Bath's Clean Air Zone

Annual report 2022

Bath & North East Somerset Council

Improving People's Lives

Contents

Supplied as attachments:

Appendix 1: Measuring the impact of the CAZ- Reporting timeline
Appendix 2: Full 2022 annual diffusion tube NO_2 data

Acronyms and Abbreviations

ANPR	Automatic Number Plate Recognition
AQMA	Air Quality Management Area
AQO	Air Quality Objective
ASR	Annual Status Report
ATC	Automatic Traffic Counter
AURN	Automatic Urban and Rural Network
BID	Business Improvement District
B&NES	Bath and North East Somerset Council
CAF	Clean Air Fund
CAP	Clean Air Plan
CAZ	Clean Air Zone
CSF	Critical Success Factor
CVRAS	Clean Vehicle Retrofit Accreditation Scheme
DEFRA	Department for the Environment, Food and Rural Affairs
DfT	Department for Transport
DVLA	Driver and Vehicle Licensing Authority
EU	European Union
FAS	Financial Assistance Scheme
FBC	Full Business Case
HGV	Heavy Goods Vehicle
JAQU	Joint Air Quality Unit
LAQM	Local Air Quality Management
LEP	Local Enterprise Partnership
LEV	Low Emissions Vehicle
LGV	Light Goods Vehicle
MTC	Manual Classified Counts
NO	Nitrogen Oxide
NO2	Nitrogen Dioxide
NOx	Nitrogen Oxides
OS	Ordnance Survey
PCM	Pollution Climate Mapping
PCN	Penalty Charge Notice
PHGV	Private Heavy Goods Vehicle
PM	Particulate Matter
PM2.5	Particulate Matter with particles less than 2.5 micrometers diameter
PM10	Particulate Matter with particles less than 10 micrometers diameter
PRMS	Public Realm and Movement Strategy
TEA	Triethanolamine
TG	Technical Guidance
TMP	Traffic Management Plan
UK	United Kingdom
ULEV	Ultra-Low Emissions vehicle
UTC	Urban Traffic Control
UTMC	Urban Traffic Management and Control
WECA	West of England Combined Authority
WHO	World Health Organisation

Bath's Clean Air Zone 2022

Air quality

NO_2 down by **26%** ($8.5\ \mu g/m^3$) on average inside Bath's Clean Air Zone.

NO_2 down by **27%** ($7.1\ \mu g/m^3$) on average in urban areas outside the zone.

all monitoring sites show a decreasing trend.

Behaviour change

1500+

applications for financial support to upgrade vehicles.

900

polluting vehicles replaced by the end of 2022.

71%

fewer high polluting vehicles driving in the zone.

How revenue was spent

£3.3 million

net income generated in 2022.

£2.5m

Allocated as our local contribution to support sustainable transport within wider WECA programmes.

Supported sustainable travel by providing new secure, lockable bike hangars for residents to store bicycles.

Supported complimentary air quality schemes by funding the operating costs of a pollutant capture device used by the council's bereavement services.

Compliance

Vans	83%
Taxis	95%
HGV >3.5T	96%
HGV >12T	96%
Bus/coach	99%

*compliance rate of vehicle types in the zone by end of December 2022.

March 2021 **6%** non-compliant vehicles

vs

1% non-compliant vehicles Dec 2022

69%

of vehicles driving in Bath each day are private cars.

How can you help?

walk or wheel

cycle

car share or use public transport

consolidate journeys and deliveries

Bath & North East Somerset Council

Improving People's Lives

Executive summary

In 2017, the Government directed Bath & North East Somerset (B&NES) Council to reduce nitrogen dioxide (NO_2) pollution in Bath to within the legal limits of an annual average limit of 40 micrograms per cubic meter ($\mu g/m^3$) and to do so in the shortest possible time and by the end of 2021 at the latest.

This type of pollution is chiefly caused by road traffic, and extensive technical work showed that a charging clean air zone together with the introduction of a traffic management scheme at Queen Square would be the only way to achieve success in the time frame. Clean air zones work by deterring certain high emission vehicles from entering areas of high pollution by levying a daily charge on the driver, encouraging a more rapid replacement of polluting vehicles for cleaner, compliant ones that would otherwise naturally occur.

On 15th March 2021, the Council introduced a charging Class C Clean Air Zone (CAZ) in Bath's city centre to drive down NO_2 pollution at several locations which regularly exceed these NO_2 limits, in particular risking children's health and the health of our most vulnerable residents. In a Class C CAZ, private cars and motorbikes are not charged, regardless of emissions.

In Bath, significant financial support has been made available to individuals and businesses to replace non-compliant, chargeable vehicles regularly driving in the zone, and 900 polluting vehicles have already been replaced using government funds. More information on how the CAZ works can be found in 'How to use this report'.

Aims and limitations of this report

This report provides an update and indicative view on how the CAZ has performed during the second year of operation in 2022. It looks at impacts on air quality, traffic flow and vehicle compliance, as well as many other measures.

Due to Covid-19 having an unprecedented impact on travel behaviour in 2020, baseline data from the last representative years (2017-2019) have been used to measure the impact and effectiveness of the zone.

You can find out more about how data is collected and presented in the section 'How to use this report'; and there is a more detailed explanation of how B&NES monitor at the end of the report in the 'Monitoring explained' section.

Key findings

A CAZ is needed within Bath to reduce air pollution to improve the health of people in the city. Everyone is affected by poor air quality and some people with respiratory problems are at particular risk if air pollution increases.

The CAZ was implemented in March 2021 and higher-emission vehicles are now charged to enter the zone. A Financial Assistance Scheme (FAS) and bus retrofit scheme were set up to upgrade or retrofit higher-emission vehicles. The Council supported hundreds of people, businesses, and bus operators by upgrading or retrofitting over 900 vehicles by the end 2022. There is also an ongoing behaviour change campaign aimed at helping people travel more actively and sustainably in Bath and the wider district.

The Covid-19 pandemic has greatly affected working habits and travel patterns since the winter of 2019/2020. The effects of the pandemic are far-reaching, and a major change of traffic composition has been an increase in delivery vehicles- mostly vans and heavy goods vehicles - as people limit their travel. This change in traffic composition has been impacting local neighbourhoods in Bath.

Throughout most of 2022, Cleveland Bridge was partially closed to traffic as structural repairs were carried out. The bridge normally carries around 17,000 vehicles per day and so the diversion of vehicles looking to avoid the bridge will have had impacts on air quality within the vicinity of the area throughout 2022.

Despite the partial closure of Cleveland Bridge and the impacts of Covid-19 still being felt across some areas, NO_2 concentrations in the zone reduced by an average of 26% compared with the baseline year in 2019.

The Council has been monitoring air quality and traffic flows outside of the CAZ to determine if the zone has displaced traffic and associated emissions, and findings show that NO_2 concentrations in the urban area outside of the CAZ but within Bath, Bathampton and Batheaston reduced by an average of 27% compared with 2019.

In general, traffic outside of the zone does not appear to have increased, however, the composition of the traffic may have changed because of the pandemic. There are ongoing surveys to understand whether the CAZ is the cause of any displacement, but it is known that throughout much of 2022, the partial closure of Cleveland Bridge significantly impacted traffic flows. It may further be noted that cars are not charged in the CAZ and thus have no reason to avoid the zone, however, may have been diverting to avoid the bridge closure.

B&NES thank the public for supporting the Council to implement the zone which is helping to improve air quality and the health of people in Bath.

Summary of annual air quality results from within the CAZ (CAZ_Only):

2019 is used as the baseline year for analysis as it is the most recent year with pre-CAZ data that has not been impacted by the Covid-19 pandemic.

- Average 2022 annual nitrogen dioxide (NO_2) concentrations within the CAZ are **26% lower than in 2019, representing a reduction of 8.5 µg/m³**. This is the average reading from a total of 65 monitoring sites that recorded data in both 2019 and 2022. Note sites with less than 25% data have been discounted from this analysis. Sites with 25-75% data capture have been annualised, and sites with over 75% data capture have been averaged.
- **One site** recorded an annual average NO_2 concentration **greater than 40 µg/m³**. This site was **Walcot Parade 4 which averaged at 40.4 µg/m³ in 2022**, however, it was installed in August 2022 in response to an exceedance in 2021. As this site only consists of 5-months of data the results were annualised, as detailed on page 35, **it is likely this annualisation may have overestimated the average for 2022**.
- Whilst **Walcot Parade 4** does exceed the limit value of 40 µg/m³ it is **still considered a compliant monitoring site by Defra and JAQU**. Defra's approach when reporting compliance to the European Commission (as confirmed by JAQU in 2019), is to round any concentration to the nearest integer, therefore, any concentration up to 40.49 µg/m³ would not be reported as exceeding[1].
- **The number of sites exceeding 40 µg/m³ decreased from 15% in 2019 to 1%** in 2022, this is a reduction of 14%, or nine sites.
- **None of the 65 sites** were found to have increased in NO_2 concentrations since 2019.
- **Four sites** recorded annual average NO_2 concentrations greater than 36 µg/m³ (within 10% of the annual mean objective) but at or below 40 µg/m³. These sites were: Wells Road (38.5 µg/m³), Anglo Terrace Façade (36.6 µg/m³), Walcot Parade 2 (39.7 µg/m³) and Wells Road 5 (38.0 µg/m³). **All these sites have an overall decreasing trend**.

Summary of annual air quality results from within the wider Bath urban area (CAZ_Boundary):

- Average 2022 annual nitrogen dioxide (NO_2) concentrations within the CAZ_Boundary are **27% lower than in 2019**, representing a reduction of 7.1 µg/m³. This is the average reading from a total of 56 monitoring sites that recorded data in both 2019 and 2022. Note sites with less than 25% data have been discounted from this analysis. Sites with 25-75% data capture have been annualised, and sites with over 75% data capture have been averaged.
- In 2022, **no sites** within the CAZ_Boundary recorded **greater than 40 µg/m³**. **This is a reduction of 2 sites** when compared to 2019 and represents a decrease in the number of sites exceeding 40 µg/m³ from 4% in 2019 to 0% in 2022.
- None of the 56 sites were found to have increased in NO_2 concentration compared with 2019.

[1] Jacobs, 2019. Local Air Quality Modelling Methodology Report. Available at: https://democracy.bristol.gov.uk/documents/s42646/Appendix%20Di%20-%20BCC%20CAZ%20OBC%2018%20-%20Modelling%20Methodology%20Report%20AQ2.pdf

Summary of annual air quality results from within the wider district (Wider_B&NES):

- Average 2022 annual nitrogen dioxide (NO_2) concentrations within the Wider_B&NES region are **24% lower than in 2019**, representing a reduction of 7.1 µg/m^3. This is the average reading from a total of 26 monitoring sites that recorded data in both 2019 and 2022. Note sites with less than 25% data have been discounted from this analysis. Sites with 25-75% data capture have been annualised, and sites with over 75% data capture have been averaged.

Summary of annual traffic flow figures:

With regards to traffic flows, 2017 and 2018 have been used as a baseline comparative year as they are the most recent years with good quality pre-CAZ data that has not been impacted by the Covid-19 pandemic.

- Nationally throughout 2022, overall road traffic figures have been closest to pre-covid usage, with figures consistently above 90%, however, recovery across public transport was slower. Additionally, **the number of commercial vehicles has remained higher than the pre-covid baseline**[2].
- Average 2022 **traffic flows within Bath were generally below pre-pandemic levels**, however, have increased slightly from 2021.
- Traffic flows from the permanent ATC network within the CAZ during the last 6-months of 2022 were unavailable. During this period, the Council's ATC network was being upgraded with newer, more reliable technology. As a result, 2 temporary surveys from a 7-day period were used to give an indicative view of traffic flows within the CAZ. The details and findings of these surveys are explained in 'Traffic flows within the CAZ'.
- On average, data analysed from the permanent ATC network within the CAZ_ Boundary, found a **9% reduction in 7-day average traffic flows** when compared to the baseline period.
- Similarly, data analysed within the Wider_B&NES area, **found a 10% reduction in 7-day average traffic flows** when compared to the baseline. The sites used for analysis can be found in 'Traffic flows within the CAZ_Boundary and Wider_B&NES'.
- Aside from the ongoing changes to travel habits due to Covid-19, traffic flows within Bath and the CAZ **were not representative** during January-October 2022 due to the partial closure of Cleveland Bridge. This partial closure likely resulted in lighter traffic diverting through the city centre, with heavier vehicles using alternative routes such as the A4 and A36.
- Throughout 2021 and 2022, the Council has gathered extensive evidence to assess any potential traffic displacement due to CAZ. Private cars, which represent most vehicles driving in the zone, are not charged. Increases in commercial vehicles seen in local communities may be due to a higher demand for home deliveries and may align with the national trends outlined further below.

[2]Department for Transport, 2023. Domestic Transport Usage by Mode. Available at: https://www.gov.uk/government/statistics/transport-use-during-the-coronavirus-covid-19-pandemic/domestic-transport-usage-by-mode

Summary of annual vehicle compliance and financial assistance scheme (FAS) figures:

- The Council's financial assistance scheme (FAS) offered local businesses and individuals grants and interest-free loans to replace or upgrade non-compliant vehicles regularly driving into the zone.
- Compliance **rates across all vehicle groups have continued to improve** since the launch of the CAZ in March 2021.
- On average, **44,000 unique vehicles** were recorded in the zone each day throughout 2022.
- Most vehicles recorded in the CAZ are private cars, with an average of **30,856 unique private cars** recorded in the zone each day during 2022, this equates to 69% of total vehicles. Private cars are **not** charged regardless of their emission standard.
- An average of 1,742 non-compliant vehicles were seen in the zone each day during the launch week of the CAZ, this compares to 497 during the last month of 2022, a **decrease of 71%**.
- Owners of over 1,500 vehicles applied for financial support to upgrade or retrofit their non-compliant vehicles through the FAS.
- By the end of 2022, the Council's FAS had supported the **upgrade of 900 vehicles** from higher emission to clean, compliant ones.
- The percentage of chargeable non-compliant vehicles (as a percentage of total traffic) entering the zone each week reduced from 6% in launch week to an average of **1% by the end of 2022**.
- Van/LGV compliance rose from 63% during launch week to **83% by the end of 2022**. 3,284 individual vans/LGVs (compliant and non-compliant) were recorded in the CAZ each day on average in 2022.
- The Council's FAS supported the **replacement of 746 vans/LGVs** from higher emission vehicles to clean, compliant ones by the end of 2022.
- Taxi/PHV compliance rose from 67% during the launch week in March 2021, to **around 95% by the end of 2022**. An average of 460 individual taxis/PHVs were recorded in the CAZ each day during 2022.
- The Council's FAS supported the **replacement of 101 taxis/PHVs** from higher emission vehicles to cleaner, compliant ones by the end of 2022.
- Bus/coach compliance rose from 73% during launch week to **99% by the end of 2022**. An average of 128 individual buses/coaches were recorded in the CAZ each day during 2022.
- The Council's FAS supported **the upgrade of 22 non-scheduled buses/coaches** from higher emission vehicles to cleaner, compliant ones by the end of 2022. Scheduled buses are considered below on page 61.
- HGV compliance for vehicles weighing greater than 3.5T but less than 12T rose from 86% during the launch week to around **96% by the end of 2022**. An average of 108 vehicles were recorded in the CAZ each day during 2022.
- HGV compliance for vehicles weighing greater than 12T rose from 93% during the launch week to an average of **96% by the end of 2022**. An average of 272 vehicles were recorded in the zone each day during 2022.

- The Council's FAS supported the **upgrade of 29 HGVs** from higher emission vehicles to cleaner compliant ones by the end of 2022.
- Out of a total fleet of 226 scheduled buses, 88 were non-compliant when the bus retrofit programme started. By the end of 2022, **all 88 buses had been successfully retrofitted** with financial support from the government, and the full fleet is now compliant with the CAZ emission standards.

How to use this report

This report provides information on the CAZ's performance during 2022. The main areas discussed are:

- Air quality data
- Traffic flow data
- Fleet compliance data

The following is also discussed throughout the report:

- Retail/business/office space vacancy figures
- Retail footfall surveys
- Park and Ride passenger data
- Walking and cycling counts
- Bus usage data
- Stakeholder feedback from Council User Group Forums
- Taxi fares and unmet demand surveys
- Early Measures Fund, zero emission parking permits
- Bus Retrofit uptake/compliance
- Financial Support Scheme uptake
- Travel advisor session uptake
- Anti-idling enforcement
- Weight restriction enforcement
- E-cargo scheme

Timescales and baseline data

To determine the effectiveness of the CAZ, data is compared since the launch of the CAZ with baseline data from similar periods before the launch, this is so the seasonal effects on air quality and traffic flow can be considered. For quarterly data, like-for-like data from previous years are compared, breaking the year into following quarters:

- Quarter 1 (Q1) January, February, March
- Quarter 2 (Q2) April, May, June
- Quarter 3 (Q3) July, August, September
- Quarter 4 (Q4) October, November, December

The primary focus of this report is the year 2022. Given the unprecedented conditions brought about by the Covid-19 pandemic in 2020 (including significant changes in transport and travel behaviour), 2020 figures have been discounted for comparative purposes, unless otherwise stated in the report.

When reading the report please note the following:

- Annual air quality data is bias-adjusted and annualised, where appropriate, unless otherwise stated. In some cases, a further adjustment is important where results are distance-adjusted to the façade. This may be used when considering the compliance of a diffusion tube site within Local Air Quality Management (LAQM) guidance.
- Baseline data from 2019 is used to compare air quality monitoring results (because the Covid-19 pandemic affected 2020 very heavily).
- Air pollution is affected by the seasons so quarterly data is compared to the same quarter from the baseline year.
- Data from 2017/2018 is used to compare traffic flows because the Council has insufficient data for some periods during 2019.
- Traffic flows also vary according to the seasons.
- Data from January-December 2022 is used throughout this report.
- Longer-term trends are also reviewed from 2017 to the end of 2022.
- There are many graphs in this report, and each has its own scale.

Where data is gathered and from/what locations

We have identified three site groupings for the comparison of data and to establish the impact of the zone on traffic flows and air quality both inside and out of the CAZ:

- The clean air zone (sites within the boundary of the CAZ that are referred to as the 'CAZ_Only')
- The boundary area (sites outside the boundary of the CAZ but within the urban area of Bath including Batheaston and Bathampton, that are referred to as the 'CAZ_ Boundary')
- The wider area (sites outside of Bath, Batheaston and Bathampton urban areas, but within the rural areas and district-wider urban areas in Bath & North East Somerset, that are referred to as 'Wider_B&NES')

Climate summary 2022

Air pollution is affected by meteorological conditions. This is a brief roundup of the monthly climate for the year, as described by the Met Office.

- 2022 was the warmest year on record for the United Kingdom, all individual months except December were above average
- Rainfall was mostly below average for the year, with January to August, and December all being generally drier than average
- It was sunnier than average for most areas, especially eastern England, with only some northern and western fringes recording less sunshine than average

As most (approximately 80%) of NO_2 from vehicle emissions occurs as a result of chemical reactions after being emitted as nitric oxide (NO), meteorological conditions are a significant factor in the resulting measured concentrations. NO_2 is usually higher in winter due to the cooler temperatures of catalysts, significantly compromising the reduction of NOx from emissions. Heatwaves also increase levels of NO_2. Long periods of unusual weather can result in annual measured concentrations becoming an outlier in a long-term trend.

Air quality data in this report is provisional and has not been adjusted to take account of weather conditions, a process known as de-weathering. This process is used to remove the impact of weather variations from trends so that the impact of other measures can be seen, such as the implementation of the CAZ or a lockdown.

Find more climatic information at:
https://www.metoffice.gov.uk/research/climate/maps-and-data/summaries/index

Cleveland Bridge closure

Cleveland Bridge was closed to all traffic on 28 June 2021 for emergency repairs. The bridge usually carries around 17,000 vehicles per day, and so the closure has affected traffic flows throughout Bath. The bridge remained fully closed to traffic until November 2021, when it partially reopened with single-way signal-control for vehicles weighing less than 18-tonnes.

As a result of the closure, traffic flows in and around Bath were impacted for much of 2022, with the bridge not fully reopening until October 2022 (although still subject to an 18-tonne weight restriction). The resultant diversions lead to traffic displacement into areas both within and surrounding the CAZ. The Council used temporary Automatic Number Plate Recognition (ANPR) cameras to identify vehicle compliance in areas where perceived traffic displacement was occurring because of the bridge closure. It was difficult to identify whether vehicles were displaced because of the bridge closure, the CAZ, or both. The Council delayed some traffic displacement monitoring in 2022 until after the full reopening of the bridge, however, further delays to its opening meant the surveys were rescheduled, looking to avoid (as far as possible) times where the traffic was unrepresentative.

Partial and full closures of Cleveland Bridge took place between the following dates:

- Partially open with single-way signal-control: 4th May-27th June 2021
- Full closure: 28th June-24th October 2021
- Partially open with single-way signal-control: 25th October 2021-1st October 2022
- Fully reopened (subject to an 18-tonne weight restriction): 2nd October 2022

Find more information surrounding the bridge renovation at:
https://beta.bathnes.gov.uk/cleveland-bridge-renovation-project/scheme-overview

Covid-19 and air quality

- Multiple lockdowns in response to the Covid-19 pandemic had a significant effect on transport and travel behaviour, locally and nationally, which is why 2020 data has been discounted (unless otherwise stated)
- Since January 2022, national weekday usage across all transport modes has increased with road traffic figures consistently above 90% when compared to a pre-covid baseline. However, public transport recovery has been much slower and remains below the baseline period despite increasing across the year[3].
- Covid-19 is still influencing how people behave. There are lower rates of public transport use and higher rates of home-working and commuting by car. This may be linked to an overall change in working pattern, with people working more flexibly post-pandemic
- Nationally, the number of commercial vehicles (LGVs and HGVs) in 2022 remained higher than a pre-covid baseline. On average in 2022, LGVs were at 111% of the baseline period, whilst HGVs were at 103%[4]. This is likely associated with the increase of online shopping and home-deliveries as a result of the pandemic.

World Health Organisation air quality targets

The targets for air pollution limits are initially set by the World Health Organisation's (WHO) Air Quality Guidelines and the UK Government then considers the potential for adopting these targets. These guidelines are intended to inform the setting of air quality standards but are not ready-made targets for adoption. The WHO itself does not expect any country to simply adopt its guidelines without first undertaking the steps LAs plan to take before setting the targets, including a fully costed analysis and developing a pathway to achieving the targets.

It is vital that the targets set are stretching but achievable, as well as appropriate to our national circumstances. That is why the government is working with internationally recognised experts to deliver the evidence to inform target setting. On 15 July 2021 the government published the advice received to date from the Air Quality Expert Group and the Committee on the Medical Effects of Air Pollutants. You can find the advice here: https://uk-air.defra.gov.uk/library/air-quality-targets

The WHO air quality targets were updated in 2021 to reduce the limits for some measures, including NO_2 and $PM_{2.5}$. The council is aware of these ambitious targets, which are much lower than the current objective threshold limits and continues to work towards the UK objectives with the ambition to go further. A central government consultation ran from 16th March to 27th June 2022 to confirm how these guidelines would be enshrined into UK legislation, the outcomes of which were published in December 2022.

[3]Department for Transport, 2023. Usage of transport by mode from January 2022. https://www.gov.uk/government/statistics/transport-use-during-the-coronavirus-covid-19-pandemic/domestic-transport-usage-by-mode

[4]Department for Transport, 2023. Daily domestic transport use by mode. https://www.gov.uk/government/statistics/transport-use-during-the-coronavirus-covid-19-pandemic

Following consideration of the consultation responses, the $PM_{2.5}$ target of 10 micrograms per cubic metre (µg per m^3) remains the same as in the consultation and is to be met by 2040. This is a reduction from the current standard of 20 µg/m^3. As published within the summary document of the consultation, the measures required to meet 10 µg/m^3 by 2030, such as action on solid fuel burning and reduction of traffic, would have a disproportionate effect on individuals and small local businesses[5]. There have also been no further changes to the population exposure reduction target for $PM_{2.5}$.

