Gloucester City Council

Annual Status Report 2021

Bureau Veritas

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2021 Air Quality Annual Status Report (ASR)

In fulfilment of Part IV of the Environment Act 1995

Local Air Quality Management

Date: August, 2021

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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, the elderly, and those with existing heart and lung conditions. There is also often a strong correlation with equalities issues because areas with poor air quality are also often less affluent areas[1,2].

The mortality burden of air pollution within the UK is equivalent to 28,000 to 36,000 deaths at typical ages[3], with a total estimated healthcare cost to the NHS and social care of £157 million in 2017[4].

Gloucester is a small city (population circa 130,000) situated on the River Severn between the Cotswolds to the east and the Forest of Dean to the west. The M5 motorway forms the eastern boundary of the majority of Gloucester which is densely populated in comparison to the surrounding authorities (Stroud District Council, Forest of Dean District Council and Tewkesbury Borough Council), which are more rural in nature.

The main source of air pollution within Gloucester that gives rise to increased pollutant concentrations is road traffic emissions from the major roads (primarily the A417, A430 and the A38) which connect the city with the main highway network. Local traffic within the centre of Gloucester can also tend to become congested, resulting in increased pollutant concentrations. Residential exposure to these pollutants is the primary concern as there are a number of properties located within close proximity to the road network.

Three Air Quality Management Areas (AQMAs) have been declared within Gloucester due to exceedances of the 40 µg/m^3 annual mean objective for NO_2; Barton Street AQMA (in

[1] Public Health England. Air Quality: A Briefing for Directors of Public Health, 2017

[2] Defra. Air quality and social deprivation in the UK: an environmental inequalities analysis, 2006

[3] Defra. Air quality appraisal: damage cost guidance, July 2020

[4] Public Health England. Estimation of costs to the NHS and social care due to the health impacts of air pollution: summary report, May 2018

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 NO_2 is completed throughout Gloucester City Council (GCC) using a network of passive diffusion tubes. During 2020 there were eighteen monitoring locations where diffusion tubes were deployed, with sixteen locations having been decommissioned since 2019.

A decrease in NO_2 concentrations was recorded at all eighteen sites in 2020 in comparison to 2019 data. Whilst the highest concentrations continued to be observed within the existing AQMAs, there were no reported exceedances of the annual mean NO_2 objective of 40 µg/m^3 at any of the monitoring locations within the AQMAs during 2020. The three AQMAs were declared as a result of road traffic emissions and the decreased concentrations during 2020 are therefore likely to be the result of reductions in vehicle traffic due to the Covid-19 pandemic and associated lockdowns enforced by the UK Government.

Actions to Improve Air Quality

Whilst air quality has improved significantly in recent decades, and will continue to improve due to national policy decisions, there are some areas where local action is needed to improve air quality further.

The 2019 Clean Air Strategy[5] sets out the case for action, with goals even more ambitious than EU requirements to reduce exposure to harmful pollutants. The Road to Zero[6] sets out the approach to reduce exhaust emissions from road transport through a number of mechanisms; this is extremely important given that the majority of AQMAs are designated due to elevated concentrations heavily influenced by transport emissions.

The GCC Air Quality Action Plan (AQAP) published in 2008, and revised in 2011, contains the actions that have been approved in relation to reducing NO_2 concentrations. Gloucester City Council has taken forward a number of direct measures during the

[5] Defra. Clean Air Strategy, 2019

[6] DfT. The Road to Zero: Next steps towards cleaner road transport and delivering our Industrial Strategy, July 2018

reporting year of 2020 in pursuit of improving local air quality. All measures are presented in Table 2.2.

During 2020, the Council commissioned an update to the existing AQAP. As part of this process a review of the current AQMAs has been completed and stakeholder workshops have been held in order to inform new measures. The revised AQAP is now in the process of being finalised and is expected to be released for consultation during 2021. A full update to Table 2.2 will be provided next year to encompass the new measures from the updated AQAP.

Conclusions and Priorities

During 2020 no exceedances of the NO_2 annual mean objective were recorded within or outside existing AQMAs. NO_2 concentrations monitored via diffusion tubes were lower at all sites than concentrations measured at the same locations during 2019.

The following has been recommended in relation to the three existing AQMAs:

- Barton Street AQMA – To remain in force as one of the six monitoring sites has recorded exceedances of the annual mean objective within the past five years, with the exception of 2020. As the remaining five sites have not exceeded the annual mean objective in the three years prior to 2020, consideration will be given to whether the boundary of this AQMA should be amended. The AQMA review being finalised as part of the update to the AQAP will be used to support any decision;
- Priory Road AQMA – To remain in force due to continued monitored exceedances of the air quality objective over the past five years, with the exception of 2020; and
- Painswick Road AQMA – To remain in force, although there have been no monitored exceedances of the air quality objective over the past five years. Consideration will be given to the possible revocation of this AQMA, supported by the AQMA review that is being finalised as part of the AQAP update.

As highlighted above, GCC are currently in the process of finalising the substantial work that has been undertaken on a revised AQAP. The updated AQAP is expected to be released for consultation later this year. As part of this work, a review of the existing AQMAs has been completed and concluded that, in line with the above, all three AQMAs should remain in force.

In terms of major changes to pollution sources, work has begun on the widening of Llanthony Road, part of the A430 Gloucester South West Bypass. The scheme is to be

delivered by 2022 in order to improve traffic flow through the city of Gloucester and GCC have reviewed the associated detailed air quality assessment[7] which concluded that *"impacts on local air quality from the scheme will not be significant and can be considered as slight beneficial".*

Local Engagement and How to get Involved

The public can engage with Gloucester City Council via their website which contains further local information on the following:

- Air quality monitoring;
- Declared AQMAs;
- Electric charging points; and
- Open fires and wood burning stoves.

The website also provides a number of simple steps that can be taken by individuals in order 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 the Think Travel website, which provides further information about the sustainable travel options available across the county of Gloucestershire, such as:
    - local walking maps;
    - cycle routes;
    - public transport journey planner
    - Park & Ride facilities;
    - eco driving;
    - car sharing; and
    - electric vehicles.
- **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

[7] Gloucester South West Bypass (Llanthony Road) Improvements: Air Quality and Greenhouse Gas Assessment available at https://ww3.gloucestershire.gov.uk/gccdocs/gcc_docs_start.aspx?action=show&appName=planning&appNumber=18/0052/GLR3MJ

engine unnecessarily – drive off soon after starting (in some areas it may be an offence to leave the engine running);

- **Walking and cycling** – Air Pollution Exposure Experiment by Camden Council and Kings College London;
- **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;
- **Maintaining your vehicle** - check tuning, tyre pressure, brakes and fuel consumption – regular servicing helps keep your car efficient and saves fuel.
- **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 you speed** – at around 50mph (80 kph) emissions will be lowest, rising dramatically above 70mph (110 kph);
- **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.

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1 Local Air Quality Management

This report provides an overview of air quality in Gloucester City Council during 2020. 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 are presented in Table E.1.

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 should prepare an Air Quality Action Plan (AQAP) within 12 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. The table presents a description of the three AQMAs that are currently designated within Gloucester City Council. All three of the current AQMAs have been declared in response to exceedances of the NO_2 annual mean objective.

Appendix D: Maps of Monitoring Locations and AQMAs provides maps of the three AQMAs and also the locations of the air quality monitoring sites across the city.

Table 2.1 – Declared Air Quality Management Areas

AQMA Name	Date of Declaration	Pollutants and Air Quality Objectives	One Line Description	Is air quality in the AQMA influenced by roads controlled by Highways England?	Level of Exceedance: Declaration	Level of Exceedance: Current Year	Name and Date of AQAP Publication	Web Link to AQAP
Painswick Road AQMA	05/10/2007	NO_2 Annual Mean	An area encompassing a number of properties on either side of Painswick Road, Gloucester.	NO	48 µg/m^3	27 µg/m^3	Gloucester AQAP 2008 (2011 Review)	https://www.gloucester.gov.uk/environment-waste-recycling/pollution/air-quality/
Barton Street AQMA	08/08/2005	NO_2 Annual Mean	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	32 µg/m^3	Gloucester AQAP 2008 (2011 Review)	https://www.gloucester.gov.uk/environment-waste-recycling/pollution/air-quality/
Priory Road AQMA	08/08/2005	NO_2 Annual Mean	An area encompassing the junction of St Oswalds Road and Priory Road.	NO	41 - 48 µg/m^3	33 µg/m^3	Gloucester AQAP 2008 (2011 Review)	https://www.gloucester.gov.uk/environment-waste-recycling/pollution/air-quality/

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

☒ **Gloucester City Council confirm that all current AQAPs have been submitted to Defra.**

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, detailed, and provides the information specified in the Guidance. The following comments are designed to help inform future reports.

1. *Robust and accurate QA/QC procedures were applied. Calculations for bias adjustment, annualisation and distance-correction factors were outlined in detail.*
2. *The Council has included discussion and review of its AQMAs and monitoring strategy, informed due to the extensive monitoring network and also the additional tubes in place to provide data. This demonstrates the Councils proactive and dedicated approach to improving air quality across the area.*
3. *Comments from last year's ASR have been mentioned and addressed. This is welcomed, and we encourage this to continue in future ASRs.*
4. *The AQAP is currently being revised by the council. This is welcomed.*
5. *The Public Health Outcomes Frameworks was mentioned, and this is encouraged. The Council have referred specifically to indicator D01, which is the fraction of mortality attributable to particulate air pollution.*
6. *Council have provided a clear map of the diffusion tube monitoring network; trends are displays and discussed in the report, this is welcomed.*
7. *Overall the report is detailed, concise and satisfies the criteria of relevant standards. The Council should continue their good and thorough work."*

The comments made within the appraisal report, as shown above, have been taken into account for the completion of the 2021 ASR.

Gloucester City Council has taken forward a number of direct measures during the current reporting year of 2020 in pursuit of improving local air quality. Details of all measures completed, in progress or planned are set out in Table 2.2.

Sixteen measures are included within Table 2.2, with the type of measure and the progress Gloucester City Council have made during the reporting year of 2020 presented. Where there have been, or continue to be, barriers restricting the implementation of the measure, these are also presented within Table 2.2. More detail on these measures can be found in the 2011 Gloucester Air Quality Action Plan.

Furthermore, in relation to the cycle network, the construction phase of the B4063 Gloucester to Cheltenham Cycleway scheme[8] is planned for the coming year. Further information on this new route can be found in Appendix C: Supporting Technical Information / Air Quality Monitoring Data QA/QC

A 12 month e-scooter trial was also launched in October 2020 with DfT and operator Zwings, designed to support a 'green' restart of local travel and help mitigate reduced public transport capacity due to the pandemic.

