2022 Air Quality Annual Status Report (ASR)

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

Date: June, 2022

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Executive Summary: Air Quality in Our Area

Air Quality in Luton Borough Council

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

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

Luton Borough Council (LBC) is a unitary authority in Bedfordshire with an estimated population of 213,528 (ONS mid-year figure for 2020) in an area of 4,336 hectares. The borough is dominated by the population centre of Luton town, with the M1 motorway running north/south on its western side, and London Luton Airport at the south east of the borough.

Road traffic is the main source of pollution in the borough, with both the town and the motorway providing significant traffic volumes. Other sources include London Luton Airport and local industry, which is distributed in pockets around the borough. As of 2022, 41 industrial processes permitted by Luton Borough Council were operational within the borough.

At present the main pollutant of concern is nitrogen dioxide (NO_2). The council monitors this pollutant as well as particulate matter; however, no exceedance of the objective for particulate matter (PM_{10}) has been either measured or modelled to date.

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

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

[3] Defra. Air quality appraisal: damage cost guidance, July 2021

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

Increasingly the focus on particulate matter has shifted to the smaller $PM_{2.5}$ fraction. Responding to growing concerns about the health effects of this pollutant, Luton Borough Council started measuring $PM_{2.5}$ levels at its town centre automatic monitoring station (*LN60 / HB007* - situated on Dunstable Road East) at the end of 2014. Since then, in 2019 *Luton Rising* (the trading name for *London Luton Airport Ltd*, the council-owned business and social enterprise that owns the airport) started monitoring $PM_{2.5}$ at its new air quality monitoring station in Wigmore Valley Park (*LA001*). And in 2021, LBC deployed five new indicative air quality monitors at sites across the borough to measure $PM_{2.5}$, PM_{10} and NO_2 in real time. The monitoring data from all of these sites is publicly available and can be accessed in near real-time via the *Herts & Beds Air Quality Network* web portal [https://tinyurl.com/5cdm2h43].

Previously, the *Local Air Quality Management* (LAQM) regime has not specified a legally binding air quality objective level for $PM_{2.5}$ that local authorities were required to work towards. However, this is set to change with the introduction of the *Environment Act 2021* establishing a legally binding duty on government to bring forward at least two new air quality targets in secondary legislation by 31st October 2022. Although still to be finalised, the proposed targets consulted on by Defra are:

- an Annual Mean Concentration Target (*'concentration target'*) – a maximum concentration of 10µg/m^3 to be met across England by 2040; and
- a Population Exposure Reduction Target (*'exposure target'*) – a 35% reduction in population exposure by 2040 (compared to a base year of 2018).

During 2021, the annual mean $PM_{2.5}$ concentration measured at *LN60 / HB007* was 9.2µg/m³, which is 0.9µg/m³ (10.8%) higher than the previous year but 0.6µg/m³ (6.1%) lower than the three year average obtained between 2017 and 2019. At *LA001* the 2021 annual average was 9.4µg/m³, a decrease of 0.7µg/m³ (6.9%) compared with 2020 and 2.2µg/m³ (19.0%) lower than in 2019. Consequently, during 2021 the annual mean concentrations at both of the borough's $PM_{2.5}$ continuous monitoring sites were below the proposed concentration target level of 10µg/m³.

During 2021, LBC monitored NO_2 levels within the borough using both an automatic analyser located at its Dunstable Road East monitoring site (*LN60 / HB007*) and a total of 53 diffusion tubes positioned at 51 different locations across the town. Changed and analysed on a monthly basis, the data from these tubes provides a measure of how NO_2 levels vary over time and is used to calculate an annual mean concentration at each monitoring location. Once corrected for measurement bias (and if necessary adjusted to

take into account the location of the tubes relative to any likely human exposure), these annual values should not exceed the national air quality objective level of 40μg/m^3. In the event that this level is, or is likely, to be exceeded on a consistent basis Local Authorities are under a duty to declare an Air Quality Management Area (AQMA) encompassing the relevant locations. Both nationally and locally the main source of high levels of nitrogen dioxide is road transport.

In addition to the monitoring undertaken by LBC, both London Luton Airport Operations Ltd. (LLAOL) and Luton Rising also operate their own air quality monitoring programmes. During 2021, the LLAOL programme consisted of a PM_{10} automatic analyser located on the airport site (*HB006)* and diffusion tubes at 19 unique locations both in the vicinity of the airport and along the flightpath leading to and from it. During the same period, the Luton Rising programme consisted of a continuous multi-pollutant monitoring station in Wigmore Valley Park (*LA001*) and a network of passive monitoring sites including 11 NO_2 diffusion tube monitoring locations distributed around Luton and the surrounding area. Of these 11 sites, nine were equipped with duplicate NO_2 diffusion tubes, whilst the remaining two were triplicate co-location studies deployed at the continuous monitoring sites *LN60 / HB007* and *LA001* respectively.

To date, LBC has identified two main areas where NO_2 concentrations either are, or are likely to, exceed the annual mean objective level:

•   along the length of the M1 Motorway; and

•   along the A505 (Dunstable Road) in part of Bury Park and the Town Centre.

Both areas have been declared as Air Quality Management Areas (AQMAs). For further information please see the Council's website (https://tinyurl.com/y9zegeyj) or its page on the UK Air web portal (https://tinyurl.com/yd8t7ma2).

Following its most recent Air Quality Management Area Declaration (Luton Air Quality Management Area N[o.] 3), Luton Borough Council developed and approved an Air Quality Action Plan (AQAP) to address the concentrations found. Following appraisal by Defra, in August 2019 the Council was advised to re-visit the source apportionment study that underpins the AQAP and to undertake additional work to quantify the likely impact of the proposed actions. In response to this feedback, the Council has commissioned environmental consultants to undertake a new source apportionment and options appraisal study. Due to be completed by the beginning of August 2022, once received the findings of this study will be used to develop a new AQAP for AQMA N[o.] 3.

Although on the whole marginally higher than during the previous year, in 2021 air pollution concentrations continued to remain lower than their pre-pandemic levels. As a result, across all three monitoring programmes (LBC, LLAOL and Luton Rising) for the second year running the annual mean NO_2 air quality objective level of 40μg/m^3 was only exceeded at a single site (*L7*, 49.7μg/m^3). A non-AQMA roadside site on Vauxhall Way, *L7* is not considered representative of relevant exposure due to being situated away from both amenities and residential accommodation.

Finally, in addition to the previously discussed monitoring, Defra also undertakes NO_2 monitoring in Luton with an automatic analyser (*CM2 / LUTR*) located on the A505 Dunstable Road as part of its *Automatic Urban and Rural Network* (AURN). Positioned at roadside, the monitor's location is not representative of relevant exposure. During 2021, the annual mean NO_2 concentration at the site was 31.4μg/m^3, 0.7μg/m^3 higher than in the previous year (an increase of 2.3%). At the other two continuous NO_2 monitors within the town, at *LN60 / HB007* the annual mean concentration was 30.2μg/m^3 (1.9μg/m^3 higher than 2020; an increase of 6.7%) and at *LA001* it was 11.3μg/m^3 (0.6μg/m^3 lower than 2020; a decrease of 5.0%). In all three cases the average concentrations for 2021 remained considerably lower than those obtained at the same locations in 2019.

As a member of the *Herts & Beds Air Quality Network*, Luton Borough Council works with colleagues in neighbouring authorities to ensure a consistent approach and to raise the awareness of air quality in Luton and the surrounding area.

Where Air Quality Management Areas have been declared, appropriate actions are identified working in conjunction with partners both within the Council (Public Health, Highways, Sustainability / Climate Change, Licensing, Development Control) and externally (Environment Agency, National Highways, local transport providers). Regular contact with these partners will ensure that steps identified are progressed with the aim of reducing concentrations of air pollutants.

Actions to Improve Air Quality

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

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

During 2021, actions taken to improve air quality within Luton have included:

i. The deployment of a network of five sensor-based indicative air pollution monitors at congestion hotspots across Luton to continuously monitor NO_2, PM_{10} and $PM_{2.5}$ levels (Figure 1).

ii. The expansion of the LBC diffusion tube monitoring network by 40% (21 new sites) to extend coverage to previously unmonitored locations identified by LBC Highways as being potential congestion hotspots.

iii. The installation of the *CityTree* fine dust filtration unit on Market Hill (Figure 2). Entirely funded by the Government's *Welcome Back Fund* [https://tinyurl.com/mpup8p8x], in addition to providing a localised reduction in particulate levels within its immediate vicinity, the integrated 43 inch display has been used to display real-time air quality data and promote the *Herts & Beds Air Quality Alert Service* [https://tinyurl.com/mr3ptc3n].

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[5] Defra. Clean Air Strategy, 2019

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

Figure 1 – One of five newly installed indicative air pollution monitors

iv.   The hosting, in partnership with the *Energy Savings Trust*, of a free electric vehicle (EV) training course for licensed taxi and private hire drivers in Luton. Held on 30th March 2022 online and at Stockwood Park, the course provided an opportunity for owners, operators and vehicle proprietors to test drive three different types of EV and learn more about the financial and operational benefits that switching to them can bring.

v.   Investment of more than £800,000 by Hackney Carriage operators in fleet improvements at the new London Luton Airport taxi rank, including the purchase of nine fully electric Hackney Carriages [https://tinyurl.com/4mcew9fx].

Figure 2 – The CityTree fine dust filtration unit on Market Hill displaying information on the Herts & Beds Air Pollution Alert System
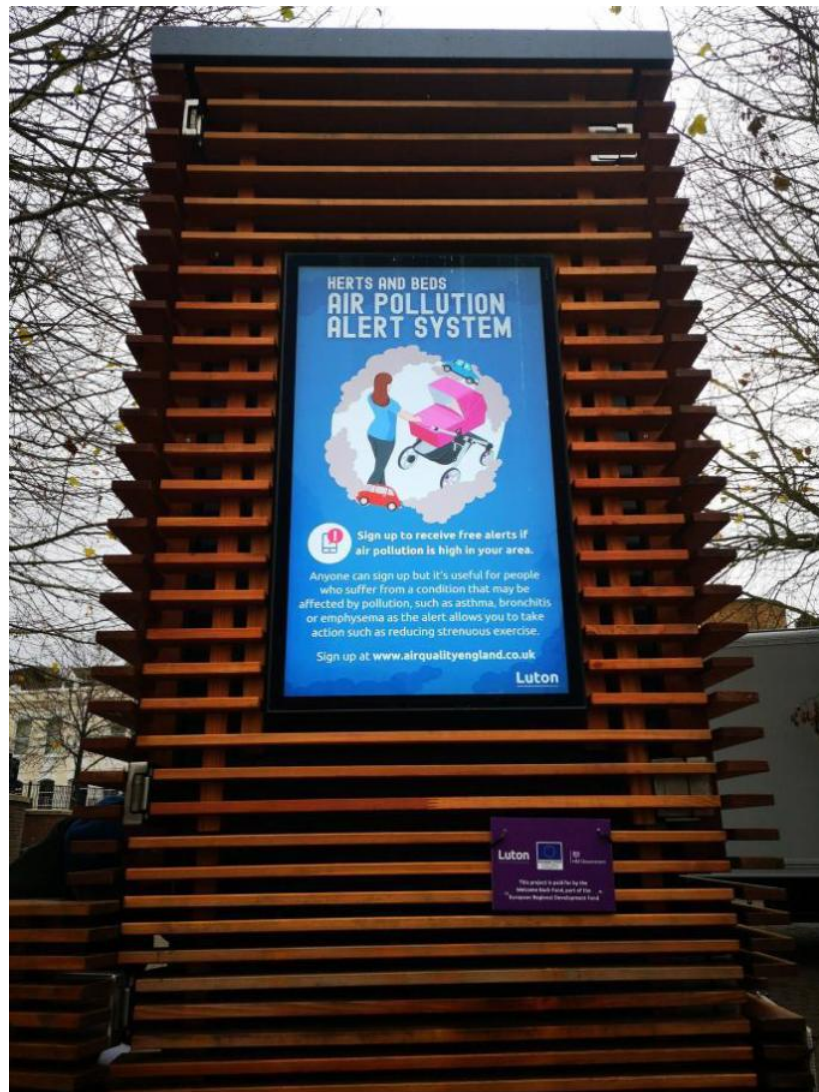
Conclusions and Priorities

With pollution levels slightly up from the COVID-19 induced lows of 2020, but still significantly below pre-pandemic concentrations, it remains to be seen how persistent these improvements will prove to be.

With no exceedances at a relevant receptor in 2021, whilst maintaining a watching brief to ascertain to what extent pollutant levels are returning to their pre-COVID concentrations, the main priorities for LBC in the coming year are:

i. To deliver a new AQAP for AQMA No. 3 that is fit for purpose, effective and fully aligned with the Council's forthcoming *Climate Change Action Plan*; and

ii. To provide an effective response to the new duties imposed on the Council by the introduction of binding new $PM_{2.5}$ targets.

Local Engagement and How to get Involved

The potential for the residents and businesses of Luton to have a positive impact on air quality is considerable. Poor air quality in the town has been shown to be as a result of busy and congested roads.

By choosing sustainable methods of travel, there will be less pollution in the local atmosphere. Recommended travel methods are:

• Walking

• Cycling

• Public Transport

• Use of Electric Vehicles

Where these are not feasible, the use of a newer vehicle that meets a higher emissions specification will produce less pollution than an older engine.
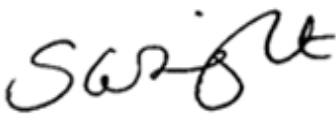
More information on journey planning, sustainable modes of travel and the local transport network can be found on the LBC *Transport and streets* webpages (https://tinyurl.com/yd8du68t).

Local Responsibilities and Commitment

This ASR was prepared by Environmental Protection at Luton Borough Council with the support and agreement of the following officers and departments:

- Andrew Loosley, Technical Officer (Environmental Protection)
- Antony Swift, Principal Transport Planer (Inclusive Economy)
- Katarzyna Wysocka, Team Manager (Sustainable Development and Transport)

This ASR has been approved by:

X *Sartfut*

Sally Cartwright
Director of Public Health

X _____

X _____

X _____

This ASR has been signed off by a Director of Public Health.

If you have any comments on this ASR please send them to Andrew Loosley at:

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Table of Contents

Figures

Tables

1 Local Air Quality Management

This report provides an overview of air quality in Luton Borough Council during 2021. It fulfils the requirements of Local Air Quality Management (LAQM) as set out in Part IV of the Environment Act (1995) and the relevant Policy and Technical Guidance documents.

The LAQM process places an obligation on all local authorities to regularly review and assess air quality in their areas, and to determine whether or not the air quality objectives are likely to be achieved. Where an exceedance is considered likely the local authority must declare an Air Quality Management Area (AQMA) and prepare an Air Quality Action Plan (AQAP) setting out the measures it intends to put in place in pursuit of the objectives. This Annual Status Report (ASR) is an annual requirement showing the strategies employed by Luton Borough Council to improve air quality and any progress that has been made.

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

2 Actions to Improve Air Quality

2.1 Air Quality Management Areas

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

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

- NO_2 annual mean.

Despite no exceedances of the air quality objectives being observed at monitoring locations representative of relevant receptors for a second consecutive year, no changes are planned to the three existing AQMAs on the basis of the 2021 data. Instead, we propose to keep a watching brief and will look to make appropriate changes once both the new objectives for $PM_{2.5}$ are in place and any legacy effects of behavioural changes related to COVID-19 are better understood.

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 National Highways?	Level of Exceedance: Declaration	Level of Exceedance: Current Year	Name, Date of Publication and Web Link for AQAP
Luton AQMA Nº.1	Declared 03/11/2003	NO$_2$ Annual Mean	24 Residential properties on either side of the M1 Motorway, near Junction 11	YES	47.6µg/m³	27.4µg/m³ (LN86; AQO not exceeded)	Within Local Transport Plan 3 2011-2026 (March 2011) [https://tinyurl.com/y9r4vhkf]
Luton AQMA Nº.2	Declared 31/03/2005	NO$_2$ Annual Mean	431 Residential properties on either side of the M1 Motorway, near Junction 11	YES	58.9µg/m³	27.4µg/m³ (LN86; AQO not exceeded)	Within Local Transport Plan 3 2011-2026 (March 2011) [https://tinyurl.com/y9r4vhkf]
Luton AQMA Nº.3	Declared 01/05/2016	NO$_2$ Annual Mean	From Dunstable Road by Kenilworth Road through to Stuart Street and Chapel Viaduct by Latimer Road, including Castle Street to Holly Street and Telford Way	NO	54.6µg/m³	35.7µg/m³ (LN52; AQO not exceeded)	Additional work currently being undertaken following feedback from Defra on source apportionment and quantifying the impact of selected measures. Work due for completion August 2022.

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

☒ **Luton Borough Council confirm that all current AQAPs have been submitted to Defra.**

2.2 Progress and Impact of Measures to address Air Quality in Luton Borough Council

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

"*On the basis of the evidence provided by the local authority the conclusions reached are acceptable for all sources and pollutants…The report is well structured, detailed and provides the information specified in the Guidance.*"

Whilst the appended commentary included four suggestions for future reports, each of which is discussed and responded to below:

1) *Rather than to the Local Transport Plan, the Council should provide direct links to the most recent Air Quality Action Plan in "Table 2.1 – Declared Air Quality Management Areas."*

   Currently, the action plans for Luton's three AQMAs are in the process of being reviewed and updated.

   In the case of AQMA $N^{os.}$ 1 & 2, due to the influence of emissions from the M1, the Council's plan to address elevated NO_2 levels within the AQMAs was set out in *Local Transport Plan 3* (*LTP3* - https://tinyurl.com/y9r4vhkf). Now this policy has been superseded by *LTP4* [https://tinyurl.com/567k53pv], there is a need to develop a new AQAP covering both AQMAs (which overlap). However, as noted below in the commentary's second suggestion, prior to commencing this work it will first be necessary to determine whether the AQMAs are actually still required. This is because over the last five years neither has recorded an exceedance of the NO_2 annual mean air quality objective level at a relevant receptor. In 2017, the annual mean NO_2 concentration at *LN86 – Bradley Road* (which is in both AQMA $N^{os.}$ 1 & 2) did exceed 40µg/m^3, however the tube is located on a flyover above the M1.

   Addressing feedback previously received from Defra regarding the adequacy of both the source apportionment underpinning the current AQAP for AQMA $N^{o.}$ 3 [https://tinyurl.com/mt6ehsv8] as well as the quantification of its likely impacts, environmental consultants have been commissioned to undertake a new source apportionment and options appraisal study. Due to be completed by the beginning

of August 2022, once received the findings of this study will be used to develop a new AQAP.

2) ***The Council should continue to monitor concentrations in AQMAs 1 and 2 in the next years with a view to undertake revocation if concentrations remain within the objective, after the impacts of COVID-19 have lessened.***

This suggestion is noted and agreed. However, in addition to NO_2 levels, once the proposed $PM_{2.5}$ concentration target comes into effect it will also be necessary to consider the fine particulate level in these areas too.

This will be of particular importance for AQMA N[os.]1 & 2, as Defra's gridded *Background Mapping Data* [https://tinyurl.com/2eb2urjd] indicates that the 1km squares along the route of the M1 through Luton have some of the highest modelled $PM_{2.5}$ concentrations within the borough. Furthermore, in 2021 all grid squares in Luton through which the M1 passes were modelled to have annual average background $PM_{2.5}$ concentrations in excess of the proposed target of $10\mu g/m^3$. This includes the grid squares containing both AQMA N[os.] 1 & 2. Consequently, it is possible to envisage a situation where the AQMAs will be revoked for NO_2 but reinstated for $PM_{2.5.}$ Should this happen, LBC will look to collaborate with National Highways in their proposed role as a designated Relevant Public Authority and Air Quality Partner to address any exceedances

However, it should be noted that the model used to generate this dataset was devised prior to the COVID-19 pandemic, and as such will not take account of the impact of any resulting behavioural changes. Additionally, it should also be noted that, even prior to COVID-19, the modelled background concentration for the town centre has routinely exceeded the actual $PM_{2.5}$ level recorded at the Council's *LN60 (HB007)* roadside monitoring station on Stuart Street. In 2021, the modelled background level for the grid square containing Stuart Street was $11.3\mu g/m^3$, however the monitored annual mean NO_2 concentration measured at roadside at LN60 *(HB007)* was only $9.2\mu g/m^3$.

3) *Distance correction should be applied to the diffusion tube L7, which has monitored exceedances in recent years. Or, if the location is not representative of relevant exposure, consideration should be given to relocating the tube to a location representative of relevant exposure.*

Diffusion tube site *L7* is not representative of relevant exposure; the nearest receptor is located approximately 250 metres further up the carriageway, at a residential property that already has another tube (*LN92 – Harrowden House*) attached to its façade.

It should be noted that when completing the ASR, in order to provide as comprehensive an overview as possible of Luton's air quality, the Council's own monitoring results are augmented by the addition of data collected by LLAOL and Luton Rising in accordance with the requirements of *LAQM.TG(16)*.

Potentially undertaken for reasons other than LAQM compliance reporting purposes (*e.g.* the development and validation of air dispersion models), many of the airport-related monitoring sites are not located at relevant receptors. As these sites are not operated by LBC, it is not within the Council's gift to re-locate them.

4) *In relation to measures to reduce PM$_{2.5}$ concentrations, the Public Health Outcomes Frameworks was briefly mentioned in the report, however it would be beneficial to provide the relevant percentage fraction of mortality attributable to particulate pollution for Luton, and expand on any direct or indirect measures that could help drive down PM$_{2.5}$ concentrations.*

Agreed - the requested information has been included in 2.3 of this year's report.

Luton Borough Council has taken forward a number of direct measures during the current reporting year of 2021/22 in pursuit of improving local air quality. Details of all measures completed, in progress or planned are set out in Table 2.2. 27 measures are included within Table 2.2, with the type of measure and the progress Luton Borough Council have made during the reporting year of 2021/22 presented. Where there have been, or continue to be, barriers restricting the implementation of the measure, these are also presented within Table 2.2.

Further information on these measures will be included in a new town centre AQAP following the completion of the source apportionment study currently underway for AQMA N$^o.$ 3. However, as many of the measures are shared with other policy areas where they offer co-benefits (*i.e.* Transport, Climate Change and Public Health), where appropriate, links to relevant documents in these areas have been included in Table 2.2

Over the past year, key completed measures have included:

- The deployment of a network of five sensor-based indicative air pollution monitors at congestion hotspots across Luton to continuously monitor NO_2, PM_{10} and $PM_{2.5}$ levels. Details of the monitors' locations and weblinks to access their monitoring data in near real-time are provided in Table F.1.

- The expansion of the LBC diffusion tube monitoring network by 40% (21 new sites) to extend coverage to previously unmonitored locations identified by LBC Highways as being potential congestion hotspots. Details of these new monitoring locations (which were established at the end of 2021) are given in Table F.2.

- The installation of the *CityTree* fine dust filtration unit on Market Hill [https://tinyurl.com/4unfww4y]. Entirely funded by the Government's *Welcome Back Fund* [https://tinyurl.com/mpup8p8x], in addition to providing a localised reduction in particulate levels within its immediate vicinity, the integrated 43 inch display has been used to display real-time air quality data and promote the *Herts & Beds Air Quality Alert Service* [https://tinyurl.com/mr3ptc3n].

- The hosting, in partnership with the *Energy Savings Trust*, of a free electric vehicle (EV) training course for licensed taxi and private hire drivers in Luton. Held on 30th March 2022 online and at Stockwood Park, the course provided an opportunity for owners, operators and vehicle proprietors to test drive three different types of EV and learn more about the financial and operational benefits that switching to them can bring.

- Investment of more than £800,000 by Hackney Carriage operators in fleet improvements at the new London Luton Airport taxi rank, including the purchase of nine fully electric Hackney Carriages [https://tinyurl.com/4mcew9fx].

Luton Borough Council expects the following measures to be completed over the course of the next reporting year:

- The completion of an air dispersion modelling study to both provide detailed and robust source apportionment data for AQMA N$^{o.}$ 3 and to evaluate the impact of potential air quality actions that could be implemented to address the exceedance of the NO_2 annual mean objective level. This work is due to be completed by August 2022.

- The promotion of the *Herts & Beds Air Pollution Alert Service* [https://tinyurl.com/mr3ptc3n] via digital noticeboards in GP surgeries and respiratory and cardiac clinics to raise awareness of the service amongst vulnerable groups and encourage new users to sign up for free notifications when air pollution levels are forecast to be moderate, high or very high. By providing an early warning to people whose breathing may get worse when air pollution increases, it will allow them to make informed decisions and, if necessary, take action to limit their exposure.

- The deployment of a further 21 additional NO_2 diffusion tubes at sites in and around Bury Park to establish an evidence base to support a review of air quality and possible traffic interventions in the area.

Luton Borough Council's priorities for the coming year are:

- To develop a new air quality action plan for AQMA N$^{o.}$ 3 ensuring that it is aligned with, and where possible embedded within, both the forthcoming *Climate Change Action Plan* and the Health Inequalities Delivery Board's *Physical Activity and Healthy Weight* work programme.

- In preparation for the arrival of the forthcoming $PM_{2.5}$ concentration target, to use the newly installed indicative air pollution monitor network to establish a better understanding of likely $PM_{2.5}$ levels away from the towns two continuous analysers. This will be of particular importance in the vicinity of the M1, where Defra modelling predicts the highest background $PM_{2.5}$ levels will be encountered.

Luton Borough Council worked to implement these measures in partnership with the following stakeholders during 2021:

- the Department for Levelling Up, Housing & Communities (funded the CityTree via the *Welcome Back Fund*);
- the Department for Transport and the Energy Savings Trust (respectively funded and delivered the EV training course for taxi and private hire drivers); and
- the Luton Hackney Carriage Association, Luton Rising and London Luton Airport Operations Ltd.

Whilst the measures stated above and in Table 2.2 will help to contribute towards compliance, Luton Borough Council anticipates that further additional measures not yet prescribed will be required in subsequent years to achieve compliance and enable the revocation of AQMA N[o.] 3. However, the absence of any exceedance of the annual mean NO_2 objective at any relevant receptor in either AQMA N[os.] 1 or 2 in the last five years would suggest that revocation of both may be feasible in the near future, provided that concentrations remain within the objective as the behavioural impacts of COVID-19 lessen.

Table 2.2 – Progress on Measures to Improve Air Quality

Measure No.	Measure	Category	Classification	Year Measure Introduced	Estimated / Actual Completion Year	Organisations Involved	Funding Source	Defra AQ Grant Funding	Funding Status	Estimated Cost of Measure	Measure Status	Reduction in Pollutant / Emission from Measure	Key Performance Indicator	Progress to Date	Comments / Barriers to Implementation
1	Implement Luton Park & Ride by securing delivery at identified locations	Alternatives to private vehicle use	Bus based Park & Ride	2025		LBC Strategy and Sustainability (action included in draft *Luton Net Zero: Climate Policy & Action Plan*)		No	Not Funded	£1m - £10m	Planning	A Park & Ride would result in fewer cars driving into Luton Town Centre and the Airport	Monitor use of Park & Ride once up and running	Potential locations for Park & Ride sites identified. Design and development work is underway at Butterfield Business Park. Feasibility study completed (2016) Next step is to secure funding/delivery	Luton Local Plan 2011 - 2031 Policy LLP5 provides policy support for Park & Ride schemes at M1 junction 10A (Policy LLP5) and Butterfield Park (Policy LLP7) [https://tinyurl.com/3cjz6n8f] Supports LTP4 Policy 4 - *Improving Public Transport* [https://tinyurl.com/567k53pv] Sources of funding to be identified
2	Pilot Low Traffic Neighbourhoods which reduces motor vehicle traffic on residential streets through physical barriers	Traffic Management	Other	2023		LBC Strategy and Sustainability Public Health Highways					Planning	Fewer vehicle movements will result in reduced emissions (NO$_2$ and particulate matter) and increased uptake of active modes of travel	Improvement in local air quality (reduction in NO$_2$ and particulate matter) Increased use of active modes of travel		
3	Deliver town-wide future cycling and walking network set out in the emerging local cycling and walking infrastructure plan	Transport Planning and Infrastructure	Cycle network	2022	2032	LBC Transport LBC Road Safety LBC Sustainable Development and Transport (action included in draft *Luton Net Zero: Climate Policy & Action Plan*)		No	Not Funded		Planning	Increase in cycling creates modal shift away from the car, resulting in reduced emissions	Increased number of people using cycle routes to access the town centre	Ongoing Portfolio of suggested network amendments developed *Local Cycling and Walking Infrastructure Plan* (LCWIP) currently being developed	LTP4 Policy 5 - *Smarter Choices* supported by LTP4 Policy 2 - *Walking and Cycling* [https://tinyurl.com/567k53pv] Supports *Strategic Vision for Sport and Physical Activity 2018-22* Outcome 10 [https://tinyurl.com/3u5z65e5]
4	Implement a local delivery hub to maximise the efficiency of deliveries / enable green 'last mile' services.	Freight and Delivery Management	Freight Consolidation Centre	2025		LBC Strategy and Sustainability (action included in draft *Luton Net Zero: Climate Policy & Action Plan*) Delivery Companies		No			Planning	Reduction in vehicle movements and emissions from LDV delivery vehicles	Volume of deliveries routed via the hub		
5	EV infrastructure across the council estate for both council and public charging	Promoting Low Emission Transport	Procuring alternative Refuelling infrastructure to promote Low Emission Vehicles, EV recharging, Gas fuel recharging	2025		LBC Sustainable Development and Transport (action included in draft *Luton Net Zero Climate Policy & Action Plan*)		No			Planning	Increased EV use will result in a decrease in emissions	EV charging point usage data		Supported by LTP4 Policy 6 - *Ultra Low Emission and Electric Vehicles* [https://tinyurl.com/567k53pv]

Measure No.	Measure	Category	Classification	Year Measure Introduced	Estimated / Actual Completion Year	Organisations Involved	Funding Source	Defra AQ Grant Funding	Funding Status	Estimated Cost of Measure	Measure Status	Reduction in Pollutant / Emission from Measure	Key Performance Indicator	Progress to Date	Comments / Barriers to Implementation
6	Deliver bus priority measures	Traffic Management	Strategic highway improvements, Re-prioritising road space away from cars, inc Access management, Selective vehicle priority, bus priority, high vehicle occupancy lane	2025		LBC Transport LBC Sustainable Development and Transport (action included in draft *Luton Net Zero: Climate Policy & Action Plan*) Bus Operating Companies					Planning	Reduced congestion and journey time should result in higher uptake and reduced emissions	Congestion reduction Passengers numbers		
7	*New Ways of Working* adopted at LBC; promotion of a hybrid working model with employees in the office 40% of their hours	Promoting Travel Alternatives	Encourage / Facilitate home-working	2022	Ongoing	LBC					Ongoing	Reduction in car journeys commuting to work will result in reduced emissions (NO_2 and particulate matter)	Number of journeys avoided	Policy implemented and guidance published	
8	Exclusive *'Taxi Only'* EV infrastructure at taxi ranks	Promoting Low Emission Transport	Procuring alternative Refuelling infrastructure to promote Low Emission Vehicles, EV recharging, Gas fuel recharging	2025		LBC Sustainable Development and Transport (action included in draft *Luton Net Zero: Climate Policy & Action Plan*)		No			Planning	Increased EV use will result in a decrease in emissions	Number of charge points installed Proportion of taxi fleet that are EVs		Supported by LTP4 Policy 6 - *Ultra Low Emission and Electric Vehicles* [https://tinyurl.com/567k53pv]
9	LBC and suppliers' fleets to be transitioned to EV	Promoting Low Emission Transport	Public Vehicle Procurement - Prioritising uptake of low emission vehicles		2028	LBC Fleet Management LBC Procurement LBC Sustainable Development and Transport (action included in draft *Luton Net Zero: Climate Policy & Action Plan*) Suppliers					Planning				
10	Improvement of Chapel viaduct / Castle Street roundabout	Traffic Management	Other			LBC Transport		No		£500k - £1m	Planning	Less idling would result in reduced emissions	Improved traffic flow	Junction Mitigation Assessment Completed (2015) [https://tinyurl.com/y52t2hr7]	Included in Luton Local Plan 2011 - 2031 Policy LLP31 - *Sustainable Transport Strategy* [https://tinyurl.com/3cjz6n8f]

