Bath Clean Air Zone

Quarterly Monitoring Report
October – December 2022

Bath & North East Somerset Council

Improving People's Lives

CONTENTS

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
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
NO_2	Nitrogen Dioxide
NO_x	Nitrogen Oxides
OS	Ordnance Survey
PCM	Pollution Climate Mapping
PCN	Penalty Charge Notice
PHGV	Private Heavy Goods Vehicle
PM	Particulate Matter
$PM_{2.5}$	Particulate Matter with particles less than 2.5 micrometers diameter
PM_{10}	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
VAT	Value Added Tax
WHO	World Health Organisation

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 annual average limit of 40 micrograms per cubic metre ($\mu g/m^3$) 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 would be the only way to achieve success in the time frame. Clean air zones work by deterring certain higher 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 than would otherwise naturally occur.

On 15 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 of the CAZ's performance during October to December 2022 (Quarter 4). It looks at impacts on air quality, traffic flow and vehicle compliance. It does not report comprehensively on all aspects of the zone, nor does it draw any conclusions about success with the Government's directive, all of which is included in the Clean Air Zone Annual Report, available here.

Due to Covid-19 having an unprecedented impact on travel behaviour in 2020, baseline data from the last representative year (which could be any year from 2017-2019) has been used to measure the impact and effectiveness of the zone, 2021 has also been used for comparative purposes. Due to seasonal effects, we also compare against similar seasons in this quarterly report, in this case the fourth quarter of the year (October-December), referred to as Q4.

You can find out more about how we measure and present the data in the section ‘How to use this report’; and there is a more detailed explanation of how we monitor at the end of the report in the ‘Monitoring explained’ section.

Key findings

All the figures in this report are quarterly averages calculated from three months’ worth of data. Data used for considering the success of the CAZ is derived from annual averages, calculated from twelve months of data. To account for the effects of seasonality on air quality, the baseline year is the same period in 2019 (October to December).

- Provisional air quality, traffic, and vehicle compliance data indicates that Bath’s Clean Air Zone is continuing to have the intended effect of improving fleet compliance, changing behaviours, and improving the city’s air quality in general.

- Our primary focus now is monitoring the traffic and air quality in locations with NO_2 concentrations close to the objective value, particularly those that may still be recovering from the impact of the partial Cleveland Bridge closure in previous quarters.

- It is important to remember these results are quarterly and so do not determine whether the scheme is successful as this is based on an annual mean figure. Some of these quarterly averages include quarters where one or more months of data is missing, which can skew the average. The full data is presented in the appendix to this report.

2022 Q4 air quality results from within the CAZ (CAZ_Only):

- Average nitrogen dioxide (NO_2) concentrations within the CAZ **are 14.7 per cent lower** than the same period in 2019 (Q4), representing an average **reduction of 5.4 µg/m^3**. This is the average reading from a total of 58 monitoring sites within the CAZ that recorded full quarterly data from October to December in both 2019 and 2022.

  (Note: This is in the context of national traffic levels remaining at around pre-pandemic levels with usage of LGV’s and HGV’s exceeding pre-pandemic levels (Department of Transport).

- In 2022 Q4, **thirteen sites** within the CAZ (CAZ_Only) **recorded greater than 40 µg/m^3.** This is a reduction of eight sites when compared with 2019 Q4 and represents a decrease in the number of sites exceeding 40 µg/m^3 from 32% in 2019 Q4 to 19% in 2022 Q4. It must be noted that these concentrations are raw and

indicative and can therefore not be compared to an annual average which accounts for the impacts of seasonality and temporary events such as key road closures.

- In 2022 Q4, **eleven sites** within the CAZ_Only recorded concentrations **greater than 36 µg/m^3 but at or less than 40 µg/m^3**. This is a reduction of two sites when compared with 2019 Q4 and represents a decrease from 20% in 2019 Q4 to 16% in 2022 Q4.

- **Two sites** recorded a quarterly average NO_2 concentration that had increased when compared to 2019 Q4, these sites are London Road 2 and Wells Road 4. It must be noted that the baseline concentration at London Road only includes 1 month of monitoring data and is therefore, not representative of the whole quarter. Additionally, whilst Wells Road 4 has increased by 1.4 µg/m^3 when compared to 2019 Q4, the figures are only indicative and are not representative of concentrations across the whole year.

2022 Q4 air quality results from within the wider Bath urban area (CAZ_Boundary):

- Average 2022 Q4 nitrogen dioxide (NO_2) concentrations within the wider Bath urban area (CAZ_Boundary) are **18.5 per cent lower** than in 2019 Q4, representing a **reduction of 5.5 µg/m^3**. This is the average reading from a total of 44 monitoring sites that recorded data in both 2019 Q4 and 2022 Q4, with full quarterly data from each site included in the analysis. This demonstrates that air quality is consistently improving across the district.

- In 2022 Q4, **two sites** within the wider Bath urban area (CAZ_Boundary) **recorded greater than 40 µg/m^3.** This is a reduction of six sites when compared with 2019 Q4 and represents a decrease in the number of sites exceeding 40 µg/m^3 from 14% in 2019 Q4 to 3% in 2022 Q4.

- **Zero sites** were found to have increased in NO_2 concentration within the CAZ_Boundary when compared to 2019 Q4.

2022 Q4 air quality results from within the wider district (Wider_B&NES):

- Average 2022 Q4 nitrogen dioxide (NO_2) concentrations within the wider region of B&NES (Wider_B&NES) are **20.9 per cent lower** than in 2019 Q4, representing a **reduction of 7.6 µg/m^3**. This is the average reading from a total of 21 monitoring sites that recorded data in both 2019 Q4 and 2022 Q4, with full quarterly data from each site included in the analysis. This demonstrates that air quality is consistently improving across the district.

2022 Q4 traffic flow figures:

- Despite Cleveland Bridge fully reopening (although subject to an 18-tonne weight restriction) in 2022 Q4, it is likely that traffic flows have continued to recover throughout this period. Additionally, due to further roadworks around Queen Square it is likely that traffic flows are still not representative during the reporting period, particularly within the CAZ.

- Nationally, average traffic volumes returned to around pre-pandemic levels and usage of LGVs and HGVs on the network are now exceeding pre-pandemic levels (Department for Transport).

- Traffic flows within the CAZ during this reporting period were unavailable. During 2022 Q4, the Council's automatic traffic counter network, particularly within the CAZ, was being upgraded with newer, more reliable technology. The renewed counters were in a process of testing during 2022 Q4 and therefore data collected during this period could not provide reliable data.

- Average traffic flows in the urban areas outside the zone's boundary, which include Batheaston and Bathampton, were **6% lower** than the baseline.

- Average traffic flows across the Wider B&NES region were **8% lower** than the baseline.

2022 Q4 vehicle compliance and financial assistance scheme (FAS) figures:

- Compliance rates across all vehicle types continued to rise in 2022 Q4 when compared to the launch week of the CAZ in March 2021.

- Taxi/PHV compliance rose from 67% during the launch week to **an average of 95% by the end of 2022 Q4**. An average of 491 individual taxis/PHVs were recorded in the CAZ each day during the quarter.

- Out of a total fleet of 226 scheduled buses, 88 were non-compliant when the bus retrofit programme started. By the end of June 2022, **the full fleet had been successfully retrofitted to meet CAZ emission standards** with financial support from the government. An average of 134 unique buses/coaches were recorded in the CAZ each day during the quarter.

- HGV compliance for vehicles weighing greater than 3.5T but less than 12T rose from 86% during the launch week to **an average of 96% in 2022 Q4**. An average of 112 vehicles were recorded in the CAZ each day during the quarter.

- HGV compliance for vehicles weighing greater than 12T rose from 93% during the launch week to **an average of 96% in 2022 Q4**. An average of 272 vehicles were recorded in the CAZ each day during the quarter.

- Van/LGV compliance rose from 63% during the launch week to **an average of 83% in 2022 Q4**. An average of 3,384 individual vans/LGVs were recorded in the CAZ each day during the quarter.

- An average of **44,890 unique vehicles** were seen in the zone each day during 2022 Q4, which is comparable to 42,182-daily average for 2022 Q3.

- Most vehicles recorded in the zone are private cars, with an average of **31,969 unique private** cars seen in the zone each day during 2022 Q4. This equates to at least 71% of all vehicles in the CAZ during the quarter. **Private cars are not charged.**

- An average of **541 non-compliant** vehicles were seen in the zone each day during 2022 Q4, compared to 1742 during the launch week of the CAZ in March 2021.

- The percentage of **chargeable non-compliant** vehicles (as a percentage of all overall traffic) entering the zone each week reduced from 5.7% in the launch week to an average of **1.2%** between October and December 2022.

- Minibus compliance varied considerably as there were only around 26 minibuses recorded in the CAZ each day during 2022 Q4. The average minibus compliance was around **76%** for the quarter.

- The Council's financial assistance scheme (FAS) offered local businesses and individual grants and interest free loans to replace and upgrade non-compliant vehicles regularly driving in the zone.

- Owners of **over 1,500 vehicles applied for financial support** to upgrade or retrofit their vehicle.

- By the end of December 2022, owners' of **1560 vehicles** had passed the Council's **eligibility checks** to apply for funding to upgrade or retrofit their non-compliant vehicles via the Council's approved finance partners.

- By the end of December 2022, **900 vehicles** have already been **replaced** with cleaner, compliant ones, with more to be replaced in the coming months. As a result, the number of chargeable, non-compliant vehicles seen in the zone has fallen.

- The Council's FAS supported the **upgrade of 22 non-scheduled buses/coaches** from higher emission to cleaner, compliant ones by December 2022.

- The Council’s FAS supported the **upgrade of 29 HGVs** from higher emission to cleaner, compliant ones by December 2022.

- The Council’s FAS supported the **upgrade of 2 minibuses** from higher emission to cleaner, compliant ones by December 2022.

How to use this report

This report provides an update and indicative view of the CAZ's performance during October to December 2022 (quarter 4). The main areas we discuss are:

- air quality data
- traffic flow data
- and fleet compliance data

This report does not attempt to establish whether compliance (now termed 'success') with the Government's direction has been met. Neither is it a comprehensive report on all aspects of the clean air zone, including its mitigation measures or data relating to CAZ operations or income (such as income from charges and fines etc).

Further information is included in the Clean Air Zone Annual Report, and/or in other subsequent quarterly reports in 2022.

Timescales and baseline data

To determine the effectiveness of the CAZ, we compare the latest data collected since the start of the CAZ with baseline data from similar periods before its launch.