The measures in Table 2.2 have helped to contribute towards compliance; however, Gloucester City Council anticipates that further additional measures will be required in subsequent years to achieve compliance within the currently declared AQMAs. A revised set of targeted measures will be set out in the revised AQAP, which is currently being finalised and is expected to be released for consultation during 2021. Table 2.2 will be updated in full next year with the new measures from the updated AQAP.

[8] New Cycle Lane Gloucester available at https://www.gloucestershire.gov.uk/gloucestershire-county-council-news/news-july-2020/new-cycle-lane-coming-to-gloucester/

Table 2.2 – Progress on Measures to Improve Air Quality

Measure No.	Measure	Category	Classification	Year Measure Introduced	Estimated / Actual Completion Year	Organisations Involved	Funding Source	Defra AQ Grant Funding	Funding Status	Estimated Cost of Measure	Measure Status	Reduction in Pollutant / Emission from Measure	Key Performance Indicator	Progress to 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	2011	-	Gloucestershire Police	Police force				Aborted	0.2 - 1 µg/m^3	Number of HGVs on named roads	HGV ban continues to be enforced	
3	Variable Message Signs (VMS)	Traffic Management	Other	2011	-	Gloucestershire County Council	No further funding is available at this time.				Planning	> 0.2 µg/m^3	Number of VMS signs	Currently no funding available	
4	Improvements/Control of the signals	Traffic Management	UTC, Congestion management, traffic reduction	2017	-	Gloucestershire County Council	Gloucestershire County Council				Planning	< 0.2 µg/m^3	N/A	No planned improvements for the foreseeable future.	
8	Greater restriction and better timing of deliveries	Freight and Delivery Management	Route Management Plans/ Strategic routing strategy for HGV's	2011	On-going	Gloucestershire County Council	No additional funding required				Implementation	< 0.2 µg/m^3	Number of HGVs on named roads	Currently deliveries are banned from 8-9am and 5-6pm	
9	Encourage bus company to buy new vehicles to provide the bus services	Vehicle Fleet Efficiency	Promoting Low Emission Public Transport	2011	2020	Gloucester City Council and Gloucestershire County Council	Central government funding and incentives				Completed	< 0.2 µg/m^3	Number of new vehicles	Continued promotion and information on council website. Meeting with Stagecoach at the end of 2017 revealed that their bus fleet is renewed on a countywide basis and is related to ages of vehicles.	
10	Upgrade existing bus fleet	Vehicle Fleet Efficiency	Vehicle Retrofitting programmes	2011	2020	Bus companies	Bus companies				Completed	< 0.2 µg/m^3	Number of buses retrofitted	On-going	
11	Reduce illegal parking	Traffic Management	UTC, Congestion management, traffic reduction	2011	On-going	Gloucestershire County Council	No additional funding required				Implementation	< 0.2 µg/m^3	Reduction in illegal parking and less parking on city centre roads.	Controlled zones established and Civil Enforcement Officer's in place to enforce zones.	

Measure No.	Measure	Category	Classification	Year Measure Introduced	Estimated / Actual Completion Year	Organisations Involved	Funding Source	Defra AQ Grant Funding	Funding Status	Estimated Cost of Measure	Measure Status	Reduction in Pollutant / Emission from Measure	Key Performance Indicator	Progress to Date	Comments / Barriers to Implementation
12	Introduce air quality measures into Gloucester City Council Taxi Licensing Policy	Promoting Low Emission Transport	Taxi Licensing conditions	2018	Completed	Gloucestershire County Council	No additional funding required				Completed	Reduced vehicle emissions	Improvement in age and euro standard of vehicles within the taxi fleet	December 18 saw introduction of new rule book where vehicles must comply with specific condition in relation to the age and length of service, e.g. Euro 6 compliant by 2023	
13	Amey Fleet	Promoting Low Emission Transport	Company Vehicle Procurement - Prioritising uptake of low emission vehicles	2018	2022	Gloucester City Council/ Amey	No additional funding required				Implementation	Reduced vehicle emissions	Improvements in age and euro standard of vehicles within Amey fleet	14 recycling and 4 street cleaning vehicles that are Euro 6 compliant have been added to the fleet	Will be changing to Ubico in April 2022 and the contract will see the procurement of new waste, recycling and street cleansing vehicles, including carbon reduction technologies
16	Improvement in Planning Application Validation Requirements	Policy Guidance and Development Control	Air Quality Planning and Policy Guidance	2018	On-going	Gloucester City Council	Building developers				Implementation	Construction dust emissions controlled during the construction phase and NO_2 controlled during the operational phase.	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.	Looking to monitor air quality at Black Dog Way flats and Hempsted Lane when site complete
17	Low Emission	Promoting Low Emission Transport	Other	2017	Ongoing	Local Authority Planning	Building developers				Implementation	Reduced vehicle emissions	Diffusion tube data	New developments - to install electric charging points where possible. In the JCS.	
18	Low Emission	Promoting Low Emission Transport	Taxi emission incentives	2018	Completed	Local taxi drivers	Taxi drivers				Implementation	Reduced vehicle emissions	Diffusion tube data	Currently 1 electric taxi in city	
19	Low Emission	Promoting Low Emission Transport	Company Vehicle Procurement - Prioritising uptake of low emission vehicles	2019	Ongoing	Gloucester City Council	Local Authority, Funding: Defra Air Quality Grant				Implementation	Reduced vehicle emissions	Diffusion tube data	Implementation - on-going	

Measure No.	Measure	Category	Classification	Year Measure Introduced	Estimated / Actual Completion Year	Organisations Involved	Funding Source	Defra AQ Grant Funding	Funding Status	Estimated Cost of Measure	Measure Status	Reduction in Pollutant / Emission from Measure	Key Performance Indicator	Progress to Date	Comments / Barriers to Implementation
20	Improve Air Quality	Public Information	Via the Internet	2020	Ongoing	Gloucester City Council	-				Implementation	Visible smoke plumes. Reduction in complaints.	Smoke control zone	Encouraging residents not to burn waste.	
21	Active Travel	Promoting Travel Alternatives	Promotion of cycling	2020	Ongoing	Gloucester City Council and Gloucestershire County Council	County Council				Implementation	Reduced vehicle emissions	Diffusion tube data	Adding a pop-up cycle route into the city on London Road.	
22	Active Travel	Promoting Travel Alternatives	Promotion of cycling	2018	Ongoing	Gloucester City Council	-				Implementation	Reduced vehicle emissions	Annual report to track mileage.	Annual basis	

Note:

The measures presented in this table are to be updated once the revised AQAP has been finalised .

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. Gloucester City Council does not currently undertake any monitoring of either $PM_{2.5}$ or PM_{10}, therefore no concentration values can be reported or estimated using the method described in Box 7.7 of LAQM.TG(16).

Efforts within Gloucester are being concentrated on monitoring NO_2 levels, with a particular focus on the established AQMAs. As primary emissions of both NO_2 and particulates predominately originate from the same source, measures implemented to reduce NO_2 levels within Gloucester will also reduce levels of PM_{10} and $PM_{2.5}$.

The current Defra 2020 background maps for Gloucester City Council (2018 based[9]) show that all background concentrations of $PM_{2.5}$ are below the 2020 annual mean target value (25 µg/m^3). The highest concentration across Gloucester is predicted to be 10.7 µg/m^3 within the 1 x 1 km grid square with the centroid grid reference of 383500 217500, an area just south of the city centre.

The Public Health Outcomes Framework data tool[10] compiled by Public Health England quantifies the mortality burden of $PM_{2.5}$ within England on a county and local authority scale. The 2018 fraction of mortality attributable to $PM_{2.5}$ pollution across England is 5.2%, and the fraction within Gloucester City Council is below the national average of 4.9%, however this is higher than the South West region average of 4.4%.

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

[9] Defra Background Mapping data for local authorities (2018-based), available online at https://uk-air.defra.gov.uk/data/laqm-background-maps?year=2018

[10] Public Health Outcomes Framework, Public Health England. data tool available online at https://fingertips.phe.org.uk/search/air%20quality#page/1/gid/1/pat/6/par/E12000009/ati/202/are/E10000013/cid/4/page-options/ovw-do-0

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.

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

This section sets out the monitoring undertaken within 2020 by Gloucester City Council and how it compares with the relevant air quality objectives. In addition, monitoring results are presented for a five-year period between 2016 and 2020 to allow monitoring trends to be identified and discussed.

3.1 Summary of Monitoring Undertaken

3.1.1 Automatic Monitoring Sites

Gloucester City Council did not carry out any automatic (continuous) monitoring of pollutants during 2020.

3.1.2 Non-Automatic Monitoring Sites

Gloucester City Council undertook non- automatic (i.e. passive) monitoring of NO_2 at 18 sites during 2020, with sixteen locations having been decommissioned since 2019. Figure A.2Table A.1 in Appendix A presents the details of the non-automatic 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 (where the annual mean data capture is below 75% and greater than 25%), 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 five years with the air quality objective of 40 µg/m^3. Note that the concentration data presented represents the concentration at the location of the monitoring site, following the application of bias adjustment and annualisation, as required (i.e. the values are exclusive of any consideration to fall-off with distance adjustment).

The full 2020 dataset of diffusion tube monthly mean values is provided in Appendix B. Note that the concentration data presented in Table B. 1 includes distance corrected values, only where relevant.

Data capture for four of the diffusion tube sites within 2020 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 located within 50 miles of the diffusion tube locations.

The NO_2 results for 2020 have been bias adjusted using a national bias adjustment factor of 0.81. Full details of the bias adjustment and QA/QC monitoring procedures are provided in Appendix C.

The annual mean NO_2 concentration was not greater than 60 µg/m^3 at any diffusion tube monitoring site, as per LAQM.TG(16) guidance, it is unlikely there were any exceedances of the NO_2 1-hour mean objective at any monitoring site.

The analysis of the 2020 monitoring data is completed below in relation to the designated AQMAs within Gloucester City Council.

The concentrations recorded at all sites within the AQMAs decreased in 2020 and were all below the annual mean objective of 40 µg/m^3. This is likely due to the impacts of the Covid-19 pandemic and the associated lockdowns enforced by the UK Government. As detailed in Appendix F: Impact of COVID-19 upon LAQM, it has been estimated that

during the first national lockdown, reductions in vehicle traffic of up to 70% were experienced across the UK by mid-April, relative to pre COVID-19 levels.

Barton Street AQMA

Monitored concentrations are presented in Table A.2 and Figure A.1. The concentrations in the Figure are compared against the annual mean objective value for NO_2.

