NORWICH
City Council

2024 Air Quality Annual Status Report (ASR)

In fulfilment of Part IV of the Environment Act 1995
Local Air Quality Management, as amended by the Environment Act 2021

This ASR is reporting on figures from the 2023 Calendar Year

Date: 18th June 2024

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Executive Summary: Air Quality in Our Area

Air Quality in Norwich City Council

Breathing in polluted air affects our health and costs the NHS and our society billions of pounds each year. Air pollution is recognised as a contributing factor in the onset of heart disease and cancer and can cause a range of health impacts, including effects on lung function, exacerbation of asthma, increases in hospital admissions and mortality. In the UK, it is estimated that the reduction in healthy life expectancy caused by air pollution is equivalent to 29,000 to 43,000 deaths a year[1].

Air pollution particularly affects the most vulnerable in society, children, the elderly, and those with existing heart and lung conditions. Additionally, people living in less affluent areas are most exposed to dangerous levels of air pollution[2].

Table ES 1 provides a brief explanation of the key pollutants relevant to Local Air Quality Management and the kind of activities they might arise from.

Table ES 1 - Description of Key Pollutants

Pollutant	Description
Nitrogen Dioxide (NO_2)	Nitrogen dioxide is a gas which is generally emitted from high-temperature combustion processes such as road transport or energy generation.
Sulphur Dioxide (SO_2)	Sulphur dioxide (SO_2) is a corrosive gas which is predominantly produced from the combustion of coal or crude oil.
Particulate Matter (PM_{10} and $PM_{2.5}$)	Particulate matter is everything in the air that is not a gas. Particles can come from natural sources such as pollen, as well as human made sources such as smoke from fires, emissions from industry and dust from tyres and brakes. PM_{10} refers to particles under 10 micrometres. Fine particulate matter or $PM_{2.5}$ are particles under 2.5 micrometres.

[1] UK Health Security Agency. Chemical Hazards and Poisons Report, Issue 28, 2022.

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

Norwich covers 39 km^2 and has a population of around 143,900 people (Census 2021). The population of the local plan defined Norwich Urban Area is around 235,000 (Census 2021) and that of Greater Norwich (Broadland, Norwich and South Norfolk) is approximately 418,000 (Census 2021). Norwich is the fourth most densely populated local authority district in the eastern region with 3,690 people per km^2.

Norwich City Council permits 29 'Part B' processes which includes a road stone coating plant, a sawmill & timber treatment process, a cement batching installation, aircraft/vehicle resprays and a crematorium. The Environment Agency permits larger 'Part A' processes which comprises just Briar Chemicals (an agrochemical company). However, no Part A or Part B processes are considered to contribute with any significance to air pollution levels in the city. The University of East Anglia operates a 20 MW natural gas boiler and three natural gas combined heat and power (CHP) engines that produce 5.7 MW of electricity and 6 MW of heat. This energy is used within the neighbouring Eaton School. The CHP stack height has been designed to provide good dispersion and, hence, this source of NO_2 is not considered to contribute with any significance to pollution levels in Norwich.

Road traffic is a major source of air pollution in Norwich. Completed source apportionment exercises have identified road traffic emissions to be the most significant source of NO_2. As a result, an Air Quality Management Area (AQMA) covering an area around the centre of Norwich was declared in 2012 due to exceedances of the NO_2 annual mean objective.

In 2023, the annual mean objective was **not** exceeded within the AQMA.

In order to tackle the exceedances within the AQMA, Norwich City Council produced an updated Air Quality Action Plan (AQAP) in 2021 (accessible here). So that any pollution hotspots can be identified (i.e. those areas where action is needed), Norwich City Council proposes to maintain and continue with the passive diffusion tube monitoring network. Diffusion tube locations are reviewed annually, with locations determined by any anticipated pollution hotspots, such as where changes to the road network may have had an impact on NO_2 levels.

During 2023, the maximum NO_2 annual mean concentration recorded at a single diffusion tube site inside the AQMA was 38.4 $\mu g/m^3$ (DT11). Outside of the AQMA the maximum concentration was 21.8 $\mu g/m^3$ (DT40) at St Stephens Road. There is a significant reduction in the concentrations inside the AQMA to that recorded in 2022 of 40.3 $\mu g/m^3$ (DT11). The

value for outside the AQMA was 19.8 µg/m^3 (DT40) which has increased back to 2020 and 2021 levels, though it is still below 2019 levels of 32.6 µg/m^3.
Therefore, it is evident that during 2023 there has not been a significant increase in NO_2 concentrations in Norwich. There were no exceedances of the NO_2 annual mean national objective within the AQMA, which is very positive. However, LAQM TG22 states that revocation of an AQMA should not be considered until there have been 3 consecutive years of annual mean NO_2 concentrations being lower than 36µg/m^3 (i.e. within 10% of the annual mean NO_2 objective) so to consider revoking the AQMA there needs to be another two years of no exceedances.

This 2024 Annual Status Report (ASR) refers to measures proposed in the new 2021 Air Quality Action Plan.

Norwich City Council proposes to continue with both automatic continuous NO_2 monitoring in tandem with passive diffusion tube monitoring.

Diffusion tube locations are reviewed annually. Locations are determined where pollution hotspots are anticipated and include sites where road changes may have had an impact on NO_2 levels, such as where higher traffic loading has resulted on alternative routes. In 2020, diffusion tube locations were also chosen in response to the submission of a planning application for a large development at Anglia Square. This was so baseline pollutant levels could be determined prior to any potential development.

We work closely with Norfolk County Council Highways Department and in 2022 we located 4 diffusion tubes outside schools on Nelson Road and Turner Road which were outside the Air Quality Management Area to aid with the School Streets initiative. The results were all very low as expected with the transient nature of school. The diffusion tube levels are continually low, and the School Streets trial didn’t progress in these locations, so these tubes shall be removed in 2024.

In response to concerns about traffic build up around Bethel Street and St Giles which was a result of a city centre street (Exchange Street) being closed to general traffic as part of COVID restrictions. Norwich City Council agreed in discussions with Norfolk County Council that we shall install some diffusion tubes in this area – we installed 5 in September 2023. Unfortunately, some of the tubes were stolen so we do not have enough data to report all of these in our DT reporting. This is discussed further in the QC section of the report. There were no exceedances from any of these 5 locations.

As a result, in 2023 we had a total of 50 diffusion tubes:

- 45 diffusion tube locations were retained
- 5 new diffusion tube locations were added

It is believed the data presented in this report, when assessed against the national annual mean objective levels, only provides an indicative assessment of pollution levels as the data has been substantially affected by the impact the Covid-19 pandemic has had on traffic levels. The NO_2 concentrations for the region have not returned to the pre-lockdown levels. The 2023 results may be following the long-term downward trend.

The requirement for a detailed assessment has not been identified for any pollutants and the council will progress to the 2025 Annual Status Report (ASR).

There has been ongoing progress with the measures to improve Norwich's Air Quality that includes:

- The new Air Quality Station at Castle Meadow was completed in Summer 2023 – photo below and is now fully commissioned. During 2023 the old and new monitoring stations were operating in tandem until end of 2023 when the old station was switched off, to ensure a full year of results from the old station.
- Optimise traffic flow at signalised junctions is undertaken for all new road layout schemes and when traffic signals are replaced as part of scheduled maintenance.
- Substantial works have been undertaken at the Heartsease ring road junction to improve pedestrian and cycle safety and improve the flow of traffic. These works were undertaken Sep 2023 and shall be completed in May 2024.
- Low NOx Buses - The buses started arriving in October 2023 and shall all be operational by May 2024. Around half of the buses operating in Norwich will then be zero emission.
- Improved transport hubs have been delivered at Norwich rail station and Norwich bus station and proposals are being developed for Bowthorpe and the Norfolk & Norwich University Hospital for 2024 and 2025 respectively.

Full details of the improvements are listed in table 2.2.

Norwich City Council is working closely with Norfolk County Council Highways/Sustainable Transport and Public Health. We are also part of the County wide Air Quality Group established between all the Local Authorities, the Environment Agency, The Integrated Care Board and various departments of Norfolk County Council including Public Health.

The Air Quality Group applied for the DEFRA funding in 2023 for a Clean Air for Norfolk campaign to run an engine idling campaign and also seek funding to assist with a project to monitor the impact of domestic burning. DEFRA really liked our bid but they were not able to support us with any funding this year. We are still working in collaboration within our group to improve air quality awareness in Norwich and the surrounding areas.

We are working closely with Public Health and shall be collaborating on our next Action Plan which is due to be revised in 2026 to add Public Health related air quality targets.

As we are still seeing fluctuations in our air quality data we shall not be reviewing our AQMA at this time and shall keep this decision under review.

Actions to Improve Air Quality

Whilst air quality has improved significantly in recent decades, there are some areas where local action is needed to protect people and the environment from the effects of air pollution.

The Environmental Improvement Plan[3] sets out actions that will drive continued improvements to air quality and to meet the new national interim and long-term targets for fine particulate matter ($PM_{2.5}$), the pollutant of most harmful to human health. The Air Quality Strategy[4] provides more information on local authorities' responsibilities to work towards these new targets and reduce fine particulate matter in their areas.

The Road to Zero[5] details the Government's approach to reduce exhaust emissions from road transport through a number of mechanisms, in balance with the needs of the local community. This is extremely important given that cars are the most popular mode of personal travel and the majority of Air Quality Management Areas (AQMAs) are designated due to elevated concentrations heavily influenced by transport emissions.

The 2021 AQAP focuses on road infrastructure changes that are designed to divert traffic away from the congested city centre and re-allocate more road space for active forms of travel (i.e., walking/wheeling and cycling). The main focus is on removing congestion from the road network as factors such as vehicle emission standards are beyond the control of Norwich City Council. In addition, the plan promotes the use of public transport by prioritising bus routes, improving bus frequency on key routes and providing easy access to Park & Ride facilities. Cycle infrastructure is also a key focus for Norwich City Council by lengthening and linking up cycle routes as well as providing segregated and safer routes (i.e. at major junctions).

Norwich City Council's main priorities are to reduce emissions from transport and promote alternative modes of travel. To achieve this, Norwich City Council are working in conjunction with Norfolk County Council to examine the feasibility of implementing the following measures over the course of the next five years:

- Expansion of the Low Emission Zone (LEZ).
- Restricting vehicles that can travel through the LEZ to a much tougher Euro emission standard (following discussions with transport operators).
- Extending engine switch off powers to accommodate the extended LEZ.

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[3] Defra. Environmental Improvement Plan 2023, January 2023

[4] Defra. Air Quality Strategy – Framework for Local Authority Delivery, August 2023

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

- Promote low and zero emission public transport through the use of external grant schemes and private investment through the Bus Service Improvement Plan.
- Reviewing traffic light junctions to reduce congestion and improve traffic flow, as well as supporting the provision of traffic light priority for buses.
- Make road junctions safer and easier for those walking, wheeling and cycling to navigate.
- Expand the cycle networks and create safe, connected corridors for those walking, wheeling and cycling.
- Review the support provided to schools in encouraging more active and sustainable travel to and from school, delivering initiatives such as School Streets, and encouraging schools to participate in air quality initiatives such as Clean Air Day.
- Engage the public and businesses through a behaviour change programme, including the use of social media to increase awareness of taking personal responsibility for reducing air pollution, such as engine switch off, walking/cycling, car sharing and using an domestic solid fuelled open fire or wood burners responsibly.

Norwich City Council believe that the implementation of these measures along with further measures in subsequent years will contribute to the reduction of NO_2 levels to below the annual mean AQS objective, so that the current AQMA designation can be eventually revoked.

Significant works have been completed in much of the city centre area of Norwich over the last 10 years, including the creation of more pedestrian areas, the removal of traffic lights and kerbside barriers at a number of junctions. On some of these streets, this also includes the removal of private motorised vehicles giving access only to buses, coaches, taxis, delivery vehicles and bikes and scooters. These changes are designed to support the vitality of the city centre by reducing conflict between vehicles, pedestrians and cyclists.

Exchange Street in Norwich had been closed to general traffic since July 2020 as part of an Experimental Traffic Regulation Order. A decision was made to reopen this road to traffic in November 2023.

With respect to public transport, Norfolk County Council and First Buses have received funding of £14.7m from the Department for Transport (DfT) through the Zero Emission Bus Regional Area (ZEBRA) fund. This has seen 70 zero-emission, battery electric buses

introduced from October 2023 and shall be completed in May 2024, replacing older and more polluting diesel buses.

This funding has enabled First Bus to electrify their most frequent cross-city routes, accounting for nearly 2/3rds of bus journeys they operate through Castle Meadow. This significant joint investment provides a benefit for passengers, whilst contributing towards improving the overall air quality in the city especially within the AQMA.

The Norwich Park & Ride service has struggled to regain patronage post-COVID. However, the Postwick site, which has been closed since the pandemic, was reopened in September 2023 on a trial basis following requests from the public and local parishes. following and remains open. A new contract for the Norwich Park & Ride service will be tendered during 2024 to be operational from Summer 2025.

A new bus passenger charter for Norfolk has been launched as part of the Norfolk Bus Service Investment Plan (BSIP) launched in October 2021. This outlines the commitment of Norfolk County Council and bus operators to improve bus services in Norwich and across Norfolk by rebuilding and increasing passenger confidence, having a green and sustainable transport offer, simple and affordable fares and making buses the primary mode of transport for most journeys. The aim is for 90% of buses in Norfolk to be Euro 5, 6 or zero emission by 2027. A new website has also been launched www.travelnorfolk.co.uk which makes it easy for people to find where their nearest bus stop is and includes live bus departure times and a comprehensive journey planner.

Norfolk County Council is looking at options to provide EV charging facilities at Park & Ride sites.

In terms of alternatives to private vehicle use, the cycle network for the greater Norwich area has been significantly upgraded over recent years. It comprises five radial and two orbital pedalway routes and a number of cycle routes connecting those pedalway routes. In addition, the Beryl micromobility scheme was launched in 2020, which now includes 470 standard bikes, 200 electric bikes and 500 electric scooters. The scooters are being operated as part of the government e-scooter trial. There has been over 1.5m total rides, 4m kilometres and 80,000 users since the launch. There are over 158 bays across Greater Norwich.

Norwich City Council have also promoted the uptake and use of electrical vehicles. There are now over 200 electrical vehicle (EV) charging points within the Norwich City Council area, with the numbers growing. The electric charging points can be found using websites

like the following links. https://www.zap-map.com/ and http://www.carwow.co.uk/electric-cars/charging-points Six of these EV charging points are owned by Norwich City Council and are located in Rose Lane Car Park, and three charging points at the UEA Enterprise Centre car park. Norwich City Council will continue to encourage the installation of EV charging points, and for significant planning projects, a relevant condition is added where applicable. The County Council is also working with District partners to facilitate the installation of EV charging points and 46 new charge points are being rolled out across Norwich during 2023 and 2024.

We hope to work again with the Environmental Science Department at the University of East Anglia (UEA), who we have previously collaborated with for various research projects.

We are working closely with Public Health on the Public Health Outcomes Framework (PHOF) on actions in relation to $PM_{2.5}$. We have had preliminary talks and shall be working with Public Health to identify sources of $PM_{2.5}$ and add to our next action plan.

Conclusions and Priorities

The 2021 AQAP presents a comprehensive review of Norwich air quality, the problem areas and the additional measures that will be required to combat this.

Norwich City Council intend to continue with automatic and passive NO_2 monitoring within the city area. As completion of road changes are implemented, Norwich City Council will keep the locations of passive monitoring under continuous review so that any resulting impacts from these changes can be determined.

The key findings for 2023 are:

- There are no exceedances of the NO_2 annual mean AQS objective within the AQMA.
- There were no exceedances of the NO_2 annual mean AQS objective at sites outside of the AQMA.
- The NO_2 annual mean was 34.4 µg m^{-3} at Norwich Castle Meadow and Norwich Castle Meadow 2 was 26.1 µg m^{-3} which did not exceed the AQS Objective of 40 µg m-3.
- The NO_2 1-hour AQS Objective of 200 µg m^{-3} was not exceeded at either AQS.

- The PM_{10} annual mean was 18.8 µg m^{-3} at Norwich Castle Meadow and Norwich Castle Meadow 2 was 13.8 µg m^{-3} which did not exceed the AQS Objective of 40 µg m-3.
- The PM_{10} 24-hour AQS Objective was not exceeded. There is an annual allowance of 35 days.
- The $PM_{2.5}$ annual mean was 5.0 µg m^{-3} at Norwich Castle Meadow and at Norwich Castle Meadow 2 was 8.2 µg m^{-3} neither exceeded the AQS Objective of 20 µg m^3.
- All automatic monitoring stations reported concentrations of NO_2, PM_{10} and $PM_{2.5}$ to be below the relevant objectives.
- There were 20 diffusion tubes that increased in NO_2 from the previous year, 12 showed a decline and 2 stayed the same. The increase is likely to be due to the increased traffic coming back into the city after the Covid restrictions were lifted. Though these figures are still well below the 2019 figures pre pandemic, and do not exceed the annual mean. The areas that declined included St Augustine's that has exceeded the limit for the past 2 years, it is not known why, though this could be linked to the increase in cleaner engines with more Euro 6 vehicles as well as more electric vehicles and buses. It will be interesting to see the trend in figures reported in the 2025 report based on the 2024 figures.

Norwich City Council own and run the Castle Meadow automatic monitoring station. Funding has been made available to replace this 25-year old station with more up to data technology.

The opportunity has been taken to replace this station with more up to date technology and relocate the new station to a roadside location, midway along Castle Meadow and close to relevant receptors. The new monitoring station has now been completed and was commissioned in July 2023. The old monitoring station ran in tandem with the new air quality station during the remainder of 2023 and is planned to be switched off and decommissioned in early 2024.

With the replacement of buses with those using a cleaner technology, and the development of the BSIP, it is hoped continual improvements in air quality in the LEZ along Castle Meadow will follow. Therefore, as it is hoped these changes will result in a measurable reduction in NO_2, the Castle Meadow monitoring station has a useful purpose.