Measure No.	Measure	Category	Classification	Year Measure Introduced	Estimated / Actual Completion Year	Organisations Involved	Funding Source	Defra AQ Grant Funding	Funding Status	Estimated Cost of Measure	Measure Status	Reduction in Pollutant / Emission from Measure	Key Performance Indicator	Progress to Date	Comments / Barriers to Implementation
11	Deployment of network of low cost pollution sensors to provide enhanced real time NO$_2$ and PM$_{2.5}$ monitoring data to public via online portal	Public Information	Via the Internet	2021	2021	LBC Transport LBC Environmental Protection LBC Sustainability	LBC Transport	No	Funded	£50k - £100k	Completed	Data to be used to inform targeted local interventions	Substantial improvement in geographical coverage of real time NO$_2$ and PM$_{2.5}$ monitoring data Improved public awareness	5 continuous indicative air quality monitors deployed Nov 2021 Real time data available via the Herts & Beds AQ Network website [https://tinyurl.com/3f78jc4c]	
12	Deliver with support from communities, *'play streets'* where children can play freely outside their own front door by temporarily restricting vehicle access	Traffic Management	Other	2023		LBC Strategy and Sustainability LBC Public Health LBC Highways					Planning				
13	Investigate expansion of pedestrianised area around Town Centre + High Town & Bury Park (either permanently or at peak times)	Traffic Management	Other		2030	LBC Highways LBC Strategy and Sustainability (action included in draft *Luton Net Zero: Climate Policy & Action Plan*) LBC Environmental Protection		No	Not Funded		Planning	Wider pedestrianisation will reduce vehicle use in the Town Centre and hence result in improved air quality	Expansion of pedestrianised area will result in more people walking into the Town Centre		
14	Development of taxi and private hire zero (or low) emissions policy, adopting phased approach until 2040	Promoting Low Emission Transport	Taxi Licensing conditions		2040	LBC Sustainable Development and Transport (action included in draft *Luton Net Zero: Climate Policy & Action Plan*) LBC Licensing Taxi Companies		No			Planning	Increased use of zero emission vehicles will result in a decrease in traffic-related pollution	Proportion of taxi fleet that are EVs		Long timescale
15	Work with schools and colleges to develop travel plans via Modeshift STARS which decrease use of the car and increase walking and cycling	Promoting Travel Alternatives	School Travel Plans		2023	LBC Sustainable Development and Transport (action included in draft *Luton Net Zero: Climate Policy & Action Plan*) School Partners		No			Ongoing	Increased uptake of lift sharing or sustainable transport methods will reduce emissions	Number of new and updated school travel plans	Ongoing	LTP4 Policy 5 - *Smarter Choices* [https://tinyurl.com/567k53pv] Supports *Strategic Vision for Sport and Physical Activity 2018-22* Outcomes 10 & 17 [https://tinyurl.com/3u5z65e5] LBC information on School Travel Planning: [https://tinyurl.com/bdzy27jj] Accredited schools have to submit their travel plans annually to maintain accreditation

Measure No.	Measure	Category	Classification	Year Measure Introduced	Estimated / Actual Completion Year	Organisations Involved	Funding Source	Defra AQ Grant Funding	Funding Status	Estimated Cost of Measure	Measure Status	Reduction in Pollutant / Emission from Measure	Key Performance Indicator	Progress to Date	Comments / Barriers to Implementation
16	Work with large employers to develop workplace travel plans	Promoting Travel Alternatives	Workplace Travel Planning	2018	2025	LBC Sustainable Development and Transport (action included in draft *Luton Net Zero: Climate Policy & Action Plan*)		No			Ongoing	Increased uptake of lift sharing or sustainable transport methods will result in reduced emissions	Increase modal shift of staff using more sustainable modes	Planning phase	LTP4 Policy 5 - *Smarter Choices* [https://tinyurl.com/567k53pv] Potential measures to encourage sustainable travel include promotion of cycling and walking, discounted bus and rail travel, and car sharing Modeshift STARS to be used to manage process
17	Anti-idling awareness campaign and enforcement	Traffic Management	Anti-idling enforcement	2022	Ongoing	LBC Parking Enforcement		No			Implement-ation	Reduced idling would result in lower emissions	Fewer drivers idling as a result of LBC intervention	Enforcement commencing Summer 2022	LTP4 calls for interventions to to be directed at areas where there are greater concentrations of vulnerable people (*e.g.* schools, hospitals and day care centres). [https://tinyurl.com/567k53pv]
18	Engage with and promote travel schemes and discounted tickets e.g. Arriva discounted tickets for organisations participating in a travel club	Vehicle Fleet Efficiency	Promoting Low Emission Public Transport	2025		LBC Sustainable Development and Transport (action included in draft *Luton Net Zero: Climate Policy & Action Plan*) Bus Operating Companies									
19	Free electric vehicle training course for taxi and private hire drivers to showcase available models	Promoting Low Emission Transport	Other		2022	LBC Sustainable Development and Transport Energy Savings Trust Department for Transport	Department for Transport	No	Funded		Completed	Increased EV uptake will result in reduced emissions	Increased EV uptake amongst taxi & private hire drivers	Hybrid event held on 30th March 2022, with online training in the morning and demonstration test drives at Stockwood Discovery Centre in the afternoon	
20	Promotion of car & lift sharing scheme via the council website	Alternatives to private vehicle use	Car & lift sharing schemes		Ongoing	LBC Sustainable Development and Transport		No			Ongoing	Lift sharing will result in fewer cars on the roads and hence reduced emissions	Number of lift share scheme users	Ongoing	Supports LTP4 Policy 1 - *Shared mobility and Mobility as a Service* [https://tinyurl.com/567k53pv] Travel Luton Liftshare: https://liftshare.com/uk
21	Consider road user charging mechanisms to fund transport improvements	Traffic Management	Road User Charging (RUC)/ Congestion charging	2025		LBC Strategy and Sustainability (action included in draft *Luton Net Zero: Climate Policy & Action Plan*)					Planning	Generate income stream to fund transport improvements that in turn will deliver emissions reductions Reduction in car use resulting in reduced emissions	Amount of funding generated and redistributed	Feasibility study completed (2019)	

Measure No.	Measure	Category	Classification	Year Measure Introduced	Estimated / Actual Completion Year	Organisations Involved	Funding Source	Defra AQ Grant Funding	Funding Status	Estimated Cost of Measure	Measure Status	Reduction in Pollutant / Emission from Measure	Key Performance Indicator	Progress to Date	Comments / Barriers to Implementation
22	Consider workplace parking levy to fund transport improvements	Traffic Management	Workplace Parking Levy, Parking Enforcement on highway	2025		LBC Strategy and Sustainability (action included in draft *Luton Net Zero: Climate Policy & Action Plan*)					Planning	Generate income stream to fund transport improvements that in turn will deliver emissions reductions Reduction in car use resulting in reduced emissions	Amount of funding generated and redistributed		
23	Investigate implementing a Clean Air/Low Emissions Zone in the Town Centre	Promoting Low Emission Transport	Low Emission Zone (LEZ) or Clean Air Zone (CAZ)	2023		LBC Transport Planning LBC Environmental Protection		No	Not Funded			Cleaner / greener transport options for staff and deliveries would reduce emissions in the town centre	Increased take up of clean energy vehicles / bikes by local businesses		To be reconsidered following the update of the AQMA No.3 source appointment and development of new AQAP Feasibility study identified as a priority in LTP4, however currently still unfunded [https://tinyurl.com/567k53pv]
24	Work with operators to introduce hybrid/low emission buses on routes within AQMA No.3	Vehicle Fleet Efficiency	Promoting Low Emission Public Transport			LBC Transport Bus Operating Companies		No	Not Funded			Improved Air Quality in AQMA #3	Reduced emissions from buses		To be reconsidered following the update of the AQMA No.3 source appointment LTP4 encourages the use of low carbon buses as part of Bus Quality Partnerships [https://tinyurl.com/567k53pv] *[Target introduction of Hybrid/low emission buses through Bury Park and on Dunstable Road* *DfT funding opportunities to be explored]*
25	Review 20mph zones in and around AQMA #3 to encourage traffic calming and lower speeds	Traffic Management	Reduction of speed limits, 20mph zones	2018		LBC Transport LBC Road Safety		No				Vehicles travelling under 30mph generally emit less particulates and so improve air quality	Increase number of vehicles adhering to 20mph within the zones	20mph zones in place (Completed 2016 – 17)	To be reconsidered following the update of the AQMA No.3 source appointment
26	Proposed project to replace a number of small town centre surface car parks with intelligent parking system enabled multi storey on Crawley Road site	Traffic Management	Other	2018		LBC Property & Construction		No			Aborted	Less engine idling and running time while drivers search for parking	Improved parking information and organisation	Planning application permitted	Work on project discontinued

Measure No.	Measure	Category	Classification	Year Measure Introduced	Estimated / Actual Completion Year	Organisations Involved	Funding Source	Defra AQ Grant Funding	Funding Status	Estimated Cost of Measure	Measure Status	Reduction in Pollutant / Emission from Measure	Key Performance Indicator	Progress to Date	Comments / Barriers to Implementation
27	Rollout of Schools Air Quality Workshops	Promoting Travel Alternatives	Promotion of cycling Promotion of walking	2022		LBC Sustainable Development and Transport		No	Not Funded		Aborted	Modal shift away from the car, resulting in reduced emissions	Decrease in number of young people travelling to school by car Increase in number of children travelling actively Improved air quality at the school gate	Successful pilot sessions held at Hillborough Junior and Bushmead Primary Exploring funding options	Project discontinued - unable to secure funding

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

As detailed in Policy Guidance *LAQM.PG16* (Chapter 7), local authorities are expected to work towards reducing emissions and/or concentrations of PM$_{2.5}$ (particulate matter with an aerodynamic diameter of 2.5µm or less). There is clear evidence that PM$_{2.5}$ has a significant impact on human health, including premature mortality, allergic reactions, and cardiovascular diseases.

Responding to growing concerns about the health effects of fine particulate matter, Luton Borough Council started measuring PM$_{2.5}$ levels at its Dunstable Road East automatic monitoring station (*LN60 / HB007)* at the end of 2014. Since then, in 2019 Luton Rising started monitoring PM$_{2.5}$ at its new air quality monitoring station in Wigmore Valley Park (*LA001*). And in 2021, LBC deployed five new indicative air quality monitors at suspected congestion hotspots across the borough to measure PM$_{2.5}$ (as well as PM$_{10}$ and NO$_2$) in real-time. Since coming into operation, the MCERTS certified *Palas Fidas 200 Fine Dust Monitoring Device* located at *LN60 / HB007* has shown the annual mean PM$_{2.5}$ concentration at this site to have remained essentially constant at between 9 and 10µg/m^3, with a single COVID-19 related deviation in 2020 when the level fell to 8.3µg/m^3.

On the basis of this monitoring, the measured annual mean PM$_{2.5}$ levels in the centre of Luton fall just within the proposed new concentration target of 10µg/m^3 (due to come into force at some point before 31st October this year). However, contrary to the result of this monitoring, Defra's modelled *LAQM Background Mapping Data* [https://tinyurl.com/2eb2urjd] consistently predicts that background levels will exceed 10µg/m^3 at this and the majority of other locations within the borough. Figure 3 shows the Defra modelled background PM$_{2.5}$ levels for each square kilometre in Luton for 2021.

Comparing the 2021 modelled and monitored levels at *LN60 / HB007*, the predicted background was 11.3µg/m^3, however the measured annual average at this roadside site was 9.2µg/m^3 - a difference of 20%. On the face of it this difference is counterintuitive, as the measurements made at roadside would be expected to be higher than the background level due to additional PM$_{2.5}$ contributed by the passing traffic.

This year, one reason for this apparent discrepancy is that the model used by Defra was devised prior to COVID-19, and as such does not take its impact on people's behaviours into account. However, this does not fully explain the observed difference as the

discrepancy pre-dates the pandemic; in 2019 the modelled background at *LN60 / HB0007* was 11.7µg/m^3 and the monitored annual mean was 10.0µg/m^3, a difference of 16%.

As the Defra modelled data is also used to calculate Public Health Outcomes Framework indicator *D01 – Fraction of mortality attributable to particulate air pollution* [https://tinyurl.com/2cjynv3f], it is possible that any overestimation by the model could to some extent explain Luton's consistently poor performance in this metric. In 2020, with a value of 6.2%, Luton had the second highest attributable mortality figure in the East of England, behind Thurrock at 6.5% and ahead of the English national average of 5.6%. However, in practice the high attributable mortality figure calculated for Luton is in large part a function of its compact urban form and high population density; in 2019 Luton was the 24th most densely populated local authority area, preceded only by London authorities and Portsmouth and Southampton.

Ultimately, as there is no evidence of a safe level of exposure to PM$_{2.5}$ or a threshold below which no adverse health effects occur[7], the case for action is undiminished regardless of which value best represents true environmental concentrations. Although the actions listed in Table 2.2 were predominantly chosen with the reduction of NO$_2$ levels in mind, several of them will also be effective at securing reductions in PM$_{2.5}$ emissions and exposure as well. More specifically, these measures fall into three categories:

- Reducing the number of vehicles on the road (*e.g.* through public transport improvements and promotion, travel planning and the promotion of lift sharing);

- Promoting modal shift to active forms of travel (*e.g.* improvements to cycle infrastructure and the prioritisation of active travel options through travel planning); and

- Improving the public provision of air quality information to enable individuals to more effectively manage their personal exposure (e.g. the *Herts & Beds Air Pollution Alert service* [https://tinyurl.com/mr3ptc3n] and the publication of near real-time air quality data via the *Herts & Beds Air Quality Network* web portal [https://tinyurl.com/5cdm2h43] and town centre CityTree electronic noticeboard).

In addition to the above, the whole of Luton Borough Council's administrative area has been a smoke control area since the 1970s [https://tinyurl.com/4k4hhzxe].

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[7] WHO. Health Effects of Particulate Matter, 2013 [https://tinyurl.com/2p928k7u]

Figure 3 – Defra modelled annual average background PM$_{2.5}$ concentration (µg/m^3) per square kilometre (2021)
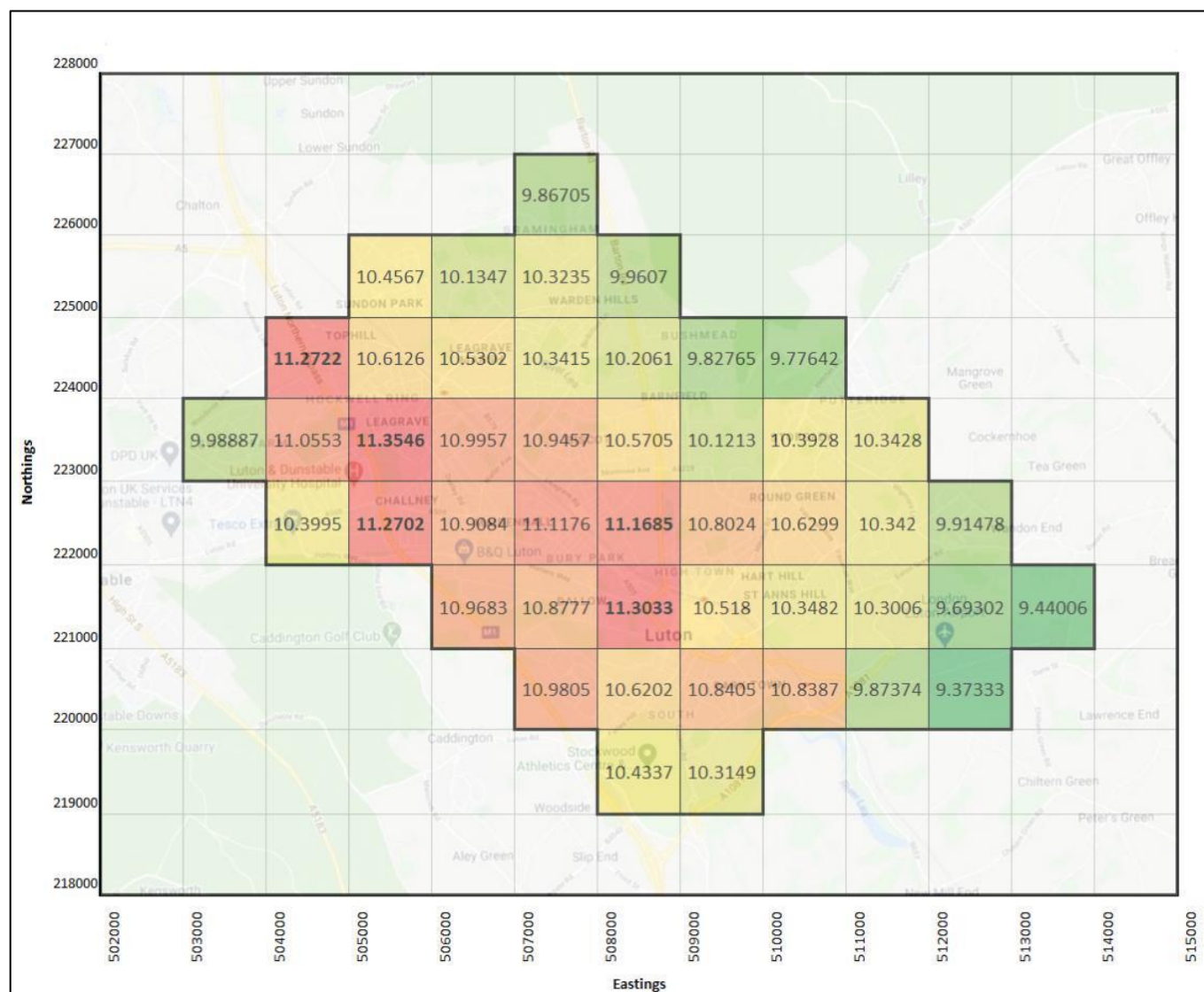
3 Air Quality Monitoring Data and Comparison with Air Quality Objectives and National Compliance

This section sets out the monitoring undertaken within 2021 by Luton Borough Council and how it compares with the relevant air quality objectives. In addition, monitoring results are presented for a five-year period between 2017 and 2021 to allow monitoring trends to be identified and discussed.

3.1 Summary of Monitoring Undertaken

3.1.1 Automatic Monitoring Sites

Luton Borough Council (LBC) undertook automatic (continuous) monitoring of nitrogen dioxide, PM_{10} and $PM_{2.5}$ at one site during 2021 (*LN60 / HB007 – Dunstable Road East –* https://tinyurl.com/w73r7gz). Located within AQMA No.3, this analyser is co-located with diffusion tubes *LN61*, *LN62* and *LN63*.

In addition to the monitoring undertaken by Luton Borough Council during 2021:

- London Luton Airport Operations Ltd. (LLAOL) continuously monitored PM_{10} at its site within the airport (*LA08 / HB006 –* https://tinyurl.com/y32oqq5r);

- Defra continuously monitored nitrogen dioxide at its Luton A505 Roadside AURN site (*CM2 / LUTR –* https://tinyurl.com/yauuwns7); and

- Luton Rising continuously monitored multiple species including nitrogen dioxide, PM_{10} and $PM_{2.5}$ at its new air quality monitoring station in Wigmore Valley Park (*LA001 –* https://tinyurl.com/y8o7oopg).

Table A.1 in Appendix A shows the details of the automatic monitoring sites. In addition to the links provided above, automatic monitoring results for these sites are also available through the *UK-Air website* [https://uk-air.defra.gov.uk] .

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

Luton Borough Council undertook non- automatic (*i.e.* passive) monitoring of NO$_2$ at 51 sites during 2021. In addition to this, LLAOL undertook similar monitoring at 19 sites and Luton Rising deployed NO$_2$ diffusion tubes at a further 11. Table A.2 in Appendix A presents the details of the non-automatic sites.

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

3.2 Individual Pollutants

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

3.2.1 Nitrogen Dioxide (NO$_2$)

Table A.3 and Table A.4 in Appendix A compare the ratified and adjusted monitored NO$_2$ annual mean concentrations for the past five years with the air quality objective of 40µg/m^3. Note that the concentration data presented represents the concentration at the location of the monitoring site, following the application of bias adjustment and annualisation, as required (*i.e.* the values are exclusive of any consideration to fall-off with distance adjustment).

For diffusion tubes, the full 2021 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.

 in Appendix A compares the ratified continuous monitored NO$_2$ hourly mean concentrations for the past five years with the air quality objective of 200µg/m^3, not to be exceeded more than 18 times per year.

As can be seen from the density plots presented in Figure A.2 in Appendix A: Monitoring Results when considering diffusion tube sites across all three monitoring networks that have been in operation for each of the last three years, the distribution of annual mean NO$_2$ concentrations at these sites in 2021 has remained essentially unchanged from the

previous year. However, due primarily to changing behaviours resulting from the response to the COVID-19 pandemic, both distributions demonstrate a considerable reduction when compared with 2019. The population mean across all passive sites was 21.6µg/m³ in 2021, 21.3µg/m³ in 2020 and 30.0µg/m³ in 2019. This indicates a slight increase from 2020 (of 1.4%) but a net reduction of 28% from the pre-pandemic levels of 2019.

As a result of this continued reduction, similar to the previous year, during 2021 the annual mean NO_2 level was only found to have exceeded 40µg/m^3 at one monitoring location – L7, a Luton Rising roadside site on Vauxhall Way (49.7µg/m^3). Despite exceeding the annual mean objective level for each of the four years during which NO_2 has been monitored at this site (as well as exceeding the 1-hour mean objective during both 2018 and 2019 by virtue of having an annual mean NO_2 concentration in excess of 60µg/m^3), L7 is not located within an AQMA. The reason for this is that, due to its remote location away from both amenities and residential accommodation, the site is not considered to be representative of relevant exposure.

During 2021, with the exception of L7, measured annual mean NO_2 levels at all other sites were at least 10% below the air quality objective level (*i.e.* <36µg/m^3). Additionally, no instances of the 1-hour mean exceeding 200µg/m^3 were observed at any of the three automatic NO_2 monitoring sites within the borough (*LN60 / HB007, LA001* or *CM2 / LUTR*).

3.2.2 Particulate Matter (PM$_{10}$)

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

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

During 2021, the annual mean PM$_{10}$ concentration measured at *LN60* (*HB007*) was 15.0µg/m^3, which is 1.2µg/m^3 (8.7%) higher than the previous year but 0.7µg/m^3 (4.5%) lower than the three year average obtained between 2017 and 2019. At *LA08 (HB006)* the annual average was 12.3µg/m^3, a decrease of 1.4µg/m^3 (10.2%) relative to 2020 and 4.9µg/m^3 (28.6%) lower than the three-year 2017 to 2019 average. Finally, at *LA001* the 2021 annual average was 10.3µg/m³, a decrease of 1.4µg/m³ (12.0%) compared with 2020 and 3.2µg/m³ (23.7%) lower than in 2019. In addition to being below the annual

mean air quality objective level of 40µg/m^3, the monitored concentrations at all three sites also met the relevant 2021 *WHO Global Air Quality Guideline* [https://tinyurl.com/5f6fc8nz] target of 15µg/m^3.

During 2021, the daily mean PM$_{10}$ concentration remained below 50µg/m^3 at both *LA08* and *LA001*, but was exceeded at *LN60* on a total of two occasions. These isolated instances do not constitute a breach of the relevant air quality objective, as for PM$_{10}$ the 24-hour mean air quality objective stipulates that the daily mean PM$_{10}$ concentration should not exceed 50µg/m³ more than 35 times a year.

It should be noted that, unlike the instruments used at *LN60 (HB007)* and *LA08 (HB006),* and although approved for use in other European countries, the GRIMM ED180 deployed at *LA001* to monitor PM$_{10}$ is not approved by Defra for use in the UK (*LAQM.TG16 para 7.164*)

3.2.3 Particulate Matter (PM$_{2.5}$)

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

Currently, the LAQM Regulations do not include a specific objective for annual mean PM$_{2.5}$. However, with the *Environment Act 2021* [https://tinyurl.com/ycxbrb3e] establishing a legally binding duty on government to bring forward at least two new air quality targets in secondary legislation by 31st October 2022, this is set to change. Although yet to be finalised, Defra recently consulted on the introduction of a new PM$_{2.5}$ annual mean concentration target of a maximum 10µg/m^3, which must be complied with across England by 2040.

During 2021, the annual mean PM$_{2.5}$ concentration measured at *LN60 (HB007)* was 9.2µg/m³, which is 0.9µg/m³ (10.8%) higher than the previous year but 0.6µg/m³ (6.1%) lower than the three year average obtained between 2017 and 2019. At *LA001* the 2021 annual average was 9.4µg/m³, a decrease of 0.7µg/m³ (6.9%) compared with 2020 and 2.2µg/m³ (19.0%) lower than in 2019. Consequently, during 2021 the monitored annual mean concentrations at both sites were below the proposed concentration target level of 10µg/m³.

It should be noted that, unlike the Palas Fidas 200 used at *LN60 (HB007)*, and although approved for use in other European countries, the GRIMM ED180 deployed at LA001 to monitor PM$_{2.5}$ is not approved by Defra for use in the UK (*LAQM.TG16 para 7.164*)

3.2.4 Sulphur Dioxide (SO$_2$)

Table A.9 in Appendix A compares the ratified continuous monitored SO$_2$ concentrations for 2021 with the air quality objectives for SO$_2$. No exceedances of any of the relevant objectives were recorded during 2021.

Appendix A: Monitoring Results

Table A.1 – Details of Automatic Monitoring Sites

Site ID	Site Name	Site Type	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Pollutants Monitored	In AQMA? Which AQMA?	Monitoring Technique	Distance to Relevant Exposure (m) [1]	Distance to kerb of nearest road (m) [2]	Inlet Height (m)
LN60 (HB007)	Dunstable Road East (CRAQM2)	Roadside	508708	221352	NO_2; PM_{10}; PM_4; $PM_{2.5}$; PM_1	Yes AQMA 3	Chemiluminescent (ThermoScientific Model 42i) Light-Scattering Monitor (Palas Fidas 200)	6.2	3.24	2.15
LA08 (HB006)	London Luton Airport	Other	511868	221144	PM_{10}	No	Unheated Beta Attenuation Mass Monitor (BAM)	N/A	N/A	1.7
LA001	London Luton Airport FutureLuToN	Other	512578	222204	NO_2; PM_{10}; $PM_{2.5}$; PM_1; SO_2; O_3; CO; Black Carbon; Benzene; Toluene; Ethylbenzene; m,p-Xylene; o-Xylene; Naphthalene	No	Chemiluminescent Light-Scattering Monitor (GRIMM EDM180)[3]	N/A	N/A	
CM2 (LUTR; UKA00605)	Luton A505 Roadside (AURN)	Roadside	505927	222644	NO_2	No	Chemiluminescent	17.1	1.5	1.7

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

[3] Instrument not approved by Defra (LAQM.TG16 para 7.164)

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

a) Luton Borough Council (LBC) sites

Diffusion Tube ID	Site Name	Site Type	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Pollutants Monitored	In AQMA? Which AQMA?	Distance to Relevant Exposure (m) [1]	Distance to kerb of nearest road (m) [2]	Tube Co-located with a Continuous Analyser?	Tube Height (m)
LN07	Guildford Street/Bute Street	Roadside	509227	221455	NO_2	No	1.5	3.1	No	2.6
LN11	Upper George Street	Roadside	508910	221321	NO_2	No	20.0	2.7	No	2.9
LN15	Armitage Garden	Roadside	505557	222325	NO_2	Yes AQMAs 1 & 2	7.0	2.1	No	2.8
LN16	Belper Road	Roadside	505492	222607	NO_2	Yes AQMA 2	5.0	2.5	No	2.7
LN17	Wyndham Road	Roadside	505324	222812	NO_2	Yes AQMA 2	4.0	1.8	No	2.8
LN18	Copperfields	Roadside	505014	223538	NO_2	Yes AQMA 2	2.0	1.6	No	2.8
LN22	1 Mistletoe Hill	Urban Background	511341	221864	NO_2	No	0.0	9.3	No	2.5
LN23	Eaton Green Road 1	Roadside	511377	221814	NO_2	No	18.0	6.4	No	2.3
LN24	19 Barnston Close	Urban Background	511902	222144	NO_2	No	0.0	7.0	No	2.5

Diffusion Tube ID	Site Name	Site Type	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Pollutants Monitored	In AQMA? Which AQMA?	Distance to Relevant Exposure (m) [1]	Distance to kerb of nearest road (m) [2]	Tube Co-located with a Continuous Analyser?	Tube Height (m)
LN25	Eaton Green Road 2	Roadside	511893	222068	NO$_2$	No	17.0	1.9	No	2.9
LN26	8 Keeble Close	Urban Background	512109	222234	NO$_2$	No	0.0	11.5	No	2.7
LN27	Eaton Green Road 3	Roadside	512134	222198	NO$_2$	No	6.0	2.3	No	2.7
LN28	Caddington Road	Roadside	507798	219832	NO$_2$	No	15.0	1.7	No	2.6
LN52	Dunstable Rd/Cardigan St Residential	Roadside	508689	221379	NO$_2$	Yes AQMA 3	0.0	4.3	No	2.8
LN53	3rd Floor Bagshawe Court F.F.	Suburban	507717	219923	NO$_2$	No	0.0	23.0	No	9.8
LN54	M1 Corner Bagshawe Court F.F.	Suburban	507712	219915	NO$_2$	No	0.0	12.0	No	2.0
LN55	M1 Corner Wyatt Court FF	Suburban	507732	219886	NO$_2$	No	0.0	13.0	No	2.9
LN56	20 Wyatt Court FF	Suburban	507747	219894	NO$_2$	No	0.0	30.0	No	2.9
LN61[t]	Dunstable Road East (CRAQM 2A)	Roadside	508708	221352	NO$_2$	YES AQMA 3	6.0	2.5	Yes	2.0
LN62[t]	Dunstable Road East (CRAQM 2B)	Roadside	508708	221352	NO$_2$	YES AQMA 3	6.0	2.5	Yes	2.0

Diffusion Tube ID	Site Name	Site Type	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Pollutants Monitored	In AQMA? Which AQMA?	Distance to Relevant Exposure (m) [1]	Distance to kerb of nearest road (m) [2]	Tube Co-located with a Continuous Analyser?	Tube Height (m)
LN63[t]	Dunstable Road East (CRAQM 2C)	Roadside	508708	221352	NO_2	Yes AQMA 3	6.0	2.5	Yes	2.0
LN64	Park Viaduct – Park Street	Roadside	509563	220952	NO_2	No	0.2	2.9	No	2.7
LN65	Park Viaduct – Queens Close	Roadside	509486	220865	NO_2	No	1.9	8.8	No	1.9
LN66	Park Viaduct	Roadside	509288	220925	NO_2	Yes AQMA 3	4.9	3.7	No	2.7
LN67	Castle Street	Roadside	509083	220709	NO_2	No	0.0	2.3	No	2.7
LN68	London Road	Roadside	508969	220487	NO_2	No	0.0	8.4	No	2.6
LN69	John Street	Roadside	509326	221357	NO_2	No	0.0	1.7	No	2.7
LN70	Crawley Green Road	Roadside	509813	221161	NO_2	No	0.0	6.0	No	2.6
LN71	Crescent Road	Urban Background	509549	221623	NO_2	No	0.0	10.3	No	2.4
LN72	Hucklesby Way	Urban Background	508937	221745	NO_2	No	0.0	8.7	No	2.5
LN73	Mill Street	Roadside	508959	221633	NO_2	No	0.0	3.9	No	2.9

Diffusion Tube ID	Site Name	Site Type	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Pollutants Monitored	In AQMA? Which AQMA?	Distance to Relevant Exposure (m) [1]	Distance to kerb of nearest road (m) [2]	Tube Co-located with a Continuous Analyser?	Tube Height (m)
LN74	Dunstable Road – Bury Park	Roadside	508165	222002	NO$_2$	No	0.0	4.8	No	2.5
LN75	New Bedford Road	Roadside	508745	222122	NO$_2$	No	0.0	5.2	No	2.5
LN76	Leagrave Road	Urban Background	507574	222948	NO$_2$	No	0.0	8.8	No	2.3
LN77	Marsh Road	Roadside	506496	224018	NO$_2$	No	0.0	4.8	No	2.5
LN78	Hibbert Street	Roadside	509109	220676	NO$_2$	No	0.2	1.4	No	2.4
LN79*	Castle Street 2	Roadside	509050	220634	NO$_2$	No		2.1	No	3.0
LN80	Windsor Street	Roadside	509038	220719	NO$_2$	No	0.5	1.0	No	2.3
LN81	Bank Close	Suburban	505034	223729	NO$_2$	Yes AQMA 2		1.7	No	2.6
LN82	11 Withy Close	Suburban	504828	223999	NO$_2$	Yes AQMAs 1 & 2	0.0	8.5	No	2.5
LN83	b/h 9 Copperfields	Suburban	505116	223467	NO$_2$	Yes AQMA 2	13.0	26.0	No	2.5
LN84	97 Lime Avenue	Suburban	505230	223304	NO$_2$	Yes AQMA 2	8.5	1.8	No	2.5

Diffusion Tube ID	Site Name	Site Type	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Pollutants Monitored	In AQMA? Which AQMA?	Distance to Relevant Exposure (m) [1]	Distance to kerb of nearest road (m) [2]	Tube Co-located with a Continuous Analyser?	Tube Height (m)
LN85	26 Belper Road	Suburban	505481	222545	NO_2	Yes AQMA 2	0.0	17.0	No	2.0
LN86	Bradley Road (by M1 Bridge)	Roadside	505586	222235	NO_2	Yes AQMAs 1 & 2		2.3	No	2.6
LN87	Shelton Way Alleyway	Suburban	510170	223162	NO_2	No	0.0	13.0	No	2.7
LN88	510 Hitchin Rd	Roadside	510107	223087	NO_2	No	0.0	8.5	No	2.7
LN89	13 Saywell Road	Suburban	510515	222612	NO_2	No	4.5	17.0	No	2.7
LN90	304 Crawley Green Road	Roadside	510846	222209	NO_2	No	0.0	14.1	No	2.7
LN91	International House	Urban Background	511122	221721	NO_2	No	0.0	22.3	No	2.7
LN92	Harrowden Court	Suburban	511037	221657	NO_2	No	0.0	11.5	No	2.7
LN93	Someries Junior School	Suburban	511332	223069	NO_2	No	0.0	35.6	No	2.4
LN94	Ashcroft High School	Suburban	511327	222588	NO_2	No	0.0	78.4	No	2.6
LN95	Wigmore Primary School	Suburban	511996	222534	NO_2	No	0.0	44.3	No	2.4

Diffusion Tube ID	Site Name	Site Type	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Pollutants Monitored	In AQMA? Which AQMA?	Distance to Relevant Exposure (m) [1]	Distance to kerb of nearest road (m) [2]	Tube Co-located with a Continuous Analyser?	Tube Height (m)
LN96	Castle Street 3	Roadside	509059	220656	NO_2	No	0.0	2.5	No	2.4

Notes:

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

(2) N/A if not applicable.