There are six diffusion tube locations within the Barton Street AQMA. Whilst the majority of sites had a data capture in excess of 75%, annualisation was required at site 13. During 2020 site 16 recorded the lowest concentration (21.6 µg/m^3) of any of the Barton Street AQMA monitoring sites, whilst the highest concentrations within the AQMA were recorded at sites 13 and 14 (31.7 µg/m^3 and 31.5 µg/m^3, respectively)

As concentrations at site 14 have been in exceedance of the annual mean objective of 40 µg/m^3 for the past five years, with the exception of 2020, the AQMA is to remain in force.

Priory Road AQMA

Monitored concentrations are presented in Table A.2 and Figure A.2Figure A.1. The concentrations in the Figure are compared against the annual mean objective value for NO_2.

There are three diffusion tube locations within the Priory Road AQMA, all with data capture sufficient that annualisation has not been required. During 2020 site 23 recorded the lowest concentration (29.5 µg/m^3) of any of the Priory Road AQMA monitoring sites, whilst the highest concentrations within the AQMA were recorded at site 24 (32.5 µg/m^3).

The NO_2 concentration at the three monitoring locations within the Priory Road AQMA has exceeded the annual mean objective of 40 µg/m^3 for the past five years with the exception of 2020. Although a general trend of reduction is observed over the past five years, the AQMA is to remain in force.

Painswick Road AQMA

Monitored concentrations are presented in Table A.2 and Figure A.3Figure A.1. The concentrations in the Figure are compared against the annual mean objective value for NO_2.

There are three diffusion tube locations within the Painswick Road AQMA, only site 8 had a data capture of less than 75% and therefore required annualisation. During 2020, site 5 recorded the lowest concentration (21.6 µg/m^3) of any of the Painswick Road AQMA

monitoring sites, whilst the highest concentrations within the AQMA were recorded at site 8 (27.9 µg/m^3).

As there has not been any exceedances of the annual mean objective at any of the three sites over the past five years, the AQMA is to remain in place. A review of the boundary of the AQMA has been completed as part of the AQAP update process, with a recommendation for monitoring locations to ensure monitoring covers all locations of relevant exposure.

Diffusion Tubes Outside of Existing AQMAs

Monitored concentrations are presented in Table A.2 and Figure A.4. The concentrations in the Figure are compared against the annual mean objective value for NO_2.

There are six diffusion tube monitoring sites located outside of the existing AQMAs, all of which have been monitoring for at least five years.

In terms of data processing, sites 21 and 26 had a data capture of less than 75% and, therefore, data for these sites was annualised. During 2020, site 3 recorded the lowest concentration (16.9 µg/m^3) of any of the monitoring sites located outside of the AQMAs, whilst the highest concentration outside of the AQMAs was recorded at site 26 (26.5 µg/m^3).

Outside of the existing AQMAs, NO_2 concentrations are compliant and there have been no exceedances of the NO_2 annual mean objective recorded over the past five years.

Due to all monitoring locations reporting concentrations below the annual mean objective, no further AQMAs need to be designated within Gloucester City Council at the current time. As detailed earlier within the ASR a detailed modelling study to review the current AQMA boundaries is currently being finalised as part of the AQAP process, this assessment will help to inform if any amendments and/or revocations are required.

Appendix A: Monitoring Results

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

Diffusion Tube ID	Site Name	Site Type	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Pollutants Monitored	In AQMA? Which AQMA?	Distance to Relevant Exposure (m) (1)	Distance to kerb of nearest road (m) (2)	Tube Co-located with a Continuous Analyser?	Tube Height (m)
3	35 Buscombe Gardens	Roadside	387670	217250	NO_2	NO	0.0	26.8	No	2.6
5	97 Painswick Rd	Roadside	384558	216946	NO_2	YES - Painswick Road	0.0	4.6	No	2.6
7	76 Painswick Rd	Roadside	384490	217027	NO_2	YES - Painswick Road	0.0	3.5	No	2.7
8	88 Painswick Road	Roadside	384509	216998	NO_2	YES - Painswick Road	0.0	3.5	No	2.5
12	219A Barton St (post)	Roadside	384000	217863	NO_2	YES - Barton Street	0.0	2.0	No	2.6
13	99 Barton St	Roadside	383717	218094	NO_2	YES - Barton Street	0.0	2.0	No	2.5
14	124 Barton St	Roadside	383726	218074	NO_2	YES - Barton Street	0.0	1.5	No	2.6
15	196 Barton St (Lamppost)	Roadside	383989	217857	NO_2	YES - Barton Street	0.0	2.5	No	2.6
16	240 Barton Street	Roadside	384081	217725	NO_2	YES - Barton Street	0.0	1.9	No	2.6
17	316 Barton St	Roadside	384175	217501	NO_2	YES - Barton Street	0.0	2.3	No	2.6

Diffusion Tube ID	Site Name	Site Type	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Pollutants Monitored	In AQMA? Which AQMA?	Distance to Relevant Exposure (m) (1)	Distance to kerb of nearest road (m) (2)	Tube Co-located with a Continuous Analyser?	Tube Height (m)
18	79 Millbrook Road	Roadside	384190	218160	NO_2	NO	0.0	1.0	No	2.6
19	61 Barnwood Rd	Roadside	385130	218585	NO_2	NO	0.0	5.0	No	2.6
20	53 Barnwood Rd	Roadside	385113	218595	NO_2	NO	0.0	2.3	No	2.5
21	Elmbridge Road	Urban Background	385430	218870	NO_2	NO	9.5	101.6	No	2.6
23	46 Priory Rd	Roadside	382898	219029	NO_2	YES - Priory Road	0.0	4.5	No	2.5
24	56 Priory Rd	Roadside	382921	219034	NO_2	YES - Priory Road	0.0	4.4	No	2.5
25	66 Priory Rd	Roadside	382950	219040	NO_2	YES - Priory Road	0.0	5.4	No	2.7
26	16 London Rd	Roadside	383560	218775	NO_2	NO	30.0	2.7	No	2.5

Notes:

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

(2) N/A if not applicable.

Table A.2 – Annual Mean NO_2 Monitoring Results: Non-Automatic Monitoring (µg/m^3)

Diffusion Tube ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Site Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2020 (%) (2)	2016	2017	2018	2019	2020
3	387670	217250	Roadside	81.0	81.0	27.9	24.0	23.7	24.3	16.9
5	384558	216946	Roadside	81.0	81.0	33.2	29.6	29.6	27.3	21.6
7	384490	217027	Roadside	81.0	81.0	33.6	32.1	29.8	31.9	23.8
8	384509	216998	Roadside	65.4	65.4	36.7	35.2	33.7	34.2	27.9
12	384000	217863	Roadside	73.4	73.4	**40.1**	36.5	36.8	36.2	27.8
13	383717	218094	Roadside	65.9	65.9	39.1	35.0	37.6	37.2	31.7
14	383726	218074	Roadside	81.0	81.0	**47.4**	**48.1**	**42.4**	**43.9**	31.5
15	383989	217857	Roadside	71.2	71.2	**42.9**	39.3	38.4	39.7	30.1
16	384081	217725	Roadside	81.0	81.0	35.1	33.0	32.1	31.2	21.6
17	384175	217501	Roadside	81.0	81.0	38.0	35.2	32.7	35.5	26.1
18	384190	218160	Roadside	81.0	81.0	31.3	30.2	29.1	29.4	21.8
19	385130	218585	Roadside	81.0	81.0	37.2	34.1	35.4	34.1	25.8
20	385113	218595	Roadside	73.6	73.6	36.5	36.5	33.0	34.7	24.8

Diffusion Tube ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Site Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2020 (%) (2)	2016	2017	2018	2019	2020
21	385430	218870	Urban Background	56.0	56.0	15.2	17.6	17.5	17.7	17.2
23	382898	219029	Roadside	81.0	81.0	**44.9**	**42.8**	**46.3**	**40.5**	29.5
24	382921	219034	Roadside	81.0	81.0	**51.1**	**48.3**	**47.4**	**43.0**	32.5
25	382950	219040	Roadside	81.0	81.0	**52.1**	**46.7**	**47.1**	**43.2**	31.9
26	383560	218775	Roadside	67.3	67.3	30.7	30.4	33.4	33.9	26.5

☒ **Annualisation has been conducted where data capture is <75% and >25% in line with LAQM.TG16.**

☒ **Diffusion tube data has been bias adjusted.**

☒ **Reported concentrations are those at the location of the monitoring site (bias adjusted and annualised, as required), i.e. prior to any fall-off with distance correction.**

Notes:

The annual mean concentrations are presented as µg/m^3.

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

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

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

Concentrations are those at the location of monitoring and not those following any fall-off with distance adjustment.

(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%).

