2018 Air Quality Annual Status Report (ASR)

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

June 2019

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Executive Summary

Health Impacts of Air Pollution

Air pollution can cause, complicate, or exacerbate many adverse health conditions. It is usually manifested by respiratory or cardiac symptoms and can lead to chronic health issues. Recent studies show that poor air quality can affect every organ in the body[1] and even cause damage to cognitive performance[2]. Exposure to poor air quality is directly related to diseases such as cancer, asthma, stroke, heart disease, diabetes, obesity and dementia[5, 6].

According to the World Health Organisation (WHO)[3], air pollution kills an estimated 8 million people worldwide every year, of which 4.2 million are attributed to exposure to outdoor air pollution and 3.8 million to indoor air pollution. Currently nine out of 10 people in the world breathe air containing health impacting levels of air pollutants.

Although air pollution affects people of all regions, ages, and social groups, it is likely to impact those who experience heavy exposure and who have greater susceptibility more[4]. The most vulnerable are children, the elderly, or those with pre-existing medical conditions.

Harmful effects of air pollution are seen at levels below air quality standards previously considered to be safe.[5,6]

The 2008 Ambient Air Quality Directive[7] (ED/2008/50/EC) sets legally binding limits for concentrations in outdoor air for major air pollutants that impact public health such as particulate matter (PM_{10} and $PM_{2.5}$) and nitrogen dioxide (NO_2), to be met before 2010. The limit values were established in 2008 and are now over 10 years old. The majority of UK cities failed to meet the objective by 2010 as required by the Directive. Significant amounts of research have been completed in the time since the air quality directive was established which has provided further evidence of the health impacts of air pollution.

The World Health Organisation (WHO) has set guideline[8] values for key air pollutants based on evidence of their health impacts. The recommended WHO guideline values are significantly lower for PM_{10} and $PM_{2.5}$ than the UK limit values. The WHO guideline values for NO_2 currently corresponds to the UK limit value of 40μgm^{-3}

(annual mean) and 200 μgm^{-3} (hourly mean), however both short- and long-term studies have found adverse health impacts at concentrations that were at or below the current UK limit values. A WHO Expert Consultation[9] has therefore recommended that a new revised limit for NO_2 is set as soon as possible. Several studies[1,2] suggest that there are in fact no 'safe' levels of air pollution and that governments should therefore be aiming for the lowest possible air pollution levels. Table E2 in Appendix E shows the WHO recommended limit values for each pollutant.

Air Quality in Oxford

The city of Oxford, in common with many urban areas throughout the United Kingdom, is subject to poor air quality, particularly in areas with high levels of road traffic. In the city, nitrogen dioxide (NO_2) continues to be the pollutant of most concern, and transport is the most significant source of emissions of oxides of nitrogen ($NO+NO_2$), commonly called NO_X. Traffic accounts for 75% of emissions.

The process of review and assessment of air quality in Oxford has been taking place since 1999. In 2010, the whole of the city of Oxford was declared as an Air Quality Management Area (AQMA) and an Air Quality Action Plan (AQAP) was adopted by the Council in 2013. More details on the AQMA and AQAP are available here:

https://www.oxford.gov.uk/info/20216/air_quality_management/206/air_quality_management_in_oxford/2

Air Quality has significantly improved over the period 2008-2018 in the city of Oxford. Over this period, we have seen declines of 37% in NO_2 levels and of 25% in Particulate Matter (PM_{10}) levels in the places where air quality is monitored.

The majority of the reductions observed over the above period have to do mainly with significant changes in traffic emissions. The introduction of a Low Emission Zone (LEZ) for buses in the city in 2014 and the retrofit of several buses to cleaner Euro VI engines (which achieve an estimated 99.5% reduction in NOx emissions compared to Euro V), have contributed to these improvements.

Oxford City Council monitored air quality at a total of 72 sites in 2018. A total of 71 sites were monitored using diffusion tubes and three sites using continuous

monitoring. In two locations air quality was measured using both monitoring techniques.

Analysis of air quality data for 2018 show that the majority of monitoring sites in Oxford continue to improve. However, the results also show that the rate at which these reductions are taking place seems to have slowed down in comparison with the previous monitoring year, and that in some areas of the city, air pollution appears to have plateaued.

At sites where NO_2 was monitored in both 2017 and 2018, 50% showed improvements in air quality; 20% measured the same levels as the previous year and 30% showed slight increases in NO_2 values. However, the majority of the increases and decreases in air pollution levels were within the margin of error of the monitoring method (between 1-2 $\mu g/m^3$), which means that the NO_2 levels measured at those locations in 2018 cannot be considered statistically significant.

Four locations in the city monitored exceedance of the annual mean legal limit value for NO_2 in 2018. This is down from a total of 17 sites just five years ago. In 2018, results also show that PM_{10} levels reduced in Oxford by 3% and $PM_{2.5}$ reduced by 9%.

In addition, analysis of NO_2 concentrations at the two urban background sites (AURN Oxford St Ebbes Primary School and Lenthal Road allotments) seem to indicate a slight increase of urban background levels in Oxford in 2018.

Urban background sites are located away from major roads, which mean that they are not dominated by local, single pollution sources, but rather by a combination of sources of a much wider area (e.g. traffic, energy systems, general combustion sources, agriculture, industry, windblown pollution, etc.).

In 2018, Oxford's urban background sites showed that the NO_2 urban background levels of the city rose by 1-3 ugm^{-3}. It is therefore likely that the minor increases in NO_2 levels observed across the city can be explained by the increase of the urban background level. While urban background levels have risen across the city, it is not reflected in the monitoring results at all sites. This is because the increase in urban background levels could be masking a larger drop in NOx reductions in traffic.

Whilst the air pollution decreases observed throughout 2018 mean that everyone living in or visiting Oxford is now breathing cleaner air than at any given time over the last decade, there is still much that needs to be done. We need to ensure that air quality levels continue to reduce significantly throughout the city, and that Oxford's air is not just cleaner, but safer to breathe.

In January 2019, Oxford City Council, and Oxfordshire County Council published updated proposals for a Zero Emission Zone (ZEZ) in Oxford city centre. The ZEZ aims to tackle Oxford's air pollution and protect the health of everyone who lives in, works in and visits the city.

From 2020, under the proposals, all non-zero emission vehicles could be banned during certain hours from parking and loading on public highway in an inner zone, while in a larger zone the requirement will be Euro 6 for buses. Citywide taxi emissions standards will apply from 2020, with increasingly improving standards to 2025.

It is also expected that the ZEZ will improve air pollution levels across Oxfordshire because the buses and taxis that serve Oxford also serve towns and villages across the county.

Actions to Improve Air Quality

Oxford's Air Quality Action Plan (AQAP) focusses on measures the City Council has the ability to address, but includes measures that we can influence, or work in partnership with others to deliver. Effective action require co-operation from all sectors including transport, construction, business and commerce, and daily choices made by every single transport user. Oxford's AQAP recognises that the City Council cannot act in isolation in order to deliver a comprehensive package of measures without engagement and delivery from a wide range of stakeholders.

The following are actions that Oxford City Council has already taken to improve air quality in the city:

1. Secured £128,500 from the Department for Environment, Food and Rural Affairs (DEFRA) Air Quality Fund for the testing of low cost innovative Air Quality sensors to map air pollution and human exposure in Oxford. This

project will be delivered in partnership with local group OxAir (link to press release);

2. Secured £122,500 from DEFRA Air Quality Fund for the development of a robust, integrated communication and engagement plan, to inform and work with businesses in the city centre on how to adopt zero emission delivery and servicing solutions for their business. (link to press release);
3. Secured £10 million from central Government as part of a £41 million project for the development of an innovative new Energy Super hub project in Oxford (ESO), to cut carbon emissions and improve air quality in the city. The project will involve the installation of a giant battery, allowing spare capacity to be fed into a new high capacity electric supply. This will power thousands of electric vehicle's via rapid charging stations to enable migration of full fleets to electric vehicles. The project will also deliver 320 heat pump installation, that will be rolled out across the city and provide low cost carbon heating to homes (link to press release)
4. Secured £2.3million from the Clean Bus Technology fund (CBTF) for the retrofit of 5 buses to fully electric and 115 to euro VI standard, with expected NO_2 savings of 5.5 tonnes/year and a total of 27.6 tonnes over the lifetime of the project (link to press release);
5. Secured nearly £200,000 from DEFRA's Air Quality Fund for the purchase of electric delivery vehicles and installation of charging points to address the specific issue of Covered Market deliveries, to help retailers get ready for the introduction of the Zero Emission Zone to be introduced progressively across the city centre from 2020 (link to press release);
6. Creation of new emission standards for Hackney Carriage Vehicles, which will see Hackney taxis adopting a phased approach to zero-emission capable vehicles between 2020 and 2025, with drivers only able to get a licence in 2025 if they have a zero-emission capable cab. The new standards were developed in consultation with City of Oxford Licensed Taxi Association (COLTA) and with feedback from taxi drivers and owners (link to press release)

7. Co-organised (in association with Green TV and Electric Drives) and delivered the first Electric Vehicle summit in Oxford. The event took place at the Saïd Business School in Oxford, on 4th-5th July 2018 and brought together key figures in the electric vehicles and EV charging markets to explore the opportunities and barriers for those working in electro-mobility (link to press release)
8. A new charter for cleaner air was been launched by Oxford City Council, Greenpeace UK, and Friends of the Earth. The charter, which was created by Oxford City Council, is believed to be the first formal cooperation with Greenpeace UK and Friends of the Earth (EWNI) (England, Wales and Northern Ireland) to be led by a local authority. (link to charter)
9. Oxford City Council attended and supported National Clean Air Summit organised by UK100 and hosted by Mayor of London Sadiq Khan which included meetings with ministers to discuss the current clean air crisis.
10. Hosted Birmingham and Nottingham to share knowledge between UK cities and facilitate partnership work across the UK.
11. Launched an educational toolkit for primary and secondary schools in Oxford, which provides science teachers with a range of interactive activities, based both in the classroom and outdoors, to raise awareness about the causes and impacts of air pollution (link to press release);
12. Launched, a city wide anti-idling campaign in partnership with Friends of the Earth called *'Oxford Air Needs Your Care'*, particularly focused on tackling vehicles idling around schools during drop off and pick up times (link to Anti-Idling campaign);
13. Published Air Quality Planning Application Guidance, in recognition that one of the ways to reduce air pollution effectively is through efficient use of the planning system. The new guidance is aimed at creating a better understanding of the air quality requirements that need to be considered by applicants prior to the submission of a valid planning proposal, and is available for download at Oxford City Council's Air Quality website;
14. Worked in collaboration with Oxfordshire County Council Public Health, and Oxford Health respiratory nurses and physios working in the Integrated

Respiratory Team project of Churchill's Hospital in Oxford, to explore ways to provide better Air Quality communication and advice for Chronic Obstructive Pulmonary Disease (COPD) patients.

15. Delivered a feasibility study, a public consultation and updated proposals for the introduction of a Zero Emission Zone (ZEZ) in Oxford city centre, following 15 months of listening to businesses, residents, transport operators and health experts in Oxfordshire. The proposed ZEZ is expected to start in 2020, with restrictions on some vehicles and journey types, which will increase gradually to all vehicles in the following years. The ZEZ is delivered in partnership between Oxfordshire County Council and Oxford City Council (link to website);
16. Launched the Go Ultra Low Oxford project (GULO), with the aim of increasing uptake of ultra-low emission vehicles through support for individuals and provision of enabling infrastructure (link to press release);
17. Launched a project for the provision of 19 electric vehicle charging points for the use of hackney carriages and private hire taxis in the city. The scheme also includes an investigation of the business case for investment in ultra-low emissions taxis based on local Oxford duty-cycles; (link to press release);
18. Participated in several DEFRA webinars, including one as main speaker, where we shared our experience of introducing and implementing a Low Emission Zone for the city with DEFRA and other local authorities, to inform consideration of the most appropriate mechanism for establishing newly proposed Clean Air Zones (CAZ);
19. Supported and run "*Test Drive the Future"* events to introduce the public to a range of electric vehicles (EVs) and the financial and environmental benefits of going electric. The events provide an opportunity to test drive vehicles, and outline the options for driving an electric car *'pay as you go'* through one of Oxford's car clubs (link to press release);
20. Created an Air Quality steering group with members from Oxford City Council, Oxfordshire County Council and relevant Councillors with the objective of specifically address the problem of poor air quality around St Clements in Oxford (link to press release);

21. Developed a set of air quality stickers placed at all monitoring locations, with relevant AQ information and direct link to Oxfordshire's air quality website, in order to improve communication around air quality with members of the public;
22. Launched the Schools Tackling Oxford's Air Pollution (STOP) Project, which provides real-time NO_2 and PM_{10} air quality monitors in 6 schools. The project was awarded the Communications Initiative of the Year at the National Air Quality Awards 2018 (link to press release);
23. Declared the whole of the city an Air Quality Management Area for NO_2;
24. Developed an Air Quality Action Plan and Low Emission Strategy for the city;
25. Introduced the first extensive Low Emission Zone (LEZ) outside of London. This won the prize for Local Authority Air Quality Initiative of the Year at the National Air Quality Awards 2015 (link to press release);
26. Launched the Oxfordshire Air Quality website to make historic and real time air quality data more readily accessible to members of the public;
27. Increased the number of diffusion tube monitoring locations in the city by nearly 50% from January 2015 – we now monitor air quality in 72 locations around the city;
28. Launched Oxford Park and Pedal which has seen over 100 cycle parking spaces introduced at two of our park and ride sites;
29. Engaged with the Oxfordshire Health Improvement Board to ensure that air quality is considered in the context of the Joint Strategic Needs Assessment (JSNA);
30. Continued to seek opportunities to work in partnership with neighbouring District Councils through participation in the Oxfordshire Air Quality Group.

Conclusions and Priorities

The results of the monitoring work carried out by Oxford City Council in 2018 show the following:

1. The annual mean Air Quality Strategy (AQS) objective for NO_2 is 40 μgm^{-3}. This objective was met for the second consecutive year at all our automatic monitoring sites: AURN Oxford Centre Roadside, Oxford High Street, and

AURN Oxford St. Ebbes. In 2018, Oxford Centre roadside registered an annual mean for NO_2 of 39 ugm^{-3}, Oxford High Street an annual mean of 38 ugm^{-3}, and Oxford St. Ebbes an annual mean of 15 ugm^{-3}. The results obtained attest for the continuous downward trend that has been observed at those sites since 2012, with the introduction of the Low Emission Zone.

2. Diffusion tube results show that the annual mean AQS objective of 40 μgm^{-3} for NO_2 was exceeded at four of the 72 monitoring locations in 2018. This is the same result as that seen in 2017. The locations where the annual mean NO_2 limit value was exceeded in 2018 are: St. Clements Street/The Plain, George Street, Cutteslowe Roundabout and High Street.

3. The AQS hourly mean objective for NO_2 is 200 μgm^{-3}, with no more than 18 exceedances allowed each year. Only one exceedance of this value was recorded in 2018. An NO_2 hourly mean of 213.1 μgm^{-3} was observed at 7am on the 26th November, at AURN Oxford Centre Roadside (St Aldates). This pollution spike was attributed to a vehicle which was in operation in front of the monitoring location. This objective was achieved at all our automatic monitoring sites in 2018.

4. There were five new locations where air pollution was monitored in 2018: Quarry Road, St Gilles', St Clements Street East, Roger Dudman Way and William Lucy Way. None of these five locations experienced exceedances of the annual mean limit value for NO_2.

5. Half of the sites where air quality was monitored in 2017 registered air quality improvements in 2018. Twenty percent of the sites measured the exact same levels of NO_2 as was measured in the previous year, and 30% of the sites showed slight increases in the NO_2 values measured in 2018 compared to 2017. However, it is important to highlight that the vast majority of the observed increases and decreases were only of 1-2 ugm^{-3}, which are well within the error margin of the monitoring method. This means that the NO_2 levels measured at those locations in 2018 cannot be considered statistically significant.

6. Five locations measured increases of 3-4 ugm^{-3} NO_2 in 2018. The locations are: Lenthal Road Allotments, Headington Roundabout, Botley Road (corner

with Mill Street), New Road, and Thames Street/Trinity Street. While increases in NO_2 were identified, the annual mean values that were measured at those locations were all within the range of 14-29 ugm^{-3}, which is below the current annual mean limit value for NO_2 (40 ugm^{-3}).

7. One site is now, for the first time, in compliance with the annual mean limit value for NO_2: BP Service Station on Woodstock Road (Wolvercote Roundabout). The concentration registered at this location (38 ugm^{-3}) is only marginally below the threshold for compliance and given the degree of uncertainty associated with the diffusion tube methodology a further year of consistent results are required to verify the result.

8. The monitoring location with the highest annual mean for NO_2 in 2018 was St. Clements Street/The Plain - with a value of 46 μgm^{-3}. This has reduced significantly over the last five years, by a total of 29%.

9. In 2018 the first full year of monitoring was completed since the opening of Westgate Oxford. Air Quality was monitored at a total of 13 locations around Westgate Oxford and results showed a reduction in air pollution at all 13 sites, by an average of 6 μgm^{-3}, when compared with the levels measured in 2015, the year prior to the start of construction works.

10. The annual mean AQS limit value for PM_{10} is 40 μgm^{-3}. WHO guidelines for PM_{10} however recommend that the annual mean limit for this pollutant should be 20 μgm^{-3}. The PM_{10} annual mean results obtained from the two automatic monitoring stations, Oxford High Street and St. Ebbes, were of 18 μgm^{-3} and 12 μgm^{-3} respectively. These figures show that both AQS and WHO limit values were achieved in 2018 for this pollutant.

11. PM_{10} may exceed the 24-hour mean limit of 50 μgm^{-3} no more than 35 times per year to meet the AQS objective. During 2018, there was only 1 exceedance to this value, which was recorded on Saturday 3rd March at the automatic monitoring station of Oxford St Ebbes. The exceedance was not directly related with pollution generated in the city but instead it was attributed to a trans-boundary pollution episode involving the dispersion of particulates from coal burning areas in Eastern Europe. The AQS objective for hourly PM_{10} was therefore met in 2018.

12. $PM_{2.5}$ has a non-mandatory AQS annual mean compliance target of 25 μgm^{-3}. As for PM_{10}, WHO guidelines are much stricter for this pollutant with a recommended annual mean limit value of 10μgm^{-3}. St Ebbes recorded a $PM_{2.5}$ annual mean of 10μgm^{-3} in 2018, which means that both the non-mandatory AQS and WHO limit values were achieved in 2018 for this pollutant.

13. Ozone (O_3) has an AQS objective for daily maximum on an eight hour running mean of 100μgm^{-3}, not to be exceeded more than 10 days a year. In 2018, Oxford St. Ebbes exceeded the AQS daily objective for ozone during a total of 27 days. Ozone develops under specific meteorological conditions, characterised by large stagnant areas of high pressure. This is why it is considered an area wide pollutant, and emissions are not alone attributed to a local area. In 2018, the ozone exceedances monitored at Oxford St. Ebbes were related with a major regional ozone episode that covered London and the entire south east of England, during a period of 35 days in June and July. The AQS objective for ozone was therefore not achieved in 2018.

