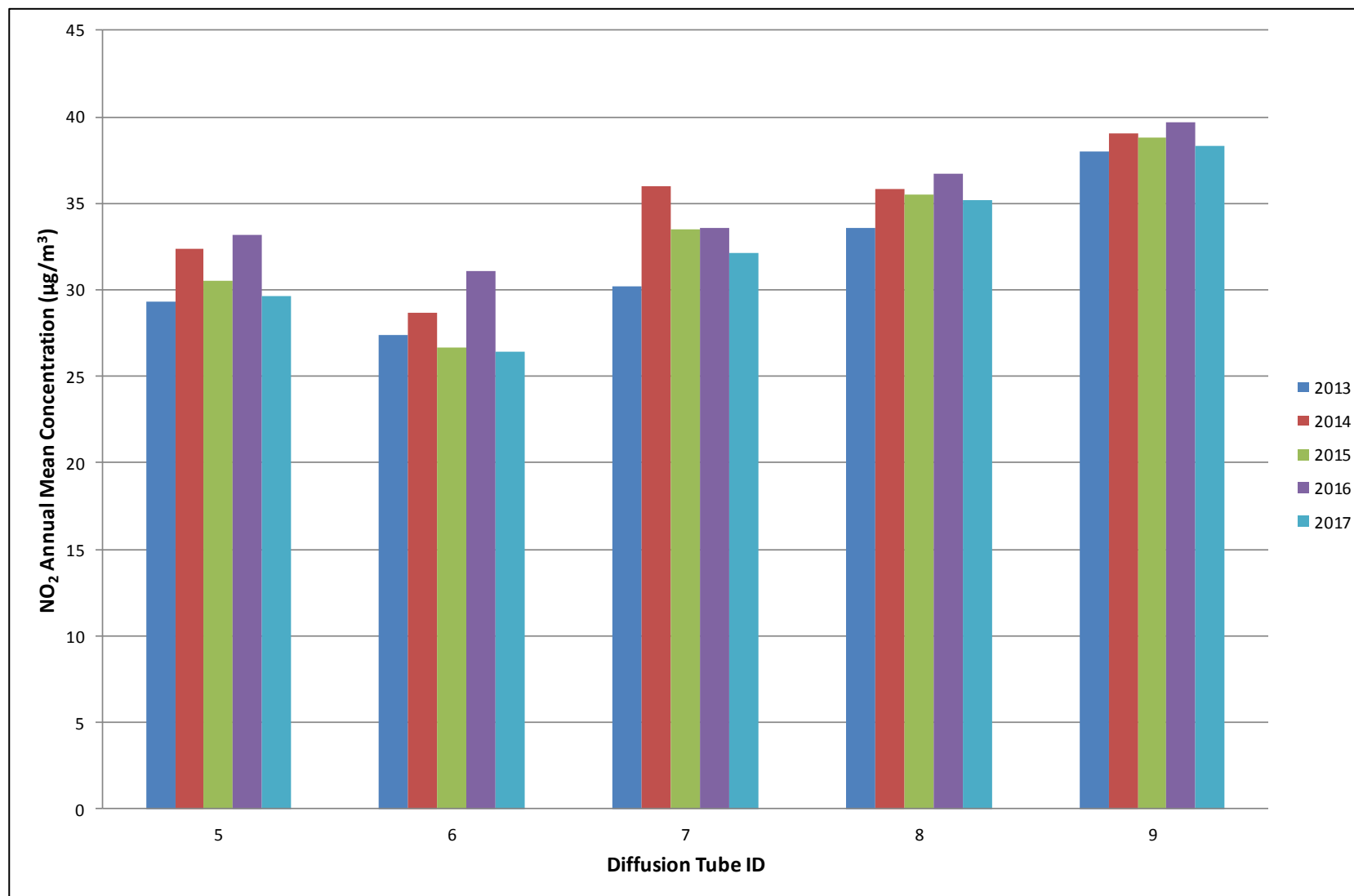


Figure A.4 – Trends in Annual Mean NO₂ Concentrations: