2020 Air Quality Annual Status Report (ASR)

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

August 2020

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Executive Summary: Air Quality in Our Area

Air Quality in Bristol

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

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

Bristol is a city, unitary authority area and ceremonial county in South West England, 105 miles (169 km) west of London, and 44 miles (71 km) east of Cardiff. It has an estimated population of 463,400[4] for the unitary authority at present, and a surrounding urban area with an estimated 661,600 residents (mid 2017). Within England and Wales it is the 8th largest city outside of London and the 10th largest local authority.

The main pollutants of concern within Bristol are nitrogen dioxide and particulate matter. Monitoring in Bristol shows that we are currently in breach of the annual objective for nitrogen dioxide and possibly the hourly objective, set at 40µg/m^3 and 200µg/m^3 (with a permissible 18 hours per year above the 200µg/m^3 limit allowed) respectively.

Nitrogen Dioxide

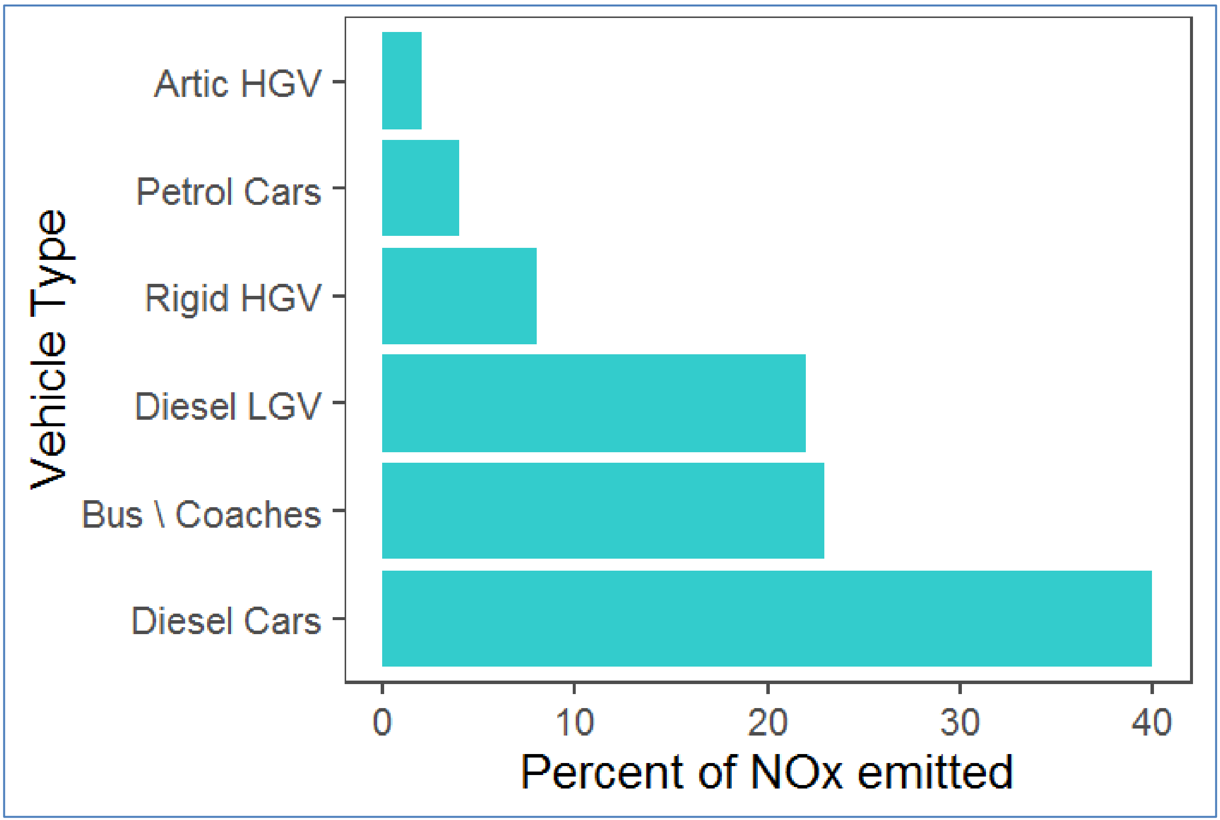
In those locations that exceed the nitrogen dioxide air quality objectives, over 80% of this pollution has been shown to be from local traffic sources. As a result, actions and decisions by BCC, other West of England (WoE) authorities and the decisions that citizens in the WoE have to make each day with regards to how they move around the area, all directly impact upon the level of air pollution in the city.

A 2017 study into the proportion of nitrogen oxide (NO_x) emissions from vehicles

[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
[4] ONS 2018 Mid-Year Population Estimate

calculated that 96% of all NO_X emissions from vehicles come from diesels, with diesel cars (40%), buses and coaches (23%) and diesel Light Goods Vehicles (22%) being the largest contributors[5].

Figure 0-1 - Proportion of NOx Emissions by Vehicle Class in Central Bristol



Health Impacts

Air pollution has negative impacts on the health of people in Bristol, especially vulnerable members of the population. Evidence suggests that it can cause permanent lung damage in babies and young children[6] and exacerbates lung and heart disease in older people[7]. A recent report into the health effects of air pollution in Bristol concluded that around 300 premature deaths each year in the City of Bristol can be attributed to exposure to NO_2 and fine particulate matter ($PM_{2.5}$), with roughly an equal number attributable to both pollutants. This represents about 8.5% of deaths in the administrative area of Bristol being attributable to air pollution[8]. This has

[5] CH2M (2017). Bristol Clean Air Zone Feasibility Study: Option Sifting
[6] Royal College of Paediatrics and Child Health, Every breath we take – The lifelong impact of air pollution, February 2016 (URL: https://www.rcplondon.ac.uk/projects/outputs/every-breath-we-take-lifelong-impact-air-pollution)
[7] Simoni et al., Adverse effects of outdoor pollution in the elderly, Journal of Thoracic Disease, January 2015 (URL:https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4311079/)

[8] Air Quality Consultants, Health Impacts of Air Pollution in Bristol, February 2017

an estimated cost to the NHS of £83m.

Monitoring

Pollutants such as sulphur dioxide, carbon monoxide and some heavy metals used to be monitored in Bristol, however, this has ceased as compliance with health based air quality objectives for these pollutants has been demonstrated. Monitoring of nitrogen dioxide continues extensively throughout the city. Nitrogen dioxide concentrations have demonstrated a slightly improving trend since 2010; however, exceedances of objectives for this pollutant are still measured widely in the city. 2019 NO_2 concentrations at diffusion tube sites show an improvement when compared to 2018 concentrations with improvements in all of the 85 diffusion tube monitoring locations for which both 2018 and 2019 monitoring data were available.

Air Quality Management Areas (AQMAs) are declared when there is an exceedance or likely exceedance of an air quality objective. Further information related to declared AQMAs can be found on the Defra website, including maps of AQMA boundaries.

Approximately 100,000 people live within the AQMA and it also includes the central employment, leisure and shopping districts, major hospitals and dozens of schools and therefore many more people are exposed to air pollution in their daily lives. There are also three small AQMAs in South Gloucestershire in Kingswood \ Warmley, Staple Hill and adjacent to the roundabout at Junction 17 of the M5. Monitoring of air pollution at the Junction 17 Cribbs Causeway AQMA has demonstrated compliance in recent years and after a public consultation exercise South Gloucestershire intends to revoke this AQMA.

Bristol's monitoring network is focused on nitrogen dioxide (NO_2), as the concentrations of this pollutant near busy roads exceed the health based UK and EU objectives.

The Bristol City Council and Defra monitoring network in 2019 consisted of:

- 7 real time NO_2 monitors which provide continuous live data which is uploaded automatically to a public open data air quality dashboard
- 4 real time particulate monitors (1 x $PM_{2.5}$ and 3 x PM_{10})
- 102 NO_2 diffusion tubes which provide a monthly and annual concentration for this pollutant.

In late 2019 a new $PM_{2.5}$ monitor was installed at Parsons Street School. 2020 will be the first year where data for this site will be available.

Defra operate the Bristol St Paul’s monitoring site which measures NO_2, particulate matter (PM_{10} and $PM_{2.5}$) and ozone (O_3). This site is in St Pauls at an “urban background” location away from busy roads. This Defra site is representative of general pollution levels over central Bristol but not of pollution levels at busy roadside locations in the city. Defra operate the PM_{10} monitor at the Temple Way site which also houses a BCC operated NO_2 analyser. This is known as an affiliate site where Defra and the Local Authority share infrastructure that houses monitoring equipment. All other sites are owned and operated by Bristol City Council.

When considering the results from all diffusion tube locations around the city there has been a decrease in NO_2 pollution levels in 2019 when compared to 2018. This equates to a 6.6µg/m^3 (-15.8%) decrease of annual NO_2 concentrations over all 85 tube locations for which data was available in 2018 and 2019. When comparing data for all tubes for which there is data from 2015 (78 tubes), the average decrease over this 5 year period is 8.7µg/m^3 (-19.5%). It should however be noted that changes over the city were not uniform with pollution falling more at some locations but actually increasing at 2 locations over the period 2015 to 2019. Concentrations remain higher than the health based EU and UK limits on many roads in the city centre and along the main arterial routes leading from the city centre.

Figure 0-2 shows the long term trends in NO_2 concentrations at a selection of city centre monitoring sites. Monitoring at Rupert Street was stopped due to the change in road layout associated with the Metrobus works. A new site on Colston Avenue was commissioned at the end of 2018 which is in a location approximately 20m from the Rupert Street site. Data was available for 2019 at this new monitoring location.

Figure 0-2 - Trends in Annual NO_2 at City Centre Sites (2010-2019)

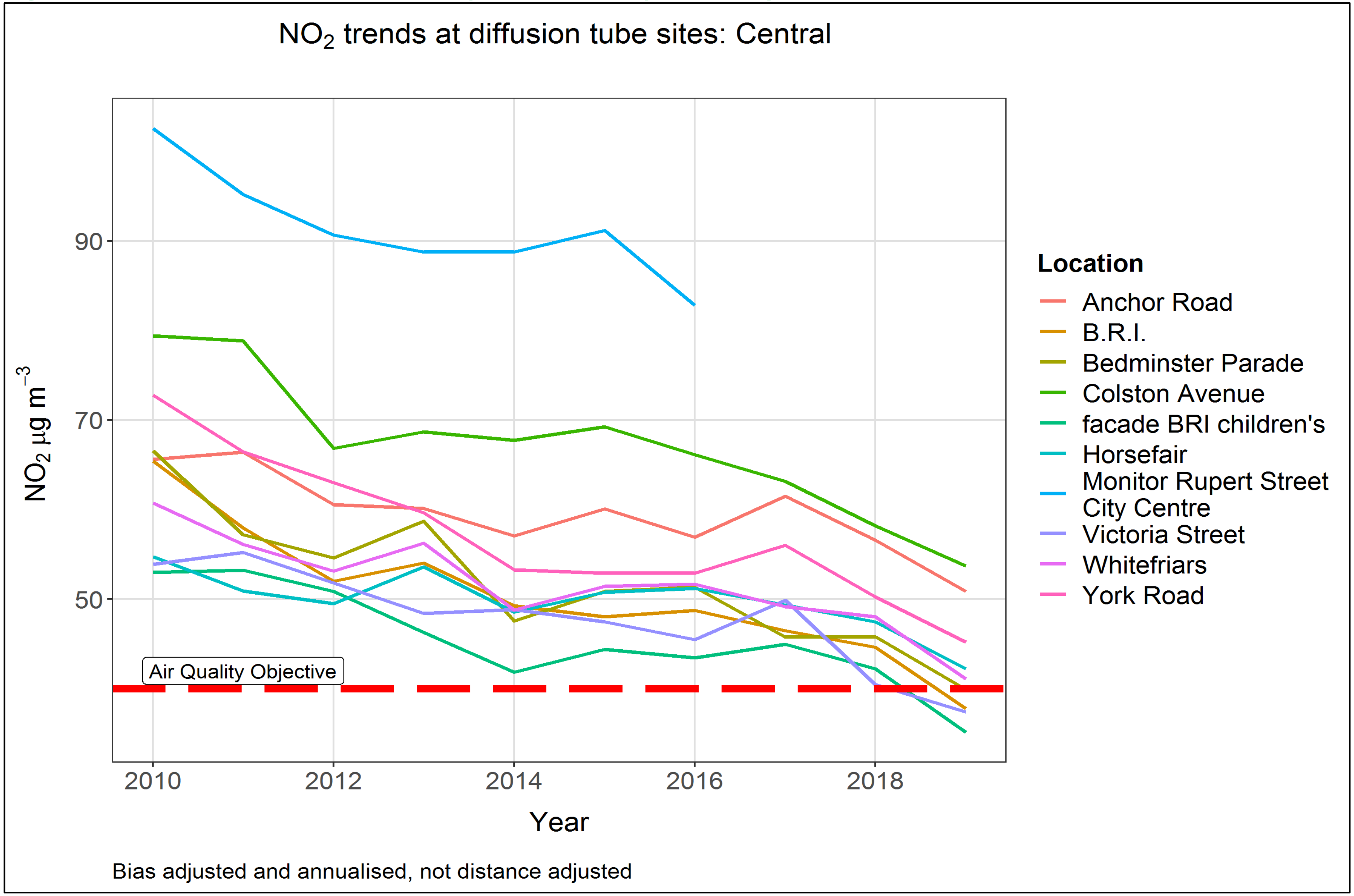
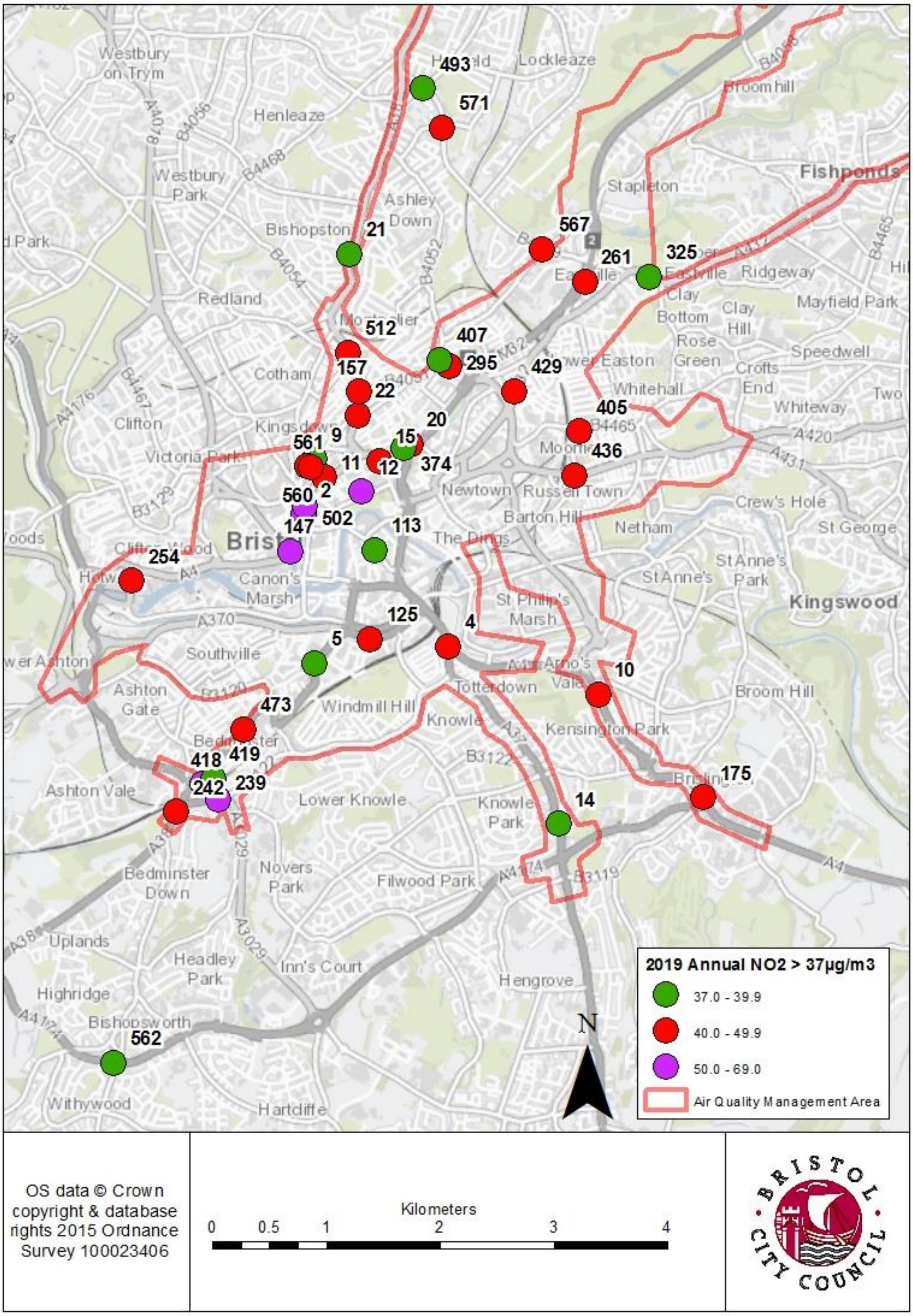


Figure 0-3 shows the locations in which monitored pollution concentrations exceed 37µg/m^3. 37µg/m^3 has been used to account for diffusion tube monitoring uncertainty. It should be noted that these are monitoring concentration and not the concentrations at relevant receptor locations as defined in the LAQM TG16 (e.g. facades of houses, schools, elderly people's homes and hospitals).

Figure 0-3 - Monitoring Locations Where 2019 Annual NO_2 > 37µg/m^3



Particulate Matter

Whilst monitoring of particulates in the city is limited it is possible that exceedance of objectives occur in some isolated areas. Health impacts from particulate pollution have been shown to occur at levels below the EU and UK target values, with the World Health Organisation (WHO) setting particulate pollution limits significantly lower than those adopted by Europe and the UK. Whilst much of the action to improve air pollution in the UK and Bristol is focussed on achieving compliance with nitrogen dioxide limits, it is important not to lose sight of the health improvements that can be achieved by reducing particulate pollution. In most cases, the measures to reduce nitrogen dioxide pollution will also reduce particulate pollution.

In those locations with the highest nitrogen dioxide pollution levels, emissions from motor vehicles are by far the largest contributor to pollution. Contribution to air pollution is also made by other combustion processes such as domestic heating (especially solid fuel burning) and industry. There is also a contribution from sources outside of the local authority area. In the case of particulate pollution, contributions from agriculture, industry and natural sources can be significant at times when weather patterns result in a build-up of pollution in the atmosphere and the formation of secondary particulate pollution. Secondary particulate matter (PM) is formed in the atmosphere through chemical reactions between other air pollutant gases such as nitrogen oxides (NOx), ammonia (NH_3) and sulphur dioxide (SO_2).

Appliances that burn solid fuel contribute to local air pollution and evidence is that their contribution is increasing due to the popularity of solid fuel burning for occasional heating requirements, especially in the winter time. Domestic solid fuel burning can generate significant levels of particulate pollution.

The health impacts from $PM_{2.5}$ pollution have been shown to occur at levels below EU and UK objectives. Recent evidence from national studies shows that domestic solid fuel burning contributes more than previously thought to particulate emissions. This new national research suggests that the health impacts from local domestic wood burning are significant. As a result of this national evidence, Bristol City Council has commissioned a study to try to determine the scale of solid fuel burning in the city and the contribution that it has to particulate pollution. This is in order to identify appropriate next steps in taking action to reduce the health impacts associated with this activity.

Under the Clean Air Act of 1993 the whole of Bristol is a smoke control area. In a smoke control area only fuel on the list of authorised fuels, or any of the following 'smokeless' fuels can be burned, unless an exempt appliance is used.

- Anthracite
- Semi-anthracite
- Gas
- Low volatile steam coal

Non-compliance with the smoke control rules can result in a fine of up to £1000.

Government proposed to amend the Clean Air Act through the new Environment Bill to make the enforcement easier. It however remains to be seen what form these changes take in the final Act.

At the end of 2017 the Department for the Environment, Food and Rural Affairs (Defra) issued a practical guide on open fires and wood burning stoves. The guide provides steps that should be taken to reduce the health impacts of burning solid fuel. This guidance can be found on the Bristol City Council smoke control webpage.

In additional to the report quantifying pollutant emissions from solid fuel use, a report into the emissions from construction Non-Road Mobile Machinery (NRMM) has also been commissioned by BCC. The aim of the report is to provide the evidence base needed to develop appropriate policies to manage emissions from this potentially significant pollutant source.

Actions to Improve Air Quality

As previously discussed, air pollution in those locations exceeding the health based limits for nitrogen dioxide originates predominantly from motor vehicles. The approach to reducing NO_2 concentrations is focused on measures to reduce the number of vehicles on our roads, clean up the emissions from those vehicles and to reduce congestion.

Development of a Clean Air Plan

Bristol City Council began work on the current Clean Air Plan in 2017. It has subsequently been directed by the UK Government to produce a Clean Air Plan to achieve compliance with air quality objectives in the shortest possible time.

For updates on the progress with the Bristol Clean Air Plan please visit the [Clean Air for Bristol Website]

Bristol Transport Strategy

The Bristol Transport Strategy was adopted in July 2019 sets out a vision on how the city will:

- create an inclusive transport system that provides realistic transport options for everyone;
- create healthy places that promote active transport, improve air quality and improve road safety;
- make better use of our streets to enable more efficient journeys;
- enable more reliable journeys by minimising the negative impact of congestion; and
- support sustainable growth by enabling efficient movement of people and goods, reducing carbon emissions.

One City Plan

The One City approach brings together a wide range of public, private, and third sector partners within Bristol. They share an aim to make Bristol a fair, healthy and sustainable city. A city of hope and aspiration, where everyone can share in its success.

Within the plan there are commitments on air pollution including:

- Making progress towards cleaner air in the fastest time possible by working with city partners on successfully planning the launch of the Clean Air Zone in 2021; and
- A target to achieve WHO Guideline values for air quality by 2030.

One City Climate Strategy

This Strategy provides more detail on the commitment within the One City Plan for Bristol to become carbon neutral by 2030. Many actions aimed at reducing carbon have benefits to air pollution. Within the One City Climate Strategy transport is an area where it has been identified that action is needed with a focus on:

switching to significantly more walking, cycling and zero carbon public transport *modes; converting the remaining vehicles to zero carbon fuels; transforming freight, aviation and shipping.*

Freight Consolidation

As part of the One City Plan, Bristol City Council are aiming for 95% of deliveries within the city centre to be made by electric freight vehicles within the next decade, with consolidation centres at all our main access routes.

In February 2020, the application process began for a £100k grant from Go Ultra Low West, a £7m transport project that provides the infrastructure for large scale conversion to electric and ultra-low emission vehicles in the West of England.

This grant will be spent over a 12-month period and used to set up and run a zero emission freight consolidation centre, or support an existing initiative with the same goal.

No Idling and School Street

In 2020, Bristol City Council were planning to ask drivers to turn their engines off when stopped to help improve air quality citywide, but especially around air pollution and idling hotspots, such as schools and hospitals. By doing so, the aim is to make Bristol a healthier place for everyone. These plans have been impacted by the Covid-19 pandemic and suspended.

School Streets has been introduced by local authorities across the UK. The scheme transforms roads directly outside of schools, removing motor vehicles so that only pedestrians and cyclists can gain access at school start and finish times. From February 2020 a trial of this was started at two schools in the city. Again, this trial has been impacted by the Covid-19 pandemic and suspended.

CLAiR-City

The four-year CLAiR-City project (Citizen-led air pollution reduction in cities), funded through the EU's Horizon 2020 program, features 16 research partners including the pilot cities of Bristol (UK); Amsterdam (NL); Aveiro region (PT); Ljubljana (SI); Sosnowiec (PL) and the Liguria region (IT). The project aimed to create a major shift in public understanding towards the causes of poor air quality – encouraging a focus on people's everyday practices like commuting and shopping rather than technology and top-down approaches. The project developed innovative tools, including a game for smart phones, to generate citizen-led policies to improve air-related health in our cities.

As a partner city Bristol has helped shape the tools being developed through extensive local engagement. Engagement activities reached over 700 people with more than 600 people playing the ClairCity Skylines Game on their phone and over 600 school children have been involved in developing "air pollution solutions"

The work described above allowed identification of a policy package, chosen by citizens of Bristol. The four policy measures identified with most public support were:

- Ban/phase out polluting vehicles;
- Make buses cleaner and greener;
- Cheap public transport; and
- Create alternatives to car use – walking and cycling

When attributing emissions of NOx to travel by motive, across all ages, genders and income brackets, over 50% of NOx emissions come from trips to the shops or leisure activities. This analysis demonstrates that it is as important to make these types of journeys practical by less polluting modes as it is for commuter trips when developing and implementing transport policies.

Travel West and West of England Combined Authority (WECA)

There is a long established collaboration between the three former Avon authorities (now referred to as the West of England authorities). In this regard, the Travel West brand acknowledges the fact that the commuter doesn't think in terms of authority boundaries.

The Joint Local Transport Plan, JTLP 4 was published in March 2020 which sets the West of England Combined Authority (WECA) regions transport vision through to 2036. A greater emphasis than previously is placed on air pollution compared to the superseded JLTP (3). The JLTP 4 document *"shows how we will aim to achieve a well-connected sustainable transport network that works for residents across the region; a network that offers greater, realistic travel choices and makes walking, cycling and public transport the natural way to travel"*

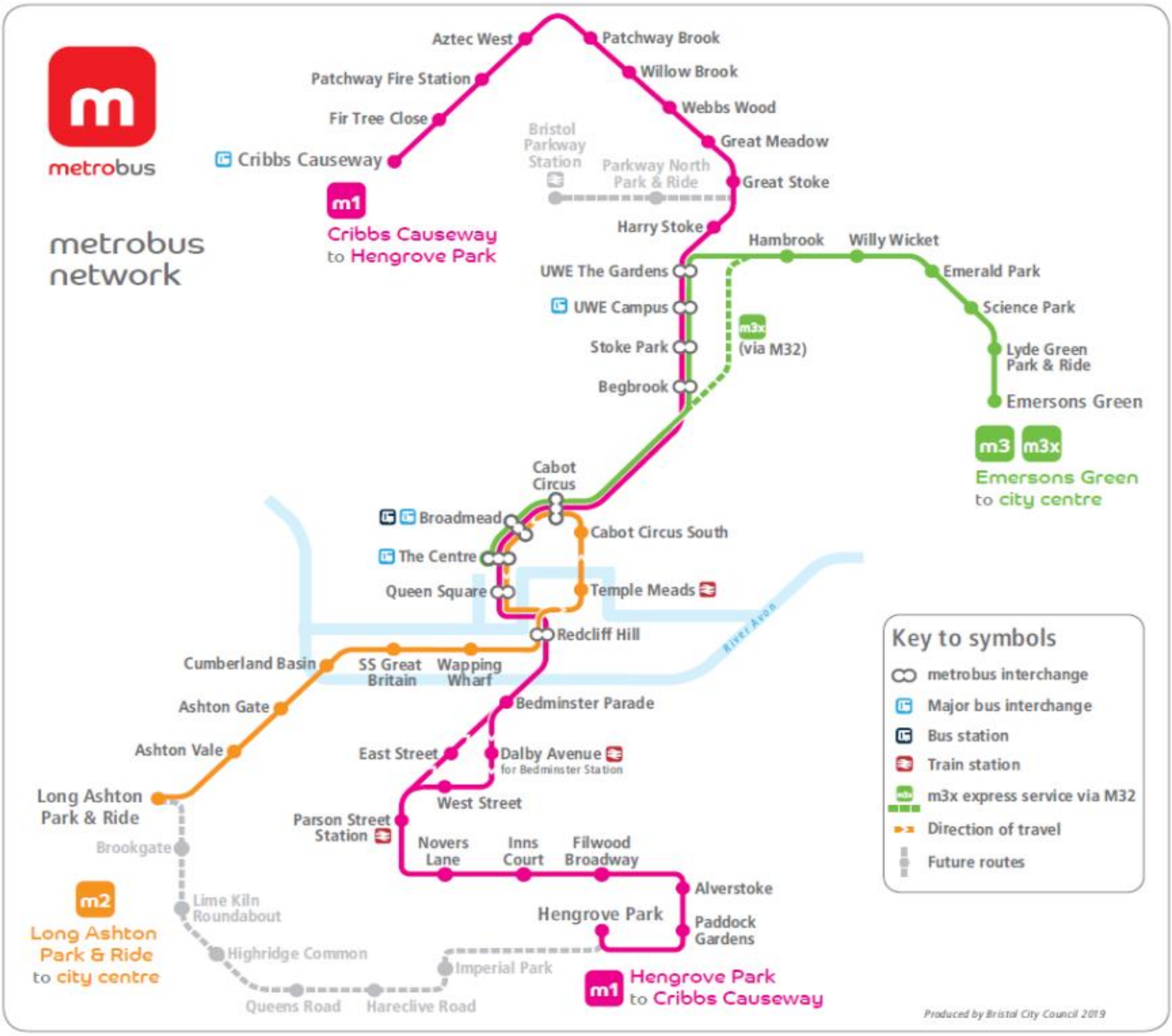
On Wednesday 1st of April 2020 the Bath & North East Somerset, Bristol and South Gloucestershire councils combined resources so the delivery of some operational transport functions is now carried out directly by WECA. Working together in this way means Bristol can achieve more to address our challenges as a region, planning public transport across council boundaries.