And because we need to consider seasonal effects on both air quality and traffic flows, we compare like-for-like data from previous years, breaking the year into 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 fourth quarter (Q4) of 2022. Given the unprecedented conditions brought about by the Covid-19 pandemic in 2020 (including significant changes in transport and travel behaviour), we have discounted 2020 figures for comparative purposes, unless otherwise stated in the report.

When reading the report please note the following:

- All 2022 air quality data is provisional.
- We use data from 2019 and 2021 to compare to 2022 air quality monitoring results.
- Air pollution is affected by the seasons, therefore baseline air quality data for this report is from October to December 2019 i.e., the fourth quarter (Q4)
- We use data from 2017/18 for comparing traffic flows, because the Council has insufficient data for some periods including 2019.
- Traffic flows also vary according to the seasons, so we compare current traffic flow data from with data from October to December (Q4) 2017/18.

- We also compare data from March 2021 (the launch of the zone) until the end of December 2022 (the end of the reporting period). However, the CAZ Annual Performance Report, looks at the annual trends from 2021 in greater detail.
- We also look at longer-term trends from 2017 to end of December 2022.

Where we gather data from/what locations

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

- The clean air zone (sites within the CAZ boundary which we call 'CAZ_Only')
- The boundary area (sites outside the CAZ boundary but within the urban area of Bath including Batheaston and Bathampton, which we call 'CAZ_Boundary')
- The wider area (sites outside of the Bath, Batheaston and Bathampton urban areas, but within the rural areas and district-wide urban areas in Bath & North East Somerset, which we call 'Wider_B&NES')

Climate summary October-December 2022

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

- October was predominately unsettled with most of the month being warmer than average. Whilst sunshine levels were above average for most of the months, there were a notable lack of frosts.
- November remained warmer than average, though it became colder at times towards the end of the month. Sunshine was broadly close to average, but the month was largely unsettled with dry spells lasting no longer than a few days.
- December was colder than average overall, with a very cold and frosty spell until mid-month. For the most part of the month rainfall was limited with sunshine levels being above average.

As most (approximately 80%) NO_2 from vehicle emissions occurs as a result of chemical reactions which take place after it is 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 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 we can see the impact of other measures 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 closed to traffic until November 2021, when it partially reopened with single-way signal-control.

As a result of the closure, traffic flows in and around Bath were impacted for the second half of 2021 and into 2022. The resultant diversions lead to traffic displacement into areas both within and surrounding the CAZ. We used temporary Automatic Number Plate Recognition (ANPR) cameras to identify vehicle compliance in areas where we were unsure whether vehicles were trying to avoid the CAZ or the bridge closure. It was difficult to identify whether vehicles were displaced because of the bridge closure, CAZ, or both. We delayed some traffic displacement monitoring until after the full reopening of the bridge, however, further delays to the bridge fully reopening meant we rescheduled these surveys looking to avoid (as far as possible) times where the traffic may be unrepresentative.

Although the partial closure of the bridge was not in place during the period covering this report (Q4), traffic volumes were still recovering after its full reopening on 2nd October 2022 (subject to an 18-tonne weight restriction). As a result, it may be said that the impacts of Cleveland Bridge can still be seen throughout this reporting period.

Find more information about 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 we've discounted 2020 data (unless otherwise stated).
- National traffic volumes have returned to pre-pandemic levels and in the case of LGVs and HGVs, pre-pandemic levels are being exceeded.
- 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.
- Online shopping and home-deliveries are increasing, which is leading to more commercial vehicles on the roads. For quarter 4 of 2022, light goods vehicles were at 111% of their pre-pandemic volumes whilst heavy goods vehicles

increased to 101% and cars reduced to 92%, respectively (Department for Transport statistics)[1].

World Health Organisation air quality targets update

The targets set for air pollution limits are initially set by the World Health Organisation's (WHO) Air Quality Guidelines and then the UK government 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 we plan to take before setting 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.

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 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[2]. 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 here.

[1] Department of Transport statistics from the Office for National Statistics. Economic activity and social change in the UK, real-time indicators,

[2] Department for Environment, Food and Rural Affairs. Environmental targets consultation summary of responses and government response, 2022.

Although the consultation has provided little change in $PM_{2.5}$ guidelines, as a Local Authority we will aim to continue to achieve and maintain success with the Ministerial Direction in addition to going further to reducing pollution levels below Government targets.

Further information

- You'll find more information on how we've measured and compared data in each individual section.
- As part of our obligations under the Local Air Quality Management (LAQM) legislation (part IV of Environment Act 1995) we have issued an Annual Status Report (ASR) alongside this report. This sets out and comments on air quality data from 2021 across the wider authority. These are 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, here: https://www.bathnes.gov.uk/services/environment/pollution-noise-nuisance/air-quality/air-quality-data-long-term
- The Clean Air Zone Annual Performance Report, published in June 2022, focuses on success with the government's directive. It also focuses on a wide range of factors as set out in the Monitoring and Evaluation Plan in the Full Business Case for Bath's Clean Air Zone. Go to: https://beta.bathnes.gov.uk/sites/default/files/2020-10/appendix_r_674726.br_.042.fbc-26_monitoring_and_evaluation_plan.pdf
- At the end of this report is a section called 'Monitoring Explained' which has been included to help you understand some of processes used to gather the data for this report.

Background information

This section provides information on why we need a CAZ in Bath, the type of air pollution that we're trying to tackle, and how we decided on a Class C charging CAZ. Further information can be found in the Full Business Case at: www.bathnes.gov.uk/BathCAZ.

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[3].

[3] Public Health England. Review of interventions to improve outdoor air quality and public health, 2019 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

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[4]. 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). Now road traffic is chiefly responsible for the poor air quality in the UK contributing to nitrogen dioxide (NO_2) pollution and particulate matter (PM) pollution.

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 we can breathe them in without noticing.

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 we breathe and are absorbed into our bodies. Vehicle exhaust emissions contribute 35 per cent of all UK nitrogen oxide emissions (NO_x) which is the single greatest source[5].

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

[4]Air Quality Management Resource Centre, UWE. Emissions vs exposure: Increasing injustice from road traffic-related air pollution in the United Kingdom, 2019
https://www.sciencedirect.com/science/article/pii/S1361920919300392
[5]DEFRA. Air quality: explaining air pollution – at a glance, 2019.
https://www.gov.uk/government/publications/air-quality-explaining-air-pollution/air-quality-explaining-air-pollution-at-a-glance

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 exceed 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 PM_{10} (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. There has been a downward trend in levels of PM in Bath since 2017.

Health impacts in Bath of NO_2 pollution

- NO_2 contributes to as many as 36,000 early deaths in the UK each year[6]
- 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[7]
- 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[5]

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.

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[6] Public Health England. Improving outdoor air quality and health: review of interventions, 2019. https://www.gov.uk/government/publications/improving-outdoor-air-quality-and-health-review-of-interventions

[7] Bath and North East Somerset Council. Clean Air 4 Bathnes. https://www.bathnes.gov.uk/services/environment/pollution/air-quality/clean-air-4-bnes

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

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'.

Since 2017, we have done significant technical work to understand what's required to comply with air quality limits, establishing that a charging clean air zone would be the only measure 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, including Birmingham (also live), Portsmouth (also live), Bradford (also live), Bristol (also live), Newcastle and Gateshead (due to launch in January 2023), Sheffield (due to launch in February 2023), Manchester, Liverpool, and Rotherham, and are also introducing clean air zones.

Other than meeting these objectives, the CAZ is seen is part of the wider obligations towards improving our 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[8]. 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.

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

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

charging clean air zone, charging all higher emission vehicles except private cars and motorbikes but including some additional traffic management.

We 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 we needed to tackle pollution, 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 we could achieve success with a Class C CAZ provided we also introduced additional traffic measures at Queen Square 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.

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

How Bath's CAZ works

Bath 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.

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.

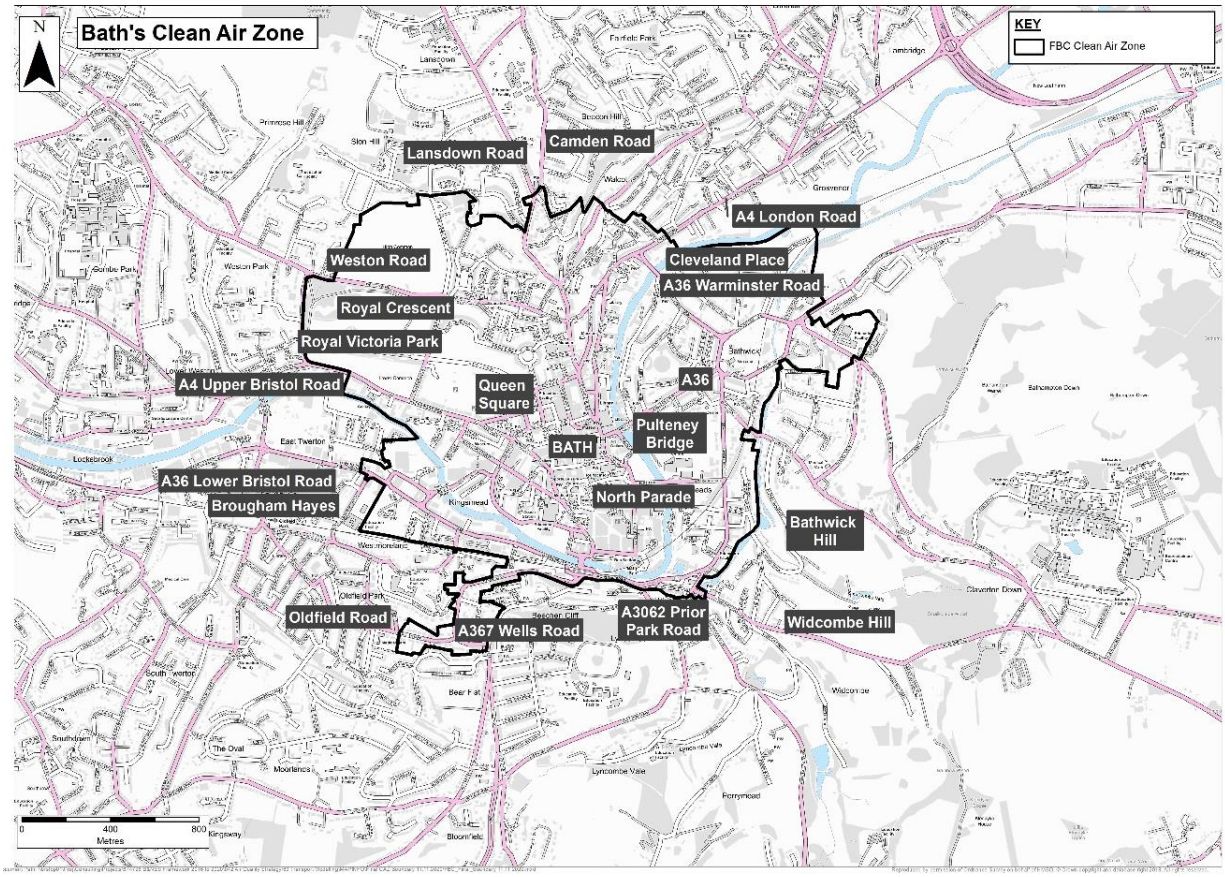
Revenue from charges and fines is used to pay for the running of the scheme. Any money made over and above this must be reinvested in sustainable transport and air quality projects.