As well as maintaining the automatic and passive monitoring network, Norwich City Council will also continue to support initiatives that contribute positively to improving air quality. These cover a range of actions, such as:

- Encouraging car sharing in partnership with companies such as Liftshare.
- Encouraging schools to develop travel plans, including using the Modeshift Stars software.
- Support the Enterprise Car Club (formerly Norfolk Car Club).
- Support walking and cycling schemes such as Beryl Bikes and the LCWIP (Local Cycling & Walking Infrastructure Plan).
- Inform citizens on health concerns when using an open fire/wood burner through a program of social media and website campaigns. Discussions are progressing on a joint approach with Public Health, Norfolk County Council and other Norfolk Local Authorities on this matter.

Local Engagement and How to get Involved

Norwich City Council are aware that air quality is a subject that has become an increasing area of interest and concern for more and more people year on year. As a result, information about air quality in general and actions that can be taken to improve air quality, can be found at the following:

- UK-AIR (the government's air information resource).
- Norwich City Council (air quality reporting website).
- Enterprise Car Club ('connecting Norfolk').
- Norfolk Liftshare (car journey sharing).
- Modeshift Stars (national schools award for schools promoting sustainable travel).
- Cycle City Ambition Programme (report for Department for Transport).
- Transforming Cities Overview (funding application to Department for Transport).

(Please note Norwich City Council does not have control over third party websites and, hence, may not necessarily endorse its content.)

Norwich City Council promote initiatives such as "Clean Air Day" and "Clean Air Night", which allow the public to raise any air quality issues or concerns and learn more about

how to help themselves with improving the air which they breathe in (both indoors and outdoors). This is done with aid from the Norfolk Countywide Air Quality Group, who promote issues such as:

- Encouraging children to walk or cycle to school and find routes away from busy roads. Poster competitions have been used to engage teachers and pupils.
- Encouraging citizens to abandon the car and use an alternative mode of transport such as car share, public transport, cycle or walk.
- Raising awareness of the safest way to use a wood-burner/open fire.
- Encouraging pedestrians to walk on side streets instead of the main road, and encouraging drivers to switch off engines when idling.
- Promoting ‘Clean Air Day’ on social media sites, with the main focus on the younger generation. Norwich City Council hope that initiatives such as ‘Clean Air Day’ would be a catalyst for behavioural changes that will continue beyond the day itself.

Local Responsibilities and Commitment

This ASR was prepared by the Environmental Protection Team of Norwich City Council with the support and agreement of the following officers and departments:

This ASR has been approved by:

Jeremy Wiggin BSc (Hons) MSc MCIHT, Head of Sustainable Transport – Norfolk County Council

Graham Nelson, Executive director of Development & City Services – Norwich City Council

Cllr Emma Hampton - Norwich City Council

This ASR has been signed off by the Director of Public Health

Stuart Lines - Director of Public Health

If you have any comments on this ASR please send them to Sally Nicholson at:

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1 Local Air Quality Management

This report provides an overview of air quality in Norwich City Council during 2023. It fulfils the requirements of Local Air Quality Management (LAQM) as set out in Part IV of the Environment Act (1995), as amended by the Environment Act (2021), 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 order to achieve and maintain the objectives and the dates by which each measure will be carried out. This Annual Status Report (ASR) is an annual requirement showing the strategies employed by Norwich City Council to improve air quality and any progress that has been made.

The statutory air quality objectives applicable to LAQM in England are presented in Table E.1.

2 Actions to Improve Air Quality

2.1 Air Quality Management Areas

Air Quality Management Areas (AQMAs) are declared when there is an exceedance or likely exceedance of an air quality objective. After declaration, the authority should prepare an Air Quality Action Plan (AQAP) within 18 months. The AQAP should specify how air quality targets will be achieved and maintained, and provide dates by which measures will be carried out.

A summary of AQMAs declared by Norwich City Council can be found in Table 2.1. The table presents a description of the 1 AQMA that is currently designated within Norwich City Council. Appendix D: Map(s) of Monitoring Locations and AQMAs provides maps of the AQMA and also the air quality monitoring locations in relation to the AQMA. The air quality objectives pertinent to the current AQMA designation are as follows:

- NO_2 annual mean

Table 2.1 – Declared Air Quality Management Areas

AQMA Name	Date of Declaration	Pollutants and Air Quality Objectives	One Line Description	Is air quality in the AQMA influenced by roads controlled by Highways England?	Level of Exceedance: Declaration	Level of Exceedance: Current Year	Number of Years Compliant with Air Quality Objective	Name and Date of AQAP Publication	Web Link to AQAP
Central AQMA	November 2012	NO_2 Annual Mean	An area encompassing Norwich City Centre, broadly following the inner link road	NO	52 µg/ m^3 (at 52 St Augustines Street)	35.1 µg/ m3	1	AQAP June 2021	AQAP June 2021

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

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

2.2 Progress and Impact of Measures to address Air Quality in Norwich City Council

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

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

1. The ASR has been signed off by the Director of Public Health. This is welcomed. Collaboration and consultation with those who have responsibility for Public Health is expected to increase support for measures to improve air quality, with co-benefits for all.

   We are continuing engaging with public health to work towards joint goals

2. The Council have responded to and addressed the comments following last years appraisal, this is appreciated, and it is encouraged that the Council continue to do this.

   Norwich City Council shall continue to address any comments you raise.

3. The Council have provided a detailed summary of the monitoring results both within and outside of the AQMA, with supporting graphs provided.

4. The Council have included detailed information regarding completed measures and priorities for the upcoming years, highlighting their pro-active approach to addressing air quality.

5. Norwich City Council have reviewed their current monitoring strategy, with the addition of 8 new diffusion tube locations. This is welcomed, as it allows for identification of any potential new hotspot locations.

6. QA/QC procedures are appropriate, with sufficient evidence for all procedures provided in the appendix.

7. Overall, the report is detailed and concise, providing a good overview of the work the Council is undertaking to improve air quality within their area, and satisfies the criteria of the relevant reporting standard. The Council should continue their good work.

Both Norwich City Council and Norfolk County Council have taken forward a number of direct measures during the current reporting year of 2023 in pursuit of improving local air quality. Details of all measures completed, in progress or planned are set out in Table 2.2. 24 measures are included within Table 2.2, with the type of measure and the progress Norwich City Council have made during the reporting year of 2023 presented. Where there have been, or continue to be, barriers restricting the implementation of the measure, these are also presented within Table 2.2.

More detail on these measures can be found in their respective Action Plans the latest Action Plan being reported in July 2021.

Key completed measures are:

- Traffic Management - Grapes Hill roundabout was completed in November 2021. Foundry Bridge completed in July 2022 and initial evidence shows reduced congestion/smoother traffic flows. Work to the Heartsease Fiveways junction to improve pedestrian and cycle safety, encouraging greater use of active travel in this area. Works commenced in September 2023 and estimated completion May 2024.
- Traffic signals along Koblenz Avenue in Norwich were optimised following highway improvement works around Norwich station. Works completed Summer 2023.
- Low NOx Buses - Funding has been secured from First Bus and government through the Zero Emission Bus Regional Area (ZEBRA) programme for 70 zero emission battery electric buses to be operated in Norwich. The first buses arrived in Norwich in October 2023 and shall all be operating by May 2024. Around half of the buses in Norwich will be zero emission by that time
- New Air Quality Monitoring Station on Castle Meadow was completed in July 2023 – this will provide us with new technology to carry out the continuous monitoring for Norwich and brings up to DEFRA standards.
- Key hubs have been developed at Norwich rail station and Norwich bus station. New transport hubs at Bowthorpe and the Norfolk & Norwich University Hospital are planned for 2024 and 2025 respectively.
- Delivery of the Transforming Cities Fund programme, which has a number of highway schemes aimed at encouraging greater use of public transport, walking, wheeling and cycling. After some challenges Cromer Road and Aylsham Road bus lanes are complete. Dereham Road bus lanes were constructed in Autumn 2023.

Norwich City Council's priorities for the coming year are:

- More bus provision schemes are being delivered during 2024 and 2025. Transforming Cities will see substantial provision of priority for buses along key transport corridors including Dereham Road, Cromer Road, Aylsham Road and Thorpe Road.
- Travel Alternatives: Extension to Thickthorn Park and Ride site. Outline of the design was completed. Though the plans have now changed for this site and they are now not extending but planning to switch Thickthorn to focus on EV charging.

- Norfolk County Council is looking at options to increase the provision of EV charging at Park & Ride sites.
- Park & Ride patronage remains significantly below pre-COVID levels. Postwick reopened in autumn 2023 and being run on trial basis - shall be reviewed in Autumn 2024. The Park & Ride service is being retendered during 2024 with a new service operational from Summer 2025.

Norwich Progress on the following measures has been slower than expected due to:

- Delivery of the Transforming Cities Fund programme, which has a number of highway schemes aimed at encouraging greater use of public transport, walking, wheeling and cycling, has been challenging given the short timescales set for delivery, inflationary pressures on costs, delays in supply chains, availability of design resource and a constrained network in which to operate. As a result of these pressures, the programme has been extended into 2024/25. These pressures remain and are being closely monitored and considered when planning and delivering future schemes.

Norwich City Council worked to implement these measures in partnership with the following stakeholders during 2023:

- Norwich County Council Highways
- Public Health Norfolk
- Norfolk Air Quality Group

Whilst the measures stated above and in Table 2.2 will help to contribute towards compliance, Norwich City Council anticipates that further additional measures not yet prescribed will be required in subsequent years to achieve compliance and enable the revocation of Central Air Quality Management Area.

Table 2.2 – Progress on Measures to Improve Air Quality

Measure No.	Measure Title	Category	Classification	Year Measure Introduced in AQAP	Estimated / Actual Completion Date	Organisations Involved	Funding Source	Defra AQ Grant Funding	Funding Status	Estimated Cost of Measure	Measure Status	Reduction in Pollutant / Emission from Measure	Key Performance Indicator	Progress to Date	Comments / Barriers to Implementation
1	Castle Meadow Low Emission Zone	Promoting Low Emission Transport	Low Emission Zone (LEZ)	2006/09	Ongoing	Norfolk County Council	Norwich City Council	NO	Funded	< £10k	Planning	Approx. 10-15 µg/m^3 NO_2	Reduction in NO_2 levels in Castle Meadow	Erratic decline in NO_2 but probably would have been worse without LEZ	Ongoing review of LEZ and the requirement to further reduce vehicle emissions. Review once electric buses are fully rolled out in 2024. Further discussions required with operators at enhanced partnership to agree revision. May need to amend TRO Norfolk CC to lead through enhanced partnership
2	Review of traffic light times & synchronisation to optimise traffic flow for all new road layout schemes.	Traffic Management	UTC, Congestion management, traffic reduction	2016	Ongoing	Norfolk County Council	Norfolk County Council	NO	Funded	£10k - 50k	Implementation	Specific value not known but will contribute to overall reduction in NO_2 levels in city centre and surrounds. NO_2 levels at CM1 reduced by >10 µg/m^3 in 2019. Reason unknown but smart traffic lights installed at end on Castle Meadow close to CM1. To date this is considered to be one explanation.	Reduced city centre congestion as well as wider network.	Ongoing.Traffic signals along Koblenz Avenue in Norwich are being optimized following highway improvement works around Norwich station. Works completed Summer 2023	This scheme was delivered in two phases; one in January – February 2023 and the other June – July 2023. All works are completed and has led to traffic signals along this corridor being better co-ordinated, reducing delays and congestion.

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3	Ring road junction improvements	Traffic Management	UTC, Congestion management, traffic reduction	2020	2024	Norfolk County Council/Norwich City Council	Norfolk County Council/Norwich City Council	NO	Funded	£1 million - £10 million	Implementation	Specific value not known but will contribute to overall reduction in NO_2 levels in city centre and surrounds.	Reduced city centre congestion as well as wider network. Increase in numbers of people walking, wheeling and cycling	Grapes Hill roundabout was completed in November 2021. Foundry Bridge completed in July 2022 and initial evidence shows reduced congestion/smoother traffic flows. Work to the Heartsease Fiveways junction to improve pedestrian and cycle safety, encouraging greater use of active travel in this area. Works commenced in September 2023.	The current design of the Heartsease roundabout is a significant barrier to walking and cycling along this corridor, which leads to a dominance of car traffic into the city. This is also a key bus corridor, which sees considerable delays. The work on Heartsease Roundabout is due for completion in May 2024.
4	Engine Switch Off Enforcement	Public Information	Other	2018	Complete August 2018	Norwich City Council	Norwich City Council	NO	Funded	< £10k	Ongoing on Castle Meadow & St Stephens St. Reach extended if LEZ extended as proposed	Complimentary to other measures; in particular Castle Meadow LEZ. NO_2 levels at CM1 reduced by >10 µg/m3 in 2019. Reason unknown but smart traffic lights installed at end of Castle Meadow close to CM1. To date this is considered to be one explanation and engine switch off may be another.	Reduction in NO_2 levels in city centre and surrounds	Engine switch off enforcement in place with issue of Fixed penalty Notices for drivers who fail to comply when requested. To date no non-compliance.	Use of powers to enforce engine switch-off via issue of fixed penalty notices. Specifically on Castle Meadow & St Stephens where bus & taxi only traffic. Any extension of the LEZ would mean extension of engine switch off enforcement area. No change to this. Though Norwich City Council are planning on writing to coach companies to remind them of the restrictions.

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5	Signage informing engine switch-off enforcement. Electronic displays at traffic lights giving waiting times.	Public Information	Other	2017	Ongoing but October 2018 for switch off enforcement on Castle Meadow	Norfolk County Council/Norwich City Council	Norfolk County Council/Norwich City Council	NO	Not Funded	£100k - £500k	Planning	Specific value not known but will contribute to overall reduction in NO_2 levels in city centre and surrounds.	Reduction in $N0_2$ levels in AQMA	Ongoing - A review of technology available to display waiting times at traffic lights has been undertaken, which highlighted that this isn't currently an option to deliver in terms of available standards and legislation.	New signage associated with enforcement of engine switch off educates road users and reinforces AQMA. Review has highlighted that this is not an option at present – shall keep under review
6	Low NOx Buses	Promoting Low Emission Transport	Public Vehicle Procurement - Prioritising uptake of low emission vehicles	N/A	Ongoing	Norfolk County Council/Norwich City Council	Norfolk County Council/Norwich City Council	NO	Funded	£1 million - £10 million	Implementation	The introduction of 15 zero emission buses is forecast to reduce air quality related emissions (NOx and $PM_{2.5}$) by 9.2 tonnes per annum.	Reduction in NO_2 levels in city centre and surrounds	24 buses retrofitted with exhaust gas treatment equipment by June 2018. Funding has been secured from First Bus and government through the Zero Emission Bus Regional Area (ZEBRA) programme for 70 zero emission battery electric buses to be operated in Norwich by March 2024. Around half of the buses in Norwich will be zero emission by that time.	Aim is to continue to work in partnership with bus operators on funding opportunities relating to low and zero NOx emission vehicles. Buses started arriving in October 2023 and shall all be operational by May 2024 replacing older, diesel buses.
7	Assess opportunity for a zero-emission bus fleet to operate the Norwich Park & Ride service when the contract is renewed in 2023	Promoting Travel Alternatives	Other		2023/2024	Norfolk County Council	Norfolk County Council	NO	Not Funded	£1 million - £10 million	Planning	Specific value not known but will contribute to overall reduction in NO_2 levels in city centre and surrounds.	Reduction in NO_2 levels in city centre and on busy feeder roads.	Park & Ride patronage continues to struggle post-COVID operating at 40-50% pre-COVID levels. An extension to the existing operation of Park & Ride is being sought to enable a re-procurement to take place in 12-18 months' time. Full consideration will be given to operating low / emission buses.	Procurement docs being drawn up aiming for zero fleet but dependent on responses received. Currently euro 5 so may move to euro 6 with a move to zero emission. Procurement 2024 for implementation 2025

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8	School Travel Plan	Promoting Travel Alternatives	School Travel Plans	Ongoing	Ongoing	Norfolk County Council	Norfolk County Council	NO	Funded	£10k - 50k	Implementation	Specific value not known but will contribute to overall reduction in NO_2 levels in city centre and surrounds.	Reduction in NO_2 levels in city centre and surrounds.Passive NO_2 monitoring to be installed outside key schools.	A review is being undertaken to identify whether a comprehensive programme of support can be offered to schools to support more pupils travelling to school actively.	County Council already promotes Modeshift Stars software with schools so they can generate and manage their own travel plans.Consideration will be given to whether school bus contracts can be amended on their renewal to utilise low emission vehicles. School travel plans to behighlighted as part of Clean Air Day campaign – led byCounty & Public Health Norfolk.Ambition to have majority of schools in the Norwich area to have an up to date school travel plan.
9	West to East traffic restriction in Norwich City Centre	Traffic Management	UTC, Congestion management, traffic reduction	2020	2023	Norfolk County Council	Norfolk County Council (TFC Funding)	NO	Funded	£1 million - £10 million	Planning	Specific value not known but will contribute to overall reduction in NO_2 levels in city centre and surrounds.	Reduction in NO_2 levels in city centre and surrounds	This scheme is currently on hold	Provides substantially improved conditions for pedestrians and reduces congestion with buses. Scheme currently on hold.