Outside of AQMAs

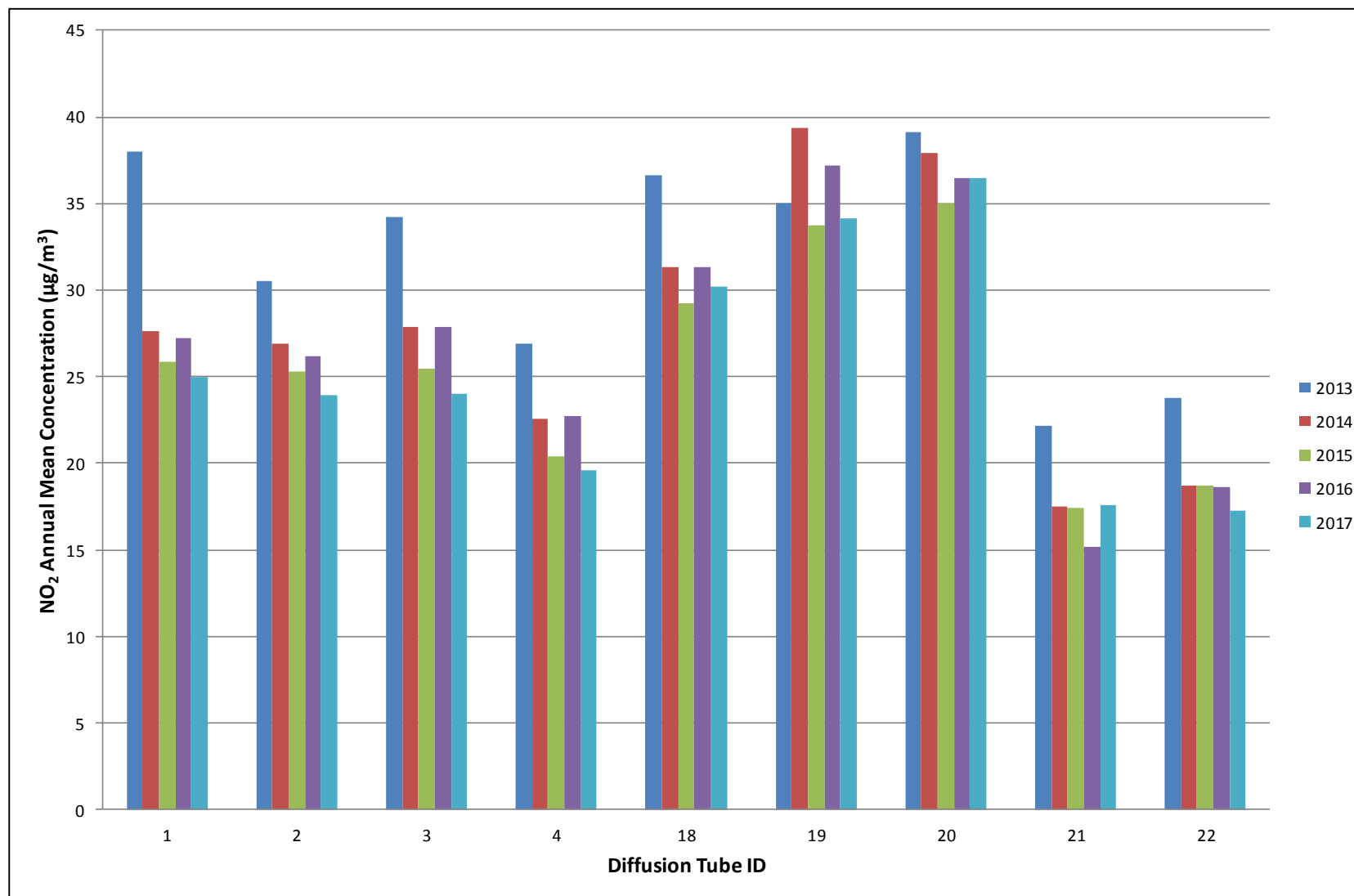
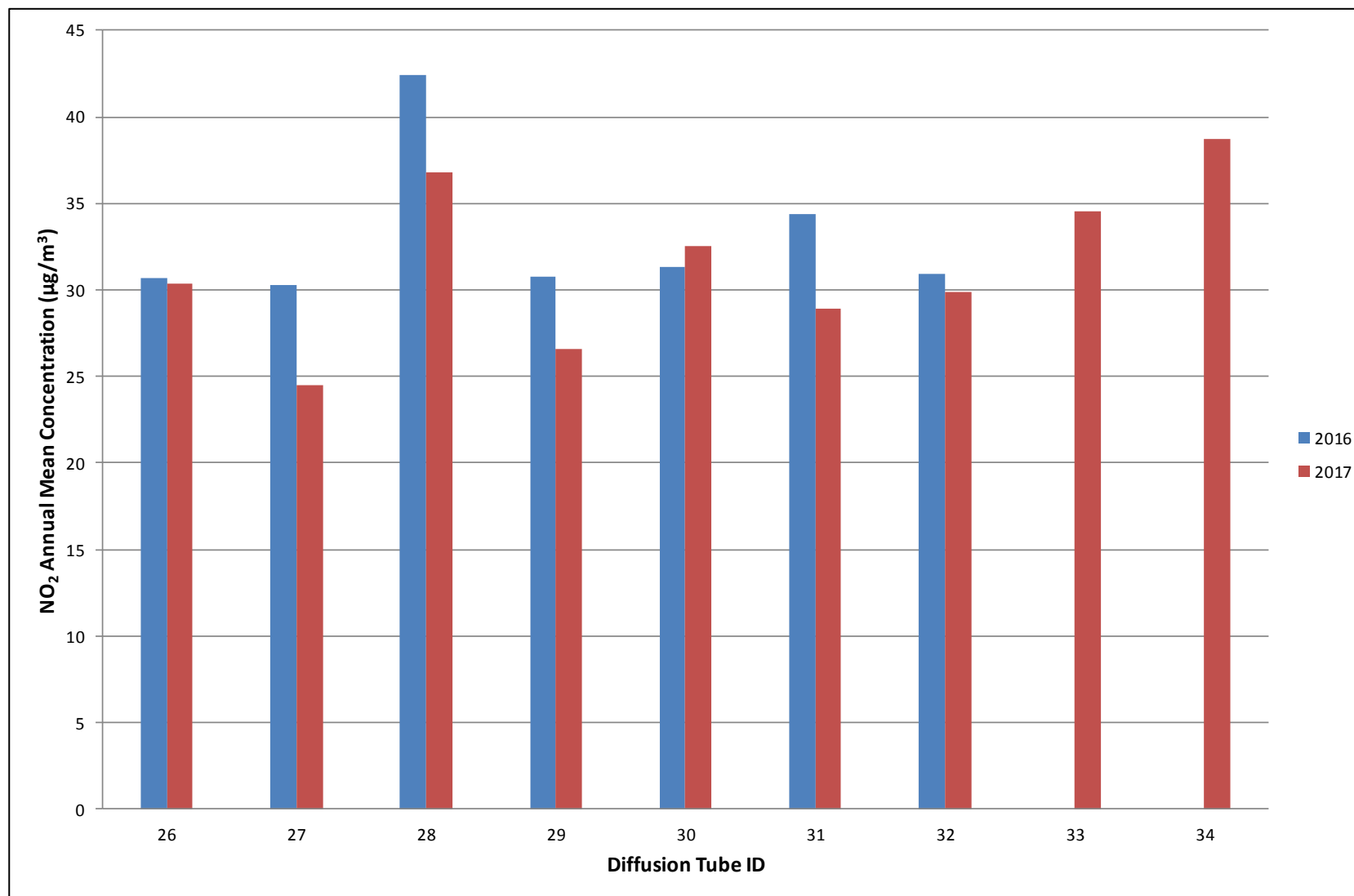