* Site closed – included for legacy purposes.

b) London Luton Airport Operations Ltd (LLAOL) sites

Diffusion Tube ID	Site Name	Site Type [LLAOL Site Group]	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Pollutants Monitored	In AQMA? Which AQMA?	Distance to Relevant Exposure (m) [1]	Distance to kerb of nearest road (m) [2]	Tube Co-located with a Continuous Analyser?	Tube Height (m)
LLA 1	Terminal front (canopy)	Other [Car Park & Drop-Off Zones]	511920	221334	NO$_2$	No			No	
LLA 2 (LA02)	Airport Approach Road	Roadside [Access Road]	511579	220960	NO$_2$	No	880.0	3.0	No	1.9
LLA 3 (LA03)	Runway Threshold Western	Other [Runway & Flightpath]	511170	220436	NO$_2$	No	1000.0	N/A	No	1.8
LLA 4 (LA04)	Runway Threshold Eastern	Other [Runway & Flightpath]	513644	221207	NO$_2$	No	550.0	N/A	No	2.0
LLA 5 (LA05)	Airside Stand 5	Other [Airfield]	511711	221337	NO$_2$	No	585.0	N/A	No	1.0
LLA 6 (LA06)	President Way Jct	Roadside [Access Road]	511682	221727	NO$_2$	No	230.0	3.0	No	2.3
LLA 7	Drop-off zone (new)	Roadside [Car Park & Drop-Off Zones]	512105	221168	NO$_2$	No			No	
LLA 8 (LA08)	BAM CoLocator	Other [Airfield]	511867	221148	NO$_2$	No	820.0	N/A	No	1.7
LLA 9 (LA09)	Stagenhoe Bottom Farm	Rural [Runway & Flightpath]	517602	222572	NO$_2$	No	30.0	N/A	No	1.2
LLA 10 (LA10)	Grove Farm Slip End	Rural [Runway & Flightpath]	507667	217744	NO$_2$	No	30.0	N/A	No	1.2
LLA 11 (LA17)	Dane Street	Roadside [Runway & Flightpath]	513140	220669	NO$_2$	No	130.0	1.0	No	2.1
LLA 12 (LA14)	Airside Stand 61	Roadside [Airfield]	511886	221566	NO$_2$	No	420.0	N/A	No	1.0

Diffusion Tube ID	Site Name	Site Type [LLAOL Site Group]	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Pollutants Monitored	In AQMA? Which AQMA?	Distance to Relevant Exposure (m) [1]	Distance to kerb of nearest road (m) [2]	Tube Co-located with a Continuous Analyser?	Tube Height (m)
LLA 13 (LA15)	Eaton Green Road	Roadside [Access Road]	511901	222055	NO$_2$	No	35.0	8.0	No	2.0
LLA 14	Undercroft Access	Kerbside [Car Park & Drop-Off Zones]	511995	221316	NO$_2$	No			No	
LLA 15	Eaton Green Road Lower	Kerbside [Access Road]	511168	221706	NO$_2$	No			No	
LLA 16	Airside South Stands	Other [Airfield]	512275	221115	NO$_2$	No			No	
LLA 17	A1081 Southbound Carriage Way	Roadside [Access Road]	509489	219237	NO$_2$	No			No	
LLA 18	A1081 New Airport Way	Roadside [Access Road]	510779	220279	NO$_2$	No			No	
LLA 19	Breachwood Green Community Hall	Rural [Runway & Flightpath]	515109	221933	NO$_2$	No			No	

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.

c) Luton Rising sites

Diffusion Tube ID	Site Name	Site Type	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Pollutants Monitored	In AQMA? Which AQMA?	Distance to Relevant Exposure (m) [1]	Distance to kerb of nearest road (m) [2]	Tube Co-located with a Continuous Analyser?	Tube Height (m)
L1(i), L1(ii), L1(iii)	Dunstable Road East	Roadside	508710	221353	NO$_2$	Yes AQMA 3	6.0	2.4	Yes	2.0
L2(i), L2(ii)	Crawley Green Road	Roadside	511155	222445	NO$_2$	No		1.2	No	2.1
L3(i), L3(ii)	Wigmore Lane	Roadside	511780	222760	NO$_2$	No		1.0	No	2.0
L4(i), L4(ii)	Eaton Green Road / Darley Road	Rural	513223	222397	NO$_2$	No		1.5	No	2.0
L5(i), L5(ii)	Chapel Road, Breachwood Green	Rural	515047	221904	NO$_2$	No		2.8	No	2.0
L6(i), L6(ii)	Winch Hill	Rural	513773	221752	NO$_2$	No		1.2	No	1.9
L7(i), L7(ii)	Vauxhall Way	Roadside	511057	221386	NO$_2$	No		2.1	No	2.0
L8(i), L8(ii)	Kimpton Road	Roadside	510543	220706	NO$_2$	No		2.1	No	2.0
L9*	Luton Parkway Station Exit (North) *(Before 03/12/2020)*	Other	510529	220598	NO$_2$	No		N/A	No	1.8
L9a(i), L9a(ii)	Luton Parkway Station Exit (North) *(After 03/12/2020)*	Other	510552	220660	NO$_2$	No		N/A	No	1.8

Diffusion Tube ID	Site Name	Site Type	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Pollutants Monitored	In AQMA? Which AQMA?	Distance to Relevant Exposure (m) [1]	Distance to kerb of nearest road (m) [2]	Tube Co-located with a Continuous Analyser?	Tube Height (m)
L10(i), L10(ii)	Luton Road, Caddington	Roadside	506541	219854	NO$_2$	No		1.0	No	2.1
L11(i), L11(ii), L11(iii)	Wigmore Valley Park	Rural	512569	222207	NO$_2$	No		N/A	Yes	1.6
V1	Crawley Green Road	Roadside	511155	222445	BTEX; Napthalene; 1,3 Butadiene	No		1.2	No	2.1
V2	Wigmore Valley Park	Rural	512569	222207	BTEX; Napthalene; 1,3 Butadiene	No		N/A	Yes	1.6
V3	Chapel Road, Breachwood Green	Rural	515047	221904	BTEX; Napthalene; 1,3 Butadiene	No		2.8	No	2.0
V4	Copt Hall Road	Rural	512497	220008	BTEX; Napthalene; 1,3 Butadiene	No		1.4	No	1.9
V5a	Luton Parkway Station Exit (North) *(After 03/12/2020)*	Other	510552	220660	BTEX; Napthalene; 1,3 Butadiene	No		N/A	No	1.8

Notes:

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

(2)   N/A if not applicable.

*   Site closed – included for legacy purposes.

Table A.3 – Annual Mean NO$_2$ Monitoring Results: Automatic Monitoring (µg/m^3)

Site ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Site Type	Valid Data Capture for Monitoring Period (%) [1]	Valid Data Capture 2021 (%) [2]	2017	2018	2019	2020	2021
LN60 (HB007)	508708	221352	Roadside	99.8	99.8	39.0	37.2	**40.4**	28.3	30.2
LA001	512578	222204	Other	97.8	97.8	-	-	16.2	11.9	11.3
CM2 (LUTR; UKA00605)	505927	222644	Roadside	98.8	98.8	**44.4**	**42.9**	39.3	30.7	31.4

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

☒ **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^3.

Exceedances of the NO$_2$ annual mean objective of 40µg/m^3 are shown in **bold**.

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

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

(1) Data capture for the monitoring period, in cases where monitoring was only carried out for part of the year.
(2) Data capture for the full calendar year (*e.g.* if monitoring was carried out for 6 months, the maximum data capture for the full calendar year is 50%).

Table A.4 – Annual Mean NO₂ Monitoring Results: Non-Automatic Monitoring (µg/m³)

a) Luton Borough Council (LBC) sites

Diffusion Tube ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Site Type	Valid Data Capture for Monitoring Period (%) [1]	Valid Data Capture 2021 (%) [2]	2017	2018	2019	2020	2021
LN07	509227	221455	Roadside	90.4	90.4	26.7	27.5	28.4	20.3	20.9
LN11	508910	221321	Roadside	100.0	100.0	34.2	33.6	34.3	27.3	30.6
LN15	505557	222325	Roadside	92.3	92.3	29.8	26.2	27.0	20.2	20.1
LN16	505492	222607	Roadside	92.3	92.3	35.3	29.5	31.1	25.0	23.9
LN17	505324	222812	Roadside	92.3	92.3	35.9	33.5	33.1	25.5	24.1
LN18	505014	223538	Roadside	92.3	92.3	24.4	23.9	22.1	16.9	18.4
LN22	511341	221864	Urban Background	100.0	100.0	22.9	21.3	23.1	16.0	16.1
LN23	511377	221814	Roadside	100.0	100.0	36.6	29.4	34.9	24.9	24.2
LN24	511902	222144	Urban Background	92.3	92.3	21.9	20.0	22.0	16.2	16.8
LN25	511893	222068	Roadside	100.0	100.0	28.7	27.5	29.6	20.9	20.0
LN26	512109	222234	Urban Background	100.0	100.0	19.7	20.1	19.9	13.8	13.7
LN27	512134	222198	Roadside	100.0	100.0	30.1	27.5	28.3	20.1	20.4

Diffusion Tube ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Site Type	Valid Data Capture for Monitoring Period (%) [1]	Valid Data Capture 2021 (%) [2]	2017	2018	2019	2020	2021
LN28	507798	219832	Roadside	92.3	92.3	**45.6**	**40.3**	38.5	29.6	29.3
LN52	508689	221379	Roadside	82.7	82.7	**43.0**	39.5	**42.8**	33.0	35.7
LN53	507717	219923	Suburban	100.0	100.0	33.1	27.9	28.2	21.6	20.5
LN54	507712	219915	Suburban	75	75.0	33.6	26.6	28.2	21.4	21.2
LN55	507732	219886	Suburban	100.0	100.0	33.3	28.8	27.4	22.5	21.0
LN56	507747	219894	Suburban	100.0	100.0	31.4	29.0	28.4	21.8	20.1
LN61, LN62, LN63	508708	221352	Roadside	100.0	100.0	**41.9**	39.4	**40.7**	30.8	32.2
LN64	509563	220952	Roadside	100.0	100.0	30.8	28.1	31.2	21.9	22.2
LN65	509486	220865	Roadside	100.0	100.0	25.5	23.3	24.0	17.5	19.6
LN66	509288	220925	Roadside	92.3	92.3	38.9	32.9	36.7	27.6	28.6
LN67	509083	220709	Roadside	92.3	92.3	**42.0**	**41.1**	**43.0**	32.7	32.9
LN68	508969	220487	Roadside	92.3	92.3	32.6	30.8	31.9	24.0	26.0
LN69	509326	221357	Roadside	90.4	90.4	31.4	29.1	30.8	22.5	24.7
LN70	509813	221161	Roadside	90.4	90.4	33.8	30.8	32.8	24.1	26.8

Diffusion Tube ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Site Type	Valid Data Capture for Monitoring Period (%) [1]	Valid Data Capture 2021 (%) [2]	2017	2018	2019	2020	2021
LN71	509549	221623	Urban Background	90.4	90.4	31.5	30.6	31.3	23.5	25.1
LN72	508937	221745	Urban Background	73.1	73.1	30.1	30.7	29.8	23.5	24.0
LN73	508959	221633	Roadside	90.4	90.4	**42.4**	37.1	38.4	28.9	30.6
LN74	508165	222002	Roadside	90.4	90.4	38.8	34.8	36.8	29.5	29.7
LN75	508745	222122	Roadside	100.0	100.0	38.4	35.8	36.5	22.0	30.8
LN76	507574	222948	Urban Background	90.4	90.4	31.7	31.5	31.3	23.8	26.4
LN77	506496	224018	Roadside	100.0	100.0	36.5	32.9	35.6	27.2	26.7
LN78	509109	220676	Roadside	100.0	100.0	32.0	28.7	31.2	23.3	23.7
LN79*	509050	220634	Roadside	-	-	32.9	37.3	33.9	24.0	
LN80	509038	220719	Roadside	92.3	92.3	34.4	36.8	33.3	24.3	25.8
LN81	505034	223729	Suburban	100.0	100.0	38.1	31.6	30.8	21.8	22.7
LN82	504828	223999	Suburban	90.4	90.4	32.3	27.0	27.6	20.9	19.7
LN83	505116	223467	Suburban	90.4	90.4	24.5	24.5	22.5	16.3	19.5
LN84	505230	223304	Suburban	100.0	100.0	27.0	25.2	25.3	16.8	19.4

Diffusion Tube ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Site Type	Valid Data Capture for Monitoring Period (%) [1]	Valid Data Capture 2021 (%) [2]	2017	2018	2019	2020	2021
LN85	505481	222545	Suburban	90.4	90.4		28.2	30.0	22.8	21.9
LN86	505586	222235	Roadside	73.1	73.1	**41.9**	36.8	38.8	28.4	27.4
LN87	510170	223162	Suburban	82.7	82.7				16.3	17.9
LN88	510107	223087	Roadside	100.0	100.0				19.9	21.2
LN89	510515	222612	Suburban	100.0	100.0				16.6	18.5
LN90	510846	222209	Roadside	92.3	92.3				20.5	22.0
LN91	511122	221721	Urban Background	92.3	92.3				17.5	18.5
LN92	511037	221657	Suburban	100.0	100.0				16.1	17.4
LN93	511332	223069	Suburban	67.3	67.3				11.1	12.1
LN94	511327	222588	Suburban	92.3	92.3				12.8	12.6
LN95	511996	222534	Suburban	100.0	100.0				13.2	13.2
LN96	509059	220656	Roadside	100.0	76.9					35.1

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

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

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

Notes:

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

Exceedances of the NO$_2$ annual mean objective of 40µg/m^3 are shown in **bold**.

NO$_2$ annual means exceeding 60µg/m^3, indicating a potential exceedance of the NO$_2$ 1-hour mean objective are shown in **<u>bold and underlined</u>**.

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

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

(1)   Data capture for the monitoring period, in cases where monitoring was only carried out for part of the year.
(2)   Data capture for the full calendar year (*e.g.* if monitoring was carried out for 6 months, the maximum data capture for the full calendar year is 50%).

*   Site closed – included for legacy purposes.

b) London Luton Airport Operations Ltd. (LLAOL) sites

Diffusion Tube ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Site Type [LLAOL Site Group]	Valid Data Capture for Monitoring Period (%) [1]	Valid Data Capture 2021 (%) [2]	2017	2018	2019	2020	2021
LLA 1	511920	221334	Other [Car Park & Drop-Off Zones]	83	83.0			37.4	20.6	19.7
LLA 2	511579	220960	Roadside [Access Road]	100	100.0	37.6	37.8	34.2	20.5	18.6
LLA 3	511170	220436	Other [Runway & Flightpath]	92.3	92.3	22.5	24.6	22.1	15.6	14.6
LLA 4	513644	221207	Other [Runway & Flightpath]	100	100.0	18.5	18.4	17.5	11.3	10.5
LLA 5	511711	221337	Other [Airfield]	100	100.0	**40.2**	**40.4**	36.7	21.6	21.9
LLA 6	511682	221727	Roadside [Access Road]	100	100.0	35.3	35.1	33.8	21.7	20.2
LLA 7	512105	221168	Roadside [Car Park & Drop-Off Zones]	92.6	92.6				26.1	25.6
LLA 8	511867	221148	Other [Airfield]	100	100.0	31.6	32.2	31.5	19.5	20.2
LLA 9	517602	222572	Rural [Runway & Flightpath]	75.3	75.3	10.6	11.2	9.7	7.6	7.3
LLA 10	507667	217744	Rural [Runway & Flightpath]	100	100.0	11.1	12.3	10.9	7.8	8.0
LLA 11	513140	220669	Roadside [Runway & Flightpath]	77.5	77.5	14.6	15.1	13.4	9.4	7.3
LLA 12	511886	221566	Roadside [Airfield]	100	100.0	38.0	37.6	35.8	21.7	21.9
LLA 13	511901	222055	Roadside [Access Road]	92.6	92.6	25.2	25.6	23.9	16.2	15.5

Diffusion Tube ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Site Type [LLAOL Site Group]	Valid Data Capture for Monitoring Period (%) [1]	Valid Data Capture 2021 (%) [2]	2017	2018	2019	2020	2021
LLA 14	511995	221316	Kerbside [Car Park & Drop-Off Zones]	100	100.0		**42.4**	**41.9**	23.2	21.0
LLA 15	511168	221706	Kerbside [Access Road]	100	100.0		32.2	31.2	20.9	22.7
LLA 16	512275	221115	Other [Airfield]	100	100.0			32.3	19.7	18.1
LLA 17	509489	219237	Roadside [Access Road]	100	100.0		**40.4**	32.1	20.2	21.5
LLA 18	510779	220279	Roadside [Access Road]	100	100.0			29.1	20.2	20.8
LLA 19	515109	221933	[Runway & Flightpath]	82.7	82.7			15.6	9.2	8.8

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

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

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

Notes:

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

Exceedances of the NO_2 annual mean objective of $40\mu g/m^3$ are shown in **bold**.

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

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

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

(1) Data capture for the monitoring period, in cases where monitoring was only carried out for part of the year.
(2) Data capture for the full calendar year (*e.g.* if monitoring was carried out for 6 months, the maximum data capture for the full calendar year is 50%).

c) Luton Rising sites

Diffusion Tube ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Site Type	Valid Data Capture for Monitoring Period (%) [1]	Valid Data Capture 2021 (%) [2]	2017	2018	2019	2020	2021
L1(i), L1(ii), L1(iii)	508710	221353	Roadside	89.1	89.1		37.0	**40.6**	30.5	32.2
L2(i), L2(ii)	511155	222445	Roadside	89.1	89.1		30.9	29.6	22.9	23.4
L3(i), L3(ii)	511780	222760	Roadside	44.8	44.8		25.5	29.7	20.9	21.7
L4(i), L4(ii)	513223	222397	Rural	89.1	89.1		16.2	20.4	13.9	12.5
L5(i), L5(ii)	515047	221904	Rural	89.1	89.1		11.2	14.5	10.3	9.1
L6(i), L6(ii)	513773	221752	Rural	89.1	89.1		14.2	17.3	11.6	10.2
L7(i), L7(ii)	511057	221386	Roadside	71.7	71.7		<u>68.9</u>	<u>69.4</u>	**48.0**	**49.7**
L8(i), L8(ii)	510543	220706	Roadside	89.1	89.1		27.6	35.1	23.5	22.3
L9*	510529	220598	Other	-	-		24.8	30.7	22.4	
L9a(i), L9a(ii)	510552	220660	Other	62.2	62.2					19.5
L10(i), L10(ii)	506541	219854	Roadside	89.1	89.1		19.0	25.1	17.7	19.1
L11(i), L11(ii), L11(iii)	512569	222207	Rural	81.8	81.8			20.0	13.0	11.5

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

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

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

Notes:

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

Exceedances of the NO$_2$ annual mean objective of 40µg/m^3 are shown in **bold**.

NO$_2$ annual means exceeding 60µg/m^3, indicating a potential exceedance of the NO$_2$ 1-hour mean objective are shown in **bold and underlined**.

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

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

(1)   Data capture for the monitoring period, in cases where monitoring was only carried out for part of the year.
(2)   Data capture for the full calendar year (*e.g.* if monitoring was carried out for 6 months, the maximum data capture for the full calendar year is 50%).
*   Site closed – included for legacy purposes.