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10	Revised layout in St Stephens Street / Red Lion Street	Traffic Management	UTC, Congestion management, traffic reduction	2020	2023	Norfolk County Council	Norfolk County Council (TFC Funding)	NO	Funded	£1 million - £10 million	Completed	Specific value not known but will contribute to overall reduction in NO_2levels in city centre.	Reduction in NO_2 levels in city centre and surrounds	The scheme is now completed	Provides substantially improved conditions for pedestrians and reduces congestion with buses
11	Transport hubs at key transport interchanges	Transport Planning and Infrastructure	Public transport improvements-interchanges stations and services	2020	2023	Norfolk County Council	Norfolk County Council (TFC Funding)	NO	Funded	£1 million - £10 million	Implementation	Specific value not known but will contribute to overall reduction in NO_2 levels in city centre.	Reduction in NO_2 levels in city centre and surrounds.	Completed (Norwich Rail Station / Norwich Bus Station) Rail station works were completed July 2022. Norwich Bus Station works to commence Spring 2023. Bowthorpe interchange will be constructed late 2023. Discussions ongoing regarding the Norfolk & Norwich University Hospital scheme.	Key hubs being developed are at Norwich Rail Station, Norwich Bus Station, Norfolk & Norwich University Hospital and Bowthorpe. Norwich bus station completion May 2024 Bowthorpe summer 2024 NNUH Easter 2025
12	Bus rapid transit	Transport Planning and Infrastructure	Bus route improvements	Ongoing	Ongoing	Norfolk County Council/Norwich City Council	Norfolk County Council/Norwich City Council	NO	Funded	> £10 million	Implementation	Specific value not known but will contribute to overall reduction in NO_2 levels in city centre and surrounds.	Reduction city centre congestion as well as wider network	Cromer Road and Aylsham Road bus lanes are complete. Dereham Road bus lanes to be constructed Autumn 2023	Transforming Cities will see substantial provision of priority for buses along key transport corridors including Dereham Road, Wroxham Road and Cromer Road. Dereham Road complete summer 24 Norwich bus station bus lane complete May 24

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13	Rationalising and simplifying of traffic on Prince of Wales Road	Traffic Management	UTC, Congestion management, traffic reduction	Longterm	2024	Norfolk County Council/Norwich City Council	Norfolk County Council/Norwich City Council	NO	Funded	> £10 million	Planning	Specific value not known but will contribute to overall reduction in NO_2 levels in city centre and surrounds.	Reduced city centre congestion	Scheme to restrict eastbound traffic movement on St Andrews Street has been approved and will be constructed early 2024. This will reduce traffic levels down Prince of Wales Road, easing congestion at the Foundry Bridge junction.	This scheme also supports the transport mobility hub completed at Norwich Rail Station. As measure 9 - this scheme is on hold
14	Extension to Thickthorn Park & Ride	Promoting Travel Alternatives	Other	2020	2024	Norfolk County Council	Norfolk County Council (TFC Funding)	NO	Funded	£1 million - £10 million	Planning	Specific value not known but will contribute to overall reduction in NO_2 levels in city centre.	Reduced city centre congestion as well as the wider network	Outline design completed. Construction planned Autumn 2023.	This scheme is currently on hold. Opportunities to install EV charge points across all Park & Ride sites is being examined.'
15	Extension to Postwick Park & Ride site	Promoting Travel Alternatives	Other	TBC	TBC	Norfolk County Council	Norfolk County Council	NO	Not Funded	£1 million - £10 million	Planning	Specific value not known but will contribute to overall reduction in NO_2 levels in city centre.	Reduced city centre congestion as well as the wider network	The Postwick site is reopening in Sep 2023 for an initial 4 month period. Patronage will be closely monitored to see if a permanent re-opening could be considered. Any extension of the existing site is reviewed,	Park & Ride patronage remains significantly below pre-COVID levels. Postwick opened in autumn 2023 and being run on trial basis - shall be reviewed in Autumn 2024.

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16	Installation of Beryl Bikes and E-Scooters across the Greater Norwich Area	Promoting Travel Alternatives	Other	2020	2020	Norfolk County Council/Norwich City Council	Norfolk County Council/Norwich City Council	NO	Funded	£100k - £500k	Implementation	Studies are showing that 30% of all journeys taken by bike or scooter would otherwise have been taken by car.	There has been over 1m total rides, 4m kilometres and 80,000 users since the launch. There are over 158 bays across Greater Norwich,	The Beryl scheme was expanded in 2023/23 to include Wymondham and Drayton. Additional of more bays continues. There are now nearly 200 e-bikes and over 480 e-scooters in the scheme.	Finding suitable space for bays to achieve optimal bay network density to drive up ridership. Progressing – new bays added every week
17	Introduction of School Streets	Transport Planning and Infrastructure	Other	2021	Ongoing	Norfolk County Council/Norwich City Council	Norfolk County Council/Norwich City Council	NO	Funded	£50k - £100k	Implementation	Specific value not known but will encourage green corridors to be utilised by students/pupils.	Reduction in traffic levels, improved air quality and greater numbers of pupils walking.	A School Streets trial was undertaken across Greater Norwich in 2022 involving 6 schools. Unfortunately, only 1 School Street remains operational in Wymondham. A review is being undertaken to identify whether cameras could be used to enforce School Streets going forwards.	The County Council will work with Sustrans and a wide range of stakeholders to implement. Trial complete – no schools in greater Norwich though shall remain under review by County
18	Wayfinding. Investment in new and transformative infrastructure to encourage more sustainable modes of transport for commuting and leisure journeys	Transport Planning and Infrastructure	Other	2020	2023	Norfolk County Council	Norfolk County Council (TFC Funding)	NO	Funded	£100k - £500k	Implementation	Specific value not known but will contribute to overall reduction in NO_2 levels in city centre.	Reduction in NO_2 levels in city centre and surrounds	Installation of a new wayfinding scheme is underway and will be complete Summer 2023, encouraging greater exploration of the city on foot. New cycle wayfinding is being implemented on a the Yellow and Green Pedalways during 2023.	Provides substantially improved conditions for pedestrians and cyclists Pedestrian wayfinding across greater Norwich complete Cycle – still being rolled out

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19	Construction of final link of Northern Distributor Road (NDR) over River Wensum joining up with A47 West	Transport Planning and Infrastructure	Other	2023	2026-29	Norfolk County Council	Norfolk County Council	NO	Partially Funded	> £10 million	Planning	Specific value not known but will contribute to overall reduction in NO_2 levels in city centre and surrounds.	Reduced city centre congestion as well as the wider network	Preferred route confirmed (July 2019). Strategic Outline Business Case approved May 2020. Contract for Design and Build awarded June 2021.Outline Business Case submitted toDfT. - approved	Government has approved the Outline Business Case for the scheme, which gives a commitment of £213m towards the project. A contractor has been appointed to design and build the scheme and the Planning Application for the project has been submitted to Norfolk County Council in their role as the planning authority. There will then be a statutory public consultation. Norwich City Council is not currently supporting this project. Submission of the Full Business Case is envisaged Summer 2025. Following all necessary approvals, construction could take place 2026-29.
20	Removal of private vehicle traffic from Tombland	Traffic Management	Strategic highway improvements, Re-prioritising road space away from cars, including Access management, Selective vehicle priority, bus priority, high vehicle occupancy lane	Long term	TBC	Norfolk County Council/Norwich City Council	Norfolk County Council/Norwich City Council	NO	Not Funded	£1 million - £10 million	Planning	Specific value not known but will contribute to overall reduction in NO_2 levels in city centre and surrounds.	Reduced city centre congestion	Not started	Long term goal. Will be considered as part of the development of the Transport for Norwich Implementation Plan.

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21	Education & information campaigns to encourage more responsible driving and the use of alternative modes	Promoting Travel Alternatives	Other	Ongoing	Ongoing	Norfolk County Council/Norwich City Council	Norfolk County Council/Norwich City Council	NO	Funded	£1 million - £10 million	Implementation	Specific value not known but will contribute to overall reduction in NO_2 levels in city centre and surrounds.	Reduction in NO_2 levels in city centre and surrounds	Ongoing	Continuation of work to promote Transport for Norwich objectives utilising funding from DfT through Access fund.
22	Installation of new Air Quality Monitoring Station	Other	Other	2021	2023	Norfolk County Council/Norwich City Council	Norfolk County Council	NO	Funded	£10k - 50k	Completed	Replaces ageing AQ Station with more up to date technology implementation of measures more reliably quantified	Accurate Monitoring of Norwich Air Quality	Completed	The old station shall be removed in 2024
23	Thorpe Road bus/cycle contraflow	Traffic Management	Strategic highway improvements, Re-prioritising road space away from cars, including Access management, Selective vehicle priority, bus priority, high vehicle occupancy lane	2020	2022	Norfolk County Council	Norfolk County Council (TFC Funding)	NO	Funded	£1 million - £10 million	Completed	Specific value not known but will contribute to overall reduction in NO_2 levels in city centre.	Reduction in NO_2 levels in city centre and surrounds	Completed	Provides a substantially improved and more direct route for buses and cyclists travelling into the city centre along a key radial route.
24	CCAG programmes	Promoting Travel Alternatives	Promotion of cycling	2014	2020	Norfolk County Council/Norwich City Council	Norfolk County Council/Norwich City Council/DfT	NO	Funded	£1 million - £10 million	Completed	Specific value not known but will contribute to overall reduction in NO_2 levels in city centre and surrounds.	Reduction in vehicle use in city centre. Increased no. people cycling.	Completed	Cycle routes have been extended and more joined up. All 2 orbital and 5 radial pedal ways now complete

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

As detailed in Policy Guidance LAQM.PG22 (Chapter 8) and the Air Quality Strategy[6], local authorities are expected to work towards reducing emissions and/or concentrations of fine particulate matter ($PM_{2.5}$)). There is clear evidence that $PM_{2.5}$ (particulate matter smaller 2.5 micrometres) has a significant impact on human health, including premature mortality, allergic reactions, and cardiovascular diseases.

Long term exposure to anthropogenic particulate air pollution is estimated to have an effect on mortality risks equivalent to a number of attributable deaths. The Public Heath Outcome Framework (PHOF) indicator D01[7] gives an estimate for this value, down to local authority area. In fact air pollution is likely to contribute a small amount to the deaths of a larger number of exposed individuals rather than being solely responsible for the number of deaths equivalent to the calculated figure of attributable deaths. However, this attributable deaths value gives a measure of the importance of air pollution for a local authority. This relative risk forms the cause for action through all delivery partners to tackle air pollution in the area.

The fraction of mortality attributable to particulate air pollution for Norwich in 2022 is 6.2% which has increased from 5.5% in 2021, possibly as a result of the Covid pandemic and the ending of 'lockdown' procedures.

The graph below is taken from Finger Tips a website that provides public health data for the period 2018 to 2022. Note that this data has not been updated to reflect 2023 results.

[6] Defra. Air Quality Strategy – Framework for Local Authority Delivery, August 2023

[7] https://fingertips.phe.org.uk/search/particulate#page/4/gid/1/pat/502/par/E10000020/ati/501/are/E07000148/iid/93861/age/230/sex/4/cat/-1/ctp/-1/yrr/1/cid/4/tbm/1

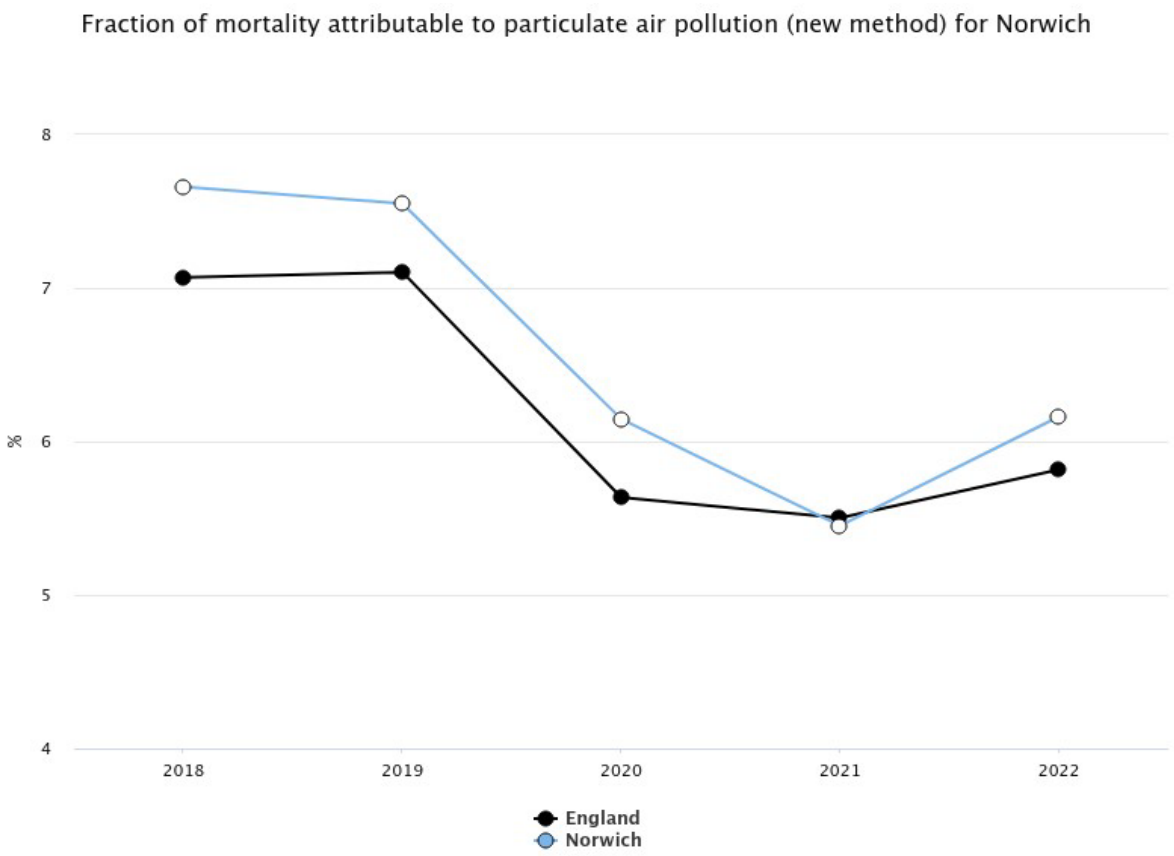


Table A.8 and Figure A.4 show the $PM_{2.5}$ monitoring results for the automatic stations Castle Meadow (CM1), Lakenfields (CM2) and Castle Meadow 2 (CM3). The $PM_{2.5}$ figures for 2023 have reduced since 2022 for CM1 and CM2, as CM3 is a new station and the first year's figures there is nothing to compare this too.

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

- **Real-Time Monitoring:** Automatic monitoring of $PM_{2.5}$ is carried out at the Automatic Urban and Rural Network (AURN) station (Norwich Lakenfields), which is an urban background site fitted with a FIDAS $PM_{2.5}$ analyser. From March 2023 Norwich City Council had two automatic monitoring stations operating. The Old Castle Meadow Station has a TEOM $PM_{2.5}$ analyser and the new station has a FIDAS $PM_{2.5}$ analyser also. Therefore, there is a large amount of historic data for $PM_{2.5}$, at background and roadside locations, that can be used to inform any trends in the ambient $PM_{2.5}$ concentration across the city.
- **Air Quality Partnerships:** Norwich City Council are working with partners within the newly formed Norfolk Countywide Air Quality Group to ensure regular two-way engagement with representatives of Public Health Norfolk and Norfolk County Council Highways. This allows for an exchange of information and data, including that referenced in the Public Health Outcomes Framework. The Air Quality Group

applied for DEFRA Funding for a Clean Air for Norfolk Campaign that would have looked at further education and the purchase of automatic $PM_{2.5}$ monitors for use within districts, though unfortunately we were unsuccessful in this bid. Work on a joint countywide communications programme is on-going.

- **Strategy Measures:** The measures listed within Table 2.2 ('Progress on Measures to Improve Air Quality') will have a positive contribution towards reducing $PM_{2.5}$ emissions and/or exposure, despite being primary orientated to NO_2. For example, reducing the volume of road traffic, increasing pedestrian only areas and promoting walk and cycle routes will also reduce vehicle brake and tyre wear – a contributor to $PM_{2.5}$ emissions. The switch to electrically powered buses will avoid the particulate matter produced from diesel engines. It is however understood that, at least in Norwich, $PM_{2.5}$ can be a transboundary pollutant.
- **Planning Applications:** The minimisation of airborne particulates will continue to be an important factor in all planning application considerations. Developers are encouraged to be part of the Considerate Contractors Scheme and have a fully adhered to onsite Environmental Policy which includes dust suppression. During 2023 Norwich City Council have also been requesting that any large developments consider the 2040 target of 10µg/m^3 in their planning.
- **Smoke Control Areas:** Norwich City Council has currently declared three smoke control areas in King Street, Norwich Airport and Bowthorpe. In these areas they are only allowed to burn in DEFRA exempt appliances using DEFRA authorised fuels which is enforced by Air Quality (Domestic Solid Fuels Standards) (England) Regulations 2020.

  The pollutants emissions from burning wood and coal are harmful to everyone (especially the young, elderly and most vulnerable) and we shall be doing further education to our residents and businesses on how to be compliant. We are also updating the enforcement procedure for these areas as introduced in the Environment Act 2021.

  We shall continue to use social media, Norwich City Council's monthly magazine and educational days such as Clean Air Day to broadcast the message. We are also working with the Air Quality Group to progress joint education projects.

- **Trading Standards:** Norwich City Council are working with Trading Standards to ensure retailers of wood and coal are complying with the new Air Quality (Domestic Solid Fuels Standards) (England) Regulations 2020.

2.3.1 Open Fires and Wood Burning Stoves

The use of open fires and wood-burning stoves has risen in popularity, particularly over recent years, causing emissions from domestic chimneys to increase. As a result, there is the potential for indoor air pollution to also increase. This is significant as pollutants such as $PM_{2.5}$ which are associated with wood burners and open fires can cause breathing problems such as asthma attacks and contribute to other health conditions.

Norwich City Council have made it a priority to identify all houses which have open fires as their primary source of heating, and especially those pertaining to their own housing stock, and are working towards installing an alternative method of heating. There are currently 63 wood burners/solid fuel appliances in Council owned properties, 17 of these are the only source of heating for the property. This could potentially feed into the Public Health Outcomes Framework for the Norwich area.

Guidance on burning can be found here.