Oxford City Council's priorities for 2019 are to:

1. Progress plans for the introduction of a ZEZ in Oxford, working in partnership with the Local Transport Authority – Oxfordshire County Council;

2. Run anti-idling campaigns across the city in partnership with Friends of the Earth (FoE) Oxford and local schools;

3. Complete evaluation of the initial trial of EV chargers and roll out a further 100 EV chargers across the city by the end of March 2021, as part of the GULO project;

4. Finalise the delivery of £2.3 million CBTF project for the retrofitting of five of the city's open-top sightseeing buses to become fully electric, and the retrofitting of 115 local buses to euro VI standards, using Selective Catalytic Reduction (SCR) technology;

5. Work in partnership with OxAir to deliver £128,500 DEFRA Air Quality Grant funded project aimed at testing low cost innovative Air Quality sensors to map air pollution and human exposure in Oxford;
6. Initiate delivery of a £122,500 DEFRA Air Quality Grant funded project aimed at the development of a communication and engagement plan, to inform and work with businesses in the city centre on how to adopt zero emission delivery and servicing solutions for their business;
7. Initiate delivery of a £40 million central Government funded project for the development of an innovative new energy super hub project in Oxford;
8. Progress £200,000 DEFRA Air Quality Grant funded project aimed at facilitating Oxford's historic Covered Market to go electric through the provision of electric charging points and electric delivery vehicles;
9. Actively engage with and support schools to raise awareness of air pollution, through the schools STOP project, and running of anti-idling campaigns;
10. Continue to improve communication with the public on air quality, review our Air Quality website and ensure we provide easy access to material about air pollution;
11. Continue the expansion of the City Council's fleet of electric vehicles which currently counts 27 full electric vehicles and 23 electric/diesel light commercial hybrid vehicles;
12. Continue developing work for the provision of electric vehicle charging infrastructure for the use of hackney carriages and private hire taxis in the city, using £370,000 of funding awarded by the Government's Office for Low Emissions Vehicles.
13. To organise and deliver a new Electric Vehicle Summit in Oxford, this time with focus on dual themes of business development and thought leadership, bringing together key leaders from across the electric vehicle and charging infrastructure industry.

How to get involved

Everyday decisions can have an impact on the air we breathe. Do you take the car when you could have cycled? Do you drive your children to school when you could have walked? We all have a huge role to play and we can all be part of the solution. Encouraging walking and cycling in the city not only has a positive impact on air quality levels, but it also has multiple other benefits, including increasing the health of wellbeing of all those who live, work and visit Oxford.

Full details of Oxford's air quality monitoring results, including real time data on pollutant levels and reference to the city's daily Air Quality Index (AQI), a metric on the daily levels of air pollution, together with recommended actions and health advice is available on the Oxfordshire Air Quality Group (OAQG) website https://oxfordshire.air-quality.info/

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1 Local Air Quality Management

This report provides an overview of air quality in Oxford during 2018. 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 Oxford City council to improve air quality and any progress that has been made.

The statutory air quality objectives applicable to LAQM in England, and the World Health Organisation (WHO) air quality guidelines can be found in Tables E1 and E2 in Appendix E.

2 Actions to Improve Air Quality

2.1 Air Quality Management Areas

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

A summary of AQMAs declared by Oxford City Council can be found in Table 2.1 below. Further information related to declared or revoked AQMAs, including maps of AQMA boundaries are available online on the website of the Department for Environment, Food & Rural Affairs (DEFRA): https://uk-air.defra.gov.uk/aqma/local-authorities?la_id=193. The boundaries of the current AQMA are also available in Oxfordshire's air quality website: https://oxfordshire.air-quality.info/.

Maps showing the locations where air quality monitoring was carried out during 2018 can be found in Appendix D. All monitoring locations are inside the city's current AQMA.

Table 2-1 – Declared Air Quality Management Areas

AQMA Name	Date of Declaration	Pollutants and Air Quality Objectives	City / Town	One Line Description	Is air quality in the AQMA influenced by roads controlled by Highways England?	Level of Exceedance (maximum monitored/modelled concentration at a location of relevant exposure)				Action Plan		
						At Declaration		Now		Name	Date of Publication	Link
The City of Oxford AQMA	Declared in 2010	NO_2 annual mean	Oxford	The whole of the administrative area of Oxford City Council	YES	78	μgm^{-3}	46	μgm^{-3}	Air Quality Action Plan 2013-2020	2013	https://www.oxford.gov.uk/downloads/file/539/air_quality_action_plan_2013.

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

2.2 Progress and Impact of Measures to address Air Quality in Oxford

Oxford City Council has taken forward a number of direct measures during the current reporting year of 2018 in pursuit of improving local air quality. Details of all measures completed, in progress or planned are set out in Table 2.2 below.

More detail on these measures can be found in the AQAP. Key completed measures in 2018 include:

- Secured £128,500 from the Department for Environment, Food and Rural Affairs (DEFRA) Air Quality Fund for the testing of low cost innovative Air Quality sensors to map air pollution and human exposure in Oxford. This project will be delivered in partnership with local group OxAir;
- Secured £122,500 from DEFRA Air Quality Fund for the development of a robust, integrated communication and engagement plan, to inform and work with businesses in the city centre on how to adopt zero emission delivery and servicing solutions for their business.;
- Secured £10 million from central Government as part of a £41 million project for the development of an innovative new Energy Super hub project in Oxford (ESO), to cut carbon emissions and improve air quality in the city. The project will involve the installation of a giant battery, allowing spare capacity to be fed into a new high capacity electric supply. This will power thousands of electric vehicle's via rapid charging stations to enable migration of full fleets to electric vehicles. The project will also deliver 320 heat pump installation, that will be rolled out across the city and provide low cost carbon heating to homes
- Secured £671.550 as part of an extension of the Clean Bus Technology fund (CBTF) for the retrofit of 37 buses to euro VI standard;
- Continuous delivery of the STOP Project to schools, providing support to teachers to any activity related with Air Quality or the Air Quality Toolkit during science weeks and along the year, as well as with the organisation and delivery of anti-idling campaigns in schools. The STOP project was awarded in October 2018 the Air Quality communications initiative of the year, at the national Air Quality Awards;

- Delivery of an Air Quality Planning Applications Guidance, aimed at creating a better understanding of the air quality requirements that need to be considered by applicants prior to the submission of a valid planning proposal. The guidance is available for download at Oxford City Council's Air Quality website;
- Delivery of updated proposals for the introduction of a Zero Emission Zone (ZEZ) in Oxford city centre, following 15 months of listening to businesses, residents, transport operators and health experts in Oxfordshire;
- Ensured that Air Quality is considered fully in the Oxford Local Plan, by creating air quality policies that are able to effectively respond to the city's air quality problems in the future;
- A new charter for cleaner air was been launched by Oxford City Council, Greenpeace UK, and Friends of the Earth. The charter, which was created by Oxford City Council, is believed to be the first formal cooperation with Greenpeace UK and Friends of the Earth (EWNI) (England, Wales and Northern Ireland) to be led by a local authority.
- Oxford City Council attended and supported National Clean Air Summit organised by UK100 and hosted by Mayor of London Sadiq Khan which included meetings with ministers to discuss the current clean air crisis.
- Hosted Birmingham and Nottingham to share knowledge between UK cities and facilitate partnership work across the UK.
- Delivery of the 12 month trial for testing different on-street charging equipment, as part of Go Ultra Low Oxford, planning for the roll out phase of the 100 EV on street chargers.
- Development of a proposal for the introduction of new emission standards for Hackney Carriage Vehicles, to facilitate the adoption of a phased approach to zero-emission capable between 2020 and 2025;
- Development of a Delivery and Servicing Survey to be shared with Covered Market retailers, to help them prepare for the introduction of Zero Emission Zone, to be introduced progressively across the city centre from 2020;

- The co-organisation and delivery of the first Electric Vehicle summit in Oxford. The event took place at the Saïd Business School in Oxford, on 4th-5th July and brought together key figures in the electric vehicles and EV charging markets to explore the opportunities and barriers for those working in electro-mobility;
- The delivery of a city wide anti-idling campaign, in partnership with the local group Friends of the Earth, particularly focused on tackling vehicles idling around schools during drop off and pick up times;
- Positive engagement with DEFRA, providing Oxford City Council's views and ideas during the open consultation phase of the new Air Quality Strategy for the UK.

Progress on the following measures has been slower than expected:

- The full delivery of funding obtained from DEFRA's Air Quality Fund for the purchase of electric delivery vehicles and installation of charging points to support retailers to get ready for the introduction of Oxford's ZEZ has been delayed due procurement issues and the need to integrate the project into plans for Market Street as a result of Jesus College redevelopment.

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

- Continue to develop work, in partnership with the Local Transport Authority – Oxfordshire County Council, for the introduction of a Zero Emission Zone (ZEZ) in Oxford city centre,
- Continue to deliver the anti-idling campaign '*Oxford Air Needs Your Care'*, in partnership with Friends of the Earth, particularly focused on tackling vehicles idling around schools during drop off and pick up times;
- To complete evaluation of trial and development of strategy and governance process to roll out a further 100 chargers by end March 2021, as part of GULO Project;

- Finalise the delivery of £2.3million CBTF project for the retrofitting of five of the city's open-top sightseeing buses to become fully electric, and the retrofitting of 115 local buses to euro VI standards, using Selective Catalytic Reduction (SCR) technology;

- To deliver a £128,500 DEFRA Air Quality Grant funded project involving partnership work with local group OxAir, aimed at testing low cost innovative Air Quality sensors to map air pollution and human exposure in Oxford;

- To deliver a £122,500 DEFRA Air Quality Grant funded project aimed at the development of a robust, integrated communication and engagement plan, to inform and work with businesses in the city centre on how to adopt zero emission delivery and servicing solutions for their business;

- Initiate delivery of a £41 million project for the development of an innovative new Energy Super hub project in Oxford (ESO), to cut carbon emissions and improve air quality in the city.

- To deliver a £200,000 DEFRA Air Quality Grant funded project aimed at facilitating Oxford's historic Covered Market to go electric through the provision of electric charging points and electric delivery vehicles;

- Continue to provide full support to the primary and secondary school community in Oxford, delivering anti-idling campaigns, and providing assistance to teachers in the implementation of citizen science AQ activities developed in the recently released AQ toolkit;

- Continue to improve communication with the public on air quality, review our Air Quality website and ensure we provide easy access to material about air pollution;

- Continue the expansion of the City Council's fleet of electric vehicles which currently counts 27 full electric vehicles and 23 electric/diesel light commercial hybrid vehicles;

- Continue developing work for the provision of electric vehicle charging infrastructure for the use of hackney carriages and private hire taxis in the city,

using £500,000 of funding awarded by the Government's Office for Low Emissions Vehicles.

- To organise and deliver a new Electric Vehicle Summit in Oxford, this time with focus on dual themes of business development and thought leadership, bringing together key leaders from across the electric vehicle and charging infrastructure industry.

Table 2-2 – Progress on Measures to Improve Air Quality

	Measure	EU Category	EU Classification	Organisations involved and Funding Source	Planning Phase	Implementation Phase	Key Performance Indicator	Reduction in Pollutant / Emission from Measure	Progress to Date	Estimated Completion Date	Comments
1	Manage bus emissions through the implementation of the Low Emission Zone	Promoting Low Emission Transport	Low Emission Zone (LEZ)	Oxford City Council/Oxfordshire County Council	Complete	On-going	All local bus services within the streets affected must be operated exclusively by buses whose engines meet the Euro V emission standard	N/A	The Low Emission zone has been implemented	Completed	Zone successfully introduced in 2014
2	Work to ensure sustainable transport measures developed in the Oxford Area Strategy of the LTP support the targets of the AQAP	Promoting Low Emission Transport	Other	Oxford City Council/ Oxfordshire County Council	Complete	Complete	Oxford Transport Strategy includes measures that support delivery of the AQAP	N/A	The Oxford Transport Strategy has been published and includes measures which support the targets of the AQAP Oxfordshire County Council measures in 2018: Proposal submitted to promote significant changes to Hythe Bridge street junction, to improve bus flow and reduction of parking on Park End Street. Removal of traffic lights on park end street Introduction of Controlled Parking Zones (CPZs) in some areas of the city (ex: Magdalen South and Wood Farm) with Hollow Way being the next street expected to be affected	On-going	
3	Support walking and cycling strategies within the LTP to ensure they assist delivery of the AQAP objectives	Promoting Travel Alternatives	Promotion of Cycling	Oxford City council /Oxfordshire County Council	Complete	Complete	Walking and Cycling strategies include measures that support delivery of the AQAP	N/A	The Active Healthy Travel Strategy has been published and includes measures to support the targets of the AQAP with various schemes around the city including new cycle assess to Headington, riverside routes, etc. Publication in 2017 of the code of conduct for dock less bike sharing operators, which lays down the process for introducing and operating dock less bike sharing schemes in Oxford as well as the core responsibilities of the operators. Being delivered by Oxfordshire County Council in 2018/2019:	On-going	Funding for Botley Road Project has been secured has secured from the Department for Transport's National Productivity Investment Fund

									Access to Headington: Project to deliver a package of travel improvements in the Headington area. Developed work for the consultation stage of Botley Road project, which is aimed at improving facilities between Binsey Lane and Eynsham Road for pedestrians, cyclists and buses.		
4	Assist in development of bus and park and ride strategies within the LTP which support the AQAP. In particular we will work with the County to promote traffic management and routing measures to reduce bus emissions	Alternatives to private vehicle use	Bus based Park & Ride	Oxford City council Oxfordshire County Council	Complete	On-going	Bus and Park & Ride strategies include measures that support delivery of the AQAP	N/A	The Bus Strategy has been published and includes measures to support the targets of the AQAP. There have also been city centre bus improvements – including Queen Street (walking, cycling, bus), improvements on the A40 -A44 strategic link road (traffic management and priority to busses at Hinksey Hill	On-going	Zero Emission Zone plans currently being progressed. On-going studies include: work place parking and access restrictions.
5	Work with the County and our partners in Low Carbon Oxford to promote travel plans with organisations across the city	Promoting travel Alternatives	Workplace Travel Planning	Oxford City council	On-going	Started	Travel Plans adopted by organisations in the city	N/A	Oxfordshire County Council currently requires the submission of a travel plan for all the major developments in the city The county council is also working on several projects related with integrated mobility: Zipp.to – multimodal journey planner: a journey planner that integrated private car, bike (including dock less), trains, buses and even flight information, with live updates, weather information and personalised mobility options	On-going	
6	Continue to work with the County and bus operators to reduce bus emissions further, supporting the tightening of emission standards in contracted services and enforcement of the anti-idling policy following implementation of the LEZ	Vehicle Fleet Efficiency	Promoting Low Emission Transport	Oxford City Council	Complete	On-going	Amount of city fleet buses retrofitted with SCR – Euro 6 technology		Continue to work with bus companies to reduce their emissions and explore ways of compliance with ZEZ. Oxford City Council was awarded £1.7milliion in 2017 from the Clean Bus Technology Fund, for the retrofitting of 78 city buses to EURO 6 and other 5 to become fully electric. Developed in 2018: In 2018 an extra £671.550 was secured as part of an extension to the CBTF, for the retrofit of an additional 37 buses to EURO 6 standard in Oxford Adoption of new emission standards for Hackney Carriage vehicles, which will see Hackney taxis adopting a phased approach to zero emission capable between 2020 and 2025, with drivers only	On-going	The successful bid(s) were possible due to joint working between Oxford City Council, Oxford Bus Company, Stagecoach and City Sightseeing Oxford The new standards were developed in consultation with COLTA (City of Oxford Licensed Taxicab Association) and with feedback from taxi drivers and owners

									able to get a license in 2025 if they have a zero emission cab		
7	Promote the uptake of electric vehicles by working with our partners to install electric vehicle recharging infrastructure	Promoting Low Emission Transport	Procuring alternative refuelling infrastructure to promote Low Emission Vehicles, EV recharging, Gas fuel recharging	Oxford City Council /Oxfordshire County Council	On-going	On-going	Charging infrastructure installed	N/A	Developed in 2018: Oxford City Council co-organised (in association with Green TV and Electric Drivers) and delivered the first Electric Vehicle summit in Oxford. The event brought together key figures in the electric vehicles and EV charging markets to explore the opportunities and barriers for those working in electro-mobility Oxfordshire county council also launched in 2018: Electra- a 12 month project (started September 2018) to develop smart Chargepoint using latest and anticipated standards and technologies. Project partners are Zeta Lighting and Urban Integrated. Work is being used by the Council to help develop strategy and policy direction for EV parking/charging.	On-going	
8	Investigate the feasibility of developing infrastructure to support emerging low or zero emission vehicle technologies, such as hydrogen cells	Promoting Low Emission Transport	Procuring alternative Refuelling infrastructure to promote Low Emission Vehicles, EV recharging, Gas fuel recharging	Oxford City Council / Oxfordshire County Council	On-going	On-going	TBC	N/A	Oxford City Council achieved in 2018: Development of a Delivery and Servicing Survey to be shared with Covered Market retailers, to help them prepare for the introduction of Zero Emission Zone, to be introduced progressively across the city centre from 2020, as part of last year's successful bid of £200.000 from DEFRA air quality Grant to enable the provision of EV infrastructure and EV fleet to the city's covered market Using £800,000 worth of grant funding won through the Go Ultra Low City Scheme to roll out EV charging solutions for properties without dedicated parking spaces; Using £500,000 worth of grant funding from the Office for Low Emission Vehicles Taxi Scheme to facilitate the installation of electric charging infrastructure to encourage the uptake of electric taxis.	On-going	Launch of Oxfordshire Hydrogen Hub, in preparation for ZEZ

									Oxfordshire county council also launched in 2018: Park and Charge - Feasibility study looking at the deployment of smart chargers to meet the needs of EV users who have to park their vehicle on the highway by using EV charging hubs centred on local authority, park and ride and retail car parks. There is an application in for Park and Charge 2 the demonstration phase of Park and Charge 1. Working with all district and the city council to deploy c.250 chargers at 30-35 car parks across Oxfordshire. Virgin Park and Charge (VPACH) - Feasibility study examining extending the use of existing Virgin Media infrastructure to supply energy and data communications to be used for electric vehicle charging for residents with no access to off road charging. Like the above project there is an application in for the demonstration phase of VPACH 1 looking to install a significant number of road side charge points across the UK. Numbers for Oxfordshire are not currently known.		
9	Continue to develop low emission and zero emission vehicles in our own fleet, and seek opportunities to increase the council's electric vehicle car-pool	Promoting Low Emission Transport	Company Vehicle Procurement – Prioritising uptake of low emission vehicles	Oxford City Council	Complete	On-going	Number of electric vehicles in Council's fleet	N/A	Oxford City Council 2018: The number of electric pool vehicles in Oxford City Council's fleet continues to increase. Opportunities to replace conventionally fuelled vehicles with electric vehicles are assessed on a case by case basis. Oxford City Council's current fleet is composed by: Cars 39 (includes 14 electric and 1 hybrid) Small vans 51 (includes 6 electric) Large vans 93 (includes 9 hybrids) Tippers 56 (includes 13 hybrids) Pick Ups 19 HGVs 52 Miscellaneous Plant, Grounds Maintenance, Municipal and Utility vehicles 36 (includes 7 electric) Total fleet 346 (14.45% reduced emissions of which 7.8% is zero emission capable). Oxfordshire County Council 2018:	On-going	Procurement processes have been created to ensure that : •Alternatives to fully internal combustion engine vehicles are identified •Impact on emissions and operating costs for ULEV vehicles are fully considered •Zero emission vehicles are the preferred solution in all cases where they are operationally feasible and financially viable. .