Figure A.1 – Trends in Annual Mean NO$_2$ Concentrations

a) Luton Borough Council (LBC) sites

a. Within Luton AQMA Nos. 1 & 2 (Located in Challney & Leagrave Wards)
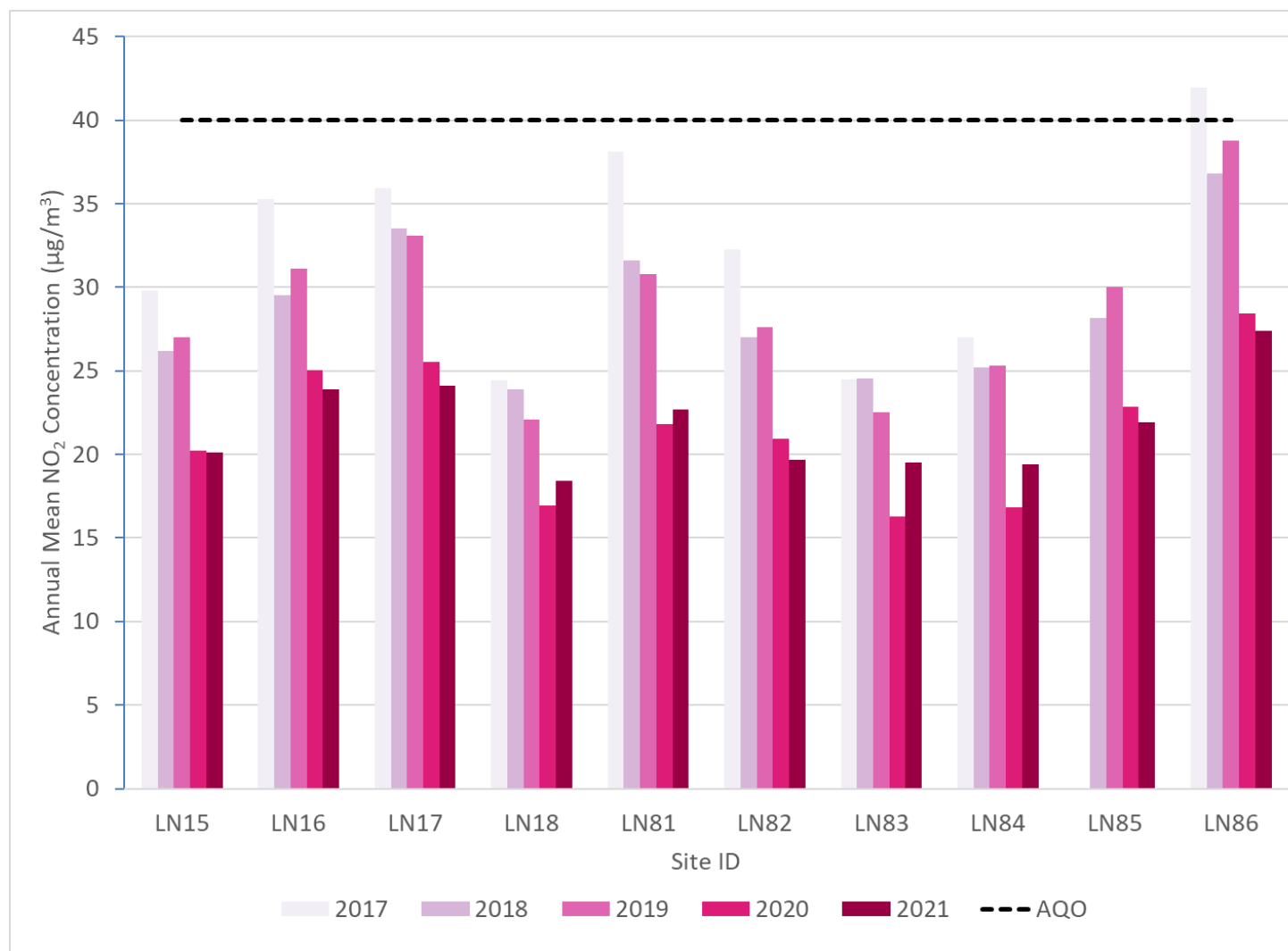
b. **Within Luton AQMA No. 3** (Located in South Ward)
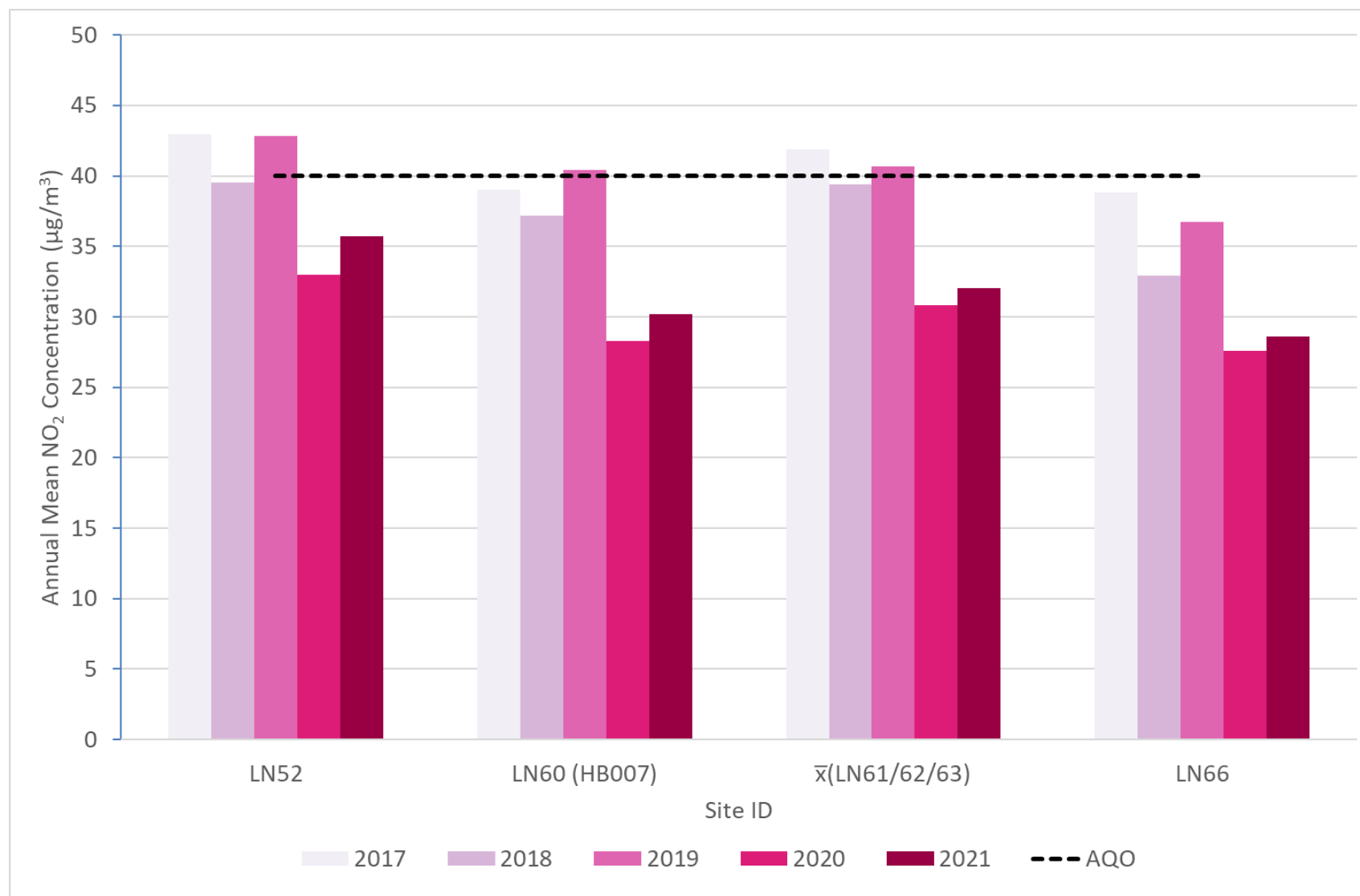
c. **Non-AQMA locations in Central / North Luton – Part 1** (Located in South, Farley, High Town, Bury Park, Biscot, Saints and Limbury Wards)
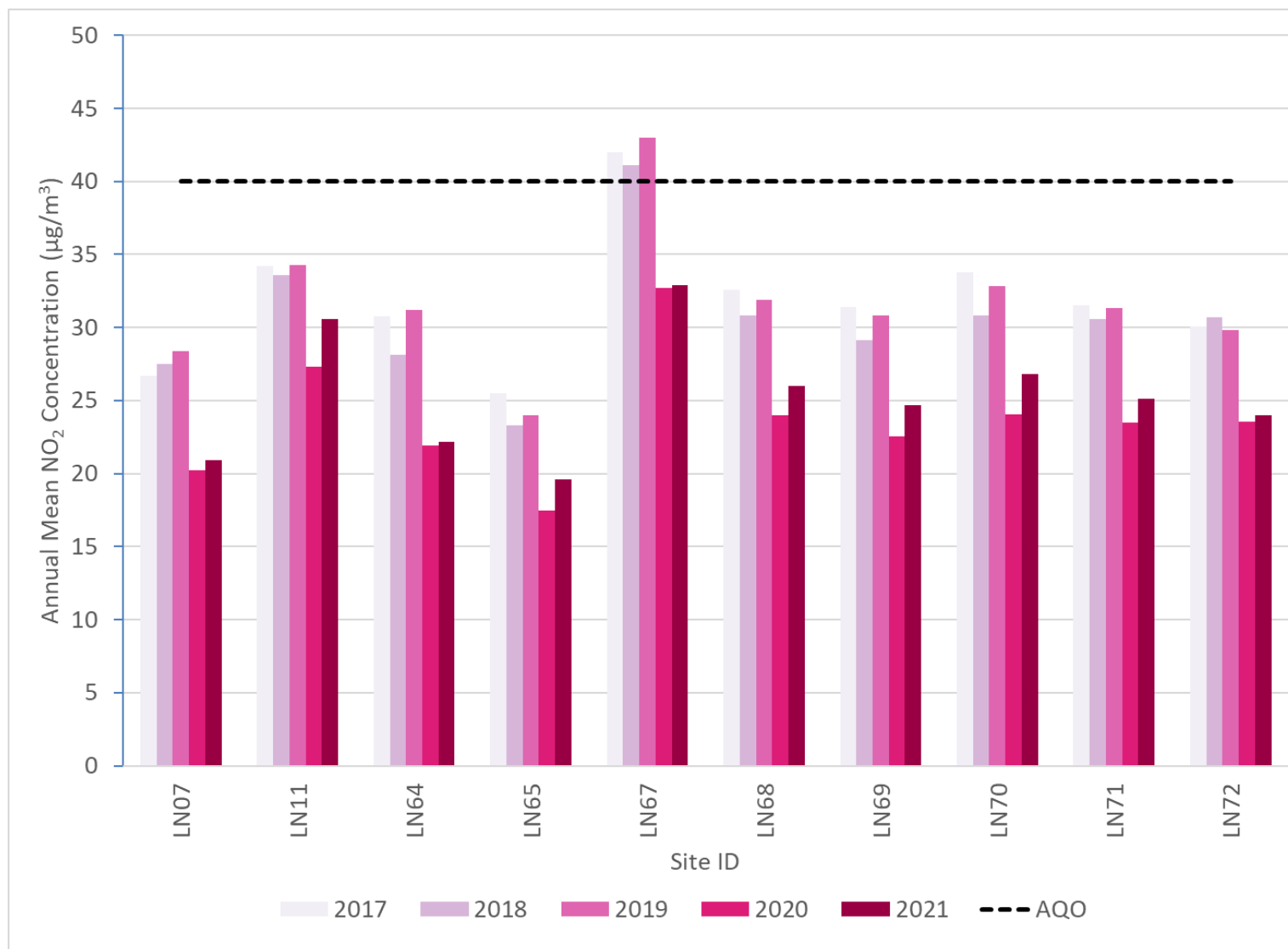
d. Non-AQMA locations in Central / North Luton – Part 2 (Located in South, Farley, High Town, Bury Park, Biscot, Saints and Limbury Wards)
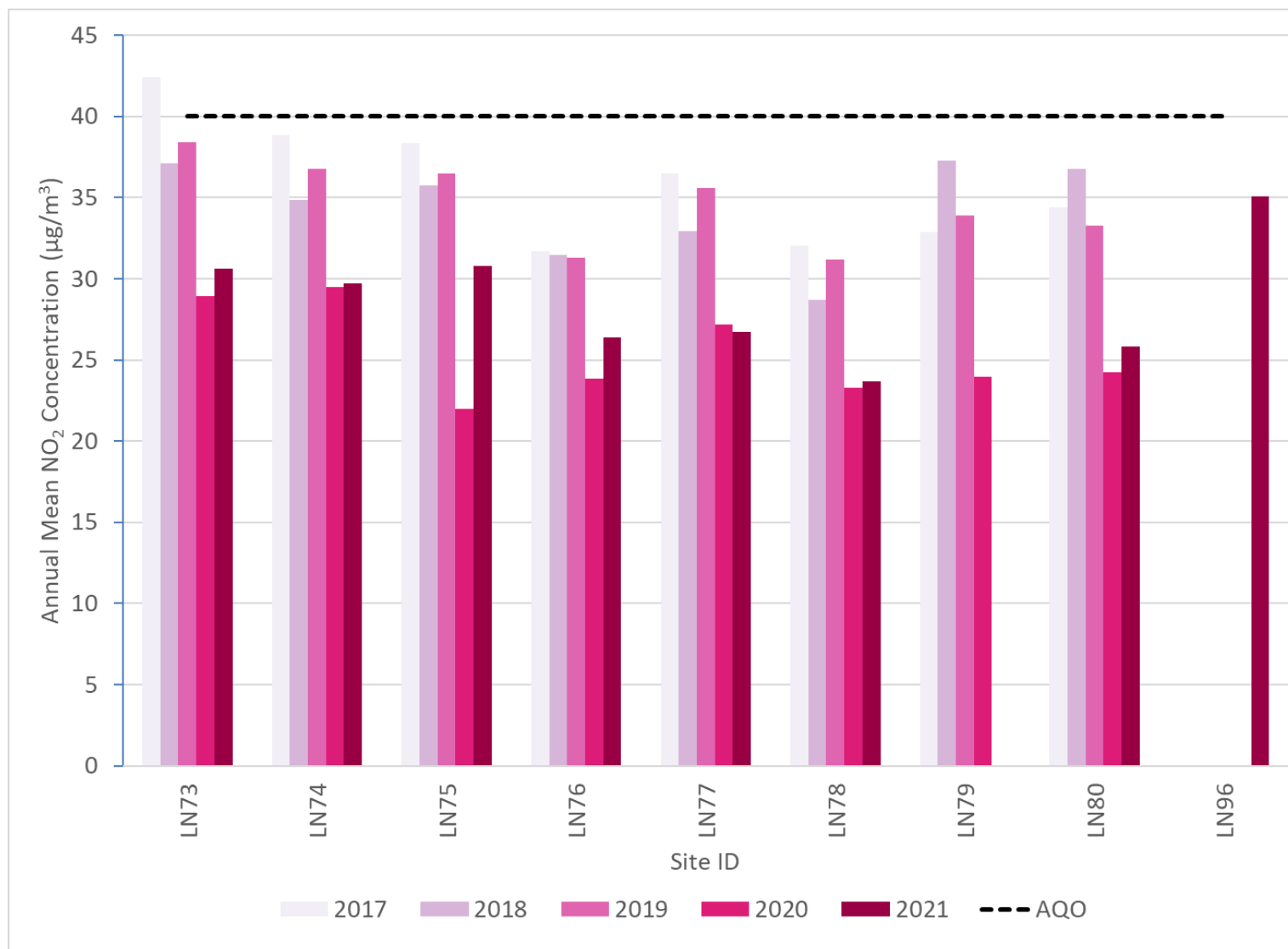
e. **Non-AQMA locations in East Luton** (Located in Crawley, Round Green and Wigmore Wards)
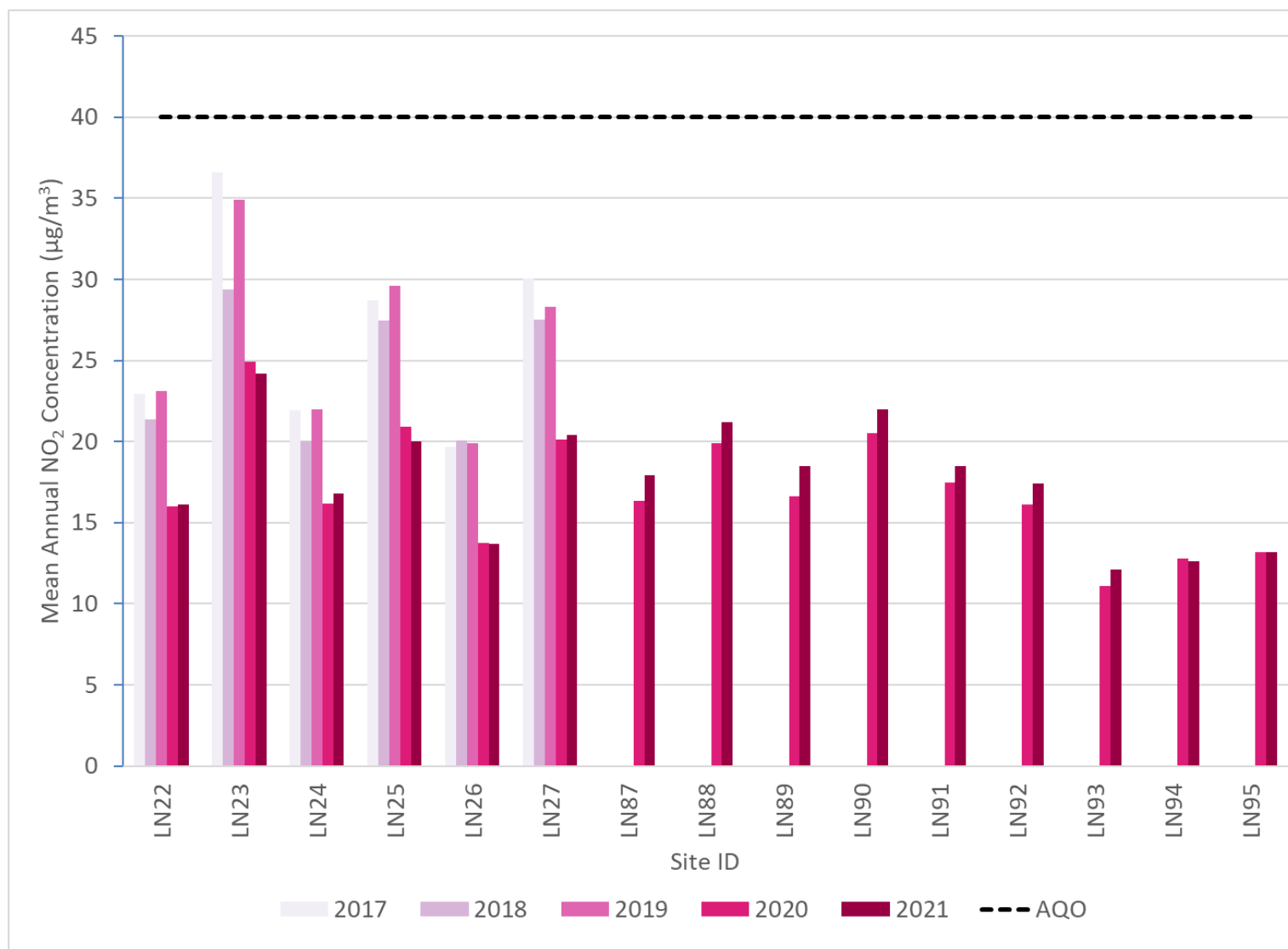
f.   Non-AQMA locations in West Luton (Located in Farley Ward)
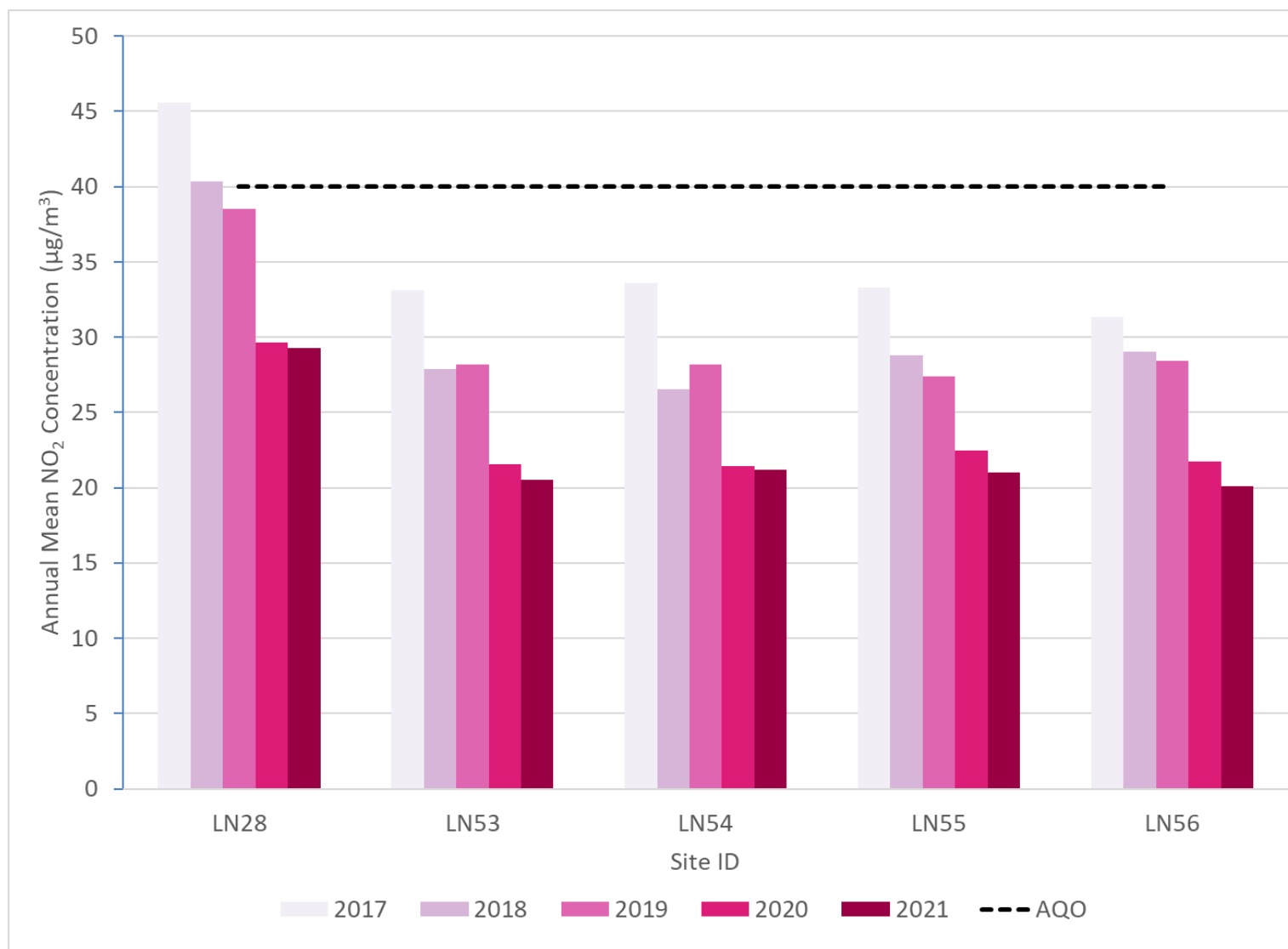
b) London Luton Airport Operations Ltd. (LLAOL) sites active during 2021

a. LLAOL Site Group: *Access Road*
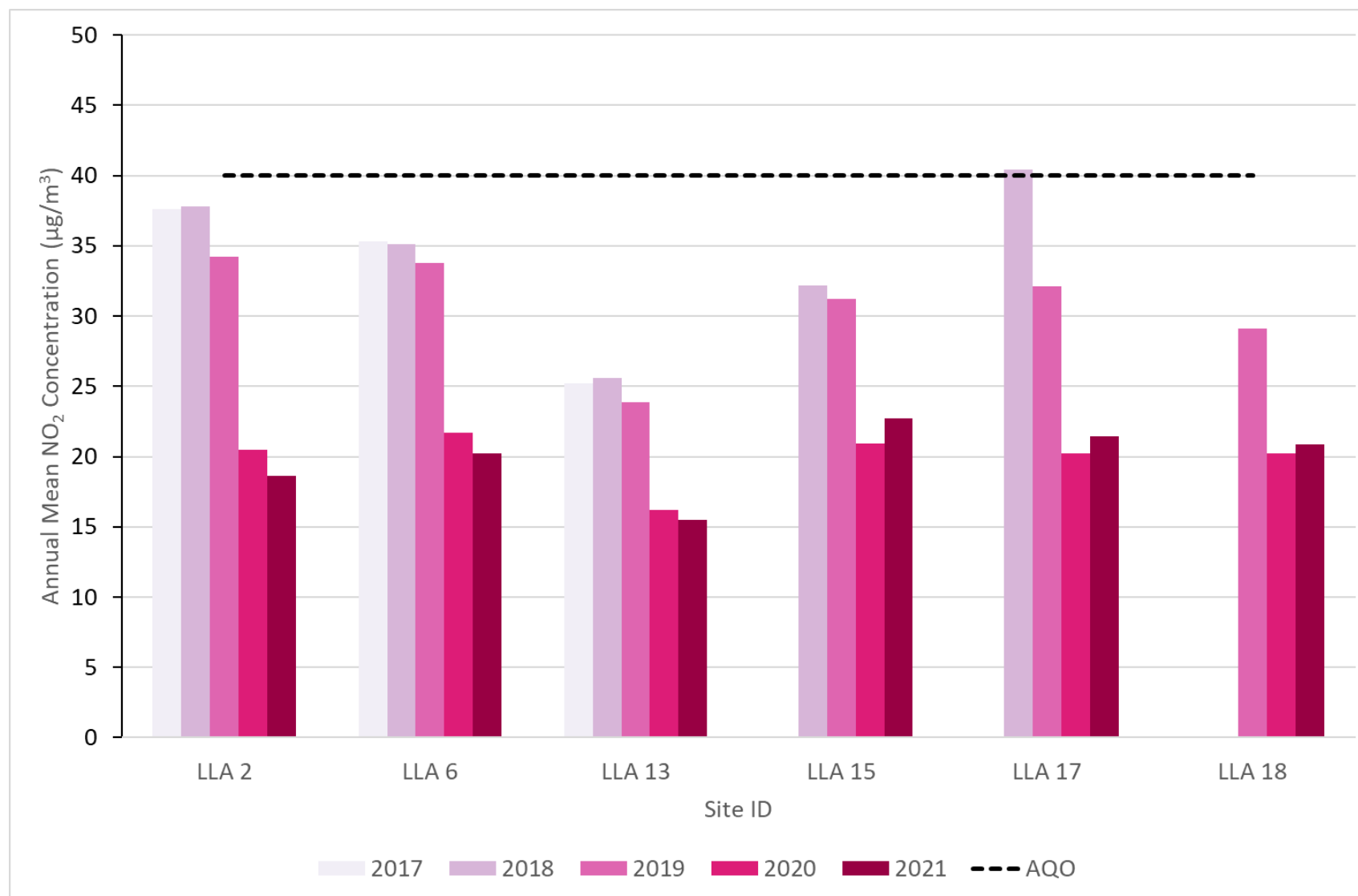
b. LLAOL Site Group: *Airfield*
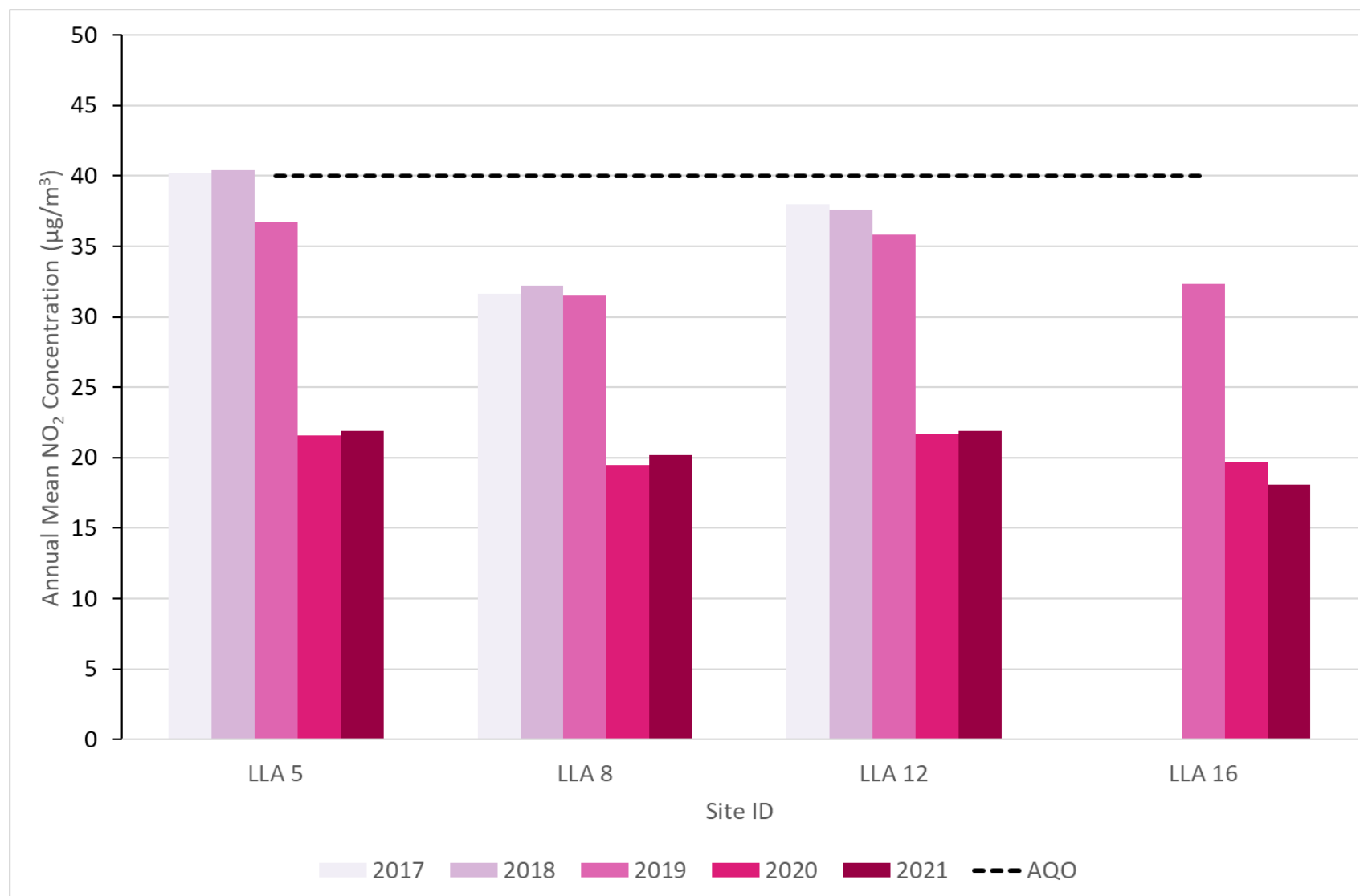
c. LLAOL Site Group: *Car Park & Drop-Off*
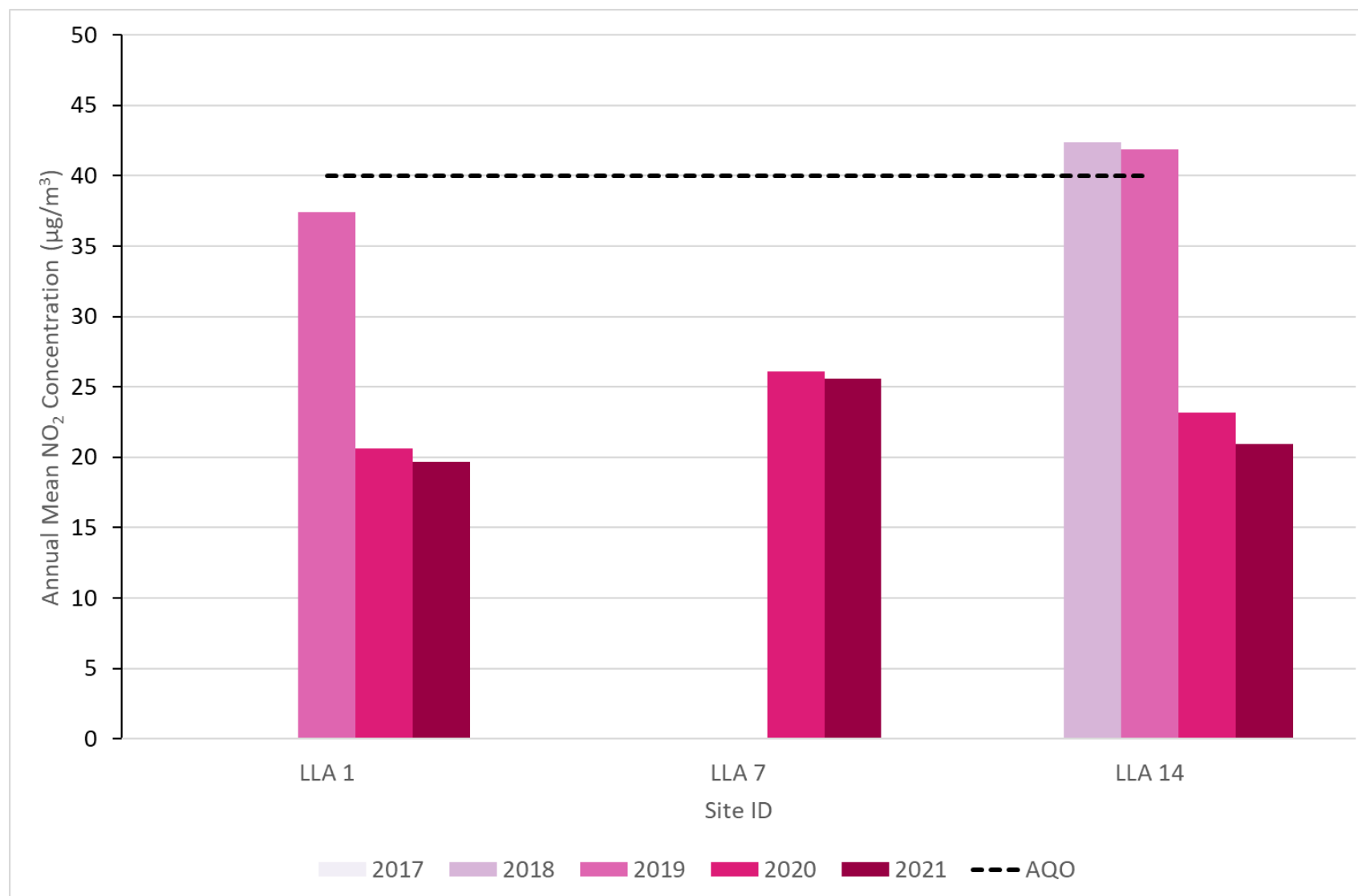
d. LLAOL Site Group: *Runway & Flightpath*
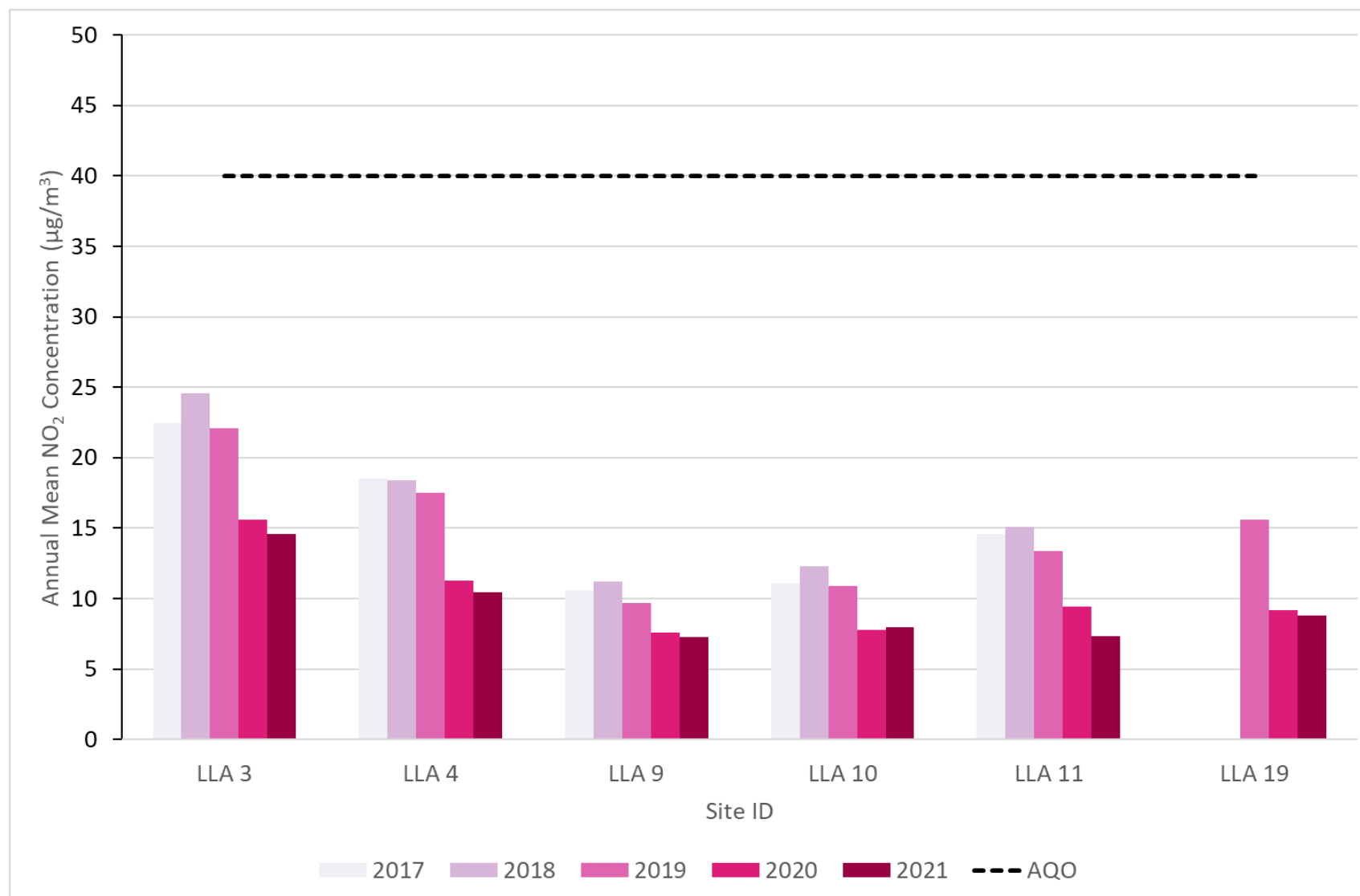
c) Luton Rising sites
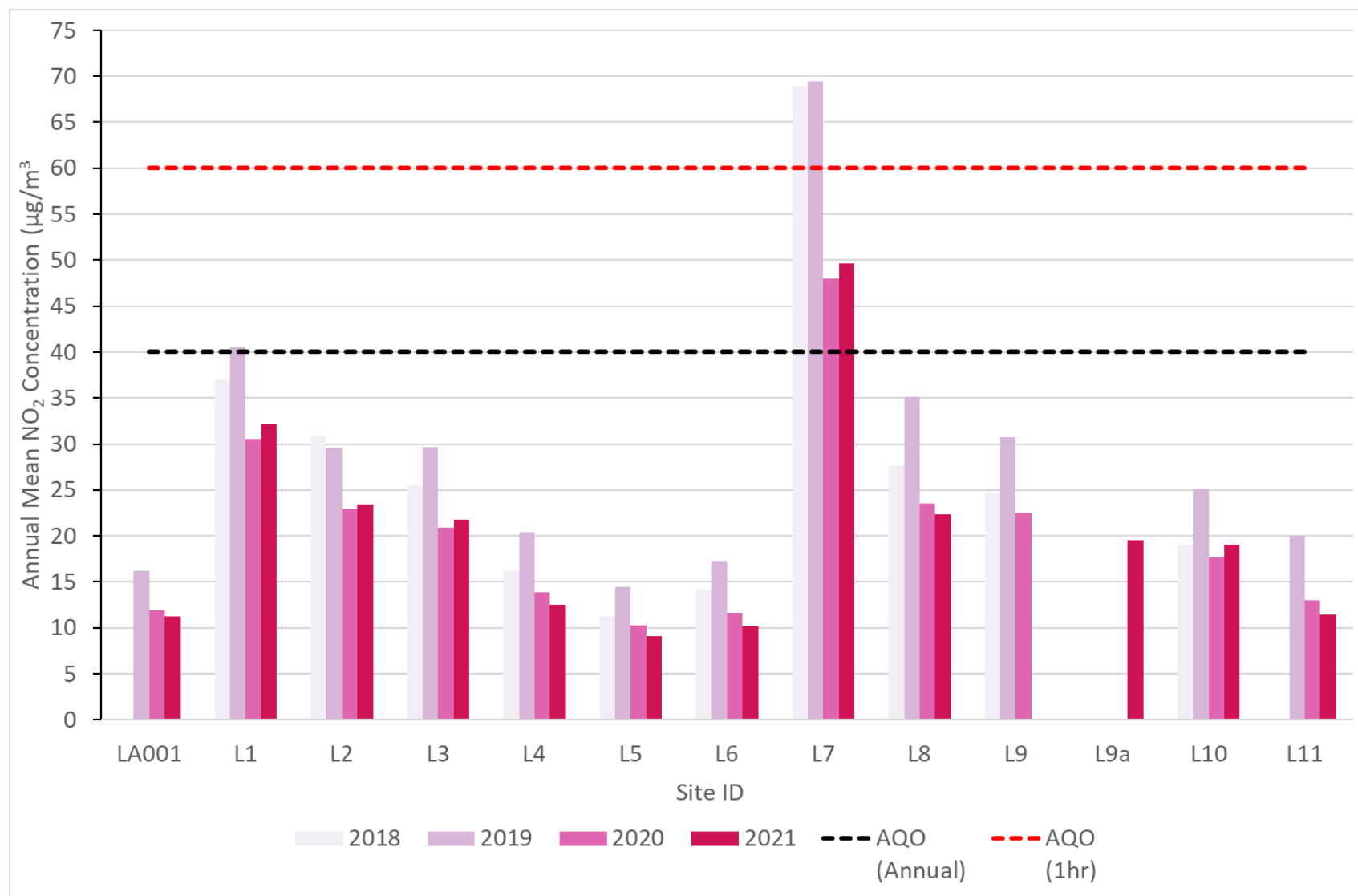
d) Defra AURN sites
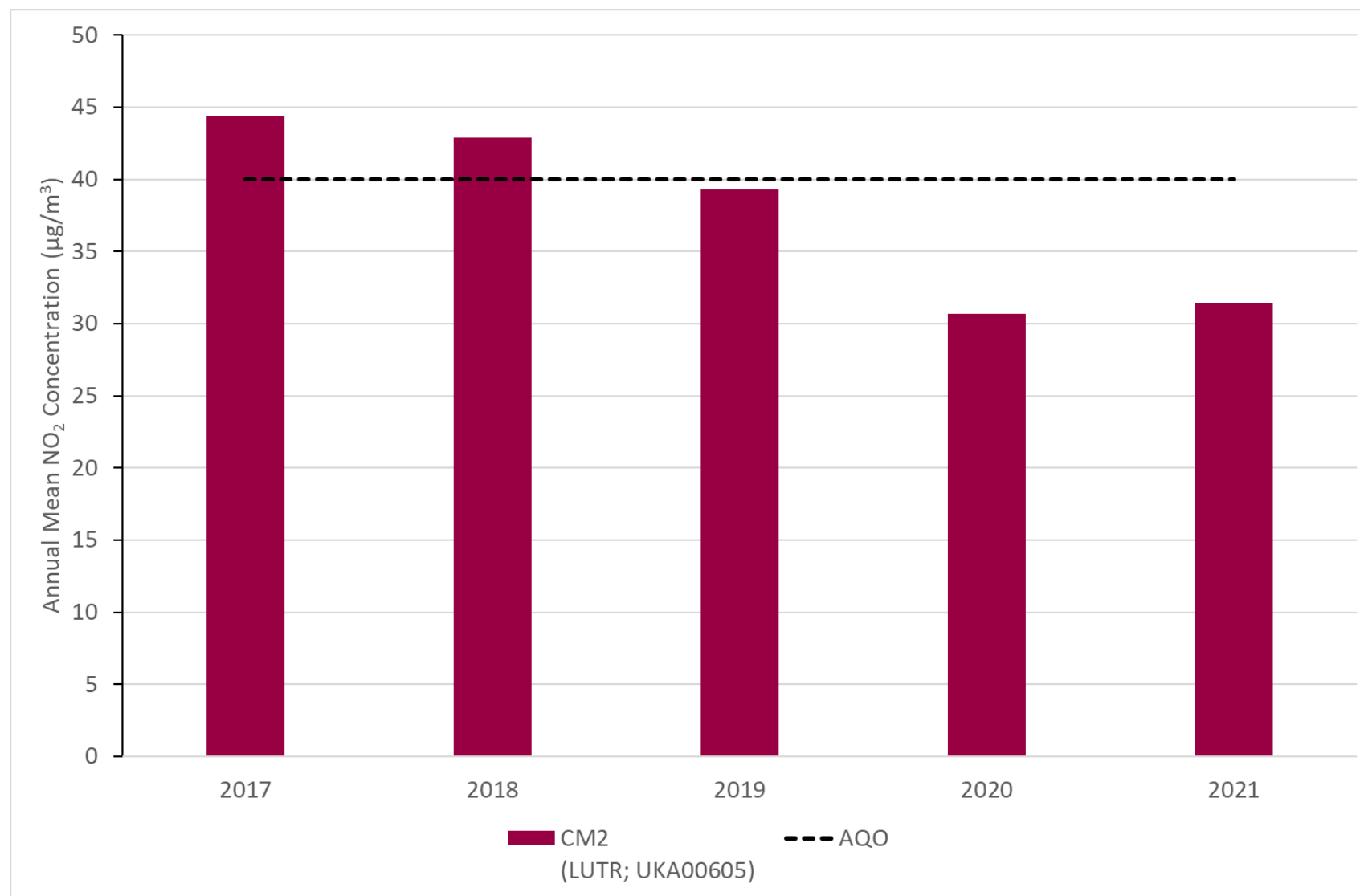
Figure A.2 – Descriptive Statistics and Histogram / Density Plots comparing the distribution of the annual mean NO₂ concentrations at all LBC, LLAOL and Luton Rising diffusion tube sites in operation for each of the last three years