Figure A.1 – Trends in Annual Mean NO_2 Concentrations: Barton Street AQMA

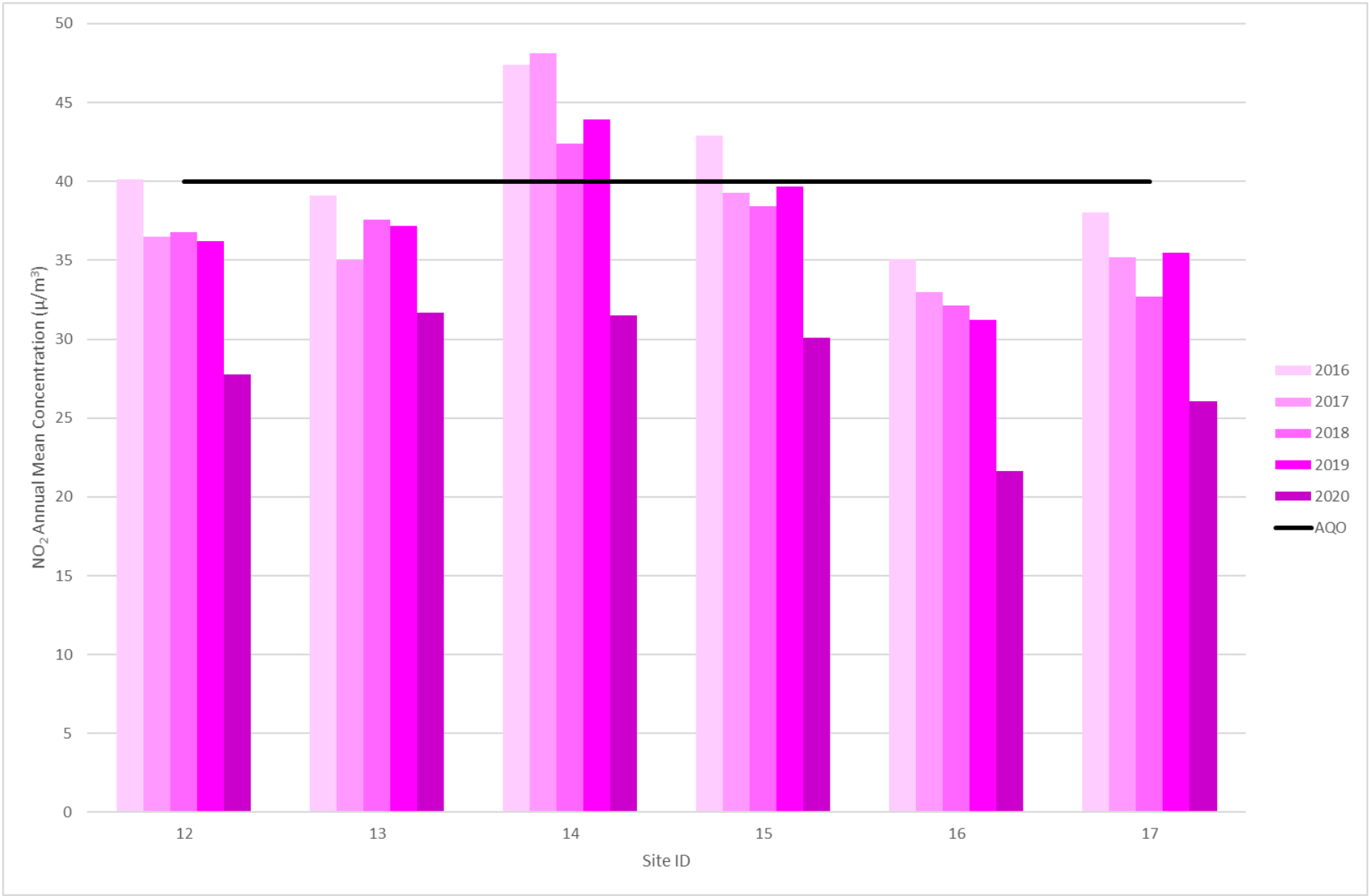


Figure A.2 – Trends in Annual Mean NO_2 Concentrations: Priory Road AQMA

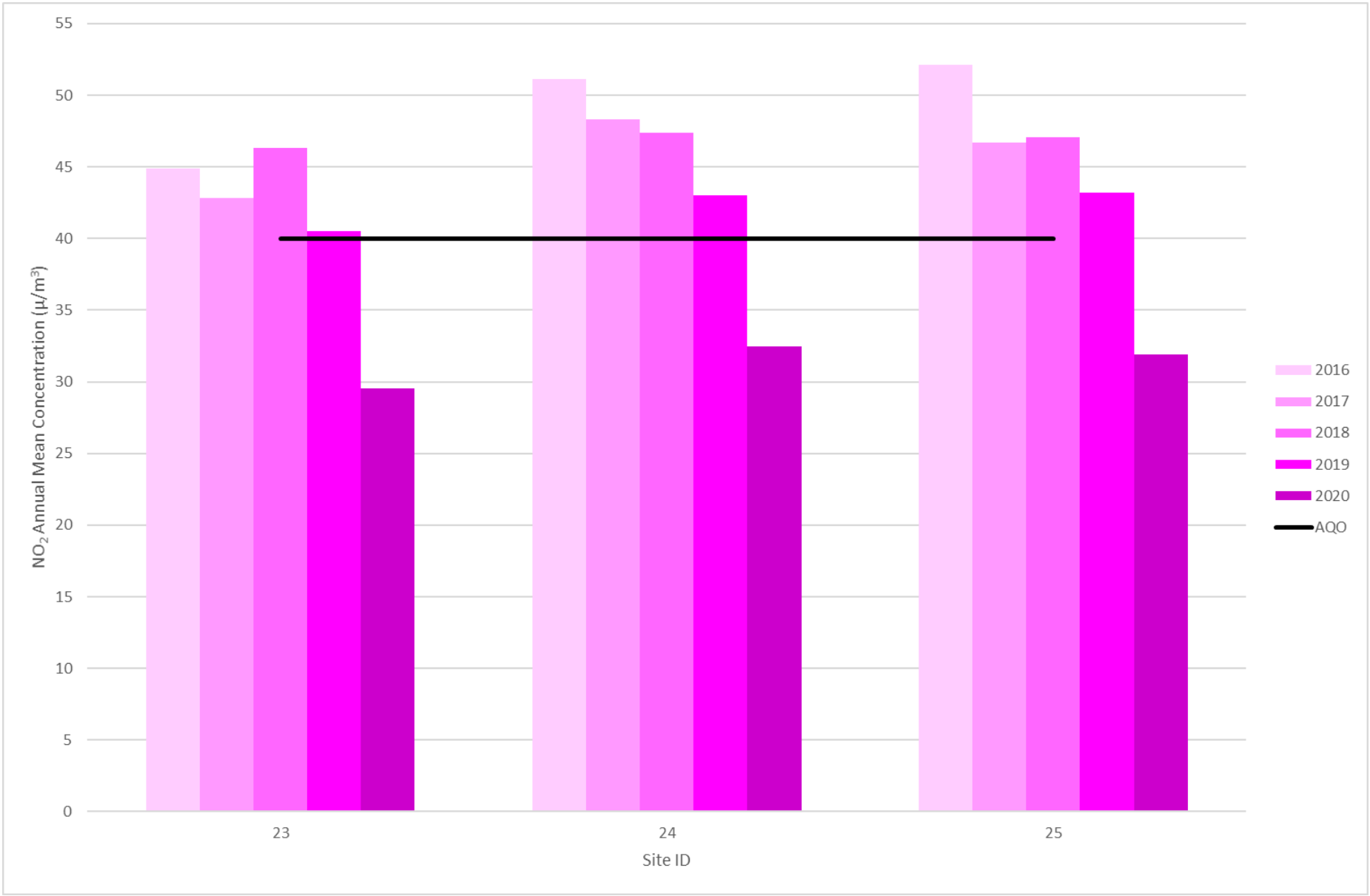


Figure A.3 – Trends in Annual Mean NO_2 Concentrations: Painswick Road AQMA

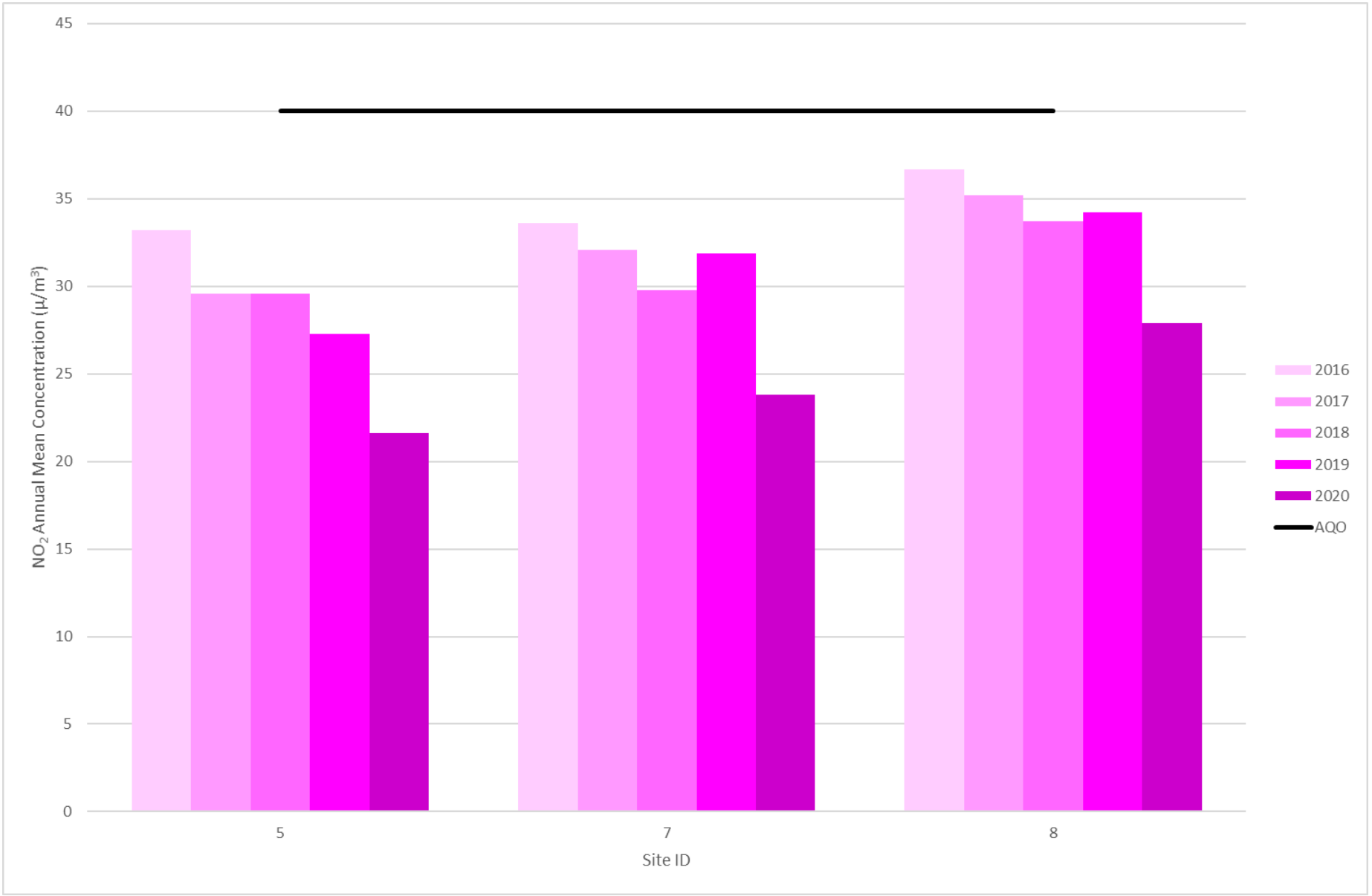
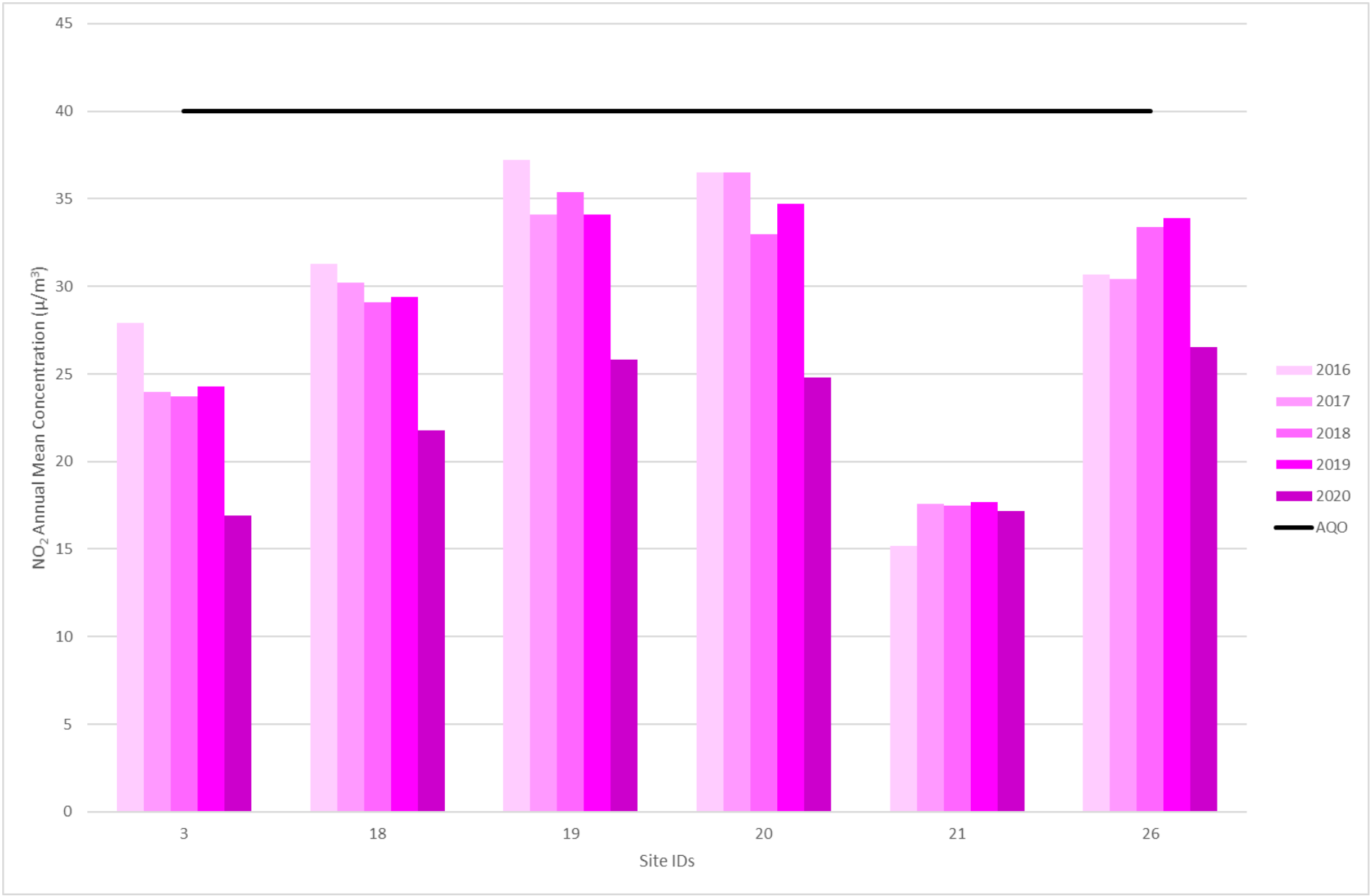