									In 2018 The County Council has begun the transition of its fleet to low emission vehicles The County now have 11 fully electric vans and cars operating, a further 5 on order, and several trials taking place in a number of service areas within the County Council. 'One Fleet' Programme: A programme 'One Fleet' has been agreed to bring all fleet into one centralised management function within the County Council. This will be a key supporting element in delivering County Council's ambition towards low emission fleet. Support has been put in place to support the transition to electric vehicles including programme to install charging infrastructure on the corporate estate, analytics devices to report on suitability of replacement with EV or Hybrid and fleet assessment advice and vehicle trials EV Charging Infrastructure for Fleet: Charging infrastructure has already been installed at 7 council sites in 2018/19, with a further 11 sites to be installed later this year. OLEV workplace charge point grant scheme was used to part fund the installation of these charge points (£500 per point for a maximum of up to 20 charge points).		
10	Promote the development of low and zero emission car clubs schemes in the city	Alternatives to private vehicle use	Car Clubs	Oxford City council	Complete	On-going	Number of low/zero emission car club vehicles available in the city	N/A	We have been working with car club providers to promote the provision of zero emission vehicles in the city as part of the GULO project	On-going	
11	Work with our Low Carbon Oxford Pathfinders to support the introduction of low emission vehicle into their fleets	Promoting Low Emission Transport	Company Vehicle Procurement – Prioritising uptake of low emission vehicles	Oxford City Council	Complete	On-going	Number of low/zero emission vehicles in LCO Pathfinder fleets	N/A	A number of Low Carbon Oxford Pathfinder events were held to bring together key organisations, to increase awareness of the impacts of business related travel and transport on the environment and human health	On-going	ZEZ effect is expected to accelerate this measure
12	Support eco-driving through inclusion of eco-driving information in the Low Carbon Hub and other travel information services, and where possible look to support eco-driving schemes with for example taxi	Public information	Via the internet	Oxford City Council	On-going	On-going	TBC	N/A	Oxfordshire County Council is currently working on the following projects: CATCH! – integrates software into a journey planner, which provides crowd-sourced information on travel (e.g. congestion, train delays etc.), increasing the tool's potential to influence travel behaviour CASPAR – aims to improve end to end	On-going	

	companies								journey for drivers in Oxfordshire by providing real-time information regarding the availability of blue badge parking spaces		
13	Explore the impact of alternative and low emission transport on air quality in Oxford	Promoting Low Emission Transport	Company Vehicle Procurement – Prioritising uptake on low emission vehicles	Oxford City Council	On-going	On-going	Feasibility study report	N/A	A feasibility study for a possible zero emission zone has been undertaken by Oxford City Council and Oxfordshire County Council	On-going	ZEZ feasibility study provided good level of information with regards to expected NOx / PM emissions savings, and impacts on people's health with the implementation of a ZEZ
14	Exploring the options available for freight consolidation and management and other schemes to reduce the amount of freight vehicles operating in the city. We also need to consider low and zero emission vehicles in relation to the final delivery leg of any such consolidation schemes	Freight and Delivery Management	Other	Oxford City Council	Complete	On-going	TBC	N/A	Report has been completed and published https://www.oxford.gov.uk/info/20216/air_quality:management/977/reducing_freight_emissions We continue to consider how we can carry out mini consolidation across our own organisation. In 2018: Oxford City Council secured £122.500 from DEFRA Air Quality fund for the development of a robust, integrated communication and engagement plan, to inform and work with businesses in the city centre on how to adopt zero emission delivery and servicing solutions for their businesses	On-going	Freight and consolidation study identified issues with viability for major consolidation. However, the ZEZ feasibility study recommended the introduction of local parcel consolidation centres as a supported measure for ZEZ implementation
15	Seek to establish a freight quality partnership to promote Eco-driving and anti-idling policies with operators in the city	Freight and Delivery Management	Freight Partnerships for city centre deliveries	Oxford City Council	On-going	Not commenced	TBC	N/A	This measure has not been progressed to date	N/A	Delivery of ZEZ has superseded this measure.
16	Support the development of Delivery and Servicing Plans (DSPs) with business across the city to further reduce unnecessary freight movements. The development of such DSP's will need to consider integration with work emerging on freight consolidation	Freight and Delivery Management	Delivery and Service Plans	Oxford City Council	Not commenced	Not commenced	TBC	N/A	Development of service and delivery plan for own sites being investigated	On-going	At the moment this is being managed through the planning process

17	Ensure that transport and environmental impact assessments for new developments are adequate to determine what levels of mitigation may be required to offset potential increases in transport activity and emissions	Policy Guidance and Developme nt Control	Low Emissions Strategy	Oxford City Council	Complete	On-going	Air Quality Assessments undertaken for all major development in the city	N/A	Oxford City Council delivered in 2018: Published Air Quality Planning Application Guidance, aimed at creating a better understanding of the air quality requirements that need to be considered by applicants prior to the submission of a valid planning proposal We are also ensuring that air quality is considered fully during the development of the Oxford Local Plan.	On-going	Air Quality planning guidance is currently available for download at Oxford City Council's Air Quality Website
18	Explore opportunities to develop policy measures that require developers to provide investments in and contributions to the delivery of low emission transport projects and plans, including strategic monitoring and assessment activities.	Policy Guidance and Developme nt Control	Low emissions strategy	Oxford City Council	On-going	On-going	TBC	N/A	The Oxford Local Plan is currently under review. This measure will be progressed through that process	Dec 2019	
19	Seek to ensure that stretching targets are set within travel plans for new developments, and that all new developments are encouraged to adopt Delivery and Servicing Plans to reduce freight movements.	Policy Guidance and Developme nt Control	Low Emissions Strategy	Oxford City council	On-going	Not Commenced	TBC	N/A	The Oxford Local Plan is currently under review. This measure will be progressed through that process	Dec 2019	
20	Seek to ensure that new developments make appropriate provision for walking, cycling, public transport and low emission vehicle infrastructure e.g. EV charging points	Policy Guidance and Developme nt Control	Low Emissions Strategy	Oxford City Council	Complete	On-going	EV charging points installed at all new major developments	N/A	Currently happening through Development Management process. The Oxford Local Plan is currently under review and further stretching targets are being sought as part of this process. This measure will be further progressed through that process	On-going	A condition is already being imposed through the planning process requiring the installation of EV charging points for commercial and residential spaces
21	We will encourage the development of voluntary area-wide travel plans for existing developments through the Community Action Groups	Promoting Travel Alternatives	Other	Oxford City council	On-going	Not commenced	TBC	N/A		Measure on hold	ZEZ effect is expected to accelerate this measure

22	Promote the development of car clubs within new developments	Alternatives to private vehicle use	Car Clubs	Oxford City Council	On-going	On-going	Number of car clubs in new developments	N/A	Where appropriate, car clubs are considered as part of mitigation measures for air quality impacts in major developments. 4 car club EV vehicles has been launched, another 6 to go in over the next 12 months.	On-going	4 Electric Car Club vehicles launched in 2018, as part of GULO project, 6 will follow in 2019
23	Development of low emission vehicle hierarchy to guide the procurement of vehicles within our fleet	Promoting Low emission Transport	Company Vehicle Procurement – Prioritising uptake of low emission vehicles	Oxford City council	On-going	Not commenced	Number of low emission vehicles within Council fleet	N/A	Formal hierarchy not adopted but opportunities for EV is considered when vehicles are replaced.	On-going	
24	Continue to assess our fleet operations in terms of mileage management and efficient routing of vehicle movements	Vehicle Fleet Efficiency	Driver training and ECO driving aids	Oxford City Council	Complete	On-going	N/A	N/A	Route and mileage management are integrated into business as usual for the fleet	On-going	Recent Installation of a box on every fleet vehicle that lists an assessment for alternative fuel which covers eco improvements
25	Maintain and develop our staff travel plan and complement this with Delivery and Servicing Plans (DSP) for key Council sites such as Town Hall	Freight and Delivery Management	Delivery and Service Plans	Oxford City council	Complete	On-going	An adopted DSP is in place for the Council's city centre locations	N/A	A report outlining options for a DSP for city centre Council sites has been prepared and consideration of the options and implementation is on-going	On-going	
26	Roll out Eco-driving training for our staff	Vehicle Fleet Efficiency	Driver training and ECO driving aids	Oxford City council	Complete	On-going	Eco-driving training in place for staff	N/A	Eco-driving training is now in place for staff	On-going	
27	Seek to develop a sub-regional approach to air quality monitoring and action planning, working closely with our County and District Colleagues, through engagement with the Oxfordshire Air Quality Partnership	Policy Guidance and Development Control	Regional Groups Co-ordinating programmes to develop Area wide Strategies to reduce emissions and improve air quality	Oxford City council	Complete	On-going	Attendance at the Oxfordshire Air Quality Group	N/A	Engagement with neighbouring District Councils has been developed through the participation in the Oxfordshire Air Quality Group	On-going	
28	Consider the benefit of including wider stakeholders such as transport providers, public health organisations and research and consulting expertise	Policy Guidance and Development Control	Regional Groups Co-ordinating programmes to develop Area wide Strategies to reduce emissions and improve air	Oxford City council	Complete	On-going	air quality updates provided to the Health improvement Board when required	N/A	Engagement with the Health Improvement Board and Oxfordshire County Council Public Health colleagues	On-going	We are also working together with a local group called OxAir, and members of the university on the characterisation of new innovative NO_2 sensors for use across a range of projects and citizen science

			quality								
29	Improve communication to increase the public's understanding of the main sources and health effects of air pollution emissions	Public information	Via the internet	Oxford City council with other district councils	Complete	On-going	County wide Oxfordshire Air Quality Group website launched	N/A	The Oxfordshire Air Quality Group website (http://oxfordshire.air-quality.info/) was launched in October 2015. As well as providing real time and historic monitoring data, the website provides information on the health impacts of air quality and a 'Children's Area'	On-going	In 2018 Oxford City Council launched in partnership with friends of the earth a city wide anti-idling campaign to reduce unnecessary emissions from stationary vehicles
30	Work with the district and County Councils in Oxfordshire to provide a co-ordinated approach to public awareness and education	Public Information	Other	Oxford City Council, Local Friends of the Earth, Schools, OxAir	On-going	On-going	Total amount of available sensors installed at schools, air quality stickers installed at all the monitoring sites linking with the AQ website, anti-idling campaign idling surveys	N/A	Developed in 2018: Launch of an Anti-Idling campaign for Oxford in March 2018 together with local Friends of the Earth. Secured £128,500 from DEFRA Air Quality fund for the testing of low cost innovative Air Quality sensors to map air pollution and human exposure in Oxford – the project also aims to educate on air quality via links with projects with schools and communities; and provide advice on how to reduce personal exposure to air pollution Initiated collaborative work with Oxfordshire County Council's Public Health England colleagues, and Oxford Health respiratory nurses and physios working on the integrated respiratory team project of Churchill's Hospital; in Oxford, to explore ways of provide better Air Quality communication and advice for COPD patients Initiated collaborative work with Oxfordshire County Council on the promotion of Oxford City Council's STOP and County's WOW project	On-going	STOP Project was awarded best Air Quality communication initiative of the year at the national Air Quality Awards in October 2018

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

As detailed in Policy Guidance LAQM.PG16 (Chapter 7), local authorities (LAs) are expected to work towards reducing emissions and/or concentrations of $PM_{2.5}$ (particulate matter with an aerodynamic diameter of 2.5 µm 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.

Oxford City Council measures $PM_{2.5}$ at St Ebbes' urban background site. In 2018 the annual mean concentration was 10 μgm^{-3}. Oxford City Council considers that many of the measures designed to reduce levels of nitrogen dioxide set out in the AQAP will also contribute to reducing levels of $PM_{2.5}$. Oxford City Council considers that the following existing measures contained in the AQAP will contribute to reducing levels of $PM_{2.5}$:

1. Manage bus emissions through the implementation of the Low Emission Zone;
2. Work to ensure sustainable transport measures developed in the Oxford Area Strategy of the LTP support the targets of the AQAP;
3. Support walking and cycling strategies within the Local Transport Plan (LTP) to ensure they assist delivery of the AQAP objectives;
4. Assist in development of bus and park and ride strategies within the LTP which support the AQAP. In particular we will work with the County to promote traffic management and routing measures to reduce bus emissions;
5. Work with the County and our partners in Low Carbon Oxford to promote travel plans with organisations across the city;
6. Continue to work with the County and bus operators to reduce bus emissions further, supporting the tightening of emission standards in contracted services and enforcement of the anti-idling policy following implementation of the LEZ;
7. Promote the uptake of electric vehicles by working with our partners to install electric vehicle recharging infrastructure;
8. Continue to develop low emission and zero emission vehicles in our own fleet, and seek opportunities to increase the Council's electric vehicle car-pools;

9. Promote the development of low and zero emission car clubs schemes in the city;
10. Work with our Low Carbon Oxford Pathfinders to support the introduction of low emission vehicle into their fleets;
11. Support eco-driving through inclusion of eco-driving information in the Low Carbon Hub and other travel information services, and where possible look to support eco-driving schemes with for example taxi companies;
12. Exploring the options available for freight consolidation and management and other schemes to reduce the amount of freight vehicles operating in the city. We will also consider low and zero emission vehicles in relation to the final delivery leg of any such consolidation schemes;
13. Seek to establish a freight quality partnership to promote Eco-driving and anti-idling policies with operators in the city;
14. Support the development of Delivery and Servicing Plans (DSPs) with business across the city to further reduce unnecessary freight movements. The development of such DSP's will need to consider integration with work emerging on freight consolidation;
15. Ensure that transport and environmental impact assessments for new developments are adequate to determine what levels of mitigation may be required to offset potential increases in transport activity and emissions;
16. Explore opportunities to develop policy measures that require developers to provide investments in and contributions to the delivery of low emission transport projects and plans, including strategic monitoring and assessment activities;
17. Seek to ensure that stretching targets are set within travel plans for new developments, and that all new developments are encouraged to adopt Delivery and Servicing Plans to reduce freight movements;
18. Seek to ensure that new developments make appropriate provision for walking, cycling, public transport and low emission vehicle infrastructure e.g. EV charging points;

19. Develop a low emission vehicle hierarchy to guide the procurement of vehicles within our fleet;
20. Maintain and develop our staff travel plan and complement this with Delivery and Servicing Plans (DSPs) for key Council sites such as Town Hall.
21. Roll out eco-driving training for our staff;
22. Redevelopment of the entire delivery system of the city's heritage site covered market for it to be emission free, through the introduction of EV infrastructure and an EV fleet to be used by market retailers for their deliveries within the city.

In addition we are working in partnership with Oxfordshire County Council on the introduction of a Zero Emission Zone in the city centre. The introduction of a Zero Emission Zone is expected to contribute to the reduction of $PM_{2.5}$ emissions.

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

3.1 Summary of Monitoring Undertaken

Oxford City Council undertook automatic (continuous) monitoring of Nitrogen Oxides (NO_X) at three sites, Particulate Matter (PM_{10} and $PM_{2.5}$) at two sites and Ozone (O_3) at one site in 2018. Non-automatic (passive) monitoring of Nitrogen Dioxide (NO_2) was carried out at seventy two locations in 2018.

Maps showing the location of the air quality monitoring (continuous and passive) conducted in 2018 can be found in Appendix D. Maps covering current and historic locations of air quality monitoring locations are provided on the Oxfordshire Air Quality Group website (https://oxfordshire.air-quality.info/). Further details on Quality Assurance/Quality Control (QA/QC), how the monitors are calibrated, how the data has been adjusted and the bias adjustment factors used for the diffusion tubes are included in Appendix B.

3.1.1 Automatic Monitoring Sites

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

Oxford City Council undertook automatic (continuous) monitoring at three sites during 2018. Table A.1 in Appendix A shows the details of the sites. National monitoring results of those sites are available at https://uk-air.defra.gov.uk/ and http://www.airqualityengland.co.uk/.

3.1.2 Non-Automatic Monitoring Sites

Oxford City Council undertook non-automatic (passive) monitoring of NO_2 at 71 sites in 2018. Table A.2 in Appendix A shows the details of those sites.

For the purposes of deciding which locations to monitor, the City Council considers in the first instance locations where there is relevant public exposure. It is important that assessments focus on locations where members of the public are likely to be regularly present for a period of time appropriate to the averaging period of the objective. Monitoring is carried out in line with DEFRA's Technical Guidance LAQM.TG (16)[10].

Approximately half of the monitoring locations are within central Oxford at locations where the City Council believes relevant exposure is most likely to be significant. The remaining locations are outside of the central area, again prioritised by locations where relevant exposure is most likely.

Monitoring of NO_2 cannot be undertaken at every location on a continuous basis. The City Council therefore makes the most efficient use of available resources by implementing a rotational system on a percentage of monitoring sites every year, ensuring such sites are covered on average every 2 to 3 years.

One important aspect of monitoring is to be able to demonstrate trends in air quality over long time periods. In order to do so, the City Council continues monitoring at a number of the same sites year on year, so that the results reported can provide a strong basis for showing trends that are independent of location.

3.2 Individual Pollutants

The air quality monitoring results presented in these sections are ratified, and, where relevant, adjusted for bias, *"annualisation"* and distance correction. Further details on adjustments are provided in Appendix B. Details of the UK air quality objectives for protection of human health, as well as of WHO's recommended limit values for comparison with the 2018 monitoring results can be found in Appendix E.

3.2.1 Nitrogen Dioxide (NO_2)

Combustion processes emit a mixture of nitrogen oxides – NO and NO_2 - collectively termed NO_X.

a) NO is described as a primary pollutant (meaning it is directly emitted from source). NO is not known to have any harmful effects on human health at ambient concentrations. However, it undergoes oxidation in the atmosphere to form the secondary pollutant NO_2.

b) NO_2 has a primary (directly emitted) component and a secondary component, formed by oxidation of NO. NO_2 is a respiratory irritant and is toxic at high concentrations. It is also involved in the formation of photochemical smog and acid rain and may cause damage to crops and vegetation.

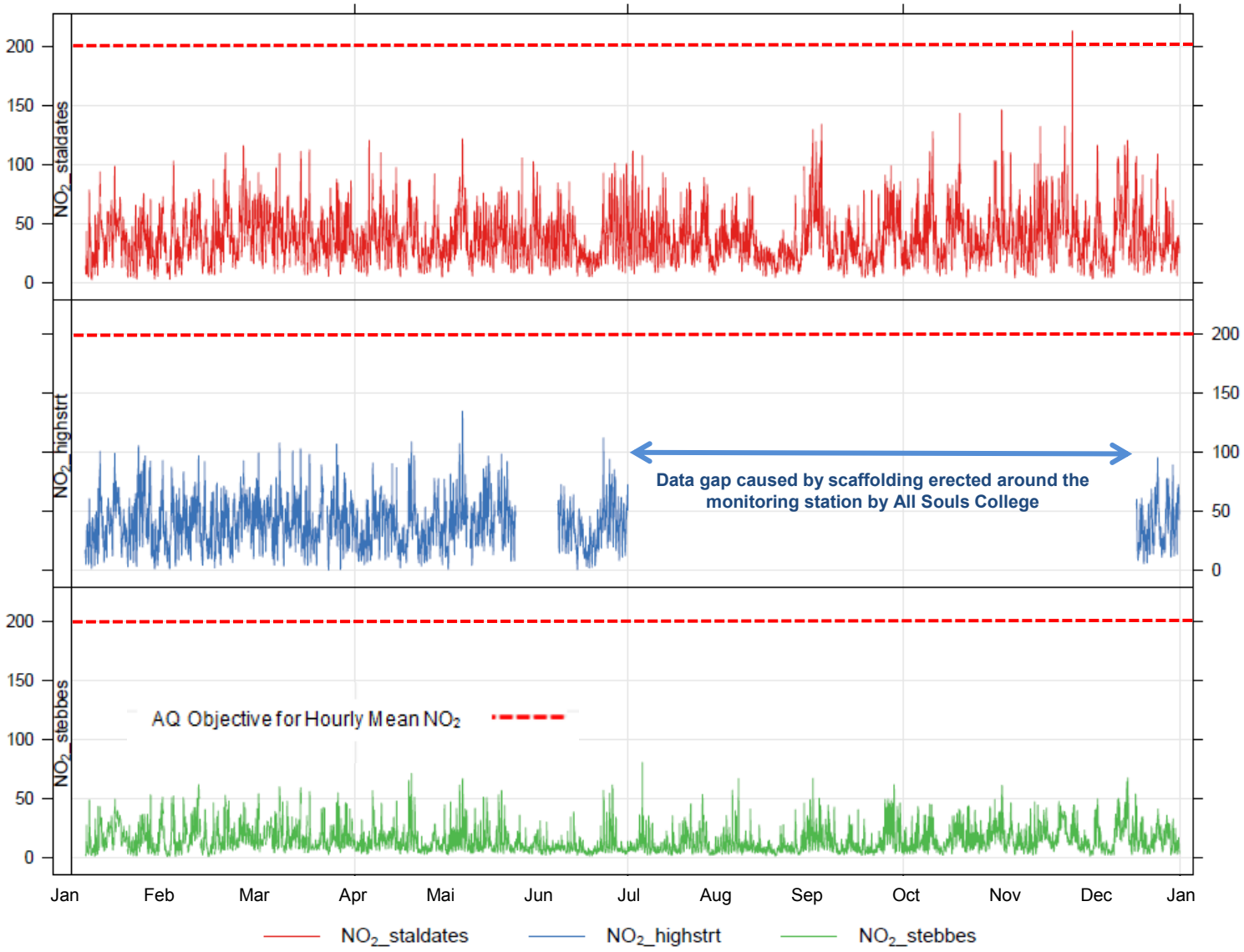
NO_2 data has been monitored by the use of automatic continuous monitors and passive monitoring (diffusion tubes) in 2018. The time series of hourly averaged

concentrations of NO_2 for the 3 automatic monitoring sites is shown in Figure 3.1. The results are expressed in μgm^{-3}.