Results

Descriptives

Descriptives

	Year	Annual mean NO₂ Concentration (µg/m³)
Mean	2019	30.0
	2020	21.3
	2021	21.6
Median	2019	30.8
	2020	21.6
	2021	21.2
Standard deviation	2019	8.98
	2020	6.63
	2021	7.26
Range	2019	59.7
	2020	40.4
	2021	42.4
Minimum	2019	9.70
	2020	7.60
	2021	7.30
Maximum	2019	69.4
	2020	48.0
	2021	49.7

Plots

Annual mean NO₂ Concentration (µg/m³)
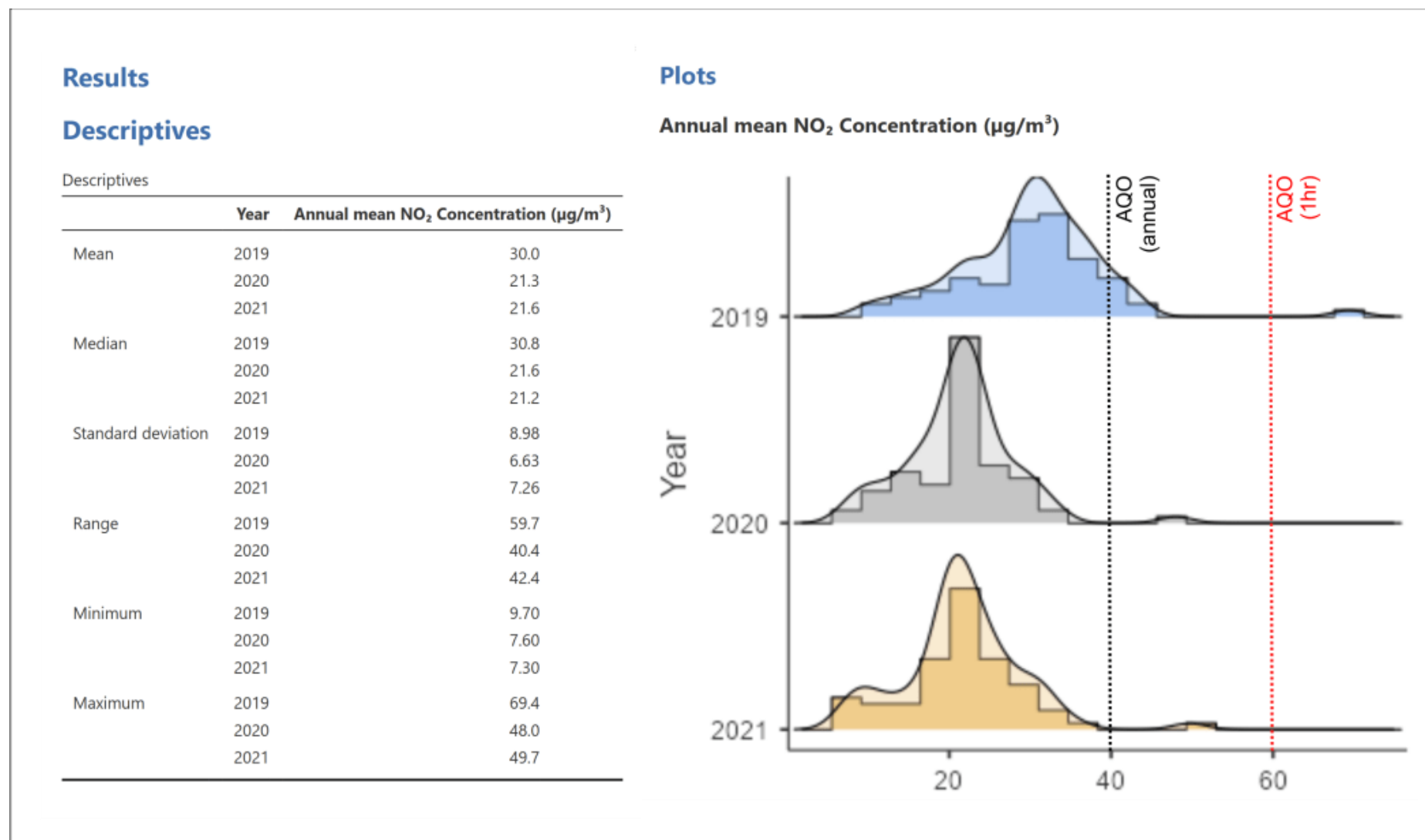
Table A.5 – 1-Hour Mean NO₂ Monitoring Results, Number of 1-Hour Means > 200µg/m³

Site ID		X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Site Type	Valid Data Capture for Monitoring Period (%) [1]	Valid Data Capture 2021 (%) [2]	2017	2018	2019	2020	2021
LN60 (HB007)		508708	221352	Roadside	99.8	99.8	0	0	0	0 (114.0)	0
LA001		512578	222204	Other	97.8	97.8			0 (65.4)	0	0
CM2 (LUTR; UKA00605)		505927	222644	Roadside	98.8	98.8	6	0	0	0	0

Notes:

Results are presented as the number of 1-hour periods where concentrations greater than 200µg/m³ have been recorded.

Exceedances of the NO₂ 1-hour mean objective (200µg/m³ 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.3 – Trends in Number of NO$_2$ 1-Hour Means > 200µg/m^3
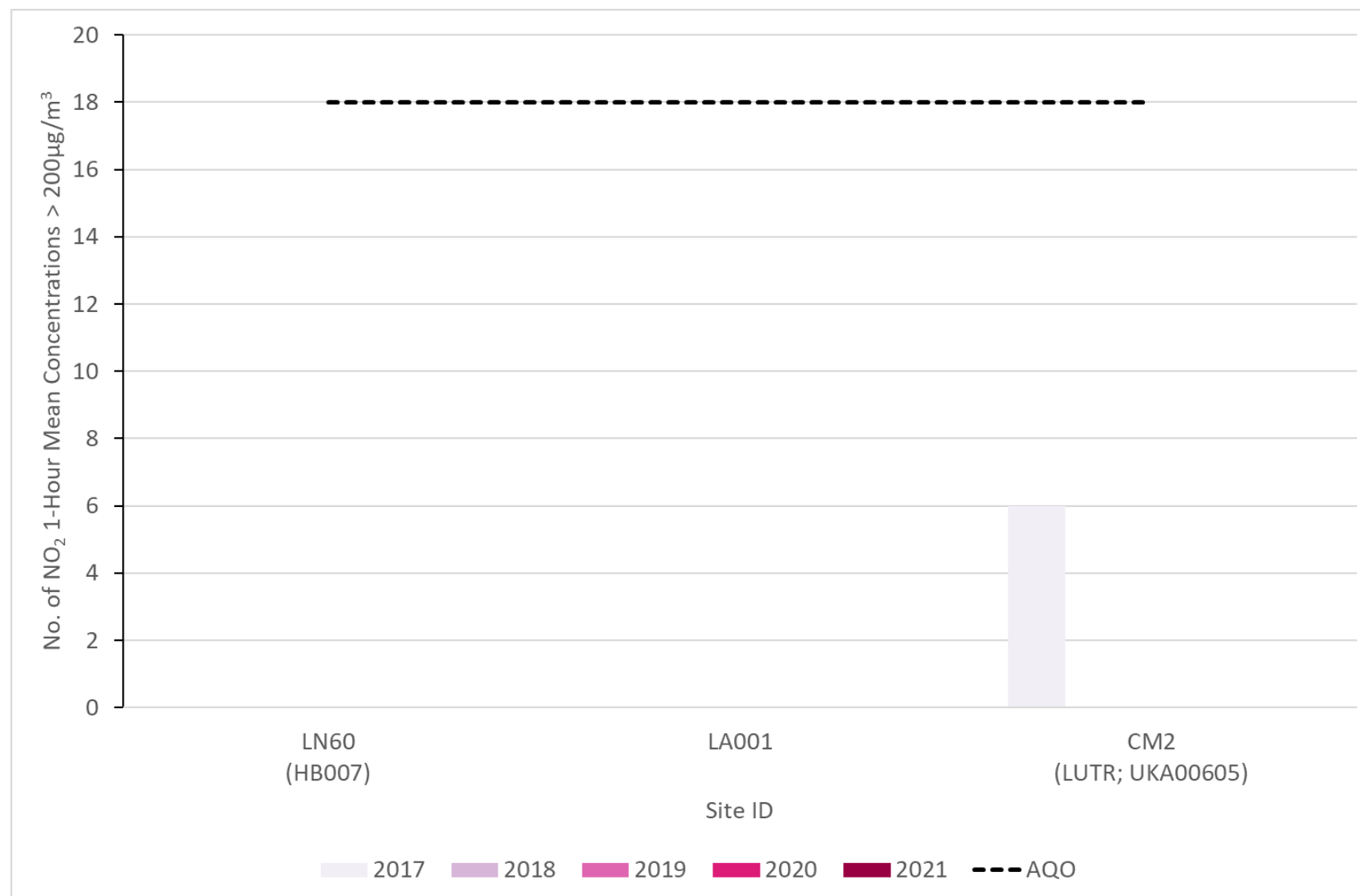
Table A.6 – Annual Mean PM$_{10}$ Monitoring Results (µg/m^3)

Site ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Site Type	Valid Data Capture for Monitoring Period (%) [1]	Valid Data Capture 2021 (%) [2]	2017	2018	2019	2020	2021
LN60 (HB007)	508708	221352	Roadside	99.7	99.7	15.7	15.6	15.8	13.8	15.0
LA08 (HB006)	511868	221144	Other	98.2	98.2	18.1	17.3	16.3	13.7	12.3
LA001	512578	222204	Other	99.0	99.0			13.5	11.7	10.3

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

Notes:

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

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

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

(1) Data capture for the monitoring period, in cases where monitoring was only carried out for part of the year.
(2) Data capture for the full calendar year (*e.g.* if monitoring was carried out for 6 months, the maximum data capture for the full calendar year is 50%).

Figure A.4 – Trends in Annual Mean PM$_{10}$ Concentrations
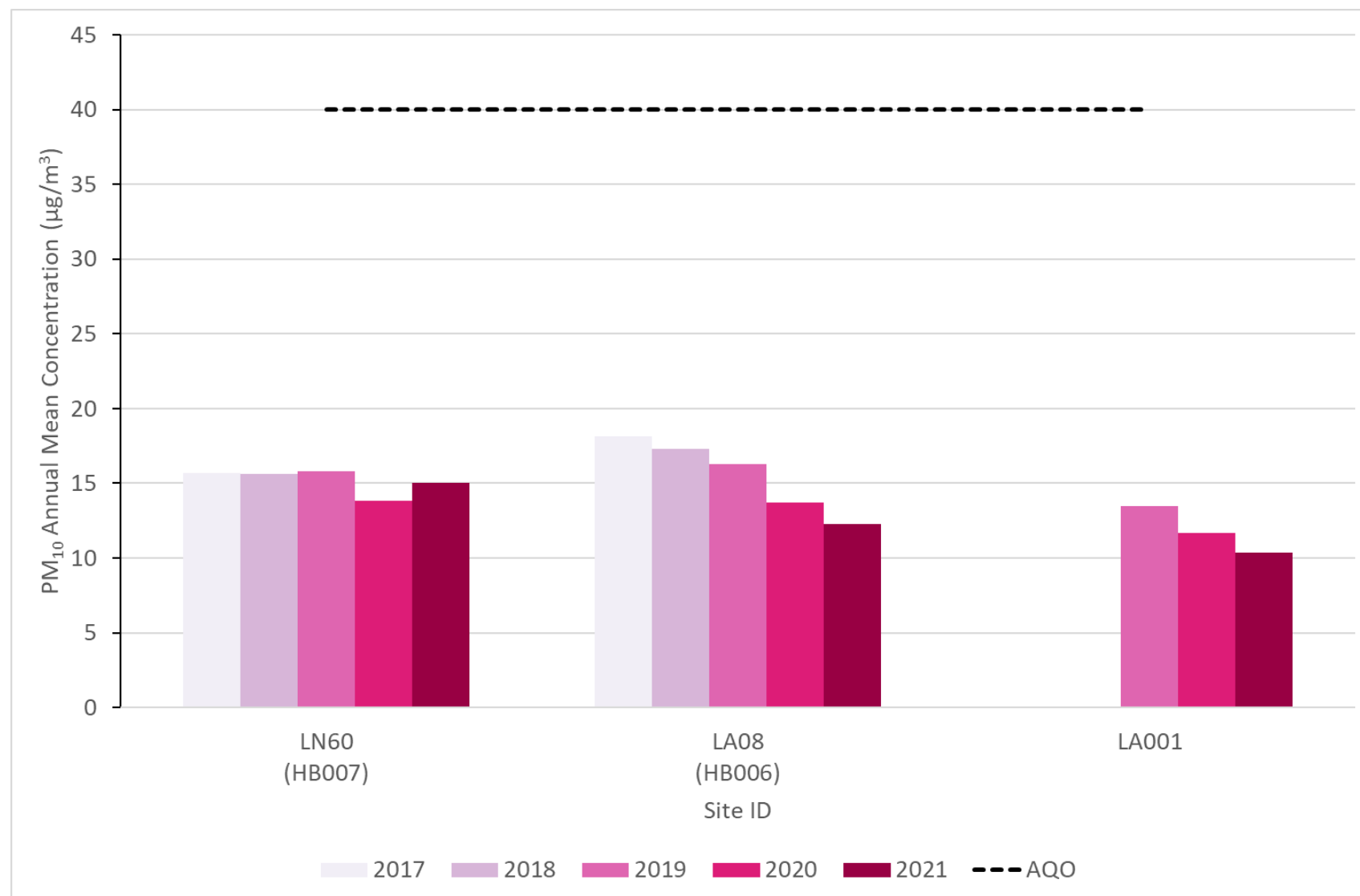
Table A.7 – 24-Hour Mean PM$_{10}$ Monitoring Results, Number of PM$_{10}$ 24-Hour Means > 50µg/m^3

Site ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Site Type	Valid Data Capture for Monitoring Period (%) [1]	Valid Data Capture 2021 (%) [2]	2017	2018	2019	2020	2021
LN60 *(HB007)*	508708	221352	Roadside	99.7	99.7	4	1	8	0	2
LA08 *(HB006)*	511868	221144	Other	98.2	98.2	1	1	1	0	0
LA001	512578	222204	Other	99.0	99.0			0 (19.6)	1 (23.1)	0

Notes:

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

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

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

(1)   Data capture for the monitoring period, in cases where monitoring was only carried out for part of the year.
(2)   Data capture for the full calendar year (*e.g.* if monitoring was carried out for 6 months, the maximum data capture for the full calendar year is 50%).

Figure A.5 – Trends in Number of 24-Hour Mean PM$_{10}$ Results > 50µg/m^3
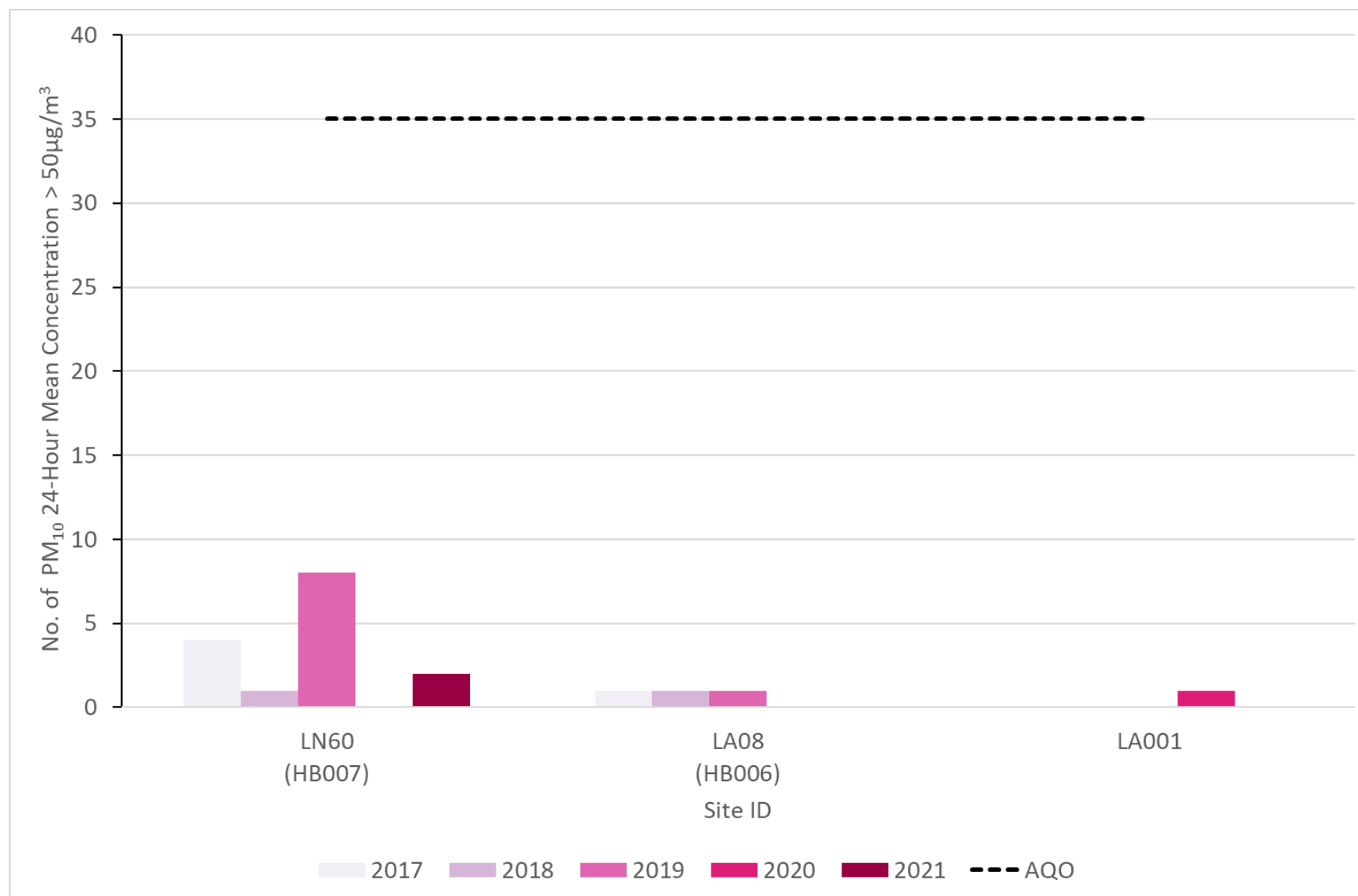
Table A.8 – Annual Mean PM₂.₅ Monitoring Results (µg/m³)

Site ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Site Type	Valid Data Capture for Monitoring Period (%) (1)	Valid Data Capture 2021 (%) (2)	2017	2018	2019	2020	2021
LN60 *(HB007)*	508708	221352	Roadside	99.7	99.7	9.8	9.6	10.0	8.3	9.2
LA001	512578	222204	Other	99.0	99.0			11.6	10.1	9.4

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

Notes:

The annual mean concentrations are presented as µg/m³.

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

(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.6 – Trends in Annual Mean PM$_{2.5}$ Concentrations
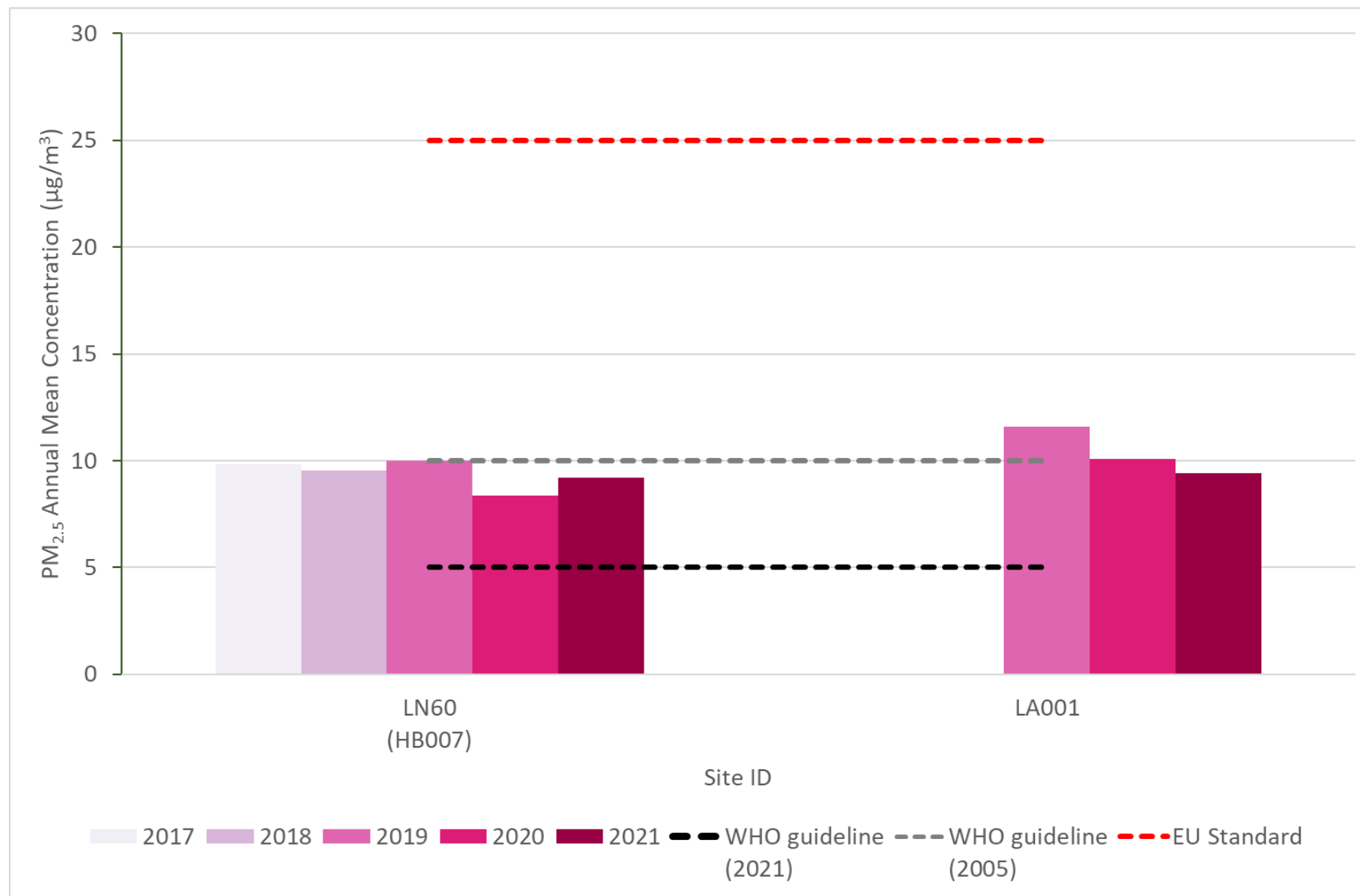
Table A.9 – SO₂ 2021 Monitoring Results, Number of Relevant Instances

Site ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Site Type	Valid Data Capture for Monitoring Period (%) [1]	Valid Data Capture 2021 (%) [2]	Number of 15-minute Means > 266μg/m³	Number of 1-hour Means > 350μg/m³	Number of 24-hour Means > 125μg/m³
LA001	512578	222204	Other	97.5	97.5	0	0	0

Notes:

Results are presented as the number of instances where monitored concentrations are greater than the objective concentration.

Exceedances of the SO₂ objectives are shown in **bold** (15-min mean = 35 allowed a year, 1-hour mean = 24 allowed a year, 24-hour mean = 3 allowed a year).

If the period of valid data is less than 85%, the relevant percentiles are 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%).

Appendix B: Full Monthly Diffusion Tube Results for 2021

Table B.1 – NO₂ 2021 Diffusion Tube Results (µg/m³)

a) Luton Borough Council (LBC) sites

DT ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Easting)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Mean: Raw Data	Annual Mean: Annualised and Bias Adjusted (0.84)	Annual Mean: Distance Corrected to Nearest Exposure	Comment
LN07	509227	221455	29.3	29.5	25.3	21.9	22.1	19.4	19.9	19.1	27.8	27.9	31.1		24.9	20.9	-	
LN11	508910	221321	42.7	40.8	42.3	36.4	31.7	34.1	33.0	28.7	36.4	31.9	42.8	35.7	36.4	30.6	-	
LN15	505557	222325	30.0	26.4	26.3	19.6		18.0	18.3	16.8	25.1	26.3	31.4	25.1	23.9	20.1	-	
LN16	505492	222607	35.7	30.9	32.3	25.8		22.3	22.4	22.5	29.0	31.4	29.9	30.3	28.4	23.9	-	
LN17	505324	222812		35.7	27.2	31.2	28.5	25.7	26.3	21.6	35.4	25.5	29.2	29.2	28.7	24.1	-	
LN18	505014	223538	25.9	27.0	21.3	24.6	18.9	16.3	19.0		23.9	16.3	24.6	22.6	21.9	18.4	-	
LN22	511341	221864	23.0	20.7	20.5	16.1	16.3	13.8	14.4	12.7	20.9	22.1	24.8	24.4	19.1	16.1	-	
LN23	511377	221814	29.2	31.6	28.1	24.0	24.9	22.7	25.2	21.7	37.3	35.6	34.2	31.1	28.8	24.2	-	
LN24	511902	222144	28.7	20.5	22.8	15.6	16.0		12.2	12.0	17.7	23.8	28.3	22.1	20.0	16.8	-	
LN25	511893	222068	25.7	24.9	23.3	18.4	21.1	16.6	19.6	17.6	28.4	31.7	30.1	28.1	23.8	20.0	-	
LN26	512109	222234	20.3	18.5	17.2	13.1	13.4	10.7	11.7	11.8	18.4	21.4	20.9	18.6	16.3	13.7	-	
LN27	512134	222198	26.2	24.4	25.4	17.7	23.1	17.0	20.5	19.2	30.8	30.2	32.0	25.2	24.3	20.4	-	
LN28	507798	219832	38.4	36.3	35.8	33.7	31.8	31.7	31.0		34.4	38.5	40.6	31.1	34.8	29.3	-	
LN52	508689	221379	36.9	44.3		50.3	41.5	44.5	45.7	35.0	46.8		46.1	34.3	42.5	35.7	-	
LN53	507717	219923	25.4	27.4	25.8	18.7	24.0	20.4	21.0	16.3	29.9	27.6	31.8	25.1	24.5	20.5	-	
LN54	507712	219915	27.3	28.6		5.2		22.5	24.8	21.4	29.3		40.5	27.4	25.2	21.2	-	
LN55	507732	219886	28.3	27.4	26.4	22.6	23.5	21.8	22.2	17.5	27.2	26.9	32.8	23.2	25.0	21.0	-	

DT ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Easting)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Mean: Raw Data	Annual Mean: Annualised and Bias Adjusted (0.84)	Annual Mean: Distance Corrected to Nearest Exposure	Comment
LN56	507747	219894	27.0	28.6	25.7	20.2	23.0	19.2	20.1	17.7	22.6	30.9	30.0	22.7	24.0	20.1	-	
LN61	508708	221352	47.2	42.9	42.2	36.3	37.4	33.5	36.8	28.4	40.7	41.4	48.4	38.4	-	-	-	Triplicate Site with LN61, LN62 and LN63 - Annual data provided for LN63 only
LN62	508708	221352	33.7	45.3	37.9	36.5	39.2	29.6	36.6	28.0	42.9	40.7	45.8	45.0	-	-	-	Triplicate Site with LN61, LN62 and LN63 - Annual data provided for LN63 only
LN63	508708	221352	39.5	43.6	36.1	35.0	37.5	28.8	34.9	27.9	43.7	37.0	46.3	36.2	38.4	32.2	-	Triplicate Site with LN61, LN62 and LN63 - Annual data provided for LN63 only
LN64	509563	220952	29.2	30.7	27.4	27.7	24.0	23.3	22.5	19.2	28.9	26.6	34.0	23.8	26.4	22.2	-	
LN65	509486	220865	27.5	25.6	27.3	24.9	19.7	20.2	19.8	17.7	23.1	23.3	29.9	21.0	23.3	19.6	-	
LN66	509288	220925	43.6	35.9		28.7	28.8	29.2	28.2	26.8	34.0	36.4	47.9	34.9	34.0	28.6	-	
LN67	509083	220709	40.3		39.2	38.4	41.0	36.0	39.6	31.0	43.6	43.2	41.0	37.2	39.1	32.9	-	
LN68	508969	220487	30.3	30.0	32.8	30.1	27.1	27.4	27.2		32.7	31.4	39.3	32.1	30.9	26.0	-	
LN69	509326	221357	29.9	32.2	29.8	29.7	27.6	26.3	24.4	20.8	34.2	33.8	34.7		29.4	24.7	-	
LN70	509813	221161	35.5	34.3	33.3		29.9	26.5	27.0	24.8	35.7	34.0	36.7	33.5	31.9	26.8	-	
LN71	509549	221623	34.1	31.6	30.7	28.7	27.1	26.9	27.0	24.8	33.0	31.4	33.0		29.8	25.1	-	
LN72	508937	221745	33.0	31.3		24.4	29.4	25.1	23.4	20.1	34.4		35.6		28.5	24.0	-	
LN73	508959	221633	37.2	42.4	36.0	29.2	37.5	31.2	32.3	29.2	43.9	43.2	39.4		36.5	30.6	-	
LN74	508165	222002	37.6	41.1	34.1	30.5	38.5	33.5	34.2	26.1	34.5	37.9	41.5		35.4	29.7	-	
LN75	508745	222122	37.7	34.7	35.9	35.8	37.0	32.6	36.9	28.5	43.4	38.6	43.9	35.1	36.7	30.8	-	
LN76	507574	222948	35.1	35.9	32.4	32.8	27.9	28.9	28.5	23.2	34.0		35.9	30.7	31.4	26.4	-	
LN77	506496	224018	36.9	34.3	34.7	24.7	30.2	24.3	27.2	22.9	36.9	36.6	39.6	32.9	31.8	26.7	-	
LN78	509109	220676	29.2	32.0	29.5	25.5	25.4	24.1	22.4	21.9	32.5	30.3	34.7	30.5	28.2	23.7	-	
LN80	509038	220719	34.3	38.5	30.3	31.0	29.1		27.3	21.7	35.8	30.3	32.5	27.6	30.7	25.8	-	
LN81	505034	223729	34.7	31.6	29.3	19.6	25.8	20.5	22.3	19.9	28.2	31.8	32.8	27.9	27.0	22.7	-	

DT ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Easting)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Mean: Raw Data	Annual Mean: Annualised and Bias Adjusted (0.84)	Annual Mean: Distance Corrected to Nearest Exposure	Comment
LN82	504828	223999	27.9	25.4	26.0	17.7	22.0	17.3		16.2	23.7	26.8	31.1	23.2	23.4	19.7	-	
LN83	505116	223467	24.9	27.6	22.7	27.1	20.1	19.2		23.7	26.0	19.1	23.8	21.4	23.2	19.5	-	
LN84	505230	223304	25.8	29.7	23.3	27.7	20.7	20.3	19.6	18.2	26.0	19.1	24.4	22.1	23.1	19.4	-	
LN85	505481	222545	31.4	26.7	29.3		23.2	21.1	21.7	20.4	25.7	28.2	34.4	25.3	26.1	21.9	-	
LN86	505586	222235	37.3	34.5	30.6	27.3		27.5		23.2	36.0	33.3	43.6		32.6	27.4	-	
LN87	510170	223162	25.9	19.6	23.6	18.2	16.5	17.0		16.0		25.0	27.6	23.3	21.3	17.9	-	
LN88	510107	223087	28.6	26.5	29.3	23.7	22.1	22.9	21.1	20.8	26.0	27.3	31.1	22.7	25.2	21.2	-	
LN89	510515	222612	27.1	26.2	22.8	21.5	18.9	16.6	17.6	14.5	24.3	23.6	27.1	23.6	22.0	18.5	-	
LN90	510846	222209	27.3	29.8	28.2	24.7	23.0		22.7	19.1	29.1	27.2	30.2	27.3	26.2	22.0	-	
LN91	511122	221721	26.6	24.7	22.7	16.0		14.9	17.5	15.6	24.8	28.5	27.3	24.1	22.1	18.5	-	
LN92	511037	221657	27.1	23.7	22.0	17.3	18.1	14.7	16.9	12.9	24.2	24.8	25.7	21.2	20.7	17.4	-	
LN93	511332	223069	18.4	17.5					9.3	9.2	15.1	16.4	19.4	16.4	15.2	12.1	-	
LN94	511327	222588	20.1	19.0	17.1	10.5	11.9	9.4	11.1	9.8	16.6	20.5		18.7	15.0	12.6	-	
LN95	511996	222534	21.9	20.1	17.4	10.0	12.9	9.3	10.5	9.8	16.5	20.4	20.8	19.2	15.7	13.2	-	
LN96	509059	220656				42.9	40.9	39.4	45.5	32.2	53.5	46.2	39.6	35.5	41.8	35.1	-	

☒ All erroneous data has been removed from the NO₂ diffusion tube dataset presented in Table B.1.