A summary of the responses and government responses can be viewed at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1125278/Environmental_targets_consultation_summary_of_responses_and_government_response.pdf

Further information

- You'll find more information on how the Council has measured and compared data in each individual section
- As part of the Council's obligations under the Local Air Quality Management (LAQM) legislation (part IV of Environment Act 1995, as amended by the Environment Act 2021), an Annual Status Report (ASR) is issued in June annually. This sets out and comments on air quality data from the previous 12 months across the wider area. These can be found at: https://www.bathnes.gov.uk/services/environment/pollution/air-quality/reports
- You can also view an interactive map of historical NO_2 data collected from monitoring locations around the area, at: https://www.bathnes.gov.uk/services/environment/pollution-noise-nuisance/air-quality/air-quality-data-long-term
- Live monitoring data from the Council's automatic analyser sites across Bath can be viewed at: https://www.ukairquality.net/
- At the end of this report is a section titled 'Monitoring explained' which has been included to help you understand some of the processes used to gather the data that is used within this report

[5]Department for Environment, Food and Rural Affairs, 2022. Environmental targets consultation summary of responses and government responses. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1125278/Environmental_targets_consultation_summary_of_responses_and_government_response.pdf

1 Background information

This section provides information on why a CAZ is needed in Bath, the type of air pollution that the Council is trying to tackle, and how a charging Class C CAZ was decided. Further information can be found in the Full Business Case at: https://beta.bathnes.gov.uk/sites/default/files/2020-10/674726.br_.042.fbc_-_bath_clean_air_plan_fbc.pdf

1.1 Air pollution

Air pollution is the leading environmental health risk to the UK public, with an estimated 28,000 to 36,000 deaths annually attributed to it in the UK alone[6].

Long-term exposure to air pollution is linked to premature death associated with lung, heart and circulatory conditions, while short-term exposure exacerbates asthma and increases hospital admissions.

There is evidence to suggest that despite strengthening environmental policies, the poorest in our society are being unfairly exposed to worse air pollution without seeing improvements[7]. Clean air is important for everyone and will alleviate stress on our health system, improve people's lives and make our society more equitable.

Types and causes of air pollution

There are different causes and sources of air pollution. Historically, combustion of fossil fuels for energy, such as coal, produced smoke and sulphur dioxide (SO_2).

A major source of poor air quality in the UK contributing to nitrogen dioxide (NO_2) pollution and particulate matter (PM) pollution, is road traffic.

Particulate matter pollution, referred to as PM_{10} or $PM_{2.5}$, is made up of tiny bits of material from all sorts of places including smoke from fires, exhaust fumes, smoking or the dust from brake pads on vehicles. These particles are too small to see, and can be breathed in without being noticed.

Nitrogen dioxide (NO_2) comes from burning fuels or other materials, so levels are especially high around roads. But they are also produced from home gas boilers, bonfires, and other sources as well. You cannot see or smell nitrogen oxides, but they mix with the air and are absorbed into our bodies. Vehicle exhaust emissions contribute to 35% of all UK nitrogen oxide emissions (NOx) which is the single greatest source[8].

[6]Public Health England, 2019. Review of interventions to improve outdoor air quality and public health. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/938623/Review_of_interventions_to_improve_air_quality_March-2019-2018572.pdf

[7]Air Quality Management Resource Centre UWE, 2019. Emissions vs exposure: Increasing injustice from road traffic-related air pollution in the United Kingdom. Available at: https://www.sciencedirect.com/science/article/pii/S1361920919300392

[8]DEFRA, 2019. Air quality: explaining air pollution – at a glance. Available at: https://www.gov.uk/government/publications/air-quality-explaining-air-pollution/air-quality-explaining-air-pollution-at-a-glance

How does air pollution affect our health?

Air pollution particles and gases enter our bodies and can damage our cells in different ways. They usually get into our lungs first and can then move into our blood to reach organs such as our heart and brain.

Any amount of pollution can be damaging to our health, but the more that you are exposed to, the bigger the risk and the larger the effect on you and your family. Some people are more vulnerable to the impacts of air pollution than others. Those more at risk from air pollution include children, pregnant and older people; and people with lung conditions such as asthma, chronic obstructive pulmonary disease (COPD) and lung cancer, and people with heart conditions such as coronary artery disease, heart failure and high blood pressure.

Air pollution in Bath

In Bath, annual average nitrogen dioxide (NO_2) levels exceeded the legal limit of 40 µg/m^3 at several locations within the city, chiefly caused by vehicle emissions.

The problem is exacerbated by Bath's topography. The city sits in the bottom of a valley surrounded by hills, and its central roads are flanked by tall buildings, which means that in certain conditions, vehicle emissions can get trapped in the atmosphere causing high levels of NO_2 in certain locations.

Particulate matter in Bath was not found to exceed legal limits for either PM10 (particulate matter less than 10 micrometers in diameter) or $PM_{2.5}$ (particulate matter less than 2.5 micrometers in diameter), except at times when there were meteorological or other events that caused spikes in these pollutants, nationally. Bath is within the permitted number of $PM_{2.5}$ 24-hour exceedances in a year. There has been a downward trend in levels of PM in Bath since 2017.

Health impacts in Bath of NO2 pollution

- NO_2 contributes to as many as 36,000 early deaths in the UK each year
- It irritates and inflames the lining of airways – which can worsen asthma and make breathing difficult among those with lung disease (such as bronchitis and emphysema). In Bath, around 12,000 people suffer from asthma
- Research shows that high levels of NO_2 can affect children's lung development and that children who grow up in highly polluted areas are more likely to develop asthma.

How we monitor air quality

B&NES has been monitoring air pollution for many years, reviewing the monitoring sites regularly, more recently to ensure coverage of key CAZ locations and potential diversion routes around the zone. Three pollutants are measured around the district: NO_2, PM_{10} and $PM_{2.5}$.

There are currently over 150 locations where NO_2 is measured, including 48 key sites with higher levels of pollution where three diffusion tubes are located at each location to improve data confidence.

To read more about how air quality is measured and analysed in relation to the effectiveness of Bath's CAZ, see the Impacts of the CAZ on Air Quality section.

To find out more information about air quality across B&NES go to:
https://www.bathnes.gov.uk/services/environment/pollution/air-quality

1.2 Why we need a charging CAZ

In 2017, following a successful ruling the Supreme Court in a case brought against the government by Client Earth, the government directed Bath and North East Somerset (B&NES) Council to reduce the annual average NO_2 levels in Bath to within legal limits in 'the shortest possible time' and 'by the end of 2021 at the latest'.

Official air quality data from 2021 was submitted to the Government's Joint Air Quality Unit (JAQU) in the summer of 2022. The data was being independently reviewed by experts and their findings are due to be published in a report encompassing all local authorities subjected to air quality improvements under the NO_2 programme later in 2023.

Since 2017, the Council has done significant technical work to understand what's required to comply with air quality limits, establishing that a charging clean air zone together with the introduction of a traffic management scheme at Queen Square would be the only measures capable of delivering the necessary air quality improvements by the end of 2021. A CAZ works by deterring higher emission vehicles from driving in the most polluted areas of the city by levying a charge, encouraging a more rapid replacement of polluting vehicles for cleaner, compliant ones than would otherwise naturally occur. Other cities around the UK have implemented a CAZ including Birmingham, Portsmouth, Bristol, and Bradford. More cities will follow in the following years.

Other than meeting these objectives, the CAZ is seen as part of the wider obligations towards improving health and the natural environment. In March 2019, the Council declared a Climate Emergency, resolving to provide the leadership in making the Council area carbon neutral by 2030[9]. And in July 2020, the Council declared an Ecological Emergency, resolving to work with local and national partners to resist the destruction of natural habitats through planning policy and development management.

The government has provided all the funds required for us to prepare and implement the CAZ, work is overseen by the government's Joint Air Quality Unit (JAQU) and subject matter experts are also independently verifying the work being done.

1.3 How we decided on a class C charging CAZ

The options for Bath to achieve success were a Class D charging clean air zone, charging all higher emission vehicles including cars and motorbikes or a Class C charging clean air zone, charging all higher emission vehicles except private cars and motorbikes but including some additional traffic management.

The Council engaged extensively with the public throughout 2018/19 before reaching a decision on a Class C charging clean air zone. The overwhelming opinion was that while pollution needed to be tackled, a class C charging CAZ would strike a better balance between tackling pollution and protecting central businesses and vulnerable residents that might be disproportionally affected by charging higher emission cars.

Technical modelling suggested that the Council could achieve success with a Class C CAZ provided additional traffic measures at Queen Square were introduced to address a particular NO_2 hotspot on Gay Street.

In addition, it was agreed that significant financial support would be given to local individuals and businesses to help them replace polluting vehicles regularly entering the zone with cleaner, compliant ones. This mitigation would reduce the impact of charges on affected businesses, while also further reducing emissions to support better air quality.

[9]Bath and North East Somerset Council, 2021. Climate Emergency, available at: https://www.bathnes.gov.uk/climate-emergency

The full business case for the CAZ was approved by central government in January 2020 and can be read here: https://beta.bathnes.gov.uk/policy-and-documents-library/baths-clean-air-zone

1.4 How Bath's CAZ works

Bath's CAZ is a Class C charging clean air zone, which means that daily charges apply to the following higher emission vehicles driving in the zone that do not comply with Euro 6/VI (diesel), or Euro 4/IV (petrol) emissions standards:

- Taxis, private hire vehicles (PHVs), vans (including pick-ups and N1 campervans), minibuses, and light goods vehicles (LGVs) - £9 per day
- Buses, coaches and heavy goods vehicles (HGVs) - £100 per day
- A discounted charge of £9 per day is also available for private (PHGVs), such as larger motorhomes and horse transporters, once registered with the Council.

Cars and motorbikes (except for taxis and PHVs) are not charged in a Class C CAZ, regardless of their emissions standard. This includes campervans classed as M1 on their V5C- (Vehicle Registration Certificate) issued by the DVLA.

Importantly, the Council is not keen to penalise or make money from the zone. Its priority is to inform people about the charge, deter polluting vehicles from entering the zone, and encourage those with chargeable, non-compliant vehicles regularly entering the zone to upgrade their vehicles, with the help of the Council's financial support scheme if needed.

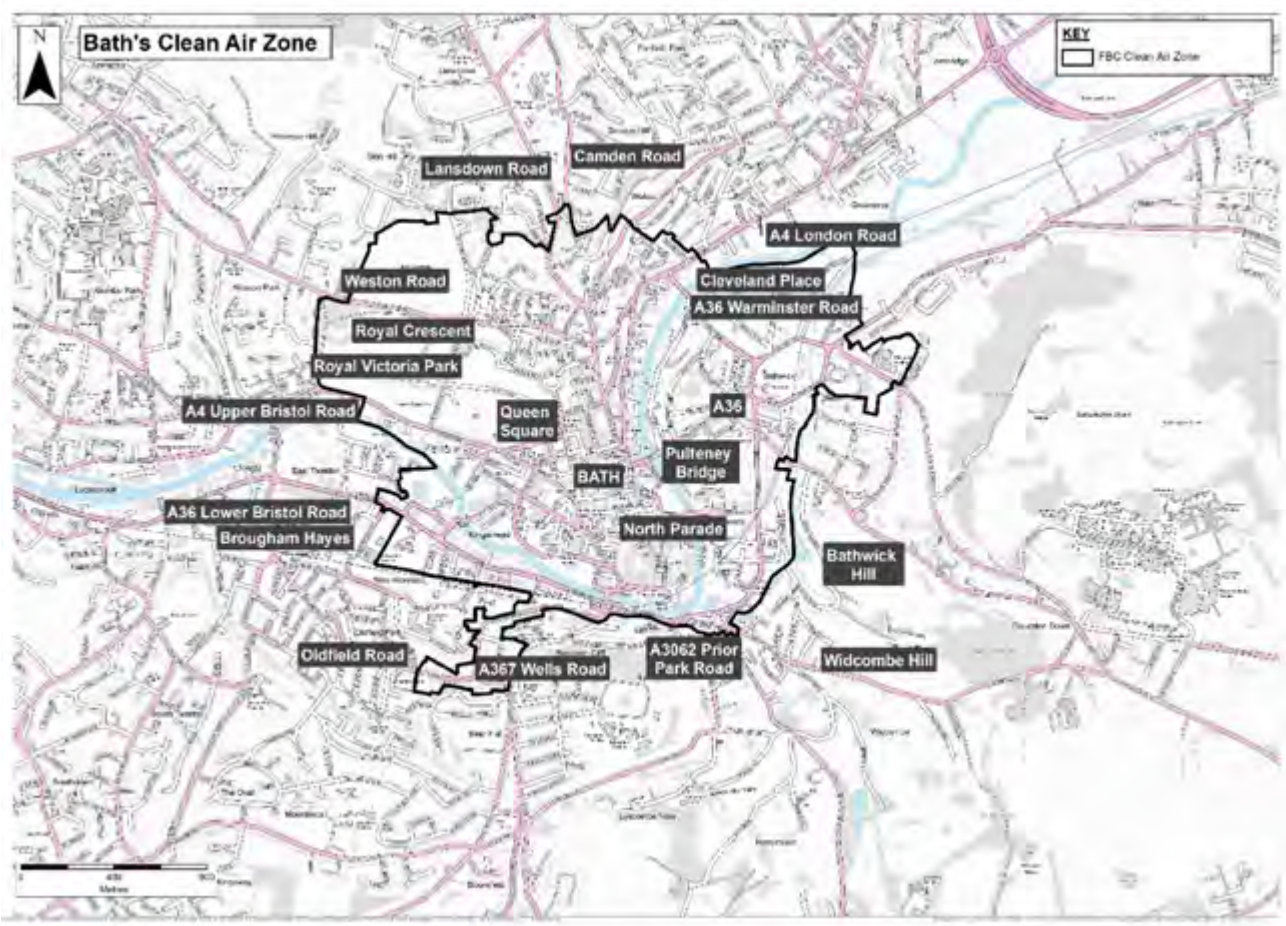
Revenue from charges and fines is used to pay for the running of the scheme. Any money made over and above this must be reinvested in sustainable transport projects.

Zone boundary

The Clean Air Zone covers the very centre of the city (see Figure 1), but its boundary is designed to ensure that annual average levels of NO_2 both inside and outside the zone are within acceptable legal limits by the end of 2021, as per the government's directive.

The Clean Air Zone is as small as possible in order to minimise the social, economic and distributional impact of the scheme, whilst at the same time capturing as many non-compliant vehicle movements as possible in and around the city, with a view to ensuring that air quality limit values are met in the shortest possible time. See the 'Impact of the CAZ on Air Quality' section for a map showing where NO_2 monitoring sites are currently located across the city.

Figure 1- A map of the CAZ boundary.



Exemptions

National exemptions apply permanently for ultra-low emission vehicles, hybrid (within Bath) and alternatively fuelled vehicles, disabled passenger tax class vehicles, disabled tax class vehicles, military vehicles, historic vehicles, and vehicles with retrofit technology accredited by the Clean Vehicle Retrofit Accreditation Scheme (CVRAS).

Local exemptions applied temporarily for two and four years (and for shorter periods) for certain vulnerable groups, hard-to-replace vehicles, and to encourage applications to the financial assistance scheme to upgrade or replace non-compliant vehicles.

Although not taking place in the reporting period of 2022, it may be noted that those exemptions that applied temporarily for 2-years, including those that were issued under the terms of the FAS, expired on 14 March 2023. Local exemptions were offered to support vulnerable groups and those upgrading to cleaner, compliant vehicles for the first two years from the launch of Bath's CAZ. The two-year exemption period provided an opportunity for individuals to consider their options and set aside funds to upgrade their vehicle.

It may also be noted that other exemptions exist, particularly those that applied for 4 years or longer that did **not** expire on 14 March 2023. More information on these exemptions can be found here:
https://beta.bathnes.gov.uk/get-exemption-or-discount-baths-clean-air-zone.

Schemes to support and encourage vehicle compliance

Alongside zone charges that deter the use of non-compliant vehicles in the zone and encourage owners to upgrade, the Council introduced two government-funded schemes that help to mitigate the impact of charges on businesses/individuals regularly travelling in the zone, and further improve air quality:

- A Financial Assistance Scheme (FAS) for businesses and individuals regularly travelling in the zone to help replace or retrofit up to 1,500 polluting, chargeable vehicles with cleaner, compliant ones (via grants and or interest-free finance worth £9.4 million)
- A Bus Retrofit Scheme to financially support local bus operators to retrofit the engines of all remaining non-compliant buses on scheduled routes in the city so that they meet the new emission standards i.e., are compliant with Euro 6 diesel standards (worth £1.7 million)

The first stage of the FAS has now closed, with a second phase utilising residual funding for prioritised cases being progressed towards the end of 2022 and into 2023. The Bus Retrofit Scheme is now complete, with all retrofits completed by June 2022.

2 Assessing the impacts of Bath's CAZ

The purpose of the CAZ is to reduce nitrogen dioxide (NO_2) pollution in Bath to within the annual average limit of 40 µg/m^3 in the shortest possible time, and by the end of 2021 at the latest.

To show that the Council has met this requirement, they will need to evidence that the annual average levels of NO_2 recorded at every valid monitoring site (according to JAQU's criteria) in Bath (both inside and outside of the zone) do not exceed 40 µg/m^3.

However, in addition to air quality, the zone's introduction also impacts traffic flows, vehicle compliance, business and personal travel behaviour, and the local economy.

Data is therefore being continually collected on a range of measures so that the Council can assess the impact of the zone and identify any emerging trends in air quality and other items that may need corrective action. The Council is committed to monitoring and reporting on these measures at various intervals and the full list, including a reporting timeline is included in Table 1.

The purpose of the Council's quarterly CAZ reports is to provide an indicative view of the zone's performance, looking at three key measures: air quality data, traffic flow data and vehicle compliance data. These reports also include data on the financial assistance and bus retrofit schemes because of their influence on fleet compliance.

The purpose of the Council's annual reports is to provide a more in-depth view of the zone's performance with extra secondary measures considered. It also considers the success of individual sites with regards to the annual limit value. Where sites record NO2 concentrations above or near the limit value, they focus in on how corrective action can be taken to address the issue.

Official air quality data from 2021 was submitted to the Government's Joint Air Quality Unit (JAQU) in the summer of 2022. Their findings are due to be published in a JAQU progress report later in 2023. This report will include updates on local authorities implementing measures as part of the NO_2 programme.

Table 1- Data collection and collation for Bath CAZ annual reporting.

Measure	Data to be used	Rationale for Inclusion	Data collection Methods	Frequency of Data Output
M1: Air quality data	NO_2 concentrations data collected at existing monitoring locations in Bath and wider B&NES	To understand changes in air quality data, particularly NO_2 concentrations.	Diffusion tubes and real time monitoring	Quarterly and annually

Measure	Data to be used	Rationale for Inclusion	Data collection Methods	Frequency of Data Output
M2: Traffic Flows	Traffic Flows in and around the CAZ areas will be collected to understand the changes in traffic flows as a result of the scheme.	To understand changes in traffic flows along key corridors and links on the highway network. This will include possible 'rat-run' routes which may have been created by the CAZ, so responding to consultation concerns by residents in specific areas.	ANPR cordon and ancillary Manual Classified Counts (MTC) or Automated Traffic Counts (ATC) on key roads or perceived 'rat-runs'	Quarterly and annually
M3: Vehicular fleet information	Number of compliant/ non-compliant vehicles travelling within Bath	To understand changes in the type of vehicles travelling in Bath.	ANPR cordon, cross-referencing with DVLA vehicle database	Quarterly and annually
M4: Retail/ business/office space vacancy figures	Vacancy statistics from internal council data (B&NES economy and growth team). Market data from property consultants. Purchasing Managers Index.	To understand changes to the number of businesses operating in Bath in order to assess economic impacts.	Internal data collection as part of ongoing process. Regular property market reports published by property consultants in the public domain could also be utilised.	Annually
M5: Retail footfall surveys	Footfall data from Bath Business Improvement District data and internal council data.	To understand changes to the number of people entering shops in Bath as well as the time they spend in each shop.	Bath BID and B&NES collect this data as part of ongoing processes.	Annually

Measure	Data to be used	Rationale for Inclusion	Data collection Methods	Frequency of Data Output
M6: Park and Ride passenger data	Occupancy statistics (Cloud Amber) and bus ticket data (First). Monitor fleet mix	To understand changes in the number of people and the type of vehicle using the P&R into Bath.	Collected as part of ongoing monitoring activities by operators. ANPR at entrance to Park and Rides	Annually
M7: Walking and cycling counts	Pedestrian and cycle counts on key arterial routes	To understand changes in the number of people walking and cycling on key routes within Bath.	Commissioning of new surveys	Annually
M8: Bus usage and fare data	Occupancy statistics (Cloud Amber) and bus ticket data (First).	To understand changes in the number of people using the bus on each route into Bath.	Collected as part of ongoing monitoring activities by operators.	Annually
M9: Stakeholder Feedback from Council User Group Forums	Stakeholder Feedback covering relevant elected members, stakeholder groups, the LEP. Voice Box survey. Protected groups survey.	Understand the views of stakeholders to scheme delivery and impacts, and to understand some of the less quantified effects, including package effects.	Part of the on-going consultation process for transport strategies in the city.	Annually
M10: Taxi fares and unmet demand	Taxi fare data and unmet demand surveys	To understand changes to fares and demand on taxis in order to assess the economic impacts	Collected as part of ongoing monitoring activities by operators.	When unmet demand surveys are performed (every three years)
M11: Early Measures Fund – Zero-Emission Parking Permits	Statistics on zero-emission vehicle parking permits scheme uptake	To understand the popularity	Collected as part of the parking permit scheme operation	Annually, and finally in 2022 when the scheme has ended

Measure	Data to be used	Rationale for Inclusion	Data collection Methods	Frequency of Data Output
M12: Bus retrofit uptake/ compliance data	Statistics on bus retrofit scheme uptake and bus compliance	To understand changes to bus fleet operating in Bath.	Collected by ANPR cameras, as part of ongoing monitoring activities by operators and from the retrofit scheme	Quarterly and annually
M13: Financial support scheme uptake	Statistics on financial support scheme uptake	To understand the success and popularity of the financial support schemes in changing to compliant vehicles	Collected as part of the financial support scheme operation	Quarterly and annually and finally after the scheme has ended
M14: Travel advisor session uptake	Statistics on meetings with travel advisors	To understand the overall success of travel advisors and	Collected as part of the travel advisor scheme operation	Quarterly and annually
M15: Anti-idling enforcement	Data from enforcement action for anti-idling	To understand the success of the measure in reducing idling	Collected as part of the anti-idling enforcement scheme operation	Annually
M16: Weight restriction enforcement	Data from enforcement action for anti-idling	To understand the success of the measure in enforcing weight restrictions	Collected as part of the weight restriction enforcement scheme operation (from Trading Standards)	Annually
M17: Only-mile delivery uptake	Statistics on only-mile delivery uptake	To understand the success of the only-mile delivery measure with businesses	Collected as part of the delivery and servicing plans operation	Quarterly and annually

3 Impacts of the CAZ on air quality

The purpose of the CAZ is to reduce NO_2 concentrations in Bath to within the annual average limit of 40 µg/m^3 in the shortest possible time, and by the end of 2021 at the latest. 40 µg/m^3 is the legal limit set for NO_2 in the Environment Act 1995 (amended by the Environment Act 2021) and the Bath and North East Somerset Council Air Quality Direction 2019[10].

To show that the Council has met this requirement, they will need to evidence that the annual average levels of NO_2 recorded at every valid monitoring site in Bath (both inside and outside of the zone) do not exceed 40 µg/m^3. This is also in line with the Critical Success Factors (CSF) developed as part of the Full Business Case for the scheme.

3.1 Critical success factors of the CAZ

To successfully monitor and evaluate the performance of the CAZ, two critical success factors (CSF) were developed.