Zone boundary

The 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 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 apply temporarily for two or 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. The range was developed in response to feedback from our public consultations and to mitigate the impact of charges on certain groups. For more information on local exemptions see www.bathnes.gov.uk/CAZexemptions

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 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 for prioritised cases being progressed in late 2022/early 2023. The Bus retrofit scheme is now complete, with all retrofits completed by June 2022.

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 micrograms per cubic metre ($\mu g/m^3$) in the shortest possible time, and by the end of 2021 at the latest.

To show that we've met this requirement, we will need to evidence that the annual average levels of NO_2 recorded at every monitoring site in Bath (both inside and outside of the zone) do not exceed 40 $\mu g/m^3$. This will require a full 12 months of data from each individual site, the results of which for 2021 are published within the Clean Air Zone Annual Report, available on our website.

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

Data is therefore being continually collected on a range of measures so that we 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 Appendix 1.

We have already introduced additional traffic and air quality monitoring in areas where the public has expressed concern about displacement effects. For more information see the Traffic Displacement Appendix (Appendix 2) supporting this report.

For more information on previous monitoring surveys that have taken place, see Appendix 2 of the CAZ Annual Report, available here: https://beta.bathnes.gov.uk/sites/default/files/Appendix%202%20Investigating%20traffic%20displacement%20concerns.pdf

The purpose of our quarterly reports is to provide an indicative view of the zone's performance, looking at three key measures outlined in Table 1: air quality data, traffic flow data and vehicle compliance data. This report also includes data on the financial assistance and bus retrofit schemes because of their influence on fleet compliance.

Secondary measures, as presented within the Monitoring and Evaluation Plan in the Full Business Case of Bath's Clean Air Zone, are reported on within the CAZ Annual Performance Report.

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

Measure	Data to be Used	Rationale for Inclusion	Data Collection Methods	Frequency of Data Collection
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	Baseline (pre-scheme) then continuous monitoring (reported quarterly).
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.	Automatic Number Plate Recognition (ANPR) camera cordon and ancillary Manual Classified Counts (MTC) or Automated Traffic Counts (ATC) on key roads or perceived 'rat-runs'	Baseline (pre-scheme) then continuous monitoring (reported quarterly).
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	Baseline (pre-scheme) then continuous monitoring (reported quarterly).

Impacts of the CAZ on air quality

The purpose of the CAZ is to reduce nitrogen dioxide (NO_2) pollution in Bath to within the annual average limit of 40 micrograms per cubic metre ($\mu g/m^3$) in the shortest possible time, and by the end of 2021 at the latest. 40 $\mu g/m^3$ is the legal limit set for NO_2 in the Environment Act 1995 Bath and North East Somerset Council Air Quality Direction 2019[9].

To show that we've met this requirement, we will need to evidence that the annual average levels of NO_2 recorded at every monitoring site in Bath (both inside and outside of the zone) does not exceed 40 $\mu g/m^3$.

How we collect and measure air quality data

We have measured air quality in Bath and North East Somerset since the mid-1990s. Currently we measure nitrogen dioxide (NO_2) and Particulate Matter ($PM_{2.5}$ and PM_{10}) concentrations in two ways: automatic analysers and diffusion tubes.

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. There are currently 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 which is 40 $\mu g/m^3$ for PM_{10} and 20 $\mu g/m^3$ for $PM_{2.5}$, except at times when there were meteorological or other events that caused spikes in these pollutants, nationally. Whilst we continue to measure it, PM data will not form part of these quarterly or annual reports.

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

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, we present air quality data for the following areas:

- The clean air zone (sites within the CAZ boundary which we call 'CAZ_Only')
- The boundary area (sites outside the CAZ boundary but within the urban area of Bath including Batheaston and Bathampton, which we call 'CAZ_Boundary')
- The wider area (sites outside of the Bath, Batheaston and Bathampton urban areas, but within the rural areas and district-wide urban areas in Bath & North East Somerset, which we call 'Wider_B&NES')

Air quality monitoring locations

As of 2022 Q4 there are a total of 137 monitoring sites across Bath, with 70 located in the clean air zone (see Figure 2) and 67 are in the city's urban area outside of the zone's boundary (see Figure 3).

Figure 2- A map showing the Clean Air Zone and the automatic analyser (squares) and diffusion tube (triangles) locations in Bath © Crown Copyright 2021. License number 100023334.

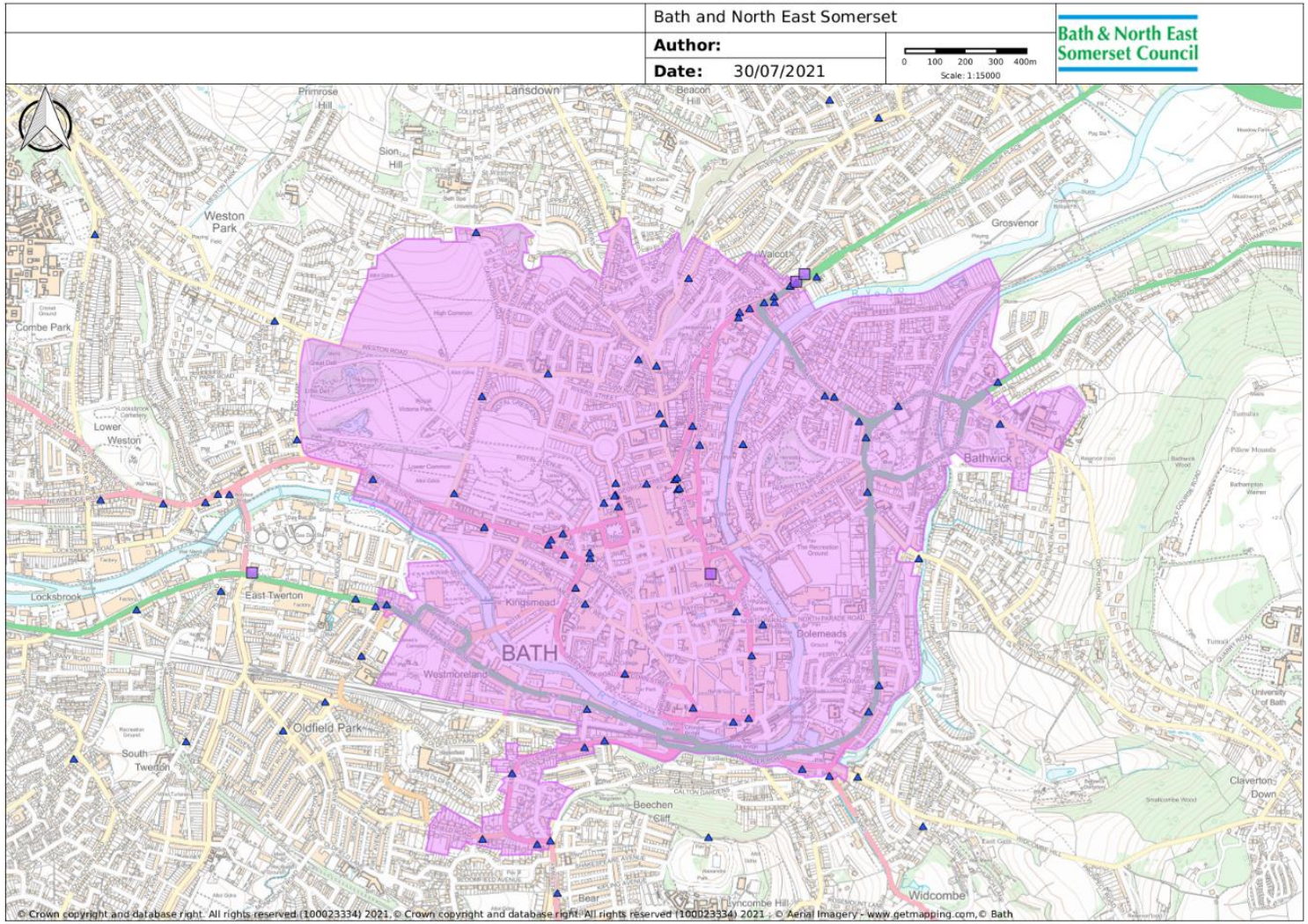
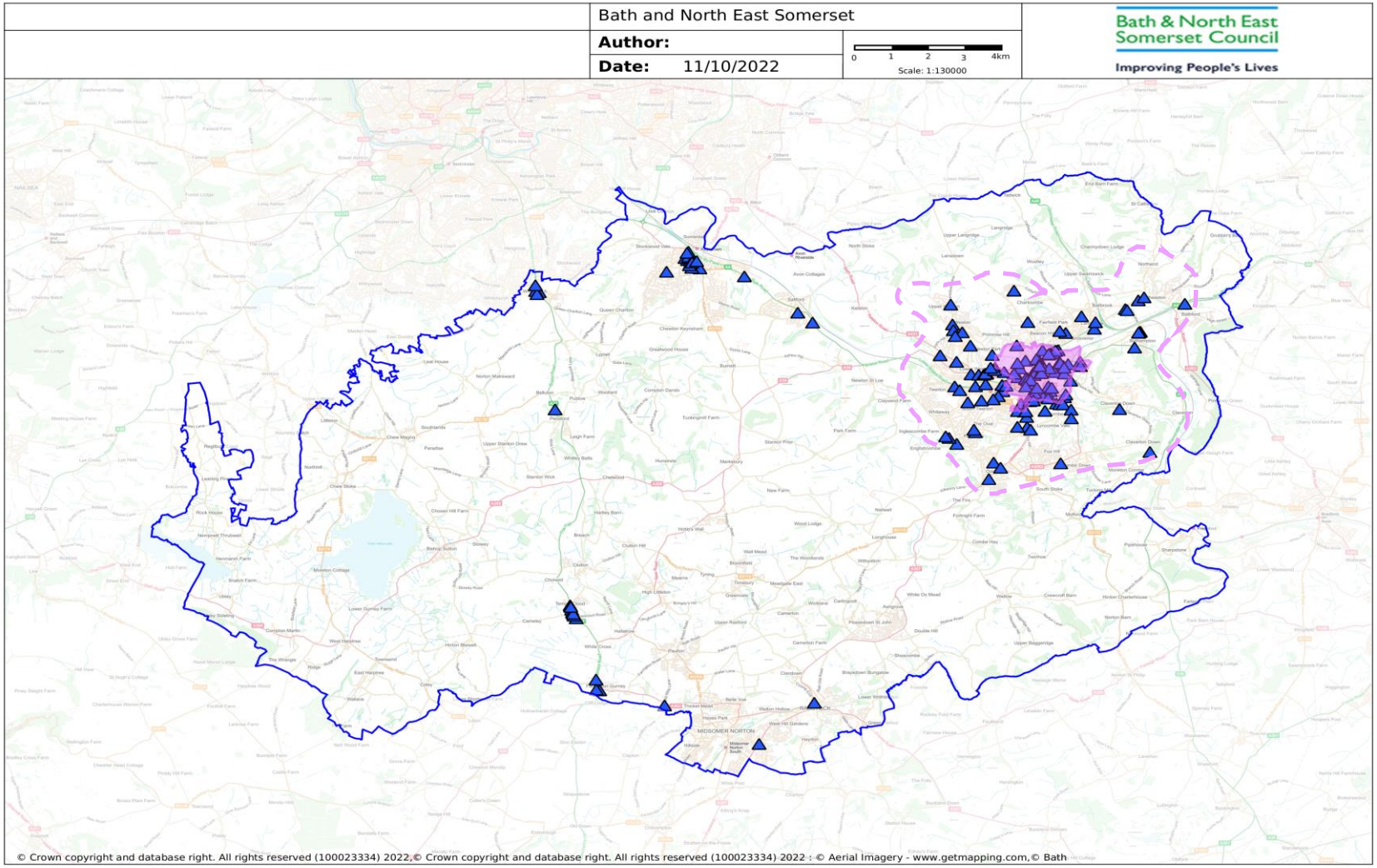