In 2018, data capture at Oxford High Street was significantly impacted by building work and the erection of scaffolding by All Souls College. This has meant data for this site has been annualised due to low capture rates.

The annualisation of the annual NO_2 followed strict procedures described in DEFRA Technical Guidance LAQM.TG (16). Details of the annualisation procedure that was used, together with more detailed information of the type and duration of works causing the poor data capture rate for this site can be found in Appendix B.

Figure 3-1- Time series of hourly averaged concentrations of NO_2 (μgm^{-3}) at automatic monitoring sites, 2018.



The AQS objective for hourly mean NO_2 concentration is 200 μgm^{-3}, and may be exceeded up to 18 times per calendar year. Figure 3.1 shows that during 2018 there was only one recorded hourly mean NO_2 measurement exceeding 200 μgm^{-3}. The highest hourly mean NO_2 measured in 2018 was of 213.1 μgm^{-3} and was registered on the 26th November 07:00 at AURN Oxford Centre Roadside (St Aldates). This exceedance was attributed to emissions from a vehicle that was in operation in front of the monitoring station during that period. Table A.4 in Appendix A summarises the NO_2 hourly mean exceedances of the 200 μgm^{-3} hourly air quality objective reported in Oxford over the past 5 years.

The threshold of the *"Moderate"* air quality band as set out by DEFRA for the NO_2 hourly mean ranges from 201 to 400 μgm^{-3}. NO_2 levels at all 3 sites were recorded within the DEFRA *"Low"* band for the whole year, with the exception of the exceedance mentioned above. The AQS hourly objective for NO_2 was therefore met in 2018.

The annual mean AQS objective for NO_2 is 40 μgm^{-3}. In 2018, Oxford High Street annual mean for NO_2 (*annualised*) was 38 μgm^{-3} and Oxford Centre Roadside 39 μgm^{-3}. At St. Ebbes, the NO_2 annual mean was 15 μgm^{-3}. This objective was therefore met at all the automatic monitoring stations in Oxford in 2018.

Table A.3 in Appendix A compares the ratified monitored NO_2 annual mean concentrations for the past 5 years with the air quality objective of 40 μgm^{-3}. Figure 3.2 (below) shows the 15 year long term trend for levels of measured NO_2 at continuous monitoring stations. The results are expressed in μgm^{-3}.

Figure 3-2 – Long term trends of Annual Mean NO_2 (μgm^{-3}) at Oxford's continuous monitoring stations, 2003-2018.

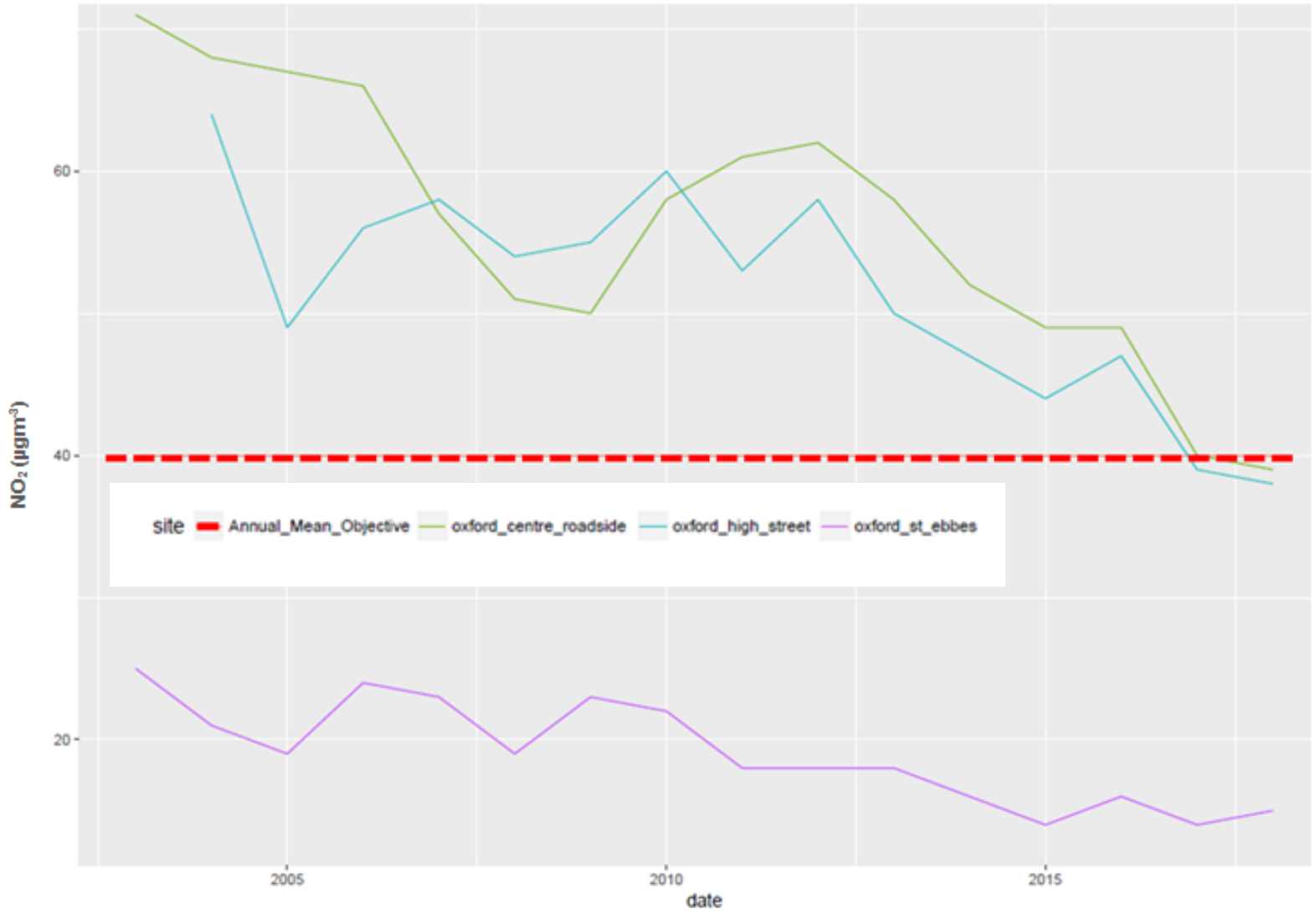


Figure 3.2 shows that the air quality levels measured in Oxford at the locations of our automatic monitoring roadside sites continued to improve throughout 2018, which is a clear indication that emissions from traffic continue to reduce. However, it also shows that the rate to which these reductions have been taking place seems to have slowed down in comparison with the previous year.

At the same time, the City's Urban Background site (Oxford St Ebbes) have seen a slight increase of NO_2 levels during the same period, which is also observed in other urban background locations where NO_2 was monitored in the city. This can be an indication that the NO_2 reductions that were seen in both roadside sites located in the city Centre could in reality have been slightly higher than what the current results show.

Appendix C shows the daily average levels of NO_2 along the entire calendar year 2018 for the automatic monitoring stations of Oxford Centre Roadside, Oxford High Street and Oxford St Ebbes.

Non-Automatic Monitoring

Non-automatic monitoring using diffusion tubes took place at 72 locations in 2018. Approximately half of this number was exposed within central Oxford, rotated between the locations where we believe relevant exposure is most likely. The remaining tubes were used outside of the central area, again prioritised by locations where relevant exposure is most likely.

The diffusion tube results show that the annual mean AQS objective of 40 μgm^{-3} for NO_2 specified by DEFRA was exceeded at only 4 of the 72 monitoring locations where NO_2 levels were measured in 2018. All the diffusion tube monitoring locations are within the existing AQMA. Seven locations were not considered representative of public exposure (as per LAQM TG16 guidelines) [10]; therefore for those there was the need to correct the results for distance. The main observations of the monitoring carried out in 2018 using non-automatic monitoring are as follow:

- 72 locations in the City of Oxford were chosen to be part of the 2018 air quality diffusion tube monitoring campaign. Of those, 5 locations were new air quality monitoring sites, and the remaining 67 sites were sites where air quality had been monitored in the previous year;

- For the second consecutive year, none of the City's NO_2 diffusion tube monitoring sites presented an annual mean NO_2 equal or above 60 ugm^{-3}. According to LAQM (TG16), this is an indication that exceedances of the hourly mean objective for NO_2 are not likely to have occurred in the city in 2018;

- In 2018, NO_2 was measured at 5 new locations in the city. The new monitoring sites were located at Quarry Road, Roger Dudman Way, St Gilles, St Clements (East), and William Lucy Way. None of the new monitoring locations measured annual mean NO_2 concentrations above the current annual mean limit value for this pollutant;

- Half of the sites where air quality was monitored in 2017 registered air quality improvements in 2018. Twenty percent of the sites measured the exact same levels of NO_2 as was measured in the previous year, and thirty percent of the sites showed slight increases in the NO_2 values measured in 2018 compared to 2017. However it is important to highlight that the vast majority of the observed increases were only of 1-2 ugm^{-3}, which are well within the error margin of monitoring method. This means that increases of the NO_2 annual mean values that were measured at those locations cannot statistically be considered real air pollution increases.

- In 2018, Oxford's urban background sites showed that the NO_2 urban background levels of the city rose by 1-3 ugm^{-3}. It is therefore likely that the minor increases in NO_2 levels observed across the city can be explained by the increase of the urban background level. While urban background levels have risen across the city, it is not reflected in the monitoring results at all sites which are likely to be because of reductions in traffic emissions offsetting the impact.

- Five locations measured increases of 3-4 ugm^{-3} NO_2 in 2018. The locations are; Lenthal Road Allotments, Headington Roundabout, Botley Road (corner with Mill Street), New Road, and Thames Street/Trinity Street. While increases in NO_2 were identified, the annual mean values that were measured at those

locations were all inside the range of 14-29 ugm^{-3}, which is below the current annual mean limit value for NO_2 (40 ugm^{-3}).

- New Road and Thames Street/Trinity Street saw increases of 4 ugm^{-3} in 2018 compared with 2017. This is likely to be due to road closures in 2017 impacting measurements and leading to reductions in NO_2 levels. These roads are now fully operational and the increase in NO_2 reflects this.

- In 2018 the first full year of monitoring was completed since the opening of the Westgate Shopping Centre. Air quality was monitored at a total of 13 locations around the Westgate Centre and results showed a reduction in air pollution at all 13 sites, by an average of 6 ugm^{-3}, when compared with the levels measured in 2015, the year prior to the start of construction works.

- Of the 72 locations where NO_2 levels were monitored in 2018, only 4 exceeded the annual mean limit value for NO_2. One of those sites is located on the North West boundary of the City (Cutteslowe Roundabout). The other three are located in the City Centre (George Street, St Clements and High Street);

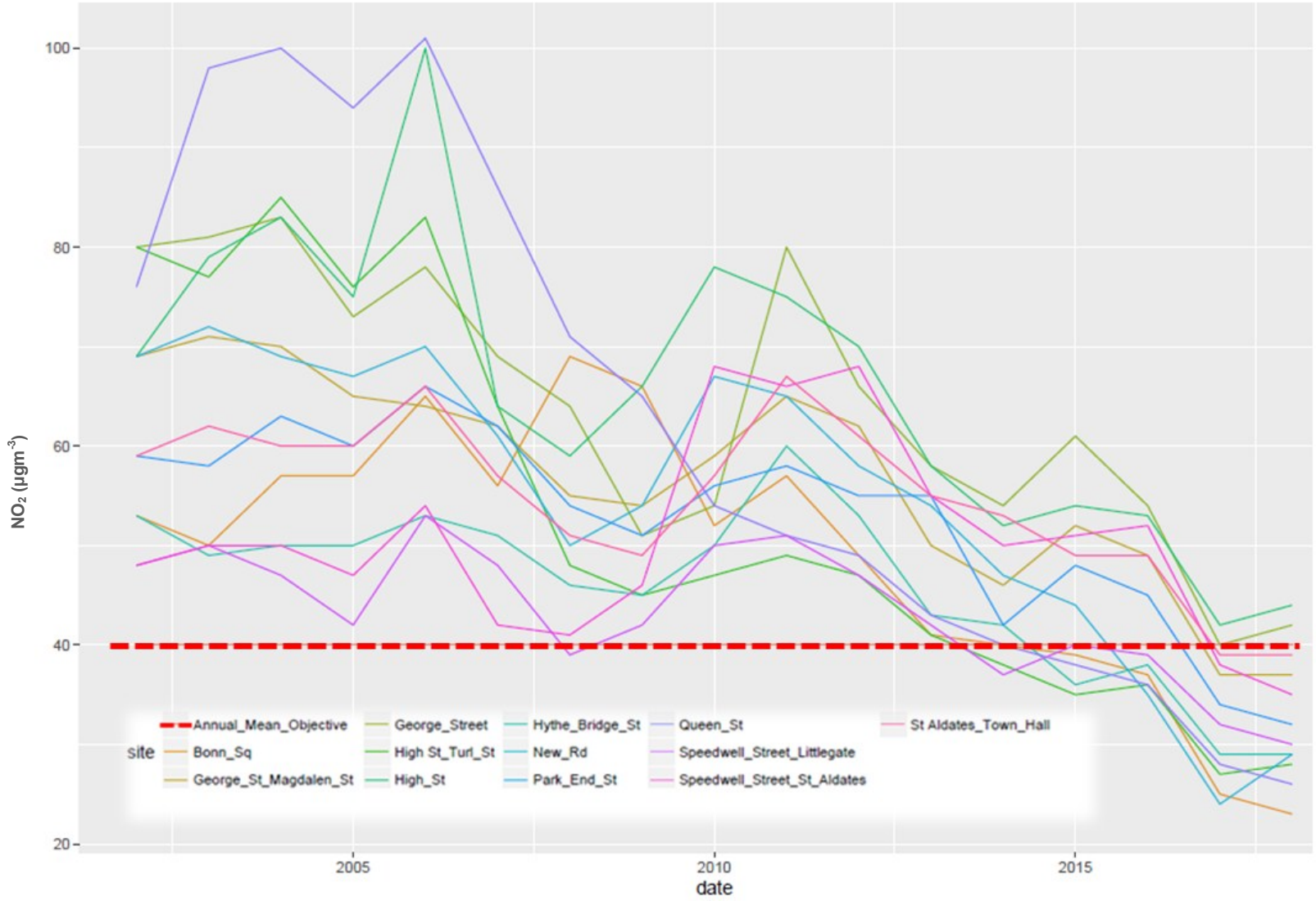
- One site is now, for the first time, in compliance with the annual mean limit value for NO_2; BP Service Station on Woodstock Road (Wolvercote Roundabout). The concentration registered at this location (38 ugm^{-3}) is only marginally below the threshold for compliance and given the degree of uncertainty associated with the diffusion tube methodology a further year of consistent results are required to verify the result.

- The monitoring location with the highest annual mean for NO_2 in 2018 was DT55 – St. Clements - with a value of 46 µgm^{-3}. In 2017 this site measured 47 µgm^{-3}. While 2018 results indicate little change from 2017, it must be noted that from June to August 2017 St Clements Street had limited traffic due to disruptive sewer works being conducted on-site. The works resulted in pollution levels being halved during that period, which was subsequently reflected in the NO_2 annual mean for 2017. Without these works and resultant road closure, St. Clements was estimated to register a final annual mean

value of 51 μgm^{-3}. This indicates that there was a clear reduction of pollution levels in St. Clements in 2018 compared to 2017.

Figure 3.3 below shows the long term trend for levels of measured NO_2 at a number of historic diffusion tube monitoring stations. The results are expressed in μgm^{-3}. It is quite clear that there has been a significant downward trend in measured levels of NO_2 at most of these locations since historic monitoring began in 2003. In 2018, air quality improvements have continued to occur in the city Centre. Overall, the annual mean objective for NO_2 was only exceeded at 4 of the 72 locations in 2018.

Figure 3-3– Long Term Trends in Annual Mean NO_2 (ugm^{-3}) at Oxford's diffusion tube monitoring locations, 2003-2018.



3.2.2 Particulate Matter (PM_{10} and $PM_{2.5}$)

Airborne particulate matter varies widely in its physical and chemical composition, source and particle size. The terms PM_{10} and $PM_{2.5}$ are used to describe particles with an effective size less than 10 and 2.5 µm respectively. These are of concern with regard to human health, as they are small enough to penetrate deep into the lungs. They can cause inflammation and a worsening of the condition of people with heart and lung diseases. In addition, they may carry surface absorbed carcinogenic compounds into the lungs. Larger particles, meanwhile, are not readily inhaled, and are removed relatively efficiently from the air by sedimentation.

In 2018, PM_{10} data was monitored by automatic continuous monitors at Oxford St. Ebbes and Oxford High Street. $PM_{2.5}$ was monitored at Oxford St. Ebbes.

The AQS objective for PM_{10} is a maximum of 50 μgm^{-3} for any 24h mean period, not to be exceeded more than 35 times a year.

The result of PM_{10} measurements during the course of 2018 show only 1 exceedance of the 50 μgm^{-3} 24h mean, which was registered on Saturday 3rd March at Oxford St Ebbes. According to Kings College,[11] the exceedance is not directly related with pollution generated in the city but instead, from an unexpected recirculation of air bringing a cocktail of particulates from coal burning areas in Eastern Europe, mixed with a regional contribution from wood burning. The analysis from King's states:

"Moderate and high particle pollution was measured throughout London and the south on Friday and Saturday, and also across large parts of the UK and western Europe including Germany, Belgium and the Netherlands. A change in wind direction to include a track from east Europe caused increase sulphate particles from Thursday 1st March, indicative of particles from coal burning areas. Air tracks from then onwards included greater time over north western Europe and the UK and particle pollution increased showing contributions from traffic, gas combustion and wood burning. Saturday brought an unexpected recirculation of air that had been over us on Friday. Wood burning particles slowly increased from Thursday through to Sunday morning. The greatest concentrations from fresh local wood burning were seen on Saturday and Sunday evenings, unusually wood burning was seen throughout the daytime and may be indicative of people remaining at home due to travel disruption and heating their homes all day. There is evidence that the particle pollution included not just fresh wood smoke but also wood smoke particles that had chemically

reacted in the atmosphere to form organo-nitrate particles. The weekend also included nitrate particles more typical of normal spring time episodes produced from chemical reactions between traffic exhausts, natural gas burning, and farming."