A number of activities that have the potential to improve air quality are underway and planned within Bristol and the wider West of England region. These range from major infrastructure projects such as Metro West to engagement in behavioural change initiatives such as work place travel planning.

Metrobus and MetroWest

Metrobus has been designed to link and connect with existing rail and bus services and is part of an integrated approach to travel investment that includes measures to improve cycling and walking, traffic and parking management and improvements to rail via MetroWest. Metrobus services started operation in 2018. Work is continuing throughout 2020 on the planning for Phase 1 of MetroWest – Portishead Branch Line

Figure 0-4 - Metrobus Details



GoUltraLowWest

GoUltraLowWest is an Office for Low Emission Vehicles (OLEV) funded project which has provided grant funding for £7m investment in promotion of electric vehicles through the West of England region.

The main objectives and strategy:

- Double the existing provision of charge points to 400 in total
- Match funded business charge points and business demonstrator cars
- 4 exemplar demonstration charging hubs
- Ultra-Low Emission Vehicle (ULEV) car club bays
- Conversion of 20% of the council fleet to ULEVs (first major BCC fleet purchases took place in 2018)

- Improving air quality

Implementation of this project is being targeted for 2017-2021.

Cycle Ambition Fund

The cycle ambition fund involves a combination of improving existing routes and revitalising streets, addressing barriers to cycling and walking such as busy roads, and overcoming the impact of the cities topography such as crossing rivers and avoiding steep hills enabling Bristol to provide better door-to-door journeys throughout the West of England region.

Local Cycling and Walking Infrastructure Plan (LCWIP)

The Local Cycling and Walking Infrastructure Plan is a detailed plan that identifies that over £400m of investment is needed and will be sought and channelled through the West of England Combined Authority. Working with Bath & North East Somerset, Bristol, North Somerset and South Gloucestershire councils, the aim is to provide high quality infrastructure to ensure the West of England is a region where cycling and walking are the preferred choice for shorter trips. Public consultation on the plan took place in early 2020.

Conclusions and Priorities

Monitoring

Whist the trend of year on year reductions in annual NO_2 concentrations since 2010 has continued into 2019, there are 10 monitoring locations where distance adjusted (representing relevant exposure) annual nitrogen dioxide concentrations are greater than 40µg/m^3. In 2019 an additional 12 sites were at risk of exceedance when considering locations where annual NO_2 concentrations were greater than 37µg/m^3 at locations of relevant exposure.

Particulate Matter (PM_{10}) trends for the past 5 years are only available from one urban background site, Bristol St Pauls, with data from two new roadside sites only being available for the past two years. At Bristol St Pauls annual PM_{10} concentrations have increased since 2015 by 1.1µg/m^3 to 16µg/m^3. 2019 annual concentrations from Temple Way and Colston Avenue were 20.9µg/m^3 and 21.9µg/m^3 respectively.

$PM_{2.5}$ concentrations at Bristol St Pauls have remained relatively stable since 2015 with a slight increase from 10.2µg/m^3 in 2015 to 10.8µg/m^3 in 2019.

The monitoring data indicates that action is needed to achieve compliance with annual NO_2 objectives. It also demonstrates that reductions in $PM_{2.5}$ concentrations are needed in order to meet the WHO guideline concentrations for this pollutant at the St Pauls background site. The failure of particulate pollution (PM_{10}) to fall indicates a need for some action at both a national and local level to reduce PM concentrations. An additional roadside $PM_{2.5}$ monitor at Parson Street School will provide data in 2020.

Measured exceedance of the annual objective was identified at two locations along Muller Road that are outside of the current AQMA boundary, however, once adjusted for distance to the closest relevant exposure, marginal compliance was shown to be achieved. Details of these exceedances are contained within Table C.2. Monitoring in these locations will continue in 2020.

Pollution Reduction Actions

Continued and widespread exceedances of the annual objective for NO_2 have been measured at locations of relevant exposure. The priority for Bristol City Council for the coming year is to agree with the Joint Air Quality Unit a programme of work to achieve compliance with air quality objectives in the shortest time possible. The other initiatives and plans will continue to be taken forward and developed. The impact of Covid-19 on local businesses and the economy could provide an additional challenge to BCC when considering the impacts of developing a plan to achieve compliance in the shortest time possible. In a statement published on the Clean Air for Bristol Website, the Mayor of Bristol stated that:

“Recognising that Covid19 has changed many aspects of life, I wrote to Grant Shapps, the Secretary for Transport, on the 27th March asking for the Government to seek urgent cross government reassessment of our proposed traffic clean air zone.

During this time of crisis, I urged the Government to reconsider timescales for the whole programme during this period of uncertainty. I do not think that now is an appropriate time to directly engage with the business community and people of Bristol on how we develop appropriate mitigations to reduce the impacts CAZ may have for them.

I have suggested, as a pragmatic approach, that we continue with the planning and development work but then stop short of implementing the scheme, and look at the programme implementation times.”

Bristol City Council will consider the conclusions within the reports commissioned on pollution from solid fuel and non-road mobile machinery to identify appropriate next steps to reduce emissions from these sources. All actions are likely to require additional resources to be made available at Bristol City Council at a time when Local Authority budgets nationally are stretched. Both NO_2 and PM pollution will be targeted by potential actions in these reports.

In response to the Covid-19 pandemic Bristol City Council announced plans in May 2020 to assist people to socially distance in certain areas of the city and to make it easier for people to walk and cycle given the reduced passenger capacity on public transport networks. A priority will be to develop and implement these plans which include pavement widening and improved cycling infrastructure in a number of locations around the city and pedestrianisation of the old city centre.

Other Items

Recent events in Bristol linked to the Black Lives Matter protests have resulted in the Mayor of Bristol starting a conversation to decide what to do with our memorials, statues and street names. We will await the outcome of this city conversation before deciding whether to rename any air quality monitoring sites.

Local Engagement and How to get Involved

How Can Pollution Be Reduced? - Transport

There are many different ways in which people can help contribute towards reducing air pollution in Bristol. Air pollution, at locations where we are recording illegal levels of nitrogen dioxide, comes predominantly from emissions from vehicles. By choosing to travel around the city by foot, by bicycle or using public transport, whenever it is possible, people can reduce their personal contribution to air pollution in the city. To find out more information on sustainable transport options throughout the West of England region you can visit the Travel West Website or its sister website Better by Bike.

For those journeys taken by cars, choosing to travel outside of peak times can help. In the longer term, when deciding to replace a car, as a general rule, the following hierarchy can be followed to identify which types of vehicles have the lowest emissions of pollutants which are harmful to health.

- Electric Vehicles
- Petrol hybrid
- Gas or petrol
- Diesel Hybrid
- Diesel

Whilst government vehicle taxation is based on the relative emissions of carbon dioxide (CO_2), this can be misleading to those looking for a vehicle with low emissions of pollutants that are directly harmful to health. Diesel cars have been promoted as being ‘low emission / eco’ vehicles. Whilst these may offer relatively low advertised CO_2 emissions, on average, diesel vehicles are generally worse for air pollutants such as nitrogen dioxide and particulates, which are of greatest concern for local air quality.

Measurement of real-world vehicle emissions have shown that large discrepancies exist between the required vehicle emissions standards, as defined by Euro emissions standards, and the level of pollution emitted under real world driving conditions. The largest discrepancies are related to nitrogen oxides (NO_x) emissions which lead to the formation of NO_2 pollution.

This illustrates why diesel cars continue to present problems to achievement of NO_2 air quality objectives in the city and why older diesel vehicles in particular are contributing significantly to NO_2 pollution. Euro 6 diesels, whilst better than Euro 5 vehicles, are still, on average, considerably worse for NO_X emissions when compared to their petrol or petrol hybrid equivalents.

Some vehicle manufacturers and models perform much better than others with some Euro 6 diesel cars now performing very well in the real world whilst others do not. The Mayor of London launched an online vehicle checker to allow consumers to get the latest data on real world vehicle emissions. The information has been compiled through robust independent emissions tests by a UK based company, Emissions Analytics and the International Council on Clean Transportation (ICCT). Emissions Analytics is a well respect independent vehicle testing company. To check the emissions of a vehicle the online checker can be accessed here.

During the current Covid-19 pandemic the travel restrictions resulted in a significant fall in measured NO_2 concentrations throughout the city. This illustrates that a reduction in emissions in the city can have an immediate positive impact on local air pollution and therefore on public health.

How Can Pollution Be Reduced? - Domestic Heating

It is important to use a wood burner or open fire correctly to ensure that Smoke Control Area regulations are not breached. The whole of Bristol is a smoke control area. This means that, for domestic heating purposes, wood can only be burnt in a Defra approved stove. It is not permitted to burn wood in an open fire in Bristol. Only exempt smokeless fuels are permitted to be burnt in an open fire.

From an air pollution perspective, if a property does not already have a stove or open fireplace, the best option is not to install one. Recent research shows that even the lowest emitting wood burning appliance emits an order of magnitude more particulate matter than a gas oil appliance and two orders of magnitude more than a gas appliance.

The lowest emission stoves currently on the market are those that are ‘Eco-design Ready’. These will meet the future EU standards set to be introduced for all new stoves in the UK in 2022. Within Bristol, as a minimum a wood burning stove should be approved for use within a smoke control area, known as an ‘exempt appliance’.

Whilst the type of solid fuel appliance used is an important factor in determining the level of pollution emitted, the way in which they are used is equally as important. Understanding the right fuels and the right way to use them is explained within guidance issued by Defra which can be found here. The measure outlined for reducing emissions include:

- Choosing the right stove
- Considering burning less
- Buying ‘Ready to Burn’ fuel
- Season freshly chopped wood before use (wood can only be burnt in Bristol within a Defra approved appliance. It is not permitted to burn even seasoned wood in an open fire or an appliance not approved by Defra for use in a smoke control area).
- Do not burn treated waste wood (e.g. old furniture) or household rubbish
- Regularly service and maintain your stove (annually)
- Get your chimney swept regularly (up to twice a year)

In February 2020, Defra published the response to its consultation on “cleaner domestic burning of solid fuels and wood” (Defra, 2018). This has proposed legislation to phase out the sale of traditional house coal over a two year period and to ban the sale of unseasoned or wet wood in volumes of less than $2m^3$. Sale of anthracite (smokeless coal) or manufactured solid fuels will continue, with a requirement that they conform to a standard of no more than 2% sulphur and emit no more than 5g smoke per hour. These standards are considerably higher (in terms of sulphur content and allowed PM emissions) than those for road fuels and vehicle emission standards.

At the same time, the Environment Bill is proceeding through Parliament (HM Government, 2020). This proposes changes to the Clean Air Act 1993 which expand and clarify the application and enforcement of Smoke Control Areas (SCAs). The three key changes are:

- The decriminalisation of SCA offences through the introduction of a series of civil penalty notices which must be issued by the local authority as part of the enforcement process (notice of intent, decision regarding the final notice and/or a final notice);

- The inclusion of non-seagoing vessels, such as canal or house boats, under the SCA provisions (they were previously exempt); and
- The creation of an offence to offer for sale any controlled fuel in England without providing information on their use in SCAs (e.g. that it is an offence to use a controlled fuel in a non-exempt appliance).

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Local Air Quality Management

This report provides an overview of air quality in the area covered by Bristol City Council during 2019. 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 Bristol City Council to improve air quality and any progress that has been made.

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

1 Actions to Improve Air Quality

1.1 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 Bristol City Council can be found in Table 1.1. Further information related to declared AQMAs can be found on the Defra website, including maps of AQMA boundaries. Alternatively, see the open data website, which provides for a map of air quality monitoring locations in relation to the AQMA(s).

Table 1.1 – 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
Bristol AQMA	Declared 01/05/2001. Amended on 01/05/2003 and 01/05/2008 and 26/10/2011	NO_2 Annual Mean	Bristol	An area covering the city centre and parts of the main radial roads including the M32.	YES	N/A	N/A	N/A	N/A	Joint Local Transport Plan 4 Clean Air Zone Plans	March 2020	https://travelwest.info/projects/joint-local-transport-plan https://www.cleanairforbristol.org
Bristol AQMA	Declared 01/05/2001. Amended on 01/05/2003 and 01/05/2008 and 26/10/2011	NO_2 1 Hour Mean	Bristol	An area covering the city centre and parts of the main radial roads including the M32.	YES	N/A	N/A	N/A	N/A	Joint Local Transport Plan 4 Clean Air Zone Plans	March 2020	https://travelwest.info/projects/joint-local-transport-plan https://www.cleanairforbristol.org
Bristol AQMA	Declared 01/05/2001. Amended on 01/05/2003 and 01/05/2008 and 26/10/2011	PM_{10} 24 Hour Mean	Bristol	An area covering the city centre and parts of the main radial roads including the M32.	YES	N/A	N/A	N/A	N/A	Joint Local Transport Plan 4 Clean Air Zone Plans	March 2020	https://travelwest.info/projects/joint-local-transport-plan https://www.cleanairforbristol.org

☒ **Bristol City Council confirm the information on UK-Air regarding their AQMA(s) is up to date**

The monitoring network in Bristol has changed considerably since the declaration of the Air Quality Management Area in 2001. There is an extensive air quality monitoring network throughout the city which provides annual NO_2 data. The monitoring locations in 2019 are not directly comparable to those in 2001 and therefore the comparison between exceedance levels at declaration in 2001 and 2019 would not provide a true reflection of trends in air pollution over that timeframe. For this reason, the corresponding columns in Table 1.1 above have not been completed. Distance adjusted data for all 102 nitrogen dioxide diffusion tube monitoring sites has been provided in Table B.1. An indication of general trends in annual NO_2 values from 2010 are shown in Figure A. 1 to Figure A. 4 and is considered to be more representative of trends in recent years than would be established from looking at data from one worst case site as requested in Table 1.1.

1.2 Progress and Impact of Measures to address Air Quality in Bristol

Defra's appraisal of last year's ASR concluded that:

- It will be important, where relevant, that Clean Air and further Action Plan measures are integrated with future updates to the JLTP, and all relevant Council Policies
- That Defra supported the proposal for additional monitoring along Muller Road, to identify possible exceedances outside the current AQMA
- That it would be useful for pollution hotspots to be clearly identified in future Annual Status Reports

All points raised in the appraisal of the 2019 ASR have been addressed. The revised JLTP4 and other council policies that have been updated have considered the air quality and the public health implications that pollution has. Additional monitoring sites have been added to the monitoring network along Muller Road with results for 2019 reported. Additional information has been provided for the locations in the city where the highest pollution concentrations have been recorded.

Bristol City Council has taken forward a number of direct measures during the current reporting year of 2019 in pursuit of improving local air quality. Details of all measures completed, in progress or planned are set out in Table 1.2.

More detail on these measures can be found in their respective Action Plans and

Strategies, links to which have been provided in the relevant sections of this report.

Key completed measures are:

- Publication of the Joint Local Transport Plan 4 in March 2020
- Adoption of the Bristol Transport Strategy in July 2019

Bristol City Council expects the following measures to be completed over the course of the next reporting year:

- Agreement with the Government's Joint Air Quality Unit on a Clean Air Plan to deliver compliance with air quality objectives in the shortest time possible.

Bristol City Council anticipates that the measures stated above and in Table 1.2 will achieve compliance in the Bristol AQMA in the shortest possible time.

Table 1.2 – Progress on Measures to Improve Air Quality

Measure No.	Measure	EU Category	EU Classification	Date Measure Introduced	Organisations involved	Funding Source	Key Performance Indicator	Reduction in Pollutant / Emission from Measure	Progress to Date	Estimated / Actual Completion Date	Comments / Barriers to implementation
1	Bristol Clean Air Zone	Promoting Low Emission Transport	Low Emission Zone	TBC	BCC	Government	Achieving Compliance within the shortest timeframe possible	To achieve compliance in line with EU regulations in all relevant locations	For latest Developments see https://www.cleanairforbristol.org/	2021	
2	Joint Transport Study and Spatial Plan	Policy Guidance and Development Control	Regional Groups Co-ordinating programmes to develop Area wide Strategies to reduce emissions and improve air quality	N/A	WoE authorities.	LA Funded	Set out a visons and plan for future development in the WoE up until 2036		Consultation in 2015 - 2019	Planning Inspectorate concerns led plan to be from examination on 7th April 2020.	Withdrawn
3	MetroBus BRT scheme	Transport Planning and Infrastructure	Bus route improvements	2018	BCC/S.Glos/NE Somerset.	Government Funding/WECA	Improved bus Services, quicker journey times and more reliable services from both northern and southern city fringes	Encouragement of modal shift through provision of quick reliable bus services.	First 3 routes currently operating. Extension to route being made in S.Glos area to connect Parkway Train station to Cribs Causeway	2022 for extension	
4	Bristol Transport Strategy	Transport Planning and Infrastructure	Other	July 2019	BCC. LA funded		Development and Adoption of Bristol Transport Strategy	Vision of plan is to improve the active travel and public transport offer of the city to allow for the decoupling of growth from increase in cars movements	Document underwent initial internal BCC consultation before moving onto wider stakeholder and public consultation phases in 2018	2019	N/A
5	Local Plan Review	Policy Guidance and Development Control	Air Quality Planning and Policy Guidance	Ongoing	BCC. LA Funded		Development and Adoption of New Local Plan Documents	Adoption of standalone policy for Air Quality and strengthen weight given to air pollution in Local Plan policy documents	Initial internal consultation and development of local plan started mid-2017. Public consultation took place in 2019	Revised programme yet to be published	Support of proposed policy in plan needs to be gained at a local level and also approved by the Planning Inspectorate.
6	OLEV Bus funding	Vehicle Fleet Efficiency	Promoting Low Emission Public Transport	Ongoing	BCC, SGC, First Bus	OLEV	110 Biogas powered buses to be introduced into the first Bus WoE fleet	Buses will be Euro VI and better with regards to emissions of NOx and reduce particulate tailpipe emissions to better than Euro VI.	Implementation Phase	2020	
7	Clean Bus Fund	Vehicle Fleet Efficiency	Promoting Low Emission Public Transport	Ongoing	BC, First Bus, CTPlus	OLEV	81 buses to be retro-fitted from Euro IV/V standard to VI	£2.2m funding to include 69 SCR retrofit and some electric/hybrid replacement	Funding awarded in Feb 2018. Implementation phase	2020	
8	Cycle City Ambition Grant	Promoting Travel Alternatives	Cycling improvements and engagement.		BCC	Govt., BCC	Increased levels of cycling in the city	Yes	Smoothing of cobbles on popular route, Improved crossing in Castle Park, 500 additional bike stands installed, improvement of harbour side bridge and 4 rounds of engagement in Easton to discuss how cycling can be encouraged. Range of other infrastructure improvements around the city.	Ongoing	Plan to implement a number of new developments to improve cycling infrastructure in the city. Details can be found at the travel west website: https://travelwest.info/projects/cycle-ambition-fund/bristol
9	Doubling existing EV charge point network from 200-400 points	Promoting Low Emission Transport	Procuring alternative Refuelling infrastructure to promote Low Emission Vehicles, EV recharging, Gas fuel recharging		WoE LAs	OLEV	Number of public/private charge points (not units)		200 additional charge points across the WoE including rapid charging hubs and on street charging infrastructure. https://travelwest.info/drive/electric-vehicles/go-ultra-low-west	2020/21	Part of Go-Ultra Low OLEV grant funded project
10	Freight Consolidation	Freight and Delivery Management	Freight Consolidation Centre (FCC)		Bristol and Bath plus private company (TBC)	BCC Subsidy, OLEV	Number of businesses signed up. No. of journeys replaced through consolidation	Reducing pollution and congestion in the AQMA is the reason for the operation of the FCC.	Application to Go Ultra Low West to set up a zero emission FCC	2021	
11	Better Bus Area Fund 2	Transport Planning and Infrastructure	Bus Route Improvements		WoE	. DfT and Cycling Ambition Fund 2	Improved services, through reduced journey time and increased reliability on 8 important corridors.	Yes	Informal public consultation took place in autumn 2017.	Ongoing	More detail is available at https://travelwest.info/projects/better-bus-area

Measure No.	Measure	EU Category	EU Classification	Date Measure Introduced	Organisations involved	Funding Source	Key Performance Indicator	Reduction in Pollutant / Emission from Measure	Progress to Date	Estimated / Actual Completion Date	Comments / Barriers to implementation
12	Prioritising purchase of EV vehicles in public sector fleets	Promoting Low Emission Transport	Public Vehicle Procurement - Prioritising uptake of low emission vehicles		WoE. OLEV Grant Funded		100 ULEV vehicles across WoE council fleet - representing 20-25% transfer. Expected that Bristol will procure around 45 EVs (10%) of the fleet.		December 2017 Cabinet Meeting decision to approve purchase of at least 50 EV's for BCC Fleet. In early 2019 there were 22 EV's in the BCC fleet with an additional 21 planned for purchase by 2021.	Ongoing	There have been difficulties with ensuring sufficient on-site charging infrastructure is available to operate the EV fleet.
13	Car Clubs	Alternatives to Private Car Use	Car Clubs		WoE.	Private and LA, EU H2020 - Replicate	160 car clubs cars deployed in Bristol. 50 EV car clubs cars planned by 2021 in WoE area.		120 car club cars currently in use in Bristol. BCC EU H2020 Replicate project. 11 EVs being trialled in 2019.	Ongoing	Expansion of 8 bays in East of Bristol planned for summer 2017. Co-Wheels using EU H2020 Replicate Grant introduced EV Car club vehicles in Ashley, Easton and Lawrence Hill in 2020. Go-Ultra Low OLEV grant to be used to introduce additional EV car club bays.
14	Portbury, Avonmouth and Severnside (PAS)	Promoting Travel Alternatives	Intensive active travel campaign & infrastructure	Ongoing	WECA, SevernNet	LA	Development of a Joint Transport Strategy for the PAS area		Transport Surveys being undertaken and consultation events held in 2020	Ongoing	
15	No Idling	Public Information	Other	Planned for 2020	BCC	BCC	Raising awareness of pollution from idling. Behaviour change	Reduce emissions from idling hotspots and locations where vulnerable are exposed to pollution	Events being organised and champions recruited	Ongoing https://www.cleanairforbristol.org/noidling/	Covid-19 stopped immediate progress on this.
16	School Streets Project	Promoting Travel Alternatives	Other	February 2020 measures rolled out at two schools in the city	BCC	BCC	Reduce traffic outside schools and encouragement of alternative modes of transport	Reduced emissions outside schools and on surrounding roads	February 2020 two schools were to introduce measures, Wansdyke Primary School and St Peter's C of E School	Impact at first two schools to be assessed and further roll out considered.	Impact of Covid-19 means 2020 activity has been suspended.

1.3 $PM_{2.5}$ – 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.

Bristol City Council have identified that the recent focus on NO_2 compliance at both a national and local level through the LAQM process has resulted in there being a lack of in depth knowledge on the scale and sources of primary $PM_{2.5}$ emissions. The clear evidence on health impacts and requirement to work towards reducing $PM_{2.5}$ emissions and/or concentrations has led Bristol City Council to commission studies to develop a more in depth understanding of local emissions of this pollutant. Whilst many actions targeted at reducing emissions of NO_2 will also reduce $PM_{2.5}$ emissions, other potentially significant sources of local primary $PM_{2.5}$ have been identified. The current focus is to better understand primary particulate emissions from solid fuel use and construction non-road mobile machinery (NRMM). These have been chosen as these are sectors over which Bristol City Council could potentially have some local control over and that national data have indicated are potentially significant sources of pollution. As a first step this will allow Bristol City Council to identify any further gaps in understanding and knowledge either at a local or national level and to then identify and develop appropriate policy measures to reduce primary particulate emissions in the city.

Bristol City Council is taking the following measures to address $PM_{2.5}$:

- Development of a Clean Air Compliance plan to tackle nitrogen dioxide pollution and to achieve compliance with annual objectives for NO_2 in the shortest time possible. Whilst the plan is focussed on compliance with nitrogen dioxide objectives, it will have benefits for particulate pollution

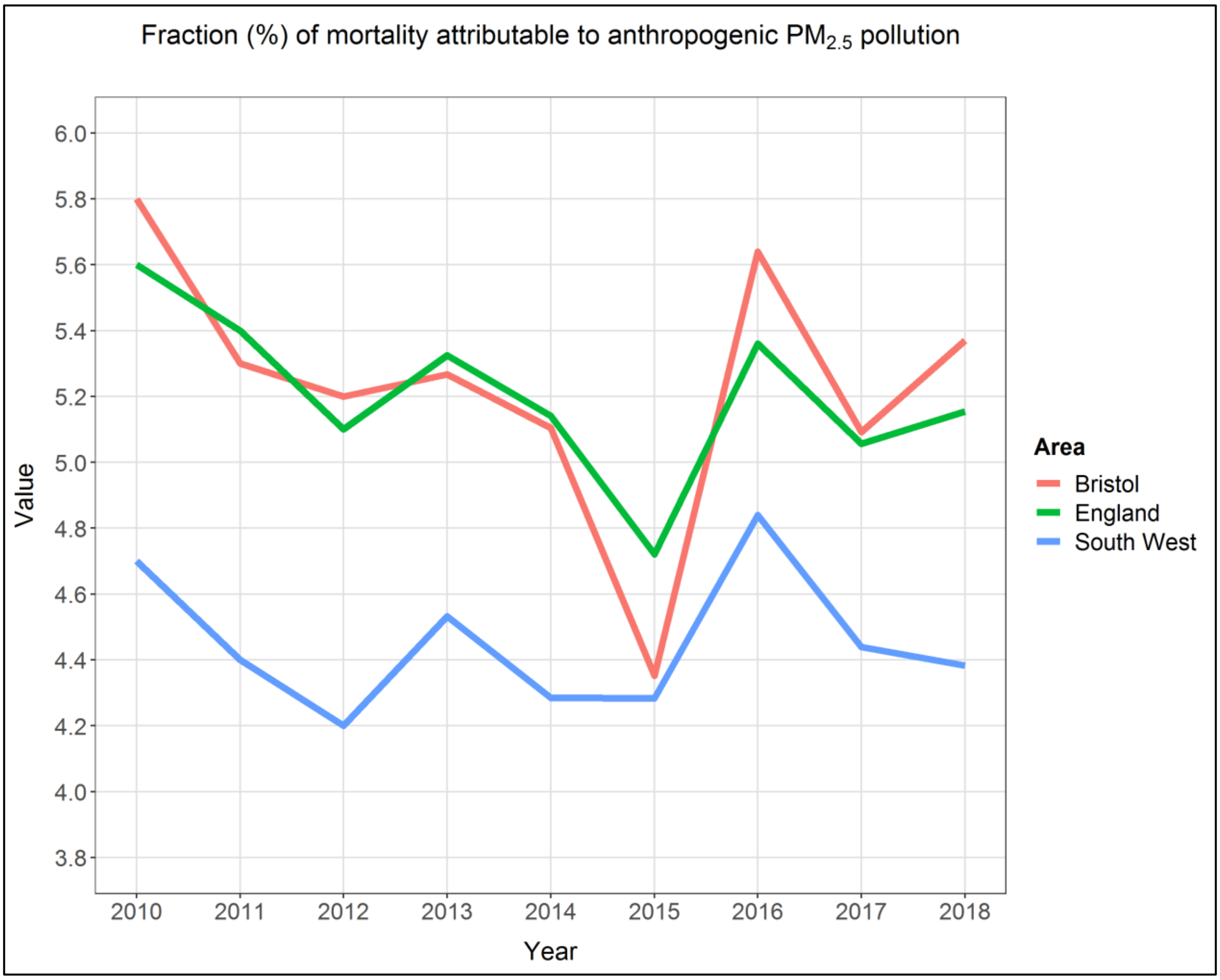
- Commissioning of reports to provide evidence on emissions of particulates in Bristol from solid fuel use and construction NRMM. The outputs will be used to identify policy options or further information requirements in order to proportionately reduce emissions from these sources

- The development of policy and infrastructure to support public and active travel will contribute to reducing particulate pollution
- The projects, as outlined in Table 1.2, that provide investment in cleaner buses and electric vehicles will reduce particulate emissions from transport

1.3.1 Public Health Outcomes Framework Indicator

In 2018, 5.4% of "all-cause adult mortality" in Bristol was considered attributable to "anthropogenic particulate air pollution"[9], which is higher than the national proportion and that for the South West as a whole. Figure 1-1 shows this value since 2010.