The primary CSF seeks to deliver compliance (in the shortest possible time) with the NO_2 concentration limit values outlined in the 2008 EU Air Quality Directive (AQD). This directive sets out sighting guidelines for monitoring locations. The Pollution Climate Mapping Model (PCM) used by JAQU in their assessment of Bath's scheme, uses locations based on these requirements. To ensure that a receptor is compliant with AQD guidelines, it must be at least 25m away from a junction, 0.5m away from the nearest obstruction (including building façades), represent 100m stretch of road and be 1.5-4m high. An ideal location is 4m from the road and 2m high. Additionally, as the AQD looks at NO_2 concentrations at the point of monitoring, results are not adjusted to the façade, unlike the requirements of a Local Air Quality Monitoring (LAQM) site.

Currently not all 138 diffusion tube receptor sites in Bath comply with AQD guidelines because many have been in place for several years to comply with LAQM positioning (see below), enabling us to compare air quality with previous years.

The secondary CSF aims to deliver a scheme which leads to compliance with the LAQM Air Quality Objectives for NO_2 concentrations. As LAQM focuses on NO_2 concentrations at the point of relevant public exposure (facades of schools, care homes, hospitals etc) NO_2 concentrations are adjusted to the nearest façade. Unlike the AQD requirements, sites can be placed on junctions and within 0.5m of a building façade, providing there is relevant public exposure.

3.2 Have we achieved success?

Success is defined by the Government as "all measured NO_2 concentrations at valid locations within the geographical extent of the local authority clean air plan are below or equal to the annual average limit value."

Official air quality data from 2021 was submitted to the Government's Joint Air Quality Unit (JAQU) in summer 2022. Their findings are due to be published in a JAQU progress report later in 2023. This report will include updates on local authorities implementing measures as part of the NO_2 programme.

[10]Environment Act 1995 Bath and North East Somerset Council Air Quality Direction, 2019. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/800802/air-quality-direction-bath-2019.pdf

The progress report is likely to indicate the Bath's CAZ is achieving success. B&NES expect to be required to maintain successful levels of NO_2 concentrations, with the CAZ and related air quality improvement measures remaining in place.

3.3 How air quality data is measured and collected

The Council has measured air quality in Bath and North East Somerset since the mid-1990s. Currently we measure NO_2, $PM_{2.5}$ and PM_{10} concentrations using multiple methods.

Automatic analysers measure NO_2 and PM in four permanent roadside locations in Bath. They take hourly readings of air pollution concentrations and provide more accurate readings than diffusion tubes. One of these monitoring stations is linked to the UK Automatic Urban and Rural Network (AURN) which provides national coverage of a range of pollutants.

Diffusion tubes are light, mobile and can be placed in many locations around the area, usually 1 to 15 metres from the road or at the kerbside (less than 1 metre from the road) and around 2-3 metres above ground level. The ambient air reacts with a chemical reagent in the tube so that NO_2 concentrations can be measured. The tubes are exposed to the air for one month before they are collected and sent to a laboratory for analysis. During 2022, there were over 150 diffusion tube locations across Bath & North East Somerset.

In recent years, average annual levels of particulate matter pollution in Bath have not exceeded the legal limit of 40 µg/m^3 for PM10 and 20 µg/m^3 for $PM_{2.5}$. Occasional 24-hour exceedances occur but only at times when there were meteorological or other events that caused spikes in these pollutants, nationally. Additionally, within 2022, if the 24-hour average was exceeded, it was within the permitted number of exceedances across the year. Whilst the Council continues to measure it, PM data will not form part of the quarterly or annual reports.

Comparing air quality data inside and outside of the zone

The Council has committed to assessing whether the introduction of the CAZ would lead to displacement impacts in areas outside of the zone's boundary.

To establish the impact of the zone on air quality in surrounding areas, and trends inside and outside of the zone, air quality data is presented in the following areas:

- The Clean Air Zone (Sites within the boundary of the CAZ referred to as the 'CAZ_Only')
- The boundary area (Sites outside the boundary of the CAZ but within the urban area of Bath including Batheaston and Bathampton, referred to as the 'CAZ_Boundary')
- The wider area (sites outside of Bath, Batheaston and Bathampton urban areas, but within the rural areas and district-wider urban areas in Bath & North East Somerset, referred to as 'Wider_B&NES')

A note on air quality monitoring locations

As of 2022, there were 171 diffusion tube monitoring sites across Bath and North East Somerset that contribute to the analysis and results within this report. There are a further four automatic analysers located within Bath.

71 sites are located within the CAZ (Figure 2) and 67 in the city's urban area outside of the zone's boundary (Figure 3), with a further 33 in the wider district. B&NES have reported on monitoring sites with long-term data or that will remain in place in the future. There are more diffusion tube locations not included in this analysis because they are in place temporarily, however, their concentrations will be reported on in the 2023 Annual Status Report as part of our obligation to LAQM reporting.

When analysing results, B&NES have only considered like-for-like data in most cases, meaning if a diffusion tube was not in place in the baseline year of 2019, it has not been included within the analysis. This ensures that our methods and findings are robust.

Figure 2- A map showing the Clean Air Zone and the automatic analyser (orange squares) and diffusion tubes (blue triangles) locations in Bath © Crown Copyright 2021. License number AC0000807498.

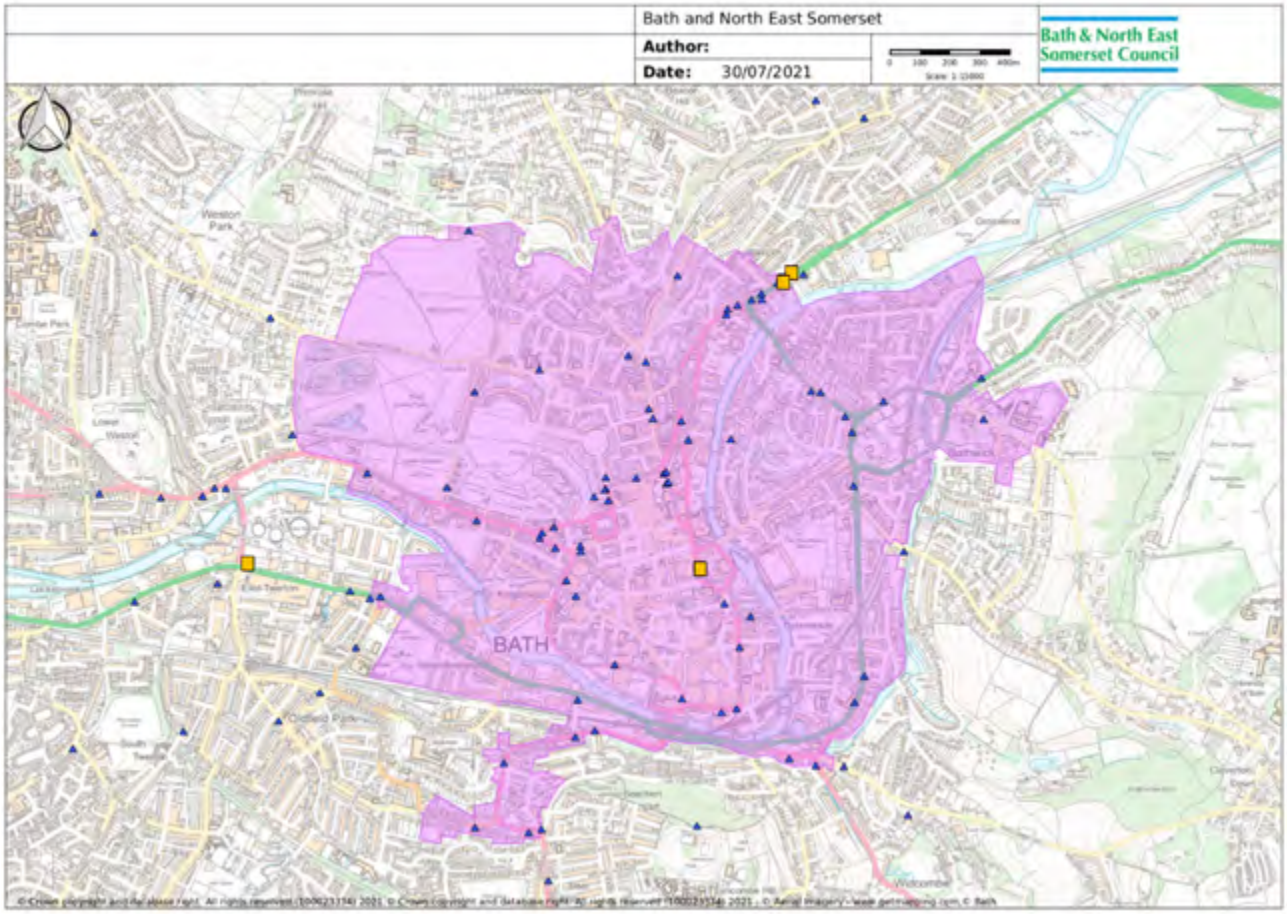
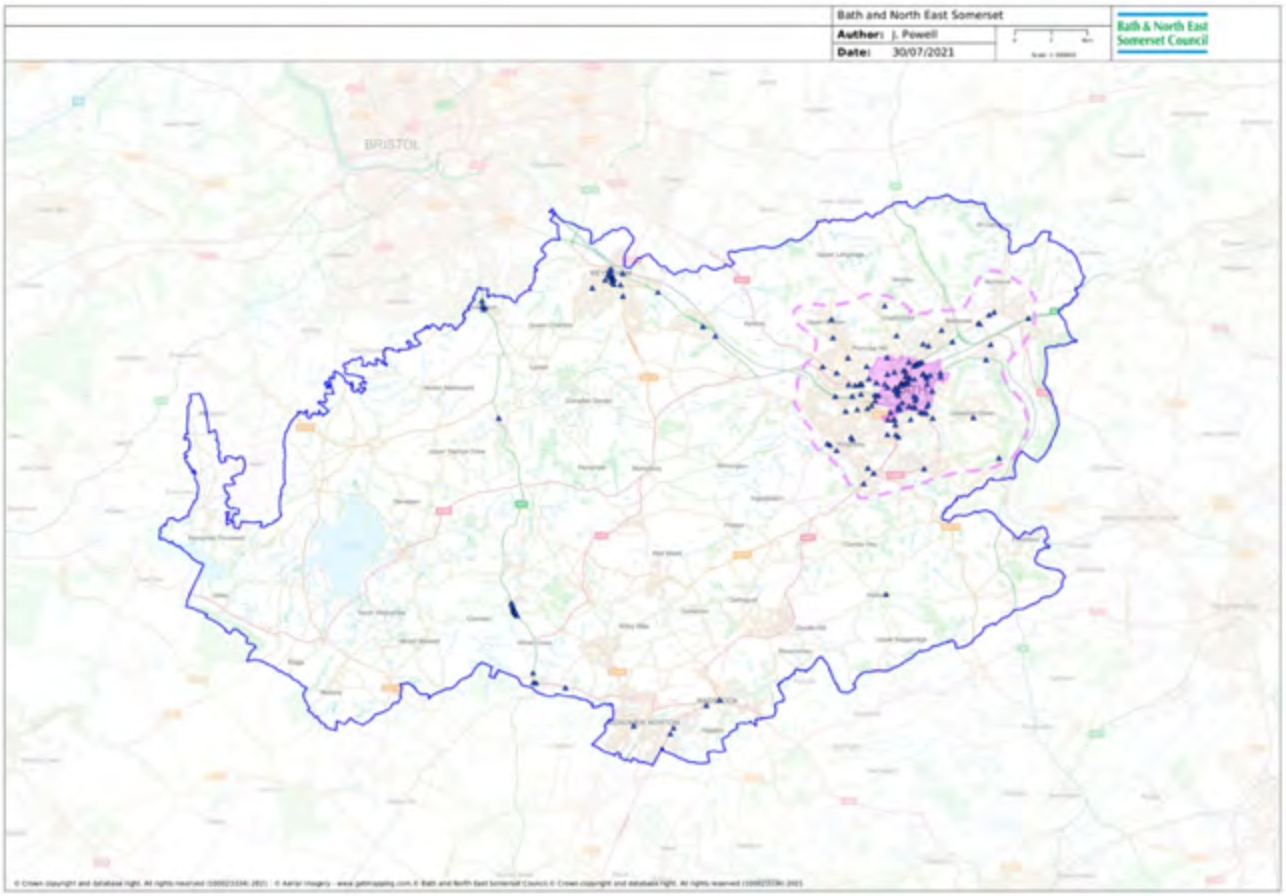


Figure 3- A map showing diffusion tube locations in three site groupings: The wider district of Bath and North East Somerset (the blue line; Wider_B&NES), the wider Bath urban area outside of the CAZ (the dotted pink line; CAZ_Boundary) and the CAZ (the pink area; CAZ_ Only). © Crown Copyright 2021. License number AC0000807498.



Number of diffusion tube sites in each location

Table 2 shows the growing number of diffusion tube air quality monitoring sites across B&NES. Additional sites were chosen based on the air pollution dispersion model developed for the CAZ Full Business Case, enabling the impact of the CAZ to be checked against what was modelled.

Triplicate sites are where three diffusion tube are co-located at one monitoring site to improve accuracy. These are located where annual NO_2 concentrations are predicted to be greater than 34 µg/m^3. The NO_2 concentration from each triplicate diffusion tube is averaged to produce one result for the site, so triplicate measurements are only counted once for analysis.

Table 2- Number of diffusion tube sites providing annualised data (triplicate sites are averaged, so only considered one location) from 2019 to the end of 2022, in the three site groupings.

Period	CAZ_Only	CAZ_Boundary	Wider_B&NES
2019	65	56	29
2020	65	56	34
2021	66	57	40
2022	71	67	33

Most of the air quality data shown in this report comes from averaging monthly diffusion tube results. Data is also reported on from four automatic analysers located in Bath.

Measuring air quality to take account of seasonal effects

Annual average concentrations are useful because they account for varying seasonal cycles of pollutants such as:

- Meteorological conditions, for example wind, precipitation, and temperature.
- And to a lesser degree, human sources of air pollution, for example increased energy generation for heating in winter or increased agricultural activities in spring

This is also why air quality data is compared against similar time periods, for example comparing data from 2022 to the baseline of 2019. Further information on monitoring can be found in the 'Monitoring Explained' section at the end of the report.

4 Annual air quality results, 2022

Although the focus of the report is 2022, historical data is analysed to identify longer-term trends, as well as focussing closely on certain sites, which do not meet the 40 µg/m^3 annual limit value. 2022 data is largely compared with baseline data from 2019, however, will also occasionally be compared to 2021 data as this was the first operational year of the CAZ. 2020 data has been discounted as a baseline because of Covid-19s unprecedented effect on traffic and travel behaviour.

The full annual diffusion tube results can be found in the Air Quality Data appendix supporting this report.

Focus sites

Here the recent and longer-term data of sites within the CAZ (CAZ_Only) and wider Bath urban area (CAZ_Boundary) is looked at, focusing on those sites that recorded high or increasing NO_2 concentrations during 2022. All other areas across the city have annual average levels below 36 µg/m^3 (90% of the annual limit value) or have falling levels of NO_2 and are therefore excluded from the table.

Table and figures included in this section:

- Table 3: Sites within the CAZ and Bath's wider urban area that recorded an NO_2 concentration greater than 40 µg/m^3 in 2022.
- Table 4: Sites within the CAZ and Bath's wider urban area that recorded an NO_2 concentration greater than 36 µg/m^3 but less than 40 µg/m^3 in 2022.
- Table 5: A breakdown of the overall number of sites recording above 36 µg/m^3 and 40 µg/m^3 in 2022.
- Table 6: Annual average NO_2 concentration in 2019 and 2022.
- Figure 4: A map of the CAZ with the five diffusion tube sites which recorded an annual average NO_2 concentration greater than 36 µg/m^3 in 2022.

Table 3: NO_2 concentrations at locations where the annual average exceeded 40 µg/m^3 in 2022, within the CAZ_Only and CAZ_Boundary site groupings. TA = triplicate average site

	Site	Site grouping	2019 Annual concentration (µg/m^3)	2022 Annual average (µg/m^3)	Change (µg/m^3)
DT304	Walcot Parade 4	CAZ_Only	N/A*	40.4	N/A

*DT304 was installed in August 2022 and the annual average only comprises of 5 months of data, so the pre-CAZ 2019 baseline is unavailable. However, additional monitoring locations at Walcot Parade do have a baseline reading. See Appendix 2 for NO_2 concentrations at these locations.

Table 4: NO_2 concentrations at locations where the annual average concentration exceeded 36 µg/m³ in 2022 but remained at or below 40 µg/m³, within the CAZ_Only and CAZ_Boundary site groupings. TA = triplicate average site

Site ID	Site	Site grouping	2019 Annual concentration (µg/m³)	2022 Annual average (µg/m³)	Change (µg/m³)
DT020 (TA)	Wells Road	CAZ_Only	45.4	38.5	-6.9
DT222 (TA)	Anglo Terrace Façade	CAZ_Only	49.0	36.6	-12.4
DT224 (TA)	Walcot Parade 2 (TA)	CAZ_Only	55.2	39.7	-15.5
DT305	Wells Road 5	CAZ_Only	N/A*	38.0	N/A

*DT305 was installed in August 2022, therefore, a pre-CAZ 2019 baseline is unavailable. However, additional monitoring locations at Wells Road do have a baseline reading. See Appendix 2 for NO_2 concentrations at these locations.

Table 5: The total number of sites within the CAZ and wider Bath urban area, which recorded greater than 40 µg/m³ and 36 µg/m³ NO_2 concentrations during 2019 and 2021. The total number of sites reporting during each period is shown along with the proportion of sites recording greater than 40 µg/m³ and 36 µg/m³ because the total number of sites is variable. Note that sites which recorded above 40 µg/m³ will also have recorded above 36 µg/m³.

CAZ_Only and CAZ_ Boundary	Total no. sites reporting	No. sites >40 µg/m³ average	Proportion sites >40 µg/m³ (%)	No. sites >36 µg/m³	Proportion sites >36 µg/m³ (%)
2019	121	12	19	28	45
2022	138	1	1	5	7
Change	17	-11	-18	-23	-38

Comments and key findings:

- This analysis considers annual data from all sites within the CAZ and the surrounding urban area.
- One site (Walcot Parade 4) recorded an annual mean concentration for 2022 above 40 µg/m³, however, the site only comprises 5 months of data and whilst it has been annualised, it is not representative of the whole year. As detailed below on page 35, the annualisation process is likely to have slightly overestimated the concentrations for the year.
- Additionally, whilst the annual limit value for NO_2 is 40 µg/m³, Defra's approach when reporting compliance to the European Commission (as confirmed by JAQU in 2019), is to round any concentration to the nearest integer, and therefore, a concentration up to 40.49 µg/m³ would not be reported as exceeding[11].

[11] Jacobs, 2019. Local Air Quality Modelling Methodology Report (AQ2). Available at: https://democracy.bristol.gov.uk/documents/s42646/Appendix%20Di%20-%20BCC%20CAZ%20OBC%2018%20-%20Modelling%20Methodology%20Report%20AQ2.pdf

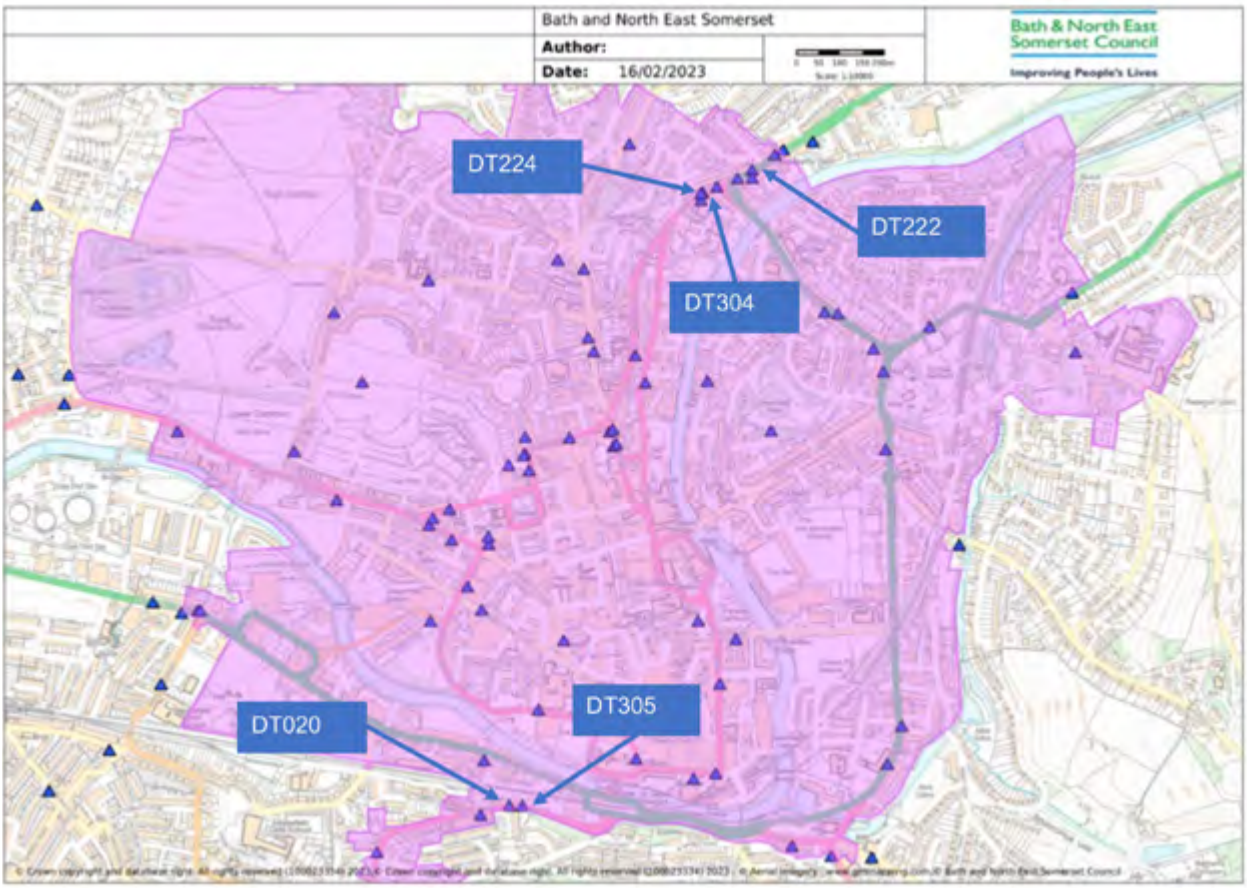
- Therefore, whilst Walcot Parade 4 does exceed the limit value at 40.4 µg/m^3 it would be considered a compliant monitoring site by Defra and JAQU if it were to have a full data set.
- As seen in Table 4, four sites (Wells Road, Anglo Terrace Façade, Walcot Parade 2, and Wells Road 5) recorded an annual mean concentration above 36 µg/m^3, but below 40 µg/m^3.
- No sites recorded an increase in NO_2 concentration between the baseline year of 2019 and 2022.
- Within the CAZ and CAZ_Boundary, 23 fewer sites recorded concentrations above 36 µg/m^3 compared with 2019, and 11 fewer sites recorded concentrations above 40 µg/m^3.

As reported on in Tables 3 and 4, there are 5 key diffusion tube sites, that fall within 3 areas of Bath that recorded concentrations above 36 µg/m^3 in 2022. Wells Road, Walcot Parade and Anglo Terrace are locations that are being given extra consideration by the Council on ways to reduce air pollution. A map of the sites exceeding 36 µg/m^3 is provided in Figure 4.

A note on distance adjusting

NO_2 concentrations reduce rapidly as you move away from the source (road). A LAQM receptor for NO_2 is a residential property, school, hospital etc. If a monitor is located at a roadside/kerbside location, then the concentrations are distance adjusted using a diffusion tube processing tool to calculate the concentration at the building façade. This is only carried out on concentrations which are above 36 µg/m^3 (within 10% of the limit value) and has not been performed on any results in this report. It is an important consideration when considering the success of the CAZ.

Figure 4- A map of the CAZ which highlights the five sites (Wells Road, Anglo Terrace Façade, Walcot Parade 2, Walcot Parade 4 and Wells Road 5) which recorded above 36 µg/m^3 at the monitor in 2022. © Crown Copyright 2022. License number AC0000807498.