Oxford St. Ebbes registered a 24 hourly mean of 55 μgm^{-3} for PM_{10} on Saturday the 3rd March, whilst Oxford High Street measured 47.3 μgm^{-3}

The AQS objective for 24-hour mean PM_{10} was fully met at Oxford High Street and Oxford St Ebbes in 2018.

Table A.6 in Appendix A shows the number of exceedances to the PM_{10} 24-hour mean objective in the past 5 years.

The annual mean AQS objective for PM_{10} is 40 μgm^{-3}. 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 40μgm^{-3}.

Oxford High Street registered an annual mean of 18 μgm^{-3}. Oxford St. Ebbes 12 μgm^{-3}. This objective was therefore met in 2018.

No AQS objective exists for $PM_{2.5}$; however a non-mandatory compliance target of 25 μgm^{-3} to be met by 2020 exists. The monitored annual mean for this pollutant was 10 μgm^{-3} at Oxford St. Ebbes. Table A.7 in Appendix A presents the ratified and adjusted monitored $PM_{2.5}$ annual mean concentrations for the past 5 years.

The figures below show the 7 year long term trend for levels of measured PM_{10} and $PM_{2.5}$ at continuous monitoring stations in Oxford, and the current recommended WHO guideline values, which are significantly lower for PM_{10} and $PM_{2.5}$ than the UK limit values. The results are expressed in μgm^{-3}.

Figure 3-4– Long term trends of Annual Mean PM_{10} (μgm^{-3}) at Oxford's continuous monitoring stations, 2011-2018.

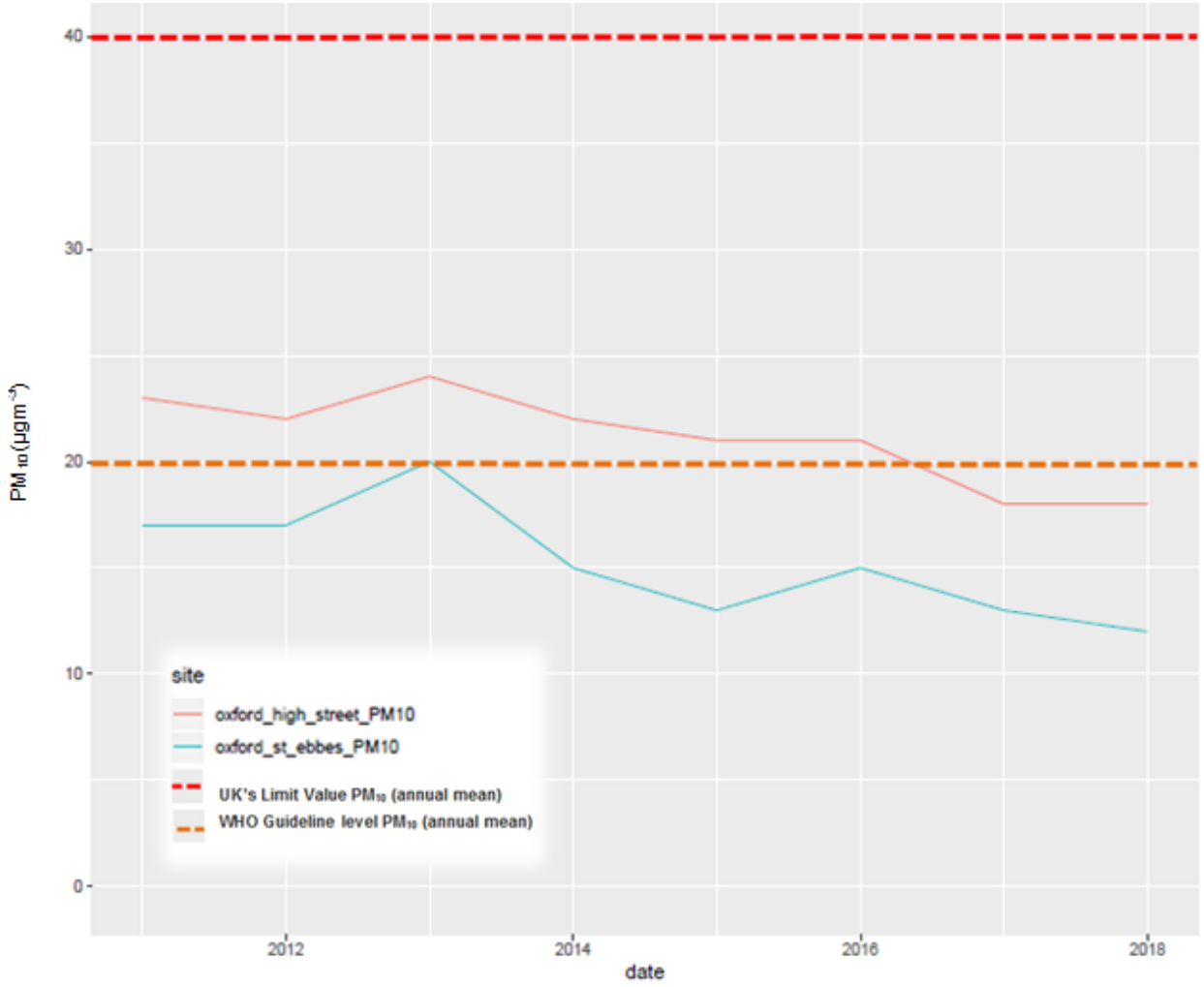


Figure 3-5– Long term trends of Annual Mean $PM_{2.5}$ (μgm^{-3}) at Oxford's continuous monitoring stations, 2011-2018

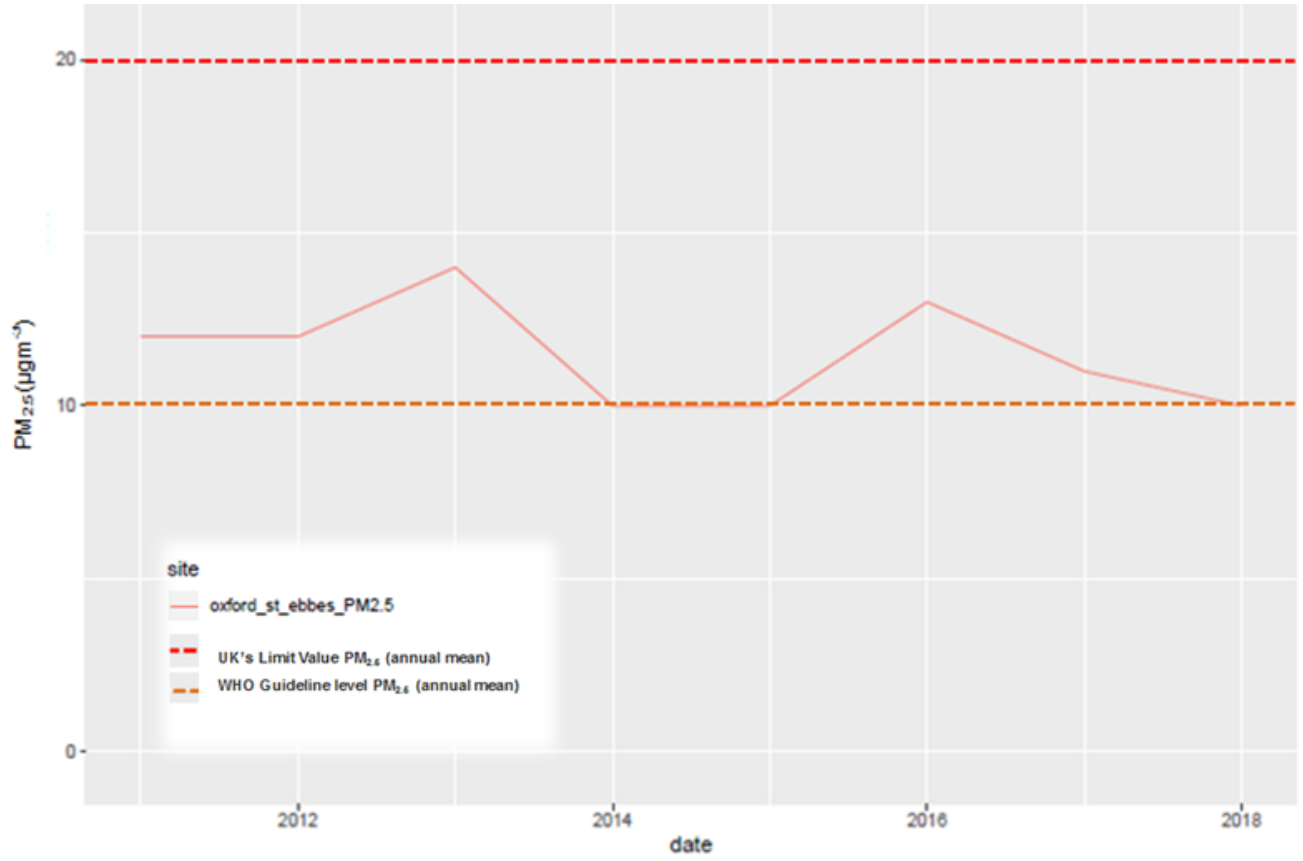


Figure 3.4 shows that PM_{10} levels measured in Oxford at the locations of our automatic monitoring sites have seen a downward trend since 2013. The step change in that year can be attributed to the Low Emission Zone, which banned high-emission buses (i.e. buses with engines older than Euro V) from the City Centre. Bus companies began converting their vehicles in the run up to the zone's introduction in 2014.

This was particularly important for the reduction of PM emissions from exhaust, as all Euro V and Euro VI bus diesels are fitted with a Diesel Particulate Filter (DPF), which reduce the amount of PM that is released from exhaust into the atmosphere by more than 80%.

Figure 3.5 shows that the steady decreases that we see in Figure 3.4 for PM_{10} are not so clear for $PM_{2.5}$. In 2013, we can also clearly see the effect caused by the introduction of the LEZ on the reduction of $PM_{2.5}$ levels.

Figures 3.4 and 3.5 also show that none of the current WHO guideline values for PM_{10} and $PM_{2.5}$ were breached in 2018. All the automatic monitoring stations measuring Particulate matter (PM_{10} and $PM_{2.5}$) in Oxford fulfilled both relevant UK limit values and WHO guideline values for these pollutants in 2018.

3.2.3 Ozone (O_3)

Ozone (O_3) is not emitted directly into the atmosphere in significant quantities, but is a secondary pollutant produced by reaction between nitrogen dioxide (NO_2) and hydrocarbons, in the presence of sunlight. Whereas nitrogen dioxide (NO_2) contributes to ozone formation, nitrogen oxide (NO) destroys ozone and therefore acts as a local sink. For this reason, ozone levels are not as high in urban areas (where NO is emitted from vehicles) as in rural areas. Ozone levels are usually highest in rural areas, particularly in hot, still, sunny weather conditions giving rise to "*summer smog*".

O_3 is measured at Oxford St. Ebbes. The AQS objective for daily maximum on an 8 hour running mean is 100 μgm^{-3} not to be exceeded more than 10 days a year. Oxford St. Ebbes did not meet the AQS objectives for this pollutant in 2018.

Oxford St. Ebbes data capture of O_3 was of 99.9 % in 2018. The site exceeded the AQS daily objective for ozone 149 times, during a total of 27 days during the year.

In 2018 there was a significant increase on the number of exceedances (+118) and days (+22) where O_3 was registered above the legal threshold, when compared with the results from 2017.

It is important to remember that ozone is an area wide pollutant, and whilst monitoring sites are relatively sparse compared to those monitoring nitrogen dioxide they represent the wider population exposure, so a single site may represent the ozone concentrations that hundreds of thousands of people have been exposed to.

In 2018, there was a major regional ozone episode that covered London and the entire south East England, for a duration of 35 days. Kings college[11] refers to this episode as being the greatest O_3 episode observed since 2008:

"The episode started on 23rd June and ran until July 27th with only four days 'low' air pollution during the 35 day period in London and south east England. The episode included 17 consecutive days of 'moderate' ozone, the greatest number of consecutive days since 2008 when we measured 23 back-to-back days between 24th April and 16th May."

The biggest concentrations of ozone were recorded at St Ebbes during the above period, but in particular during the first week of July, with a maximum level of 157.7 μgm^{-3} (hourly mean) being observed on the 1st July 18:00.

Appendix C shows the daily average levels of O_3 along the entire calendar year 2018 for the automatic monitoring station of Oxford St. Ebbes.

Appendix A: Monitoring Results

Table A 1 – Details of automatic monitoring sites

Site ID	Site Name	Site Type	X OS Grid Ref	Y OS Grid Ref	Pollutants Monitored	In AQMA?	Monitoring Technique	Distance to Relevant Exposure (m) (1)	Distance to kerb of nearest road (m) (2)	Inlet Height (m)
CM1	Oxford Centre Roadside (AURN)	Roadside	451359	206157	NO_2	YES	Chemiluminescence	1	3	2.5
CM2	Oxford High Street	Roadside	451677	206272	NO_2 PM_{10}	YES	Chemiluminescence TEOM	1	2	1.5
CM3	Oxford St Ebbes (AURN)	Urban Background	451118	205353	NO_2 PM_{10} $PM_{2.5}$ O_3	YES	Chemiluminescence TEOM - FDMS TEOM - FDMS UV Absorption	10	2	2.5

Notes:

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

(2) N/A if not applicable.

Table A 2 – Details of non-automatic monitoring sites

Site ID	Site Name	Site Type	X OS Grid Ref	Y OS Grid Ref	Pollutants Monitored	In AQMA?	Distance to Relevant Exposure (m) (1)	Distance to kerb of nearest road (m) (2)	Tube collocated with a Continuous Analyser?	Height (m)
DT1	St Ebbes	Urban B.	451118	205353	NO_2	YES	10	2	YES	2.5
DT2	Weirs Lne./Abingdon Rd. LP1	Roadside	451904	204215	NO_2	YES	2	2	NO	3
DT3	LP 52 Abingdon Rd.	Roadside	451914	204154	NO_2	YES	3	2	NO	3
DT4	Boundary Brook Rd/ Iffley Rd	Roadside	452961	204662	NO_2	YES	0	2	NO	3
DT5	Lenthall Rd Allotments	Urban B.	452818	203448	NO_2	YES	5	N/A	NO	1.5
DT6	Templar Square	Roadside	454336	203952	NO_2	YES	2	2	NO	3
DT7	Oxford Rd/ Between Towns Rd	Roadside	454472	204246	NO_2	YES	3	2	NO	3
DT8	Oxford Rd(Cowley) LP13	Roadside	454355	204296	NO_2	YES	0	1	NO	3
DT9	Cowley Rd/ Divinity Rd	Roadside	453151	205536	NO_2	YES	3	1	NO	3
DT72	Cowley Rd./ James Street	Roadside	452761	205745	NO_2	YES	1	1	NO	3
DT74	Quarry Road	Kerbside	455314	206619	NO_2	YES	5	1	NO	2.5
DT11	Gypsy Lne/Old Rd/Warneford Drive	Roadside	453910	206334	NO_2	YES	3	5	NO	3
DT12	Churchill Drive/Old Rd	Roadside	454493	206367	NO_2	YES	1	1	NO	3
DT13	Windmill Rd./Old Rd	Roadside	454876	206447	NO_2	YES	3	0.5	NO	3

DT14	Windmill Rd. W	Roadside	454554	207102	NO_2	YES	0	2.5	NO	3
DT15	London Rd./BHF	Roadside	454433	207058	NO_2	YES	0	2.5	NO	3
DT16	Headley Way/London Rd. LP2	Roadside	453982	206817	NO_2	YES	1	2	NO	3
DT17	49 London Rd. /Latimer/Sandfield Rds	Roadside	454138	206903	NO_2	YES	2	2	NO	3
DT75	Roger Dudman Way	Roadside	450306	206897	NO_2	YES	0	0.5	NO	2.5
DT18	The Roundway	Roadside	455596	207367	NO_2	YES	0	5	NO	3
DT20	Barton Lane LP2	Roadside	454999	207759	NO_2	YES	3	1	NO	3
DT21	North Way /Barton Village Rd LP20	Roadside	455116	207796	NO_2	YES	0	0.5	NO	3
DT76	St Gilles	Roadside	451226	206504	NO_2	YES	0	2	NO	2.5
DT77	St Clements 2	Roadside	452451	205999	NO2	YES	0	1	NO	2.5
DT25	Cuttleslowe Rbout 3 Elsfield Rd.	Roadside	450419	210256	NO_2	YES	5	2	NO	3
DT26	Cuttleslowe Rbout 3 Summers Place	Roadside	450389	210189	NO_2	YES	1	2	NO	3
DT27	Wolvercote Rbout 78 Sunderland Ave.	Roadside	449824	210198	NO_2	YES	1	1	NO	3
DT28	Wolvercote Rbout 51 Sunderland Ave	Roadside	449856	210162	NO_2	YES	1	1	NO	3
DT71	BP City Motors	Roadside	449617	210216	NO_2	YES	5	5	NO	3
DT29	Pear Tree P&R N Gateway	Roadside	449530	210734	NO_2	YES	10	4	NO	3
DT30	Osney	Kerbside	450668	206053	NO_2	YES	2	2	NO	3

	Lne/Hollybush Row									
DT31	Beckett St.	Roadside	450566	206227	NO_2	YES	5	2	NO	3
DT32	Royal Oxford Hotel	Roadside	450674	206273	NO_2	YES	0	2.5	NO	3
DT33	Botley RD/ Mill St	Roadside	450409	206224	NO_2	YES	1	1	NO	3
DT34	Abbey Rd Corner	Roadside	450356	206255	NO_2	YES	0	1	NO	3
DT35	Botley Rd /Hillview Rd	Roadside	450029	206207	NO_2	YES	1	2	NO	3
DT37	Botley Rd S (Duke St)	Roadside	449655	206227	NO_2	YES	0	2	NO	3
DT36	Botley Rd N (Prestwich Place)	Roadside	449657	206245	NO_2	YES	0	2	NO	3
DT39	St Aldate's	Roadside	451359	206157	NO_2	YES	0	2	YES	2.5
DT40	Queen St.	Roadside	451270	206144	NO_2	YES	0	2	NO	3
DT41	Bonn Square	Roadside	451216	206133	NO_2	YES	0	2	NO	3
DT42	New Rd.	Roadside	451073	206191	NO_2	YES	2	3.5	NO	3
DT43	Park End St.	Kerbside	450885	206275	NO_2	YES	2	1	NO	3
DT44	Hythe Bridge St.	Roadside	450795	206343	NO_2	YES	0	2	NO	3
DT45	Worcester St.	Roadside	450942	206424	NO_2	YES	2	2	NO	3
DT46	Beaumont St.	Kerbside	451167	206519	NO_2	YES	2	1	NO	3
DT47	George St. / Magdalen St.	Kerbside	451222	206387	NO_2	YES	2	0.5	NO	3
DT73	Walton Street LP18	Roadside	450960	206590	NO_2	YES	1	1	NO	2.5
DT48	George St.	Kerbside	450981	206344	NO_2	YES	0	0.5	NO	3
DT49	Cornmarket St.	Urban Centre	451322	206242	NO_2	YES	0	2	NO	3
DT50	High St. / Turl St.	Roadside	451467	206222	NO_2	YES	1	2.5	NO	3
DT51	50 High St.	Roadside	451900	206250	NO_2	YES	0	2.5	NO	3

DT52	Longwall St.	Kerbside	451972	206283	NO_2	YES	1	1	NO	3
DT53	Magdalen Bridge	Roadside	452099	206117	NO_2	YES	0	2	NO	3
DT54	York Place	Kerbside	452325	206015	NO_2	YES	0	2	NO	3
DT55	St Clements	Kerbside	452326	205992	NO_2	YES	1	1	NO	3
DT56	High St.	Kerbside	451576	206232	NO_2	YES	2	1	NO	3
DT57	Speedwell St. / St. Aldate's	Roadside	451407	205807	NO_2	YES	1	3	NO	3
DT58	Folly Bridge	Roadside	451437	205529	NO_2	YES	0	1	NO	3
DT59	Thames St.	Roadside	451353	205643	NO_2	YES	1	3	NO	3
DT60	New Butterwyke Pl/ Thames St.	Roadside	451248	205710	NO_2	YES	5	2	NO	3
DT61	Friars Wharf	Roadside	451219	205707	NO_2	YES	0	3	NO	3
DT62	1 Blackfriars Rd.	Roadside	451072	205750	NO_2	YES	0	3	NO	3
DT63	Thames St. / Trinity St.	Roadside	450926	205797	NO_2	YES	0	10	NO	3
DT64	Thames St. / Oxpens Rd.	Roadside	450887	205825	NO_2	YES	0	1	NO	3
DT65	Speedwell St. / Littlegate	Roadside	451206	205780	NO_2	YES	1	2	NO	3
DT66	36 Faulkner St.	Urban B.	451149	205859	NO_2	YES	1	20	NO	3
DT67	Old Greyfriars St.	Roadside	451149	205947	NO_2	YES	5	5	NO	3
DT68	Norfolk St.	Roadside	451030	205962	NO_2	YES	0	1.5	NO	3
DT69	Paradise Square	Roadside	450982	205973	NO_2	YES	0	1	NO	3
DT70	Castle St.	Roadside	451062	206067	NO_2	YES	0	1.5	NO	3
DT78	William Lucy Way	Urban B.	450378	207135	NO_2	YES	3	20	NO	2

Notes:

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

(2) N/A if not applicable.