Figure 1-1 - Public Health Outcomes Framework Indicator 3.01



[9] Public Health Outcomes Framework, *Source: Background annual average PM2.5 concentrations for the year of interest are modelled on a 1km x 1km grid using an air dispersion model, and calibrated using measured concentrations taken from background sites in Defra's Automatic Urban and Rural Network (http://uk-air.defra.gov.uk/interactive-map.) Data on primary emissions from different sources and a combination of measurement data for secondary inorganic aerosol and models for sources not included in the emission inventory (including re-suspension of dusts) are used to estimate the anthropogenic (human-made) component of these concentrations. By approximating LA boundaries to the 1km by 1km grid, and using census population data, population weighted background PM2.5 concentrations for each lower tier LA are calculated.*

Solid Fuel Use

Appliances that burn solid fuel contribute to local air pollution, and strong evidence[10] exists that their contribution is increasing due to the popularity of solid fuel burning for occasional heating requirements in the winter time.

Recent evidence suggests that the contribution of domestic wood burning in the UK has been underestimated by a factor of 3 in the national emissions inventory[11] making it the largest source of $PM_{2.5}$ emissions in the UK. A 2017 report by Kings College London[12] analysed monitoring data to estimate that on an annual basis, wood burning's contribution to $PM_{2.5}$ ranged from between 6 to 9% averaged across UK urban areas. In London and Birmingham wood burning contributed to between 23% and 31% of the urban derived $PM_{2.5}$. The report concluded that control of wood burning is an important urban issue but that "*it should be remembered that the majority of PM_{10} and $PM_{2.5}$ in urban and rural areas is not from primary emissions. Instead the majority comes from reactions between other gaseous pollutants forming secondary particles."* The new evidence highlights that improvements in local air pollution could be achieved by reducing the contribution of domestic solid fuel burning to $PM_{2.5}$ emissions. The latest National Emissions Inventory Data attributes 38% of $PM_{2.5}$ emissions nationally to domestic solid fuel use whilst only 7% of the population have access to an open fire or stove to burn solid fuel.

The contribution of solid fuel combustion to $PM_{2.5}$ concentrations has been recognised in the Air Quality Strategy which was published by government in early 2019.

The whole of Bristol is a smoke control area. This means that wood can only be burned in a Defra approved stove. Wood cannot be burned in an open fire in Bristol. Only exempt smokeless fuels are permitted to be burnt in an open fire.

Government acknowledged that the current system of enforcement in smoke control areas is not fit for purpose within their 2019 Clean Air Strategy. Changes are proposed to the legislation in the new Environment Bill in order to make enforcement of smoke control regulations easier for Local Authorities.

In February 2020, Defra published the response to its consultation on "cleaner domestic burning of solid fuels and wood". This has proposed legislation to phase out

[10] Air Quality Expert Group (2017), The Potential Air Quality Impacts from Biomass Combustion
[11] Waters, L. 2016. Summary Results of the Domestic Wood Use Survey.
[12] Environmental Research Group – Kings College London, NPL (March 2017) Airborne Particles from Wood Burning in UK Cities

the sale of traditional house coal over a two year period and to ban the sale of unseasoned or wet wood in volumes of less than 2m^3. Sale of anthracite (smokeless coal) or manufactured solid fuels will continue, with a requirement that they conform to a standard of no more than 2% sulphur and emit no more than 5g smoke per hour.

At the same time, the Environment Bill is proceeding through Parliament (HM Government, 2020). This proposes changes to the Clean Air Act 1993 which expand and clarify the application and enforcement of Smoke Control Areas (SCAs). The three key changes are:

- The decriminalisation of SCA offences through the introduction of a series of civil penalty notices which must be issued by the local authority as part of the enforcement process (notice of intent, decision regarding the final notice and/or a final notice);
- The inclusion of non-seagoing vessels, such as canal or house boats, under the SCA provisions (they were previously exempt); and
- The creation of an offence to offer for sale any controlled fuel in England without providing information on their use in SCAs (e.g. that it is an offence to use a controlled fuel in a non-exempt appliance).

Non-Road Mobile Machinery

In the Governments 2019 Clean Air Strategy it was stated that Non-Road Mobile Machinery (NRMM) accounted for 15% of all diesel use in the UK, often in urban areas and therefore it potentially has a significant impact upon local air quality. Information on emissions from this type of use is limited at both a national and local scale and Bristol City Council has commissioned analysis to develop an understanding of this pollutant source in the city.

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

2.1 Summary of Monitoring Undertaken

2.1.1 Automatic Monitoring Sites

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

Bristol City Council undertook automatic (continuous) monitoring at 6 sites during 2019. Table A.1 in Appendix A shows the details of the sites. The $PM_{2.5}$ monitor at Parson Street was installed in late 2019. Annual data will not be available at this site until the end of 2020. In addition to the BCC automatic network, Defra operate an urban background monitoring site at Bristol St Paul's and a PM_{10} monitor at the same location as BCCs Temple Way NOx analyser. National monitoring results are available on the Defra website. Local monitoring data has been made available on the council's open data air quality dashboard.

Maps showing the location of the monitoring sites are provided in Appendix D. Further details on how the monitors are calibrated and how the data has been adjusted are included in Appendix C.

2.1.2 Non-Automatic Monitoring Sites

Bristol City Council undertook non- automatic (passive) monitoring of NO_2 at 102 sites during 2019. Table A.2 in Appendix A shows the details of the sites.

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

2.2 Individual Pollutants

The air quality monitoring results presented in this section are, where relevant, adjusted for bias[13] and "annualisation" (where the data capture falls below 75%). Further details on adjustments and results are provided in Appendix C with distance adjusted results reported in Appendix B.

2.2.1 Nitrogen Dioxide (NO_2)

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

[13] https://laqm.defra.gov.uk/bias-adjustment-factors/bias-adjustment.html

with distance adjustment).

For diffusion tubes, the full 2019 dataset of monthly mean values is provided in Appendix B. Note that the concentration data presented in Table B1. includes distance corrected values, only where relevant.

Table A.4 in Appendix A compares the ratified continuous monitored NO_2 hourly mean concentrations for the past 5 years with the air quality objective of 200µg/m^3, not to be exceeded more than 18 times per year.

Data capture rates at 5 out of the 7 automatic NO_2 monitoring sites were above the required 90% rate, with the lowest capture rate of 79% being recorded at the Fishponds Road site. This lower data collection rate is due to an ongoing analyser fault with a new analyser that it has proven difficult to rectify. The problem started in early 2019 and is still causing some data losses in 2020 and it is likely that data collection rates for 2020 will also be impacted by this issue. The other site to fall below 90% data collecetion was the Defra AURN St Pauls site at 85%.

The continuous monitoring data in 2019 shows a reduction in measured annual NO_2 concentrations when compared to 2018 data at all sites. The Parson Street roadside site saw the largest decrease of -6.7µg/m^3 when comparing 2019 with 2018 concentrations. The second biggest fall was observed at Temple Way with a decrease of -5.1µg/m^3 in 2019 when compared to 2018. Colston Avenue was the only automatic sites to record exceedances of the annual objective for NO_2. 2019 was the first full year of monitoring at the new Colston Avenue site. Annual NO_2 concentrations in 2019 were 65.9µg/m^3, which is considerably higher than the 40µg/m^3 objective. Annual concentrations of NO_2 were close to exceeding objectives at both Fishponds and Temple Way, with annual values of 39.5µg/m^3 and 39.2µg/m^3 respectively, in 2019.

When considering trends at automatic sites since 2015, the two urban background sites of Brislington Depot and St Pauls have seen reductions in annual NO_2 concentrations over this period of -6.2µg/m^3 and -2.9µg/m^3 respectively. The trend at roadside sites has been one of falling NO_2 concentration over this period with the largest reduction of -11.9µg/m^3 being recorded at Parsons Street, However, concntrations at Fishponds Road have been stable with only a -0.2µg/m^3 reduction during this period. This highlights that there are differences in the way that pollution concentrations have changed over the city during this timeframe.

Colston Avenue was the only site at which an hourly value greater than the 200 µg/m^3 hourly objective was measured in 2019, with 8 hours recorded. This is close to being half of the permitted 18 hours of exceedence allowed each year at any one location.

Taking an average of all diffusion tube sites for which there is data since 2015 (78 in total) there has been an average of an 8.7µg/m^3 reduction in annual NO_2 values over the period 2015-2019. When looking at the difference between 2019 data compared to 2018 at the 85 sites with data for both years, the average reduction in NO_2 concentrations was an average of a 6.6 µg/m^3 reduction. These monitoring sites are kerbside or roadside sites with the exception of two urban background sites.

Consideration of trends in NO_2 concentrations at a selection of kerb/roadside sites on the busiest road corridors throughout Bristol, since 2010, show that a similar pattern is observed in all parts of the city. Monitoring has shown consistent exceedence of the annual objectives for NO_2 at many locations but with a consistent reduction in concentrations of NO_2 over this period. Some sites have seen larger reductions than others over this period. Trends in various parts of the city from 2010 to 2020 are shown in Appendix A: Monitoring Results..

Figure 2-1 and Figure 2-2 show nitrogen dioxide diffusion tube monitoring locations in Bristol. Those sites shown in red or purple indicate locations where exceedence of the annual objective was measured in 2019. The data has been annualised but not distance adjusted in these maps.

All our air pollution monitoring data is available on our open data portal through an ‘Air Quality Dashboard’ which can be viewed here.

Figure 2-1 - Nitrogen Dioxide Monitoring Results 2019 – Central Area

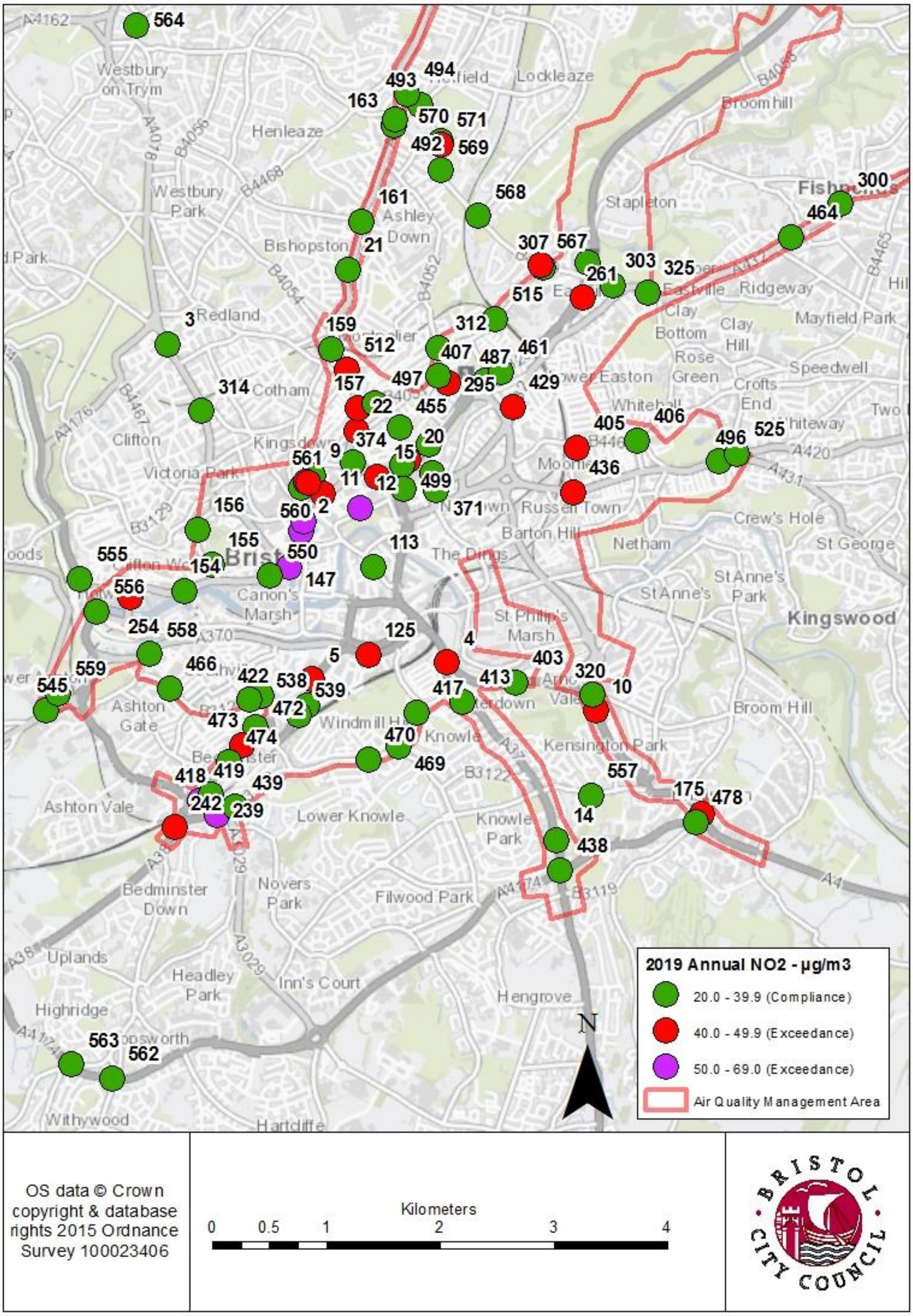
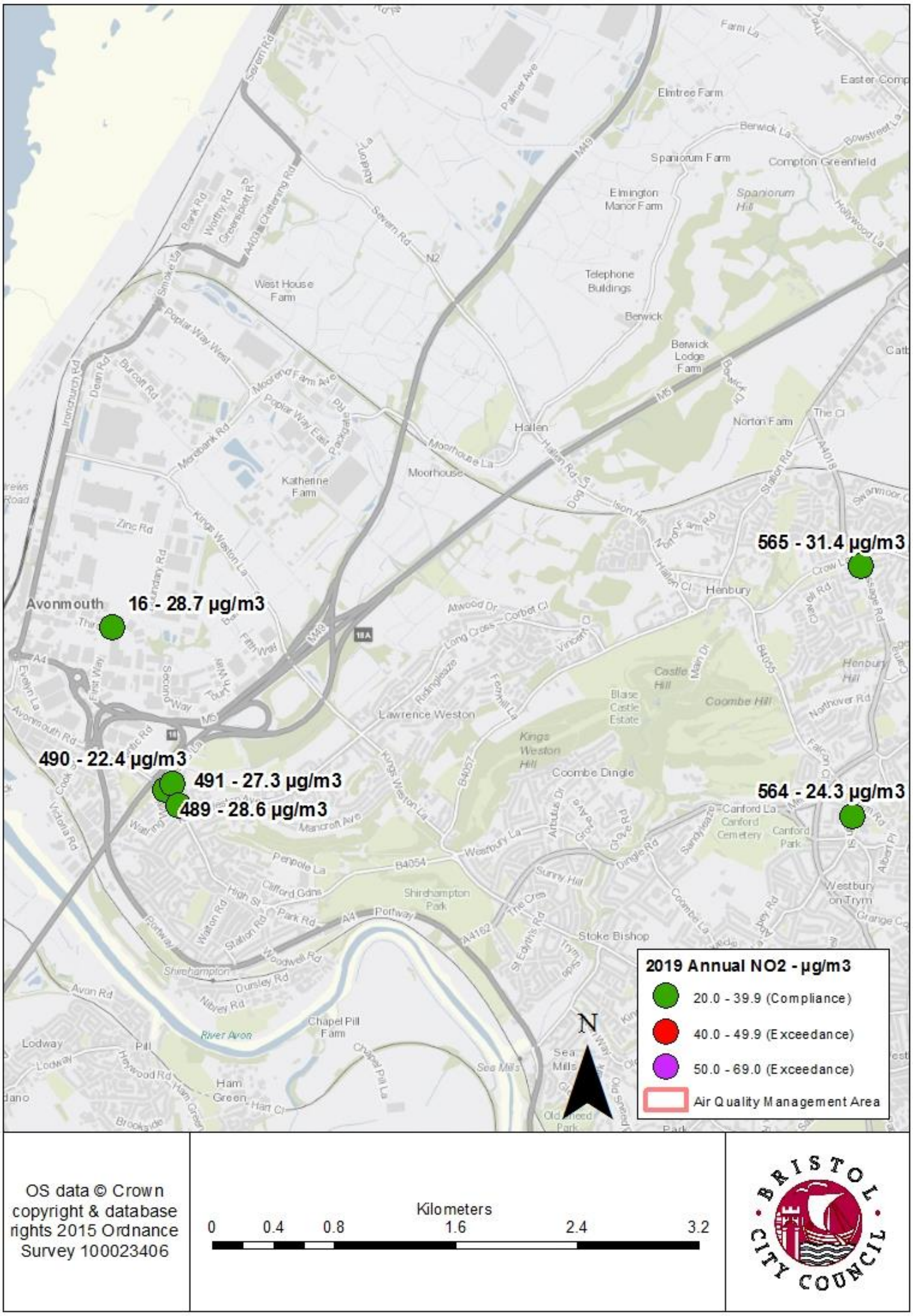


Figure 2-2 - Nitrogen Dioxide Monitoring Results 2019 – Avonmouth



2.2.2 Particulate Matter (PM_{10})

Table A.5 in Appendix A compares the ratified and adjusted monitored PM_{10} annual mean concentrations for the past 5 years with the air quality objective of 40µg/m^3.

Table A.6 in Appendix A compares the ratified continuous monitored PM_{10} daily mean concentrations for the past 5 years with the air quality objective of 50µg/m^3, not to be exceeded more than 35 times per year.

PM_{10} was monitored at three locations throughout in 2019, one urban background site and two roadside sites.

There are no exceedances of the annual mean or hourly mean objectives at any of the monitoring sites. Data for 2019 at the St Pauls urban background site shows a 0.1µg/m^3 increase in annual concentrations to 16.0µg/m^3 in 2019 compared to 2018 and this is the second year in a row which has seen an increase. The 2019 annual concentration is higher than all years back to 2015. The trend of 24hr concentrations is one that conversely shows a decrease over this period. As was the case in 2018 there were no 24-hr periods averaging above above 50µg/m^3 in 2019. It should be noted that date collection rates for the Bristol St Paul's site was 84.7% and does not meet the target of 90%.

Data for 2019 from the Temple Way and Colston Avenue sites did not show any exceedence of objectives and recorded annual PM_{10} concentrations of 20.9µg/m^3 and 21.9µg/m^3 respectively. As would be expected, measured PM_{10} concentrations are higher at these roadside sites than the AURN urban background site. The data from Temple Way shows a reduction of 1.7µg/m^3 in 2019 when compared to 2018. Despite the reduction in annual concentrations, there were 10 days of the year when the 24 hour average was above the 50 µg/m^3 in 2019 compared to 4 in 2018. 5 days above this level were recorded at Colston Avenue in 2019. At all sites the number of days exceeding the 24 hour average of 50µg/m^3 were below the 35 days per year which are allowed to exceed this average value before breach of the air quality objective occurs.

Although no exceedances are reported from the monitoring data it is proposed that the AQMA declaration for PM_{10} is retained as a precautionary measure.

2.2.3 Particulate Matter ($PM_{2.5}$)

Table A.7 in Appendix A presents the ratified and adjusted monitored $PM_{2.5}$ annual mean concentrations for the past 5 years.

$PM_{2.5}$ is measured at the Bristol St Pauls AURN site. The annual average for this pollutant in 2019 was 10.8µg/m^3 which is below the UK annual objective of 25µg/m^3 but above the World Health Organisations (WHO) air quality guideline value of 10µg/m^3. This is a decrease of 1.2µg/m^3 when compared to the 2018 annual average of 12µg/m^3.

Between 2011 and 2019 $PM_{2.5}$ concentrations have fallen at this site by 26%. Since 2015 annual $PM_{2.5}$ concentrations have fluctuated between 9.7 µg/m^3 and 12.0µg/m^3. Rather than displaying a clear trend of rising or falling it has fluctuated up and down within this range over the most recent 5 year period.

Appendix A: Monitoring Results

Table A.1 - Details of Automatic Monitoring Sites

Site ID	Site Name	Site Type	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Pollutants Monitored	In AQMA?	Monitoring Technique	Distance to Relevant Exposure (m) (1)	Distance to kerb of nearest road (m) (2)	Inlet Height (m)
203	Brislington Depot	Urban background	361178	171566	NOX NO2 NO	FALSE	Chemiluminescent	NA	18	3.5
215	Parson Street School	Roadside	358042	170582	NOX NO2 NO PM2.5	TRUE	Chemiluminescent / BAM	0	4	1.5
270	Wells Road	Roadside	360903	170024	NOX NO2 NO	TRUE	Chemiluminescent	9	1	1.5
452	AURN St Pauls	Urban background	359488	173924	NOX NO2 NO PM2.5 PM10 O3	TRUE	Chemiluminescent / BAM	NA	NA	4
463	Fishponds Road	Roadside	362926	175590	NOX NO2 NO	TRUE	Chemiluminescent	0	3	1.5
500	Temple Way	Roadside	359522	173381	NOX NO2 NO PM10	TRUE	Chemiluminescent / BAM	0	5	1.5
501	Colston Avenue	Roadside	358640	173090	NOX NO2 NO PM10	TRUE	Chemiluminescent / BAM	3	2	1.5

Notes:

(1) 0m if the monitoring site is at a location of exposure (e.g. installed on the façade of a residential property). NA if not possible to calculate relevant exposure

(2) N/A if not appropriate to adjust to nearest kerb.

Table A.2 – Details of Non-Automatic Monitoring Sites

Site ID	Site Name	Site Type	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	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)
2	Colston Avenue	Roadside	358628	173011	NO2	TRUE	NA	1	FALSE	2.8
3	Blackboy Hill	Roadside	357448	174650	NO2	FALSE	0	3	FALSE	2.8
4	Three Lamps	Roadside	359903	171850	NO2	TRUE	NA	3	FALSE	3.2
5	Bedminster Parade	Roadside	358723	171704	NO2	TRUE	0	1	FALSE	3.2
9	B.R.I.	Roadside	358729	173499	NO2	TRUE	0	1	FALSE	2.4
10	Bath Road	Roadside	361217	171429	NO2	TRUE	5	4	FALSE	3.2
11	Whitefriars	Roadside	358813	173342	NO2	TRUE	NA	5	FALSE	3.2
12	Galleries	Roadside	359142	173211	NO2	TRUE	NA	1	FALSE	2.4
14	Red Lion Knowle	Roadside	360871	170291	NO2	TRUE	6	2	FALSE	3.2
15	Horsefair	Roadside	359294	173485	NO2	TRUE	NA	2	FALSE	2.2
16	Third Way	Roadside	352287	178698	NO2	FALSE	NA	2	FALSE	2.7
20	Newfoundland Way	Roadside	359567	173630	NO2	TRUE	NA	3	FALSE	2
21	Gloucester Road	Roadside	359035	175306	NO2	TRUE	3	2	FALSE	2.8
22	Stokes Croft	Roadside	359109	173886	NO2	TRUE	0	2	FALSE	2.5
113	Victoria Street	Roadside	359258	172696	NO2	TRUE	2	3	FALSE	2.8

Site ID	Site Name	Site Type	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	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)
125	York Road	Roadside	359214	171917	NO2	TRUE	3	2	FALSE	1.8
147	Anchor Road	Roadside	358514	172691	NO2	TRUE	NA	1	FALSE	2.2
154	Hotwells Road	Roadside	357601	172483	NO2	TRUE	NA	1	FALSE	2.4
155	Jacobs Wells Road South	Roadside	357838	172713	NO2	TRUE	NA	2	FALSE	3.2
156	Jacobs Wells road opp Clifton hill	Roadside	357709	173018	NO2	TRUE	0	2	FALSE	2.5
157	Stokes Croft Ashley Road	Roadside	359119	174090	NO2	TRUE	0	2	FALSE	2.4
159	Cromwell Road	Roadside	358891	174608	NO2	TRUE	4	2	FALSE	2.5
161	Bishop Road	Roadside	359152	175733	NO2	TRUE	4	2	FALSE	2.2
163	Strathmore Road	Roadside	359435	176574	NO2	TRUE	7	3	FALSE	3.6
175	top of Brislington Hill	Roadside	362147	170525	NO2	TRUE	13	2	FALSE	3.2
239	Parson St. A38 East	Roadside	357880	170506	NO2	TRUE	8.3	0.7	FALSE	3.2
242	Parson Street Bedminster Down Road	Roadside	357510	170401	NO2	TRUE	5	0.5	FALSE	3.2
254	Merchants Road Hotwells	Roadside	357118	172429	NO2	TRUE	3.7	0.8	FALSE	2.6
260	Stapleton Road South	Roadside	361140	175366	NO2	TRUE	1.5	3.5	FALSE	2.4
261	Stapleton Road Heath Street	Roadside	361103	175059	NO2	TRUE	5	3	FALSE	2.1

Site ID	Site Name	Site Type	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	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)
295	Lamppost 16 Ashley Road St. Pauls	Roadside	359913	174315	NO2	TRUE	0	2	FALSE	2.8
300	Facade Haart Estate Agents 755 Fishponds Road Fishponds	Roadside	363365	175883	NO2	TRUE	2	1	FALSE	2.4
303	Facade 784 Muller Road Fishponds	Roadside	361368	175170	NO2	TRUE	0	6	FALSE	2.2
307	Lamppost Glenfrome Road \ Muller Road Horfield	Roadside	360747	175328	NO2	TRUE	3	2	FALSE	2.2
312	Lamppost Ashley Hill St. Pauls	Roadside	359832	174616	NO2	TRUE	4	2	FALSE	2.7
314	Lamppost Whiteladies Road \ Cotham Hill Clifton	Roadside	357751	174063	NO2	FALSE	2	1	FALSE	2.4
320	Monitor Bath Road Brislington	Roadside	361180	171567	NO2	TRUE	NA	18	TRUE	6
325	Facade 258 Fishponds Road Fishponds	Roadside	361667	175103	NO2	TRUE	0	8	FALSE	2.4
363	5102 façade	Roadside	359075	173613	NO2	TRUE	0	3	FALSE	2.7
370	Great George Street lamppost	Roadside	359775	173513	NO2	TRUE	0	2	FALSE	2.5

Site ID	Site Name	Site Type	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	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)
371	Lamb Street façade	Roadside	359813	173373	NO2	TRUE	14	1	FALSE	2.6
373	123 Newfoundland Street façade	Roadside	359747	173774	NO2	TRUE	0	17	FALSE	2.1
374	St. Paul Street	Roadside	359509	173595	NO2	TRUE	0	8	FALSE	2.3
403	Lamp post 48 230 Bath Road	Roadside	360508	171676	NO2	TRUE	0	2	FALSE	2.8
405	Whitehall Rd/Easton Rd lamppost 4TZ	Roadside	361051	173743	NO2	TRUE	1	1	FALSE	2.5
406	Whitehall Rd lamppost 17 nr junction with Chalks Rd	Roadside	361576	173806	NO2	TRUE	0	2	FALSE	2.3
407	lamppost sussex place	Roadside	359829	174370	NO2	TRUE	6.7	1.8	FALSE	3.2
413	Wells Rd bus lane sign just below junction with Knowle Rd	Roadside	360043	171508	NO2	TRUE	4	3	FALSE	3.2
417	St John's Lane No 26 lamppost 15 (just past roundabout)	Roadside	359635	171413	NO2	TRUE	0	1	FALSE	3.2
418	Bedminster Down Rd lamppost between Ashton	Roadside	357737	170642	NO2	TRUE	0	2	FALSE	2.8