Figure A.4 – Trends in Annual Mean NO_2 Concentrations: Outside of AQMAs



Appendix B: Full Monthly Diffusion Tube Results for 2020

Table B. 1 – NO_2 2020 Diffusion Tube Results ($\mu g/m^3$)

DT ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Easting)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov*	Dec*	Annual Mean: Raw Data	Annual Mean: Annualised and Bias Adjusted (0.81)	Annual Mean: Distance Corrected to Nearest Exposure	Comment
3	387670	217250	31.7	25.7	23.2	16.4	13.2	16.0	15.7	21.2	26.3	23.0	-	-	20.9	16.9	-	
5	384558	216946	36.4	24.0	30.6	20.3	23.3	22.0	20.4	28.8	35.7	30.2	-	-	26.7	21.6	-	
7	384490	217027	44.1	28.6	32.5	22.1	20.2	24.7	24.6	30.5	37.7	33.9	-	-	29.4	23.8	-	
8	384509	216998	45.2	35.5	36.1	22.4	22.9	27.4	27.8	-	-	34.6	-	-	31.1	27.9	-	
12	384000	217863	-	31.6	36.9	27.3	32.3	28.8	30.6	40.5	44.4	40.6	-	-	34.3	27.8	-	
13	383717	218094	-	32.1	36.2	24.7	27.2	26.0	26.7	37.1	41.8	-	-	-	31.0	31.7	-	
14	383726	218074	54.5	44.9	38.5	26.0	29.1	30.8	36.3	42.3	47.2	46.5	-	-	38.9	31.5	-	
15	383989	217857	50.3	40.1	36.0	-	27.1	30.2	32.4	37.0	41.6	42.5	-	-	37.1	30.1	-	
16	384081	217725	45.2	22.3	30.2	23.6	21.4	19.9	19.1	26.5	33.0	29.7	-	-	26.7	21.6	-	
17	384175	217501	42.3	35.6	34.2	23.7	23.3	25.1	28.2	35.1	40.6	39.1	-	-	32.2	26.1	-	
18	384190	218160	37.6	29.7	30.0	21.0	22.0	20.9	21.1	27.7	33.3	30.0	-	-	26.9	21.8	-	
19	385130	218585	35.4	29.6	38.1	29.6	30.8	24.9	32.8	26.6	44.3	33.6	-	-	31.9	25.8	-	
20	385113	218595	38.1	31.7	35.6	27.3	26.3	25.4	24.8	32.1	37.8	-	-	-	30.6	24.8	-	
21	385430	218870	-	23.6	18.3	15.0	-	-	13.4	18.3	23.2	23.7	-	-	19.0	17.2	-	
23	382898	219029	48.0	35.2	35.2	27.0	32.1	31.7	32.6	38.5	45.4	44.7	-	-	36.5	29.5	-	
24	382921	219034	50.8	38.7	43.0	29.4	35.7	35.7	33.4	44.5	49.4	45.3	-	-	**40.1**	32.5	-	
25	382950	219040	51.7	39.2	40.5	28.5	35.2	37.6	33.1	42.2	45.3	44.6	-	-	39.4	31.9	-	
26	383560	218775	51.9	42.5	28.3	19.6	19.0	21.3	-	28.7	-	34.7	-	-	30.1	26.5	-	

☒ **All erroneous data has been removed from the NO_2 diffusion tube dataset presented in Table B.1.**

☒ **Annualisation has been conducted where data capture is <75% and >25% in line with LAQM.TG16.**

☐ **Local bias adjustment factor used.**

☒ **National bias adjustment factor used.**

☒ **Where applicable, data has been distance corrected for relevant exposure in the final column.**

☐ **Gloucester City Council confirm that all 2020 diffusion tube data has been uploaded to the Diffusion Tube Data Entry System.**

Notes:

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

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

See Appendix C for details on bias adjustment and annualisation.

* November and December data has not been included within the calculation of the annual mean due to under/over exposure of diffusion tubes resulting from Covid-19 restrictions.

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

New or Changed Sources Identified Within Gloucester City Council During 2020

Work has begun on the widening of Llanthony Road, part of the A430 Gloucester South West Bypass. The scheme (planning application reference 18/0052/GLR3MJ) is due to be delivered by 2022 and will improve traffic flow through Gloucester by providing two traffic lanes in each direction. An air quality assessment[7] was completed for the scheme in 2018 and concluded that:

"impacts on local air quality from the scheme will not be significant and can be considered as slight beneficial".

Additional Air Quality Works Undertaken by Gloucester City Council During 2020

During 2019 Gloucester City Council commissioned an update to the 2008 AQAP (last updated 2011). As part of this process a review of the current AQMAs has been completed and stakeholder workshops have been held in order to inform new measures. The revised AQAP is now in the process of being finalised and is expected to be released for consultation later this year.

In addition, preliminary design work of a cycleway linking Gloucester and Cheltenham along the B4063[8] has been completed by Highways England and passed to Gloucester County Council's design team for further development. The new route will link the cycle route along London Road in Gloucester to cycling improvements along the A40 in Cheltenham, aiming to improve health and wellbeing whilst reducing traffic emissions. Construction of the cycleway is planned for 2021/22 and a map of the route is shown in

Figure C. 1.

A 12 month e-scooter trial was also launched in October 2020 with DfT and operator Zwings, designed to support a 'green' restart of local travel and help mitigate reduced public transport capacity due to the pandemic.

Figure C. 1 – B4063 Gloucester to Cheltenham Cycle Improvements Scheme

QA/QC of Diffusion Tube Monitoring

The diffusion tubes for the year 2020 were supplied and analysed by Gradko International Ltd, the tubes were prepared 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 – Annual Mean NO_2 Monitoring Results: Non-Automatic Monitoring (µg/m^3).

Gradko is a UKAS accredited laboratory and participates in the AIR-PT Scheme 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 latest available AIR-PT results are AIR-PT AR036 (January – February 2020), AIR-PT AR037 (May – June 2020), AIR-PT AR039 (July – August 2020) and AIR-PT AR040 (September – October 2020). Whilst the rounds PT AR037 and PT AR039 were cancelled due to the pandemic, Gradko scored 75% on PT AR036 and PT AR040. The percentage score reflects the results deemed to be satisfactory based upon the z-score of < ± 2.

The precision of the current 27 local authority co-location studies in 2020 detailed within the national bias adjustment factor spreadsheet (version 06/21) was 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%).

Diffusion tube monitoring during 2020 was largely undertaken in line with the Diffusion Tube Monitoring Calendar and recommended exposure period (5 weeks (+/- 4 days)), with the exception of the November and December periods. During November the diffusion tubes were under-exposed and during December they were over-exposed. The monitored concentrations have been reviewed and have not been included in the calculation of the site specific annual means, due to increased uncertainty in the results, in line with laboratory advice and LAQM.TG(16).

Diffusion Tube Annualisation

In regards to the 2020 diffusion tube set, annualisation was required at four of the eighteen diffusion tube locations due to data capture being below 75%. Annualisation has been completed in line LAQM.TG(16) and using the Diffusion Tube Data Processing Tool (version 1.1)[11].

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 as follows:

- Swindon Walcot (Urban Background)
- Newport (Urban Background)
- Leamington Spa (Urban Background)
- Bristol St Paul's (Urban Background)

The Bristol St Paul's site was used in place of the Cwmbran site that was used last year due to the low data capture experienced at this site during 2020.

Full working details of the diffusion tube annualisation carried out are presented in Table C. 1 below.