Figure 3 - A map showing diffusion tube locations in three site groupings: The wider area of Bath and North East Somerset (the blue line; Wider_B&NES), the wider Bath urban area outside of the CAZ (the dotted pink line; CAZ_Boundary) and in the CAZ (the pink area; CAZ_Only). © Crown Copyright 2021. License number 100023334.



Numbers of diffusion tube sites in each location

Table 2 shows the growing number of diffusion tube air quality monitoring sites across the area. Additional sites were chosen based on the air pollution dispersion model developed for the CAZ Full Business Case, enabling us to check the impact of the clean air zone against what was modelled.

Triplicate sites are where three diffusion tubes 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 which were active during each quarter (triplicate sites are averaged so only considered one location) from 2019 Q4 to 2022 Q4 in the three site groupings. This is the total number of sites and is not representative of the number of sites reporting full quarterly data.

Period	CAZ_Only	CAZ_Boundary	Wider_B&NES
2019 Q4	65	56	29
2020 Q4	65	56	34
2021 Q4	68	61	41
2022 Q4	70	67	35

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

Measuring air quality to take account of seasonal effects

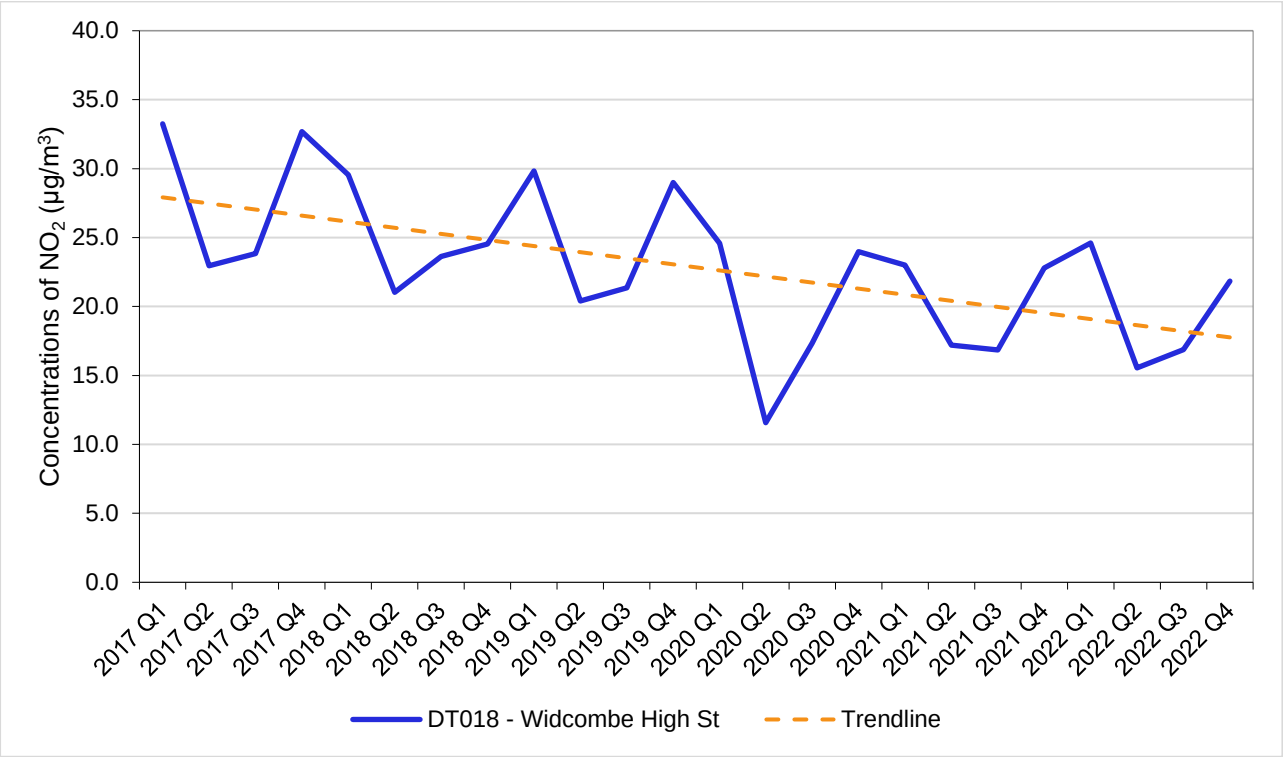
Annual average concentrations are useful because they account for varying seasonal cycles of pollutants such as:

- Meteorological conditions, for example wind, precipitation, and temperature; and
- 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.

Figure 4, seen below, shows quarterly average NO_2 concentrations for Widcombe High Street from 2017 to 2022 Q4. This site has been chosen as it is a long-term site with a high data capture that clearly presents the effects of seasonality.

As seen in Figure 4, concentrations of nitrogen dioxide are higher within the winter months, although the graph is showing an overall downward trend since 2017 at Widcombe High Street, NO_2 concentrations are higher within the first and fourth quarters of each year.

Figure 4- Quarterly average NO_2 concentrations at Widcombe High Street since 2017.



Increased winter NO_2 concentrations are primarily due to:

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

Therefore, to account for seasonality within these reports we compare air quality data against similar time periods, for example comparing data for the first quarter (January to March) of 2022 with the first quarter (January to March) of 2019. Further information on air quality monitoring can be found in the ‘Monitoring Explained’ section at the end of this report.

Quarterly air quality results, 2022 Q4

To identify emerging trends, we present provisional NO_2 data for the three months of October to December 2022, or 2022 Quarter 4. We compare it with baseline data from the fourth quarter of 2019 and to previous years' data to account for seasonal differences and to show the impact of the zone's launch on air quality so far. 2020 Q4 data has been discounted as a baseline because of Covid-19's unprecedented effect on traffic and travel behaviour.

All other areas across the city have quarterly average levels of nitrogen dioxide below 36 µg/m^3 or have falling levels of NO_2 and are therefore excluded from the tables. The full monthly diffusion tube results can be found in the appendix to this report.

Tables 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 Q4.
- Table 4: The diffusion tube locations where the quarterly average exceeded 36 µg/m^3 but remained at or less than 40 µg/m^3, within the CAZ_Only and CAZ_Boundary site groupings
- Table 5: The diffusion tube locations where the 2022 Q4 quarterly average NO_2 concentrations increased when compared to 2019 Q4.
- Table 6: The number of sites, that when averaged during the quarter, provisionally recorded NO_2 concentrations greater than 40 µg/m^3 and 36 µg/m^3.
- Table 7: Provisional quarterly average NO_2 concentration in 2019 Q4 and 2022 Q4 grouped by locations inside and outside the zone.

Table 3- NO_2 concentrations at locations where the quarterly average exceeded 40 µg/m^3 in 2022 Q4, within the CAZ_Only and CAZ_Boundary site groupings. TA= triplicate average site. Quarters with at least one month of data missing are highlighted orange. Data may be missing for multiple reasons including damaged diffusion tubes or those recording invalid results.