Site ID	Site Name	Site Type	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	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)
	Motors & Plough PH									
419	Parson St lamppost outside Bristol Scuba	Roadside	357832	170686	NO2	TRUE	4	0.5	FALSE	2.8
420	North St/Dean Lane on roundabout sign	Roadside	358277	171562	NO2	TRUE	1	1	FALSE	2.8
422	North St/Langton Park T junction	Roadside	358168	171525	NO2	TRUE	0	1	FALSE	2.4
423	facade BRI children's	Roadside	358623	173386	NO2	TRUE	0	13	FALSE	2
429	facade villiers road stapleton road junction	Roadside	360484	174097	NO2	TRUE	0	6	FALSE	2.6
436	Shiners Garage	Roadside	361013	173352	NO2	TRUE	0	3	FALSE	2.5
438	A37 Junction w/ Airport Road	Kerbside	360903	170024	NO2	TRUE	9	1	TRUE	2.4
439	Parson Street School	Roadside	358042	170582	NO2	TRUE	0	4	TRUE	1.5
455	St. Pauls Day Nursery	Urban background	359487	173924	NO2	TRUE	NA	NA	TRUE	2.8
461	Millpond School Fence	Roadside	360381	174405	NO2	TRUE	0	14	FALSE	1.7
464	Fishponds Road	Roadside	362927	175592	NO2	TRUE	0	3	TRUE	3
466	Savanna coffee drainpipe	Roadside	357466	171622	NO2	TRUE	0	2	FALSE	2.4
469	Lamppost corner	Roadside	359479	171114	NO2	TRUE	3	1	FALSE	2.8

Site ID	Site Name	Site Type	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	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)
	park avenue									
470	Victoria Park Primary	Roadside	359213	170997	NO2	TRUE	10	3	FALSE	3.2
472	Jamiesons Autos	Roadside	358226	171284	NO2	TRUE	0	4	FALSE	2.4
473	B&G Snax West St	Roadside	358105	171124	NO2	TRUE	0	2	FALSE	2.8
474	Martial Arts West Street	Roadside	357991	170979	NO2	TRUE	0	2	FALSE	2.4
478	T shirt Shop W. Town Lane	Roadside	362091	170447	NO2	TRUE	0	5	FALSE	2.8
487	Junction 3 Millpond Street	Kerbside	360243	174327	NO2	TRUE	4	5	FALSE	2
489	Avonmouth Road Outside No 12	Roadside	352634	177629	NO2	FALSE	3	5	FALSE	2
490	Avon School Barrack's Lane	Roadside	352683	177670	NO2	FALSE	NA	4	FALSE	2.8
491	Avonmouth Road Outside No 76	Roadside	352722	177525	NO2	FALSE	2	4	FALSE	2.6
492	On 1 way sign at bottom of Wellington Hill	Roadside	359445	176627	NO2	TRUE	10	3	FALSE	2.8
493	No 67 Filton Avenue on wall facing Muller Rd	Roadside	359677	176758	NO2	FALSE	0	2	FALSE	2.3
494	Muller Road - Adjacent to	Roadside	359558	176850	NO2	FALSE	5.5	0.5	FALSE	2.1

Site ID	Site Name	Site Type	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	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)
	Darnley Avenue									
496	385 Church Road Redfield	Roadside	362296	173620	NO2	TRUE	0	3	FALSE	2.3
497	20 Ashley Road	Roadside	359268	174132	NO2	TRUE	4	1	FALSE	2.3
499	Temple Way Nox site	Roadside	359522	173381	NO2	TRUE	0	5	TRUE	1.5
502	Co-located Colston Ave	Roadside	358640	173090	NO2	TRUE	3	2	TRUE	1.5
512	Colston girls	Roadside	359026	174432	NO2	TRUE	2	3	FALSE	2
515	St. Werburghs park nursery	Roadside	360333	174871	NO2	TRUE	2	3	FALSE	2
525	Summer hill a420	Roadside	362455	173687	NO2	TRUE	0	1	FALSE	2
538	Dalby avenue	Roadside	358681	171478	NO2	TRUE	NA	NA	FALSE	2
539	Dalby avenue church lane	Roadside	358599	171391	NO2	TRUE	2	2	FALSE	2
545	Ashton park school	Urban background	356379	171436	NO2	TRUE	NA	NA	FALSE	2
550	Cathedral School	Roadside	358353	172613	NO2	TRUE	0	9	FALSE	2
555	420 Hotwell Road A4	Roadside	356679	172589	NO2	TRUE	2	3	FALSE	2
556	South Eastern stair access Plimsoll Bridge	Kerbside	356827	172303	NO2	TRUE	NA	NA	FALSE	2
557	Talbot Road 20mph lamppost	Roadside	361171	170685	NO2	FALSE	7	1	FALSE	2

Site ID	Site Name	Site Type	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	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)
558	Coronation Road Walter Street No Entry	Roadside	357294	171926	NO2	TRUE	1	2	FALSE	2
559	Except local buses sign Blackmoors Lane	Roadside	356485	171580	NO2	TRUE	8	2	FALSE	2
560	Lamppost outside BRI CAZ	Roadside	358665	173439	NO2	TRUE	2	2.5	FALSE	2
561	Lamppost opposite BRI CAZ	Roadside	358688	173431	NO2	TRUE	3	5	FALSE	2
562	Lamp post near Queens Head pub South Bristol link	Roadside	356960	168194	NO2	FALSE	9	1	FALSE	2
563	Lamp post at junction with Highridge rd. near Cox brothers garage. South Bristol link.	Roadside	356606	168316	NO2	FALSE	4	2	FALSE	2
564	Westbury on Trym High Street Lamp post by Athena restaurant	Roadside	357173	177453	NO2	FALSE	1	1	FALSE	2

Site ID	Site Name	Site Type	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	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)
565	A4018 Lamp post by layby before roundabout for Crow Ln/ Knowle Ln	Roadside	357227	179101	NO2	FALSE	0	1	FALSE	2
567	Muller road/ Glenfrome road junction north	Roadside	360728	175345	NO2	FALSE	1.5	1.5	FALSE	2
568	Traffic light on the corner of Shaldon road	Roadside	360178	175779	NO2	FALSE	3.5	0.5	FALSE	2
569	Lamppost on North corner of Draycott road junction with Muller road.	Roadside	359855	176186	NO2	FALSE	2	2.5	FALSE	2
570	Muller road junction with Downend road lamppost north of the junction.	Roadside	359847	176439	NO2	FALSE	2.6	0.4	FALSE	2
571	Muller road junction with Downend road traffic light to the south of the junction.	Roadside	359848	176411	NO2	FALSE	5.5	1	FALSE	2

Notes:

(1) 0m if the monitoring site is at a location of exposure (e.g. installed on the façade of a residential property). NA if not possible to calculate relevant exposure

(2) N/A if not appropriate to adjust to nearest kerb.

Table A.3 – Annual Mean NO_2 Monitoring Results

Site ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Site Type	Monitoring Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2019 (%) (2)	NO_2 Annual Mean Concentration ($\mu g/m^3$) (3) (4)				
							2015	2016	2017	2018	2019
203	361178	171566	Urban background	Automatic	94.2	94.2	31.4	28	29.5	25.4	25.2
215	358042	170582	Roadside	Automatic	99.2	99.2	**44.2**	**46.2**	**41.1**	39	32.3
270	360903	170024	Roadside	Automatic	98.3	98.3	39.3	**41.5**	39	33	29.7
452	359488	173924	Urban background	Automatic	85.2	85.2	26.3	27.4	23.7	23.8	23.4
463	362926	175590	Roadside	Automatic	79.4	79.4	39.7	**42.7**	39.1	**41.5**	39.5
500	359522	173381	Roadside	Automatic	99.6	99.6			37.8	**44.3**	39.2
501	358640	173090	Roadside	Automatic	98.5	98.5				**<u>67.2</u>**	**<u>65.5</u>**
2	358628	173011	Roadside	Diffusion Tube	93	93	**<u>69.2</u>**	**<u>66.1</u>**	**<u>63.1</u>**	**58.2**	**53.7**
3	357448	174650	Roadside	Diffusion Tube	100	100	37.9	37.6	34.4	34.4	27.7
4	359903	171850	Roadside	Diffusion Tube	100	100	**53.3**	**55.2**	**52.7**	**53.5**	**41**
5	358723	171704	Roadside	Diffusion Tube	100	100	**50.9**	**51.3**	**45.8**	**45.8**	39.9

Site ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Site Type	Monitoring Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2019 (%) (2)	NO_2 Annual Mean Concentration (µg/m^3) (3) (4)				
							2015	2016	2017	2018	2019
9	358729	173499	Roadside	Diffusion Tube	93	93	**48**	**48.8**	**46.5**	**44.6**	37.8
10	361217	171429	Roadside	Diffusion Tube	100	100	**49.3**	**54.5**	**51.6**	**51.5**	**42.2**
11	358813	173342	Roadside	Diffusion Tube	100	100	**51.4**	**51.7**	**49.1**	**48.1**	**41.1**
12	359142	173211	Roadside	Diffusion Tube	100	100	**52.5**	**52.8**	**56.6**	**57.5**	**51.8**
14	360871	170291	Roadside	Diffusion Tube	65	65	**40.1**	**42.3**	**41.1**	**47.6**	38.7
15	359294	173485	Roadside	Diffusion Tube	93	93	**50.8**	**51.2**	**49.4**	**47.5**	**42.2**
16	352287	178698	Roadside	Diffusion Tube	100	100	35.9	35.7	35.2	32.6	28.7
20	359567	173630	Roadside	Diffusion Tube	93	93	**58.7**	**55.5**	**<u>61.1</u>**	**50**	**42.4**
21	359035	175306	Roadside	Diffusion Tube	85	85	**51.6**	**50.2**	**49.3**	**46.4**	38.3
22	359109	173886	Roadside	Diffusion Tube	93	93	**49.7**	**54.4**	**52.5**	**51**	**44.3**
113	359258	172696	Roadside	Diffusion Tube	100	100	**47.5**	**45.5**	**49.9**	**40.5**	37.4
125	359214	171917	Roadside	Diffusion Tube	100	100	**52.9**	**52.9**	**56**	**50.3**	**45.2**
147	358514	172691	Roadside	Diffusion Tube	82	82	**<u>60.1</u>**	**56.9**	**<u>61.5</u>**	**56.6**	**50.9**
154	357601	172483	Roadside	Diffusion	100	100	37.2	39.6	38.5	36.1	30

Site ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Site Type	Monitoring Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2019 (%) (2)	NO_2 Annual Mean Concentration (µg/m³) (3) (4)				
							2015	2016	2017	2018	2019
				Tube							
155	357838	172713	Roadside	Diffusion Tube	100	100	39.9	**43.1**	37.9	**40**	31.1
156	357709	173018	Roadside	Diffusion Tube	100	100	38.9	**41.2**	39.3	36.2	30.5
157	359119	174090	Roadside	Diffusion Tube	92	92	**53.3**	**52.8**	**48.5**	**45.4**	**43.1**
159	358891	174608	Roadside	Diffusion Tube	100	100	**44.1**	**44.8**	**42**	**43.2**	35.8
161	359152	175733	Roadside	Diffusion Tube	84	84	**43.7**	**41.6**	38.8	38	31.7
163	359435	176574	Roadside	Diffusion Tube	100	100	37	39.6	38	36.6	30.8
175	362147	170525	Roadside	Diffusion Tube	100	100	**52.9**	**56.5**	**54**	**54.9**	**44.6**
239	357880	170506	Roadside	Diffusion Tube	100	100	**69.2**	**68.9**	**66.8**	**65.2**	**54.4**
242	357510	170401	Roadside	Diffusion Tube	93	93	**61.7**	**68.4**	**56**	**51.1**	**41**
254	357118	172429	Roadside	Diffusion Tube	100	100	**54.4**	**51.8**	**52.2**	**49.4**	**40.5**
260	361140	175366	Roadside	Diffusion Tube	100	100	**45.6**	**45.4**	**42.6**	**43.1**	36.2
261	361103	175059	Roadside	Diffusion Tube	100	100	**51.3**	**53.1**	**52.4**	**51**	**41.5**
295	359913	174315	Roadside	Diffusion Tube	90	90	**63.3**	**55.7**	**65.1**	**59.6**	**48.1**

Site ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Site Type	Monitoring Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2019 (%) (2)	NO_2 Annual Mean Concentration (µg/m^3) (3) (4)				
							2015	2016	2017	2018	2019
300	363365	175883	Roadside	Diffusion Tube	100	100	**45.9**	**48.1**	**45.9**	**41.1**	35.1
303	361368	175170	Roadside	Diffusion Tube	100	100	**46.1**	**46.2**	**44**	**43.8**	36.5
307	360747	175328	Roadside	Diffusion Tube	100	100	36.6	37.4	32.6	37.3	30.7
312	359832	174616	Roadside	Diffusion Tube	100	100	36.8	**41.6**	38.5	38.5	32.8
314	357751	174063	Roadside	Diffusion Tube	75	75	**43.9**	**41.5**	38.3	37.7	31.3
320	361180	171567	Roadside	Diffusion Tube	94	94	31.3	31	30.7	27.9	23.5
325	361667	175103	Roadside	Diffusion Tube	100	100	**50.8**	**50.5**	**49.2**	**48.1**	39.4
363	359075	173613	Roadside	Diffusion Tube	81	81	39.2	39.6	38.5	37.2	34
370	359775	173513	Roadside	Diffusion Tube	100	100	37.7	38.4	37.5	36.6	30.1
371	359813	173373	Roadside	Diffusion Tube	100	100	**44.8**	**42.7**	**44.7**	**42.2**	34.1
373	359747	173774	Roadside	Diffusion Tube	92	92	38.3	39.5	38.5	35.7	31.2
374	359509	173595	Roadside	Diffusion Tube	83	83	**47.1**	**47.2**	**45.2**	**47.8**	39.9
403	360508	171676	Roadside	Diffusion Tube	100	100	**41.5**	37.5	35.7	35.5	28.1
405	361051	173743	Roadside	Diffusion	92	92	**53.1**	**42.6**	**50.4**	**56.2**	**48.5**

Site ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Site Type	Monitoring Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2019 (%) (2)	NO_2 Annual Mean Concentration (µg/m^3) (3) (4)				
							2015	2016	2017	2018	2019
				Tube							
406	361576	173806	Roadside	Diffusion Tube	100	100	35.4	36.2	38.9	38.5	31
407	359829	174370	Roadside	Diffusion Tube	90	90	**43.1**	**48.7**	**44.5**	**46.7**	37.3
413	360043	171508	Roadside	Diffusion Tube	100	100	39.3	**40**	38.7	37.6	31.2
417	359635	171413	Roadside	Diffusion Tube	100	100	**43.6**	**43.4**	35.2	36	31
418	357737	170642	Roadside	Diffusion Tube	100	100	**<u>63.7</u>**	**<u>69.3</u>**	**58.4**	**55.7**	**51.1**
419	357832	170686	Roadside	Diffusion Tube	100	100	**53.6**	**55.8**	**51.3**	**45**	39
420	358277	171562	Roadside	Diffusion Tube	90	90	36.7	38.6	33.3	37.1	30.4
422	358168	171525	Roadside	Diffusion Tube	92	92	35	39.4	36.5	34.1	27.4
423	358623	173386	Roadside	Diffusion Tube	100	100	**44.4**	**43.5**	**45**	**42.2**	35.2
429	360484	174097	Roadside	Diffusion Tube	100	100	**50.4**	**52.1**	**47.8**	**46.8**	**41.2**
436	361013	173352	Roadside	Diffusion Tube	100	100	37.9	**47.6**	**45.8**	**50.6**	**42**
438	360903	170024	Kerbside	Diffusion Tube	100	100	**43.1**	**43.4**	**43.2**	36.6	31.8
439	358042	170582	Roadside	Diffusion Tube	100	100	**41**	**43.5**	37.7	37.7	31.7

Site ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Site Type	Monitoring Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2019 (%) (2)	NO_2 Annual Mean Concentration ($\mu g/m^3$) (3) (4)				
							2015	2016	2017	2018	2019
455	359487	173924	Urban background	Diffusion Tube	100	100	26.5	27.9	26	24.4	20.8
461	360381	174405	Roadside	Diffusion Tube	71	71	33.2	37	30.4	33.9	26
464	362927	175592	Roadside	Diffusion Tube	94	94	34.9	36.9	36.8	34.4	29.7
466	357466	171622	Roadside	Diffusion Tube	100	100	34	35.8	33.4	33.2	27.4
469	359479	171114	Roadside	Diffusion Tube	100	100	35.3	39.2	34.6	36.2	27.4
470	359213	170997	Roadside	Diffusion Tube	100	100	38.7	39.4	35.9	37.9	29.4
472	358226	171284	Roadside	Diffusion Tube	100	100	**40**	**45.2**	**41.6**	37.3	33.7
473	358105	171124	Roadside	Diffusion Tube	100	100	**49.6**	**57**	**40.1**	**44**	**42.4**
474	357991	170979	Roadside	Diffusion Tube	100	100	38.5	38.7	35.8	31.9	29.1
478	362091	170447	Roadside	Diffusion Tube	100	100	36.3	36.7	35.4	36.5	28.8
487	360243	174327	Kerbside	Diffusion Tube	100	100	**46.2**	**45.7**	**44.5**	**41.9**	35.1
489	352634	177629	Roadside	Diffusion Tube	100	100	36.9	38.6	37.7	35.5	28.6
490	352683	177670	Roadside	Diffusion Tube	100	100	31.9	32.4	31	26.8	22.4
491	352722	177525	Roadside	Diffusion	100	100	33.8	36.5	34.4	33.5	27.3

Site ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Site Type	Monitoring Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2019 (%) (2)	NO_2 Annual Mean Concentration ($\mu g/m^3$) (3) (4)				
							2015	2016	2017	2018	2019
				Tube							
492	359445	176627	Roadside	Diffusion Tube	100	100	37.6	**40.3**	36.8	34.8	31.3
493	359677	176758	Roadside	Diffusion Tube	100	100	36.2	**41.5**	**41.9**	**41.8**	37
494	359558	176850	Roadside	Diffusion Tube	100	100	37.5	**43.3**	39.5	38.7	32
496	362296	173620	Roadside	Diffusion Tube	100	100	39.3	**41.1**	**41.1**	39.2	33
497	359268	174132	Roadside	Diffusion Tube	92	92	**41.8**	**43.1**	**42.4**	38	29.1
499	359522	173381	Roadside	Diffusion Tube	90	90			38.5	**43.2**	33.6
502	358640	173090	Roadside	Diffusion Tube	97	97					**68.7**
512	359026	174432	Roadside	Diffusion Tube	76	76				**47.5**	**40.6**
515	360333	174871	Roadside	Diffusion Tube	100	100				33.7	27.9
525	362455	173687	Roadside	Diffusion Tube	100	100				**43.5**	35.3
538	358681	171478	Roadside	Diffusion Tube	99	99				33.7	26.6
539	358599	171391	Roadside	Diffusion Tube	92	92				**43.3**	35.6
545	356379	171436	Urban background	Diffusion Tube	90	90				34.9	28.6

Site ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Site Type	Monitoring Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2019 (%) (2)	NO_2 Annual Mean Concentration (µg/m^3) (3) (4)				
							2015	2016	2017	2018	2019
550	358353	172613	Roadside	Diffusion Tube	100	77				36.9	35.1
555	356679	172589	Roadside	Diffusion Tube	100	77					32
556	356827	172303	Kerbside	Diffusion Tube	85	85					37
557	361171	170685	Roadside	Diffusion Tube	59	59					25.2
558	357294	171926	Roadside	Diffusion Tube	100	100					27.8
559	356485	171580	Roadside	Diffusion Tube	92	92					29
560	358665	173439	Roadside	Diffusion Tube	94	56					**40.4**
561	358688	173431	Roadside	Diffusion Tube	100	60					**47**
562	356960	168194	Roadside	Diffusion Tube	100	52					37.3
563	356606	168316	Roadside	Diffusion Tube	100	52					24.6
564	357173	177453	Roadside	Diffusion Tube	100	52					24.3
565	357227	179101	Roadside	Diffusion Tube	100	52					31.4
567	360728	175345	Roadside	Diffusion Tube	100	42					**44**
568	360178	175779	Roadside	Diffusion	100	42					36.2

Site ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Site Type	Monitoring Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2019 (%) (2)	NO_2 Annual Mean Concentration (µg/m^3) (3) (4)				
							2015	2016	2017	2018	2019
				Tube							
569	359855	176186	Roadside	Diffusion Tube	100	42					31.4
570	359847	176439	Roadside	Diffusion Tube	100	42					33.1
571	359848	176411	Roadside	Diffusion Tube	100	42					**42.8**

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

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

☒ **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 adjustment**

Notes:

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

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

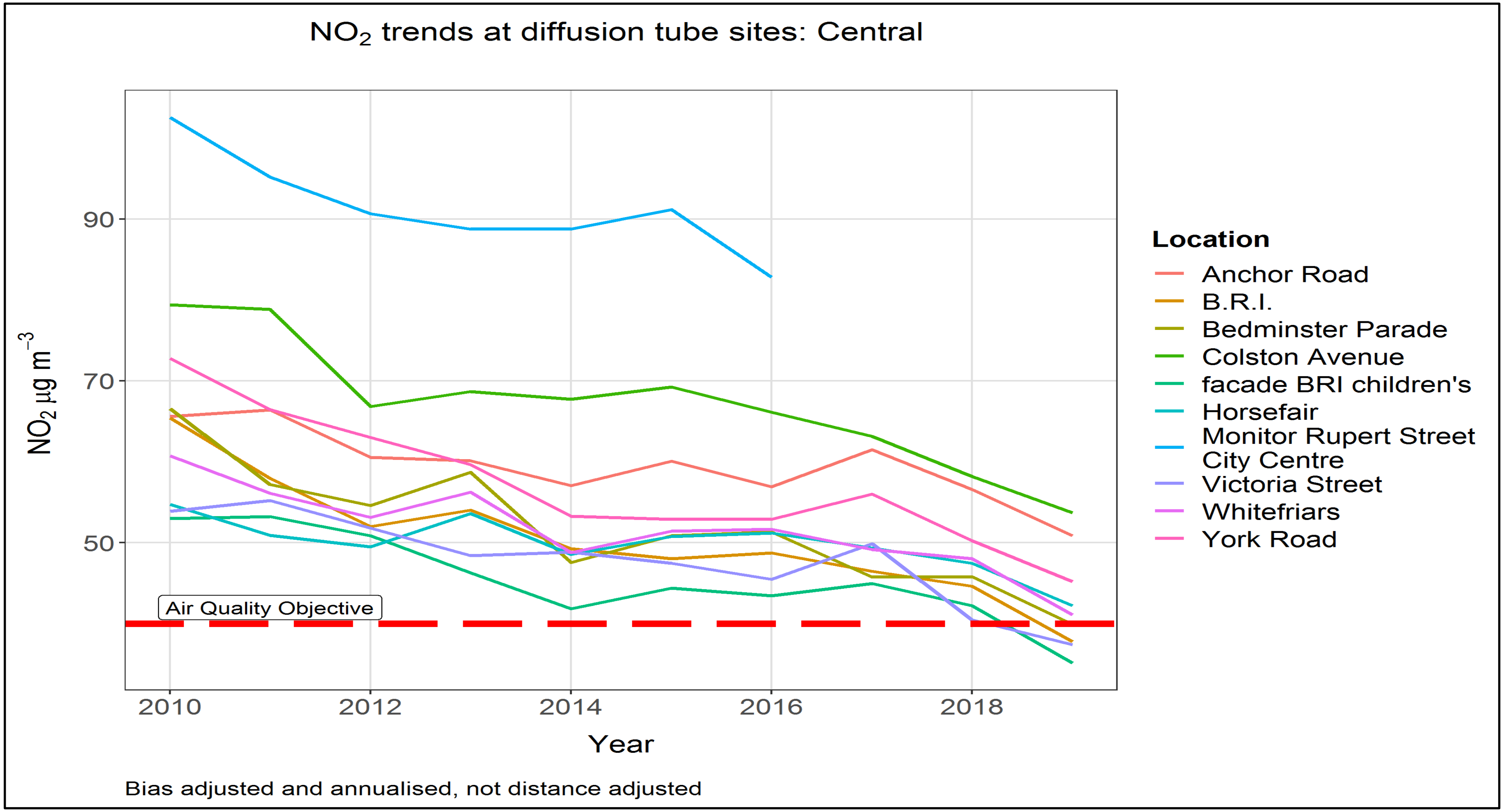
(1) Data capture for the monitoring period, in cases where monitoring was only carried out for part of the year.

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

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

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

Figure A. 1 – Trends in Annual Nitrogen Dioxide at City Centre Locations 2010 to 2019*



*Colston Avenue (502) data not inlcuded as only one year of data is currently available (68.7µg/m^3 in 2019)

Figure A. 2 – Trends in Annual Nitrogen Dioxide at Gloucester Road Locations 2010 to 2019

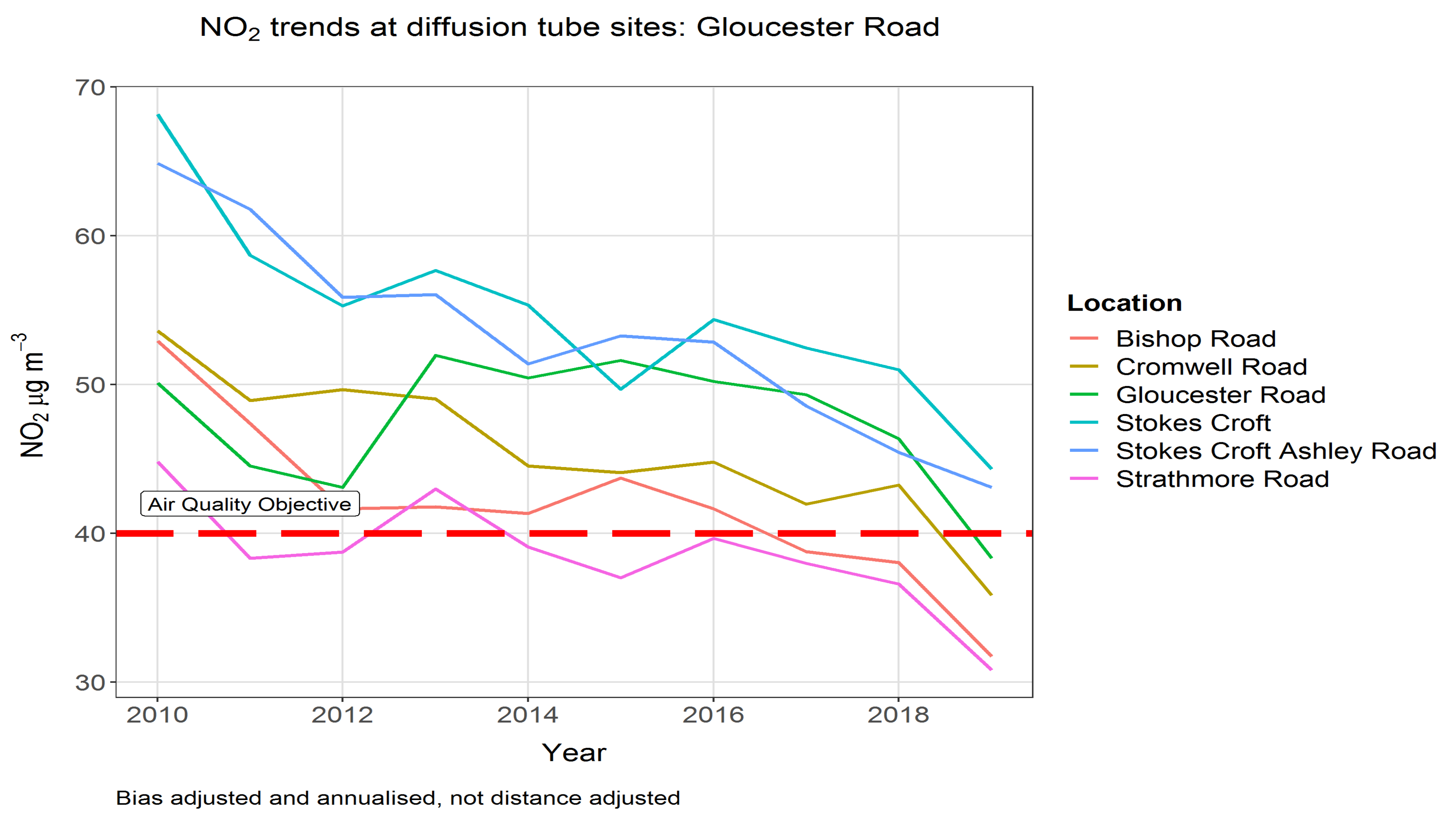


Figure A. 3 - Trends in Annual Nitrogen Dioxide at Parson Street Gyratory Locations 2010 to 2019

