



# NORWICH City Council

## 2023 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

Date: 25th August 2023

<b>Information</b>	<b>Norwich City Council Details</b>
<b>Local Authority Officer</b>	Sally Nicholson
<b>Report Reviewed by</b>	Chris Gooding Environmental Health Manager Vicki Hopps, Regulatory Services Manager
<b>Report Appraised by</b>	Jeremy Wiggan, Head of Sustainable Transport, Norfolk County Council Keith Mawson, Advanced Public Health Officer Policy and Prevention Public Health
<b>Department</b>	Development and City Services
<b>Address</b>	City Hall Norwich NR2 1NH
<b>Telephone</b>	01603 989669
<b>E-mail</b>	SallyNicholson@norwich.gov.uk
<b>Report Reference Number</b>	Norwich_2023_ASR
<b>Date</b>	25th August 2023

## Executive Summary: Air Quality in Our Area

### Air Quality in Norwich

Air pollution is associated with a number of adverse health impacts. It is recognised as a contributing factor in the onset of heart disease and cancer. Additionally, there are emerging links between air quality and dementia which is now one of the leading causes of death in Norfolk. Air pollution particularly affects the most vulnerable in society: children, the elderly, and those with existing heart and lung conditions. There is also often a strong correlation with equalities issues because areas with poor air quality are also often less affluent areas<sup>1,2</sup>.

The mortality burden of air pollution within the UK is equivalent to 29,000 to 43,000 deaths at typical ages<sup>3</sup>, with a total estimated healthcare cost to the NHS and social care of £157 million in 2017<sup>4</sup>.

Norwich covers 39 km<sup>2</sup> 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<sup>2</sup>.

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

---

<sup>1</sup> Public Health England. Air Quality: A Briefing for Directors of Public Health, 2017

<sup>2</sup> DEFRA. Air quality and social deprivation in the UK: an environmental inequalities analysis, 2006

<sup>3</sup> DEFRA. Air quality appraisal: damage cost guidance, January 2023

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

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<sub>2</sub> 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 emissions road traffic emissions to be the most significant source of NO<sub>2</sub>. 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<sub>2</sub> annual mean objective. In 2022, the annual mean objective was still exceeded within the AQMA, with a concentration of 40.3 µg/m<sup>3</sup> being recorded at site DT11 (St Augustine's Street). It is believed the reason for the exceedance at this location is due to slow-moving traffic with stop/start driving conditions, and street canyon effect due to buildings on either side of the road, preventing good dispersion of pollutants. Therefore, it is evident that there are still areas within the AQMA where the Air Quality Strategy (AQS) objective is breached.

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<sub>2</sub> levels.

During 2022, the maximum NO<sub>2</sub> annual mean concentration recorded at a single diffusion tube site inside the AQMA was 40.3 µg/m<sup>3</sup> (DT11). Outside of the AQMA the maximum concentration was 19.8µg/m<sup>3</sup> (DT40) at St Stephens Road. These concentrations inside the AQMA are comparable to that recorded in 2021 of 40.2 µg/m<sup>3</sup> (DT11). The value for outside the AQMA was 21.3 µg/m<sup>3</sup> (DT40) so the levels have fallen slightly in 2022. Therefore, it is evident that during 2022 there has not been a significant increase in NO<sub>2</sub> concentrations in Norwich. There remains an exceedance of the NO<sub>2</sub> annual mean AQS objective within the AQMA, therefore the AQMA designation shall remain. However, as the AQS objective is only exceeded at one site in 2022, the size of the current AQMA is to be reviewed during the current reporting year to see if the AQMA boundary can be amended.

This 2023 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<sub>2</sub> 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<sub>2</sub> 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 pickups and drop off peaks which is not affectively demonstrated with passive monitoring. Low-cost automatic monitors have been considered for outside schools to give a better picture; though these are more costly than passive monitors and were unsuccessful in our funding bid to the DEFRA Air Quality Grant Scheme for the automatic monitors for this year.

There was a new tube located at Bracondale in 2021 but was not reported in the 2022 report, this was sited in relation to the redevelopment of the Deal Ground site and the old Colman's site to establish a baseline.

There was also a new tube located at Heigham Road in 2022 which was placed at this location as a trial as it is a busy road with traffic backing up at a busy junction with residential receptors close by. There were no exceedances at this location.

We also co-located 3 tubes with our Castle Meadow Air Quality Station in response to DEFRA's recommendation of conducting a diffusion tube co-location study at the Castle Meadow roadside location. This commenced in January 2022.

As a result, in 2022 we had a total of 45 diffusion tubes:

- 36 diffusion tube locations were retained
- 8 new diffusion tube locations were added
- 1 new diffusion tube DT51 was added in 2021 but omitted from the report

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 continuous analysers do however provide some very interesting results when monthly means are evaluated. As a result, no adjustments will be made to passive diffusion tube (DT) monitoring positions for the following year as limited confidence can be given to

the results for 2022 but monitoring positions will be added to as further road infrastructure changes are implemented.

The requirement for a detailed assessment has not been identified for any pollutants and the council will progress to the 2024 Annual Status Report (ASR).

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

- Reviewing of traffic light times & synchronisation to optimise traffic flow for all new road layout schemes, these works are ongoing as they are undertaken every time traffic signals are replaced at junctions.
- Further improvements to the Heartsease ring road junction have been approved to improve pedestrian and cycle safety, encouraging greater use of active travel in this area. Works to start September 2023 and be complete by March 2024
- Low NO<sub>x</sub> 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 by March 2024. Around half of the buses in Norwich will be zero emission by that time. As part of this project, the Roundtree Way First Bus depot will be converted to an all-electric bus only depot.
- The works for the revised layout in St Stephens Street / Red Lion Street are now complete. This provides substantially improved conditions for pedestrians and reduces congestion with buses.
- The new Air Quality Station at Castle Meadow is progressing to be completed in 2023.

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 there has also been a new 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.

## **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<sup>5</sup> sets out actions that will drive continued improvements to air quality and to meet the new national interim and long-term PM<sub>2.5</sub> targets. The National Air Quality Strategy, due to be published in 2023, will provide more information on local authorities' responsibilities to work towards these new targets and reduce PM<sub>2.5</sub> in their areas. The Road to Zero<sup>6</sup> - details the approach to reduce exhaust emissions from road transport through a number of mechanisms; this is extremely important given that 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.
- Promote low and zero emission public transport through the use of external grant schemes and private investment through the Bus Service Improvement Plan.

---

<sup>5</sup> DEFRA. Environmental Improvement Plan 2023, January 2023

<sup>6</sup> DfT. The Road to Zero: Next steps towards cleaner road transport and delivering our Industrial Strategy, July 2018

- 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 open fire 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<sub>2</sub> 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, 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. These changes are designed to support the vitality of the city centre by reducing conflict between vehicles, pedestrians and cyclists.

With respect to public transport Norfolk County Council & First Eastern Counties have received confirmation of £14.7 million funding from the Department for Transport (DfT) through the 'Zero Emission Bus Regional Access' (ZEBRA) scheme, which will mean a total of 70 zero-emission buses will be arriving in Norwich in 2024.

This funding will enable 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 will provide a benefit for passengers, whilst contributing towards improving the overall air quality in the city especially within the Air Quality Management Area.



The Norwich Park & Ride service has struggled to regain patronage post-COVID. However, the Postwick site, which has been closed since the pandemic, is being reopened in September 2023 on a trial basis for at least four months following requests from the public and local parishes. A new range of Park & Ride fares is also being launched to encourage more people to use the wider service.

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](http://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.

There is an extension to Thickthorn Park & Ride site planned for completion in spring 2024.

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, 110 electric bikes and 250 electric scooters available to hire.

There has been over 1 million total rides, 3 million kilometres and 70,000 users since the Beryl launch and there are over 110 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. 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.

Exchange Street in Norwich is currently closed to general traffic as part of an Experimental Traffic Regulation Order. The impacts of this are being closely monitored and a decision on whether to make this closure permanent will be made towards the end of 2023.

We are hoping to rebuild our relationship with the Environmental Science Department at the University of East Anglia (UEA) we have previously collaborated on research projects. It is hoped there shall be further collaborations with the UEA, and other partner authorities, will nurture research projects into air pollution.

We are working closely with Public Health on the Public Health Outcomes Framework (PHOF) on actions in relation to PM<sub>2.5</sub>. We have had preliminary talks and shall be working with Public Health to identify sources of PM<sub>2.5</sub> and add to our next years 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<sub>2</sub> 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. Prior to the next phase of road changes, Norfolk County Council will be embarking on a program of passive monitoring to acquire baseline information so that the full impact of the proposed road schemes can be assessed.

The key findings for 2022 are:

- There were no exceedances of the NO<sub>2</sub> annual mean AQS objective at sites outside of the AQMA.
- Within the AQMA, the 40 µg/m<sup>3</sup> objective was only exceeded at one passive monitoring site (DT11: 40.3 µg/m<sup>3</sup>).
- The AQS Objectives were not exceeded.
- The NO<sub>2</sub> annual mean was 27.0 µg m<sup>-3</sup> which did not exceed AQS Objective of 40 µg m<sup>-3</sup>.
- The NO<sub>2</sub> 1-hour AQS Objective of 200 µg m<sup>-3</sup> was not exceeded.
- The PM<sub>10</sub> annual mean was 20.0 µg m<sup>-3</sup> which did not exceed AQS Objective of 40 µg m<sup>-3</sup>.

- The PM<sub>10</sub> exceeded the daily mean AQS Objective of 50 µg m<sup>-3</sup> on 3 days. There is an annual allowance of 35 days.
- The PM<sub>2.5</sub> annual mean was 7.0 µg m<sup>-3</sup> which did not exceed AQS Objective of 25 µg m<sup>-3</sup>.
- All automatic monitoring stations reported concentrations of NO<sub>2</sub>, PM<sub>10</sub> and PM<sub>2.5</sub> to be below the relevant objectives.
- There were 8 diffusion tubes that increased in NO<sub>2</sub> from the previous year. This 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. It will be interesting to see the trend in figures in the 2024 report based on the 2023 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 date 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 progressed during 2022 and is on schedule to be fully commissioned in Summer 2023. The current monitoring station will continue to be operated in tandem for a short period of time so any discrepancies in data can be identified.

With the replacement of buses with those using a cleaner technology, and the development of the BSIP, it is hoped 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<sub>2</sub>, 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 positive 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 Mobi-Mix, 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).
- [Mobi Mix Project](#) (mobility hubs and e-scooters).
- [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', 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 on Clean Air Day 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*

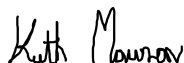
*Keith Mawson, Advanced Public Health Officer -Policy and Prevention Public Health*

*Cllr Beth Jones - Deputy leader: Housing, and Community safety - Norwich City Council*

*Cllr Emma Hampton (Climate Change PH) - Norwich City Council*

If you have any comments on this ASR please send them to Sally Nicholson at:  
Environmental Protection Officer, Norwich City Council, City Hall, Norwich, NR2 1NH  
01603 989669 [SallyNicholson@norwich.gov.uk](mailto:SallyNicholson@norwich.gov.uk) or  
[EnvironmentalProtection@norwich.gov.uk](mailto:EnvironmentalProtection@norwich.gov.uk)

This ASR has been signed off by an Advanced Public Health Officer on behalf of Public Health.



**Keith Mawson Advanced Public Health Officer**

**On behalf of Norfolk County Council Public Health**

## Table of Contents

<b>Executive Summary: Air Quality in Our Area</b> .....	<b>ii</b>
Air Quality in Norwich City Council .....	ii
Actions to Improve Air Quality .....	v
Conclusions and Priorities .....	ix
Local Engagement and How to get Involved.....	xi
Local Responsibilities and Commitment .....	xii
<b>1 Local Air Quality Management</b> .....	<b>1</b>
<b>2 Actions to Improve Air Quality</b> .....	<b>2</b>
2.1 Air Quality Management Areas .....	2
2.2 Progress and Impact of Measures to address Air Quality in Norwich City Council .....	4
2.3 PM <sub>2.5</sub> – Local Authority Approach to Reducing Emissions and/or Concentrations .....	13
<b>3 Air Quality Monitoring Data and Comparison with Air Quality Objectives and National Compliance</b> .....	<b>16</b>
3.1 Summary of Monitoring Undertaken.....	16
3.1.1 Automatic Monitoring Sites .....	16
3.1.2 Non-Automatic Monitoring Sites .....	16
3.2 Individual Pollutants .....	16
3.2.1 Nitrogen Dioxide (NO <sub>2</sub> ) .....	17
3.2.2 Particulate Matter (PM <sub>10</sub> ) .....	18
3.2.3 Particulate Matter (PM <sub>2.5</sub> ).....	19
<b>Appendix A: Monitoring Results</b> .....	<b>21</b>
<b>Appendix B: Full Monthly Diffusion Tube Results for 2022</b> .....	<b>41</b>
<b>Appendix C: Supporting Technical Information / Air Quality Monitoring Data QA/QC</b> .....	<b>44</b>
New or Changed Sources Identified Within Norwich City Council During 2022.....	44
Additional Air Quality Works Undertaken by Norwich City Council During 2022.....	44
QA/QC of Diffusion Tube Monitoring .....	44
Diffusion Tube Annualisation .....	45
Diffusion Tube Bias Adjustment Factors .....	45
NO <sub>2</sub> Fall-off with Distance from the Road.....	46
QA/QC of Automatic Monitoring .....	47
PM <sub>10</sub> and PM <sub>2.5</sub> Monitoring Adjustment .....	48
Automatic Monitoring Annualisation .....	48
NO <sub>2</sub> Fall-off with Distance from the Road.....	48
<b>Appendix D: Map(s) of Monitoring Locations and AQMAs</b> .....	<b>50</b>

<b>Appendix E: Summary of Air Quality Objectives in England</b> .....	<b>53</b>
<b>Glossary of Terms</b> .....	<b>55</b>
<b>References</b> .....	<b>58</b>

## Figures

Figure A.1 – Trends in Annual Mean NO <sub>2</sub> Concentrations.....	30
Figure A.2 – Trends in Number of NO <sub>2</sub> 1-Hour Means > 200µg/m <sup>3</sup> .....	34
Figure A.3 – Trends in Annual Mean PM <sub>10</sub> Concentrations .....	36
Figure A.4 – Trends in Number of 24-Hour Mean PM <sub>10</sub> Results > 50µg/m <sup>3</sup> .....	38
Figure A.5 – Trends in Annual Mean PM <sub>2.5</sub> Concentrations .....	40
Figure D.1 – Map of Non-Automatic Monitoring Site.....	50

## Tables

Table 2.1 – Declared Air Quality Management Areas.....	3
Table 2.2 – Progress on Measures to Improve Air Quality.....	8
Table A.1 – Details of Automatic Monitoring Sites .....	21
Table A.2 – Details of Non-Automatic Monitoring Sites .....	22
Table A.3 – Annual Mean NO <sub>2</sub> Monitoring Results: Automatic Monitoring (µg/m <sup>3</sup> ).....	25
Table A.4 – Annual Mean NO <sub>2</sub> Monitoring Results: Non-Automatic Monitoring (µg/m <sup>3</sup> ) ....	26
Table A.5 – 1-Hour Mean NO <sub>2</sub> Monitoring Results, Number of 1-Hour Means > 200µg/m <sup>3</sup> .....	33
Table A.6 – Annual Mean PM <sub>10</sub> Monitoring Results (µg/m <sup>3</sup> ) .....	35
Table A.7 – 24-Hour Mean PM <sub>10</sub> Monitoring Results, Number of PM <sub>10</sub> 24-Hour Means > 50µg/m <sup>3</sup> .....	37
Table A.8 – Annual Mean PM <sub>2.5</sub> Monitoring Results (µg/m <sup>3</sup> ).....	39
Table B.1 – NO <sub>2</sub> 2022 Diffusion Tube Results (µg/m <sup>3</sup> ) .....	41
Table C.1 – Annualisation Summary (concentrations presented in µg/m <sup>3</sup> ).....	<b>Error!</b>
<b>Bookmark not defined.</b>	
Table C.2 – Bias Adjustment Factor .....	<b>Error! Bookmark not defined.</b>
Table C.3 – Local Bias Adjustment Calculation .....	<b>Error! Bookmark not defined.</b>
Table C.4 – NO <sub>2</sub> Fall off With Distance Calculations (concentrations presented in µg/m <sup>3</sup> ) .....	<b>Error! Bookmark not defined.</b>
Table E.1 – Air Quality Objectives in England .....	<b>Error! Bookmark not defined.</b>



# 1 Local Air Quality Management

This report provides an overview of air quality in Norwich City Council during 2022. 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 – Air Quality Objectives in England](#)

## 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 one AQMA that is currently designated within Norwich. Appendix D: Map(s) of Monitoring Locations and AQMAs provides maps of AQMA and also the air quality monitoring locations in relation to the AQMA. The air quality objective pertinent to the current AQMA is designation for the NO<sub>2</sub> 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	Nov-12	NO2 Annual Mean	An area encompassing Norwich city centre, broadly following the inner link road	NO	52 µg/ m <sup>3</sup> (at 52 St Augustines Street)	39	Has not yet been compliant	AQAP June 2021	<a href="#">AQAP June 2021</a>

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

DEFRA's appraisal of last year's ASR concluded that the report was well structured, detailed, and provides the information specified in the Guidance. The following comments are designed to help inform future reports:

1. The Council mention and address comments from last year's ASR. This is welcomed and is encouraged to continue in future ASRs.