Site ID	Site	Site Grouping	2019 Q4 NO_2 concentration (µg/m^3)	2022 Q4 NO_2 concentration (µg/m^3)	Change	Missing data?	Reason missing
DT020 (TA)	Wells Road	CAZ_Only	57.7	50.2	-7.5	Dec-19	Missing tubes
DT042	Dorchester Street	CAZ_Only	49.1	42.2	-6.9		
DT043	St. James Parade	CAZ_Only	42.4	41.0	-1.4		
DT060	Victoria Buildings	CAZ_Only	48.4	42.8	-5.6	Dec-19	Faulty tube
DT090 (TA)	Anglo Terrace	CAZ_Only	52.4	42.0	-10.4		
DT172 (TA)	London Road 2	CAZ_Only	39.2	40.2	1.0	Nov-19 and Dec-19	Missing tubes
DT198 (TA)	Walcot Parade	CAZ_Only	55.4	47.0	-8.4		
DT222 (TA)	Anglo Terrace Façade	CAZ_Only	54.8	48.7	-6.1		
DT224 (TA)	Walcot Parade 2	CAZ_Only	63.5	52.8	-10.7		
DT235 (TA)	Wells Road 2	CAZ_Only	41.1	42.5	1.4		
DT248 (TA)	Chapel Row 2	CAZ_Only	43.4	41.7	-1.7		
DT304	Walcot Parade 4	CAZ_Only	N/A	52.7	N/A	2019 baseline	Site new in August 2022
DT305	Wells Road 5	CAZ_Only	N/A	49.0	N/A	2019 baseline	Site new in August 2022
DT062	Argyle Terrace	CAZ_Boundary	45.2	41.8	-3.4	Oct-22	Missing tubes

DT230 (TA)	Upper Bristol Road 4	CAZ_Boundary	50.1	42.5	-7.6	Nov-19	Missing tubes

Table 4- NO_2 concentrations where the quarterly average exceeded 36 µg/m^3 but remained less than 40 µg/m^3, within the CAZ_Only and CAZ_Boundary site groupings. TA= triplicate average site. Quarters with at least one month of data missing are highlighted orange. Data may be missing for multiple reasons including diffusion tubes going missing or invalid results.

Site ID	**Site**	**Site Grouping**	**2019 Q4 NO_2 concentration (µg/m^3)**	**2022 Q4 NO_2 concentration (µg/m^3)**	**Change**	**Missing data?**	**Reason missing**
DT003	Broad Street	CAZ_Only	44.9	38.7	-6.2		
DT173	Upper Bristol Road 2	CAZ_Only	39.9	38.6	-1.3		
DT182 (TA)	Gay Street-Lower	CAZ_Only	45.2	37.9	-7.3		
DT225 (TA)	Cleveland Terrace	CAZ_Only	42.9	38.1	-4.8		
DT227 (TA)	Wells Road 3	CAZ_Only	46.4	38.7	-7.7		
DT234 (TA)	Gay Street 2	CAZ_Only	43.7	38.8	-4.9		
DT237	Broad Street 2	CAZ_Only	42.6	39.4	-3.2		
DT239 (TA)	Broad Street 4	CAZ_Only	42.8	38.3	-4.5		
DT246 (TA)	Dorchester Street 2	CAZ_Only	42.8	38.3	-4.5		

DT288	Victoria Buildings Façade	CAZ_Only	N/A	36.2	N/A	2019 baseline	Site new in October 2021
DT297	Midland Bridge Road	CAZ_Only	N/A	38.3	N/A	2019 baseline	Site new in January 2022
DT231 (TA)	Upper Bristol Road 5	CAZ_Boundary	46.2	37.2	-9.0		
DT299	Upper Bristol Road 6	CAZ_Boundary	N/A	38.1	N/A	2019 baseline	Site new in July 2022

Table 5- NO_2 concentrations at locations where the quarterly average increase in 2022 Q4 when compared to 2019 Q4, within the CAZ_Only and CAZ_Boundary site groupings. TA= triplicate average site. Quarters with at least one month of missing data are highlighted orange. Data may be missing for multiple reasons including diffusion tubes going missing or invalid results.

Site ID	**Site**	**Site Grouping**	**2019 Q4 NO_2 concentration ($\mu g/m^3$)**	**2022 Q4 NO_2 concentration ($\mu g/m^3$)**	**Change**	**Missing data?**	**Reason missing**
DT172 (TA)	London Road 2	CAZ_Only	39.2	40.2	1.0	Nov-19 and Dec-19	Missing tubes
DT235 (TA)	Wells Road 4	CAZ_Only	41.1	42.5	1.4		

Table 6- The total number of sites at locations in the clean air zone and outside the boundary but within urban areas of Bath, which recorded greater than 40 µg/m^3 and 36 µg/m^3 NO_2 concentrations during 2019 Q4 and 2022 Q4. The total number of sites reporting during each period is shown along with the proportion of sites recording greater than 40 µg/m^3 and 36 µg/m^3 because the total number of sites is variable. Note that sites which recorded above 40 µg/m^3 will also have recorded above 36 µg/m^3. Some sites reported here do not have full quarterly data available and are missing one- or two-month's data.

CAZ_Only and CAZ_Boundary	Total no. sites reporting	No. sites >40 µg/m^3 average	Proportion sites >40 µg/m^3 (%)	No. sites >36 µg/m^3	Proportion sites >36 µg/m^3 (%)
2019 Q4	121	29	46	48	77
2022 Q4	137	15	22	28	40
Change	16	-14	-24	-20	-37

N.B. It should be noted that new sites were added for a variety of reasons including in response to requests and to verify model predictions. This table considers all sites reporting during the quarter, regardless of how many months are missing. Any numerical discrepancies are due to rounding.

Comments and key findings:

- To identify emerging trends, we compare provisional NO_2 data for the months October to December (Q4) to baseline data from the fourth quarter in 2019. This accounts for seasonality as there is a clear increasing trend in NO_2 concentrations during the winter.

- This data for each quarter has been averaged across every site reporting for that quarter, in the site groupings. Some of the results include quarters that did not record full data, as more or more months may be missing.

- Missing or invalid data can lead to misleading results by, for example, skewing an average. We have omitted results from our analysis if there is missing data because losing one- or two-month's information from a three-month quarter means at least 33.3% or 66.6% of the data is missing.

- Multiple monitoring locations have been added since 2019 Q4 across B&NES. See Table 2 for details. Sites were added for a range of reasons including in response to public requests as well as verifying model predictions for the CAZ, therefore, there are more sites in 2022 Q4 then 2019 Q4.

- **Two sites** recorded a quarterly average NO_2 concentration that had increased when compared to 2019 Q4, these sites are London Road 2 and Wells Road 4. It must be noted that the baseline concentration at London Road only includes 1 month of monitoring data and is therefore, not representative of the whole quarter. Additionally, whilst Wells Road 4 has increased by 1.4 µg/m^3 when compared to 2019 Q4, the figures are only indicative and are not representative of concentrations across the whole year.

- In 2022 Q4, **thirteen sites** within the CAZ (CAZ_Only) **recorded greater than 40 µg/m^3.** This is a reduction of eight sites when compared with 2019 Q4 and represents a decrease in the number of sites exceeding 40 µg/m^3 from 32% in 2019 Q4 to 19% in 2022 Q4.

- In 2022 Q4, **two sites** within the wider Bath urban area (CAZ_Boundary) **recorded greater than 40 µg/m^3.** This is a reduction of six sites when compared with 2019 Q4 and represents a decrease in the number of sites exceeding 40 µg/m^3 from 14% in 2019 Q4 to 3% in 2022 Q4.

- In 2022 Q4, eleven sites within the CAZ_Only recorded concentrations greater than 36 µg/m^3 but at or less than 40 µg/m^3. This is a reduction of two sites when compared with 2019 Q4 and represents a decrease from 20% in 2019 Q4 to 16% in 2022 Q4.

- In 2022 Q4, two sites within the wider Bath urban area (CAZ_Boundary) recorded greater than 36 µg/m^3 but less than 40 µg/m^3. This is a reduction of four sites when compared with 2019 Q4 and represents a decrease from 6% in 2019 Q4 to 2% in 2022 Q4.

- We are undertaking traffic flow monitoring alongside air quality monitoring to determine the effect of traffic. The temporary changes in traffic patterns due to the closure of Cleveland Bridge has continued to impact these results into 2022 Q4.

- It is anticipated that continued improvements in vehicle compliance rates and vehicle upgrades through our FAS, will further improve NO_2 concentrations at our monitoring sites.

Trend analysis

Here we present trend analysis by comparing 2022 Q4 to the baseline, 2019 Q4. For analysing quarterly data, we discount any sites where one or more months' data is missing from the quarter, from the analysis. Since a quarter comprises three months, and NO_2 concentrations vary seasonally, including a quarterly average concentration for analysis with one or more months missing, would skew the results. Therefore, when analysing data, we only consider quarters with three months full data.

In this quarterly analysis we compare sites that have full quarterly data from both the baseline, 2019 Q4, and the current quarter, 2022 Q4. This means that the data we are considering is like-for-like, comparable and robust.

Triplicate sites (where three diffusion tubes are co-located) are used to increase the accuracy of the data. Where these sites exist, the average from all three diffusion tubes is taken monthly and reported as one result.

We include the full quarterly diffusion tube data (regardless of if there are any months missing data for whatever reason), for all site groupings in both 2019 Q4 and 2022 Q4, in an appendix to this report.

Table 7- Quarterly average NO_2 concentrations in 2019 Q4 and 2022 Q4 in the three site groupings. The results only consider like-for-like data, meaning only diffusion tube sites which recorded full (all three months) quarterly data in both 2019 Q4 and 2022 Q4 are included.

Period	**CAZ_Only NO_2**	**CAZ_Boundary NO_2**	**Wider_B&NES NO_2**
2019 Q4	36.7	29.8	36.4
2022 Q4	31.3	24.3	28.8
Number of sites reporting full results during all three quarters	58	44	21
Change 2019 Q4 – 2022 Q4 ($\mu g/m^3$)	-5.4	-5.5	-7.6
Change 2019 Q4 – 2022 Q4 (per cent)	-14.7%	-18.5%	-20.9%

Comments and key findings:

- For analysing quarterly data, we have discounted any sites where one or more months' data is missing from the quarter, from the analysis.

- For our quarterly analysis we also only compare sites that have full quarterly data from both the baseline, 2019 Q4, and this year, 2022 Q4. This means that the data we are considering is like-for-like, comparable and robust. Some sites are discounted due to not having full baseline (2019 Q4) or current (2022 Q4) data.

- Triplicate sites (where three diffusion tubes are co-located) are used to increase the accuracy of the data. Where these sites exist, the average from all three diffusion tubes is taken monthly and reported as one result.

- Average nitrogen dioxide (NO_2) concentrations within the CAZ are **14.7 per cent lower** than the same period in 2019 (Q4), representing an **average reduction of 5.4 µg/m^3.** This is the average reading from a total of 58 monitoring sites within the CAZ that recorded full quarterly data from October to December in both 2019 and 2022.

- There was also an NO_2 reduction found in the Bath urban areas outside the zone's boundary, including Batheaston and Bathampton, averaging a **18.5 per cent reduction, or 5.5 µg/m^3 on average**, from a total of 44 CAZ_Boundary monitoring sites that recorded full quarterly data from October to December in both 2019 and 2022.