Figure A.5 – Trends in Annual Mean NO₂ Concentrations: New Monitoring Sites



Appendix B: Full Monthly Diffusion Tube Results for 2017

Table B.1 – NO₂ Monthly Diffusion Tube Results - 2017

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 (0.89) and Annualised ⁽¹⁾	Distance Corrected to Nearest Exposure ⁽²⁾
1	42.1	34.4	28.9	24.8	26.5	23.0	22.5	19.9	23.8	25.0	31.8	34.8	28.1	25.0	-
2	36.4	33.0	26.8	23.3	24.5	20.2	21.8	21.2	23.9	23.0	34.1	34.2	26.9	23.9	-
3	37.2	38.6	33.4	21.4	28.5	25.3	21.9	22.5	18.6	14.2	30.6	30.9	26.9	24.0	-
4	32.9	30.3	26.1	18.5	22.3	17.6	16.1	17.5	13.6	16.5	26.5	26.7	22.0	19.6	-
5	47.2	40.1	45.9	28.1	35.3	27.3	28.3	22.8	24.0	24.6	35.9	39.9	33.3	29.6	-
6	45.8	33.3	30.5	29.2	32.2	24.4	24.6	22.2	20.5	20.4	34.6	38.1	29.7	26.4	-
7	49.7	42.4	36.6	34.2	31.4	33.4	32.3	26.7	26.9	31.3	43.1	44.8	36.1	32.1	-
8	-	44.3	46.6	37.7	33.3	38.6	35.4	32.7	32.2	41.1	42.2	51.6	39.6	35.2	-
9	49.7	47.5	50.1	41.0	39.2	43.3	40.2	36.9	23.6	44.2	45.9	54.9	43.0	38.3	-
10	38.6	45.3	25.0	24.2	24.4	17.8	21.4	17.5	23.6	20.4	31.0	34.0	26.9	24.0	-
11	42.6	37.0	33.0	30.8	31.4	25.3	28.3	21.4	27.5	21.9	37.1	38.9	31.3	27.8	-
12	52.5	35.4	37.5	39.2	40.8	35.6	41.5	31.1	38.5	31.3	64.7	43.6	41.0	36.5	-
13	49.0	40.6	35.6	39.7	41.9	33.9	39.2	31.2	36.4	32.2	42.0	50.6	39.4	35.0	-
14	64.4	51.2	49.2	51.2	44.9	55.3	50.8	57.5	49.9	46.8	64.3	62.6	54.0	48.1	-
15	55.4	36.7	41.2	41.8	39.6	40.8	44.6	36.5	42.7	41.5	56.6	52.4	44.2	39.3	-
16	-	45.0	33.9	35.9	32.1	32.8	34.1	28.4	32.7	33.4	47.7	52.2	37.1	33.0	-

Gloucester City Council

17	54.2	29.7	40.9	39.3	36.1	33.8	36.0	33.2	37.2	37.4	46.6	50.5	39.6	35.2	-
18	49.1	35.7	28.3	29.6	28.2	26.9	27.4	-	-	28.0	40.3	45.6	33.9	30.2	-
19	55.3	45.1	38.0	39.1	41.1	34.6	32.7	30.1	33.6	28.3	41.7	39.6	38.3	34.1	-
20	58.2	46.4	41.1	35.4	38.6	33.0	35.1	28.1	34.2	55.5	41.6	45.4	41.0	36.5	-
21	-	-	-	-	-	-	13.3	13.9	17.3	18.2	26.0	-	17.7	17.6	-
22	35.0	29.2	4.7 ⁽⁴⁾	15.9	16.4	14.0	13.8	12.4	14.9	14.0	25.1	23.6	19.5	17.3	-
23	60.8	59.9	51.8	45.2	47.7	12.6	52.2	41.6	45.7	39.9	64.7	55.4	48.1	42.8	-
24 (1)	56.8	52.5	49.1	46.8	54.2	57.1	57.1	42.6	49.5	54.7	64.8	58.3	53.6	47.7	-
24 (2)	62.0	58.3	52.4	46.8	62.4	56.0	55.8	41.2	52.6	51.2	64.8	56.7	55.0	49.0	-
25	63.2	56.1	48.9	48.6	55.4	58.8	53.7	41.3	50.0	47.8	47.6	57.9	52.4	46.7	-
26	58.4	43.2	-	-	-	-	-	-	-	-	-	50.6	50.7	30.4	-
27	41.4	33.9	27.4	24.1	27.1	22.5	21.2	18.6	26.6	21.7	32.6	33.7	27.6	24.5	-
28	63.6	43.9	45.3	43.1	40.6	35.2	37.9	30.7	39.4	33.6	1.5 ⁽³⁾	117.8 ⁽³⁾	41.3	36.8	24.2
29	47.9	28.8	30.3	27.0	27.7	23.9	28.0	19.5	26.9	24.2	33.1	41.1	29.9	26.6	-
30	47.7	36.9	36.9	36.9	30.9	34.1	33.5	29.8	34.8	29.9	41.3	46.0	36.5	32.5	-
31	49.4	35.1	32.0	31.6	30.0	26.3	29.3	25.5	27.3	25.9	38.9	37.8	32.4	28.9	-
32	46.8	40.2	33.0	29.3	16.4	25.1	40.8	21.2	39.2	30.2	39.5	42.0	33.6	29.9	-
33	-	-	-	-	37.7	28.2	30.2	24.7	35.0	28.1	43.8	44.2	34.0	34.5	-
34	-	-	-	-	35.5	38.1	23.1	33.0	37.5	36.8	48.2	52.2	38.1	38.7	29.7

Local bias adjustment factor used

National bias adjustment factor used

Annualisation has been conducted where data capture is <75%

Where applicable, data has been distance corrected for relevant exposure

Notes:

Exceedances of the NO₂ annual mean objective of 40µg/m³ are shown in **bold**.

NO₂ annual means exceeding 60µg/m³, indicating a potential exceedance of the NO₂ 1-hour mean objective are shown in **bold and underlined**.

- (1) See Appendix C for details on bias adjustment and annualisation.
- (2) As per LAQM.TG(16) guidance, distance correction has been applied to all concentrations to those within 10% of the objective.
- (3) Results removed due to erroneous data being reported.
- (4) Result removed due to diffusion tube being received by the lab with dirt in the tube.

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

Sources of Pollution

Gloucester City Council have not identified any potential **new sources** within the district as described in Chapter 7, Section 1 of Defra LAQM.TG(16).

Diffusion Tube Bias Adjustment Factor

The diffusion tube data has been corrected using a bias adjustment factor, which is an estimate of the difference between diffusion tube concentration and continuous monitoring, 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/NO₂ 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 recommend the use of a local bias adjustment factor where available and relevant to diffusion tube sites.

Gloucester City Council do not operate any continuous NO₂ monitoring stations within the District and therefore a co-location study is not available to derive a local bias factor, thus the national bias adjustment factor spreadsheet⁶ has been used.

Diffusion tubes for Gloucester City Council are supplied and analysed by Gradko International Ltd. The tubes were prepared using the 20% TEA in water preparation method. The national bias adjustment factor for Gradko 20% TEA in water is 0.89 for the year 2017 (based on 34 studies) as derived from the national bias adjustment factor spreadsheet.