*Norwich City Council has mentioned and addressed comments from 2022 ASR within the 2023 ASR*

2. There are robust QA/QC procedures in place, with all calculations outlined in detail. The Council applied the national bias adjustment factor in 2021 and provide robust justification for this choice.

*QA/QC procedures of the automatic monitoring stations have been described in the 2023 ASR, as well as a comparison of the national and local bias adjustment factor.*

3. The Council provide a discussion and review of its AQMAs and monitoring strategy and have made necessary changes through removal and additional tubes. This is commended, demonstrating the Council's continued dedication approach to monitoring and addressing air quality.

*Norwich City Council will review the concentrations reported in the 2023 ASR and amend the monitoring network towards any identified hotspots, if required.*

4. Although the Council state that they have dropped three diffusion tube monitoring sites in 2021, they do not mention the commission of site DT51. Although all data is included in the ASR, there is no text stating why this site was commissioned. This information would be a useful addition to the report.

*There was a new tube DT51 located at Bracondale in 2021 but was not reported in the 2022 report, this was sited in relation to the redevelopment of old Colman's site to establish a baseline. Apologies for this omission.*

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

*Norwich City Council will review the concentrations reported in the 2023 ASR and Review the measures and priorities for 2024*

6. Overall, the report is detailed, concise and satisfies the criteria of relevant reporting standards. The Council should continue their good and thorough work.

Both Norwich City Council and Norfolk County Council have taken forward a number of direct measures during the current reporting year of 2022 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 2022 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](#).

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

**Key completed measures are:**

- Traffic Management - Grapes Hill roundabout was completed Nov 2021 and initial evidence shows reduced congestion/smoothier traffic flows.

Approval has been given for improvements to be made to the Heartsease Fiveways junction to improve pedestrian and cycle safety, encouraging greater use of active travel in this area. Works to start Sep 2023 and be complete by March 2024

The Foundry Bridge junction near Norwich Rail Station was completed July 2022 with the aim of improving flow for general traffic, buses, cycles and pedestrians.

Revised layout in St Stephens Street / Red Lion Street - Reduction in NO<sub>2</sub> levels in city centre and surrounds. Provides substantially improved conditions for pedestrians and reduces congestion with buses. Evidence of this reduction can be seen at from the diffusion tube results for site DT34 at St Stephens Street as the NO<sub>2</sub> levels have dropped during 2022.

- Transport hubs at key transport interchanges - Rail station works were completed July 2022.

**Norwich City Council's priorities for the coming years are:**

- 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 by March 2024. Around half of the buses in Norwich will be zero emission by that time
- Completion of the new Air Quality Monitoring Station on Castle Meadow – this will provide us with new technology to carry out the continuous monitoring for Norwich and brings up to DEFRA standards
- Traffic signals along Koblenz Avenue in Norwich are being optimized following highway improvement works around Norwich station. Works to be completed Summer 2023
- Traffic Management - Approval has been given for improvements to be made to the Heartsease Fiveways junction to improve pedestrian and cycle safety, encouraging greater use of active travel in this area. Works to start September 2023 and be complete by March 2024.
- Traffic Management - West to East traffic restriction in Norwich City Centre - Provides substantially improved conditions for pedestrians and reduces congestion with buses. This scheme will be constructed early 2024.
- Travel Alternatives: Extension to Thickthorn Park and Ride site. Outline of the design has been completed and planning application submitted. This extension will provide a sustainable travel option into the city centre as well as the Norwich Research Park. Construction planned Autumn 2023.

Norwich City Council worked to implement these measures in partnership with the following stakeholders during 2022:

- Norwich County Council Highways
- Norfolk Air Quality Group

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

- The new Air Quality Station at Castle Meadow was delayed due to contractor availability to install and waiting for delivery of equipment.
- 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 2023/24. These pressures remain and are being closely monitored and considered when planning and delivering future schemes.

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	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	Norwich City Council	Norwich City Council		Funded	<£10k	Planning	Approx. 10-15 µg/m³ NO <sub>2</sub>	Reduction in NO <sub>2</sub> levels in Castle Meadow.	Erratic decline in NO <sub>2</sub> but probably would have been worse without LEZ.	Ongoing review of LEZ and the requirement to further reduce vehicle emissions. Review once new electric bus role out in place. Plans being considered to extend the geographical scope of the LEZ.
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		Funded	£10k - £50k	Implementation	Specific value not known but will contribute to overall reduction in NO <sub>2</sub> levels in city centre and surrounds. NO <sub>2</sub> levels at CM1 reduced by >10 µg/m³ 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 to be completed Summer 2023	Congestion should be minimised, but this needs to be monitored and where applicable diffusion tube sites reviewed.
3	Ring road junction improvements	Traffic Management	UTC, Congestion management, traffic reduction	2020/23	2023/24	Norwich City Council / Norfolk County Council	Norwich City Council / Norfolk County Council		Funded	£1m - £10m	Completed (Grapes Hill) / Planning (Heartsease)	Specific value not known but will contribute to overall reduction in NO <sub>2</sub> levels in city centre and surrounds.	Reduced city centre congestion as well as wider network / increased numbers of people walking and cycling.	Grapes Hill roundabout was completed Nov 2021 and initial evidence shows reduced congestion/smoothed traffic flows. Approval has been given for improvements to be made to the Heartsease Fiveways junction to improve pedestrian and cycle safety, encouraging greater use of active travel in this area. Works to start Sep 2023 and be complete by March 2024 The Foundry Bridge junction near Norwich Rail Station was completed July 2022 with the aim of improving flow for general traffic, buses, cycles and pedestrians.	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.
4	Engine switch-off enforcement	Public Information	Other	2018	Completed August 2018	Norwich City Council	Norwich City Council		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 <sub>2</sub> levels at CM1 reduced by >10 µg/m³ in 2019.	Reduction in NO <sub>2</sub> 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	Use of powers to enforce engine switch-off via issue of fixed penalty notices. Enforcement commenced specifically on Castle



Measure No.	Measure	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
												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.		no non-compliance.	Meadow & St Stephens where bus & taxi only traffic. Any extension of the LEZ would mean extension of engine switch off enforcement area.
5	Signage informing engine switch-off enforcement. Electronic displays at traffic lights giving waiting times.	Public Information	Other	2017 – trial on Riverside Road.	Ongoing but October 2018 for switch off enforcement on Castle Meadow	Norwich City Council / Norfolk County Council	Norwich City Council / Norfolk County Council		Not Funded	£100k - £500k	Planning	Specific value not known but will contribute to overall reduction in NO <sub>2</sub> levels in city centre and surrounds.	Reduction in NO <sub>2</sub> 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.
6	Low NO <sub>x</sub> Buses	Promoting Low Emission Transport	Public Vehicle Procurement - Prioritising uptake of low emission vehicles	N/A	Ongoing. 15 zero emission buses to be introduced by March 2024.	Norwich City Council / Norfolk County Council	Norwich City Council / Norfolk County Council		Funded	£1m - £10m	Implementation	The introduction of 15 zero emission buses is forecast to reduce air quality related emissions (NO <sub>x</sub> and PM <sub>2.5</sub> ) by 9.2 tonnes per annum.	Reduction in NO <sub>2</sub> 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 NO <sub>x</sub> emission vehicles
7	Assess opportunity for a zero-emission bus fleet to operate the Norwich Park & Ride service when the contract is renewed in 2023	Promoting Low Emission Transport	Other		2023/24	Norfolk County Council	Norfolk County Council		Not Funded	£1m - £10m	Planning	Specific value not known but will contribute to overall reduction in NO <sub>2</sub> levels in city centre and surrounds.	Reduction in NO <sub>2</sub> levels in city centre and on busy feeder roads.	See comment to the right.	Park & Ride patronage continues to struggle post-COVID operating at 40-50% pre-COVID levels. Time. A Park & Ride site closed since the pandemic is being reopened in September 2023 for a trial period of at least 4 months and new, lower fares are being promoted. Full consideration will be given to operating low /zero emission buses.
8	School Travel Plans	Promoting Travel Alternatives	School Travel Plans	Ongoing	Ongoing	Norfolk County Council	Norfolk County Council		Funded	£10k - £50k	Implementation	Specific value not known but will contribute to overall reduction in NO <sub>2</sub> levels in city centre and surrounds.	Reduction in NO <sub>2</sub> levels in city centre and surrounds. Passive NO <sub>2</sub> 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

Measure No.	Measure	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
															travel plans to be highlighted as part of Clean Air Day campaign – led by County & Public Health Norfolk.
9	West to East traffic restriction in Norwich City Centre	Traffic Management	UTC, Congestion management, traffic reduction	2020/23	2022/23	Norfolk County Council	Norfolk County Council (TCF funding)		Funded	£1m - £10m	Planning	Specific value not known but will contribute to overall reduction in NO <sub>2</sub> levels in city centre.	Reduction in NO <sub>2</sub> levels in city centre and surrounds.	This scheme will be constructed early 2024.	Provides substantially improved conditions for pedestrians and reduces congestion with buses.
10	Revised layout in St Stephens Street / Red Lion Street	Traffic Management	UTC, Congestion management, traffic reduction	2020/23	2022/23	Norfolk County Council	Norfolk County Council (TCF funding)		Funded	£1m - £10m	Completed	Specific value not known but will contribute to overall reduction in NO <sub>2</sub> levels in city centre.	Reduction in NO <sub>2</sub> levels in city centre and surrounds.	This scheme is now complete.	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	2020/23	2022/23	Norfolk County Council	Norfolk County Council (TCF funding)		Funded	£1m - £10m	Completed (Norwich Rail Station / Norwich Bus Station) Implementation (Bowthorpe interchange)	Specific value not known but will contribute to overall reduction in NO <sub>2</sub> levels in city centre.	Reduction in NO <sub>2</sub> levels in city centre and surrounds.	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.
12	Bus rapid transit	Transport Planning and Infrastructure	Bus route improvements	Ongoing	Ongoing	Norwich City Council / Norfolk County Council	Norwich City Council / Norfolk County Council		Funded	> £10m	Implementation	Specific value not known but will contribute to overall reduction in NO <sub>2</sub> levels in city centre and surrounds	Reduced 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.
13	Rationalising and simplifying of traffic on Prince of Wales Road	Traffic Management	UTC, Congestion management, traffic reduction	Long term	2023/24	Norwich City Council / Norfolk County Council	Norwich City Council / Norfolk County Council		Funded	> £10m	Planning	Specific value not known but will contribute to overall reduction in NO <sub>2</sub> 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.
14	Extension to Thickthorn Park and Ride site	Promoting Travel Alternatives	Other	2020/23	2023/24	Norfolk County Council	Norfolk County Council (TCF funding)		Funded	£1m - £10m	Planning	Specific value not known but will contribute to overall reduction in NO <sub>2</sub> levels in city centre.	Reduced city centre congestion as well as wider network.	Outline design completed. Construction planned Autumn 2023.	This will provide a sustainable travel option into the city centre as well as the Norwich Research Park.
15	Extension of Postwick Park and Ride site	Promoting Travel Alternatives	Other	TBC	TBC	Norfolk County Council	Norfolk County Council		Not Funded	£1m - £10m	Planning	Specific value not known but will contribute to overall reduction in NO <sub>2</sub> levels in city centre.	Reduced city centre congestion as well as 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.
16	Installation of Beryl Bikes, E-Bikes and E-scooters across	Promoting Travel Alternatives	Other	2020	Scheme largely installed by end of 2020.	Norwich City Council / Norfolk County Council	Norwich City Council / Norfolk		Funded	£100k - £500k	Implementation	Studies are showing that 30% of all journeys taken by bike or	There has been over 1m total rides, 3m kilometres	The Beryl scheme was expanded in 2023/23 to include Wymondham and	Finding suitable space for bays to achieve optimal bay network density to drive up

Measure No.	Measure	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
	the greater Norwich area				Contract with Beryl runs until 2025 with option to extend.		County Council					scooter would otherwise have been taken by car.	and 70,000 users since the launch. There are over 110 bays across Greater Norwich,	Drayton. Additional of more bays continues. There are now nearly 100 e-bikes and over 250 e-scooters in the scheme.	ridership.
17	Introduction of School Streets	Transport Planning and Infrastructure	Congestion management, traffic reduction	2021/22	Ongoing	Norwich City Council / Norfolk County Council	Norwich City Council / Norfolk County Council		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.
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	2020/23	2022/23	Norfolk County Council	Norfolk County Council (TCF funding)		Funded	£100k - £500k	Implementation	Specific value not known but will contribute to overall reduction in NO <sub>2</sub> levels in city centre.	Reduction in NO <sub>2</sub> 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
19	Construction of final link of Northern Distributor Road (NDR) over River Wensum joining up with A47 West	Transport Planning and Infrastructure	Other	2023-2025	2025	Norfolk County Council	Norfolk County Council		Partially Funded	> £10m	Planning	Specific value not known but will contribute to overall reduction in NO <sub>2</sub> levels in city centre and surround.	Reduced city centre congestion as well as 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 to DfT.	Major scheme promoted by the County Council which the City Council is not currently supporting pending preparation of a Transport for Norwich Strategy and Action Plan to address congestion and air quality issues. Post construction monitoring will be undertaken.
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	Norwich City Council / Norfolk County Council	Norwich City Council / Norfolk County Council		Not Funded	/£1m - £10m	Planning	Specific value not known but will contribute to overall reduction in NO <sub>2</sub> 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.
21	Education & information campaigns to encourage more responsible driving and the use of alternative modes	Promoting Travel Alternatives	Other	Ongoing	Ongoing	Norwich City Council / Norfolk County Council	Norwich City Council / Norfolk County Council		Funded	£1m - £10m	Implementation	Specific value not known but will contribute to overall reduction in NO <sub>2</sub> levels in city centre and surrounds.	Reduction in NO <sub>2</sub> 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	2021	2023	Norwich City Council/Norfolk County Council	Norfolk County Council		Funded	£50k	Commissioning	Replaces ageing AQ station with more up to date technology implementation of		In progress	None

Measure No.	Measure	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
												measures more reliably quantified.			
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	2020/21	2021/22	Norfolk County Council	Norfolk County Council (TCF funding)		Funded	£1m - £10m	Completed	Specific value not known but will contribute to overall reduction in NO <sub>2</sub> levels in city centre.	Reduction in NO <sub>2</sub> 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	2014-2019	2019/20	Norwich City Council / Norfolk County Council	Norwich City Council / Norfolk County Council / DfT		Funded	£1m - £10m	Completed	Specific value not known but will contribute to overall reduction in NO <sub>2</sub> levels in city centre and surrounds.	Reduction in vehicle use in city centre. Increased no. people cycling.	Complete	Cycle routes have been extended and more joined up. All 2 orbital and 5 radial pedal ways now substantially complete.