[11] Diffusion Tube Data Processing Tool (v1.1) available at https://laqm.defra.gov.uk/tools-monitoring-data/dtdp.html

Table C. 1 – Annualisation Summary (concentrations presented in µg/m^3)

Site ID	Annualisation Factor Swindon Walcot	Annualisation Factor Newport	Annualisation Factor Leamington Spa	Annualisation Factor Bristol St. Paul's	Average Annualisation Factor	Raw Data Annual Mean	Annualised Annual Mean	Comments
8	1.12	1.07	1.10	1.13	1.11	31.1	34.4	
13	1.26	1.15	1.32	1.32	1.26	31.0	39.1	
21	1.14	1.06	1.11	1.15	1.11	19.0	21.2	
26	1.10	1.06	1.09	1.11	1.09	30.1	32.7	

Diffusion Tube Bias Adjustment Factors

The diffusion tube data presented within the 2020 ASR have been corrected for bias using an adjustment factor. Bias represents the overall tendency of the diffusion tubes to under or over-read relative to the reference chemiluminescence analyser. LAQM.TG16 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.

Gloucester City Council do not operate any continuous NO_2 monitoring stations within the City, and therefore a co-location study is not available to derive a local bias factor, thus the National Bias Adjustment Factor Spreadsheet[12] has been used.

National Diffusion Tube Bias Adjustment Factor Spreadsheet — Spreadsheet Version Number: 06/21

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

This spreadsheet will be updated at the end of Sept 2021
LAQM Helpdesk Website

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

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

Step 1: Select the Laboratory that Analyses Your Tubes from the Drop-Down List
If a laboratory is not shown, we have no data for this laboratory.

Step 2: Select a Preparation Method from the Drop-Down List
If a preparation method is not shown, we have no data for this method at this laboratory.

Step 3: Select a Year from the Drop-Down List
If a year is not shown, we have no data[2]

Step 4: Where there is only one study for a chosen combination, you should use the adjustment factor shown with caution. Where there is more than one study, use the overall factor[3] shown in blue at the foot of the final column.
If you have your own co-location study then see footnote[4]. If uncertain what to do then contact the Local Air Quality Management Helpdesk at LAQMHelpdesk@bureauveritas.com or 0800 0327953

Analysed By[1]	Method (To undo your selection, choose (All) from the pop-up list)	Year[2] (To undo your selection, choose (All))	Site Type	Local Authority	Length of Study (months)	Diffusion Tube Mean Conc. (Dm) (µg/m³)	Automatic Monitor Mean Conc. (Cm) (µg/m³)	Bias (B)	Tube Precision[4]	Bias Adjustment Factor (A) (Cm/Dm)
Gradko	20% TEA in water	2020	R	Gedling Borough Council	10	31	25	24.1%	G	**0.81**
Gradko	20% TEA in water	2020	R	SOUTHAMPTON CITY COUNCIL	12	37	27	37.1%	G	**0.73**
Gradko	20% TEA in water	2020	R	Fareham Borough Council	10	25	14	77.4%	G	**0.56**
Gradko	20% TEA in water	2020	R	Fareham Borough Council	12	30	22	35.1%	G	**0.74**
Gradko	20% TEA in water	2020	R	Fareham Borough Council	10	22	17	26.5%	G	**0.79**
Gradko	20% TEA in water	2020	R	SOUTHAMPTON CITY COUNCIL	11	32	31	4.9%	G	**0.95**
Gradko	20% TEA in water	2020	KS	Marylebone Road Intercomparison	12	57	43	33.3%	G	**0.75**
Gradko	20% TEA in water	2020	R	Bath & North East Somerset	11	32	29	13.0%	G	**0.89**
Gradko	20% TEA in water	2020	R	Gateshead Council	12	22	17	28.1%	G	**0.78**
Gradko	20% TEA in water	2020	R	Gateshead Council	12	23	21	11.6%	G	**0.90**
Gradko	20% TEA in water	2020	R	Gateshead Council	10	26	25	6.5%	G	**0.94**
Gradko	20% TEA in water	2020	R	Gateshead Council	12	28	21	30.5%	G	**0.77**
Gradko	20% TEA in water	2020	R	Gateshead Council	12	31	32	-3.4%	G	**1.03**
Gradko	20% TEA in water	2020	R	Luton Borough Council	9	38	28	33.8%	G	**0.75**
Gradko	20% TEA in water	2020	R	Nottingham City Council	12	31	34	-8.5%	G	**1.09**
Gradko	20% TEA in water	2020	R	Dudley MBC	13	33	28	19.9%	G	**0.83**
Gradko	20% TEA in water	2020	UB	Dudley MBC	13	23	14	61.2%	G	**0.62**
Gradko	20% TEA in water	2020	R	Dudley MBC	13	44	34	30.6%	G	**0.77**
Gradko	20% TEA in water	2020	R	Ards and North Down Borough Council	10	27	20	34.0%	G	**0.75**
Gradko	20% TEA in water	2020	R	Belfast City Council	10	26	21	22.8%	G	**0.81**
Gradko	20% TEA in water	2020	R	Belfast City Council	10	41	36	12.6%	G	**0.89**
Gradko	20% TEA in water	2020	R	Belfast City Council	10	36	25	43.9%	G	**0.69**
Gradko	20% TEA in water	2020	R	Lancaster City Council	11	27	23	19.9%	G	**0.83**
Gradko	20% TEA in water	2020	R	Lancaster City Council	10	32	28	13.0%	G	**0.89**
Gradko	20% TEA in water	2020	R	Eastleigh Borough Council	9	23	20	13.6%	G	**0.88**
Gradko	20% TEA in water	2020	UB	Eastleigh Borough Council	9	22	19	17.9%	G	**0.85**
Gradko	20% TEA in water	2020	R	Lisburn & Castlereagh City Council	10	23	18	32.5%	G	**0.75**
Gradko	20% TEA in water	2020		**Overall Factor[3] (27 studies)**				**Use**		**0.81**

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

[12] National Diffusion Tube Bias Adjustment Factor Spreadsheet version 06/21 available at https://laqm.defra.gov.uk/bias-adjustment-factors/national-bias.html

method. The national bias adjustment factor for Gradko 20% TEA in water is 0.81 for the year 2020 (based on 27 studies) as derived from the national bias adjustment factor spreadsheet.

The bias adjustment factors utilised for the past five years are presented in Table C. 2 below.

Table C. 2 – Bias Adjustment Factor

Monitoring Year	Local or National	If National, Version of National Spreadsheet	Adjustment Factor
2020	National	03/21	0.81
2019	National	03/19	0.93
2018	National	03/18	0.93
2017	National	03/17	0.89
2016	National	03/16	0.94

NO_2 Fall-off with Distance from the Road

Wherever possible, local authorities should ensure that monitoring locations are representative of exposure. However, where this is not possible, the NO_2 concentration at the nearest location relevant for exposure should be estimated using the Diffusion Tube Data Processing Tool/NO_2 fall-off with distance calculator available on the LAQM Support website.

No diffusion tube NO_2 monitoring locations within Gloucester City Council required distance correction during 2020 as all monitored concentrations were below the annual mean air quality objective.