QA/QC of Diffusion Tube Monitoring

The diffusion tubes for the year 2017 were supplied and analysed by Gradko International Ltd, the tubes were prepared using the 20% TEA in water preparation

⁶ National Diffusion Tube Bias Adjustment Factor Spreadsheet version 03/18 available at <https://laqm.defra.gov.uk/bias-adjustment-factors/national-bias.html>

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 NO₂ 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 AIR-PT results, AIR-PT AR 0018 (January to February 2017), AIR-PT AR019 (April to May 2017), AIR-PT AR021 (July to August 2017) and AIR-PT AR022 (September to October 2017). Gradko has scored 100% on all results. The percentage score reflects the results deemed to be satisfactory based upon the z-score of $< \pm 2$.

Thirty two out of the thirty four local authority co-location studies in 2017 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%).

Short-term to Long-term Data Adjustment

In regards to the 2017 diffusion tube data set, annualisation was required at four diffusion tube locations due to data capture being below 75%. Annualisation has been completed in line with Box 7.9 and Box 7.10 within LAQM.TG(16) and full working details are presented in Table C 2.

In completing the annualisation process, data has been taken from a number of automatic monitoring sites that are part of the AURN. In line with LAQM.TG(16) the monitoring sites that have been used lie within a radius of approximately 50 miles of the sites to be annualised.

All monitoring stations that were used are background monitoring stations and as such are not influenced by local sources of air pollution such as road traffic emissions at roadside monitoring sites. The monitoring sites that were used are listed in Table C.1.

Table C.1 – AURN Monitoring Stations Used for Annualisation

Pollutant	Background AURN Sites used for Annualisation
NO ₂	<ul style="list-style-type: none"> • Bristol St Pauls – Urban Background • Cwmbran – Urban Background • Leamington Spa – Urban Background

Distance from Road Correction

In line with LAQM.TG(16) distance correction has been applied to NO₂ monitoring sites that have recorded an annual mean concentration above the annual mean objective, or within 10% of the annual mean objective. There were two sites within Gloucester’s NO₂ monitoring network that were within 10% of the NO₂ annual mean objective in 2017; Site 12 and Site B5.

The NO₂ Fall-Off with Distance Calculator (v4.2)⁷ has been used to derive the NO₂ concentration at a location of relevant exposure; the results of the calculations are presented in Table C.3.

⁷ NO₂ Fall-Off with Distance Calculator (Version 4.2), available online at <https://laqm.defra.gov.uk/tools-monitoring-data/no2-falloff.html>

Table C 2 – Diffusion Tube Short Term to Long Term Monitoring Data Adjustment

Site ID	Unadjusted Diffusion Tube Mean ($\mu\text{g}/\text{m}^3$)	Annualisation Factor Bristol St Pauls	Annualisation Factor Cwmbran	Annualisation Factor Leamington Spa	Average Annualisation Factor	Annualised & Bias Adjusted (0.89) Concentration ($\mu\text{g}/\text{m}^3$)
Site 21	17.7	1.056	1.157	1.129	1.114	17.6
Site 26	50.7	0.691	0.648	0.680	0.673	30.4
Site 33	34.0	1.124	1.162	1.141	1.142	34.5
Site 34	38.1	1.124	1.162	1.141	1.142	38.7

Table C.3 – NO₂ Fall-Off With Distance Calculations

Site ID	Distance (m)		NO ₂ Annual Mean Concentration ($\mu\text{g}/\text{m}^3$)		
	Monitoring Site to Kerb	Receptor to Kerb	Background ⁽¹⁾	Monitoring to Site	Predicted at Receptor
Site 28	2.0	29.0	16.7	36.8	24.2
Site 34	1.4	8.9	16.2	38.7	29.7