Table A 3 – Annual mean NO_2 monitoring results

Site ID	Site Name	Monitoring Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2018 (%) (2)	NO_2 Annual Mean Concentration ($\mu g/m^3$) (3)				
					2014	2015	2016	2017	2018
CM1	Oxford Centre Roadside (AURN)	Automatic	95	95	**52**	**49**	**49**	40	39
CM2	Oxford High Street	Automatic	49	49	**47**	**44**	**47**	39	38
CM3	Oxford St Ebbes (AURN)	Automatic	98	98	17	14	16	14	15
DT1	St Ebbes	Passive	100	100	17	16	18	14	15
DT2	Weirs Lne./Abingdon Rd. LP1	Passive	100	100	35	39	34	28	27
DT3	LP 52 Abingdon Rd.	Passive	100	100	37	**42**	38	31	29
DT4	Boundary Brook Rd/ Iffley Rd	Passive	83	83	NM	NM	34	28	27
DT5	Lenthall Rd Allotments	Passive	100	100	13	15	14	10	14
DT6	Templar Square	Passive	100	100	NM	NM	25	21	20
DT7	Oxford Rd/ Between Towns Rd	Passive	100	100	NM	NM	36	31	28
DT8	Oxford Rd(Cowley) LP13	Passive	100	100	NM	NM	34	29	27
DT9	Cowley Rd/ Divinity Rd	Passive	100	100	NM	NM	28	25	24
DT72	Cowley Rd./ James Street	Passive	100	100	NM	NM	NM	29	29
DT74	Quarry Road	Passive	75	75	NM	NM	NM	NM	16
DT11	Gypsy Lne/Old Rd/Warneford	Passive	92	92	NM	NM	24	20	18

	Drive								
DT12	Churchill Drive/Old Rd	Passive	50	50	NM	NM	NM	22	24
DT13	Windmill Rd./Old Rd	Passive	100	100	NM	NM	29	23	23
DT14	Windmill Rd. W	Passive	100	100	**40**	**44**	**43**	33	32
DT15	London Rd./BHF	Passive	100	100	36	34	34	26	25
DT16	Headley Way/London Rd. LP2	Passive	92	92	NM	NM	35	27	25
DT17	49 London Rd. /Latimer/Sandfield Rds	Passive	100	100	NM	NM	37	24	25
DT75	Roger Dudman Way	Passive	50	50	NM	NM	NM	NM	20
DT18	The Roundway	Passive	100	100	32	32	33	23	26
DT20	Barton Lane LP2	Passive	100	100	NM	31	29	25	27
DT21	North Way /Barton Village Rd LP20	Passive	100	100	NM	30	30	26	24
DT76	St Gilles	Passive	100	100	NM	NM	NM	NM	33
DT77	St Clements 2	Passive	100	100	NM	NM	NM	NM	36
DT25	Cuttleslowe Rbout 3 Elsfield Rd.	Passive	100	100	NM	40	48	35	35
DT26	Cuttleslowe Rbout 3 Summers Place	Passive	100	100	NM	**42**	**40**	**41**	**41**
DT27	Wolvercote Rbout 78 Sunderland Ave.	Passive	83	83	NM	39	34	29	29
DT28	Wolvercote Rbout 51 Sunderland Ave	Passive	92	92	NM	34	32	26	27

DT71	BP City Motors	Passive	100	100	NM	**44**	NM	**41**	38
DT29	Pear Tree P&R N Gateway	Passive	92	92	NM	38	36	28	25
DT30	Osney Lne/Hollybush Row	Passive	100	100	28	32	33	27	28
DT31	Beckett St.	Passive	100	100	33	30	39	29	31
DT32	Royal Oxford Hotel	Passive	100	100	**41**	**40**	38	32	31
DT33	Botley RD/ Mill St	Passive	100	100	NM	28	29	23	26
DT34	Abbey Rd Corner	Passive	92	92	NM	28	30	23	22
DT35	Botley Rd /Hillview Rd	Passive	100	100	NM	**40**	**40**	34	32
DT37	Botley Rd S (Duke St)	Passive	100	100	NM	34	22	25	23
DT36	Botley Rd N (Prestwich Place)	Passive	100	100	NM	29	35	27	27
DT39	St Aldate's	Passive	100	100	**53**	**49**	**49**	39	39
DT40	Queen St.	Passive	92	92	**40**	38	36	28	26
DT41	Bonn Square	Passive	100	100	**40**	39	37	25	23
DT42	New Rd.	Passive	100	100	**47**	**44**	35	24	29
DT43	Park End St.	Passive	100	100	**42**	**48**	**45**	34	32
DT44	Hythe Bridge St.	Passive	92	92	**42**	36	38	29	29
DT45	Worcester St.	Passive	92	92	**52**	**50**	**51**	38	37
DT46	Beaumont St.	Passive	100	100	**43**	**44**	**45**	31	31
DT47	George St. / Magdalen St.	Passive	92	92	**46**	**52**	**49**	37	37
DT73	Walton Street LP18	Passive	100	100	NM	NM	NM	27	26
DT48	George St.	Passive	100	100	**54**	**61**	**54**	**40**	**42**
DT49	Cornmarket St.	Passive	100	100	29	31	30	23	24

DT50	High St. / Turl St.	Passive	92	92	38	35	36	27	28
DT51	50 High St.	Passive	100	100	**47**	**45**	**43**	34	33
DT52	Longwall St.	Passive	100	100	**50**	**50**	**49**	38	38
DT53	Magdalen Bridge	Passive	100	100	NM	27	28	22	23
DT54	York Place	Passive	100	100	32	30	28	23	23
DT55	St Clements	Passive	100	100	**65**	**67**	**61**	**47**	**46**
DT56	High St.	Passive	92	92	**52**	**54**	**53**	**42**	**44**
DT57	Speedwell St. / St. Aldate's	Passive	100	100	**50**	**51**	**52**	38	35
DT58	Folly Bridge	Passive	100	100	NM	**40**	**41**	31	33
DT59	Thames St.	Passive	100	100	28	30	32	25	27
DT60	New Butterwyke Pl/ Thames St.	Passive	100	100	**44**	38	39	29	30
DT61	Friars Wharf	Passive	83	83	25	25	27	20	19
DT62	1 Blackfriars Rd.	Passive	100	100	NM	26	27	20	20
DT63	Thames St. / Trinity St.	Passive	83	83	19	20	23	16	20
DT64	Thames St. / Oxpens Rd.	Passive	100	100	27	27	32	25	23
DT65	Speedwell St. / Littlegate	Passive	100	100	37	**40**	39	32	30
DT66	36 Faulkner St.	Passive	100	100	34	30	31	22	23
DT67	Old Greyfriars St.	Passive	83	83	NM	26	30	21	20
DT68	Norfolk St.	Passive	75	75	23	30	35	23	24
DT69	Paradise Square	Passive	100	100	29	24	27	26	24
DT70	Castle St.	Passive	100	100	**42**	**47**	**42**	28	29
DT78	William Lucy Way	Passive	42	42	NM	NM	NM	NM	22

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

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

Notes:

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

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

(1) 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 B for details.

Table A 4 – NO_2 Monthly Diffusion Tube Results - 2018

Site ID	NO_2 Mean Concentrations (µg/m^3)														
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Mean		
													Raw Data	Bias Adjusted (0.89)* and Annualised (1)	Distance Corrected to Nearest Exposure (2)
DT1	18	18	22	15	12	9	10	12	12	18	21	17	15.4	15*	
DT2	30	33	36	35	27	29	30	26	28	34	31	30	30.8	27	
DT3	35	35	34	33	28	22	36	30	30	36	36	36	32.6	29	
DT4	NR	34	36	31	23	23	27	25	NR	30	35	40	30.4	27	
DT5	17	17	20	13	11	8	10	11	12	16	21	17	14.5	14*	
DT6	22	26	29	25	20	15	17	19	17	25	30	29	22.8	20	
DT7	36	33	38	30	24	23	32	29	32	32	39	37	32.0	28	
DT8	34	35	36	28	27	22	26	27	24	30	37	39	30.4	27	
DT9	32	26	34	28	24	18	20	24	26	32	35	33	27.5	24	
DT72	35	39	37	34	31	27	29	24	24	33	36	36	32.2	29	
DT74	23	22	21	17	14	NR	12	10	NR	20	25	NR	18.2	16	
DT11	26	26	28	20	17	10	16	16	17	24	NR	25	20.6	18	
DT12	NR	29	36	NR	24	16	NR	24	NR	NR	NR	32	26.8	24	
DT13	30	33	32	22	20	17	24	21	22	31	31	31	26.2	23	
DT14	39	39	42	35	25	23	39	37	35	40	38	40	36.0	32	
DT15	29	32	37	30	24	26	27	22	21	30	34	27	28.3	25	
DT16	31	29	32	28	26	21	22	21	NR	27	35	36	27.7	25	
DT17	30	31	31	23	35	28	26	22	24	30	28	32	28.4	25	

DT75	20	28	32	19	25	20	NR	NR	NR	NR	NR	NR	24.1	20	
DT18	25	34	31	28	27	26	30	25	26	34	31	33	29.2	26	
DT20	32	34	35	30	29	28	28	24	24	35	34	34	30.6	27	
DT21	34	28	34	25	19	15	23	24	25	29	32	33	26.9	24	
DT76	41	35	40	37	30	27	48	39	37	42	37	38	37.5	33	
DT77	41	40	49	35	36	34	39	35	42	43	47	50	40.8	36	
DT25	49	41	47	41	35	30	36	32	33	40	43	48	39.6	35	
DT26	44	50	50	49	54	43	53	38	42	45	40	48	46.4	**41**	38
DT27	36	33	35	35	22	NR	NR	26	NR	33	36	37	32.6	29	
DT28	NR	34	34	27	28	28	28	27	30	34	31	34	30.5	27	
DT71	50	42	50	40	41	32	47	38	41	41	43	48	42.8	38	32
DT29	31	31	33	27	22	16	28	28	27	NR	34	35	28.2	25	
DT30	31	36	38	28	29	25	30	26	29	33	34	34	31.1	28	
DT31	33	40	44	34	33	30	38	28	30	40	37	36	35.2	31	
DT32	34	36	40	38	29	32	36	31	31	37	39	37	35.0	31	
DT33	31	35	35	30	29	30	23	21	21	32	34	28	29.1	26	
DT34	32	35	35	NR	21	21	16	17	18	22	32	31	25.3	22	
DT35	41	38	51	31	30	26	34	30	31	36	39	40	35.6	32	
DT37	30	28	34	21	20	16	23	23	24	29	32	34	26.2	23	
DT36	34	33	37	26	26	25	32	25	29	33	31	34	30.4	27	
DT39	44	45	49	48	46	43	40	33	39	46	53	42	44.0	39	
DT40	33	34	29	26	26	25	25	NR	26	27	35	30	28.7	26	
DT41	29	32	32	24	23	20	25	22	26	25	30	30	26.3	23	
DT42	33	40	40	32	32	31	29	28	33	32	36	30	32.9	29	
DT43	40	36	37	32	36	30	35	36	38	40	35	36	36.0	32	
DT44	31	35	38	28	32	31	29	NR	34	32	29	34	32.0	29	
DT45	NR	46	45	40	45	40	43	39	43	44	38	40	42.1	37	34

DT46	39	38	40	35	31	25	33	33	33	32	35	37	34.3	31	
DT47	47	51	49	NR	40	35	35	33	39	39	43	43	41.4	37	34
DT73	30	35	36	26	27	23	19	22	27	30	38	32	28.7	26	
DT48	51	50	53	45	44	45	52	45	47	42	48	45	47.4	**42**	39
DT49	29	33	33	25	23	13	19	22	26	30	33	33	26.4	24	
DT50	30	37	36	NR	30	25	26	27	30	32	35	36	31.2	28	
DT51	31	41	41	34	37	40	31	34	34	42	43	44	37.6	33	
DT52	44	45	49	39	44	36	38	40	45	39	51	47	43.1	38	
DT53	27	30	29	22	25	25	19	20	22	28	28	30	25.4	23	
DT54	34	32	33	25	19	17	18	19	23	27	33	33	26.1	23	
DT55	56	52	56	44	52	45	47	49	53	52	56	59	51.9	**46**	**44**
DT56	48	46	51	49	48	41	45	45	49	NR	54	63	49.0	**44**	40
DT57	36	41	43	32	41	38	38	33	38	41	38	46	38.8	35	
DT58	33	43	41	32	36	36	34	31	35	41	40	38	36.7	33	
DT59	29	36	34	33	31	26	23	24	24	36	34	33	30.3	27	
DT60	36	40	39	34	37	34	32	24	29	37	34	35	34.1	30	
DT61	NR	NR	27	22	20	19	17	15	17	28	24	27	21.7	19	
DT62	27	30	27	21	20	19	13	16	17	29	27	28	22.9	20	
DT63	23	26	NR	NR	23	23	16	17	16	27	25	26	22.1	20	
DT64	25	31	29	24	28	28	22	22	21	28	24	29	25.9	23	
DT65	36	41	39	30	34	29	23	29	29	36	38	42	34.0	30	
DT66	28	29	28	20	20	14	18	19	21	24	28	31	23.4	23*	
DT67	27	27	26	18	NR	NR	16	18	18	NR	27	29	23.0	20	
DT68	25	35	NR	NR	26	23	21	27	27	29	NR	33	27.4	24	
DT69	25	33	33	25	23	18	20	23	25	30	41	32	27.4	24	
DT70	32	38	36	29	34	29	27	27	30	39	33	38	32.6	29	
DT78	NR	NR	NR	NR	NR	NR	15	21	17	NR	23	28	20.8	22*	

☒ **Local bias adjustment factor used**

☐ **National bias adjustment factor used**

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

☒ **Where applicable, data has been distance corrected for relevant exposure**

Notes:

Exceedances of the 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 B for details on bias adjustment and annualisation.

(2) *Distance corrected to nearest relevant public exposure. 7 Monitoring sites were corrected for distance in 2018 upon specific advice taken from Bureau Veritas, acting on behalf of Defra. The Council decided not to correct for distance site DT52 as air quality exposure levels at nearest receptor are comparable to the ones obtained at the monitoring location and correcting for distance would underestimate true exposure levels.

* Tubes corrected using local bias adjustment obtained from urban background co-location study (details available in Appendix B)

Table A 5 – 1 Hour Annual mean NO_2 monitoring results

Site ID	Site Type	Monitoring Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2018 (%) (2)	NO_2 1-Hour Means > 200µg/m^3 (3)				
					2014	2015	2016	2017	2018
CM1	Roadside	Automatic	95	95	0	2	0	0	1
CM2	Roadside	Automatic	49	49	0	0	0	0	0 (106)
CM3	Urban Background	Automatic	98	98	0	0	0 (76)	0	0

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 6 - Annual mean PM_{10} monitoring results

Site ID	Site Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2018 (%) (2)	PM_{10} Annual Mean Concentration ($\mu g/m^3$) (3)				
				2014	2015	2016	2017	2018
CM2	Roadside	47	47	22	21	20	18	18
CM3	Urban Background	97	97	15	13	15	13	12

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

Notes:

Exceedances of the PM_{10} annual mean objective of 40$\mu g/m^3$ 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 B for details.

Table A 7 – 24Hour mean PM_{10} monitoring results

Site ID	Site Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2018 (%) (2)	PM_{10} 24-Hour Means > 50µg/m^3 (3)				
				2014	2015	2016	2017	2018
CM2	Roadside	47	47	0	1	4	2	0 (30)
CM3	Urban Background	97	97	0	6	0 (24)	2	1

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 8 – $PM_{2.5}$ monitoring results

Site ID	Site Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2018 (%) (2)	$PM_{2.5}$ Annual Mean Concentration ($\mu g/m^3$) (3)				
				2014	2015	2016	2017	2018
CM3	Urban Background	96	96	10	10	13	11	10

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

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.

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

Automatic Monitoring Sites

Oxford City Council currently operates three continuous monitoring sites. All routine calibration and maintenance is carried out and recorded in accordance with manufacturers' and Automated Urban Monitoring Network site operators' manual. Instrument drift is routinely checked by:

- a daily internal instrument calibration which is carried out automatically using an electronic calibration check;
- every two weeks a manual external instrument calibration is carried out by Oxford City Council using gas cylinders that can be traced back to reference standards for each pollutant;
- every six months an audit of instrument response is carried out by an external organization using independent gas calibration standards.

The above checks enable data to be examined subsequently for instrument drift, which is expected, or for faulty data which is usually not expected. Instrument drift is routinely adjusted by means of the 2 weekly external gas calibrations. Scaled data is calculated using the gas calibrations for each analyser.

Data from the continuous monitoring sites is collected and independently validated by Ricardo Energy & Environment following robust QA/QC procedures[12].

A dedicated supporting unit is also employed for each site, responding to equipment breakdowns and scheduled maintenance and servicing.

Data capture

During the course of 2018, Oxford City Council's automatic roadside monitoring station of Oxford High Street suffered from a major incident that affected the performance of both NO_x and PM_{10} analysers.

On the 1st July 2018, All Souls College in Oxford carried out building work for a 6 month period to the facades of their main building, directly above the location of the council's automatic roadside monitoring station of Oxford High Street. The proposed works involved the replacement of several damaged ashlars and weatherings with new limestone, the dismantling and re-installation of an existing old chimney, and the stonework cleaning of High Street elevation.

During the entire construction period the monitoring station was enclosed inside the scaffolding and hence completely protected from the outdoor environment, due to a plastic sheet installed around the scaffolding to protect members of the public from exposure to dust from the construction site.