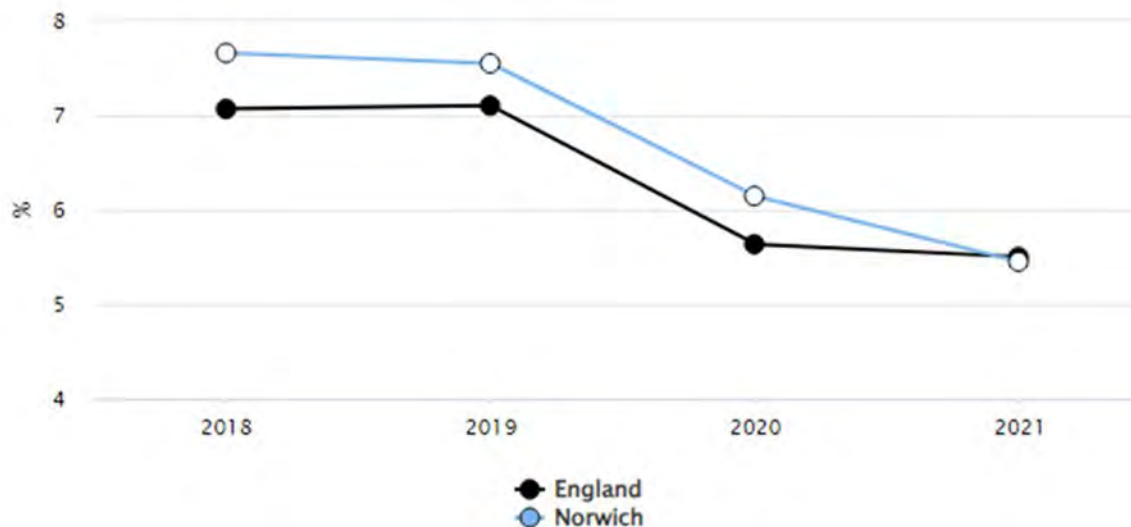
## 2.3 PM<sub>2.5</sub> – Local Authority Approach to Reducing Emissions and/or Concentrations

As detailed in Policy Guidance LAQM.PG22 (Chapter 8), local authorities are expected to work towards reducing emissions and/or concentrations of PM<sub>2.5</sub> (particulate matter with an aerodynamic diameter of 2.5µm or less). There is clear evidence that PM<sub>2.5</sub> has a significant impact on human health, including premature mortality, allergic reactions, and cardiovascular diseases.

The Public Health Outcome Framework (PHOF) indicator 3.01<sup>7</sup> gives a local estimate for Norwich of PM<sub>2.5</sub> in 2021. This is the fraction of mortality attributable to particulate air pollution is 5.5%. This relative risk is important as it forms the basis of action through all delivery partners to tackle air pollution in the area.

The graph below is taken from Finger Tips<sup>8</sup> a website that provides public health data.

**Fraction of mortality attributable to particulate air pollution for Norwich compared to England for based on the background annual average PM<sub>2.5</sub> concentrations for the year**



<sup>7</sup> <https://www.pushbikes.org.uk/sites/default/files/Particulate%20Matter.pdf>

<sup>8</sup> <https://fingertips.phe.org.uk/search/particulate#page/4/gid/1/pat/502/par/E1000020/ati/501/are/E07000148/iid/93861/age/230/sex/4/cat/-1/ctp/-1/yrr/1/cid/4/tbm/1>

Norwich City Council is taking the following measures to address PM<sub>2.5</sub>:

- **Real-Time Monitoring:** Automatic monitoring of PM<sub>2.5</sub> 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<sub>2.5</sub> analyser. Norwich City Council also operate a PM<sub>2.5</sub> TEOM analyser at the locally managed automatic monitoring station (Castle Meadows). Therefore, there is a large amount of historic data for PM<sub>2.5</sub>, at background and roadside locations, that can be used to inform any trends in the ambient PM<sub>2.5</sub> 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. This allows for an exchange of information and data, including that referenced in the Public Health Outcomes Framework.
- **Strategy Measures:** The measures listed within Table 2.2 ('Progress on Measures to Improve Air Quality') will have a positive contribution towards reducing PM<sub>2.5</sub> emissions and/or exposure, despite being primary orientated to NO<sub>2</sub>. 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<sub>2.5</sub> emissions. It is however understood that, at least in Norwich, PM<sub>2.5</sub> is primarily 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.
- **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.

- **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<sub>2.5</sub> 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 2022 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 2018 and 2022 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 1 site during 2022; Castle Meadow. Table A.1 in Appendix A shows the details of the automatic monitoring sites. There is also an AURN monitoring station within Norwich; Norwich Lakenfields. Table A.1 in Appendix A shows the details of the two 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<sub>2</sub> at 34 locations with 1 duplicate site and 5 triplicate sites that came to a total of 45 tubes sited during 2022. 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<sub>2</sub>)

Table A.3 and Table A.4 in Appendix A compare the ratified and adjusted monitored NO<sub>2</sub> annual mean concentrations for the past five years with the air quality objective of 40µg/m<sup>3</sup>. 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 2022, the maximum NO<sub>2</sub> annual mean concentration recorded at a diffusion tube site within the Central Norwich AQMA was 40.3 µg/ m<sup>3</sup> (DT11). Over the last five years, the NO<sub>2</sub> annual mean AQS objective (40 µg/ m<sup>3</sup>) has been exceeded at this site for every year, except 2020. There were no other diffusion tubes within the AQMA that recorded an NO<sub>2</sub> annual mean concentration within 10% of the AQS objective. The maximum NO<sub>2</sub> annual mean concentration is relatively comparable to that recorded within the AQMA in 2020 (39.4 µg/ m<sup>3</sup>), indicating that there has not been a significant increase in NO<sub>2</sub> concentrations during 2022 in Norwich.

I reviewed the Diffusion tube results for 2022 and I have found 8 locations that showed an increase in NO<sub>2</sub> from 2021 these sites were King Street (DT1), St Augustines (DT9), Cattle Market Street (DT19), Rotary House (DT21), Quantrell House (DT31), 7a Gunns Court (DT37) and Queens Road North & South (DT49) and (DT50). This 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. It will be interesting to see the trend in figures in the 2024 report based on the 2023 figures.

For the six diffusion tube sites that are located outside of the AQMA (DT4 and DT40, DT53, DT54, DT55 and DT56), the maximum NO<sub>2</sub> annual mean concentration was 19.8µg/m<sup>3</sup> in 2022. This is less than the that recorded in the previous reporting year (21.3µg/m<sup>3</sup>), indicating that there has been a 99reduction in NO<sub>2</sub> outside of the AQMA.

For diffusion tubes, the full 2022 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<sub>2</sub> concentration recorded at the Castle Meadow automatic monitoring site (CM1) was 27 µg/m<sup>3</sup>, which is lower than that recorded in the previous reporting year. At the Norwich Lakenfields urban background AURN monitoring site (CM2), the annual mean NO<sub>2</sub> concentration (10 µg/ m<sup>3</sup>) was also comparable to the NO<sub>2</sub> concentration recorded in 2021 (10 µg/ m<sup>3</sup>).

Table A.5 in Appendix A compares the ratified continuous monitored NO<sub>2</sub> hourly mean concentrations for the past five years with the air quality objective of 200µg/m<sup>3</sup>, not to be exceeded more than 18 times per year.

The AQS objective for the NO<sub>2</sub> hourly mean concentration was not exceeded at either of the two automatic monitoring stations during 2022. A maximum NO<sub>2</sub> hourly mean concentration of 113 µg/m<sup>3</sup> and 65 µg/m<sup>3</sup> were recorded at CM1 and CM2, 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<sub>2</sub> concentration greater than 63.9 µg/m<sup>3</sup>, indicating that it is unlikely that the NO<sub>2</sub> hourly mean was exceeded at these sites.

### 3.2.2 Particulate Matter (PM<sub>10</sub>)

Table A.6 in Appendix A: Monitoring Results compares the ratified and adjusted monitored PM<sub>10</sub> annual mean concentrations for the past five years with the air quality objective of 40µg/m<sup>3</sup>.

The annual mean PM<sub>10</sub> concentration at the Castle Meadow (CM1) automatic monitoring site was 20µg/ m<sup>3</sup>, which is comparable to that recorded in both 2021 and 2020 (19µg/ m<sup>3</sup>). For the AURN Norwich Lakenfields (CM2) monitoring site, the annual mean PM<sub>10</sub> concentration was measured to be 14.0 µg/m<sup>3</sup> which, as with the CM1 site, is comparable to that of 2020 and 2021 (13.0 µg/m<sup>3</sup>).

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

At the Castle Meadow (CM1) monitoring station, there were three PM<sub>10</sub> 24-hour mean concentrations greater than 50 µg/m<sup>3</sup> with the maximum 24-hour mean being 71 µg/m<sup>3</sup>. This concentration was exceeded four times at the Norwich Lakenfields AURN site (CM2), with a daily concentration of 73 µg/m<sup>3</sup> being recorded. This is however well below the

annual limit of exceedance limit of 35 days that the AQS objective allows the PM<sub>10</sub> daily concentration to reach 50 µg/m<sup>3</sup>. The PM<sub>10</sub> concentration recorded at both automatic monitoring stations demonstrates the compliance with both the annual mean and daily objective within Norwich during 2022.

### 3.2.3 Particulate Matter (PM<sub>2.5</sub>)

Table A.8 in Appendix A presents the ratified and adjusted monitored PM<sub>2.5</sub> annual mean concentrations for the past five years.

The PM<sub>2.5</sub> annual mean concentration recorded at the Castle Meadow (CM1) automatic monitoring site was 7.0 µg/m<sup>3</sup>, whilst at the AURN Norwich Lakenfields (CM2) monitoring site, a PM<sub>2.5</sub> annual mean concentration of 9.0 µg/m<sup>3</sup> was recorded. It should however be noted that the PM<sub>2.5</sub> 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<sub>2.5</sub> measurements in Norwich and the TEOM measurements can be used to track any reduction of the PM<sub>2.5</sub> annual mean. For example, relative to 2022, it can be seen that the PM<sub>2.5</sub> concentration has reduced from that in 2021 at the Castle Meadows site (9µg/m<sup>3</sup>), whilst the AURN Norwich Lakenfields site has remained the same (9 µg/m<sup>3</sup>).

### 3.2.4 Ozone (O<sub>3</sub>)

Ozone monitoring is carried out at the Norwich Lakenfields site (CM2). There are no regulatory objectives for ozone, but the following statistics were recorded in 2022:

- Annual Mean 53.0 µg/m<sup>3</sup>, 99% data capture (50.0 µg/m<sup>3</sup>, 97% data capture in 2021).
- Air Quality Strategy Objective for 2005 (O<sub>3</sub>) daily maximum 8-hour running mean > 100 µg/m<sup>3</sup> on more than 10 days – 22 exceedances (5 in 2021).
- EC Population Information Threshold (O<sub>3</sub>) 1-hour mean > 180 µg/m<sup>3</sup>– 5 exceedances (0 in 2021).
- EC Health Protection Target Value (O<sub>3</sub>) daily maximum 8-hour running mean > 120 µg/m<sup>3</sup> on more than 25 days – 0 exceedance (0 in 2021).

Ozone is harmful to humans when inhaled and to plants when they respire. Urban pollutants such as NO<sub>2</sub> mop up ozone and hence, as NO<sub>2</sub> levels change, ground level ozone trends will be useful to capture. It could also be potentially used to provide public health alerts.



## 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) <sup>(1)</sup>	Distance to kerb of nearest road (m) <sup>(2)</sup>	Inlet Height (m)
CM1	Castle Meadow	Kerbside	623202	308615	PM10, NOx, NO <sub>2</sub> , PM2.5	Y	Chemiluminescent (Ambirak); TEOM	N/A	1	2.5
CM2	Lakenfields	Urban Background	623637	306940	O <sub>3</sub> , PM10, NOx, NO <sub>2</sub> , PM2.5	N	Chemiluminescent (Thermo); FDMS	10	N/A	2.5