Appendix D: Maps of Monitoring Locations and AQMAs

Figure D.1 – NO₂ Diffusion Tube Monitoring Locations: Priory Road AQMA

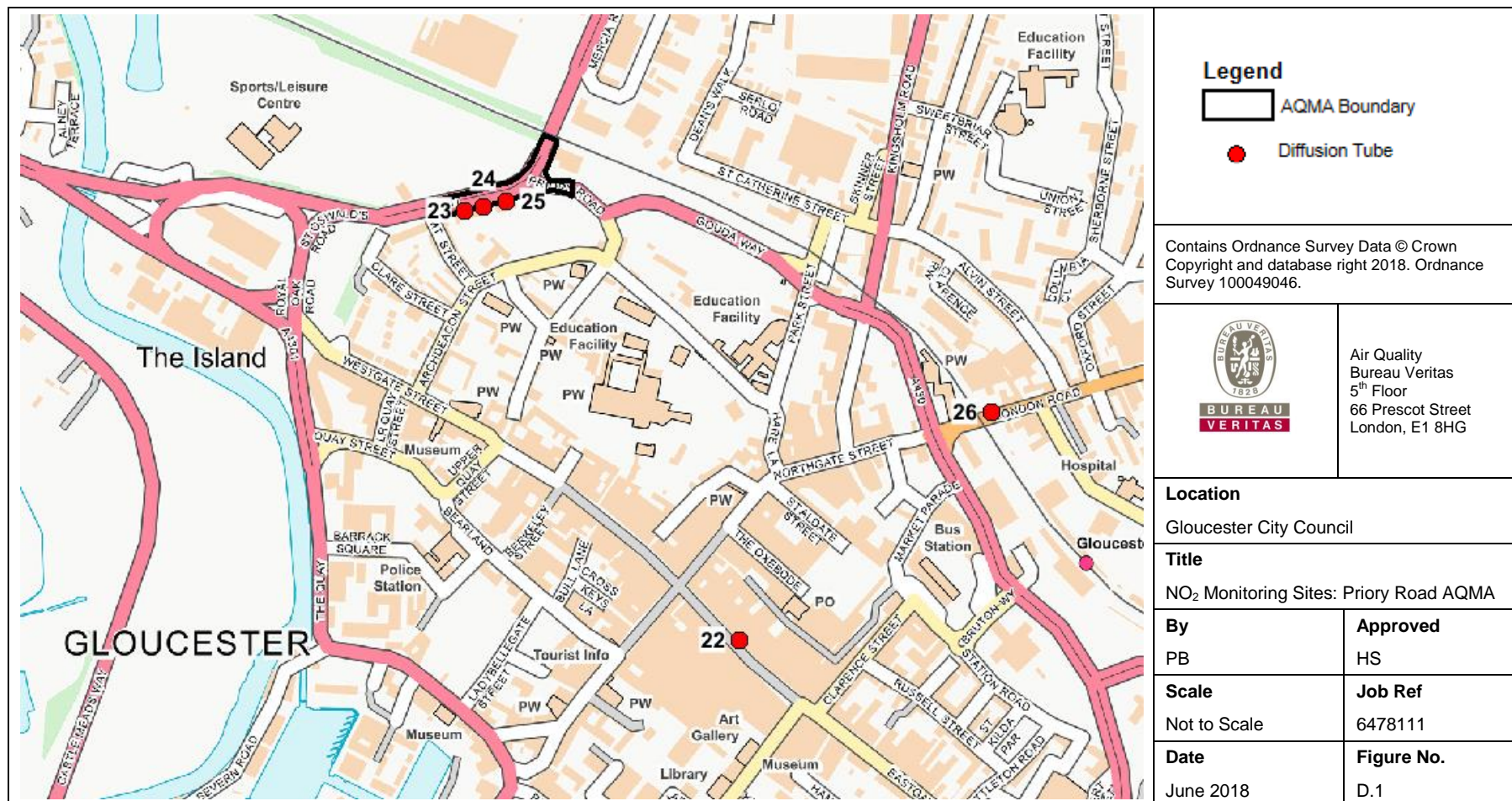


Figure D 2 – NO₂ Diffusion Tube Monitoring Locations: Barton Street AQMA

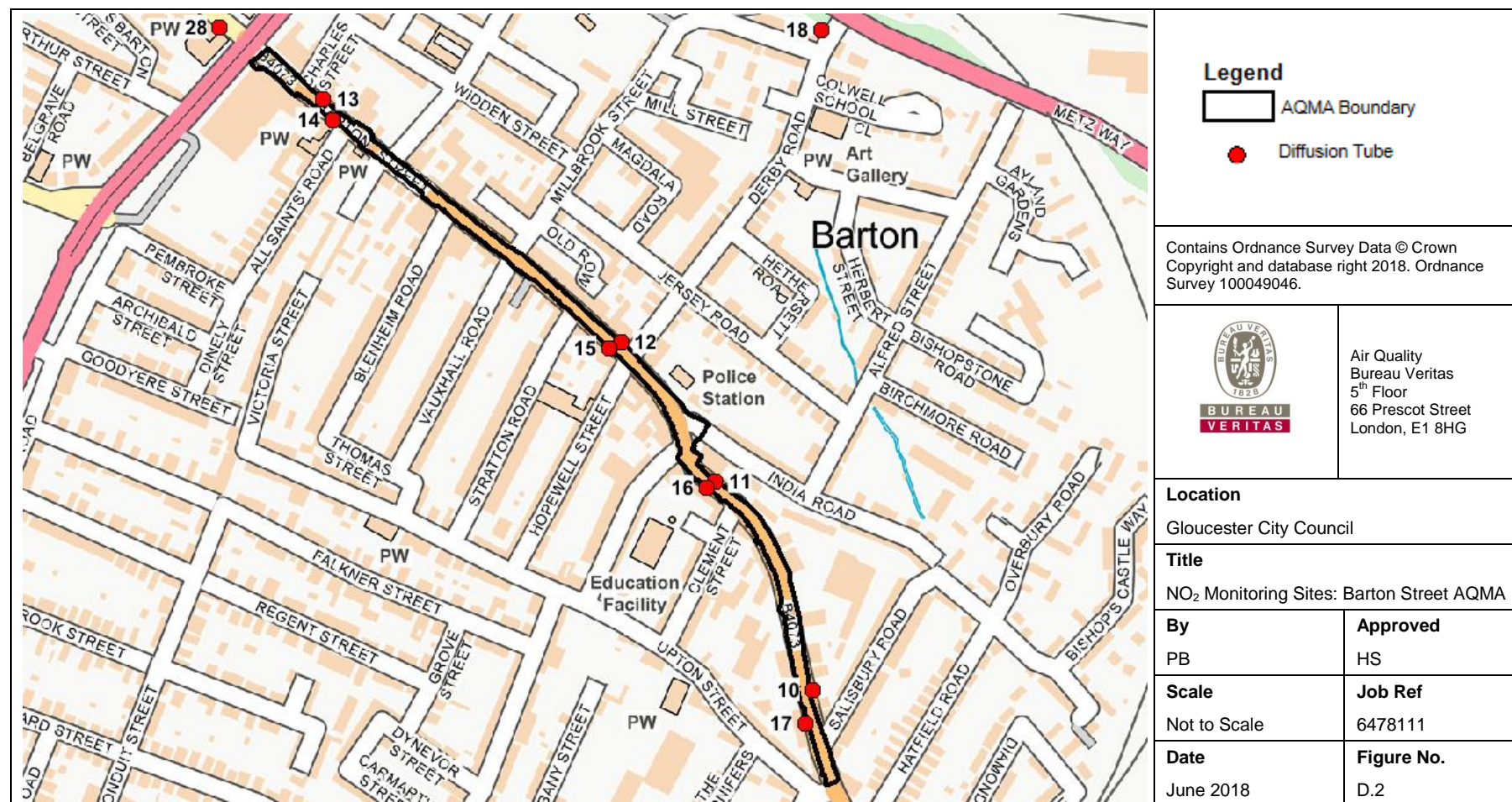


Figure D.3 – NO₂ Diffusion Tube Monitoring Locations: Painswick Road AQMA

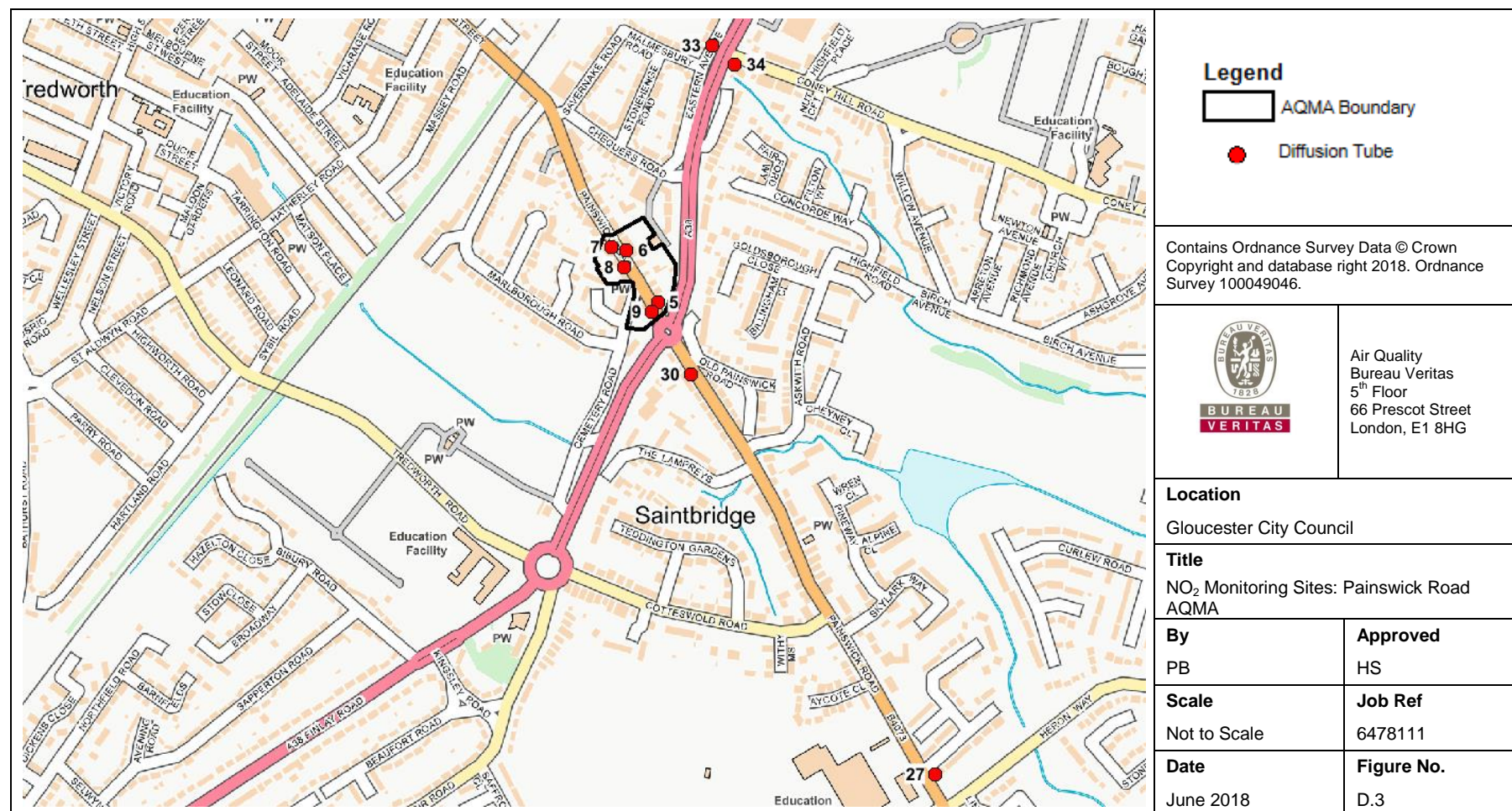