The monitoring station was left running during the first 3 months but had eventually to be shut down, as continued exposure to dust resulting from the construction work were damaging the monitoring instruments and the air conditioning unit.

Annualisation

The poor data capture rates observed at Oxford High Street have led to the need of annualisation of the 2018 air quality data of that monitoring station.

Methodology used to report low data capture

a) Hourly Mean NO_2

LAQM.TG (16) was utilised to report NO_2 Hourly Mean for St. Ebbes.

b) 24 Hour mean PM_{10}

LAQM.TG (16) was utilised to report PM_{10} Hourly Mean for St. Ebbes.

c) **Annual Mean NO_2 and PM_{10}** (***annualisation***)

The procedures that were used to annualise NO_2 and PM_{10} data at Oxford High Street are described within LAQM TG (16) guidance, Box 7.9 (page 49), and involved the identification of 2 to 4 nearby long term continuous monitoring sites lying within a radius of about 50 miles from Oxford High Street. The data capture of the selected sites needed to be at least 85%, and the sites to be chosen needed to be background (Urban background, Suburban or Rural), to avoid any type of

interference of local pollution effects that may have occurred at Urban Centre, Roadside or Kerbside locations. Details of the data and monitoring sites used for the calculation of the annualisation of NO_2 and PM_{10} annual means can be observed in Figures B1 and B2 below.

Table B 1 - Data used in the calculation procedure of NO_2 annual mean of Oxford High Street

Urban Background site	Distance to site	Annual Mean 2018 (Am)	Period Mean 2018 (Pm)	Data capture (Annual)	Ratio (Am/Pm)	Annualisation
St Ebbes (AURN)	05 miles	14.7	15.3	98.4%	0.96	
Swindon Walcot (AURN)	27 miles	13.3	13.6	97.3%	0.98	
AVG					**0.97**	
Oxford High Street			**39**			**37.8**

Table B 2 - Data used in the calculation procedure of PM_{10} annual mean of Oxford High Street

Urban Background site	Distance to site	Annual Mean 2018 (Am)	Period Mean 2018 (Pm)	Data capture (Annual)	Ratio (Am/Pm)	Annualisation
St Ebbes (AURN)	05 miles	12.0	13.2	97.0%	0.91	
Chilbolton (AURN)	42 miles	12.3	12.6	92.7%	0.98	
AVG					**0.94**	
Oxford High Street			**19.1**			**18.0**

Non-Automatic Monitoring Sites

Diffusion tubes are supplied and analysed by an accredited laboratory (South Yorkshire Air Quality Samplers), using the 50% TEA in Acetone method.

The laboratory is subject to quality assurance testing as part of their accreditation. This involves an independent comparison to other laboratories. The results of inter-comparisons are available for scrutiny.

As diffusion tubes are not the reference method due to its low accuracy when compared with automatic monitoring, it is necessary to bias correct them.

A bias correction factor is applied to diffusion tube results to account for laboratory bias and to correct to continuous monitoring results. Oxford City Council carries out two co-location studies annually, and has used the results to calculate two locally derived bias adjustment factors for each separate year studied.

In 2018, the following bias correction factors were derived from the following Oxford's AURN sites:

AURN Oxford Centre (Roadside) - **0.89**

AURN Oxford St Ebbes (Urban Background) - **0.97**

In March 2010, Local Air Quality management Helpdesk have issued a briefing note[14] with regards to the influence of location on diffusion tube bias and whether roadside collocation studies should be used to adjust background diffusion tubes and vice versa.

The document concludes the below:

"The value of a collocation study (and the subsequent bias adjustment) will be improved if the concentrations being measured are similar to those in the wider survey".

"Care should be taken to avoid applying a bias adjustment factor derived from a local collocation study carried out for concentrations that are very different to those being measured in the wider survey".

In other words, collocation results from a low concentration site (typically a background site) should not be used to derive a bias adjustment factor for survey results from high concentration sites (typically roadside sites) and vice versa.

In light of the above, Oxford City Centre decided to apply both bias adjustment factors that were obtained locally in 2018 to correct the diffusion tube data from its air quality network, following the following approach:

- The local bias of **0.89** obtained from local AURN roadside site was applied to adjust all monitoring roadside sites,
- The local bias of **0.97** obtained from local AURN urban background site was applied to adjust all monitoring urban background sites.

The average of the national bias correction factor for diffusion tubes that were tested using the same Acetone method (50% TEA) was of **0.86** in 2018. The two locally derived bias adjustment factors were also preferred due to the following:

a) The bias adjustment factors of our local studies are slightly higher than the one that was obtained nationally. Using the calculated local bias to adjust Oxford's NO_2 diffusion tube results represents therefore a much more conservative approach;

b) For a question of methodology and consistency with previous AQ AS reports;

c) Due to the fact that our local co-location studies have both presented *"good"* precision for the diffusion tubes in 2018, together with high quality chemiluminescence results, and an extremely high data capture rate for NO_x (>95%) obtained from our AURN monitoring sites of Oxford Centre roadside and Oxford St Ebbes.

Annualisation

The annual mean NO_2 has been also annualised for all the cases where diffusion tube annual data capture was below 75%, following the specific annualisation procedure described on LAQM (TG16).

In 2018, diffusion tube results were annualised at 3 locations:

- William Lucy Way
- Roger Dudman Way
- Churchill Drive/Old Road

Appendix C: Calendar Plots of Oxford's automatic monitoring

Figure C 1- Daily NO_2 averages at AURN automatic monitoring station of Oxford Centre roadside along calendar year 2018

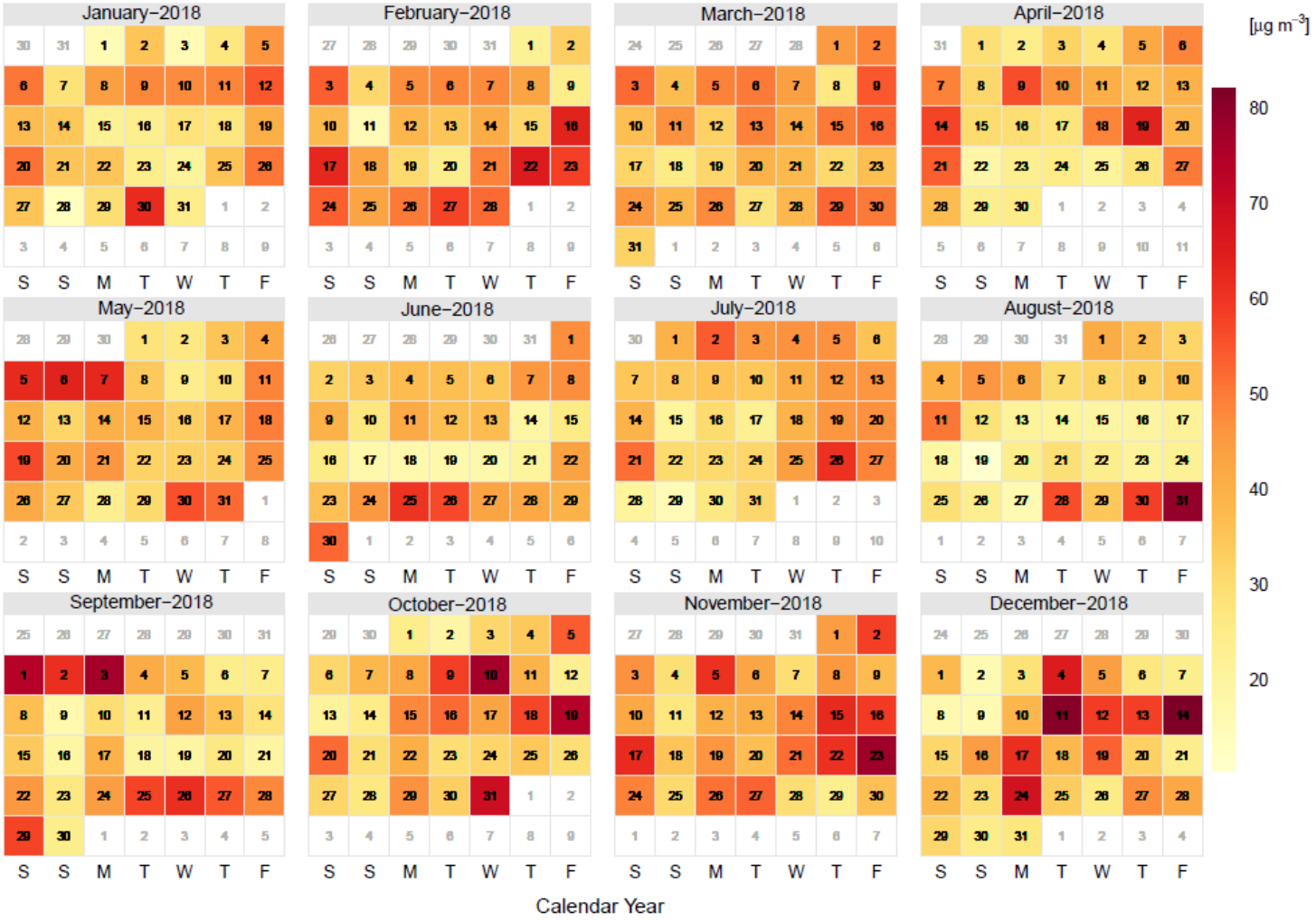


Figure C 2- Daily NO_2 averages at AURN automatic monitoring station of Oxford St Ebbes along calendar year 2018

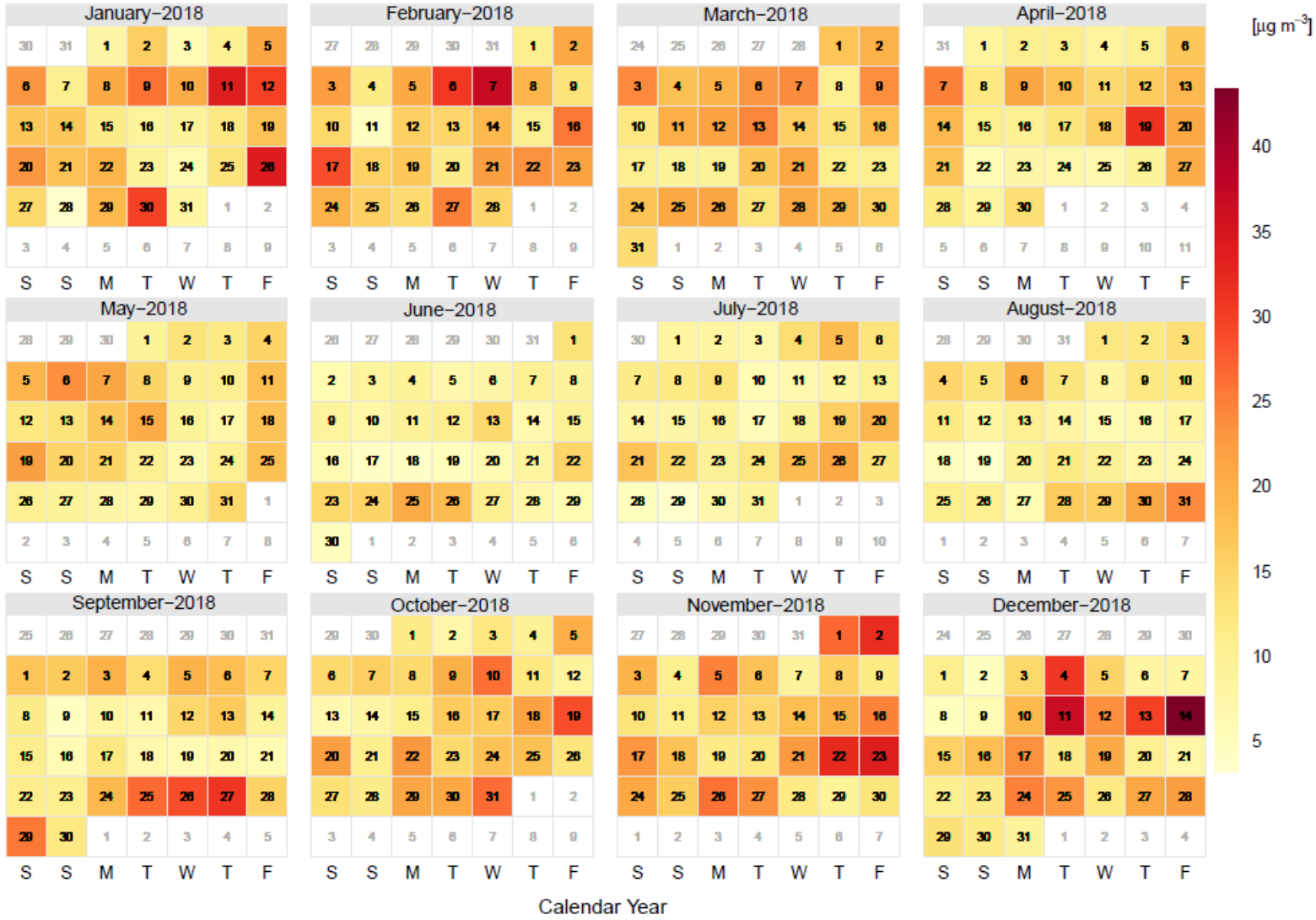


Figure C 3- Daily NO_2 averages at automatic monitoring station of Oxford High Street along calendar year 2018

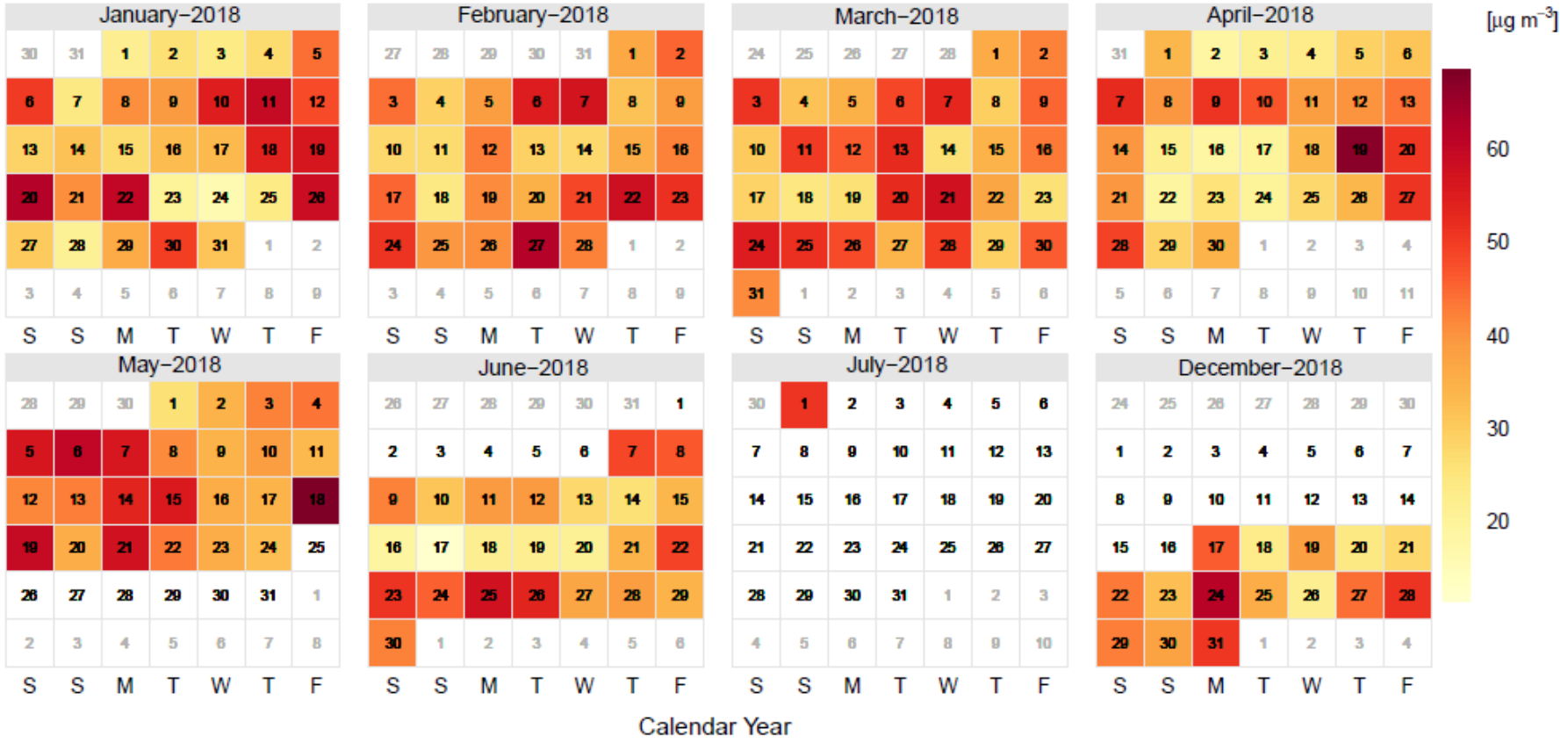
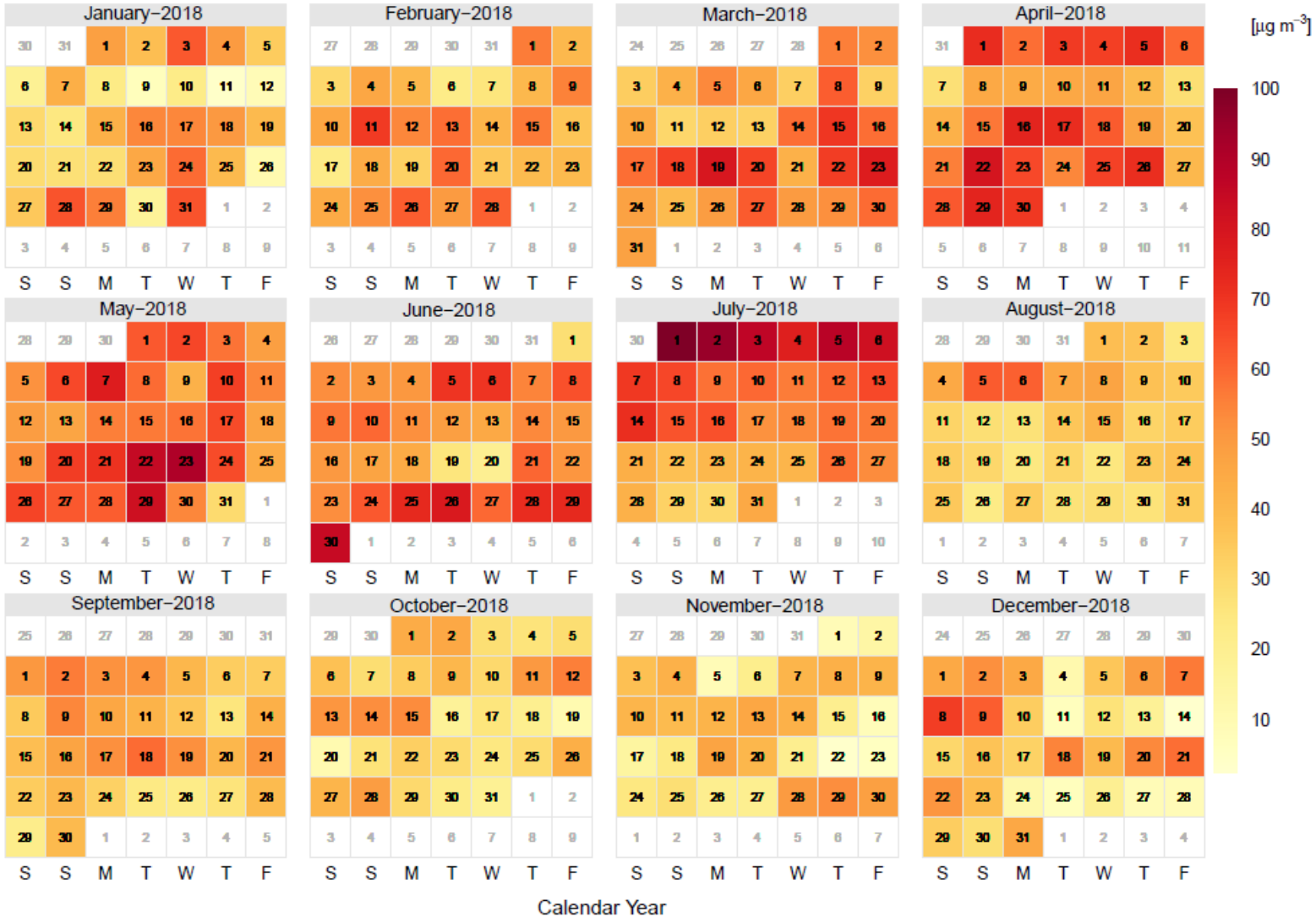
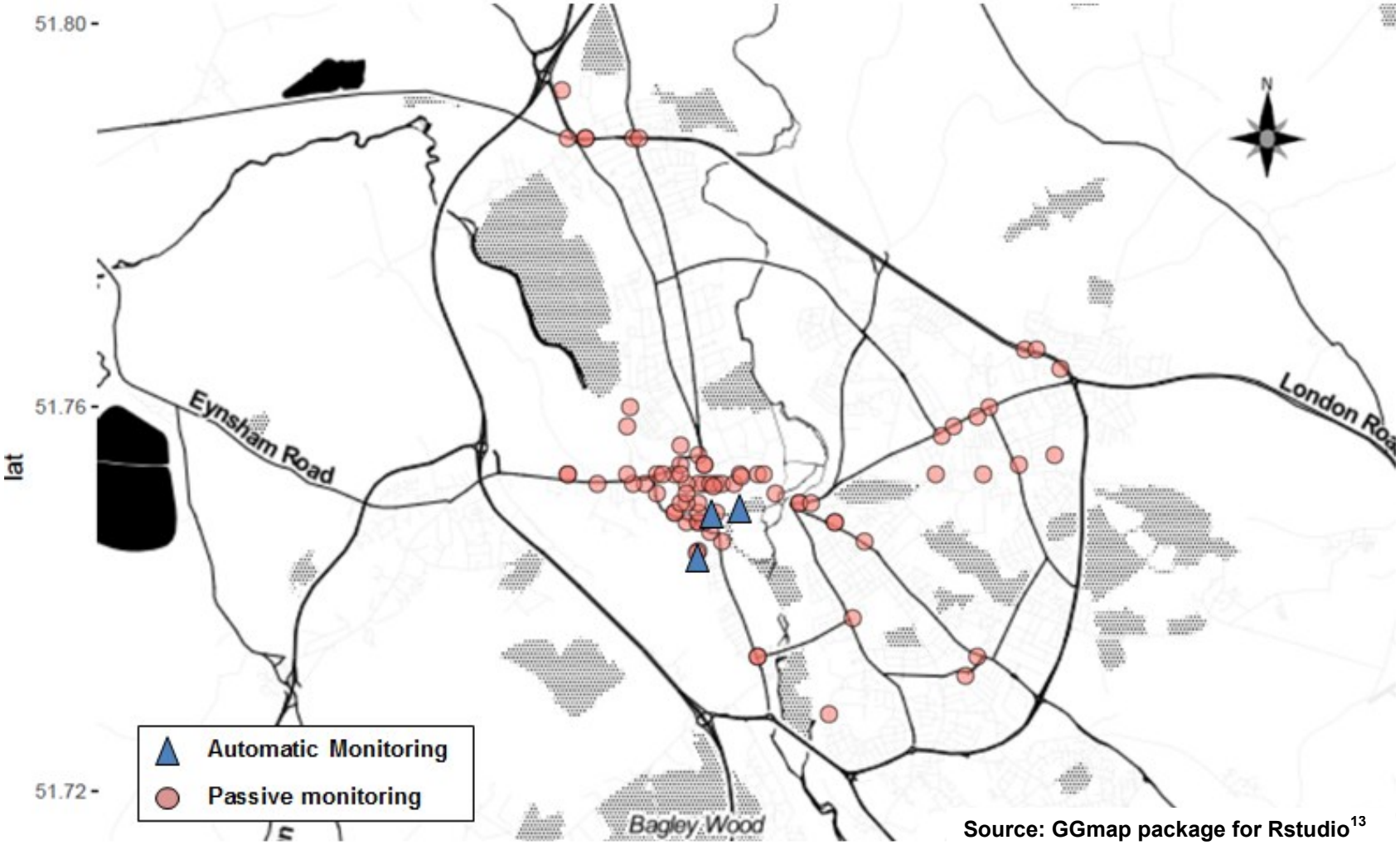