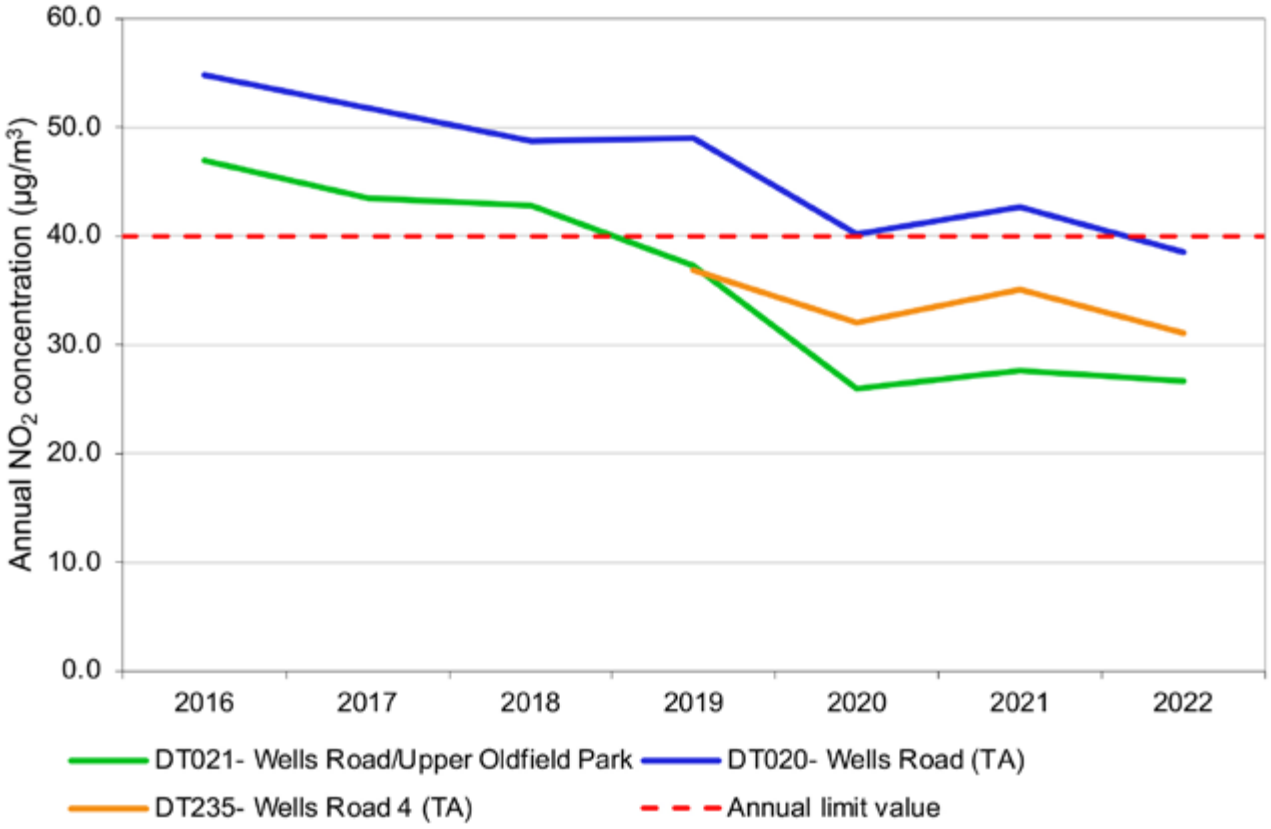


Case study locations

The following section looks at hotspot locations which have previously had NO_2 concentrations exceeding the annual limit value, whilst also being sensitive to changes in traffic flows. The graphs below present annual NO_2 data from 2016 at Wells Road, Queen Square, and locations within the vicinity of Cleveland Bridge.

Wells Road

Figure 5- Annual average NO_2 concentrations at sites along Wells Road from 2016 through to 2022



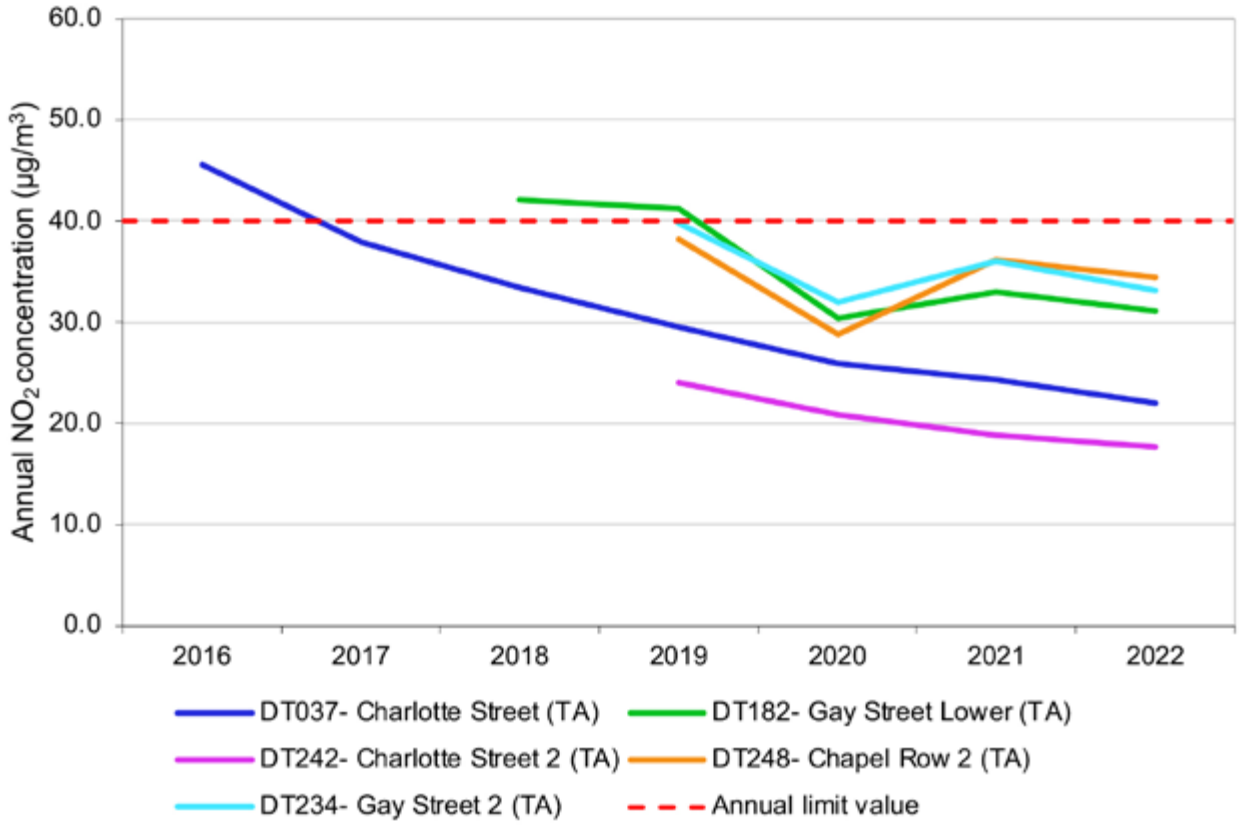
Comments and key findings:

- All sites have an overall decreasing trend.
- A slight increase in concentrations at all sites between 2020 and 2021 is almost certainly due to increasing traffic levels associated with the end of the pandemic and the Cleveland Bridge closure.
- General fleet improvements may be a leading cause of decreasing NO_2 after the introduction of Euro 6 emission standards in 2015.

Queen Square

Queen Square, a location that was implemented with a traffic management plan alongside the launch of the CAZ in 2021, has several NO_2 monitoring locations along the surrounding roads of the area. Many of these sites were added in 2019 to support the CAZ, however, longer term monitoring has taken place along Charlotte Street, Gay Street and Chapel Row.

Figure 7- Annual average NO_2 concentrations at sites within the vicinity of Queen Square from 2016 to 2022



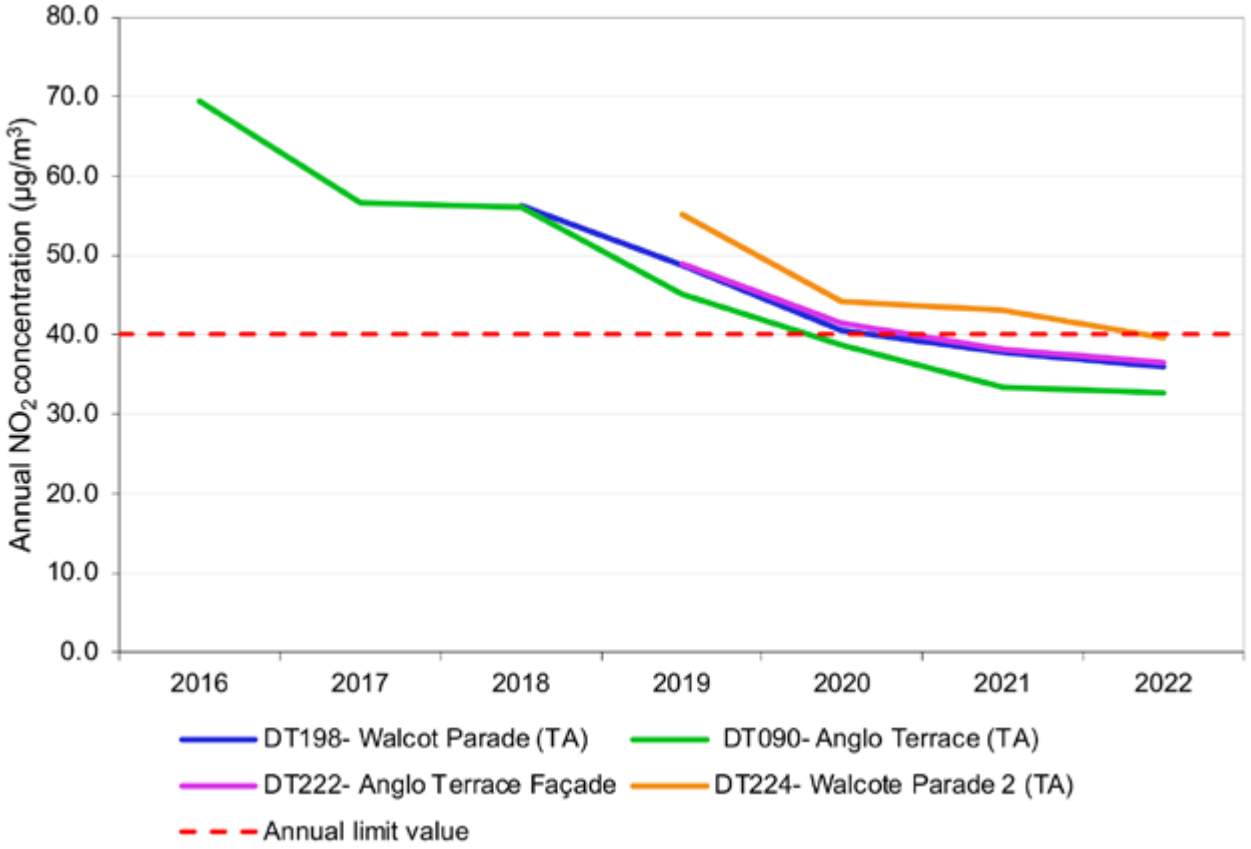
Comments and key findings:

- All sites have an overall decreasing trend.
- A slight increase in concentrations at all sites between 2020 and 2021 is almost certainly due to increasing traffic levels associated with the end of the pandemic and Cleveland Bridge closure.
- DT037 (Charlotte Street) and DT182 (Gay Street Lower) have both previously exceeded the limit value, with DT234 (Gay Street 2) averaging marginally below. However, in 2022, all monitoring sites recorded below 40 µg/m^3.

Locations within the vicinity of Cleveland Bridge

Monitoring sites situated along London Road, and within the vicinity of Cleveland Bridge, have previously been subject to concentrations of NO_2 above the annual limit value.

Figure 8- Annual average NO_2 concentrations at sites within the vicinity of Cleveland Bridge from 2016 to 2022



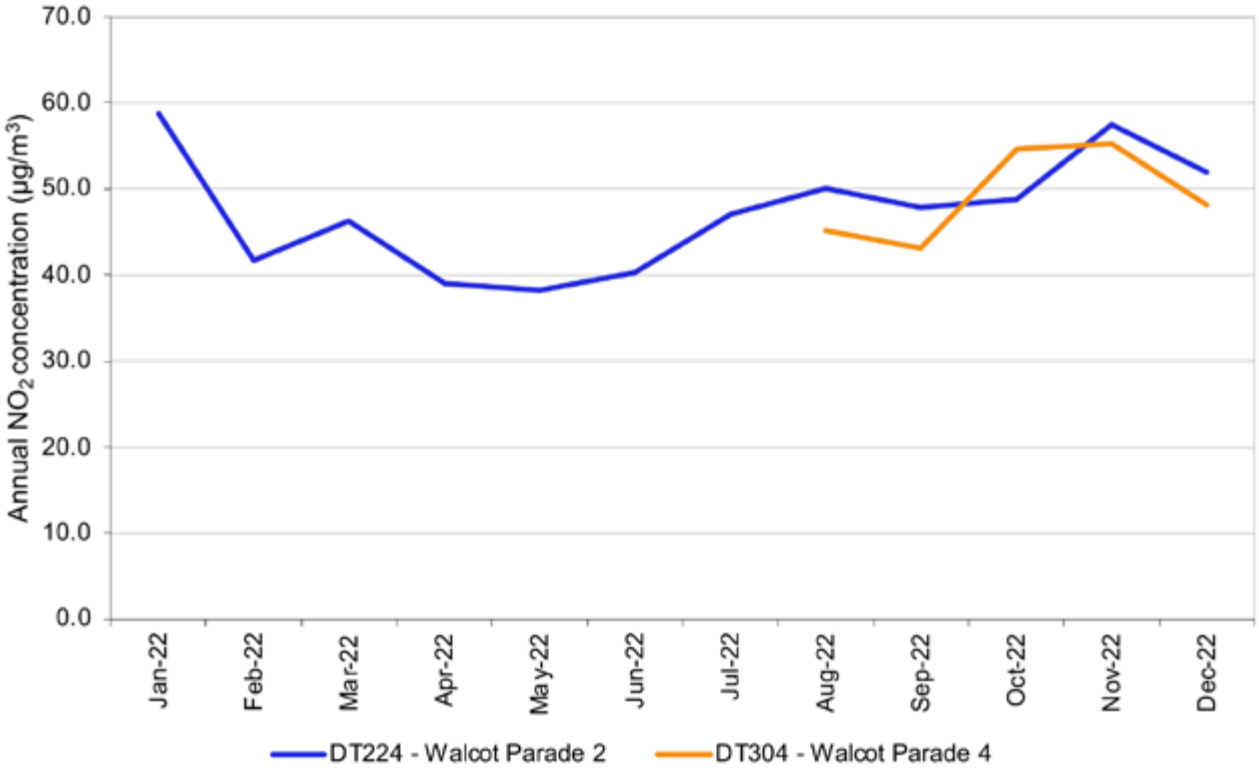
Comments and key findings:

- This location has been monitored carefully due to the varying partial and full closures of Cleveland Bridge across 2021 and into much of 2022.
- All the diffusion tube locations presented in Figure 8 previously exceeded the annual limit value, however, concentrations have an overall decreasing trend with zero sites exceeding in 2022.

Figure 9, below, presents monthly data for 2022 at the long-term diffusion tube site at Walcot Parade 2 (DT224) and the site that was introduced in August 2022, Walcot Parade 4 (DT304).

In 2021, DT224 recorded an annual average concentration above 40 µg/m^3 at 43.1 µg/m^3, however, it did not meet the AQD siting criteria and was considered an invalid monitoring location by JAQU. In response to this, B&NES installed an additional diffusion tube site slightly further along that did meet the siting criteria. The results of monitoring are presented in Figure 9, below.

Figure 9- monthly NO_2 concentrations at Walcot Parade from January-December 2022



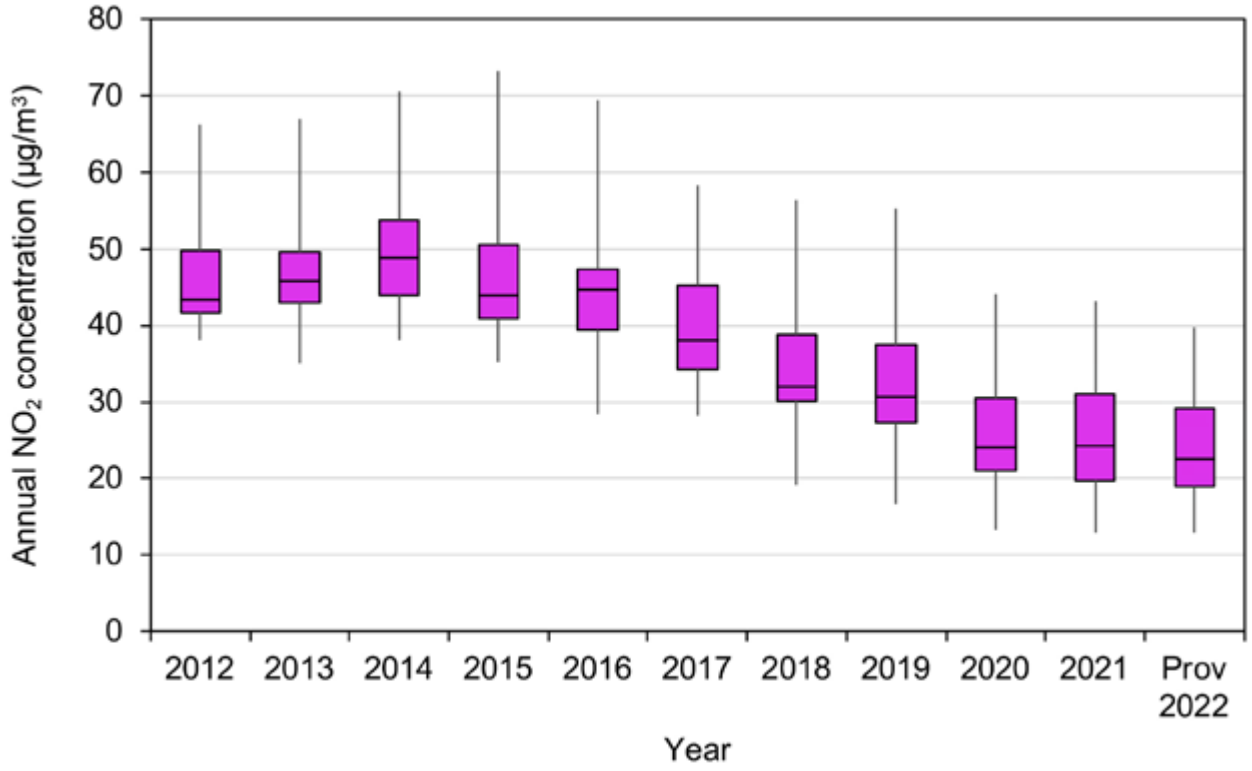
Comments and key findings:

- As DT304 was installed in August 2022, the annual averages were annualised using the diffusion tube processing tool provided by Defra.
- Despite showing similar monthly concentrations, and tracking the same, DT304 showed a higher annual average concentration than DT224, recording slightly above the objective limit.
- Whilst DT304 is sited slightly closer to the road (and further from the façade), this may be due to the annualisation process slightly overestimating figures.
- Figure 9 suggests that if a full 12-months of data was collected at DT304, the annual average NO_2 concentration may be below the objective value.

Long-term trends

It is important to investigate individual sites where NO_2 concentrations are high or increasing. It is also important to understand longer-term trends and more wide-ranging trends. Figure 10, below, shows boxplots of sites within the CAZ for the last 11 years.

Figure 10- Boxplots within the CAZ showing the range in NO_2 concentrations over the last 11 years.



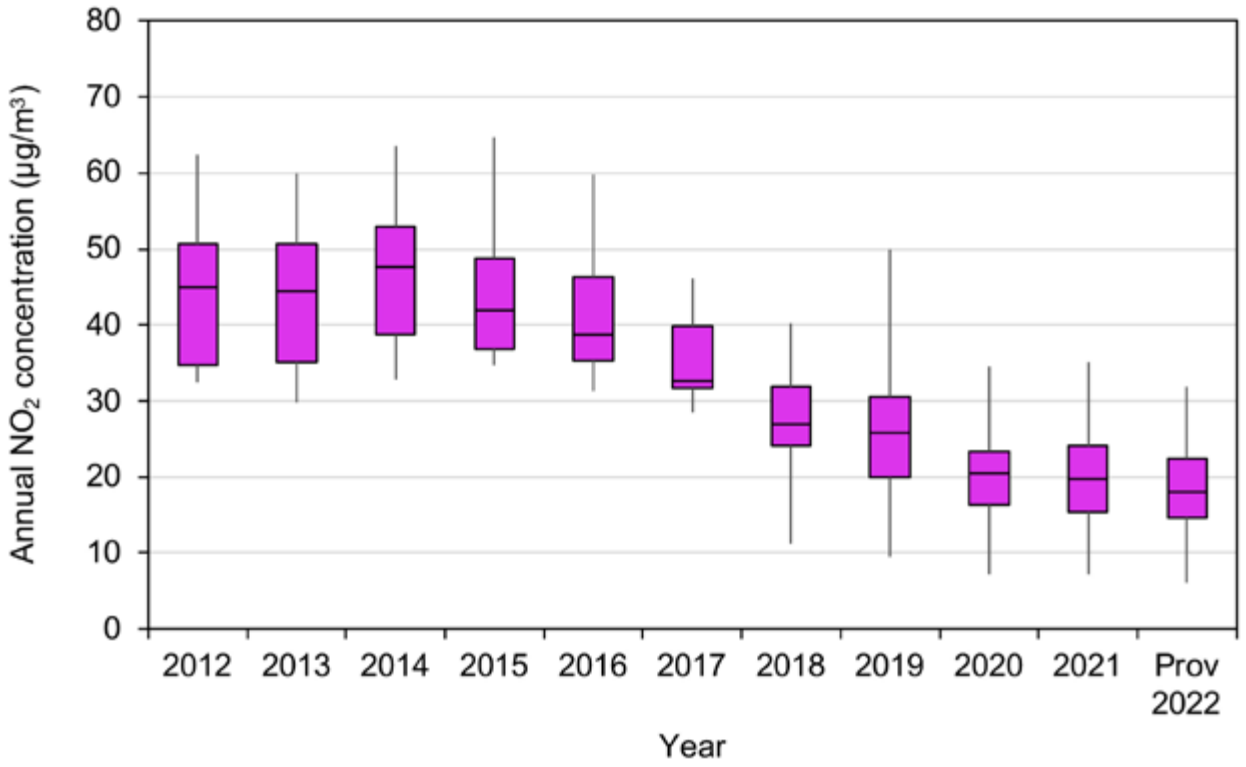
The whiskers show the minimum and maximum annual average NO_2 concentrations during that year. The bottom of the pink box shows the first quartile, the black line in the box is the median result and the top of the pink box is the third quartile. The box therefore represents the inter-quartile range, where 50% of the data is found.

Comments and key findings:

- There is a clear decrease in the full range of data from 2014 onwards, with there being a gentler decrease from 2020 onwards.
- Aside from the slight increase in median NO_2 during 2021 likely because of the impact of Covid-19, the last increase in median was 2016.
- The minimum and maximum data continues to decrease, as shown by the whiskers. The lowest datapoint in 2012 is near equivalent to the highest datapoint in 2022.
- Figure 10 shows that the interquartile range and median results for 2022 have gently decreased, whereas they remained relatively unchanged between 2020 and 2021.
- NO_2 concentrations in 2020 were lower than average likely due to the impact of Covid-19, however, concentrations in 2022 are on average lower.

Figure 11, below, shows boxplots of sites in the urban area outside of the CAZ for the last 11 years.

Figure 11- Boxplots showing the range in NO_2 concentrations within the CAZ_Boundary over the last 11 years. The whiskers show the minimum and maximum annual average NO_2 concentrations during that year. The bottom of the pink box shows the first quartile; the black in the box is the median result; the top of the pink box is the third quartile. The box represents the inter-quartile range, where 50% of the data is found.