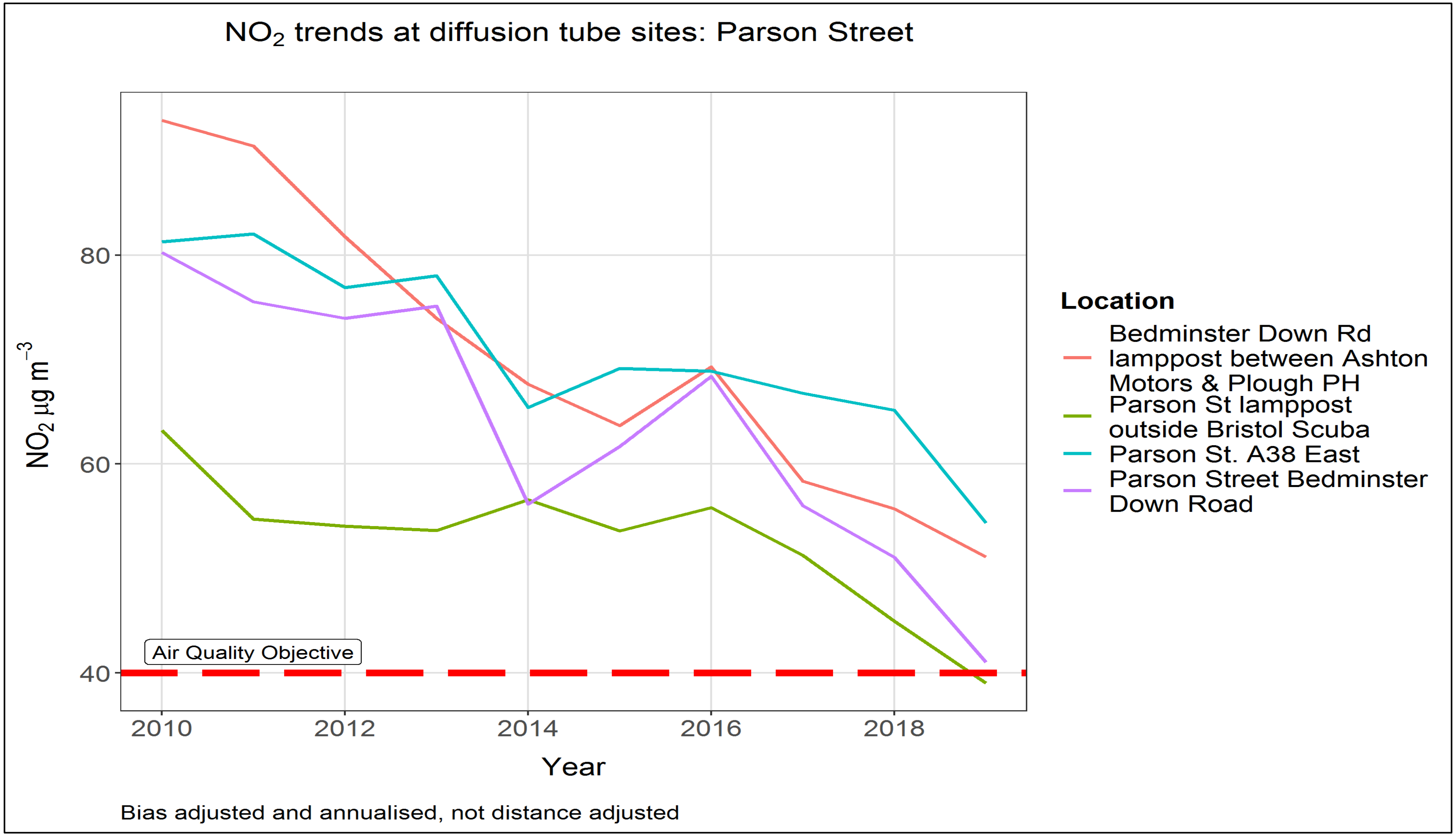


Figure A. 4 – Trends in Annual Nitrogen Dioxide at Newfoundland Way / M32 Locations 2010 to 2019

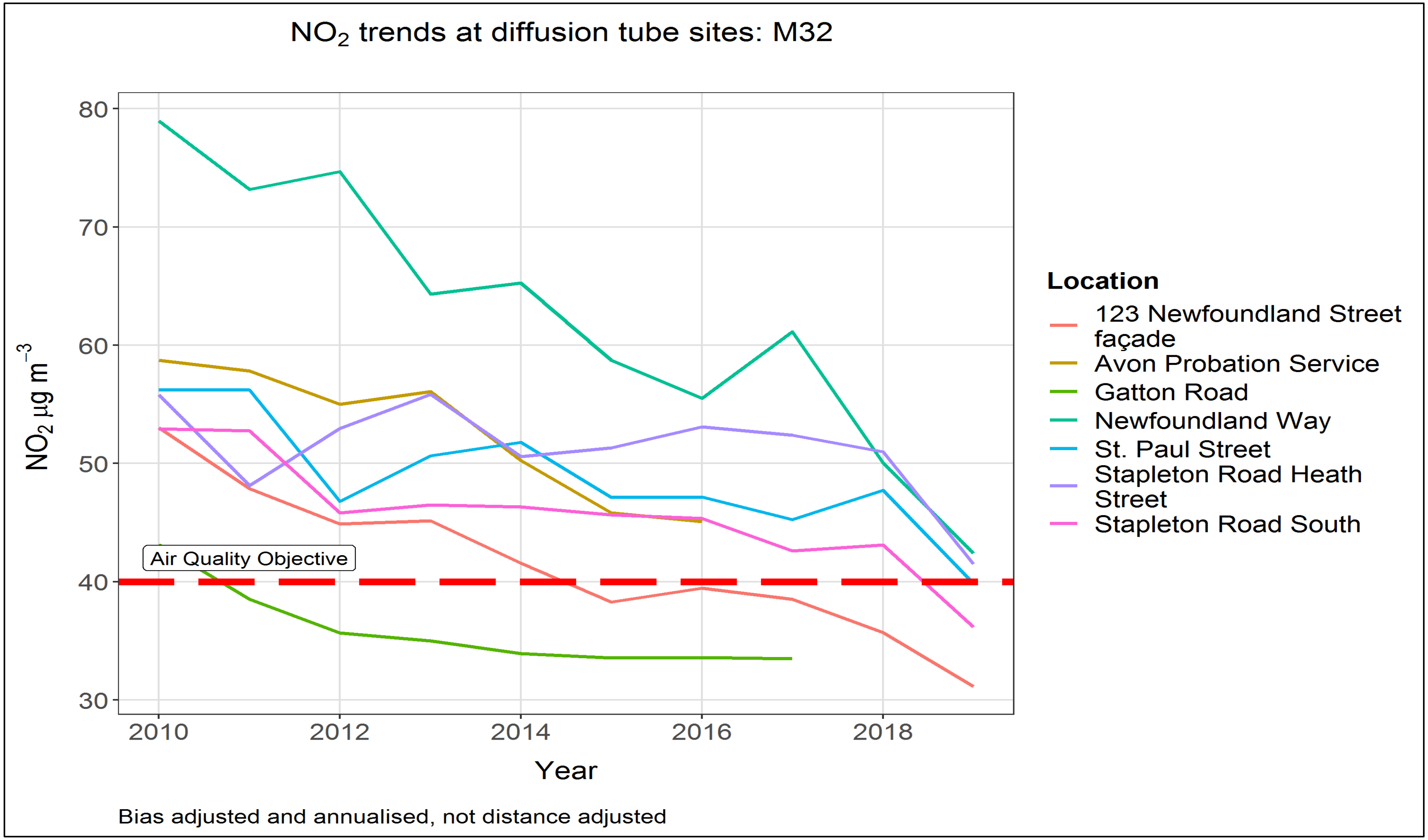


Table A.4 – 1-Hour Mean NO_2 Monitoring Results

Site ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Site Type	Monitoring Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2019 (%) (2)	NO_2 1-Hour Means > 200µg/m^3 (3)				
							2015	2016	2017	2018	2019
203	361178	171566	Urban background	Automatic	94.2	94.2	1 (133)	0	0	0	0
215	358042	170582	Roadside	Automatic	99.2	99.2	0	0	1	0	0
270	360903	170024	Roadside	Automatic	98.3	98.3	5	1	2 (168)	0	0
452	359488	173924	Urban background	Automatic	85.2	85.2	0	0	0	0 (93)	0
463	362926	175590	Roadside	Automatic	79.4	79.4	0	0	0	1	0 (118)
500	359522	173381	Roadside	Automatic	99.6	99.6			2	0	0
501	358640	173090	Roadside	Automatic	98.5	98.5					8

Notes:

Exceedances of the NO_2 1-hour mean objective (200µg/m^3 not to be exceeded more than 18 times/year) are shown in **bold.**

(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) If the period of valid data is less than 85%, the 99.8th percentile of 1-hour means is provided in brackets.

Table A.5 – Annual Mean PM_{10} Monitoring Results

Site ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Site Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2019 (%) (2)	PM_{10} Annual Mean Concentration (µg/m^3) (3)				
						2015	2016	2017	2018	2019
452-AURN St Pauls	359488	173924	Urban background	85.6	85.6	14.9	15.4	14.7	15.9	16
500-Temple Way	359522	173381	Roadside	93.8	93.8				22.6	20.9
501-Colston Avenue	358640	173090	Roadside	92.5	92.5					21.9

Notes:

Exceedances of the PM_{10} annual mean objective of 40µg/m^3 are shown in **bold.**

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

Table A.6 – 24-Hour Mean PM_{10} Monitoring Results

Site ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Site Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2019 (%) (2)	PM_{10} 24-Hour Means > 50µg/m^3 (3)				
						2015	2016	2017	2018	2019
452-AURN St Pauls	359488	173924	Urban background	84.7	84.7	3	5	2	0 (27)	0 (28)
500-Temple Way	359522	173381	Roadside	92.3	92.3				4	10
501-Colston Avenue	358640	173090	Roadside	92.6	92.6					4

Notes:

Exceedances of the PM_{10} 24-hour mean objective (50µg/m^3 not to be exceeded more than 35 times/year) are shown in **bold.**

(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) If the period of valid data is less than 85%, the 90.4th percentile of 24-hour means is provided in brackets.

Table A.7 – $PM_{2.5}$ Monitoring Results

Site ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Site Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2019 (%) (2)	$PM_{2.5}$ Annual Mean Concentration (µg/m^3) (3)				
						2015	2016	2017	2018	2019
452 - AURN St Pauls	359488	173924	Urban background	85.7	85.7	10.2	11.7	9.7	12	10.8

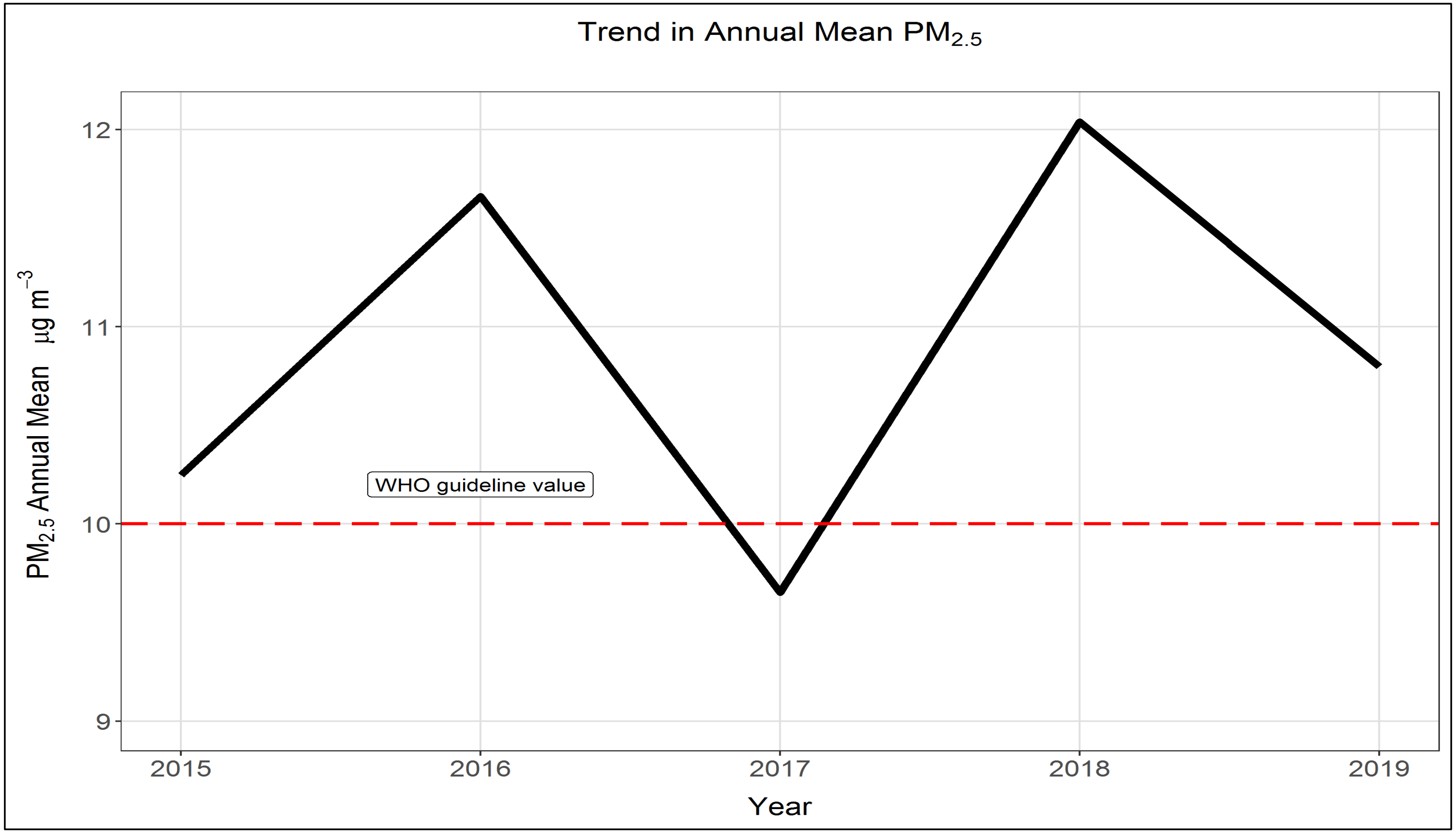
Notes:

(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) All means have been “annualised” as per Boxes 7.9 and 7.10 in LAQM.TG16, valid data capture for the full calendar year is less than 75%. See Appendix C for details.

Figure A.5 – Trends in Annual Mean $PM_{2.5}$ Concentrations



Appendix B: Full Monthly Diffusion Tube Results for 2019

Table B1. - NO_2 Monthly Diffusion Tube Results - 2019

Site ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	NO_2 Mean Concentrations ($\mu g/m^3$)														
			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Mean		
															Raw Data	Bias Adjusted (0.82) and Annualised (1)	Distance Corrected to Nearest Exposure (2)
2	358628	173011		74.5	64.6	62.8	58.7	61.9	61.0	66.3	68.4	69.1	67.7	65.5	65.5	**53.7**	**53.7**
3	357448	174650	39.0	37.8	27.8	40.6	30.5	31.7	24.1	19.2	33.2	36.0	49.3	36.0	33.8	27.7	27.7
4	359903	171850	48.4	56.2	45.5	53.5	43.6	52.2	39.8	38.7	53.0	58.5	61.3	50.2	50.1	**41.0**	**41.0**
5	358723	171704	52.6	53.3	57.7	50.3	50.0	46.3	45.6	41.7	45.0	49.7	49.4	42.5	48.7	39.9	39.9
9	358729	173499	52.4	54.9	46.7	46.7	39.8	43.7	35.5	41.5	48.1	51.3		46.4	46.1	37.8	37.8
10	361217	171429	55.2	54.5	49.4	58.8	48.9	48.0	47.7	33.9	50.9	54.7	64.8	50.2	51.4	**42.2**	36.2
11	358813	173342	54.5	56.5	51.0	53.9	46.7	43.6	45.6	46.4	50.6	50.2	52.5	49.9	50.1	**41.1**	**41.1**
12	359142	173211	56.8	66.0	65.1	64.1	61.4	60.5	63.0	61.4	64.2	62.9	70.1	63.1	63.2	**51.8**	**51.8**
14	360871	170291		45.0	40.3	49.8	46.4	47.8		45.6		49.0	52.5		47.0	38.7	30.7
15	359294	173485		51.5	48.7	44.9	47.6	51.0	47.9	50.8	56.9	55.2	61.6	50.3	51.5	**42.2**	**42.2**
16	352287	178698	37.1	45.8	35.2	32.5	28.6	27.3	28.8	31.0	32.6	35.6	45.4	39.2	34.9	28.7	28.7
20	359567	173630	55.0		55.2	40.5	48.9	45.4	47.0	60.3	53.0	54.3	51.7	57.8	51.7	**42.4**	**42.4**
21	359035	175306			55.9	34.0	43.1	47.8	44.7	49.9	46.4	52.2	42.2	51.1	46.7	38.3	33.7
22	359109	173886	58.9	58.5	52.0	59.3	45.9	55.9	47.5	48.5	59.7	55.6		52.8	54.1	**44.3**	**44.3**
113	359258	172696	54.5	59.0	51.8	46.3	41.7	35.7	39.9	46.3	42.7	28.9	50.1	50.4	45.6	37.4	35.3

Site ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	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 (0.82) and Annualised (1)	Distance Corrected to Nearest Exposure (2)
125	359214	171917	58.2	72.3	58.5	58.1	48.0	52.9	46.2	45.9	50.2	54.5	60.9	56.0	55.1	**45.2**	39.1
147	358514	172691	63.5		60.9	62.1		60.8	56.3	64.1	56.7	66.0	69.7	60.5	62.1	**50.9**	**50.9**
154	357601	172483	47.1	38.2	38.5	41.0	32.3	34.5	27.3	26.4	32.0	38.5	46.1	37.6	36.6	30.0	30.0
155	357838	172713	40.5	46.9	36.4	42.2	35.3	36.0	32.3	31.2	34.6	36.8	46.8	36.5	38.0	31.1	31.1
156	357709	173018	43.1	41.2	34.6	39.0	31.7	33.5	27.0	25.4	34.2	40.0	48.7	48.3	37.2	30.5	30.5
157	359119	174090	57.1	61.5	53.4	49.4	49.1	49.3	42.8	44.5		55.4	58.6	56.8	52.5	**43.1**	**43.1**
159	358891	174608	46.1	50.5	43.4	47.7	40.1	41.7	36.8	31.7	43.2	46.0	51.9	45.3	43.7	35.8	31.1
161	359152	175733	42.6	52.2		39.1	30.2	31.1	30.8	31.3		40.9	45.2	43.6	38.7	31.7	27.9
163	359435	176574	42.6	43.5	38.8	38.4	34.7	36.4	28.5	26.3	35.0	38.9	48.1	40.0	37.6	30.8	26.2
175	362147	170525	53.5	61.4	54.3	49.4	53.7	58.3	58.0	48.7	55.2	60.8	50.2	49.7	54.4	**44.6**	30.6
239	357880	170506	68.1	74.7	72.1	65.4	63.0	70.1	64.0	52.4	61.5	66.2	74.3	64.0	66.3	**54.4**	35.7
242	357510	170401	48.5	53.0	51.0	51.5	51.0	49.0	48.7		45.3	49.2	57.8	45.6	50.1	**41.0**	30.2
254	357118	172429	52.7	51.5	54.8	44.5	48.3	48.4	47.1	36.3	47.5	50.7	55.9	54.7	49.4	**40.5**	32.4
260	361140	175366	47.6	51.1	43.7	42.7	43.1	42.7	41.3	40.3	33.4	43.3	51.3	48.6	44.1	36.2	34.6
261	361103	175059	54.2	50.9	57.2	50.2	48.1	47.8	43.4	38.9	48.6	52.8	61.1	54.0	50.6	**41.5**	35.9
295	359913	174315	72.7	82.8	67.8	58.8		52.0	50.8	46.0	52.9	51.3	52.0	58.7	58.7	**48.1**	**48.1**
300	363365	175883	51.8	45.7	50.0	32.5	41.0	40.3	38.0	35.2	41.4	42.1	52.7	43.1	42.8	35.1	31.1
303	361368	175170	49.5	46.1	50.1	43.2	39.3	43.5	44.5	37.4	46.0	45.0	43.7	46.1	44.5	36.5	36.5
307	360747	175328	43.8	46.0	32.6	39.8	32.4	33.4	23.8	27.1	37.6	42.0	50.4	40.9	37.5	30.7	27.8

Site ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	NO_2 Mean Concentrations ($\mu g/m^3$)														
			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Mean		
															Raw Data	Bias Adjusted (0.82) and Annualised (1)	Distance Corrected to Nearest Exposure (2)
312	359832	174616	46.1	48.7	39.1	41.6	35.7	36.4	33.9	29.4	38.5	39.2	49.8	42.1	40.0	32.8	29.3
314	357751	174063	41.7	49.0	39.8	36.0	32.7	26.4	30.4	30.4		38.9			36.1	31.3	27.9
320	361180	171567	35.5	34.8	29.9	24.0	26.1	24.3	21.8	25.0	27.0	29.7	35.8	33.3	28.6	23.5	23.5
325	361667	175103	52.7	58.3	49.4	45.9	47.7	47.6	39.5	39.0	48.6	45.9	53.0	49.1	48.1	39.4	39.4
363	359075	173613	48.7	47.9	40.0	36.3		33.0		35.4	38.0	40.7	48.3	46.3	41.5	34.0	34.0
370	359775	173513	48.0	41.1	39.3	35.9	33.4	25.4	29.0	30.3	35.4	40.4	44.6	37.0	36.7	30.1	30.1
371	359813	173373	50.3	47.2	44.1	37.8	38.8	36.4	34.7	34.4	40.5	45.1	50.4	39.4	41.6	34.1	28.3
373	359747	173774	43.0	52.3		47.1	30.8	12.7	28.2	32.4	35.7	44.6	44.7	46.5	38.0	31.2	31.2
374	359509	173595	51.3	67.0	40.3	55.2			39.4	35.0	45.0	47.7	51.8	53.3	48.6	39.9	39.9
403	360508	171676	46.3	40.2	31.4	35.5	30.4	29.4	25.7	26.8	32.7	34.1	42.2	36.7	34.3	28.1	28.1
405	361051	173743	61.9	71.2	57.5	63.8	56.6	56.2	47.3	44.5		65.6	58.9	67.8	59.2	**48.5**	**44.4**
406	361576	173806	48.9	36.9	49.0	33.7	36.0	36.7	32.4	26.8	36.6	37.4	42.8	36.0	37.8	31.0	31.0
407	359829	174370	51.0	59.1	39.7	58.8	40.8	45.0		28.0	36.2	42.8	53.4	45.5	45.5	37.3	30.9
413	360043	171508	45.7	40.0	40.7	37.4	37.0	35.7	31.8	36.0	35.4	37.7	42.3	37.0	38.1	31.2	27.9
417	359635	171413	47.6	45.1	38.4	37.2	36.1	32.5	26.1	31.8	34.7	38.1	46.4	39.4	37.8	31.0	31.0
418	357737	170642	77.4	77.1	61.6	61.4	60.8	57.8	43.3	55.3	57.9	59.6	69.9	66.0	62.3	**51.1**	**51.1**
419	357832	170686	60.1	61.0	47.8	46.0	44.5	42.5	29.3	44.0	42.9	49.5	51.0	53.0	47.6	39.0	29.9
420	358277	171562	45.0	41.4	40.1	38.5	36.1	32.0		27.9	34.7	35.9	39.7	36.9	37.1	30.4	28.5
422	358168	171525	43.0	41.4	36.9	33.6	30.6	29.9	15.2	26.4		37.2	38.6	34.8	33.4	27.4	27.4

Site ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	NO_2 Mean Concentrations ($\mu g/m^3$)														
			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Mean		
															Raw Data	Bias Adjusted (0.82) and Annualised (1)	Distance Corrected to Nearest Exposure (2)
423	358623	173386	54.4	54.4	48.6	39.2	42.6	38.8	18.9	40.8	41.5	44.4	48.1	43.0	42.9	35.2	35.2
429	360484	174097	60.2	59.8	54.2	43.3	44.5	49.0	17.7	55.1	56.9	56.9	50.0	55.5	50.2	**41.2**	**41.2**
436	361013	173352	59.8	66.0	57.3	52.0	57.1	44.5	27.6	45.4	49.4	52.0	57.8	45.2	51.2	**42.0**	**42.0**
438	360903	170024	49.1	47.4	39.1	39.2	33.2	34.3	24.7	38.4	38.5	42.0	41.3	38.4	38.8	31.8	23.7
439	358042	170582	44.2	42.6	38.4	47.7	35.7	36.3	24.6	34.0	37.3	38.2	46.2	39.2	38.7	31.7	31.7
455	359487	173924	36.3	32.6	24.7	23.6	19.8	19.0	13.5	19.7	24.6	27.3	34.9	28.9	25.4	20.8	20.8
461	360381	174405	46.7	33.0	33.9	35.9		29.4		23.9	32.1		42.3	32.0	34.3	26.0	26.0
464	362927	175592	44.6	41.8	39.1	33.2	27.2	28.8	29.4	29.8	34.3	38.4	44.1	39.4	36.2	29.7	29.7
466	357466	171622	38.5	39.8	30.9	37.1	30.0	27.9	26.4	26.7	30.5	36.5	43.7	33.0	33.4	27.4	27.4
469	359479	171114	46.8	39.1	26.7	38.3	29.0	30.9	21.0	23.9	29.9	35.8	48.1	31.1	33.4	27.4	24.4
470	359213	170997	47.8	33.4	37.5	39.2	37.0	39.5	30.9	26.0	31.6	33.8	42.2	31.6	35.9	29.4	23.3
472	358226	171284	50.0	52.0	36.0	54.6	36.6	36.4	31.1	32.5	35.7	42.3	46.1	39.7	41.1	33.7	33.7
473	358105	171124	50.5	58.0	74.4	39.0	35.5	40.5	31.4	48.9	38.4	74.0	72.5	56.8	51.7	**42.4**	**42.4**
474	357991	170979	40.1	45.5	32.9	38.9	30.5	31.0	25.4	29.6	31.7	37.3	46.7	36.7	35.5	29.1	29.1
478	362091	170447	43.1	34.6	33.5	42.7	31.1	32.7	31.4	27.0	34.9	34.5	45.7	30.3	35.1	28.8	28.8
487	360243	174327	50.6	51.8	44.4	37.4	35.6	38.2	33.8	41.9	44.8	47.5	42.4	45.7	42.8	35.1	33.0
489	352634	177629	44.3	37.8	40.4	36.7	30.1	32.6	30.0	31.1	32.8	29.7	42.9	30.0	34.9	28.6	27.4
490	352683	177670	40.1	30.0	29.7	23.7	25.0	24.0	23.3	21.9	25.6	26.6	32.8	24.9	27.3	22.4	22.4
491	352722	177525	44.5	39.0	34.2	34.4	23.9	30.0	27.6	26.6	29.6	32.6	44.3	32.1	33.2	27.3	26.4

Site ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	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 (0.82) and Annualised (1)	Distance Corrected to Nearest Exposure (2)
492	359445	176627	46.5	51.5	33.3	39.2	29.1	33.3	28.2	31.4	35.3	40.5	48.5	41.7	38.2	31.3	25.5
493	359677	176758	54.1	54.0	46.6	42.7	40.2	41.5	38.4	38.6	45.9	42.1	52.6	44.9	45.1	37.0	37.0
494	359558	176850	46.6	48.2	34.5	37.5	34.4	31.6	30.2	31.8	35.7	38.8	52.0	47.2	39.0	32.0	24.9
496	362296	173620	52.6	46.1	40.8	34.2	34.1	34.3	35.8	37.4	38.0	40.7	42.7	46.9	40.3	33.0	33.0
497	359268	174132		51.9	33.7	37.0		25.7	22.8	24.4	31.0	40.5	45.4	42.5	35.5	29.1	25.9
499	359522	173381	51.4	45.2	41.8	50.4	38.7	40.5	35.3	33.4	40.0	42.1	46.9	38.7	40.9	33.6	33.6
502	358640	173090	84.1	90.8	77.4	77.5	79.7	84.8	76.4	90.8	86.5	90.5	78.1	86.9	83.8	**<u>68.7</u>**	**59.0**
512	359026	174432		50.4			48.7	50.7	44.8	41.3	52.9	54.0	57.6	45.7	49.5	**40.6**	37.8
515	360333	174871	50.8	35.3	32.0	34.6	31.4	35.3	25.2	23.4	31.3	35.4	38.8	34.3	34.0	27.9	27.3
525	362455	173687	50.9	53.1	46.6	40.3	40.4	37.4	33.6	41.1	40.6	44.3	45.6	43.2	43.1	35.3	35.3
538	358681	171478	40.1	36.2	30.6	35.7	28.4	30.2	25.9	23.2	29.4	36.3	40.6	32.1	32.4	26.6	26.6
539	358599	171391	56.4	43.2	40.0	45.7	43.7	44.0	38.4	38.1		40.7	47.6	40.0	43.4	35.6	32.6
545	356379	171436	39.0	52.0	31.1	47.2	29.6	28.4	24.2	26.5	31.7		37.2	37.3	34.9	28.6	28.6
550	358353	172613				54.6	42.8	43.3	37.6	39.9	44.0	41.6	47.0	35.0	42.9	35.1	35.1
555	356679	172589				54.5	41.6	39.4	36.8	27.0	41.5	33.6	46.6	30.7	39.1	32.0	29.7
556	356827	172303		55.2		24.5	47.2	41.9	46.6	42.3	46.9	49.4	49.0	47.7	45.1	37.0	37.0
557	361171	170685	40.3	35.4					32.4	28.2		36.8	35.0	32.2	34.3	25.2	20.6
558	357294	171926	47.2	37.5	39.2	35.6	28.4	27.0	23.1	27.6	30.9	35.6	39.8	34.6	33.9	27.8	26.6
559	356485	171580	51.4	49.4		40.8	30.2	29.5	25.6	24.2	34.2	36.0	35.2	32.9	35.4	29.0	23.8

Site ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	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 (0.82) and Annualised (1)	Distance Corrected to Nearest Exposure (2)
560	358665	173439						34.8	39.5	46.4	47.8	49.5	47.1	47.5	44.5	**40.4**	37.9
561	358688	173431						47.6	47.9	44.8	53.0	58.9	54.8	57.0	52.0	**47.0**	**43.7**
562	356960	168194							32.6	42.1	47.5	43.4	48.6	42.8	42.8	37.3	24.1
563	356606	168316							24.7	24.1	28.0	30.9	34.7	27.2	28.3	24.6	20.6
564	357173	177453							20.0	19.5	25.4	28.6	37.4	38.3	28.2	24.3	22.8
565	357227	179101							35.8	30.8	34.1	36.6	46.9	34.6	36.5	31.4	31.4
567	360728	175345								51.2	53.4	50.9	56.8	63.7	55.2	**44.0**	39.9
568	360178	175779								36.6	43.2	48.2	51.3	48.1	45.5	36.2	29.1
569	359855	176186								25.8	36.4	43.4	51.6	39.8	39.4	31.4	29.1
570	359847	176439								31.9	41.5	37.5	45.8	50.8	41.5	33.1	27.2
571	359848	176411								37.0	44.8	73.6	64.3	49.1	53.8	**42.8**	32.7

☒ **Local bias adjustment factor used**

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

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

Notes:

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

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

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

(2) Distance corrected to nearest relevant public exposure.