- There was also an NO_2 reduction found in the Wider_B&NES site grouping, averaging a **20.9 per cent reduction, or 7.6 µg/m^3** on average, from a total of 21 Wider_B&NES monitoring sites that recorded full quarterly data from October to December in both 2019 and 2022.

- Given that traffic levels have largely returned to those seen pre-pandemic and above, this reduction of NO_2 concentration in the Bath urban area is likely due to the natural replacement of older, more polluting vehicles with cleaner, compliant ones, boosted by the Council's financial assistance to local drivers to replace hundreds of non-compliant vehicles.

- CAZs seek to speed up the replacement of non-compliant vehicles so it is anticipated that we will see further air quality improvements once the effects of the pandemic on the demand and supply of compliant vehicles have diminished.

- Covid is likely to have contributed to reductions in NO_2 concentrations. Pre-Covid statistics show that rural areas traditionally have higher of work at around 32%

compared with urban areas at around 13%[10]. Home working has increased significantly among urban dwellers during the pandemic.

- Significant reductions in NO_2 seen in 2020 are likely because of Covid-19 restrictions reducing traffic flows. Due to the unprecedented nature of the pandemic, reduced traffic flows and improved air quality, we may expect to see NO_2 concentrations in the coming year, exceed those of 2020.

[10] DEFRA. Statistical Digest of Rural England, 2020. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/984921/Home_Working_Dec_2020_final_with_cover_page.pdf

Impacts of the CAZ on traffic flow

A clean air zone is primarily designed to improve the compliance of vehicles driving in higher polluting areas, and not to influence traffic volumes i.e., it is aimed at reducing pollution, not congestion.

However, road traffic is the most significant cause of NO_2 pollution in Bath, so we 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 changes in traffic is negatively impacting air quality and/or road safety as a result of introducing the zone.

How we measure changes in traffic flow

We monitor where traffic is going and the volume of traffic on particular routes using manual classified counts (MTC), automated traffic counts (ATC) and automatic number plate recognition (ANPR) cameras.

To report on the CAZ, we focus on key roads inside and outside the clean air zone 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.

To understand the impact of the zone on changes to traffic flows, we compare 2022 Q4 data with a similar time frame before the zone was introduced. Depending on the available data, this baseline data will be from 2017 or 2018. We have discounted data from 2020 due to the unprecedented impact on traffic and travel caused by the Covid-19 restrictions, and the Council has insufficient data for the year 2019. Sometimes there is no baseline data to draw on if the monitoring location is new or temporary.

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.

Online shopping and home-deliveries are increasing, which is leading to more commercial vehicles on the roads. In 2022 Q4, light goods vehicles on average increased to 111% of their pre-pandemic levels whilst heavy goods vehicles increased to 101% and cars reduced to 92%, respectively (Department for Transport statistics).

Figure 5 shows a map of the wider area, including the city of Bath, where automatic traffic counts (ATCs) are in place to analyse traffic flow. These are shown using a red diamond icon. A list of the locations used in the analysis can be found in Table 8, including the year the baseline data was recorded.

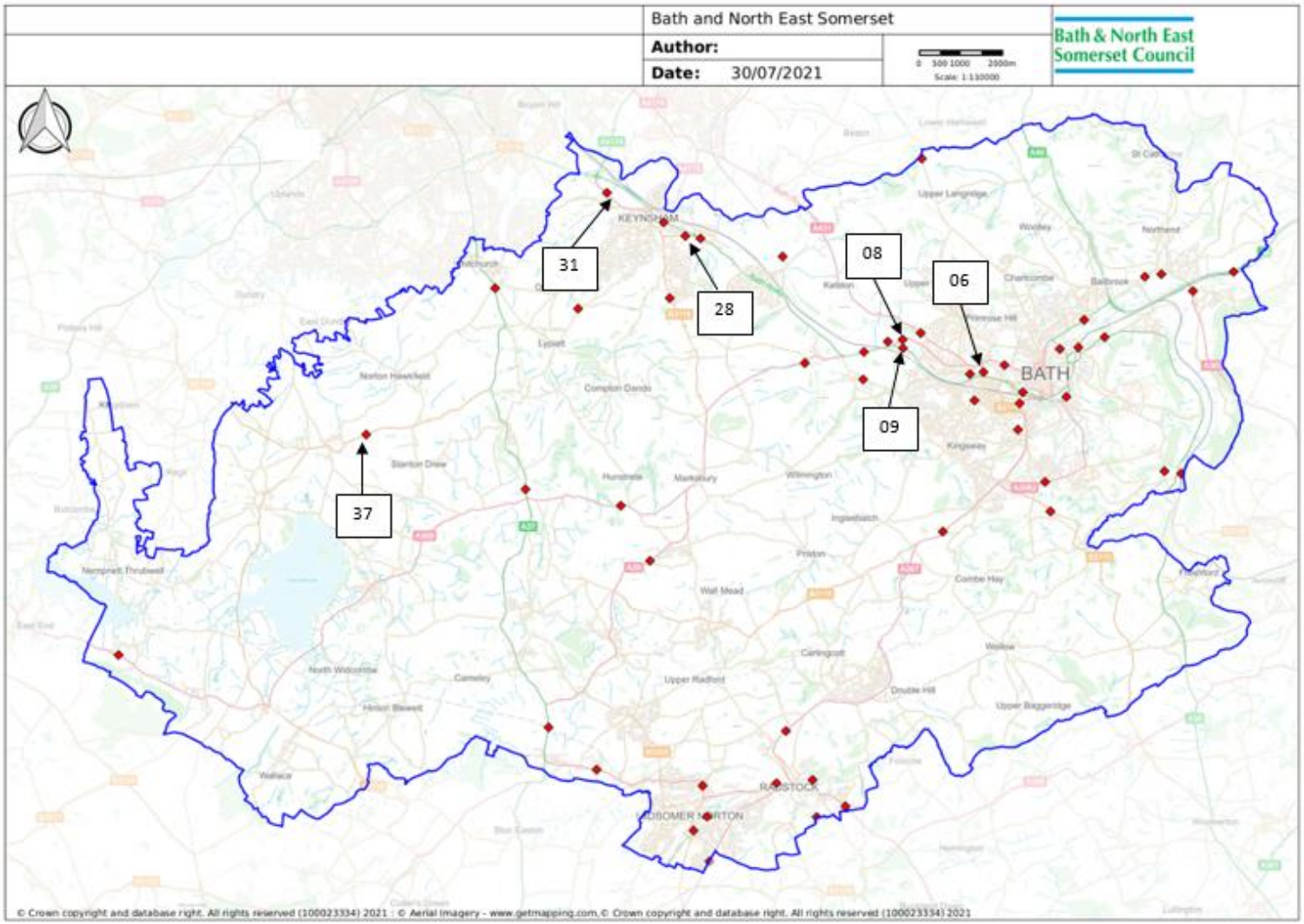
These permanent ATCs were selected as they were in use prior to the introduction of the CAZ and can therefore be used for comparison purposes.

Where possible we have used three sites from each site grouping to draw conclusions. Other monitoring methods such as temporary ANPR cameras will be used to monitor areas of perceived concern. Additionally, it must be noted that whilst there is sufficient data for analysis (with the exception of the CAZ), there are a few days missing in either quarter in our current and baseline years due to data loss, however, this is not considered to be significant for the purposes of analysis.

Table 8- ATC locations from Figure 5 (following page), along with their site category.

Site ID	Location	Site Category	Baseline data year
06	A3064 Windsor Bridge, North of Stable Yard	CAZ_Boundary	2018
08	A4 Newbridge Road	CAZ_Boundary	2017
09	A36 Lower Bristol Road, East of Newbridge	CAZ_Boundary	2018
28	Bath Road, Keynsham	Wider_B&NES	2018
31	A4175 Durley Hill, West of Durley Lane	Wider_B&NES	2018
37	B3130 Chew Magna, East of Sandy Lane	Wider_B&NES	2018

Figure 5- ATC locations (red diamonds) used for traffic flow analysis. The number refers to the site ID which can be found in Table 8. © Crown Copyright 2021. License number 100023334.



Traffic flow data results

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

Table 9- Two-way traffic flow data for ATCs by site grouping from the last year with representative data (2016, 2017 or 2018) and 2022. CAZ_Only last representative year was 2016/2017.

		5-Day Average			7-Day Average		
Year	**Month**	**CAZ_Only**	**CAZ_Boundary**	**Wider_B&NES**	**CAZ_Only**	**CAZ_Boundary**	**Wider_B&NES**
	October	[redacted]	16087	13566	[redacted]	14838	12756
2017/18	November		15195	14097		15195	13143
	December		13935	12870		13935	12243
	October		14226	12372		14226	11808
2022	November		14391	12793		14391	12150
	December		12552	11933		12552	11158

Table 10- Percentage change in average monthly traffic flows from 2017/18 to 2022. The bottom row shows the average change for the entire quarter (October to December), 2017/18 Q4 to 2022 Q4.

	5-Day Average			7-Day Average		
	CAZ_Only	**CAZ_Boundary**	**Wider_B&NES**	**CAZ_Only**	**CAZ_Boundary**	**Wider_B&NES**
October	[redacted]	-4%	-9%	[redacted]	-4%	-7%
November		-6%	-9%		-5%	-8%
December		-9%	-7%		-10%	-9%
2017/18 Q4-2022 Q4 average		6%	-8%		-6%	-8%

Comments and key findings:

- Nationally, traffic levels have generally returned to pre-pandemic levels (Department for Transport)[11].

- *Traffic flows within the CAZ during quarter 3 and 4 of 2022 were unavailable. During this reporting period, the Council's automatic traffic counter network, particularly within the CAZ, was being upgraded with newer, more reliable technology. The renewed counters were in a process of testing during 2022 Q3 and therefore the data collected during this period could not be relied upon. It may also be noted that the installation of this technology has been funded from grants received from central government and ensures that the Council has the most up to date monitoring methods as an authority, capable of monitoring the volume, classification, speed and movement paths of active travel modes as well as different vehicle types.

- Traffic flows are being monitored to understand any changes in the urban area of Bath outside the CAZ, and in the wider Council area, as presented in Figure 5 (a map of the ATC locations), Table 8 (a description of the ATC locations from which we analysed data), Table 9 (the data on vehicle numbers passing the selected ATCs: in the baseline period either 2017 or 2018 and this year 2022, and Table 10 (change in traffic flow between 2017/18 Q4 and 2022 Q4).