Comments and key findings:

- The CAZ_Boundary shows a greater interquartile range in the earlier years in the CAZ, which may represent that the wider urban area contains many monitoring sites located at road sides (higher concentrations of NO_2) and those sites which are located as background sites (much lower concentrations), thus resulting in a greater range of values.
- The interquartile range reduced in size through time. This is despite there being an increase in sites but may be because the reducing NO_2 concentrations are approaching background levels towards the end of 2022, so the reduction is smaller.
- Like that of the CAZ_Only grouping, the maximum 2022 data is almost at the same concentrations as the minimum data in 2012. This overall shows how vast the reductions have been since 2012.

An alternative way to consider the data is using histograms. The blue columns in Figures 12 and 13 below relate to the baseline data in 2019, whilst the orange columns relate to 2022 data.

Figure 12- A histogram showing the number of CAZ sites listed in 'bins' (x-axis) of annual NO_2 concentrations in both 2019 and 2022.

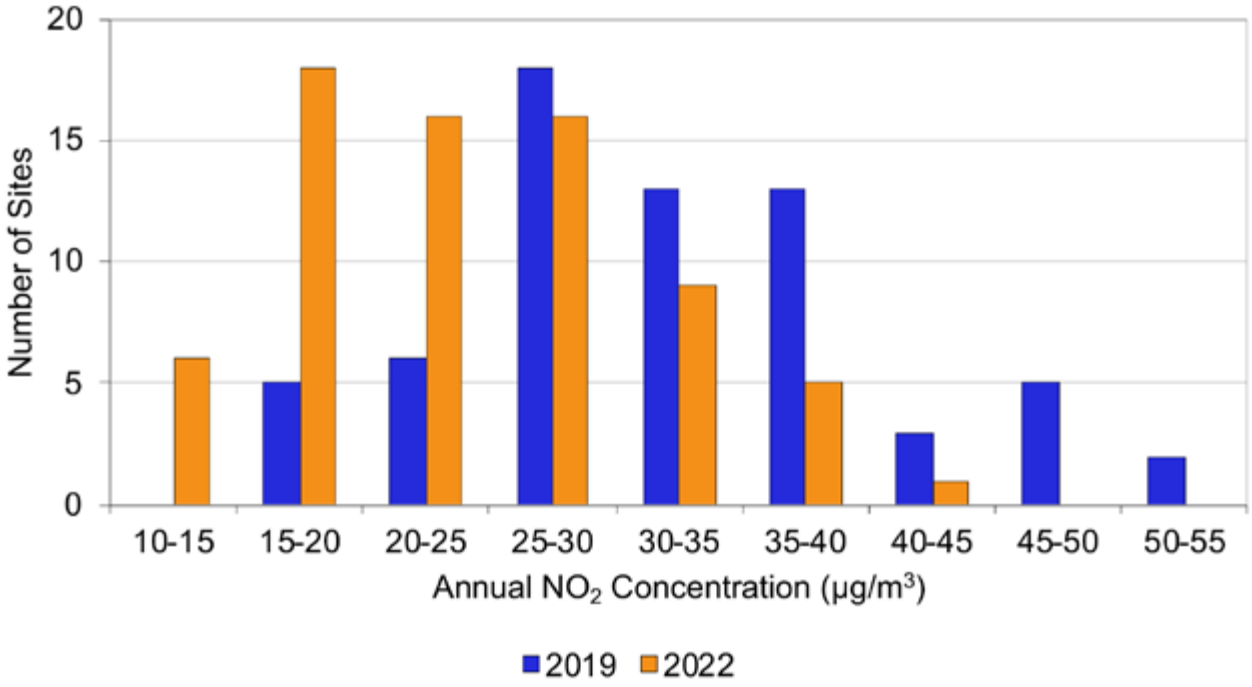
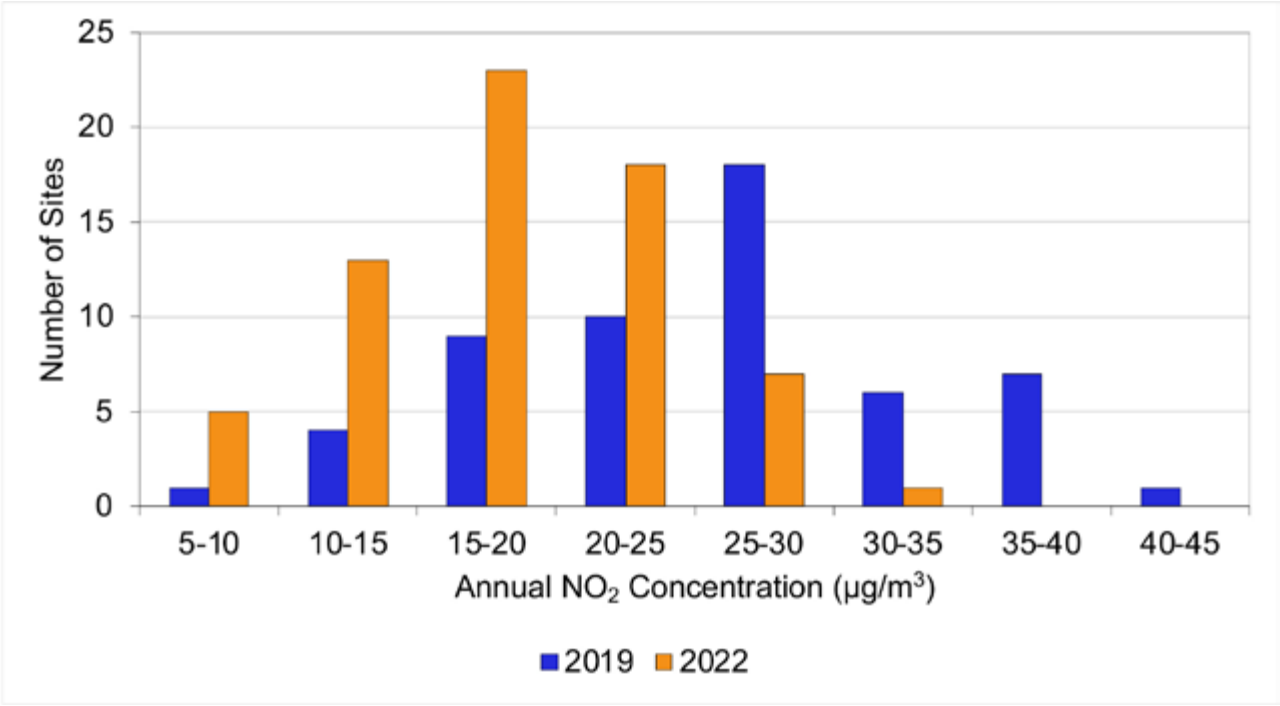


Figure 13- A histogram showing the number of CAZ_Boundary sites listed in 'bins' (x-axis) of annual NO_2 concentrations in both 2019 and 2022



Comments and key findings:

- There is a clear shift in the distribution of sites, as they record lower NO_2 concentrations in 2022 than in 2019.
- Zero sites within the CAZ_Boundary recorded above the limit value in 2022, with only one site exceeding in the CAZ (Walcot Parade 4 at 40.4 µg/m^3).

- Zero sites within both the CAZ and CAZ_Boundary in 2022 fell within the 45-55 µg/m^3 bin, compared to seven in 2019.
- Overall, Figures 12 and 13 indicate a positive improvement in NO_2 concentrations since the implementation of the CAZ.

Table 6, below, provides a breakdown of the NO_2 concentrations at sites across the three site groupings. The annual average NO_2 concentration across all three site groupings is shown dependent on how many sites were recording data during both 2019 and 2022.

Table 6- Provisional NO_2 concentrations across the three site groupings

Period	CAZ_Only NO_2 (µg/m^3)	CAZ_Boundary NO_2 (µg/m^3)	Wider_B&NES NO_2 (µg/m^3)
2019	32.4	25.7	30.1
2021	25.4	20.0	24.6
2022	23.9	18.6	23.0
Number of sites reporting results	65	56	26

Comments and key findings:

- NO_2 concentrations have continued to fall across all site groupings since the baseline year of 2019. This is most pronounced within the CAZ_Only (26%) and CAZ_Boundary (27%) and least pronounced in the Wider_B&NES grouping (24%).
- Note that the baseline NO_2 concentrations in 2019 is different across all three site groupings. The CAZ_Only grouping has a greater actual NO_2 reduction when compared to the other site groupings despite the percentage reduction being marginally lower.
- Additionally, NO_2 concentrations have continued to decrease when compared to 2021. Concentrations within the CAZ have decreased a further 6% in 2022 when compared to 2021, with reductions also being seen in the CAZ_Boundary (7%) and Wider_B&NES (7%). These continued reductions within the CAZ and wider authority suggest that air quality improvements are not being limited to just the CAZ.

Automatic analyser trends

The previous results discuss the outcomes of the Council's diffusion tube monitoring. With hundreds of diffusion tubes sited across the CAZ and wider authority, they are useful for understanding trends in air quality and localised pollution, but they are not as accurate as automatic analysers.

The locations of the Council's four permanent automatic analysers can be found in Figure 2, earlier in the report. These analysers are bulky and cannot be moved, whilst they are more accurate than diffusion tubes, they are less useful for localised air pollution of wider geographical trends.

Table 7- Annual average NO_2 Data from the four automatic analysers in Bath

Year	A4 London Road	Chelsea House	Guildhall	Windsor Bridge
2016	-	29	34	33
2017	-	29	30	33
2018	-	26	29	30
2019	29	22	27	29
2020	28	20	19	23
2021	27	18	20	23
2022	25	18	20	21

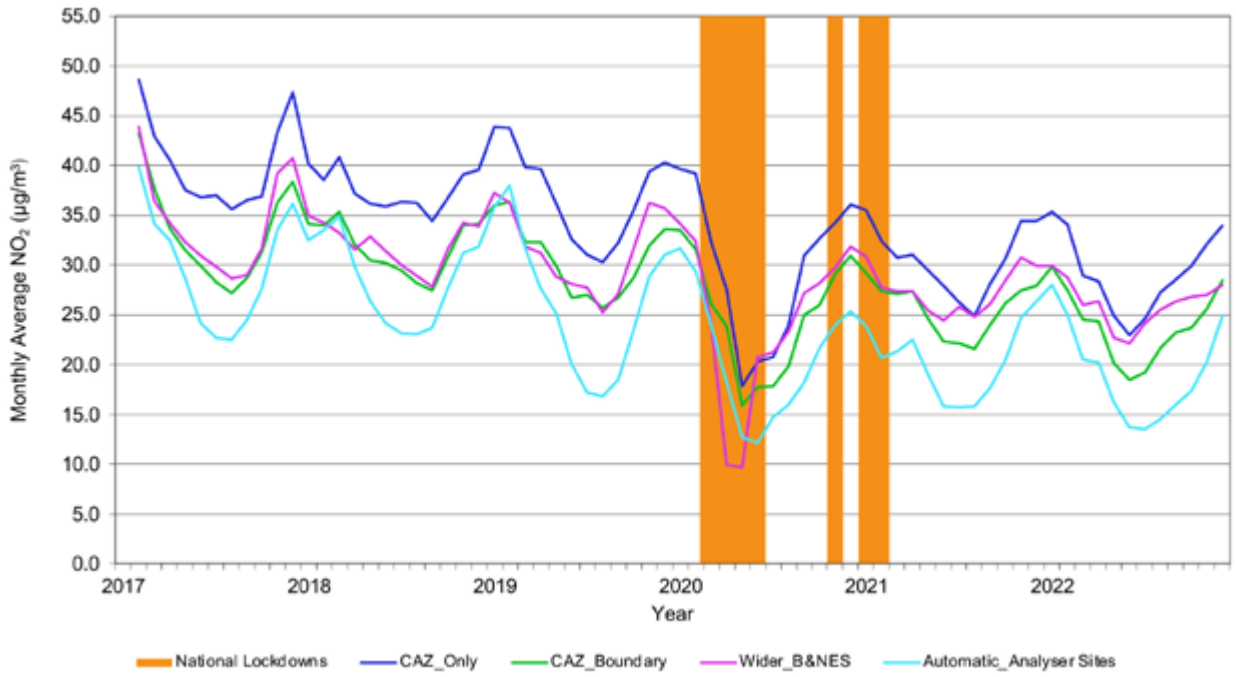
Comments and key findings:

- All four automatic analysers in 2022 continued to record annual average NO_2 concentrations well below the 40 µg/m^3 annual limit value.
- The largest decrease since 2016 was found at the Guildhall with a 14 µg/m^3 decrease over 6 years.
- The A4 London Road side recorded the highest NO_2 concentration in 2022 at 25 µg/m^3, however, this is still well below the limit value and remains decreased.

Monthly long-term data

Figure 14, below, shows the monthly average readings that were taken from 51 long-term monitoring diffusion tube sites (18 within the CAZ, 12 in the urban area outside of the CAZ, and 21 in the wider area outside of Bath) and three automatic analysers at Chelsea House, the Guildhall and Windsor Bridge in Bath.

Figure 14- Monthly average diffusion tube NO_2 concentrations in B&NES from 2017 to 2022, separated into the three site groupings alongside the average of three automatic analyser sites in Bath (Chelsea House, Guildhall and Windsor Bridge). A fourth automatic analyser site on the A4 London Road has limited data so was omitted. Note that the data presented is raw and un-adjusted.



Comments and key findings:

- The data used in this analysis is raw monthly data and is unadjusted.
- For comparative purposes, sites have only been included and compared that have been in place since 2017 (many additional monitoring sites have been added which are not included).
- The automatic analyser data is lower than that of the diffusion tubes for multiple reasons. One reason is that the automatic analysers are more accurate than diffusion tubes which need to be adjusted with a bias factor from the automatic analysers. There are also only three data sources for the automatic analysers, all of which are roadside locations so have higher concentrations of NO_2.
- There is a general downward trend with average monthly NO_2 concentrations falling since 2017. This is likely due to the natural replacement of older, more polluting vehicles with cleaner, compliant ones. The aim of the CAZ is to accelerate the natural replacement rate to rapidly improve fleet compliance; however, it may be noted that the impacts of Covid-19 have stalled this acceleration nationally with new vehicle registrations in 2022 Q3 being the lowest since 1981[12].
- There is a clear seasonal trend in the data, with increased NO_2 concentrations in the winter. This is part of the reason why concentrations appear to be increasing towards the end of 2022 despite concentrations overall decreasing.
- A marked decrease in mid-2020 is due to significantly less traffic on the roads due to the impacts of Covid-19.

As mentioned above, increased winter NO_2 concentrations are primarily due to:

- Lower vehicle catalytic temperatures meaning exhaust emissions abatement technology is less effective.
- Increased emissions from domestic sources, such as gas flues.
- NO_2 is retained in colder air for longer than warmer air.

Roadside increment

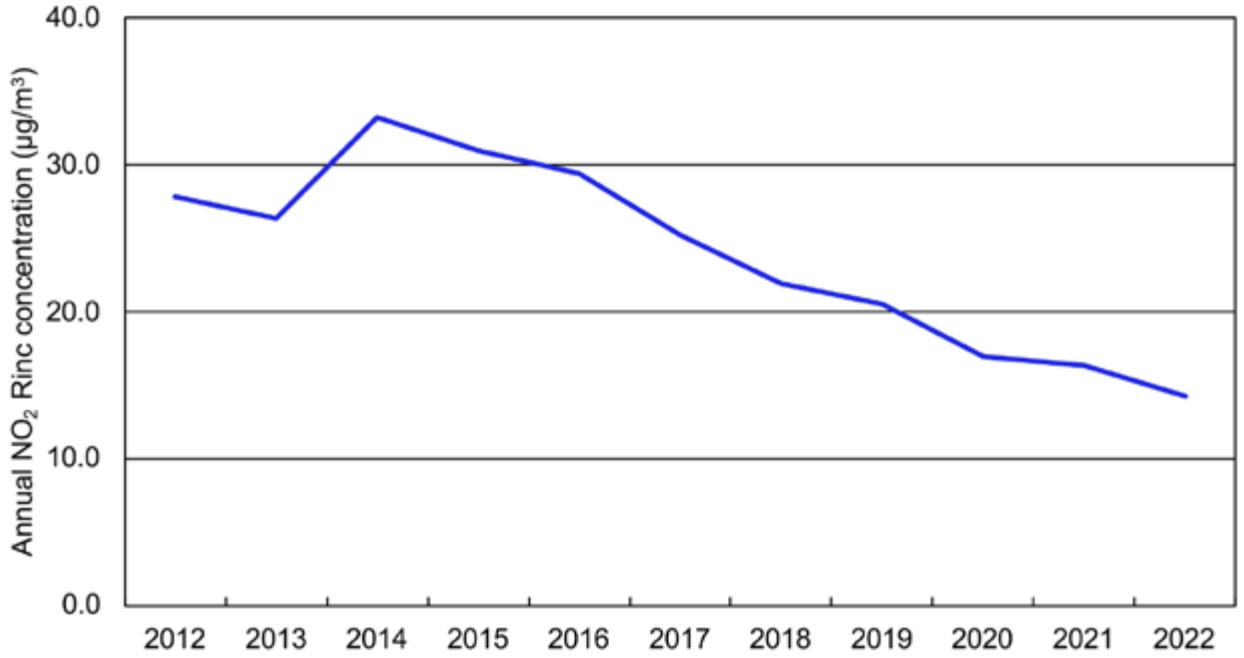
The roadside increment (Rinc) of NO_2 concentration shows the changes in traffic related NO_2 concentration, derived by the following equation:

Average NO_2 concentration – Background NO2 concentration

The graph below (Figure 15) shows a deeper understanding of the contribution of traffic to the NO_2 concentration near the CAZ.

[12]Department for Transport, 2022. Vehicle licensing statistics: July to September 2022. Available at: https://www.gov.uk/government/statistics/vehicle-licensing-statistics-july-to-september-2022/vehicle-licensing-statistics-july-to-september-2022

Figure 15- Trends in Rinc in the CAZ_Boundary area since 2012



Comments and key findings:

- In this analysis, the Rinc has been calculated by subtracting the annual average Alexandra Park NO_2 concentration, from the annual average NO_2 concentration from seven sites within the CAZ_Boundary area (that have data from 2012).
- The Rinc is useful as it demonstrates the proportion of NO_2 pollution from road traffic sources, as opposed to other sources e.g., gas boilers.
- Background sites are positioned away from roads to avoid localised pollution from road traffic. In Bath, the urban background location is at Alexandra Park, which is in the urban area outside of the CAZ.
- There is a clear decreasing trend in the Rinc from 2014 likely due to natural fleet upgrades and the introduction of Euro 6 emission standards in 2015.
- The Rinc in 2020 was likely lower than normal due to the impacts of Covid-19. With traffic volumes returning to pre-pandemic volumes in 2021, the Rinc has continued to decrease.

5 Impacts of the CAZ on traffic flow

A CAZ is primarily designed to improve the compliance of vehicles driving in polluted areas rather than reducing traffic volumes meaning it is aimed at reducing pollution, not congestion.

However, road traffic is the most significant cause of NO_2 pollution in Bath, so the Council monitor any changes in traffic flow in and around the zone and on the highway network around the city. This data helps us understand whether the zone is negatively impacting air quality and/or road safety on other roads.

It is important to remember that not all vehicles are chargeable, and most vehicles have no need to avoid the zone or seek alternative routes. Our traffic counts record any traffic movement, regardless of the vehicle type or compliance status.

Additionally, due to an increase in shopping and home-deliveries as a result of the pandemic, nationally there remains an increase in commercial vehicles on the road. On average in 2022, LGVs increased to 111% of their pre-pandemic volumes whilst HGVs increased to 103%[13].

5.1 How changes in traffic flow are measured

B&NES monitor the direction and volume of traffic on specific routes using manual classified counts (MTC), automated traffic counts (ATC) and automatic number plate recognition (ANPR) cameras.

This report focuses on key roads inside and outside the CAZ and on connecting highways. Traffic flows are continually monitored at various locations across the city, and for the purpose of monitoring the impact of the CAZ, are reported quarterly and annually.

Understanding the data used throughout this section

To understand the impact of the zone, data has been compared from a similar time frame in 2017 or 2018. Data from 2020 has been discounted due to the unprecedented impact on traffic and travel caused by the Covid-19 restrictions. In addition, the Council has insufficient data for the year 2019. Sometimes there is no baseline data available if the monitoring location is new or temporary.

Within the CAZ, traffic flows from the Council's permanent ATC network for the second half of 2022 were unavailable. During this period, the network, particularly within the CAZ, was being upgraded with new, more reliable technology. The renewed counters were in a process of testing during the later period of 2022, and as a result, the data collected was too unreliable to be used for this report.

Therefore, to understand traffic flows within the CAZ, data from two temporary surveys from a two-week period in 2022 have been used for analysis. These surveys are not representative of the whole year and are instead being used to provide an indicative view of traffic flows. The results and locations of these temporary surveys are presented in Figure 16 and Table 8.

[13]Department for Transport, 2023. Daily domestic transport use by mode. Available at: https://www.gov.uk/government/statistics/transport-use-during-the-coronavirus-covid-19-pandemic

The ATC network within the CAZ_Boundary and Wider_B&NES has largely been unaffected by the period of testing, and sufficient data is available to be used for analysis. Figure 18 shows a map of B&NES where permanent ATCs have been used for analysis, a list of these locations can be found in Table 9. These permanent ATCs were selected as they were in use prior to the introduction of the CAZ and can therefore be used for comparison purposes.

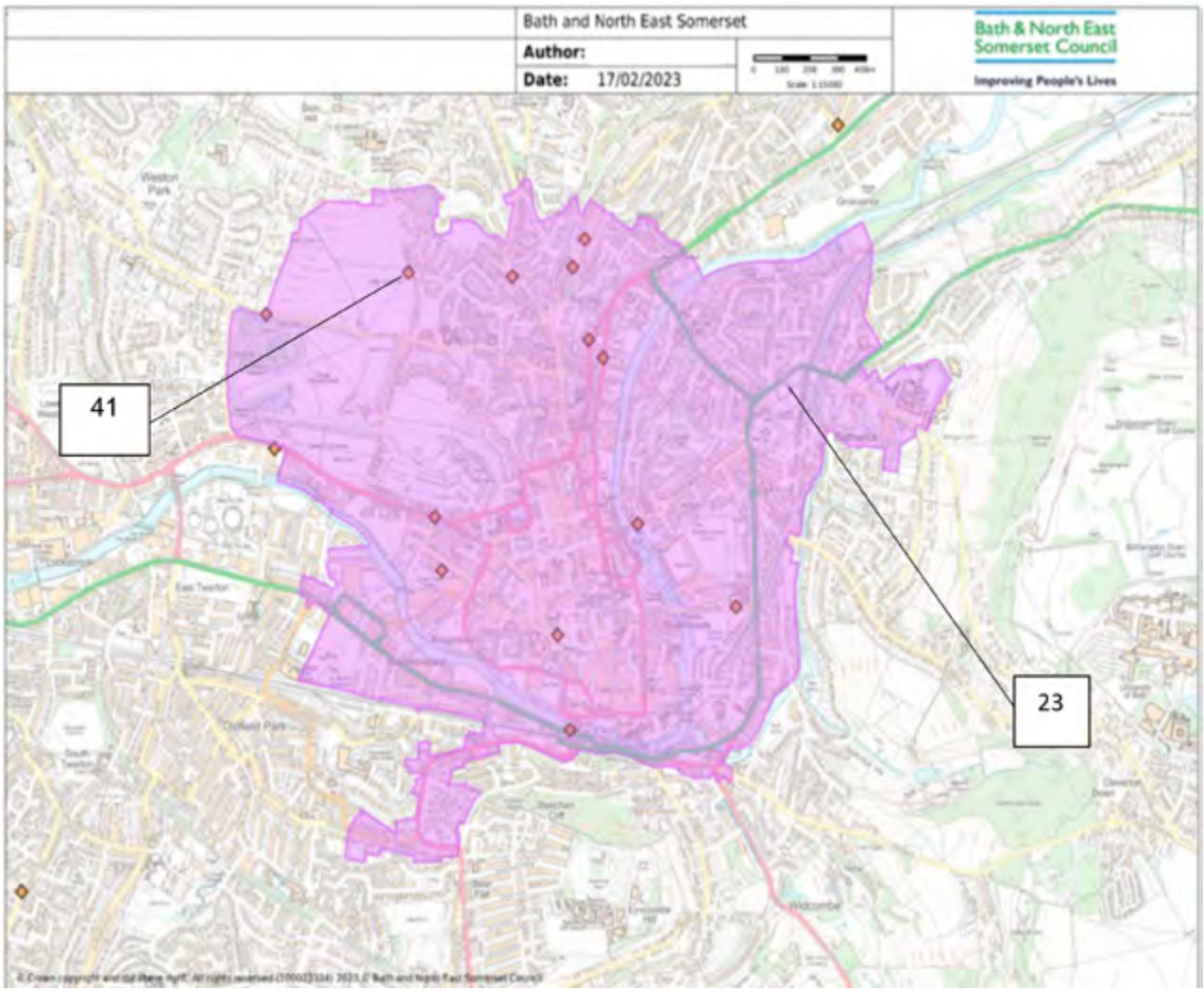
Where possible, within the CAZ_Boundary and Wider_B&NES, three sites from each site grouping have been used to draw conclusions.