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

New Sources of Pollution

There have not been any significant new sources of pollution to consider within the annual status report.

Clean Air Zone Progress to Date

Bristol City Councill are continuing to develop plans to achieve complaince with air quality objectives in the shortest time possible as directed by government. The timeframe for this work is being influenced by the Covid-19 pandemic. For the latest information on the development of these plans please visit the Clean Air for Bristol Website.

Locations Recording Exceedence Outside AQMA

The next section of the report discusses the locations which have shown some exceedances of the annual objective for NO_2 in the past 5 years but are located outside of the AQMA. Table C. 1 and Table C.2 list all these locations and provides measured pollutant concentrations for the past 5 years where available.

Table C. 1 - Tubes Outside AQMA Exceeding the Annual Air Quality Objective for NO2 Since 2015 – Blackboy Hill and Whiteladies Road

Site	Site ID	Annual Mean Concentrations ($\mu g/m^3$)					Action
		2015	2016	2017	2018	2019	
Blackboy Hill	3	37.9	37.6	34.4	34.4	27.7	Exceedance recorded in 2013 with compliance recorded each year since.
Lamppost Whiteladies Road \ Cotham Hill Clifton	314	**43.9**	**41.5**	38.3	37.7	31.3	Despite exceedances being measured, from 2014-2016, the NO_2 concentration at a relevant receptor location was below the air quality strategy objective when calculated using the distance calculator tool. 2018 and 2019 monitoring data is compliant without distance adjustment.

Blackboy Hill and Whiteladies Road

The 2011 Detailed Assessment concluded that an extension to the central AQMA should be made to include Whiteladies Road and Blackboy Hill. Bristol City Council were planning to start the consultation process for the extension of the AQMA, however, the 2011 data considered for both these sites in the 2012 Updating and

Screening Assessment[14] showed that there had been a marked reduction in NO_2 concentrations measured in these locations compared to 2010. The 2017, 2018 and 2019 data for Tube 314 shows compliance with the annual objective for NO_2. Data for Tube 3 for the past 5 years shows compliance with the annual objective for NO_2.

This confirms that the decision in 2012 to defer the declaration of an AQMA along Whiteladies Road was the right approach to take. Data for 2015 and 2016 at Tube 314 on Whiteladies Road shows that using the distance adjustment calculator to determine pollution levels where relevant exposure occurs, that compliance with objectives was achieved. Late in 2019 diffusion tube 314 had to be moved as the post on which it was placed was removed from the street. A replacement tube has been placed along Whiteladies Road in a similar location.

Whilst monitoring will be ongoing along Whiteladies Road, discussion of these sites will not be included within future ASR's unless new exceedances are recorded in these locations in future years.

Table C. 2 - Tubes Outside AQMA Exceeding the Annual Air Quality Objective for NO2 Since 2015 – Muller Road

	Site ID	Annual Mean Concentrations (µg/m³)					Action
		2015	2016	2017	2018	2019*	
No.67 Filton Avenue on wall facing Muller Rd	493	36.2	**41.5**	**41.9**	**41.8**	37.0	2016 was the first full year of monitoring in this location with data from 2015 being annualised. 2019 data shows that the site was compliant with the annual objective for nitrogen dioxide for the first time since 2015. The monitoring location is on the façade of a residential dwelling and is therefore representative of relevant exposure. In 2019 additional sites were set up along Muller Road to identify whether other locations outside of the AQMA have exceedances in locations of relevant exposure. This extra data will allow Bristol City Council to consider whether it is necessary to expand the current AQMA boundary which follows Gloucester Road and passes within 175m of monitoring site 493.

[14] Bristol City Council. (2012). 2012 Updating and Screening Assessment for Bristol City Council.

	Site ID	Annual Mean Concentrations ($\mu g/m^3$)					Action
		2015	2016	2017	2018	2019*	
Muller Road - Adjacent to Darnley Avenue	494	37.5	**43.3**	39.5	38.7	32.0	2016 was the first full year of monitoring in this location with data from 2015 being annualised. The NO_2 concentration at the relevant receptor location (using distance from roads calculator) was below the air quality strategy objective in 2016. In 2017, 2018 and 2019 data show compliance at the monitoring site. Monitoring will continue here through 2020.
Muller road/ Glenfrome road junction north	567	N/A	N/A	N/A	N/A	**44.0** (39.9)	This site was set up in 2019 to investigate whether there are exceedances along Muller Road. The tubes were established in mid-2019 with results being annualised. Monitoring data was in breach of air quality objectives in at this location in 2019. The distance adjusted concentration to the nearest receptor was 39.9µg/m^3 in 2019. Monitoring will continue in 2020.
Muller road junction with Downend road traffic light to the south of the junction.	571	N/A	N/A	N/A	N/A	**42.8** (32.7)	This site was set up in 2019 to investigate whether there are more exceedances along Muller Road. The tubes were established in mid-2019 with results being annualised. Monitoring data was in breach of air quality objectives in at this location in 2019. The distance adjusted concentration to the nearest receptor was 32.7µg/m^3 in 2019 and not in exceedance of the objective. Monitoring will continue in 2020.

*Distance adjusted data reported in ()

Muller Road

Monitoring sites 493 and 494 were added to the monitoring network in 2015 along Muller Road. Both recorded exceedances of the annual NO_2 objective during 2016. When adjusted for distance to relevant exposure Tube 494 was compliant, however, tube 493 is at a location of relevant exposure. Tube 493 is located approximately 175m from the boundary of the current AQMA which runs along Gloucester Road. Monitoring continued in 2019 and shows compliance at Tube 493 with an annual average NO_2 concentration of 37.0µg/m^3. Tube 494 was compliant with objectives without distance correction at 32.0µg/m^3.

Due to the continued monitored exceedance outside of the existing AQMA the Local Air Quality Management helpdesk was consulted in 2019 in order to agree an appropriate course of action for. BCC asked the LAQM Helpdesk four questions via e-mail in July 2019. The query reference was 5607 with the following answers received to the following questions:

Q1: Should BCC consider amending the AQMA boundary to include the monitored location of exceedance based on the 3 years of monitored marginal exceedance?

A1: *Due to the marginal exceedances I think the best approach would be for further investigation to understand the extent of the additional exceedances outside of the AQMA, this could be additional monitoring or a detailed modelling assessment.*

Q2: Would there be a requirement to conduct modelling to support this or is diffusion tube data sufficient evidence given that modelling will be verified against monitoring data anyway?

A2: *A modelling study would provide information on the wider area, across areas where monitoring has possibly not be completed. This could lead to a better understanding of the area and provide a full review of the current designations of AQMAs.*

Q3: Would consideration be needed of possibly extending the AQMA further along Muller Road given that there is the possibility of other locations of exceedance outside of the AQMA boundary?

A3: *Following the completion of a detailed study (modelling or further monitoring), the extent of any possible amendments should be investigated and implemented where required.*

Q4: Should BCC amend the AQMA boundary what is the current process by which this can be done and does it involve a requirement for public consultation?

A4: *Consultation is encouraged, with Defra being the key statutory consultee but a recommended list is provided within Chapter 6 of PG(16).*

As a result of the information provided above, Bristol City Council added a number of new diffusion tube monitoring locations along Muller Road in August 2019. Diffusion tube monitoring was chosen over modelling as it provides more robust data and will be helpful if modelling is conducted at a later date and Figure C.2 shows the location of the new monitoring sites on Muller Road and the 2019 measured NO_2 concentrations. Measured and distance adjusted concentrations for those tubes exceeding the objective are reported in Table C.2. For tubes 567, 568, 569, 570 and 571, where monitoring started in August 2019, the results have been annualised as per Box 7.10 in LAQM.TG16.

For the first time since 2015 no exceedance was measured at diffusion tube site 493. Despite a general city wide trend of falling NO_2 concentrations, nitrogen dioxide levels here have remained relatively stable since 2015.

The additional monitoring has highlighted another location on Muller Road that is very close to exceedance of objectives at a location with relevant exposure. An annual NO_2 concentration of 44.0µg/m^3 was measured at tube 567 on the junction of Muller Road with Glenfrome Road. When adjusted for distance to the nearest location of relevant exposure marginal compliance of 39.9µg/m^3 was predicted. It is proposed to continue monitoring in these locations in 2020.

Figure C. 1 - Muller Road 2019 Measured Annual NO_2 Concentrations – North

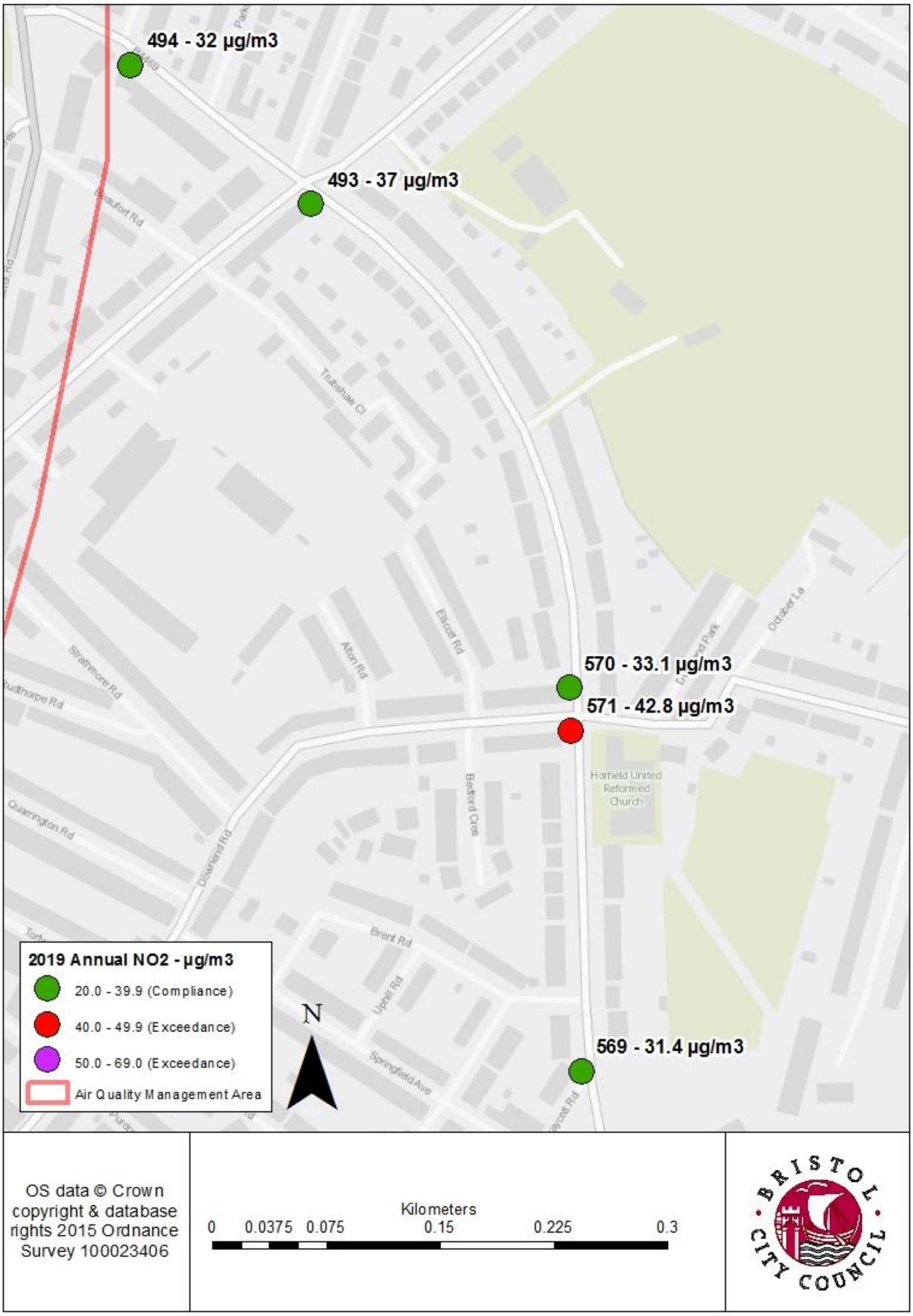
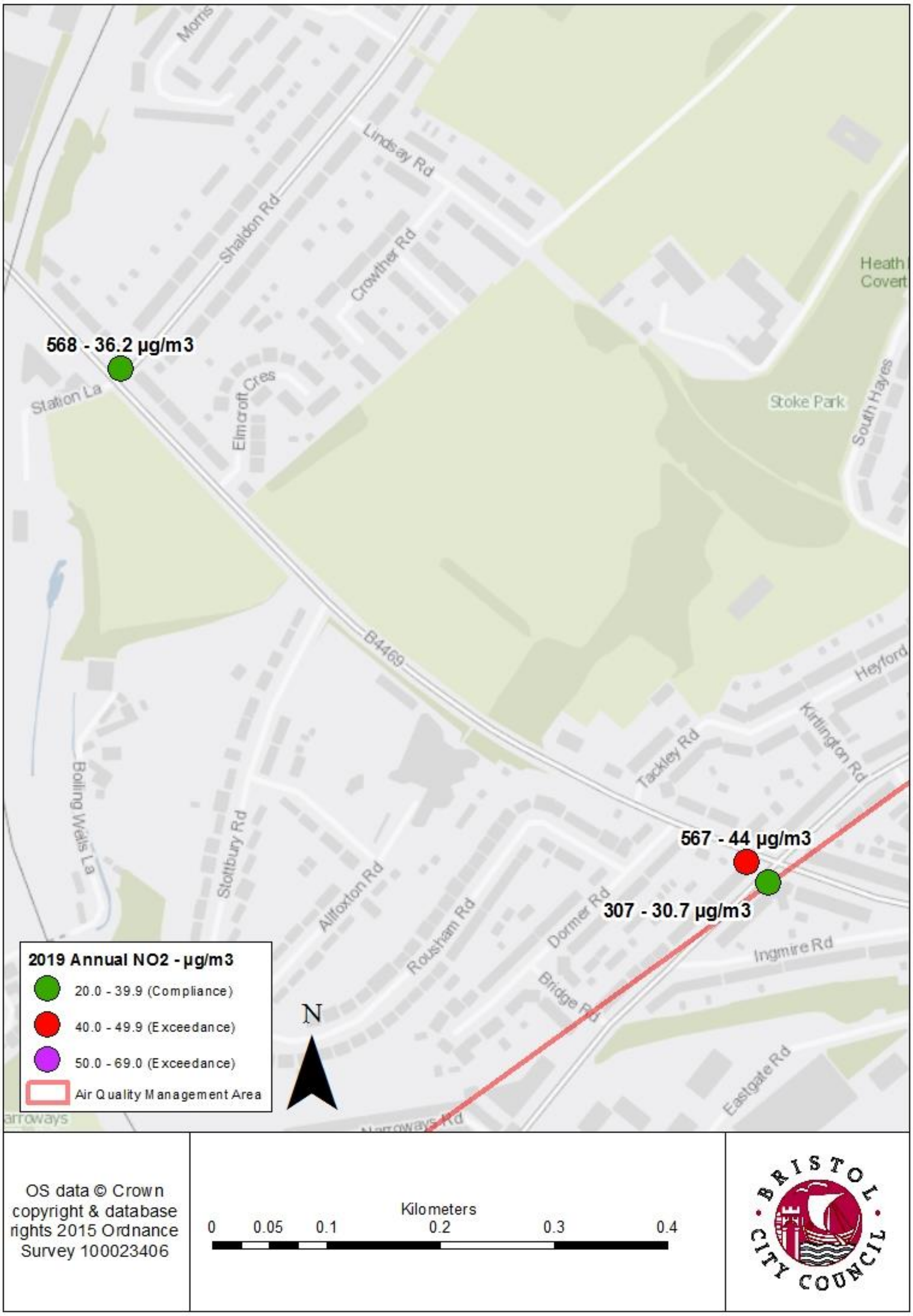


Figure C.2 - Muller Road 2019 Measured Annual NO_2 Concentrations - South



Local Pollution Hotspots – Measured Data

In the review of the 2019 ASR provided by Defra, a request was made for future ASRs to highlight and identify pollution hotspots in the city.

In order to identify the locations in the city with the highest monitored pollution levels, a summary of results and map showing monitoring data, in locations where annual NO_2 concentrations above 50µg/m^3 were measured in 2019, are shown in Table C. 3 and mapped in Figure C. 3. Six monitoring locations had measured concentrations above 50µg/m^3 in 2019. This figure of over 50µg/m^3 has been chosen by BCC to illustrate the most polluted sites in the city, there are other sites in exceedance of the 40µg/m^3 objective but that are below 50µg/m^3, results for which have been reported in detail within this report.

Colston Avenue – Tube 502 and Tube 2

In 2019 the annual NO_2 concentration at Tube 502 was 68.7µg/m^3 with 53.7µg/m^3 being measured at Tube 2. Tube 502 has the highest recorded annual NO_2 concentration measured within Bristol. It is a city centre location impacted by large numbers of vehicles, including many buses, with high levels of congestion and restricted pollutant dispersion. At the nearest location of relevant exposure, concentrations of 59.0µg/m^3 have been calculated. Tube 2 is located in the centre of the city and therefore it is not possible to adjust for distance to the nearest receptor with any confidence.

Parsons Street Gyratory A38 East – Tube 239 and Tube 418

Tube 239 is located less than 1m from the kerbside with 2019 NO_2 measured at 54.4µg/m^3. The road in this location has a relatively steep incline, with 3 lanes of traffic often accelerating from a standing start from traffic lights, located a relatively short distance from the monitoring site. The nearest relevant exposure is 9m from the kerbside and shows compliance at 35.7µg/m^3 when adjusted for this distance.

Tube 418 is located next to the façade of a house on the A38 Bedminster Down Road. The 51.1µg/m^3 annual NO_2 concentration measured here in 2019 is representative of relevant exposure. This location is 2m from the kerb and is subject to 3 lanes of traffic which is often either accelerating or queuing in this location.

Galleries - Tube 12

This tube is located inside a tunnel and is therefore not representative of relevant exposure.

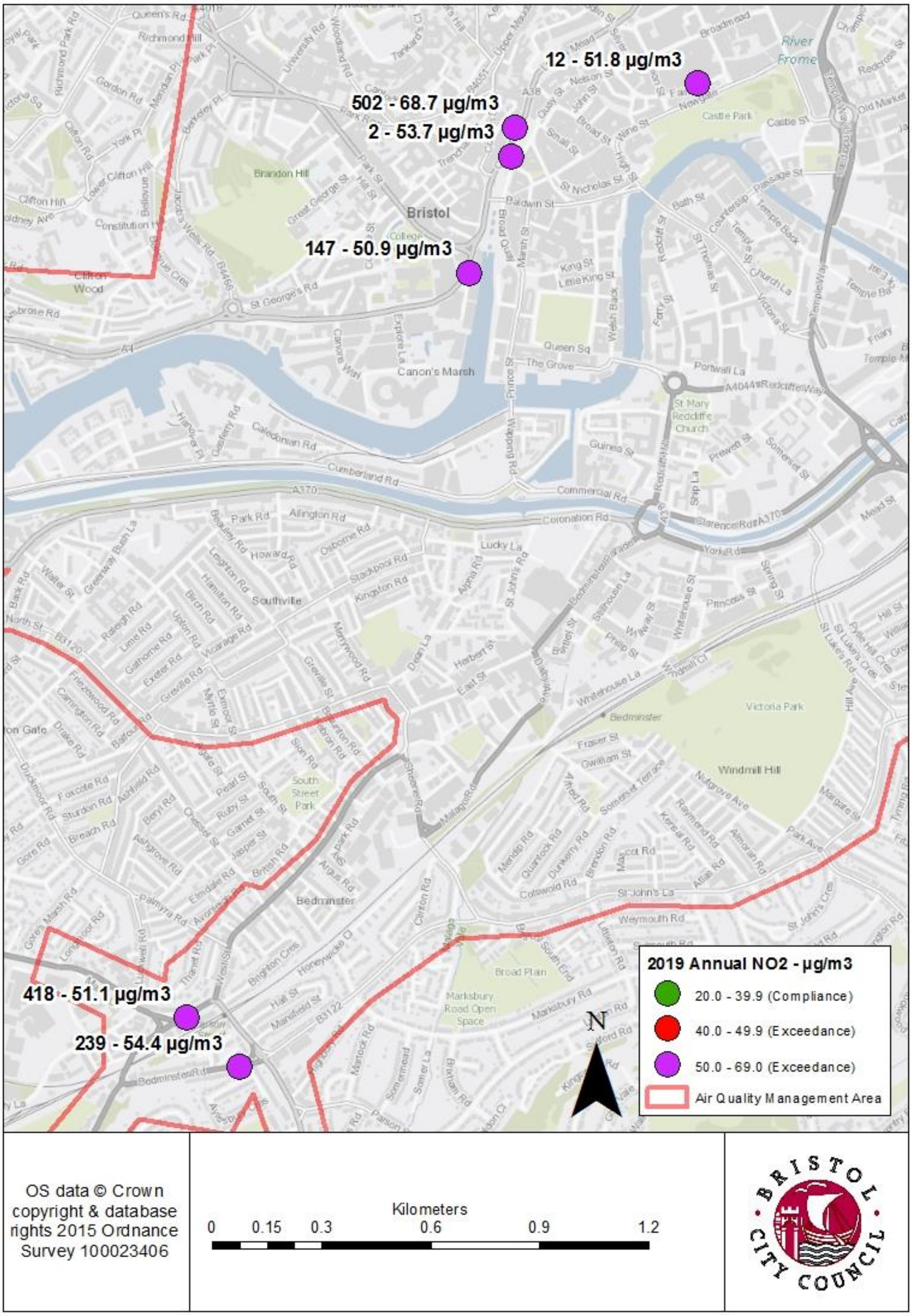
Anchor Road –Tube 147

This tube is located at a pedestrian crossing with traffic often either queuing of accelerating by the tube which is located 1m from the kerb.

Table C. 3 – Locations at which NO_2 Concentrations Above 50µg/m^3 were Measured in 2019

Site ID	Site Name	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	NO_2 Annual Mean Concentration (µg/m^3)				
				2015	2016	2017	2018	2019
2	Colston Avenue	358628	173011	**<u>69.2</u>**	**<u>66.1</u>**	**<u>63.1</u>**	**58.2**	**53.7**
12	Galleries	359142	173211	**52.5**	**52.8**	**56.6**	**57.5**	**51.8**
147	Anchor Road	358514	172691	**<u>60.1</u>**	**56.9**	**<u>61.5</u>**	**56.6**	**50.9**
239	Parson St. A38 East	357880	170506	**<u>69.2</u>**	**<u>68.9</u>**	**<u>66.8</u>**	**<u>65.2</u>**	**54.4**
418	Bedminster Down Rd lamppost between Ashton Motors & Plough PH	357737	170642	**<u>63.7</u>**	**<u>69.3</u>**	**58.4**	**55.7**	**51.1**
502	Co-located Colston Ave	358640	173090					**<u>68.7</u>**

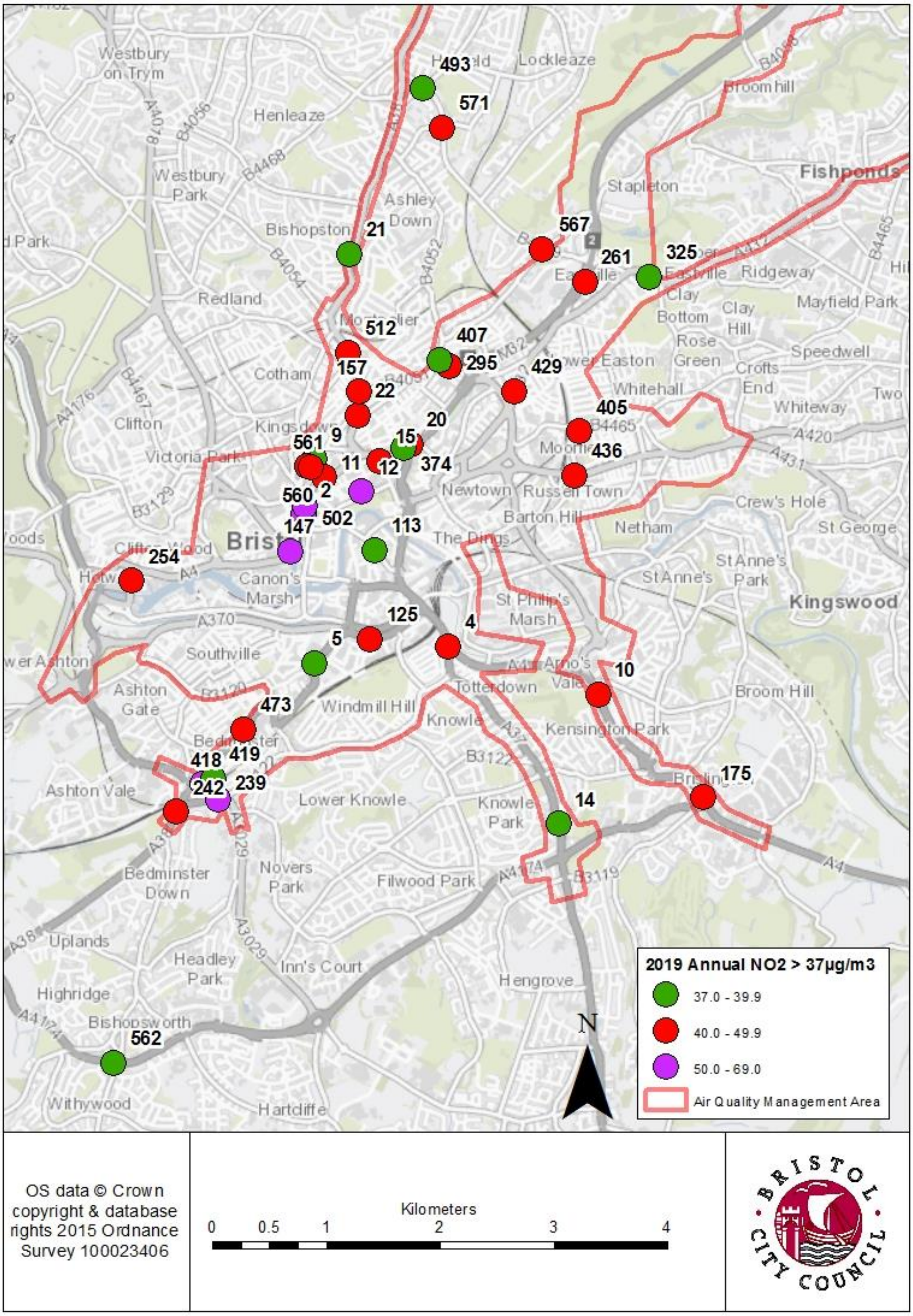
Figure C. 3 - 2019 Measured Annual NO_2 Concentrations > 50µg/m^3



Diffusion tube data for 2019 shows that there were 28 monitoring locations at which exceedances of the annual objective for NO_2 were measured. When taking into account diffusion tube measurement uncertainty it is useful to consider monitoring locations with annual concentrations above 37µg/m^3 which could indicate a location of possible exceedance. The value of 37µg/m^3 has been chosen by Bristol City Council for the purposes of highlighting potential areas of exceedance. An additional 12 locations are at risk of exceedance if this criterion is used to define a "hotspot".