- General traffic flows (i.e., both compliant and non-compliant traffic) across an average seven-day week reduced by 6% in the urban area of the city outside the CAZ, and an 8% reduction of traffic in the wider area, compared with the baseline.

- The data from the available permanent ATCs are, in general, showing that levels of traffic outside of the zone's boundary in Bath has not increased because of the zone, when compared to the baseline year.

- In addition, the closure of Cleveland Bridge (28 June 2021- November 2021 full closure; November 2021-October 2022 - partial closure) is known to be significantly affecting the levels and directions of traffic flow throughout the entire second half of 2021 and into much of 2022. Although the bridge fully reopened (subject to an 18-tonne restriction) at the beginning of 2022 Q4, traffic volumes will still be recovering throughout this reporting quarter.

[11] Department of Transport statistics from the Office for National Statistics. Economic activity and social change in the UK, real-time indicators, 2021 https://www.ons.gov.uk/economy/economicoutputandproductivity/output/bulletins/economicactivityandsocialchangeintheukrealtimeindicators/23september2021

Areas of potential traffic displacement

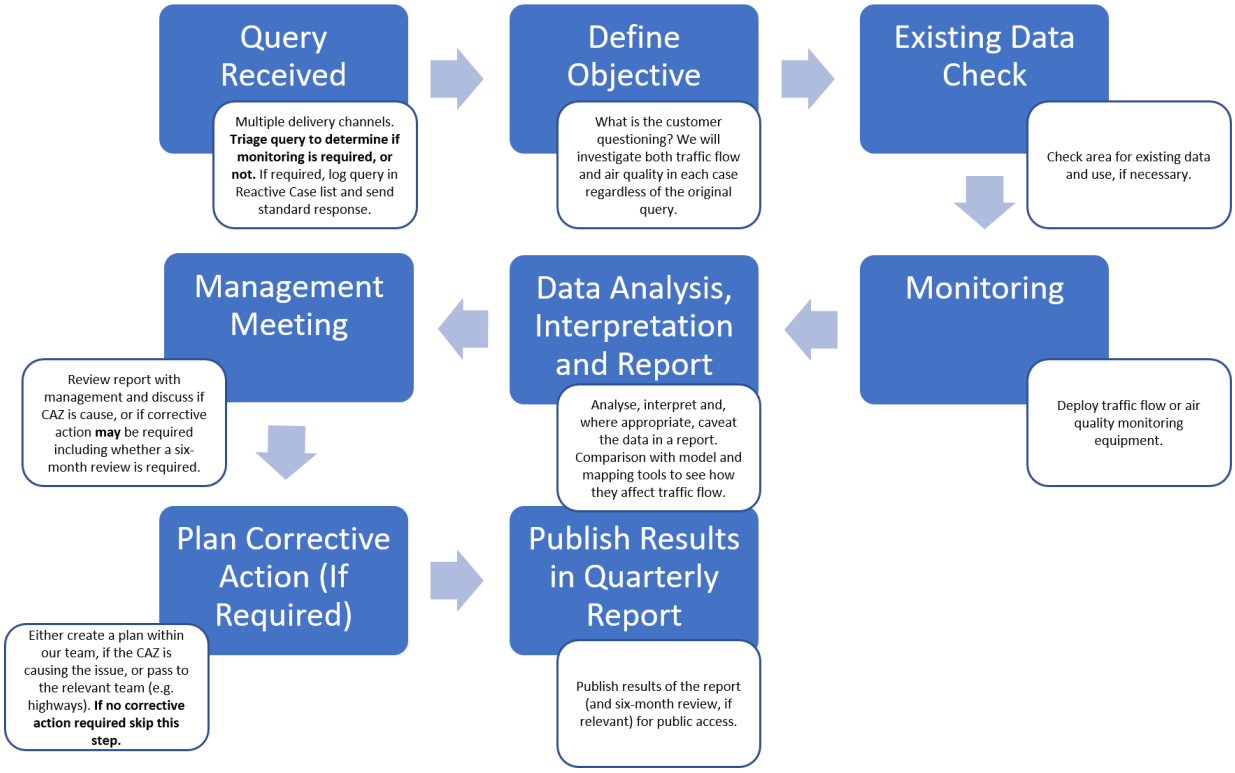
A key commitment of the Council during the business case development stage of the project was to monitor any concerns arising from the introduction of the CAZ. The purpose of the CAZ is to improve vehicle compliance rates whilst minimising the impact on normal traffic flows. Nationally, average traffic volumes returned to at least pre-pandemic levels and usage of LGVs and HGVs on the network are now exceeding pre-pandemic levels (Department for Transport).

We are actively investigating 10 discrete locations where the public have expressed concern about a perceived increase in traffic in their communities since the launch of the CAZ. All locations logged and active are set out in Appendix 2 supporting this report. Information and analysis surrounding our previous monitoring surveys that be viewed here.

How we're investigating possible traffic displacement

From the launch of the CAZ in March 2021, comments from residents about potential CAZ-related impacts have been logged and investigated. Figure 6 shows the process we have put into place when following up these queries.

Figure 6 - A process map showing the details of the traffic displacement process followed when a query is received.



Comments about traffic displacement:

- The pandemic was an unforeseen event that was not predicted and inevitably, traffic flows have been impacted in a way outside of any modelling done for the Full Business Case. In early 2021, there were lower levels of traffic, particularly cars, although the increase of home deliveries has increased to a record 35% of all retail spend[12], which accounts for a proportion of the greater numbers of LGVs and HGVs in local communities. As lockdown restrictions have lifted the numbers of commercial vehicles have increased beyond pre-pandemic levels.
- In June 2021, Cleveland Bridge closed to traffic for urgent repairs to the structure of the bridge. Despite partially reopening in November 2021, and fully reopening in October 2022, the impact of the closure of the bridge has displaced traffic throughout the second half of 2021 and into much of 2022.

An updated traffic displacement appendix will be published alongside the 2022 Annual CAZ Report, due to published in the summer of 2023. Information and analysis surrounding our previous monitoring surveys can be viewed here.

[12] ONS. Retail sales, Great Britain: January 2021. https://www.ons.gov.uk/businessindustryandtrade/retailindustry/bulletins/retailsales/january2021

The impact of the CAZ on fleet compliance

Vehicles contribute approximately 80% of nitrogen oxide (NO_x) emissions in the vicinity of the main roads in Bath. Older vehicles generally emit more NO_x as recent technological advances in selective catalytic reduction has led to a lowering of NO_x emissions from vehicles, particularly those of a Euro 6 standard.

The purpose of the clean air zone 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, financial assistance is available to help support businesses and individuals that need help to do this, mitigating the impact of charges.
Improvements 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 reaction to the introduction to Bath's CAZ and other zones around the country 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 financial assistance scheme which offers grants and or interest-free finance to those regularly driving in the zone to replace non-compliant vehicles.

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

How we measure fleet compliance in Bath

We measure changes in fleet composition using data gathered from 68 automatic number plate recognition (ANPR) cameras positioned around the perimeter of Bath's Clean Air Zone, and within the zone itself. Where traffic displacement concerns have been raised outside of the zone and we have determined that there is an increase in traffic flow, additional traffic and compliance monitoring is being undertaken using temporary ANPR cameras.

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 us to understand the

number of compliant vehicles seen in the zone (and in areas of potential traffic displacement) as a percentage of total vehicles driving in these areas each week.

To understand how fleet compliance in the zone has changed as a result of introduction of the CAZ, we are looking at weekly data from the cameras since the zone launched.

Vehicle compliance data for Bath CAZ

The following comments and findings refer to Figure 7 on the following page.

Comments and key findings:

- A vehicle is compliant when it meets the minimum emission standards for Bath's CAZ i.e., it's either euro 6 diesel, euro 4 plus petrol, hybrid, alternatively fuelled vehicles, or an electric vehicle.

- The percentage of chargeable non-compliant vehicles (as a percentage of all traffic) entering the zone each week reduced from 5.7% in the launch week, to an average of 1.2% between October and December.

- An average of 541 non-compliant vehicles were seen in the zone each day, during 2022 Q4 compared to 1742 during the launch week in March, a decrease of 69%.

- An average of 44,890 unique vehicles were seen in the zone each day during the quarter, which is comparable to the 42,182-daily average for 2022 Q3.

- **Most vehicles recorded in the zone are private cars,** with an average of 31,969 unique private cars seen in the zone each day during 2022 Q4. This equates to around 71% of all vehicles in the CAZ during the quarter.

- Bus/coach compliance rates **averaged at 99%** during the quarter, with an average of 134 individual vehicles seen per day.

- HGV (>12 tonne) compliance rates **averaged at 96%** during the quarter, with an average of 272 individual vehicles seen per day.

- HGV (>3.5 tonne) compliance rates **averaged at 96%** during the quarter, with an average of 112 individual vehicles seen per day.

- Taxi/private hire vehicle compliance rates **averaged at 95%** during the quarter, with an average of 491 individual vehicles seen per day.