5.2 Traffic flows within the CAZ

Table 8: Temporary ATC locations used within the CAZ_Only analysis. The locations can be viewed below, in Figure 16.

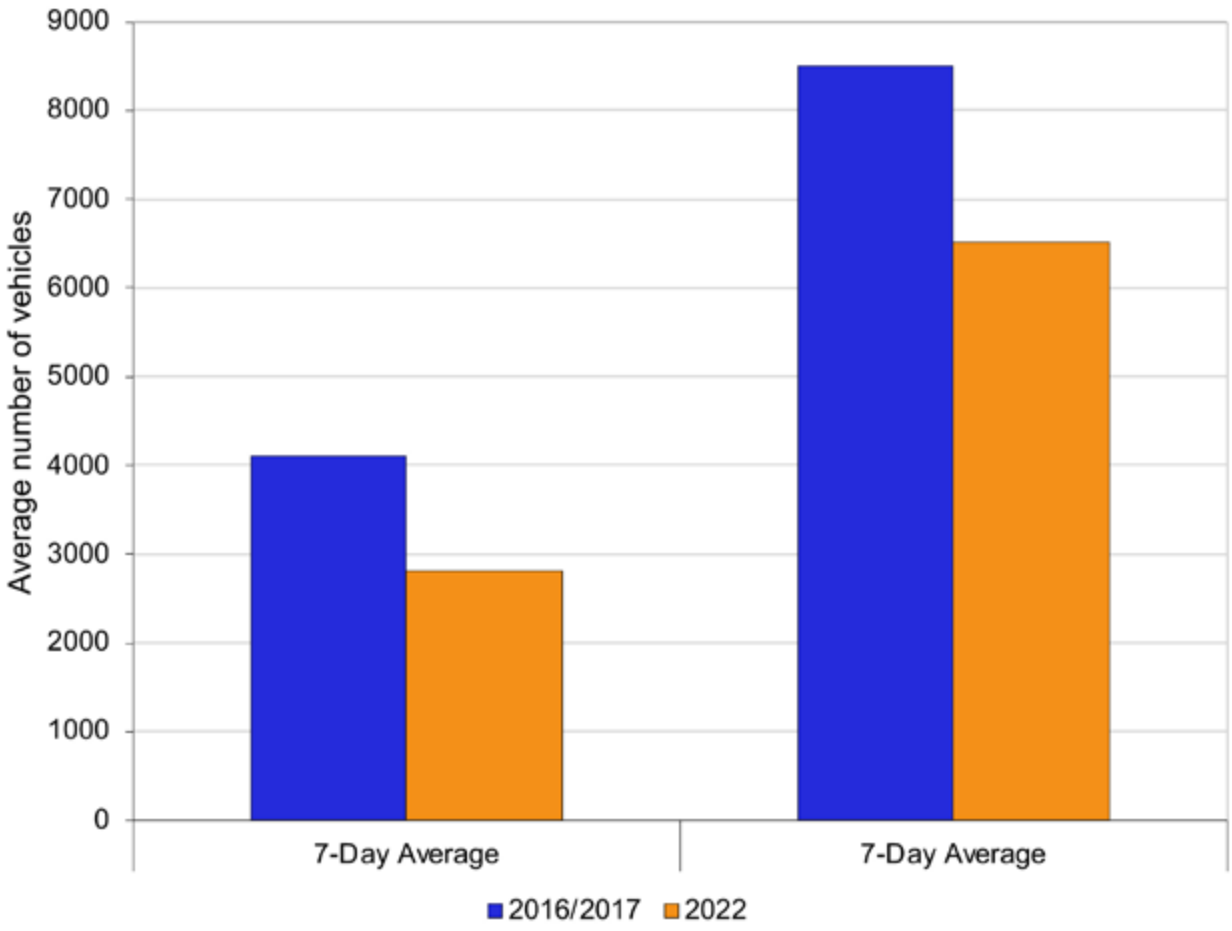
Site ID	Location	Site category
23 (temporary survey)	Beckford Road	CAZ_Only
41 (temporary survey)	Cavendish Road	CAZ_Only

Figure 16: Temporary ATC locations (orange diamonds) used for traffic flow analysis within the CAZ. The number refers to the site ID which can be found in Table 8, above. © Crown Copyright 2021. License number AC0000807498.



Traffic flow results within the CAZ

Figure 17- 2022 traffic volumes within the CAZ compared to the baseline period (2016/2017) at the two temporary ATC sites. Note that these surveys only use data from a period of 7 days.



Comments and key findings:

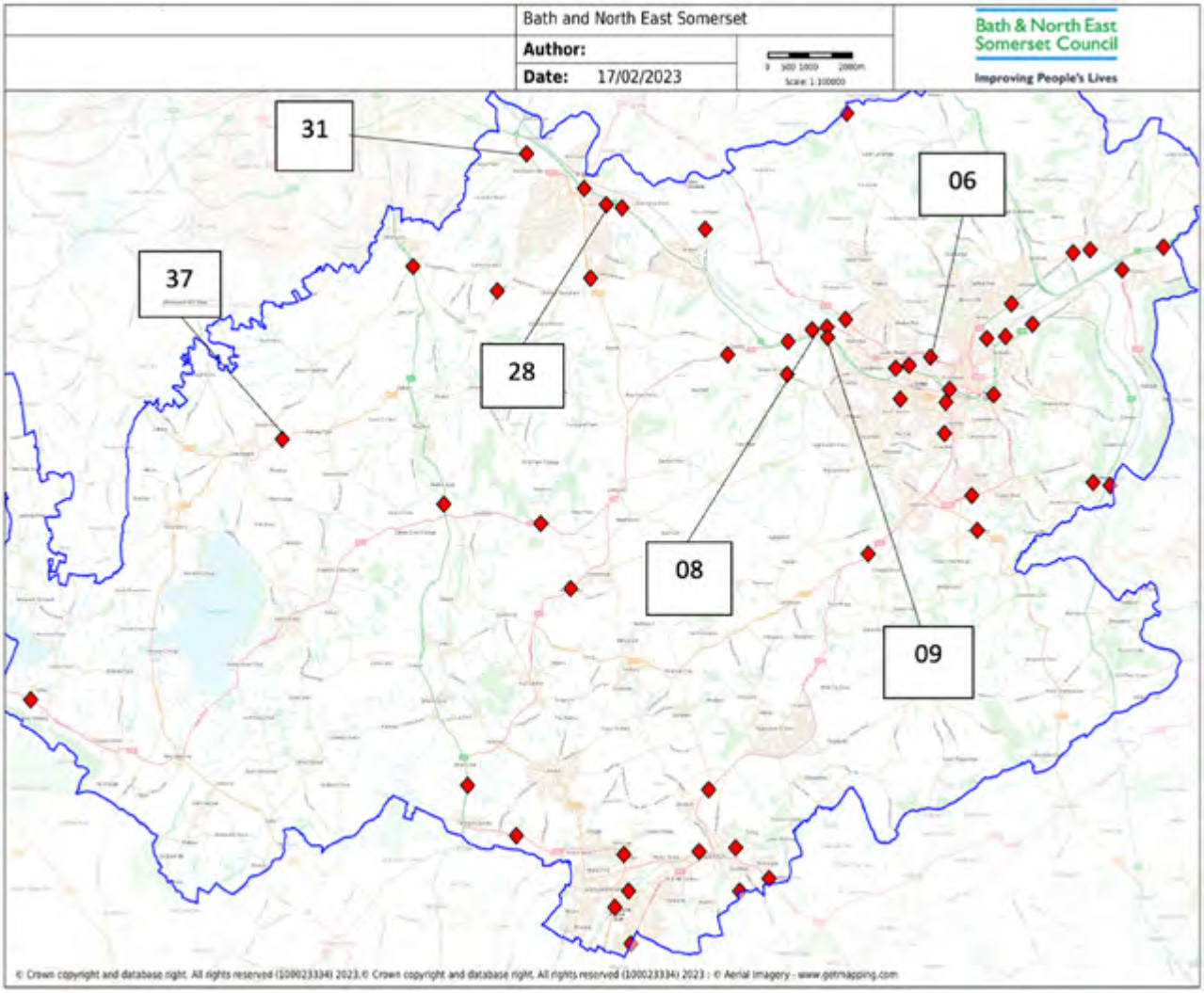
- Both examples have been selected on availability of data within the baseline date and 2022.
- While Cavendish Road and Beckford Road experience large differences in overall traffic flow, they both present a decrease from the pre-CAZ baseline in 2016/17 to 2022.
- For Beckford Road there has been a larger decrease in traffic flows for the full 7-day week. Cavendish Road has experienced similar decreases.

5.3 Traffic flows within the CAZ_Boundary and Wider_B&NES

Table 9: Permanent ATC locations used within the CAZ_Boundary and Wider_B&NES analysis. These locations can be viewed below, in Figure 18,

Site ID	Location	Site category
06	A3064 Windsor Bridge, North of Stable Yard	CAZ_Boundary
08	A4 Newbridge Road, East of A36 Lower Bristol Road	CAZ_Boundary
09	A36 Lower Bristol Road, East of Newbridge	CAZ_Boundary
28	B3116 Bath Road Keynsham, East of Unity Road	Wider_B&NES
31	A4175 Durley Hill, West of Durley Hill	Wider_B&NES
37	B3130 Chew Magna, East of Sandy Lane	Wider_B&NES

Figure 18: Permanent ATC locations use for traffic flow analysis within the CAZ_Boundary and Wider_B&NES. The number refers to the site ID which can be found in in Table 9, above. © Crown Copyright 2021. License number AC0000807498.



Traffic flow results within the CAZ_Boundary and Wider_B&NES

Annual and quarterly traffic flow data is analysed here to identify short and long-term trends. This section outlines data from the selected permanent ATCs and is used to identify trends in and around the CAZ.

Table 10: Two-way traffic flow data for permanent ATCs within the CAZ_Boundary and Wider_B&NES from the last year with representative data (2016, 2017 or 2018) and 2022.

Year	Quarter	7-day average	
		CAZ_Boundary	Wider_B&NES
2016/2017/2018	1	14978	12469
	2	15667	13182
	3	15312	12850
	4	15202	12717
2022	1	13812	11520
	2	13696	11698
	3	14107	11270
	4	14164	11704

Table 11: Percentage change in average monthly traffic flows within the CAZ_Boundary and Wider_B&NES from 2016/2017/2018 to 2022. The bottom row shows the average change between the years.

Quarter	7-day average	
	CAZ_Boundary	Wider_B&NES
1 (Jan-Mar)	-8%	-8%
2 (Apr-Jun)	-13%	-11%
3 (Jul-Sep)	-8%	-12%
4 (Oct-Dec)	-7%	-8%
Average change baseline to 2022	-9%	-10%

Comments and key findings:

- Both the CAZ_Boundary and Wider_B&NES area have experienced a similar decreasing trend.
- There is a pronounced dip in traffic flows during 2021 Q1 due to the final Covid-19 lockdown.
- Excluding the impacts of the Covid-19 lockdowns, both areas have experienced a linear decrease in flow with previous matching quarters.
- Minor increases and decreases within years are present due to the changing weather conditions.

Diurnal traffic flow trends

An 'inner-cordon' traffic survey has been carried out in Bath using data from eleven ATCs, as seen in Figure 19, that are roughly around the CAZ boundary. The survey has not been consistent and there is missing data, but it can offer insights into the diurnal trends in traffic flow in the city centre to help us understand changes in travel behaviour.

Figure 19- Map of inner-cordon ATC sites for hourly traffic flow analysis

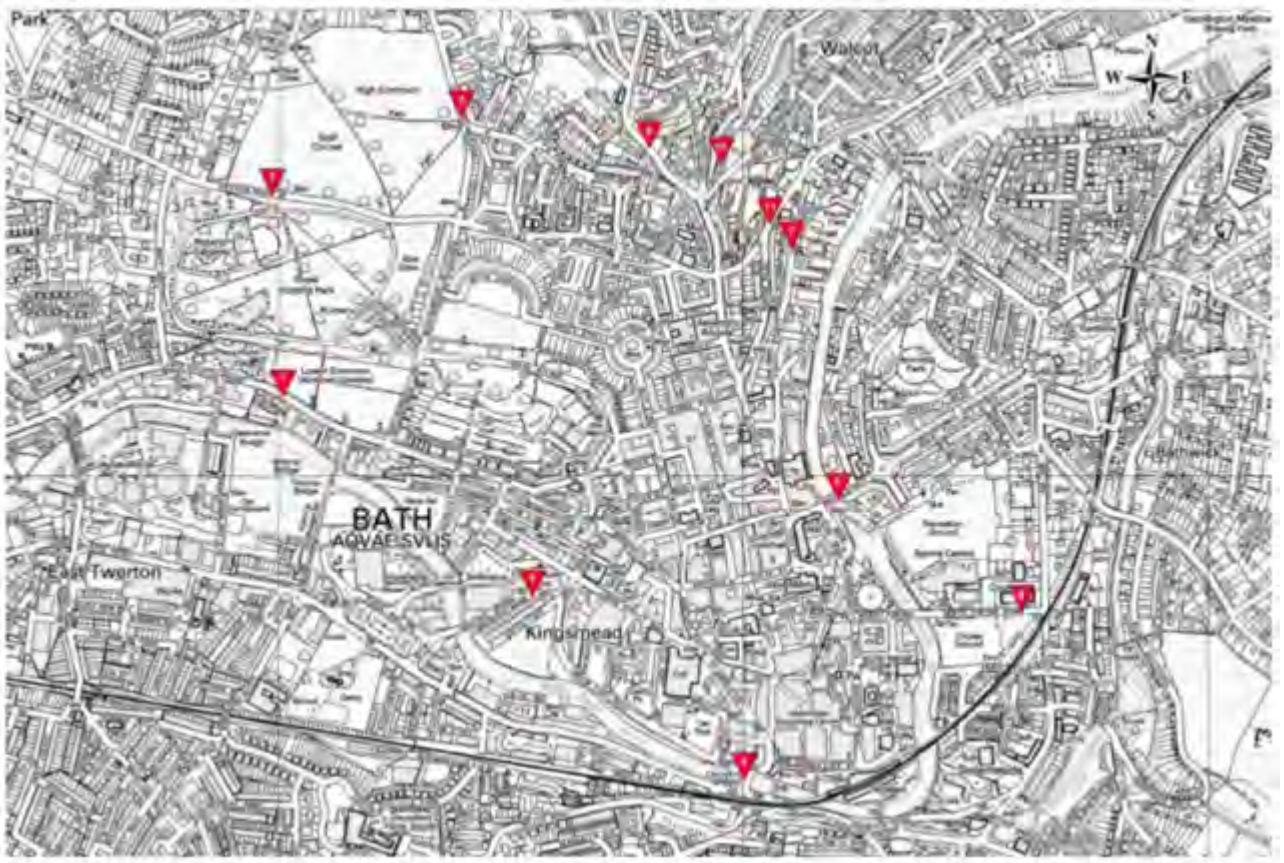
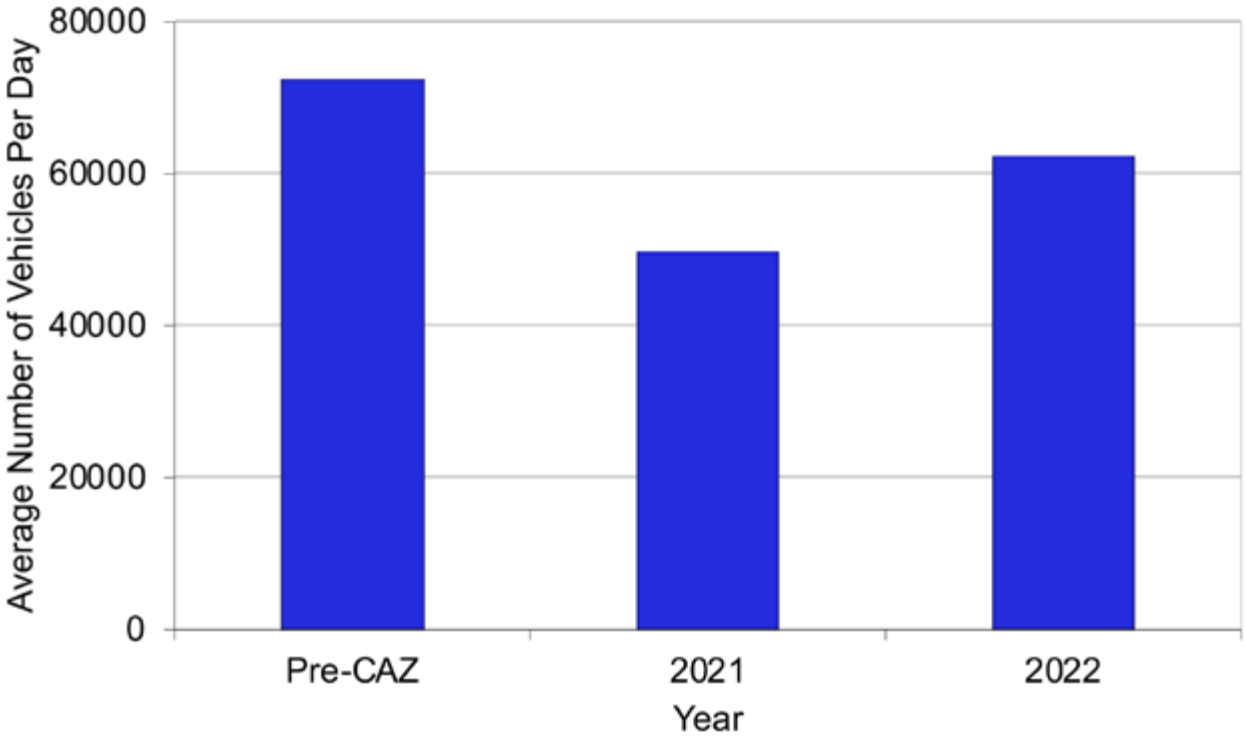


Figure 20, below, shows the number of cars passing eleven ATCs within Bath city centre, split over a day, to illustrate changes that occurred in 2021, and 2022. The pre-CAZ baseline average is from 2000-2020 without 2014 and 2019, equating to an 18-year average.

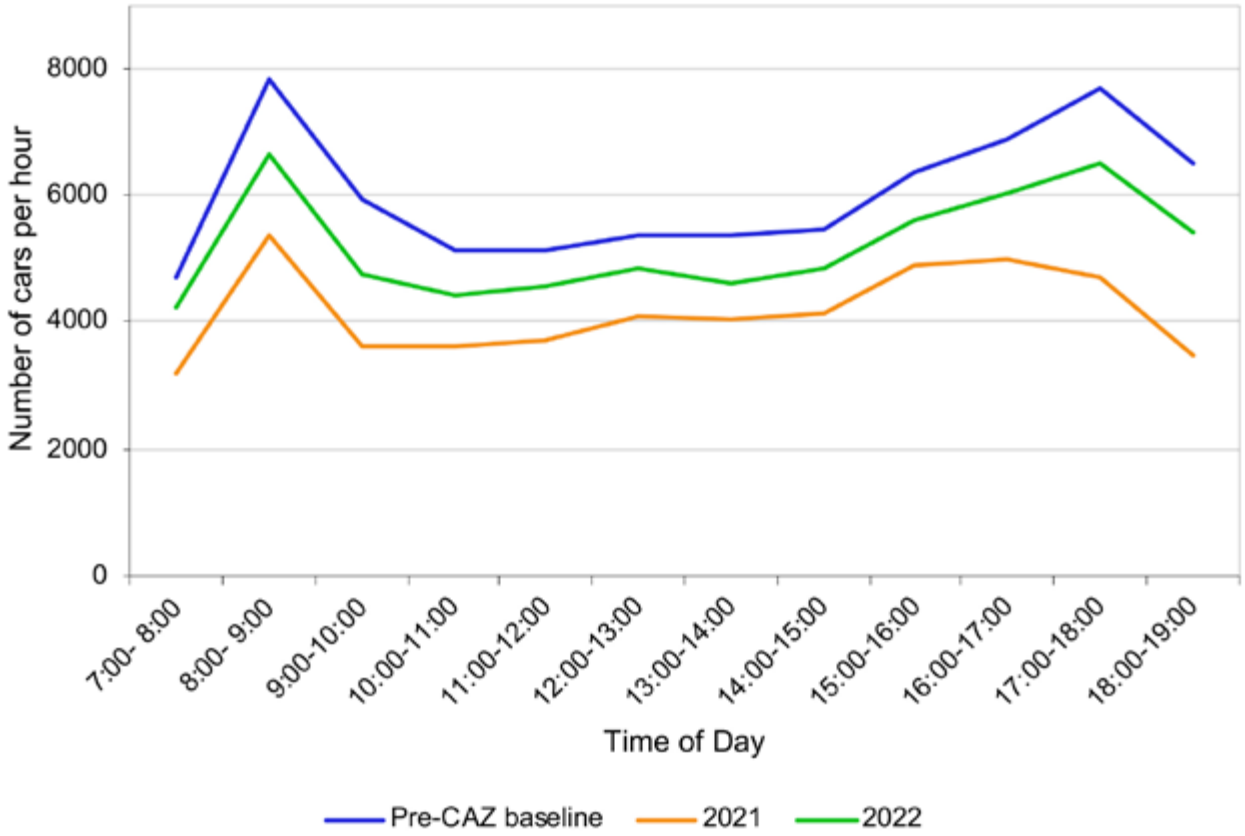


Comments and Key Findings

- The pre-CAZ average baseline is higher than both 2021 and 2022. Traffic volumes through 2021 would have been impacted by the multiple Covid-19 lockdowns the nation experienced and therefore, traffic volumes are substantially lower than other years.
- However, it is a good sign that figures for 2022 have remained below the pre-CAZ average, demonstrating a decrease in traffic flow since CAZ implementation.
- On average vehicle use is on the rise nationally, so to experience a decrease in traffic flow through the CAZ is a positive improvement[14].

[14]Department for Transport, 2023. Usage of transport by mode from January 2022. https://www.gov.uk/government/statistics/transport-use-during-the-coronavirus-covid-19-pandemic/domestic-transport-usage-by-mode

Figure 21- Bath inner cordon car count over the time of day. The pre-CAZ baseline draws on data from 2000-2020 but does not include 2014 or 2019.



Comments and key findings:

- Fewer cars travelled through the inner cordon in both 2021 and 2022 compared to the pre-CAZ baseline average, however, numbers are gradually rising. The morning peak (8-9am) saw almost 8,000 cars on average pre-CAZ introduction but in 2022, only 6,500 cars were recorded.
- Throughout the day in 2022, 800 fewer vehicles on average were recorded when compared to the pre-CAZ baseline. This is comparable to the 1800 fewer vehicles recorded on average in 2021.
- The Covid-19 pandemic has contributed largely to the reductions in 2021, however, the data does show that volumes of cars are beginning to gradually recover despite there being continuing changes to working patterns and shopping habits.
- In 2022, the morning peak remained pronounced between 8-9am, and unlike 2021, the evening peak has also steadily returned between 5-6pm. This trend was not as prominent in 2021, suggesting that working patterns are steadily beginning to return to those seen pre-pandemic.