These locations are spread throughout the city on many different central roads and arterial routes, the locations of which are shown in Figure C.4.

Figure C. 4 - 2019 Measured Annual NO_2 Concentrations > 37µg/m[3]



Local Pollution Hotspots – Distance Adjusted

Air quality objectives apply in locations at which relevant exposure occurs. For annual NO_2 concentrations this is defined in LAQM TG16 as: *All locations where members of the public might be regularly exposed. Building façades of residential properties, schools, hospitals, care homes etc.*

When monitoring doesn't take place in a location that represents relevant exposure it is possible to adjust monitoring data to account for the distance between the pollutant source, monitoring location and relevant receptor. There are 19 locations with annual NO_2 concentrations above 37µg/m^3 at relevant receptor locations throughout Bristol. These are shown in Figure C.5 and Table C.4.

Figure C. 5 - 2019 Annual NO_2 Concentrations above 37µg/m^3 at locations of relevant exposure

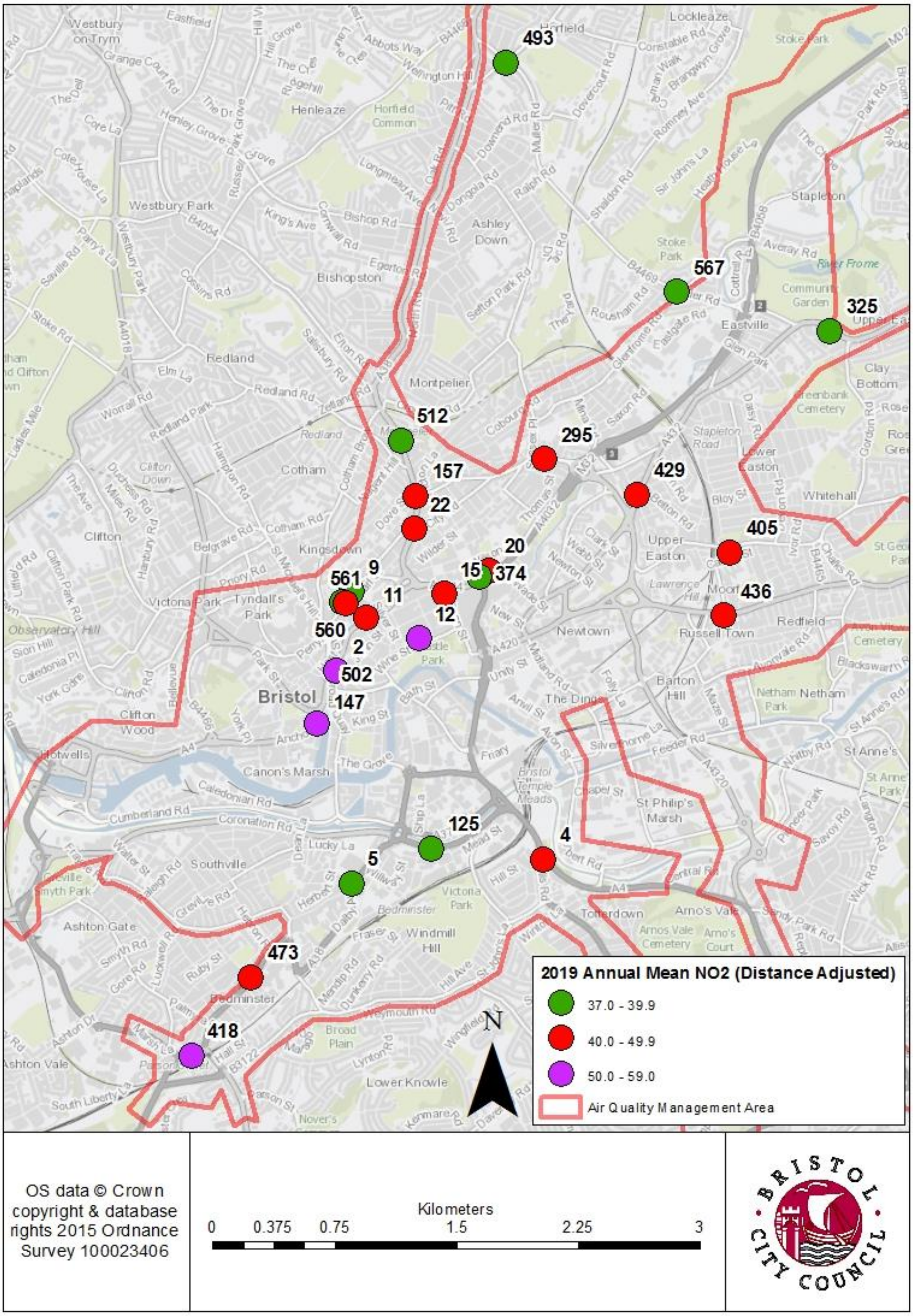


Table C. 4 - Locations with NO_2 above 37µg/m^3 at locations of relevant exposure in 2019

Site ID	Site Name	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	NO_2 Annual Mean Concentration (µg/m^3)					
				2015	2016	2017	2018	2019	2019 Distance Adjusted
5	Bedminster Parade	358723	171704	**50.9**	**51.3**	**45.8**	**45.8**	39.9	39.9
9	B.R.I.	358729	173499	**48.0**	**48.8**	**46.5**	**44.6**	37.8	37.8
22	Stokes Croft	359109	173886	**49.7**	**54.4**	**52.5**	**51.0**	**44.3**	**44.3**
125	York Road	359214	171917	**52.9**	**52.9**	**56.0**	**50.3**	**45.2**	39.1
157	Stokes Croft Ashley Road	359119	174090	**53.3**	**52.8**	**48.5**	**45.4**	**43.1**	**43.1**
295	Lamppost 16 Ashley Road St. Pauls	359913	174315	<u>**63.3**</u>	**55.7**	<u>**65.1**</u>	**59.6**	**48.1**	**48.1**
325	Facade 258 Fishponds Road Fishponds	361667	175103	**50.8**	**50.5**	**49.2**	**48.1**	39.4	39.4
374	St. Paul Street	359509	173595	**47.1**	**47.2**	**45.2**	**47.8**	39.9	39.9
405	Whitehall Rd/Easton Rd lamppost 4TZ	361051	173743	**53.1**	**42.6**	**50.4**	**56.2**	**48.5**	**44.4**
418	Bedminster Down Rd lamppost between Ashton Motors & Plough PH	357737	170642	<u>**63.7**</u>	<u>**69.3**</u>	**58.4**	**55.7**	**51.1**	**51.1**
429	facade villiers road stapleton road junction	360484	174097	**50.4**	**52.1**	**47.8**	**46.8**	**41.2**	**41.2**
436	Shiners Garage	361013	173352	37.9	**47.6**	**45.8**	**50.6**	**42.0**	**42.0**
473	B&G Snax West St	358105	171124	**49.6**	**57.0**	**40.1**	**44.0**	**42.4**	**42.4**
493	No 67 Filton Avenue on wall facing Muller Rd	359677	176758	36.2	**41.5**	**41.9**	**41.8**	37.0	37.0
502	Co-located Colston Ave	358640	173090					<u>**68.7**</u>	**59.0**
512	Colston girls	359026	174432				**47.5**	**40.6**	37.8
560	Lamppost outside BRI CAZ	358665	173439					**40.4**	37.9
561	Lamppost opposite BRI CAZ	358688	173431					**47.0**	**43.7**
567	Muller road/ Glenfrome road junction north	360728	175345					**44.0**	39.9

QA/QC of Diffusion Tube Monitoring

Precision calculations were undertaken for all sites in the co-location study. The precision checks indicated a “good” precision rating for all measurement periods at all sites when two or more tubes were available for analysis. Automatic monitor data capture rates were good at all sites for all months except for May at the Brislington site, Feb, Sept, Oct, Dec at the Fishponds site and for July, August and October at the Defra St Pauls site. Due to the real time monitor data losses at Fishponds and St Pauls, neither of the results from these sites have been used in the diffusion tube bias adjustment calculations, as described in detail later in this section of the report. Summary tables from the analysers used for bias adjustment and precision calculation are included in the Figures below.

Figure C.6 - Summary Data for Bias and Precision Calculation: Brislington

Checking Precision and Accuracy of Triplicate Tubes

AEA Energy & Environment
From the AEA group

Diffusion Tubes Measurements										Automatic Method		Data Quality Check	
Period	Start Date dd/mm/yyyy	End Date dd/mm/yyyy	Tube 1 μgm^{-3}	Tube 2 μgm^{-3}	Tube 3 μgm^{-3}	Triplicate Mean	Standard Deviation	Coefficient of Variation (CV)	95% CI of mean	Period Mean	Data Capture (% DC)	Tubes Precision Check	Automatic Monitor Data
1	08/01/2019	04/02/2019	36.6	34.6	35.3	36	1.0	3	2.5	44	99.9	Good	Good
2	04/02/2019	06/03/2019	34.6	34.5	35.2	35	0.4	1	0.9	32	99.9	Good	Good
3	06/03/2019	03/04/2019	30.4	29.7	29.7	30	0.4	1	1.0	26	95.9	Good	Good
4	03/04/2019	01/05/2019	23.1	25.5	23.5	24	1.3	5	3.2	20	99.8	Good	Good
5	01/05/2019	05/06/2019	26.0	25.8	26.4	26	0.3	1	0.8	22	60.2	Good	or Data Capture
6	05/06/2019	02/07/2019	24.6	23.7	24.8	24	0.6	2	1.5	17	85.1	Good	Good
7	02/07/2019	07/08/2019	22.7	21.4	21.3	22	0.8	4	1.9	20	99.8	Good	Good
8	07/08/2019	03/09/2019	24.4	25.2	25.4	25	0.5	2	1.3	18	99.9	Good	Good
9	03/09/2019	02/10/2019	27.1	26.5	27.4	27	0.5	2	1.1	20	99.8	Good	Good
10	02/10/2019	05/11/2019	28.7	30.7	29.8	30	1.0	3	2.5	24	98.8	Good	Good
11	05/11/2019	03/12/2019	36.5	35.1		36	1.0	3	9.2	31	98.6	Good	Good
12	03/12/2019	08/01/2020	33.1	33.4		33	0.2	1	2.1	23	98.5	Good	Good
13													
											Overall survey -->	Good precision	Good Overall DC

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

Site Name/ ID: 203 - Brislington

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

(Check average CV & DC from Accuracy calculations)

Accuracy (with 95% confidence interval)
without periods with CV larger than 20%
Bias calculated using 11 periods of data
Bias factor A 0.86 (0.77 - 0.96)
Bias B 17% (4% - 29%)
Diffusion Tubes Mean: 29 μgm^{-3}
Mean CV (Precision): 2
Automatic Mean: 25 μgm^{-3}
Data Capture for periods used: 98%
Adjusted Tubes Mean: 25 (22 - 28) μgm^{-3}

Accuracy (with 95% confidence interval)
WITH ALL DATA
Bias calculated using 11 periods of data
Bias factor A 0.86 (0.77 - 0.96)
Bias B 17% (4% - 29%)
Diffusion Tubes Mean: 29 μgm^{-3}
Mean CV (Precision): 2
Automatic Mean: 25 μgm^{-3}
Data Capture for periods used: 98%
Adjusted Tubes Mean: 25 (22 - 28) μgm^{-3}

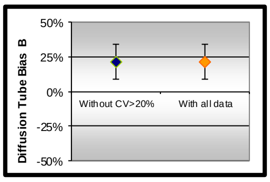


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Figure C.7 - Summary Data for Bias and Precision Calculation: Fishponds

Checking Precision and Accuracy of Triplicate Tubes

AEA Energy & Environment
From the AEA group

Period	Start Date dd/mm/yyyy	End Date dd/mm/yyyy	Tube 1 µgm^{-3}	Tube 2 µgm^{-3}	Tube 3 µgm^{-3}	Triplicate Mean	Standard Deviation	Coefficient of Variation (CV)	95% CI of mean	Period Mean	Data Capture (% DC)	Tubes Precision Check	Automatic Monitor Data
	Diffusion Tubes Measurements									Automatic Method		Data Quality Check	
1	09/01/2019	06/02/2019	44.9	42.7	46.2	45	1.8	4	4.4	48	99.8	Good	Good
2	06/02/2019	07/03/2019	43.4	41.5	40.5	42	1.5	4	3.7	40	72	Good	or Data Capture
3	07/03/2019	02/04/2019	37.4	39.2	40.7	39	1.7	4	4.2	42	99.1	Good	Good
4	02/04/2019	02/05/2019	30.3	33.6	35.6	33	2.7	8	6.6	27	99.7	Good	Good
5	02/05/2019	06/06/2019	29.1	29.8	22.7	27	3.9	14	9.7	38	99.7	Good	Good
6	06/06/2019	04/07/2019	29.5	28.1	29.0	29	0.7	2	1.8	32	98.6	Good	Good
7	04/07/2019	08/08/2019	29.9	28.9		29	0.7	2	6.2	42	99.7	Good	Good
8	08/08/2019	03/09/2019	29.2	30.3		30	0.8	3	7.0	45	99.8	Good	Good
9	03/09/2019	03/10/2019	35.1	33.8	34.0	34	0.7	2	1.8	48	5.8	Good	or Data Capture
10	03/10/2019	07/11/2019	39.4	37.4	38.3	38	1.0	3	2.5	28	39.7	Good	or Data Capture
11	07/11/2019	03/12/2019	44.2	46.8	41.3	44	2.7	6	6.8	39	98.4	Good	Good
12	03/12/2019	09/01/2020	37.6	39.5	41.1	39	1.8	4	4.4	49	30	Good	or Data Capture
13													

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

Overall survey --> Good precision | Poor Overall DC

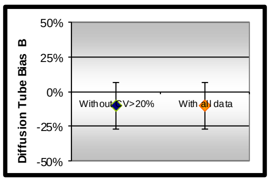
Site Name/ ID: 463 - Fishponds Road

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

(Check average CV & DC from Accuracy calculations)

Accuracy (with 95% confidence interval)
without periods with CV larger than 20%
Bias calculated using 8 periods of data
Bias factor A 1.13 (0.95 - 1.4)
Bias B -12% (-29% - 5%)
Diffusion Tubes Mean: 35 µgm^{-3}
Mean CV (Precision): 6
Automatic Mean: 39 µgm^{-3}
Data Capture for periods used: 99%
Adjusted Tubes Mean: 39 (33 - 48) µgm^{-3}

Accuracy (with 95% confidence interval)
WITH ALL DATA
Bias calculated using 8 periods of data
Bias factor A 1.13 (0.95 - 1.4)
Bias B -12% (-29% - 5%)
Diffusion Tubes Mean: 35 µgm^{-3}
Mean CV (Precision): 6
Automatic Mean: 39 µgm^{-3}
Data Capture for periods used: 99%
Adjusted Tubes Mean: 39 (33 - 48) µgm^{-3}



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Version 04 - February 2011

Figure C.8 - Summary Data for Bias and Precision Calculation: Parsons Street

Checking Precision and Accuracy of Triplicate Tubes

AEA Energy & Environment
From the AEA group

Period	Start Date dd/mm/yyyy	End Date dd/mm/yyyy	Tube 1 µgm^{-3}	Tube 2 µgm^{-3}	Tube 3 µgm^{-3}	Triplicate Mean	Standard Deviation	Coefficient of Variation (CV)	95% CI of mean	Period Mean	Data Capture (% DC)	Tubes Precision Check	Automatic Monitor Data
	Diffusion Tubes Measurements									Automatic Method		Data Quality Check	
1	08/01/2019	04/02/2019	42.9	44.8	44.8	44	1.1	2	2.7	46	99.9	Good	Good
2	04/02/2019	06/03/2019	43.9	40.2	43.6	43	2.0	5	5.1	39	99.8	Good	Good
3	06/03/2019	03/04/2019	37.9	38.3	39.1	38	0.6	2	1.5	32	99.9	Good	Good
4	03/04/2019	01/05/2019	48.1	47.7	47.5	48	0.3	1	0.8	31	99.9	Good	Good
5	01/05/2019	05/06/2019	35.3	36.8	35.1	36	0.9	3	2.3	27	99.8	Good	Good
6	05/06/2019	02/07/2019	37.2	36.4	35.2	36	1.0	3	2.4	24	99.9	Good	Good
7	02/07/2019	07/08/2019	27.9	20.1	25.8	25	4.0	16	10.0	25	99.9	Good	Good
8	07/08/2019	03/09/2019	35.0	34.9	32.3	34	1.5	4	3.8	23	99.7	Good	Good
9	03/09/2019	02/10/2019	37.5	37.1	37.3	37	0.2	1	0.6	31	99.8	Good	Good
10	02/10/2019	05/11/2019	39.2	37.4	38.0	38	0.9	2	2.3	30	98.9	Good	Good
11	05/11/2019	03/12/2019	45.7	46.7	46.1	46	0.5	1	1.2	40	98.7	Good	Good
12	03/12/2019	08/01/2020	41.0	38.8	37.9	39	1.6	4	4.0	36	99	Good	Good
13													

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

Overall survey --> Good precision | Good Overall DC

Site Name/ ID: 215 - Parsons Street

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

(Check average CV & DC from Accuracy calculations)

Accuracy (with 95% confidence interval)
without periods with CV larger than 20%
Bias calculated using 12 periods of data
Bias factor A 0.83 (0.75 - 0.92)
Bias B 21% (8% - 34%)
Diffusion Tubes Mean: 39 µgm^{-3}
Mean CV (Precision): 4
Automatic Mean: 32 µgm^{-3}
Data Capture for periods used: 100%
Adjusted Tubes Mean: 32 (29 - 36) µgm^{-3}

Accuracy (with 95% confidence interval)
WITH ALL DATA
Bias calculated using 12 periods of data
Bias factor A 0.83 (0.75 - 0.92)
Bias B 21% (8% - 34%)
Diffusion Tubes Mean: 39 µgm^{-3}
Mean CV (Precision): 4
Automatic Mean: 32 µgm^{-3}
Data Capture for periods used: 100%
Adjusted Tubes Mean: 32 (29 - 36) µgm^{-3}

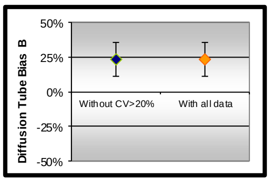

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Figure C.9 - Summary Data for Bias and Precision Calculation: St Pauls

Checking Precision and Accuracy of Triplicate Tubes

AEA Energy & Environment
From the AEA group

	Diffusion Tubes Measurements										Automatic Method		Data Quality Check	
Period	Start Date dd/mm/yyyy	End Date dd/mm/yyyy	Tube 1 μgm^{-3}	Tube 2 μgm^{-3}	Tube 3 μgm^{-3}	Triplicate Mean	Standard Deviation	Coefficient of Variation (CV)	95% CI of mean		Period Mean	Data Capture (% DC)	Tubes Precision Check	Automatic Monitor Data
1	09/01/2019	06/02/2019	35.9	35.5	37.6	36	1.1	3	2.7		33.7	96.4	Good	Good
2	06/02/2019	04/03/2019	33.2	33.6	30.9	33	1.5	5	3.7		29.1	99.8	Good	Good
3	04/03/2019	02/04/2019	23.3	25.3	25.5	25	1.2	5	3.0		19.8	99.9	Good	Good
4	02/04/2019	02/05/2019	21.8	24.2	24.9	24	1.6	7	4.1		16.9	99.2	Good	Good
5	02/05/2019	06/06/2019	20.1	21.4	18.0	20	1.7	9	4.2		19	97.1	Good	Good
6	06/06/2019	04/07/2019	19.4	20.5	17.2	19	1.7	9	4.2		16	99.3	Good	Good
7	04/07/2019	08/08/2019	13.1	13.6	13.8	14	0.4	3	0.9		15	64.4	Good	or Data Capture
8	08/08/2019	04/09/2019	19.7	19.5	20.1	20	0.3	1	0.7		15	0.2	Good	or Data Capture
9	04/09/2019	03/10/2019	24.3	23.8	25.9	25	1.1	4	2.7		21	100	Good	Good
10	03/10/2019	07/11/2019	26.9	26.9	28.2	27	0.8	3	1.9		25	70.4	Good	or Data Capture
11	07/11/2019	04/12/2019	34.2	35.0	35.7	35	0.7	2	1.8		30	97.4	Good	Good
12	04/12/2019	09/01/2020	29.2	28.7	28.8	29	0.3	1	0.7		26.3	96.3	Good	Good
13														
											Overall survey -->		Good precision	Poor Overall DC

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

Site Name/ ID: 452 - St Pauls

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

(Check average CV & DC from Accuracy calculations)

Accuracy (with 95% confidence interval)	
without periods with CV larger than 20%	
Bias calculated using 9 periods of data	
Bias factor A	0.87 (0.81 - 0.93)
Bias B	15% (7% - 23%)
Diffusion Tubes Mean:	27 μgm^{-3}
Mean CV (Precision):	5
Automatic Mean:	24 μgm^{-3}
Data Capture for periods used:	98%
Adjusted Tubes Mean:	24 (22 - 25) μgm^{-3}

Accuracy (with 95% confidence interval)	
WITH ALL DATA	
Bias calculated using 9 periods of data	
Bias factor A	0.87 (0.81 - 0.93)
Bias B	15% (7% - 23%)
Diffusion Tubes Mean:	27 μgm^{-3}
Mean CV (Precision):	5
Automatic Mean:	24 μgm^{-3}
Data Capture for periods used:	98%
Adjusted Tubes Mean:	24 (22 - 25) μgm^{-3}

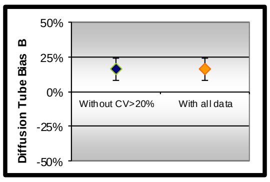

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Figure C.10 - Summary Data for Bias and Precision Calculation: Wells Road

Checking Precision and Accuracy of Triplicate Tubes

AEA Energy & Environment
From the AEA group

	Diffusion Tubes Measurements										Automatic Method		Data Quality Check	
Period	Start Date dd/mm/yyyy	End Date dd/mm/yyyy	Tube 1 μgm^{-3}	Tube 2 μgm^{-3}	Tube 3 μgm^{-3}	Triplicate Mean	Standard Deviation	Coefficient of Variation (CV)	95% CI of mean		Period Mean	Data Capture (% DC)	Tubes Precision Check	Automatic Monitor Data
1	08/01/2019	04/02/2019	50.1	48.4	48.9	49	0.9	2	2.2		45	99.9	Good	Good
2	04/02/2019	06/03/2019	45.2	50.3	46.8	47	2.6	6	6.5		34	99.8	Good	Good
3	06/03/2019	03/04/2019	41.1	40.7	35.6	39	3.0	8	7.6		27	91	Good	Good
4	03/04/2019	01/05/2019	37.1	39.2	41.3	39	2.1	5	5.2		24	99.8	Good	Good
5	01/05/2019	05/06/2019	34.9	32.9	31.7	33	1.6	5	4.1		22	99.8	Good	Good
6	05/06/2019	02/07/2019	32.0	35.4	35.7	34	2.1	6	5.1		23	99.8	Good	Good
7	02/07/2019	07/08/2019	28.1	21.8	24.3	25	3.2	13	7.8		24	97.4	Good	Good
8	07/08/2019	03/09/2019	39.6	38.8	36.9	38	1.4	4	3.5		25	99.8	Good	Good
9	03/09/2019	02/10/2019	39.5	39.8	36.4	39	1.9	5	4.7		27	99.8	Good	Good
10	02/10/2019	05/11/2019	43.9	39.7	42.5	42	2.1	5	5.3		36	99.1	Good	Good
11	05/11/2019	03/12/2019	42.6	40.3	41.2	41	1.1	3	2.8		36	98.7	Good	Good
12	03/12/2019	08/01/2020	37.4	40.7	37.0	38	2.0	5	4.9		31	99.1	Good	Good
13														
											Overall survey -->		Good precision	Good Overall DC

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

Site Name/ ID: 270 - Wells Road

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

(Check average CV & DC from Accuracy calculations)

Accuracy (with 95% confidence interval)	
without periods with CV larger than 20%	
Bias calculated using 12 periods of data	
Bias factor A	0.76 (0.69 - 0.84)
Bias B	32% (19% - 44%)
Diffusion Tubes Mean:	39 μgm^{-3}
Mean CV (Precision):	5
Automatic Mean:	30 μgm^{-3}
Data Capture for periods used:	99%
Adjusted Tubes Mean:	30 (27 - 33) μgm^{-3}

Accuracy (with 95% confidence interval)	
WITH ALL DATA	
Bias calculated using 12 periods of data	
Bias factor A	0.76 (0.69 - 0.84)
Bias B	32% (19% - 44%)
Diffusion Tubes Mean:	39 μgm^{-3}
Mean CV (Precision):	5
Automatic Mean:	30 μgm^{-3}
Data Capture for periods used:	99%
Adjusted Tubes Mean:	30 (27 - 33) μgm^{-3}

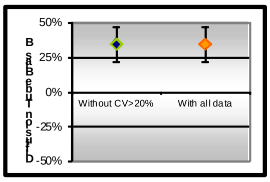

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Figure C.11 - Summary Data for Bias and Precision Calculation: Temple Way

Checking Precision and Accuracy of Triplicate Tubes

AEA Energy & Environment
From the AEA group

Diffusion Tubes Measurements										Automatic Method		Data Quality Check	
Period	Start Date dd/mm/yyyy	End Date dd/mm/yyyy	Tube 1 μgm^{-3}	Tube 2 μgm^{-3}	Tube 3 μgm^{-3}	Triplicate Mean	Standard Deviation	Coefficient of Variation (CV)	95% CI of mean	Period Mean	Data Capture (% DC)	Tubes Precision Check	Automatic Monitor Data
1	08/01/2019	04/02/2019	51.4							50.3	99.7		Good
2	04/02/2019	07/03/2019	45.7	46.5	43.6	45	1.5	3	3.7	42.6	99.3	Good	Good
3	07/03/2019	02/04/2019	43.1	42.0	40.4	42	1.4	3	3.4	40.3	99.7	Good	Good
4	02/04/2019	01/05/2019	50.4							55.6	99.9		Good
5	01/05/2019	05/06/2019	37.1	38.9	40.2	39	1.6	4	4.0	38	99.6	Good	Good
6	05/06/2019	02/07/2019	40.7	39.2	41.8	41	1.3	3	3.2	33	99.4	Good	Good
7	02/07/2019	07/08/2019	35.5	35.7	34.6	35	0.6	2	1.5	29	99.8	Good	Good
8	07/08/2019	03/09/2019	33.1	33.8	33.2	33	0.4	1	0.9	25	99.7	Good	Good
9	03/09/2019	02/10/2019	40.1	39.5	40.5	40	0.5	1	1.3	32	99.7	Good	Good
10	02/10/2019	05/11/2019	42.4	42.4	41.7	42	0.4	1	1.0	39	99.4	Good	Good
11	05/11/2019	03/12/2019	42.2	46.4	52.0	47	4.9	10	12.2	47.3	99.9	Good	Good
12	03/12/2019	08/01/2020	35.6	41.8	38.5	39	3.1	8	7.7	34.2	99.5	Good	Good
13													
											Overall survey -->	Good precision	Good Overall DC

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

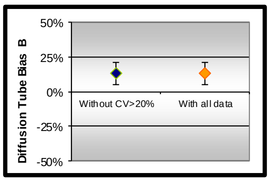
(Check average CV & DC from Accuracy calculations)

Site Name/ ID: 500 - Temple Way

Precision 10 out of 10 periods have a CV smaller than 20%

Accuracy (with 95% confidence interval)
without periods with CV larger than 20%
Bias calculated using 10 periods of data
Bias factor A: 0.9 (0.84 - 0.97)
Bias B: 12% (3% - 20%)
Diffusion Tubes Mean: 40 μgm^{-3}
Mean CV (Precision): 4
Automatic Mean: 36 μgm^{-3}
Data Capture for periods used: 100%
Adjusted Tubes Mean: 36 (34 - 39) μgm^{-3}

Accuracy (with 95% confidence interval)
WITH ALL DATA
Bias calculated using 10 periods of data
Bias factor A: 0.9 (0.84 - 0.97)
Bias B: 12% (3% - 20%)
Diffusion Tubes Mean: 40 μgm^{-3}
Mean CV (Precision): 4
Automatic Mean: 36 μgm^{-3}
Data Capture for periods used: 100%
Adjusted Tubes Mean: 36 (34 - 39) μgm^{-3}



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Diffusion Tube Bias Adjustment Factors (BAF)

Somerset Scientific Services were used throughout the whole of 2019 to provide and analyse diffusion tubes for BCC. This lab is not UKAS accredited for diffusion tube analysis but does participate in the AIR PT Scheme for nitrogen dioxide tubes. All reference materials are of at least analytical grade or equivalent. Standards are prepared using equipment that is all within the normal quality system. The tubes used are recycled Gradko tubes prepared and set on a monthly basis. The tube changing frequency is as per the calendar on the Air Quality Archive web site and is carried out by Bristol City Council officers. The tubes are prepared with 50 µL of 20% triethanolamine in water. The method follows that set out in the practical guidance document.