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

☐ Local bias adjustment factor used.

☒ National bias adjustment factor used.

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

☒ Luton Borough Council confirm that all 2021 diffusion tube data has been uploaded to the Diffusion Tube Data Entry System.

Notes:

Exceedances of the NO$_2$ annual mean objective of 40µg/m^3 are shown in **bold**.

NO$_2$ annual means exceeding 60µg/m^3, indicating a potential exceedance of the NO$_2$ 1-hour mean objective are shown in **<u>bold and underlined</u>**.

See Appendix C for details on bias adjustment and annualisation.

b) London Luton Airport Operations Ltd (LLAOL) sites

DT ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Easting)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Mean: Raw Data	Annual Mean: Annualised and Bias Adjusted (0.78)	Annual Mean: Distance Corrected to Nearest Exposure	Comment
LLA 1	511920	221334	25.1	21.3	15.9	16.3		19.0	22.0	25.5		34.4	37.5	35.4	25.2	19.7	-	
LLA 2	511579	220960	19.8	20.3	21.2	16.7	16.9	20.0	18.9	20.0	29.6	31.7	37.9	33.2	23.9	18.6	-	
LLA 3	511170	220436	26.4	17.2		13.5	13.7	13.4	12.6	12.9	18.8	22.2	29.6	25.7	18.7	14.6	-	
LLA 4	513644	221207	16.5	13.8	11.8	8.1	10.2	9.0	6.4	9.3	15.1	18.4	22.2	20.0	13.4	10.5	-	
LLA 5	511711	221337	29.1	21.0	21.0	18.0	17.7	16.6	22.4	26.8	40.3	41.9	38.0	44.3	28.1	21.9	-	
LLA 6	511682	221727	25.6	22.3	23.1	17.0	19.7	17.5	18.6	19.4	31.3	38.5	37.7	40.2	25.9	20.2	-	
LLA 7	512105	221168	28.7	20.2	23.8	20.4	24.6		31.2	33.8	43.5	47.5	46.2	41.0	32.8	25.6	-	
LLA 8	511867	221148	27.5	19.3	19.2	15.1	15.9	19.2	19.0	21.4	31.7	41.5	34.0	46.3	25.8	20.2	-	
LLA 9	517602	222572	14.7	12.0			6.3	5.0	5.0	5.0	9.2		11.0	15.7	9.3	7.3	-	
LLA 10	507667	217744	15.2	12.0	10.0	8.4	7.3	6.6	7.8	4.5	9.7	12.9	11.8	16.5	10.2	8.0	-	
LLA 11	513140	220669	16.3	8.0	9.3	8.2	6.4		6.8		11.7	1.2		16.8	9.4	7.3	-	
LLA 12	511886	221566	28.4	24.6	18.2	16.1	17.5	19.2	22.3	23.7	39.4	45.1	36.8	45.6	28.1	21.9	-	
LLA 13	511901	222055	25.2	21.0	21.6	18.5	11.4	15.2	14.7	9.5	24.9		25.7	30.6	19.8	15.5	-	
LLA 14	511995	221316	29.3	25.2	18.2	16.5	19.1	19.0	23.3	25.1	36.4	37.9	36.9	35.5	26.9	21.0	-	
LLA 15	511168	221706	35.0	25.6	29.0	25.3	22.3	23.7	25.2	20.0	36.9	36.7	36.0	34.0	29.1	22.7	-	
LLA 16	512275	221115	28.6	25.0	18.1	13.4	14.4	13.4	9.4	17.8	30.8	36.2	32.9	37.7	23.1	18.1	-	
LLA 17	509489	219237	24.7	27.6	25.1	22.8	17.8	27.2	21.9	24.1	31.2	34.0	36.7	37.2	27.5	21.5	-	
LLA 18	510779	220279	30.8	28.7	24.2	24.1	18.0	23.1	22.3	22.4	32.1	31.2	33.0	30.6	26.7	20.8	-	
LLA 19	515109	221933	15.8	13.2	10.5			7.1	5.7	5.1	12.0	13.3	12.4	17.7	11.3	8.8	-	

☒ **All erroneous data has been removed from the NO$_2$ diffusion tube dataset presented in Table B.1.**

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

☐ **Local bias adjustment factor used.**

☒ **National bias adjustment factor used.**

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

☒ **Luton Borough Council confirm that all 2021 diffusion tube data has been uploaded to the Diffusion Tube Data Entry System.**

Notes:

Exceedances of the NO$_2$ annual mean objective of 40µg/m^3 are shown in **bold**.

NO$_2$ annual means exceeding 60µg/m^3, indicating a potential exceedance of the NO$_2$ 1-hour mean objective are shown in **bold and underlined**.

See Appendix C for details on bias adjustment and annualisation.

c) Luton Rising sites

DT ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Easting)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Time Weighted Annual Mean: Raw Data	Time Weighted Annual Mean: Annualised and Bias Adjusted (0.84)	Time Weighted Annual Mean: Distance Corrected to Nearest Exposure	Comment
L1(i)	508710	221353	41.3	40.5		36.6	42.7	33.5	33.0	26.3	47.2	42.7	46.5	37.4	-	-	-	Triplicate Site with L1(i), L1(ii) and L1(iii) - Annual data provided for L1(iii) only
L1(ii)	508710	221353	35.3	43.4		40.2	41.4	33.4	32.8	24.2	44.4	44.9	40.6	35.6	-	-	-	Triplicate Site with L1(i), L1(ii) and L1(iii) - Annual data provided for L1(iii) only
L1(iii)	508710	221353	43.8	46.0		35.1	42.6	34.1	35.6	27.6	45.8	43.8	41.3	35.1	38.4	32.2	-	Triplicate Site with L1(i), L1(ii) and L1(iii) - Annual data provided for L1(iii) only
L2(i)	511155	222445	36.0	34.8		26.6	27.5	22.3	23.3	20.8	26.6	30.1	30.7	28.4	-	-	-	Duplicate Site with L2(i) and L2(ii) - Annual data provided for L2(ii) only
L2(ii)	511155	222445	34.7	34.0		28.0	25.8	23.8	23.9	17.9	29.3	29.3	31.6	32.1	27.9	23.4	-	Duplicate Site with L2(i) and L2(ii) - Annual data provided for L2(ii) only
L3(i)	511780	222760	32.9	31.3						16.3	26.1	30.8	30.0		-	-	-	Duplicate Site with L3(i) and L3(ii) - Annual data provided for L3(ii) only
L3(ii)	511780	222760	32.1	30.9						17.3	27.7	33.8	30.1		28.1	21.7	-	Duplicate Site with L3(i) and L3(ii) - Annual data provided for L3(ii) only
L4(i)	513223	222397	19.9	17.1		10.3	13.6	11.1	10.4	11.6	15.8	18.4	17.5	19.2	-	-	-	Duplicate Site with L4(i) and L4(ii) - Annual data provided for L4(ii) only
L4(ii)	513223	222397	20.5	16.5		10.1	12.9	11.2	11.1	10.7	17.1	20.0	19.2	15.9	14.8	12.5	-	Duplicate Site with L4(i) and L4(ii) - Annual data provided for L4(ii) only
L5(i)	515047	221904	16.7	15.8		7.5	8.7	7.3	7.5	8.1	10.9	12.6	13.0	14.6	-	-	-	Duplicate Site with L5(i) and L5(ii) - Annual data provided for L5(ii) only
L5(ii)	515047	221904	14.6	13.8		8.4	8.4	5.5	7.3	7.6	11.6	12.9	14.0	13.9	10.8	9.1	-	Duplicate Site with L5(i) and L5(ii) - Annual data provided for L5(ii) only
L6(i)	513773	221752	17.2	14.8		8.5	10.1	8.4	9.0	8.8	11.6	13.9	16.1	15.5	-	-	-	Duplicate Site with L6(i) and L6(ii) - Annual data provided for L6(ii) only
L6(ii)	513773	221752	17.5	15.7		8.6	10.1	9.1	8.8	9.7	11.6	14.5	15.7	14.1	12.1	10.2	-	Duplicate Site with L6(i) and L6(ii) - Annual data provided for L6(ii) only
L7(i)	511057	221386	65.6	60.2		48.4	65.9	60.5		58.5	69.0	63.4	55.7		-	-	-	Duplicate Site with L7(i) and L7(ii) - Annual data provided for L7(ii) only
L7(ii)	511057	221386	60.9	-		49.2	61.6	50.6		56.4			55.6		59.1	**49.7**	-	Duplicate Site with L7(i) and L7(ii) - Annual data provided for L7(ii) only
L8(i)	510543	220706	32.4	32.4		24.4	24.5	20.3	21.5	17.3	28.7	30.7	32.6	30.6	-	-	-	Duplicate Site with L8(i) and L8(ii) - Annual data provided for L8(ii) only
L8(ii)	510543	220706	32.9	32.1		23.8	25.2	20.5	21.4	18.0		31.0	30.2	29.2	26.6	22.3	-	Duplicate Site with L8(i) and L8(ii) - Annual data provided for L8(ii) only
L9a(i)	510552	220660	25.0	27.7		20.3	19.7	18.4	17.6	15.9	27.6				-	-	-	Duplicate Site with L9a(i) and L9a(ii) - Annual data provided for L9a(ii) only
L9a(ii)	510552	220660	27.5	26.3		21.3	21.5	17.4	18.6	17.3	27.5				21.5	19.5	-	Duplicate Site with L9a(i) and L9a(ii) - Annual data provided for L9a(ii) only
L10(i)	506541	219854	26.7	22.9		20.7	20.6	19.6	20.1	18.4	26.3	23.4	31.0	23.0	-	-	-	Duplicate Site with L10(i) and L10(ii) - Annual data provided for L10(ii) only

DT ID	X OS Grid Ref (Easting)	Y OS Grid Ref (Easting)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Time Weighted Annual Mean: Raw Data	Time Weighted Annual Mean: Annualised and Bias Adjusted (0.84)	Time Weighted Annual Mean: Distance Corrected to Nearest Exposure	Comment
L10(ii)	506541	219854	25.6	24.4		20.6	19.6	19.2	19.7	17.7	26.3	25.0	31.5	22.2	22.7	19.1	-	Duplicate Site with L10(i) and L10(ii) - Annual data provided for L10(ii) only
L11(i)	512569	222207	20.7	15.4		8.6	10.0	9.8	8.4	9.1		21.1	22.2	16.1	-	-	-	Triplicate Site with L11(i), L11(ii) and L11(iii) - Annual data provided for L11(iii) only
L11(ii)	512569	222207	17.9	14.2		10.4	11.7	8.1	8.9	8.9		18.2	19.3	20.6	-	-	-	Triplicate Site with L11(i), L11(ii) and L11(iii) - Annual data provided for L11(iii) only
L11(iii)	512569	222207	16.4	14.5		9.0	9.9	8.4	8.0	10.2		18.1	19.5	18.0	13.6	11.5	-	Triplicate Site with L11(i), L11(ii) and L11(iii) - Annual data provided for L11(iii) only

☒ **All erroneous data has been removed from the NO₂ diffusion tube dataset presented in Table B.1.**

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

☐ **Local bias adjustment factor used.**

☒ **National bias adjustment factor used.**

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

☒ **Luton Borough Council confirm that all 2021 diffusion tube data has been uploaded to the Diffusion Tube Data Entry System.**

Notes:

Exceedances of the NO₂ annual mean objective of 40µg/m³ are shown in **bold**.

NO₂ annual means exceeding 60µg/m³, indicating a potential exceedance of the NO₂ 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 Luton Borough Council During 2021/22

Luton Borough Council has not identified any new sources relating to air quality within the reporting year of 2021/22.

Additional Air Quality Works Undertaken by Luton Borough Council During 2021/22

During the reporting year 2021/2022, Luton Borough Council commissioned environmental consultants to undertake a new source apportionment and options appraisal study for Luton AQMA $N^{o.}$ 3. Due to be completed by August 2022, the findings of this study will be used to inform the development of a new AQAP.

In addition to the commissioned study, LBC also purchased and deployed a network of five sensor-based indicative air quality monitors at congestion hotspots across the borough, as well as adding 21 new NO_2 diffusion tube sites to its passive monitoring programme (representing a 40% increase in the total number of tubes deployed by LBC). Details of these additional monitoring locations, the ratified data from which will be included in future ASRs, are provided in Appendix F.

QA/QC of Automatic Monitoring

The nitrogen dioxide analyser on Dunstable Road East (*LN60 / HB007*) is subject to fortnightly routine calibration by a Luton Borough Council Officer. The co-located FIDAS particulate analyser does not require calibration. Both instruments are maintained by Acoem and are routinely serviced on a six monthly basis.

All automatic monitoring data collected at the Dunstable Road East, London Luton Airport *(LA08)* and Luton A505 Roadside *(LUTR)* sites is managed by Ricardo Energy & Environment using the quality control procedures utilised by Defra's national air quality network stations. These procedures represent best practice and fully meet the requirements set out in *LAQM.TG16*. Ricardo Energy & Environment currently provide

UKAS accredited quality control audits and data management services to all Defra national network (AURN) air quality monitoring stations.

All data collected at the above sites is screened and scaled (based on site calibrations) and the final data sets presented within this report (Figure C.1, Figure C.2 and Figure C.3) have benefitted from a full process of data ratification, including thorough additional data quality checks and a ratification process that corrects data for instrument sensitivity drift between routine calibrations.

All automatic monitoring data collected at Luton Rising's *London Luton Airport FutureLuToN (LA001)* site during 2021 has been validated and ratified by Air Quality Data Management (AQDM) to the standards described in *LAQM.TG(16)*, with Enviro Technology Services undertaking routine calibration and fulfilling local site operator (LSO) duties. The site datasets published online (summarised in Figure C.4) are managed by Ricardo Energy & Environment in full compliance with the requirements of *LAQM.TG(16)*, which includes the screening, validation and ratification of the raw data.

Live and historical data for all automatic monitoring sites is available via the *Herts & Beds Air Quality Network* pages on the Air Quality England website [https://tinyurl.com/khvpphd5].

Figure C.1 - 2021 Air Pollution Report – LN60: Luton Dunstable Road East (Site ID: HB007)

Source: https://tinyurl.com/mrycaavr

Air Pollution Report

1st January to 31st December 2021

Air Quality England

Luton Dunstable Road East (Site ID: HB007)

These data have been fully ratified
Only relevant statistics for LAQM are presented in the table. Cells with - indicate no data available or calculated.

Pollutant	NO µg/m³	NO₂ µg/m³	NOₓ as NO₂ µg/m³	PM₁₀ µg/m³	PM₂₅ µg/m³
Number Days Low	-	365	-	363	363
Number Days Moderate	-	0	-	2	2
Number Days High	-	0	-	0	0
Number Days Very High	-	0	-	0	0
Max Daily Mean	140	84	276	55	45
Annual Max	419	165	741	86	62
Annual Mean	24	30	67	15	9
98th Percentile of daily mean	-	-	-	39	-
90th Percentile of daily mean	-	-	-	25	-
99.8th Percentile of hourly mean	-	110	-	-	-
98th Percentile of hourly mean	109	75	240	45	29
95th Percentile of hourly mean	73	64	172	34	22
50th Percentile of hourly mean	16	27	52	12	7
% Annual data capture	99.79	99.79	99.79	99.67	99.67

Instruments:
PM_{10}: FIDAS
PM_{25}: FIDAS

All gaseous pollutant mass units are at 20°C and 1013mb. Particulate matter concentrations are reported at ambient temperature and pressure. NO_X mass units are NO_X as NO_2 µg m-3

1 / 3
Report produced by Ricardo Energy & Environment

Pollutant	Air Quality Standards regulations 2010	Exceedances	Days
PM10 particulate matter (Hourly measured)	daily mean > 50 microgrammes per metre cubed	2	2
PM10 particulate matter (Hourly measured)	Annual mean > 40 microgrammes per metre cubed	0	-
PM2.5 particulate matter (Hourly measured)	Annual mean > 25 microgrammes per metre cubed	0	-
Nitrogen dioxide	Hourly Mean > 200 microgrammes per metre cubed	0	0
Nitrogen dioxide	**Annual Mean > 40 microgrammes per metre cubed**	**0**	**-**

Annual Graph

Luton Dunstable Road East 01/01/2021 - 31/12/2021
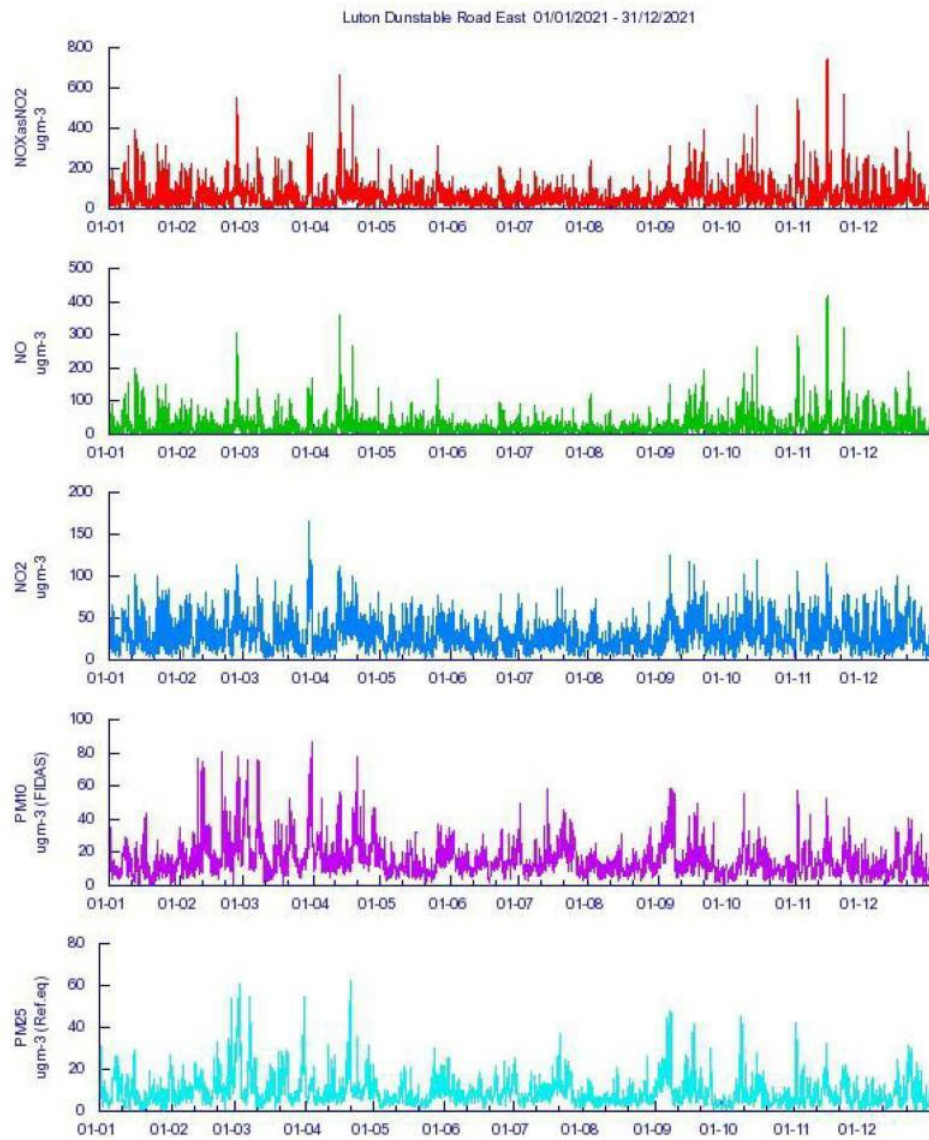
3 / 3
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Figure C.2 -   2021 Air Pollution Report – LA08: London Luton Airport (Site ID: HB006)

Source: https://tinyurl.com/mjhs2m4c

Air Pollution Report

1st January to 31st December 2021

Air Quality England

London Luton Airport (Site ID: HB006)

These data have been fully ratified
Only relevant statistics for LAQM are presented in the table. Cells with - indicate no data available or calculated.

Pollutant	PM$_{10}$ µg/m³
Number Days Low	357
Number Days Moderate	0
Number Days High	0
Number Days Very High	0
Max Daily Mean	36
Annual Max	86
Annual Mean	12
98th Percentile of daily mean	28
90th Percentile of daily mean	19
98th Percentile of hourly mean	32
95th Percentile of hourly mean	25
50th Percentile of hourly mean	11
% Annual data capture	**98.15**

Instruments:
PM$_{10}$: BAM Gravimetric Equivalent (correction applied)

All gaseous pollutant mass units are at 20°C and 1013mb. Particulate matter concentrations are reported at ambient temperature and pressure. NO$_X$ mass units are NO$_X$ as NO$_2$ µg m-3

1 / 2
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Pollutant	Air Quality Standards regulations 2010	Exceedances	Days
PM$_{10}$ particulate matter (Hourly measured)	daily mean > 50 microgrammes per metre cubed	0	0
PM$_{10}$ particulate matter (Hourly measured)	**Annual mean > 40 microgrammes per metre cubed**	**0**	-

Annual Graph

London Luton Airport 01/01/2021 - 31/12/2021

2 / 2
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Figure C.3 - 2021 Air Pollution Report – CM2 : Luton A505 Roadside (Site ID: LUTR)

Source: https://tinyurl.com/4j26dxu3

Air Pollution Report

1st January to 31st December 2021

Air Quality England

Luton A505 Roadside (Site ID: LUTR)

These data have been fully ratified
Only relevant statistics for LAQM are presented in the table. Cells with - indicate no data available or calculated.

| Pollutant	NO µg/m³	NO₂ µg/m³	NOₓ as NO₂ µg/m³
Number Days Low	-	365	-
Number Days Moderate	-	0	-
Number Days High	-	0	-
Number Days Very High	-	0	-
Max Daily Mean	173	75	330
Annual Max	453	142	802
Annual Mean	36	31	87
99.8th Percentile of hourly mean	-	106	-
98th Percentile of hourly mean	157	85	316
95th Percentile of hourly mean	116	72	247
50th Percentile of hourly mean	21	28	62
% Annual data capture	99.44	98.85	98.85

All gaseous pollutant mass units are at 20°C and 1013mb. Particulate matter concentrations are reported at ambient temperature and pressure. NOₓ mass units are NOₓ as NO₂ µg m-3

Pollutant	Air Quality Standards regulations 2010	Exceedances	Days
Nitrogen dioxide	Hourly Mean > 200 microgrammes per metre cubed	0	0
Nitrogen dioxide	**Annual Mean > 40 microgrammes per metre cubed**	**0**	-

1 / 2
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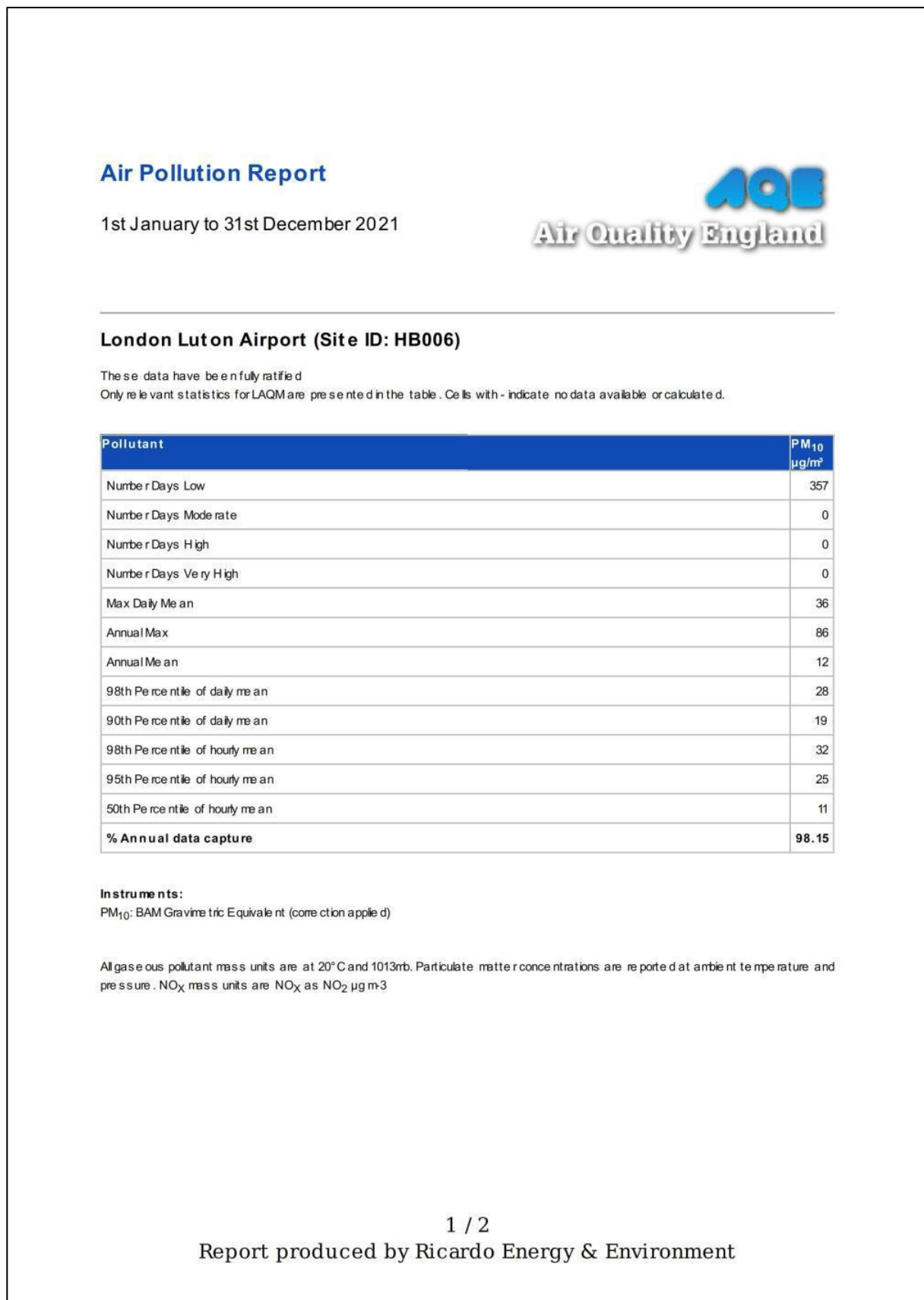
Annual Graph

Luton A505 Roadside 01/01/2021 - 31/12/2021

2 / 2
Report produced by Ricardo Energy & Environment

Figure C.4 - 2021 Air Pollution Report – LA001 : London Luton Airport FutureLuToN

Source: https://tinyurl.com/4787abwm

Air Pollution Report

1st January to 31st December 2021

Air Quality England

Luton Airport FutureLuToN (Site ID: LA001)

These data have been fully ratified
Only relevant statistics for LAQM are presented in the table. Cells with - indicate no data available or calculated.