6 The Impacts of the CAZ on fleet compliance

Transport is widely acknowledged as a key driver of air quality issues. It is estimated that around 92% of all nitrogen oxide (NOx) emissions in the wider area are attributable to road traffic. Older vehicles generally emit more NOx as recent technological advances in selective catalytic reduction has led to a lowering of NOx emissions from vehicles, particularly those with a Euro 6 standard.

The purpose of the CAZ is to speed up the natural replacement of older, more polluting vehicles with cleaner, compliant ones that meet the city's minimum emission standards. It does this by levying charges on owners of non-compliant vehicles that don't meet emission standards (i.e., pre-euro 6 diesel and pre-euro 4 petrol vehicles), so that they are incentivised to upgrade or replace their vehicle sooner than they might otherwise do (to avoid paying a daily charge). In Bath, although the scheme has now closed, financial assistance has been available to help support businesses and individuals that need help to do this, mitigating the impact of the charges.

Improvement in Bath's fleet are brought about in the following ways:

- Naturally as part of regular fleet upgrade programmes and because of pressure on manufacturers from government, environmental organisations, and the public to improve vehicle emissions.
- More recently and locally, as a specific to the introduction to Bath's CAZ and other zones around the country, particularly Bristol, e.g., drivers bringing forward plans to upgrade or replace older vehicles to avoid charges.
- And in response to direct Council and government-funded interventions to encourage upgrades, including a bus retrofit scheme and the FAS which offered grants and or interest-free finance to those regularly driving in the zone to replace non-compliant vehicles.

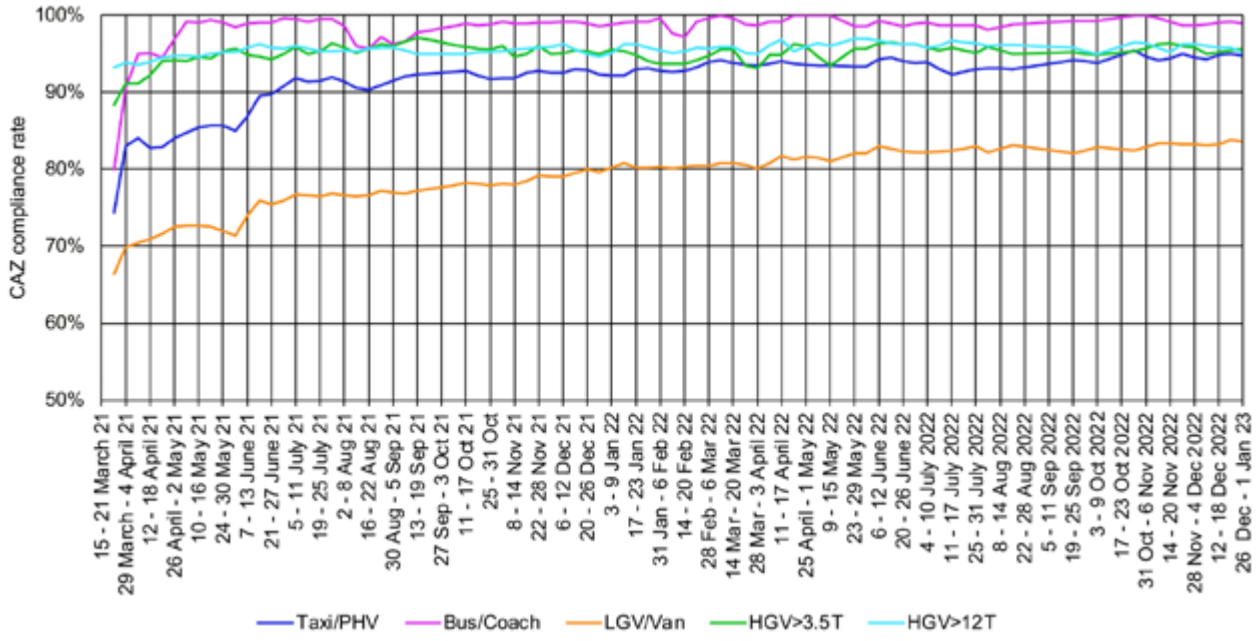
To understand whether the CAZ is working to reduce emissions and air quality, the Council are monitoring rates of vehicle compliance in the zone.

How B&NES measure fleet compliance in Bath

The Council measure changes in fleet composition using data gathered from 68 automatic number plate recognition (ANPR) cameras positioned around the perimeter of Bath's CAZ, and within the zone itself. The camera captures individual number plates which are then cross referenced with a DVLA vehicle database to establish the number of vehicles in the zone on any given day, the type of vehicle captured in the zone e.g., bus, HGV, van etc., its age, and the euro standard of the vehicle (if available). This enables the number of compliant vehicles driving in the zone to be understood, whilst identifying areas of potential traffic displacement. To understand how fleet compliance in the zone has changed following the introduction of the CAZ, weekly data from the cameras is analysed.

Vehicle compliance data for Bath CAZ

Figure 22- Vehicle compliance rates within the CAZ as a 7-day rolling average. Please note the y-axis compliance rates start at 50%.



Comments and key findings:

- 44,000 unique vehicles in the zone each day on average in 2022 (compliant, non-compliant, chargeable, and non-chargeable vehicles).
- A vehicle is compliant when it meets the minimum emission standards for Bath's CAZ i.e., its either Euro 6 diesel, Euro 4 petrol, hybrid, alternatively fuelled or electric.
- Most vehicles in the zone are private cars, with an average of 30,856 unique private cars seen in the zone each day during 2022. This equates to 69% of all vehicles.
- Private cars and motorbikes are not charged, however, compliance for these vehicles is currently over 70% if the Euro 4 petrol and Euro 6 diesel criteria was to be applied.
- The percentage of chargeable non-compliant vehicles (as a percentage of all traffic) entering the zone each week fell from 6% in the launch week to 1% by the end of 2022.
- 1,742 non-compliant vehicles were seen in the zone, on average, each day, during the launch week in March 2021, compared to 497 each day, on average, during December 2022. This is a decrease of 71%.
- Bus/Coach compliance rose from 73% during the launch week to 99% by the end of 2022. 128 individual buses/coaches were recorded, on average, in the CAZ each day during 2022.
- HGV compliance for vehicles weighing greater than 12T rose from 93% during launch week to 96% by the end of 2022. An average of 272 vehicles were recorded in the CAZ each day during 2022.
- HGV compliance for vehicles weighing greater than 3.5T but less than 12T rose from 86% during launch week to 96% by the end of 2022. An average of 108 vehicles were recorded in the CAZ each day during 2022.
- Taxi/PHV compliance rose from 67% during the launch week to around 95% by the end

of 2022. An average of 460 vehicles were recorded in the CAZ each day during 2022.

- Van/LGV compliance rose from 63% during the launch week to around 83% by the end of 2022. 3,284 individual vans/LGVs (compliant and non-compliant) were recorded in the CAZ each day, on average, during 2022.
- As seen in Figure 22, rates of compliance have steadily increased since the launch in March 2021. It is anticipated that compliance will continue to improve into 2023, particularly with respect to compliant LGVs which were most significantly impacted by demand after the pandemic.
- Compliance was supported through the government-funded FAS and bus retrofit scheme, in addition to drivers upgrading outside of these schemes.

7 The impact of the CAZ on other measures

The Council committed to measuring the impact of the zone on the city of Bath, in terms of footfall, business, retail, public transport etc to understand any adverse or positive effects. The plan was published prior to the Covid-19 pandemic and during the public consultations when the Council was potentially proposing a class C charging CAZ that would also charge private cars.

After significant consultation, a charging zone C (not charging private cars) was approved and the CAZ was launched five months later than planned in March 2021, more than a year into the Covid-19 pandemic.

Please note: The following measures may well have been disproportionately affected by Covid-19 and many of our partners, providing data, have concluded that the effect of Covid is far greater than that of the CAZ. Nonetheless, the Council has considered each measure to assess the effect of the zone.

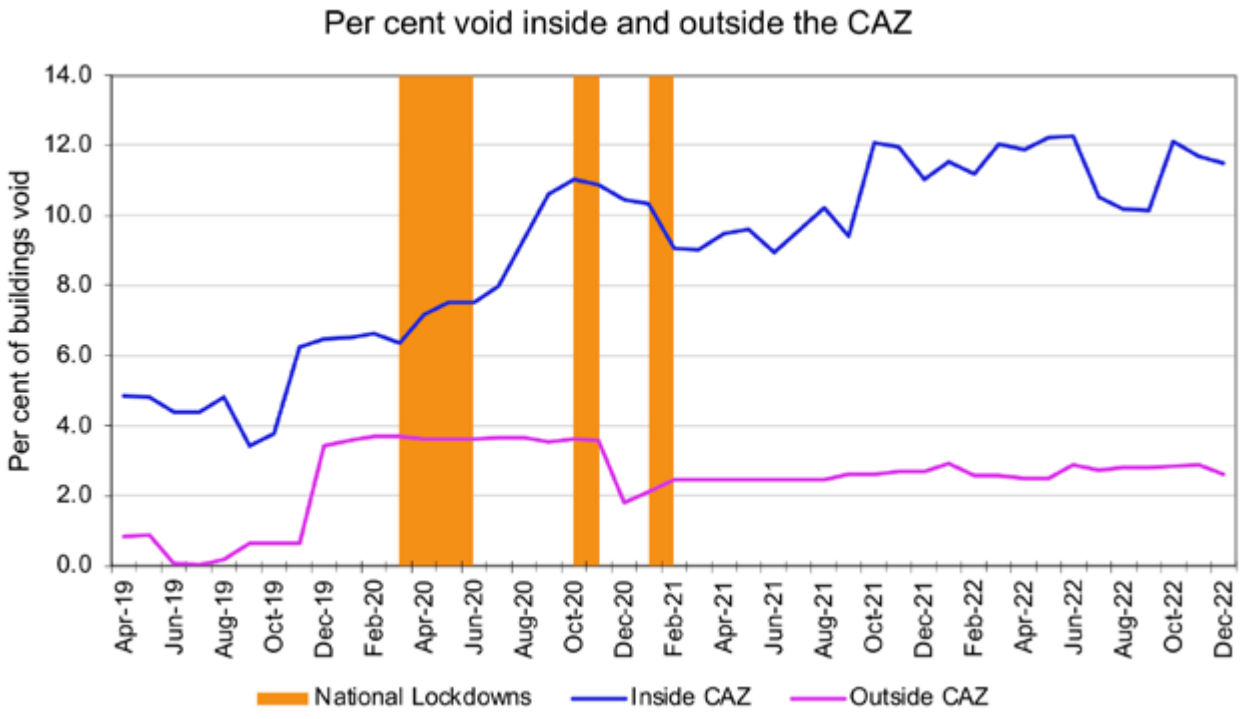
7.1 Retail, business, and office space vacancy rate

Vacancy figures for buildings within Bath are considered to assess whether the CAZ has had an impact on the number of businesses operating in Bath, with a view of ensuring the economic impacts of the CAZ are not negative.

This data is continually collected by the Council's Property Services team, in relation to its own assets. Most of the Council-owned properties are within the CAZ.

The theoretical rent is the full amount the Council could collect if all the Council-owned properties were filled. To add context, rental values in the centre of Bath have dropped dramatically in the last few years, with rents now approximately 30-40% below what they were 5 years ago. The reason the theoretical rent has dropped is largely due to the impact of Covid-19, together with the move of some retailers to online retailing, reducing demand for business space in the centre of cities.

Figure 23, below, the percentage of the Council-owned buildings which are vacant at a given time.



Comments and key findings:

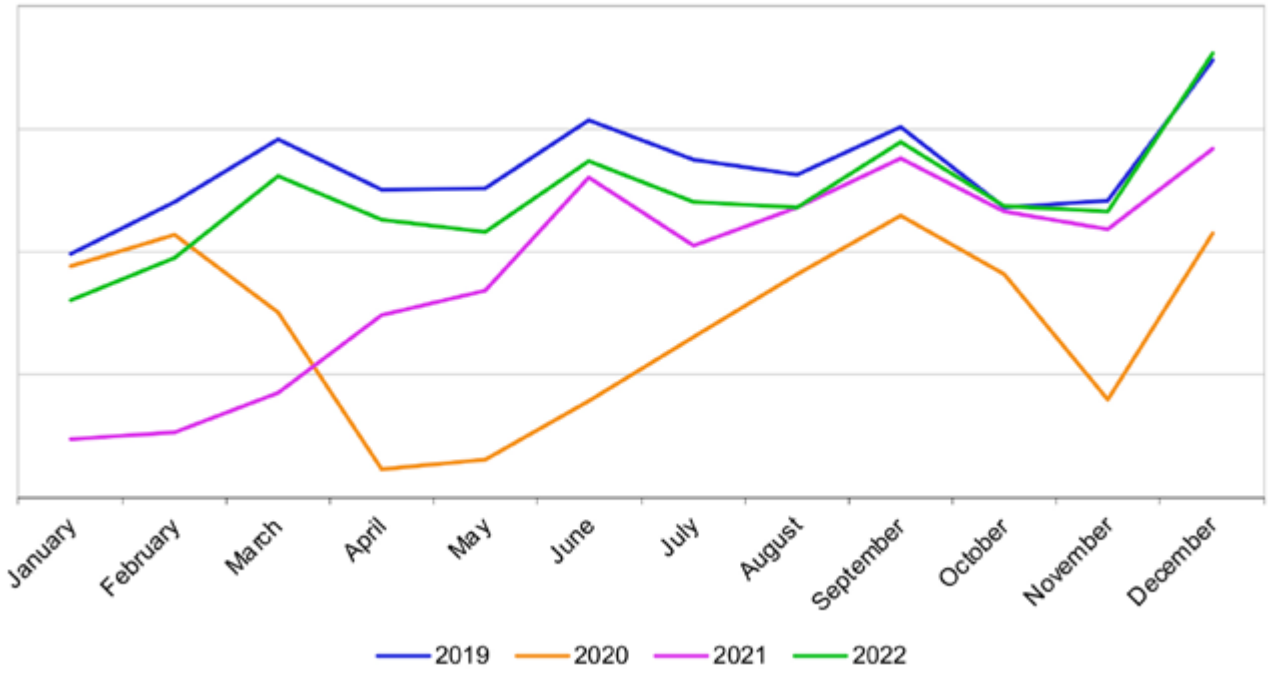
- Property vacancies have risen within the CAZ from around 5% in April 2019 to around 12% in December 2022, outside of the CAZ within the same time frame vacancies have risen from approximately 1% to 3%.
- The Covid-19 lockdowns the nation experienced had notable impacts on the increase in vacancies especially within the CAZ_Boundary, which is centred in the city of Bath.
- Vacancy figures outside the CAZ_Boundary have stayed relatively consistent since the implementation of the CAZ in mid-March 2021, there has been more fluctuation within the CAZ.
- The Council owns more properties within the CAZ and therefore this area is subject to the possibility of more fluctuation than outside the CAZ boundary.

7.2 Retail footfall trends

Footfall trend data from Bath's Business Improvement District (BID) has been analysed to understand the number of people in Bath. The data is collected by Bath Business Improvement District (BID) and is not the Council's own data.

Figure 24 shows the footfall trends in Bath from 2019 until 2022, from the following locations: Burton Street, House of Fraser (Milsom Street), Milsom Street, Northgate Street, Sawclose and Southgate Street.

Figure 24- Footfall trends in Bath city centre from the Bath BID. Data is collected from those locations mentioned above. Note that footfall data is provided by counters in 10 locations and is therefore not reliable as a true measure as the same person can be counted in multiple locations. However, it is helpful in identifying trends across time, as demonstrated below.



Comments and key findings:

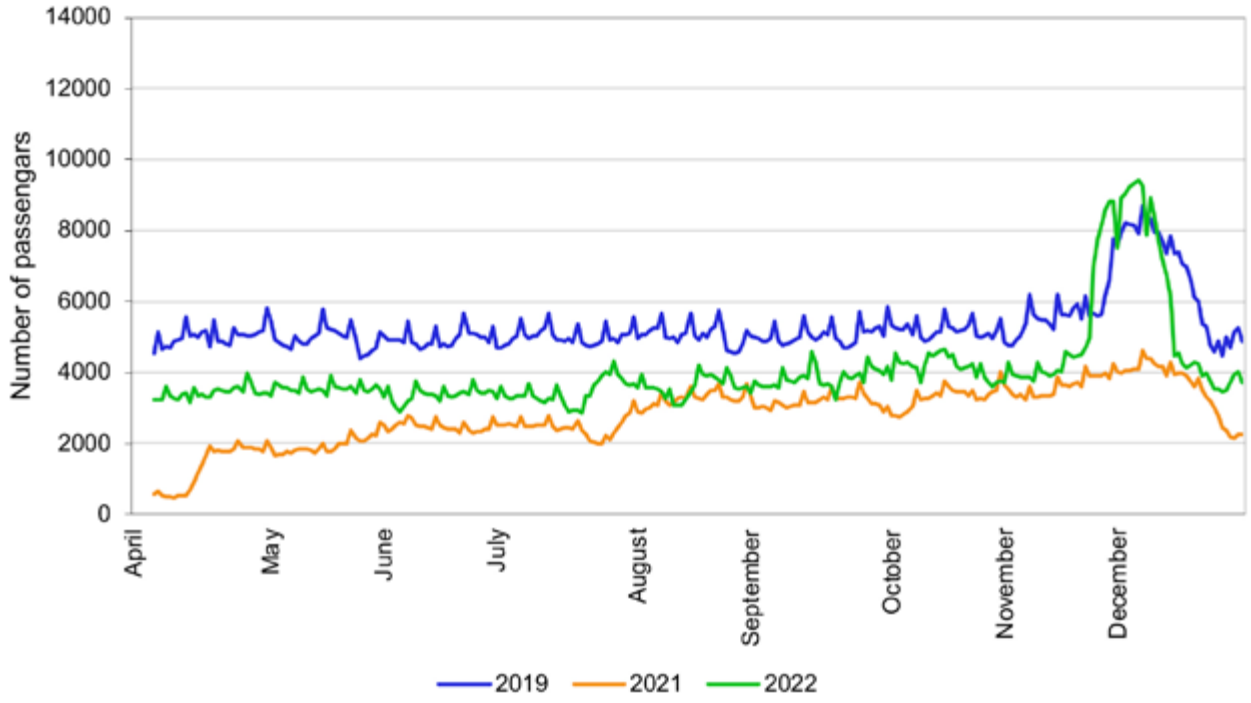
- Prior to the Covid-19 pandemic in 2019, footfall trends remained relatively stable, with a defined peak around the Christmas period.
- Within Figure 24, there are three sudden drops in footfall which are the likely result of the Covid-19 lockdowns. The first sudden and extended drop starts in April 2020 during the first lockdown, there is a second drop around the Autumn lockdown in October/ November 2021, and finally, the impacts of the last lockdown can be seen early in 2021.
- There are clear returns to higher footfall after each lockdown and by mid-2021, footfall had almost returned to pre-pandemic levels. Throughout 2022, footfall tracks slightly below 2019, however, was up 32% on 2021.
- Additionally, footfall trends in 2022 can be seen to meet and at times exceed those volumes recorded in 2019 from October onwards. This is likely associated with Christmas shopping and the return of Bath's popular Christmas Market, which returned for the first-time post-pandemic in December 2022.

Whilst the Bath BID trends show that Bath has had a good post-pandemic recovery rate and that the city is keeping pace, it is too difficult to determine the impact of the CAZ on footfall trends across Bath due to the impacts of Covid-19. Although the trends for 2022 do track slightly below the 2019 baseline, this is likely associated with a change in shopping behaviour post-pandemic, however, data will continue to be collected into the future to monitor this.

7.3 Park and ride passenger rates

Park and Ride (P&R) data is collected by bus operators and contributed by WECA and is shown graphically for 2019-2022 in Figure 25. The data is used to understand people's travel habits into the city of Bath. The P&R sites are located at Lansdown to the north of Bath (878 spaces), Newbridge to the west of Bath (698 spaces) and Odd Down to the south of Bath (1230 spaces). P&R can be an attractive method of travelling into the centre of Bath as parking is often more expensive than travelling on the P&R, additionally, congestion can also become a problem in the city centre.

Figure 25: Total daily Park and Ride bus passenger numbers for the three P&R sites in Bath: Lansdown, Newbridge, and Odd Down. Note the figures collected are based on a financial year and present data from April-December. The number of daily passengers has been smoothed within the figure to reduce the effect of weekday and weekend variations.



Comments and key findings:

- Prior to the pandemic, the average park and ride bus ridership was stable throughout most of 2019 with around 5,000 daily passengers, there was a marked increase in people using the service in December.
- After the Covid-19 pandemic, park and ride bus ridership was clearly reduced with figures increasing slightly towards the end of the year but not returning to those pre-pandemic figures. Unlike other years, there was no marked increase in December's figures with ridership being 50% of that seen pre-pandemic, this is likely due to Bath's Christmas Market being cancelled.
- For 2022, the Park and Ride bus ridership figures remain higher than 2021, however, they are largely below those figures seen in 2019. This is likely due to a change in working pattern as a result of the pandemic.
- However, Figure 25 does show ridership figures for December 2022 to be higher than both the baseline and 2021, this is the result of enhanced P&R services for Bath's Christmas Market. Throughout this period, there was increased frequency in P&R buses

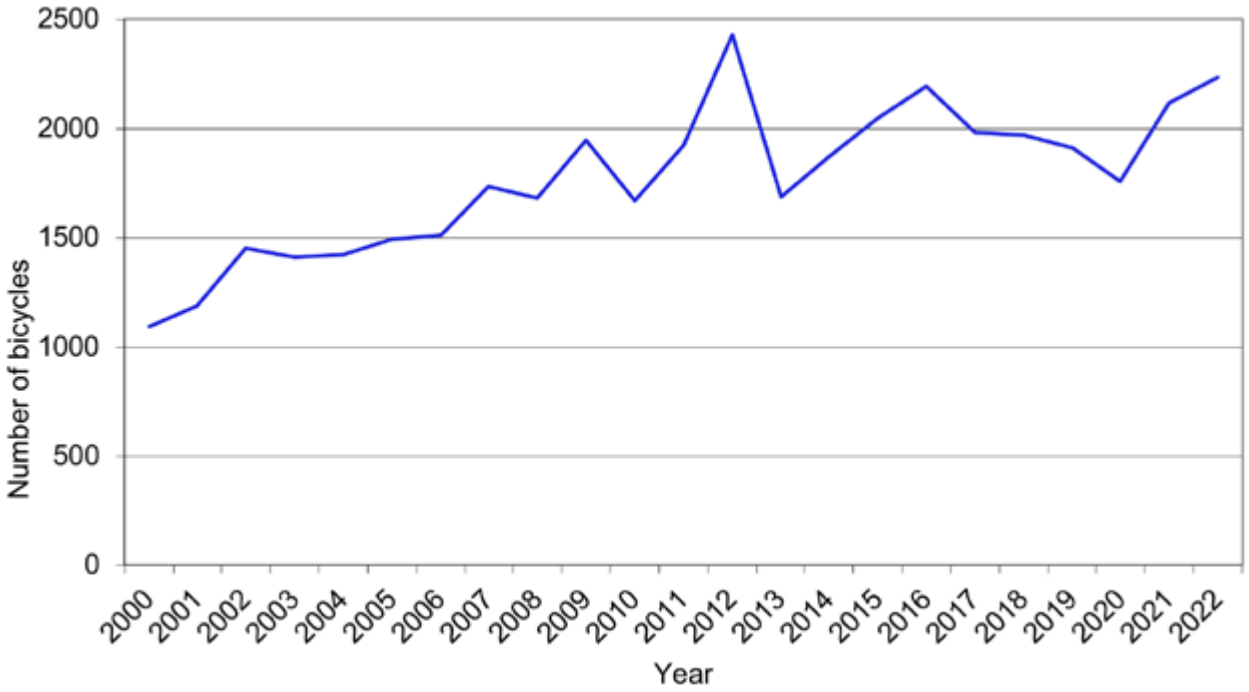
(one every five minutes) to account for the vast number of people returning to the market for the first-time post-pandemic. The success of this meant ridership figures were particularly elevated in 2022 and were higher than those seen in 2019.