Figure C 4- Daily O_3 averages at automatic monitoring station of Oxford St Ebbes along calendar year 2018



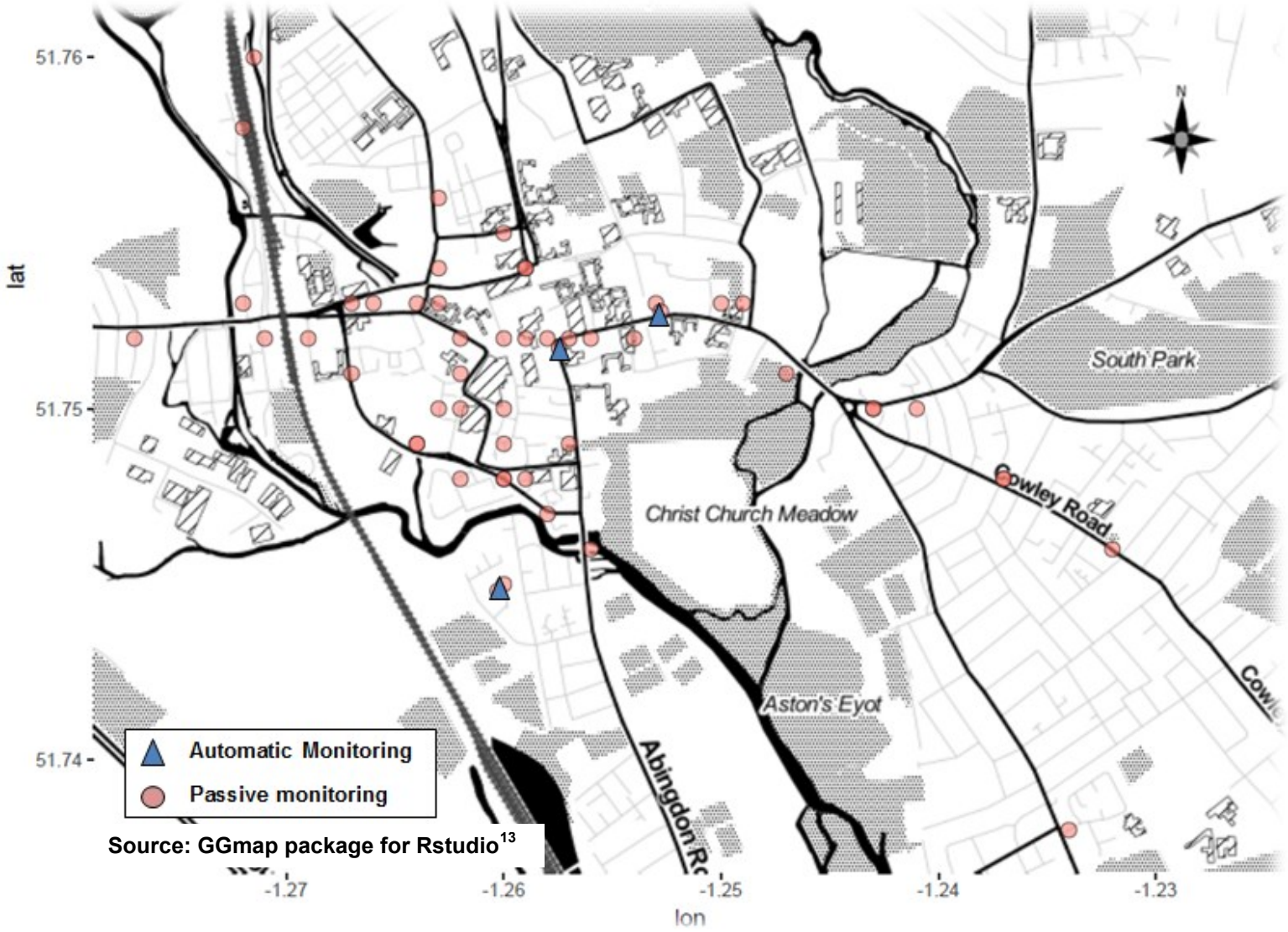
Appendix D: Map(s) of Monitoring Locations and AQMAs

Figure D 1– Oxford's air quality monitoring locations, 2018



Source: GGmap package for Rstudio[13]

Figure D 2– Oxford city centre air quality monitoring locations, 2018

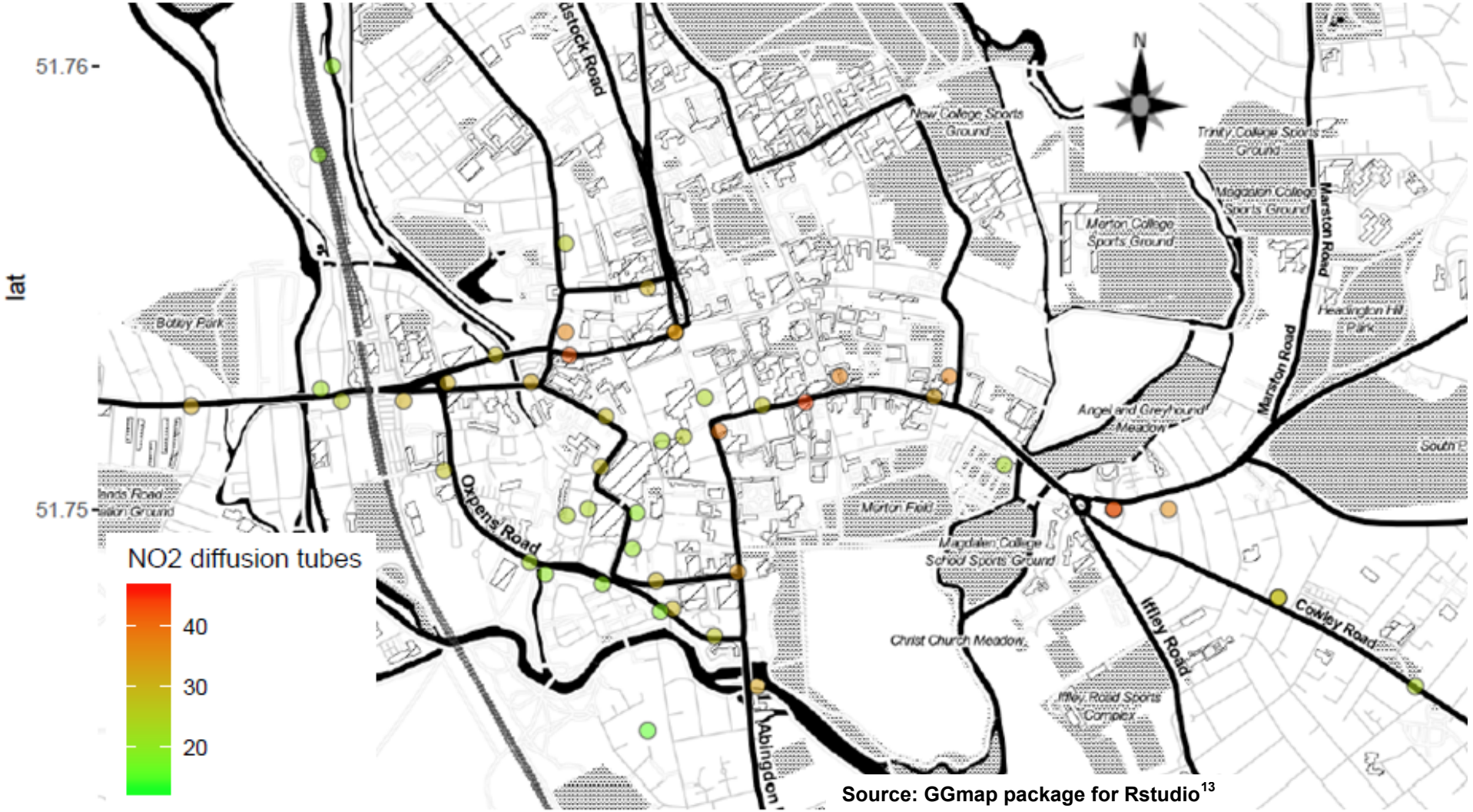


Source: GGmap package for Rstudio[13]

Figure D 3– Oxford's diffusion tube locations by level of NO_2, 2018

Source: GGmap package for Rstudio[13]

Figure D 4– Oxford city centre diffusion tube locations by level of NO_2, 2018



Source: GGmap package for Rstudio[13]

Figure D 5– West Gate diffusion tube locations by level of NO_2, 2018

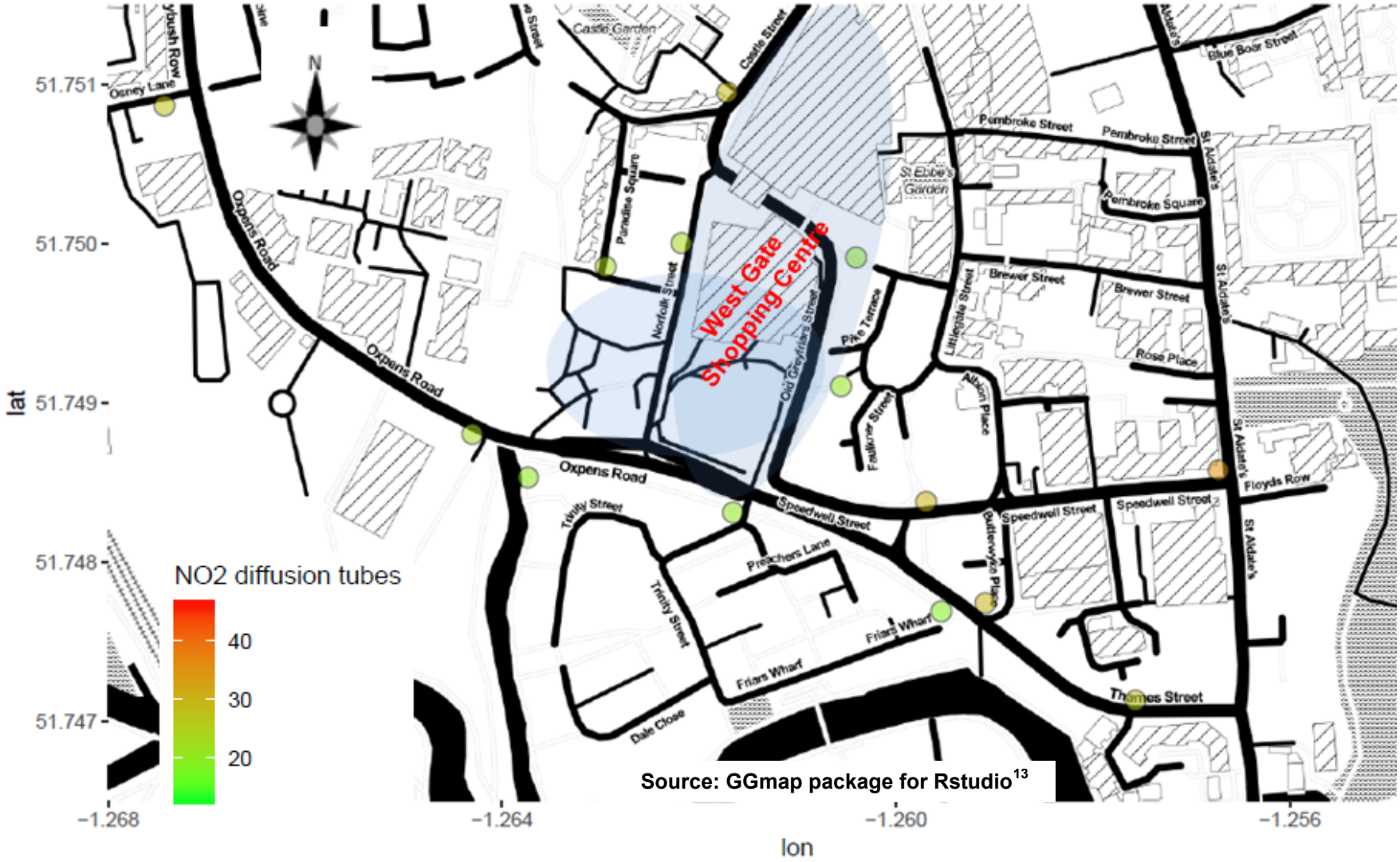


Figure D 6– Botley road diffusion tube locations by level of NO_2, 2018

Figure D 7– St Clements diffusion tube locations by level of NO_2, 2018

Appendix E: Summary of Air Quality Objectives in England

Table E 1 – Air Quality Objectives in England

Pollutant	Air Quality Objective[1]	
	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
Particulate Matter ($PM_{2.5}$) [2]	25 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
Ozone (O_3)	100 µg/m^3 not to be exceeded over 10 days a year	8-hour mean

Table E 2 – World Health Organisation recommended guidelines

Pollutant	Guidelines for each pollutant	
	Concentration	Measured as
Nitrogen Dioxide (NO_2)	200 µg/m^3	1-hour mean
	40 µg/m^3	Annual mean
Particulate Matter (PM_{10})	50 µg/m^3	24-hour mean
	20 µg/m^3	Annual mean
Particulate Matter ($PM_{2.5}$)	25 µg/m^3	24-hour mean
	10 µg/m^3	Annual Mean
Ozone (O_3)	100 µg/m^3	8-hour mean

[1] The units are in microgrammes of pollutant per cubic metre of air (µg/m^3).
[2] Non-mandatory target value, to be achieved by 2020.

Glossary of Terms

Abbreviation	Description
AQ	Air Quality
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'
AQI	Air Quality Index
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
AQS	Air Quality Strategy
ASR	Air quality Annual Status Report
AURN	Automatic Urban and Rural Network
CAZ	Clean Air Zone
CBTF	Clean Bus Technology Fund
COLTA	City of Oxford Licensed Taxicab Association
COPD	Chronic Obstructive Pulmonary Disease
Defra	Department for Environment, Food and Rural Affairs
DMRB	Design Manual for Roads and Bridges – Air quality screening tool produced by Highways England
DPF	Diesel Particulate Filter
DSPs	Delivery & Service Plans
EU	European Union
EV	Electric Vehicle
FDMS	Filter Dynamics Measurement System
FoE	Friends of the Earth

GULO	Go Ultra Low Oxford
JSNA	Joint Strategic Needs Assessment
LAQM	Local Air Quality Management
LAQM PG16	Local Air Quality Management Policy Guidance 16
LAQM TG16	Local Air Quality Management Technical Guidance 16
LES	Low Emission Strategy
LEZ	Low Emission Zone
LTP	Local Transport Plan
NO_2	Nitrogen Dioxide
NO_x	Nitrogen Oxides
O_3	Ozone
OAQG	Oxfordshire's Air Quality Group
OLEV	Office for Low Emission Vehicles
OxAir	Oxford's local group with the interest to measure air quality in Oxford from a human, spatial and temporal perspective
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
SCR	Selective Catalytic Reduction
STOP	Schools Tackling Oxford's Air Pollution
TEA	Triethanolamine (NO_2 Absorbent)
UK	United Kingdom
WHO	World Health Organisation
ZEZ	Zero Emission Zone

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