Pollutant	O$_3$ µg/m³	NO µg/m³	NO$_2$ µg/m³	NO$_x$ as NO$_2$ µg/m³	SO$_2$ µg/m³	CO mg/m³	PM$_{10}$ µg/m³	PM$_{25}$ µg/m³	BC µg/m³	C$_6$H$_6$ µg/m³	TOLUENE µg/m³	ETHBENZ µg/m³	mpXYLENE µg/m³	oXYLENE µg/m³
Number Days Low	362	-	362	-	0	0	361	360	0	0	0	0	0	0
Number Days Moderate	12	-	0	-	0	0	0	1	0	0	0	0	0	0
Number Days High	0	-	0	-	0	0	0	0	0	0	0	0	0	0
Number Days Very High	0	-	0	-	0	0	0	0	0	0	0	0	0	0
Max 15 min SO2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Max 8 Hour CO	-	-	-	-	-	1	-	-	-	-	-	-	-	-
Max 8 Hour Ozone	138	-	-	-	-	-	-	-	-	-	-	-	-	-
Max Daily Mean	101	23	42	60	3	0	41	40	1	1	3	1	4	2
Annual Max	145	122	84	244	5	1	135	118	4	3	25	11	39	14
Annual Mean	53	2	11	14	1	0	10	9	0	0	0	0	0	0
98th Percentile of daily mean	-	-	-	-	-	-	26	-	-	-	-	-	-	-
90th Percentile of daily mean	-	-	-	-	-	-	18	-	-	-	-	-	-	-

1 / 5

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99.9th Percentile of 15 minute mean	-	-	-	-	-	-	-	-	-	-	-	-	-	-
99.8th Percentile of hourly mean	-	-	64	-	-	-	-	-	-	-	-	-	-	-
99.7th Percentile of hourly mean	-	-	-	-	3	-	-	-	-	-	-	-	-	-
98th Percentile of hourly mean	96	10	42	54	2	0	33	31	1	1	2	1	4	2
95th Percentile of hourly mean	86	5	32	38	1	0	25	23	1	0	1	0	2	1
50th Percentile of hourly mean	54	1	8	10	1	0	8	7	0	0	0	0	0	0
% Annual data capture	98.04	97.83	97.83	97.83	97.50	97.87	98.98	98.98	97.93	83.23	82.33	70.67	81.03	73.55

Instruments:

PM_{10}: GRIMM EDM 180

PM_{25}: GRIMM EDM 180

All gaseous pollutant mass units are at 20°C and 1013mb. Particulate matter concentrations are reported at ambient temperature and pressure. NO_X mass units are NO_X as NO_2 µg m-3

2 / 5

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Pollutant	Air Quality Standards regulations 2010	Exceedances	Days
Carbon monoxide	Daily maximum 8-hour running mean > 10 milligrammes per metre cubed	0	0
PM$_{10}$ particulate matter (Hourly measured)	daily mean > 50 microgrammes per metre cubed	0	0
PM$_{10}$ particulate matter (Hourly measured)	Annual mean > 40 microgrammes per metre cubed	0	-
PM$_{2.5}$ particulate matter (Hourly measured)	Annual mean > 25 microgrammes per metre cubed	0	-
Nitrogen dioxide	Hourly Mean > 200 microgrammes per metre cubed	0	0
Nitrogen dioxide	Annual Mean > 40 microgrammes per metre cubed	0	-
Ozone	8-hour running mean > 100 microgrammes per metre cubed	71	12
Sulphur dioxide	15 Minute mean > 266 microgrammes per metre cubed	0	0
Sulphur dioxide	Hourly mean > 350 microgrammes per metre cubed	0	0
Sulphur dioxide	Daily Mean > 125 microgrammes per metre cubed	0	0
Sulphur dioxide	Annual mean > 20 microgrammes	0	-

3 / 6

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	per metre cubed		
Sulphur dioxide	**Winter Mean > 20 microgrammes per metre cubed**	0	-

4 / 5

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Annual Graph

Luton Airport FutureLuToN 01/01/2021 - 31/12/2021
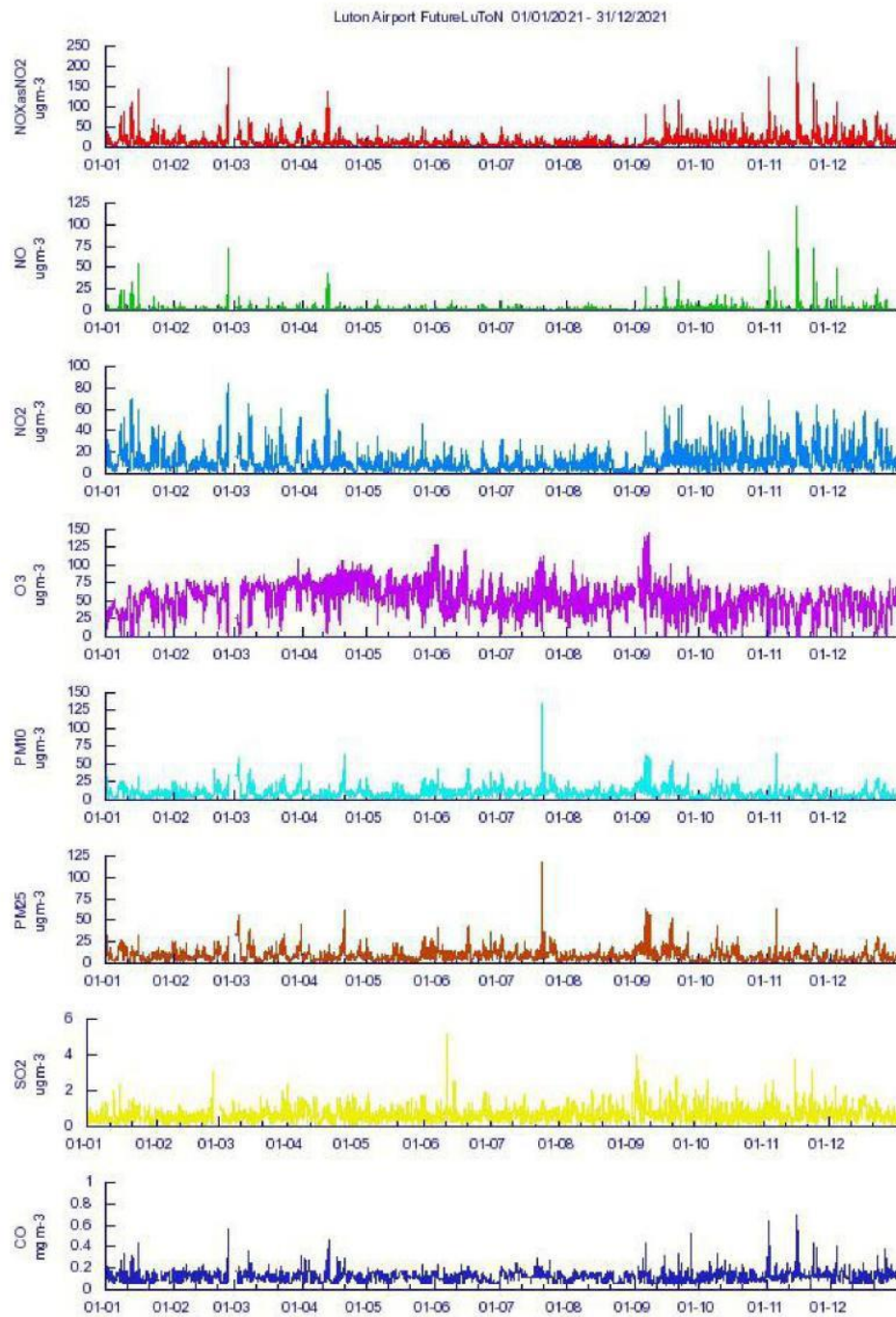
5 / 5
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PM$_{10}$ and PM$_{2.5}$ Monitoring Adjustment

Particulate monitoring is undertaken at three sites within Luton:

i) *LN60 (HB007)* – Dunstable Road East [https://w3w.co/final.much.shots]; LBC operated Palas Fidas 200 measuring both PM$_{10}$ and PM$_{2.5}$. No correction applied to PM$_{10}$ data. Correction factor of 0.9434 applied to PM$_{2.5}$ data (*i.e.* divide by 1.06).

ii) *LA08 (HB006)* – London Luton Airport [https://w3w.co/client.taxi.super]; LLAOL operated unheated Beta Attenuation Mass Monitor (BAM) measuring PM$_{10}$, correction factor of 0.8333 applied (*i.e.* divide by 1.2).

iii) *LA001* – London Luton Airport FutureLuTon (Wigmore Valley Park) [https://w3w.co/feared.same.format]; LLAL operated GRIMM EDM 180 measuring both PM$_{10}$ and PM$_{2.5}$. No correction factor applied to either PM$_{10}$ or PM$_{2.5}$ data. It should be noted that the instrument used at this location is not of a type approved by Defra (as detailed in *LAQM.TG16 Para 7.164*).

Automatic Monitoring Annualisation

All automatic monitoring locations within Luton Borough Council recorded data capture of greater than 75% therefore it was not required to annualise any monitoring data. In addition, any sites with a data capture below 25% do not require annualisation.

QA/QC of Diffusion Tube Monitoring

The tubes deployed by both Luton Borough Council and Luton Rising are supplied by Gradko International Ltd. and use a preparation of 20% Triethanolamine (TEA) in deionised water. The exposed tubes are analysed in accordance with Gradko's documented in-house *Laboratory Method GLM7* which complies with the guidelines set out in Defra's *'Diffusion Tubes for Ambient NO$_2$ Monitoring: Practical Guidance'* [https://tinyurl.com/j6976rah]. The analysis of diffusion tube samples to determine the amount of nitrogen dioxide present on the tubes is within the scope of their UKAS schedule. Gradko participates in the AIR NO$_2$ PT scheme, with the most recently published results at time of writing indicating that during the early part of 2021, 25% of QC

samples were analysed satisfactorily[8]. For the whole year, reported nitrogen dioxide diffusion tube collocation studies indicate that the laboratory achieved good precision in all 32 studies where tubes prepared with 20% TEA in water were used[9].

The tubes deployed by LLAOL are supplied by SOCOTEC Didcot and use a preparation of 50% TEA in acetone. Analysed in accordance with SOCOTEC's standard operating procedure ANU/SOP/1015, during 2021 the laboratory achieved good precision in 20 out of 23 reported collocation studies where 50% TEA in acetone tubes were used[9]. Also a participant in the AIR NO_2 PT scheme, during early 2021 all 100% of the QC samples tested by SOCTEC were deemed to have been analysed satisfactorily[8].

Using the *Diffusion Tube Data Processing Tool v2.0* [https://tinyurl.com/e9zdbnxr] to check the precision of replicate tube data, the results for the triplicate LBC tubes (LN61/62/63) co-located with the continuous analyser on Dunstable Road East were shown to demonstrate *"Good precision"* ()   Luton Borough Council (LBC) co-location study). Undertaking a similar check on the triplicate sets of Luton Rising tubes co-located with the continuous analysers on both Dunstable Road East (*L1*) and Wigmore Valley Park (*L11*), a similar result was obtained with both sets also being shown to have *"Good precision"* (a)
        Luton Borough Council (LBC) co-location study).

During 2021, all of LBC's diffusion tubes were exposed in adherence with that year's *Diffusion Tube Monitoring Calendar* [https://tinyurl.com/kawdzjmu], with all tubes being exposed and collected within ±1 day of the specified date in accordance with both *LAQM.TG16 Para 7.191* and the ±2 day tolerance referred to in the *Important Notes* tab of the *Diffusion Tube Processing Tool*. During this same period, the LLAOL and Luton Rising programmes both deviated from the monitoring calendar, with LLAOL's exposure and collection dates differing by more than ±2 days for 2 monitoring periods (a)   London Luton Airport Operations Ltd. (LLAOL)) and Luton Rising's for 4 periods (b)   Luton Rising). Furthermore, at only 3 weeks, the duration of Luton Rising's initial monitoring period (Jan) was less than the *LAQM.TG(16)* recommended minimum of 4 weeks (-4 days). Consequently, rather than a simple annual mean, the reported results output by the

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[8] Defra / LGC (March 2021) - Summary of Laboratory Performance in AIR NO_2 Proficiency Testing Scheme (January 2019 – March 2021); https://tinyurl.com/5n7n9jfz

[9] Defra (April 2022) – National Diffusion Tube Bias Adjustment Factor Spreadsheet version 03/22; https://tinyurl.com/5n85xbkr

Diffusion Tube Processing Tool for the Luton Rising dataset are time weighted. *LAQM.TG(16)* para 7.191 notes that deviation from the recommended exposure period may have a detrimental effect on data quality, stating that:

> *"If diffusion tubes are left out for significantly longer or shorter periods than the four and five weeks recommended, then the data may not be reliable as the diffusion rate may not have been accurately defined."*

Table C.1 - Comparison of Diffusion Tube Deployment Dates with 2020 Monitoring Calendar

a)   London Luton Airport Operations Ltd. (LLAOL)

Month	Calendar ON date	Calendar OFF date	Calendar Exposure (Days)	Calendar Exposure (Weeks)	LLAOL ON date	LLAOL OFF date	LLAOL Exposure (Days)	LLAOL Exposure (Weeks)	Deviation From Calendar ON date (Days)	Deviation From Calendar OFF date (Days)
Jan	06/01/2021	03/02/2021	28	4.0	06/01/2021	03/02/2021	28	4.0	0	0
Feb	03/02/2021	03/03/2021	28	4.0	03/02/2021	03/03/2021	28	4.0	0	0
Mar	03/03/2021	31/03/2021	28	4.0	03/03/2021	31/03/2021	28	4.0	0	0
Apr	31/03/2021	05/05/2021	35	5.0	31/03/2021	05/05/2021	35	5.0	0	0
May	05/05/2021	02/06/2021	28	4.0	05/05/2021	02/06/2021	28	4.0	0	0
Jun	02/06/2021	30/06/2021	28	4.0	02/06/2021	29/06/2021	27	3.9	0	-1
Jul	30/06/2021	04/08/2021	35	5.0	29/06/2021	05/08/2021	37	5.3	-1	1
Aug	04/08/2021	01/09/2021	28	4.0	05/08/2021	01/09/2021	27	3.9	1	0
Sep	01/09/2021	29/09/2021	28	4.0	01/09/2021	05/10/2021	34	4.9	0	**6**
Oct	29/09/2021	03/11/2021	35	5.0	05/10/2021	01/11/2021	27	3.9	**6**	-2
Nov	03/11/2021	01/12/2021	28	4.0	01/11/2021	29/11/2021	28	4.0	-2	-2
Dec	01/12/2021	05/01/2022	35	5.0	29/11/2021	05/01/2022	37	5.3	-2	0

Notes:

Exposure periods outside the 4 to 5 weeks (±4 days) recommended by *LAQM.TG(16)* are underlined.

ON/OFF deployment date deviations in excess of the ±2 days deemed acceptable by *LAQM.TG16 Para 7.191* shown in **bold**.

b) Luton Rising

Month	Calendar ON date	Calendar OFF date	Calendar Exposure (Days)	Calendar Exposure (Weeks)	Luton Rising ON date	Luton Rising OFF date	Luton Rising Exposure (Days)	Luton Rising Exposure (Weeks)	Deviation From Calendar ON date (Days)	Deviation From Calendar OFF date (Days)
Jan	06/01/2021	03/02/2021	28	4.0	15/01/2021	05/02/2021	21	<u>3.0</u>	**9**	2
Feb	03/02/2021	03/03/2021	28	4.0	05/02/2021	05/03/2021	28	4.0	2	2
Mar	03/03/2021	31/03/2021	28	4.0	05/03/2021	01/04/2021	27	3.9	2	1
Apr	31/03/2021	05/05/2021	35	5.0	01/04/2021	07/05/2021	36	5.1	1	2
May	05/05/2021	02/06/2021	28	4.0	07/05/2021	02/06/2021	26	3.7	2	0
Jun	02/06/2021	30/06/2021	28	4.0	02/06/2021	09/07/2021	37	5.3	0	**9**
Jul	30/06/2021	04/08/2021	35	5.0	09/07/2021	03/08/2021	25	3.6	**9**	-1
Aug	04/08/2021	01/09/2021	28	4.0	03/08/2021	01/09/2021	29	4.1	-1	0
Sep	01/09/2021	29/09/2021	28	4.0	02/09/2021	29/09/2021	27	3.9	1	0
Oct	29/09/2021	03/11/2021	35	5.0	30/09/2021	02/11/2021	33	4.7	1	-1
Nov	03/11/2021	01/12/2021	28	4.0	03/11/2021	30/11/2021	27	3.9	0	-1
Dec	01/12/2021	05/01/2022	35	5.0	01/12/2021	09/01/2022	39	5.6	0	**4**

Notes:

Exposure periods outside the 4 to 5 weeks (±4 days) recommended by *LAQM.TG(16)* are <u>underlined</u>.

ON/OFF deployment date deviations in excess of the ±2 days deemed acceptable by *LAQM.TG16 Para 7.191* shown in **bold**.

Diffusion Tube Annualisation

Annualisation was required for sites with between 25 and 75% annual data capture in both the LBC and Luton Rising datasets (*i.e.* for the LBC site *LN93* with an annual data capture of 67.3% and the Luton Rising duplicate sites *L3(i)/L3(ii)* and *L9a(i)/L9a(ii)* with annual data capture of 44.8% and 62.2% respectively). This was undertaken using whole year data sets obtained from the *UK Air Data Selector* [https://tinyurl.com/s6fpm8xx] for the following *Automatic Urban & Rural Network* (AURN) monitoring sites (all of which are within a 50 mile radius of Luton and have data capture rates of in excess of 85% for the calendar year):

- London N. Kensington (*UKA00253*) – Type: Urban Background
- London Hillingdon (*UKA00266*) – Type: Urban Background
- Oxford St Ebbes (*UKA00518*) – Type: Urban Background
- London Haringey Priory Park South (*UKA00568*) – Type: Urban Background

In both case the annualisation calculation was undertaken using the *Diffusion Tube Processing Tool v2.0* (https://tinyurl.com/bd2bz5bb); the output of this correction is presented in Table C.5.

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.TG16* provides guidance with regard to the application of a bias adjustment factor to correct diffusion tube monitoring. Triplicate co-location studies can be used to determine a local bias factor based on the comparison of diffusion tube results with data taken from NO_x/NO_2 continuous analysers. Alternatively, the national database of diffusion tube co-location surveys provides bias factors for the relevant laboratory and preparation method.

Obtained from version 03/22 of the *National Diffusion Tube Bias Adjustment Factor Spreadsheet* (https://tinyurl.com/2maujh9v), Luton Borough Council have applied a national bias adjustment factor of 0.84 to the LBC and Luton Rising monitoring data for 2021 (Gradko; 20% TEA in water; based on 32 studies).

In the case of the LLAOL data, a national bias adjustment factor of 0.78 has been applied to the 2021 monitoring data. This factor was also obtained from version 03/22 of the

spreadsheet and is based on 23 co-location studies using 50% TEA in acetone tubes prepared and analysed by SOCOTEC Didcot.

As both the LBC and Luton Rising monitoring programmes include co-location studies (two in the case of the latter) it was possible to calculate local bias adjustment factors for both data sets using the *Diffusion Tube Data Processing Tool v2.0*:

- based on a single triplicate co-location study at the Dunstable Road East air quality monitoring station (*HB007/LN60 – LN61/62/63*) an adjustment factor of 0.79 was obtained for the LBC tubes (see Table C.5); and
- based on two triplicate studies, one at Dunstable Road East [*HB007/LN60 – L1(i)/(ii)/(iii)*] and one at Wigmore Valley Park [*LA001 – L11(i)/(ii)/(iii)*], an adjustment factor of 0.79 was also obtained for the Luton Rising tubes (see Table C.5).
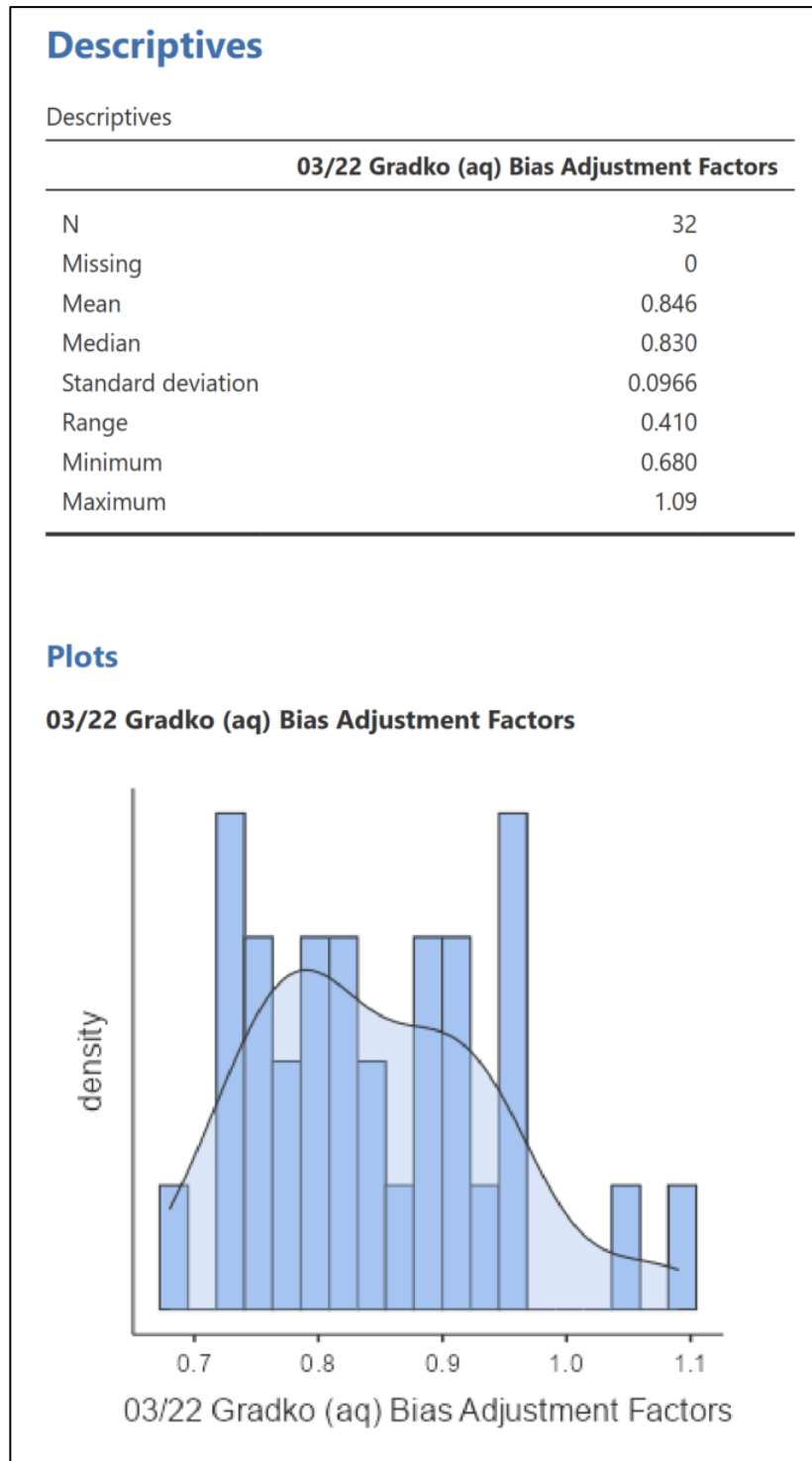
In previous years the difference between local and national bias adjustment factors has generally been smaller than that encountered in 2021 (normally of the order of 1% or so). Adopting a precautionary approach, in these cases the typically marginally higher national factor has been selected to present a worst case picture of NO_2 concentrations. However, with relatively little difference between the two factors, in the past the impact of this selection has not been particularly significant. In 2021, with the difference between the two factors being 6.1% for both datasets, the impact of the adjustment factor choice will be of greater significance. Again, adopting a precautionary approach, the higher national adjustment factor has been selected to correct the LBC and Luton Rising data for 2021. Comparing the local factor of 0.79 obtained for both datasets with the values obtained for the 32 co-location studies reported in version 03/22 of the *National Diffusion Tube Bias Adjustment Factor Spreadsheet* (Figure C.5), the value was found to be in the 32nd percentile with a z-score of -0.58.

For both sets of data, the impact of applying the national factor in preference to the local figure has been characterised (Table C.2) and shown graphically relative to last year's results (Figure C.6). In both cases the selection of the national factor has no effect in terms of compliance, with only one site (*L7*) exceeding the annual mean air quality objective level for both factors and all others remaining below 40µg/m^3 regardless of which factor was applied. However, as shown in Figure C.6 the selection of the national factor does alter how these results compare with those from the previous year, changing the picture from an overall reduction to a slight increase.

A summary of bias adjustment factors used by Luton Borough Council over the past five years is presented in Table C.3.

Figure C.5 - **Descriptive Statistics and Histogram/Density Plot for the results of the 32 co-location studies for Gradko 20% TEA in water tubes reported in version 03/22 of the *National Diffusion Tube Bias Adjustment Factor Spreadsheet*.**

Descriptives

Descriptives

	03/22 Gradko (aq) Bias Adjustment Factors
N	32
Missing	0
Mean	0.846
Median	0.830
Standard deviation	0.0966
Range	0.410
Minimum	0.680
Maximum	1.09

Plots

03/22 Gradko (aq) Bias Adjustment Factors

03/22 Gradko (aq) Bias Adjustment Factors

Table C.2 – Comparison of diffusion tube output obtained using local and national bias correction factors

a)   Luton Borough Council (LBC) sites

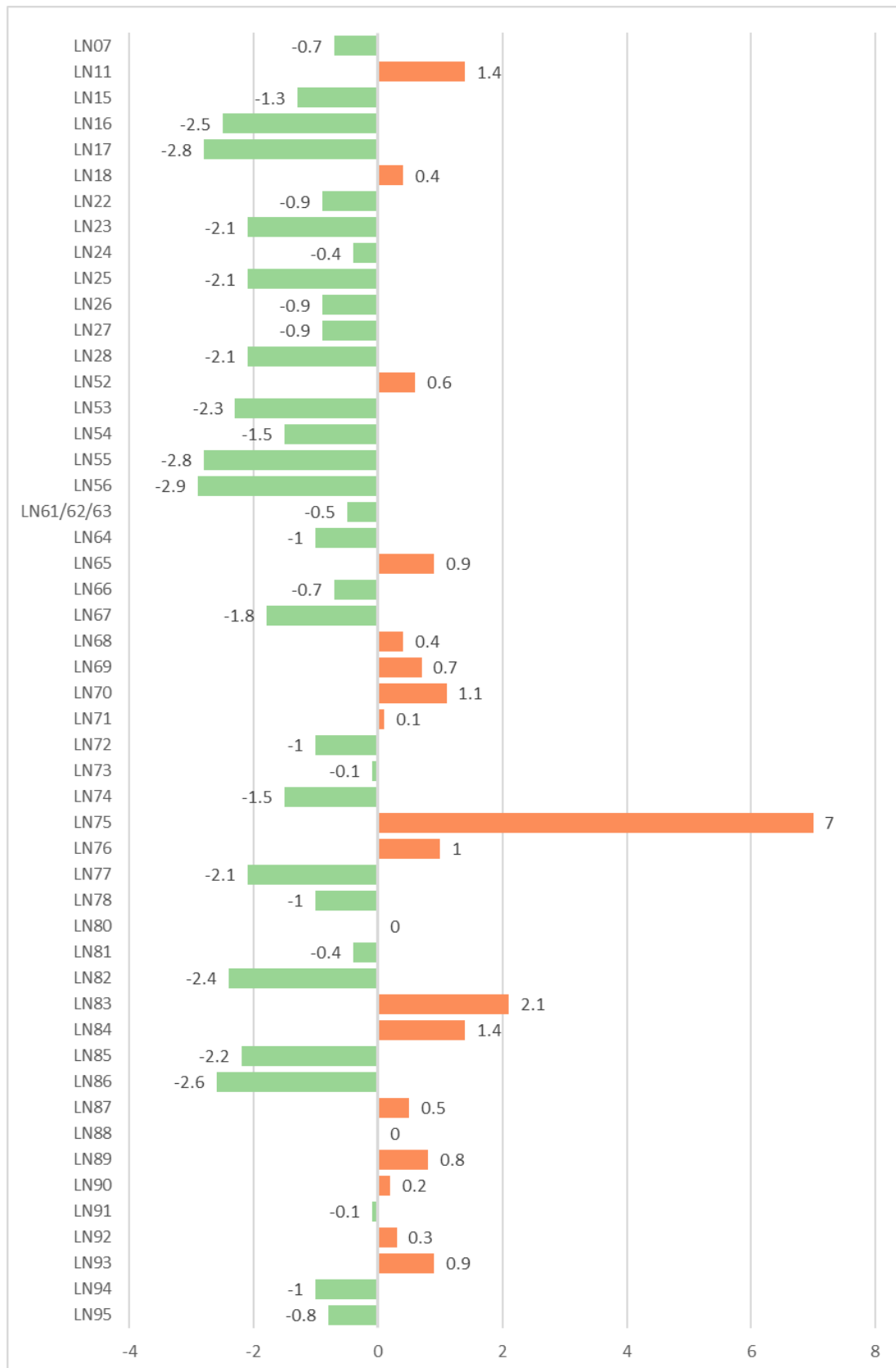|	Local	National
Bias Correction Factor	0.79	0.84
Percentage Difference	6.1%	6.1%
Number of exceedances (excluding co-location sites)	0	0
Max	33.6µg/m³	35.7µg/m³
Min	11.8µg/m³	12.6µg/m³
Range	21.8µg/m³	23.1µg/m³
Average	21.6µg/m³	23.0µg/m³
Median	20.7µg/m³	22.0µg/m³
Standard Deviation	5.28µg/m³	5.61µg/m³
Higher than previous year (when rounded to 1 decimal place)	17 (34%)	33 (66%)
Lower than previous year (when rounded to 1 decimal place)	31 (62%)	16 (32%)
Unchanged (when rounded to 1 decimal place)	2 (4%)	1 (2%)
Max increase (cf. 2020)	7.0µg/m³ (LN75, 32%)	8.8µg/m³ (LN75, 40%)
Max decrease (cf. 2020)	-2.9µg/m³ (LN56, -13%)	-1.7µg/m³ (LN56, -8%)
Average difference (cf. 2020)	-0.5µg/m³	0.8µg/m³
Mean percentage difference (cf. 2020)	-2.0%	4.2%

b) **Luton Rising sites**

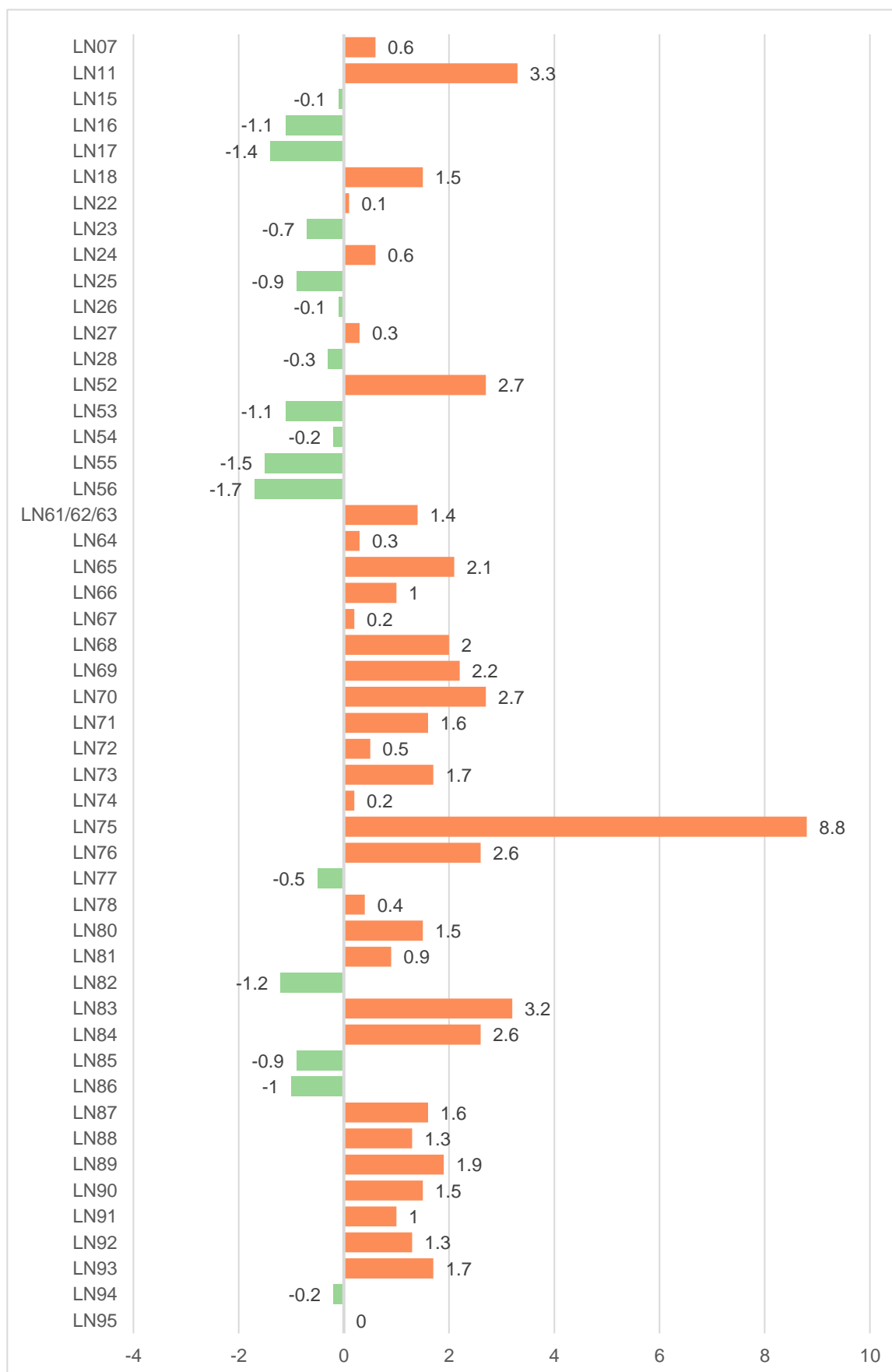|	Local	National
Bias Correction Factor	0.79	0.84
Percentage Difference	6.1%	6.1%
Number of exceedances (excluding co-location sites)	1	1
Max	46.7µg/m³	49.7µg/m³
Min	8.5µg/m³	9.1µg/m³
Range	38.2µg/m³	40.6µg/m³
Average	19.8µg/m³	21.1µg/m³
Median	17.9µg/m³	19.1µg/m³
Standard Deviation	11.1µg/m³	11.8µg/m³
Higher than previous year (when rounded to 1 decimal place)	2 (20%)	5 (50%)
Lower than previous year (when rounded to 1 decimal place)	8 (80%)	5 (50%)
Unchanged (when rounded to 1 decimal place)	0 (0%)	0 (0%)
Max increase (cf. 2020)	1.3 (L3, 6%)	2.7 (L3, 13%)
Max decrease (cf. 2020)	-2.5 (L8, -11%)	-1.5 (L11, -12%)
Average difference (cf. 2020)	-1.2µg/m³	0.1µg/m³
Mean percentage difference (cf. 2020)	-7.8%	-0.8%