**Notes:**

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

(2) N/A if not applicable

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

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) <sup>(1)</sup>	Distance to kerb of nearest road (m) <sup>(2)</sup>	Tube Co-located with a Continuous Analyser?	Tube Height (m)
DT1A, DT1B	256 King St	Roadside	623863.04	307678.6	NO <sub>2</sub>	Yes. Norwich.	0.0	3.5	No	2.5
DT4A, DT4B, DT4C	Lakenfields AQS	Urban Background	623681.24	307015.82	NO <sub>2</sub>	No. Norwich.	20.0	1.5	Yes	2.5
DT6	130 Magdalen St	Roadside	623160.89	309550.43	NO <sub>2</sub>	Yes. Norwich.	0.0	4.0	No	2.5
DT9	13 St Augustines St	Kerbside	622905.81	309496.11	NO <sub>2</sub>	Yes. Norwich.	1.0	1.5	No	2.5
DT11	52 St Augustines St	Kerbside	622825.87	309573.17	NO <sub>2</sub>	Yes. Norwich.	0.0	1.0	No	2.5
DT13	Castle Meadow (Middle)	Roadside	623141.06	308606.69	NO <sub>2</sub>	Yes. Norwich.	N/A	2.5	No	2.5
DT16	Zipfel House	Roadside	623185.69	309649.68	NO <sub>2</sub>	Yes. Norwich.	0.0	3.0	No	1.5
DT19	27 Cattle Market St	Roadside	623320.58	308430.88	NO <sub>2</sub>	Yes. Norwich.	0.0	2.0	No	1.5
DT21	Rotary House	Roadside	623879.53	307658.91	NO <sub>2</sub>	Yes. Norwich.	3.0	2.0	No	2.5
DT22	Carrow Bridge House	Roadside	623900.96	307709.56	NO <sub>2</sub>	Yes. Norwich.	0.0	5.0	Yes	3.0
DT25	Bargate Court	Roadside	623422.42	309388.23	NO <sub>2</sub>	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) <sup>(1)</sup>	Distance to kerb of nearest road (m) <sup>(2)</sup>	Tube Co-located with a Continuous Analyser?	Tube Height (m)
DT26A, DT26B, DT26C	3 Riverside Rd	Roadside	623870.26	308515.77	NO <sub>2</sub>	Yes. Norwich.	0.0	3.0	No	3.0
DT29A, DT29B, DT29C	Chapelfield North	Kerbside	622532.23	308490.36	NO <sub>2</sub>	Yes. Norwich.	1.5	1.0	No	2.5
DT31A, DT31B, DT31C	Quantrell House	Kerbside	623380	307700	NO <sub>2</sub>	Yes. Norwich.	0.0	3.0	No	3.0
DT34	41 St Stephens Street	Kerbside	622898	308114	NO <sub>2</sub>	Yes. Norwich.	6.0	0.5	No	3.0
DT37	7a Gunns Court	Kerbside	622492	308520	NO <sub>2</sub>	Yes. Norwich.	3.0	2.5	No	3.0
DT39	49 Duke St	Kerbside	622884	309082	NO <sub>2</sub>	Yes. Norwich.	0.0	1.0	No	3.0
DT40	St Stephens Rd (Kingsley Rd)	Roadside	622695	307855	NO <sub>2</sub>	No, Norwich	1.5	2.0	No	2.2
DT41	Magdalen St (RSPCA)	Roadside	623148	309277	NO <sub>2</sub>	Yes. Norwich.	1.5	3.5	No	2.5
DT42	Magdalen St (Bus Stop)	Roadside	623151	309326	NO <sub>2</sub>	Yes. Norwich.	20.0	2.5	No	3.0
DT44	Botolph/Edwards St	Roadside	622910	309391	NO <sub>2</sub>	Yes. Norwich.	20.0	2.0	No	2.2
DT45	Pitt St W	Roadside	622904	309418	NO <sub>2</sub>	Yes. Norwich.	>20 n/a	2.2	No	2.1
DT46	Pitt St E	Roadside	622987	309486	NO <sub>2</sub>	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) <sup>(1)</sup>	Distance to kerb of nearest road (m) <sup>(2)</sup>	Tube Co-located with a Continuous Analyser?	Tube Height (m)
DT47	Duke St/St Crispins	Roadside	622869	309187	NO <sub>2</sub>	Yes. Norwich.	>20 n/a	2.5	No	2.5
DT48	Riverside/Aspland	Roadside	623878	308532	NO <sub>2</sub>	Yes. Norwich.	0.0	1.2	No	2.2
DT49	Queens Rd N	Roadside	623480	307679	NO <sub>2</sub>	Yes. Norwich.	0.0	2.0	No	2.0
DT50	Queens Rd S	Roadside	623474	307692	NO <sub>2</sub>	Yes. Norwich.	0.0	1.1	No	2.2
DT51	70 Bracondale	Roadside	624028	307322	NO <sub>2</sub>	Yes. Norwich.	0.0	5.0	No	2.1
DT52	Heigham Road	Roadside	621958	309000	NO <sub>2</sub>	Yes. Norwich.	0.0	9.0	No	1.8
DT53	Nelson Primary School 1	Kerbside	621573	309434	NO <sub>2</sub>	No, Norwich	9.0	1.5	No	2.0
DT54	Nelson Primary School 2	Kerbside	621574	309463	NO <sub>2</sub>	No, Norwich	3.0	1.5	No	2.3
DT55	82 Turner Road 1	Kerbside	621268	309494	NO <sub>2</sub>	No, Norwich	5.4	3.5	No	2.3
DT56	92 Turner Road 2	Kerbside	621267	309508	NO <sub>2</sub>	No, Norwich	3.7	2.6	No	2.3
DT57, DT58, DT59	Castle Meadow AQMS 3	Roadside	623204	308616	NO <sub>2</sub>	Yes. Norwich.	3.8	1.5	Yes	2.5

**Notes:**

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

(2) N/A if not applicable.



**Table A.3 – Annual Mean NO<sub>2</sub> Monitoring Results: Automatic Monitoring (µg/m<sup>3</sup>)**

Site ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Site Type	Valid Data Capture for Monitoring Period (%) <sup>(1)</sup>	Valid Data Capture 2022 (%) <sup>(2)</sup>	2018	2019	2020	2021	2022
CM1	623202	308615	Kerbside	96%	75	<b>54</b>	<b>41</b>	30	30	27
CM2	623637	306940	Urban Background	99%	89	12	13	10	10	10

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

**Notes:**

The annual mean concentrations are presented as µg/m<sup>3</sup>.

Exceedances of the NO<sub>2</sub> annual mean objective of 40µg/m<sup>3</sup> 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<sub>2</sub> Monitoring Results: Non-Automatic Monitoring (µg/m<sup>3</sup>)**

Diffusion Tube ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Site Type	Valid Data Capture for Monitoring Period (%) <sup>(1)</sup>	Valid Data Capture 2022 (%) <sup>(2)</sup>	2018	2019	2020	2021	2022
DT1A, DT1B	623863.04	307678.6	Roadside	100	99.2	33.3	34.2	25.6	25.7	27.1
DT4A, DT4B, DT4C	623681.24	307015.82	Urban Background	83.3	91.4	11.8	12.0	10.0	9.8	8.5
DT6	623160.89	309550.43	Roadside	91.6	91.1	27.1	29.8	21.7	21.8	21.9
DT9	622905.81	309496.11	Kerbside	100	88.6	37.4	<b>40.1</b>	33.0	32.8	34.3
DT11	622825.87	309573.17	Kerbside	100	99.2	<b>44.4</b>	<b>46.0</b>	39.4	<b>40.2</b>	<b>40.3</b>
DT13	623141.06	308606.69	Roadside	83.3	86.1	<b>44.9</b>	<b>46.9</b>	35.5	36.4	34.1
DT16	623185.69	309649.68	Roadside	100	99.2	33.4	36.1	30.5	28.6	28.8
DT19	623320.58	308430.88	Roadside	91.6	89.7	36.1	34.8	22.9	23.7	25.9
DT21	623879.53	307658.91	Roadside	100	99.2	29.1	30.9	24.9	22.9	24.5
DT22	623900.96	307709.56	Roadside	100	99.2	31.1	29.4	21.7	21.6	20.9
DT25	623422.42	309388.23	Roadside	100	99.2	29.6	32.4	25.9	25.9	24.8
DT26A, DT26B, DT26C	623870.26	308515.77	Roadside	100	99.2	39.3	<b>43.3</b>	32.6	30.6	27.2

Diffusion Tube ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Site Type	Valid Data Capture for Monitoring Period (%) <sup>(1)</sup>	Valid Data Capture 2022 (%) <sup>(2)</sup>	2018	2019	2020	2021	2022
DT29A, DT29B, DT29C	622532.23	308490.36	Kerbside	100	99.2	<b>41.3</b>	<b>43.4</b>	29.8	29.4	27.7
DT31A, DT31B, DT31C	623380	307700	Kerbside	100	99.2	37.2	38.6	29.9	28.0	28.8
DT34	622898	308114	Kerbside	58.3	58.3	<b>41.2</b>	<b>40.3</b>	29.2	26.4	23.9
DT37	622492	308520	Kerbside	91.6	92.5	29.9	30.3	24.6	22.6	23.4
DT39	622884	309082	Kerbside	100	99.2	30.0	31.9	20.2	19.5	19.6
DT40	622695	307855	Roadside	100	99.2		32.6	21.5	21.3	19.8
DT41	623148	309277	Roadside	91.6	91.4		34.2	27.4	29.4	28.2
DT42	623151	309326	Roadside	91.6	91.4		33.0	21.4	27.4	26.7
DT44	622910	309391	Roadside	91.6	91.4			22.5	21.3	20.7
DT45	622904	309418	Roadside	100	99.2			25.4	22.7	22.5
DT46	622987	309486	Roadside	100	99.2			25.4	23.9	24.0
DT47	622869	309187	Roadside	100	99.2			19.8	22.1	20.7
DT48	623878	308532	Roadside	100	99.2			27.3	26.8	23.0

Diffusion Tube ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Site Type	Valid Data Capture for Monitoring Period (%) <sup>(1)</sup>	Valid Data Capture 2022 (%) <sup>(2)</sup>	2018	2019	2020	2021	2022
DT49	623480	307679	Roadside	100	99.2			24.9	24.7	26.7
DT50	623474	307692	Roadside	100	94.2			25.3	24.2	25.5
DT51	624028	307322	Roadside	100	99.2				27.2	26.3
DT52	621958	309000	Roadside	91.6	94.2					16.0
DT53	621573	309434	Kerbside	100	99.2					12.0
DT54	621574	309463	Kerbside	100	99.2					10.7
DT55	621268	309494	Kerbside	91.6	88.6					12.0
DT56	621267	309508	Kerbside	100	99.2					12.4
DT57, DT58, DT59	623204	308616	Roadside	100	99.2					31.3

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

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  $\mu\text{g}/\text{m}^3$ .

Exceedances of the NO<sub>2</sub> annual mean objective of  $40\mu\text{g}/\text{m}^3$  are shown in **bold**.

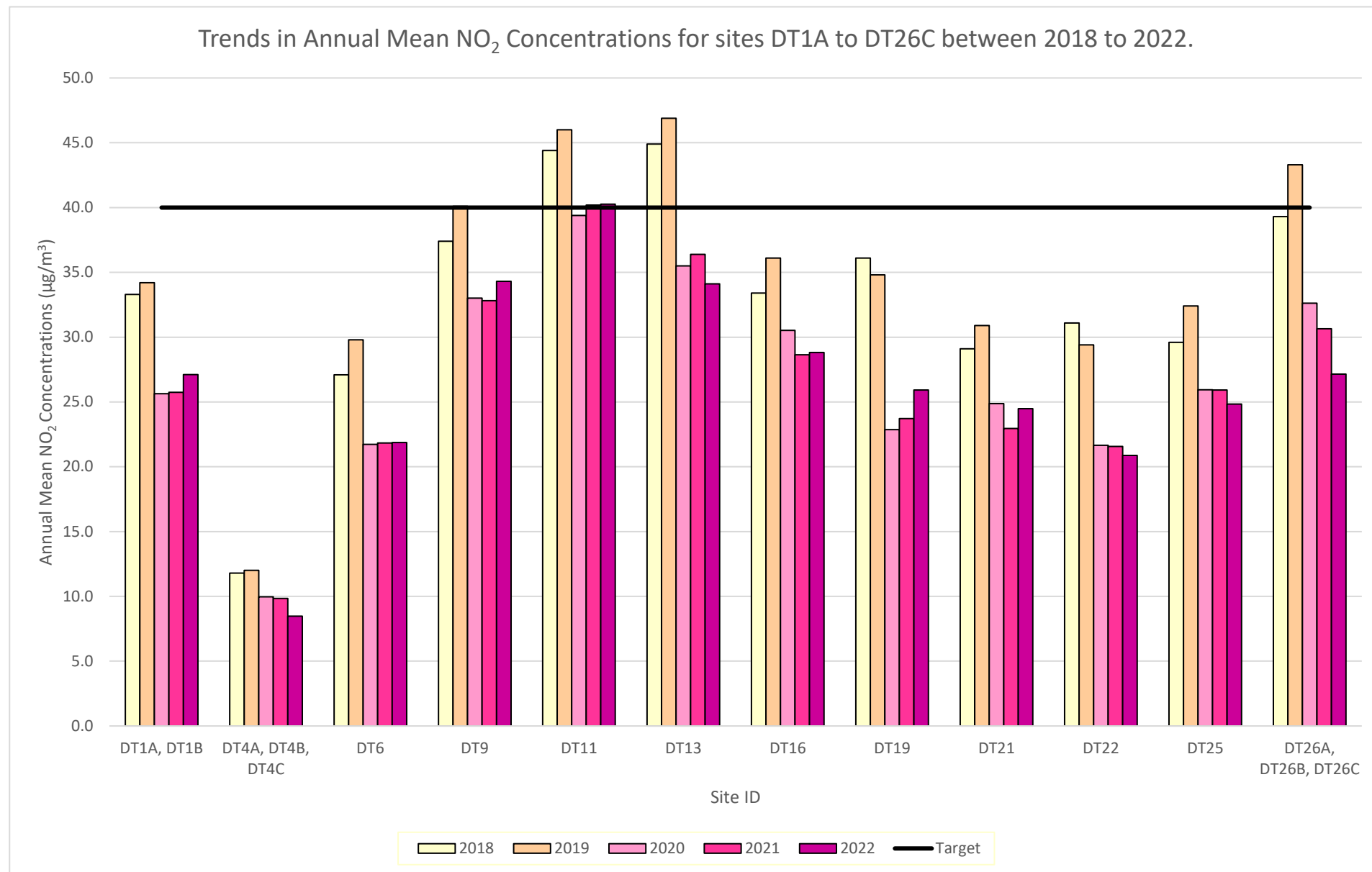
NO<sub>2</sub> annual means exceeding 60µg/m<sup>3</sup>, indicating a potential exceedance of the NO<sub>2</sub> 1-hour mean objective are shown in **bold and underlined**.

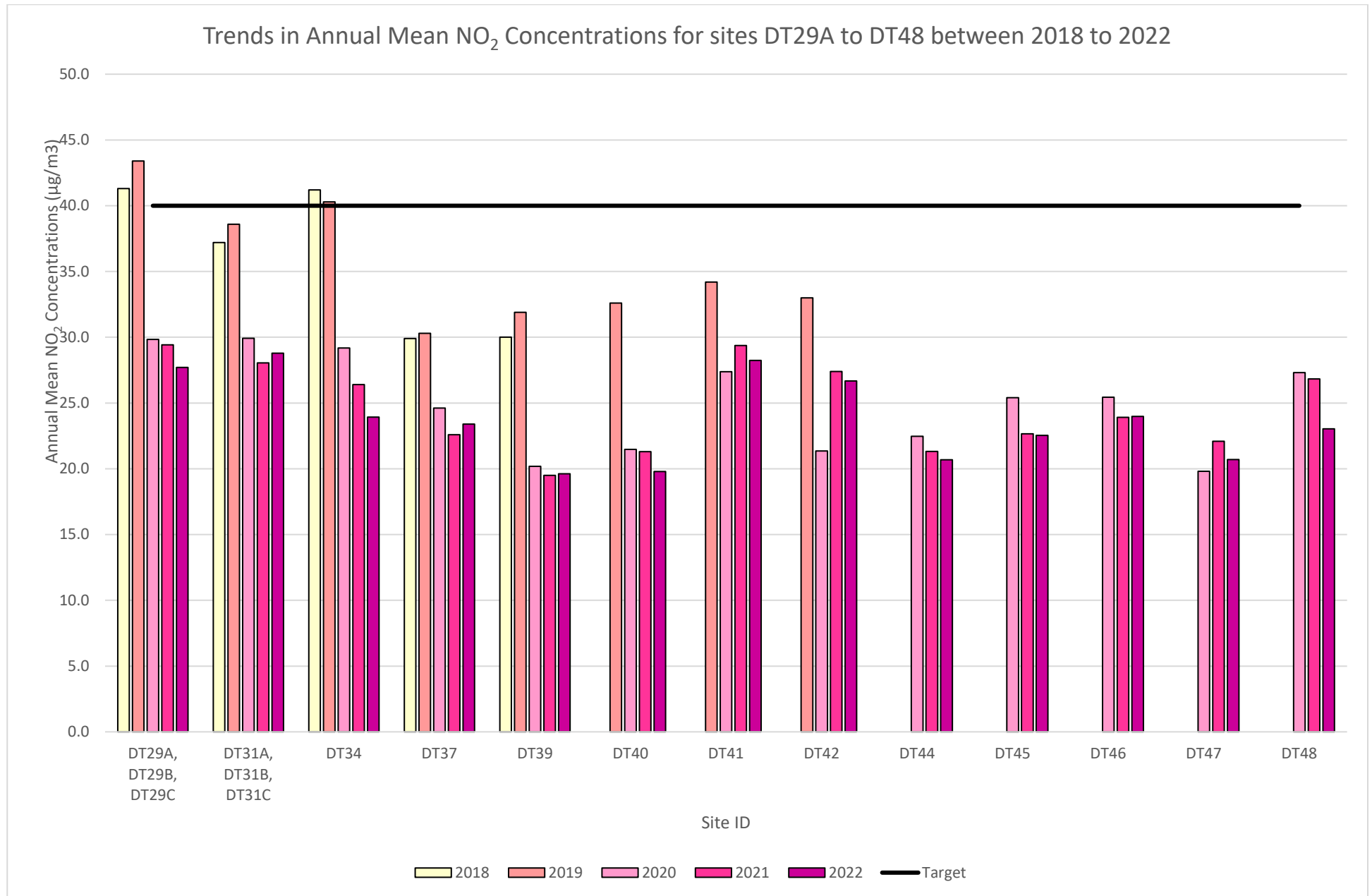
Means for diffusion tubes have been corrected for bias. All means have been “annualised” as per LAQM.TG22 if valid data capture for the full calendar year is less than 75%. See Appendix C for details.