Appendix D: Maps of Monitoring Locations and AQMAs

Figure D.1 – NO_2 Diffusion Tube Monitoring Locations: Barton Street AQMA

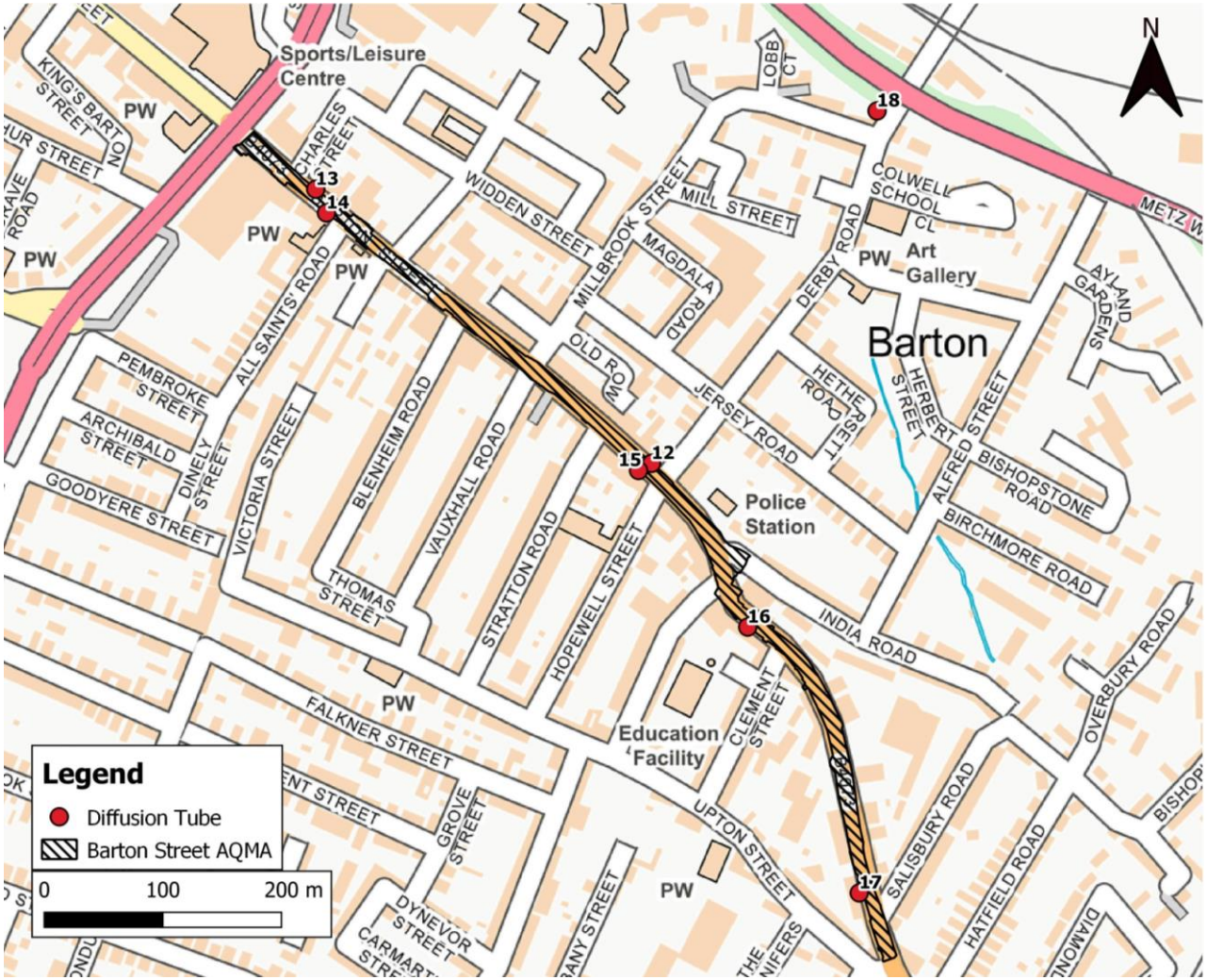


Figure D.2 – NO_2 Diffusion Tube Monitoring Locations: Priory Road AQMA

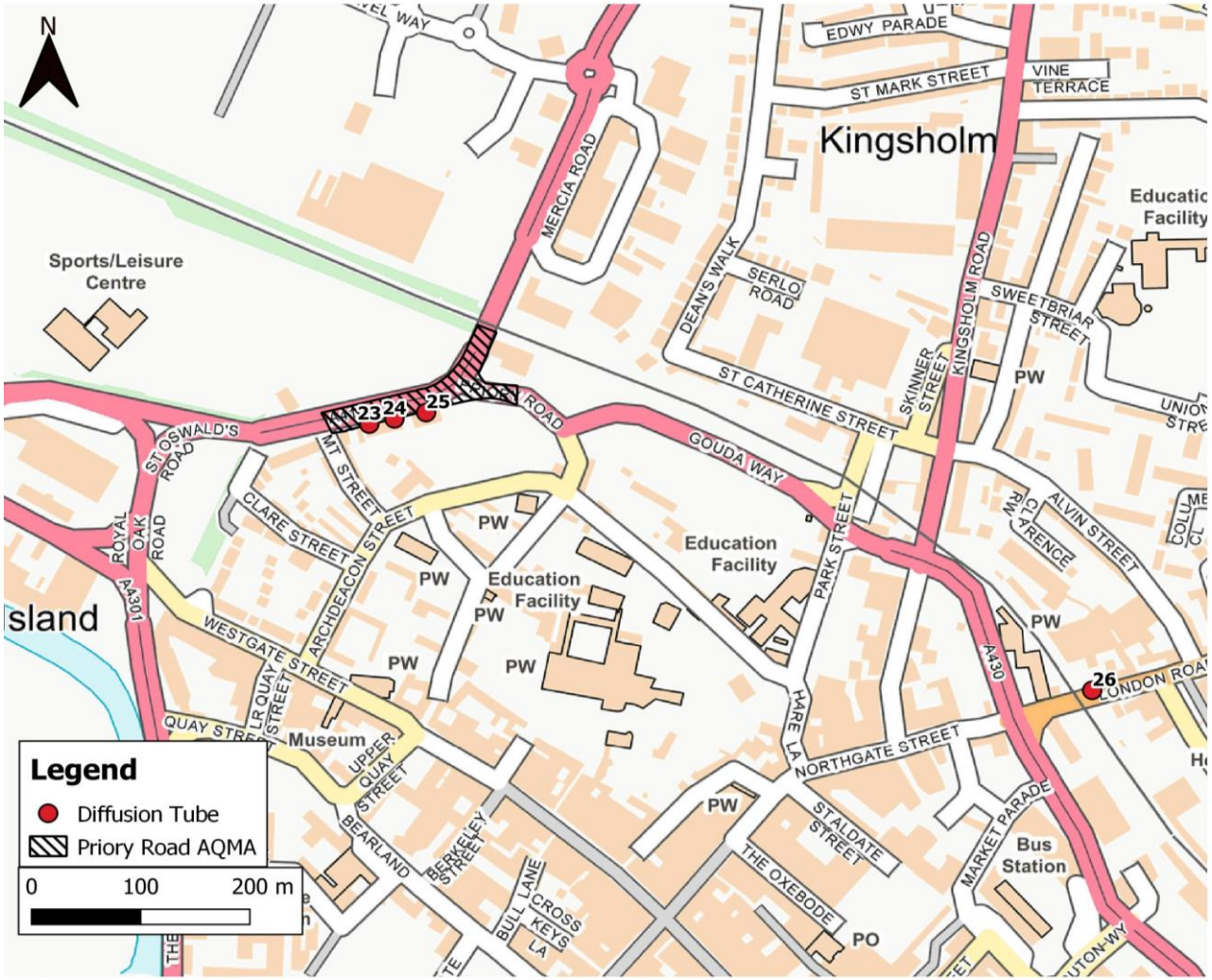


Figure D.3 – NO_2 Diffusion Tube Monitoring Locations: Painswick Road AQMA

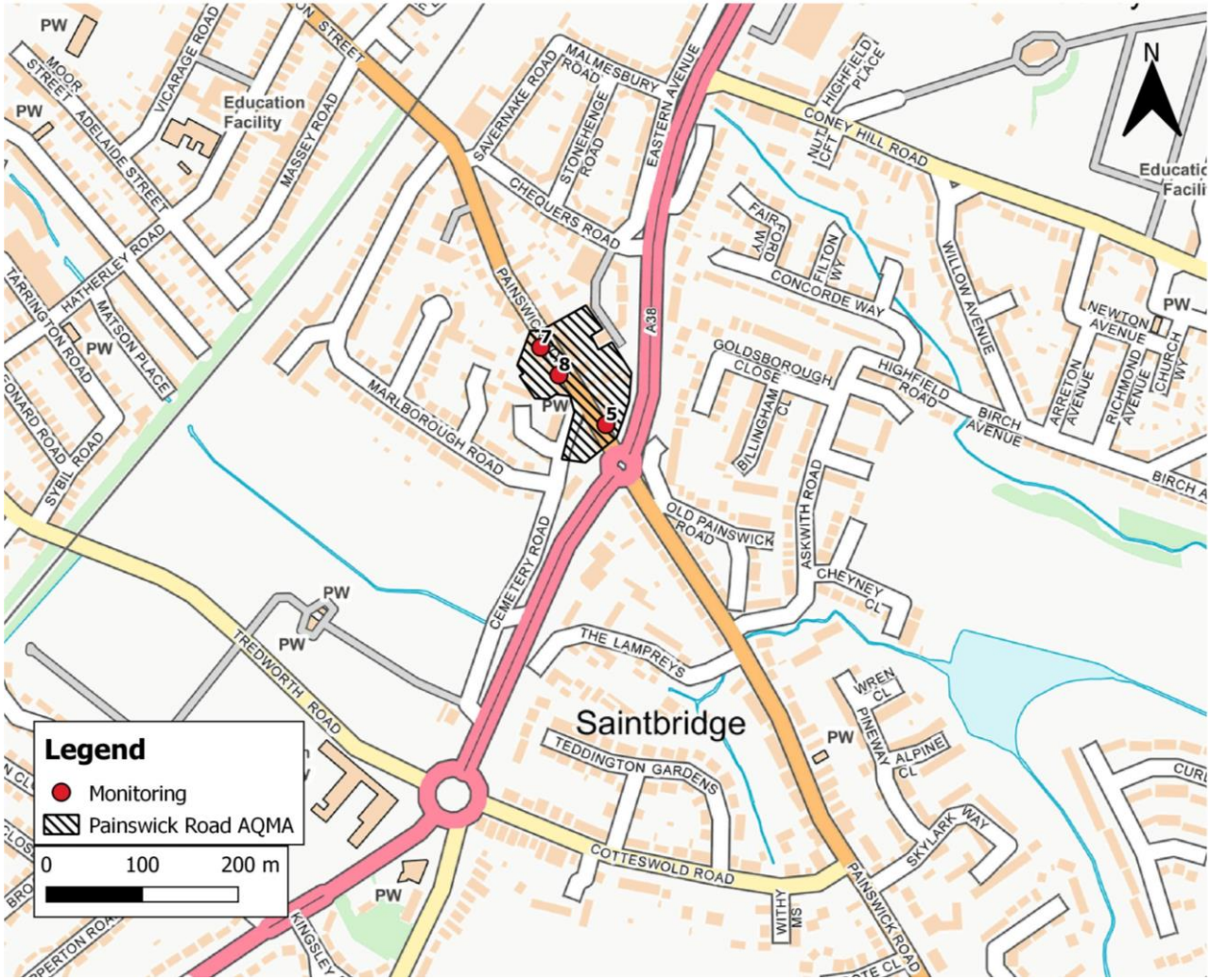


Figure D.4 – NO_2 Diffusion Tube Monitoring Locations: Barnwood/Elmbridge

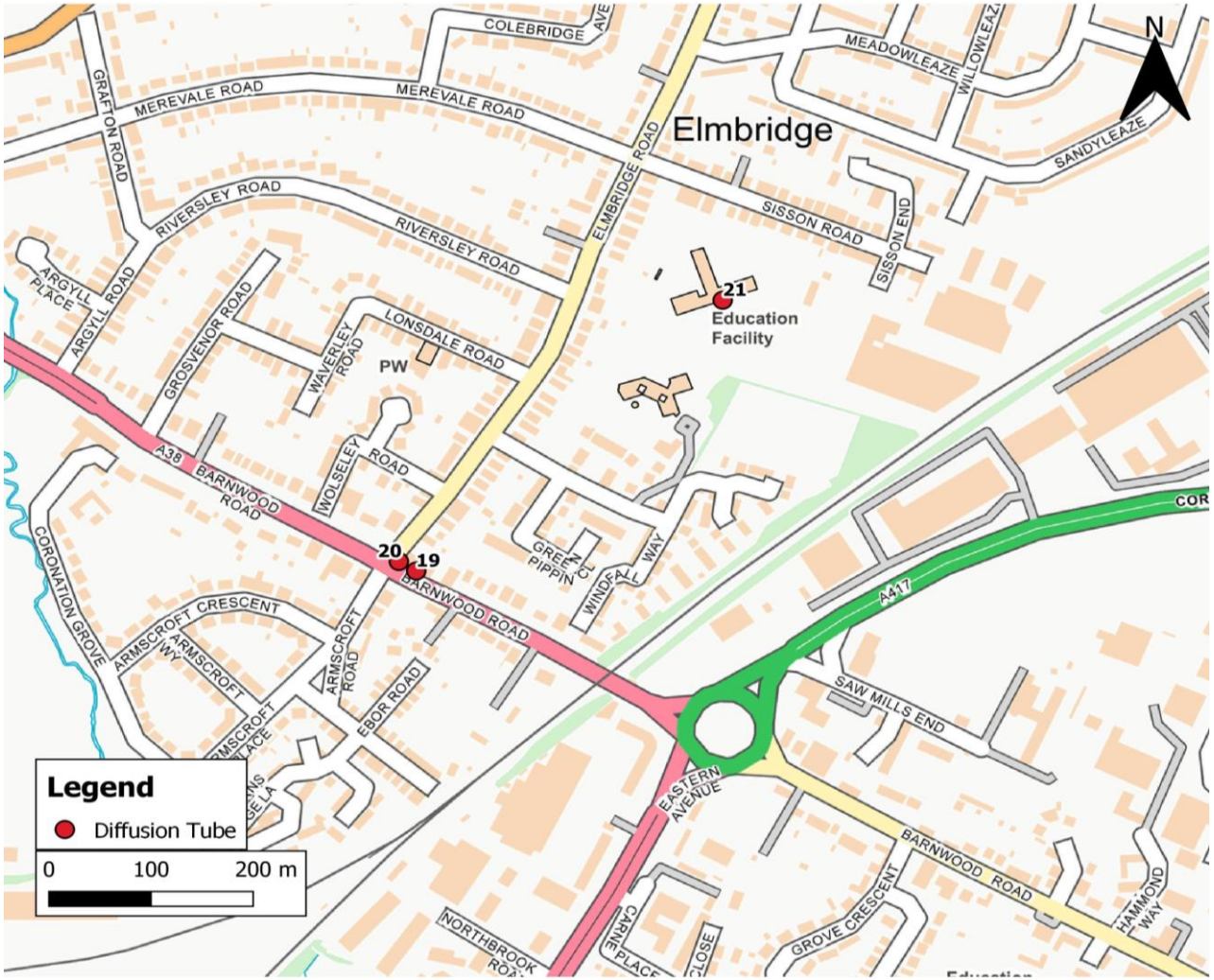


Figure D.5 – NO_2 Diffusion Tube Monitoring Locations: M5

Appendix E: Summary of Air Quality Objectives in England

Table E.1 – Air Quality Objectives in England[13]