Figure C.6 -   Differences in 2021 NO$_2$ concentration relative to reported 2020 annual mean values
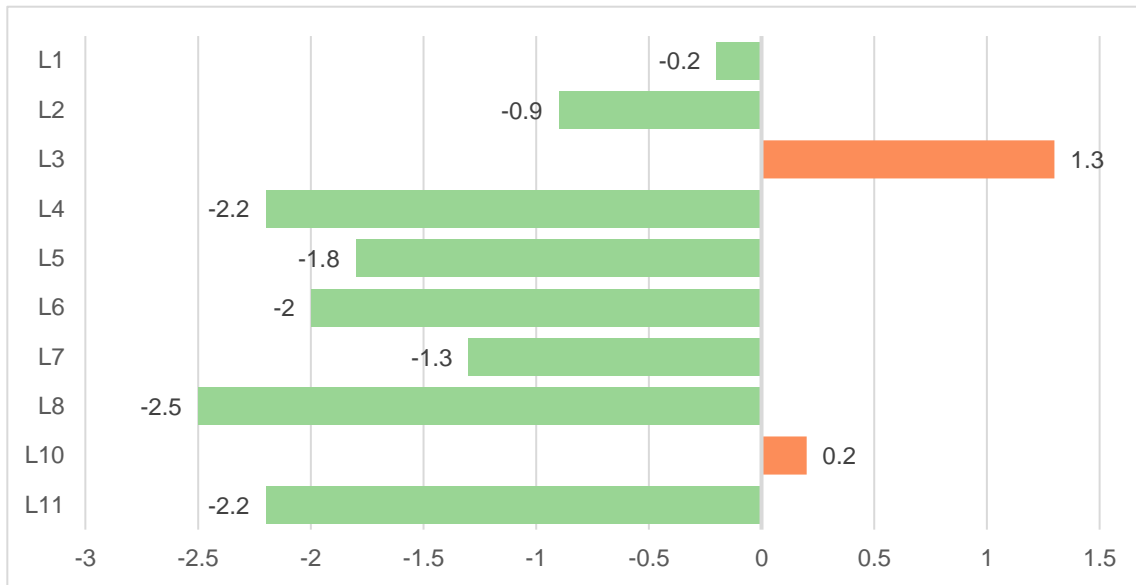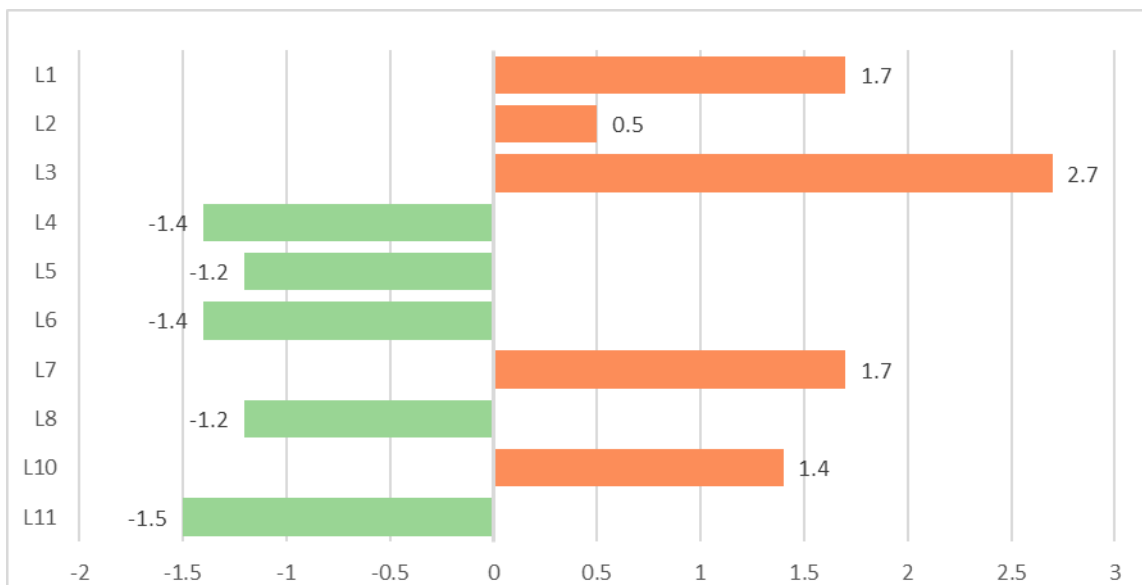
a)   Luton Borough Council dataset

i)   2021 Data adjusted using locally derived correction factor (0.79)

ii)   2021 Data adjusted using national correction factor (0.84)

Site	Value
LN07	0.6
LN11	3.3
LN15	-0.1
LN16	-1.1
LN17	-1.4
LN18	1.5
LN22	0.1
LN23	-0.7
LN24	0.6
LN25	-0.9
LN26	-0.1
LN27	0.3
LN28	-0.3
LN52	2.7
LN53	-1.1
LN54	-0.2
LN55	-1.5
LN56	-1.7
LN61/62/63	1.4
LN64	0.3
LN65	2.1
LN66	1
LN67	0.2
LN68	2
LN69	2.2
LN70	2.7
LN71	1.6
LN72	0.5
LN73	1.7
LN74	0.2
LN75	8.8
LN76	2.6
LN77	-0.5
LN78	0.4
LN80	1.5
LN81	0.9
LN82	-1.2
LN83	3.2
LN84	2.6
LN85	-0.9
LN86	-1
LN87	1.6
LN88	1.3
LN89	1.9
LN90	1.5
LN91	1
LN92	1.3
LN93	1.7
LN94	-0.2
LN95	0

b)   Luton Rising dataset

i)   2021 Data adjusted using locally derived factor (0.79)

ii)   2021 Data adjusted national factor (0.84)

Table C.3 - Bias Adjustment Factor

a) Luton Borough Council (LBC) sites

Monitoring Year	Local or National	If National, Version of National Spreadsheet	Adjustment Factor
2021	National	03/22	0.84
2020	National	03/21	0.81
2019	National	03/20	0.93
2018	National	03/19	0.93
2017	National	03/18	0.89

b) London Luton Airport Operations Ltd. (LLAOL) sites

Monitoring Year	Local or National	If National, Version of National Spreadsheet	Adjustment Factor
2021	National	03/22	0.78
2020	National	03/21	0.82 (Gradko) 0.77 (SOCOTEC)
2019	National	03/20	0.87
2018	National	03/19	0.92
2017	National	03/18	0.97

c) Luton Rising sites

Monitoring Year	Local or National	If National, Version of National Spreadsheet	Adjustment Factor
2021	National	03/22	0.84
2020	National	03/21	0.81
2019	National	03/20	0.93
2018	National	03/19	0.93

NO$_2$ Fall-off with Distance from the Road

Wherever possible, monitoring locations are representative of exposure. However, where this is not possible, the NO$_2$ concentration at the nearest location relevant for exposure has been estimated using the NO$_2$ fall-off with distance calculator available on the LAQM Support website. Where appropriate, non-automatic annual mean NO$_2$ concentrations corrected for distance are presented in Table B.1.

No automatic NO$_2$ monitoring locations within Luton Borough Council required distance correction during 2021.

Table C.4 – Annualisation Summary (concentrations presented in µg/m³)

a) Luton Borough Council (LBC) sites

Site ID	Annualisation Factor London N. Kensington	Annualisation Factor London Hillingdon	Annualisation Factor Oxford St Ebbes	Annualisation Factor London Haringey Priory Park South	Average Annualisation Factor	Raw Data Simple Annual Mean	Annualised Data Simple Annual Mean	Comments
LN93	0.9688	0.9437	0.9885	0.8778	0.9447	15.2	14.4	

b) Luton Rising sites

Site ID	Annualisation Factor London N. Kensington	Annualisation Factor London Hillingdon	Annualisation Factor Oxford St Ebbes	Annualisation Factor London Haringey Priory Park South	Average Annualisation Factor	Raw Data Time Weighted Annual Mean	Annualised Data Time Weighted Annual Mean	Comments
L3(i)	0.9419	0.9190	0.9664	0.8518	0.9198	-	-	*Duplicate Site with L3(i) and L3(ii) - Annual data provided for L3(ii) only*
L3(ii)	0.9419	0.9190	0.9664	0.8518	0.9198	28.1	25.9	*Duplicate Site with L3(i) and L3(ii) - Annual data provided for L3(ii) only*
L9a(i)	1.0972	1.0878	1.0667	1.0559	1.0769	-	-	*Duplicate Site with L9a(i) and L9a(ii) - Annual data provided for L9a(ii) only*
L9a(ii)	1.0972	1.0878	1.0667	1.0559	1.0769	21.5	23.2	*Duplicate Site with L9a(i) and L9a(ii) - Annual data provided for L9a(ii) only*

Table C.5 – Local Bias Adjustment Calculation

### a) Luton Borough Council (LBC) co-location study

	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	12	-	-	-	-
Bias Factor A	0.79 (0.75 - 0.82)	-	-	-	-
Bias Factor B	27% (21% - 33%)	-	-	-	-
Diffusion Tube Mean (µg/m^3)	38.4	-	-	-	-
Mean CV (Precision)	5.7%	-	-	-	-
Automatic Mean (µg/m^3)	30.2	-	-	-	-
Data Capture	100%	-	-	-	-
Adjusted Tube Mean (µg/m^3)	30 (29 - 31)	-	-	-	-

Overall Diffusion Tube Precision	Good Overall Precision	-	-	-	-
Overall Continuous Monitor Data Capture	Good Overall Data Capture	-	-	-	-

Local Bias Adjustment Factor	0.79

b)   Luton Rising co-location studies

	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	10			
Bias Factor A	0.78 (0.74 - 0.82)	0.79 (0.74 - 0.85)			
Bias Factor B	28% (22% - 35%)	26% (18% - 35%)			
Diffusion Tube Mean (µg/m^3)	38.6	13.7			
Mean CV (Precision)	5.0%	8.8%			
Automatic Mean (µg/m^3)	30.1	10.8			
Data Capture	100%	97%			
Adjusted Tube Mean (µg/m^3)	30 (29 - 32)	11 (10 - 12)			

Overall Diffusion Tube Precision	Good Overall Precision	Good Overall Precision	-	-	-
Overall Continuous Monitor Data Capture	Good Overall Data Capture	Good Overall Data Capture	-	-	-

Combined Local Bias Adjustment Factor	0.79

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

Figure D.1 – Overview of Luton
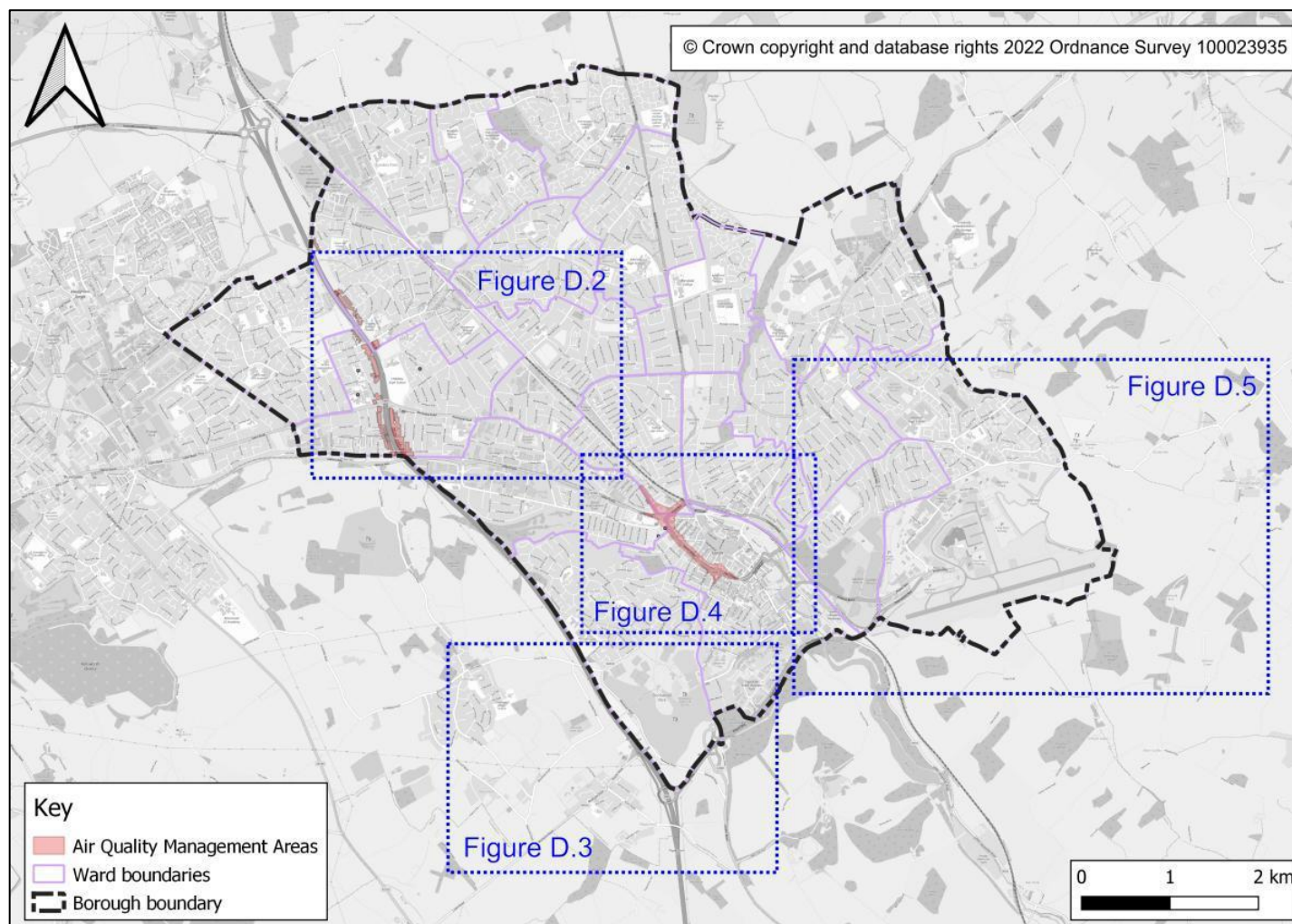
Figure D.2 - NO₂ monitoring locations in the vicinity of Luton AQMA Nºs. 1 & 2 along the route of the M1 *(Monitoring locations in Challney, Leagrave, Limbury & Saints wards)*
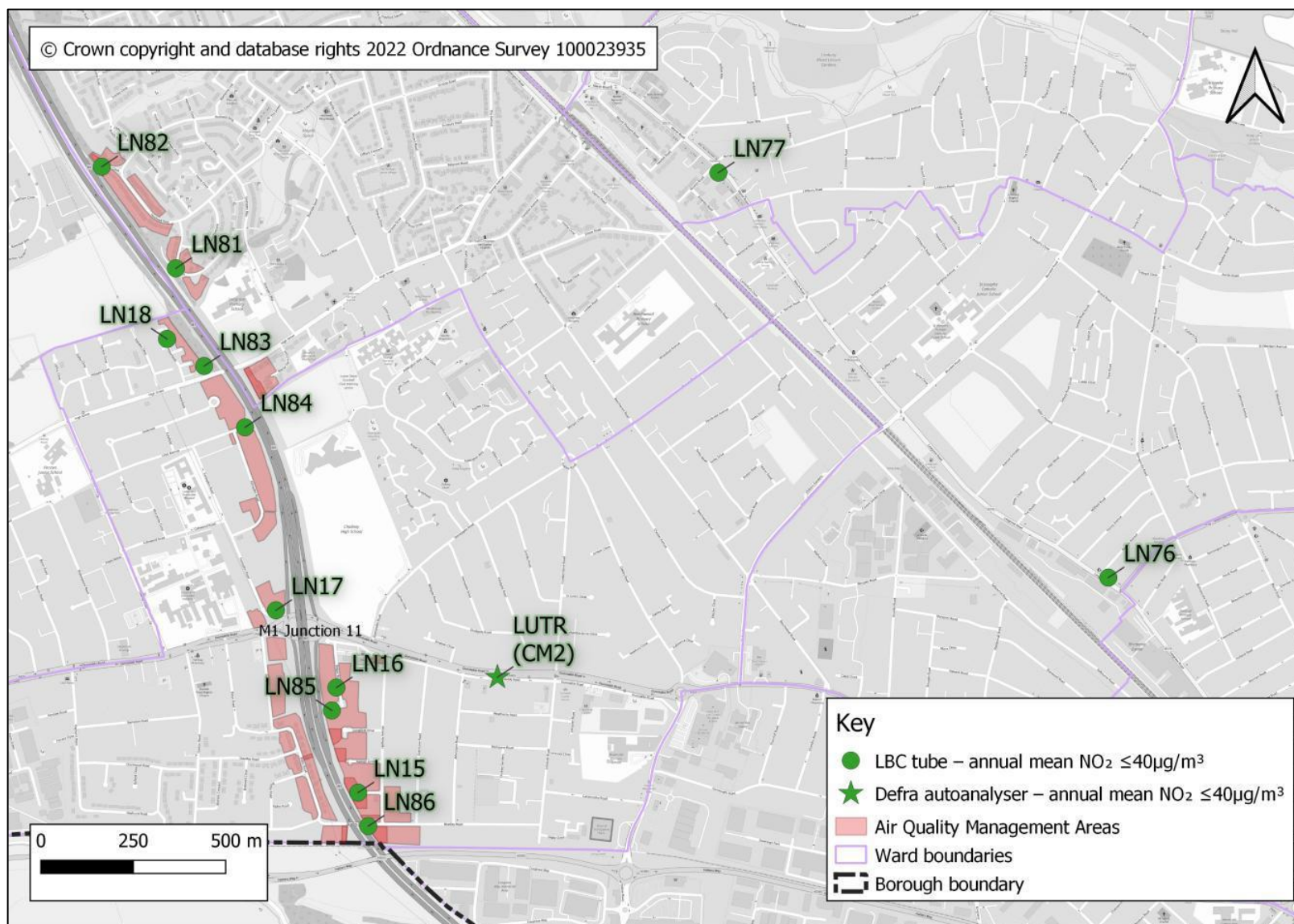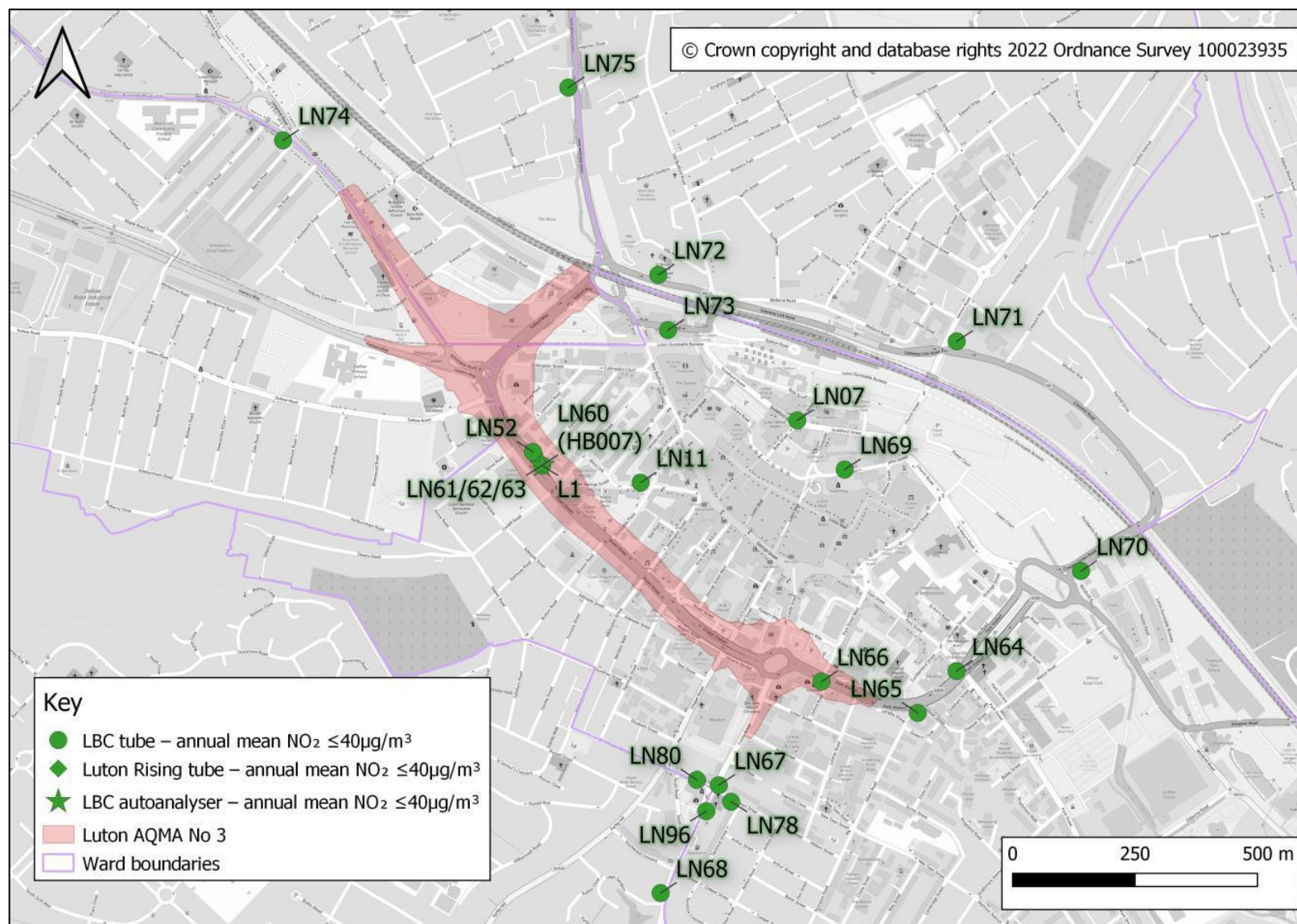
Figure D.3 - NO₂ monitoring locations in South Luton in the vicinity of the M1 *(Monitoring locations in Farley ward)*
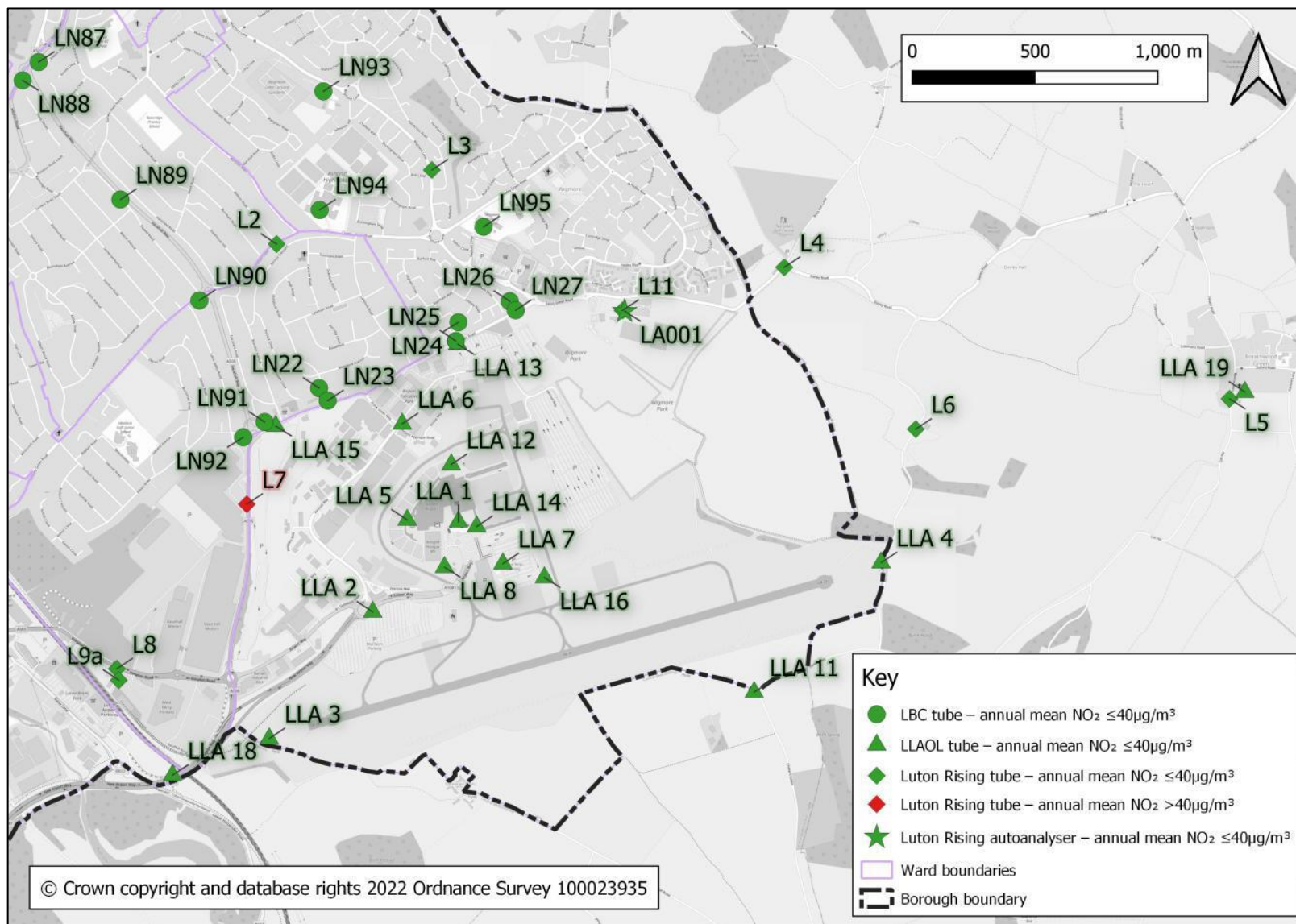
Figure D.4 - **Town centre NO₂ monitoring locations in the vicinity of Luton AQMA No 3** *(Monitoring locations in Biscot, Dallow, Farley, High Town & South wards)*

Figure D.5 - **NO₂ monitoring locations in the vicinity of London Luton Airport** *(Monitoring locations in Crawley & Wigmore wards)*

Appendix E: Summary of Air Quality Objectives in England

Table E.1 – Air Quality Objectives in England[10]

Pollutant	Air Quality Objective: Concentration	Air Quality Objective: Measured as
Nitrogen Dioxide (NO_2)	200µg/m^3 not to be exceeded more than 18 times a year	1-hour mean
Nitrogen Dioxide (NO_2)	40µg/m^3	Annual mean
Particulate Matter (PM_{10})	50µg/m^3, not to be exceeded more than 35 times a year	24-hour mean
Particulate Matter (PM_{10})	40µg/m^3	Annual mean
Sulphur Dioxide (SO_2)	350µg/m^3, not to be exceeded more than 24 times a year	1-hour mean
Sulphur Dioxide (SO_2)	125µg/m^3, not to be exceeded more than 3 times a year	24-hour mean
Sulphur Dioxide (SO_2)	266µg/m^3, not to be exceeded more than 35 times a year	15-minute mean

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

Appendix F: Details of new monitoring sites added to LBC network during 2021/22

Table F.1 – New indicative monitoring sites

Site ID	Site Name	Site Type	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Pollutants Monitored	In AQMA? Which AQMA?	Distance to Relevant Exposure (m) [1]	Distance to kerb of nearest road (m) [2]	Inlet Height (m)	Link to Real Time Data
LN97	Chaul End Lane	Roadside	506411	222554	NO_2; PM_{10}; $PM_{2.5}$	No	N/A			https://tinyurl.com/5feua3br
LN99	Dunstable Road – Bury Park 2	Roadside	508380	221764	NO_2; PM_{10}; $PM_{2.5}$	Yes AQMA 3	6.5	3.2	2.6	https://tinyurl.com/2cnsnebx
LN101	Beech Hill Community Primary School	Roadside	508000	222078	NO_2; PM_{10}; $PM_{2.5}$	No	9.0	3.5		https://tinyurl.com/yckk9nt9
LN103	L&D Hospital, Lewsey Road	Roadside	504987	222805	NO_2; PM_{10}; $PM_{2.5}$	No	12.5	2.0	2.6	https://tinyurl.com/mvuerzs5
LN105	Peoples Park	Urban Background	509339	222128	NO_2; PM_{10}; $PM_{2.5}$	No	N/A		2.6	https://tinyurl.com/88yfp67n

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 F.2 – New non-automatic monitoring sites

Diffusion Tube ID	Site Name	Site Type	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Pollutants Monitored	In AQMA? Which AQMA?	Distance to Relevant Exposure (m) [1]	Distance to kerb of nearest road (m) [2]	Tube Co-located with a Continuous Analyser?	Tube Height (m)
LN98	Chaul End Lane	Roadside	506411	222554	NO$_2$	No	N/A		Yes (LN97 - Indicative)	
LN100	Dunstable Road - Bury Park 2	Roadside	508380	221764	NO$_2$	Yes AQMA 3	6.5	3.2	Yes (LN99 - Indicative)	2.3
LN102	Beech Hill Community Primary School	Roadside	508000	222078	NO$_2$	No	9	3.5	Yes (LN101 - Indicative)	
LN104	L&D Hospital, Lewsey Road	Roadside	504987	222805	NO$_2$	No	12.5	2	Yes (LN103 - Indicative)	2.3
LN106	Peoples Park	Urban Background	509339	222128	NO$_2$	No	N/A		Yes (LN105 - Indicative)	2.3
LN107	2 Chertsey Close	Urban Background	511573	221897	NO$_2$	No	0		No	2.2
LN108	Laxton Close (Lamp post #4)	Suburban	512473	222295	NO$_2$	No	N/A		No	2.3
LN109	59 Malthouse Green (Lamp post #14)	Suburban	512915	222308	NO$_2$	No	N/A		No	2.4
LN110	Hedley Rise (Lamp post #15)	Suburban	512738	222385	NO$_2$	No	4.5	2.2	No	2.4
LN111	61 Lalleford Road (Signpost)	Roadside	511521	222203	NO$_2$	No			No	2.6

Diffusion Tube ID	Site Name	Site Type	X OS Grid Ref (Easting)	Y OS Grid Ref (Northing)	Pollutants Monitored	In AQMA? Which AQMA?	Distance to Relevant Exposure (m) [1]	Distance to kerb of nearest road (m) [2]	Tube Co-located with a Continuous Analyser?	Tube Height (m)
LN112	140 Prospect Way	Industrial	511254	221466	NO$_2$	No	0		No	2.3
LN113	786 Dunstable Road	Roadside	505005	222696	NO$_2$	No	0		No	2.3
LN114	20 Bradgers Hill Road	Roadside	509293	223741	NO$_2$	No	0		No	2.2
LN115	69 Windmill Road	Roadside	509995	220892	NO$_2$	No	0		No	2.1
LN116	85 Hitchin Road	Roadside	509655	221842	NO$_2$	No	0	1.33	No	2.3
LN117	258 Stockingstone Road	Roadside	509136	223217	NO$_2$	No	0		No	2.2
LN118	Fulbourne Close (Signpost)	Roadside	506407	222732	NO$_2$	No	N/A		No	2.3
LN119	Challney High School for Boys	Urban Background	505588	222871	NO$_2$	No	0		No	2.5
LN120	20 High Street	Roadside	505723	223787	NO$_2$	No	0		No	2.4
LN121	4c Marsh Road	Roadside	506990	223425	NO$_2$	No	0		No	2.4
LN122	404 - 410 Selbourne Road	Roadside	506918	223295	NO$_2$	No	0		No	2.1

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.

Glossary of Terms

Abbreviation	Description
AQAP	Air Quality Action Plan - A detailed description of measures, outcomes, achievement dates and implementation methods, showing how the local authority intends to achieve air quality limit values'
AQMA	Air Quality Management Area – An area where air pollutant concentrations exceed / are likely to exceed the relevant air quality objectives. AQMAs are declared for specific pollutants and objectives
ASR	Annual Status Report
AURN	Automatic Urban & Rural Network – the UK's largest automatic monitoring network and is the main network used for compliance reporting against the Ambient Air Quality Directives.
BAM	Beta Attenuation Mass Monitor – air quality monitoring instrument that uses the absorption of beta radiation by solid particles extracted from an air flow to measure PM10 and PM2.5
Defra	Department for Environment, Food and Rural Affairs
DfT	Department for Transport
DMRB	Design Manual for Roads and Bridges – Air quality screening tool produced by National Highways
EU	European Union
FDMS	Filter Dynamics Measurement System
LAQM	Local Air Quality Management
LSO	Local Site Operator
MCERTS	The Environment Agency's Monitoring Certification Scheme for equipment
NO_2	Nitrogen Dioxide
NO_x	Nitrogen Oxides
PM_{10}	Airborne particulate matter with an aerodynamic diameter of 10µm or less
$PM_{2.5}$	Airborne particulate matter with an aerodynamic diameter of 2.5µm or less
QA/QC	Quality Assurance and Quality Control
SO_2	Sulphur Dioxide
WHO	World Health Organisation

References

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