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

This section sets out the monitoring undertaken within 2023 by Norwich City Council and how it compares with the relevant air quality objectives. In addition, monitoring results are presented for a five-year period between 2019 and 2023 to allow monitoring trends to be identified and discussed.

3.1 Summary of Monitoring Undertaken

3.1.1 Automatic Monitoring Sites

Norwich City Council undertook automatic (continuous) monitoring at 2 sites during 2023. Table A.1 in Appendix A shows the details of the automatic monitoring sites.

In March 2023 Norwich City Council installed a new Air Quality Monitoring Station on Castle Meadow, the old AQS continued to operate during 2023 alongside the new station and shall be switched off in January 2024. There is also an AURN monitoring station within Norwich; Norwich Lakenfields. Table A.1 in Appendix A shows the details of the three automatic monitoring sites. The Envista – Air Resources Manager page presents automatic monitoring results for Norwich City Council, with automatic monitoring results also available through the UK-Air website.

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

3.1.2 Non-Automatic Monitoring Sites

Norwich City Council undertook non- automatic (i.e. passive) monitoring of NO_2 at 36 sites during 2023. Table A.2 in Appendix A presents the details of the non-automatic sites.

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

3.2 Individual Pollutants

The air quality monitoring results presented in this section are, where relevant, adjusted for bias, annualisation (where the annual mean data capture is below 75% and greater than 25%), and distance correction. Further details on adjustments are provided in Appendix C.

3.2.1 Nitrogen Dioxide (NO_2)

Table A.3 and Table A.4 in Appendix A compare the ratified and adjusted monitored NO_2 annual mean concentrations for the past five years with the air quality objective of 40µg/m^3. Note that the concentration data presented represents the concentration at the location of the monitoring site, following the application of bias adjustment and annualisation, as required (i.e. the values are exclusive of any consideration to fall-off with distance adjustment).

During 2023, the maximum NO_2 annual mean concentration recorded at a diffusion tube site within the Central Norwich AQMA was 38.4 µg/ m^3 (DT11). Over the last five years, the NO_2 annual mean AQS objective (40 µg/ m^3) has been exceeded at this site for every year, except 2020 when it was 39.4 µg/ m^3. So, this drop in results is very promising, and it shall be interesting to see in next years results if this trend continues.
There were no diffusion tubes within the AQMA that recorded an NO_2 annual mean concentration within 10% of the AQS objective.
The maximum NO_2 annual mean concentration has fallen within the AQMA, indicating that there has not been a reduction in NO_2 concentrations during 2023 in Norwich.

Of the Diffusion tube results for 2023 compared against the 2022 figures, out of the 36 locations, 20 locations showed an increase in NO_2, 12 sites showed a decrease in NO_2 and 2 sites that remained the same, there were also 2 sites that were new to 2023 so I had no comparison.

The increase in levels is still likely to be due to the increased traffic coming back into the city after the Covid restrictions were lifted. Though these figures are still well below the annual mean. The 12 locations where there was an decrease and the 2 that stayed the same show a promising reduction of NO_2 in some areas

From the 20 locations all locations were still below the 2019 figures, however DT44 Botolph/Edwards Street and DT49 Queens Road North were only installed in 2020 so we have no comparison to the pre covid levels, these areas shall be kept under scrutiny, next years figures shall give us a clearer picture.

For the seven diffusion tube sites that are located outside of the AQMA (DT4 and DT40, DT52, DT53, DT54, DT55 and DT56), the maximum NO_2 annual mean concentration was 21.8 µg/m^3 in 2023. This has increased to similar levels to 2020 and 2021, of 21.5 µg/m^3 and 21.3 µg/m^3 though still well below the 2019 level of 32.6 µg/m^3.

For diffusion tubes, the full 2023 dataset of monthly mean values is provided in Appendix B. Note that the concentration data presented in Table B.1 includes distance corrected values, only where relevant.

The annual mean NO_2 concentration recorded at the Castle Meadow automatic monitoring site (CM1) was 34.4µg/m^3, which is significantly higher than that recorded in the previous reporting year. There is no obvious reason for this, though may be due to a bus stop being located outside the station. However, it is still well below the AQS objective and the 2019 result of 41 µg/m^3.

At the Norwich Lakenfields urban background AURN monitoring site (CM2), the annual mean NO_2 concentration (8.5 µg/ m^3) dropped considerably from the NO_2 concentration recorded in 2022 (10 µg/ m^3). Again there is no clear evidence to why this is at this time.

From July 2023 the new Castle Meadow 2 Air Quality Station (CM3) was commissioned, and the results are recorded in Table A3. This station is sited the southern end of castle meadow and is plotted on map in Appendix D. This site was chosen due to availability of space along Castle Meadow, and it is at a more central location. There was not a full year of results from the air quality station though it achieved 45.9% data capture and these results were annualised using the methodology in the Technical Guidance (7.140) because the annual data capture was less than 75% and there was at least 3 months monitoring.

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

The AQS objective for the NO_2 hourly mean concentration was not exceeded at any of the three automatic monitoring stations during 2023. A maximum NO_2 hourly mean concentration of 154.9µg/m^3,62.3 µg/m^3 and 81.7 µg/m^3 (98^{th} Percentile µg/m^3) were recorded at CM1, CM2 and CM3 respectively.

This is especially relevant for the Castle Meadow (CM1) automatic monitoring analyser as this site is located in a place where pedestrians typically stay for one hour or more.

No single diffusion tube site recorded an annual mean NO_2 concentration greater than 50.5 µg/m^3, indicating that it is unlikely that the NO_2 hourly mean was exceeded at these sites.

3.2.2 Particulate Matter (PM_{10})

Table A.6 in Appendix A: Monitoring Results compares the ratified and adjusted monitored PM_{10} annual mean concentrations for the past five years with the air quality objective of 40µg/m^3.

The annual mean PM_{10} concentration at the Castle Meadow (CM1) automatic monitoring site was 19µg/ m^3, which is lower than that recorded in 2022 (20µg/ m^3). For the AURN Norwich Lakenfields (CM2) monitoring site, the annual mean PM_{10} concentration was measured to be 11.8 µg/m^3 which, as with the CM1 site, which is lowest it has been in the last 5 years and has fallen from 2022 (14.0 µg/m^3). The annual mean PM_{10} concentration

at the Castle Meadow 2 (CM3) automatic monitoring site was 13.8 µg/m^3 which was 75% data capture as this analyser was installed in March 2023.

Table A.7 in Appendix A compares the ratified continuous monitored PM_{10} daily mean concentrations for the past five years with the air quality objective of 50µg/m^3, not to be exceeded more than 35 times per year.

At the Castle Meadow (CM1) monitoring station, there were no PM_{10} 24-hour mean concentrations greater than 50 µg/m^3 with the maximum 24-hour mean being 50 µg/m^3. This concentration was not exceeded at the Norwich Lakenfields AURN site (CM2), with a daily concentration of 45.9 µg/m^3 being recorded. At Castle Meadow 2 (CM3) monitoring station there were also no concentrations greater than 50 µg/m^3 with the maximum 24-hour mean being 20.1 µg/m^3 (90.4th Percentile µg/m^3 as less than 85%)

Therefore, no automatic stations exceeded the PM_{10} 24-hour mean concentrations of 50 µg/m^3 or the annual limit of exceedance of 35 days that the AQS objective allows. The PM_{10} concentration recorded at all automatic monitoring stations demonstrates the compliance with both the annual mean and daily objective within Norwich during 2023.

3.2.3 Particulate Matter ($PM_{2.5}$)

Table A.8 in Appendix A presents the ratified and adjusted monitored $PM_{2.5}$ annual mean concentrations for the past five years.

The $PM_{2.5}$ annual mean concentration recorded at the Castle Meadow (CM1) automatic monitoring site was 5.0 µg/m^3, whilst at the AURN Norwich Lakenfields (CM2) monitoring site, a $PM_{2.5}$ annual mean concentration of 7.6 µg/m^3 was recorded. The new Castle Meadow (CM3) monitoring site was 8.2 µg/m^3.

It should however be noted that the $PM_{2.5}$ TEOM analyser at the Castle Meadow site is not considered to be equivalent to the reference measurement method. There is, however, a long history of $PM_{2.5}$ measurements in Norwich and the TEOM measurements can be used to track any reduction of the $PM_{2.5}$ annual mean. For example, relative to 2023, it can be seen that the $PM_{2.5}$ concentration has reduced from that in 2022 at the Castle Meadows site (7µg/m^3), whilst the AURN Norwich Lakenfields site reduced to (7.6 µg/m^3).

The TEOM shall be decommissioned in January 2024 and the results from the FIDAS at the Castle Meadow Station (CM3) shall be used from then on, which shall produce more robust results.

Appendix A: Monitoring Results

Table A.1 – Details of Automatic Monitoring Sites

Site ID	Site Name	Site Type	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Pollutants Monitored	In AQMA? Which AQMA?	Monitoring Technique	Distance to Relevant Exposure (m) (1)	Distance to kerb of nearest road (m) (2)	Inlet Height (m)
CM1	Castle Meadow	Kerbside	623202	308615	PM_{10}, NOx, NO_2, $PM_{2.5}$	Y	Chemiluminescent (Ambirak); TEOM	N/A	1	2.5
CM2	Lakenfields	Urban Background	623637	306940	O_3, PM_{10}, NOx, NO_2, $PM_{2.5}$	N	Chemiluminescent (Thermo); FDMS	10	N/A	2.5
CM3	Castle Meadow 2	Kerbside	623112	308532	PM_{10}, NOx, NO_2, $PM_{2.5}$	Y	Chemiluminescent (APNA-370); FDMS	4	1	1.8

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

Diffusion Tube ID	Site Name	Site Type	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Pollutants Monitored	In AQMA? Which AQMA?	Distance to Relevant Exposure (m) (1)	Distance to kerb of nearest road (m) (2)	Tube Co-located with a Continuous Analyser?	Tube Height (m)
DT1A, DT1B	256 King St	Roadside	623863.04	307678.6	NO_2	Yes, Norwich	0.0	3.5	No	2.5
DT4A, DT4B, DT4C	Lakenfields AQS	Urban Background	623681.24	307015.82	NO_2	No	20.0	1.5	Yes	2.5
DT6	130 Magdalen St	Roadside	623160.89	309550.43	NO_2	Yes, Norwich	0.0	4.0	No	2.5
DT9	13 St Augustines St	Kerbside	622905.81	309496.11	NO_2	Yes, Norwich	1.0	1.5	No	2.5
DT11	52 St Augustines St	Kerbside	622825.87	309573.17	NO_2	Yes, Norwich	0.0	1.0	No	2.5
DT13	Castle Meadow (Middle)	Roadside	623141.06	308606.69	NO_2	Yes, Norwich	N/A	2.5	No	2.5
DT16	Zipfel House	Roadside	623185.69	309649.68	NO_2	Yes, Norwich	0.0	3.0	No	1.5
DT19	27 Cattle Market St	Roadside	623320.58	308430.88	NO_2	Yes, Norwich	0.0	2.0	No	1.5
DT21	Rotary House	Roadside	623879.53	307658.91	NO_2	Yes, Norwich	3.0	2.0	No	2.5
DT22	Carrow Bridge House	Roadside	623900.96	307709.56	NO_2	Yes, Norwich	0.0	5.0	No	3.0
DT25	Bargate Court	Roadside	623422.42	309388.23	NO_2	Yes, Norwich	0.0	4.0	No	3.0

Diffusion Tube ID	Site Name	Site Type	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Pollutants Monitored	In AQMA? Which AQMA?	Distance to Relevant Exposure (m) [1]	Distance to kerb of nearest road (m) [2]	Tube Co-located with a Continuous Analyser?	Tube Height (m)
DT26A, DT26B, DT26C	3 Riverside Rd	Roadside	623870.26	308515.77	NO_2	Yes, Norwich	0.0	3.0	No	3.0
DT29A, DT29B, DT29C	Chapelfield North	Kerbside	622532.23	308490.36	NO_2	Yes, Norwich	1.5	1.0	No	2.5
DT31A, DT31B, DT31C	Quantrell Huse C	Kerbside	623380	307700	NO_2	Yes, Norwich	0.0	3.0	No	3.0
DT34	41 St Stephens Street	Kerbside	622898	308114	NO_2	Yes, Norwich	6.0	0.5	No	3.0
DT37	7a Gunns Court	Kerbside	622492	308520	NO_2	Yes, Norwich	3.0	2.5	No	3.0
DT39	49 Duke St	Kerbside	622884	309082	NO_2	Yes, Norwich	0.0	1.0	No	3.0
DT40	St Stephens Rd (Kingsley Rd)	Roadside	622695	307855	NO_2	No	1.5	2.0	No	2.2
DT41	Magdalen St (RSPCA)	Roadside	623148	309277	NO_2	Yes, Norwich	1.5	3.5	No	2.5
DT42	Magdalen St (Fly Over)	Roadside	623151	309326	NO_2	Yes, Norwich	20.0	2.5	No	3.0
DT44	Botolph/Edwards St	Roadside	622910	309391	NO_2	Yes, Norwich	20.0	2.0	No	2.2
DT45	Pitt St W	Roadside	622904	309418	NO_2	Yes, Norwich	>20 n/a	2.2	No	2.1
DT46	Pitt St E	Roadside	622987	309486	NO_2	Yes, Norwich	>20 n/a	2.1	No	2.2

Diffusion Tube ID	Site Name	Site Type	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Pollutants Monitored	In AQMA? Which AQMA?	Distance to Relevant Exposure (m) [1]	Distance to kerb of nearest road (m) [2]	Tube Co-located with a Continuous Analyser?	Tube Height (m)
DT47	Duke St/St Crispins	Roadside	622869	309187	NO_2	Yes, Norwich	>20 n/a	2.5	No	2.5
DT48	Riverside/Aspland	Roadside	623878	308532	NO_2	Yes, Norwich	0.0	1.2	No	2.2
DT49	Queens Rd N	Roadside	623480	307679	NO_2	Yes, Norwich	0.0	2.0	No	2.0
DT50	Queens Rd S	Roadside	623474	307692	NO_2	Yes, Norwich	0.0	1.1	No	2.2
DT51	70 Bracondale	Roadside	624028	307322	NO_2	No	0.0	5.0	No	2.1
DT52	Heigham Road	Roadside	621958	309000	NO_2	No	0.0	5.0	No	1.8
DT53	Nelson Primary School 1	Kerbside	621573	309434	NO_2	No	9.0	1.5	No	2.0
DT54	Nelson Primary School 2	Kerbside	621574	309463	NO_2	No	3.0	1.5	No	2.3
DT55	82 Turner Road 1	Kerbside	621268	309494	NO_2	No	5.4	2.0	No	2.3
DT56	92 Turner Road 2	Kerbside	621267	309508	NO_2	No	3.7	2.6	No	2.3
DT57, DT58, DT59	Castle Meadow AQMS 3	Roadside	623204	308616	NO_2	Yes, Norwich	3.8	1.0	Yes	2.5
DT61	Aldwych House, Bethel St	Roadside	624068	307319	NO_2	Yes, Norwich	2.0	2.0	No	2.3
DT64	28 St Giles St	Roadside	623099	308478	NO_2	Yes, Norwich	2.0	1.5	No	2.4

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.3 – Annual Mean NO_2 Monitoring Results: Automatic Monitoring (µg/m^3)

Site ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Site Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2023 (%) (2)	2019	2020	2021	2022	2023
CM1	623202	308615	Kerbside	85.5	85.5	**41**	30	30	27	34.4
CM2	623637	306940	Urban Background	81	81	13	10	10	10	8.5
CM3	623112	308532	Kerbside	93.1	45.9					(24.14) 26.1

☒ **Annualisation has been conducted where data capture is <75% and >25% in line with LAQM.TG22**

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

☒ **Where exceedances of the NO_2 annual mean objective occur at locations not representative of relevant exposure, the fall-off with distance concentration has been calculated and reported concentration provided in brackets for 2023.**

Notes:

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

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

All means have been "annualised" as per LAQM.TG22 if valid data capture for the full calendar year is less than 75%. See Appendix C for details.