- Throughout 2023, further work is being done to increase Park and Ride uptake by working with local stakeholders to promote and attract new users. This work includes bespoke parking solutions for Royal United Hospital (RUH) staff, Bath University open days and extended hours of service during local sporting events (such as the Bath Half Marathon and Bath Rugby home games).

7.4 Cycling counts

Cycling counts are collected by the Council to understand how people are travelling in Bath. Increasing active and sustainable transport is part of the wider Council strategy due to the associated health benefits of walking and cycling. The Council measures cycle numbers using a network of automatic traffic counters (ATCs) that can detect bicycles passing over them. Figure 26, below, shows the overall number of bicycles detected passing over eleven inner-Bath ATC sites. **Note: the data is from one day per year so can be significantly affected by bad weather**.

Figure 26- Bath inner cordon bicycle count trend over the last 22 years.

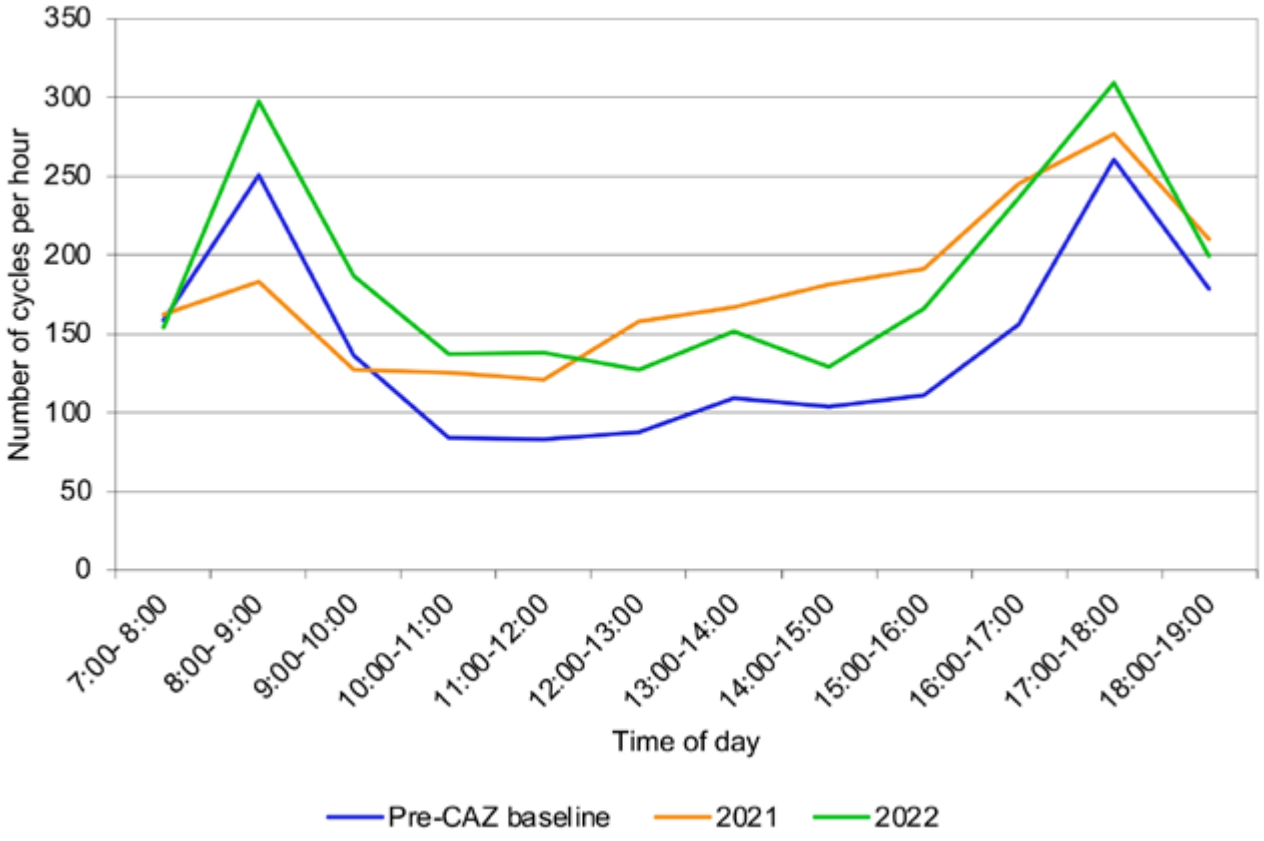


Comments and key findings:

- This survey is carried out on one day during the year so the weather can significantly change the number of people cycling that day.
- People choosing to travel by bicycle has been increased in Bath since 2000.
- In 2022, more than double the number of bicycles were recorded when compared to 2000.

- A peak in 2012 could be related to the London 2012 Olympics, which spurred interest in cycling around the UK.
- The Covid-19 pandemic may have boosted cycling as more people chose not to take public transport.
- Schemes promoting active and sustainable travel are gaining traction across the country and in Bath, with behaviour change being promoted both through the CAZ and the implementation of the first trial Liveable Neighbourhood schemes. This may be the reason that more people are choosing to cycle in recent years.

Figure 27, below, shows the number of bicycles passing the same eleven ATCs but split over a day, to illustrate changes that occurred in 2022. The pre-CAZ baseline is from 2000-2020 without 2014 and 2019, equating to an 18-year average.



Comments and key findings:

- The pre-CAZ daily spread of bicycles shows a clear morning (8-9am) and evening (5-6pm) peak where rush hour existed. Figure 27 shows that this trend has returned in 2022 with volumes exceeding those of the baseline, this shows that to some extent working patterns are returning to those seen pre-pandemic.
- The hourly number of cycles in 2022 exceeds that of the pre-CAZ baseline, and largely that of 2021, except during mid-afternoon.
- Unlike those peaks seen in 2022, the lower 2021 morning peak would be consistent with more flexible working due to the Covid-19 pandemic. Peak hours still existed in 2021, however, the morning peak is diminished, potentially due to an increase in working from home.

- By also comparing the overall volumes recorded in 2022 to the pre-CAZ baseline, bicycle travel has increased 14% within these inner cordon surveys. This is a positive indication of an uptick in more sustainable travel within Bath.

7.5 Bus usage rates

Now the scheme is operational, the Council has reviewed the available bus usage statistics and are unable to draw any meaningful conclusions. This is due to the absence of a pre-pandemic (2019) baseline and fluctuating number of operators. Additionally, this data includes journey data for trips across the whole of B&NES and not just into Bath.

7.6 Stakeholder feedback from Council user groups

Ipsos Mori have produced an in-depth evaluation report investigating how the CAZ has affected people in a deep-dive case study.

7.7 Taxi fares and unmet demand rates

The taxi survey performed by the Council is only an indication of customer demand on Hackney Carriages and not the wider taxi trade. The last survey was carried out before the CAZ was introduced and the next survey is scheduled for 2023, therefore, there is no data for 2022. Since 2015, there has been no change in the number of Hackney Carriage licenses issued with the cap set at 125, there will be no changes in this until 2023 at the earliest. The Hackney Carriage fares are reviewed annually and are determined by indices set from the Office for National Statistics. The Council's licensing team have suggested that the introduction of the CAZ has had no impact on the Council Hackney Carriage license number or fares.

7.8 Early measures fund- zero emission vehicle parking permits

On 1 April 2019, the Council introduced a scheme to reduce the cost of parking permits for zero-emission vehicles. Discounts on the standard permit prices were available across a range of parking permit types.

There was a total of 170 reduced price permits available each year, the scheme ran from April 2019 through to March 2022. Table 12, below, shows the number of zero-emission parking permits issued up until March 2022, note that data is collected in financial years, therefore, there are no figures available for 2022-2023.

Table 12: Number of zero-emission parking permits issued per financial year.

Year	Number of ULEV permits issued
2019-2020	18
2020-2021	30
2021-2022	43

Key comments and findings:

- The number of permits issued grew each year, although they did not reach the total number of permits available.
- The Council expect growth in the local zero-emission market to continue and this will be beneficial.
- Ultra-low emission vehicles (ULEVs), which include hybrids, made up an average of 9% of total private cars at the beginning of 2023. This is around 3000 ULEVs out of a total of 32,000 private cars. This figure continues to grow.

7.9 Bus Retrofit uptake and compliance rates

Traffic and air quality modelling prepared for the CAZ Final Business Case included the assumption that all scheduled public bus services would be compliant (Euro 6 standard) by its launch. At the time of launch, 88 out of a fleet of 226 scheduled buses operating in Bath were non-compliant.

To prepare for the launch in March 2021, the Council secured government funds to support bus operators to upgrade the remaining 88 buses with engine emissions abatement technology as certified by the Clean Vehicle Retrofit Accreditation Scheme (CVRAS).

In autumn 2020, agreements were finalised with six bus operators to commence installation of the retrofit technology as soon as possible. In addition, two buses not operating as a public-registered bus service (Wessex Water) were upgraded (replaced with new Euro 6 buses). Additionally, some coaches were retrofitted through the Council's financial assistance scheme.

Approximately £1.7 million was awarded towards grants to operators to retrofit buses operating on public registered bus services.

Comments and key findings:

- By the end of June 2022, all 88 non-compliant buses operating as public buses in central Bath were successfully retrofitted with emission abatement technology.
- Preliminary reporting continues to suggest that on average the NOx reduction for retrofitted vehicles exceeds the 80% target set as part of CVRAS and therefore the vehicles are operating in line with compliant/Euro VI standards.

7.10 Financial assistance scheme uptake rates

To mitigate the impact of charges and further support air quality improvements, the Council has invested £9.4 million of government funds in a financial assistance scheme (FAS) that offers grants and interest-free loans to businesses and individuals wishing to replace non-compliant, chargeable vehicles with cleaner, compliant ones.

Businesses and individuals could apply for funding to upgrade or retrofit their vehicle if they passed a basic eligibility test, proving that they travel at least two days per week on average in the zone over a 60-day period. Those passing the test could then apply for grants and/or interest free loans via the Council's approved FAS administrators.

Table 13 below shows the number of vehicles that, by the end of December 2022, were eligible to be replaced, as well as the number that were replaced.

Table 13- Vehicles eligible for the financial assistance scheme and the number of vehicles that were replaced up until the end of December 2022

Vehicle category	Number vehicles eligible for FAS funding to upgrade/ retrofit	Number of vehicles upgraded by Dec 2022
M1 (taxis or private hire vehicles as private cars are compliant	150	101
M2 (minibuses)	4	2
M3 (buses and coaches)	22	22
N1 (light goods vehicles i.e. vans)	1347	746
N2; N3 (heavy goods vehicles <12T; HGVs>12T	38	29
Total	1560	900

Comments and key findings:

- By the end of 2022, 1560 vehicles had passed basic eligibility tests, and 900 vehicles have already been replaced.
- 746 non-compliant LGVs regularly travelling into the zone and 101 taxis/PHVs have already been replaced through the scheme.
- HGVs already have a higher compliance rate across the UK and in Bath and were therefore not a priority for the FAS. However, 38 HGVs regularly travelling into Bath have been approved for finance and 29 have been replaced.
- At the end of December 2022, approx. £8 million had been spent upgrading and retrofitting vehicles via the FAS (this includes the Bus Retrofit Programme).

Second Phase of the Financial Assistance Scheme (FAS)

After the first phase of the FAS had closed, a small amount of residual funding was prioritised to those motorists with older, more polluting vehicles frequently travelling within the CAZ, or, to those who had previously expressed an interest in the scheme after it had launched.

Table 14- Vehicles applying for the second phase of the financial assistance scheme (FAS2), with the number of vehicles eligible and the number of those invited to make an application.

Vehicle category	Number vehicles applying for FAS2	Number of vehicles eligible for funding to upgrade/retrofit under FAS2	Number of vehicles invited to make an application to FAS2
M1 (taxis or private hire vehicles as private cars are compliant)	20	14	12
M2 (minibuses)	0	0	0
M3 (buses and coaches)	0	0	0
N1 (light goods vehicles i.e., vans)	73	28	14
N2; N3 (heavy goods vehicles <12T; HGVs>12T)	2	0	0
Total	95	42	26

Key comments and findings:

- By the end of December 2022, there were applications for 95 vehicles to be considered for the second phase of the FAS, 42 of those vehicles were eligible for funding.
- This second phase of the FAS is being progressed into 2023.

7.11 Travel advisor session uptake rates

The Council's team of travel advisors has been the main point of contact for people applying to the FAS, both within the first and second phase of the scheme. They work to provide information to people and support through the FAS process.

By the end of December 2022, Travel Advisors contacted a total of 2000 people, informing and guiding people through the first stage of the CAZ FAS. By the end of 2022, a total of 1,560 vehicles were deemed eligible for funding to upgrade or retrofit the vehicle, with 900 of those successfully completed.

When launching the second phase of the FAS, a different approach was taken with engagement with most of this being done online via questionnaires. By the end of December 2022, 100 questionnaires had been completed.

7.12 Anti-idling enforcement

Since the launch of the Clean Air Zone in March 2021, the Council has been keen to maintain awareness around driver behaviour including the request not to idle engines, especially in locations where vulnerable people could be more negatively impacted by the effects of pollution, e.g., schools.

The Council has recently launched an anti-idling 'Kick the Habit' campaign targeted at schools across BaNES offering limited free printed resources, including banners and posters, to raise awareness of the dangers of excessive idling. Additionally, the Clean Air Schools Toolkit has been refreshed to include classroom activities, worksheets, and poster design competitions. Campaign materials can be found on the following webpage: https://beta.bathnes.gov.uk/engineoff

Additionally, businesses, organisations and residents are being encouraged to make a pledge to 'Kick the Habit' by turning off their engine when parked and waiting. Pledges can be made at https://beta.bathnes.gov.uk/engineoff

7.13 Weight restriction enforcement

A webform for members of the public to report allegations of breaches of vehicle weight restrictions, both within and outside of the CAZ, has been developed. Officers within Public Protection and Trading Standards are responding to complaints and carrying out proactive monitoring of roads carrying weight restriction limits.

To view the webform and report a breach of a weight restriction, visit the following webpage: https://beta.bathnes.gov.uk/report-breach-road-weight-restrictions

7.14 E-Cargo scheme

The Council hopes to encourage more sustainable delivery practices within the city to further support air quality improvements, tackle congestion, and help reach carbon neutral targets by 2030.

In 2021, the Council secured £500,000 from the Government to support the use of e-cargo bike deliveries within Bath. E-Cargo bike couriers offer fast, zero-carbon deliveries for businesses who need to transport small to medium sized packages over a short distance. This delivery method offers businesses an affordable, eco-friendly alternative to fossil-fuelled deliveries made by vans.

The E-Cargo Bath Scheme encourages businesses in Bath to trial deliveries with e-cargo bike couriers to reduce the number of vehicles on our roads. The scheme hopes to inspire businesses to adopt e-cargo bike deliveries in the long-term and prove that sustainable delivery practices are cost efficient in comparison to traditional delivery methods.

As of December 2022, direct contact was made with 470 businesses through calls and follow up emails, with 100 city centre businesses having visits from a member of the CAZ team. An additional 200 promotional postcards were also delivered to businesses outside of the city centre, but within the catchment.

Whilst several businesses expressed an interest in making use of the trial, overall uptake was low, and the scheme has since been aborted in early 2023. However, other E-cargo projects are planned locally and are to be delivered by WECA.

8 Conclusions

The high levels of NO_2 recorded in Bath present a public health risk that's not acceptable to the Council, or to central Government. Any amount of pollution can be damaging to our health, but the more pollution you are exposed to, the greater the risk and larger the effect. Some people are more vulnerable to the impacts of air pollution than others. Those more at risk from air pollution include children, those who are pregnant, and older people; people with lung conditions such as asthma, chronic obstructive pulmonary disease (COPD) and lung cancer; and people with heart conditions such as coronary artery disease, heart failure and high blood pressure.

The Council is committed to reporting on the impact of the CAZ on air quality, traffic flow and vehicle compliance on an annual and quarterly (moving into an interim report in 2023) basis so that progress towards the target can be monitored. This target is to reduce NO_2 concentrations to below the annual limit value of 40 µg/m^3 at all individual monitoring locations in Bath.

This report has set out related data and key findings from 2022, and as highlighted in our summary, the trends are encouraging. Air quality is improving across the entire district, despite traffic returning to near pre-pandemic levels.

Air quality conclusions

Average nitrogen dioxide (NO_2) concentrations within the CAZ in 2022 are 26% lower than in 2019, representing a reduction of 8.5 µg/m^3. A reduction of 27% or 7.1 µg/m^3 was also recorded in the urban area outside of the zone, showing that areas outside of the CAZ are not being negatively impacted.

Whilst this improvement is showing a significant reduction in concentrations of NO_2, one site did exceed the limit value recording at 40.4 µg/m3. However, as this site, Walcot Parade 4, was installed in August 2022 and only contained five months of monitoring data, it is likely the annualisation of the diffusion data has overestimated the concentrations of NO_2.

Additionally, as Walcot Parade 4 recorded concentrations below 40.49 µg/m^3 it is considered a compliant monitoring location by Defra and JAQU. Defra's approach when reporting compliance to the European Commission (as confirmed by JAQU in 2019), is to round any concentration to the nearest integer, therefore, any concentration up to 40.49 µg/m^3 would be not reported as exceeding[15].

Every diffusion tube site within the CAZ in both 2021 and 2022 recorded NO_2 concentrations lower than 2019. As NO_2 is also continuously improving in areas outside of the zone, it implies that the CAZ is having its intended effect without negatively impacting other areas within the authority.

[15]Jacobs, 2019. Local Air Quality Modelling Methodology Report. Available at: https://democracy.bristol.gov.uk/documents/s42646/Appendix%20Di%20-%20BCC%20CAZ%20OBC%2018%20-%20Modelling%20Methodology%20Report%20AQ2.pdf

Traffic flow conclusions

Nationally, traffic flows have returned to pre-pandemic levels, with volumes in Bath still being slightly below throughout 2022. Within the CAZ, traffic flows from the Council's permanent ATC network for the second half of the reporting year were unavailable. During this period the network, particularly within the CAZ, was being upgraded with new, more reliable technology. However, two temporary ATC surveys from a 7-day period within the zone show a reduction in traffic flows when compared to a pre-pandemic baseline. It may be noted that these surveys are not representative of the year and are instead included to provide an indicative overview.

Traffic flows within the CAZ_Boundary and Wider_B&NES have also decreased 9%-10% when compared to a pre-pandemic baseline.

A key commitment of the Council is to monitor any concerns arising from the introduction of the CAZ in 2021. In 2021, traffic flows were substantially impacted by the Covid-19 restrictions during the first half of the year, with the full and partial closure of Cleveland Bridge also impacting 2021 and 2022. The Council are investigating several locations where the public has expressed concerns over a perceived increase in traffic in their communities since the zone's launch.

The locations and the results of the most recent monitoring surveys can be found in Appendix 2 of the 2022 Q3 Report, or online at: https://beta.bathnes.gov.uk/sites/default/files/Appendix%202%20-%20Investigating%20traffic%20displacement%20concerns%20Q3%202022.pdf

These locations are currently being reviewed, and the results of more recent monitoring surveys will be published towards the end of 2023.

Vehicle compliance conclusions

The CAZ is encouraging the purchase of new or second hand, lower emission vehicles, and discouraging motorists with polluting vehicles, with the desired effect of improving local air quality.

On average 44,000 unique vehicles a day enter the zone, however, 69% of these are private cars which are not charged. By the end of 2022,497 non-compliant, chargeable vehicles were seen in the zone each day, compared to 1,742 per day during the first week of launch in March 2021.

By the end of 2022, 900 of the most polluting vehicles had been replaced or upgraded via the Council's Financial Assistance Scheme and more vehicles are planned, particularly with the launch of the second phase of the scheme.

Next steps

The significant reductions in NO_2 concentrations across the area are heartening but with four locations over 36 µg/m^3 and one location over 40 µg/m^3, there is still work to do. The Council will be focusing their efforts on these areas in the coming months.

The Council would like to thank the public for their support and continue to urge all residents to do their bit by walking, cycling, or taking public transport whenever they can.

9 Monitoring explained

9.1 Air quality monitoring techniques

Across BaNES, there are two main monitoring methods whereby data on air quality is obtained: diffusion tubes and automatic analysers. These methods are outlined below.

Automatic Analysers

High-resolution measurements can be taken by automatic analysers that draw in ambient air. There are four of these instruments located within B&NES that are constantly monitoring air quality. The locations of the automatic analyser can be viewed in Figure 2 or via the following link: https://www.ukairquality.net/

One of the automatic analysers, located along the A4 London Road, makes up part of the Automatic Urban and Rural Network (AURN) which feeds into a national monitoring network. The data produced by these analysers is compared with that of diffusion tubes to ensure accurate results, also known as bias adjusting.

Bias adjusting represents the overall tendency of the diffusion tubes to under or over-read relative to the automatic analysers, this is calculated by co-locating diffusion tubes with an automatic analyser to calculate the difference.

Diffusion Tubes

Less expensive than automatic analysers, diffusion tubes can be located on existing street furniture, often a lamppost or drainpipe. Due to the ease of deployment, hundreds of diffusion tubes can be located across a local authority to gain an overall view of pollution. Current locations of diffusion tubes can be viewed in Figures 2 and 3, or alternatively, via the interactive map at the following link: https://www.bathnes.gov.uk/services/environment/pollution-noise-nuisance/air-quality/air-quality-data-long-term

The diffusion tubes are exposed to ambient air for one month at a time, before being sent to a laboratory for analysis. The data is then adjusted to consider inaccuracies before an annual mean is derived at the end of each calendar year. Diffusion tubes are passive samplers and consist of a small plastic tube containing a chemical reagent called triethanolamine (TEA), in the case of NO_2 monitoring.

9.2 Traffic Monitoring Techniques

Across B&NES, there are multiple methods used to collect traffic flow data, as well as composition and the compliance of these vehicles if travelling within the CAZ.

Automatic Number Plate Recognition (ANPR)

As part of the CAZ project, ANPR cameras were installed at the entry/exit points of the boundary as well as within the zone, to form a cordon. The cameras obtain the numberplates from the vehicles and the vehicle information can be drawn from the DVLA database. Further useful data can be generated from matching entries into the system, for example, journey times through the CAZ.

Automatic Traffic Counters (ATC)

Permanent Automatic Traffic Counters
As part of the ongoing traffic monitoring network across B&NES, that was in place before the implementation of the CAZ, there are permanent ATCs located at multiple locations across the authority. The current ATC locations can be seen in Figure 18. These counters are built into the road surface and continuously monitor data on vehicle volume, speed, and classification.

As mentioned within section 'Traffic flows within the CAZ', the permanent ATCs, largely located within the CAZ, were being upgraded throughout the second half of 2022 and into 2023. The new counters are capable of monitoring the volume, classification, speed and movement paths of active travel modes (e.g., bicycles), as well as different vehicle types.

Temporary radar Automatic Traffic Counters
To quickly respond to potential traffic issues, particularly in locations where permanent ATCs are not installed, it is important to have monitoring equipment that is ready to deploy at short notice. Temporary radar ATCs can be fastened to existing street furniture and monitor vehicle volume and speed, however, it is not capable of detecting the vehicle type.

Video survey equipment
Much like the temporary ATCs mentioned above, video survey cameras are easy to install on existing street future at short notice, often for shorter periods of time. This survey technique does not record the speed of vehicles but can detect volume and classification. This can be useful in cases where it is important to know the type of vehicle using a particular route. These cameras can also be used to assess how many vehicles enter/exit junctions and are reliable in analysing turning counts, which can be important.

Manual traffic counts
At times, manual traffic counters are superior to automatic monitoring equipment. Enumerators can be deployed for shorter periods of time to manually count vehicles passing along a specific place or turning into a specific road.