Pollutant	Air Quality Objective: Concentration	Air Quality Objective: Measured as
Nitrogen Dioxide (NO_2)	200 µg/m^3 not to be exceeded more than 18 times a year	1-hour mean
Nitrogen Dioxide (NO_2)	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
Particulate Matter (PM_{10})	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
Sulphur Dioxide (SO_2)	125 µg/m^3, not to be exceeded more than 3 times a year	24-hour mean
Sulphur Dioxide (SO_2)	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).

Appendix F: Impact of COVID-19 upon LAQM

COVID-19 has had a significant impact on society. Inevitably, COVID-19 has also had an impact on the environment, with implications to air quality at local, regional and national scales.

COVID-19 has presented various challenges for Local Authorities with respect to undertaking their statutory LAQM duties in the 2021 reporting year. Recognising this, Defra provided various advice updates throughout 2020 to English authorities, particularly concerning the potential disruption to air quality monitoring programmes, implementation of Air Quality Action Plans (AQAPs) and LAQM statutory reporting requirements. Defra has also issued supplementary guidance for LAQM reporting in 2021 to assist local authorities in preparing their 2021 ASR. Where applicable, this advice has been followed.

Despite the challenges that the pandemic has given rise to, the events of 2020 have also provided Local Authorities with an opportunity to quantify the air quality impacts associated with wide-scale and extreme intervention, most notably in relation to emissions of air pollutants arising from road traffic. The vast majority (>95%) of AQMAs declared within the UK are related to road traffic emissions, where attainment of the annual mean objective for nitrogen dioxide (NO_2) is considered unlikely. On 23rd March 2020, the UK Government released official guidance advising all members of public to stay at home, with work-related travel only permitted when absolutely necessary. During this initial national lockdown (and to a lesser extent other national and regional lockdowns that followed), marked reductions in vehicle traffic were observed; Department for Transport (DfT) data[14] suggests reductions in vehicle traffic of up to 70% were experienced across the UK by mid-April, relative to pre COVID-19 levels.

This reduction in travel in turn gave rise to a change of air pollutant emissions associated with road traffic, i.e. nitrous oxides (NO_x), and exhaust and non-exhaust particulates (PM). The Air Quality Expert Group (AQEG)[15] has estimated that during the initial lockdown period in 2020, within urbanised areas of the UK reductions in NO_2 annual mean concentrations were between 20 and 30% relative to pre-pandemic levels, which

[14] Prime Minister's Office, COVID-19 briefing on the 31st of May 2020

[15] Air Quality Expert Group, Estimation of changes in air pollution emissions, concentrations and exposure during the COVID-19 outbreak in the UK, June 2020

represents an absolute reduction of between 10 to 20 µg/m^3 if expressed relative to annual mean averages. During this period, changes in $PM_{2.5}$ concentrations were less marked than those of NO_2. $PM_{2.5}$ concentrations are affected by both local sources and the transport of pollution from wider regions, often from well beyond the UK. Through analysis of AURN monitoring data for 2018-2020, AQEG have detailed that $PM_{2.5}$ concentrations during the initial lockdown period are of the order 2 to 5 µg/m^3 lower relative to those that would be expected under business-as-usual conditions.

As restrictions are gradually lifted, the challenge is to understand how these air quality improvements can benefit the long-term health of the population.

Impacts of COVID-19 on Air Quality within Gloucester City Council

During 2020, the air quality monitoring programme continued in Gloucester City Council and the following reductions in monitored NO_2 concentrations in the AQMAs were observed in comparison to 2019:

- Barton Street AQMA: 15 – 30 % reduction;
- Priory Road AQMA: 25 – 27 % reduction;
- Painswick Road AQMA: 18 – 25 % reduction;

Overall, across the City as a whole, reductions in monitored concentrations in comparison to 2019 range between 3 – 30 % and the average reduction was 24 %. This has provided an evidence base that shows it is achievable to reach the annual mean objective across Gloucester.

Opportunities Presented by COVID-19 upon LAQM within Gloucester City Council

In response to the Covid-19 pandemic, the council secured funding to install temporary cycle lanes along both London Road and Stroud Road[8] in order to help people travel safely across the City. Since this trial the council have been looking at a revised design that could be introduced permanently in order to continue to encourage cycling and walking in the area. The changes will form part of the council's ambitious plan to create a cycle way linking Gloucester and Cheltenham along the B4063[8].

Challenges and Constraints Imposed by COVID-19 upon LAQM within Gloucester City Council

- During 2020, the diffusion tube monitoring programme across Gloucester City Council was disrupted during September, November and December. Tubes were under-exposed during September and November and over-exposed during December. Monthly results recorded during September look to be generally in line with those from tubes exposed in line with the national monitoring calendar and recommended exposure times, so have been included in the calculations for the annual average, shown in Table A.2. The concentrations monitored during November are much higher and those for December are much lower than those observed during other months in 2020 and therefore have not been included in calculations of the annual mean, in line with LAQM.TG(16). This has affected data capture within 2020, resulting in some monitoring sites having to be annualised. **Small Impact.**
- As with previous years, a national bias adjustment factor has been utilised to adjust the diffusion tube results for 2020. Within 2019 there were 27 co-location studies that were utilised to calculate the bias factor for the laboratory and preparation method used. For 2020, this number has remained the same (27 studies). This has therefore not caused any greater degree of uncertainty in the resultant annual mean NO_2 concentrations in 2020 than in previous years. **No Impact.**
- A revised AQAP is being developed for the Barton Street, Priory Road and Painswick Road AQMAs. However, owing to the reallocation of Council resources during 2020, the development and implementation of the AQAP has been slightly delayed. Current estimates are that the revised AQAP will be prepared in and sent out for draft consultation during 2021. **Small Impact.**

The impacts as presented above are aligned with the criteria as defined in Table F 1, with professional judgement considered as part of their application.

Table F 1 – Impact Matrix

Category	Impact Rating: None	Impact Rating: Small	Impact Rating: Medium	Impact Rating: Large
Automatic Monitoring – Data Capture (%)	More than 75% data capture	50 to 75% data capture	25 to 50% data capture	Less than 25% data capture
Automatic Monitoring – QA/QC Regime	Adherence to requirements as defined in LAQM.TG16	Routine calibrations taken place frequently but not to normal regime. Audits undertaken alongside service and maintenance programmes	Routine calibrations taken place infrequently and service and maintenance regimes adhered to. No audit achieved	Routine calibrations not undertaken within extended period (e.g. 3 to 4 months). Interruption to service and maintenance regime and no audit achieved
Passive Monitoring – Data Capture (%)	More than 75% data capture	50 to 75% data capture	25 to 50% data capture	Less than 25% data capture
Passive Monitoring – Bias Adjustment Factor	Bias adjustment undertaken as normal	<25% impact on normal number of available bias adjustment colocation studies (2020 vs 2019)	25-50% impact on normal number of available bias adjustment studies (2020 vs 2019)	>50% impact on normal number of available bias adjustment studies (2020 vs 2019) and/or applied bias adjustment factor studies not considered representative of local regime
Passive Monitoring – Adherence to Changeover Dates	Defra diffusion tube exposure calendar adhered to	Tubes left out for two exposure periods	Tubes left out for three exposure periods	Tubes left out for more than three exposure periods
Passive Monitoring – Storage of Tubes	Tubes stored in accordance with laboratory guidance and analysed promptly.	Tubes stored for longer than normal but adhering to laboratory guidance	Tubes unable to be stored according to be laboratory guidance but analysed prior to expiry date	Tubes stored for so long that they were unable to be analysed prior to expiry date. Data unable to be used
AQAP – Measure Implementation	Unaffected	Short delay (<6 months) in development of a new AQAP, but is on-going	Long delay (>6 months) in development of a new AQAP, but is on-going	No progression in development of a new AQAP
AQAP – New AQAP Development	Unaffected	Short delay (<6 months) in development of a new AQAP, but is on-going	Long delay (>6 months) in development of a new AQAP, but is on-going	No progression in development of a new AQAP

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	Annual Status Report
Defra	Department for Environment, Food and Rural Affairs
DMRB	Design Manual for Roads and Bridges – Air quality screening tool produced by Highways England
EU	European Union
FDMS	Filter Dynamics Measurement System
LAQM	Local Air Quality Management
NO_2	Nitrogen Dioxide
NO_x	Nitrogen Oxides
PM_{10}	Airborne particulate matter with an aerodynamic diameter of 10µm or less
$PM_{2.5}$	Airborne particulate matter with an aerodynamic diameter of 2.5µm or less
QA/QC	Quality Assurance and Quality Control
SO_2	Sulphur Dioxide

References

- Local Air Quality Management Technical Guidance LAQM.TG16. April 2021. Published by Defra in partnership with the Scottish Government, Welsh Assembly Government and Department of the Environment Northern Ireland.
- Local Air Quality Management Policy Guidance LAQM.PG16. May 2016. Published by Defra in partnership with the Scottish Government, Welsh Assembly Government and Department of the Environment Northern Ireland.
- Gloucester City Council 2019 Annual Status Report.
- Gloucester Air Quality Action Plan 2008 (2011 Review).
- National Diffusion Tube Bias Adjustment Factor Spreadsheet, published March 2021.
- Diffusion Tube Data Processing Tool version 1.1 June 2021, Defra.