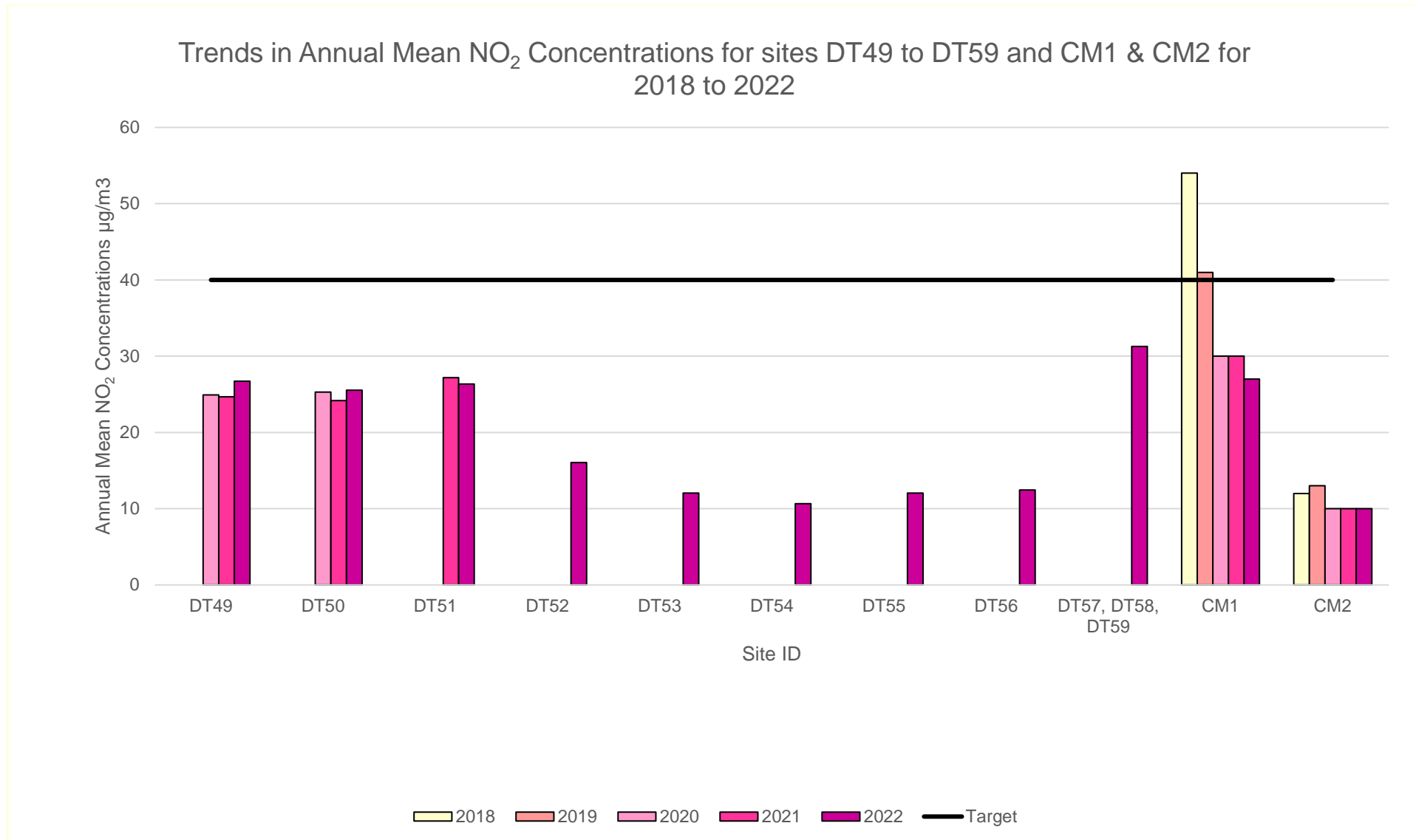
Concentrations are those at the location of monitoring and not those following any fall-off with distance adjustment.

- (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%).

**Figure A.1 – Trends in Annual Mean NO<sub>2</sub> Concentrations**









**Table A.5 – 1-Hour Mean NO<sub>2</sub> Monitoring Results, Number of 1-Hour Means > 200µg/m<sup>3</sup>**

Site ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Site Type	Valid Data Capture for Monitoring Period (%) <sup>(1)</sup>	Valid Data Capture 2022 (%) <sup>(2)</sup>	2018	2019	2020	2021	2022
CM1	623202	308615	Kerbside	98	98	19	1	0	0	0
CM2	623637	306940	Urban Background	89	89	0	0	0	0	0

**Notes:**

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

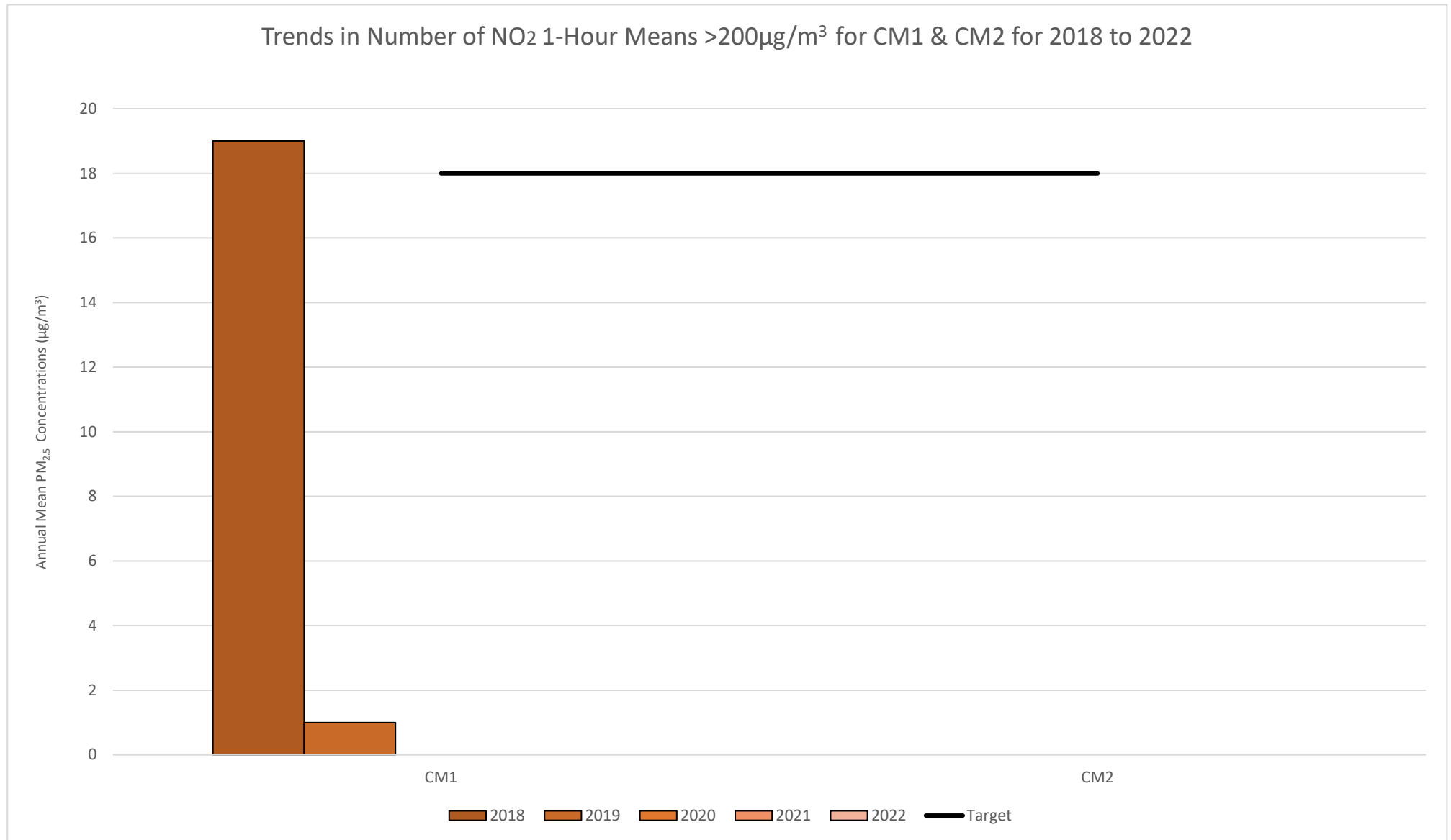
Exceedances of the NO<sub>2</sub> 1-hour mean objective (200µg/m<sup>3</sup> not to be exceeded more than 18 times/year) are shown in **bold**.

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%).

**Figure A.2 – Trends in Number of NO<sub>2</sub> 1-Hour Means > 200µg/m<sup>3</sup>**



**Table A.6 – Annual Mean PM<sub>10</sub> Monitoring Results (µg/m<sup>3</sup>)**

Site ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Site Type	Valid Data Capture for Monitoring Period (%) <sup>(1)</sup>	Valid Data Capture 2022 (%) <sup>(2)</sup>	2018	2019	2020	2021	2022
CM1	623202	308615	Kerbside	93.8	75	27	19	19	19	20
CM2	623637	306940	Urban Background	97	87	16	14	13	13	14

**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<sup>3</sup>.

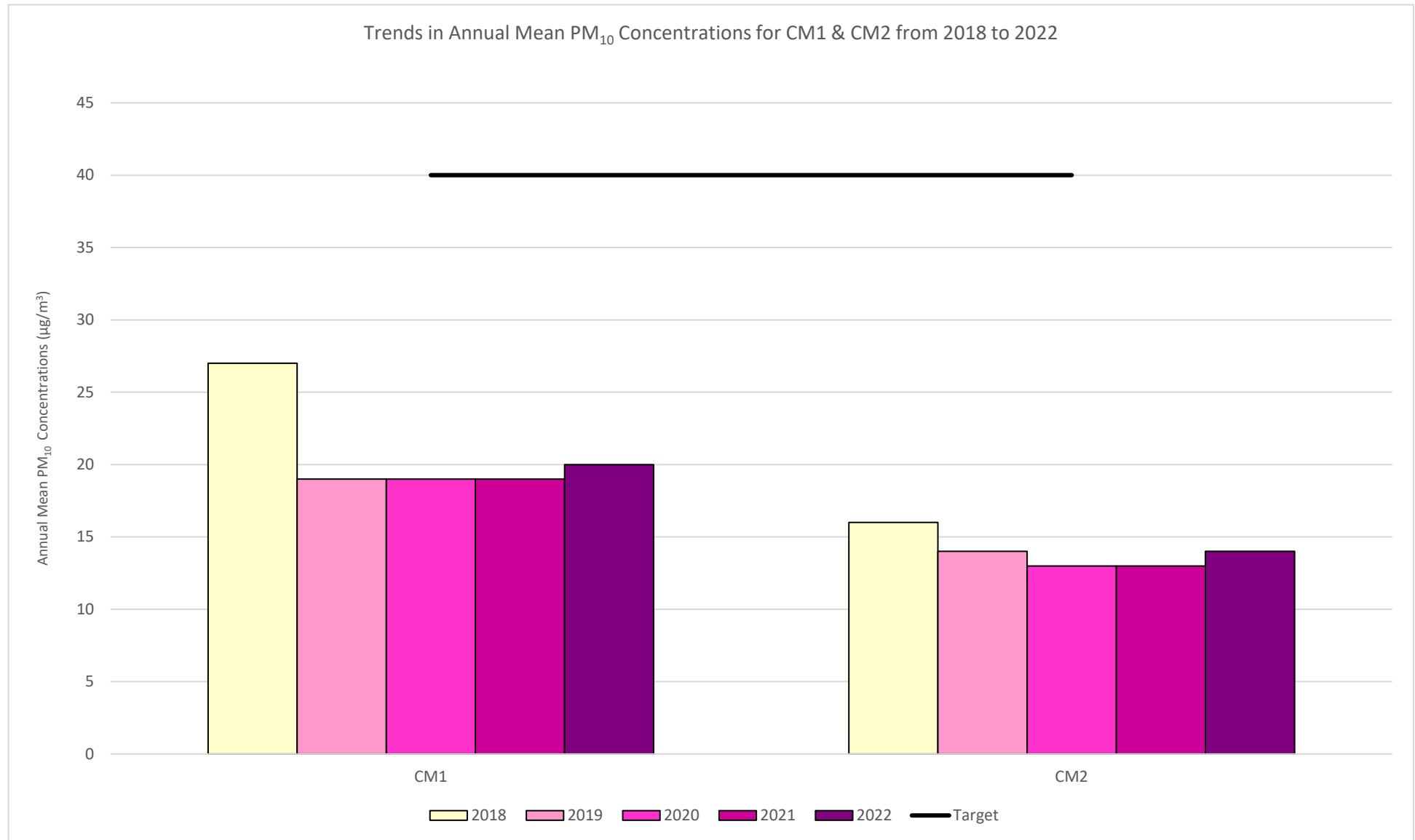
Exceedances of the PM<sub>10</sub> annual mean objective of 40µg/m<sup>3</sup> are shown in **bold**.