Table C.5 – AIR PT Scheme Results for Somerset County Council

Air PT Round	Percent Of tubes submitted found to be satisfactory
Air PT AR030 – Jan/Feb 2019	100%
Air PT AR031 – April/May 2019	100%
Air PT AR033 – July/August 2019	100%
Air PT AR034 – Sept/November 2019	100%

Discussion of Choice of Factor to Use

Box 7.1 of LAQM TG16 and consultation with the LAQM helpdesk was used in order to determine the most appropriate BAF to use in 2019. Bristol has a relatively large network of automatic NO_X analysers that are operated using robust QA/QC procedures. In 2019, 5 of these sites recorded data capture rates of more than 90%. The precision of the analysis at these co-located triplicate tubes was classed as good for all sites and all months.

The locally derived bias adjustment factor calculated for 2019 was 0.82 which is lower than the bias adjustment factors used each year since 2015. For this reason, the LAQM helpdesk was consulted in May 2019 (query reference 6261) in order to seek advice and guidance on the application of the bias adjustment factor. The LAQM helpdesk confirmed that LAQM TG(16) Box 7.11 had been applied correctly along with the methodology as outlined in paragraph 7.193 to determine a locally derived BAF.

The alternative to applying a locally derived bias adjustment factor is to use a national factor. For Somerset Scientific Services the national factor is based on data from just two sites and in 2019 was 0.78.

Despite being lower than calculated in previous years, the 2019 locally derived BAF is still more conservative than the national figure that would otherwise then need to be applied if the locally derived factor was not used. After detailed analysis of data capture rates, diffusion tube data capture rates, tube precision and consultation with the LAQM helpdesk, the BCC co-location sites have been identified as appropriate to use for bias adjustment calculations for 2019.

Bias adjustment factors used since 2015 have been provided in Table C. 1 to provide transparency and put the 2019 BAF in context to those used in previous years.

Table C. 6 – Bias Adjustment Factors 2015-2019

Year	Bias Adjustment Factor
2015	0.93
2016	0.93
2017	0.95
2018	0.92
2019	0.82

Short-term to Long-term Data Adjustment

Data capture rates for sites 14, 314, 461, 557, 560, 561, 562, 563, 564, 565, 567, 568, 569, 570 and 571 were below 75% as monitoring was either carried out for part of the year or diffusion tubes were tampered with by members of the public and taken from their sites.

Annualisation of diffusion tube data for all sites with less than 75% data capture was carried out in accordance with the methodology in Box 7.10 of LAQM TG16[15]. Data from the Background AURN monitoring sites at Swindon Walcot and Newport were used in the process.

The calculations made to annualise the data for these sites are included in Table C. 7.

[15] Defra, Local Air Quality Management Technical Guidance TG16 (Feb 2018)

Table C. 7 – Annualisation Calculation for tubes with <75% Data Capture for 2019

SITEID	B1	B2	D1RAW	B1 WHEN D1	B2 WHEN D1	R1	R2	RA	ANNUALISED NO2	BIASED ANNUALISED NO2
14	19.54	13.10	47.05	19.16	13.31	1.02	0.98	1.00	**47.15**	38.66
314	19.54	13.10	36.14	18.19	12.66	1.07	1.04	1.05	38.12	31.26
461	19.59	13.14	34.35	20.88	14.49	0.94	0.91	0.92	31.69	25.98
557	19.59	13.14	34.32	21.82	14.66	0.90	0.90	0.90	30.79	25.24
560	19.55	13.10	44.64	18.24	11.56	1.07	1.13	1.10	**49.23**	**40.37**
561	19.55	13.10	52.01	18.24	11.56	1.07	1.13	1.10	**57.36**	**47.03**
562	19.54	13.10	42.85	18.90	12.03	1.03	1.09	1.06	**45.48**	37.29
563	19.54	13.10	28.26	18.90	12.03	1.03	1.09	1.06	29.99	24.59
564	19.55	13.10	28.19	19.10	12.16	1.02	1.08	1.05	29.62	24.29
565	19.55	13.10	36.47	19.10	12.16	1.02	1.08	1.05	38.32	31.42
567	19.55	13.10	55.21	20.62	13.16	0.95	1.00	0.97	**53.66**	**44.00**
568	19.55	13.10	45.49	20.62	13.16	0.95	1.00	0.97	**44.21**	36.25

SITEID	B1	B2	D1RAW	B1 WHEN D1	B2 WHEN D1	R1	R2	RA	ANNUALISED NO2	BIASED ANNUALISED NO2
569	19.55	13.10	39.37	20.62	13.16	0.95	1.00	0.97	38.26	31.37
570	19.55	13.10	41.51	20.62	13.16	0.95	1.00	0.97	**40.34**	33.08
571	19.55	13.10	53.75	20.62	13.16	0.95	1.00	0.97	**52.24**	**42.83**

QA/QC of Automatic Monitoring

The Council's monitoring network is operated and run by officers trained in all aspects of the monitoring processes including routine site operations, field calibrations and data ratification. The QA/QC for the AURN Bristol St Pauls and Temple Way sites is carried out by Ricardo-AEA.

Routine Site Operations

The Council's monitoring sites have a programme of routine operational checks and programmed fortnightly site visits including:

- Daily communications checks on lines, data transfer and analyser operation;
- Daily checks of data quality;
- Repairs of faulty equipment under arrangements with outside contractors;
- Fortnightly site inspections of equipment operational status, site safety, security and calibration checks;
- Planned six monthly servicing and re-calibration of analysers by equipment suppliers under contract to the Council.

The Temple Way site is an affiliate site which is owned and maintained by Bristol City Council but also incorporated in the Defra AURN network. This site is maintained in accordance with the QA/QC processes as required for sites that form part of the National AURN network.

Equipment Servicing and Maintenance Regimes

BCC analysers have planned maintenance schedules that broadly follow those assigned to the AURN and affiliated site network. All analysers are maintained following manufacturers' instructions and have a six monthly full service and re-calibration conducted under the servicing contract. During 2019 the Equipment Support Services (ESU) were carried out by ESU1 Ltd. BCC's internal data ratification procedures have been used to ensure that the reported data is valid and meets the required standards. Results of the servicing, calibrations and repairs that were carried out by ESU1 Ltd are fully documented and stored centrally. BCC staff carry out routine maintenance during regular fortnightly site visits where all associated equipment such as sample lines, modem, and electrical system are examined and sample inlet filters are changed. Any faults, repairs or changes made to the equipment are also recorded and stored centrally and at analyser locations.

Calibration Methods

The calibration procedures are the same for all the Council's continuous analysers, with a two point zero/span calibration check being performed at regular intervals of two weeks. The methodology for the calibration procedure being derived from the manufacturers' instruction handbooks and from the AURN Site Operator's Manuals, as follows:

- Pre-calibration check - the site condition and status of the analyser is recorded prior to the zero/span check being conducted;
- Zero check – the response of the analyser to the absence of the gas being monitored;
- Span check – the response of the analyser to the presence of the gas of a known concentration;
- Post calibration check - the site condition and status of the analyser upon completion of all checks.

Each analyser zero/span check is fully documented with records being kept centrally using Google Sheets. Diagnostics data is recorded automatically through Envista ARM. Calibration factors are calculated in Google Sheets and are used in the scaling and ratification process.

Analyser Calibration

A two point calibration is conducted on Bristol City Council analysers with a reference NO mixture at a concentration of approximately 470ppb. Gases are supplied and certified by BOC.

Zero Air Generation

The contents of the portable scrubber (hopcalite, activated charcoal, purafil and drierite) are changed when necessary or at least every six months.

Appendix D: Map(s) of Monitoring Locations and AQMAs

Figure D.1 - Extent of Air Quality Management Area

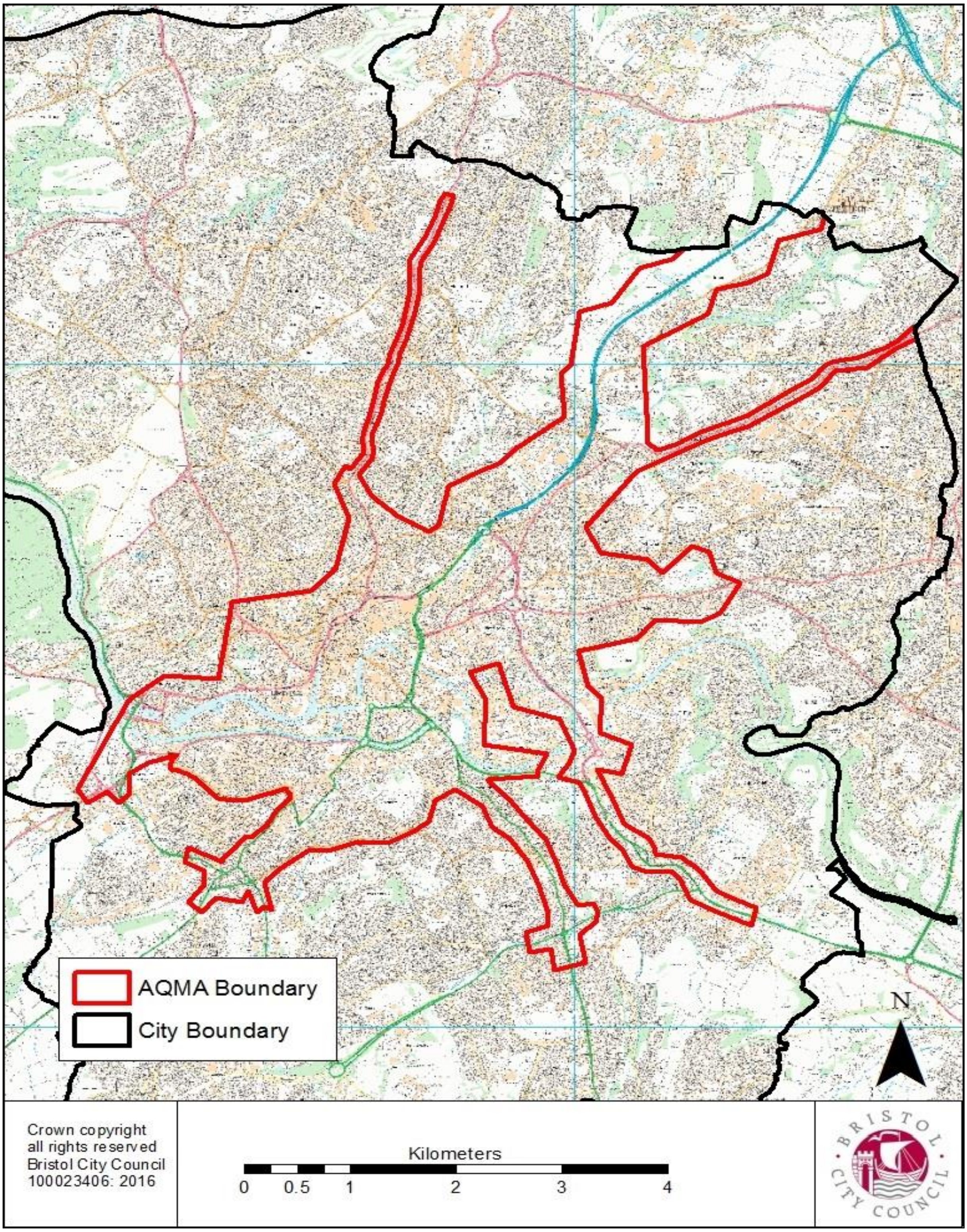


Figure D.2 - Central Monitoring Locations: 2019 Annual NO_2 Concentrations

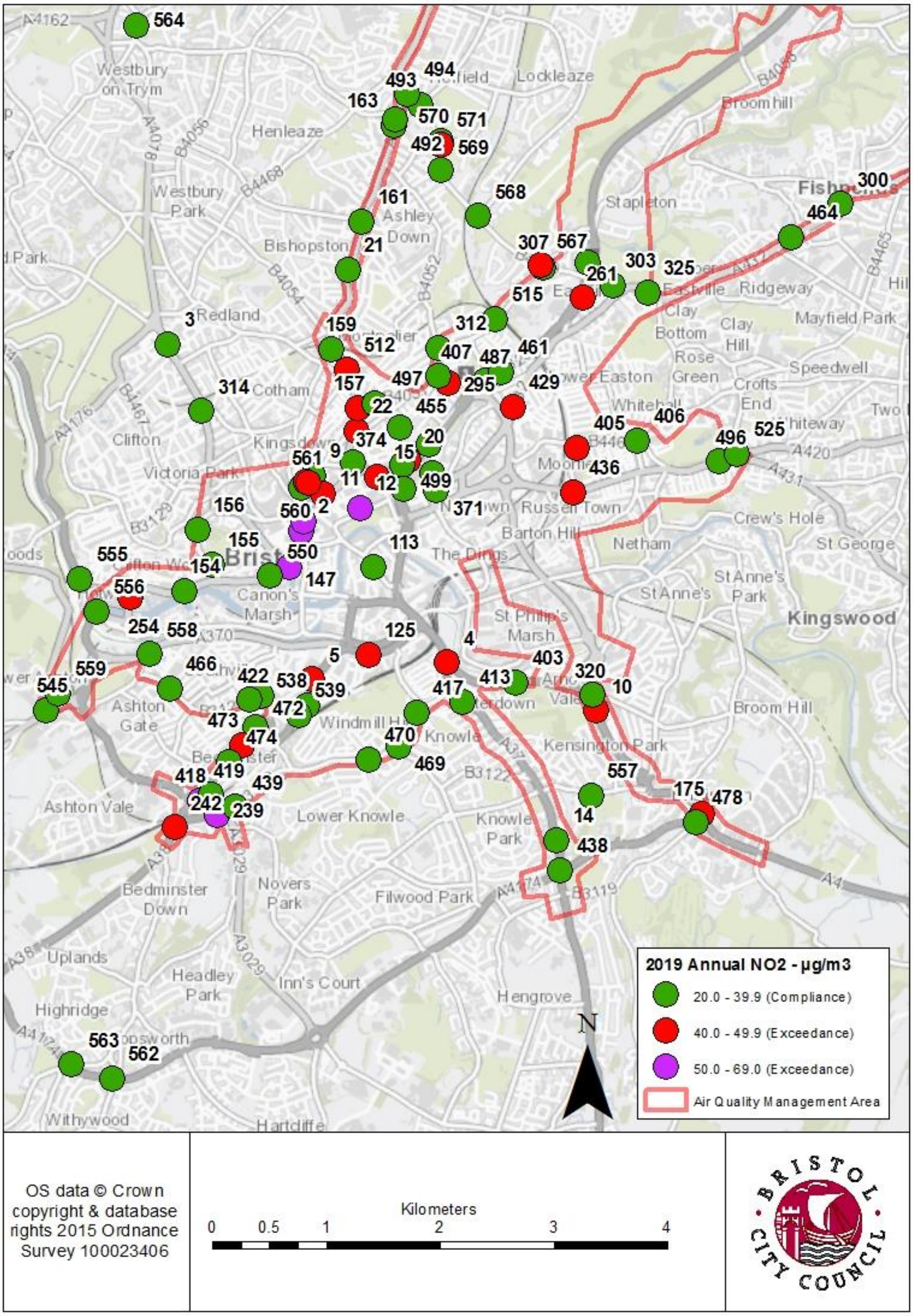


Figure D.3 - Central Monitoring Locations: 2019 Annual NO_2 Concentrations Distance Adjusted (where relevant)

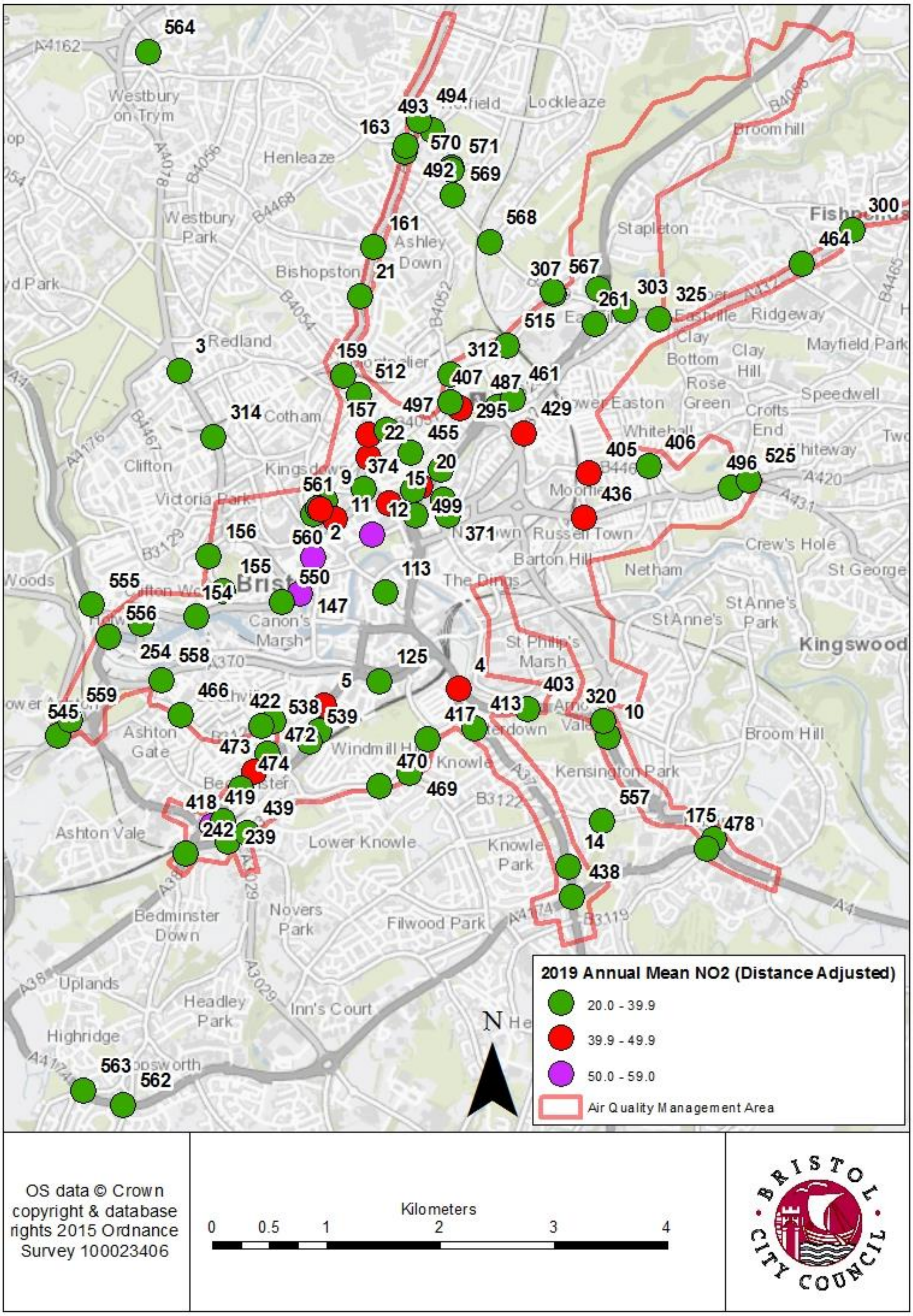


Figure D.4 - Avonmouth Monitoring Locations

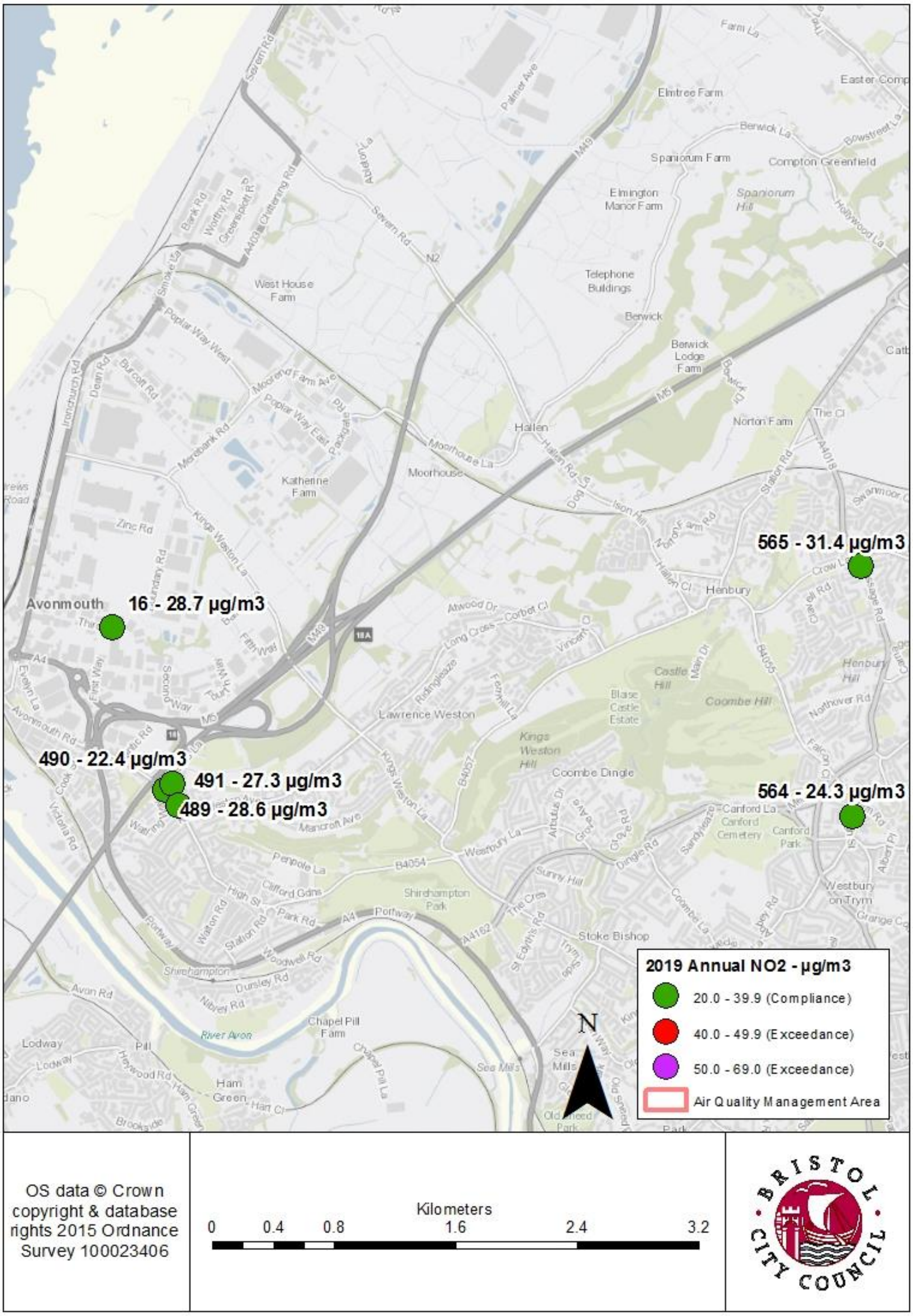
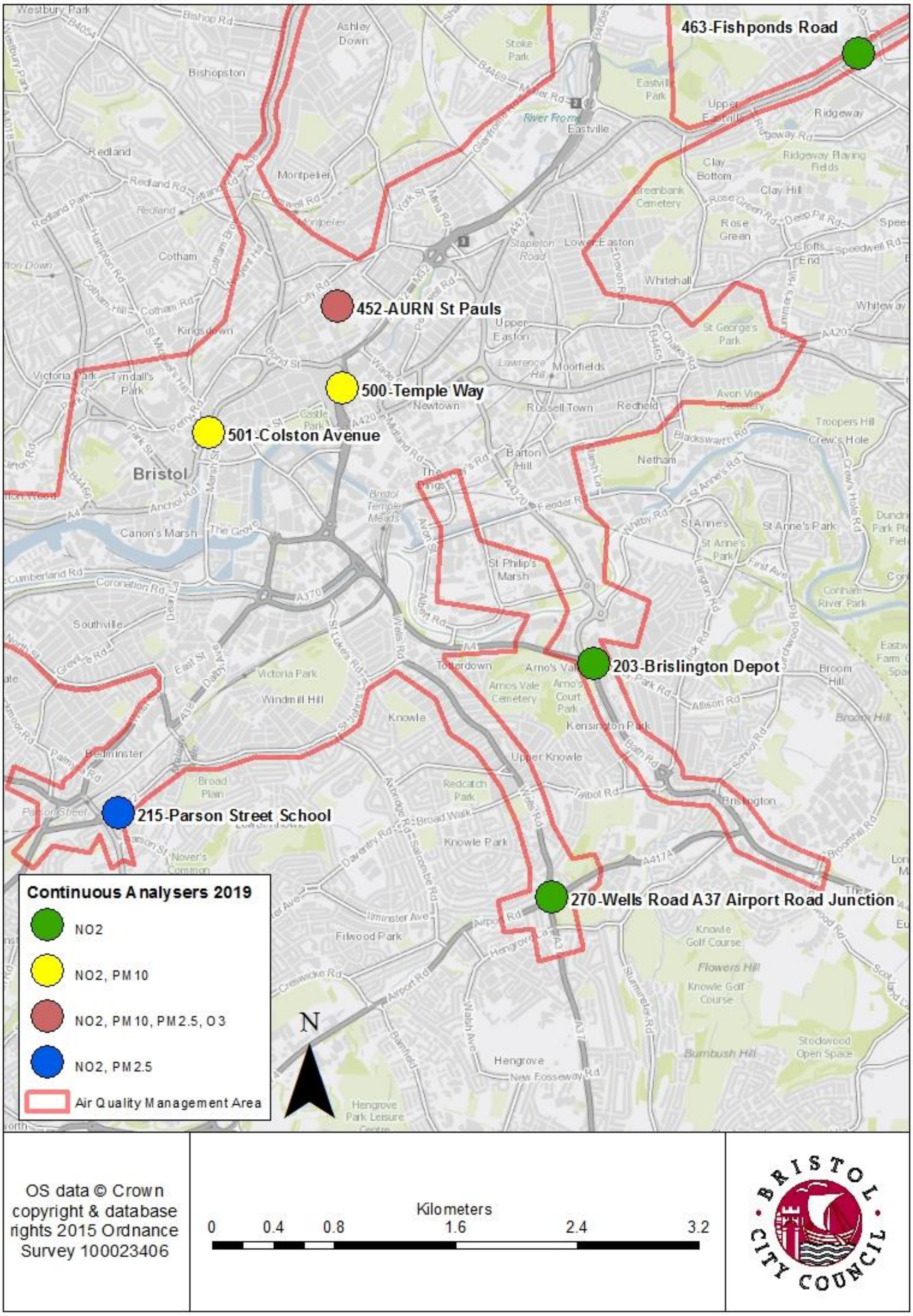


Figure D.5 - Continuous (real-time) Monitoring Locations in 2019



Appendix E: Summary of Air Quality Objectives in England

Table E.1 – Air Quality Objectives in England

Pollutant	Air Quality Objective[16]	
	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

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

Glossary of Terms

Abbreviation	Description
AQAP	Air Quality Action Plan - A detailed description of measures, outcomes, achievement dates and implementation methods, showing how the local authority intends to achieve air quality limit values’
AQMA	Air Quality Management Area – An area where air pollutant concentrations exceed / are likely to exceed the relevant air quality objectives. AQMAs are declared for specific pollutants and objectives
ASR	Air quality Annual Status Report
Defra	Department for Environment, Food and Rural Affairs
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
NRMM	Non-Road Mobile Machinery
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
SO_2	Sulphur Dioxide