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

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

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

Table A.4 – Annual Mean NO_2 Monitoring Results: Non-Automatic Monitoring (µg/m^3)

Diffusion Tube ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Site Type	Valid Data Capture for Monitoring Period (%) [1]	Valid Data Capture 2023 (%) [2]	2019	2020	2021	2022	2023
DT1A, DT1B	623863.04	307678.6	Roadside	100	100	34.2	25.6	25.7	27.1	26.6
DT4A, DT4B, DT4C	623681.24	307015.82	Urban Background	97	97	12.0	10.0	9.8	8.5	8.5
DT6	623160.89	309550.43	Roadside	91.4	91.4	29.8	21.7	21.8	21.9	23.1
DT9	622905.81	309496.11	Kerbside	100	100	**40.1**	33.0	32.8	34.3	31.1
DT11	622825.87	309573.17	Kerbside	89	89.0	**46.0**	39.4	**40.2**	**40.3**	38.4
DT13	623141.06	308606.69	Roadside	94.5	94.5	**46.9**	35.5	36.4	34.1	36.8
DT16	623185.69	309649.68	Roadside	100	100	36.1	30.5	28.6	28.8	28.5
DT19	623320.58	308430.88	Roadside	100	100	34.8	22.9	23.7	25.9	25.6
DT21	623879.53	307658.91	Roadside	100	100	30.9	24.9	22.9	24.5	23.5
DT22	623900.96	307709.56	Roadside	89.5	89.5	29.4	21.7	21.6	20.9	22.4
DT25	623422.42	309388.23	Roadside	100	100	32.4	25.9	25.9	24.8	26.2
DT26A, DT26B, DT26C	623870.26	308515.77	Roadside	100	100	**43.3**	32.6	30.6	27.2	33.3

Diffusion Tube ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Site Type	Valid Data Capture for Monitoring Period (%) [1]	Valid Data Capture 2023 (%) [2]	2019	2020	2021	2022	2023
DT29A, DT29B, DT29C	622532.23	308490.36	Kerbside	91.4	91.4	**43.4**	29.8	29.4	27.7	28.6
DT31A, DT31B, DT31C	623380	307700	Kerbside	100	100	38.6	29.9	28.0	28.8	29.7
DT34	622898	308114	Kerbside	64.1	64.1	**40.3**	29.2	26.4	23.9	26.7 (30.2)
DT37	622492	308520	Kerbside	90.9	90.9	30.3	24.6	22.6	23.4	23.9
DT39	622884	309082	Kerbside	100	100	31.9	24.6	22.6	23.4	19.1
DT40	622695	307855	Roadside	91.7	91.7	32.6	21.5	21.3	19.8	21.8
DT41	623148	309277	Roadside	93.1	93.1	34.2	27.4	29.4	28.2	28.3
DT42	623151	309326	Roadside	89.5	89.5	33.0	21.4	27.4	26.7	25.6
DT44	622910	309391	Roadside	71	71.0		22.5	21.3	20.7	31.4 (35.5)
DT45	622904	309418	Roadside	100	100		25.4	22.7	22.5	21.8
DT46	622987	309486	Roadside	94.5	94.5		25.4	23.9	24.0	22.9
DT47	622869	309187	Roadside	100	100		19.8	22.1	20.7	20.5
DT48	623878	308532	Roadside	89.5	89.5		27.3	26.8	23.0	27.3

Diffusion Tube ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Site Type	Valid Data Capture for Monitoring Period (%) [1]	Valid Data Capture 2023 (%) [2]	2019	2020	2021	2022	2023
DT49	623480	307679	Roadside	100	100		24.9	24.7	26.7	29.2
DT50	623474	307692	Roadside	100	100		25.3	24.2	25.5	26.8
DT51	624028	307322	Roadside	100	100			27.2	26.3	20.7
DT52	621958	309000	Roadside	100	100				16.0	16.9
DT53	621573	309434	Kerbside	100	100				12.0	11.3
DT54	621574	309463	Kerbside	100	100				10.7	10.8
DT55	621268	309494	Kerbside	91.7	91.7				12.0	12.3
DT56	621267	309508	Kerbside	91.7	91.7				12.4	12.4
DT57, DT58, DT59	623204	308616	Roadside	92.8	92.8				31.3	35.2
DT61	624068	307319	Roadside	33.1	33.1					16.1 (18.2)
DT64	623099	308478	Roadside	33.1	33.1					19.1(21.6)

☒ **Annualisation has been conducted where data capture is <75% and >25% in line with LAQM.TG22**

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

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

Notes:

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

Exceedances of the NO_2 annual mean objective of 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**.

Means for diffusion tubes have been corrected for bias. All means have been "annualised" as per LAQM.TG22 if valid data capture for the full calendar year is less than 75%. See Appendix C for details.

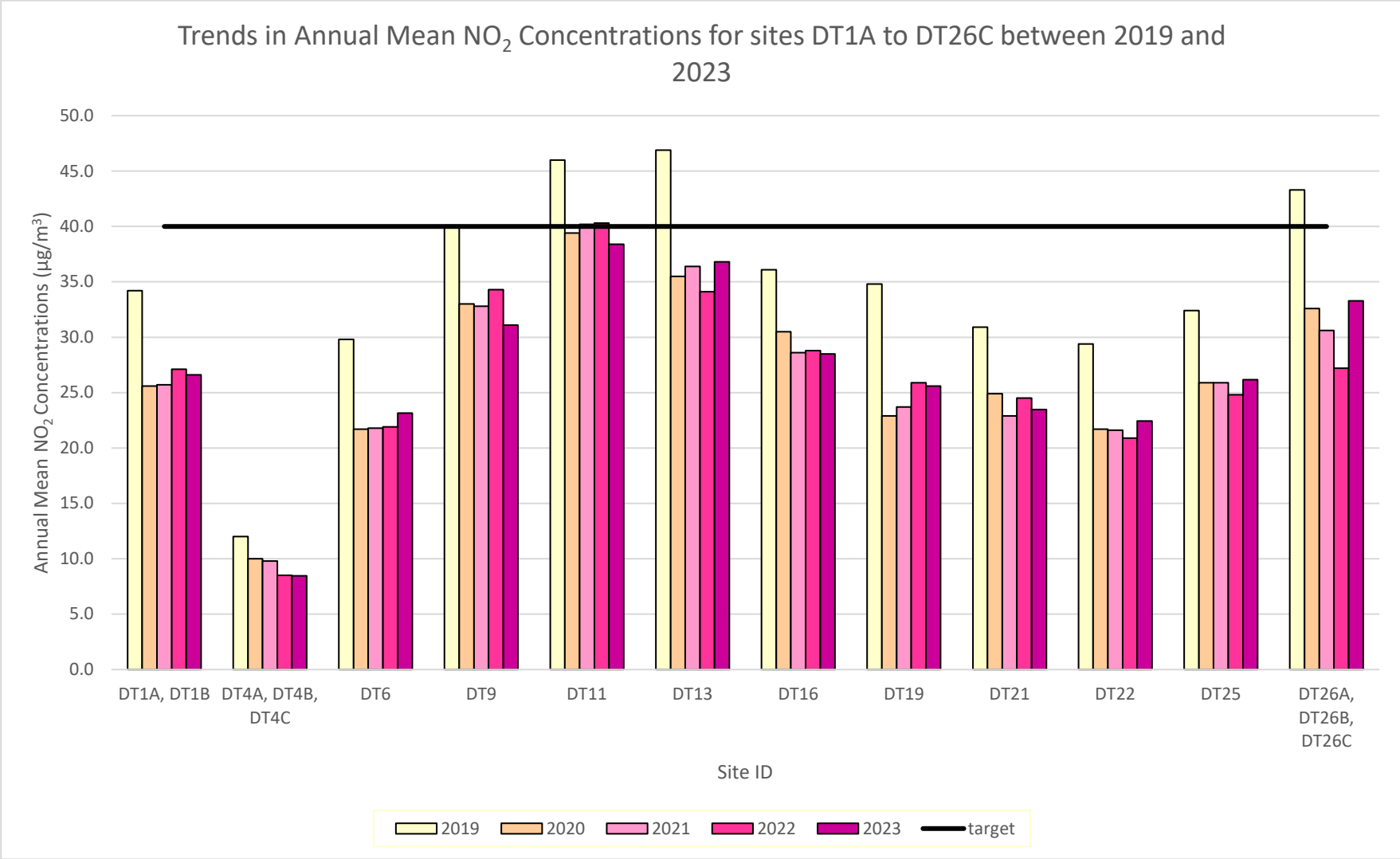
Concentrations are those at the location of monitoring and not those following any fall-off with distance adjustment.

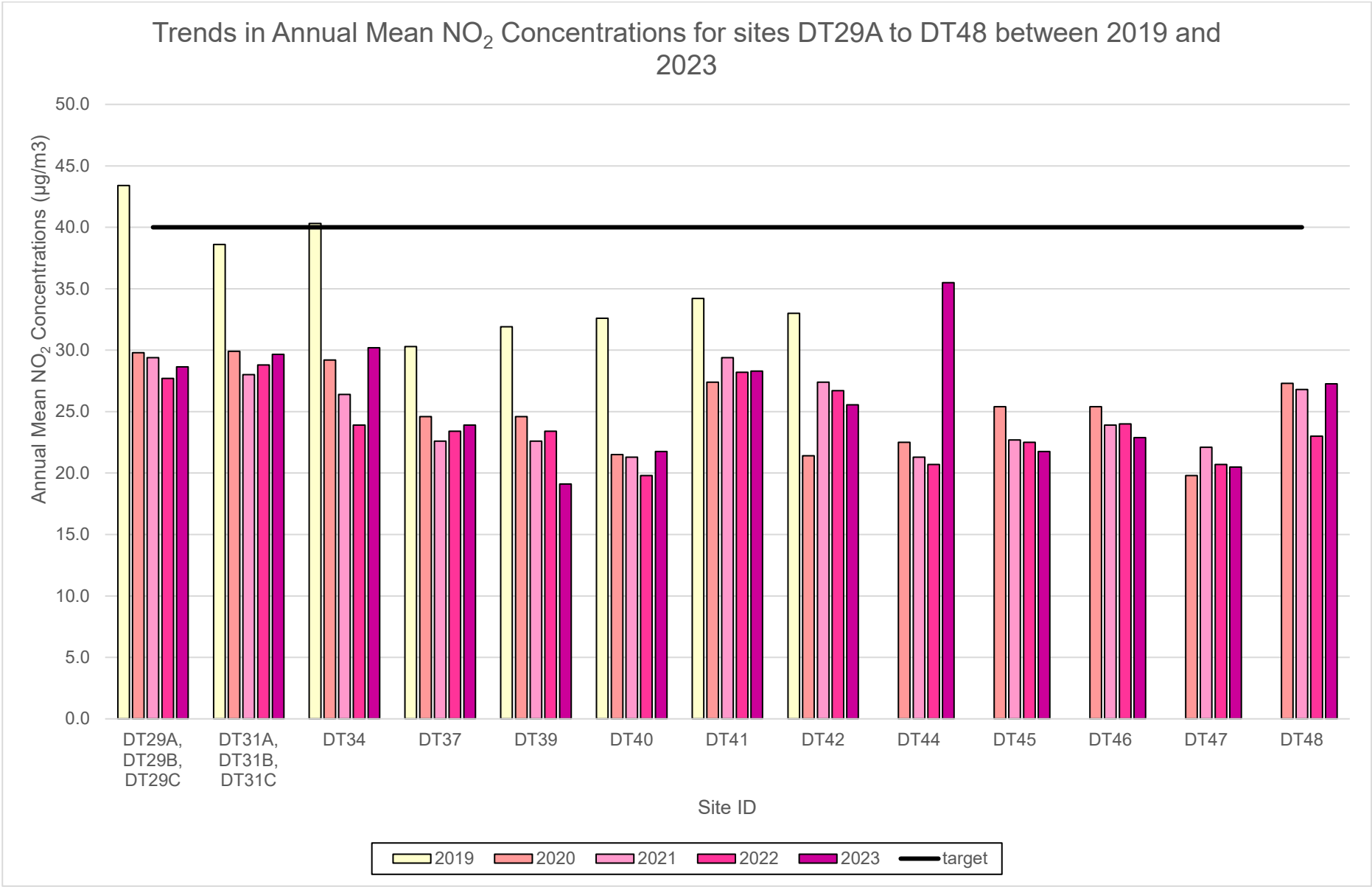
(1) Data capture for the monitoring period, in cases where monitoring was only carried out for part of the year.

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

Figures in brackets are annualised.

Figure A.1 – Trends in Annual Mean NO_2 Concentrations




Trends in Annual Mean NO2 Concentrations for sites DT29A to DT48 between 2019 and 2023
Annual Mean NO2 Concentrations (µg/m3)
50.0
45.0
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
DT29A, DT29B, DT29C
DT31A, DT31B, DT31C
DT34
DT37
DT39
DT40
DT41
DT42
DT44
DT45
DT46
DT47
DT48
Site ID
2019
2020
2021
2022
2023
target

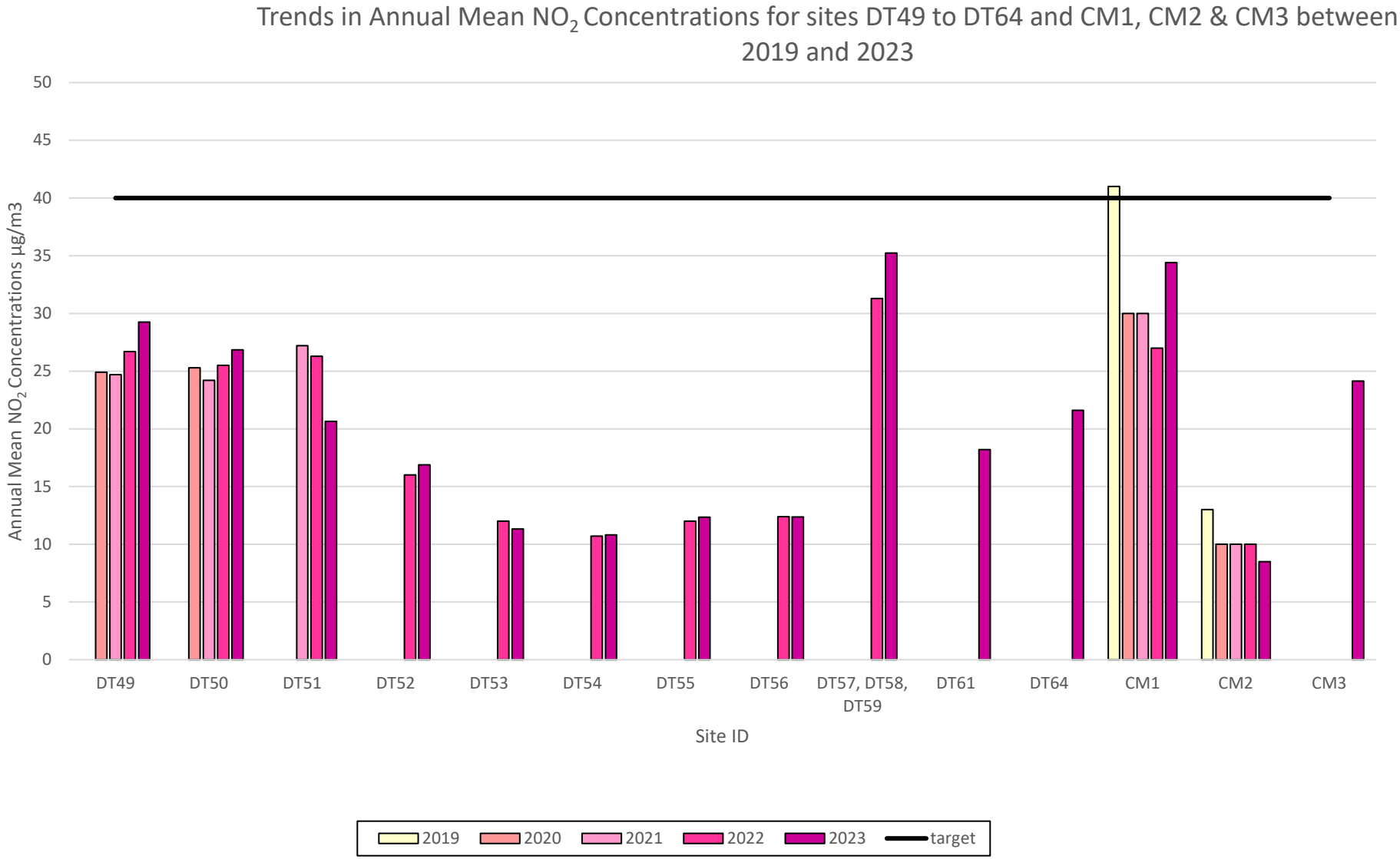

Trends in Annual Mean NO2 Concentrations for sites DT49 to DT64 and CM1, CM2 & CM3 between 2019 and 2023
Annual Mean NO2 Concentrations µg/m3
50
45
40
35
30
25
20
15
10
5
0
DT49
DT50
DT51
DT52
DT53
DT54
DT55
DT56
DT57, DT58, DT59
DT61
DT64
CM1
CM2
CM3
Site ID
2019
2020
2021
2022
2023
target

Table A.5 – 1-Hour Mean NO_2 Monitoring Results, Number of 1-Hour Means > 200µg/m^3

Site ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Site Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2023 (%) (2)	2019	2020	2021	2022	2023
CM1	623202	308615	Roadside	85.5	85.5	1	0	0	0	0
CM2	623637	306940	Urban Background	81	81	0	0	0	0	0
CM3	623112	308532	Roadside	81.7	45.9					0

Notes:

Results are presented as the number of 1-hour periods where concentrations greater than 200µg/m^3 have been recorded.

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**.

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

(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%).

Table A.6 – Annual Mean PM_{10} Monitoring Results ($\mu g/m^3$)

Site ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Site Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2023 (%) (2)	2019	2020	2021	2022	2023
CM1	623202	308615	Roadside	92.1	92.1	19	19	19	20	19
CM2	623637	306940	Urban Background	94	94	14	13	13	14	11.8
CM3	623112	308532	Roadside	99.7	78.4					13.8

☒ **Annualisation has been conducted where data capture is <75% and >25% in line with LAQM.TG22**

Notes:

The annual mean concentrations are presented as $\mu g/m^3$.

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

All means have been “annualised” as per LAQM.TG22 if valid data capture for the full calendar year is less than 75%. See Appendix C for details.