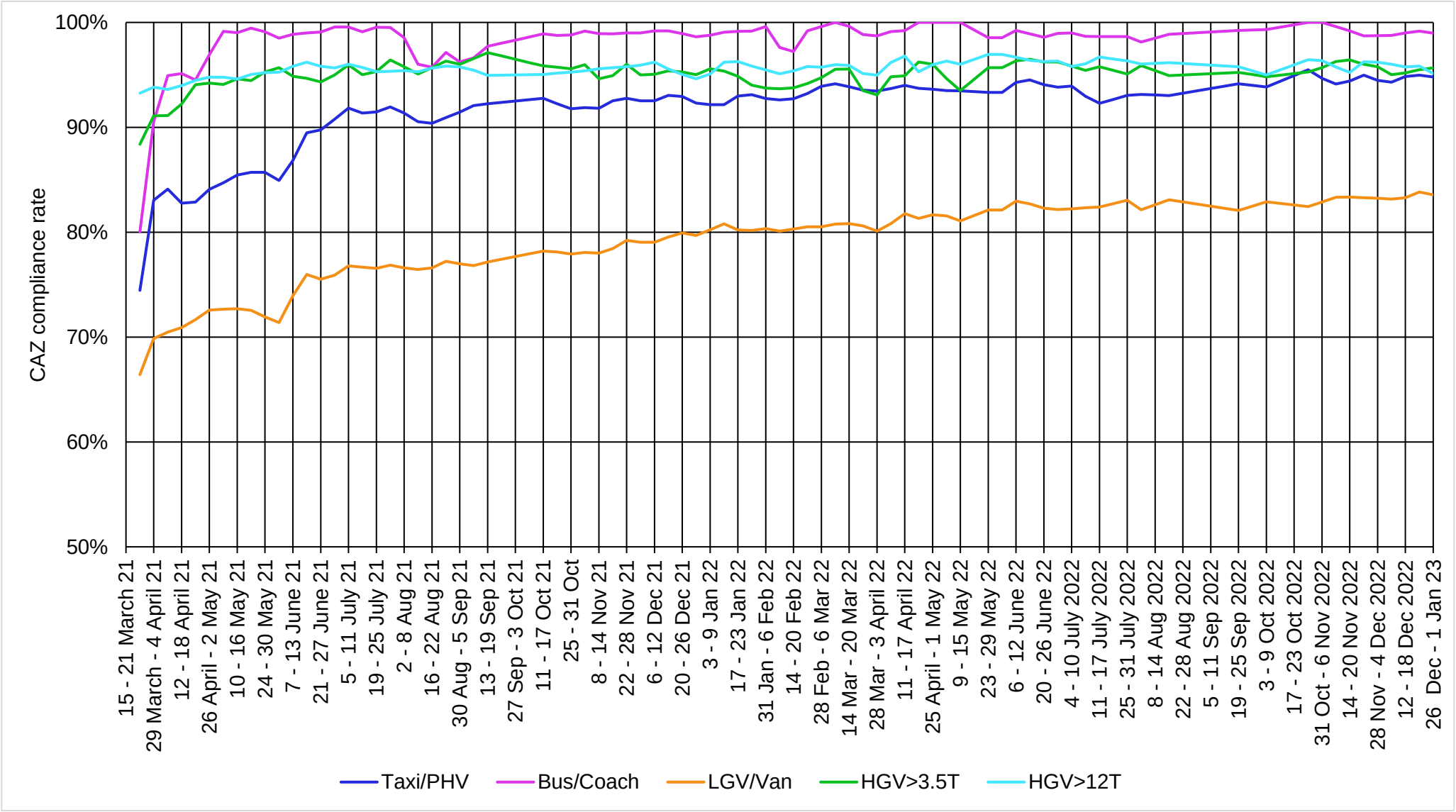
- Light goods vehicles/van compliance **averaged at 83%** during the quarter, with an average of 3,384 individual vehicles seen per day.

- Minibus compliance varied considerably as there were only around 26 minibuses recorded in the CAZ each day during 2022 Q4. However, the average rate of compliance was **76%.**

- Rates of compliance are anticipated to continue to improve towards into 2023 particularly with respect to the supply of compliant LGVs which have been impacted most significantly by the pandemic.

- Compliance was supported through the government-funded FAS and bus retrofit schemes, in addition to drivers upgrading outside of these schemes.

Figure 7- Vehicle compliance rates within the CAZ as a 7-day moving average. Please note the y-axis compliance rate starts at 50%.



Bus retrofit upgrade programme

Traffic and air quality modelling prepared for the approved 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, 87 out of a fleet of 226 scheduled buses operating in Bath were non-compliant.

To prepare for launch, the Council secured government funds to support bus operators to upgrade the remaining 87 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) and some coaches were retrofitted through the Council ’s financial assistance scheme.

Approximately £1.7 million was awarded as part of an implementation fund towards grants to operators to retrofit buses operating on public registered bus services.

Comments:

- By the end of June 2022, 100 per cent (88) of non-compliant buses operating as public buses in central Bath were successfully retrofitted with emission abatement technology.

- Preliminary reporting suggests 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 6 standards.

Financial support 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 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 the vehicle if they passed a basic eligibility test, proving that they travel at least two days per week on average over a 60-day period. Those passing the test could then apply for grants and/or interest loans via the Council's approved vehicle asset finance providers.

Table 11 below shows the number of vehicles that, by the end of December 2022, were eligible to be replaced and the number of vehicles replaced.

Table 11- Vehicles eligible for the financial assistance scheme and the number of vehicles already replaced up to the end of December 2022.

Vehicle category	Number vehicles eligible for FAS funding to upgrade/ retrofit	Number vehicles upgraded at end of Dec 22
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

*The two minibuses upgraded were LGVs and so included in those figures, below.

Comments and key findings:

- By the end of 2022 Q4, **1560** vehicles had passed basic eligibility tests, and **900** vehicles have already been replaced.

- **746** non-compliant LGVs (including 2 minibuses) regularly travelling in 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 financial assistance scheme. However, 38 HGVs regularly travelling into Bath have been approved for finance and **29** have been replaced.

- Owners whose vehicles have passed eligibility tests can then approach the Council's approved list of finance providers to secure grants and interest free finance to replace their vehicles.

- Around 650 individuals and businesses have been supported through the first stage of the scheme.

- At the end of December 2022, approx. £8 million had been spent upgrading and retrofitting vehicles via the financial assistance scheme (this includes the bus retrofit programme)

- After the first phase of the FAS had closed, a small amount of residual funding has been prioritised to those with local exemptions which will be ending in March 2023, or to those who had previously expressed an interest in the scheme after it had launched. By the end of December 2022, 95 vehicles had applied for the second phase of the scheme, with 42 vehicles being eligible for funding to upgrade/retrofit.

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, pregnant and older people; people with lung conditions such 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 quarterly basis so that we can monitor progress towards our target. This target is to reduce NO_2 concentrations to below the annual limit value of 40 $\mu g/m^3$ at all individual monitoring locations in Bath.

This report has set out related data and key findings from 2022 Q4, and, as highlighted in our Executive Summary, the trends are encouraging. Air quality is improving across the entire district, despite traffic returning to around pre-pandemic levels.

Air quality

We are pleased to note that provisional average nitrogen dioxide (NO_2) concentrations within the CAZ for 2022 Q4 are 14.7% lower than the same period in 2019, representing a reduction of 5.4 $\mu g/m^3$. There was an average reduction of 18.5% or 5.5 $\mu g/m^3$ in the CAZ_Boundary site grouping.

We also note that despite this general improvement, quarterly average concentrations of NO_2 at thirteen monitoring sites within the CAZ still exceed 40 $\mu g/m^3$ and we will continue to monitor these sites closely. However, compared with baseline data for the same quarter in 2019 (Q4), eight fewer sites recorded NO_2 concentrations over 40 $\mu g/m^3$ and two fewer sites recorded NO_2 concentrations over 36 $\mu g/m^3$ but less than 40 $\mu g/m^3$, which indicates progress towards our target.

Traffic flow

Nationally traffic flows have returned to pre-pandemic levels. Average traffic flows in the CAZ_Boundary, were 6% lower than the baseline. Average traffic flows in the Wider_B&NES region were 8% lower than the baseline. These reflect roughly what we would expect for the quarter. Importantly, we note that levels of traffic outside of the zone's boundary in Bath has not increased because of the zone, when compared with the baseline.

A key commitment of the Council is to monitor any concerns arising from the introduction of the CAZ, and while traffic flows have been substantially impacted and changed by the Covid-19 restrictions, we are investigating several locations where the public have expressed concerns over a perceived increase in traffic in their communities since its launch. These are outlined in Appendix 2, supporting this report.

Vehicle compliance

The aim of the zone is to improve the emission standards of vehicles driving in Bath. An average of 541 non-compliant vehicles were seen in the zone each day, during 2022 Q4 compared to 1742 during the launch week in March. Additionally, the number of unique vehicles entering the zone during 2022 Q4 was around 44,890, this has increased slightly compared to 2022 Q3, however, the vast majority are still private cars (71%).

95% of all taxis/private hire vehicles now entering the zone are compliant, compared with 67% prior to the zones launch. At the end of December 2022, 100% of non-compliant public buses on scheduled routes in Bath had been upgraded to meet standards.

To support the natural replacement of vehicles that happens as a result of a charging CAZ, the Council has, at the end of December 2022, supported the replacement of 900 vehicles, including 746 vans. Additionally, after the first phase of the FAS had closed, a small amount of residual funding has been prioritised to those with local exemptions which will be ending in March 2023, or those who had previously expressed an interest after the scheme had launched. By the end of December 2022, 95 vehicles had applied for the second phase of the scheme, with 42 vehicles eligible for FAS funding to upgrade/retrofit.

Next steps

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.

We would like to thank the public and businesses for their commitment to supporting the Council to improve air quality in the city, especially those that have upgraded their vehicles or sought support from the Council to upgrade or replace vehicles. We continue to urge all residents to do their bit by walking, cycling, or taking public transport whenever they can.

Monitoring Explained

Air Quality Monitoring Techniques

There are multiple methods whereby data on air quality is obtained.

Automatic Analyser

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 analysers can be seen in Figure 2. One of the automatic analysers makes up part of the Automatic Urban and Rural Network (AURN) which feeds back to a national monitoring network. The data produced by these machines is compared with that of diffusion tubes to ensure accurate results.

Diffusion Tubes

Less expensive than automatic analysers, diffusion tubes can be located on existing street furniture. Due to the ease of deployment, hundreds of diffusion tubes can be located within a district building a picture of air pollution over a large area. Current locations of diffusion tubes can be seen in Figures 2 and 3. The tubes are exposed to ambient air for one month, before being sent to a laboratory for analysis. Data is then adjusted to consider laboratory or other inaccuracies before an annual mean is derived. 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.

Traffic Monitoring Techniques

There are multiple methods whereby data on traffic flow and composition is obtained.

Automatic Number Plate Recognition (ANPR)

As part of the CAZ project, ANPR cameras were installed within and at entry/exit points to the zone, forming a cordon. The cameras focus on the numberplates of vehicles and then 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 Count (ATC)

Permanent Automatic Traffic Counters

As part of ongoing traffic monitoring, that was in place pre-CAZ, there are permanent ATCs at multiple locations in the district. Current locations of ATCs can be seen in Figure 5. These counters are built into the road and continuously monitor data on vehicle volume, speed and classification.

Temporary Radar Automatic Traffic Counters

To quickly respond to potential traffic displacement issues, 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.

Video Survey Equipment

Much like Temporary radar ATCs, video survey cameras are easy to install on existing street furniture, at short notice. These cameras do no record vehicle speed but do record vehicle volume and classification, which can be useful in cases where it is important to know the type of vehicles using a route. These cameras can be used to assess how many vehicles enter/ exit junctions, which can be important.

Manual Traffic Counts

At times, manual traffic counts are superior to automatic equipment. Enumerators can be employed to manually count vehicles passing a specific point.