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.3 – Trends in Annual Mean PM<sub>10</sub> Concentrations**



**Table A.7 – 24-Hour Mean PM<sub>10</sub> Monitoring Results, Number of PM<sub>10</sub> 24-Hour Means > 50µg/m<sup>3</sup>**

Site ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Site Type	Valid Data Capture for Monitoring Period (%) <sup>(1)</sup>	Valid Data Capture 2022 (%) <sup>(2)</sup>	2018	2019	2020	2021	2022
CM1	623202	308615	Kerbside	93.8	93.8	8	5	0	0	3
CM2	623637	306940	Urban Background	88.7	88.7	1	4	0	0	4

**Notes:**

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

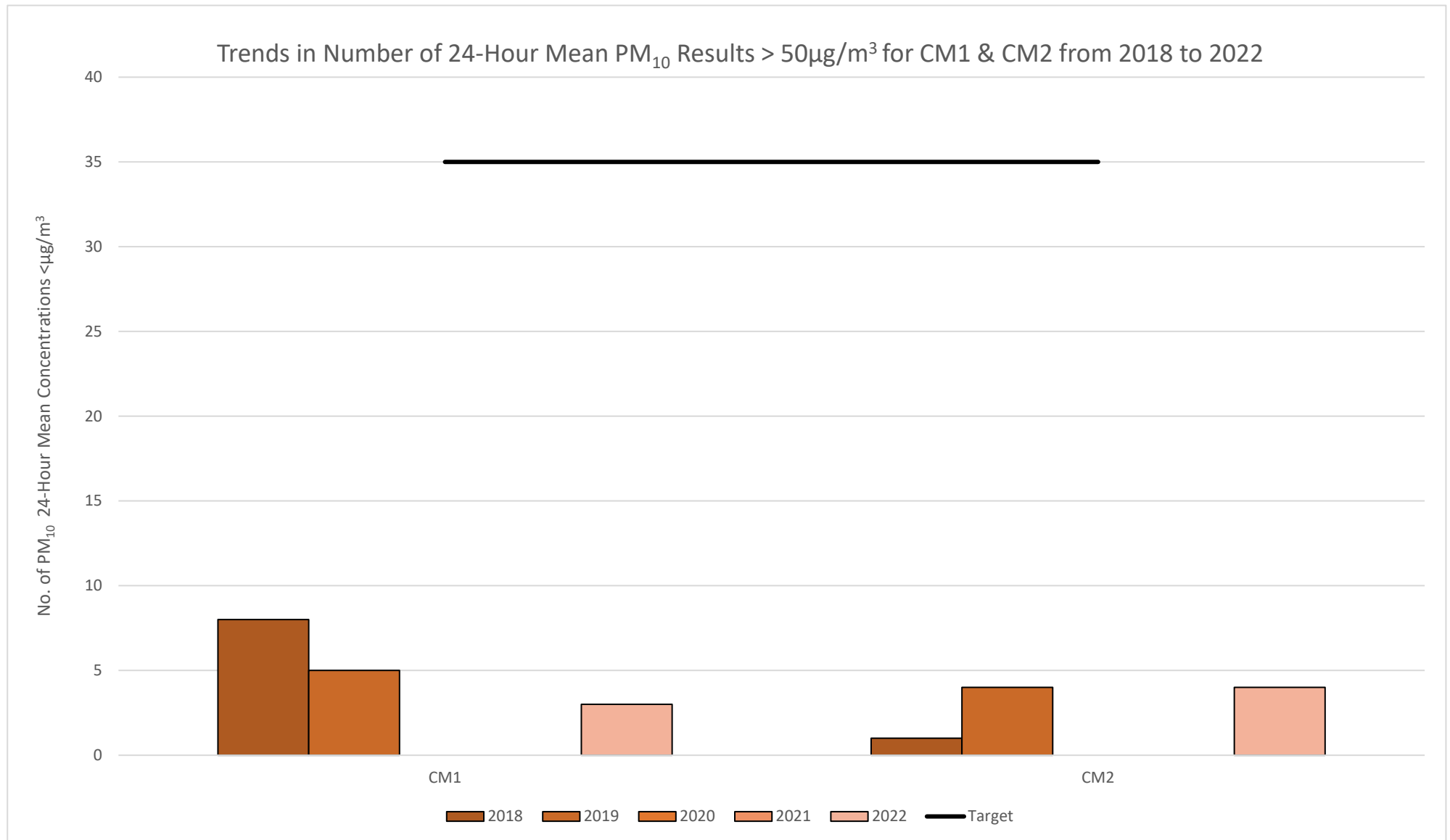
Exceedances of the PM<sub>10</sub> 24-hour mean objective (50µg/m<sup>3</sup> not to be exceeded more than 35 times/year) are shown in **bold**.

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.4 – Trends in Number of 24-Hour Mean PM<sub>10</sub> Results > 50µg/m<sup>3</sup>**



**Table A.8 – Annual Mean PM<sub>2.5</sub> Monitoring Results (µg/m<sup>3</sup>)**

Site ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Site Type	Valid Data Capture for Monitoring Period (%) <sup>(1)</sup>	Valid Data Capture 2022 (%) <sup>(2)</sup>	2018	2019	2020	2021	2022
CM1	666555	333444	Roadside	96.2	75	10	10	10	9	7
CM2	777444	333555	Urban Background	97	97	10	10	8	9	9

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

**Notes:**

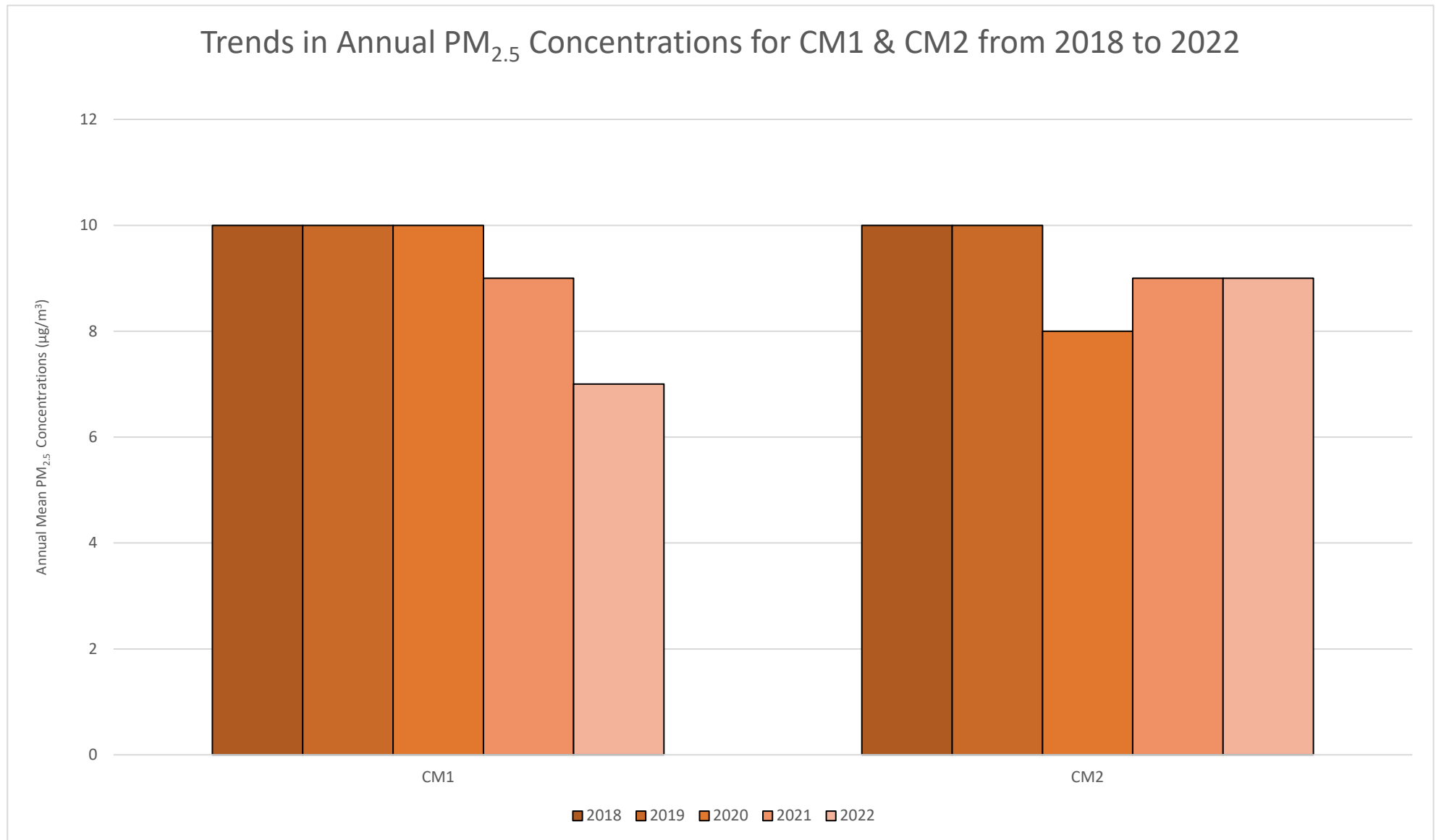
The annual mean concentrations are presented as µg/m<sup>3</sup>.

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.5 – Trends in Annual Mean PM<sub>2.5</sub> Concentrations**





## Appendix B: Full Monthly Diffusion Tube Results for 2022

Table B.1 – NO<sub>2</sub> 2022 Diffusion Tube Results (µg/m<sup>3</sup>)

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	Bias Adjusted (0.82) and Annualised	Annual Mean: Distance Corrected to Nearest Exposure	Comment
DT1A	623863	307679	36.6	31.9	41.4	27.4	28.3	31.5	30.1	31.6	30.8	35.7	36.7	39.6	-	-	-	Duplicate Site with DT1A and DT1B - Annual data provided for DT1B only
DT1B	623863	307679	38.1	26.7	40.9	30.3	28.7	31.9	28.7	28.9	28.6	36.7	39.8	36.5	33.1	27.1	-	Duplicate Site with DT1A and DT1B - Annual data provided for DT1B only
DT4A	623681	307016	16.5	10.6	14.7	9.0	7.5	5.9	7.1	9.2	9.9	11.4	15.1		-	-	-	Triplicate Site with DT4A, DT4B and DT4C - Annual data provided for DT4C only
DT4B	623681	307016	16.3		14.4	9.1	8.1	6.4	7.0	9.0	10.0	11.0	14.0		-	-	-	Triplicate Site with DT4A, DT4B and DT4C - Annual data provided for DT4C only
DT4C	623681	307016	16.8		15.2	8.4	7.7	6.3	6.8	8.6	10.2		13.4		10.3	8.5	-	Triplicate Site with DT4A, DT4B and DT4C - Annual data provided for DT4C only
DT6	623161	309550	31.8		29.3	23.8	24.1	22.1	20.7	22.0	29.1	29.5	31.1	31.2	26.7	21.9	-	
DT9	622906	309496	45.1	29.7	44.5	38.6	<0.56	66.2	32.1	42.2	43.5	37.4	39.5	41.3	41.8	34.3	-	
DT11	622826	309573	63.9	46.8	44.9	42.8	48.9	49.1	45.8	45.8	53.8	48.1	54.2	50.4	49.1	<b>40.3</b>	-	
DT13	623141	308607		37.0	48.9	37.8	37.3	34.7	36.6		48.2	44.2	49.1	42.2	41.6	34.1	-	
DT16	623186	309650	46.0	38.5	40.3	27.0	32.4	29.0	30.4	27.2	33.9	39.0	39.2	43.6	35.1	28.8	-	
DT19	623321	308431	30.2	25.3	43.1		25.9	28.1	29.7	33.7	29.2	31.2	36.4	35.8	31.6	25.9	-	
DT21	623880	307659	31.1	32.1	30.3	27.4	29.6	30.5	28.3	24.9	24.2	33.9	32.2	33.2	29.9	24.5	-	
DT22	623901	307710	35.4	25.5	27.9	25.8	23.4	20.7	20.0	26.0	26.2	23.6	27.9	26.9	25.5	20.9	-	
DT25	623422	309388	39.8	27.5	30.8	29.8	29.3	26.1	26.3	28.7	32.4	31.7	33.3	30.5	30.3	24.8	-	
DT26 A	623870	308516	32.7	24.3	32.2	23.5	27.5	26.9	26.8	38.3	37.9	43.5	43.2	42.5	-	-	-	Triplicate Site with DT26A, DT26B and DT26C - Annual data provided for DT26C only
DT26 B	623870	308516	35.9	20.9	34.9	23.1	25.3	25.7	27.3	38.0	36.9	42.8	42.4	42.3	-	-	-	Triplicate Site with DT26A, DT26B and DT26C - Annual data provided for DT26C only
DT26 C	623870	308516	35.6	23.6	36.4	22.5	23.6	25.6	28.7	35.1	36.6	43.0	43.3	45.8	33.1	27.2	-	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	Bias Adjusted (0.82) and Annualised	Annual Mean: Distance Corrected to Nearest Exposure	Comment
DT29 A	622532	308490	43.0	30.8	34.7	31.0	31.5	28.1	26.6	34.7	40.5	32.1	36.4	36.3	-	-	-	Triplicate Site with DT29A, DT29B and DT29C - Annual data provided for DT29C only
DT29 B	622532	308490	43.7	30.5	30.6	34.3	28.9	31.0	29.0	35.0	41.3	31.4	38.2	35.2	-	-	-	Triplicate Site with DT29A, DT29B and DT29C - Annual data provided for DT29C only
DT29 C	622532	308490	41.7	29.0	39.8	32.4	29.6	29.6	28.8	35.1	43.6	30.4	36.8	37.7	33.8	27.7	-	Triplicate Site with DT29A, DT29B and DT29C - Annual data provided for DT29C only
DT31 A	623380	307700	30.5	33.6	39.9	30.2	29.6	35.1	33.3	32.2	32.3	37.4	41.0	43.1	-	-	-	Triplicate Site with DT31A, DT31B and DT31C - Annual data provided for DT31C only
DT31 B	623380	307700	41.3	33.3	42.1	29.1	33.2	33.8	34.0	31.4	36.3	39.6	39.0	42.2	-	-	-	Triplicate Site with DT31A, DT31B and DT31C - Annual data provided for DT31C only
DT31 C	623380	307700	43.0	34.8	40.5	32.3	34.5	33.9	31.1	31.7	36.3	17.7	40.1	42.6	35.1	28.8	-	Triplicate Site with DT31A, DT31B and DT31C - Annual data provided for DT31C only
DT34	622898	308114						23.3	19.9	27.7	24.5	32.8	35.8	37.1	29.2	23.9	-	
DT37	622492	308520	35.0	29.2	31.7	22.8	22.7	21.8		22.2	28.8	31.0	33.8	39.1	28.5	23.4	-	
DT39	622884	309082	28.4	20.0	32.3	24.3	19.5	16.8	17.8	22.4	24.5	26.0	28.4	28.4	23.9	19.6	-	
DT40	622695	307855	33.8	24.7	29.3	24.2	20.8	16.4	13.5	22.7	25.1	24.0	28.5	29.6	24.1	19.8	-	
DT41	623148	309277	43.8	30.8	36.4	33.1	30.3	29.4	29.7	34.3	39.9	36.0	38.9		34.4	28.2	-	
DT42	623151	309326	42.0	34.2	34.4	25.5	28.2	26.3	26.4	27.6	36.5	39.6	39.8		32.5	26.7	-	
DT44	622910	309391	26.4	21.6	32.1	23.5	20.4	18.7	18.7	20.6		27.4	34.0	34.0	25.2	20.7	-	
DT45	622904	309418	30.0	22.4	36.4	25.5	20.2	23.4	23.2	24.3	27.7	29.9	33.4	35.3	27.5	22.5	-	
DT46	622987	309486	37.6	26.8	32.8	26.7	27.6	23.9	25.4	29.3	24.3	31.8	32.9	34.6	29.2	24.0	-	
DT47	622869	309187	27.4	21.5	36.7	22.9	21.7	19.5	19.4	26.9	25.5	25.2	29.1	28.5	25.2	20.7	-	
DT48	623878	308532	31.3	24.1	30.5	18.7	21.0	21.1	19.3	30.6	34.0	34.4	36.3	37.5	28.1	23.0	-	
DT49	623480	307679	35.5	46.1	39.2	33.8	27.5	23.4	25.8	34.1	33.6	26.5	37.0	31.1	32.6	26.7	-	
DT50	623474	307692	<1.37	30.0	39.9	27.5	29.7	26.7	27.9	28.0	30.3	34.1	32.6	36.1	31.1	25.5	-	
DT51	624028	307322	37.0	25.8	42.5	39.3	27.0	24.3	28.0	39.4	30.4	26.5	35.3	32.8	32.1	26.3	-	