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

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

Figure A.2 – Trends in Annual Mean PM_{10} Concentrations

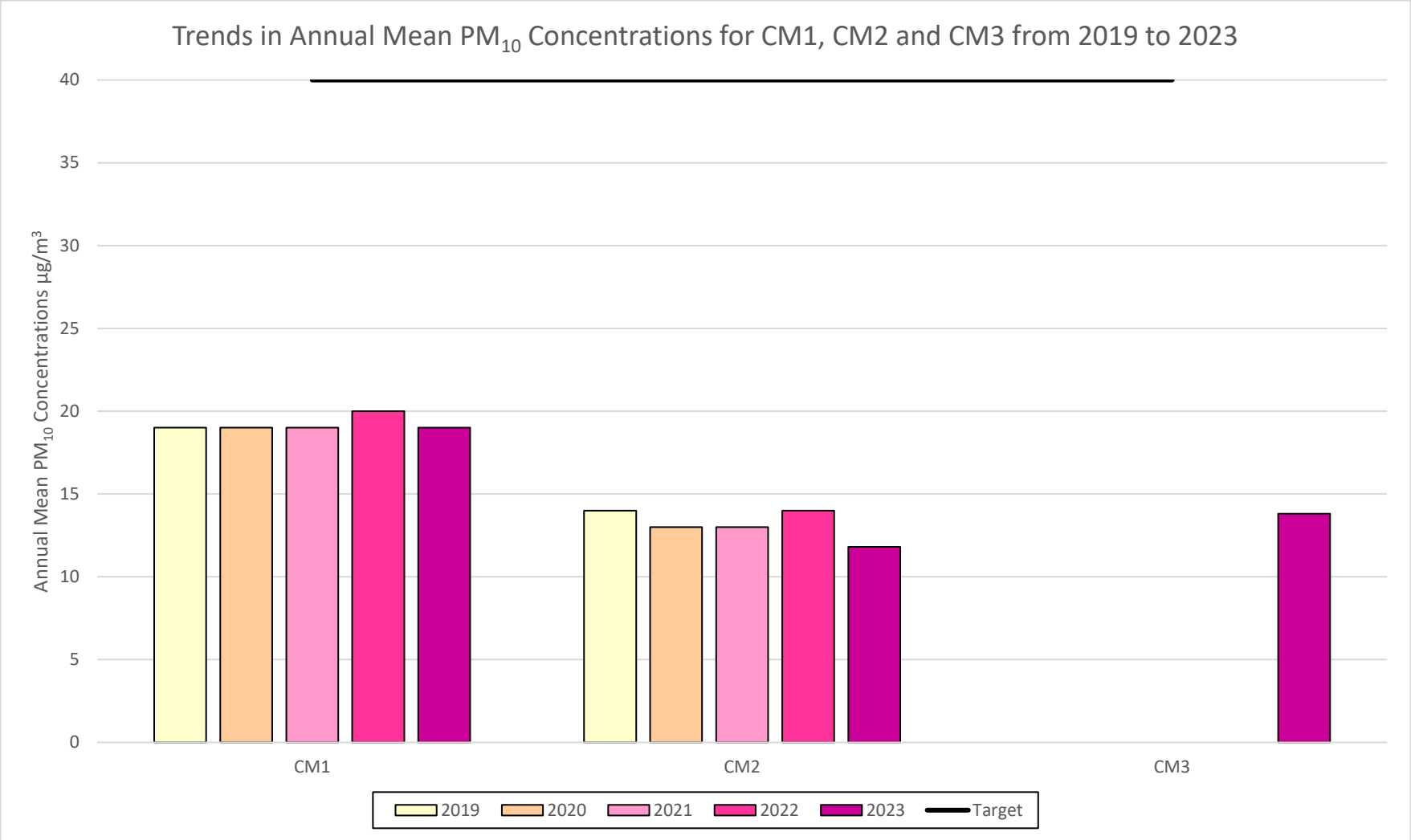


Table A.7 – 24-Hour Mean PM_{10} Monitoring Results, Number of PM_{10} 24-Hour Means > 50µg/m^3

Site ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Site Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2023 (%) (2)	2019	2020	2021	2022	2023
CM1	623202	308615	Roadside	92.1	92.1	5	0	0	3	0
CM2	623637	306940	Urban Background	94	94	4	0	0	0	0
CM3	623112	308532	Roadside	99.7	78.4					0

Notes:

Results are presented as the number of 24-hour periods where daily mean concentrations greater than 50µg/m^3 have been recorded.

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**.

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

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

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

Figure A.3 – Trends in Number of 24-Hour Mean PM_{10} Results > 50µg/m³

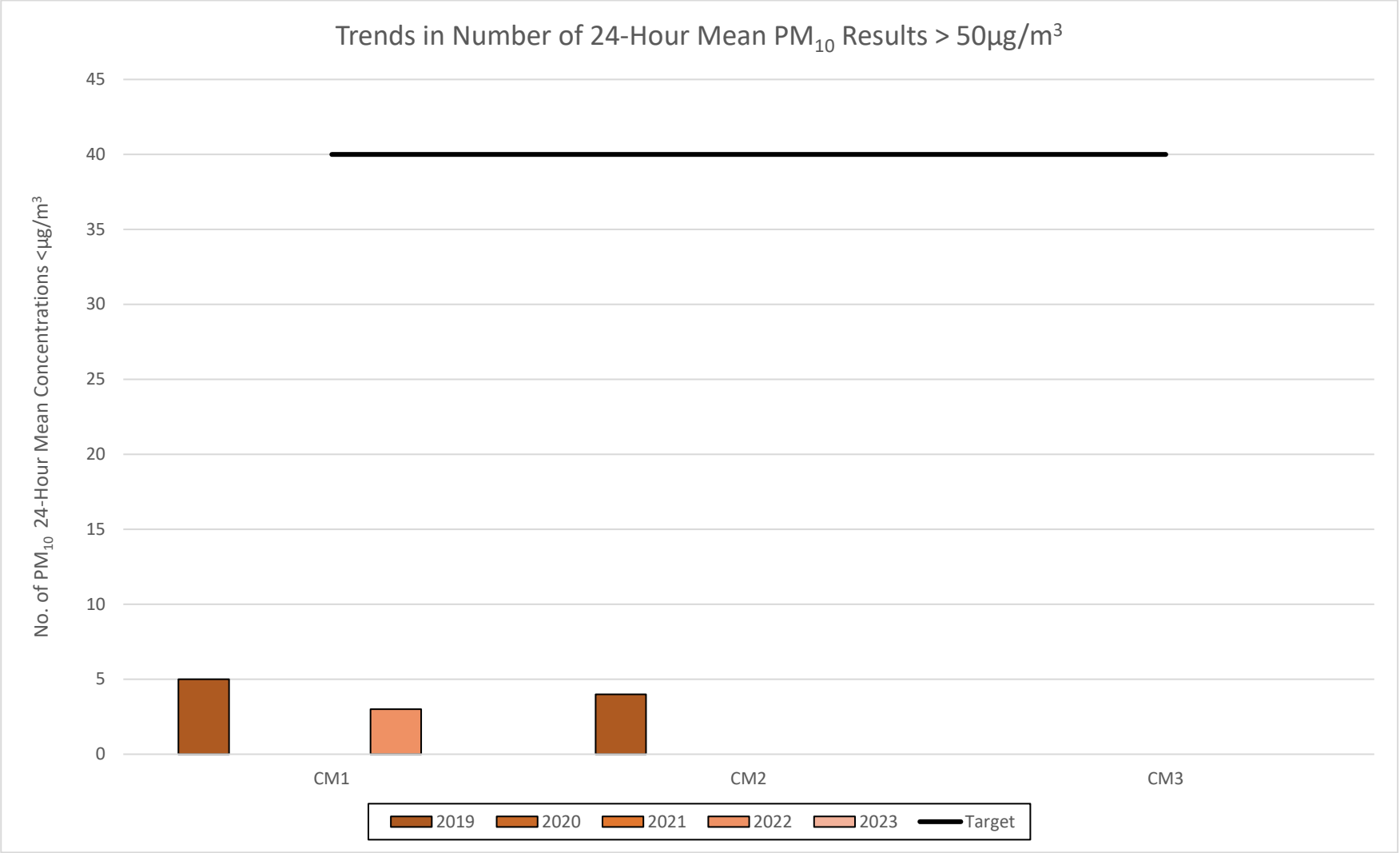


Table A.8 – Annual Mean $PM_{2.5}$ Monitoring Results (µg/m^3)

Site ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Site Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2023 (%) (2)	2019	2020	2021	2022	2023
CM1	623202	308615	Roadside	92.7	92.7	10	10	9	7	5
CM2	623637	306940	Urban Background	94	94	10	8	9	9	7.6
CM3	623112	308532	Roadside	99.7	78.4					8.2

☒ **Annualisation has been conducted where data capture is <75% and >25% in line with LAQM.TG22**

Notes:

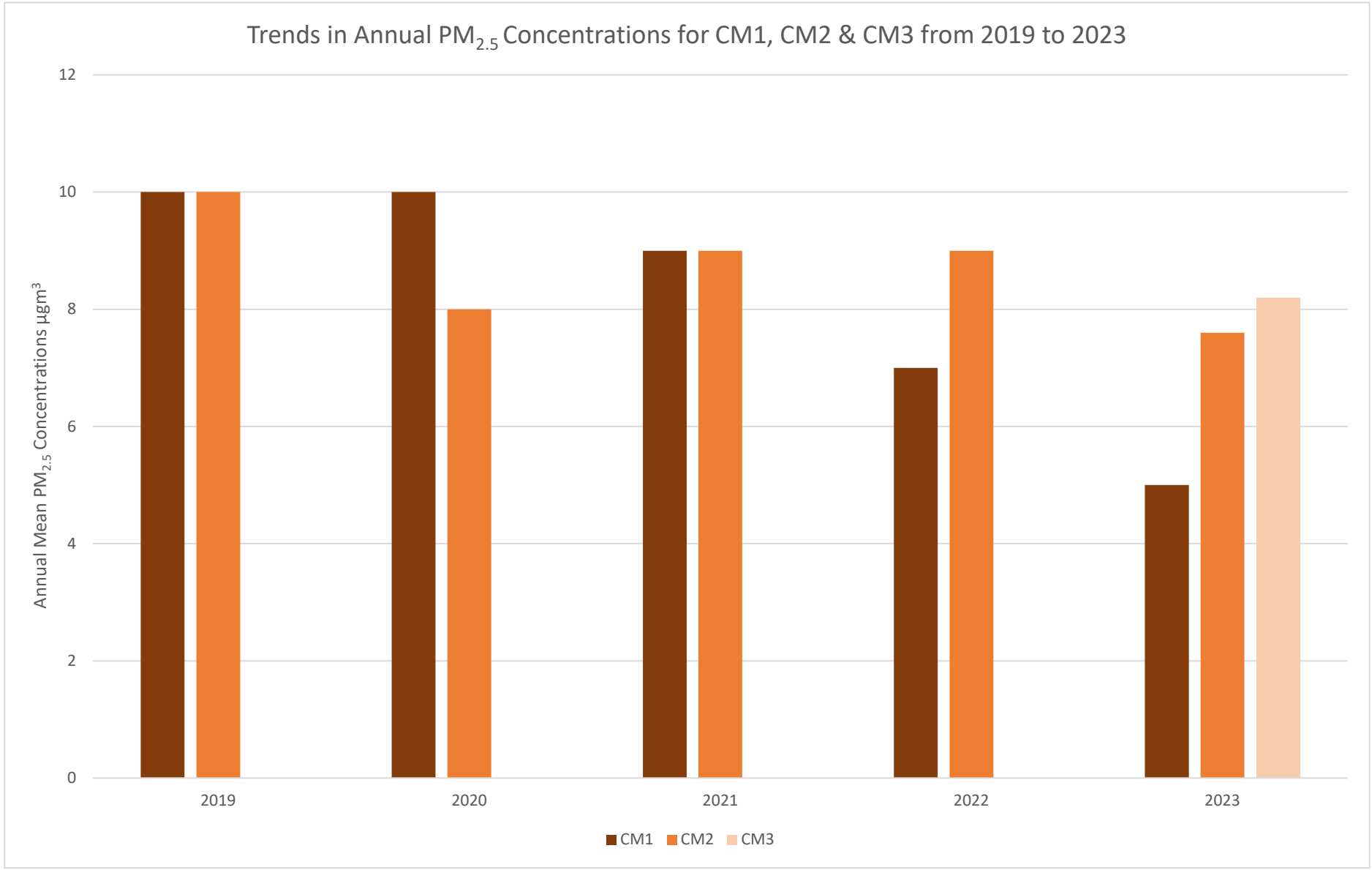
The annual mean concentrations are presented as µg/m^3.

All means have been “annualised” as per LAQM.TG22 if valid data capture for the full calendar year is less than 75%. See Appendix C for details.

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

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

Figure A.4 – Trends in Annual Mean $PM_{2.5}$ Concentrations



Appendix B: Full Monthly Diffusion Tube Results for 2023

Table B.1 – NO_2 2023 Diffusion Tube Results ($\mu g/m^3$)

DT ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Mean: Raw Data	Annual Mean: Annualised and Bias Adjusted 0.88	Annual Mean: Distance Corrected to Nearest Exposure	Comment
DT1A	623863	307679	34.7	33.5	29.6	30.8	25.5	27.7	27.2	29.6	34.4	34.5	30.9	29.3	-	-	-	Duplicate Site with DT1A and DT1B - Annual data provided for DT1B only
DT1B	623863	307679	33.7	33.2	31.3	25.4	24.3	26.7	28.0	28.5	32.3	32.2	31.1	26.8	30.1	26.6	-	Duplicate Site with DT1A and DT1B - Annual data provided for DT1B only
DT4A	623681	307016	12.7	12.8	9.0	7.8	6.1	8.0	6.6	7.8	9.5	10.9	12.2	9.8	-	-	-	Triplicate Site with DT4A, DT4B and DT4C - Annual data provided for DT4C only
DT4B	623681	307016	10.9	14.3	10.3	7.7	6.1	7.9	6.7	7.6	9.7	12.8	12.2	10.4	-	-	-	Triplicate Site with DT4A, DT4B and DT4C - Annual data provided for DT4C only
DT4C	623681	307016	10.5	14.1	10.3	7.6	6.5	7.5	6.7	8.2	9.7	12.3		10.6	9.6	8.5	-	Triplicate Site with DT4A, DT4B and DT4C - Annual data provided for DT4C only
DT6	623161	309550	34.2	34.9	27.5	19.2	20.5	20.5	24.3	22.6		28.7	30.0	23.9	26.2	23.1	-	
DT9	622906	309496	39.4	43.2	32.1	31.3	38.1	33.8	26.1	30.5	37.3	37.4	46.0	23.9	35.1	31.1	-	
DT11	622826	309573	50.1	50.5		44.6	37.3	40.0	41.7	39.4	48.8	49.0	36.2	44.9	43.4	38.4	-	
DT13	623141	308607	42.9	47.6	38.2		43.7	42.1	37.9	41.1	47.5	45.8	41.7	30.6	41.6	36.8	-	
DT16	623186	309650	42.6	38.0	33.9	30.7	19.0	22.8	31.1	29.1	34.5	34.9	36.2	33.8	32.2	28.5	-	
DT19	623321	308431	33.9	34.2	30.2	32.6	28.4	31.2	23.2	28.4	33.8	25.9	22.7	24.5	28.9	25.6	-	
DT21	623880	307659	32.5	32.5	28.4	27.5	19.1	28.6	26.2	25.6	28.0	12.9	27.1	28.5	26.5	23.5	-	
DT22	623901	307710	35.3	32.2	24.7	23.5	21.5	22.9	21.7	22.8	25.6	26.4		22.7	25.3	22.4	-	
DT25	623422	309388	35.5	37.0	27.0	25.5	27.7	26.6	24.5	27.6	31.3	33.1	33.4	25.7	29.6	26.2	-	
DT26A	623870	308516		41.1	36.7	41.7	33.6	37.2	28.2	34.6	45.7	39.7	37.3	29.6	-	-	-	Triplicate Site with DT26A, DT26B and DT26C - Annual data provided for DT26C only
DT26B	623870	308516	40.1	40.4	34.9	38.1	34.4	37.6	28.6	32.2	40.5	40.1	38.1	34.5	-	-	-	Triplicate Site with DT26A, DT26B and DT26C - Annual data provided for DT26C only
DT26C	623870	308516	39.5	83.7	37.2	41.2	32.2	37.6	28.1	34.1	41.7	40.9	38.2	33.1	37.6	33.3	-	Triplicate Site with DT26A, DT26B and DT26C - Annual data provided for DT26C only

DT ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Mean: Raw Data	Annual Mean: Annualised and Bias Adjusted 0.88	Annual Mean: Distance Corrected to Nearest Exposure	Comment
DT29 A	622532	308490	42.8	41.4	31.5	28.3	31.7	28.1	27.5	31.7		34.5	37.1	29.4	-	-	-	Triplicate Site with DT29A, DT29B and DT29C - Annual data provided for DT29C only
DT29 B	622532	308490	36.3	35.1	31.3	28.4	31.3	28.2	28.8	32.0		37.5	33.6	26.4	-	-	-	Triplicate Site with DT29A, DT29B and DT29C - Annual data provided for DT29C only
DT29 C	622532	308490	38.0	39.4	29.6	30.1	30.1	27.9	27.7	31.9		35.8	35.8	28.4	32.4	28.6	-	Triplicate Site with DT29A, DT29B and DT29C - Annual data provided for DT29C only
DT31 A	623380	307700	41.1	39.3	34.0	31.4	27.4	27.9	32.5	30.9	36.5	35.7	34.0	32.3	-	-	-	Triplicate Site with DT31A, DT31B and DT31C - Annual data provided for DT31C only
DT31 B	623380	307700	37.6	37.6	34.6	32.2	26.9	30.7	30.0	30.9	38.7	32.0	37.8	34.3	-	-	-	Triplicate Site with DT31A, DT31B and DT31C - Annual data provided for DT31C only
DT31 C	623380	307700	42.0	36.3	34.9	27.2	26.5	26.3	32.5	30.3	37.5	35.2	36.0	31.8	33.5	29.7	-	Triplicate Site with DT31A, DT31B and DT31C - Annual data provided for DT31C only
DT34	622898	308114		35.4	28.4	29.7	30.2				31.7	34.2	32.4	26.1	30.8	26.7(30.2)	-	(Annualised as below 75% and above 25% data capture)
DT37	622492	308520	32.0	33.4	28.5	25.1	18.5		22.1	22.9	26.7	30.3	29.7	28.3	27.0	23.9	-	
DT39	622884	309082	26.2	28.7	21.8	19.0	20.7	18.5	14.9	18.5	23.5	24.9	24.8	17.5	21.6	19.1	-	
DT40	622695	307855	30.9	32.5	22.8	21.6	22.1	23.0		20.1	24.1	26.3	26.0	22.0	24.6	21.8	-	
DT41	623148	309277	37.9	41.1	31.6	31.8	30.9	29.4	28.5	28.7	33.0		33.2	26.8	32.0	28.3	-	
DT42	623151	309326	38.8	39.4	26.2	23.0	22.6	23.2	25.8	26.7	32.6	34.0		27.2	28.9	25.6	-	
DT44	622910	309391	27.0	34.0		22.0	18.5		33.1		41.0	50.7	42.9	49.6	35.5	31.4	-	Annualised as below 75% and above 25% data capture
DT45	622904	309418	28.7	32.2	24.4	23.8	21.5	21.1	20.1	21.0	27.0	29.8	26.7	20.4	24.6	21.8	-	
DT46	622987	309486	34.3	32.4	25.5		18.5	21.7	21.5	23.9	26.8	29.5	26.9	25.2	25.9	22.9	-	
DT47	622869	309187	24.9	32.8	22.7	24.2	22.7	21.0	17.0	21.2	22.8	26.7	26.1	18.6	23.2	20.5	-	
DT48	623878	308532	36.4	39.2	30.6	29.5	27.1	27.7	21.1	27.7	36.3	36.0		29.7	30.8	27.3	-	
DT49	623480	307679	36.3	38.9	29.2	34.0	36.5	34.1	26.6	30.4	33.4	36.1	35.5	27.4	33.0	29.2	-	
DT50	623474	307692	39.2	35.2	29.1	28.5	24.8	24.7	27.1	27.8	33.0	33.7	35.4	24.5	30.3	26.8	-	
DT51	624028	307322	36.0	41.1	16.8	36.0	14.5	33.5	20.8	8.5	18.9	8.2	29.7	22.0	23.3	20.7	-	