Figure D.4 – NO₂ Diffusion Tube Monitoring Locations: St Pauls

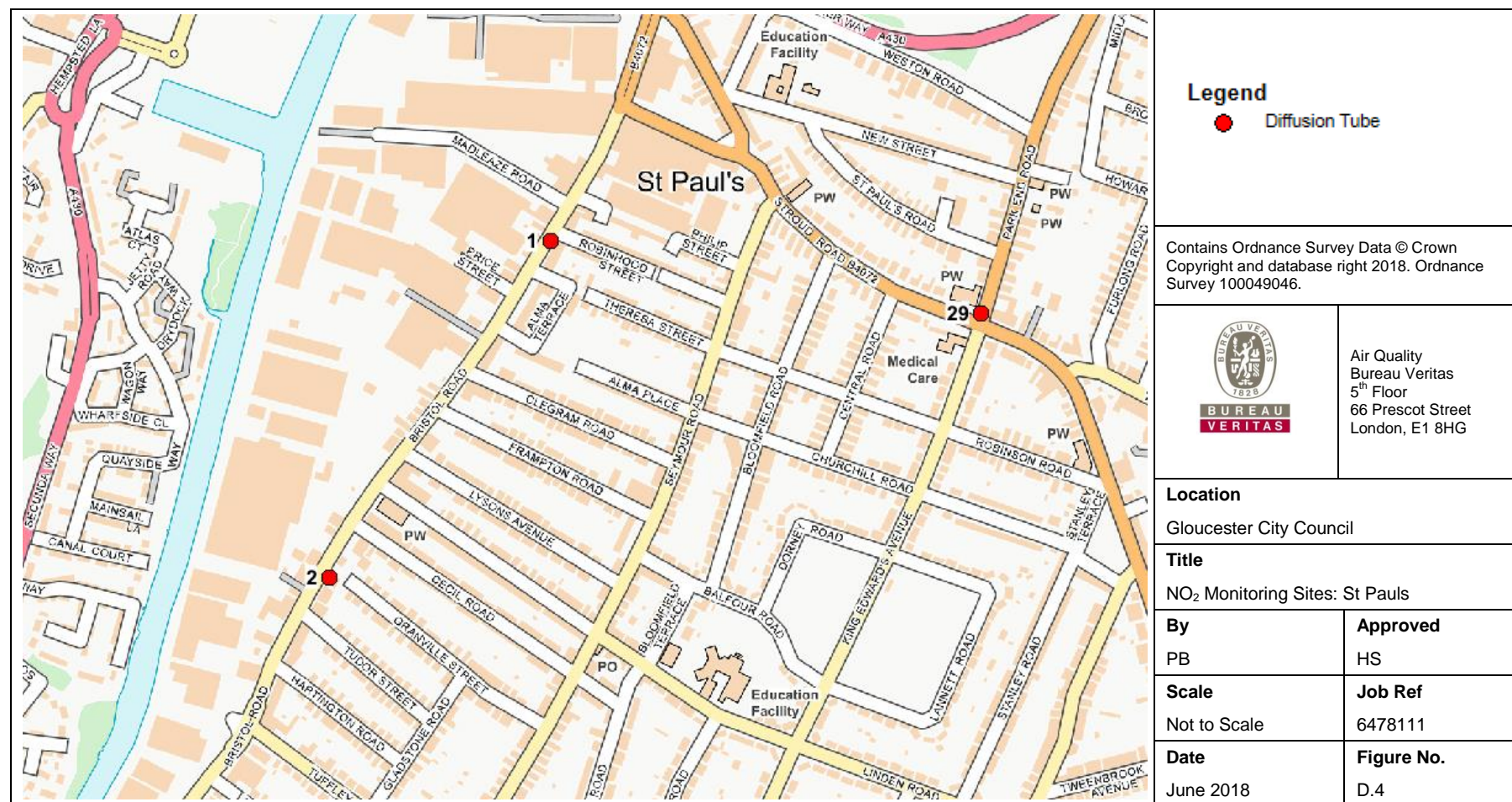


Figure D.5 – NO₂ Diffusion Tube Monitoring Locations: M5

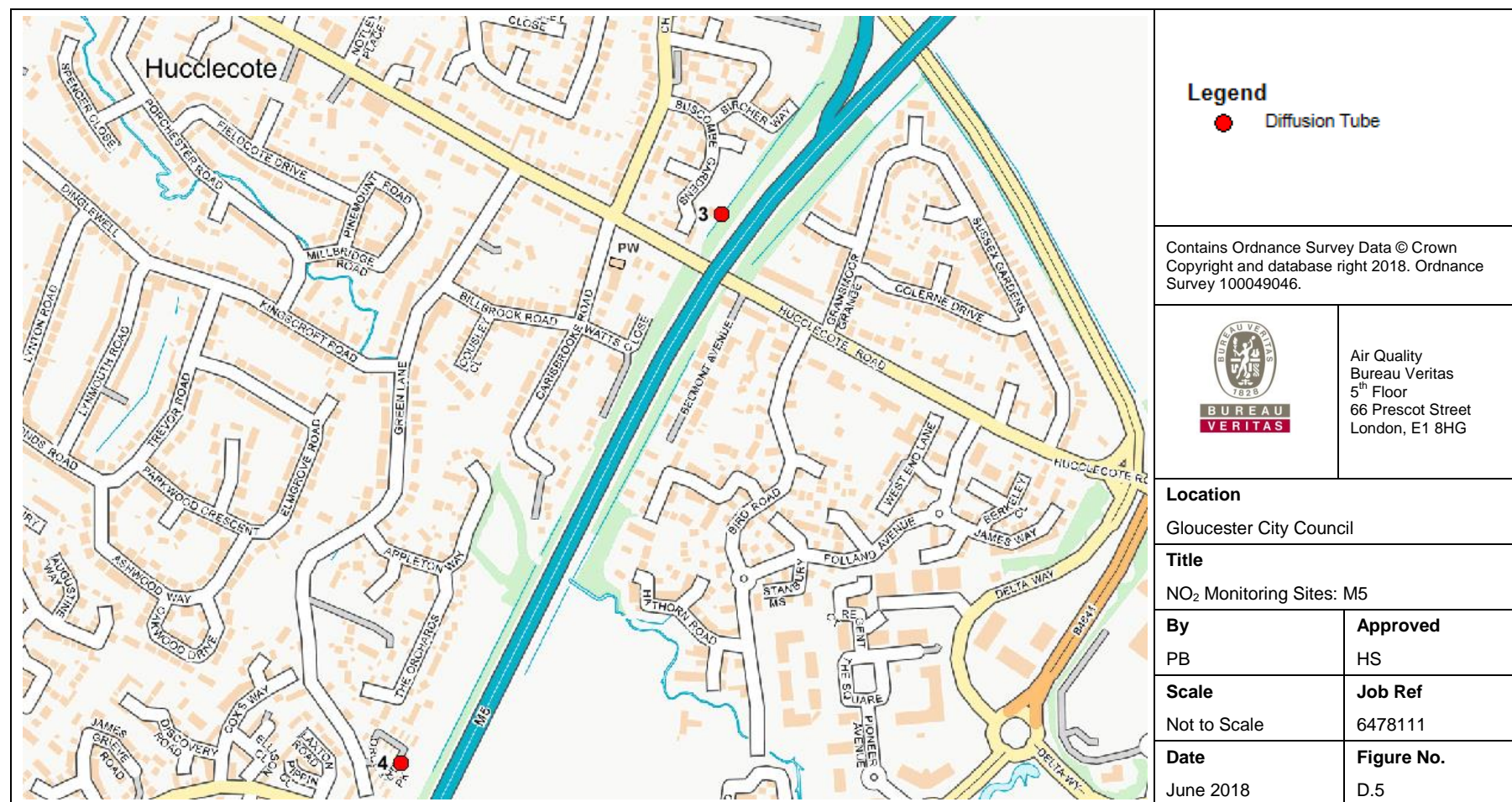


Figure D.6 – NO₂ Diffusion Tube Monitoring Locations: Barnwood/Elmbridge

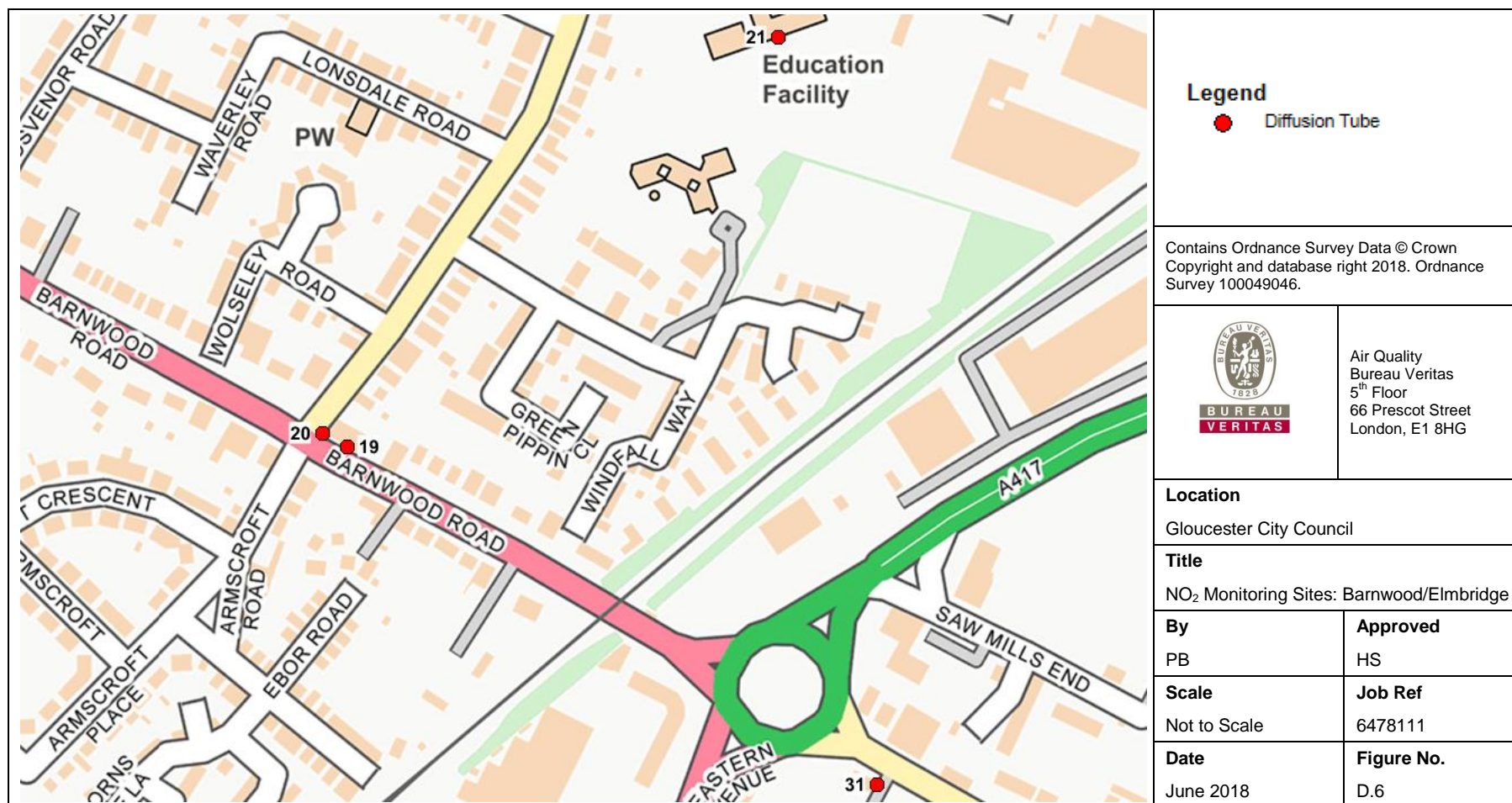
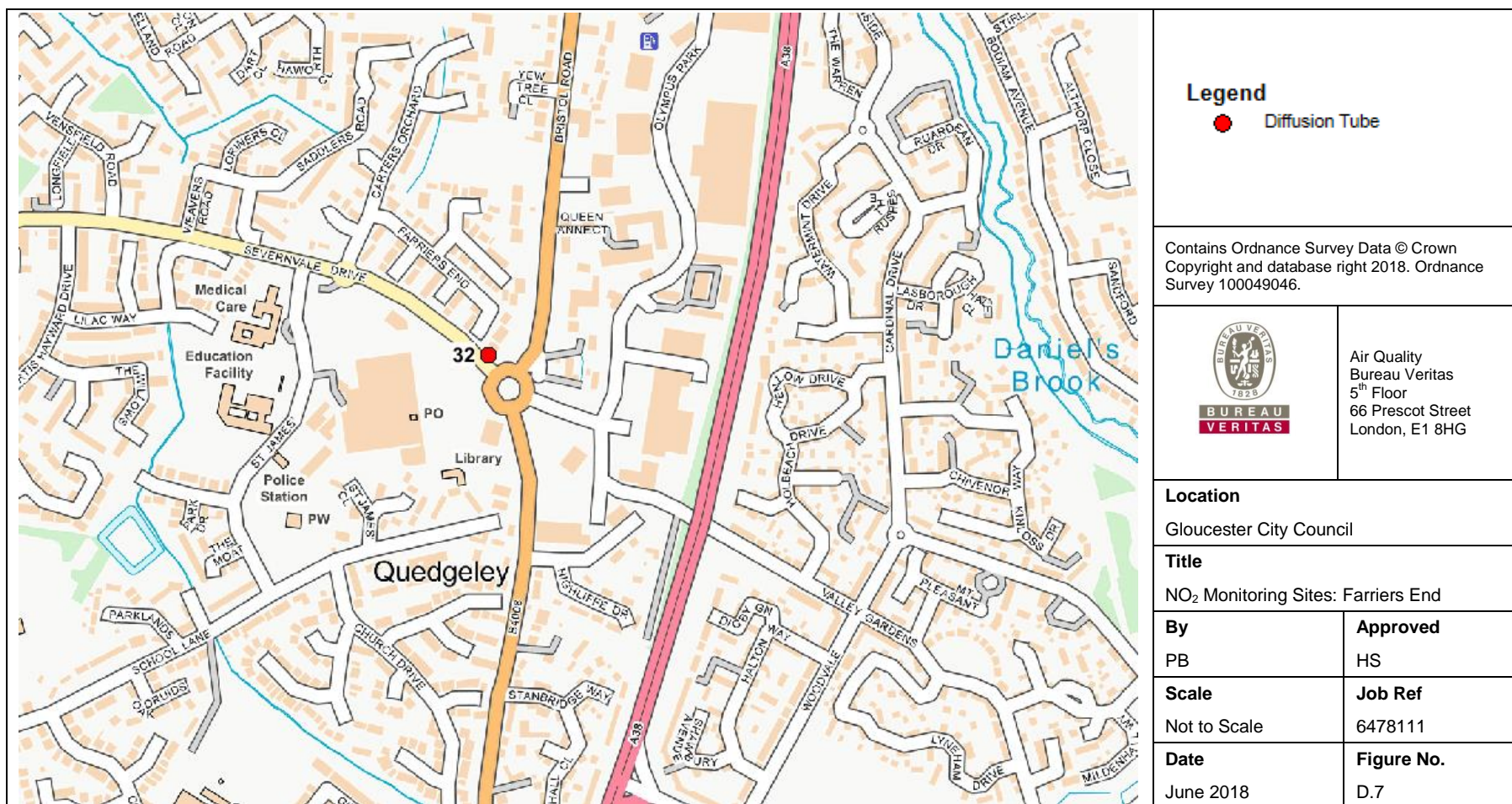


Figure D.7 – NO₂ Diffusion Tube Monitoring Locations: Farriers End



Appendix E: Summary of Air Quality Objectives in England

Pollutant	Air Quality Objective	
	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

Glossary of Terms

Abbreviation	Description
ANPR	Automatic Number Plate Recognition
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
EU	European Union
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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- Gloucester City Council 2017 Annual Status Report.
- Gloucester City Council 2016 Annual Status Report.
- Gloucester Air Quality Action Plan 2008 (2011 Review).
- National Diffusion Tube Bias Adjustment Factor Spreadsheet, version 03/18 published in March 2018.
- Thinktravel Smarter Choices Evaluation, Gloucestershire County Council, July 2017