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	Bias Adjusted (0.82) and Annualised	Annual Mean: Distance Corrected to Nearest Exposure	Comment
DT52	621958	309000		18.4	26.6	20.2	17.8	15.5	16.1	17.6	19.9	21.6	21.0	20.2	19.6	16.0	-	
DT53	621573	309434	18.7	12.5	20.7	12.2	13.6	11.0	10.1	11.0	13.2	16.0	19.0	19.0	14.7	12.0	-	
DT54	621574	309463	20.5	15.3	17.6	11.8	11.0	8.2	8.1	9.5	11.9	11.3	14.4	19.9	13.0	10.7	-	
DT55	621268	309494	18.9	14.2	19.7	14.1		7.7	8.7	10.9	13.6	15.8	18.3	20.2	14.7	12.0	-	
DT56	621267	309508	21.5	14.6	22.4	13.5	11.8	9.3	9.7	12.9	12.7	15.9	19.2	21.0	15.2	12.4	-	
DT57	623204	308616	36.4	29.3	47.7	39.9	33.2	30.8	34.0	41.5	37.2	42.7	46.1	41.7	-	-	-	Triplicate Site with DT57, DT58 and DT59 - Annual data provided for DT59 only
DT58	623204	308616	39.4	25.3	47.9	36.8	34.4	32.1	29.7	42.1	35.8	46.4	43.6	34.6	-	-	-	Triplicate Site with DT57, DT58 and DT59 - Annual data provided for DT59 only
DT59	623204	308616	38.2	25.9	43.7	40.4	28.8	31.8	35.6	40.8	38.3	45.0	49.3	42.1	38.1	31.3	-	Triplicate Site with DT57, DT58 and DT59 - Annual data provided for DT59 only

- All erroneous data has been removed from the NO<sub>2</sub> diffusion tube dataset presented in Table B.1.
- Annualisation has been conducted where data capture is <75% and >25% in line with LAQM.TG22.
- 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 2022 diffusion tube data has been uploaded to the Diffusion Tube Data Entry System.

**Notes:**

Exceedances of the NO<sub>2</sub> annual mean objective of 40µg/m<sup>3</sup> are shown in **bold**.

NO<sub>2</sub> annual means exceeding 60µg/m<sup>3</sup>, indicating a potential exceedance of the NO<sub>2</sub> 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 2022**

Norwich City Council has not identified any new sources relating to air quality within the reporting year of 2022.

### **Additional Air Quality Works Undertaken by Norwich City Council in 2022**

Norwich City Council has not completed any additional works within the reporting year of 2022.

### **QA/QC of Diffusion Tube Monitoring**

The diffusion tubes deployed in 2022 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<sub>2</sub> 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<sub>2</sub> concentrations are of a high calibre.

The current version of the AIR-PT scheme shows that first round of results from 2022, running from January – February 2022 AIR PT AR049, Gradko were awarded a score of 100% and the second round of results running from May – June 2022 AIR PT AR050, Gradko International were awarded a score of 100%. The percentage is an indication of the results deemed satisfactory based upon the z-score of  $< \pm 2$ .

For all 15 observations in 2022, the precision of NO<sub>2</sub> 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 2022, the diffusion tubes were not deployed in line with the monitoring calendar, with some changes occurring, we were 10 days late with our January and May tubes and also fluctuated being early and late over the other months. 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

#### Table C.1 – Annualisation Summary (concentrations presented in $\mu\text{g}/\text{m}^3$ )

There was one diffusion tube monitoring location that recorded data capture was less than 75% but greater than 25% which was DT34. In such instances it is necessary to annualise the data. Results are presented in Table C.2 below:

Other than DT34 the data capture across the diffusion tube network in 2022 ranged from a minimum of 83% to a maximum of 100%.

Indeed, 23 of the 34 diffusion tube sites recorded a data capture of 100% in 2022, indicating that the diffusion tube network was well maintained, with minimal loss of data occurring.

Site ID	Annualisation Factor <i>Lakenfields</i>	Annualisation Factor <i>Castle Meadow</i>	Average Annualisation Factor	Raw Data Annual Mean	Annualised Annual Mean
DT34	1.0658	1.0012	1.0335	29.2	30.2

### Diffusion Tube Bias Adjustment Factors

The diffusion tube data presented within the 2022 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  $\text{NO}_x/\text{NO}_2$  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 national bias adjustment factor of 0.82 to the 2022 monitoring data. A summary of bias adjustment factors used by Norwich City Council over the past five years is presented in Table C..

**Table C.1 – National Bias Adjustment Factor Spreadsheet 06/23**

Step 1:	Step 2:	Step 3:	Step 4:							
Select the Laboratory that Analyses Your Tubes from the Drop-Down List	Select a Preparation Method from the Drop-Down List	Select a Year from the Drop-Down List	Where there is only one study for a chosen combination, you should use the adjustment factor shown with caution. Where there is more than one study, use the overall factor: shown in blue at the foot of the final column.							
If a laboratory is not shown, we have no data for this laboratory.	If a preparation method is not shown, we have no data for this method at this laboratory.	If a year is not shown, we have no data.	If you have your own co-location study then see footnote. If uncertain what to do then contact the Local Air Quality Management Helpdesk at LAQMHelpdesk@bureauventas.com or 0800 0327953							
Analysed By:	Method	Year	Site Type	Local Authority	Length of Study (months)	Diffusion Tube Mean Conc. (Dm) (µg/m <sup>3</sup> )	Automatic Monitor Mean Conc. (Cm) (µg/m <sup>3</sup> )	Bias (B)	Tube Precision	Bias Adjustment Factor (A) (Cm/Dm)
Gradco	50% TEA in acetone	2022		Overall Factor <sup>5</sup> (15 studies)				Use		0.82

**Table C.2 – Bias Adjustment Factor**

Monitoring Year	Local or National	If National, Version of National Spreadsheet	Adjustment Factor
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
2018	Local	-	0.86

**Table C.3: Local Bias Adjustment Calculation**

	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	11	-	-	-	-
Bias Factor A	0.71 (0.66-0.77)	-	-	-	-
Bias Factor B	41% (30% -52%)	-	-	-	-
Diffusion Tube Mean (µg/m <sup>3</sup> )	38.0	-	-	-	-
Mean CV (Precision)	5.3%	-	-	-	-
Automatic Mean (µg/m <sup>3</sup> )	27.0	-	-	-	-
Data Capture	96%				
Adjusted Tube Mean (µg/m <sup>3</sup> )	27 (25-29)				

**Note:**

Although not used to bias adjust the 2022 data, the results of the co-location study are presented for transparency.

**NO<sub>2</sub> Fall-off with Distance from the Road**

Wherever possible, monitoring locations are representative of exposure. However, where this is not possible, the NO<sub>2</sub> concentration at the nearest location relevant for exposure has been estimated using the Diffusion Tube Data Processing Tool/NO<sub>2</sub> fall-off with distance calculator available on the LAQM Support website. Where appropriate, non-automatic annual mean NO<sub>2</sub> concentrations corrected for distance are presented in Table B.1.

No diffusion tube NO<sub>2</sub> monitoring locations within Norwich City Council required distance correction during 2022.

**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), the following QA/QC procedures were implemented:

- 2-weekly calibrations of the analysers, carried out by a member of the Norwich City Council Environmental Protection team.
- 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<sub>10</sub> and PM<sub>2.5</sub> Monitoring Adjustment**

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<sub>10</sub> 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<sub>10</sub> for the annual mean and 24-hour mean readings. The Norwich Lakenfields AURN site has a FIDAS analyser to monitor PM<sub>10</sub> and PM<sub>2.5</sub>.

### **Automatic Monitoring Annualisation**

All automatic monitoring locations within Norwich recorded data capture of greater than 75% therefore it was not required to annualise any monitoring data.

### **NO<sub>2</sub> Fall-off with Distance from the Road**

Wherever possible, monitoring locations are representative of exposure. However, where this is not possible, the NO<sub>2</sub> concentration at the nearest location relevant for exposure



has been estimated using the NO<sub>2</sub> fall-off with distance calculator available on the LAQM Support website. Where appropriate, non-automatic annual mean NO<sub>2</sub> concentrations corrected for distance are presented in Table B.1.

No automatic NO<sub>2</sub> monitoring locations within Norwich required distance correction during 2022.

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

Figure D.1 – Map of Automatic & Non-Automatic Monitoring Sites (Overview)

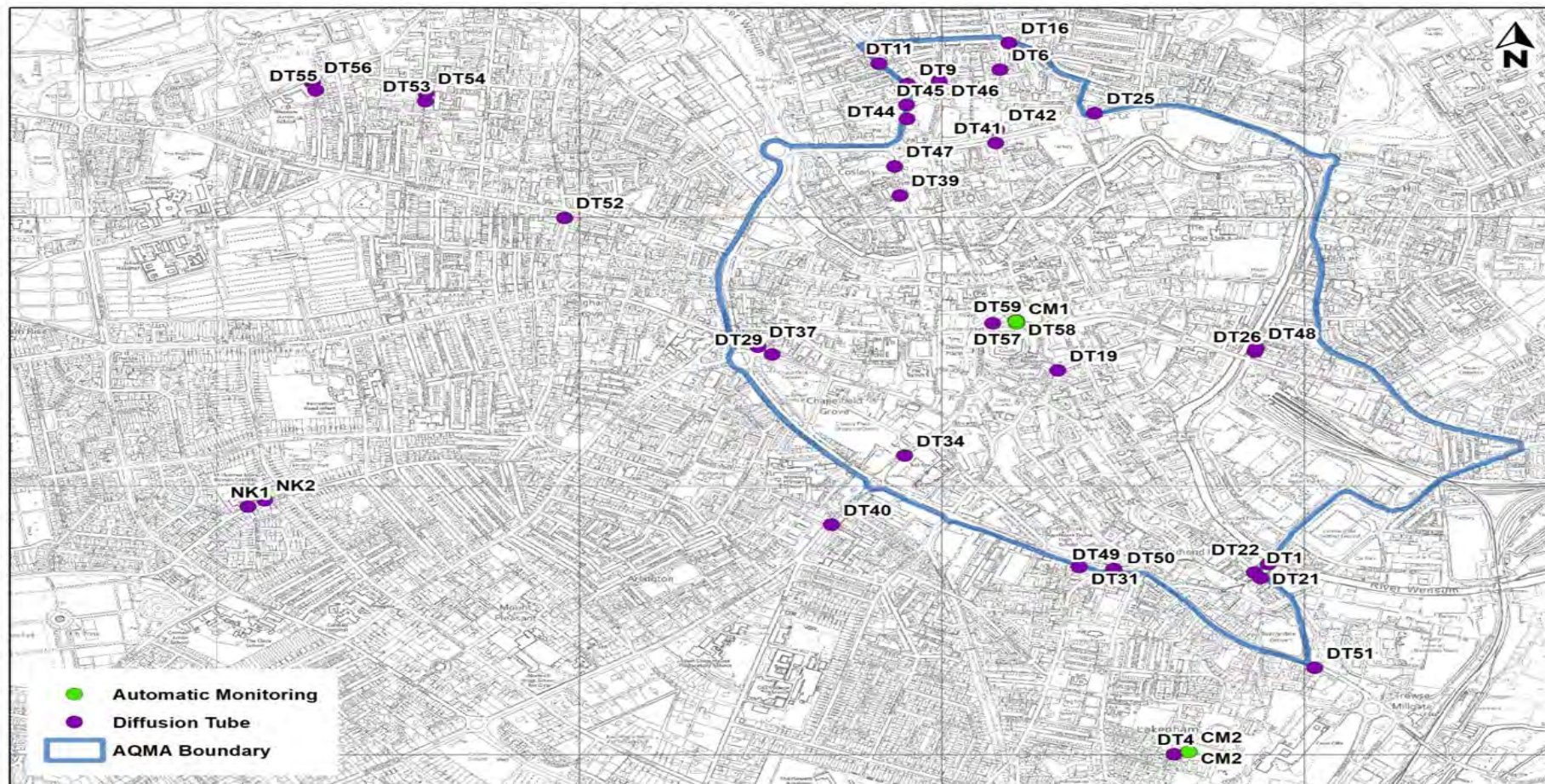




Figure D.2 – Map of Non-Automatic Monitoring Sites (North of AQMA)

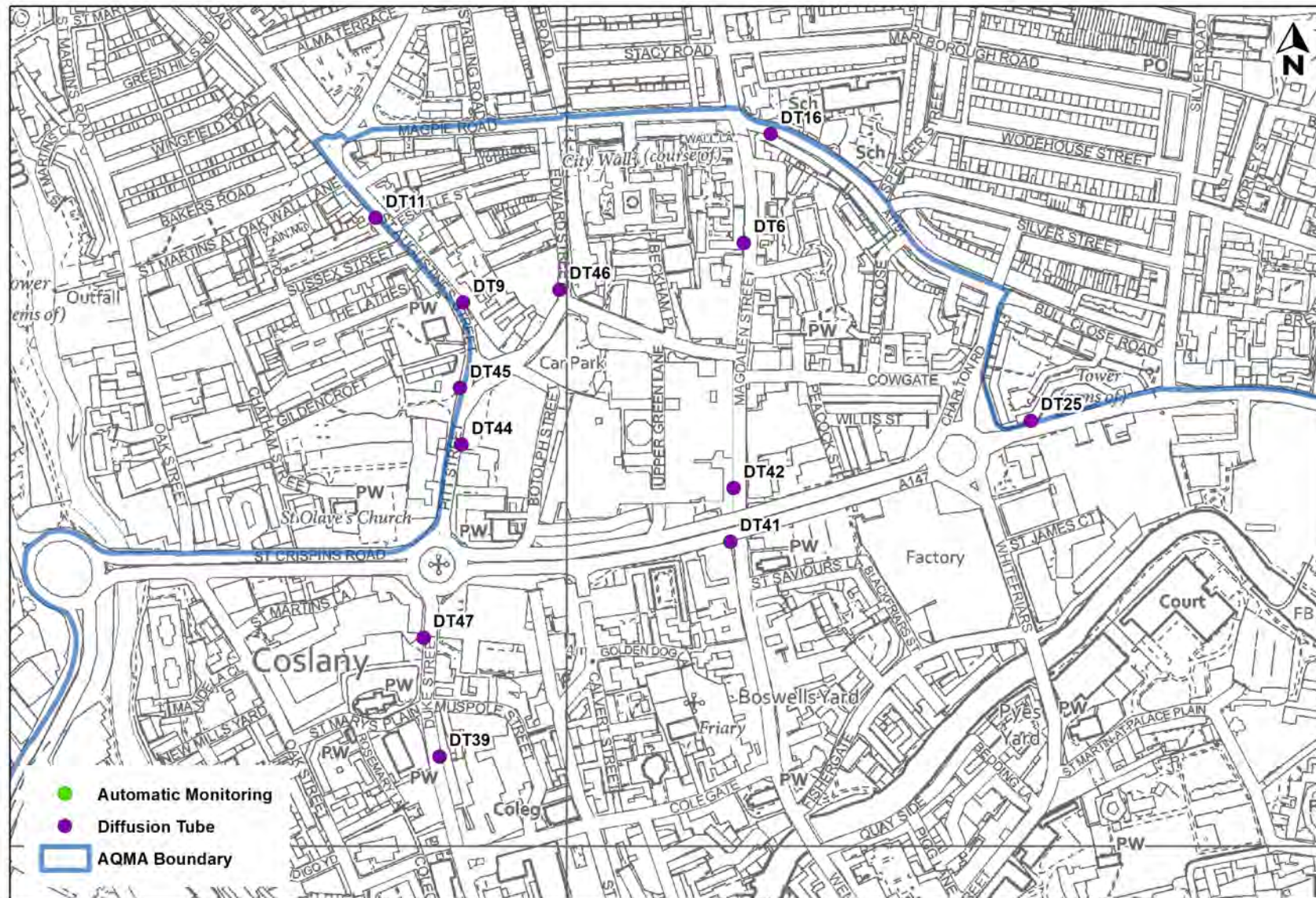




Figure D.3 – Map of Automatic & Non-Automatic Monitoring Sites (Centre of AQMA)