DT ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Mean: Raw Data	Annual Mean: Annualised and Bias Adjusted 0.88	Annual Mean: Distance Corrected to Nearest Exposure	Comment
DT52	621958	309000	25.8	25.5	18.3	16.1	14.9	17.3	15.4	16.5	20.1	21.1	20.2	18.0	19.1	16.9	-	
DT53	621573	309434	21.8	19.6	12.2	9.6	8.0	8.1	10.7	9.3	12.3	14.7	16.0	10.7	12.8	11.3	-	
DT54	621574	309463	20.0	17.7	12.4	8.2	8.0	9.0	9.0	10.0	11.7	15.1	14.0	11.1	12.2	10.8	-	
DT55	621268	309494	21.1	18.4	13.5	10.4	10.8	9.2		8.8	12.9	16.2	18.3	12.9	13.9	12.3	-	
DT56	621267	309508	22.2	16.7	12.7	11.9	9.0	10.7		10.6	12.8	17.4	17.1	11.9	14.0	12.4	-	
DT57	623204	308616	38.0	48.0	38.0	42.8	44.5	42.7	31.2	37.8	42.8	42.8	34.2		-	-	-	Triplicate Site with DT57, DT58 and DT59 - Annual data provided for DT59 only
DT58	623204	308616		50.0	38.6	38.9	42.2	42.9	31.0	37.3	46.0	39.9	36.3		-	-	-	Triplicate Site with DT57, DT58 and DT59 - Annual data provided for DT59 only
DT59	623204	308616	38.5		35.5	46.0	45.4	44.2	29.8	38.5	45.6	40.7	33.9		39.8	35.2	-	Triplicate Site with DT57, DT58 and DT59 - Annual data provided for DT59 only
DT61	624068	307319									18.7	22.3	22.1	14.5	19.6	16.1(18.2)	-	(Annualised as below 75% and above 25% data capture)
DT64	623099	308478									19.4	25.9	25.5	21.8	23.2	19.1 (21.6)	-	(Annualised as below 75% and above 25% data capture)

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

☒ **Annualisation has been conducted where data capture is <75% and >25% in line with LAQM.TG22**

x **Local bias adjustment factor used.**

National bias adjustment factor used.

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

☒ **Norwich City Council confirm that all 2023 diffusion tube data has been uploaded to the Diffusion Tube Data Entry System**.

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**.

See Appendix C for details on bias adjustment and annualisation.

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

New or Changed Sources Identified Within Norwich City Council During 2023

Norwich City Council has not identified any new sources relating to air quality within the reporting year of 2023.

Additional Air Quality Works Undertaken by Norwich City Council During 2023.

Norwich City Council has not completed any additional works within the reporting year of 2023.

QA/QC of Diffusion Tube Monitoring

The diffusion tubes deployed in 2023 were supplied and analysed by Gradko International using the 50% TEA in acetone preparation method. Gradko International are a UKAS accredited laboratory, partaking in the AIR-PT scheme for NO_2 diffusion tube analysis and Annual Field Intercomparison Exercise. These provide strict criteria relating to the performance that participating laboratories must meet, thereby ensuring that the reported NO_2 concentrations are of a high calibre.

The current version of the AIR-PT scheme shows that January – February AIR PT AR055, May – June AIR PT AR056, July – August AIR PT AR058 and September – October AIR PT AR059 2023 Gradko results were all awarded a score of 100%. The percentage is an indication of the results deemed satisfactory based upon the z-score of < ±2.

For all 14 observations in 2023, the precision of NO_2 diffusion tubes supplied by Gradko International were classified as ‘good’. The precision is an indication of the laboratory’s performance and consistency in both the preparation, analysis and handling of the diffusion tubes. Full details of the precision summary results are available here.

During 2023, the diffusion tubes were not all deployed in line with the monitoring calendar, with some changes occurring, the tubes were 4 days short in February, for days too long

in March and 4 days to short in April. However, no diffusion tube was left out beyond the recommended four to five weeks of TG(22). As a result, data has not had to be removed for any month, and all data has been used in the annual results.

Diffusion Tube Annualisation

There were four diffusion tube monitoring locations that recorded data capture less than 75% but greater than 25% which were DT34, DT44, DT61 and DT64. In such instances it is necessary to annualise the data. Results are presented in Table C.1 below:

The data for Lakenfields and Castle Meadow 2 were below 85% and therefore can not be used for annualisation. Therefore, Castle Meadow and Wicken Fen sites which had over 85% data capture were used for determining the annualisation factor.

There were two diffusion tubes DT60 Forum Car Park, Bethel St and DT63 53 St Giles St that had data capture below 25%. These tubes were installed in September 2023 in response to concerns about traffic build up, unfortunately they were missing on two occasions, so we only got two months of data. Therefore, we cannot annualise these results and the data for these passive monitoring sites cannot be reported.

The data capture across the diffusion tube network in 2023 ranged from a minimum of 33% to a maximum of 100%.

Due to health and safety concerns some changes were made to diffusion tube heights to enable them to be changed with a grabber instead of ladder.

Unfortunately, although the tubes are still high enough not to be reached by the public we have noticed more diffusion tubes going missing and have only achieved 18 out of the 36 sites reaching 100% data capture in 2023. These sites and heights shall be reviewed during the year where there are specific hot spots for losses of tubes.

*See table C.4 for annualisation calculation for CM3.

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

Site ID	Annualisation Factor Lakenfields	Annualisation Factor Castle Meadow	Annualisation Factor Castle Meadow 2	Annualisation Factor Wicken Fen	Average Annualisation Factor	Raw Data Annual Mean	Annualised Annual Mean
DT34		0.9693		0.9912	0.9803	30.8	30.2
DT44		0.9860		0.9365	0.9613	35.5	-

Site ID	Annualisation Factor Lakenfields	Annualisation Factor Castle Meadow	Annualisation Factor Castle Meadow 2	Annualisation Factor Wicken Fen	Average Annualisation Factor	Raw Data Annual Mean	Annualised Annual Mean
DT61		0.8949		0.9644	0.9297	19.6	18.2
DT64		0.8949		0.9644	0.9297	23.2	21.6
CM3*					0.925	26.1	24.14

Diffusion Tube Bias Adjustment Factors

The diffusion tube data presented within the 2023 ASR have been corrected for bias using an adjustment factor. Bias represents the overall tendency of the diffusion tubes to under or over-read relative to the reference chemiluminescence analyser. LAQM.TG22 provides guidance with regard to the application of a bias adjustment factor to correct diffusion tube monitoring. Triplicate co-location studies can be used to determine a local bias factor based on the comparison of diffusion tube results with data taken from NO_x/NO_2 continuous analysers. Alternatively, the national database of diffusion tube co-location surveys provides bias factors for the relevant laboratory and preparation method.

Norwich City Council have applied a local bias adjustment factor of 0.88 to the 2023 monitoring data. A summary of bias adjustment factors used by Norwich City Council over the past five years is presented in Table C.2.

Table C.2 – Bias Adjustment Factor

Monitoring Year	Local or National	If National, Version of National Spreadsheet	Adjustment Factor
2023	Local	-	0.88
2022	National	06/23 (15 studies)	0.82
2021	National	03/22 (14 studies)	0.83
2020	Local	-	0.88
2019	National	09/20 (29 studies)	0.89

Table C.3 – Local Bias Adjustment Calculation

Norwich co-located the diffusion tubes at Lakenfields Automatic Station CM2 and Castle Meadow AQS CM1 for 2023.

	Local Bias Adjustment Input 1	Local Bias Adjustment Input 2	Local Bias Adjustment Input 3	Local Bias Adjustment Input 4	Local Bias Adjustment Input 5
Periods used to calculate bias	9	7			
Bias Factor A	0.83 (0.75 - 0.94)	0.94 (0.79 - 1.15)			
Bias Factor B	20% (6% - 34%)	6% (13% - 26%)			
Diffusion Tube Mean (µg/m^3)	10.0	38.0			
Mean CV (Precision)	3.8%	3.6%			
Automatic Mean (µg/m^3)	8.3	35.8			
Data Capture	98%	94%			
Adjusted Tube Mean (µg/m^3)	8 (7 - 9)	36 (30 - 44)			

Notes:

A combined local bias adjustment factor of 0.88 has been used to bias adjust the 2023 diffusion tube results.

NO_2 Fall-off with Distance from the Road

Wherever possible, monitoring locations are representative of exposure. However, where this is not possible, the NO_2 concentration at the nearest location relevant for exposure has been estimated using the Diffusion Tube Data Processing Tool/NO_2 fall-off with distance calculator available on the LAQM Support website. Where appropriate, non-automatic annual mean NO_2 concentrations corrected for distance are presented in Table B.1.

No diffusion tube NO_2 monitoring locations within Norwich City Council required distance correction during 2023.

QA/QC of Automatic Monitoring

In order to satisfy the requirements outlined in LAQM TG(22), at the Norwich City Council owned automatic monitoring station Castle Meadow (CM1) and Castle Meadow 2 (CM3), the following QA/QC procedures were implemented:

- 4-weekly calibrations of the analysers, carried out by a member of the Norwich City Council Environmental Protection team. (Increased to 4 weekly from 2 weekly due to difficulties getting NO gas)
- Annual audits.
- 6-monthly servicing of the monitoring sites.
- Data ratification.

Calibration of the analysers was carried out using certified compressed gas standards (ISO17025). This ensured that the calibration gas was traceable to the national and international standards. In addition to the calibration, sample filters were changed for both gaseous and TEOM analysers and any faults were identified, thus minimising data loss. Audits of the monitoring sites were carried out by Ricardo-AEA Ltd and consisted of a number of performance checks to identify any faults with the equipment. The calibration cylinders were also checked against other standard gas to confirm the gas concentration. Any identified faults were forwarded on to the service unit for repair.

Both the validation and ratification of data from the Castle Meadow automatic monitoring station is provided by Air Quality Data Management (AQDM) to the standards described in LAQM TG(22). Validation is the process that operates on data during the collection stage; all data is continually screened algorithmically and manually for anomalies. The anomalies may occur due to equipment failure, human error, power failure, interferences or other disturbances. Ratification is the process that finalises the data to produce the measurements suitable for reporting. All available data is critically assessed so that the best data scaling is applied and all anomalies are appropriately edited; generally, this occurs at three, six or twelve month intervals. Public access to live/historic data is available on the AQDM website.

The Norwich Lakenfields automatic monitoring station is part of the AURN operated by Bureau Veritas. The AURN have appointed LSO's and servicing is conducted by Acoem UK on a six monthly basis. Audits are conducted by Ricardo-AEA Ltd annually. Live and historic data is available through the DEFRA website.

PM_{10} and $PM_{2.5}$ Monitoring Adjustment

For the Castle Meadows Station the Volatile Correction Method (VCM) allows corrections to be applied to the TEOM measurements for the loss of volatile components of particulate matter that occur due to the high sampling temperatures employed by these instruments.

The resulting corrected measurements have been demonstrated as equivalent to the gravimetric reference equivalent. The VCM works by using the volatile particulate matter measurements provided by nearby FDMS instruments (within 130 km) to assess the loss of PM_{10} from the TEOM; this value is then added back onto the TEOM measurements. The VCM model was applied to the Castle Meadow TEOM data to calculate the indicative gravimetric equivalence PM_{10} for the annual mean and 24-hour mean readings. The Norwich Lakenfields AURN site has a FIDAS analyser to monitor PM_{10} and $PM_{2.5}$, as does Norwich's new AQS Castle Meadow 2.

Automatic Monitoring Annualisation

Norwich City Council had a new AQS in 2023 Castle Meadow 2 (CM3) this was only commissioned in July 2023 and therefore it had a data capture below 75% but greater than 25%. Therefore, the NO_2 annual means were annualised using the methodology in the Technical Guidance 7.140 because the annual data capture was less than 75% and there was at least 3 months of monitoring data. This is shown in table C4 below.

The Norwich Castle Meadow 2 (CM3) NO_2 reported hourly objective used the 99.8th percentile (Technical Guidance 7.195) as the annual data capture was less than 85%.

The PM_{10} for CM3 was less than 85% so the 90.4th percentile (Technical Guidance 7.182) was reported.

Table C.4 Annualisation Calculation for CM3

Background Site	Annual Mean (Am) 2023	Period Mean (Pm) 2023	Ratio (Am/Pm)
CM1	34.4	39.7	0.88
Lakenfields	8.5	8.72	0.97
Average (Ra)			0.925
M = 26.1 x 0.925 = 24.14 annualised			

NO_2 Fall-off with Distance from the Road

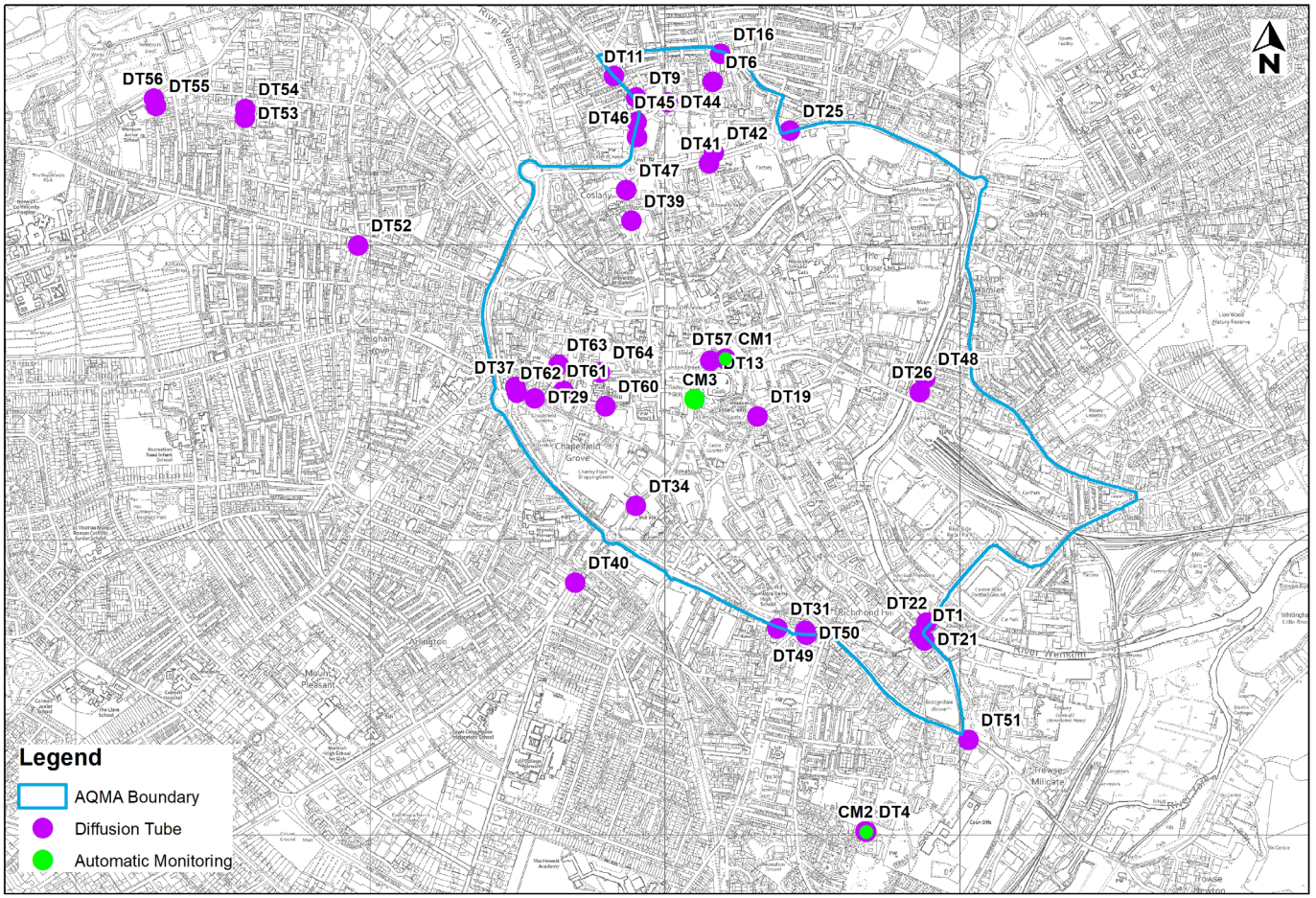
Wherever possible, monitoring locations are representative of exposure. However, where this is not possible, the NO_2 concentration at the nearest location relevant for exposure has been estimated using the NO_2 fall-off with distance calculator available on the LAQM Support website. Where appropriate, automatic annual mean NO_2 concentrations corrected for distance are presented in Table A3.

No automatic NO_2 monitoring locations within Norwich City Council required distance correction during 2023.

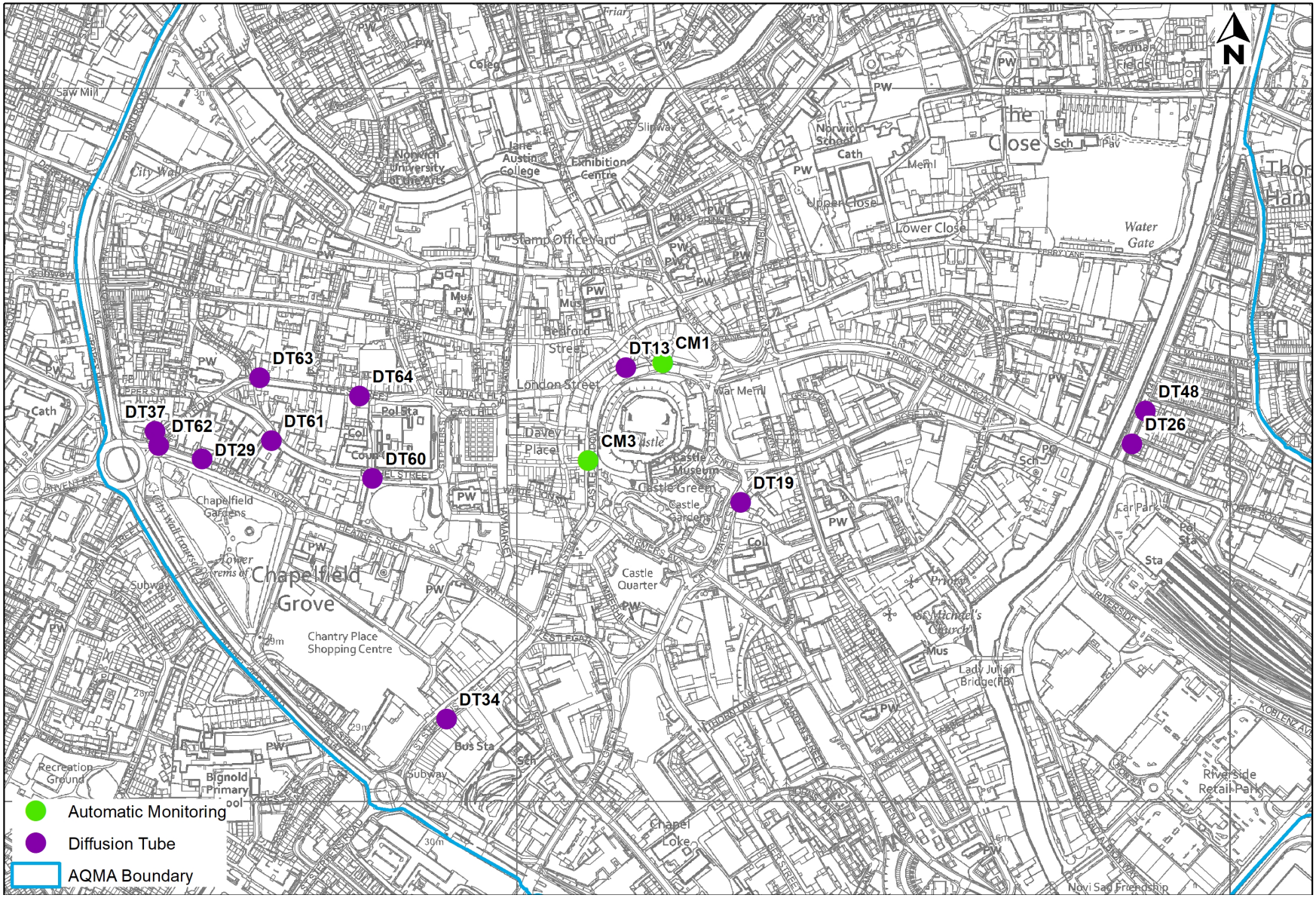
Appendix D: Map(s) of Monitoring Locations and AQMAs

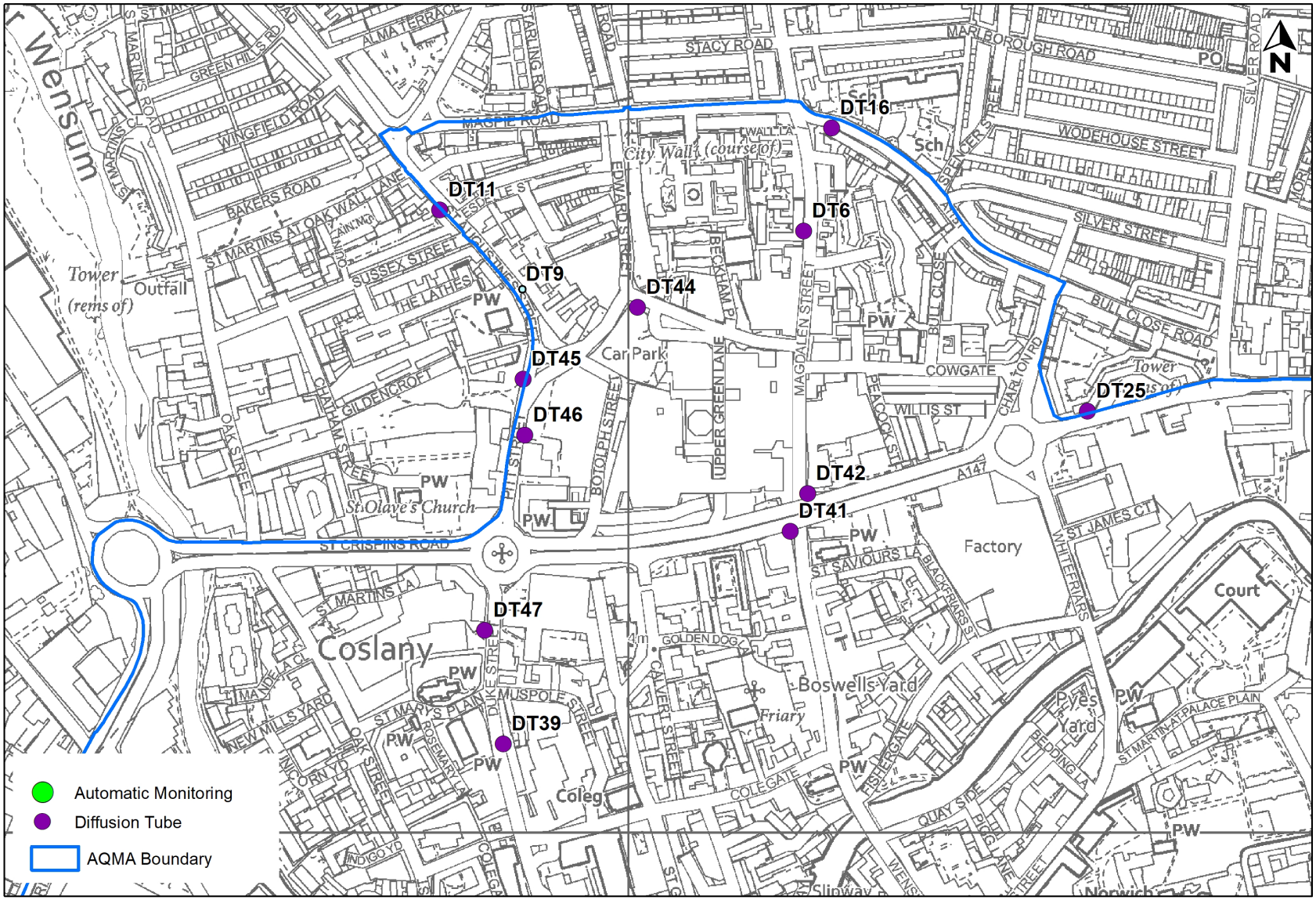
Figure D.1 – Map of Non-Automatic Monitoring Site

Diffusion Tube Location Overview showing AQMA Boundary

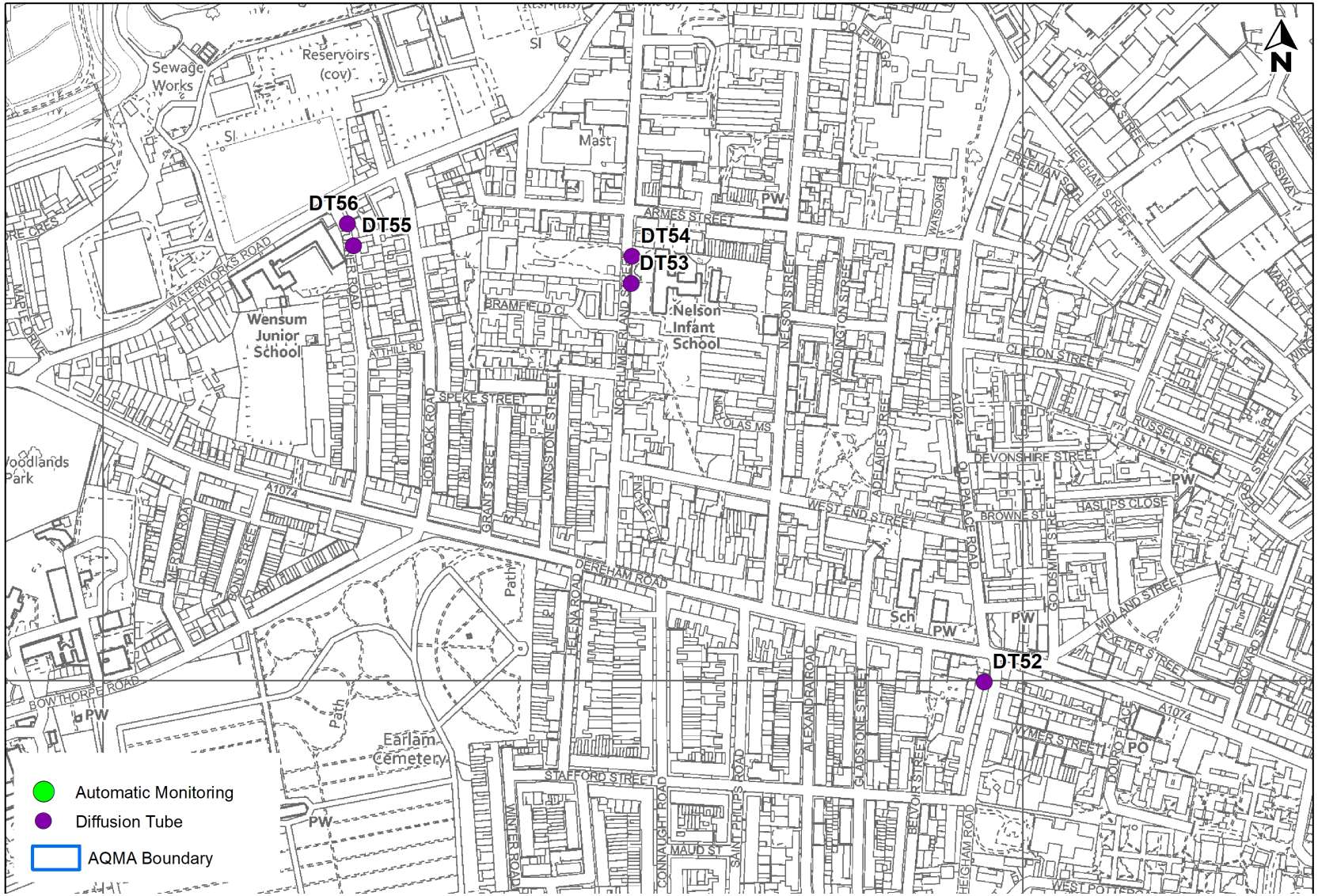


Diffusion Tubes – Central Norwich

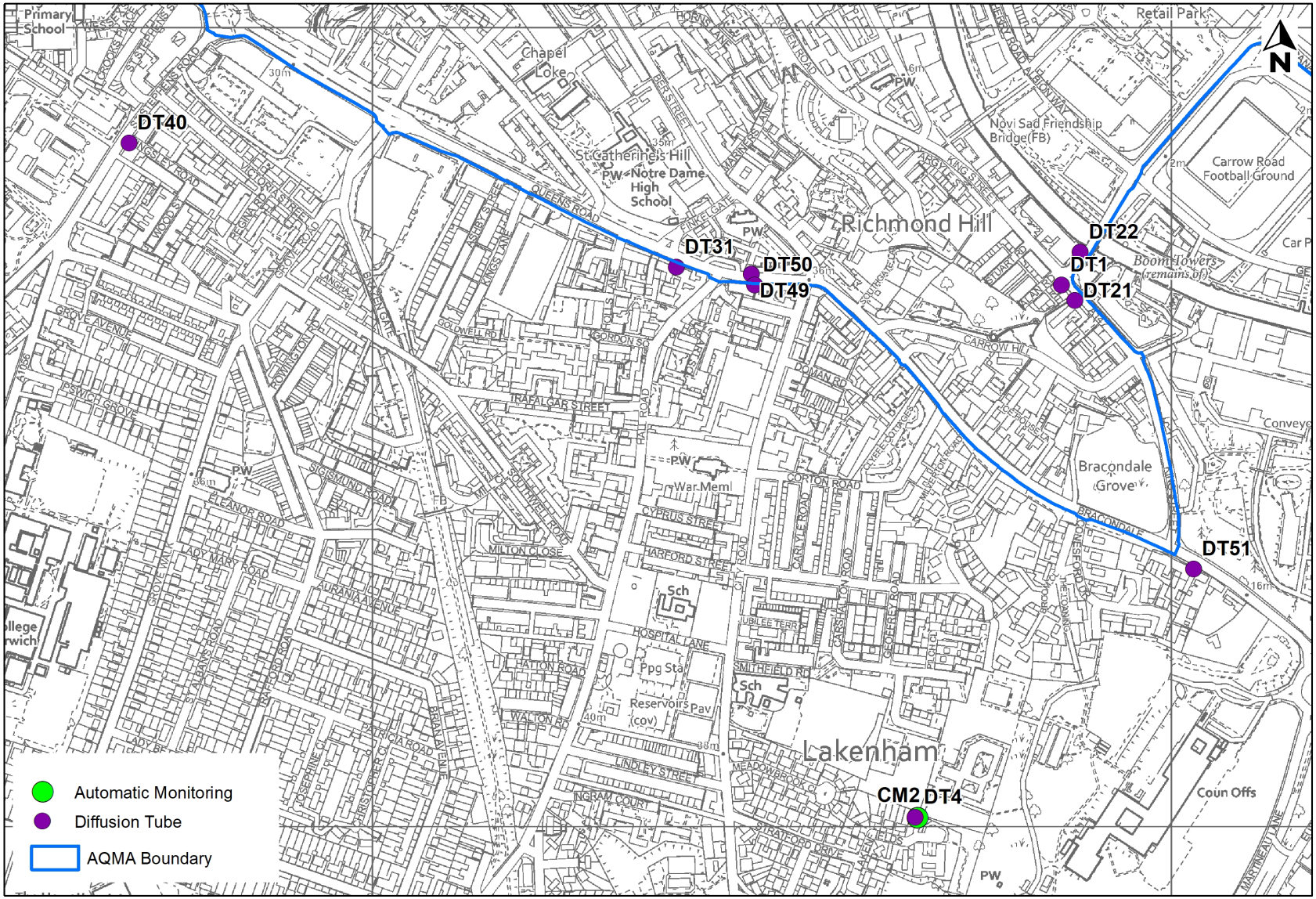




Diffusion Tubes – North Norwich



Diffusion Tubes – North West Norwich



Diffusion Tubes – South of Norwich

Appendix E: Summary of Air Quality Objectives in England

Table E.1 – Air Quality Objectives in England[7]

Pollutant	Air Quality Objective: Concentration	Air Quality Objective: Measured as
Nitrogen Dioxide (NO_2)	200µg/m^3 not to be exceeded more than 18 times a year	1-hour mean
Nitrogen Dioxide (NO_2)	40µg/m^3	Annual mean
Particulate Matter (PM_{10})	50µg/m^3, not to be exceeded more than 35 times a year	24-hour mean
Particulate Matter (PM_{10})	40µg/m^3	Annual mean

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

Glossary of Terms

Abbreviation	Description
AQAP	Air Quality Action Plan - A detailed description of measures, outcomes, achievement dates and implementation methods, showing how the local authority intends to achieve air quality limit values'
AQMA	Air Quality Management Area – An area where air pollutant concentrations exceed / are likely to exceed the relevant air quality objectives. AQMAs are declared for specific pollutants and objectives
AQS	Air Quality Station
ASR	Annual Status Report
Defra	Department for Environment, Food and Rural Affairs
DMRB	Design Manual for Roads and Bridges – Air quality screening tool produced by National Highways
EU	European Union
FDMS	Filter Dynamics Measurement System
LAQM	Local Air Quality Management
NO_2	Nitrogen Dioxide
NO_x	Nitrogen Oxides
PM_{10}	Airborne particulate matter with an aerodynamic diameter of 10µm or less
$PM_{2.5}$	Airborne particulate matter with an aerodynamic diameter of 2.5µm or less
QA/QC	Quality Assurance and Quality Control

References

- Local Air Quality Management Technical Guidance LAQM.TG22. August 2022. Published by Defra in partnership with the Scottish Government, Welsh Assembly Government and Department of the Environment Northern Ireland.
- Local Air Quality Management Policy Guidance LAQM.PG22. August 2022. Published by Defra in partnership with the Scottish Government, Welsh Assembly Government and Department of the Environment Northern Ireland.
- Chemical hazards and poisons report: Issue 28. June 2022. Published by UK Health Security Agency
- Air Quality Strategy – Framework for Local Authority Delivery. August 2023. Published by Defra.
- https://fingertips.phe.org.uk/search/particulate#page/4/gid/1/pat/502/par/E10000020/ati/501/are/E07000148/iid/93861/age/230/sex/4/cat/-1/ctp/-1/yrr/1/cid/4/tbm/1