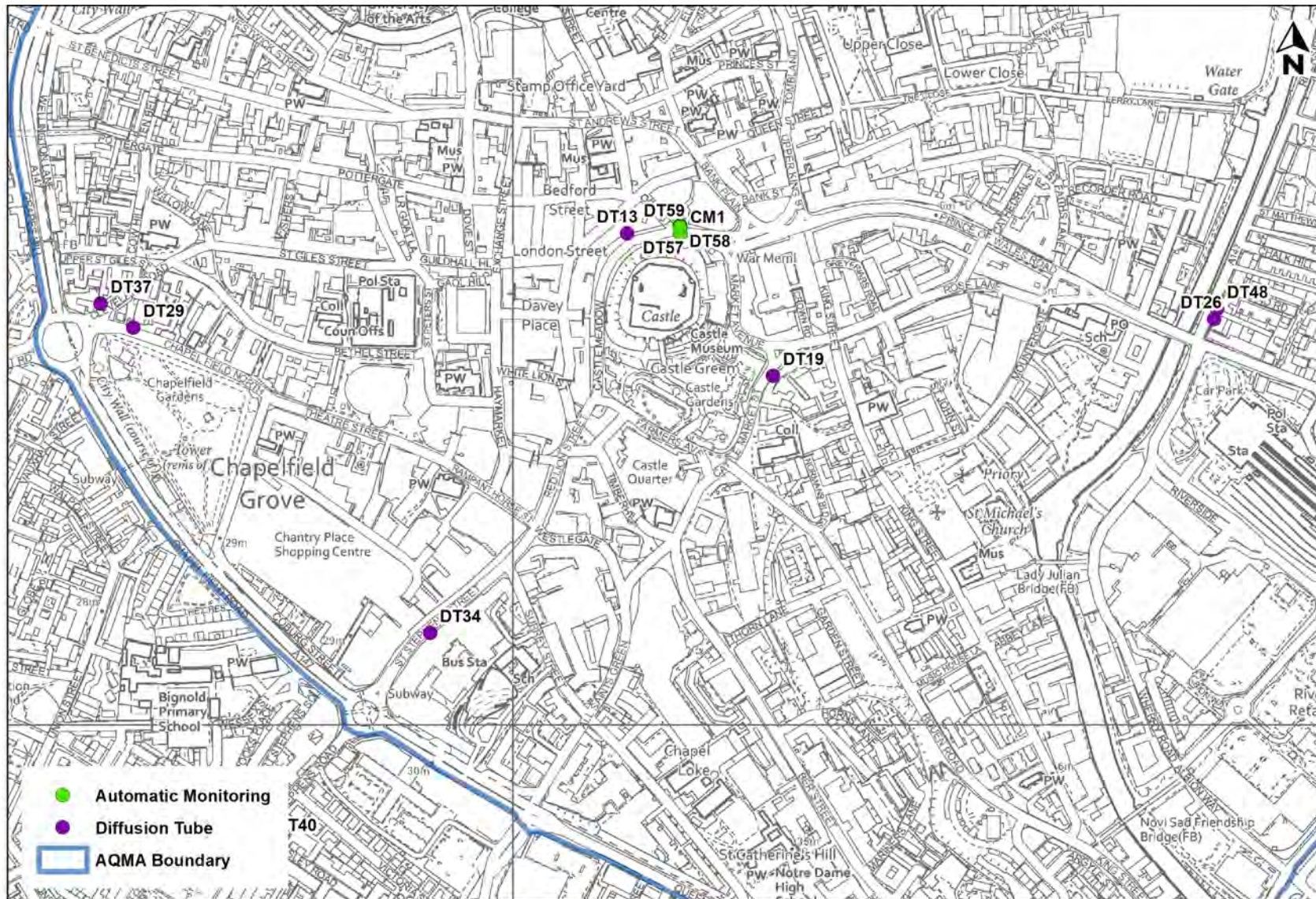




Figure D.4 – Map of Automatic & Non-Automatic Monitoring Sites (South of AQMA)

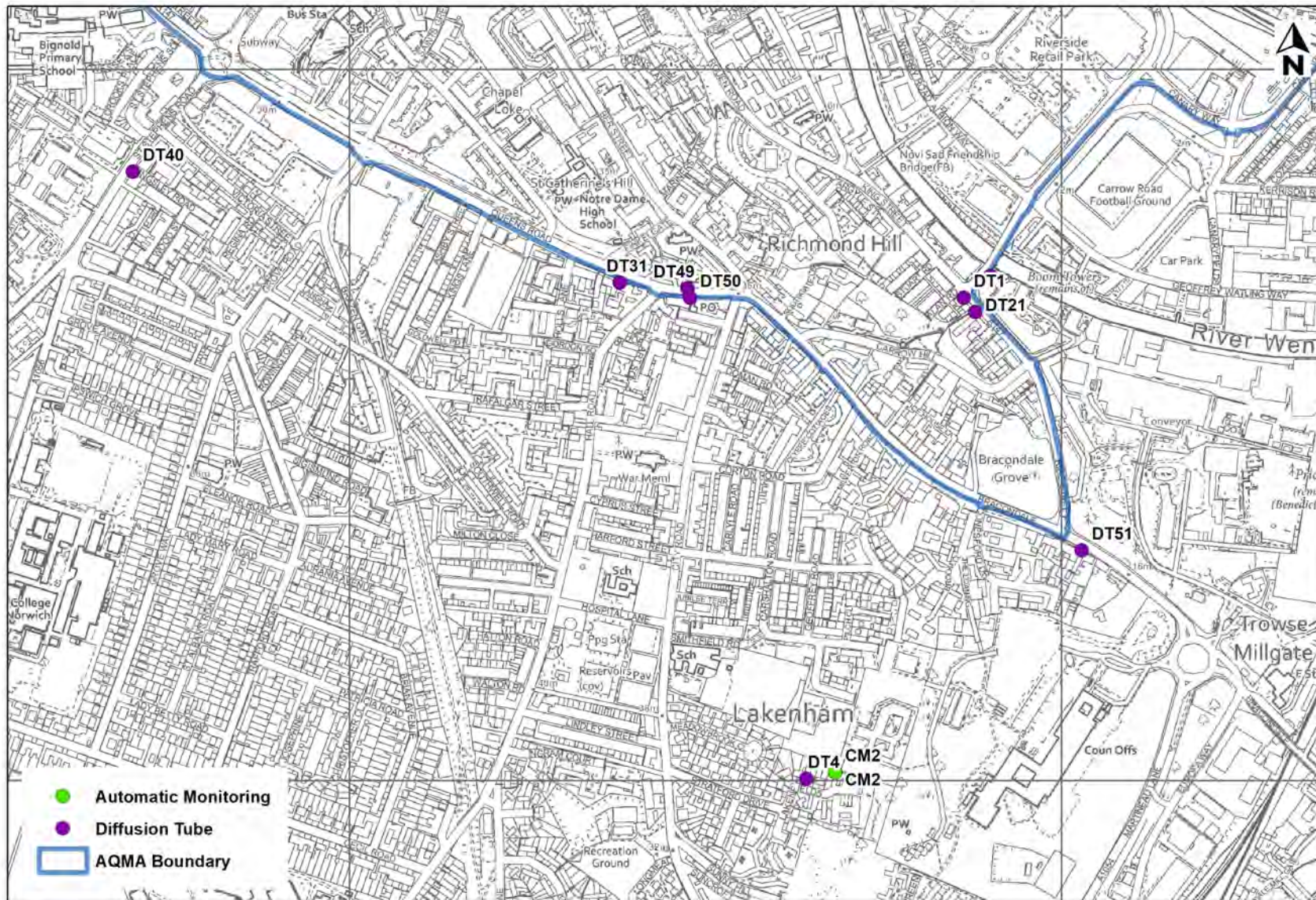
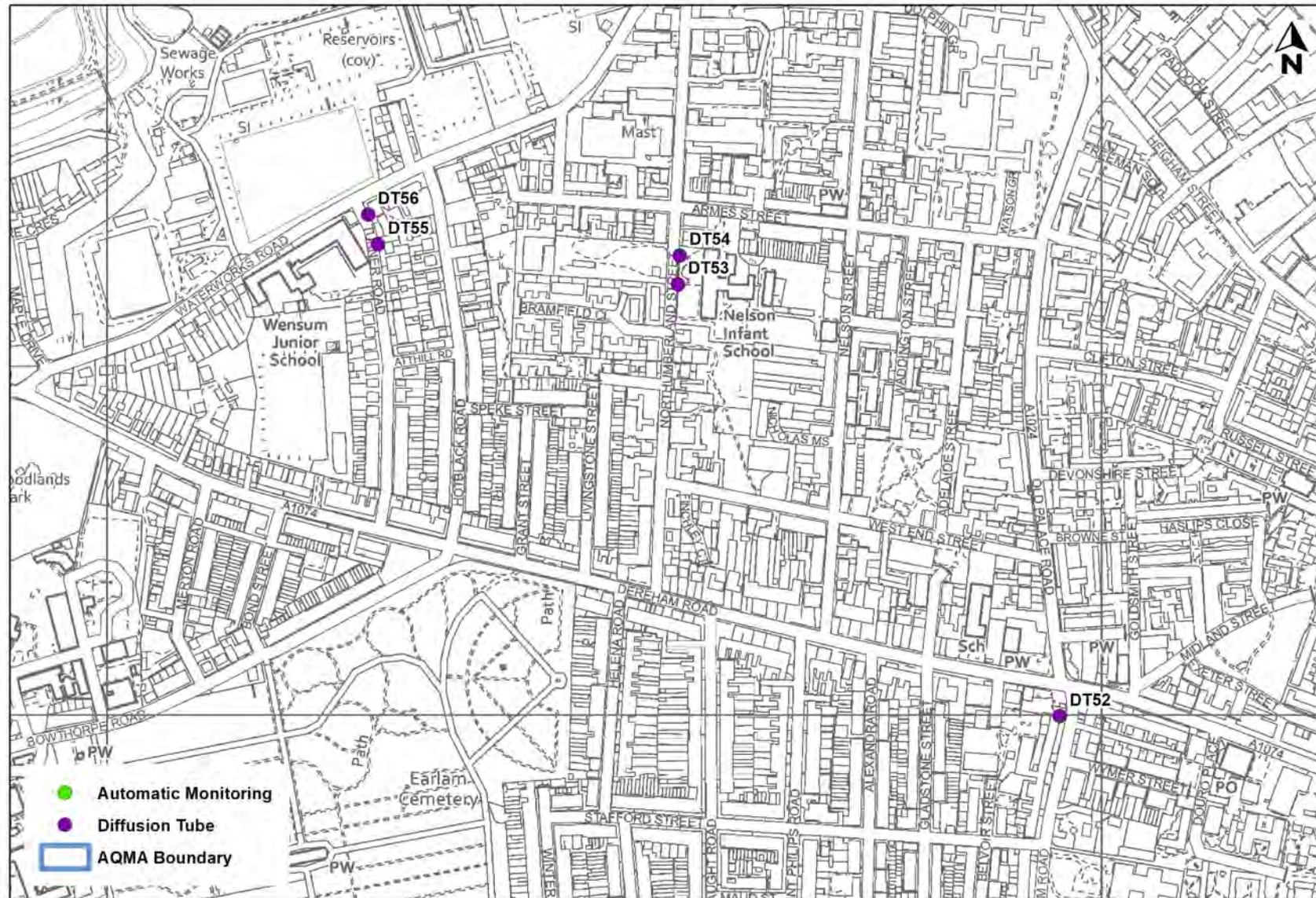




Figure D.5 – Map of Automatic & Non-Automatic Monitoring Sites (North West of AQMA)



## Appendix E: Summary of Air Quality Objectives in England

[Table E.2 – Air Quality Objectives in England](#)<sup>7</sup>

Pollutant	Air Quality Objective: Concentration	Air Quality Objective: Measured as
Nitrogen Dioxide (NO <sub>2</sub> )	200µg/m <sup>3</sup> not to be exceeded more than 18 times a year	1-hour mean
Nitrogen Dioxide (NO <sub>2</sub> )	40µg/m <sup>3</sup>	Annual mean
Particulate Matter (PM <sub>10</sub> )	50µg/m <sup>3</sup> , not to be exceeded more than 35 times a year	24-hour mean
Particulate Matter (PM <sub>10</sub> )	40µg/m <sup>3</sup>	Annual mean
Sulphur Dioxide (SO <sub>2</sub> )	350µg/m <sup>3</sup> , not to be exceeded more than 24 times a year	1-hour mean
Sulphur Dioxide (SO <sub>2</sub> )	125µg/m <sup>3</sup> , not to be exceeded more than 3 times a year	24-hour mean
Sulphur Dioxide (SO <sub>2</sub> )	266µg/m <sup>3</sup> , not to be exceeded more than 35 times a year	15-minute mean

<sup>7</sup> The units are in microgrammes of pollutant per cubic metre of air (µg/m<sup>3</sup>).

## 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
AQDM	Air Quality Data Management
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
EC	European Community
EU	European Union
FDMS	Filter Dynamics Measurement System
FIDAS	The FIDAS is an air quality monitor that monitors PM10 and PM2.5 in accordance with EU and UK legislation
LAQM	Local Air Quality Management
LEZ	Low Emissions Zone. Where certain types of vehicles cannot enter without meeting set emission standards or facing a penalty charge
NO <sub>2</sub>	Nitrogen Dioxide
NO <sub>x</sub>	Nitrogen Oxides
PM <sub>10</sub>	Airborne particulate matter with an aerodynamic diameter of 10µm or less
PM <sub>2.5</sub>	Airborne particulate matter with an aerodynamic diameter of 2.5µm or less
QA/QC	Quality Assurance and Quality Control
SO <sub>2</sub>	Sulphur Dioxide
Street Canyon	Generally defined as narrow streets where the height of buildings on both sides of the road is greater than the road width, leading to the formation of vortices and recirculation of air flow that can trap pollutants and restrict dispersion
TEOM	Tapered Element Oscillating Microbalances



Abbreviation	Description
VCM	Volatile Correction Method

## 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.